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MAY 23 & 24, 2015

# International Multi Track Conference on Sciences, Engineering & Technical Innovations

VOL - 1

Edited By  
Dr Manoj Kumar

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Conference Website:[www.imtc.ctgroup.co.in](http://www.imtc.ctgroup.co.in) | Email ID: [imtc15@ctgroup.in](mailto:imtc15@ctgroup.in)

*Proceeding of*  
**International Multi Track Conference on  
Sciences, Engineering & Technical Innovations**

**intcis**  
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Organised By

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**First Impression : 2015**

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**Sciences, Engineering & Technical Innovations**

**ISBN : 978-81-929077-2-7**

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*Published By*

**CT EDUCATIONAL SOCIETY  
CT INSTITUTE OF ENGINEERING  
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ISBN : 978-81-929077-2-7

*Typeset by*

***Aryana Software Development Cell  
C/o. CT Institutions  
U.E.II-Pratappura Road, Shahpur,  
Jalandhar -144020 Punjab, INDIA***

*Printed by*

***AN Enterprises  
198-Fateh Puri,  
Behind Singh Steel, Jalandhar***

## Preface

This Conference Proceedings volume contains the written versions of most of the contributions presented during the **International Multi Track Conference on Sciences, Engineering & Technical Innovations (IMTC-15)** which was organized by CT Institute of Engineering, Management & Technology (CTIEMT), Jalandhar on May 22 & 23, 2015. This conference aims to disseminate the latest research in Wireless Network & Mobile Computing, Optical Communication, Software Engineering/Cloud Computing/Biomedical Signal Processing, Image /Speech Recognition, Neural Network/Fuzzy Logic, Analog/Digital/VLSI/Antenna, Civil Engineering, Electrical Engineering, Mechanical Engineering, Pharmaceutical & Biotechnology, Applied Sciences, Management & Education and other relevant topics and applications. This conference is co-sponsored by Indian Space Research Organization (ISRO) and Punjab Technical University, Jalandhar.

The friendliness and candidness of IMTC-15 shall enhance the ability of all the delegates to grow by interacting with the experienced resource persons and young researchers. We would like to thank all participants for their contributions to the Conference program and for their contributions to these Proceedings. Sincere gratitude to the International Advisory Committee and the National Scientific Program Committee, whose members gave precious inputs and were always side by side with the Organizers.

My Gratitude is due to S. Charanjit Singh Channi, Chairman, CT Group of Institutions, Jalandhar, who has been really very encouraging and supportive. It is our pleasant duty to acknowledge the financial support from the Indian Space Research Organization (ISRO) and Punjab Technical University, Jalandhar.

This conference and the proceedings have been possible due to the unstinted support of the Management of CT group. A fundamental role in the conference preparation has been played by the local organizing committee and the members of the staff, each of which gave an outstanding contribution.

I am very thankful to my colleagues and the whole staff rendering their services for this conference. Finally, I very cordially thank all the people of CT group for their efforts to maintain the high scientific level of conference and proceedings.



**Dr. Manoj Kumar**  
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## Keynote Address

Prof. R.N. Weerasinghe  
Head/ Senior Lecturer  
Department of Entrepreneurship  
University of Sri Jaywardenepura  
Sri Lanka

Topic: Systematic View of Innovation: Role of Universities in NIS of Developing Countries

The systematic view of national innovation agenda has attracted much attention from the latter part of the 1980s and it is a popular research theme all around the world at present. Freeman (1988), Lundvall (1992) and Nelson (1993) are the renowned early contributors to this perspective, which is focused on interrelationships and interdependencies among the major actors of national innovation system that work to create, develop and diffuse new knowledge mainly for the commercialization of new products, services and processes. Similar discussions on the role of different actors such as government, universities and firms in terms of their contribution to the NIS have appeared even in the early studies of national innovations systems. Out of the three principal actors, universities and science and technology research centers are considered knowledge creators. They need to step forward to infringe innovation via government agencies and the industry, which is the back bone of the commercialization process. The prominent role of the university has been highlighted in the Triple Helix (Etzkowitz and Leydesdroff, 2000) focusing on the importance of knowledge creation for innovation. Interdependencies and the requirement for overlapping the roles of the three actors are highly emphasized in Triple Helix III through strong tight linkages among the actors.

Galli and Tuebal (1997) have discussed the transition of the national innovation system from system 1 (S1) to system 2 (S2), which emphasizes the operations of two sectors, business and university. Accordingly, S1 characterizes the national innovation systems in some developing countries such as Latin American countries, India and Russia as seen during 1980s and 1990s, with unilateral weak relationships. Further, it had been a closed system maintaining minimum interactions with outside world for foreign trade, limited knowledge and technology sharing with the protectionist economic policies. Similar kinds of unilateral flows and weak linkages continue to persist in most developing countries despite their being more open to the world than in the past. As increasingly complex changes are being introduced to the economic and business environment, Galli and Tueball (1997) recommend a transition from the traditional S1 to new S2, which is characterized by more openness to the outside world, more interactions with subsystems through interface units, centrality of the functioning of the system coupled with techno-economic capabilities, presence of interfacing units, and a restructured business sector. This view promotes universities' and business sector's having more linkages with the outside world. There are two other major focuses of this model; the first is establishing interface units in the university sector to promote industry-university R&D contacts directly or indirectly and, the second is the creation of technologies to connect industry with the outside world as well as among different businesses and sectors. As a result, new interrelations, linkages and transactions have appeared in the model in addition to the traditional unilateral linkages in the S1. Industry- university linkages are promoted aggressively through collaborative researches, training programs, knowledge and technology transfers stemming from a restructuring of the university sector with the UIU for mutual benefit. The role of large firms and capital goods suppliers is also emphasized, especially in providing the required facilitation for SMEs through funds and knowledge transferring within the business sector. As proposed here, technology centers act as a mechanism linking the outside world to the industries by providing hard and soft functions and producing technological capabilities relevant to firms as explained by Galli and Tuebal (1997).

Traditionally, universities were responsible for providing facilities mainly for higher education and performing basic research, resulting in their being known as teaching universities. Even at present, this remains unchanged in many developing countries. However, there is a growing need to link application with the interdisciplinary approaches in problem solving in the industries through a new institutional approach, as one of the major cornerstones of modern innovation systems (Galli and Teubal, 1997; Lee and Win, 2003; Arvanitis et al., 2008). Facilitating students to acquire practical experience (Klevatorick et al., 1995) and sharing university infrastructure with industry for developing innovations (Galli and Teubal, 1997) are also suggested for mutual benefit.

There is a vital requirement for knowledge generated by universities and public research organizations, as it plays an important role in interactive innovation models and exemplifies how collaboration can reduce the uncertainty embedded in innovation processes (Guta, 2011). Hence, characterized with an interactive nature with the feedback in each and every point, the chain-linked model provides empirical evidence that new firms can emerge with new product ideas that individuals and firms identify from the market even though they do not

engage in investment based basic research (Drejer and Jorgensen, 2004). Organizations can use the market as a source of empirical knowledge and transform market ideas into commercial products, motivating entrepreneurs to seek existing latent knowledge (Hargadon and Fanelli, 2003; Metcalfe and Ramlogan, 2005). Further, the importance of collaborations and networks through Venture Capital (VC) Firms, Technology Transfer Offices (TTOs) and regional or government agencies for successful academic spin-offs have also been emphasized (Munari and Toschi, 2009).

This is an attempt to review the role of universities in the knowledge production process, not in a fragmented and isolated manner, but from the integrative and collaborative aspects. In addition, this paper intends to critically review the role of universities in the present context. It emphasizes the importance of stronger interactions with the business sector through the establishment of interface units such as incubators, business support services and consulting units, and joint research/technology programs. Further, the role of universities in terms of collaborating with the government and related institutions towards making policies, rules and regulations is also focused upon. The transition of knowledge infrastructure emanating from Mode I to Mode II (Gibbons et al., 1994) is discussed herein on the basis of the idea presented in *third mission* of universities. With this aim, the role of national universities in Sri Lanka has been studied empirically, with special emphasis on their contribution towards innovation and relationships maintained with the other main actors identified. Data on Sri Lankan universities have been collected through secondary sources such as published statistical reports and conducting in-depth interviews with high officials of the national (government) universities in Sri Lanka. It is expected to share the findings of the present study with other developing countries in order to strengthen the universities and other research and development institutions to build up the national knowledge infrastructure required towards promoting innovation.

# Plenary Session

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Topic: Change Management

Management of Change – or Managing in Change...?

“The world is not a thing. It is a complex, never-ending, always changing tapestry”.

Human beings are creatures with an internal urge to understand, rule and manage the world they live in. This has helped us advance from the level of “one of the primates” to an extraordinarily clever problem solver, developer, creator and facilitator that has, indeed, been able to multiply and fill and rule the world – as some of the holy scriptures of mankind demand us to do.

Some say man’s success has been built on shortsighted exploitation of our environment and at the expense of other living things and the supporting structures keeping this whole planet alive. Even disasters fatal to all life on earth have been forecasted throughout centuries due to the often drastic changes and turbulence man’s efforts have created.

Man is but one small actor in the vast network of variables forming this tapestry we have labelled with words such as our world, universe, cosmos and other names of this sort. Yet, our achievements have made us believe that we are omnipotent and in control of the development at all levels. In our effort to control and to lead the development in the direction we wish to, we create a lot of turbulence. Sometimes it is desirable, sometimes unexpected and unwanted movement of variables affecting us.

This presentation tackles rather briefly three topics:

1. The essence of change: One way to describe change will be given.
2. Change management: Is it possible and if so, to what extent?
3. Higher education and change: The role of universities in the management of change?

In our world we constantly are under the influence of three types of variables. Type one consists of variables we know and can affect and manage pretty well. Type two variables we know but can manage only to a limited extent and sometimes not at all. Type three variables are such that we do not even have clear knowledge of them. Yet, they do affect us in many, sometimes very dramatic ways. Some examples of all these will be given and their influence on us and our daily efforts will be described. Man’s success has been able to diminish or even eliminate the influence of some earlier, fatal variables (famine, illnesses, even the effect of some natural disasters). Yet, some variables are still totally beyond our management powers. Paradoxically, our success has also created new variables that may be difficult or even impossible to manage. Turbulence in the tapestry has increased and the movement of variables has become quicker and more difficult to see in advance as a side effect of our development.

Due to the complex environment we are living in, change management has become more important than ever. At the same time it has become more difficult. Various types of analysis, strategic planning and other such traditional tools and methods are exploitable in understanding changes and preparing ourselves to face them. Yet, they may be ineffective and sometimes “blind” tools even in industry and commerce, not to mention in living a good life that after all should, perhaps, be the reason why we exist.

Higher education has a role in preparing those who will lead mankind to manage the ever more demanding challenges. Therefore, also some reasons will be given why teaching of critical thinking, decision making capacity and other meta-skills will become ever more important in change management – or managing in change, as actually, that is the best man as a small variable can do.

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**Track-1**

**Technical Session 1**

**ANALOG/ DIGITAL/ ANTENNA/ VLSI**



# Effect of Orientation of Partitioning of State Diagram on Switching Activity in Digital Systems

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**Abstract--** Switching activity in the digital systems determine the power consumption of the system. The partitioning of the state diagram helps to reduce the switching activity. The minimum switching activity can be obtained by the proper orientation of the partitioning of the state diagram. The paper describes the effect of orientation of partitions on the switching activity which in turn effects the power consumption of the system.

**Keywords-** Orientation of Partitions; State diagram; Low power; Less switching

## I. INTRODUCTION

The power requirements of the digital systems are effected by the switching activity of the system. Lesser the switching activity, lesser will be the power requirements. Another way to reduce the power requirements is to reduce the power consumption of the hardware components. Since power consumption is one of the most important parameters to be considered while designing the digital systems, various methods have been used in the past to ruce the power consumption of the system. M. G. De, R. K. Brayton and V. A. Sangiovanni introduced computer aided design algorithm for the state assignment [1]. The algorithm focused on the logic minimization of the combinational component before the state encoding. A state encoding scheme using the non uniform code length was proposed by P. Surti, L. F. Chao and A. Tyagi [2]. The state set with high probability was encoded with lesser number of bits and the state set with less probability was encoded with more number of bits. This scheme reduced the power requirements of the system. An algorithm for automatic synthesis of network of interactive FSM's was defined by L. Benini, G. DeMicheli and F. Vermeulen [3]. The finite state machine was decomposed into various sub machines with only one sub machine clocked at any given time. This approach resulted in a less power dissipation.

T. L. Edward introduced L-map method for state minimization [4]. This method focused on removing all the redundant states to make the system with lesser power requirements.

D. Liu and C. Svensson estimated the power consumption in CMOS chips [5]. The estimated power was found out to be dependent on the clock frequency. So, with the reduction in the clock frequency, the power consumption can be reduced

An integer linear programming technique for the low power state assignment was proposed by A. Sagahyroon, F. A. Aloul and A. Sudnitson [6]. The primary goal of the

technique was to reduce the switching activity during state transition.

Zhao et al. reduced the power consumption by the reduction in number of clocked transistors in the flip flop design [7]. Approximately 24% reduction in the power was achieved as compared to the standard flip flop model. A multi objective genetic algorithm for state assignment was proposed by Jassani et al. [8]. The goal was to find the state assignment for minimum component count and minimum switching activity. An algorithm for area and switching activity minimization was proposed by M. Yang, J. Lai and X. Hongying [9]. A relay based algorithm was used to achieve the goal of minimum area and switching activity.

Shyu et al. proposed a method to reduce the power consumption by combining individual single bit flip flops into multi bit flip flops [10]. 20% to 30% power reduction was achieved using the method.

The algorithms discussed above are complex in nature and require extra programming during the design process. However, the switching activity reduction can be easily achieved by properly partitioning the state diagram into two parts and then encoding the states. The paper is the extension of the partition algorithm presented earlier. The paper discusses the effect and the importance of proper orientation of the partition while applying the partitioning algorithm.

The significance of partitioning is described in section II. Then, a brief description of the partitioning algorithm is given in section III. The effect of the orientation of partition is discussed in section IV and the conclusion is given in section V.

## II. SIGNIFICANCE OF PARTITIONING

The main objective of the partitioning is to reduce the Hamming Distance between the codes of the states. Partitioning of the state diagram helps to assign the same state codes to the different states with just one bit difference, thereby reducing the Hamming Distance between the state codes to minimum. Different orientation of partition may lead to the different switching activities of the system. The following sections describe the effect of selecting different partitions on the switching activity with the help of examples.

## III. PARTITIONING ALGORITHM

The motivation for using the partitioning approach has been taken from the work done by S. Chattopadhyay and P. N. Reddy [11]. The partitioning algorithm involves dividing the whole state diagram into two parts. Each part is coded

separately. After each state is assigned its state code, a most significant bit is added to the state codes to differentiate both the parts from each other.

#### IV. EFFECT OF ORIENTATION OF PARTITION

The effect of proper partitioning can be determined by comparing the results obtained by different partition orientations. The switching activity of some examples is calculated using the different partition orientations and the results are then compared.

1) Consider the finite state machine having six states  $s_0$ ,  $s_1$ ,  $s_2$ ,  $s_3$ ,  $s_4$  and  $s_5$  as shown in Fig 1.

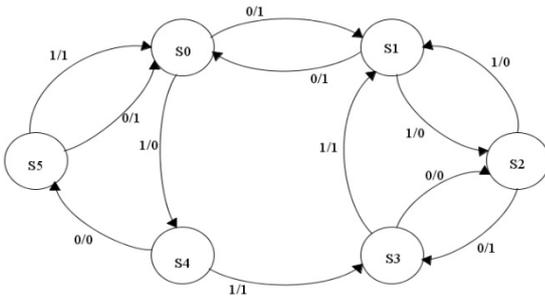


Fig.1 State Diagram Example with Six States

Option 1: Divide the state diagram into two partitions as shown below:-

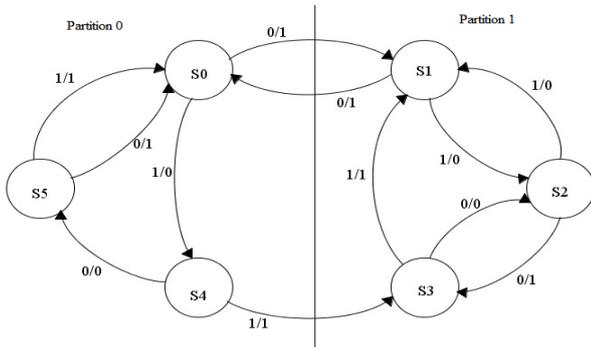


Fig.2 Partition of State Diagram Example with Six States using Option 1

Assign  $S_0 = 00$ ,  $S_5 = 01$  and  $S_4 = 10$  in Partition 0

Assign  $S_2 = 00$ ,  $S_1 = 01$  and  $S_3 = 10$  in Partition 1

Therefore, the state codes for states  $s_0$  to  $s_5$  becomes (000, 101, 100, 110, 010 and 001)

Option 2: Divide the state diagram into two partitions as shown below:-

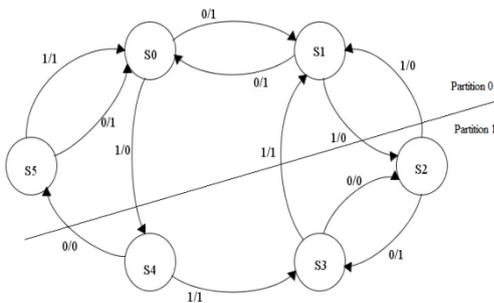


Fig.3 Partition of State Diagram Example with Six States using Option 2

Assign  $S_0 = 00$ ,  $S_1 = 01$  and  $S_5 = 10$  in Partition 0

Assign  $S_3 = 00$ ,  $S_2 = 01$  and  $S_4 = 10$  in Partition 1

Therefore, the state codes for states  $s_0$  to  $s_5$  becomes (000, 001, 101, 100, 110 and 010)

Option 3: Divide the state diagram into two partitions as shown below:-

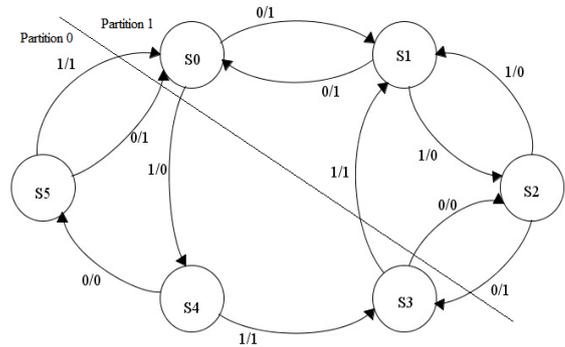


Fig.4 Partition of State Diagram Example with Six States using Option 3

Assign  $S_4 = 00$ ,  $S_5 = 01$  and  $S_3 = 10$  in Partition 0

Assign  $S_1 = 00$ ,  $S_0 = 01$  and  $S_2 = 10$  in Partition 1

Therefore, the state codes for states  $s_0$  to  $s_5$  becomes (101, 100, 110, 010, 000 and 001)

The summary of the results is given below:-

Let  $h_{ij}$  = Hamming distance between state  $i$  and state  $j$ . Number of bits switched between two states can be calculated as: (Number of transitions between states \* Hamming distance). Total switching activity can be calculated by adding number of bits switched during all the possible transitions.

TABLE.1 COMPARISON AMONG DIFFERENT PARTITION ORIENTATIONS

State Diagram Example with Six States:-	
State codes using Option 1	000, 101, 100, 110, 010 and 001
State codes using Option 2	000, 001, 101, 100, 110 and 010
State codes using Option 3	101, 100, 110, 010, 000 and 001
Total Switching activity	$2 * h_{05} + h_{04} + h_{45} + 2 * h_{01} + h_{34} + 2 * h_{12} + 2 * h_{23} + h_{13}$
Total switching activity using Option 1	16 bits
Total switching activity using Option 2	14 bits
Total switching activity using Option 3	14 bits

Switching Activity (in bits)

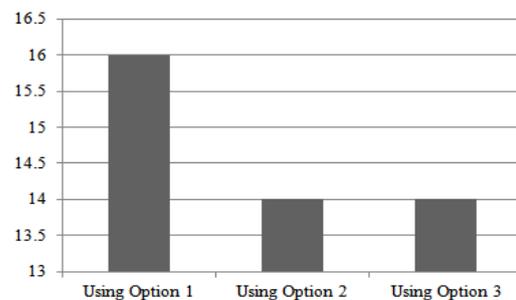


Fig.5 Comparison among different partition orientations

Fig.5 shows that the switching activity varies with the orientation of partition. So, the proper partitioning of the state diagram is required for minimum switching activity.

## V. CONCLUSION

Switching activity varies depending on the orientation of the partition while using the algorithm for state assignment. This in turn effects the power requirements of the digital system. Thus, in order to minimize the power requirements of the system, switching activity should be minimized by appropriately selecting the orientation of the partition.

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# A Compact UWB CPW fed Slotted Microstrip Antenna with Truncated Ground Plane

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**Abstract**—This paper investigates a novel design of compact CPW-fed patch antenna that covers ultra-wide bandwidth from 3.03 -14.32 GHz. Truncation in coplanar ground plane has been introduced in order to increase the impedance bandwidth. In addition, dual parasitic strips have been included with the slotted patch structure to enhance the antenna performance by reducing return loss parameter. The proposed antenna geometry is limited to the compact size of 40 mm X 26.4 mm X 1.6 mm. The performance of proposed antenna design is analyzed in terms of return loss, group delay and radiation properties. Simulation in HFSS reveals that antenna has almost constant group delay performance throughout the impedance bandwidth.

**Keywords**- Microstrip Patch Antenna, Ultrawide Band, Coplanar Waveguide, Return Loss, Group Delay, Parasitic Strips

## I. INTRODUCTION

The incessant progress in Ultra-wideband applications and systems is commendable since frequency band of 3.1-10.6 GHz has been allocated for communications by FCC in 2002. The several promising features of UWB technology such as low-power, high data rate, multipath interference insusceptibility and robustness to jamming due to its low-probability of detection (LPD) RF signature, has engrossed considerable attention of researchers[1]. Antennas with features such as small size, low radiation loss, low profile, less dispersion, ease of manufacturing, ease of integration with monolithic microwave circuits etc. are in huge demand at present [2]. Coplanar-waveguide (CPW) antennas have been considered as promising choice for role of antennas in UWB systems.

Extensive research has been conducted to design antennas with wide bandwidth so as to utilize the single antenna structure for multiple applications and operations simultaneously. E. Kermaniyan et al. proposed a compact trapezoidal shaped slotted patch antenna with CPW feed in 2014 with UWB bandwidth in the range from 2.8 GHz to 12 GHz [3]. G. sanyal proposed the use of circular defected ground structure along with circular CPW fed microstrip patch antenna to provide high gain over the wide band of 12-14 GHz. Also, the performance has been compared with the same design of Circular CPW patch without any defect in ground structure [4]. In 2006, reflector with optimized air gap from rectangular slotted CPW feed antenna has been designed. The U-shaped tuning stub is located at the slot center to get UWB response with impedance bandwidth of about 120% [5]. The multiband operation is achieved by designing rectangular slotted CPW feed antenna by T. Hongnara where a fractal stub and parasitic line in rectangular slot provides notch frequencies at two

bands in wideband operation [6]. M. M. Fakharian et al. in 2014, proposed a novel CPW fed design that is inspired from palmate shaped leaf in structure along with tapering in ground plane to get UWB response in frequency range from 3 to 14 GHz [7]. Wu and Guan combined two parasitic strips in the ground plane of slotted CPW patch antenna to obtain notch filtering characteristics in UWB range of 2.2 to 12.5 GHz. In addition, the complete structure possess compact design with small height of 0.508 mm [8]. M. Majidzadah et al. proposed a simple structure of compact circular CPW fed antenna with modifications in ground plane using dual square rings and parasitic strip to get ultra wide bandwidth of 154 % in frequency band 3-23.5 GHz [9]. William and Nakkeeran optimized the design of semicircular feeding structure in rectangular slot coplanar ground plane by introducing notches in ground structure to get broadband frequency response from 5 GHz to 10.3 GHz [10]. In 2013, Majidzadah and Ghobadi proposed a CPW fed ring shaped antenna for UWB operational range. By introducing square slots and parasitic stubs in the ground plane, Band notch characteristics have been obtained in 5-6 GHz to avoid interference with WLAN applications [11]. R. Kumar et al. designed a wideband CPW feed slotted rectangular antenna using High Frequency structure simulator(HFSS) to cover the frequency range from 5.32 to 8.27 GHz [12].

This paper is focused on designing of novel CPW fed antenna along with truncations in ground plane to obtain ultra wide band response over the frequency range 3.03 GHz to 14.32 GHz. The paper is organized as follows: Brief introduction about UWB antennas along with literature review is provided. Then proposed antenna design is discussed followed by results and discussions. The paper ends with brief conclusion followed by references.

## II. PROPOSED ANTENNA DESIGN STRUCTURE

The name coplanar waveguide feed is attributed from the fact that both patch structure and ground plane shares the same plane above the dielectric substrate. This is opposed to traditional convention in microstrip antennas in which substrate separates both the patch antenna and ground plane. Fig. 1 shows the proposed antenna design and structure. The proposed antenna geometry is designed on FR4 (Flame Retardant-Type 4) Epoxy substrate having dielectric constant of 4.3. The thickness of chosen substrate is kept at 1.6 mm. The anticipated design offers several advantages such as simple design, easy to fabricate, ultra wide bandwidth of approximately 12 GHz etc. The various

geometric parameters and dimensions chosen are shown in table 1.

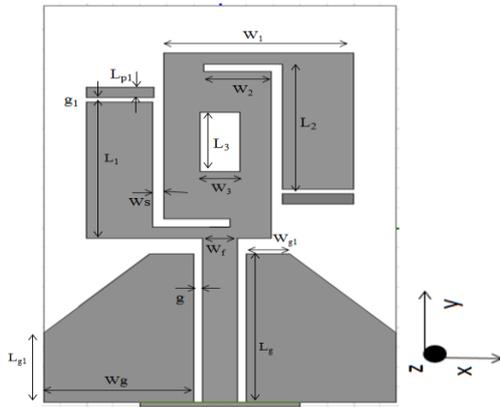


Fig. 1. (a) Proposed CPW feed Antenna Design (Top View)



Fig. 1. (b) Side View of Proposed CPW Feed Antenna Design

The designed structure is excited by 50Ω impedance transmission line. In addition, the coplanar ground plane is truncated on both sides of feed to exceed the available impedance bandwidth. Apart from modifications in ground plane, two parasitic strips have been added to the slotted rectangular patch design, resulting in enhanced antenna performance. The anticipated design is simulated by using high frequency finite element based antenna simulator known as HFSS(High Frequency Structure simulator). The antenna structure is excited by SMA connector in HFSS whose height is central with respect to metallized area of CPW feed.

### III. RESULTS AND DISCUSSIONS

Fig. 2 represents the simulated return loss for the novel designed CPW fed antenna geometry using HFSS. As it can be clearly seen from the graph that return loss is constantly less than -10 dB for the frequency range 3.03 GHz to 14.32 GHz i.e. for the entire above said range, signal transmission by antenna is more than 90%, resulting in total impedance bandwidth of 11.29 GHz.

Table 1. Geometric Parameter for Antenna Design

Parameters	Values (mm)
$L_1$	13.71
$W_1$	14.18
$L_g$	15
$W_g$	11.2
$g$	0.7
$g_1$	0.5
$W_f$	2.6
$L_2$	17.57

$W_2$	5
$L_3$	6
$W_3$	3
$L_{g1}$	7
$W_{g1}$	3.2
$L_{p1}$	1
$W_s$	0.8
$h$	1.6

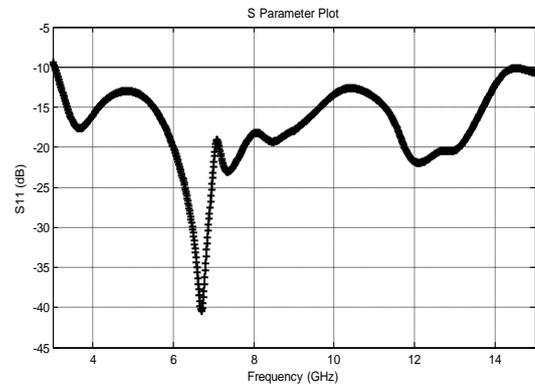


Fig. 2. Return loss plot for simulated design

Fig. 3 shows group delay parameter for the same frequency range of 3.03-15 GHz. UWB transmission is done in form of short pulses. Group delay represents the extent of pulse distortion during transmission. As in [12], it represents the change of phase shift,  $\theta$  in pulse with respect to angular frequency,  $\omega$  i.e.

$$\text{Group Delay} = \frac{d\theta}{d\omega} \quad (1)$$

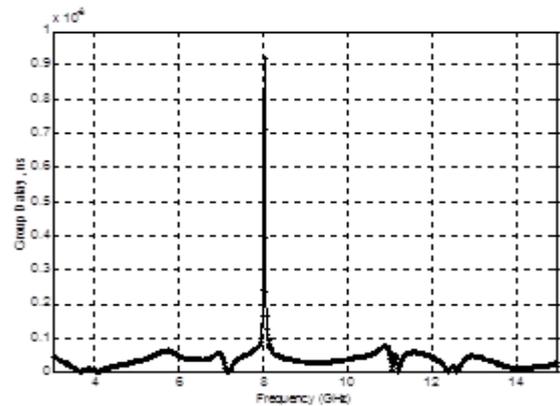


Fig. 3. Group delay plot for proposed design

As it can be seen from fig. 3, except at frequency 8 GHz, there is no large variation in group delay plot. Phase is nearly constant and linear over the entire bandwidth that indicates the signal in form of pulses can be transmitted with very little distortion and dissipation over the impedance bandwidth.

#### A. Effect of Truncations in ground plane:

Ground plane in the proposed geometry has been truncated in order to take trapezoidal form, resulting in

tremendous increase in impedance bandwidth. This has been illustrated in fig. 4.

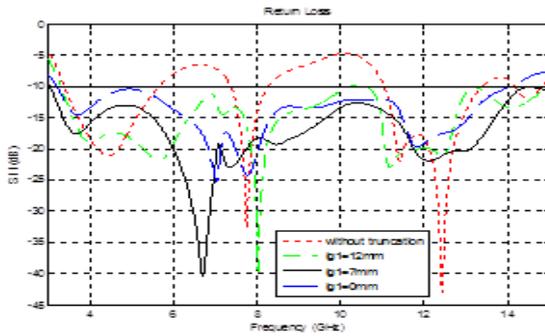


Fig. 4. Return loss for various vertical truncations in ground plane

As indicated in figure 4, without truncation in ground plane, three bands i.e. 3.5-5.65 GHz, 7.38-8.25 GHz, 11.04-13.41 GHz were obtained in the frequency range 3-15 GHz. With introduction of triangular truncation in ground plane of 3mm, two wide bands obtained in the same range from 3.34 -10.1 GHz and 10.6-13-16 GHz. When vertical length of truncation is increased from 3 to 8 mm, it resulted in ultra wide bandwidth from 3.03 to 14.32 GHz. With further increase in vertical length of truncation to 15 mm, bandwidth remained the same as for 8mm truncation, but return loss reduced comparatively. Thus, selecting vertical length of 8mm for triangular truncation in ground plane gives maximum impedance bandwidth of 11.29 GHz with maximum return loss of -40.22 dB at 6.68 GHz.

After optimizing vertical length for triangular truncation in coplanar ground plane, various horizontal lengths ( $Wg1$ ) for truncation have been considered viz. 0.2 mm, 3.2 mm, 5.2 mm and 8.2 mm. As shown in figure 5, out of various values for  $Wg1$ , optimum result has been obtained for horizontal length of 3.2 mm. Choosing  $Wg1=0.2$  mm, resulted in three frequency bands from 2.7-4.2 GHz, 7.5-9.76 GHz and 12.39-15 GHz. Increasing horizontal length up to 3.2 mm results in increase in impedance bandwidth, but further increasing horizontal length of truncation, deteriorates the bandwidth again. Thus, triangular truncation with vertical length  $Lg1=7$  mm and horizontal length of  $Wg1=3.2$  mm results in optimum performance with total operational frequency range from 3.03 GHz to 14.32 GHz.

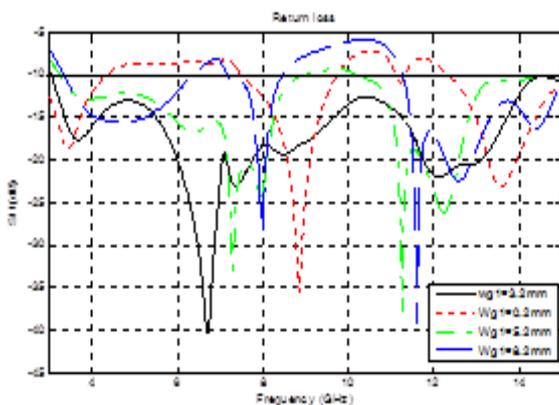


Fig. 5. Return loss for various horizontal truncations in the Ground plane

### B. Effect of Dual Parasitic Strips:

As it can be analyzed from return loss plot in figure 6 that impact of parasitic strips lies in reducing return loss further, thereby increasing the antenna performance.

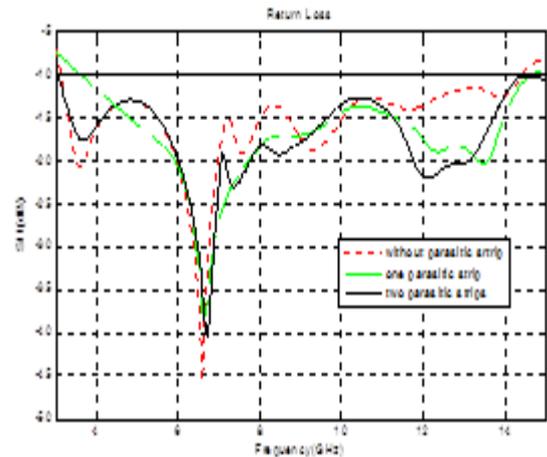


Fig. 6. Effect of parasitic strips on return loss plot

As return loss represents power reflected back through feeding point due to mismatch in impedance between transmission line and patch radiator, therefore less is return loss, more will be signal transmission by the patch antenna. When no parasitic element is included, bandwidth is less than -10 dB for the frequency range 3.03 -14.32 GHz but return loss was comparatively high, particularly for frequencies from 7 to 14 GHz. By introducing parasitic strips with patch antenna, return loss further reduces for the same frequency range i.e. 3.03-14.32 GHz, thereby, resulting in optimum antenna performance by using dual parasitic strips of 1mm at 0.5 mm distance from patch boundary in y-direction.

Radiation pattern is graphical depiction of power radiated from antenna in all directions. It represents amount of power radiated in particular direction in relative to other directions. 2D radiation patterns are considered at two different azimuth angles i.e.  $0^\circ$  and  $90^\circ$  to analyze co-polarization and cross-polarization performance of patch antenna in E plane. Figure 7 shows 2D radiation patterns at  $0^\circ$  and  $90^\circ$  azimuth angles for various different frequencies throughout the impedance bandwidth. Elevation angle  $\theta$  has been considered from  $0^\circ$  to  $360^\circ$  for observing 2 D radiation properties.

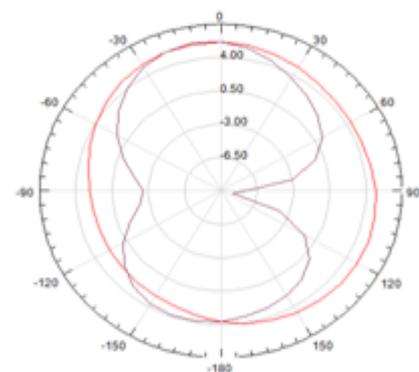


Fig. 7. (a) Radiation pattern at  $\phi=0^\circ$  and  $\phi=90^\circ$  at 4 GHz

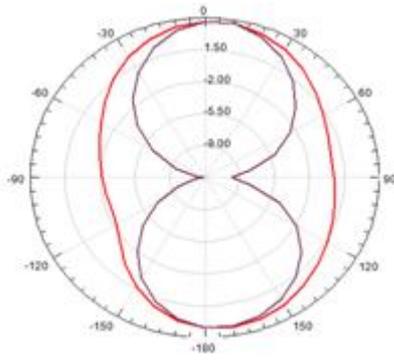


Fig. 7. (b) Radiation pattern at  $\varphi=0^\circ$  and  $\varphi=90^\circ$  at 6 GHz

As shown in figure 7(a), radiation pattern is quite symmetrical at X-Y plane ( $\varphi=0^\circ$ ) i.e. it radiates almost equally in all directions whereas in X-Z direction, antenna radiation is quite negligible. Thus, radiation in cross polarization plane for E plane is negligible. This radiation pattern nearly takes donut shape when visualized in 3D pattern.

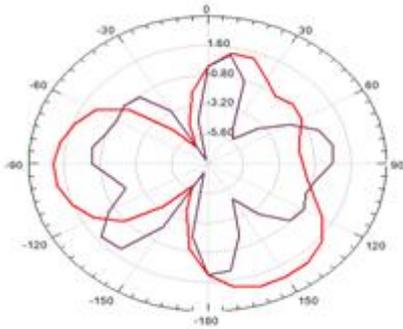


Fig. 7. (c) Radiation pattern at  $\varphi=0^\circ$  and  $\varphi=90^\circ$  at 8 GHz

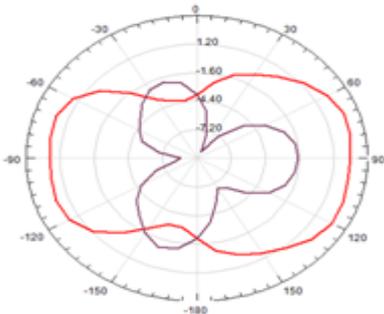


Fig. 7. (d) Radiation pattern at  $\varphi=0^\circ$  and  $\varphi=90^\circ$  at 10 GHz

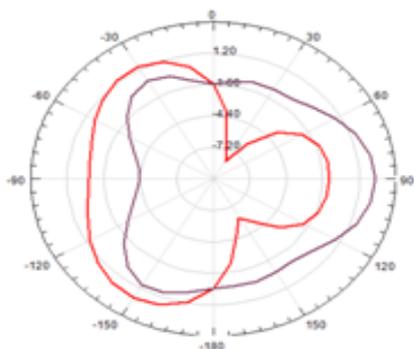


Fig. 7. (e) Radiation pattern at  $\varphi=0^\circ$  and  $\varphi=90^\circ$  at 12 GHz

On analyzing figure 7(b) -7(f), it is clear that on approaching high frequencies, radiation pattern is more directed towards directional pattern i.e. it radiates more in some particular directions in relative to others. Radiation pattern till 6 GHz is still considered somewhat symmetrical but beyond 6 GHz, radiation patterns approaches more towards certain directions. As indicated in figure 7(a)-7(f), it is observed that gain is positive in E plane, for almost the entire frequency range from 3.03 GHz to 11.32 GHz. Thus, the novel proposed CPW fed design provides good performance in the entire impedance bandwidth range, along with constant group delay response.

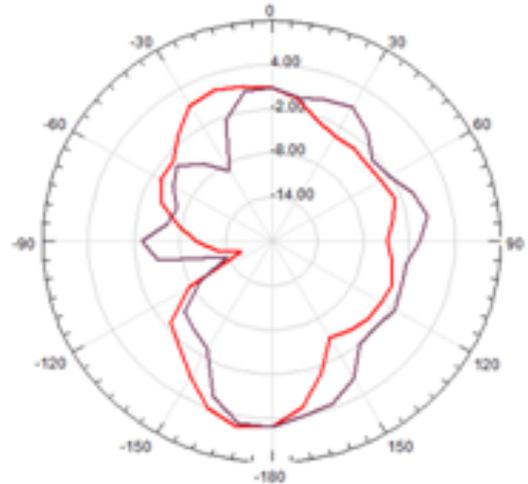


Fig. 7. (f) Radiation pattern at  $\varphi=0^\circ$  and  $\varphi=90^\circ$  at 14 GHz

#### IV. CONCLUSION

This paper presents a novel design for slotted Rectangular CPW fed antenna with dual parasitic elements in order to meet the need for high data rate transmission in the ultra-wide bandwidth. Further, the coplanar ground plane is truncated at both sides in provide impedance matching in wide frequency range from 3.03 GHz to 14.32 GHz. The proposed design possesses several advantages such as simple design, compact size, ultra-wide bandwidth of 11.29 GHz and ease of fabrication etc. Also, the use of FR4 Epoxy material as substrate allows low cost of production. The novel designed antenna finds several applications in radar and imaging, sensor data collection, locating and tracking applications etc.

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# Comparison Analysis of Return Loss for Slot Loaded Microstrip Patch Antennas for Frequency Band 5-6 GHz

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**Abstract**—A novel miniature wideband rectangular patch antenna is designed for wireless local area network (WLANs) applications and operating for 2-8 GHz ISM band, and wideband applications. In this paper, comparison is made of the proposed antenna and reference [1] for parameter called return loss. Both of antennas operate on same frequency. The proposed antenna has a good and deep return loss results.

**Keywords**—Wideband Antenna, Microstrip Patch Antenna, Patch Antenna, Wireless Applications, 'Y' shape

## I. INTRODUCTION

The requirement for wireless communication systems has increased sharply to fulfill the need of data rate for the wireless local area networks (WLANs). The main ambition of advance wireless communication system is the high speed networking service for various media communication. Microstrip patch antennas offer numerous advantages such as low cost, light weight, low profile, ease of fabrication and conformity [2-3]. Instead of these advantages it also has some disadvantages like narrow bandwidth and low gain.

Several techniques have been recommended to overcome the restrictions of the simple microstrip patch antenna. Applying perturbations is method amongst those all suggested for designing the microstrip patch antenna. To comply with the requirements in communication systems such as the Wireless local network (WLAN, high speed wireless applications it is often mandatory that antennas are of compact size, low cost and capable of operating at multiband frequencies [4].

The job of designing antenna becomes very challenging while seeing trade-offs related with operation over frequency bands, constraints on size and limitations of commercial low cost materials. Low cost and conformal antennas support the operation of many modern communication systems [5]. The development of patch antennas progresses day-by-day as James et al. [6] presented microstrip patch antenna array for microwave life detection system. This system was developed by Chen and Huang in the year of 2000 and scope of this system is to search human objects under earthquake rubble or behind the barrier. The operating frequency of antenna of this life rescue system is 1.150 GHz.

Agata et al. suggested a novel printed bow-tie antennas for dual-band dual-mode mobile handset applications. They

introduced this antenna for dual-band GSM/DCS 1800 operation on a single handset employing dual-band antenna concepts [7]. Behera et al. presented a balanced amplifying microstrip patch antenna at 2.4 GHz. He discussed the advantages of an ideal balanced configuration which comprises good isolation with improved stability, good input and output external matching, cancellation in the load of products and harmonics are considered in designing a balanced configuration for the active antenna [8].

Onofrio Losito proposed high efficiency and broadband microstrip leaky-wave antenna. He was able to achieve tremendous antenna characteristics such as wider band of 33% for VSWR < 2, higher gain and higher efficiency [9]. Roy et al. proposed miniaturized broadband microstrip antennas for HIPERLAN/2 application. They reported U-slot loaded and V-slot loaded proximity coupled microstrip antennas. The performances of two antennas are investigated in frequency band of high performance wireless local area network.

Mohammad Tariqul Islam et al. presented a high gain microstrip patch antenna. His design comprises contemporary techniques; probe feeding, inverted patch structure and stacked multiple slotted patch. The composite effect of integrating these techniques and by introducing the novel multiple shaped patch, offer a low profile, broadband, high gain, and compact antenna element [10]. Asghar et al. proposed a circular microstrip patch array antenna for c-band altimeter system. The aim of this antenna construction was to obtain a high gain, an acceptable pattern and a reasonable value of SWR for altimeter system application [11]. Lai et al. presented and discussed a circular patch microstrip array antenna for ku-band wireless application. The proposed antenna is simplest in construction, low cost and miniaturized in size. This design is suitable for the wireless applications such as WLAN, Radio astronomy and Passive sensors for satellite services [12].

## II. DESIGN METHODOLOGY

To design and analyze the proposed antenna, High Frequency structure Simulator (HFSS) electromagnetic software tool is utilized. HFSS is a high performance full-wave electromagnetic (EM) field solver for arbitrary 3D volumetric passive device modeling. It integrates visualization, simulation, solid modeling and automation in

an easy-to-learn environment where solutions to 3D EM problems are quickly and accurately obtained [12].

Ansoft HFSS employs the Finite Element Method (FEM), adaptive meshing, and brilliant graphics to give unparalleled performance and insight to all 3D EM problems. Ansoft HFSS can be used to calculate parameters such as S-Parameters, Resonant Frequency, and Fields. HFSS is an interactive simulation system whose basic mesh element is a tetrahedron thus allowing us to solve any arbitrary 3D geometry.

### III. ANTENNA DESIGN ANALYSIS

The geometry of the reference antenna is showed in Fig.1. It consists of a printed rectangular patch antenna on FR4 substrate of thickness 0.8 mm and a relative permittivity 4.4. The substrate has a length of  $L=20$  mm and the width of  $W=15$  mm. The dimensions of the partial conducting ground plane are  $15\text{mm}\times 7$  mm. The excitation is launched through a 50 Ohm microstrip feed line, which has the length 8mm and the width 1.5mm. In this paper, rectangular slot on the radiator element and rectangular step have been used for bandwidth improvement, in order to cover the entire 5-6GHz band, and make the antenna suitable for 5 to 6 GHz applications.

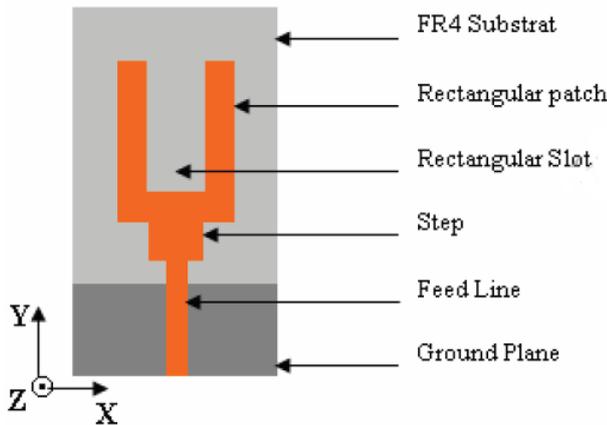


Fig 1. Reference Antenna with Slot and With Step

Table 1: Dimension of Reference Antenna

FR4 Substrate	240mm
Rectangular Patch	56mm
Rectangular Slot	18mm
Step	6mm
Feed Line	12mm
Ground Plane	105mm

In figure 1, wideband is achieved with the help of rectangular slot and step length on the substrate.

The structure of the proposed antenna design is to be studied in this section. Figure 2 represents the architectural view of the proposed antenna. The circular patch antenna of specified dimensions is separated from the ground plane by a substrate of 'Rogers RT/duroid 5880' of finite thickness. Co-axial probe feed is preferred to analyze the antenna for better impedance matching. Slotted perturbations are employed in upper half of the circular patch antenna [13].

The dimensions of the slots are to be chosen through literature as well as iterative trials so that the proposed antenna geometry could be able to radiate at multi resonant frequencies.

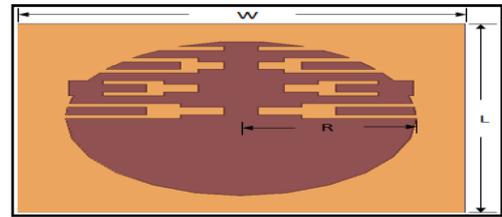


Fig. 2. a) Geometry of proposed antenna [13]

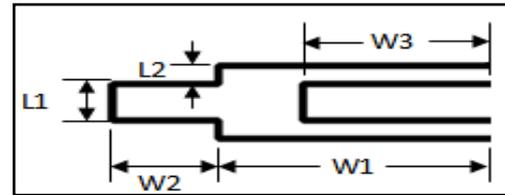


Fig. 2. b) Elementary slotted structure 1

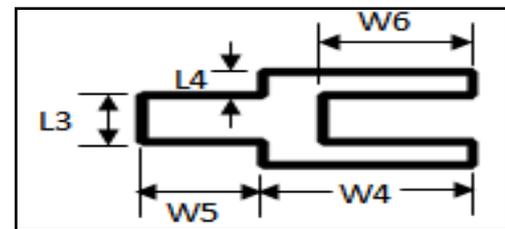


Fig. 2. c) Elementary slotted structure 2

The dimensions of the patch antennas are playing very important role in deciding the performance characteristics of the analyzed antenna. The dimensions of the ground plane i.e. length and width of the ground plane are same as the length and width of the substrate material, therefore ground plane dimensions are not included in the table 1. The dielectric constant of the substrate material plays a vital role in deciding the resonant frequency as well as impedance bandwidth of the patch antenna is represented by the ' $\epsilon_r$ '. Radius of the circular patch is represented by the ' $R$ ' and height of the substrate material is denoted by ' $h$ ' and their typical values are mentioned in table 2.

Table 2 Dimension of Reference Antenna

Antenna Parameters	Dimensions
L	50.10 mm
W	52.00 mm
R	22.33 mm
$\epsilon_r$	2.2
h	1.58 mm
L1	2.00 mm
L2	1.00 mm
L3	2.00 mm
L4	1.00 mm
W1	13.00 mm
W2	5.00 mm
W3	9.00 mm
W4	7.00 mm
W5	4.00 mm
W6	5.00 mm

#### IV. RESULTS AND DISCUSSIONS

In this section, the discussion is made on the result of both the antenna. The return loss of the reference antenna is shown in figure 3.

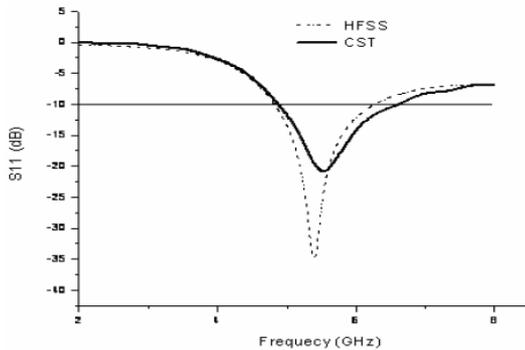


Fig.3. Return loss vs. frequency plot of proposed antenna geometry

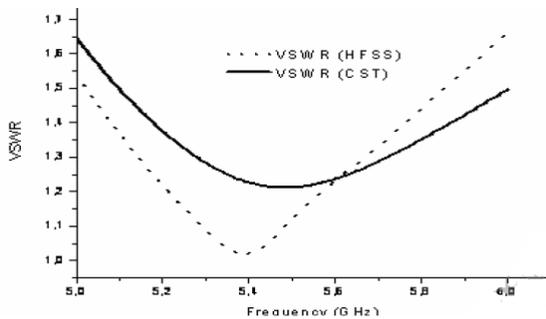


Fig.4. VSWR vs frequency plot of reference antenna

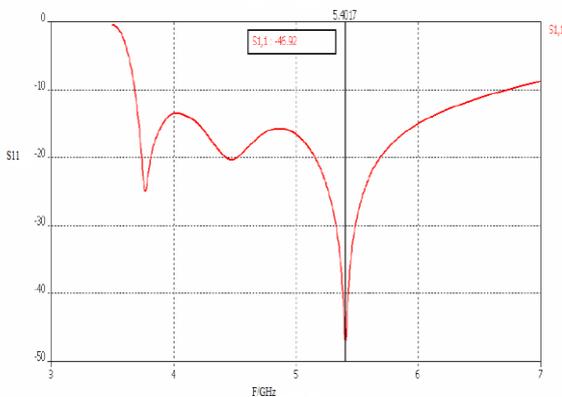


Fig. 5 Return loss vs. frequency plot of proposed antenna geometry

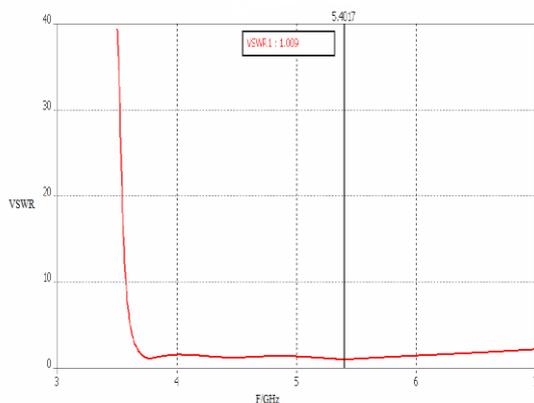


Fig.6. VSWR vs frequency plot of reference antenna

The Return loss and VSWR is better when the curve is deeper and wide dip, with good bandwidth. The proposed antenna is showing acceptable return loss over the entire range in the figure 5. The return loss of - 48.56dB is attained at 5.4GHz correspondingly. The performance of the antenna is better if there is perfect impedance matching and return loss is less than -10 dB. Figure 5 represents the resonance frequencies for the simulation result at 5.4 GHz is realized. The bandwidth of the proposed antenna is 3.8GHz that lies between the frequencies ranging from 3GHz to 7GHz. The resonance frequencies can be diverse by varying the dimensions of the patch.

#### V. CONCLUSION

A novel patch antenna with y-shape slot design is investigated with the simulation software. The novel design with the return loss and VSWR of antenna is shown in the result. As it is investigate from the end result that it is displaying good characteristics to work for many wireless communication applications and it is far improved than the reference antenna in study of return loss and VSWR. It is proposing return loss to be less than -10 dB for frequency 5.2GHz so supporting many wireless applications. It also gives wide bandwidth of 3.8 GHz and VSWR is also less than 2. For future work more slots can be made in patch to improve the performance of purposed antenna and to obtain multiband behavior.

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# Low Voltage and High Gain Double Gate MOSFET based OTA

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**Abstract-** OTA is very popular in electronics industry due its large number of applications. Double gate MOSFETs are strong contenders for nano scale region due its better control over SCEs. In this paper we will design low power, better phase margin OTA using double gate MOSFETs. The simulations are done at 45nm technology.

**Keywords-** DG MOSFETs, OTA, Analog Tunable circuits, Gain , Phase margin, low supply voltage

## I. INTRODUCTION

Electronics devices based on silicon is large as like – laptops, palmtops, cellular, and many more. Due to great dealing out of silicon based devices, silicon has made system on chip possible. A low power and voltage design to recompense is required for increasing number of devices on chip. With the breach of 90 nm, silicon industry has moved to nano area to according to ITRS [1]. There are number of problems arises due scaling in conventional bulk CMOS device like SCE's, [2] [3] threshold voltage, non –scaling of vertical dimensions, these problems degrade the performance of circuits and affects the reliability of devices. Double Gate devices have better control over SCE's and junction leakage due to improved electrostatic gate control of back gate [4]. Double Gate MOSFETs are promising devices due to better scalability in nano circuits. With scaling down  $v_{dd}$  ,  $v_{gs}$  also decreases. It allows working in subthreshold region with increased transconductance  $g_m$  [5]. They are also suitable for analog RF devices because of the capability to handle gigahertz frequency range. By tuning of back gate, they provide better characteristics in area , power dissipation and lastly the speed [6] in independent driven mode[IDDG] where two gates are separately biased whereas symmetrically driven mode (SDDG) used in digital applications due to better  $I_{on}/I_{off}$  ratio [7]. The circuit symbols for n-type and p-type double gate MOSFETs are shown in Fig.1. In this paper, the basic device structure using DG-MOSFETs is shown, where back gate will be used for the tuned circuit performance. A low power and high gain at 45 nm. OTA using double gate MOSFETs is designed for the study. The simulations are done using spice tool.

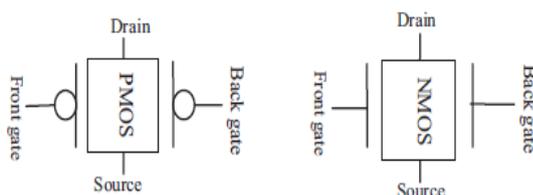


Fig.1 Circuit Symbols for n-type and p-type double gate MOSFETs

## II. DEVICE STRUCTURE AND FEATURES

The double gates can work in two modes symmetrically driven [SDDG] and independently driven mode [IDDG]. The device structure is shown in Fig. 2. The front and back gates are connected to work in symmetrically driven mode and for analog tunable circuits, the front and back gates are biased at different voltages to achieve desired characteristics of device. The gate length is 45 nm. The symmetrical driven mode is better than independently driven mode [IDDG] as discussed in [8] [10-11].

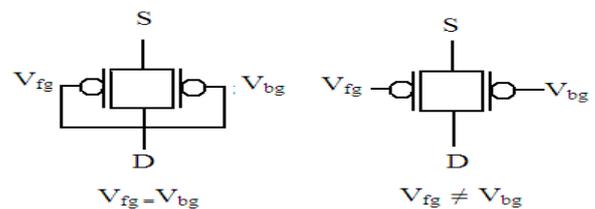


Fig.2 The SDDG and IDDG refer to symmetrically and independently driven double-gate MOSFET

## III. OPERATIONAL TRANSCONDUCTANCE AMPLIFIER

Fig.3(c) shows OTA based double gate MOSFETs. The reported OTA works in independently driven mode and shows very less gain [9]. With decreasing gate length, the channel mobility is degraded. Even for shorter channel length, output conductance is increased which will affect the gain of OTA. In this paper, a new design of OTA to improve gain at 45 nm technology is discussed. The simulations of the existing design have been done using tanner EDA tool version 13.0 at 45 nm CMOS technology for phase response, transient and AC analysis. Existing OTA circuit works at supply voltage of  $V_{DD}$  equals to 1.16V and  $V_{SS}$  equals to -1.16V respectively. The bandwidth is measured as difference between lower frequency and upper frequency at -3dB down from maximum gain of circuit obtained. As frequency increases, the gain is decreased due to capacitive affects at high frequencies. The open loop gain is function of frequency and shown in equation:

$$A_{OL}(f) = \frac{A}{\sqrt{1 + \left(\frac{f}{f_o}\right)^2}} \quad (1)$$

Where  $A$  is internal gain and  $f, f_o$  are operating frequency and cut-off frequency respectively. The block diagram and circuit symbol is shown in Fig. 3(a) and 3(b) respectively. The open loop gain of existing circuit is observed as 2.6 dB.

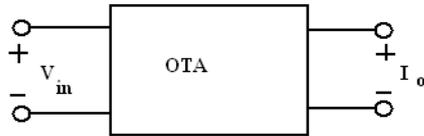


Fig.3(a) Block diagram of OTA

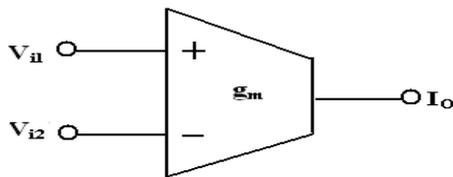


Fig.3 (b) Circuit symbol of OTA

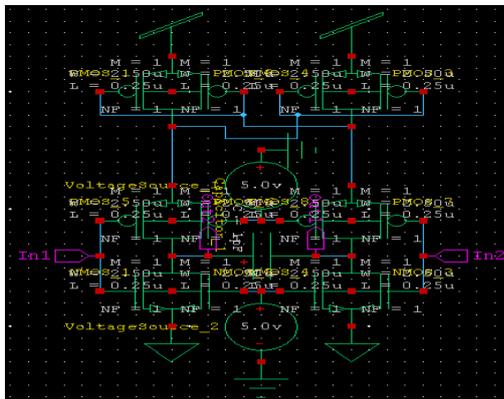


Fig.3(c) OTA based double gate MOSFETs

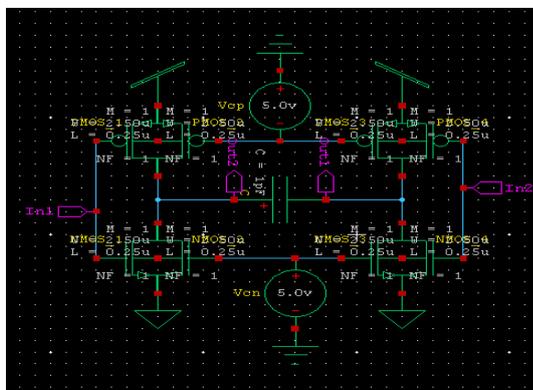


Fig.4 Proposed OTA based double gate MOSFETs

The proposed OTA works in independently driven mode. The input  $V_{in1}$  and  $V_{in2}$  are given at back gates through inverters which are also made of double gate MOSFETs. Amplifier transconductance,  $G_m$ , is in general a function of the transconductance of transistors at the input stage. It is well known that the transconductance can be increased either by increasing the biasing current of the input

transistors or by increasing the size of the input transistors. The proposed OTA works in independently driven mode. Differential currents flow and charge a load capacitor of 0.1 fF. The loads transistor as active pMOS which gives positive feedback to circuit and increase the gain of circuit. The proposed amplifier will exhibits a positive feedback property. The upper transistor gives positive feedback to circuit which will increase the gain of circuit.

Table 1 Different Parameters

PARAMETERS	Existing OTA	PROPOSED OTA
$C_L$ (fF)	0.1	0.1
Supply Voltage(V)	1.16	0.92
Gain(dB)	2.6	4.85

#### IV. RESULTS

The simulations are done at  $V_{dd}$  of 0.92 V. and biasing at back gates is  $v_{cn} = -v_{cp} = 0.1V$ . The gain is 4.85 dB as shown in Fig.5 (a) .

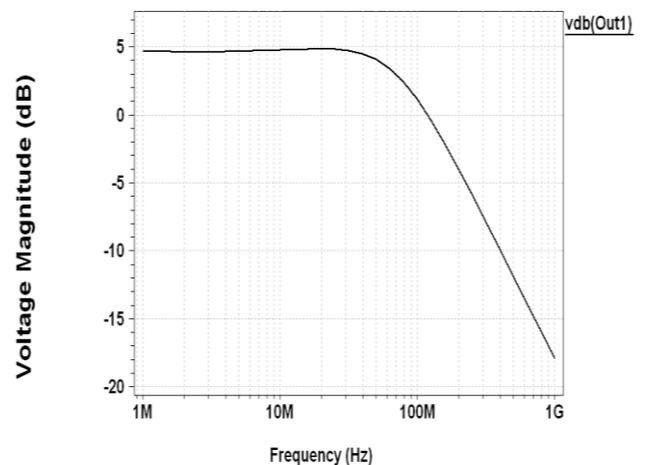


Fig.5 (a) Differential gain of OTA

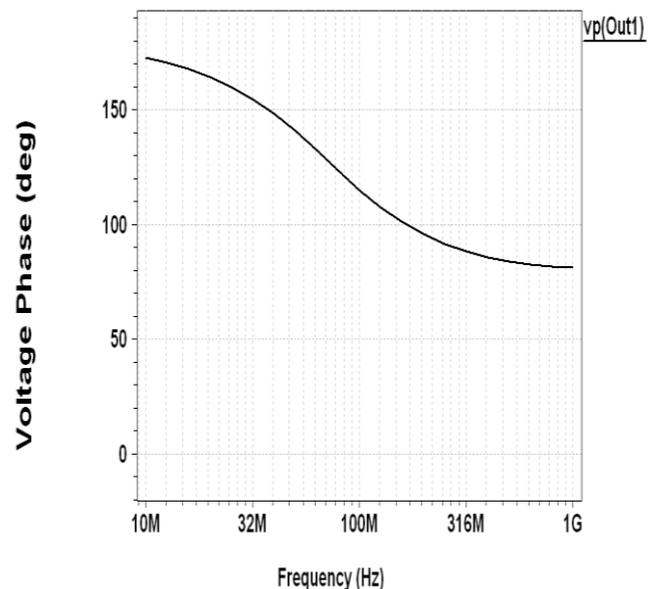


Fig.5 (b) Phase response for input1

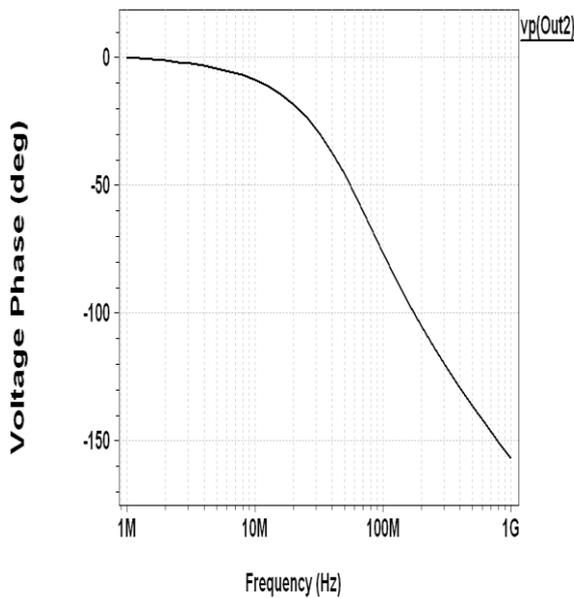


Fig.5(c) Phase Response for input2

## CONCLUSION

The work in this paper presented appropriateness of double gate MOSFETs for designing of analog circuits like OTA and filters. The designed OTA shows high gain, low power dissipation. The circuit is suitable for high frequency applications and high gain. The proposed circuit is suitable for designing analog filters consists of OTA and capacitor which are also called as integrators. Using double gates, further phase margin, temperature variation and bandwidth will be explored in future.

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# Comparison between H-shape and E-shape Microstrip Antenna

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**Abstract**— Microstrip antenna is most commonly used antenna because of its various advantages. It was first developed in 1970 with frequency ranging from 1GHz to 6GHz. Because of its flat compact size it is easy to use for air bones and space crafts. Thick dielectric substrate with low dielectric constant is used for better efficiency and larger bandwidth. Some parameters of microstrip antenna such as radiation pattern, directivity, Voltage Standing Wave Ratio (VSWR), width of patch, effective di-electric constant and gain are discussed followed by its types (Rectangular shaped, H-shaped and E-shaped).

**Keywords**— Voltage Standing Wave Ratio, Global Positioning System, Band Width, Microwave

## I. INTRODUCTION

An antenna also called as aerial is an electrical device which is used to convert electric power into radio waves and vice versa. An antenna is used with radio transmitter and radio receiver. It radiates in horizontal directions equally by omnidirectional antenna or in particular direction with directional antenna. Electromagnetic waves are such radio waves which carry signals through the air without any loss in transmission [1]. Among all the antenna, microstrip antenna is most widely used because of its compact size, light weight, low cost, superior portability and many other advantages [2]. It gets its application in biomedical applications, satellite communication radars, aerospace etc. However with these advantages and applications it has disadvantages like low gain, narrow bandwidth. In section II, simple microstrip antenna is introduced followed by parameters used in designing of a microstrip antenna in section III. Section IV discusses different types of antennas and section V summarises and compares those types.

## II. MICROSTRIP ANTENNA

Microstrip antenna also called a patch antenna is most widely used antenna type used these days. A lots of research is required to be done for its performance. It was first developed in 1970s for popular frequency ranges from 1 GHz to 6 Ghz[3]. Its flat and compact size make it more comfortable for airborne and space craft applications. It has other advantages like light weight, low cost, low profile, superior portability ease of fabrication, planner configuration suitable for arrays. It can be easily integrated with MW monolithic integrated circuits. With the reduction in size and with the use of high dielectric constant material make it useful in GPS receivers hand sets and other mass produced wireless products.

The design of conventional microstrip antenna is shown in fig.1 [4].

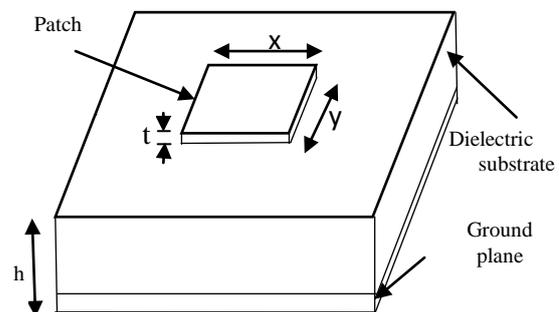


Fig.1 Rectangular microstrip antenna

x=length of patch

y=breath of patch

t=height of patch

h=height of dielectric substrate

The upper side of patch antenna is radiating patch and lower side is grounded. The patch is commonly of conducting material like copper or gold. It can be of any shape. The radiating patch and feed lines both are photo etched on the dielectric substrate[3,4].

For larger B.W, better efficiency and radiation, thick dielectric substrate with low dielectric constant is required which makes it bulky on the other hand if we design a compact micro strip antenna with high dielectric constant, makes its bandwidth narrow. So a compromise between them is always there[4].

## III. SOME ANTENNA PARAMETERS

Width of patch (W) is calculated by the following equation[5]:

$$W = \frac{c}{2f_o} \sqrt{\frac{2}{\epsilon_r + 1}} \quad (1)$$

where, c= speed of light

$\epsilon_r$ = substrate dielectric constant

$f_o$ = resonant frequency

Patch length (L) is calculated by the equation[5]:

$$L = \frac{c}{2f_o \sqrt{\epsilon_{eff}}} - 2\Delta L \quad (2)$$

where,  $\epsilon_{eff}$ = effective dielectric constant

$\Delta L$ =length extension

Ground length ( $L_g$ ) is calculated by[5]:

$$L_g = 6h + L \quad (3)$$

where, L=length of patch

h= height of substrate above ground

**Radiation pattern:** It is a graphical representation of the radiation properties of the antenna as a function of space coordinates[6]. For rectangular shape antenna it is near about 2.55 Ghz, for E-shape antenna it lies between 1 to 15 Ghz and in H-shape antenna with the decrease in centre strip width the pattern of radiation broadened in the E plane.

**Directivity:** It is defined as the ratio of radiation intensity of antenna in a given direction to the radiation intensity in all the directions[6].For rectangular antenna it is between 5 to 8dB and for H-shape antenna it is near about -25dB and for E-shape antenna it is near about 12.5dB.

**VSWR:** it is stand for voltage standing wave ratio. It is defined as the ratio of maximum voltage to the minimum voltage i.e[6].

$$VSWR = \frac{V_{max}}{V_{min}} \quad (4)$$

For rectangular antenna it ranges from 1 to  $\infty$  when  $\Gamma$  ranges from 0 to 1, where  $\Gamma$  is reflection constant[7]. For H-shape antenna it is between 1.5 to 1 and for E-shape it is near to 1.5.

**Effective dielectric constant ( $\epsilon_{reff}$ ):** If the value of  $\epsilon_{reff}$  becomes high then dielectric constant ( $\epsilon_r$ ) the fringing fields around the patch will spread in the air also confined in dielectric substrate. The expression for  $\epsilon_{reff}$  is given by[7]:

$$\epsilon_{reff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2} \left[ 1 + 12 \frac{h}{W} \right]^{-\frac{1}{2}} \quad (5)$$

where  $\epsilon_{reff}$ = Effective dielectric constant

$\epsilon_r$  = dielectric constant

h=height of dielectric substrate

W= width of patch

Gain is calculated by[5]:

$$G = \eta * D \quad (6)$$

where  $\eta$ =efficiency

D= directivity

Width of patch ( $W_p$ ) is a calculated by[5]:

$$W_p = 6h + W \quad (7)$$

where h=height of substrate above ground

W=width of patch.

#### IV. DIFFERENT DESIGNS OF MICROSTRIP ANTENNA

After the invention of rectangular microstrip antenna some designs are suggested to overcome the limitation which are faced in rectangular strip antenna. Some of them are:-

- A. H-shape patch or dual U slot antenna
- B. E-shape patch microstrip antenna
- C. H-shape patch or dual U slot antenna

The top view of the H-shaped microstrip patch antenna is shown in Fig.2. and dimensions of U-slot H-shaped patch antenna are shown in Fig.3. To feed the antenna, edge feed is used in the design of antenna. H-shaped patch antenna is constructed by cutting two U-shaped notches in the H-patch[5].

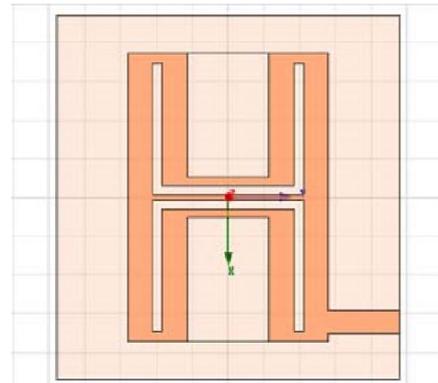


Fig.2 Top view of U slot H-shaped patch

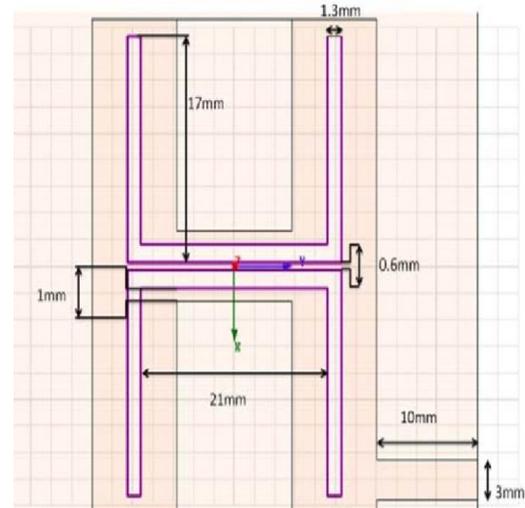


Fig.3 Dimensions of U slot H-shaped antenna

In Fig.4 , W is the width of E-shaped microstrip antenna and L is the length of two outer patch strips.  $W_s$  and  $L_s$  is the width of slot respectively.  $W_t$  and  $L_t$  are the dimensions of centre arm. The second resonant frequency can be calculated by L2C2. The slot width  $W_s$ , length  $L_s$  and position  $W_t$  plays an important role in controlling the

achievable bandwidth. RLC Equivalent circuit of E-shaped patch antenna is shown in Fig.5[8].

#### A. E-shape Patch Microstrip Antenna

The E-shaped microstrip patch antenna is very simple to construct. It can be constructed by incorporating two parallel slots into the microstrip patch antenna. The geometry is shown in Fig.4[8].

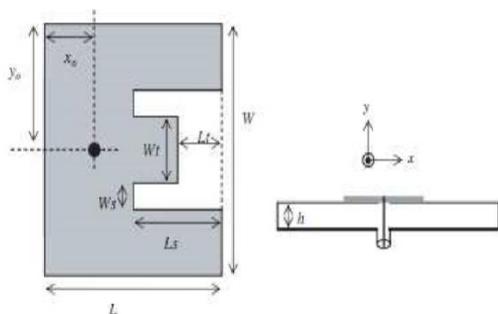


Fig.4 E-shaped microstrip patch antenna

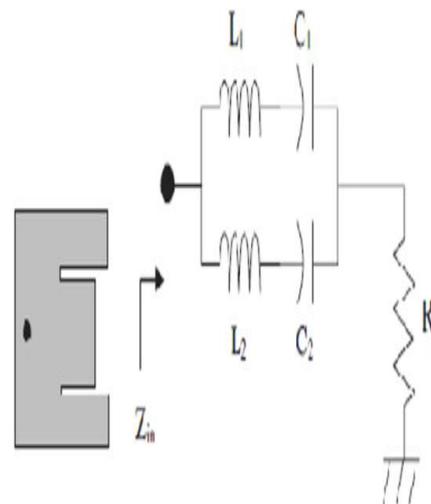


Fig.5 Equivalent circuit of E-shaped patch antenna.

Table 1. Summary of parameters

Parameters	Rectangular	H-shape	E-shape
$\epsilon_r$	2.2	4.4	2.2
Height of substrate	1.5 mm	6.7mm	1.575mm
Gain	5-8dB	-25dB	3dB
W	30mm	37.26mm	23.717mm
$\epsilon_{eff}$	2.06mm	4.08mm	21.074mm
$\Delta L$	0.86mm	0.738mm	0.41469mm
L	39.37mm	27.35mm	19.835mm
L <sub>eff</sub>	41.09mm	28.83mm	20.665mm
bandwidth	2.919Ghz	3.5Ghz	8.6-9.8Ghz
F <sub>o</sub>	1.5Ghz	2.45Ghz	5Ghz

## V. CONCLUSION

In this paper design and parameters of microstrip antenna are discussed. Microstrip antenna is widely used due to its various advantages. It was invented in 1970. Microstrip antenna is easy to integrate with MW monolithic integrated circuit. H-shaped patch antenna and E-shaped patch antenna are two important types of microstrip antenna. According to the parameters, E-shape microstrip antenna is better than the H-shape microstrip antenna. E-shape antenna has gain of 3dB as compared to -25 dB of H-shape antenna. E-shape microstrip antenna has BW of 8.9 to 9.8 Ghz whereas H-shape patch antenna has BW of 3.5Ghz. More research work has to be done to improve the parameters of both antennas.

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# A Survey on Comparison of Multiple Antennas Techniques for Wireless Communication

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**Abstract**—The paper gives an overview of the critical developments in the field of multiple antennas techniques for wireless communication systems. The field of multiple antenna systems, often called multiple-input multiple-output (MIMO) systems has gained overwhelming interest in the field of wireless communication. The objective of this paper is to survey the research efforts of recent years to accomplish a comparison between spatial multiplexing (SM), spatial diversity (SD) and beamforming techniques for the enhancement of the bit rate, the error performance or the signal-to-noise-plus-interference ratio (SNIR). The recent advances in MIMO and further issues and challenges in this technology has also been highlighted in this paper.

**Keywords**—MIMO, SM, SD, SNIR

## I. INTRODUCTION

There has been rapid growth in the field of wireless in recent years. Mobile communication has gone through generations of evolution to bring enhanced and value-added features and services such as support for multimedia applications, integrated services and high usability to consumers. Wireless has provided the ability to connect anytime, anywhere and with any technology. A major concern for the future is the ability of the existing wireless infrastructure to absorb the increased traffic demand with good performance. For satisfying this demand, a certain quality of service is required, not only for high bit rates, but also for good error performance. The problem with most of the wireless communication system is the disruptive characteristics of wireless channels, mainly caused by multipath fading effects, which makes it challenging to accomplish both higher bit rates and smaller error rates at the same time for given bandwidth.

To achieve a high system capacity for multimedia applications in wireless communications, various methods have been proposed in past decades. Among them, the MIMO system using multiple antennas at both the transmitter and the receiver has attracted a lot of research interest due to its potential to increase the system capacity without extra bandwidth. It provides a more reliable transmission with multiple antennas as compared to a single antenna system [1]. In addition to multiplexing gain and diversity gain, multiple antennas techniques provide various benefits such as interference suppression, antenna gain.

With such a technique, spectral efficiency can be improved in order to increase the speed of operation and network capacity by transmitting different data streams on different antennas simultaneously. To combat the effect of interference, MIMO is generally combined with orthogonal frequency division multiplexing (OFDM) technique [2]. These advantages make MIMO a very attractive and promising option for future mobile wireless communication systems.

In this paper an attempt has been made to survey the literature related to multi antenna based techniques for the enhancement of the wireless systems and to find out the open issues and challenges in this area. The rest of the paper is organised as MIMO manifestation in section 2. Section 3 describes literature survey and related work that has been carried out in this field. In next section, open issues and challenges has been discussed and conclusion and future scope are provided in section 5.

## II. MIMO MANIFESTATION

The evolution of multiple antennas techniques in wireless system is organised in this section. As shown in figure 1, single-input multiple-output (SIMO), multiple-input single-output (MISO) and MIMO are regarded as special cases for multiple antenna techniques. The transmission techniques that utilizes only one transmit antenna and multiple receiver antennas are called as SIMO techniques. Similarly, techniques that has multiple transmit antennas are called as MISO technique. Finally, techniques that utilizes multiple antennas at both transmitter and receiver sides are called as MIMO techniques.

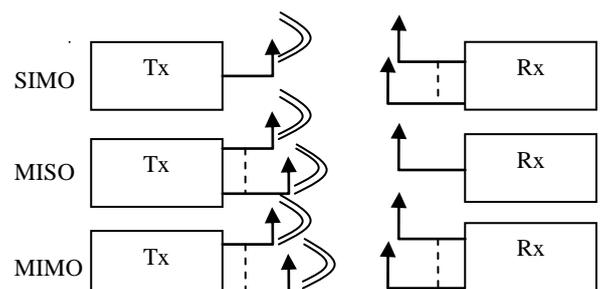


Figure 1: Differences Between SIMO, MISO and MIMO.

- In SM techniques, the antennas are physically separated by a few wavelengths to experience independent fading channels [3]. In SM technique, the users information bit sequence is divided into  $M$  sub-sequences, which are then modulated and transmitted simultaneously within the same frequency band or time slot to achieve high bit rate called as multiplexing gain as illustrated in figure 2. Then the transmitted sequence is separated using interference-cancellation type of algorithm. This is the basic principle of SM. Most of SM channel encoders and decoders employ 1-dimensional coding operating solely in the time domain in order to guarantee certain error performance. Higher bit rates and moderate receiver complexity are the benefits of using SM. But the detection algorithms used at the receiver are complex.

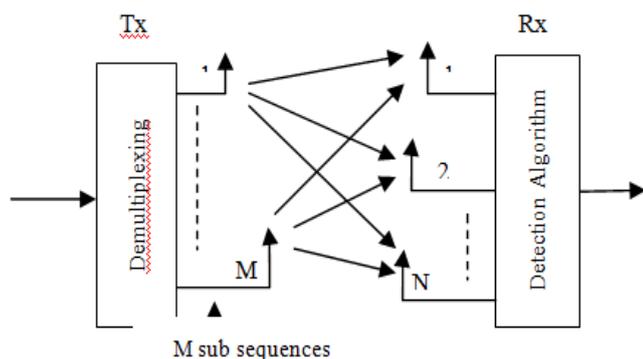


Figure 2: Spatial Multiplexing

- SD techniques, for example, Alamouti's transmission diversity scheme [4] helps in providing diversity gain and coding gain (good error performance) as compared to single antenna transmission by sending redundant signals over multiple antennas as shown in figure 3. Various equalization techniques are used at the receiver to mitigate the effect of ISI. SD techniques has an advantage over SM techniques that the channel coding (1-dimensional) can operate in both time and space domain. But this scheme has certain disadvantages such as high receiver complexity, requirement of the channel estimation at the receiver and ISI or CFOs can cause data loss.

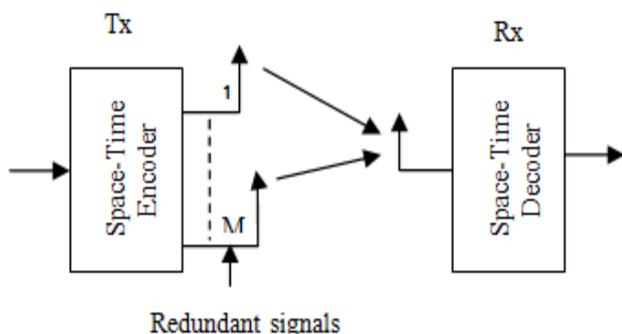


Figure 3: Spatial Diversity

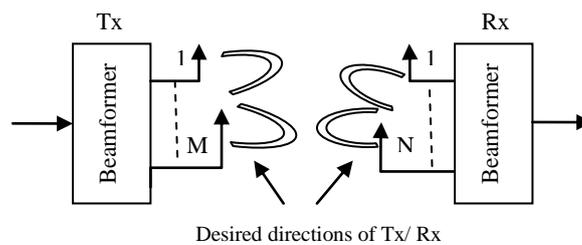


Figure 4: Beamforming

- Smart antennas using beamforming have been employed to improve the signal-to-noise ratio (SNR) at the receiver and to mitigate the effect of co-channel interference. The achieved SNR is called as antenna gain. The beam patterns of the transmit and receive antenna are focused in certain desired direction whereas undesired directions can be suppressed [5]. This is the principle used in beamforming. Linear coding is employed in spatial domain. To focus in certain desired direction, the antenna pattern needs to be updated regularly if the transmitter or receiver is moving.

### III. LITERATURE SURVEY

Many researchers have deployed various multiple antenna techniques for wireless communication systems. Some of the research work has been discussed in this paper. Telatar [6] was the first to obtain expressions for capacity and error-exponents for multiple transmit antenna systems in the presence of fading and Gaussian noise. Here, capacity was derived under the assumption that fading was independent from one channel use to another. Rachna [2] discussed the performance of various standards of wireless communications using multiple antenna techniques. The work showed that the channel estimation errors result in performance degradation. Mietzner [5] discussed the transmitter and receiver structures for spatial multiplexing, spatial diversity, and smart antenna techniques. MIMO techniques for frequency-selective fading channels, diversity reception, differential and non-coherent schemes, as well as practical aspects influencing the performance of multiple-antenna systems had also been addressed. Tarokh [7] concluded that the diversity order for space-time codes was same for slowly varying flat fading channels having perfect channel information and flat fading under mobility conditions. He demonstrated that this diversity order had been preserved only when the channel state information was available to the receiver. Foschini [8] examined exploitation of multi-element array (MEA) technology to provide extraordinary capacity to wireless systems. With MEAs, the capacity of the system was increased with the increase in SNR under the assumption that fading had been quasi-static; i.e., constant over a long period of time and then changing in an independent manner. A major conclusion was that the capacity of a multi-antenna system far exceeds that of a single antenna system. In particular, the capacity had grown at least linearly with the number of transmit antennas as long as the number of receive antennas is greater than or equal to the number of transmit antennas. Lei Shao [9]

proposed a novel rate-one (i.e., one symbol per transmission), space–frequency block code (SFBC) for an OFDM system to obtain maximum diversity over frequency-selective channels. The work showed that SFBC had smaller processing delay than STBC and there exists a trade off between robustness and decoding complexity.

#### IV. ISSUES AND CHALLENGES

A lot of research has been reported in the literature related to the use of multiple antennas techniques in wireless system. But there is an ample scope for researchers to work on the issues in this direction. Based on the literature survey, the various issues and challenges have been discussed below. Despite of having so many benefits, multiple antenna systems has various issues in practical and real-time implementations. First issue is that the cellular network base stations can support limited number of mobile terminals because of having limited processing capability. Moreover, the channel state information (CSI) of each mobile station needs to be known to the base station. Channel estimation errors may results in the severe performance degradation. Thus accurate channel estimation is of prime importance in MIMO communications. Another important issue is the intercarrier interference (ICI) due to multipath fading channels and inaccurate channel estimation. Moreover, multiple transmitter and receiver chains leads to increased hardware cost and increased complexity of the systems. This makes real-time implementations of near optimum multiple antenna techniques very challenging. Various detrimental effects can arise during practical implementations such as ISI effects, carrier frequency offsets, spatial correlation effects.

#### V. CONCLUSION AND FUTURE SCOPE

This paper provides the guidelines for future research in the area of multiple antenna technology. Future standards of wireless communication will continue to use MIMO technology. This literature survey has addressed transmitter and receiver structures, benefits and limitations for spatial multiplexing, spatial diversity, and beamforming techniques. Although an enormous amount of research has already been published on multiple-antenna systems, but there are still interesting open problems and issues that deserve further investigation especially in practical implementations. In future work, MIMO can be combined with orthogonal frequency and code division multiple access (OFCDMA) to utilize extraordinary capacity without any increase in the bandwidth.

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# Metamaterial Antenna- A Review

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**Abstract**-The study of metamaterials is among the most important and attractive topics of the electromagnetic field theory and applications in the past 15 years. Much effort has been devoted to scientific research into the new physical phenomena with great progress. This paper presents the reviews about the applications of metamaterials in innovative antenna designs from an engineering perspective. The new understanding of metamaterials offers us great possibility to translate the physical concepts of metamaterials in laboratories to innovative antenna designs in practical engineering applications. The technologies have been successfully developed, significantly improving key performances of antennas at microwave and millimetre-wave bands. The recently invented metamaterial-based antennas demonstrate not only wide operating bandwidth, high antenna efficiency, high gain, but also significantly reduced volume with simple mechanical structures. Negative refraction in metamaterials has generated great excitement in the scientific community. Although negative refraction has been realized in microwave and infrared by using metamaterials and by using two-dimensional waveguide structures. The advantages of using metamaterial antennas over conventional antennas are given in this paper.

**Keywords**— *Metamaterials, negative refractive index, miniaturized antenna system, CRLH (composite right and left handed materials), AMC's (Artificial magnetic conductors) surfaces. Zero index and zero phase shift metamaterials*

## I. INTRODUCTION

Mobile devices, digital televisions, RFID technology, wireless local area network and satellite communication system requires antenna with Dual, Multi, moderately wide and extremely wide band operations. The antennas are categorized as either natural antenna or metamaterial antenna. Natural antenna is the antenna having electromagnetic properties found in nature i.e. right handed properties and metamaterial antenna is the antenna having electromagnetic properties that are not exist in the nature i.e. left hand properties. The choice of either a natural or metamaterial antenna depends on the requirements of the target communication system.

The metamaterials and their specific features for antenna system are discussed in this paper. The special property of metamaterials such as negative permittivity, negative permeability, and negative refractive index are also given. The size of antenna plays a very important role for the performance of antenna. When we talk about the small size of antenna then it must not be related with the physical size of the antenna. The small antennas are categorized into four categories from the view of function, Physical dimensions, and partially constrained physical dimensions, in addition to dimensions small in comparison with the wavelength. The

types are FSA (Functionally small antenna), PCSA (Physically constrained small antenna), PSA (Physically small antenna), and ESA (Electrically small antenna). The demand for low cost miniature antennas has been increased. So, the electrically small antenna i.e. miniaturized antenna and their effect on the performance of antenna is discussed.

CRLH-TL (Composite right left handed) metamaterials transmission line can be structured and engineered to exhibit electromagnetic properties that are made for specific applications. In addition, CRLH metamaterials may be used to develop new applications and to construct new devices that may not be possible with RH materials. In antenna system, antenna array and other RF devices can be formed based on CRLH metamaterial structures. These metamaterial transmission lines provide left handed propagation and support backward waves. One configuration of metamaterial i.e. AMC (artificial magnetic conductor) demonstrated its usefulness and yields a highly resonant radiating system. A mushroom-like EBG (Electromagnetic band gap), uniplanar compact EBG, PEANO curve, and Hilbert curve are four types of artificial magnetic conductor surfaces which act as a ground plane for a low profile antenna. The AMC surface structures are designed to have an in-phase reflection property for a plane wave of normal incidence in the vicinity of 2.45 GHz.

## II. METAMATERIALS

Metamaterials are artificial composite structures with exotic materials which have the necessary properties that are absent in the naturally occurring materials. The physical properties of metamaterial are not primarily depend on the intrinsic properties of the chemical constituents, but rather on the internal, specific structure of material, i.e. metamaterials are periodic materials that derives its properties from its structure rather than its components.

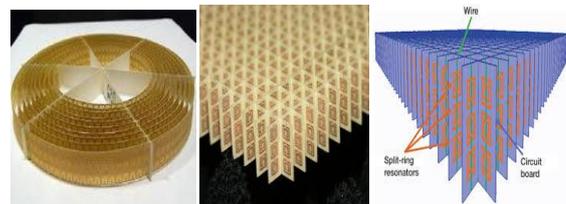


Fig 1: Different types of metamaterials

The development of metamaterials was started in 1898 when Jag dish Chandra Bose conducted the 1<sup>st</sup> microwave experiment on twisted structures-geometries. Then in 1914, Lindeman worked on “artificial” chiral media by embedding many randomly oriented small wire helices in a host medium.

After that Light weight microwave lenses by periodical spheres, disks, strips, and effective refractive index of the artificial media made by Kock in 1948. Then In 1967, Veselago did the theoretical study on plane wave propagation in materials with negative permittivity and permeability. In 2000, Smith and Schultz worked on the experiment of Anomalous refraction in composite medium.

Metamaterials exhibit highly unusual properties, such as extreme values of effective permittivity and permeability, phase and group velocity anti- parallelism, etc. These are particularly left handed materials characterized by a simultaneously negative permittivity and permeability as well by a negative refractive index, have been proposed for the realization of many different types of microwave components having advanced characteristics and small size. Therefore a numerous MTM applications have been developed. To categorize materials the parameters taken are permittivity and permeability. On the basis of this classification there are mainly four types of materials as given in the figure 2 that are DPS (double positive), ENG (epsilon negative), DNG (double negative) and MNG (mue negative).

DPS: If both the permittivity and permeability of material have positive real part, they will be called “double positive media”. As shown in the first quadrant of Fig.2 and Example dielectrics.

ENG: If the permittivity of material is negative and permeability is positive, these single negative materials will be called “epsilon negative media”. As shown in the second quadrant of Fig.2 and Example plasmas.

DNG: If both the permittivity and permeability of material are negative, they will be called “double negative media”. As shown in the third quadrant of Fig.2 and Example not found in nature but physically realizable.

MNG: If the permittivity of material is positive but permeability is negative, these single negative materials will be called “mue-negative media”. As shown in the fourth quadrant of Fig.2 and Example gyro- tropic magnetic materials.

Zero index: If both the permittivity and permeability of material is zero and very close to zero, the materials will be called “zero index”.

materials, wire media, bianisotropic media, linear and non linear media, and local and non local media.

Negative permittivity and permeability: The resonating wires affect the electric response of the medium and give material negative permittivity. The resonating loops affect the magnetic response of the medium and give material negative permeability.

Negative refractive index: It happens due to the simultaneous existence of negative permittivity and negative permeability. Due to negative refractive index, the group and phase velocities of electromagnetic wave appear in opposite direction such that the direction of propagation is reversed with respect to the energy flow direction. The negative index of refraction is also termed as bending of light in the wrong way. In this the light makes a negative angle with the normal. The chiral metamaterials were proposed as an alternative to realize negative refractive index. Chiral metamaterials are metamaterials made of unit cells

Without symmetry planes. The back-ward waves exist in chiral media.

### III. METAMATERIAL ANTENNAS

Now a days modern communication system require microwave components with high performance and small size,so compact antennas are required. Metamaterial based antennas are the class of antennas which uses metamaterials to increase the performance of antenna system. Some of the antenna applications of metamaterials are miniaturized antenna, composite right left handed transmission lines, artificial magnetic conductor surfaces, and zero index, etc. With the understanding of the concept of metamaterials, the technologies have been developed to address a variety of engineering challenges in antenna designs. Here are some examples of metamaterial-based antennas active integrated , antenna array(including smart antennas), Dielectric antennas(such as dielectric resonant antennas), micro strip antennas(such as patches), lens antennas(sphere), wire antenna(such as dipole and loops), aperture antennas(such as pyramidal horns), reflector antennas(such as parabolic dish antenna), and leaky wave antenna etc.

### IV. ANTENNA APPLICATIONS OF METAMATERIALS

#### A. Miniaturized antenna system

The Miniaturized antennas are the electrically small antennas based on metamaterials. An Electrically Small Antenna – (ESA) is an antenna of dimensions much smaller than the wavelength. In the classical sense, there are two types of ESA; one is an electric element, which couples to the electric field and is referred to as a capacitive antenna, and another is a magnetic element (electric loop), which couples to the magnetic field and is referred to as an inductive antenna. The top loaded monopole, multi-wire, rectangular cage type and cage type are the few examples of ESAs which were used in early days for radio communication. These were operating in low and high frequencies. Operating frequencies have gradually been raised to higher regions; from MF and HF bands to VHF,

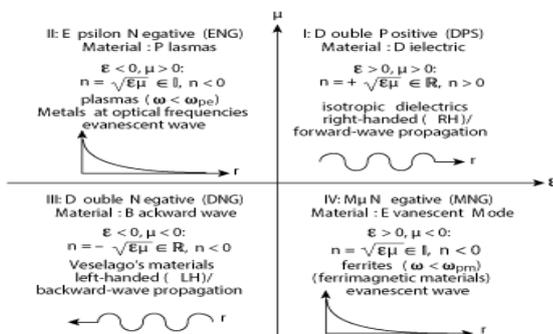


Fig 2: Permittivity – permeability, where R and I represent real and imaginary terms and  $\omega_{pe}$  and  $\omega_{pm}$  are the electric and magnetic plasma frequencies, respectively.

The various types of electromagnetic composite media are double negative materials, chiral materials, omega

UHF, and SHF in recent years. Use of higher frequencies and smaller-sized electronic devices gave impetus to develop smaller antennas.

An electrically small dipole antenna is also a very inefficient radiator because of very small radiation resistance while simultaneously having a very large capacitance reactance, a large impedance mismatch to any realistic power source exist. To overcome from this problem the dedicated matching networks must be design and added to such electrically small antennas to make them efficient radiator.

The main part of antenna system is the matching network because its size significantly reduces the effective miniaturization of the overall antenna system. It is possible if electrically small dipole antenna is enclosed in an electrically small epsilon negative shell leads to an effective radiator.

By H.A. Wheeler electrically small antenna is defined as an antenna with a volume smaller than a radian sphere.

$$\frac{2\pi r}{\lambda} \ll 1$$

Where r is the radius of the sphere, and λ is the free space wavelength.

When the antenna becomes electrically small, the propagating modes are replaced by evanescent modes with high Q, where

$$Q \propto \frac{1}{r^3}$$

Thus, In short the maximum bandwidth of an electrically small antenna is regulated by its maximum dimensions enclosed within a sphere of radius r. The examples of near electrically small antennas are Goubau antenna, Foltz antenna and Rogers cone antenna. The performance properties of electrically small antennas include the antennas impedance, radiation efficiency, pattern characteristics, polarization, and VSWR bandwidth.

Meandered-line antenna and the effect of a high impedance material surface on the antennas far field radiation pattern is shown in the diagram given below in fig 3. The current density in the antenna without an underlying high-impedance metamaterial, with the current densities variation indicated by change in colour; corresponding intensity variation in the waves that the antenna radiates in both the directions; current density variation in the antenna with high impedance metamaterial beneath it; corresponding intensity variation of the waves the antenna radiates in the direction away from the metamaterial; no radiation in the other direction.

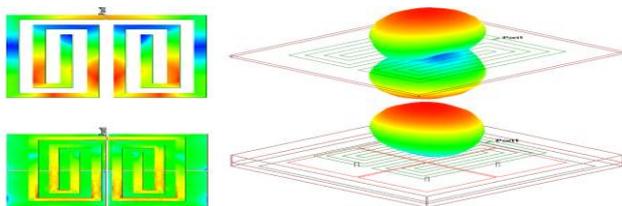


Fig 3: Meandered-line antenna and the effect of a high impedance material surface on the antennas far field radiation pattern

### B. CRLH: Composite right and left handed metamaterials

As discussed metamaterials are also known as left handed materials because they are the only materials that support negative index of refraction. But there are many metamaterials that exhibits both the properties of left handed and right handed materials are known as composite right and left handed metamaterials. At low frequencies these materials act as left handed and at high frequencies these materials act as right handed materials. CRLH metamaterials can be structured and engineered to exhibit electromagnetic properties that are tailored for specific applications. In addition, CRLH metamaterials may be used to develop new applications and to construct new devices that may not be possible with RH materials.

In antenna system, antenna array and other RF devices can be formed based on CRLH metamaterial structures. For implementation an antenna device includes a dielectric substrate having two surfaces on both the sides opposite to each other; a cell conductive patch formed on the first surface; a cell ground conductive electrode formed on the another surface and in a footprint projected by the cell conductive patch onto the second surface; a main ground electrode formed on the second surface and separated from the cell ground conductive electrode; a cell conductive via connector formed in the substrate to connect the cell conductive patch to the cell ground conductive electrode; a conductive feed line formed on the first surface and having a distal end located close to and electromagnetically coupled to the cell conductive patch to direct an antenna signal to or from the cell conductive patch; and a conductive stripe line formed on the second surface and connecting cell ground conductive electrode to the main ground electrode. The cell conductive patch, the substrate, the cell conductive via connector and the cell ground conductive electrode, and the electromagnetically coupled conductive feed line are structured to form a composite left and right handed (CRLH) metamaterial structure.

In the transmission line structure left handed propagation support backward waves only if metamaterial transmission line structure is there. For this, the elements like unit cells with series capacitor and shunt inductor are added to conventional transmission line model. Gap and interdigital capacitors are used as series capacitor but actually interdigital capacitor has highest capacitance. Vias are used as shunt inductors. Equivalent circuit for a CRLH transmission line is shown in fig 4.

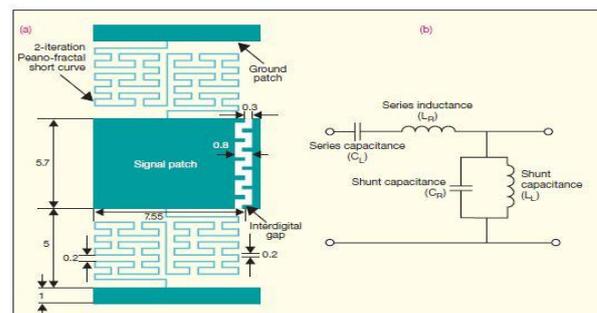


FIG 4: (a) the basic configuration of the novel CRLH transmission-line unit cell (with dimensions in millimetres) and (b) its equivalent-circuit model.

### C. AMC's

AMC stands for artificial magnetic conductors one of the significant area of research of metamaterials. Basically it is a type of electromagnetic band gap material or artificially engineered material with a magnetic conductor surface for a specified frequency band. AMC surfaces have two important and interesting properties that do not occur in nature and have led to a wide range of microwave circuit applications. First, AMC surfaces have a forbidden frequency band over which surface waves and currents cannot propagate, making them useful as ground planes and planar or waveguide type filters. For example, antenna ground planes that use AMC surfaces have good radiation patterns without unwanted ripples based on suppressing the surface wave propagation within the band gap frequency range. Second, AMC surfaces have very high surface impedance within a specific limited frequency range, where the tangential magnetic field is small, even with a large electric field along the surface. Therefore, an AMC surface can have a reflection coefficient of +1 (in-phase reflection). Planar periodic metallic arrays surfaces when placed on a grounded dielectric substrate and they introduce a zero degrees reflection phase shift to incident waves. A mushroom-like EBG (Electromagnetic band gap), uniplanar compact EBG, PEANO curve, and Hilbert curve are four types of artificial magnetic conductor surfaces which act as a ground plane for a low profile antenna. Measured gain of horizontal wire antenna on AMC ground planes. The gains were measured at the frequency points with the smallest S11 value

Table 1: Gain of horizontal wire antenna on AMC ground planes

AMC Type	Antenna gain [dBi]
Mushroom-like EBG	9.1
UC-EBG	7.69
Peano curve of order 1	8.27
Hilbert curve of order 2	8.1

### D. Zero Index Metamaterials

The zero index metamaterials are used to achieve high directivity and high gain antennas. The signal propagating in a zero index medium will stimulate a spatially static field structure that varies in time; the phase at any point in a zero index metamaterial will have the same constant value once steady state is reached. The zero index metamaterials are also used to achieve a zeroth-order resonance antenna because the index is zero or near zero, the wavelength in the medium is effectively infinite and the resonance is independent of the physical dimensions. The physical size of the antenna can thus be made smaller than a half wavelength. The perfectly uniform current distribution associated with the zero-order mode may also decrease the overall efficiency.

### E. Zero Phase Shift Metamaterials

The loop antennas are able to generate uniform and strong magnetic field in an electrically larger interrogation zone by introducing strong electromagnetic coupling between the segment lines which result in compensated phase shift along the direction of propagation. For the wireless local area network applications the zero phase shift line is used to form a circularly polarized omnidirectional antenna. The zero

phase shift loop antenna have been able to offer an interrogative zone with the perimeter of around two operating wavelengths.

### F. Advantages of using Metamaterial Antennas over Conventional Antennas

When we compare conventional material antennas with metamaterial based antennas it seems that metamaterial antenna exhibit some specific features which are not found in conventional material antennas. Some of the advantageous features are given below:

- The metamaterial antennas are electrically small antennas have very high radiation efficiencies and Q factor and used for high frequencies wireless communication.
- The metamaterial antennas provide enhancement in directivity and bandwidth.
- Metamaterial based antenna uses left hand properties.
- The Balanced CRLH-TL leaky wave antenna is able to achieve continuous back fire to end fire frequencies dependent beam scanning with a true broadside beam, good impedance matching over an entire operating band and simple feeding structure.
- The lens based on negative refraction has unlimited resolution provided that the condition  $n=-1$  is met exactly. This can happen only at one frequency. These lenses can focus the near field and to do this it must amplify the highly localized near field to reproduce the correct amplitude at the image.
- These antennas increase the transmission rate and control the direction and polarization of the transmission.
- The metamaterial antenna provides reconfiguration, improved efficiency, bandwidth performance over conventional antenna and also increases the beam scanning range of antenna array.

### V. CONCLUSION

In particular, metamaterials have offered us new opportunities to develop innovative technologies for industrial applications. Metamaterials have been applied in the development of innovative technologies for antenna design with greatly enhanced key performance such as operating bandwidth, gain and efficiency with a miniaturized volume compared to conventional antenna designs.

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# An Analysis on Synthetic Aperture Radar & its Applications

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**Abstract**—In this paper we have discuss the recent development and trend of SAR and related techniques, including the fields of its applications, specifications of airborne and spaceborne SARs. Basically SAR radar is used to make high resolution two dimensional and three dimensional images of mapped area. A SAR is a coherent mostly airborne and side looking radar system utilizes the path of the platform i.e. the flight path to simulate the extremely large antenna electronically, and it generates high resolution remote sensing images. A brief review is presented on the recent development and trend of SAR and it is related to the techniques with selected topics which includes the fields of specifications, applications of airborne and spaceborne SARs (Synthetic Aperture Radars), and interpretations of amplitude data, InSAR (interferometric SAR) data, and PolSAR (polarimetric SAR) data.

**Keywords** - SAR (Synthetic Aperture RADAR), Airborne SAR, Spaceborne SAR, Interferometric SAR (InSAR), Polarimetric SAR(PoSAR)

## I. INTRODUCTION

Radar is used in the military and non-military purposes in many applications such as guidance, imaging, global positioning and remote sensors. Development of radar can be used as a tool for the detection of ships and air crafts which was started during 1920s. First continuous wave radar system was demonstrated by the scientist Taylor in the year 1922. The very first pulse radar was developed in the year 1934 which is having an operating frequency of 60MHz by NRL (Naval Research Laboratory), in US. At the same time, radar systems was used for detection and tracking of the aircraft were developed in the Germany and the Great Britain in the early 1930s. The first imaging radar was developed during the World War II, which uses the B-Scan which produces an image in the form of a rectangle. The on linear relation between the distance and angle to the side of aircraft which produces the great distortion on the display. It is the type of distortion was greatly improved by development of PPI(Plan Position Indicator). Its beam of antenna was rotated 360° about the aircraft and a picture of ground was produced. In the year 1950s, the SLAR (Side Looking Airborne Radar) was developed. The Scanning had been achieved with the SLAR (Side Looking Airborne Radar) by the fixed beam pointed to the side as the aircraft's motion moving the beam across the land. The early versions of SLAR (Side Looking Airborne Radar) systems

were used primarily for military reconnaissance purposes. Till the mid of 1960s, the first high-resolution SLAR (Side Looking Airborne Radar) image was disclosed and made this available for scientific use. However, the image formed by SLAR (Side Looking Airborne Radar) is very poor in azimuth resolution. For SLAR (Side Looking Airborne Radar), as the azimuth beamwidth is small then finer will be the azimuth resolution. To obtain image of high-resolution then one has to resort either to an impractically long antenna or to employ short wavelengths so, that the radar has content of high attenuation in the atmosphere[1].

Signal processing is another way of achieving the better resolution from radar. Synthetic Aperture Radar (SAR) is a technique that uses the signal processing technique to improve their solutions which are beyond the limitation of physical antenna aperture. InSAR (interferometric SAR), forward motion of actual antenna is used to 'synthesize' long antenna. SAR allows using the longer wavelengths and still achieving good resolution with antenna structures of the reasonable size.

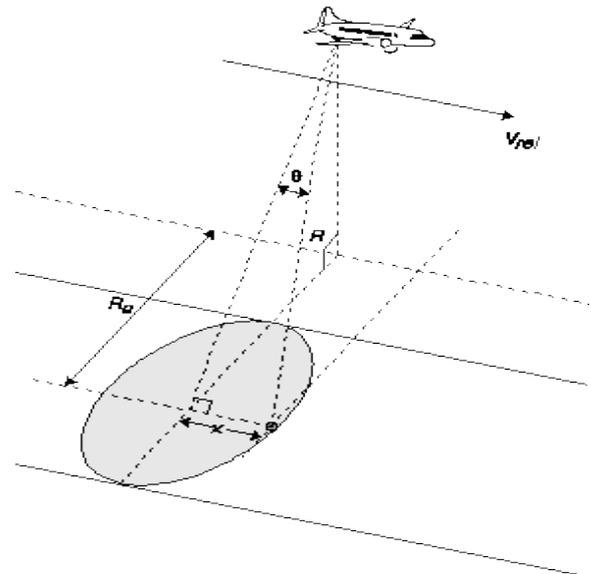


Fig.1. Synthetic Aperture Radar (SAR) Geometry

SAR began with an observation by Carl Wiley in 1951 that a radar beam oriented obliquely to the radar platform velocity vector will receive signals having frequencies offset from the radar carrier frequency due to the Doppler Effect. He noted that the Doppler frequency spread was

related to the width of the antenna beam and could be split and filtered in the receiver, such that the desired antenna beamwidth could be made narrower. He also noted that for a given filter bandwidth, the narrowest angular beam would occur broadside to the platform velocity.

## II. BLOCK DIAGRAM OF SAR

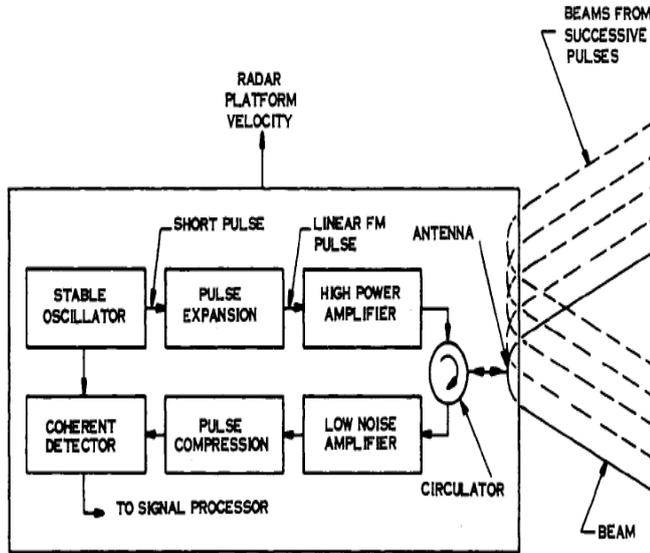


Fig.2. Simplified block diagram of SAR

A SAR is a phase coherent sensor that repetitively transmits high-power pulses and detects the return signals. See Fig.2. These signals are being processed coherently to produce the (2-D) two-dimensional radar images. The typical SAR (synthetic aperture radar) transmitter section is designed to overcome the limitations of peak power in the components and to satisfy the range resolution and severe azimuth requirements. High resolution in azimuth requires severe phase stabilities from one pulse to another pulse over the integration time. High range resolution requires wide range of RF bandwidths. To meet the signal-to-noise ratio (S/N) and target detection requirements, a high average radiated power can be obtained by a high transmitted pulse duty cycle. These requirements on the transmitter can be satisfied by transforming short wide-band pulses into long pulses with the same swept bandwidth utilizing a frequency dispersive delay line. Alternately, the electronic circuits using a voltage controlled oscillator (VCO) and can also provides the desired transmitted pulse. The output from the high power amplifier passes through a circulator and is radiated by the radar antenna. And the received signal is passed through the same circulator, and is amplified and pulse is compressed. The pulse compression circuit can use a frequency dispersive delay line which converts a wideband linearly swept FM long pulse to a short pulse with same bandwidth. The phase of the short pulse is measured by the phase coherent detector, and the resultant signal is delivered to the device called the signal processor.

The SAR is mounted on a platform moving at a constant velocity. The PRF is sufficiently high so as to avoid azimuth ambiguity. This criterion requires that the radar platform displacement cannot exceed one half the antenna

size between the two successive transmit pulses. This geometrical constraint on the pulse-to-pulse displacement of the antenna beam is indicated by dashed lines in Fig.2. In a SAR (Synthetic Aperture Radar) the phase stability is exceedingly important. The prime oscillator provides the signal for the transmitter as well as the reference signal for the receiver must be stable. The timing of the transmit pulses must be of a very precise w.r.t. the prime oscillator. If the radar platform velocity is not constant, the deviations must be to the prime oscillator. If the radar platform velocity is not constant, the deviations must be measured and this data used to compensate either the incoming signal or passed on to the signal processor as a correction [2].

## III. APPLICATIONS OF SAR

### A. Spaceborne SAR

The spaceborne radar are those in which the SAR radars are assembled or placed on carriers like space crafts, satellites and etc. The Spaceborne Imaging Radar (SIR) it is a Synthetic Aperture Radar which was launched from the Space Shuttle Endeavour (STS-59) and (STS-68) of 1994. The radar was run by NASA's Space Radar Laboratory. SIR utilizes 3 radar frequencies: L-band 24 cm wavelength, X band 3 cm and C band 6 cm, allowing for the study of hydrology, geology, oceanography and ecology. Comparing the radar images to the data which is collected by teams of people on the ground and as well as aircraft and ships using simultaneous measurements of vegetation, soil moisture, snow, sea state and the weather conditions during each flight.[4]

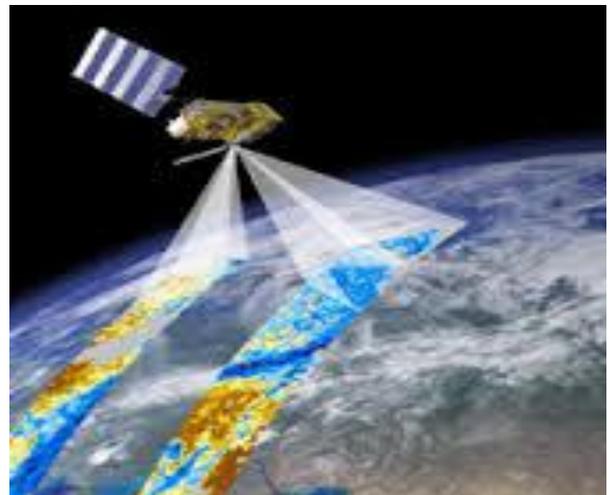


Fig 3 Spaceborne SAR

The SIR mission has revealed the hidden river channels in the Sahara Desert indicating significant climate change in the past. It was also used for the volcano research by keeping researchers at safe distance from hazardous and inaccessible areas. The radar was also used to generate the three dimensional mappings of the Earth's surface in detail.

In a SAR application, a single radar antenna is attached to an aircraft or with the spacecraft so as to radiate a beam whose wave-propagation direction has a substantial component and it is perpendicular to the flight-path direction. The beam is allowed to be broad in the vertical

direction then it will illuminate the terrain from nearly beneath the aircraft out towards the horizon.

### B. Airborne SAR

During the last decade, SAR (synthetic aperture radar) became an indispensable source of information in the Earth observation. This can be possible mainly due to the current trend toward higher spatial resolution and novel imaging modes. A major driver for this development still is the airborne SAR technology, which is usually ahead of the capabilities of spaceborne sensors by several years. Today's airborne sensors are capable of delivering the high-quality SAR data with the decimeter resolution and it allows the development of novel approaches for the analysis of data and information extracted from SAR (synthetic aperture radar).

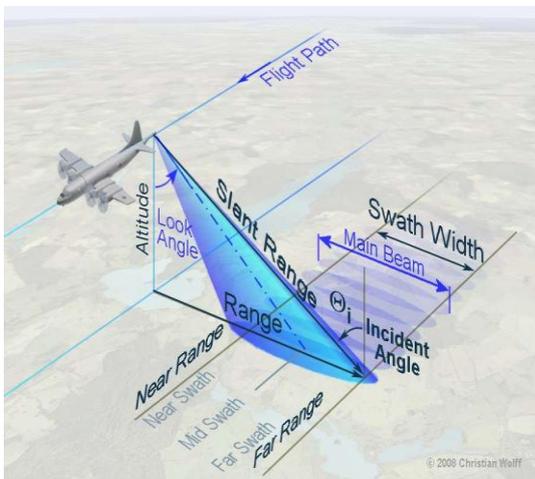


Fig 4 Airborne SAR

High-resolution airborne SAR systems are revolutionizing the information extraction in a wide range of remote sensing applications. Examples are environmental remote sensing, road traffic, hazard and disaster monitoring, as well as reconnaissance and security related applications. However, airborne sensors will remain limited to local and/or regional aspects. For global coverage, spaceborne SAR systems become mandatory. In a changing and dynamic world, high-resolution and timely geospatial information with global access and coverage becomes increasingly important. SAR remote sensing will play a major role in this task, since SAR is the only sensor technology that combines all-weather, day-and-night with high-resolution imaging capability.[5] One challenge for future spaceborne SAR systems.

The major applications of Airborne SAR are:

- VHR Polarimetric Imaging
- Change Detection
- Soil Moisture Estimation
- Forest Structure/3-D Imaging
- Traffic Monitoring

During the last few years the Single channel and the two channel SAR (synthetic aperture radar) is an extension gained a lot of attention. The InSAR (interferometric SAR)

and PolSAR (polarimetric SAR). In this, two or more synthetic aperture Radar images had been acquired from slightly displaced tracks and under this slightly different incidence angles, are combined.

Through the analysis of phase differences, these acquisitions allows for the generation of precise large-scale digital surface models. First InSAR experiments were already conducted in the year 1970s and the 1980s, using JPL's (Jet Propulsion Laboratory's) airborne and spaceborne sensors. However, it was not until the Shuttle Radar Topography Mission in 2000, which provided medium resolution digital elevation models for most of the land masses on Earth, which In SAR became a highly recognized and operational remote sensing tool. Today, the TanDEM-X mission, consisting of two high-resolution SAR satellites, is generating a new global digital elevation model of the Earth's surface with unprecedented accuracy.

### C. Polarimetric SAR radar:

SAR polarimetry (PolSAR) is another major extension of conventional single-channel SAR imaging. Like all electromagnetic waves also microwaves have a vectorial nature, and a complete description of the scattering problem in radar science requires a vectorial matrix formulation.

This is the task of radar polarimetry, a technique which was initiated by the introduction of the theoretical concept of the Bscattering matrix [ by G. W. Sinclair in 1948 .However, it took until the 1980s and the 1990s that high quality polarimetric SAR data became widely available with the growing number of polarimetric airborne sensors like German Aerospace center's (DLR's) E-SAR the Canadian CV580 system, or NASA/JPL's AIRSAR. One special characteristic of SAR polarimetry is that it allows a discrimination of different types of scattering mechanisms.

Certain polarimetric scattering models even provide a direct physical interpretation of the scattering process, allow in an estimation of physical ground parameters like soil moisture and surface roughness as well as unsupervised classification methods with automatic identification of different caterer characteristics and target types.

### D. Interferometric SAR:

Today, InSAR is a powerful and well-established technique, which is operational on most airborne and spaceborne sensors. Besides topographic mapping, an extended version of SAR interferometry, called differential interferometry (DInSAR), can be used for precise mapping of elevation changes. This technique allows the detection of surface deformations on a subwavelength scale, usually in the millimeter range. Due to its extreme precision, DInSAR has found a multitude of applications, ranging from the monitoring of ecological stress-change processes like sudden coseismic displacements or volcanic bulging before eruptions, over monitoring of man-made subsidence due to mining activities up to measurement of glacier dynamics.

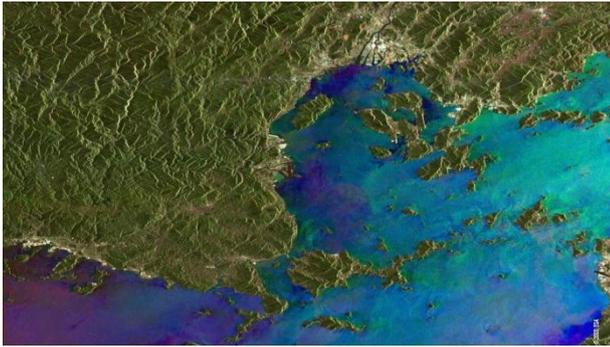


Fig 5 Hiroshima Japan SAR satellite image

#### IV. DESIGN PARAMETERS

Basically, the system hardware consists of (i) the microwave components such as antenna, oscillator, mixer, power amplifier and circulator, and (ii) the low frequency electronics components such as integrated circuits, resistors and capacitors.

Name of The Project	Frequency of Operation	Antenna Type	Gain (dBi)	Beam-width (Degree)	
				Az	Elv
NASA AIRSAR	P-BAND	All Microstrip	14	19	38
	L-BAND		18	8	44
	C-BAND		24	2.5	50
DLR E SAR	P-BAND	Microstrip	12	30	60
	L-BAND	Microstrip	17	18	35
	S-BAND	Microstrip	n.a.	20	35
	C-BAND	Microstrip	17	19	33
	X-BAND	Horn	17.5	17	30
CCRS C/X SAR	C-BAND	ALL HORN	26	3.3	25
	X-BAND		28.5	1.4	26
NASD A X/L-BAND SAR	L-BAND	Microstrip Waveguide-Slot	18	2.3	40
	X-BAND		26.5	2.3	40
DCRS EMISAR	L-BAND	All Microstrip	17.1	10	42
	C-BAND		26	2.4	31
LYNX	C-BAND	Horn-Fed-Dish	n.a.	3.2	7

Fig.6 Comparison of antenna parameters between SAR system[6]

The design of the microwave subsystem is generally more difficult to handle. Therefore, the microwave subsystem was given more attention in the initial stage of the design. The low frequency sections were carefully designed to match the microwave's specifications. Subsystem level design determines the requirements of SAR subsystem.

The radar subsystem can be functionally divided into three assemblies: (i) Transmitter; (ii) Receiver; and (iii) antenna.

Each of these assemblies can be further divided into subassemblies and components. Fig. 3 shows the block diagram of the SAR system. The transmitter generated the

required signal and transmitted via an antenna. Further amplification and filtering process is done by IF section of the receiver. Finally the IF signals are digitized and stored in high-density digital recorder for future analysis.

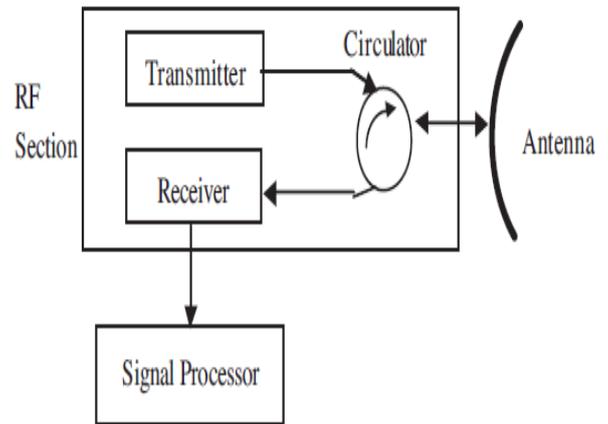


Fig.7. System Block Diagram

#### V. CONCLUSION

Finally, we come to know that Synthetic Aperture Radar (SAR) has been most rising and sensing technique in today's phenomena, because it is capable of generating fine-resolution images of the earth terrain unhindered by weather and illumination conditions. It is being widely used in space like for satellite or space shuttles or space crafts to discover life on other planets and also used by highly secured areas like military, especially by air force on airplanes, drones and etc. using the airborne technology.

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# Implementation of 64 Bit CRC for 3G Using Parallel Execution

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**Abstract-** Cyclic redundancy check is highly utilized method for checking the presence of error in the data that have been introduced during transmission over a media. As the size of message bit increases in 3G, the CRC computation of the data becomes slow which is a major drawback in a communication process. To match with the speed of transmitting data it is significant to optimize the rate of CRC computation. A 64 bit CRC generator provides with more swiftness as compared to the 32 bit CRC for 3G. This paper focuses on implementation of 64 bit CRC on 3G through parallel execution unit that will generate CRC for various packets and will combine them to create the final CRC result. Consequently, this method will immensely reduce the clock cycles to calculate CRC. Based on this concept, the comparative analysis between 32 bit CRC and 64 bit CRC is also included in the paper. The latency decreases for the 64 bit CRC parallel execution unit and throughput increases.

**Keywords-** Cyclic Redundancy Check, 3G

## I. INTRODUCTION

The main aim of wireless communication system is to make sure that the transmitted message reaches the destination fast and error free. So, for the steady and reliable transmission, we are implementing 64 bit parallel CRC generator for 3G. During the data transmission the errors get introduced. So it becomes necessary that they are detected in order to make the signal error free. Communication system uses many error detection algorithms to achieve reliable communication between sender and receiver. CRC is by far the most popular method used for detecting errors in digital data. But it cannot be used to correct the errors. The sender and receiver mutually decide a generator polynomial. Checksum bits are sent along with the transmitted message. The receiver has to decide that whether or not checksum is in accordance with the data. This is to determine the presence of errors. If the error has occurred, the receiver sends the negative acknowledgement (NAK). The NAK is send in two cases

- The data received is incomplete.
- The data is not received at all.

So in such cases, the receiver requests the transmitter to send that message again. The CRC standards differ in many ways other than for the selection of generator polynomial. CRC is used in many communication systems such as asynchronous transfer mode (ATM), fiber distributed data interface (FDDI), Ethernet, 2G and 3G links, line technologies such as ADSL/VDSL, Wireless LAN , Bluetooth etc.[3] Linear feedback shift register is generally the hardware solution for CRC in which the serial bit architecture is used for encoding

and decoding. But LFSR cannot be efficiently used for high bit rate.[3] To overcome this problem we make use of parallel multiple execution units for fast CRC calculation. To execute parallel 64 bit CRC calculation in 3G we use 64 bit long polynomial. The 64 bit polynomial is given as

$$X^{64} + X^{62} + X^{57} + X^{55} + X^{54} + X^{53} + X^{52} + X^{47} + X^{46} + X^{45} + X^{40} + X^{39} + X^{38} + X^{37} + X^{35} + X^{33} + X^{32} + X^{31} + X^{29} + X^{27} + X^{24} + X^{23} + X^{22} + X^{21} + X^{19} + X^{17} + X^{13} + X^{12} + X^9 + X^7 + X^4 + X + 1$$

In this paper we propose the method to generate the CRC code based on the execution of the multiple parallel executions to enhance the computation speed which would be helpful in 3G communication.

## II. METHODOLOGY

The 64 bit CRC of any input sequence can be calculated either serially or parallel. A serial computation method is slow as CRC is found by shifting the generator polynomial and XORing it with the input sequence for each message bit. But the parallel computation method divides the data in number of smaller execution units and executes them parallel. The resultant CRC of each unit is XORed to obtain the final CRC. A given input sequence is divided into M execution units with N bytes each and independent remainder of each execution unit is calculated. As a result, there are M remainders for M execution units. These remainders are XORed with each other to find the final CRC result which is appended at end of the input sequence. A 64 bit generator polynomial produces a 64 bit CRC result which not only improves the error detection capability but it also makes the process faster as 64 bits of the input sequence are XORed with generator at a time.

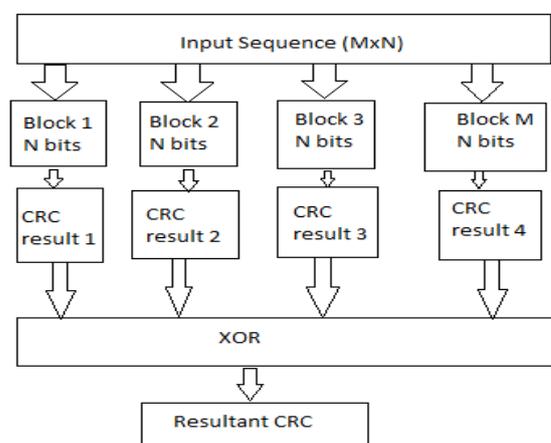


Fig. 1. CRC Calculation using Parallel Execution units

### A. Design of CRC generator

In the proposed design of 3G, the 64 bit long polynomial is used. The 64 bit polynomial is given as

$$X^{64}+X^{62}+X^{57}+X^{55}+X^{54}+X^{53}+X^{52}+X^{47}+X^{46}+X^{45}+X^{40}+X^{39}+X^{38}+X^{37}+X^{35}+X^{33}+X^{32}+X^{31}+X^{29}+X^{27}+X^{24}+X^{23}+X^{22}+X^{21}+X^{19}+X^{17}+X^{13}+X^{12}+X^9+X^7+X^4+X+1$$

This has a hex code 0x42F0E1EBA9EA3693

### III. PARALLEL EXECUTION

A high speed 3G requires a faster computation. Consider a message of 2048 bits to be transmitted by 3G network. A serial computation would be slow as it would compute the bits serially. But in parallel computation the data bits are divided into 2, 4, 8, 16 blocks. For 2048 data bits, 2 blocks will have 1024 bits each, 4 blocks will have 512 bits each, 8 blocks will have 256 bits each and 16 blocks will have 128 bits each. For 2048 bits divided in two blocks, the time required to compute CRC will be same as needed for 1024 bits. Hence computation time is decreased. As the number of blocks increases, the computation time for CRC will decrease. At the same time the components used in the circuit to design such CRC generator will increase

When the message of 2048 bits is divided into two blocks, each block will have 1024 bits. Two execution units are divided by 64 bit CRC polynomial thus producing two independent 64 bit remainders. These remainders are XORed to obtain the final 64 bit CRC.

When the message of 2048 bits is distributed into 8 blocks, each block will have 258 bits. The 8 execution units will produce 8 independent 64 bit remainders which will be XORed to obtain the final result.

### IV. COMPARISON OF 32 BIT AND 64BIT CRC

The 32 bit CRC and 64 bit CRC not only differs in their generator polynomial but also shows difference in throughput, clock cycles, latency and speed. Clock cycles in 32 bit CRC are more as compared to the 64-bit CRC. More the clock cycles slower the system will be. 64-bit CRC has reduced clock cycles which increase the speed. Greater the processing speed better becomes the system. Latency of 32 bit CRC is more than 64 bit CRC which increases the time delay in computation of CRC for 32 bit CRC. Having less latency in 64 bit decreases the processing delay of CRC thus making the system faster. The throughput in case of 32 bit CRC is less than 64 bit CRC. Hence chances of error in the message delivered are more than 64 bit CRC. The increased throughput of 64 bit CRC increases the successful message delivery over the communication system.

For fast CRC Calculation, Latency Throughput and speed plays a vital role to show the performance of system.

#### A. Latency:

Latency in a network symbolifies the delay i.e. the time taken by a packet of data to reach the receiver from the transmitter. Latency is factor that contributes to network speed. Low-latency network experiences small time delays, high-latency networks experiences long time delays. Latency of a network depends upon-

- Transmission- It includes the delay caused by the medium of propagation.
- Router-time taken to change the starting bits (header) of the data.
- Propagation-Time taken to reach the receiver.
- Other delays-The delay due to storage or due to the passing from the bridges and other intermediate devices.

Latency is calculated by [1]

$$Latency(s) = \frac{NComp + (M - 1)Comb}{F_{System}}$$

Here,

N=number of blocks per byte

M= number of divisions of input data

Comp= number of cycles to calculate the CRC

Comb= number of cycles to calculate XOR of all remainders

$F_{system}$  =system clock frequency which is fixed for Spartan 3 kit as 50 MHz

#### B. Throughput

It is the speed at which something can be processed. i.e the amount of data successfully transferred from one place to another within a given time slot. It is calculated bit per second or data per second. Throughput depends on

- Limitation of physical medium in which it travels.
- Processing power of the system.

Throughput of a system is given by [1]

$$Throughput \left( \frac{bits}{s} \right) = F_{System} \frac{M*N*8}{N*Comp + (M-1)Comb}$$

Here,

N=number of blocks per byte

M= number of divisions of input data

Comp= number of cycles to calculate the CRC

Comb= number of cycles to calculate XOR of all remainders

$F_{system}$  =system clock frequency which is fixed for Spartan 3 kit as 50 MHz

#### C. Speed:

32-bit CRC can process 33-bits of data a time, whereas 64-bit CRC can process 65-bits of data which is comparatively a faster processing rate as compared to the 32-bit CRC. Higher the speed better performance it will give. Clock cycles in 64-bit CRC are reduced as compared to 32-bit CRC which increases the speed and performance.

### V. RESULT

The simulation result for 64 bit CRC and 2048 input data is computed by Xilinx ISE 9.1i. using parallel execution units are formed by 2, 4, 8, 16 blocks.

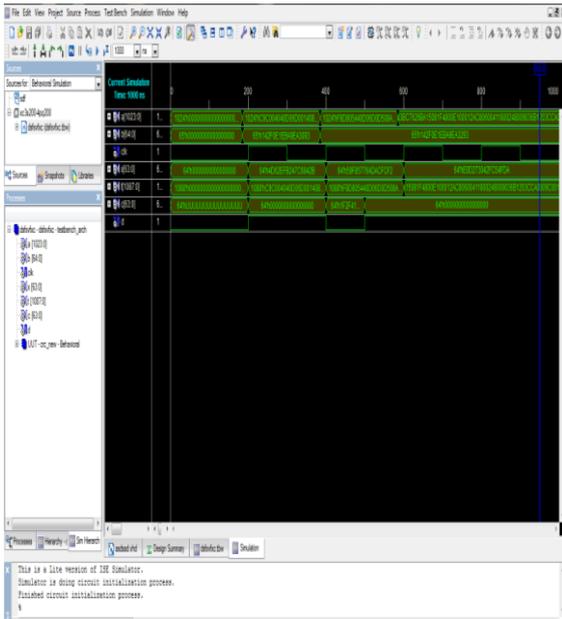


Fig. 2. Simulation waveform for 64 bit CRC generator

The latency and throughput for various execution units is given in following table:

Table I. The latency and throughput for different execution

Execution Unit	N	M	Comp	Comb	Latency	Through put MHz
1 EU	256	1	2048	1	10485 us	0.195
2 EU	128	2	1024	1	2621 us	0.78
4 EU	64	4	512	1	655 us	3.12
8 EU	32	8	256	1	164 us	12.48
16 EU	16	16	128	1	41 us	44.64

The table shows that latency decreases as the number of execution unit increases which in turn decreases the delay in the system. Hence parallel execution becomes faster than serial execution with the increase in execution units.

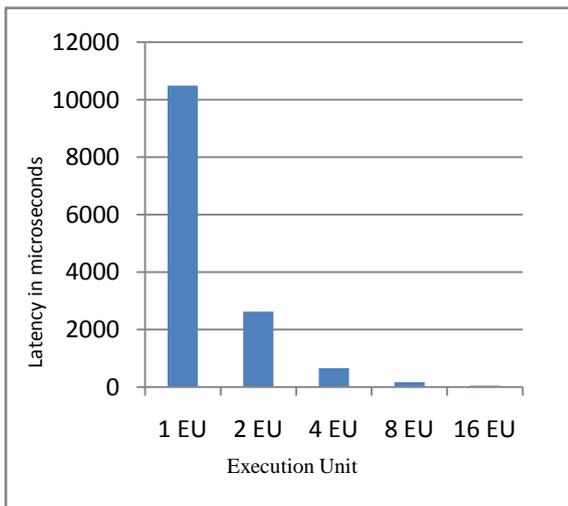


Fig. 3. Latency for different execution units

Similarly the throughput of the system increases. Hence successful message delivery rate increases and the rate of

error in the data decreases. The throughput increases with the increase in the execution units.

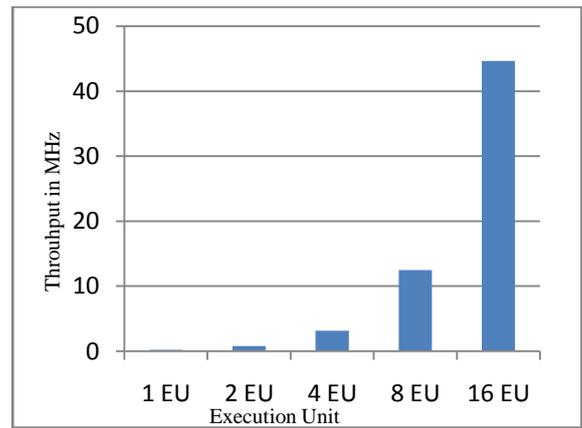


Fig. 4. Throughput for different execution units

## VI. CONCLUSION

The fast CRC generator using parallel multiple execution units has been designed and results are verified. The performance comparison of fast CRC using single execution unit and 2, 4, 8, 16 execution units are obtained in term of latency and throughput and resources utilization. The clock cycles for 64-bit crc is reduced as compared to 32-bit crc. The crc result is generated at faster rate. It is concluded that as number of multiple parallel execution units increases, the latency is decreases and throughput is increases which is very beneficial for error detection during data transmission in fast CRC.

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# High Frequency DDR SDRAM Controller with Improved Bandwidth using Virtex-6

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**Abstract**---The speed of the CPU is increasing rapidly. So, it is necessary to speed up the memory to maintain the overall performance of the modern electronic system. To increase the computer performance, the frequency and bandwidth of the memory are required to be higher and on the other side the power consumption, memory latency should be low. To meet all these demanding requirements, the DDR SDRAM (Double Data Rate Synchronous DRAM) is very frequently used in electronic system. As compared to any other DRAM, DDR SDRAM has higher speed, higher efficiency, higher stability, lower power consumption and lower memory latency. For this reason, a high performance (i.e. higher bandwidth and higher operating frequency), more compatible DDR SDRAM has been implemented and verified in this paper. Using this compatible architecture in the electronic system, the system will be faster, flexible and transplantable. Besides this, it will take short time to market, requires lesser manual work and reduces the product cost.

**Keywords:** DDR SDRAM, Virtex-6

## I. INTRODUCTION

Performance of modern computer systems has seen dramatic improvements in the past thirty years due to advancements in silicon process technology. The advancements in silicon process technology have enabled the number of transistors on a single chip to roughly double every two years as suggested by Moore's Law. As a corollary to Moore's Law, processor performance also doubles roughly every two years. In the same time period the performance of the memory has to be doubled to maintain the system performance or to reduce the speed gap. The growing speed gap between memory and processor nowadays has become the bottleneck of processing in the embedded system. The great advent of high performance memory systems (such as Synchronous Dynamic Random Access Memory and Rambus Dynamic Random Access Memory), which have been running on desktop computers and many other electronic systems, close that speed gap in some extent. The logic designers are often faced to communicate with external memories and applications where large I/O channel bandwidths are required. Besides this, the current electronic systems demands the other requirements also to obtain the better system performance, such as higher bandwidth, lower power consumption, lower memory latency, higher efficiency, higher stability, small in size, low cost and of course short time to market. To fulfill the above requirements, minimize the speed gap and maximize the system performance [7]. In the year of 2000, JEDEC released the first standard specifications of DDR SDRAM.

DDR SDRAM achieves high data rate and high bandwidth by using 2n-bit prefetch operation. Double data rate is achieved by using both edges of the clock- high and low that is the data is clocked into or out of the device on both the rising and falling edges of the clock. All control signals, change only on the rising clock edge. During any data access, the controller provides the DDR SDRAM with a clock, inverted clock, address and control signals. During a write cycle, the controller also provides data and a data strobe signal (DQS) [8].

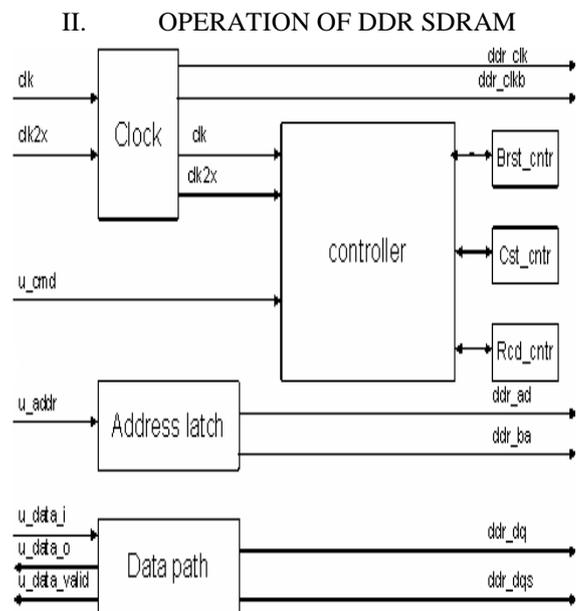


Fig 1. Functional block diagram of DDR SDRAM [15]

The functional block diagram of the DDR SDRAM controller is shown in Figure 1. It consists of five modules, address latch module, data path module, clock, controller module and counter comparator. The address latch module provides address (i.e. which row and column is activated of a particular bank). The data path modules handles the read and write operation of the DDR SDRAM and also keeping in mind that all the timing requirements should be met. The clock provides the internal and external clock signals to implement the DDR SDRAM controller. The controller module provides the control signals and commands.

Depending on the user's request, the appropriate control signals are sent to the DDR SDRAM along with the address, data and data mask lines. The State Controller is the heart of the DDR SDRAM Controller; it makes sure

that correct transactions take place in sequence and that the DDR SDRAM devices timings are not violated in the process. The counter comparator block keeps track of the various DDR SDRAM timing requirements such as power-up period, active-to-read delay, precharge period, periodic refresh interval, auto refresh period, CAS latency, etc.

A. Initialization Sequence

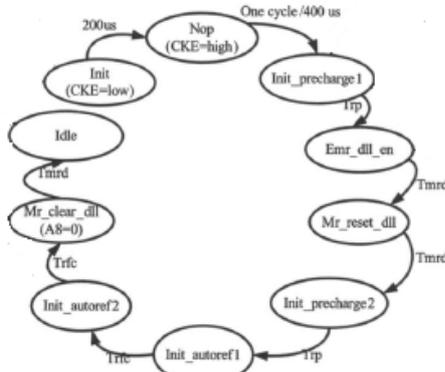


Fig 2. Initialization Finite State Machine [10]

DDR SDRAM should be powered up and initialize according to the above shown finite state machine. During reset, the FSM is forced to the IDLE state. After reset, a 200µs delay is required to get the proper operation. After the 200µs delay has been satisfied, a DESELECT or NOP command should be applied. The operations which are already in progress are not affected. Then a PRECHARGE ALL command is used to deactivate the open row in a particular bank or the open row in all banks. Next a LOAD MODE REGISTER command should be issued to enable DLL and next to disable DLL. The command can only be issued when all banks are idle. After that, to get the “all banks idle” state, a PRECHARGE ALL command is applied [16].

B. Register Definition

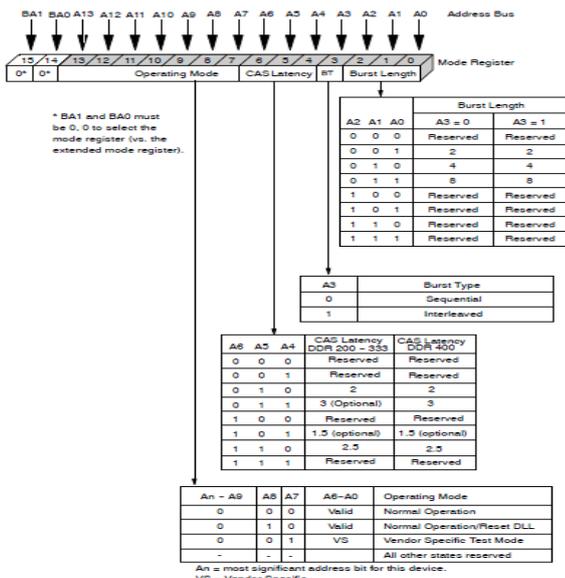


Fig 3. Mode Register Definition [4]

The mode register definition includes the selection of a burst length, a burst type, CAS latency and an operating mode, as shown in Figure 3. By applying the MODE

REGISTER SET command (with BA0 = 0 and BA1 = 0), the mode register is programmed. Mode register bits A0-A2 specify the burst length, A3 specifies the type of burst (sequential or interleaved), A4-A6 specifies the CAS latency, and A7-A13 specifies the operating mode. The description of the mode register is shown in Figure 3.

III. DDR SDRAM COMMAND DEFINITIONS

Table 1 represents the commands which are issued by the controller using the following control signals.

- Chip Select (CS<sub>n</sub>) - Enables the SDRAM command decoder when LOW, disabled when HIGH.
- Row Address Select (RAS<sub>n</sub>) – Command lines.
- Column Address Select (CAS<sub>n</sub>) - Command lines.
- Write Enable (WE<sub>n</sub>) - Command lines.
- Clock Enable (CKE<sub>n</sub>) - (always held High after device configuration) This section describes how the user would issue different DDR SDRAM commands through the controller.
- Deselect: The DESELECT function (CS= High) is used to prevent the new commands from being executed by the DDR SDRAM.
- No Operation (NOP): This command is used to direct DDR SDRAM not to do any operation.
- Active: To activate (or open) a row in a particular bank for a subsequent access the ACTIVE command is used. The value on the B0, B1 inputs selects the bank, and the address provided on inputs A0-Ai selects the row [4].
- Read: To initiate a burst read access to an active row the READ command is issued. The value on the B0, B1 inputs selects the bank, and the address provided on inputs A0-Ai selects the starting column location. Depending upon the value on input A10 determines whether or not auto precharge is used.
- Write: To initiate a burst write access to an active row the WRITE command is issued. The value on the B0, B1 inputs selects the bank, and the address provided on inputs A0-Ai selects the starting column location. Depending upon the value on input A10 determines whether or not auto precharge is used. The row will remain open for subsequent accesses, if auto precharge is not selected. The data will be written to the memory when DM (Data Mask) signal is kept low, otherwise if the DM signal is registered high, the corresponding data inputs will be ignored, and a write will not be executed to that byte/column location.
- Burst Terminate: The BURST TERMINATE command is used to truncate read bursts (with auto precharge disabled).
- Precharge: To deactivate the open row in a particular bank or the open row in all banks the PRECHARGE command is used. Depending upon

the value on input A10 determines whether or not auto precharge is used.

- Auto Refresh: This command is used during normal operation of the DDR SDRAM. During an auto refresh command, the address bits goes under a “don’t care” condition.
- Load Mode Register: When all banks are idle, the LOAD MODE REGISTER command can be issued. The mode registers are loaded via inputs A0-A11[4].

Table 1. List the standard DDR SDRAM commands

Command	CS_n	RAS_n	CAS_n	WE_n
D ESELECT DEVICE (NOP)	H	X	X	X
NO OPERATION (NOP)	L	H	H	H
ACTIVE (Select bank and activate row)	L	L	H	H
READ (Select bank and column, and start READ burst)	L	H	L	H
WRITE (Select bank and column, and start WRITE burst)	L	H	L	L
BURST TERMINATE	L	H	H	L
PRECHARGE (Deactivate row In bank or banks)	L	L	H	L
AUTO REFRESH or SELF REFRESH (Enter self refresh mode)	L	L	L	H
LOAD MODE REGISTER	L	L	L	L

#### IV. DESIGN AND IMPLEMENTATION

##### A. Address Latch Module

The address latch module gets its control signals from the controller, and generates row, column, and bank addresses for the DDR SDRAM. The address latch also generates burst\_max, cas\_lat\_max values for the burst counter (brst\_cntr), and cas-latency counter (cslt\_cntr). The controller generates address and control lines on the negative edge of clock to guarantee the hold time on the First decode burst length; input address (u\_addr [2:0]) represents burst length from which burst maximum values for the burst counter (brst\_cntr) are generated. Then, Generate CAS Latency maximum and half values for CAS Latency counter. Input address (u\_addr [6:4]) represents CAS Latency. After this, generate MRS Address which is used to provide operating condition for DDR SDRAM. Then generate row address bits which are registered coincident with the active command are used, to select the bank and row to be accessed. Then generate column

address bits which is registered coincident with the read/write command are used to select the bank and the starting column location for the burst access.

##### B. Data Path Module

- For Read and Write: The controller first goes into the ACT state (active row, where a row in that bank is opened with an ACTIVE command). After that, a WRTIE or READ command is issued to the particular row of a bank and subject to the tRCD specification. The controller goes from ACT to WRITE (during write), then to the WRITE\_DATA state where it issues control signals for data path module to accept data. Then burst operation takes place in data path.
- During Write: Applying a WRITE command, write bursts are initiated, the bank, row and column addresses are provided with this command. On the first rising edge of DQS, the first valid data-in element will be registered. Then, subsequent data elements will be registered on successive edges of DQS. Between the WRITE command and the first rising edge of DQS (on low state) is known as write preamble. The state on DQS (low state) following the last data-in element is known as the write postamble.

- For generating DQS signal (During a memory Write): The DQS signal must be center aligned with the data at the pins of the DDR SDRAM device. The memory device requires the DQS and CLK to be approximately phase-aligned. The controller block generates the ddr\_dqs\_t for generating the DQS signal during a Write cycle. The ddr\_dqs\_t signal controls the 3-state output while the ddr\_dqs\_o\_tmp (ddr\_dqs\_toggle) holds the DQS flip flop in reset. The ddr\_dqs\_o\_tmp helps to meet the Write preamble timing required by the memory. The ddr\_dqs\_o\_tmp is released after a clock cycle and the DDR flip flops clocked by CLK generate the DQS to the memory. A toggle flip-flop which is clocked with the negative edge of clk2x generated the ddr\_dqs signal. This ensures the ddr\_dqs edges are at the center of ddr\_dq. The 3-stated signal for ddr\_dqs is also generated from the negative edge of clk2x.

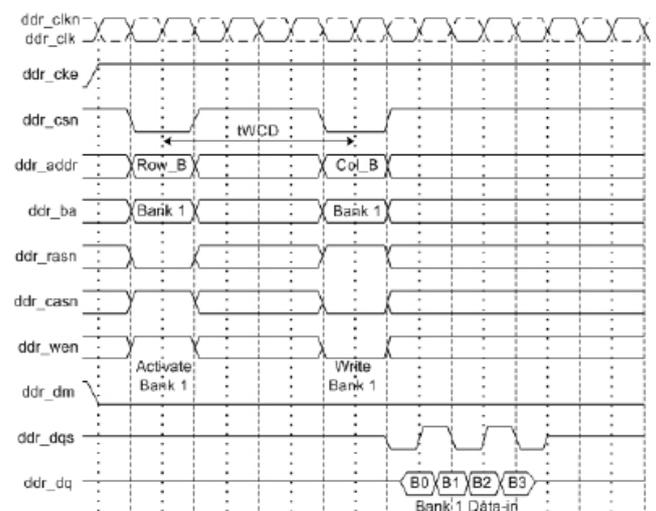


Fig 4. Write Operation

- For generating DQ signal (During a memory Write): The controller block generates the write\_en signal to control the tri-state output of the data path. For a write





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# Rectangular Dielectric Resonator Antenna with Varactor Diode

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**Abstract-** A new design to utilize multimode DRA's for wideband application is presented. The proposed DRA Consist of rectangular DRA with two parallel strips. The proposed designed is analyzed and designed in HFSS

**Keywords-**DRA, RDRA, HFSS

## I. INTRODUCTION

Dielectric resonator antenna has many attractive advantages. The attempts have been made to improve DRA characteristics by considering higher order modes in design procedure.

## II. THEORY

The attempts have been made to improve RDRA characteristics by considering higher order modes in the design procedure. For instance, the higher order modes of rectangular and circular DRAs were excited to achieve broadside radiation patterns with enhanced gain. To mitigate the tolerance problem of fabrication at millimeter-wave frequencies, where the size of the antenna is too small, a larger DRA was designed to operate at higher order modes . The resonance bands associated with the dominant mode and higher order modes were merged in different ways and using different excitation methods to design DRAs with larger impedance bandwidths, when the number of resonances increases, it becomes difficult to control antenna properties. Non radiating modes get excited in between, and even sometimes the radiating modes are not excited with appropriate polarizations and orientation (e.g., tilted), resulting in degradation of far-field properties. Effective size reduction methods cannot be easily applied for multimode DRAs. Increasing the permittivity of the dielectric resonator in order to miniaturize the antenna results in reducing the impedance bandwidth for individual modes, thus decreasing the overall antenna bandwidth. Therefore, an effective mechanism is required to remove unwanted modes, adjust the frequency distance between individual modes, reduce antenna size and cross polarization, and preserve radiation patterns within a wide bandwidth.

### A. Rectangular Dra With Two Parallel Strips Model

This new design to utilize multimode DRAs for wideband applications. It is based on two vertically oriented strips which provide more flexibility for designers to adjust the antenna properties. To excite the RDRA for multimode operation, one of the strips, the internal strip, is connected to

the micro strip line. A parametric study is performed to show that the length of the two strips and the permittivity and the thickness of material in between them are important parameters to improve the antenna characteristics. Four radiating modes, including the higher order. The radiation patterns of the excited modes are quite similar and consequently do not degrade the antenna performance over the impedance bandwidth. The work done by the variation of heights of the 2 strip leading to the radiation properties of the RDRA the same work can be performed using the Varacter diode between the 2 strips.

## III. ANTENNA STRUCTURE AND SPECIFICATIONS

The RDRA consists of DRA having dimensions 4.6mm X 9.0mm X 10.8mm and material dielectric constant  $\epsilon_r = 9.8$  located on 20mm X 30mm ground plane .

Table 1 : Design Dimensions of DRA

S.No	Element	Dimension(mm)
1.	Ground plane	20X30
2.	Substrate	20X30x0.8
3.	DRA	4.6x9x10.8
4.	Width of micro strip	2.4
5.	Length of stub and micro strip	18.693
6.	Ground slot (l x w)	3.743x0.404

Table 2 : Effect of variation in height of external strip

External strip(mm)	inner strip(mm)	air gap(m m)	RESONANT FREQUENCY(GHz)
8.5	3	1	13.75
9.5	3	1	14

Table 3 : Effect of variation in height of internal strip

External strip(mm)	inner strip(mm)	air gap(mm)	RESONANT FREQUENCY(GHz)
8.5	4	1	14.20
8.5	5	1	13.80

Table 4: Effect of variation in air gap between two strips

External strip(mm)	inner strip(mm)	air gap(mm)	RESONANT FREQUENCY(GHz)
8.5	5	1	13.75
8.5	5	2	13.80

Table 5: Effect of variation in capacitance of varactor diode in between two parallel plates

External strip(m m)	inner strip (mm)	air gap (mm)	Resonant Frequency (GHz)	Capacitance B/W STRIPS(pF)
8	5	1	14.2	0
8	5	1	12.80	1
8	5	1	12.50	500
8	5	1	13	1000

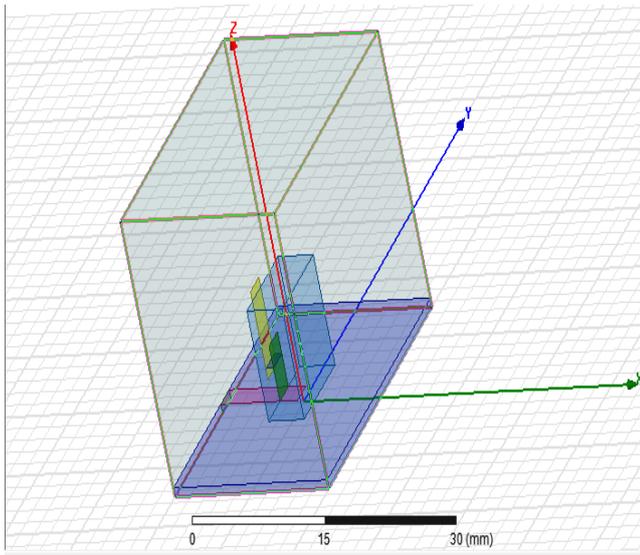


Figure 1: RDRA with Varactor Diode

#### IV. SOFTWARE BASED DESIGN OF ANTENNA

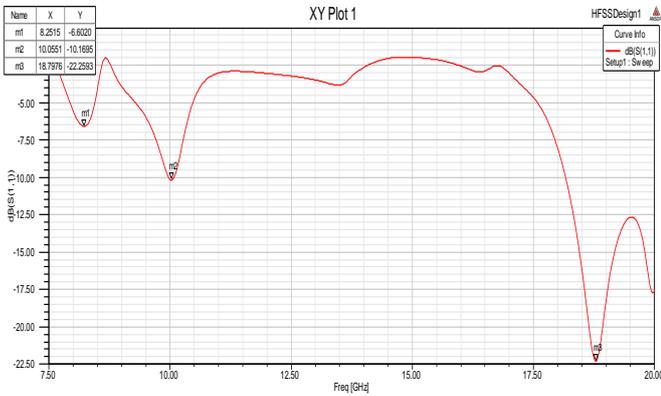


Figure 2: Return Loss of Different DRA sizes

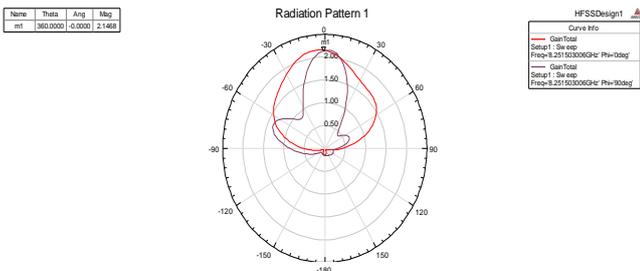


Figure 3: Radiation Pattern at f= 8.25 Ghz

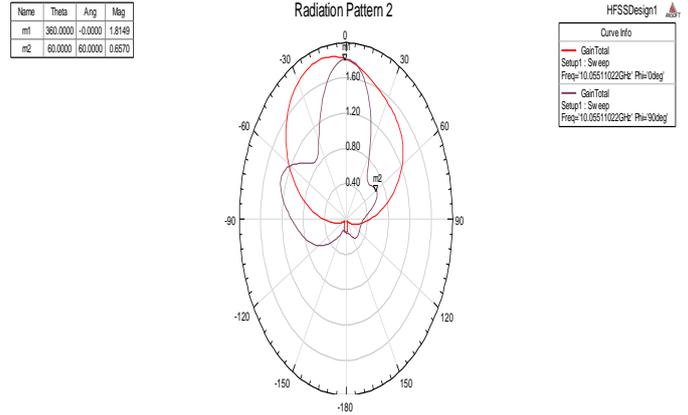


Figure 4: Radiation Pattern at f= 10.05 Ghz

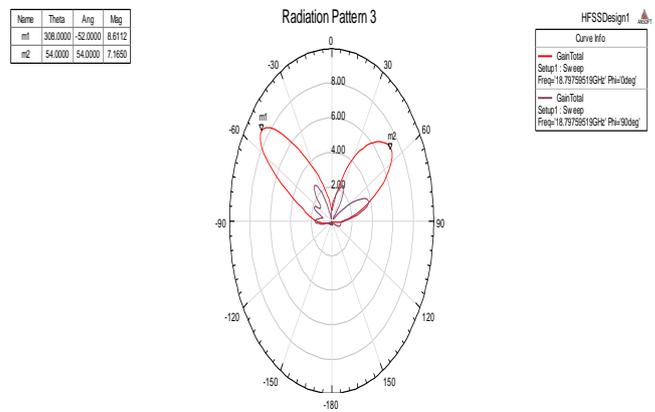


Figure 5: Radiation Pattern at f= 18.7 Ghz

#### V. CONCLUSIONS

This paper presents new design to utilize multimode DRA's for wideband application. The radiation characteristics of proposed antenna have been investigated using HFSS. In such a design the radiation patterns of the excited modes are quite similar and consequently do not degrade the antenna performance over the impedance bandwidth.

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**Track-1**

**Technical Session 2**

**IMAGE PROCESSING**



# Scope of Hybrid Neuro-Fuzzy Approach in Improving Restoration of Degraded Historical Documents

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**Abstract**—Ancient downgraded documents are often hard to read, have low contrast, and are corrupted by various artifacts. Separating text from badly downgraded document is very cumbersome task in image processing domain. Before processing of any textual information, the text must be segmented from the degraded document. Numbers of techniques are used for character recognition from downgrading document. This paper discusses the strengths & weaknesses of various techniques that are being used for text restoration in degraded documents and proposes a novel Neuro-Fuzzy based hybrid algorithm to improve their performance.

**Keywords**—*Degraded Document, Quantization, Neuro-fuzzy Restoration*

## I. INTRODUCTION

Historical documents carries important and valuable information of our past related to tradition, religion, science, literature and war strategies [1]. These documents were written around several hundreds of years ago which are often fade, rip or degrade over time. These documents are mostly available in numerous structures like stone and metal carvings, palm leaf or paper manuscripts etc. These Documents are preserved and available for reference all around the world. Ancient downgraded documents are often hard to read, have low contrast, and are corrupted by various artifacts. Separating text from badly downgraded document is very challenging task in image processing domain [2].

Degradation means reduction in visual quality of an image with respect to the original source. Degradations impose great challenges in the act of Character Recognition, document image retrieval and other document analysis tasks. Common reasons behind such degradation are bleed-through effect, ink fading, deterioration of paper material, cellulose structure etc. Some example documents are shown in figure 1.

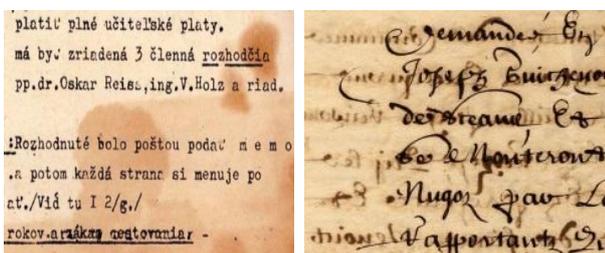


Fig 1 Degraded documents

Various approaches/techniques were developed to improve quality of downgraded documents in last few decades. Some of examples include Binarization, Adaptive image contrast method, Edge continuity relation, Probabilistic approach and soft computing techniques etc.

This paper discusses different degraded document retrieval techniques and their comparison in section II. This is followed by Problem formulation in section III. New Research methodology is proposed in Section IV and finally, paper is concluded in section V.

## II. LITERATURE SURVEY

In literature, different techniques are proposed for retrieval and restoration of degraded historical documents. These are described as follows:

### A. Binarization Methods:

Binarization is simplest way to separate foreground from background. These techniques use threshold level to extract text from poor document. These binarization techniques use three different approaches to find thresholding levels known as Global, local and Hybrid thresholding methods [3].

- Global Thresholding Methods:** This method estimates optimal threshold level on the bases of particular image. Some of the important global thresholding techniques found in literature are Otsu's method [4], Entropy [5], Solihin's quadratic integral ratio (QIR) [6]. It has been observed that Otsu's and Entropy algorithms tend to over-threshold and are not suitable for historical documents [7]. The QIR algorithm is more accurate but still unable to work well on uneven background or in poor illumination. These methods are usually not suitable for downgrading document images, because they do not have a clear pattern that separates foreground text and background [8].

- b) *Local Thresholding Method*: On the other hand, Local thresholding methods estimates threshold for every pixel on the bases of neighboring pixels. Local thresholding methods are generally more complex and time consuming but perform better for low quality images. Common local thresholding techniques are Niblack's, Sauvolas and Wolf's algorithm. Niblack's algorithm always identifies the text regions correctly as foreground but produces binarization noise in non-text regions [9]. Sauvola's algorithm outperforms Niblack's algorithm in those images where the text and background pixels have large difference in pixel value otherwise the results degrade significantly [10]. Wolf's algorithm normalizes the contrast and the mean gray value of the image to find out threshold level. This method does not give good results when background gray scale value changes very sharply [11].
- c) *Hybrid Techniques*: Hybrid techniques use both global and local thresholding to filter out important textual information from visually poor historical documents. Hybrid techniques are more superior to Global or Local thresholding techniques as it combines benefits of both. These techniques may be classified in two categories: Adaptive Image Contrast and Adaptive Binarization.

- i. *Adaptive Image Contrast*: This approach is basically a combination of image contrast and image gradient which further enhances the contrast of an image [12]. Global Binarization of adaptive contrast map with canny edge map are used to detect the text stroke edges. Then local threshold is calculated from text stroke edge pixels and text is segmented. Various steps involved in this technique are shown in figure2.

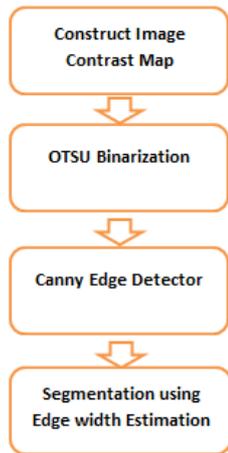


Fig 2 Hybrid Adaptive Image Contrast Method

- ii. *Adaptive Binarization*: The Adaptive Binarization technique is a combination of global and local (Hybrid) thresholding. First Iterative Global Thresholding (IGT) is applied, and then noisy portion is further processed by reapplying IGT. This is an effective way to combine the advantages of global and local thresholding for better noise adaptability with less computational and time cost [13].

### B. Edge Continuity Relation:

The 3-phase framework of the Edge Continuity Relation (ECR) approach to restore a writing order is another method proposed. In first local phase, a neural network for degree 4 and a theoretical approach for degree higher than 4 is used to estimate ECR at even nodes as shown in figure 3. Then maximum weighted matching is used to identify double-traced lines. In the last phase best candidates of single-stroked path is chosen by SLALOM smoothness [14].

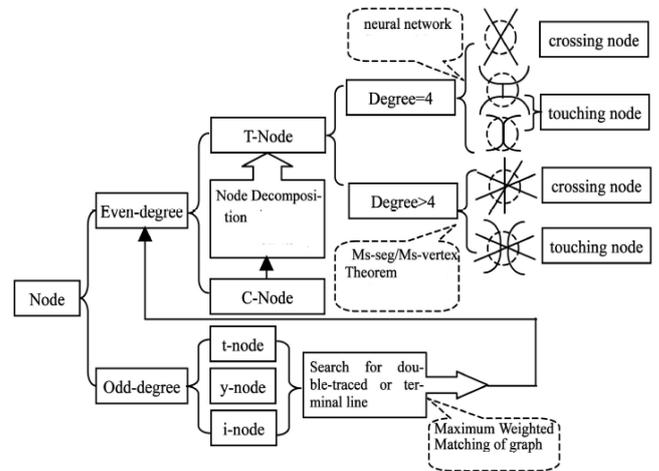


Fig 3 Edge Continuity Relation (ECR) [14]

### C. Probabilistic Generative approach:

This approach autonomously corrects the document by restoring the characters using probabilistic approach. [15]. It uses statistical information about characters. It deals with large patches which covers multiple characters after that it will learn the character representation which explicitly separates the text from severely degraded document. This approach can directly identify the character because of unsupervised approach.

### D. Soft Computing Techniques:

Soft computing techniques are used to model any nonlinear problem by using the computational power of software environment. Most of these techniques use nature inspired approaches which are tolerant to imprecision and uncertainty. These methods are generally complex, time consuming and resource inefficient.

- a) *Particle Swarm Optimization (PSO)*: This technique is proposed by Kennedy and Eberhart in 1995. A New novel PSO approach is proposed to restore historical documents [16]. In this paper Particle Swarm Optimization (PSO) in contrast to bilateral filter is applied to enhance the degraded documents. Results shows superiority of hybrid PSO technique in comparison to Non-linear filter.
- b) *Artificial Neural Network (ANN)*: ANN is an inspired model of brain neural network formed by an interconnected group of nodes. A typical ANN network consist of three types of layers- input, hidden and output layers as shown in figure 4. Each artificial neuron is represented with circular node and direction of arrow represents T-data flow from the previous layer

neuron to nodes of next layer. In [17], Hopfield neural network is proposed to restore the Image by the associative memory effect. This network has to memorize all possible correct patterns in advance for perfect recognition & therefore it is unsuitable to treat too much degraded pattern as there may be several possibilities in which a character/pattern may degrade.

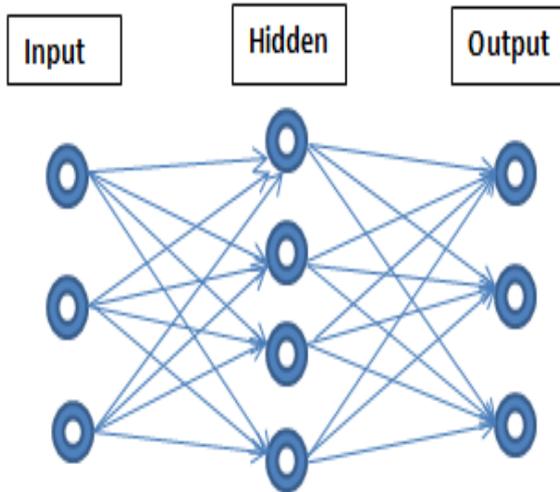


Fig 4 ANN (Artificial Neural Network)

### III. PROBLEM FORMULATION

As it is known that degraded documents suffers from ink bleeding, show through, deterioration of paper material etc. To deal with such problems, several approaches have been discussed in section II. But some drawbacks of such approaches are observed like although Global thresholding methods are fast and produce good result on clean documents but don't perform well on degraded documents. In Local thresholding methods, results are better than degraded documents, but it is sensitive to window size. Similarly in case of Hybrid techniques, which produce good results on degraded documents but its performance decreases when background is non-uniform. On the other hand in Edge continuity relation, skeleton of noisy images cannot reflect their structures well and sometimes it is not possible to recognize the spurious and real segments. In Hopfield neural network, an associative memory does not work well on too much degraded documents. Apart from these, Probabilistic approach equations used for reconstruction of characters, takes too much time and Particle swarm optimization (PSO) is also very time consuming and inaccurate.

### IV. PROPOSED METHODOLOGY

In this section, a new novel Neuro-Fuzzy approach for character restoration in degraded documents is proposed. Basic flow diagram of proposed technique is shown in figure 5. First of all, RGB color image is acquired which is usually a degraded historical document. Then, input image is passed through data reduction phase which uses 8 colors Quantization instead of binarization. As binarization reduces the data from  $256 \times 256 \times 256$  possibilities to only two binary states i.e. 0 and 1 which results in loss of prominent

information from already degraded input image. This results in inefficiency of any restoration technique.

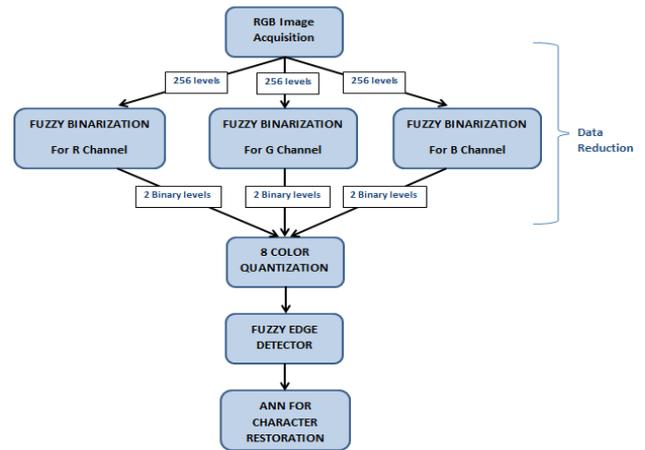


Fig 5 Proposed Algorithms

This proposed technique reduces the image into 8 colors by using Fuzzy binarization on all three color channels i.e. Red, Green and Blue. This step not only eliminates the uneven background but also retains four times more information as compared to binarization. After Quantization Fuzzy edge detector is used to filter out the edges of all the characters and finally characters are recognized and restored by trained Artificial Neural Network (ANN).

### V. CONCLUSION

As discussed in the review presented in this paper, it is quite evident that existing techniques may not yield promising results on all of the aspects viz. Execution time, Non-uniform backgrounds, noise sensitivity & extent of degradation, when used exclusively for character restoration of degraded documents. Therefore, to minimize these limitations, a new hybrid algorithm shall be devised by combining the strengths of individual techniques. This paper suggests one such approach which combines the strengths of ANN & Fuzzy logics & proposes a Neuro-Fuzzy based hybrid algorithm for improved restoration of degraded historical documents.

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# Identification of Organisms using DNA Barcodes

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**Abstract**— DNA barcoding is a system for fast and accurate species identification which will make ecological system more accessible by using short DNA sequence instead of whole genome and used for eukaryotes. The short DNA sequence is generated from standard region of genome known as marker. DNA barcoding has many applications in various fields like preserving natural resources, protecting endangered species, controlling agriculture pests, identifying disease vectors, monitoring water quality, authentication of natural health products and identification of medicinal plants. For species identification using DNA barcoding, similarity search methods have been used that include some already existing algorithms like Needleman Wunsch, Smith waterman, BLAST and FASTA. BLAST is being used for fast species identification but not give accurate results like Smith waterman which is a very slow process. BLAST has been performed using a sequence to study the effect of word size on accuracy and results show that larger the word size, less will be number of hits and smaller the word size, more will be number of hits. More number of hits means more accuracy. So idea is to combine the features of accuracy of Smith Waterman and speed of BLAST algorithm. A new algorithm is proposed with combined features of both these algorithms.

**Keywords**- BLAST, COI, DNA, FASTA, IBOL, Marker

## I. INTRODUCTION TO DNA BARCODING

Monitoring the biological effects of global climate, Identification of organisms has become important to preserve species because of increasing habitat destruction. There is estimation of 5 to 50 million plants and animals, living on earth, out of which less than 2 million have been identified. Extinction of animals and plants is increasing yearly means thousand of them are lost each year and most of them are not identified yet.[1] The high level of destruction and endangerment of ecosystem has lead to improved system for identifying species. In recent years new ecological approach called DNA barcoding has been proposed to identify species and ecology research. [2][3] DNA barcoding is a system for fast and accurate species identification which will make ecological system more accessible. [4] It first came to attention of the scientific community in 2003 when Paul Hebert's science research group at university of Guelph published a paper titled "biological identifications through DNA bar codes". DNA barcoding is a new tool for identification of species and for taxonomic research. It is not a new concept as Carl Woese used rRNA and molecular markers like rDNA and mtDNA to discover archea i.e. prokaryotes and then for drawing evolutionary tree. But DNA barcoding uses short DNA sequence instead of whole genome and used for eukaryotes. This short DNA sequence is taken from standard region of genome to generate DNA barcode. DNA barcode is short DNA sequence made of four

nucleotide bases A (Adenine), T (Thymine), C (Cytosine) and G (Guanine). Each base is represented by a unique color in DNA barcode as shown in figure 1. Even non experts can identify species from small, damaged or industrially processed material. [5]

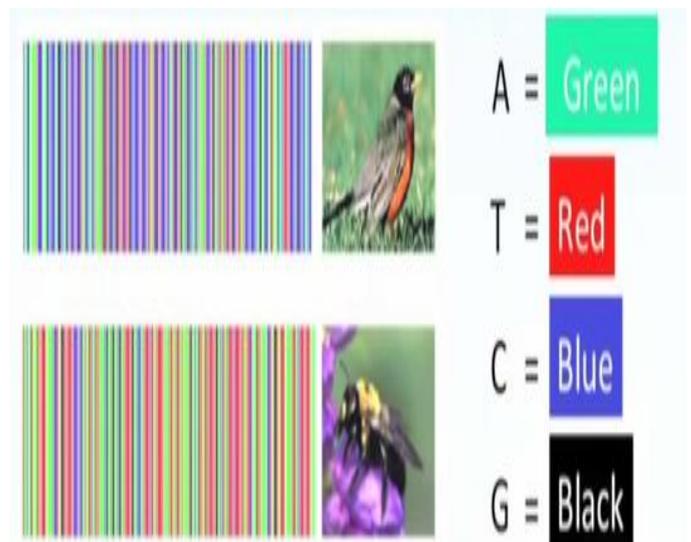


Fig. 1. DNA Barcode [15]

The standard region used to generate DNA barcode is known as marker. This marker varies among species. In animals Paul Hebert proposed the use of COI or cox1 present in mitochondrial gene as marker for generating barcode and now it is recognized by International Barcode of Life (IBOL) as official marker for animals. Reason for choosing this is, its small intra specific and large inter specific differences. It is not suitable for other group of organisms because it is uniform in them. So ITS (Internal Transcribed Spacer) is recognized for fungus and two genes from chloroplast genome, rbcL and matK are recognized as barcode markers for plants by IBOL. [12][13]

The sequence data generated from standardized region is used for identification of organism and to construct a phylogentic tree. In this tree related individuals are clustered together and can provide large amount of information about specie. [11][14]

## II. APPLICATIONS OF DNA BARCODING

### A. Controlling Agricultural Pest

Pest damage in agriculture can cost farmers billion dollars. DNA barcoding can help with this problem by identifying pests in any stage of life which makes it easier to control them. The global tephritid barcoding initiative contributes to management of fruit flies by providing tools to identify and stop fruit flies at border.

### B. Identifying Disease Vectors

Vector species causes many serious animal and human infectious diseases like malaria. DNA barcoding allows non ecologists to identify these vector species to understand these diseases and cure them. A global mosquito barcoding initiative in building a reference barcode library that can help public health officials to control these diseases causing vector species more effectively and with very less use of insecticides.

### C. Sustaining Natural Resources

Over harvesting of natural resources like hardwood trees and fishes is causing species, extinction and economies collapse of industries that rely on them. Using DNA barcoding natural resource managers can monitor illegal trade of products made of these natural resources. Fishbol is reference barcode library for hardwood trees to improve management and conservation of natural resources.

### D. Protecting Endangered Species

Primate Population is reduced by 90% in Africa because of bush meat hunting. DNA barcoding can be used by law enforcement to bush meat in local markets which is obtained from bush meat.

### E. Monitoring Vector Quality

Drinking water is a process resource for living being. By studying organism living in lakes, rivers and streams, their health can be measured or determined. DNA barcoding is used to create a library of these species that can be difficult to identify. Barcoding can be used by environmental agencies to improve determination of quality and to create better policies which can ensure safe supply of drinking water.

### F. Routine Authentication of Natural Health Products

Authenticity of natural health products is an important legal, economic, health and conservation issue. Natural health products are often considered as safe because of their natural origin.

### G. Identifying of plant leaves even if flowers or fruit are not available

### H. Identification of medical plants [21]

## III. PROCEDURE OF DNA BARCODING

The process of DNA barcoding involves two basic steps: First is building the barcode library of identified species and second is matching the barcode sequence of the unknown sample with the barcode library (known as sequence alignment) for its identification. The first step requires ecologic expertise in selecting one or several individuals per species as reference samples in the barcode library. Tissue samples for generation barcodes are either housed in museum or they can be live specimen in the field. These specimens go through lab processes that are tissue sampling and DNA processing and sequencing to generate DNA barcode in form of chromatogram. Chromatogram is visual representation of DNA sequence produced by sequencer. This barcode can be stored in database for future use or can be used as query sequence to be compared with sequence already present in database. [6]

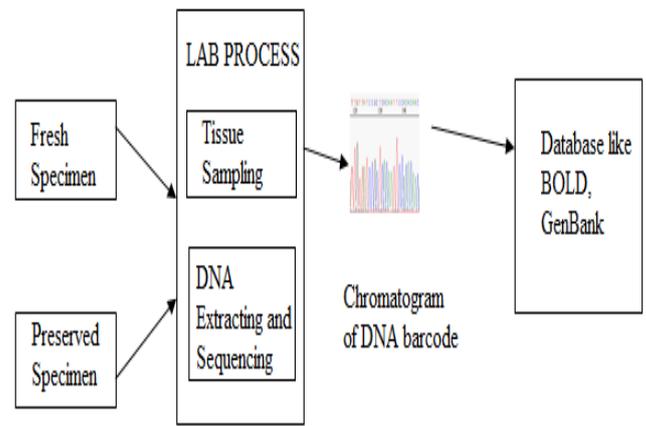


Fig. 2. DNA Barcoding Procedure

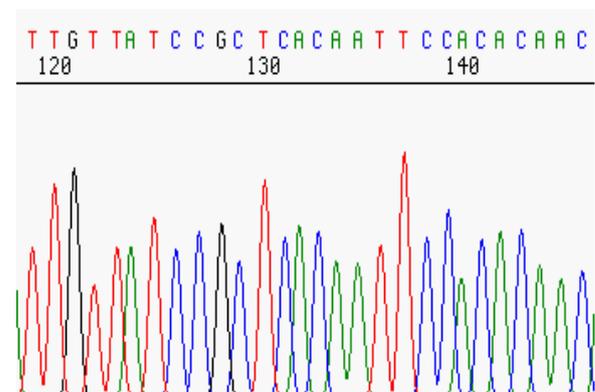


Fig. 3. Chromatogram of DNA barcode generated by sequencer [20]

## IV. LITERATURE REVIEW

*P.D.N. Hebert et al. (2003)*, have stated that identification of organisms lies in construction of systems that uses DNA sequences as barcodes. In this paper, author has established that mitochondrial gene cytochrome c oxidase 1 (CO1) can serve as main part of identification system for animals. CO1 has taken from mitochondrial gene of genome in animals and has 100 % successfully in identification of animals. CO1 identification system will provide a reliable, accessible and cost effective solution to the current problem of species identification.

*Z.T. Nagy et al. (2013)*, has concluded that DNA barcoding is now a popular and well accepted tool for identification of various species and detection of taxonomic diversity, since its introduction in 2003. This method is becoming an essential part of taxonomic practice. DNA barcoding is a tool that makes species identification easier. Also bodies like iBOL (Barcode of Life Project) and CBOL (Consortium for the Barcode of life) for their projects.

*John Waugh (2007)*, discussed that since 250 years lot of work in systematic has done but still majority of species are still unidentified. Increasing extinction rates and need of biological monitoring leads to DNA barcoding. So DNA barcoding is technology that has been proposed that might expedite the species identification. This method involves various markers for various species for efficient results. For this there is need of various identification

programmers to be co ordinate. DNA barcoding may prove to be very useful taxonomic tool.

Paul Hebert et al. (2005) has discussed that DNA barcoding is an appropriate system developed to provide fast, accurate and automatable species identification by using short DNA sequence generated from standardized region of gene. It makes taxonomic system more accessible, beneficial to ecologists, conservationists. One day DNA barcoding will lead us to a state when everyone will have easy access to name and biological attributes of any species on the planet. It also highlights diversity in species and may represent new species. It also highlights diversity in species and may represent new species. Even though it is beneficial, it also has been controversial in some scientific areas.

W.J. Kress et al. (2012) have stated that DNA barcoding is a new method for fast identification of species used in DNA based on DNA sequences, generated from small standardized region of genome. As a research tool for ecologists, it expands ability to diagnose species by including all life history stages of organisms. The DNA barcoding involves building of DNA barcode library of known species and then matching barcode sequence of unknown sample against the barcode library for identification. It has grown because number of sequences has generated as barcode and in terms of its application.

A. CB et al. (2014) concludes that pair wise sequence alignment is one of the methods to arrange two biological sequences to identify similarity which indicates functional, structural relationship between them. Pair wise alignment has two methods: local and global alignment methods. Local alignment is applicable in searching local similarity in large sequences. Global alignment aligns the sequences by taking whole sequence at a time. Local and global pair wise alignment methods are analyzed to find out similarity between the sequences.

D.L. Dalton et al. (2011) have discussed that smuggling of wildlife animals for commercial purpose has lead to population decline in South Africa. So, mitochondrial CO1 gene was sequences to determine species of unknown sample in three suspects of South Africa forensic wildlife cases. Two unknown samples were identified as domestic cattle and third were identified as common reedbuck.

A.G. Khallaf et al. (2014), stated that due to substitution of species, accurate identification of seafood species in markets is a growing concern. It has become prime priority of governments to identify the already processed fish products. DNA Barcoding was applied to some samples purchased from Egyptian markets and were analyzed. Sequencing of mitochondrial cytochrome c oxidase (CO1) gene revealed 33.3% species substitution in fish products which demonstrates that DNA barcoding is a reliable tool for detecting fish products.

D.P. Little et al. (2007) have concluded that to use DNA sequences for species identification, an algorithm to compare the sequences is needed. Two novel alignment free algorithms were used to identify query sequences for purpose of DNA barcoding. Gymnosperm nrITS2 and plastid matK sequences were used on test data. Results show that DNA barcoding could be used to identify

samples with a very less error. Geographic range can be used as elimination factor without which DNA barcoding do not appear to be useful for species level identification.

## V. SEQUENCE ALIGNMENT

Sequence Alignment is a process of comparing two or more sequences whether DNA, RNA, or protein sequence to look for similar patterns in sequences. [8][11] DNA sequence is made of four bases A (Adenine), T (Thymine), C (Cytosine) and G (Guanine) and for identification of species these need to be aligned means these need to be compared with sequences in database. Comparison of sequences has become very helpful in understanding the information content and functions of genetic sequence and can tell that how much the sequences are closely related. Sequence alignment provides solution to many problems in bioinformatics including identifying the new species, finding relationship between species and for predicting the function and structure of genes and proteins. [7]

DNA sequence alignment is of two types:

- Pair wise sequence alignment
- Multiple sequence alignment

Pair wise sequence alignment is a process of aligning or comparing two sequences at one time. Multiple sequence alignment is process of aligning or comparing more than two or three sequences with database sequences for doing phylogenetic analysis. It is done to study and analyze the relationship between various taxa using phylogenetic or evolutionary tree. We will consider pair wise alignment in our paper.

## VI. PAIR WISE SEQUENCE ALIGNMENT

Pair wise alignment is a process of aligning two sequences at one time to check for similarity between them. These methods are used to find the best matching local or global alignments of two sequences. For example if two sequences are taken from different organisms and aligned, and if these two sequences are from a common ancestor then because of similarity, they will get aligned. The purpose of this arrangement is to determine the relationship between the biological sequences. [9] It is based on a score which is evaluated from the number of same characters in two sequences, number and length of gaps required to align sequence so that the two sequences get aligned. [10] Alignments can be of two types local alignment and global alignment. Global alignment technique involves the attempt to align every character in every sequence. In this, number of characters in sequences or size should be same. This approach would be time consuming and inconvenient for longer sequences. Local alignments are appropriate for dissimilar sequences which may contain similar character sequence. [9]

### A. *Already Existing Pair Wise Sequence Alignment*

Some already existing algorithms for pair wise sequence alignment are Needleman-Wunsch, Smith Waterman, FASTA (Fast Alignment) and BLAST (Basic Local Alignment Search Tool).

#### 1) *Needleman-Wunsch Algorithm*

It was published in 1970. It performs a global alignment on two nucleotide or protein sequences. This

algorithm provides a method of finding the ideal global alignment of two sequences by maximizing the matches and minimizing the number of gaps that are necessary to align the two sequences. The alignment with the highest score must be the best alignment for which score matrix has to be prepared. Algorithm is as following.

A and B are sequences and  $A_i$  and  $B_j$  represents the base of sequence at position  $i$  and  $j$ .

Step 1: Score matrix is created.

Step 2: Trace backing is done.

Step 3: Compute an alignment that actually gives this score, you start from the bottom right cell, and compare the value with the three possible sources (diagonal, up, and bottom) to see which it came from. If diagonal, then  $A_i$  and  $B_j$  are aligned, if up, then  $A_i$  is aligned with a gap, and if left, then  $B_j$  is aligned with a gap.

The time complexity of this algorithm is  $O(MN)$  and space complexity is also same i.e.  $O(MN)$ .

#### 2) Smith Waterman Algorithm

It was published in 1981. The Smith–Waterman algorithm is a well-known algorithm used for local sequence alignment. It is very similar to Needleman-Wunsch algorithm only difference is that instead of looking at the total sequence, the Smith–Waterman algorithm compares segments of all possible lengths and checks for similarity. Algorithm is as following:

Step 1: Score matrix is created. All cells have values either 0 or 1.

Step 2: Trace backing is done. It starts with the maximum value in score matrix.

Step 3: Now compute the alignment, the local alignment value takes the maximum value of all the three values taken in the Global alignment with the value “0”. And trace back starts with the maximum value in the score matrix and traverse diagonally aligning every character of both the sequences until it encounter the value “0” in the score matrix. [9]

The time and space complexity is same as of Needleman Wunsch algorithm. Space complexity is same because same matrix is used and same amount of space for trace back is needed.

#### 3) FASTA

FASTA stands for fast alignment. FASTA is fast searching algorithm used for comparing query sequence with database. It comes under dynamic programming was developed by Lipman and Pearson in 1985. FASTA is faster than smith waterman and Needleman Wunsch algorithms which are good for two sequence comparison but when to compare with entire database, they are very slow than FASTA. Algorithm is as following:

I is query sequence and J is test sequence.

Step 1: Identify common  $k$  words or simply words between I and J using a dot plot matrix. For DNA  $k=6$  i.e., 6 nucleotides.

Step 2: score diagonals with  $k$  word matches, identify 10 best diagonals.

Step 3: Rescore initial region with a substitution score matrix.

Step 4: Join initial regions for gaps.

Step 5: Perform Dynamic programming for final alignment.

The complexity of the FASTA algorithm depends on size of the  $k$ -tuples, that means larger the  $k$ -tuples, the faster the algorithm. The true complexity is not easily determined because the speed of alignment of two sequences depends on total number marked cells variable diagonals. The space complexity of this algorithm is also  $O(MN)$  like the Needleman-Wunsch and Smith Waterman because it uses a matrix. But it use less space because not all cells in the matrix are marked.

#### 4) BLAST

BLAST stands for Basic local alignment search tool. TBLAST algorithm was developed by Altschul, Gish, Miller, Myers and Lipman in 1990 to increase the speed of FASTA by finding fewer and better spots of denser matching during the algorithm. BLAST concentrates on finding regions of high local similarity in alignments without gaps. Algorithm:

Step 1: Word Search Method: Sequence is filtered to remove complexity regions

Step 2: Identification of exact word match method, searches the database for neighborhood word. Words having equal or greater scores than neighborhood score threshold are taken for alignment.

Step 3: Maximum segment pair alignment method, it extends the possible match as ungapped alignment in both directions that stops at maximum score.

The complexity of the BLAST algorithm is  $O(MN)$ . This is the same time complexity as all of the other algorithms but BLAST significantly reduces the numbers of segments which need to be extended so the algorithm runs faster than all the previous algorithms. Using BLAST for nucleotide sequences, DNA barcoding has been used as a tool for identification of three species in forensic wildlife in South Africa [16] and also it has revealed high level of mislabeling in fish fillets purchased from Egyptian markets. [17]

## VII. METHODOLOGY

Parameters to be considered are word length or word size and number of hits in sequence alignment. Word size denoted by  $k$ , is the length of word or segment that is to be used as size of segment of sequence before starting the alignment. Number of hits is number of matches or alignments found in sequences.

To study the effect of change in work length on accuracy of species identification, BlastN was performed using mRNA sequence (nucleotide sequence) of invertebrate animal species named as Anaspides Tasmania against non redundant database. It returns top 100 sequences having some similarity, for each query sequence.[18] It is a fresh water species i.e. common resident of lakes, streams and pools in caves, in Tasmania highlands. To observe the effect of word length parameter, values of 7, 11 and 15 are were used with expect value,  $E=10$ .

Sequence used for the observation is as follows which is extracted from CO1 region of anaspides specie and is of size 657 bases and is in Fasta format.

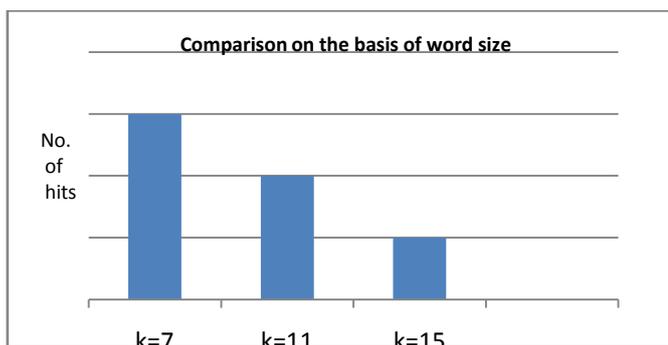
>EMBOSS\_001

```
TCTTTAGATTTTTATTTTTGGAGCTTGGTCTGGCATAAGTA
GGCACCGCCCTAAGACTTATTATTCGGGCTGAATTAGGA
CAACCTGGTAGACTTATTGGTGATGATCAAATTTACAAC
GTGGTCGTAACAGCTCATGCTTTTTGTGATAATTTTTTTT
ATAGTTATGCCATTATAATTGGTGGATTTGGAAATTGA
CTTGTTCCCTTAATATTAGGTGCTCCTGATATAGCTTTT
CCTCGTATAAATAATATAAGATTTTGGACTTCTTCCACCT
TCTTTAACTCTTCTCCTATCCAGAGGAATAGTTGAAAGA
GGTGTGGCACAGGATGAAGTGTATCCTCCTTTAGCT
GCTGGAATCGCCATGCAGGCGCTTCTGTGGACTTAGGA
ATTTTTTCTCTTCATATAGCGGGAGCTTCTTCTATTTTA
GGGGCGGTAATTTTTATTACTACTTCTATTAATATGCGT
GCCAATGGTATAACTTTAGATCGAATACCTTTATTTGTC
TGATCCGTTTTTATTACTGCTATTCTTTTACTACTCTCT
CTTCCCCTTTTAGCAGGGCAATCACAATACTTCTCACT
GACCGTAACTTAAATACTTCTTTCTTTGACCCCGCTGGA
GGAGGAGATCCATTCTTTATCAACATAAATGC
```

Table I. VARYING NUMBER OF HITS WITH DIFFERENT WORD SIZE

Word size (k)	No. of hits
7	518310295
11	32757086
15	14769504

The results from word size k=7 returned 518310295 hits, k=11 returned 32757086 i.e. less hits than returned by k=7 and then k=15 returned 14769504 which is least of all. So the observations tells us that decreasing the word size gives more number of hits i.e. more alignments or matches and increasing the word size gives less number of hits. [19]



Comparison on the basis of word size

Table II. COMPARISON OF SEQUENCE ALIGNMENT ALGORITHMS [9]

	Complexity	Alignment	Accuracy	Speed
Needleman Wunsch	O(MN)	Global alignment	Less accurate than smith waterman	Slow for searching entire database

Smith waterman	O(MN)	Local alignment	More accurate	Slow for searching entire database
FASTA	Time complexity depends on k	Local alignment	Less accurate than Smith Waterman	Faster than above
BLAST	O(MN)	Local alignment	Less than Smith Waterman	Fastest

## VIII. PROPOSED WORK

In this paper, an algorithm is proposed for local sequence alignment which gives more accurate results for better sequence alignment.

In the proposed model of sequence alignment algorithm, the concept of gapped alignment from Smith Waterman is combined with the concept of word size and heuristic approach of BLAST and FASTA algorithms. In this model, first of all, break the query sequence into words of size 3, 4 or 5. The small size of words is to get more number of hits while matching because with small word the small matches cannot be missed. Then store these words in indexed table. Suppose we have query sequence ACTGACTGCCCGTAAATGCATC. Now with word size k=3, underlined word are stored in table with their indices as shown below.

ACTGACTGCCCGTAAATGCATC

ACTGACTGCCCGTAAATGCATC

Then from the indexed table, the words are matched with sequences present in database. The databases used for DNA barcoding are BOLD and Genbank. Then these words are matched with query database and aligned with insertions and deletions. Then these aligned words are extended to both left and right directions till the score is increasing. Then the highest scored pair is chosen.

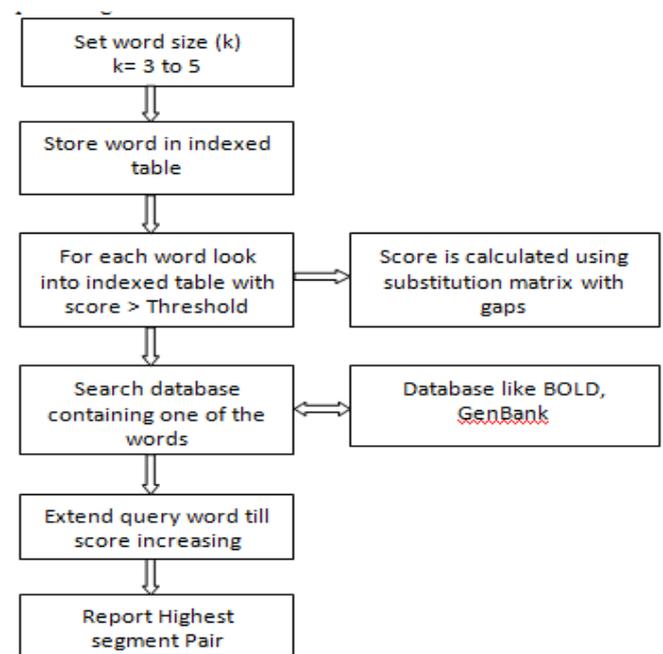


Fig. 4. Design of Proposed Work

### A. Proposed Algorithm

Step 1: Decompose the query sequence into words of length  $k$ , use  $k=3$  to 5.

Step 2: Store all words in hash table for faster searching and matching.

Step 3: For each word, look into hash table with a score greater than threshold. These scores are calculated using a substitution matrix by including gaps in sequences. These gaps are also known as indels (insertions and deletions).

While comparing sequences A and B, if gap is inserted in B then it is known as deletion and in sequence A, at corresponding base it will be insertion.

Step 4: Search the database for sequences containing any one of words.

Step 5: Extend the hit (matched word) in both directions until its score is increasing.

Step 6: Report the highest scoring pair if its score is greater than cut off and lower than expect value.

### B. Feature in Proposed Algorithm.

Proposed algorithm is combination of best features of smith waterman and BLAST algorithm. That means accuracy of identification provided by smith waterman and fast search provided by heuristic technique of BLAST algorithm. So, proposed algorithm provides faster search and accurate results.

Also word size used will be 3 to 5 for faster search and sensitivity (accuracy). Because speed is directly proportional to word size and sensitivity is inversely proportional to word size. So, large word size will give faster search speed and less sensitivity, and small word size will give less search speed and more sensitivity. So, the word size has chosen to be 3 to 5.

### C. Parameters

#### 1) Word Size

Word size is size of word taken from sequence that is used for searching in databases. Its value to be used in proposed algorithm will be 3 to 5.

#### 2) Threshold

All the words must have score at least equal to threshold.

#### 3) Expect value

It is the number of hits one can expect that means estimation of how many times you would expect a result. Its default value to be used is 10.

#### 4) Cut off value

It is used for reporting Highest Scoring Segment. Its default value to be used is calculated from expect value.

## IX. CONCLUSION

DNA barcoding is a system for fast and accurate species identification which will make ecological system more accessible. It has many applications in various fields like preserving natural resources, protecting endangered species. For species identification similarity search methods [20] have been used that include some already existing algorithms like Neeldeman Wunsch, Smith waterman, BLAST and FASTA. BLAST is being used for

fast species identification but not give accurate results like Smith waterman which is a very slow process. BLAST has been performed using a sequence to study the effect of word size on accuracy and results show that larger the word size, less will be number of hits and vice versa. So idea is to combine the features of accuracy of Smith Waterman and speed of BLAST algorithm. An algorithm is proposed on this idea with word size 3 to 5, having both accuracy and speed.

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# Evaluating the Effectiveness of Joint Trilateral Filter and Mix-CLAHE for Underwater Image Enhancement

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**Abstract** - Underwater images are the images captured to explore the underwater life and world. Underwater images have problems like low contrast, uneven illumination and haze that degrades the quality. Haze in underwater images result in less visual clarity, loss of contrast and diminishing of colors in underwater images. Therefore, haze removal or dehazing from underwater images is very essential and important to enhance the quality. Underwater image enhancement techniques such as MIX-CLAHE[6], Joint Trilateral filter[9] have been developed in literature so far to remove the effect of haze. This paper focuses on evaluating the performance of Joint Trilateral filter and MIX-CLAHE for underwater image enhancement. The main focus of this paper is to find the better technique among these two algorithms for underwater image haze removal and enhancement.

**Keywords** - Underwater Image, Joint Trilateral Filter, MIX- CLAHE., Underwater image Haze removal.

## I. INTRODUCTION

Digital image enhancement techniques provide a multitude of choices for improving the visual quality of images and improving the interpretability. It accentuates and sometimes sharpens image features such as edges, boundaries, or contrast to make a graphic display more helpful for display and analysis.

### A. Underwater Image Enhancement

Underwater images are the images that are taken under the sea and oceans. Underwater Imaging is a very important research area in ocean engineering. Underwater images are captured to explore underwater world, perform underwater Surveys, Archaeology, Weather Forecasting, Remote Sensing, Deep Sea Diving and scuba diving and underwater aquatic life. The prevailing research indicates that underwater images raise new challenges and impose significant problems as a result of light. Underwater images are essentially characterized by their poor visibility because light is exponentially attenuated as it travels in the water and the scenes result poorly contrasted and hazy. Exploring, understanding and investigating underwater activities of images are gaining importance. Scientists are keen to explore mystifying underwater world. Various techniques have been proposed to enhance the underwater images. Underwater image enhancement techniques

become very popular due to the use of various vision underwater applications. We have analyzed two techniques MIX CLAHE[6] and Joint Trilateral Filter[9] for underwater image enhancement and have evaluated the effectiveness of performance of two techniques.

### B. Contrast Limited Adaptive Histogram Equalization (CLAHE)

The CLAHE [6] algorithm partitions the images into contextual regions and applies the histogram equalization to each one. This evens out the distribution of used gray values and thus makes hidden the top features of the image more visible. The total gray spectrum is employed to state the image. Contrast Limited Adaptive Histogram Equalization, (CLAHE) is a better version of AHE, or Adaptive Histogram Equalization. Both overcome the limitations of standard histogram equalization. A number of adaptive contrast limited histogram equalization techniques (CLAHE) are provided. Sharp field edges could be maintained by selective enhancement within the field boundaries. Selective enhancement is accomplished by first detecting the field edge in a portal image and then only processing those parts of the image that lie in the field edge [6].

#### 1) CLAHE on RGB Color Model:

The RGB color model is definitely an additive color model. Here red, green and blue light are added together in a variety of ways to replicate a wide variety of colors. The worth of R, G, and B components could be the amount of the respective sensitivity functions and the incoming light [6]. In RGB color space, CLAHE is applied on most of the three components individually and the consequence of full-color RGB may be obtained by combining them. The value of R,G and B components is sum of the respective sensitivity functions and the incoming light :

$$R = \int_{300}^{830} S(\gamma)R(\gamma)d\gamma \quad (1)$$

$$G = \int_{300}^{830} S(\gamma)G(\gamma)d\gamma \quad (2)$$

$$B = \int_{300}^{830} S(\gamma)B(\gamma)d\gamma \quad (3)$$



Figure 1 a) Input Image b) Enhanced Image after applying CLAHE-RGB

2) *CLAHE on HSV color model:*

HSV is really a cylindrical-coordinate representation of points within an RGB color model. In color space it describes colors when it comes to the Hue (H), Saturation (S), and Value (V). [6]The HSV model takes RGB components to be in the range (0, 1).Regardless of the worth staying at either min or max intensity level, hue and saturation levels won't differ. CLAHE can just only be applied on V and S components. Value V is computed by taking the maximum value of RGB given as:

$$V = \max(R, G, B) \quad (4)$$

Saturation S is controlled by how widely separated the RGB values are. When values are close together, color will be close to gray. When values are far apart, color will be intense to pure.[6]

$$S = \frac{V - \min(R, G, B)}{V} \quad (5)$$

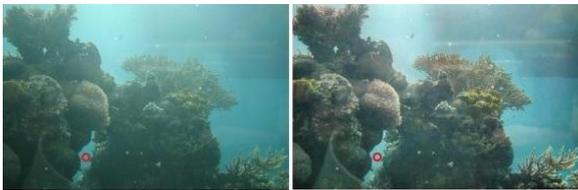


Fig. 2 a)InputImage b)Enhanced image after applying CLAHE-HSV

3) *Mixture CLAHE*

Mixture CLAHE[6]mix the results of CLAHE-RGB and CLAHE –HSV using Euclidean norm. It enhances the image contrastand preserve naturallook of the underwater image. It also removes the unwanted artifacts and reduces the noise in underwater images. Steps involved in applying Mix CLAHE are as follows:

**STEP 1 :**Mix-CLAHE first normalize the result of CLAHE-RGB using equation:

$$[r_{c1}, g_{c1}, b_{c1}] = \left[ \frac{R_c}{R_c + G_c + B_c} + \frac{G_c}{R_c + G_c + B_c} + \frac{B_c}{R_c + G_c + B_c} \right] - (6)$$

**STEP 2 :**The results of CLAHE-HSV is converted to RGB color model by finding chroma  $C = V * S$  and  $H' = \frac{H}{60}$  and Value of X is determined as follows: $X = C(1 - |H' \text{ mod } 2| - 1)$  - (7)

**Step 3 :** The conversion from HSV to RGB which is denoted by  $(r_{c2}, g_{c2}, b_{c2})$  is based on following conditions :  $(r_{c2}, g_{c2}, b_{c2}) = \{ (0,0,0), \text{ if } H' \text{ is undefined}, (C, X, 0) \text{ if } 0 \leq H' < 1, (X, C, 0) \text{ if } 1 \leq H' < 2, (0, C, X) \text{ if } 2 \leq H' < 3, (0, X, C) \text{ if } 3 \leq H' < 4, (X, 0, C) \text{ if } 4 \leq H' < 5, (C, 0, X) \text{ if } 5 \leq H' < 6 \}$

**Step 4:** Finally, Both conversions of step 1 and 3 are integrated using a Euclidean norm:

$$RGB_n = \left[ \sqrt{r_{c1}^2 + r_{c2}^2}, \sqrt{g_{c1}^2 + g_{c2}^2}, \sqrt{b_{c1}^2 + b_{c2}^2} \right] \quad (9)$$

Fig.3 Methodology of applying MIX-CLAHE



Figure 4 a) Input Image b)Enhanced image after applying Mixture-CLAHE

C. *Joint Trilateral Filter*

Joint Trilateral filter [9] is used for underwater image dehazing. It consists of sequence of steps through which the technique is applied on the image and result is produced. Joint trilateral filter can remove overly dark fields of underwater images by refining transmission depth map. The enhanced images are characterized by reduced noise level, better exposedness of dark regions [9]. Steps used in applying Joint Trilateral Filter are as follows:

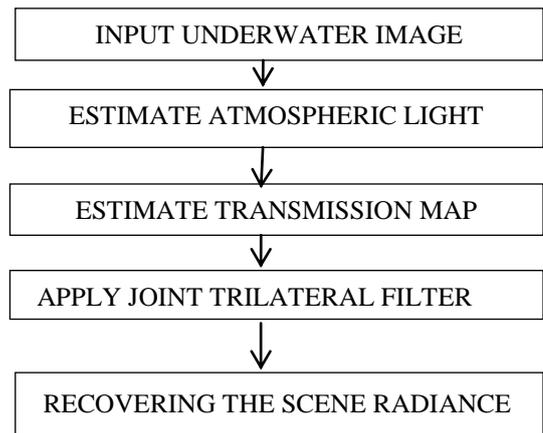


Fig.5 Methodology of applying Joint Trilateral Filter [9]

1) *Input image and estimate light:*

First of all, the input image is haze image. The input image is composed of two components. First component is transmission of light from object. The second component is transmission of light by the particles of medium due to scattering[9]. Mathematically, it can be written as

$I(x) = j(x)t(x) + (1 - t(x))A$  - (10) Where I is the achieved image and J is the haze free image, t is transmission along vision. A is the veiling color constant and  $x = (x, y)$  is a pixel.[9]

### 2) Estimate Transmission Map:

The next step is to take the Maximum intensity of the red color channel to compare with maximum intensity of green and blue color. **S. Serikawa and H. Lu (2014) [9]** define the dark channel  $j_{dark}(x)$  for underwater image  $j(x)$  as

$$j_{dark}(x) = \min_r(\min_{y \in \Omega(x)} j_c(x)) \quad (11)$$

Where  $j_c(x)$  refers to a pixel x in red color in observed image and  $\Omega$  refers to patch in image.

Here, minimum operation on Equation 10 is taken, **S. Serikawa and H. Lu (2014) [9]** assume transmission as

$$\min(I_c(x)) = \tilde{t}_c(x) \min_{y \in \Omega(x)}(j_c(x)) + (1 - \tilde{t}(x))A \quad (12)$$

Where  $A_c$  is the homogenous backgroundlight.

### 3) Apply Joint Trilateral Filter:

In this step, **S. Serikawa and H. Lu (2014) [9]** apply joint trilateral filter on reference image or input image I. Let  $I_p$  and  $g_p$  be the intensity value at pixel p of minimum channel image and guided image.

JTF [9] is explained by equation as

$$JTF(I)_p = \frac{1}{\sum_{q \in w_k} W_{JTF(G)} W_{JTF(pq)}(G) I_q} \quad (13)$$

Where  $w_k$  is local window and I is the input image and q is pixel and  $W_{JTFpq}(G)$  is kernel weights function[9] and can be written as:

$$W_{JTFpq}(G) = \frac{1}{|w|} \sum_{k:(p,q)w_k} \left(1 + \frac{(G_p - \mu_k)(G_q - \mu_k)}{\sigma^2 + \epsilon}\right) \quad (14)$$

### 4) Recovering the scene radiance:

The scene radiance can be recovered by using Equation (10).It restrict transmission  $t(x)$  to a lower bound  $t_0$  which means that a certain amount of haze are preserved in very dense haze regions. Here  $t_0$  is chosen as 0.1. The final scene radiance  $J(x)$  [9] can be written by Equation 10as:

$$J(x) = \frac{I_c(x) - A_c}{\max(t(x), t_0)} + A_c \quad (15)$$



Figure 6 a) Input Image b) Enhanced Image after applying Joint Trilateral Filter

## II. LITERATURE SURVEY

Y.Y. Schechner, N. Karpel(2004) [1,2] analyzed the physical effects of visibility degradation and proposed an

image recovery algorithm based on a couple of images taken at different orientations with a polarizer. Improvement of scene contrast and color correction, and nearly doubled the underwater visibility range was obtained. A.T. Çelebi & S. Ertürk(2012) [3] proposed Empirical Mode Decomposition based underwater image enhancement approach. The enhanced image is constructed by combining the IMF's ( Intrinsic Mode Functions ) of spectral channels with different weights in order to obtain an enhanced image with increased quality. The weight estimation is carried out automatically using a genetic algorithm. The proposed approach provide better interpretability, visibility and perception of objects in the images. The enhanced images have more visual details ,better quality and good contrast. J. Y Chiang and Y C Chen (2012)[4] proposed a novel algorithm called Wavelength Compensation and Dehazing to enhance underwater images. The dehazing algorithm used to compensate the attenuation discrepancy along the propagation path and to take the influence of the possible presence of an artificial light source into consideration. Firstly depth map was estimated and then the segmentation of foreground and background within a scene was done. The light intensities of foreground and background were compared to determine whether an artificial light source was employed during the image capturing process. After compensating the effect of artificial light, the haze phenomenon and discrepancy in wavelength attenuation along the underwater propagation path to camera were corrected. on the amount of attenuation corresponding to each light wavelength, color change compensation was conducted to restore color balance. WCID significantly enhanced the visibility and shown superior color fidelity in the images. H. Wen, Y. Tian, T. Huang & W.Gao(2013) [5] derived underwater optical model to describe formation of underwater image in true physical process and then proposed effective enhancement algorithm with derived optical model to improve perception of underwater images or video frames. M.S. Hitam, W. N. J. H. W. Yussof, E.A. Awalludin & Z. Bachok (2013) [6] proposed a method called mixture contrast limited adaptive histogram equalization (CLAHE-Mix) for under-water images. This method reduced significant noise introduced by CLAHE to ease the subsequent processing of under-water images. CLAHE was applied to the image in RGB and Hue-Saturation-Value (HSV) color models separately. Here, the pixel distribution was set according to the Rayleigh distribution for the CLAHE process in both color models. These processes of applying CLAHE in the RGB and HSV color models produced two independent images: the image processed using CLAHE in RGB color model, which is called CLAHE-RGB, and another image processed using CLAHE in HSV color model, which is called CLAHE-HSV. These images were integrated to produce a contrast-enhanced image with low noise using Euclidean norm. This approach considerably improved the visual quality of underwater images by enhancing contrast, as well as dropping noise and artifacts. The limitation includes that the output image sometimes becomes greenish. P. N. Andono, I. Purnama, & M.Hariadi (2013) [7] have

introduced that Success of scale-invariant feature transform (SIFT) image registration is bound when attempted on camera footage taken under water and largely as a result of poor image quality inherent to imaging in aquatic environments. To overcome this shortcoming, they have introduced a fresh approach to pre-processing of true-color imagery taken under water on the basis of the Contrast Limited Adaptive Histogram image Equalization (CLAHE) algorithm in that the distribution function of the pixel intensity values of an underwater recorded image is dominated by Rayleigh scattering, and that the noise may be removed as a function. Z.Chen, H.Wang, J. Shen., X. Li, & L. Xu " (2014) [8] found a region specialized method to restore underwater image acquired in optically inhomogeneous environments. A novel bright channel prior is explored based on statistics on haze free images. A region specialized process had been taken. Dark Channel prior used to estimate haze concentration and depth map. The enhanced clarity and color fidelity were obtained. S. Serikawa and H. Lu (2014) [9] presented a novel method for enhancing underwater images by image dehazing. A new underwater model had also been proposed to compensate the attenuation discrepancy along the propagation path. The proposed underwater model was suitable in underwater environment. They also proposed a fast joint trilateral filter for underwater image dehazing. The joint trilateral filter removed overly dark fields of underwater images by refining transmission depth map. The enhanced images were characterized by reduced noise level, improved quality, finest details and edges are enhanced, better exposedness of dark regions

### III. EXPERIMENTAL RESULTS

In the experiments, the two algorithms have been implemented on wide variety of hazy underwater images in MATLAB. We tested the two algorithms for many different foggy and hazy underwater images. These algorithms successfully removes the haze from heavy haze portions from underwater images and improve contrast and enhance the quality of underwater images. In this section, we compare Joint Trilateral Filter and MIX-CLAHE by showing their comparison through images.

#### A. MIX-CLAHE Results

Figure 3.1 shows the results of the underwater image enhancement and haze removal by Mix-CLAHE. It is clearly shown that all the haze has been removed to a great extent but still uneven illumination is there.. So we can say the given technique is not so efficient solving the uneven illumination problem in underwater image



Figure 7 Input images and MIX CLAHE Results

#### B. Results of Joint Trilateral Filter

Figure 3.2 shows the results of the underwater image enhancement and haze removal by Joint Trilateral Filter. It is clearly shown that all the haze has been removed to a great extent and problem of uneven illumination has been removed to a great extent.. So we can say the given technique is very efficient for improving the contrast and solving the uneven illumination problem of underwater images. The overall quality of underwater images is also enhanced.



Figure 8 Input images and Joint Trilateral Filter Results

### III. CONCLUSION

This paper has evaluated the effectiveness of performance of two techniques for underwater image enhancement and haze removal that are Mix CLAHE[6] and Joint Trilateral Filter [9]. This paper has also focused on the methodology of both the techniques. Both techniques MIX-CLAHE[6] and Joint Trilateral Filter[9] have been designed and implemented in MATLAB using image processing toolbox. The performance comparison between both techniques has been done on the basis of visual results. The experimental results have shown that the Joint Trilateral Filter outperforms for most of underwater hazy images than the MIX CLAHE. Thus, Joint Trilateral Filter[9] has significant good results over Mixture Contrast Limited Adaptive Histogram Equalization technique. Joint Trilateral Filter[9] removes the haze from underwater images to a great extent, improves the overall contrast and enhances the overall quality of underwater images.

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# ROI based Hough Transform for Lane Mark Detection

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**Abstract-** Lane detection plays an important role in Intelligent Transportation Systems. It is the process of extracting road lane markings and edges and estimating the position of the vehicle in the lane. Recently much work is performed in the field of lane detection. Lane detection is an important aspect of autonomous vehicles. It is also a preventive measure for road accidents. The overall objective of this paper is to evaluate the effectiveness of ROI based Hough Transform for lane detection technique for various kinds of road images. Various parameters like geometric accuracy, error rate are used for calculating the effectiveness of this technique. The result has shown the effectiveness of the ROI based Hough Transform with accuracy of more than 80%.

**Keywords-** ROI, Hough Transform, Canny edge detector, Lane detection

## I INTRODUCTION

Road accidents have grown to be one of the most serious problems nowadays that are risking the lives of people. Among all modes of transportation, roads provide the finest connections among these modes. Lane detection is a technique in which lane marks are detected as well as recognized in the area where the ground traffic circulates. Detecting as well localizing lanes from a road image is an important component of ITS (Intelligent Transportation system). The main purpose of lane detection is to locate the road lanes or white markers that help the drivers to identify the road area and non-road area in order to reduce the road accidents. The lane detection system is extraction of road lane markings and edges and estimates the positioning of the vehicle within the lane. A lane is just a part of the area of the road marked which is often utilized by an individual type of distinct vehicles as to manage and guide drivers so that the traffic conflicts may be reduced. Lane detection algorithms detect lane markings and the edges of the road, and estimate the vehicle position in the lane. Lane detection provides a framework for the support of many other single-camera based Mobil eye functions as vehicle detection; in this case, it contributes to the correct position of the vehicle in the same lane.

Advanced driver assistance systems (ADAS) are the systems that are designed to assist the driver in its driving process. Many systems like lane excursion detection and warning, intelligent cruise control, collision avoidance

system, blind spot detection are a part of ADAS. Lane departure warning system (LDWS) is a part of ADAS whose objective is to detect the lane marks and to warn the driver in case when the vehicle has tendency to depart from the lane. Many techniques have been made until now to detect and locate the lane marks. The techniques used for this task varied from using monocular or stereo-vision, using different morphological operations or B-snake and probabilistic grouping. Other approaches used various models and techniques for this task, such as processing bird's eye view, perspective view and distance transform techniques that have high computational costs. Based on the previous work done in lane detection field, a method is planned in this paper to detect and localize the lane marks by using Hough Transform. This technique of lane detection gives accurate results on lane detection of straight as well as curved roads.

## II LITERATURE SURVEY

Bertozi et al. have proposed a parallel real-time stereo vision system for the detection of generic obstacle and lanes system, called GOLD. This system centered on a full-custom massively parallel hardware, detects both generic obstacles and the lane position in a structured environment at an interest rate of 10 Hz. The output of the processing is displayed to provide visual feedbacks to the driver. It is displayed on both an on-board monitor and a control-panel [1]. Nedevschi et al. proposed a stereovision based 3D lane mark detection method. The normal assumptions like that of flat road, constant pitch angle or lack of roll angle are eliminated. The road and the obstacle features are separated based on the 3-D information. The lane is modeled as a 3-Dimensional surface defined by the lane width, the vertical and horizontal curves, and the roll angle. The lane detection is incorporated into a following process. Utilizing the past parameters and the automobile dynamics, the current lane parameters are predicted and this prediction gives search regions for the existing detection. The detection starts with estimation of the vertical profile. After the estimation of vertical profile, horizontal profile is detected by employing a model-matching technique in the image space, utilizing the information of already detected vertical profile. By estimating the difference of the common heights of the left and right lane borders, roll angle is detected [2]. Sun

et al. have proposed a general evolutionary Gabor filter optimization (EGFO), that optimizes the parameters of a couple of Gabor filters in the context of vehicle detection. Integrating genetic algorithms (GAs) and incremental clustering approach into this approach, unifies filter design with filter selection. Filter design is conducted using GAs, which is a worldwide optimization approach that encodes the Gabor filter parameters in a chromosome; and genetic operators are used in order to optimize them. Using an incremental clustering approach, filters that are possessing similar characteristics in the parameter space are grouped for Filter selection [3]. Shan et al. have discussed a method of structured road lane detection for blind people aid. Firstly, the image is processed by implementing Median Filter, then the region of interest in the initial image is marked off. Image segmentation is done using Canny Edge Enhancement. Modified Hough Transform is used for road lane detection. Finally, according to the detected region, it is judged whether racing course of blind has a deviation. This algorithm was very robust and real-time [4]. Tseng et al. have proposed a lane mark detection algorithm by making the use of geometry information and modified Hough transform. By utilizing geometry information, the captured image was split into road part and non-road part. The histogram of intensities was applied to quantize the street image into a binary image. The modified Hough transform with road geometry consideration was applied to detect the lane marks. The algorithm was time consuming and failed when the lane boundaries intersected in a region which was a non-road part [5]. Cheng et al. have proposed a lane detection method whose motive is to handle moving vehicles in the traffic scenes. It works in three steps: First, by predicting the color information, lane marks are extracted. Next, the vehicles that have the same color as the lane marks then usage of size, shape, and motion information of vehicles is made in order to distinguish them from the real lane marks. Finally, the accumulation of the pixels in the extracted lane-mark mask is done to find the boundary lines of the lane. The algorithm is robust to get or discover the left and right boundary lines of the lane and is not suffering from the passing traffic [6]. Alvarez et al. have presented a composite index to quantitatively gauge the performance of road detection algorithms. The measure is based on a heavy combination of different evaluations which make use of a trade-off between precision and recall scores. Obtaining a single index score is a major benefit. It can be utilized to easily compare algorithms or to properly set their parameters. Human perception criterion can be employed to improve its usefulness [7]. Aly et al. have proposed a robust and real time approach to locate lane marks in urban streets. It is based on generating a top view of the road, then filtering is done by using selective oriented Gaussian filters. Fast RANSAC algorithm is used for fitting Bezier Splines, which is then followed by a post-processing step [8]. Teng et al. have presented a real-time lane detection algorithm that used multiple cues. The algorithm uses bar filter to efficiently detect bar-shape objects like road lane, color cue and Hough Transform. Utilization of particle

filtering technique has been done for the guarantee of real-time lane detection. This algorithm improved the accuracy of the lane detection and is a necessary part for driver assistant system [9]. Nuthong et al. have proposed an algorithm for lane tracking that is used to detect the lane as an initialization for lane tracking. The algorithm takes as an image from a video stream as an input. The image is then segmented into a number of small tiles and Principle Component Analysis (PCA) is applied to each tile to be able to get the centroid and the principle axis. The probable lines are observed using k-means clustering techniques by following the recovery of the original image from most of the tiles. Out of these lines, two lines are selected for the lanes of the road and the corresponding centroid points are chosen that are marked as control points of smoothing splines represented the lane [10]. Li et al. [2011] have proposed a new lane detection method in which Instead of detecting each feature point separately from limited local view, a lane mark segment detection method is designed for detecting each lane mark segment on the whole based on some prior knowledge. Particle filtering is carried out to ensure the stability of tracking process [11]. Arshad et al. [2011] have proposed a lane detection algorithm whose motive is to detect the lane marks with moving vehicles based on the color information. First, an adaptive region of interest ROI is extracted which mainly exists in the bottom half of the image. Then based on color information the lane marks are extracted [12]. Shen et al. have discussed a monocular vision system that can locate the positions of the road lane in real time. The algorithm has worked in five steps. Initially, edge detection was done to find all present edges from road image. Canny edge detection has been used to achieve the edge map from road image for its accurate edge detection. Then matching is done to eliminate unwanted figures. After it, a searching method based on priority and orientation has been used for enhance and label potential lane segments from edge map, degrading unwanted edge features. Based on searching results, a linking condition is used to assemble matched segment that further strengthen the confidence of the potential lane line. Finally a cluster algorithm is used to localize the road-lane lines [13]. DhanaLakshmi et al. have discussed a novel algorithm that is used to detect the multicolor lanes on the road. Lanes are exactly found by using the color and edge orientations. Yellow and white colored lanes are identified by using color segmentation. This technique is accompanied by edge orientation in that the boundaries are eliminated, regions are labeled and lanes are detected finally [14]. Le et al. have discussed a method for the task of finding the pedestrian lanes which are indicated by painted markers for the blind people aid. It is an assistive navigation system that has been developed for the blind by making the use of geometric figures like straight line, parabola, or hyperbola. Based on color and local intensity information, this method has detected correctly pedestrian marked lanes in different light and weather conditions like sunny, cloudy, strong shadows, times of day [15]. Ghazali et al. have proposed a lane detection technique that uses H-MAXIMA transformation and improved Hough

Transform. Firstly, the region of interest from the input image is selected for reducing searching space; then the image is divided into near field of view and far field of view. In near field of view, Hough transform has been applied to detect lane markers after image noise filtering [16]. Mariut et al. have proposed a lane detection algorithm that uses Hough transform to detect the lane marks that is used to detect the potential lines in the images. The algorithm has the ability to detect the lane marks as well as characteristics of lane marks. The inner margins of the lane are extracted by generating the magnitude image in order to ensure the right direction of the lane marks [17].

### III OVERVIEW OF ALGORITHM

The proposed algorithm works in two steps – pre-processing and post-processing. Pre-processing is low level image processing that deals with images from the camera and generate useful information for detection parts. It includes ROI selection and gray scale conversion. Initially the road image is captured by the camera and a region of interest is extracted from the input image in order to reduce the search area and to save computational time. Then the gray scale conversion of the image is done to reduce the processing. Post-processing includes canny edge detection and then Hough transform is applied to detect the lane marks of the road image.

#### A. Region of Interest

The region of interest selection is extracted from the original image by cropping the road image that increases the speed and accuracy of the lane detection algorithm. The maximum region of interest mainly lies in the bottom half of the road image where all the necessary objects such as lane markings, pedestrians and other vehicles are present. On the basis of the dimensions of the image, the region of interest is calculated by reducing each side of the image to a particular size. The speed improvement in the lane detection algorithm comes from the reduction in the size of the image to be processed while the accuracy improvement comes from the elimination of objects outside the ROI that may have features similar to the lane marking.

#### B. Gray-scale Conversion

The image color format is converted into gray- scale format as Canny edge detection works with monochromatic images. Gray-scale conversion transforms a 28 bit, 3 channel RGB color image into 8 bit, one channel, gray- scale image. Generally, road surface can be made up of various obstacles such as shadows, tire skids, oil stains, diverse pavement style which changes the color of the road surface and lane markings to form one image region to another. Due to this, the image is converted into gray scale as the processing of gray scale images is minimum as compared to the original image.

#### C. Gradient Image

The image gradient is a measure of how the image is changing. The gradient of an image gives two pieces of information: magnitude and direction. The magnitude of the gradient describes how quickly the image is changing

whereas the direction of the gradient specifies the direction in which the image is changing. The objective of gradient image is to highlight the lane mark's margins.

First, we will generate the gradient image for x-axis as,

$$\frac{\partial I}{\partial x}(i, j) = \frac{1}{2} [(I(i, j + 1) - I(i, j) + I(i + 1, j + 1) - I(i + 1, j))] \quad (1)$$

Then, the gradient image for y-axis is obtained as:

$$\frac{\partial I}{\partial y}(i, j) = \frac{1}{2} [(I(i + 1, j) - I(i, j) + I(i + 1, j + 1) - I(i, j + 1))] \quad (2)$$

Using these gradient images, we will generate the gradient image as:

$$\nabla J = \left( \frac{\partial J}{\partial x}, \frac{\partial J}{\partial y} \right) \quad (3)$$

The magnitude image is represented as:

$$\|\nabla J\| = \sqrt{\left(\frac{\partial J}{\partial x}\right)^2 + \left(\frac{\partial J}{\partial y}\right)^2} \quad (4)$$

Using the estimated mid-lane and this magnitude image, we extract the inner margins of the lane marks which will be used to detect the lane marks by using Hough Transform.

#### D. Edge Detection

The goal of edge detection here is to find all present edges from road image as far as possible because in which potential road line may be included. So a reliable and accurate edge detector should be selected firstly. There are a lot of edge detectors, for example, Canny, Sobel, Prewitt, Roberts and Laplacian operator that are usually tuned for specific type of profiles. This work makes use of canny edge detector to detect a wide range of edges in the images. Canny edge detector is a multiple stage algorithm whose aim is to discover the optimal edge detection. It uses gradient vector of an intensity image. Canny edge detection is a four step process: Gaussian blur to clear any speckles, gradient operator is applied for obtaining the gradients' intensity and direction, Non-maximum suppression, Hysteresis thresholding to find beginning and end of the edge.

#### E. Hough Transform

Hough Transform (HT) is an efficient tool for detecting straight lines in an image, even in the presence of noise and missing data. It is able to find the dominant lines of an image by counting each unique equation for every possible line through each point of the image. The basic principle of the Hough Transform is that every point in the image has infinite number of lines, which pass through it but with a different angle. The goal of the transform is to identify the lines that pass through the most points in the image. These are the lines that most closely match the features in the image. Hough transform algorithm uses an array, called an accumulator, to detect lines. The dimension of the accumulator is equal to the

number of an unknown Hough transform parameters. The  $\rho$  parameter represents the distance between the line and the origin, and the parameter  $\theta$  represents the angle of the vector from the origin to the closest point on the line. A count (initialized at zero) in Hough accumulator at point  $(\rho, \theta)$  is incremented for each line it considers.

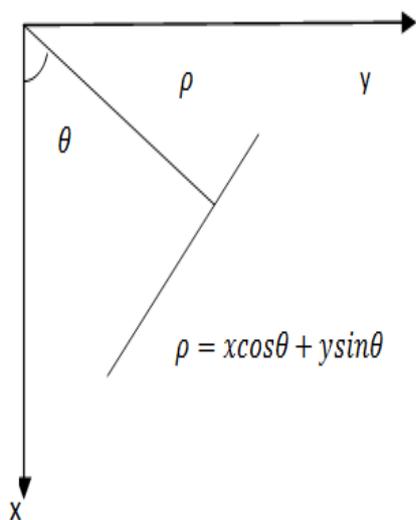


Fig.1 Hough transform for detecting straight lines.

#### IV EXPERIMENTS & RESULTS

We have performed the experiments on different test images in MATLAB under Hp computer having Intel(R) Core™ i5 processor, 32 bit windows 7 operating system, 4.00 GB RAM and RADEON Graphics. This technique has been implemented on a number of images acquired along the roads with different illumination situation in different situations such as single/double lane marks, supplementary road marks etc.

##### A. Detection of lane marks using Hough transform:

The results show the performance of lane detection algorithm to detect and localize the lane marks in road image. Figure 2(a) shows the input image and Figure 2(b) shows the histogram of the input image. Figure 2(c) shows the segmented image and Figure 2(d) shows the lane colored image.

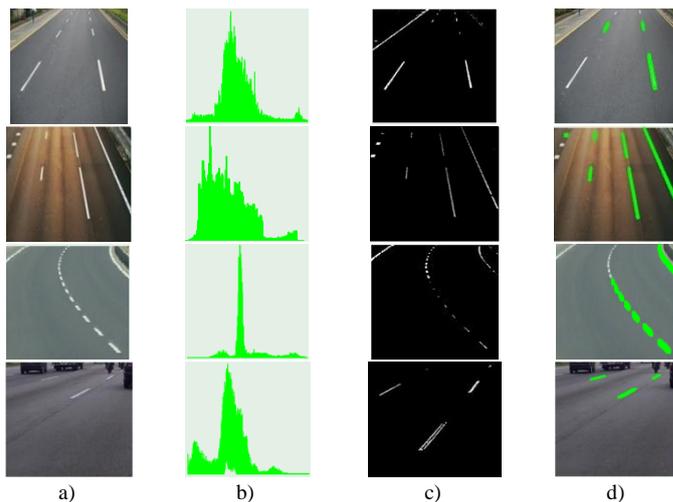
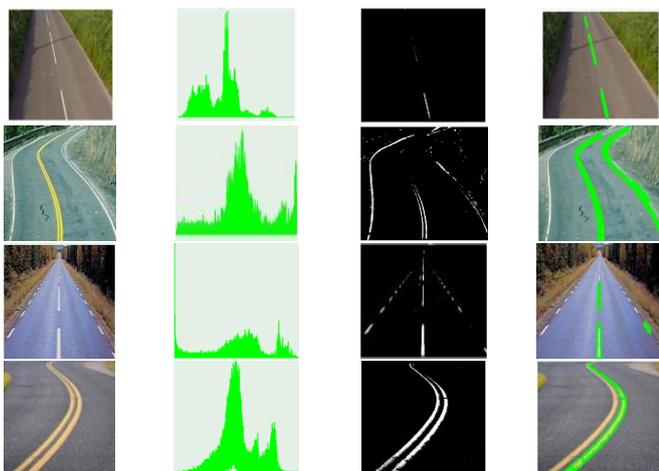


Fig.2 Results of proposed algorithm. a) Input Image b) Histogram Image c) Segmented Image d) Lane colored image.

##### B. Performance Evaluation

This section provides the performance of the proposed algorithm by taking accuracy, error rate and sensitivity as a parameters.

##### a) Geometric Accuracy

Accuracy is the major requirement of the lane detection techniques. Geometric accuracy is the accuracy of a resulted image compared to the original image. The geometric accuracy of the algorithm is 82%. The error rate is 18%. Therefore the algorithm is quite accurate to detect lane marks in different road conditions.

Table 1. Accuracy analysis

IMAGES	ACCURACY RATE	ERROR RATE
ROAD1	0.5197	0.4803
ROAD2	0.6005	0.3995
ROAD3	0.7541	0.2459
ROAD4	0.8475	0.1525
ROAD5	0.9149	0.0851
ROAD6	0.9462	0.0538
ROAD7	0.9804	0.0196
ROAD8	0.9950	0.005

##### b) Sensitivity

Sensitivity analysis is a method to predict the end result of a choice if a scenario works out to a differ set alongside the key prediction (s). Sensitivity of this technique is 70% in most cases.

Table 2. Sensitivity analysis

IMAGES	SENSITIVITY
ROAD1	0.2404
ROAD2	0.3489
ROAD3	0.4571
ROAD4	0.7403
ROAD5	0.8715
ROAD6	0.9096
ROAD7	0.9740
ROAD8	0.9925

## V. CONCLUSION

The lane detection technique is an essence of Intelligent Transportation Systems. The technique based on ROI and Hough transform has been presented in this paper and has a significant accuracy of 80% with sensitivity 70%. We have seen that the technique does not show much effectiveness in case of curved road lanes. We can use Modified Hough Transform for the detection of curved lanes along with the various filters like bilateral, modified median and Wiener filter.

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# Image Noise Models and Filtering Techniques A Survey

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**Abstract**—Due to the growing demand of digital image processing services over communication networks, precise measurement of the quality of digital images at the end-user to offer the best quality of service have received increasing research attention in recent years. The major issue of quality degradation of the image is noise introduced during the capturing or transmission of the image. Therefore, developing accurate noise removal algorithms is a key requirement to improve its QoS in digital image processing applications. In this paper, we survey different noises introduced in digital images and noise removal techniques independently, and investigate relevant issues in developing quality metrics. Experiments have been conducted for subjective analysis of results and comparing the performance of the quality metrics.

**Keywords**— Salt & Pepper Noise, Gaussian Noise, Mean Filter, Median Filter, Wiener Filter, Order Filter

## I. INTRODUCTION

A grey scale image is represented in two dimensional array  $f(x,y)$ , where each element of the matrix is a pixel having 256 distinct grey levels, where each pixel is 8 bit weighted with gray level values varying from 0-255 [1]. During the transmission and compression of an image, some of the degradation occurs at the receiver end, where Image restoration algorithms are used to retrieve and estimate original image. Image restoration is often used in the meadow of image processing where an image was somehow degraded, but need to be improved before it can be implemented in a particular application [15]. Noise is the random variation of brightness or spectral information in digital image produced by the sensor and circuitry of a scanner, digital camera or originated in film fragment of image. Image noise is generally regarded as an undesirable by-product of image capture and can be categories in different classes based on their cause of occurrence. Mainly noise in Digital images is classified as Impulse noise, Gaussian noise, Shot noise, Quantization noise, Film grain, on-isotropic noise, Multiplicative noise (Speckle noise) and Periodic noise [16]. The prominence in this review paper is concentrated on the study and experimental evaluation of Salt-and-pepper Noise, Gaussian Noise, Quantization Noise, and Sparkle Noise in Image Processing as digital image are mostly affected with those noises and algorithms used to remove this noise are also observed with their performance comparison based on subjective observations. Mathematically, Noise is represented by the percentage of the degraded pixels from the original image [2] and expressed as:

$$M(i,j) = \begin{cases} N(i,j) & \text{with prob. } P \\ O(i,j) & \text{without prob. } 1 - P \end{cases} \dots \dots \dots (i)$$

In above Equation, digital image  $M(i,j)$  is represents a as a sum of  $N(i,j)$  &-  $O(i,j)$ , where  $N(i,j)$  represents the noisy pixel &  $O(i,j)$  represents the noise free pixel.[3]. Many active research projects concerned with Noise removal or reduction from digital image processing are going on in the field of Digital Image Processing. The focus in this review paper is concentrated on study, evaluation of different noise in digital image and removal of these noises using different noise removal algorithms based on subjective analysis. The rest of the paper is organized as fallow, Section 2 describes the different sources of noise in digital image processing and their techniques as well as different noise removal algorithms, and Section 3 describes brief literature survey on research done on different noise sources and their removal algorithms till date. In section 4 these noise are implemented on a digital image and Noise removal algorithms are applied on it and their subjective analysis is performed and Section 5 conclude the paper.

## II. NOISES IN IMAGE &- REMOVAL ALGORITHMS

An Image is corrupted by the noise during the transmission and the acquisition. Noise is any unwanted information that degrades the image due to miss-focus of lens, atmospheric turbulence, relative motion between camera and object which causes the motion blur. The goal of de-noising is the removal of the noise while retaining the important signal features of original image as much as possible. De-noising is done through the filtering method can be linear filtering or non linear filtering. The different kind of noises that appears in the image are discussed below.

### A. Gaussian Noise

Gaussian Noise has a probability density function of the normal distribution and Probability density function is given as:

$$P(z) = \left( \frac{1}{\sqrt{2\pi\sigma}} \right) e^{-\frac{(z - \mu)^2}{2\sigma^2}}$$

Where

$$\begin{cases} P = P_a \text{ for } z = a \\ P_b \text{ for } z = b \\ 0 \text{ otherwise} \end{cases} \dots \dots \dots (ii)$$

Where  $z$  represents grey level,  $\mu$  is average value of  $z$ ,  $\sigma$  is standard deviation,  $\sigma^2$  Is variance [5].

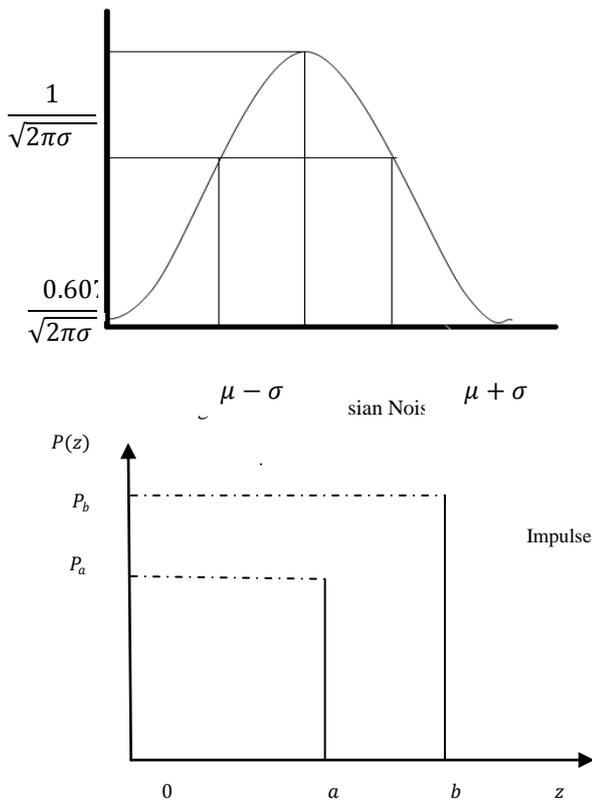


Fig 2: PDF of Salt and Pepper Noise

**B. Salt &- Pepper Noise**

Salt and Pepper Noise In the grey scale images salt & pepper noise is caused by memory fault locations or there can be timing errors in the process of digitization [8]. In this noise there are two assumptions of two saturation values such as a and band they are equal to the maximum and minimum values of the digitized image and the probability of each value is less then 0.2.If the value of each probability exceeds the noise will swamp out image [5].This noise is also called as impulse noise is given as

$$P(z) = \begin{cases} Pa & \text{for } z = a \\ Pb & \text{for } z = b \\ 0 & \text{otherwise} \end{cases} \dots \dots \dots (iii)$$

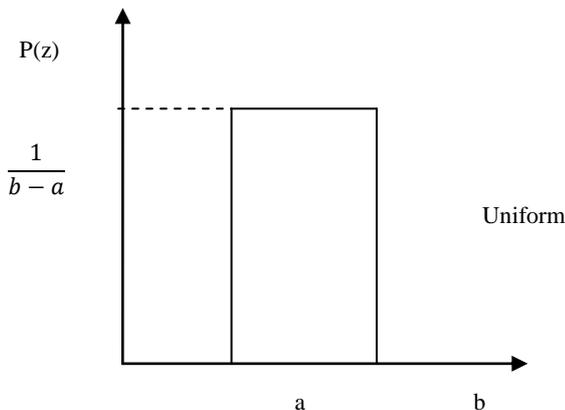


Fig 3: PDF of Quantization Noise

**C. Quantization Noise**

Quantization Noise is also called as uniform noise. This noise is caused by quantizing the pixel of image to a number of discrete levels because of uniform distribution [9].It is given by:

$$P(Z) = \begin{cases} \frac{1}{b-a} & \text{if } a \leq z \leq b \\ 0 & \text{otherwise} \end{cases} \dots \dots (iv)$$

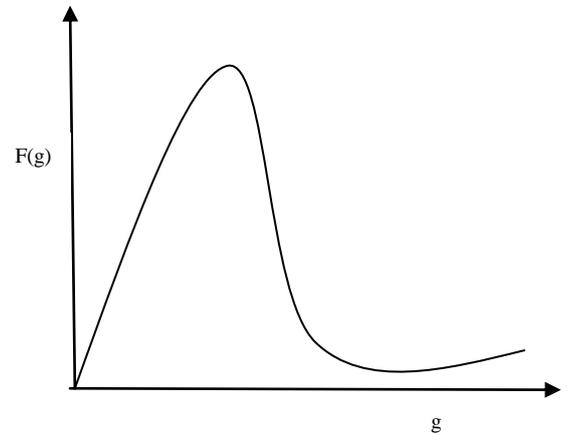


Fig 4: PDF of Speckle Noise

**D. Speckle Noise**

Speckle Noise is also called as granular noise [9] and multiplicative noise that mainly occurs in all coherent imaging system like a laser, acoustic, SAR (Synthetic Aperture Radar) imagery. This noise follows a gamma distribution and is given as

$$F(g) = (g^{\alpha-1} / (\alpha - 1)! a^\alpha) e^{-g/a}$$

where  $a^2\alpha = \text{variance}$  ,  $g = \text{grey level}$ [11]

**III. FILTERING TECHNIQUES**

There are various techniques that are used for the removal of noise. They are as:

**A. Mean Filter**

Mean Filter is a linear filter, where each pixel a mask is used in the signal. Every segment of pixel which comes under the mask are averaged together to form a single pixel [10].The average filter removes the Gaussian white noise but does not reduce the impulse noise which is its disadvantage [1].So that's why this filter (linear filter) is used in Gaussian white noise [1].Median filter is non linear which overcomes the disadvantage of mean filter [1]. These are used as smoothers for image processing as well as signal processing and time series processing. The main advantage of this filter is that it can remove the effect of input noise values with extremely high magnitudes. The output y of median filter at time t corresponding to its input values is calculated as:

$$Y(t) = \text{median}\left\{X\left(t - \frac{T}{2}\right), X(t - T, +1), \dots, X(t), \dots, X\left(t + \frac{T}{2}\right)\right\} \dots \dots \dots (v)$$

Where t= size of the window [10].

Various types of median filters are:

- 1) *Standard Median Filter*: It is based on order statistic. The disadvantage of this method is that it destroys the edges.
- 2) *Adaptive Median Filter*: It is another method to reduce the impulse noise. These methods have been improved, but image restoration quality is still not satisfactory [1].
- 3) *Weighted Median filter*: The center weight median filter, adaptive length median filter. These filters provide the good results at the small noises and provide difficulty at higher level noises.
- 4) *Boundary Discriminative Noise Detection Filter*: This technique can improve the image that is 90% corrupted by noise. This method is time consuming so it is not suitable for real applications [1].

### B. Wiener Filter

Wiener filter is based on the statistical approach that is used to filter out the noise. The main purpose for the use of this filter is the reduction of the mean square error as much as possible. It filtered out the image from different view. In this, technique used is linear time invariant filtering, which gives the much similar output as the original signal.

- 1) *Assumption*: The signal and the noise added in the signal are stationary linear random processes having known spectral characteristics.
- 2) *Requirement*: It must be realizable and can be causal.
- 3) *Performance Criteria*: Mean Square Error is minimum [5].

### C. Order Filter

Order Filter is the statistic non linear filter whose output response is depend upon the ranking of the pixels in the area of the image and then the value of the center pixel is replaced by the ranking result value that has to be determined. The order filter is categorized as Min Filter and Max Filter. When the filter selects the center value of the pixel to the smallest value that is 0<sup>th</sup> percentile then it is called as the min filter and when the filter selects the center value of the pixel to the largest value that is 100<sup>th</sup> percentile then it is called as the max filter. This is accomplished by a procedure in which the max. and min intensity values are find out within a windowed pixel region[12,13].

## IV. RESULTS &- DISCUSSION

In this paper, the two noises salt & pepper noise and Gaussian noise is added to the image. Then we have studied the different types of filtering techniques like average mean filter, Wiener filter, Median filter and order filter to filter out these noises. Here we studied that when the average mean filter is applied to the image to remove the salt and pepper noise then the image gets blurred. The Wiener filter removes the noise with a very small fraction. After the implementation of the order filter the impulse noise is

removed with a greater fraction than that of the Wiener filter. But it does not fully remove this noise, whereas with the use of Median filter, the impulse noise is completely vanished from the image.

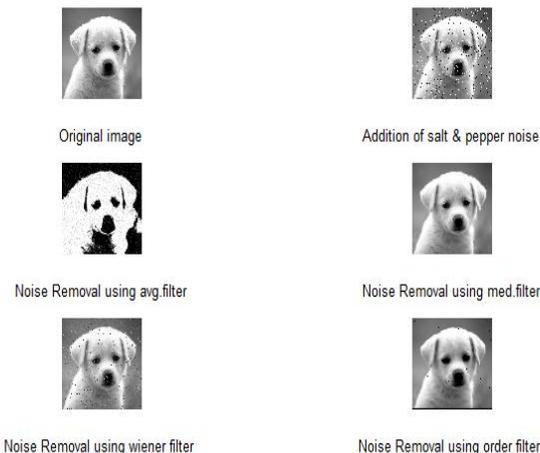


Fig 5: Various Filters Implementation on Salt & Pepper Noise

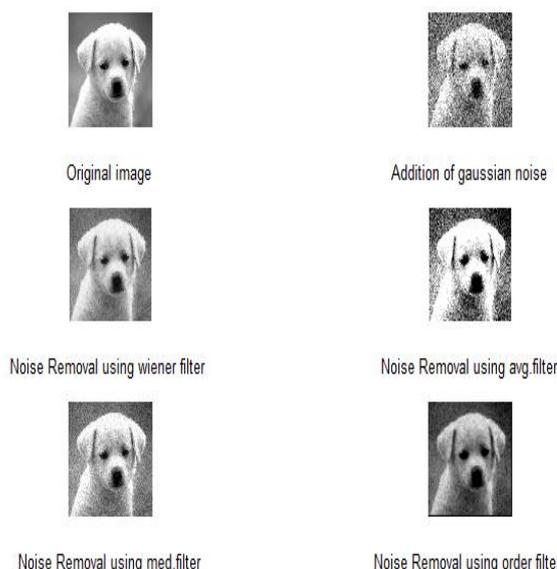


Fig 8: Various Filters Implementation on Gaussian Noise

For the Gaussian noise removal, when the average filter is applied to image then the output of the image get blurred. The median filter removes this noise with a fraction greater than the average filter. Whereas the order filter provides the good results than the average filter and the median filter but it also doesn't remove noise completely. The Wiener filter removes Gaussian noise fully from the image.

## V. CONCLUSION

In this paper, we have studied the different filtering methods for the removal of different noises such as salt and pepper noise and Gaussian noise. Here, we conclude that out of all the filters we have used the median filter works best to remove the salt and pepper noise but does not provide the good result for Gaussian noise where as the wiener filter is best for the removal of the Gaussian noise but does not good for the salt and pepper noise. The average filter does not provide the good results for the removal of both noises. The order filter reduces the effect of both the noises but does not completely remove these noises.

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# Contrast Enhancement Techniques Based on Histogram Equalization

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**Abstract-** In computer vision applications image enhancement plays an important role. Recently much work is performed in the field of images enhancement. Many techniques have already been proposed up to now for enhancing the digital images. In this paper number of techniques has been studied, the survey has shown that how different techniques of contrast enhancement correlate to each other and which technique is efficient to use for image enhancement. At the end of paper various gaps in the literature and its limitations have discussed.

**Keywords—**Enhancement, Histogram Equalization, Contrast Image

## I INTRODUCTION

Digital Image processing is a vast approach used to modify image quality and show a qualitative result in various fields like medical images, satellite images and also in industrial applications. The approach used to modify the images and to improve the quality of the image is called image enhancement. In order to improve the quality of the image we deal with brightness and contrast of the image so that information and feature should easily extracted from the image while performing the techniques like segmentation, recognition etc. Contrast enhancement tends to improve the clarity of the object in the image by adjusting the brightness between objects and their backgrounds. Here the process of contrast stretching is used that corresponds to provide tonal enhancement which improves and balance the brightness differences between dark ,grays and highlight edges of the image. Image enhancement removes the impulsive noise, enhance the edges and also smoothen the non- impulsive noise. For enhanced image it shows more appropriate results than input image and provides more useful graphic display. But enhancement dose not changes content of image it only enhances the active range of selected region so that features can be easily detected. To remove different noise different filter is used so initially while enhancing the image which filter is required to remove which type of noise is analyzed and also to analyze which region of the image needs to enhance in order to extract the required information. Image enhancement is performed by using two methods:

- Spatial Domain Methods
- Frequency Domain Methods

In spatial domain techniques, transformation operation is directly performed on the image pixels and the pixel values

are updated to enhance the image.

$$G(x, y) = T[f(x, y)]$$

Where  $f(x, y)$  is the input image,  $G(x, y)$  is the processed output image and  $T$  represents an operation on 'f' defined over some neighborhood of  $(x, y)$ . Where in Frequency domain firstly the image is transformed to its frequency representation by modifying the spectral transformation of an image. Secondly inverse transformation process to the spatial domain is carried out. It distributes frequency by it high and low range .The high frequencies correspond to pixel values that change rapidly across the image and strong low frequency components correspond to large scale features in the image. Various techniques of contrast enhancement have been discussed here.

### A. Histogram equalization :

Histogram equalization is a point processing enhancement method that optimizes the contrast of an image by destruction or by equalizing the histogram of the image at all points. It improves the local contrast in order to enhance the image. Number of times a value appears in the data set is maintained by histogram table. For an 8-bit image, there will be 256 promising samples in the image and histogram will count the number of times that each test value really occurs in the image. The basic shape of a histogram does not convey much valuable information. The shape and extension of the histogram directly corresponds to contrast of the image that is narrow histogram distributions are used to represent low contrast images; and wide histogram distributions are used to represent high contrast images as shown in fig 1.

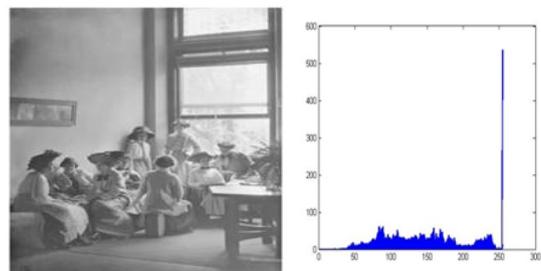


Fig 1a) Input image b) Histogram of input image

### B. Brightness Preserving Bi-Histogram Equalization (BBHE)

Bi-histogram equalization divides the histogram into two parts on the basis of their mean brightness value, represented by  $X_T$  it is the average intensity of all the pixels that construct the input image and is called as separation intensity. Here histogram that range 0 to L-1 is divided in two parts as, 0 to  $X_T$  and  $X_{T+1}$  to L-1.

#### C. *Dualistic Sub-image Histogram Equalization (DSIHE):*

According to this, a histogram is divided into sub-histograms, one which include high intensity pixels and other with low intensity pixels. The separation is done on the basis of their median values and each part equalized with HE technique. At the end final results are obtained, by composing processed sub-images into one image. Histogram equalization can affect the original brightness of image where BHE and DSIHE conserve the original brightness and overcome the artifacts generated by Histogram Equalization.

#### D. *Adaptive Histogram Equalization :*

Adaptive histogram equalization is contrast enhancement technique used in computer image processing. The idea behind the technique is that it only operates on small regions called as tiles of the image, rather than whole image. Every tile's contrast is enhanced, so that the histogram of the output region should match the histogram specified by the 'Distribution' parameter. Bilinear interpolation is applied in order to combine the Neighboring tiles which eliminate artificially limits specified above. In contrast, noise amplification problem with homogeneous images is not resolved.

#### E. *Recursive Mean Separate Histogram Equalization (RMSHE):*

RMSHE is used to provide scalable brightness to the image. Here input histogram is divided in two parts on the basis of their respective means. It is the more usual enhancement and improves the brightness conservation. The images that are failed to enhance by HE and BHE can be enhanced by RMHSE.

## II LITERATURE SURVEY

Tyan et al. for image enhancement Novel algorithms have been proposed using the fuzzy logic with filtering and edge detection. The fuzzy enhancement technique is based on IF ..., THEN... rules, which further modifies the contrast of the image and dynamic range of gray level. Fuzzy filtering technique uses Fuzzy membership functions in the frequency domain and provides better restoration results degraded from additive random noise. The fuzzy edge detection algorithm provides a variety of information as compared to other method [1]. Y.S. Choi have proposed a robust fuzzy logic approach based on the conflicting goals of image enhancement like removing impulse noise, smoothing out non-impulse noise, and enhancing (or preserving) edges and more. For each of the above conflicts three different types of filters has been driven with their selection methods based on local context, and predecessor clauses of the fuzzy rules is obtained. After combining the result of all the filters, the overall result of the fuzzy rule-based system is generalized [2]. F. Farbiz et al. Have proposed new fuzzy-logic-control based filter that not only removes impulsive noise, smoothen the Gaussian noise but

also preserve edges at the same time with one filter. The result of this approach has been shown that there is no need of floating point calculations, a very fast performance of the filter as compared to other filter till than qualitative result in edge preserving as well and provide optimize results for complex images [3]. C. Munteanu et al. have introduces an evolutionary optimization process based automatic image enhancement technique. Author describes a novel objective standard for enhancement, and with the respective standard best image get find but Due its complexity, an evolutionary algorithm (EA) as a global search strategy for best enhancement result is given and the algorithm shows superior result [4]. Y. Tokuda et al. In this study, the derivation of an image quality adjustment parameter, optimum gamma value is expressed as an optimization problem. Subjectivity, to analyzed interactive evolutionary computation an image quality enhancement support system is used. After comparing it with a manually derived gamma value, image quality, and derivation time, this technique has been verified [5]. Q. Yang represent some nonlinear transform functions author proposed a regularized incomplete beta function that are most commonly used in image contrast enhancement. But the problem of adaptively defining the coefficients of the beta function is still there. In image contrast enhancement differential evolution is applied so that the global quickly search ability of the differential evolution algorithm, adaptive mutation, the optimal  $\alpha$ ,  $\beta$  values of beta function can be utilized and an adaptive contrast enhanced image can be formed. To avoid local optimum trapping, a chaotic differential evolution algorithm is proposed [6]. P. Hoseini has proposed a various algorithm, for increasing the contrast a hybrid algorithm with the combination Genetic Algorithm (GA), Ant Colony Optimization (ACO), and Simulated Annealing (SA). Here in order to obtained contrast enhancement, the global transformation of the input intensities is used and to map the input intensities to the output intensities ACO algorithm is implemented. It generates local transformation functions SA which further modifies the transfer functions of ACO. GA describes the evolutionary process of ants' characteristics [7]. M.I. Quraishi analyze various Image Enhancement techniques with different soft computing techniques such as Bacterial Foraging Optimization, Differential Evolution, Harmony Search, and a hybrid Particle Swarm Adapted Bacterial and Foraging Optimization algorithm. A new algorithm Particle Swarm Adapted Bacterial Foraging (PS-BFO) gives better results in the application of proportional integral derivative controller tuning. Globally the performance of the PS-BFO is analyzed on 23 numerical benchmark functions. PS-BFO uses individual's best location and the global best location in order to search the directions of tumble behavior for each bacterium and results shows that in most cases PS-BFO performs much better than BFOA. Have done a comparison on three different edge detection approaches based on search, fuzzy logic and zero-crossing. Fuzzy technique is used by one of them for image enhancement and applied in the area of optical measurements [8]. P. P. Sarangi et al. Have discussed a Differential Evolution (DE) algorithm and defines its compatibility for searching optimal solutions which can enhance the contrast in gray scale images. Moreover the solution to solve optimization problems an

adaptive search process is given. Here contrast enhancement is performed by gray level modification using an objective parameterized intensity transformation function. Proposed algorithm converts the parameters of the transformation function by maximizing the objective fitness criterion. For better analyses, results of the algorithm has been compared with histogram equalization, contrast stretching and particle swarm optimization (PSO) based image enhancement techniques [9]. Senthilkumaran et al. In medical images Magnetic resonance imaging (MRI) technique plays a special role which provides rich information about the human soft tissue anatomy and also in the process of diagnosing various brain diseases including stroke, cancer, and epilepsy MRI provides knowledgeable information, the basic technique used for MRI in image enhancement is Histogram equalization. Here the author shows a brief analyses and comparison on different Techniques like Local histogram equalization (LHE), Global Histogram Equalization (GHE), Adaptive Histogram Equalization (AHE), Brightness preserving Dynamic Histogram equalization (BPDHE) with different objective and quality measure parameters for MRI brain image Enhancement [10]. Mohd. et al. have specified that in digital image processing the most simplest and effective technique is Histogram equalization (HE) but in order to preserve the brightness and actual look of the image the problem occurs as during the enhancement process the original look of image is affected. Author proposed several equalization methods such as Bi- and Multi-histogram equalization methods which can overcome the limitation and can preserve the original look of the image. Bi-HE method actually enhances the contrast and can preserve the brightness as well, but the natural look of the image gets destroyed. So to maintain the natural look of image, Multi-HE methods are proposed, in which the proposed method the histogram of an input image is decomposed into multiple segments and at each segment HE is applied independently [11]. Shamim et al. proposed an efficient color image enhancement method for endoscopic images. The enhancement process goes through two steps firstly with the help of FICE Fuji Intelligent Color Enhancement). RGB endoscopic images are converted into three 2-D spectral images and then image with the maximum entropy is selected as the base image .and in the next stage selected image is used for color reproduction. In color reproduction, the chrominance map of an input color image is added to the base image. This chrominance guide is found by coordinating luminance and composition data between these two pictures taking into account neighborhood measurement strategy. The separation between luminance segments of base dark picture and source shading pictures is computed utilizing 2-standard Euclidean separation. The proposed technique highlights a percentage of the tissue attributes in the base endoscopic picture which will empower better analysis. The execution of the plan is contrasted and other related calculations as far as reproduction rate, picture quality, proficiency of shading propagation and twisting [12]. Chang, Yung Tseng, et al. Shows as traditional histogram methods fails to acquire the balanced contrast which leads to preserve low brightness. Here author gives the mean-variance analysis method to partition the grey scale image into four sub images for individual image. This

technique is proposed to enhance the contrast of the palm bone X-ray radiographs. Result shows that proposed algorithm is better than the global histogram equalization (GHE) technique and brightness preserving bi-histogram equalization (BBHE) technique [13]. Zhigang et al. have proposed adaptive enhancement algorithm for low illumination color image that is for low contrast and brightness. The three step algorithm firstly performs the global brightness adaptive adjustments in which dynamic range of brightness of image get adaptively adjusted. In the next step locally adaptive contrast adaptive enhancement is performed by expanding difference between center pixel and neighborhood with brightness mean value and variance. And in the last step color restoration is done. Result has shown that dark region detail by this algorithm is more efficient and the output image is more colorful than other techniques [14]. Raju et al. have proposed a histogram and fuzzy logic based algorithm which can enhance the low contrast color images. In this RGB image is converted into HSV and under the control of two parameters M and K, V Component is stretched, where M is considered as average intensity and K is contrast intensification and 128 is taken as value of K [15].

### III GAPS IN EXISTING WORK

- The existing k factor has been taken statically i.e. 128 by most of researchers.
- Most of the methods depends upon certain predefined rules no concentrate on the objects or regions in the given image; so may imbalance the color of the output image.
- Edges plays significant role in vision processing but image enhancement technique can degrade the edges too.

### IV CONCLUSION AND FUTURE WORK:

Many techniques have already been proposed up to now for enhancing the digital images. To overcome the limitations of earlier techniques a new technique can be proposed which can evaluate k factor automatically using the ant colony optimization to find the best similarity value among the given set of values which represents the image in more efficient manner. The newest approach would have the ability to boost the contrast in digital images in efficient manner by utilizing the modified edge preserving smoothing hypothesis based adaptive k-fuzzy image enhancement algorithm. As edge preserving smoothing has ability to reduce the effectuation of noise and also it preserves the edges in efficient manner so provides better results.

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# Real-Time Adiabatic Approach to LSM Based Segmentation

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**Abstract**—Image Segmentation plays a vital role in image processing. From last few decades, many novel techniques have been developed and implemented successfully. Level set method is considered best active contour model for image segmentation. An improved level set method have been developed which focuses on the shape based images extraction. The method is applied on set of two images and very good segmentation results are obtained.

**Keywords**—LSM, Contour, Entropy, Histogram, Wavelets

## I. INTRODUCTION

Digital image processing is a technique of using computer algorithms to perform image processing on digital images. The application areas include Medical Diagnosis, Astronomical Image Evaluation, remote sensing, collecting data from ancient records etc. Image segmentation is a process of partitioning of the image into a set of regions and these set of regions are visually distinct and uniform with respect to some property, such as grey level, texture or color. This partitioning is domain independent [1]. It is to get more information in the region of interest in an image and clearly differentiate the object and the background in an image [2]. There are numerous techniques used for image segmentation but there is no single algorithm working with all types of images. The algorithm developed for a group of images may not always apply to another set of images [3]. But in past few years active contour models are performing very well in image segmentation. These models are used to describe the boundaries of shapes in an image and are called *Snakes* and Level set method.

## II. LEVEL SET METHOD (LSM)

The level set method was developed by Osher and Sethian [4]. Level set methods (LSM) are a conceptual framework used for numerical analysis of different surfaces and shapes. The numerical computations involving curves and surfaces can be performed on a fixed Cartesian grid without having to parameterize these objects [5]. This is a great tool for modeling time-varying objects [5]. The contours or surfaces are represented as the zero level set of a higher dimensional function, which is called a level set function. With this approach and representation, the problem can be easily formulated and solved using well-established mathematical theories like calculus of variations and partial differential equations (PDE) [6]. A Hybrid level set active contour incorporates both the edge and region information and use the advantages of both the edge based [7] and region-based

models [8]. The edge term, region term and other image properties are included to evolve the contour [9] and then finally integrated and formulated in zero of the level set function. This results in high accuracy of segmentation in noisy images. Moreover, the objects with smooth boundaries can easily be detected, which is not possible with edge based models because of boundary leakage [10].

Consider a curve shown in figure 1. It moves in normal direction with some speed function say  $F$  and  $F=F(L, G, I)$  where  $L$  = Local properties,  $G$  = Global properties of the fronts,  $I$  = Independent properties. To develop mathematical model, we need to parameterize the moving interface. A high dimensional function  $\phi$  is introduced in level set method to represent the interface implicitly i.e. we usually defines the interface as an iso-contour of some function [11].The segmentation boundary is defined as part of a surface where the contour level is 0, i.e., the zero level set [12].

Let  $\phi(x, t = 0)$  be defined as

$$\phi(x, t = 0) = \pm d \tag{1}$$

where  $x$  is a point in  $\mathbb{R}^N$  [13],  $t$  is time, and  $d$  is the distance between position  $x$  and the zero level set. The  $d$  is positive if  $x$  is outside zero level set, otherwise, the sign is negative [12]. For propagating surface to always match with the zero level set of the evolving function  $\phi$ , it must have

$$\phi(x(t), t) = 0 \tag{2}$$

according to chain rule [10],

$$\phi_t + \nabla \phi \cdot x'(t) = 0 \tag{3}$$

if speed function  $F$  is defined as the speed in the outward normal direction, then

$$x'(t) \cdot n = F \tag{4}$$

$$n = \nabla \phi / |\nabla \phi| \tag{5}$$

Therefore evolution equation [14] for  $\phi$  is,

$$\phi_t + F |\nabla \phi| = 0, \text{ given } \phi(x, t=0) \tag{6}$$

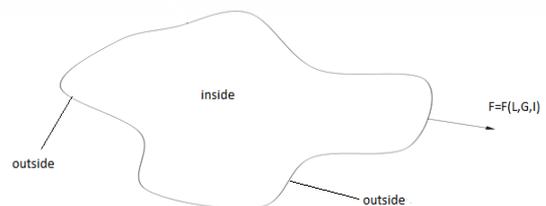


Fig 1. Curves moving with Speed F in Normal Direction [12].

### III. RESULTS AND DISCUSSION

The level set method has been implemented successfully and the contour is also extracted in real time domain with successful time. The improved level set method has various advancements over the traditional LSM. The entropy change is also calculated. The improved results of contour extracted are illustrated in table 1.



Fig.2. Test Image 1

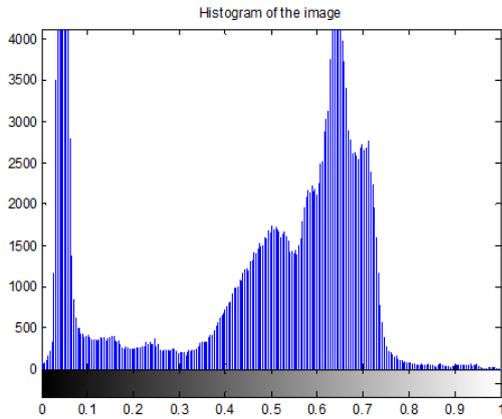


Fig.3. Histogram of the Test Image 1

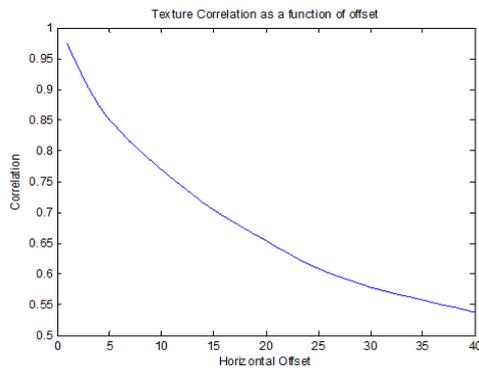


Fig.4. Entropy Graph of Test Image 1



Fig.5. Extracted Contour of Test Image 1



Fig.6. Test Image 2.

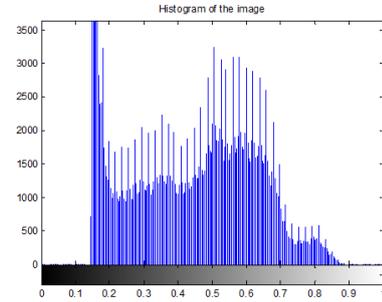


Fig.7. Histogram of the Test Image 2

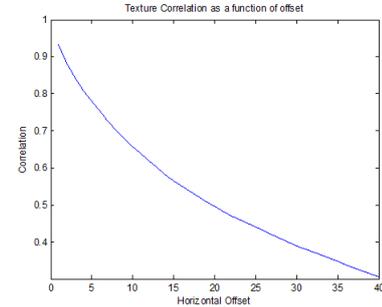


Fig.8. Entropy Graph of Test Image 2



Fig.9. Extracted Contour of Test Image 2

TABLE I  
Improved Parameters

Image Type	Entropy of the Image	Entropy Change	Real Processing Time (milliseconds)
Test Image 1	6.485	0.636	350
Test Image 2	7.85	0.50	750

### IV. CONCLUSION AND FUTURE SCOPE

The method is applied to different images and has produced very promising results. The performance is superior in terms of accuracy and efficiency. The entropy and processing time has been improved. The model can be applied to some other set of images with different parameters and wavelets to provide better results.

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# To Minimize the Error Rate in Face Recognition System using DWT and LDA

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**ABSTRACT**--- In the past decade, the minimization of error rate in face recognition system is a challenge. It is a challenging problem and widely studied in the different type of images. These problems come due to illumination and pose effect due to light. The optimization of human face recognition and detection is an important problem in the real life. Now-a-days, there several methods are proposed to recognition face in different problem. There occur many invariant changes in human faces due to the illumination and pose variations. In this paper we proposed a novel method in face recognition to minimize the error using discrete wavelet transform and LDA for optimize result. Discrete wavelet transform is used for quality feature extraction. In this paper, we use discrete wavelet transform for the feature selection and extraction from the live faces from our data-sets. The proposed method shows the better result as compare to the previous result because our method show the minimum error in live images of face.

**Keywords**- Image processing, Feature Extraction, Detection, Binarization, DWT

## I. INTRODUCTION AND RELATED WORK

Face recognition system is a part of biometrics. Face recognition system is mainly created for security purpose in real life. Humans are very good to check identity and verify to recognizing faces and complex patterns. Now-a-days, a number of applications are used by the army or police forces and civilians need to effective face recognition in different ways. The main significant purpose of face recognition system is to identification, verification and physical access control. When an access point gets an image of anyone's face and compares it with the pre-stored database of faces. If the image is matched, access is granted for further processing and result action is performed. The areas where red alert or have a high level security, there should be different and specials security checks such as face and checking cards etc. This kind of face recognition system works in sensitive areas like air ports for facilitation of staff and other people to pass through different security levels without showing their identification. Applications where face verification can be used efficiently including secure transactions in business field such as e-commerce, m-commerce and banking. Face recognition can also be used in government security issues helps to provide national ID cards, passports, license, UID Aadhar Card etc. It can be helpful and successful in the checking for criminal records, enhancement of security by using surveillance cameras in conjunction using face recognition system, finding lost children's by using the images received from

the cameras fitted at some public places, knowing in advance if some VIP is entering the hotel, Detection of a criminal at public place, it can be used in different areas of science and geographical area for comparing entity with a set of entities, etc.

Face recognition is used for both verification and identification in the real life. Detailed information of illumination and pose invariant face recognition techniques can found for feature extraction and feature selection for future work. Variations in face due to illuminating, pose and lighting conditions should not fetter its efficiency. Aneesh M U et al. proposed an algorithm for the application to select the feature subset from the database is commonly known as feature selection and PSO algorithm is used as bird flocking and fish-schooling, this algorithm is also known as on binary PSO [1]. Matthew A. Turk et al. identify an approach to the detection and identification of human faces which tracks human faces of the individuals to face recognition as 2D- recognition. The face images are projected on to the feature space (Eigen faces) images and find the variation among the images of face. The face space framework provides the ability to learn to recognize new faces as unsupervised manner to provide the solution of the problems through Eignfaces [2]. Priya Sisodia et al. worked the useful property of Gabor in the face datasets with robustness against slight object distortion, rotation and variation in illumination of due to light. In this paper they used a number of parameter use to represent Gabor feature and space complexity reduction with help of SVM classifier on facial data. Gabor filter removes variability that occurs due to changes in the lighting and noises [3]. Zhenhua Chai et al. gave a new method that allows for obtain more robust histograms of local patterns by using a more discriminative spatial division strategy is use the face measures. Spatial histograms are more suitable to obtain from regions clustered pixel relations by making better use of spatial information. PCA and whitening process are applied on the face image for the final vector dimension reduction to face recognition [4]. Jun Wang et al. is applied modifications of Hausdroff distance measurements by using k-nearest neighbors to obtain the average distance from each point in the model image with the test image KNNHD's various degree. The average of the distances to the k-nearest points is more suitable than the distance to one single point [5]. Chandrappa D N et al. are used techniques Gabor wavelets and morphological shared weighted neural network based automatic face recognition. These techniques used to

transform images as independent of gray-level shifts. Face detection is performed under the MSWNN that recognize all the human faces in different environments for multi-view recognition [6]. Muhammad Sharif et al. proposed an Elastic Bunch Graph Map (EBGM) algorithm to implement face recognition system using by Gabor filters and calculate maximum intensity points in each filter image at different angles and orientation [7]. Dong Hui et al. applied matching SURF algorithm to detect the points and match points through high time efficient KD-tree nearest neighbor searching methods and find the results better as compare to SIFT matching algorithm and used the Haar wavelet to measure the points. SURF algorithm is used as the image's scale rotation [8]. Shih-wei Lin et al. proposed on linear discriminant analysis as classification method. LDA shows high correlation between features and noise in the images of the face. The PSO provides the better solution using LDA to determine best feature subset. The PCA based feature reused to increase the accuracy of the system. Data without feature selection may be redundant or noisy which may degrade classification accuracy rate [9], [11]. David Barina presented the use of two-dimensional Gabor wavelets in image processing. The key idea of this work is to utilize a Gabor wavelet as a multi-scale partial differential operator of a given order. The best results are obtained with the derivative of the Gaussian function which is closely followed by the Gabor wavelet using the discontinuous Haar wavelet [10].

## II. CATEGORIES OF FACE RECOGNITION AND PROPOSED MODEL

Holistic methods are methods which identify a face using the whole face images as input and extract the overall features. Feature based are methods which are used the local facial features for recognition (like eyes, mouths, fiducial points etc.). Hybrid methods are methods which are used both feature based and holistic features to recognize a face. In the proposed work we have used hybrid method is used to improve the face quality and the error rate minimization according to need of the secure whole world.

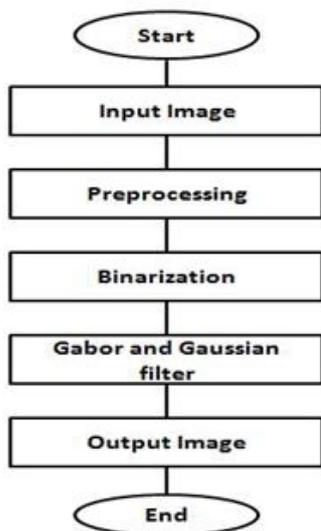


Fig.1. Steps of proposed model

The proposed system in figure 1, uses the own datasets for the live face images in the face recognition system. We have proposed discrete wavelet transform, Gabor filter and Gaussian filter. Discrete wavelet transform is used to feature detection and feature selection. It is apply by using two filter that is Gabor and Gaussian filter. If there is minimum distance between the face points then the system reduces the point distance. Gabor filter is used also for feature detection to provide the quality of face images. Gabor filter works on the different angle and rotation with orientation.

### A. Discrete Wavelet Transforms (DWT):

Wavelet transform has recently most popular for analysis, de-noising and compression of signals and images. Discrete wavelet transform (DWT) are applied to discrete data sets and produce discrete output, it is used to map data from the time domain to the wavelet domain. Wavelet domain defines the  $n \times n$  dimensions of the matrices to inputs of size  $n$ . Depending on the boundary conditions; such matrices can be orthogonal or closed to the orthogonal. When the matrix is orthogonal it denotes to the rotation in the wavelet domain. DWT are used in two levels that is single level and multilevel, we have used the multi-level wavelet in our model (cA, cD, cE, cH, cV) in which cA is used for approximation, cD for detail coefficients

Experiment Result:

Error rate:

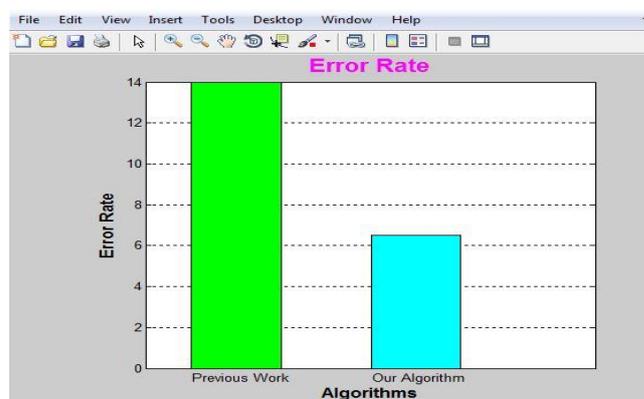


Fig2. Error Rate (%)

Table 1 Comparison table of error rate (%)

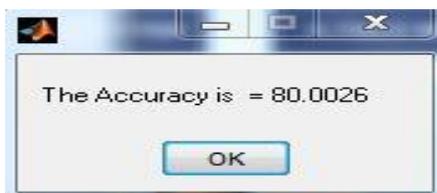
Methods	Error Rate (%)
Eigenfaces	25
Laplacianfaces	17
Fisherfaces	20
FDS	16
Schurfaces	14
Proposed Method	6.50

To find the result, we have calculated the results on the basis of parameter accuracy and error rate. In the figure 1, in our proposed method we have main focus on the error rate of the precious method. In previous work, five methods

were used name as Eigenfaces, Laplacianfaces, Fisherfaces, FDS and Schurfaces, these method were used for minimize the error rate. But in our methodology, we have used DWT and Linear Discriminant Analysis to find the results. By using LDA methodology, our results are better; we have compared the graph and map the values for the results in table, in the previous method the error rate was 14% for the faces but we have calculated minimum error rate is 6.5% for the live faces.

To minimize the error rate using proposed method face recognition algorithm the own database is used. For this, we take datasets of 40 face images and find the error which is very less as compare to the previous method.

Accuracy:



Accuracy is an important issue of the current time, if the faces are blur and noisy due to lightening and pose effects. Accuracy is calculated by the following formulas:

$$\text{accuracy} = 100 - \left( \frac{\text{Prediction difference}}{\text{Actual area}} \times 100 \right)$$

Accuracy is the nearness of a calculation to the true value. We have calculated the accuracy of the face recognition system. Accuracy is finding on the basis of area, dilation, efficiency and orientation of the face image. In this part we examine the limitations of the previous work and it has improved as future optimization in terms of accuracy.

### III. CONCLUSION AND FUTURE WORK

The face recognition system is used widely in verification and identification for the security. Various image processing technique and methods are used to improve the face data to identify. The digital image processing techniques is working currently in the research area to optimize the results, we have optimized the results. Our method shows better result as compare to the previous method. In the future work, the face recognition system will provide the quality of live faces. There are limited issues that have to need to improve of the recognized faces.

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# Comparative Analysis of Text Detection in Images

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**Abstract-** Detection of text regions in natural view is an essential part of computer vision. In this paper we have shown the comparison of different text detection techniques on the basis of text detection algorithms. Recognizing the text in real view images is becoming a wide and prominent research area, this is so because of the availability of imaging devices in low cost consumer products such as mobile phones.

**Keywords:** Edge Detection, OCR, DCT

## I. INTRODUCTION

Due to the increase in use of digital image capturing devices, such as digital cameras, mobile phones and PDAs, content-based image analysis techniques are becoming popular. It has various areas and among all the contents in images, text information has created great interests, because of its easy understanding at both sides human as well as computer, and it also finds wide applications like license plate reading, sign detection and translation, mobile text recognition, content-based web image search and many more other. Detecting text in natural view, such as sign boards on streets and buildings, advertisements, traffic signs, movie marques and so on, are a basic part of computer vision applications, including robotics. The text detection architecture is as follows:

- Text extraction-from the collection of images, extracting the relevant data from the images is basically concerned with text extraction. In field of document analysis text extraction have many applications such as detection of vehicle license plate, maps.
- Text detection-for auto indexing and information retrieval there are so many applications of text detection & recognition in general. There is more improved & advanced system's for area like license car plate recognition. for visually impaired person, vehicle license plate recognition system and text reading programs are available. Basically text detection consists of two steps. ect.

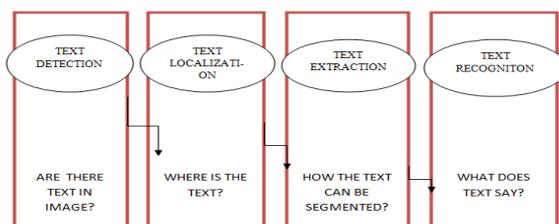


Fig-1 Texture based architecture

### A. Edge based detection method

Edge based methods are very efficient methods. This method is most reliable feature as compare to others .Very high contrast between the background and text is considered in

### B. Connected-Component Based Detection Method

Bottom up approach is used in the connected component based method and grouping of smaller components in larger components is done until all regions are identified in the image.

### C. Texture Based Method

Construction of gray level co-occurrence matrix is involved in texture based method which is a feature based algorithm. This matrix is used for the calculations of features like contrast, dissimilarity and is the results for feature extraction in texture based method.

### D. Region Based Text Extraction

Variance related to background and properties of text colour is considered in this region based method. The first step is to merge small regions successfully to make a large region is to retrieves text information from these regions using OCR or other technologies. Concentration here is on the first step of text region detection in natural view.

## II. APPROACH

### A. Edge Based Detection

Algorithm for edge based text region extraction -The basic steps of the edge-based text extraction algorithm are extracted discussed below

- Using Gaussian kernel create pyramid by successively filtering the input image.
- By half down sample the image in each direction.
- For edge detection convolve the resultant image with directional filter at different orientation kernels.
- Create a feature map associating a weight factor with each pixel to classify it as candidate or not for text region
- Eliminate non text regions for carrying out the dilation operation to enhance the text region.
- To eliminate noise blobs present in the image perform area based filtering.
- .With text in white pixel against a plain black background edge based techniques and also the edges of the text boundary that are identified and merged.

### 1) Algorithm by Xiaqing Liu et al.:

Xiaqing's method consists of three stages:

- Candidate text region detection: In this three main characteristics of edge are used which are strength, density, and orientation to generate a feature map. Pixel intensity gives possibility of text in a feature map, which is a binary image.
- Text region localization: Morphological dilation operation is used in this. To find non text regions two constraints utilised, first to find very small isolated blocks and second to filter out the block whose width is very small than that's corresponding height.
- Character extraction: Here already existing OCR engines were used for character extraction.

#### 2) *Algorithm by Xin Zhang et al.:*

Xin proposed this two phase method: Text background removal: For this first transition map model is utilized and second method edge based text detection is used to improve the accuracy of text extraction rate of first model. This method is called color-edge combined algorithm because this is composed of two methods. Text extraction: in this character extraction is done in OCR model, after the image is binarised.

#### B. *Connected Component Based Text Region Extraction*

Algorithm for Connected Component based text region extraction:

The basic steps of the connected-component text extraction algorithm are as follows: Use only luminance(Y) to convert the input image to YUV color space (luminance+chrominance) and channel for further processing. Using only Y channel to convert the image into gray scale. Compute. Using sharpen filter Sharpen the edge image by convolving it. Considering the sharpened edge image as the input intensity image compute horizontal and vertical projection files. Segment the candidate text regions based on adaptive threshold values calculated for vertical and horizontal projections. To eliminate possible non-text regions perform gap filling.

#### C. *Texture Based Text Region Extraction*

Algorithm for texture based text region extraction -The texture based procedure given in consists of five phases:

- a) Background suppression in DCT domain
- b) Text feature extraction
- c) Texture classification
- d) Merging
- e) Refinement.

The basic steps of the texture based text extraction algorithm are given below.

- Divide the input image into 8x8 blocks and apply DCT for each block.
- Suppress the background of image using high pass filter
- Perform inverse DCT on each block to obtain processed image

- Divide the processed image into 50X50 blocks
- Calculate the features homogeneity and contrast at 00, 450, 900, 1350 orientations for each block using gray-level co-occurrence matrix.
- Filter the non-text blocks using text features and discriminant functions.
- Merge the obtained text blocks into text regions
- Refine the size of the detected text regions to cover the missed text present in undetected blocks.

#### 1) *Algorithm by Chu duc et al.:*

For car license plate text detection proposed this architecture by Chu duc. Text descriptor is used which describes alignment, regularity, similarity and connectivity of segments by using the scale and rotation invariant. Method consists of following stages:

- Improved connective Hough Transform (ICHT): it records all possible line segments passing through each extracted edge point.
- Unconstrained Fast LP Detection: Reduce and sub-sample LS map for extracting dense region.
- ICHT Texture Descriptor for LP Verification: candidates are filtered using aspect ratio constraint which is in between 2 and 5. After this false candidates are eliminated. Then, before the normalization in size remaining candidates are expanded by ten percent in both width and height.

#### 2) *Algorithm by Kwang et al.:*

To detecting text from image for this he used support vector machine (SVM) to detect the texture properties by using Kwang implemented a texture based algorithm. The output of CAMSHIFT and SVMs gives robust and efficient text detection. For SVM we have to train it so that it produces good results. The accuracy of text extraction is depends on the training given to the SVM.

#### D. *Region Based Text Extraction:*

Algorithm by bunke and Kronenberg- Kronenberg and Bunke, proposed a algorithm for "Identification of Text on Colored Book and Journal Covers", in this they minimize color variations by applying clustering methods in pre-processing step. They proposed two methods:

- Top down analysis: in this phase the image is split in vertical and horizontal directions alternatively. The output is in rectangular shaped blocks and text containing at least two colors. Depending on this information we reject homogeneous regions means regions having no text.
- Bottom up analysis: it detects homogeneous regions using a region growing method. Beginning with a starting pixel, pixels are merged if they are from the identical cluster. We know that characters of printed text generally do not touch each other; several regions are detected for a text region. After this the outputs of two methods are combined to distinguish between text and non text regions. After this phase region is binarized using previously gathered information. And this is given as an input to OCR.

This method not only limited for book covers, we can use it for other types of images.

1) *Algorithm by Otsu:*

Otsu is one of the most important methods used for binarizing the image. In Otsu algorithm we consider two aspects first is text and another is background, and calculates threshold value in such way that it should minimize difference between the text and background. Although the method is promising, it still depends on global threshold, which is not a good measure for differentiating between text and non-text regions for document images with very variable text and background.

2) *Algorithm by Debapritam Sarkar and Raghunath:*

They implemented an algorithm to detect the hand written text and it is divided in six steps:

- a) **Graphical Smoothing:** In this they considered a square box of length  $n \times n$  pixels. First they checked whether 50% or more square box is filled with black pixels, if yes then they fill complete square with black pixels to achieve smoothing of the image.
- b) **Smoothing by Neighbouring Black Squares:** If 3 or more squares around a white square are black then the white block is also made black to have better smoothing.
- c) **Calculating the Height of the Component.**
- d) **Creation and Movement of Template:** A temporary block is created, and scanned for total no of black pixels in it. If this number is greater then the number of the previous position of the template, the previous information is discarded. Otherwise the previous position of the template is of current interest and the central line of the template in the horizontal direction is drawn and is called midline. This process continues till scanning of image is not completed.
- e) **Joining of Midlines:** here we first calculate distance between two midlines and then joined. For joining two methods are implemented, in first they draw straight line between two midlines and in second method one midline extended to the other.
- f) **Extraction and Linking**

Table-1 Comparison of various image using text detection methods using one image

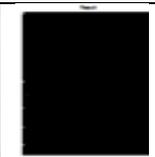
Original image	Edge based image	Connected component based image	Texture based image
			

Table-2 Comparison of various algorithms of text detection

Technique	Author	Benefits	Limitation
Edge based technique	Xiaoqing Liu	Localize and extract text from both indoor/outdoor scene images	It can only deal with printed characters against clean background
Edge based technique	Xin Zhang	Robust to the image with multilingual text	The accuracy of text extraction is totally depends on training given to the Support Vector Machine (SVM)
Texture based region	Kwang	Detecting the text from images used for SVM.	The accuracy of text extraction is totally depends on training given to the SVM.
Texture based region	Chu duc	Used for car license plate text detection	
Region Based text extraction	bunke and Kronenberg	This method not only limited for book covers, we can use it for other types of images	Depending on this information we reject homogeneous regions means regions having no text
Region Based text extraction	Otsu	used for binarizing the image	it still depends on global threshold, which is not a good measure for differentiating between text and non-text regions for document images with very variable text and background

III. CONCLUSION

In this paper we compare the different techniques of text detection in images. the comparison is based on the basis of techniques benefits and imitations.

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# Image Steganography Based on Chaotic Encryption

## *Art of Hiding Data*

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**Abstract--** Steganography is the science of hiding secret message in an appropriate digital multimedia in such a way that the existence of the embedded message should be invisible to anyone apart from the sender or the intended recipient. This paper presents an irreversible scheme for hiding a secret image in the cover image that is able to improve both the visual quality and the security of the stego-image while still providing a large embedding capacity. This is achieved by a hybrid steganography scheme incorporates an optimal chaotic based encryption scheme. Firstly encrypted image is cover in various cover images like baboon, house, man and Lena and the experimental result confirm that the cover image Lena is the best suitable one because it is not complex but embedding of message is better filled in complex image which is cover image baboon. So at last baboon in best suitable one to carry encrypted message over media.

**Keyword-** Image steganography, HVS, chaotic-based encryption Capacity

## I. INTRODUCTION

With the rapid growth of network and Internet communications, information security becomes an important topic in real-time data transmission. In order to increase security, it is necessary to develop solutions protecting data, especially secret data. Information hiding has emerged as an effective scheme which makes private communication secure. Steganography is a branch of information hiding carried out by embedding important data (e.g. text and image) in multimedia such as images, audios or videos. Since the digital images are the most widely used medium on the Internet and take advantage of human limited visual perception of colors and also provide a larger embedding capacity ratio, they are considered to be good carriers for steganography schemes. The image in which secret image will be inserted is called "coverimage". The image that carries secret image is called "stego-image". In order to enhance the security, many steganography schemes have been developed which encrypt the secret data by employing a data encryption scheme before hiding it. Data encryption is used to protect secret data against illicit access by transforming it into an unrecognizable form using a particular cipher algorithm along with a secret key to obtain the cipher data. In the decryption stage, only the user who has the key can retrieve the secret data from the cipher one. In general, the main purpose of a cryptography scheme is to make the secret data unreadable by a third party without hiding the existence of it. Steganography, in contrast, attempts to make data invisible to the unauthorized users. In this way, they are unable to notice the existence of the hidden data. Despite the differences among steganography and

cryptography, combining them seems to allow a better private communication. A steganography scheme is usually evaluated based on three parameters: embedding capacity (payload), visual quality, and security. The first parameter, pay-load, is determined by the amount of data concealed into a cover image. Higher payload allows inserting more data into the cover image. However, the embedding capacity can be increased in so far as the security of the secret data can still be ensured after embedding. The second parameter, visual quality, is considered to be good when the difference between the cover image and the stego-image can be perfectly imperceptible by Human Visual Sensitivity (HVS). Unfortunately, the fact is that there is an inverse relationship between the visual quality and the embedding capacity. This means that achieving just one requirement will totally sacrifice the other. The most straightforward solution to deal with this trade-off is to establish a balance between both of them. Finally, security preserves the secret data from being stolen by attackers. The major concern of this study focuses on increasing both the visual quality and the security of the stego-image while the capacity of the embedded secret image is kept at an acceptable level.

## II. EXPERIMENTAL REVIEW

The experiments are grouped into three categories. First, the stego-image quality and embedding capacity are investigated. Second, the suitable cover images for hiding the secret image in the proposed scheme are Embedding capacity estimation. At the beginning, to determine the type of each block in order to estimate the embedding capacity, a threshold, T, must be set to judge whether a block belongs to a complex area or a smooth area.

Block Type I: The block is located in a very complex area. In this case, each pixel of Block type I can hold at most 5 secret bits.

Block Type II: The block is located in nearly a complex area. The embedding capacity of Block type II is at most 3 bits for each pixel.

Block Type III: The Block type III is located in a smooth area and is vulnerable to noises produced by embedding secret bits. By this way, the payload of each pixel for a Blocktype III is considered to be at most 2 bits.

Block Type IV: The block belongs to type IV which is located in a rather smooth area. The block type IV has less tolerance to tolerance to changes and just 1 secret bit can be hidden in each pixel.

In the proposed scheme, each block needs to spend 2 identifier bits to determine the block type. For this purpose, we

use '00\_' to identify the Block type I and IV, '01\_' to identify the Block type II, and '10\_' to identify the Block type III due to the fact that boundaries of the Block types I and II, Block types II and III, and Block types III and IV may have overlap with each other and this is why the identifier bits should be used.

### III. EXPERIMENTAL RESULTS AND ANALYSIS

In this section, the experimental results are presented in order to evaluate the performance of the proposed scheme. For this purpose, after a brief explanation of the experimental setup, the experiments are grouped into three categories. First, the stego-image quality and embedding capacity are investigated. Second, the suitable cover images for hiding the secret image in the proposed scheme are studied. Finally, the security of the proposed scheme is evaluated against attacks.

#### A. Chaotic-Based Encryption Scheme

In steganography schemes without a secret key, if the existence of the secret image into the stego-image be detected by gabbers, the scheme will be failed. Generally, a solution deals with this problem is to encrypt the secret image before embedding into the cover image in order to increase the security. In this way, the secret image is protected by transforming into an unrecognizable form. [1] Chaotic systems have several significant features that are common with cryptography, such as sensitivity to initial conditions, random-like behavior and controlling parameters. These features are favorable to secure communications. The encryption strategy adopted for encrypting the secret image plays a vital role in the security of the entire proposed scheme. Suppose we need to send the image of girl but before using steganography technique directly we need to encrypt it like as shown and then it is decrypted by symmetric key at receiver end.

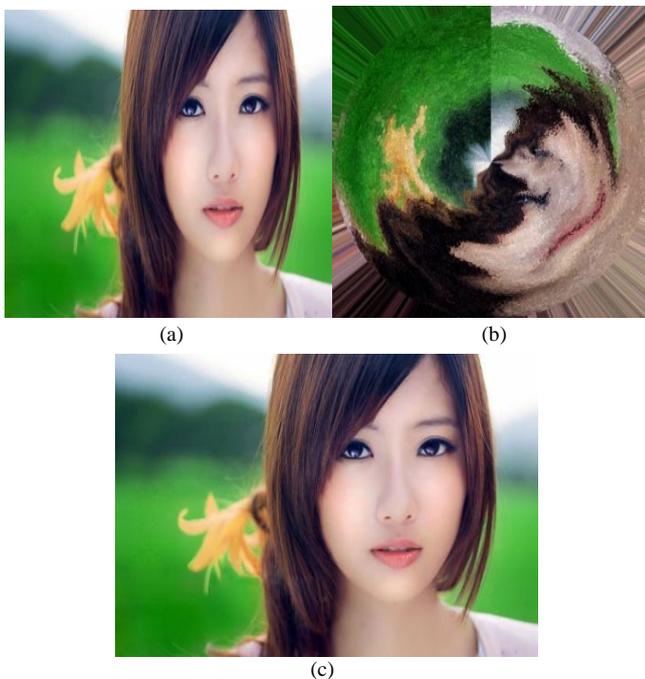


Fig 1:- (a) The original secret image, (b) the cipher image, (c) the decrypted image.

#### B. Experimental Setup

To evaluate the proposed steganography scheme different experiments are done with platform on processor with 2.2 GHz and 3GB RAM. To conduct our experiments, four well-known images of “Baboon”, “Houses”, “Man” and “Lena” as 8-bit grayscale of size  $512 \times 512$  are used as the cover images. These cover images are shown as:-

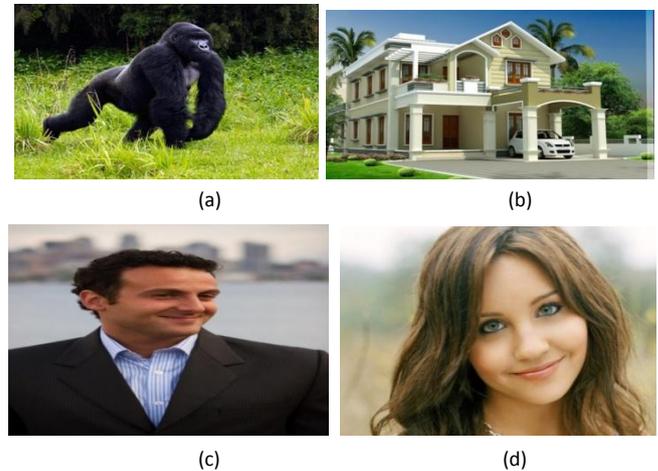


Fig 2:-Cover images (a)Baboon (b)House (c)Man (d)Lena

We also use a secret image, “Girl”, as shown in Fig. 1(b), with different sizes:  $128 \times 128$ ,  $256 \times 128$ ,  $256 \times 256$ , and  $320 \times 256$ . Moreover, for some experiments the secret images of sizes  $384 \times 256$  and  $256 \times 512$  are used. As mentioned before embedding into the cover image, the secret image should be encrypted by a chaotic-based encryption scheme.

#### C. Investigation of Stego-Image Quality & Embedding Capacity

In this section, we evaluate the performance of the proposed scheme by two most important criteria as most steganography schemes used, the stego-image quality and the embedding capacity. The embedding capacity is calculated by the number of secret bits concealed in each cover image. The stego-image quality is evaluated from two viewpoints: subjective measurement (HVS) and objective measurement (PSNR). Moreover, to know how competitive the proposed scheme is, we compare it with three related schemes:-

#### D. Objective Measurement

PSNR is an objective measurement .The higher the PSNR value, the smaller the difference between the cover image pixels and the stego-image pixels. The difference between the cover image and the stego-image will be imperceptible for human eyes if the PSNR be larger than 32 dB. Figs. 3–6 exhibit the results of the embedding capacity and the PSNR value when embedding different sizes of Girl as secret image in four cover images: Lena, Baboon, Houses and Man. The simulations compare the results before optimizing the secret key(non-optimal proposed scheme) and after optimizing the secret key(optimal proposed scheme). The overall PSNR value of each image is different according to the complexity of the cover image. Indeed , the higher complexity of the cover image results in higher PSNR value, especially in higher payloads. “Baboon”, for example, is an image whose complexity is high.

The rich edge areas in “Baboon” lead to a relatively large number of Block type I where at most 5 bits of the secret image can be embedded into each pixel. Since more blocks in Baboon are identified as Block type I, for example for secret image of size  $320 \times 256$ , by replacing just 3 LSBs in each pixel of Block type I, the whole secret image can be embedded. Therefore, the quality will be improved. In contrast to high complexity images, smoother images like “Lena” tend to have more number of Blocktype IV where at most 1 bit of the secret image can be embedded in to each pixel. Thus, for obtaining larger payloads we need to replace 5 LSBs of each pixel in Block type I which results in lower PSNR.

Secret image: “Girl”,  $128 \times 128$

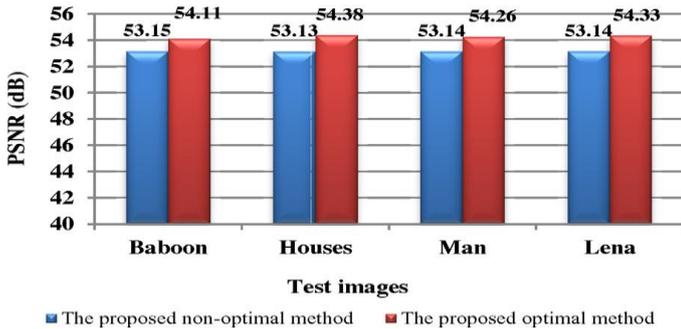


Fig:-3 The result of embedding “Girl” as secret image of size  $128 \times 128$  in four cover images

Secret image: “Girl”,  $256 \times 128$

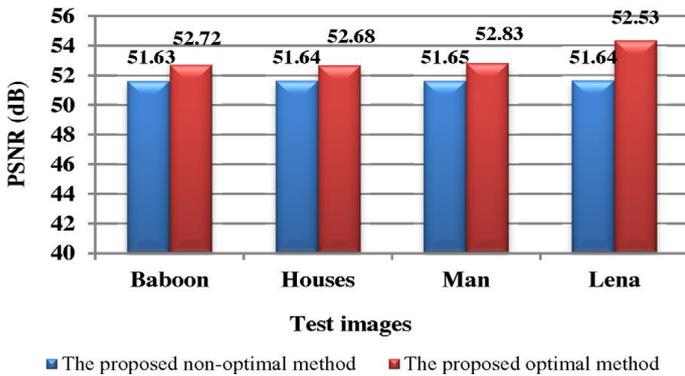


Fig:-4 The result of embedding “Girl” as secret image of size  $256 \times 128$  in four cover images.

Secret image: “Girl”,  $256 \times 256$

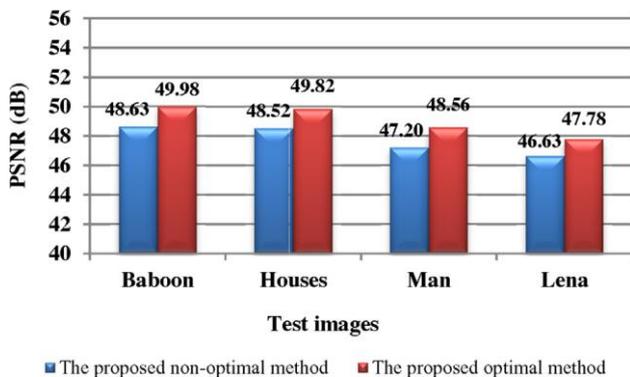


Fig5:- The result of embedding “Girl” as secret image of size  $256 \times 256$  in four cover images.

Secret image: “Girl”,  $320 \times 256$

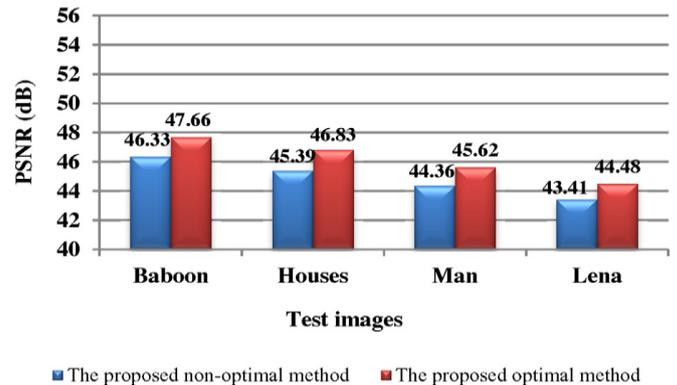


Fig6:- The result of embedding “Girl” as secret image of  $320 \times 256$  in four cover images.



(a) Secret Image  $128 \times 128$   
Payload Ratio 0.5bpp  
PSNR 54.33db

(b) Secret Image  $256 \times 128$   
Payload Ratio 1bpp  
PSNR 52.53db



(c) Secret Image  $256 \times 256$   
Payload Ratio 2bpp  
PSNR 47.78db

(d) Secret Image  $320 \times 256$   
Payload Ratio 2.5bpp  
PSNR 44.48db

Fig7:- Stego-images obtained by the proposed scheme.

### E. Subjective Measurement

HVS is a subjective measurement[2] which referred to examining the stego-image with naked eye to identify any obvious distortion. Thus, a good steganography scheme should be able to produce a stego-image which is indistinguishable from the cover image. Fig. 7 shows the quality of the stego-images generated by the proposed scheme for the test image Lena. From the HVS, it can be seen that stego-images are visually indistinguishable from the corresponding cover image even by increasing the size of the secret image. In other words, no perceptible artifacts are added to the stego-image even when 5 LSBs of each pixel in Block type I are replaced with secret image bits. It is due to the fact that the change in edge areas does not seriously affect the stego-image quality as seen by HVS. Also, besides the HVS, it is important to keep high the PSNR value. Within the same figure, we see that even for 2.5

bpp, the PSNR is still larger than 44 dB. It is obvious that such higher values of PSNR will certainly not create any significant distortion to impulse the attackers mind about estimating the secret image.

How-ever, if the cover image is rougher (e.g. Baboon), the quality of the proposed scheme is significantly increased with the same capacity. In fact, our proposed scheme can preserve more image details and avoid serious visual quality degradation.

#### IV. COVER IMAGE SELECTION BASED ON IMAGE COMPLEXITY

In this section, we investigate which cover images are more suitable for embedding the secret image [3] in the proposed scheme. The selection is based on the number of each type of block exists in each image. Block type I shows the complex areas of an image while Block type IV shows the smooth areas. As shown in Table 1, the cover image Baboon is more complex than the other cover images.

The number of block types for each cover image.

Number of blocks	Cover image			
	Lena	Baboon	Houses	Man
<i>Block type I</i>	12,988	37,975	29,932	21,987
<i>Block type II</i>	13,999	20,553	16,022	16,709
<i>Block type III</i>	18,546	5003	10,491	17,783
<i>Block type IV</i>	20,003	2005	9091	9057

The rich edge areas in Baboon lead to a relatively large number of Block type I (37,975). On the other hand, the cover image Lena is an example whose complexity is less than the others (it consists of 20,003 Block type IV). From Figs. 3–6, it is deducted that complex images are more suitable cover images in the proposed scheme, especially in larger payloads since they are able to provide both higher PSNR and higher embedding capacity than smoother images. It is due to the number of Block type I which is the most important factor effects on both visual quality and embedding capacity. This is because 5 bits of the secret image can be embedded into each pixel if the block belongs to Block type I while it is 3, 2, and 1 bit for Block types II, III, and IV, respectively.

#### V. CONCLUSION

Experimental results demonstrate that compared with other steganography schemes, the proposed scheme produces higher quality stego-images under the same embedding capacity. How-ever, the embedding capacity in the proposed scheme is variable for different type of images. The results verify that in our scheme complex images can provide both higher embedding capacity and higher visual quality than smoother images.

Even though our proposed scheme already delivers good results, further improvements to the presented scheme can be made if more features are extracted from neighboring pixels. This allows us to provide a stego-image with higher quality and higher embedding capacity.

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# In Degraded Color Edge Detection using HUE, PCA and Hybrid Canny

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**Abstract---** This paper has focused on detecting the edges for the Hue factor in Human visual system (HSV). Hue is usually represented by position significance, so the existing edge detection techniques have been incapable to correctly perceive edges of hue factor in HSV color plane. Therefore, in this research paper, a new color edge detection technique has been proposed. This technique has its basis on the mixture of hue factor and principal component analysis to resolve the problems with existing methods. The proposed algorithm has been designed and implemented in image processing toolbox of MATLAB. The significant improvement of the algorithm over the existing edge detectors has been proved with the help of various parameters.

**Keywords-** Edge Detection, Canny Edge Detector, PCA

## I. INTRODUCTION

An Edge is an area of significant change in the image intensity/contrast and edge Detection is locating areas with strong intensity contrasts. Edge recognition is the name for a set of mathematical methods which target at classifying points in a image at which the image intensity varies sharply or, has discontinuities. Moreover, edges are a important confined changes of intensity in a digital image. . Edge detection is very helpful in case of noise free images. But in case of noisy images it is a challenging task. Noisy images are corrupted images. Their parameters are difficult to analyze and detect[1]. Edge detection is a fundamental tool used in most image processing applications to obtain information from the frames as a precursor step to feature extraction and object segmentation. There is a set of curled line up segments identified as edges. It is used in picture segmentation, object detection, information hiding, image coding and so on. Thus apply an edge detection algorithm to an image may ease the total of data to be processed and may sort out information that possibly will be regard as less related while preserving the main structural properties of an digital image. If edge detection step be successful, the consequent task of interpreting the information contents in original image may be easy.

## II. LITERATURE SURVEY

Liu et al. (2006) [1] has proposed a new color edge detector based on vector differences. The basic technique gives as its output the maximum distance between the vectors within a mask. When applied to scalar-valued images, the method reduces to the classic morphological gradient. A quantitative evaluation using Pratt's figure of merit shows the new technique to outperform other recently

proposed color edge detectors. The method is equal to that of the classic morphological gradient when the operators are reduced to a single channel form. The CMG is sensitive to image noise and this problem is addressed by the development of the RCMG. Juneja and Sandhu (2009) [2] has presented the comparative analysis of various Image Edge Detection methods. The methods are applied to the whole image. No specific texture or shape is specified. The objective is to investigate the effect of the various methods applied in finding a representation for the image under study. A representation of the image can be obtained through the Canny and Laplacian of Gaussian methods. Among the various methods investigated, the Canny method is able to detect both strong and weak edges, and seems to be more suitable than the Laplacian of Gaussian. Gao and Zhau (2010) [3] has proposed a new mathematical methods QFD, and describe its geometric meaning and physical meaning and apply QFD to digital image processing. This method is appropriate for constructing a local boundary model. A new concept: quaternion fractional differential (QFD), and apply it to edge detection of color image. This method is called edge detection based on QFD. Dezert et al. (2011) [4] has presented an algorithm is based on the fusion of local edge detectors results expressed into basic belief assignments thanks to a flexible modeling, and the proportional conflict redistribution rule developed in DS<sub>m</sub>T framework. The purpose of DS<sub>m</sub>T is to overcome the limitations of DST mainly by proposing new underlying models for the frames of discernment in order to fit better with the nature of real problems, and proposing new efficient combination and conditioning rules. The basic belief assignment (bba) associated with the edge of a pixel in each channel of the image is defined according to its gradient magnitude, and one can easily model the uncertainty about our belief it belong or not to an edge. PCR5 and DS rules have been applied in this work to combine these bba's to get the global bba for final decision-making. Other rules of combination of bba's could also have been used instead but they are known to be less efficient than PCR5 or DS rules in high and low conflict cases respectively. Jordan et al. (2011) [5] has proposed edge detection in multispectral images based on the self-organizing map (SOM) concept. To generate a global ordering of spectral vectors. With a global ordering, a one-to-one correspondence between pixel values and scalars is guaranteed. The edge probability is only determined by the adjacent pixels. This method omits linearization and uses the SOM more efficiently for edge detection while also retaining

greater flexibility. Somasundaram et al. (2012) [6] has proposed a novel edge detection method based on 32 fuzzy rules. Edge detection is one of the pre-segmentation processes of MRI head scans. It detects edges in a better way than the traditional Canny edge detector and Sobel edge detection operator and thus takes less time for edge detections. It produces sharp and clear edges that can be used for segmenting brain portions in MRI of human head scans. Jie and Ning (2012) [7] has proposed an adaptive threshold edge detection which applies the bilateral filtering it uses OTSU, which is based on gradient magnitude to maximize the separability of the resultant classes, to determine the low and high thresholds of the canny operator. Finally, the edge detection and connection has performed. Firstly, this algorithm applies bilateral filtering to smooth the image, which not only has suppressed the noise of the image, but also has well preserved the edges. Secondly, OTSU is performed to adaptively determine the low and high thresholds. Ju et al. (2012) [8] has proposed a novel image segmentation algorithm based on the adaptive edge detection and an improved mean shift. According to the ostu method, an adaptive threshold algorithm has been applied to improve canny operator in edge detection. The edge detection method has better performance and strong adaptability. Then the resulting edge information is incorporated into the main two steps of image segmentation based on mean shift. Since the discontinuity and homogeneity information are combined flexibly, the proposed algorithm takes the best of local and global image information. Xu et al. (2012) [9] has proposed a novel approach of edge detection for color image in order to efficiently preserve edge in noise appearance. Firstly, multi-structure elements are designed in order to construct morphological gradient operators with performance of noise suppressing. Then, the color image is transformed from RGB to HSV color space due to the latter is consistent with human vision perception. Finally, morphological edge detection operators in HIS color space based on multi-structure elements has been presented.

Xin and Ki (2012) [10] has proposed an improved Canny algorithm to detect edges in color image. Algorithm is composed of the following steps: quaternion weighted average filter, vector Sobel gradient computation, non-maxima suppression based on interpolation, edge detection and connection. Algorithm is also applied to deal with color images of transmission line icing. Wang

et al. (2013) [11] has discussed the problems that the traditional edge detection algorithms are sensitive to noise and the environment of plate scene is complex, plate image is smoothed with Gaussian filter, and by comparison of edge images from non-subsampled contour let edge detection algorithm and multi-scale wavelet edge detection algorithm, a new algorithm, pulse coupled neural network edge detection algorithm based on multi-scale wavelet transform is proposed. Firstly, multi-scale wavelet is used to detect edge of smoothed plate image, and then pulse coupled neural network is employed to debar the fake edge, followed by binary calculation with K-means clustering algorithm.

Fu et al. (2013) [12] has compared the two improved methods, which are improved Sobel operator and improved wavelet transform using the multi-scale morphological filtering, subjective visual have achieved better results. However there are advantages and disadvantages in objective evaluations. So improvement is further done by using two improved methods with the wavelet transform fusion technology. The experimental results has shown that the fused image has increased significantly in information entropy and the average gradient compared to the improved Sobel operator, and it also has improved the peak signal to noise ratio and the distortion degree compared to the improved wavelet edge detection method. The fused image can concentrate the advantages of the two improved methods together and make complementary advantages. Eventually, the good de-noising effect and complete edge are achieved.

Franchini et al. (2013) [13] has proposed a hardware implementation of an edge detection method for color images that exploits the definition of geometric product of vectors given in the Clifford algebra framework to extend the convolution operator and the Fourier transform to vector fields. The proposed architecture has been prototyped on the Celoxica Field Programmable Gate Array (FPGA) board. The proposed hardware architecture allows for an average speedup ranging between 6x and 18x for different image sizes against the execution on a conventional general-purpose processor. Clifford algebra based edge detector can be exploited to process not only color images but also multispectral gray-scale images. Abid et al. (2013) [14] has proposed a new method for image edge detection based on multilayer perceptron (MLP). The method is based on updating a MLP to learn a set of contours drawn on a 3x3 grid and then take advantage of the network generalization capacity to detect different edge details even for very noisy images. The method is applied first to Gray scale images and can be easily extended to color ones. The method works well even for very low contrast images for which other edge operators fail. Lei and Fan (2014) [15] has proposed a novel color edge detection method based on the fusion of hue component and principal component analysis to solve the problems. First, a novel computational method of hue difference is defined, and then it is applied to classical gradient operators to obtain accurate edges for hue component. Moreover, complete object edges can be obtained by using the edge fusion of the first principal component and hue component of color image with low-computational complexity. The proposed gradient operators are found to be very effective to obtain better edge results for color images.

### III. PROPOSED METHODOLOGY

Figure 1 shows the proposed methodology:

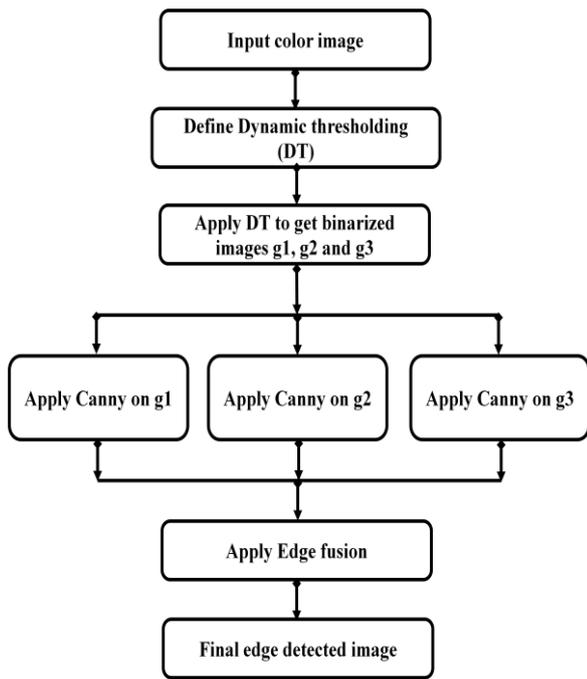


Fig 1: Flowchart of proposed algorithm

#### IV. RESULTS AND DISCUSSIONS

The proposed technology has been design and implemented in matlab using image processing tool box. Subsequent section contain experimental result and performance evaluation existence and proposed technique.

##### A. Experimental results

Here is some representation of proposed algorithm to detect edges in a color image. Firstly input image is shown below:-



Fig 2(a): shows the input image



Fig 2(b): Hue Image

Figure 2(b) shows the hue image of given input image, the hue image describes the true color of an image. From color image to grey-scale image, leads to the outcome that a few edges are missed. In addition, mainly of the missing edges consequence from hue changes. Also the pixel values are same in grey scale images. So to detect missed edges we apply hue analysis to color image.

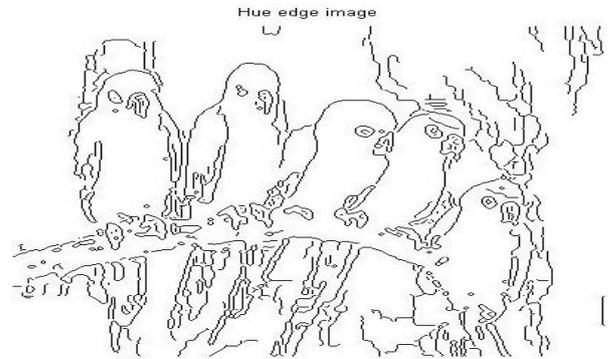


Fig: 2(c): Hue Detected Edge Image

Figure 2(c) shows the hue detected edge image, we can present a superior edge detection representation for color image once the problem of edge detection of hue component is solved.



Fig 2(d): PCA Image

Figure 2(d) shows the PCA image of the given input image, the PCA describes the major component information of a part in an image. The three color components are condensed into one containing a main component of information. So to detect missed edges we apply PCA analysis to color image.

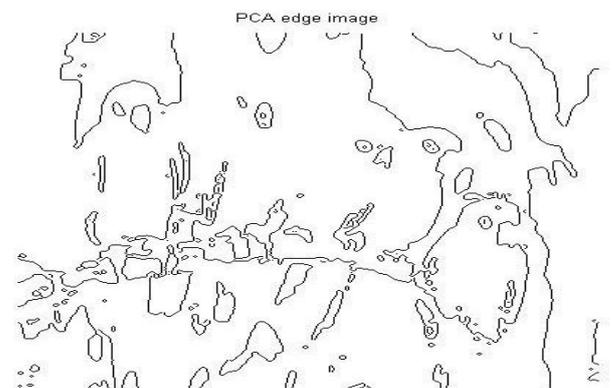


Fig 2(e): PCA Edge Detected Image

Figure 2(e) shows the PCA detected edge image, we can present a superior edge detection representation for color image once the problem of edge detection of PCA component is solved.

Figure 2(f) shows fusion of hue and PCA edge image combine significant information from two or more images into a particular image and gets clearer results to detect edges in color image.

Figure 2(g) shows improved canny based edge describes. The improved canny detection detects fine edges in an image. It preserves edges of an image even in low intensity images.

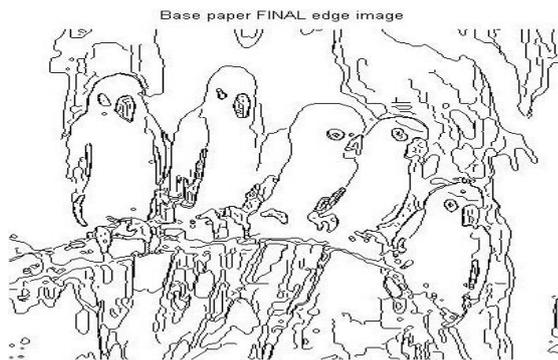


Fig 2(f): Fusion of Hue and PCA Edge Image

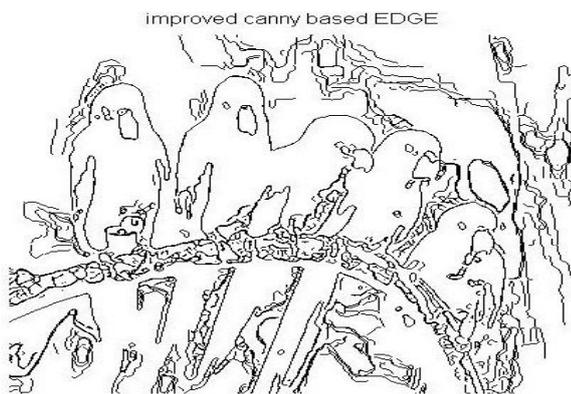


Fig 2(g): Improved Canny Based Edge Detection

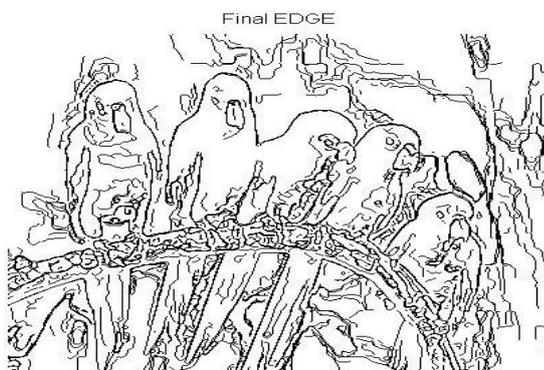


FiG 2(h): Final Edge Detected Image

Figure 2(h) gives the final result of edge detection in a color image by fusion of hue component, PCA and improved canny based edge detection.

### B. Performance Evaluation

This section contains the cross validation between existing and proposed techniques. Some well-known image performance parameters for digital images have been selected to prove that the performance of the proposed algorithm is quite better than the existing methods.

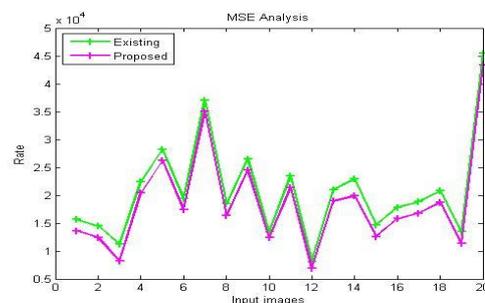
#### a) Mean Square Error

Table 1 is showing the quantized analysis of the mean square error. As mean square error need to be reduced therefore the proposed algorithm is showing the better results than the available methods as mean square error is less in every case.

Table 1 MSE values of many images for existing and proposed Edge

Images	Existing Edge Detection	Proposed Edge Detection
1. jpg	15677	13646
2. jpg	14518	12488
3. jpg	11313	8286
4. jpg	22449	20410
5. jpg	28265	26244
6. jpg	19440	17406
7. jpg	37081	35022
8. jpg	18461	16444
9. jpg	26558	24514
10. jpg	13483	12459
11. jpg	23474	21436
12. jpg	8153	6934
13. jpg	21023	18968
14. jpg	22921	19897
15. jpg	14649	12588
16. jpg	17852	15802
17. jpg	18858	16782
18. jpg	20799	18714
19. jpg	13480	11437
20. jpg	45434	43374

Table 1 shows the result of MSE for many images, the two corresponding values for each image shows the difference between the existing and proposed Edge Detection. Here in this the values are decreased for each image from existing to proposed Edge Detection.



Graph 1: MSE Evaluation

Graph 1 shows the various images on X-axis and rate on Y-axis, the two lines graph indicate the results according to the values of existing and proposed Edge Detection of

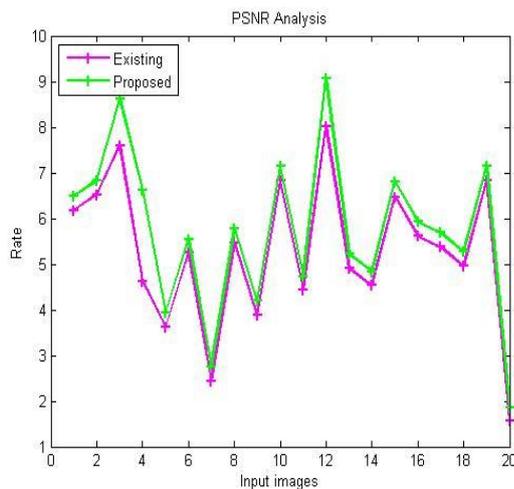
previous MSE table and results shows the Pratt figure of merit for MSE

b) Peak signal to noise ratio

Table 2: PSNR values of many images

Images	Existing Edge Detection	Proposed Edge Detection
1. jpg	6.1782	6.4868
2. jpg	6.5117	6.8207
3. jpg	7.5950	8.6254
4. jpg	4.6188	6.6264
5. jpg	3.6183	3.9215
6. jpg	5.2438	5.5514
7. jpg	2.4393	2.7462
8. jpg	5.4683	5.7723
9. jpg	3.8888	4.1961
10.jpg	6.8329	7.1407
11.jpg	4.4249	4.7320
12. jpg	8.0176	9.0728
13. jpg	4.9039	5.2152
14. jpg	4.5285	4.8330
15. jpg	6.4727	6.7908
16. jpg	5.6139	5.9261
17. jpg	5.3758	5.6934
18. jpg	4.9504	5.2682
19. jpg	6.8339	7.1478
20. jpg	1.5570	1.8627

Table 2 shows the result of PSNR for many images, the two corresponding values for each image shows the difference between the existing and proposed Edge Detection. Here in this the values are increased for each image from existing to proposed Edge Detection.



Graph 2: PSNR Evaluation

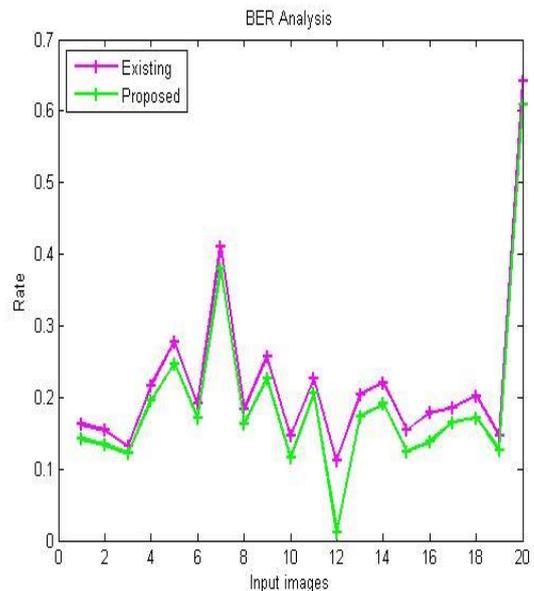
Graph 2 shows the various images on X-axis and rate on Y-axis, the two bar graph indicate the results according to the values of existing and proposed Edge Detection of previous PSNR table and results shows the Pratt figure of merit for PSNR.

c) Bit Error Rate:

Table 3: BER values of many images for existing and proposed Edge Detection

Images	Existing Edge Detection	Proposed Edge Detection
1. jpg	0.1619	0.1416
2. jpg	0.1536	0.1334
3. jpg	0.1317	0.1214
4. jpg	0.2165	0.1961
5. jpg	0.2764	0.2461
6. jpg	0.1907	0.1704
7. jpg	0.4100	0.3788
8. jpg	0.1829	0.1627
9. jpg	0.2571	0.2267
10.jpg	0.1463	0.1162
11.jpg	0.2260	0.2056
12.jpg	0.1109	0.0108
13.jpg	0.2039	0.1734
14.jpg	0.2208	0.1906
15.jpg	0.1545	0.1241
16.jpg	0.1781	0.1377
17.jpg	0.1860	0.1654
18.jpg	0.2020	0.1713
19.jpg	0.1463	0.1260
20.jpg	0.6423	0.6099

Table 3 shows the result of BER for many images, the two corresponding values for each image shows the difference between the existing and proposed Edge Detection. Here in this the values are decreased for each image from existing to proposed Edge Detection.



Graph 3: BER Evaluation

Graph 3 shows the various images on X-axis and rate on Y-axis, the two graph indicate the results according to the values of existing and proposed Edge Detection of previous BER table and results shows the Pratt figure of merit for BER.

## V. CONCLUSION AND FUTURE SCOPE

A new color edge detection technique based on the mixture of hue factor and principal component analysis to resolve the problems with existing methods has been proposed in this paper. The edges of the original image have been evaluated by using the hybrid canny based edge detector operator to trace the edges. The algorithm has been designed and implemented in MATLAB. The performance metrics has shown the efficiency of the proposed algorithm over the reported work.

This work has not considered any artificial intelligence based algorithm, so in near future, fuzzy logic, genetic algorithm and particle swarm optimization edge detection may be used to improve the more results.

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# A Review Paper on Steganographic Techniques

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**Abstract**---Today's data is transferred in public communication system is not secure because of interception by eavesdropper. Steganography, is a better technique for writing hidden messages in another file format like text, image, video etc. In this paper, we survey on some steganographic techniques and also on some papers that used steganographic method for data transform over the networks. Steganographic method is used based on the steganography techniques that are hiding secret data in a file. Performance was tested through the measures mean squared error(MSE) & peak signal to noise ratio(PSNR).

**Keywords**—Steganography, Steganographic Techniques, PSNR, MSE

## I. INTRODUCTION

Steganography is the art of concealing a file, image, or secret message within another message, image, or file [1]. The word steganographic combination of the Ancient Greek words steganos, meaning "covered, concealed", and graphein meaning "writing"[1]. For example, the hidden message may be in invisible ink between the visible lines of a private letter. Steganography technique is that which is basically used for information security. Steganography transmits data by actually hiding the existence of the message so that a viewer cannot detect the transmission of message and hence cannot try to decrypt it[1]. Steganography is not to alter the structure of the secret message, but hides it inside a cover object. After hiding process cover object & stego-object are similar. So, steganography (hiding information) and cryptography (protecting information) are totally different from one another. Detecting procedure of steganography known as Steganalysis[2].

## II. STEGANOGRAPHY TECHNIQUES

### A. Classification of Steganographic Categories

Steganography is basically classified into three categories:

- 1) Pure steganography: Pure steganography that where no stego key is used for secure communication [3]. It is based on assumption that there are no other party is aware for the communication [3].
- 2) Secret key steganography: Secret key steganography it where the stego key is exchanged before to communication is known as secret key steganography. This is most susceptible to interception [3].
- 3) Public key steganography: Public key steganography that where both public and private keys are used for secure communication over the network is known as public key steganography[3].

### B. Types of file format in Steganography

There are five types of file format in steganography that are mostly used. Mostly used format is used image and audio file format. Steganography is a method by which we transfer secret data into image or audio. Following five types of file formats used for steganography.

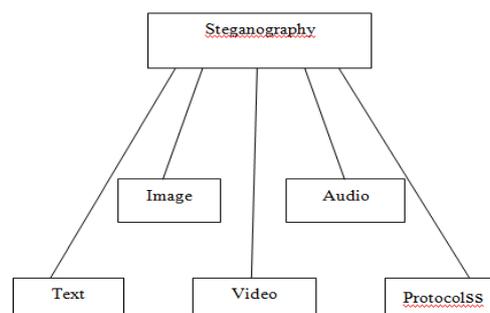


Fig 1. Categories of file formats used for steganography.

- 1) Text Steganography: General technique in text steganography, such as number of tabs, white spaces, capital letters, just like Morse code and etc is used to achieve information hiding [2].
- 2) Image Steganography: Taking the cover object as image in steganography is known as image steganography. Generally, in this technique pixel intensities are used to hide the information [2].
- 3) Video Steganography: Video Steganography is a technique that hides any kind of files or information into digital video format. Video is used as carrier for hidden information [2]. Generally discrete cosine transform alter values which is used to hide the information in each of the images in the video, which is not noticeable by the human eye [2].
- 4) Audio Steganography: When taking audio as a carrier for information hiding it is called audio steganography [2]. Audio steganography uses digital audio formats such as AVI MPEG etc for steganography.
- 5) Network Steganography: When taking cover object as network protocol, such as TCP, UDP, IP etc, where protocol is used as carrier, is known as network protocol steganography [2]. There exist covert channels in the OSI network layer model where steganography can be achieved in unused header bits of TCP/IP fields [2]. Pure steganography: Pure steganography that where no stego key is used for secure communication [3]. It is based on assumption that there are no other party is aware for the communication [3].

### C. Steganography Methods

Classification of steganographic methods are basically in six categories.

- 1) Substitution methods: Substitution methods are those which substitute redundant parts of a cover with a secret message [3]. Least significant bit (LSB) based steganography is the simplest techniques that hides a secret message in the LSBs of pixel values without introducing other distortions. The changes in the value of the LSB are imperceptible for human eyes. Spatial domain techniques are broadly classified into [2]:
  - *Least significant bit*
  - Pixel value differencing
  - Edges based data embedding method
  - Random pixel embedding method
  - Mapping pixel to hidden data method
  - Labeling or connectivity method
  - Pixel intensity based method
  - Texture based method
  - Histogram shifting methods
- 2) Transform domain techniques: Transform domain technique is a complex way of hiding information in an image. It embed secret information in a transform space of the signal.[3]. There are various algorithms & transformations are used in the image to hide information in it [2].
  - DFT (Discrete Fourier transformation technique) [2].
  - Lossless or reversible method[2].
  - DCT(Discrete cosine transformation technique ) [2].
  - DWT (Discrete Wavelet transformation technique) [2].
- 3) Spread spectrum techniques : Spread spectrum techniques those which adopt ideas from spread spectrum communications [3].
- 4) Statistical methods: Statistical methods are that which encode information by changing several statistical properties of a cover & use hypothesis testing in the extraction process [3].
- 5) Distortion techniques: Distortion techniques are those which store information by signal distortion & measure the deviation from the original cover image in the decoding process [3]. Distortion techniques need knowledge of the original cover image during the decoding process because the decoder functions to check for differences between the original image & the distorted cover image in way to restore the secret message. Encoder adds a sequence of changes to the cover image. Information is described as being stored by signal distortion [2].
- 6) Cover generation methods: Cover generation methods are those which encode information in the order a cover for secret communication is created [3]. Substitution methods: Substitution methods are those which

substitute redundant parts of a cover with a secret message [3].

### III. RELATED WORK

Jatinder Kaur, Ira Gabba [9] in 2013, in this paper Steganography using visual cryptography is proposed. The secret message is inserted into smaller matrix of size 8x8 and inserted into input image. In later work the technique can be verified for robustness. They used RSA algorithm process with it. Presently, this application supports hiding data in lossless jpg images. Future work on this application would be to support hiding data in video files or audio files. Juhi Saurabh1, Asha Ambhaikar [5] in 2012, In this paper, an intelligent algorithm is used to achieve higher capacity and robustness, the message bits are embedded into multiple, vague and deeper layers by using the proposed genetic algorithm. By using this method of data hiding the observer will not be able to suspect that the data is there at all. It is difficult for audio file. The key idea of the algorithm is random and higher LSB layer bit embedding keeping minimal embedding distortion of the host audio. Manpreet Kaur Er. Amandeep Kaur [7] in 2014, In the steganography, Hash-LSB method is an efficient steganographic method for embedding the secret message into the cover video. RSA algorithm is used for this work. A specific technique uses Hash function and RSA algorithm, is very usable to send data over any channel. This technique is also useful for audio. Anil Kumar, Rohini Sharma [6] in 2013, In this paper, a secured Hash based LSB technique for image steganography has been proposed. An efficient steganographic method for embedding secret messages into cover images without producing any major changes has been accomplished through the Hash-LSB method. In this paper, a new way of hiding information in an image with less variation in image bits have been developed, it makes their technique secure and more efficient. RSA algorithm to secure the secret message so that it is not easy to break the encryption without the key. The H-LSB technique have been applied to .tiff images. Analysis of the developed technique have been evaluated on the basis of performance by comparing it with simple LSB technique, which showed results a very good MSE and PSNR values for the stego images. Deepali [10] in 2012 they describe method of Steganography based on embedding encrypted message bits using RSA Algorithm in the 1st least significant and last 4 significant bits of the pixel of image. They have also used MD5 hash algorithm. The results shows that the PSNR is improved in the case of LSB techniques. hash algorithm provides data integrity.

Arfan Shaikh, Kirankumar Solanki, Vishal Utekar, Neeraj Vishwakarma [4] in 2014, In this paper, they propose two novel approaches of substitution technique of audio steganography that improves the capacity of cover audio for embedding data. Using these methods, message bits are embedded into multiple and variable LSB's. For more secure communication we are providing security by using the RSA algorithm which is based on cryptography. Third parties cannot percept the existence of message embedded in the audio file. The properties of the audio file remains the same after hiding the secret message. The target of this paper is to implement two techniques like Steganography and Cryptography for confidential communication between the

two entities. In our paper they are using multiple LSB algorithm which is much more secure than the standard LSB technique. In addition to it they are using RSA algorithm for extra security which is based on cryptography.

Praveen, Arun [8] in 2013, proposed a method which is based on audio-video crypto steganography. This is the combination of audio steganography and video steganography using advanced chaotic algorithm is used as the secure encryption method. Reversible data hiding methods used for video and audio. Satisfactory results are obtained in both audio and video steganography.

#### IV. CONCLUSION & FUTURE WORK

In this paper we survey some papers that are related to Steganography. Different papers show different problems and different solutions. So we found some future problems from these papers on which future work will be done. In future the technique can be verified for robustness. In future we can improve the MSE and PSNR and also improve the quality of the image after hiding the data in an image.

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# Performance Comparison of Various Edge Detection Techniques

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**Abstract**— Image interpretation is one of the main objectives in image processing, in which partition of the image into background and object is a severe step. For this, image segmentation needs to segment the object from the background appearance to read the image properly and identify the contents of the image. Edge Detection is a fundamental tool for image segmentation. In this paper, we studied various edge detection techniques and comparative analysis of these techniques is being carried out by intriguing parameter like edge threshold, orientation using the MATLAB. The subjective evaluation of the images showed that under the noisy conditions, Canny Edge Detection algorithm performs better than other techniques.

**Keywords**—Sobel, Prewitt, Roberts, LoG, Canny Technique

## I. INTRODUCTION

Edge detection is one of the most important techniques that have been commonly implemented in image processing. These are used in image segmentation, image registration and identification of image processing. The concept of the edge in an image is the most important feature of the image because the edge contains valuable information about the internal objects inside image. Hence, edge detection is one of the key research works in image processing. Edge detection of an image is a very important step for understanding image features. Therefore, other image processing applications such as segmentation, identification, and object recognition can take place whenever edges of an object are detected. Most image processing techniques involve treating the image as a two dimensional signal and applying standard signal processing techniques to it. Image processing usually refers to digital image processing, but optical and analog image processing also are possible. There are many ways to perform edge detection, the majority of techniques grouped as gradient method, which locates edges by looking for the maximum and minimum in the first derivative of the image, where Laplacian method finds for zero crossings in the second derivative to find edges of the image. An edge has the one-dimensional shape of a ramp and scheme the derivative of the image that can underscore their position. The process of partitioning a digital image into multiple regions or sets of pixels is known as image segmentation. In image partitions, there are different objects which have the same texture or color. These results are a set of regions that cover the entire image together and contours set extracted from the image. The various adjacent regions are completely different with respect to the same individuality.

The different approaches are by finding boundaries between regions in intensity levels based on discontinuities, thresholds based on the distribution of pixel properties, such as intensity values, or based on finding the regions directly [2]. Region based methods in image segmentation are based on continuity. These techniques divide the entire image into sub regions depending on some rules like all the pixels in one region must have the same gray level [3]. Edge detection is the problem of fundamental importance in image analysis. Edge detection techniques are generally used for finding discontinuities in gray level images. To detect consequential discontinuities in the gray level image is the important common approach in edge detection. Image segmentation methods for detecting discontinuities are boundary based methods. In this paper an attempt is made to review some of the most commonly used edge detection techniques for image Edge Detection and also subjective analysis of such techniques is carried out using MATLAB. Section 2 introduces the basic edge detection procedure, and section 3 covered literature survey on edge detection techniques and their performance analysis. Section 4 provides comprehensive theoretical explanation and mathematical background for edge detection. In Section 5 different edge detection techniques are implemented and their subjective performance analysis is performed and discussion based on this analysis is made.

## II. EDGE DETECTION PROCEDURE

### A. Filtering

The major classical edge detectors work fine with high quality images, but not good enough for noisy pictures because they cannot distinguish edges of various different significance. Noise is unpredictable contamination on the original image. There are various types of noise, but the most broadly studied two kinds of noises that are white noise and salt and pepper noise. During salt and pepper noise, pixels in the image are very different from their surrounding pixels in color or intensity; the defining characteristic is that the value of a noisy pixel bears no relation to the color of surrounding pixels. In general this type of noise will only affect a small number of image pixels [8].

### B. Enhancement

The quality of the digital image is enhanced with the concerning digital image enhancement techniques. The crucial objective of enhancement techniques is to produce an image which is better and more suitable than the

original image for a specific application. For these image improvement problems, linear filters have been used properly. Not all image sharpening problems can be solved satisfactory through the use of linear filters.

### C. Detection

There are many points in an image have a nonzero value for the gradient, and all of these points are not considered as edges for a particular application. Some methods should be used to determine which points are edge points or not [1].

## III. LITERATURE SURVEY

Othman Z. et al. discussed, that canny method can produce equally good edge with the smooth continuous pixels and thin edge. Sobel edge detection method cannot produce smooth and thin edge compared to canny method. But same like other method, Sobel and Canny methods also very sensitive to the noise pixels. Sometime all the noisy image cannot be filtered perfectly. it was shown that between Sobel and Canny edge detection algorithms, response given by Canny edge detection was better than result of Sobel detector used in these MRI images[10]. Maini R. et al. worked on the most commonly used edge detection techniques of Gradient-based and Laplacian based Edge Detection. Gradient-based algorithms such as the Prewitt filter have a major drawback of being very sensitive to noise. The size of the kernel filter and coefficients are fixed and cannot be adapted to a given image. An adaptive edge-detection algorithm is necessary to provide a robust solution that is adaptable to the varying noise levels of these images to help distinguish valid image contents from visual artifacts introduced by noise [11]. Shrivakshan G.T. et al. studied different edge detection Gradient-based & Laplacian based techniques. Edge Detection Techniques are compared with case study of identifying a shark fish type. Gradient-based algorithms have major drawbacks in sensitive to noise.

The dimension of the kernel filter and its coefficients are static and it cannot be adapted to a given image. A novel edge-detection algorithm is necessary to provide an errorless solution that is adaptable to the different noise levels of these images to help in identifying the valid image contents produced by noise [12]. Senthilkumaran N. et al. focused on the soft computing approach to edge detection for image segmentation. The soft computing approaches namely, fuzzy based approach, Genetic algorithm based approach and Neural network based approach is applied on a real life example image of nature scene and the results show the efficiency of image segmentation [13]. Sharifi M. et al. classified the most commonly used algorithms into five category, then seven algorithms have been applied to 30 images and lastly two sets were presented. Subjective evaluation of images showed that under noisy conditions ISEF, Canny, Marr-Hildreth, Kirsch, Sobel, Lapla2 and Lapla1 exhibit better performances, respectively [14].

## IV. EDGE DETECTION TECHNIQUES

There are various edge detection techniques in the literature for image segmentation. The most commonly used discontinuity based edge detection techniques are

reviewed in this section. These techniques are Roberts's edge detection, Sobel Edge Detection, Prewitt edge detection, LoG edge detection and Canny Edge Detection [15].

### A. Roberts Edge Detection

The Roberts edge detection is introduced by Lawrence Roberts (1965). It performs simple, quick to compute, 2-D spatial gradient measurement on an image. This method emphasizes regions of high spatial frequency which often correspond to edges. The input to the operator is a grayscale image the same as to the output is the most common usage for this technique. Pixel values in every point in the output represent the estimated complete magnitude of the spatial gradient of the input image at that point [17]. The angle of orientation of the edge giving rise to the spatial incline in relative to the pixel lattice orientation and given by:

$$\theta = \arctan(G_X + G_Y)^{-3\pi/4}$$

### B. Prewitt Edge Detection

To estimate the magnitude and orientation of an edge Prewitt is a correct way. Even there also different gradient edge detection wants a quite time consuming calculation to take estimation of the direction from the magnitudes in the x and y-directions, the compass edge detection obtains the direction directly from the kernel with the highest response. The Prewitt kernel is very much related to the Sobel and used for spotting both vertical and horizontal edges in images [18]. The Prewitt edge detector is an appropriate way to estimate the magnitude and orientation of an edge. The Prewitt operator is estimated in the 3x3 neighborhood for eight directions. The entire eight masks are calculated then the one with the largest module is selected. Prewitt operator is similar to the Sobel operator and is used for detecting vertical and horizontal edges in images [19,20].

### C. LoG Edge Detection

The Laplacian of Gaussian (LoG) was proposed by Marr (1982). It has two major effects, it smoothes the image and it computes the Laplacian, which yields a double edge image. Locating edges then consists of finding the zero crossings between the double edges. The Laplacian is generally used to find whether a pixel is on the dark or light side of an edge [15].

### D. Sobel Edge Detection:

The Sobel edge detector technique uses two masks with 3x3 sizes, one gradient approximation is in the x-direction and other approximation in the y-direction. The kernel slid over the image, which changes square of pixels at a time. This algorithm calculates the gradient of the image intensity at each point, and then provides the direction to increase the image intensity at each point from light to dark. Sobel algorithms working by using a mathematical procedure called convolution and commonly analyze second derivatives of the digital numbers over space. The Sobel convolution kernels are designed to give response to edges vertically and horizontally. These masks are convolved with the image. It calculates two gradients namely horizontal and vertical gradient (G<sub>x</sub> and G<sub>y</sub>), and

then combined together to calculate the absolute magnitude of the gradient at each point and the orientation of that particular gradient [14]. These numbers are used to compute the edge magnitude which given by:

$$|G| = \sqrt{[(G_X)^2 + (G_Y)^2]}$$

#### E. Canny Edge Detection:

The Canny edge detector is the standard edge detection method in the industry. Canny saw the edge detection problem as a signal processing optimization problem, so an objective function is produced to be optimized. The solution to this problem was a rather difficult exponential function, but Canny found various ways to approximate and optimize the edge-searching problem. The steps in the canny edge detection technique are as follows:

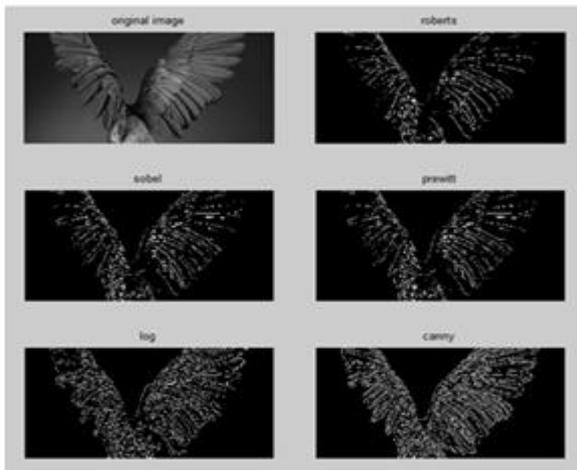


Fig 1: Edge Detection Techniques Analysis

Smoothing the image with a two dimensional Gaussian. In large amount of cases the computation is costly for two dimensional, so it is being estimated by two one dimensional Gaussians, each one in the x and y direction. Take the gradient of the image. This genuinely gives two consequences, the gradient in the x direction and y direction. To facilitate this, the magnitude and direction of the gradient is being computed at each pixel. After that for each pixel check if the magnitude of the gradient is greater at one pixel's away in either the positive or the negative direction perpendicular to the gradient. The Canny Edge Detector uses the method of the thresholding which is referred to as "hysteresis". If a pixel has a value above the low threshold and is the neighbour of an edge pixel, it is set as an edge pixel. So, if a pixel has a value above the low threshold but is not the neighbor of an edge pixel, it is not set as an edge pixel [16].

#### V. IMPLEMENTATIONS &- DISCUSSIONS

Initially, in this section we compare the relative performances of various edge detection techniques such as Roberts, Sobel, Prewitt, LoG and Canny Edge Detection. These edge detection techniques are implemented using MATLAB 7.4. The main objective is to produce a clean edge map by extracting the various edge features of the image. The original image and the image obtained by using different edge detection techniques are given in figure below:

Edge detection	ORIENTATION	
	Horizontal	Vertical
Roberts		
Sobel		
Prewitt		
LOG		
Canny		

Fig 2: Edge Detection Analysis based on orientation

After comparing the results with MATLAB automatic values, we moved deeper into the concept of determining the effects of the parameters such as orientation and Thresholding on the various edge detection techniques. In the following table, we can see that when there is effect of horizontal orientation, Prewitt edge detection technique provides us with better performance than the rest of the edge detection techniques. This is due to the less need of edge linking and therefore clearer edge maps for the input image. The same reasons can be seen behind the better performance of Roberts Edge detection Technique when we apply the vertical orientation effect. The Canny edge detection technique has more detection sensitivity that it also detects the noise elements as edges as shown in figure-1. So, it is not efficient when orientation parameter comes into effect. The other parameter which we dig deeper into is the threshold value for the image for edge detection. We checked the performance of the image with various threshold values for different edge detection techniques.

Edge detection	Threshold=0.009	Threshold=0.01	Threshold=0.05
Roberts			
Sobel			
Prewitt			
LoG			
Canny			

Fig 3: Edge Detection Analysis based on Threshold

In the following table, we determined the relative performance of the various edge detection techniques by giving the threshold parameter some values other than default. As we keep increasing the threshold value, the detection efficiency keeps decreasing for the Robert, Sobel, Prewitt, Log edge detection techniques whereas for the Canny edge detection technique the efficiency increases as the noise detection decreases with the increase in threshold value. In Log edge detection, we can see that the figure totally disappeared for the same threshold value for which canny is giving the best results. So, we observed that the Canny edge detection technique is more efficient than the rest of the techniques when threshold parameter comes into account.

## VI. CONCLUSION

From our experimental results we conclude that the Canny Edge detection technique is best in comparison to the other techniques on considering the default parameter values. The Orientation and Thresholding parameters have different effects on the various Edge detection techniques. On considering the Threshold parameter the Canny Edge detection technique outperforms the other edge detection techniques with the best results. For Orientation parameter, we found out that different orientation may lead to different efficiency for edge detection. The Prewitt edge detection techniques results best when horizontal orientation is applied whereas for Vertical orientation Roberts edge detection technique comes out as the best technique.

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# Locating the best Way of Face Recognition

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**Abstract**—The process of face recognition involves the examination of facial features in an image, recognizing those features and matching them to one of the many faces in the database. There are many algorithms capable of performing face recognition; such as: Principal Component Analysis, Discrete Cosine Transform, 3D recognition methods, Gabor Wavelets method etc. There were many issues to consider when choosing a face recognition method. The keys ones were: Accuracy, Time limitations, Process speed and Availability. With these in mind the PCA based method of face recognition has found to be better because: Simplest and easiest method to implement, Very fast computation time. PCA has the ability to recognizing a face with a different background is difficult. This overall objective of this paper is to find the suitable future directions to extend this work.

**Keywords:** - Face Recognition, PCA, SOM, MPCA.

## I. INTRODUCTION

Face detection is a computer technology that determines the locations and sizes of human faces in arbitrary (digital) images. It detects facial features and ignores other things, such as buildings, trees and bodies. Various government agencies are now actually more motivated to improve security data systems centered on body or behavioral characteristics, often called biometrics. The most frequent biometrics are fingerprints and iris, but many other human characteristics have already been studied in last year's such as finger/palm geometry, voice, signature, face. UID Authority of India (UIDAI) has been setup by the Govt. of India with a mandate to issue a distinctive identification number to every resident in the United States proposes to use biometrics for de-duplication and verification/authentication. Figure 1 is showing a family image where bounding boxes are showing face detected images.

The face area plays a significant role in carrying identity of persons. Humans have ability to acknowledge the faces. Humans can recognize 1000s of faces and identify familiar faces despite large changes in the visual stimulus as a result of viewing conditions, expression, aging, sex, and distractions such as glasses, or changes in hair. It is quite helpful for security purposes. Humans have the natural ability to acknowledge the face but developing a computer algorithm to do the same is difficult.

Face recognition is basically useful for two primary authenticity modes. Verification is generally described as one to 1 matching system because the machine tries to match the image presented the in-patient against a specific

image already on file. Identification checks the image presented against all others already in the database. Identification systems are referred to as a 1-to-n matching system, where n is the total amount of images in the database.



Fig 1: a) Database Approach b)Image Found

There are many application areas by which face recognition could be exploited for those two purposes. Security in access control to buildings, airports/seaports, ATM machines and border checkpoints, computer/ network security; email authentication on multimedia workstations. Other application is surveillance as a big amount of CCTVs could be monitored to look for known criminals, drug offenders, etc. and authorities could be notified when one is located. General identity verification in Electoral registration, banking, electronic commerce, identifying newborns, national IDs, passports, drivers licenses, employee IDs is application. Criminal justice systems mug-shot/booking systems, post-event analysis, forensics image database investigations in searching image databases of licensed drivers, benefit recipients, missing children, immigrants and police bookings. "Smart Card" applications In place of maintaining a database of facial images, the face-print could be stored in a good card, bar code or magnetic stripe, authentication of which is performed by matching the live image and the stored template. Multi-media environments with adaptive human computer interfaces and video indexing will also be the applications of the system.

## II. FACE RECOGNIZATION TECHNIQUES

Face recognition can be an evolving area, changing and improving constantly. This section gives the summary of various approaches and techniques along with their

advantages and disadvantages. Different approaches of face recognition could be categorized in three main groups such as for instance holistic approach, feature-based approach, and hybrid approach [2]. Some image processing techniques extract feature points such as for instance eyes, nose, and mouth and then used as input data toward the application. Various approaches have already been proposed to extract these facial points or features from the images. The essential approaches are as follows.

#### A. Geometry-based Technique

In this technique feature are extracted utilizing the size and the relative position of important aspects of images. In this technique under the first method firstly the direction and edges of important component is detected and then building feature vectors from these edges and direction. Canny filter and gradient analysis usually applied in this direction. Second, methods are based on the grayscales difference of unimportant components and important components, by utilizing feature blocks, set of Haar-like feature block in Adaboost method to alter the grayscales distribution into the feature. In LBP method, every face image divides into blocks and each block has its corresponding central pixel. Then this technique examine its neighbor pixels, based on the grayscales value of central pixel it changes neighbor to 0 or 1. After a histograms is build for each and every region and then these histograms are combined to a function vector for the face image.

#### B. Template Based Technique

This technique extracts facial feature using appropriate energy function. Methods have already been proposed by Yuille, detecting and describing features of faces using deformable templates. In deformable templates the feature of interest, an eye fixed for example, is described by way of a Parameterized template. These parameterized templates enable a priori knowledge about the expected shape of the features to guide the detection process. A power function is defined to links peaks, edges, and valleys in the image intensity with corresponding properties of the template. From then on the template matching is performed with the image, thereby deforming itself to find the best fit. For the descriptor purpose final parameter value is used. In the Template based first an eye fixed template is used to detect the eye from image. Then a correlation is found out between the eye templates with various overlapping parts of the facial skin image. Eye region have a maximum correlation with the template.

#### C. Appearance Based Approach

This process processes the image as two dimensional patterns. The concept of "feature" in this process is different from simple facial features such as for example eyes and mouth. Any extracted characteristic from the image is described a feature. This method group found best performer in facial feature extraction as it keep the information of image and reject the redundant information. Method such as for example principal component analysis (PCA) and independent component analysis are accustomed to extract the feature vector. The key intent behind PCA is to reduce the large dimensionality of observed variable to small intrinsic dimensionality of independent variable without

losing much information. It has been observed that many natural signals, including speech, natural images, are better called linear combinations of sources with super-Gaussian distributions. Because case, ICA method a lot better than PCA method because: ICA provides a much better probabilistic type of the data. It uniquely identifies the mixing matrix. It finds a needless orthogonal basic which might reconstruct the information a lot better than PCA in the current presence of noise such as for example variations lighting and expressions of face. It is sensitive to high order statistics in the information, not only the covariance matrix.

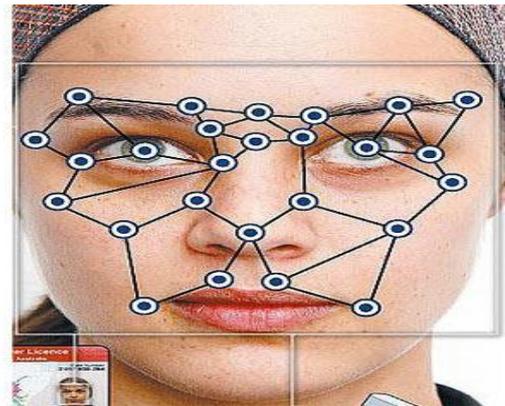


Fig 2: Geometry Based Approach

#### D. Color Based Method

With the help of different color models like RGB skin region is detected. The image obtained after applying skin tone statistics is afflicted by binarization. Firstly it's transformed to gray-scale image and then to a binary image through the use of suitable threshold. All of this is performed to eradicate the color and saturation values and consider only the luminance part. After this luminance part is transformed to binary image with some threshold as the features for face are darker than the background colors. After thresholding noise is removed through the use of some opening and closing operation. Then eyes, ears, nose facial features may be extracted from the binary image by thinking about the threshold for areas which are darker in the mouth when compared to a given threshold. After having the triangle, it is simple to have the coordinates of the four corner points that form the potential facial region.

### III. LITERATURE SURVEY

H. Josh et al. [1] observed that the human face is inherently symmetric and they wish to exploit this symmetry in face recognition. The average-half-face has been previously shown to accomplish just that for a set of 3D faces when utilizing eigenfaces for recognition. They build upon that work and present a contrast of the utilization of the average-half-face to the utilization of the initial full face with 6 different algorithms placed on two- and three-dimensional (2D and 3D) databases. The average-half-face is made of the full frontal face image in two steps; first the facial skin image is centered and divided in two and then the two halves are averaged together (reversing the columns of one of the halves). The resulting average-half-face is then

used as the input for face recognition algorithms. Previous work has shown that the accuracy of 3D face recognition using eigenface with the average-half-face is significantly a lot better than utilising the full face. They compared the outcomes utilizing the average-half-face and the full face using six face recognition methods; eigenfaces, multi-linear principal components analysis (MPCA), MPCA with linear discriminant analysis (MPCALDA), Fisherfaces (LDA), independent component analysis (ICA), and support vector machines (SVM). They utilized two well-known 2D face database in addition to a 3D face database for the comparison. Their results reveal that generally it's more advanced than employ the average-half-face for frontal face recognition. The effects with this discovery may end in substantial savings in storage and computation time. A.K.Jain et al. [2] discussed recent developments in automated face recognition that impact the forensic face recognition community. Improvements in forensic face recognition through research in facial aging, facial marks, forensic sketch recognition, face recognition in video, near-infrared face recognition, and utilization of soft biometrics is going to be discussed. Finally, current limitations and future research directions for face recognition in forensics are suggested. J. Shermina et al. [3] provided a research on an efficient illumination invariant face recognition system using Discrete Cosine Transform (DCT) and Principal Component Analysis

(PCA). For processing the illumination invariant image, low frequency components of DCT are used to normalize the illuminated image, odd and even components of DCT is useful for compensation in illumination variation and PCA is useful for recognition of face images. The existing approaches in illumination Invariant face recognition are comprehensively reviewed and discussed. The proposed approach is validated with Yale Face Database B. Experimental results demonstrate the potency of this approach in the performance of face recognition. L. Ahmad et al. [4] developed an experience recognition systems based on a single mixture of four individual techniques namely Principal Component Analysis (PCA), Discrete Cosine Transform(DCT), template Matching using Correlation (Corr) and Partitioned Iterative Function System (PIFS). They fused the scores of many of these four techniques within a face recognition system. They performed a comparative study of face recognition rate of this face recognition system at two precision levels namely at Top-5 and at Top-10 IDs. They experiment it with a regular ORL face database. Experimentally, they see that recognition

rate by PCA-DCT technique is preferable to by individual PCA and DCT techniques and recognition rate by PCA-DCT-Corr technique is better compared to PCA-DCT technique. Overall, they find the machine based on mixture of all the four individual techniques outperforms. A. Dian et al. [5] focused on developing an experience recognition system based on Principal Component Analysis (PCA) and Self-Organizing Maps (SOM) unsupervised learning algorithm. The preprocessing steps contain grey scaling, cropping and binarization. The selected dataset for his research is Essex database which are collect at University of Essex which include 7900 face images

obtained from 395 individuals (male and female). K.Brendan et al. [6] studied the influence of demo graphics on the performance of face recognition algorithms.

The recognition accuracies of six different face recognition are compute don large scale gallery that is partitioned so that all partition consists entirely of specific demographic cohorts. Eight total cohorts are isolated based on race/ethnicity, and age group. Experimental results demonstrate that both commercial and the non trainable algorithms consistently have lower matching accuracies on single cohorts than the remaining cohorts within their demographic. Additional experiments investigate the impact of the demographic distribution in working outset on the performance of a trainable face recognition algorithm. They indicated that the matching accuracy for race/ethnicity and age cohorts could be improved by training exclusively on that specific cohort. Operationally, this leads to a scenario, called dynamic face matcher selection, where multiple face recognition algorithms (each trained on different demographic cohorts) are available for a biometric system operator to choose based on the demographic information extracted from the probe image. This procedure should cause improved face recognition accuracy in many intelligence and police force face recognition scenarios. Finally, they show an alternative to dynamic face matcher selection is always to train face recognition algorithms on datasets which are evenly distributed across demographics, as

this approach offers consistently high accuracy across all cohorts. G.Teja et al. [7] gave a review of different face recognition techniques available as of today. The focus is on subspace techniques, investigating the utilization of image pre-processing applied as a preliminary step in order to reduce error rates. The Principle Component Analysis, Linear Discriminant Analysis and their modified ways of face recognition are implemented under subspace techniques, computing False Acceptance Rates (FAR)and False Rejection Rates (FRR) on a typical test group of images that pose typical difficulties for recognition. By making use of a selection of image processing techniques it is demonstrated that the performance is highly influenced by the sort of pre-processing steps used and that Equal Error Rates (EER) of the Eigenface and Fisherface methods can be reduced using the method proposed in this paper. H. Taketo et al. [8] mentioned that there is are markably huge improvement in the area of face recognition technology from the start of FERET program in 1993 around 2010. While MBE 2010 Still Face is regarded as being one of the best references in choosing appropriate face recognition algorithms from types of software programs on the planet, several points appear to be missing that have to be taken into consideration in the evaluation of recognition accuracy when face recognition technology is manufactured usage of in criminal investigations. They are the evaluation of the influence coming from longer lapse of time, shooting angles change of face expression and accessories. Since the images taken by CCTVs on streets aren't always ideal mug shots, these points will also be crucial in selecting the best face recognition algorithms as something to fight crimes. Police Info-Communications Research Center (PICRC) attempts to

gauge the accuracy of face recognition technology by choosing some of the representative face recognition algorithms mentioned in MBE 2010 Still Face. PICRC has certain image database that's to res two groups of full-faced photographs of people taken at intervals of 15 years. For example when it comes to evaluation of the idea after the representative face recognition algorithms compared the photographs of the folks with those of the former selves already stored in the database step by step, the amount of face recognition accuracy were verified. It's confirmed that the most recent face recognition algorithms are hardly influenced by the four points mentioned above. This result can conclude that the analyses produced in MBE 2010 Still Face ought to be reliable enough even for police organizations to select suitable face recognition algorithms for criminal investigations. N. Koichiro et al. [9] proposed a completely automatic method for multi view face recognition. They first build a 3D model from each frontal target face image, which can be used to generate synthetic target face images. The pose of a query face image is also estimated using a multi-view face detector so that the synthetic target face images can be generated to resemble the pose variation of a query face image. Procrustes analysis is then placed on align the synthetic target images and the query image, and block based MLBP features are extracted for face matching. Experimental results on two public-domain databases, and a Mobile face database collected using mobile phones reveal that the proposed approach outperforms two state-of-the-art face matchers in automatic multiview face recognition. The proposed approach can also be easily extended to leverage existing face recognition systems for automatic multi view face recognition. C. Bangyu et al. [10] introduced a BCI system employing a rapid serial visual presentation (RSVP) paradigm to evaluate the potency of face recognition with ERP components. They analyzed the ERP components elicited by face recognition and evaluate their contributions to the rapid face recognition using single-trial ERP. They discovered that amplitudes of N170 and VPP show no significant difference between the target face and non-target face. The amplitude of N2 and P3 show significant difference. The averaged areas under ROC curve (AUC) of single-trial ERP classification reach 0.851 on rapid face recognition task for 8 subjects, and the very best two reach 0.889 and 0.921. The results reveal that the averaged AUC using N170 and VPP is 0.548, which indicates N170 and VPP are mixed up in face recognition process. However, N2 and P3 contribute a great deal more to the accuracy of the face area recognition by single-trial ERP comparing to the trivial contributions of N170 and VPP. M. Gayathri et al. [11] introduced a novel face recognition problem domain: the medically altered face for gender transformation. A data group of >1.2 million face images was constructed from wild videos obtained from You Tube of 38 subjects undergoing hormone replacement therapy (HRT) for gender transformation over an amount of several months to three years. The HRT achieves gender transformation by severely altering the total amount of sex hormones, which in turn causes changes in the appearance of the face area and body. This paper explores that the impact of face changes as a result of

hormone manipulation and its ability to disguise the face area and hence, its power to effect match rates. Face disguise is achieved organically as hormone manipulation causes pathological changes to your body producing a modification of face appearance. This paper analyzes and evaluates face components versus full face algorithms in an endeavor to spot regions of the face area which are resilient to the HRT process. The experiments demonstrate that periocular face components using simple texture-based face matchers, local binary patterns, histogram of gradients, and patch-based local binary patterns out performs matching against the total face.

Furthermore, the experiments reveal that a fusion of the periocular using one of the straightforward texture-based approaches (patched-based local binary patterns) out performs two Commercial Off The Shelf Systems full face systems: Pitt Patt SDK and Cognetic Face VACs v8.5. The evaluated periocular-fused patch-based face matcher out performs. D. Anggraini et al. [12] focused on developing a face recognition system centered on Principal Component Analysis (PCA) and Self-Organizing Maps (SOM) unsupervised learning algorithm. The preprocessing steps contain grey scaling, cropping and binarization. The selected dataset with this research is Essex database which are collect at University of Essex which include 7900 face images taken from 395 individuals (male and female). Face recognition is a vital element of object recognition research that the scientific community shows an increasing attention in the past few decades. Since then, the rapid development of technology and the commercialization of technological achievements, face detection became more popular. One of many challenges in face recognition systems is to acknowledge faces around different poses and illuminations. The face area recognition phases include image preprocessing, feature extraction, and clustering. This research gives attention to developing a face recognition system centered on Principal Component Analysis (PCA) and Self-Organizing Maps (SOM) unsupervised learning algorithm. The preprocessing steps contain grey scaling, cropping and binarization. The selected dataset with this research is Essex database which are collect at University of Essex which include 7900 face images taken from 395 individuals (male and female). X. Yong et al. [13] attempted to improve the face area recognition accuracy by reducing the uncertainty. First, they reduced the uncertainty of the face area representation by synthesizing the virtual training samples. Then, they selected useful training samples which are similar to the test sample from the set of all of the original and synthesized virtual training samples. Moreover, they state a theorem that determines the top of bound of how many useful training samples. Finally, they devise a representation approach based on the selected useful training samples to do face recognition. Experimental results on five widely used face databases demonstrate that their proposed approach can not merely obtain a high face recognition accuracy, but additionally has a lower computational complexity than the other state-of-the-art approaches. M. L. Kafai et al. [14] recognized an unknown face having an external reference face graph (RFG). An RFG is generated

and recognition of confirmed face is achieved by comparing it to the faces in the constructed RFG. Centrality measures are utilized to spot distinctive faces in the reference face graph. The proposed RFG-based face recognition algorithm is robust to the changes in pose and it can also be alignment free. The RFG recognition is used in conjunction with DCT locality sensitive hashing for efficient retrieval to make sure scalability. Experiments are conducted on several publicly available databases and the outcome show that the proposed approach outperforms the state-of-the-art methods without the preprocessing necessities such as for example faces alignment. Due to the richness in the reference set construction, the proposed method also can handle illumination and expression variation. O. Milos et al. [15] presented relevant machine learning methods with main focus on neural networks. Some aspects of theory of neural networks are addressed such as for example visualization of processes in neural networks, internal representations of input data as a cause for new feature extraction methods and their applications to image compression and classification. Machine learning methods can be efficiently employed for feature extraction and classification and therefore are directly applicable to biometric systems. Biometrics relates to the recognition of men and women based on physiological and behavioral characteristics. Biometric recognition uses automated methods for recognition and this is why it's closely linked to machine learning. Face recognition is discussed in this presentation - it covers the aspects of face detection, detection of facial features, classification in face recognition systems, state-of-the-art in biometric face recognition, face recognition in controlled and uncontrolled conditions and single-sample problem in face recognition. Iris recognition is analyzed from the point of view of state-of-the-art in iris recognition, 2D Gabor wavelets, use of convolution kernels and possibilities for the look of new kernels. Software and hardware implementations of face and iris recognition systems are discussed and an implementation of a multimodal interface (face and iris section of a system) has been presented. Also a contribution of Machine Learning Group working at FEI SUT Bratislava to this research area is shown. B. Limin et al. [16] introduced the development process of face recognition and analyses representative algorithms for every period. Considering different races and variety of samples in database, and a wide selection of pose, shelter, illumination, and expressions, different algorithms are tested on the basis of the application requirement. It adopts CAS-PEAL-R1 face database, composed entirely by Asian faces, while the previous face recognition test are almost all based on Europe and America face database. The key work is to have two indices when applying different algorithms on R1 face database and then analysis the advantages in addition to disadvantages of every algorithm. Based on the comparison of the indices for every algorithm, it revealed that LBP algorithm achieves state-of-the-art performance in both recognition rate and time, therefore it meets certain requirements for real-time recognition. In addition, although the SFD obtained the highest recognition rate in the comparison, it doesn't satisfy certain requirements in real-time recognition system for its long recognition time. Contrast previous face recognition algorithms utilized on R1

face database, even more comprehensive algorithms are introduced and tested on R1 in this paper and it sure can provides more comprehensive reference for later researchers. S. Radhey et al. [17] presented an evaluation of the state-of-the-art face recognition using 2D, 3D and multimodal imagery methods. The twofold motivations are to offer the insight studies of automatic face recognition of 2D and 3D face imagery methods and to critically review the exiting 2D and 3D face recognition methods. Research trends up to now are summarized, and challenges confronting the development of more accurate face recognition systems are identified. These challenges include the face recognition under unconstrained environment, such as for example variation in illumination, pose, facial expression, occlusion, and time delay.

#### IV. CONCLUSION AND FUTURE SCOPE

Face detection is widely used in many applications. So, it is essential to discover a suitable method for face detection. The literature survey has shown the various face detection algorithms. It is available that there exists trade-off between accuracy versus computation time. The algorithms which provide accurate matching details are frustrating and also the fast algorithms aren't much accurate so in the foreseeable future new face detection will soon be proposed which could increase the accuracy of face detection in addition to which comes up with less computational complexity. This work has not considered any improvement in the PCA based face recognition by integrating it with certain filters, contrast enhancement techniques or neural based training etc. So in future we will integrate the proposed technique with some well known noise removal and image enhancement methods.

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# Overview of Various Transformation Functions For Medical Image Registration

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**Abstract**—Image registration seeks to compare and combine images acquired from multiple modalities, at different time or at different viewpoints by feature based approach or optimizing the similarity measure of two image sets. In the landmark based registration, the transformation function is required to spatially match the features. Landmark based registration is versatile in the sense that it can be applied to any image, no matter what the object or subject is. Image guidance systems designed for neurosurgery, hip surgery, and spine surgery often relies on feature based registration. Accuracy is important to these systems. Transformation functions play a major role in both linear and non-linear image registration. In this paper various transformation functions used in medical image registration are represented.

**Keywords**— Image Registration, Feature Detection, Feature Matching, Transformation Function, Resampling

## I. INTRODUCTION TO IMAGE REGISTRATION

Image registration is the ascertaining process of geometrically aligning two images taken at different times, orientation or sensors. . It geometrically aligns two images—source image and target image. The source image is the image that is kept unchanged and is used as the reference. The target image is the image that is re-sampled to spatially align with the source image.

The purpose of image registration is to find the set of transformation coefficients that map the target to the source image. An image registration process must determine the best geometric transformation  $t$  from a transform model  $T$  to align the images. Registration is the determination of a geometrical transformation that aligns points in one view of an object with corresponding points in another view of that object or another object. The present differences between images are introduced due to different imaging conditions.

This technique is used in a variety of scientific applications such as remote sensing, map updating, weather forecasting, and computer vision to provide an integrated view of the image data. Image registration is particularly difficult when images are obtained through different sensor types or when complex geometric transformations are required to relate the images, e.g. when registering images of different human brains (multi-subject registration).

Image registration is not an end in itself but adds value to images, e.g. by allowing structural (CT, MR, ultrasound) and functional (PET, SPECT, functional MRI (fMRI)) images to be viewed and analyzed in the same coordinate

system, and facilitates new uses of images, e.g. to monitor and quantify disease progression over time in the individual or to build statistical models of structural variation in a population.

## II. BASIC STEPS OF IMAGE REGISTRATION

### A. Feature Detection

Feature detection identifies the relevant features in the two images, such as edges, regions, contours, corners, etc size. For further processing, these features can be represented by their point representatives, which are called control points (CPs) in the literature.

### B. Feature Matching

In this step, the correspondence between the features in the two images is established. Various feature descriptors and similarity measures are used for that purpose.

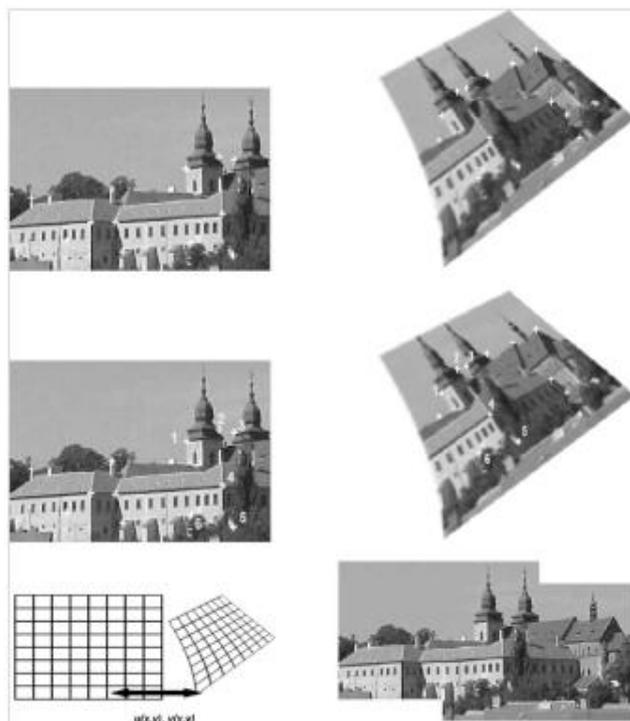


Fig.1.Four steps of image registration: top row—feature detection (corners were used as the features in this case). Middle row—feature matching by invariant descriptors (the corresponding pairs are marked by numbers). Bottom left—transform model estimation exploiting the established correspondence. Bottom right—image resampling and transformation using appropriate interpolation technique.

### C. Transformation Model Estimation

The type and parameters of the so-called mapping functions, aligning the sensed image with the reference image, are estimated. The parameters of the mapping functions are computed by means of the established feature correspondence.

### D. Image Resampling And Transformation

In this step, the correspondence between the features in the Two images is established. Various feature descriptors and similarity measures along with spatial relationships among the features are used for that purpose (see Fig. 1).

## III. TRANSFORMATION FUNCTIONS

After the feature correspondence has been established the mapping function is constructed. It should transform the sensed image to overlay it over the reference one. The correspondence of the CPs from the sensed and reference images together with the fact that the corresponding CP pairs should be as close as possible after the sensed image transformation are employed in the mapping function design

### A. Global And Local Mapping Models

Models of mapping functions can be divided into two broad categories according to the amount of image data they use as their support. Global models use all CPs for estimating one set of the mapping function parameters valid for the entire image. On the other hand, the local mapping functions treat the image as a composition of patches and the function parameters depend on the location of their support in the image.

### B. Rigid And Non Rigid Transforms

Image registration algorithms can also be classified into two main categories according to the transformation model which is used to relate the reference image space with the target image space. The first broad category of transformation models includes rigid transformations, which are a combination of translation, rotation, global scaling, shearing and perspective components. Rigid transformations are global in nature, thus not being able to model local deformations.

The second category includes nonrigid transformations. These transformations allow local warping of image features, thus providing support for local deformations. Nonrigid transformation approaches include polynomial wrapping, interpolation of smooth basis functions. The optimal transformation depends on the type of relation between the overlapping images. This in turn, depends on the estimation of the parameters of the transformation model. The number of parameters depends on the chosen transformation model.

When an image is transformed with a nonlinear transformation, straight lines may not remain straight, but the adjacency relation between the points will be preserved. Nonlinear transformation functions can be used to produce the effect of lens distortion or other global or local deformations. Depending on the amount of deformation desired, different transformation functions may be needed.

Nonlinear transformation functions can, in general, be grouped into global and local.

## IV. RIGID BODY TRANSFORMATIONS

Rigid-body transformations consist of only rotations and translations, and leave given arrangements unchanged. They are a subset of the more general affine transformations. For each point  $(x_1, x_2, x_3)$  in an image, an affine mapping can be defined into the co-ordinates of another space  $(y_1, y_2, y_3)$ .

### A. Translation

Translation involves moving the whole image in a given  $x, y$  direction. In terms of 2D space, the image plane is moved up, down, left, or right (or any combination of these directions).

### B. Rotation

The rotation transformation is slightly more complex than the translation operation. In this type of transformation, the image is rotated clockwise or counterclockwise about a fixed position.

### C. Scaling

The final affine transformation is scaling, which is used to make objects bigger or smaller. The scaling operation can be considered as zooming in and out of the image plane. Transformation preserves distances between every pair of points.

## V. NON RIGID BODY TRANSFORMATIONS

A rigid registration is composed solely of a rotation and translation and literally preserves the 'rigid' body constraint, i.e. a body is rigid and must not undergo any local variations during the transformation. This type of registration is distance preserving and is adequate for many applications in medical imaging including multimodality and intra-patient registration. However, for interpatient registration or patient-atlas matching, non-rigid algorithms are required. In a non-rigid approach, the 'rigid' body constraint is no longer acceptable as it does not account for the non-linear morphometric variability between subjects i.e. there exists inherent anatomical variations between different individuals resulting in brain structures that vary in both size and shape. These non-rigid algorithms allow one image to deform to match another image, thus overcoming any local variations.

Nonrigid registration is the process of finding a coordinate transformation between two or more images that is anatomically correct and not constrained to be rigid or affine. Determining such transformations, which frequently have several hundred thousand degrees of freedom, requires substantially more computational effort than finding a rigid transformation. In a non-rigid transformation, the shape and size of the image are altered i.e. stretching or shrinking the image. This is typically known as skewing or distorting the image.

Nonrigid image registration is an essential tool required for overcoming the inherent local anatomical variations that exist between images acquired from different individuals. It deals with changing local morphology over time. It is

further divided into two types - parametric and non parametric deformations. Parametric deformations (Basis function) includes piecewise affine, RBF (thin splines), Bsplines whereas non parametric (physical model) includes elastic, fluid, optical flow. Parametric deformations such as B-Splines define a regular grid over the image (with a spacing typically many times the voxel size), with a set of parameters for each point of the grid. The drawback is that parametric deformations can offer too few degrees of freedom in certain areas of the image, while allowing too many in others.

Nonrigid transformations are important not only for applications to nonrigid anatomy, but also for interpatient registration of rigid anatomy and inpatient registration of rigid anatomy when there are nonrigid distortions in the image acquisition procedure. Non linear image registration refers to a class of methods where the images to be registered have geometric differences that cannot be accounted for by similarity (global translation, rotation, and scaling) transformations (see Fig. 2).

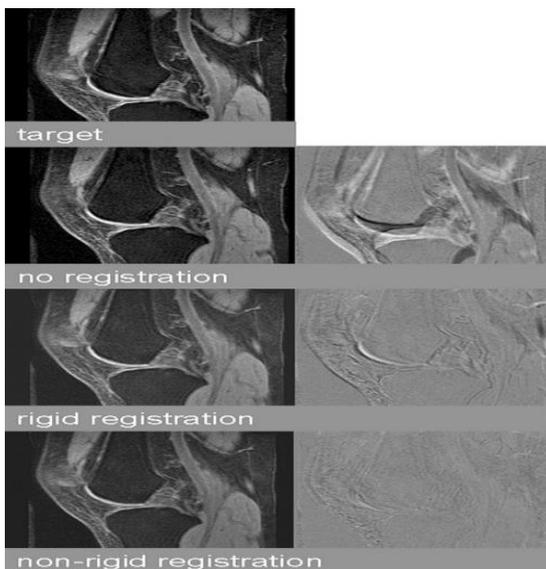


Fig.2. A more unusual application is registering images of knee joints for the purpose of tracking changes in the thickness of cartilage. The knee particularly is difficult to image consistently in three dimensions on consecutive occasions due to the high degree of mobility around the joint regardless of any disease process. Nonrigid registration, in this case can recover most of the differences between scans of the same subject acquired at different times.

In medical imaging, non-linear registration was initially used to standardize MR and CT brain images with respect to an atlas. Most work on non linear registration has used medical images, and in particular brain images. The brain is of tremendous interest because of many applications in neuroscience and neurosurgery, presenting many unique challenges. Nonrigid registration of the brain is a difficult task, but has many important applications including comparison of shape and function between individuals or groups, development of probabilistic models and atlases, measurement of change within an individual, and determination of location with respect to a preacquired image during stereotactic surgery. Detailed nonrigid registration and comparison of brain images requires the determination of correspondence throughout the brain and

the transformation of one image space with respect to another according to the correspondences.

## VI. CONCLUSION

In this paper we have presented a survey of various transformation functions used for image registration. Each step involved in image registration has its own set of issues. We have focused on the transformation step as the performance of any image registration algorithm depends upon the performance of transformation function used. Non-linear transformation functions are important not only for applications to nonrigid anatomy, but also for interpatient registration of rigid anatomy and intra-patient registration of rigid anatomy when there are nonrigid distortions in the image acquisition procedure. Nonlinear transformation functions can, in general, be grouped into global and local. If the source and reference image have geometrical differences that can be accounted by global translation, rotation, and scaling then rigid transformation functions are used. Whereas most of the medical images involve distortions that can be addressed only with the help of nonrigid transformation functions. Nonrigid registration can recover most of the differences between scans of the subject involving high degree of mobility and is hence a preferred choice for medical image registration.

## ACKNOWLEDGMENT

I would like to thank CT Institute of Engineering, Management & Technology, Jalandhar for organizing International Multi-Track Conference on Sciences, Engineering and Technical Innovations in our college and giving us the opportunity to publish our research work in the this International Conference.

Next, I would like to thank all faculty members and staff of the Department of Computer Science and Engineering/ Information Technology, CT Institute of Engineering, Management & Technology, Jalandhar for their generous help in various ways for the completion of this thesis. I owe special thanks to Ms. Taranvir Kaur, Ms. Rupinder Kaur Gill and Mr. Ritej Gaba, Assistant Professor CSE/IT Department at CTIEMT Jalandhar for their valuable insights and constructive criticism that has improved this paper substantially. I am grateful to them for sharing their time and expertise. They helped me with their suggestions and support throughout the course.

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**Track-1**

**Technical Session 3**

**OPTICAL COMMUNICATION**



# Performance Investigation of Four Wave Mixing Effect on Multichannel/ High Bit Rate SDWDM Networks

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**Abstract--** Unlike the linear effects that can be possibly compensated, the nonlinear effects accounts for degradation of the system -performance. To meet with growing need of high data rate and bandwidth, various efforts are made nowadays for the efficient communication systems. There are techniques developed like WDM to use the high available bandwidth efficiently for users . It is a technique used for sharing the media with the users and used for the high capacity transmission. In this paper we have mentioned about WDM systems and discussed various nonlinearities in WDM such as SPM, FWM, SBS, SRS, CPM . Our initial perceptive is on FWM effects and its mitigation. Also, practical implementation of various performance parameters like fiber length and core diameter that are having the effect of increasing or decreasing FWM is carried out. From the observed outputs the four wave mixing effect is lesser with the increase in the length and core diameter of the fiber. The results have shown that WDM systems have better receiver sensitivity. The FWM effect on WDM system is also lesser than other conventional techniques.

**Keywords--** WDM systems, Non Linear Effects, Fiber Optics Communication, Four Wave Mixing, Optisystem Simulation

## I. INTRODUCTION

Wdm Systems: When the number of users remains same or is very high on a communication line, a multiplexing method used is called Wavelength Division Multiplexing. WDM is atechnology in which transmission of whole information through multiple channels over a single fiber another added advantage is transmission of information without any signal integrity loss. Efficiency of optical fiber communication system has also been improved by Wavelength division multiplexing (WDM). WDM has provided system of optical fiber communication with large channel capacity.

WDM fully utilizes the large bandwidth given by optical fiber [1-2] by allowing huge amounts of data in various channels to be transferred at different wavelengths. In WDM system, there are some form of undesirable effects through which the optical fiber suffers, known as nonlinear effects.[1-3].

Non Linear Effects: Non-linear effects degrade the performance of WDM system It is very difficult to overcome the various non-linear effects. Non-linearity can be broadly classified into three types based upon the type of input signal: SPM, CPM and FWM. Stimulated scattering effects like SBS and SRS can be induced directly by inelastic scattering.

### A. Self Phase Modulation

In SPM, the phase of an optical signal given is modulated by itself. SPM mainly depends on signal power levels. SPM is occurring at high levels of signal. It results in phase shift and a non-linear pulse spreading. Pulses are overlapped and no longer be distinguish by the receiver in SPM. SPM is used basically for fast optical switching, about the formation of standard and dispersion-managed optical solitons [1].

### B. Cross Phase Modulation

The most popular phenomenon in WDM system is the Cross-Phase Modulation (CPM/XPM). CPM is a non-linear effect in which the wavelength of one light can affect the phase of another wavelength of light , through the optical Kerr effect. Kerr effect is a very limiting factor for optical network. The change in phase of one channel due to variation in power of adjacent channels positively affects the system performance [3].

### C. Four Wave Mixing

Another dominated effect in WDM systems is Four wave mixing (FWM), having very low chromatic dispersion and dense channel spacing. FWM is a process in which interaction of various frequencies signals with each other and creation of new spectral components takes place [4].FWM is mainly used in squeezing and wavelength conversion [5-7].

### D. Stimulated Raman Scattering

In SRS, propagation of light is only through a medium. During the propagation of light, interaction of photons with silica molecules taking place. They are also interact with themselves and produce scattering effects like Raman scattering in reverse and forward directions among the fiber resulting in distribution of energy in a random direction [4].

### E. Stimulated Brillouin Scattering

In SBS, propagation of light is also through the medium. The interaction of photons with silica molecules taken place only during propagation of light. Mainly interaction among themselves produces scattering effects such as SBS in a reverse direction The basis of Brillouin amplification is formed by this gain generated from that such waveforms [6].

## II. LITERATURE SURVEY

G.E. Kaiser [8], author discussed that how the various non linearities affects the optical communication systems.

Further, the author has also mentioned the methods to suppress the four wave mixing effects, self phase modulation and cross phase modulation. N. Mohamad Saaid[9] , author presented a review on different methods for the suppression of nonlinear optical effects in WDM systems that had been proposed by many researchers. The nonlinear optical suppression methods can be predicted by using chirped fiber Bragg gratings, laser oscillations, unconventional modulation formats. Amarpal singha et.al.[10] , author worked on the combined effect of various order like fifth order and third order parameters of dispersion at different input channel powers on the FWM and core effective areas, which has not predicted in the early time. FWM power against the channel power graphs for the combined and individual effects of parameters has presented, and it has been seen from the results that FWM decreased for the combined effect of parameter of dispersion. Farma'n Ullah et.al [11] , the author described the effect of Four-wave mixing over WDM systems on 40 Gbps AP-DCDM. The system was checked by Opti system software simulating the AP-DCDM-WDM design .Manisha Ajmani et. al [12] , author's main motive is on the FWM and its mediation. Also, the analysis of various parameters that has a sucha major effect in increasing and decreasing FWM is being carried out in action.. Yamazaki et.al [13] ,the author discussion is about the Nonlinear compensation with digital back-propagation can improve Q-factor by more than 1dB, proven by experimental analysis.

### III. BLOCK DIAGRAM OR SIMULATION

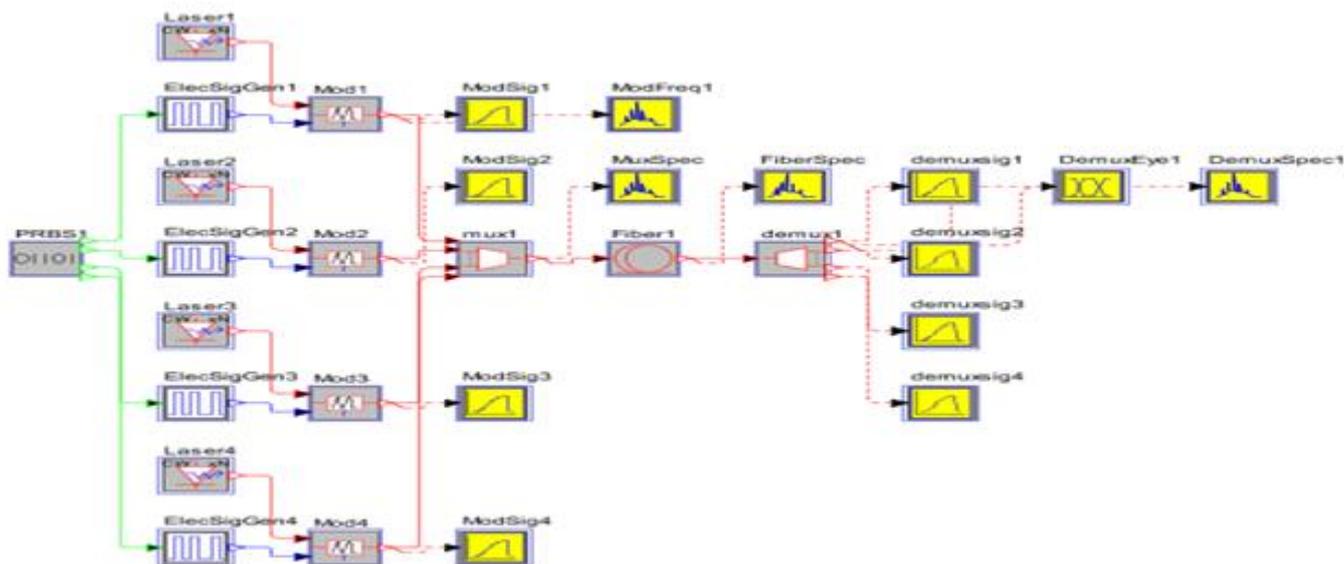


Figure 1. Simulation using four user WDM systems

### IV. IMPLEMENTATIONS AND DISCUSSIONS

Initially, in this section, we compare the relative performance of the WDM system. These systems are implemented with the OPT-SIM software. The main objective is to mitigate the non linear effects such as the four wave mixing effect and to produce the clean wide eye pattern free from the non linear effects and the linear spectrum analyzer graph by changing the parameters like

In optical fiber communication, Wavelength division multiplexing (WDM) is a technology of transmitting data from different laser sources simultaneously over the same link at each data channel has its own unique wavelength. The WDM technique enables bidirectional communications over single strand of fiber, and also enables multiplication of capacity [14].The figure 1. presents the block diagram or the simulation model for the four user-WDM systems. In this system , the four laser sources laser 1, laser 2 , laser 3, laser 4 are taken such that all carried on its own wavelength  $\lambda_1, \lambda_2, \lambda_3, \lambda_4$  simultaneously transmits the data over the same optical link. Here, the external modulators are connected to modulate the laser wavelength with the external carriers through electric signal generators. The modulators are connected to the multiplexer to multiplex the four wavelengths signals from the laser sources into one wavelength. Now, these signals are travelling through the optical fiber so that data is transmitted to the receiver. At the receiver end , there are demultiplexers used to demultiplex the single wavelength into the four signals outputs. The eye diagram and the spectrum analyzer are used at the receiver end to determine the various effects in the output pattern. Using Opt-Sim software, there are two types of simulating models have been created to study FWM effects. The two models used are external modulated and direct-modulation signal. Direct-Modulation:- Here the bias of a semiconductor laser diode varies by the RF signal directly. External-Modulation: Here modulation of light is by an lithium-niobate optical modulator. External modulation is preferable over any modulation because there is having best performance, instead of high cost.

length and core diameter of the fiber. In this operation four CW lasers are used being sources of signals. The channel-spacing is set to 0.1.

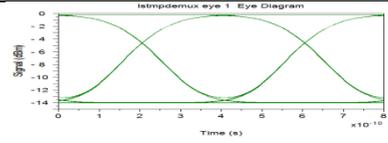
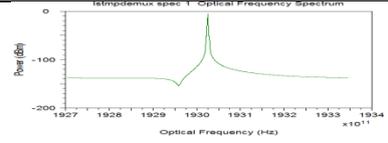
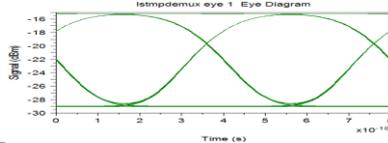
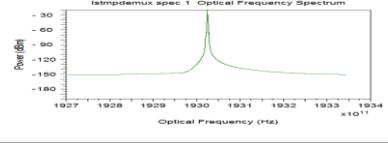
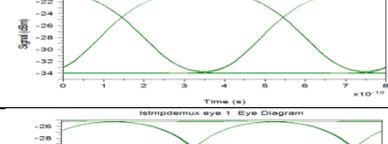
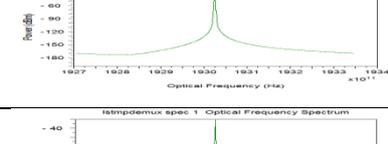
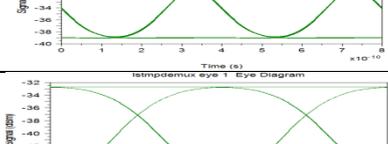
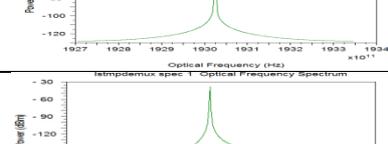
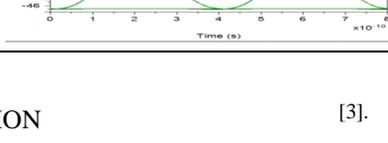
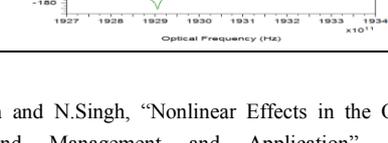
After comparing the results in Table 1 given below, we moved deeper into the concept of determining the effects of the parameters such as fiber length and core diameter on the output of the WDM systems. We have seen that initially when the fiber length is 20 km and core diameter is 10um,

then the eye diagram output shows there are four wave mixing effects occurs and the spectrum analyzer is not linear i.e the system is not efficient. When we further increase the fiber length to 80km and core diameter is also increased to 12  $\mu\text{m}$ , then there is a small reduction of FWM effects. As we increases the parameters such as length to 120um and core diameter also increased to 18um, the eye diagram

response is very efficient and there is no FWM effect and spectrum analyzer output is also very efficient with respect to frequency. As a result, the FWM products are reduced with the increase of fiber length and core diameter.

But the core diameter parameter cannot be set too high because it limits the bandwidth in the WDM systems.

Table 1. Parametric effects on the WDM system to mitigate the FWM effects

S.NO	Length of an optical fiber (inkm)	Core diameter (in $\mu\text{m}$ )	Eye Diagram Output (signal vs time)	Spectrum Analyze Output (power vs frequency)
1	20	10		
2	80	12		
3	100	15		
4	120	18		
5	140	20		

## V. CONCLUSION

The performance of WDM networks is heavily influenced by nonlinearity characteristic present in the fiber. Therefore the fiber nonlinear effects provide additional limitation in WDM systems. The FWM effects cannot be reduced with the default parameters. However, our numerical simulation results have shown that the FWM effects can be reduced by the changing parameters such as length of the fiber and diameter of the core.

This can be done with the increase of the length and core diameter of the fiber. So, the non linear effects are mitigated with the increase of the fiber length and core diameter.

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# Performance Analysis of OCDMA System using 1-D, 2-D and 3-D Techniques- A Review

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**Abstract**— In this paper we present an in-depth review on the trends and directions taken by the researchers worldwide in Optical Code Division Multiple Access (OCDMA) techniques. In this paper, the focus is to compare BER using 1-D, 2-D, 3-D coding schemes. BER reduces with the use of 2-D codes as compared to 1-D codes. The research is going on in the field of 3-D codes and these codes will become the inseparable part of advanced optical communication systems and networks due to its various desirable features and functionalities.

**Keywords**— OCDMA, BER, 1-D, 2-D, 3-D codes

## I. INTRODUCTION

The optical CDMA system is a versatile multiple access technique as compared to time division multiple access technique (TDMA) and wavelength division multiple access (WDMA) because in WDMA and TDMA systems users are assigned different wavelengths and different timeslots respectively to distinguish the data recovered at receiver end but in optical CDMA, users are assigned unique codes. Only the intended user with specific code will access the data at the receiver due to multiple users simultaneously accessing the network. This reduces the Multiple Access Interference (MAI) that occurs at the receiver due to multiple users accessing the network simultaneously. The code properties of unique codes assigned to users play an important role in receiving MAI. In a CDMA communication system, MAI is recognized as the source of noise that limits the system capacity. Several designs for receiver structure are proposed to be used in typical OCDMA system using Optical Orthogonal Codes (OOC) in order to improve the system performance and increase the capacity by mitigating the MAI effect. Advantage offered by optical CDMA is requiring very simple protocols is that the network performance is not devastated if the number of users increases above the number of supported users. In CDMA, every user will be allocated the entire spectrum all of the time and CDMA uses unique spreading codes to spread the baseband data before transmission. In optical CDMA, each user is identified by different codes or addresses.

The principle of OCDMA is based on spread-spectrum techniques, which have been widely used in mobile satellite and digital cellular communication systems.

The concept is to spread the energy of the optical signal over a frequency band that is much wider than the minimum bandwidth required to send the information. For example, a

signal that conveys 3b/s may be spread over a 1 MHz bandwidth. This spreading is done by a code that is independent of the signal itself. Thus an optical encoder is used to map each bit of information into a high rate (longer code length) optical sequence.

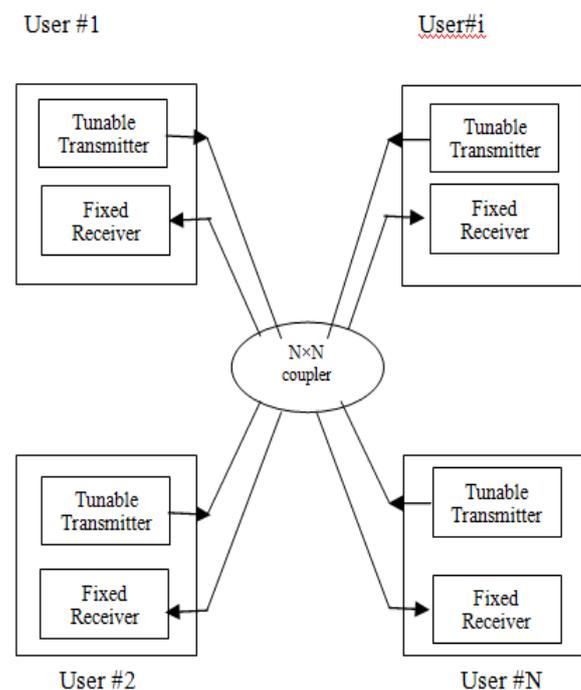


Fig. 1. Basic N x N OCDMA network architecture [1]

The CDMA technique has its origin in the spread spectrum (SS) technique. In SS transmission, the input signal is coded in such a way that its spectrum spreads over a much wider range than the original signal. At the receiver, the spread signal is decoded and its original form is restored. While despreading the input signal, unwanted noise or intentional jamming signals are spreaded, i.e. though input signal and distortion might carry the same power, the power spectral density of the distortion covers a wider area, thus enabling the receiver to detect the input signal and noticing some additional but only weak noise. Furthermore a despreading of the input signal is impossible without exact knowledge of the code sequence, thus increasing the security of the transmission.

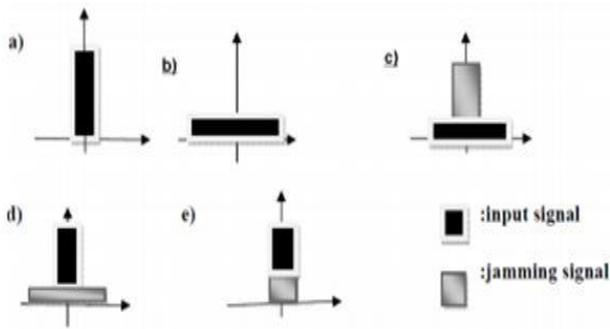


Fig 2: Principle of spread spectrum communication [2]

Both synchronous and asynchronous OCDMA techniques have been used [3]. Synchronous accessing schemes follow rigorous transmission schedule, they produce more successful transmission i.e. higher through puts and asynchronous multiplexing are more efficient when traffic tends to be bursty in nature or when real time communication requirements are relaxed, such as in data transmission or file transfer.

## II. DIFFERENT OCDMA TECHNIQUES

One Dimensional OCDMA codes (1-D) was used for time domain coding or spectral coding and Two Dimensional OCDMA codes (2-D) codes were proposed with (wavelengths and time slots forming the two dimensions. To improve the system performance, hybrid 2D systems combining time spreading and frequency hopping .The Three Dimensional OCDMA codes (3-D) families have space/wavelength/time codes. The 3-D Single Pulse per Plane (SPP) codes were implemented using differential detection and direct detection.

1-D OCDMA codes- These codes were used in time domain coding and in spectral coding. The limitation of these codes was a large cross correlation peaks which limited the number of simultaneous users or in other terms the quality of service .In order to rectify the above limitation, 2D codes were used. In this paper author found that a new code structure for spectral amplitude coding OCDMA system based on double weight (DW) code families. By using a mapping technique, codes that have a larger number of weights can be developed. Modified double-weight (MDW) code is a DW code family variation that has variable weights of greater than two [4]. Further, author gives description of ultra short pulse spectral phase coded OCDMA, demonstration of 2.5 Gb/s four user OCDMA system operating at bit error rate  $\leq 10^{-11}$  utilizing programmable spectral phase encoding. On the subsystem level ,two key component technologies , femto second encoding/decoding and low power high contrast nonlinear discrimination have been developed and characterized .In this high fidelity femto second encoding/decoding for length 31 codes has been demonstrated in experiment of system [5], and many other researchers have done by authors they work at 2-D codes for OCDMA have been shown to be more versatile compared to the one-dimensional codes for their good spectral efficiency as well as better BER performance. The 2-D codes also benefit from the reduction of the wavelength/time-like

property over 1-D codes. The 3-D codes are important as these produce a larger code set. The author presented a new family of 3-D single pulse per plane codes for differential detection (SPDD) for optical CDMA systems (based on the 1-D golomb ruler sequences), which achieve good code cardinality and a very high BER performance. The improved BER performance is obtained by using two codes to encode '1' and '0' bits in the encoder and adopting the Differential Detection in the receiver. The comparison of our 3-D SPPP codes for differential detection with some of the best reported 2-D/3-D codes shows that the 3-D SPDD codes perform significantly better than the others. The number of simultaneous users supported at  $1e-9$  is much more increased over those supported by the earlier proposed 2-D/3-D orthogonal codes [6]. The author founded Optical CDMA technique is required to meet the increased demand for high speed, large capacity communications in optical networks .In this, we have presented an OCDMA model to the range of 100 km. The simulation results reveal that the transmission distance is limited mainly by the multi-access interference (MAI) which arises when there are a large number of users in the system because of the fact that one user data becomes noise for all other users in the channel [7].

Table 1. BER Comparison using 1D OCDMA codes

1-D	BER	Distance
2004 S. A. Aljunid et al.	$10^{-12}$	70 km
2011 C.M. Negi, Amit Pandey, Gireesh G. Soni et al.	$10^{-59}$	5km
2012 N. Ahmed, S. A. Aljunid, A. Fadil et al.	$1.61133 \times 10^{-18}$	60 km
2014 Kumbirayi Nyachionjekal and Wellington Makondo et al	$7.39 \times 10^{-23}$	28m

2D OCDMA codes were proposed with wavelengths and time slots forming the two dimensions. The application of multiple Bragg grating fiber in OCDMA was also proposed and was used as encoder and decoder. By using a multiple grating fiber as encoder and decoder, the system was simplified and fast optical frequency hopping was implemented. This 2-D code suffers from the impact of timing skew as the time dimension of the code is large. The impact of fiber dispersion on the code performance of the 2-D codes have been extensively investigated and it has been shown that these are prone to the problem of timing skew arising in the fiber, if large time dimensions are used for better BER performance. In order to overcome the limit of two dimensional codes, three dimensional codes have been proposed.

The author founded the optical time-spreading/frequency hopping differential CDMA system with Prime/optical orthogonal codes. Two orthogonal Prime/OOC codes encoding one and zero, respectively, differential detection can be implemented. Compared with the normal direct chip detection, differential detection not only improves system performances in BER, but also resists interference such as

MAI [8]. The author describes the basic principles of a new family of wavelength/time multiple-pulses-per-row (W/T MPR) codes, for incoherent FO-CDMA networks, which have good cardinality, spectral efficiency, and minimal cross correlation values. compared various W/T codes and showed that W/T MPR codes have better cardinality and spectral efficiency for given wavelength time dimensions, in addition to having minimal correlation values, which makes it suitable for FO-CDMA networks [9], and the author describes a technology demonstrator for an incoherent optical code-division multiple-access scheme based on wavelength/time codes. The system supports 16 users operating at 1.25 Gsymbols/s/user while maintaining bit-error rate (BER)  $<10^{-11}$  for the correctly decoded signal [10]. In this the Optical CDMA network for OOCs codes in detail and verified the autocorrelation and cross correlation properties of W/T SPR codes, by simulation using opt system, and shown to be minimal for unipolar codes, which is desired to keep multiple access interference low in broadcast networks. As a result of which, better performance is obtained in broadcast networks, wherein MAI is the main cause for errors[11].The author founds that One OCDMA PON system Multi-length Two-Weight Carrier Hopping Prime Codes is selected as encoder scheme, encoded information is transmitted through Optical fiber. Hard Limiter is utilized in receiver terminal to ensure lower bit error rate. Simulation shows that it can be used for large capacity optical networks [12].

Table 2. BER Comparison using 2-D OCDMA codes

2D	BER	Distance
2012 Savita R.Bhosale, S.L.Nalbalwar,S.B.Deosarkar[13]	$<10^{-9}$	60km
2012 Kanchan Sharma ,Surekha Bhangari [14]	$1.58^{-41}$	60km

3-D OCDMA codes: In order to overcome the limit of two dimensional codes, three dimensional codes have been proposed. These are space/wavelength/time codes. The three dimensional Single Pulse per Plane (SPP) codes were implemented using differential detection and direct detection. In this detection technique only wanted chip in the optical domain is filtered [15].

Table 3. BER Comparison using 3-D OCDMA codes

3D	BER	Distance
2013 Minal Garg, R.S. Kaler et al.	$10^{-67}$	5km
2014 systemsDevendra Kr. Tripathi, Pallavi Singh, N.K. Shukla, H.K. Dixit	$10^{-95}$	More than 270 km
2014 Anisha Sihmar and Neena Gupta et al.	$6.62 \times 10^{-6}$	100 km

### III. CONCLUSION

There are various techniques used to improve the BER OCDMA system. In all these techniques, improved BER performance is achieved at the expense of increased system cost and increased system complexity. In OCDMA system, we use all 1D, 2D and 3D codes. In 1D codes data is spread either in time or in frequency domain. But there are some drawbacks in 1D, having out of phase autocorrelation cannot be zero because there are multiple optical pulses within one period. In order to overcome the limit of 1D optical code, 2D can be the best solution spread either in wavelength/time or in space/time domain. In 2D OCDMA pulses are placed in different chips is of either different wavelength or different space. The out of phase auto correlation and cross correlation of 2D code families are equal to "0" and "1" respectively. The 2D OCDMA system is much improved in comparison to the 1D OCDMA systems and it also provides larger user code set. But these 2D codes suffer from the impact of timing skew as the time dimension of the code is large and has MAI problem with not better results of BER. If large time dimensions are used for better BER performance and in order to overcome the limit of 2D codes, 3D code used.

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# Performance Analysis of Inter-Satellite Optical Links at 8 Gbps

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**Abstract-** The future of satellite communication is highly graceful due to the evolution of wireless optical communication links. The inter-satellite optical links used in free space to fulfil the future demands of high speed and high bandwidth data. These links are used for connecting different satellite orbits. In this paper performance of these links are analysed at data rate of 8 Gbps over 6000km distance for different input power with 10 transmitters and 5 receivers. The performance is analysed with BER analyser. The simulation result is analysed in optisystem 7.0.

**Keywords -** Bit Error Rate (BER), Inter-satellite Optical Wireless Communication (IsOWC), Optical Wireless Channel (OWC)

## I. INTRODUCTION

Satellite communication is a whole world communication service. The satellite communication have large scope in continuously rising demands in business, consumer services, mobile communications, high bandwidth Internet data and military applications on world level in today and tomorrow communications[1].In today satellite communications microwave technology is used for connecting the satellites. But in future satellite to satellite communications will be by optical wireless channels (OWCs). Optical wireless channels use free space for inter-satellite optical links for transmitting data, voice or video [2].Optical inter-satellite links have smaller size, less weight, less transmitted power, less interference, high bandwidth, high data rate and high security as compared to microwave inter-satellite links [3].In these links laser light is used for transmission data at high data rate of Gbps for thousands of kilometres at the speed of  $3 \times 10^8$  m/s [4].This technology can be used in GEO (36000 km altitudes),

MEO (5000–20000 km) or LEO (800 km–1500 km) earth orbits without investing too much money [5].To increase the performance and link reliability of inter-satellite optical link, spatial diversity techniques are used. It consists of multiple transmit and/or receiver antennas [6].Diversity scheme can be employed at receiver or transmitter side. In receiver diversity i.e. single-input-multiple-output (SIMO) scheme the receive signal will be affected if the transmitter input varies. Hence transmitter diversity i.e. multiple-input-single-output (MISO) scheme is used [7].In this paper optical wireless channels (OWC) is used for optimizing the performance of inter-satellite communication with parameters like quality factor, bit error rate at different input power. The simulation is done for 10 numbers of transmitters and 5 numbers of receivers over distance of 6000 km at data rate of 8 Gbps in optisystem 7.0.

## II. SYSTEM DESIGN

The basic Inter-satellite Optical Wireless Communication is shown in Fig.1.It consists of three main section i.e. transmitter, optical wireless channel and receiver. In transmitter section consists of a laser, PRSB (Pseudo Random Bit Sequence), NRZ (Non Return to Zero) and Mach-Zehnder modulator. The input power is split into 10 numbers of OWCs having distance 6000 km at 1550 nm. This power then combined by power combiner. The receiver section consists of power splitter for splitting power to 5 number of receivers, APD photodiode for converting optical signal to electrical signal, low pass filter, 3R regenerator and BER(Bit Error Rate) analyser.BER analyzer is used for eye diagram, Q factor and minimum BER at different input power[8].

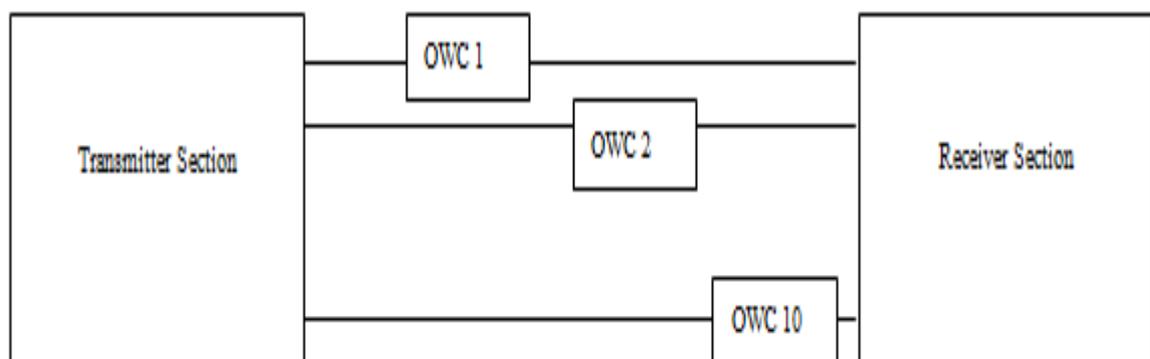


Fig. 1. Basic block diagram of Inter-satellite Optical Wireless Communication System [8]

### III. RESULTS AND DISCUSSION

Table I Parameters Used [8]

S.No.	Parameters	Values
1.	OWC channel distance	6000km
2.	Bit rate	8 Gbps
3.	Aperture diameter of transmitter	10 cm
4.	Aperture diameter of receiver	30 cm
5.	Frequency used	1550 nm
6.	Dark current	10 nA

The performance of IsOWC is analysed in the presence of shot noise as follows.

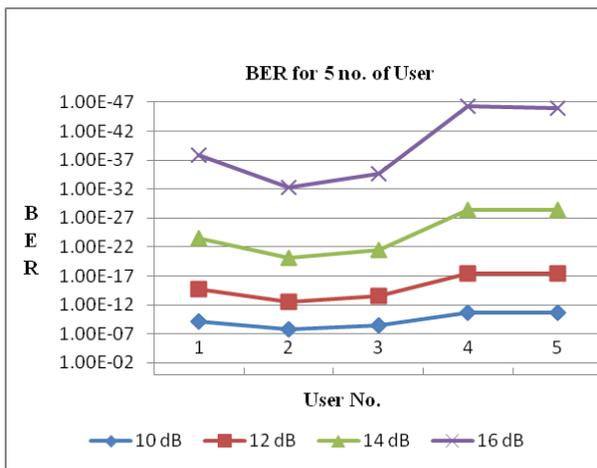


Fig. 2. BER for 5 numbers of users (receivers) at different input power in Inter-satellite Optical Wireless Communication System

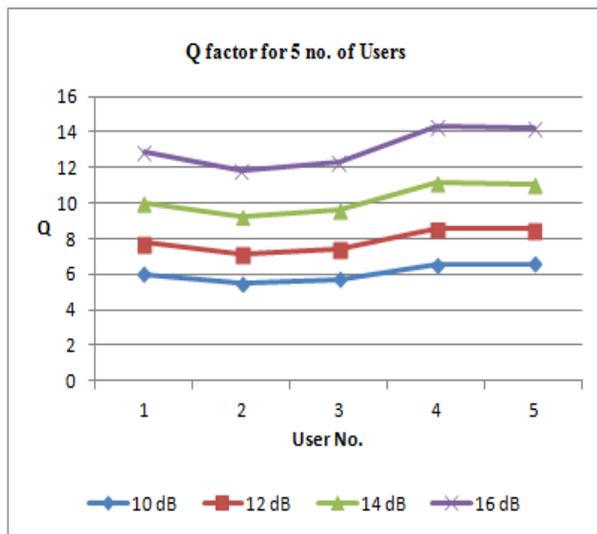


Fig. 3. Q factor for 5 numbers of users (receivers) at different input power in of Inter-satellite Optical Wireless Communication System

In Fig. 2 the BER is determined for 5 numbers of receivers at 10 dB, 12 dB, 14 dB and 16 dB input power. As from figure it is clear that for input power of 10 dB BER lies between  $1.50 \times 10^{-8}$  to  $2.13 \times 10^{-8}$ . But with increase in input power up to 16 dB, there is decrease in BER from  $4.82 \times 10^{-33}$  to  $4.82 \times 10^{-47}$ . Hence decrease in BER, means less noises and better communication at 16 dB as compared to

others. In Fig 3 relative Q factors are shown. As at 16 dB input power, BER is lowest so it has highest Q factor as compared others.

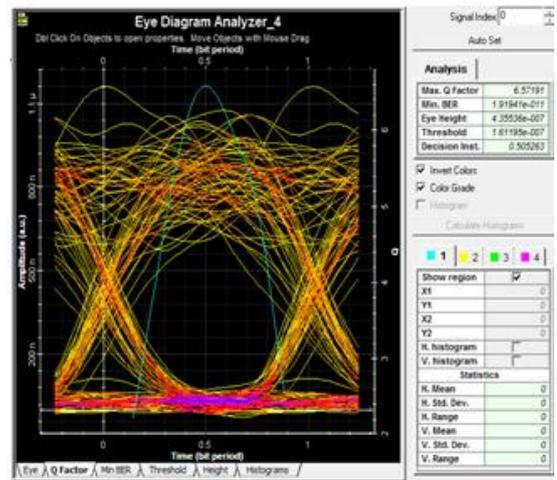


Fig. 4. BER performance for receiver at 10 dB input power in Inter-satellite Optical Wireless Communication System

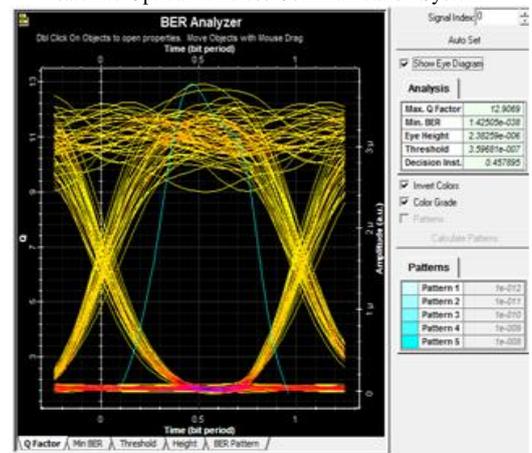


Fig. 5. BER performance for receiver at 16 dB input power in Inter-satellite Optical Wireless Communication System

### IV. CONCLUSION

In this paper the performance of Inter-Satellite Optical Links has been analysed at data rate of 8 Gbps. To measure the performance of Inter-Satellite Optical Link diversity plays an important role. By using diversity scheme, quality of satellite to satellite communication can be improved as compared to without diversity. In satellite communication the performance can be further increased by increasing the input power in a particular diversity scheme. Thus increasing the input power up to 16 dB,  $4.82 \times 10^{-47}$  BER can be easily obtained, which is a better result for LEO communication techniques.

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# Comparative Analysis of VCSEL Laser and DFB Laser for CATV Transmission

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**Abstract---** This paper evaluates and compares Distributed Feedback (DFB) laser and Vertical Cavity Surface Emitting Laser (VCSEL) for CATV transmission. Comparison has been done on the basis of CSO-CTB distortions and RF Spectra. The simulation results exhibit the better performer among both lasers taking into consideration the parameters chosen for evaluation.

**Keywords-** DFB, VCSEL, CATV, CSO, CTB, RF

## I. INTRODUCTION

During recent years, a Community Access Television system has become famous among the cable industry. CATV transmission systems have altered from old cable based one way analog video transmission to two ways hybrid fiber transmission. In one way transmission system many RF amplifiers were used to overcome high losses of the cables that affect the quality of received signal. The use of optical fiber reduces the RF amplifiers in the transmission, high transmission power or lower fiber transmission losses are required to increase the system capability. RF parameters such as Composite second order (CSO), and Composite triple beat (CTB) limits the transmission performance of CATV system. These distortions can be degraded by using Stimulated Brillouin scattering (SBS) [1]. In general, CSO and CTB distortions are main flaw in the system [2]. There is chance of having inter modulation products which produce distortion in the network can arise when several numbers of channels in CATV system are amplified. To improve the performance of CATV system these amplification should be degraded. Several methods have been introduced to overcome these problems induced by distortions in the CATV system like SBS suppression, CTB distortion, detection techniques and expensive externally modulated transmitter are required [4]. It is difficult to attain good performance of CSO and CTB. Low distortion lasers are extremely important element in CATV transmission systems. Directly-modulated DFB lasers results poor output due to the high degree of linearity [8]. Direct modulation also produces frequency 'chirp' which causes nonlinear distortion when combined with fiber. K.S. Bhatia et al. (2014) stated CATV system is analyzed using optic system software in which nonlinear distortion is examined which results from the propagation of multiple carrier frequencies through a laser diode. [10]

## II. RELATED WORK

Vineet Anand et al. (2014) forwarded the use of Fabrot Parot etalon to reduce the line width of the optical signal, which leads to the reduction of the fiber dispersion. These parameters can also be decreased when we use external

modulator in the system [9].

K.S Bhatia et al. (2014) CATV system is analyzed using optisystem software in which non linear distortion is examined which results from the propagation of multiple carrier frequencies through a laser diode. [10]

Hai han Lu et al. [1998] proposed a directly modulated 80-channel Erbium Doped Fiber Amplifier (EDFA) repeated system using half-split-band and wave division [11].

Sandeep Singh et al. (2014) stated that besides outer effects because of attenuation, fiber non-linearities and dispersion such inner distortions which occurs because of harmonic and intermodulation distortions also plays a very big role, which are examined at different tones. Such distortions can be controlled by controlling RIN and clipping techniques [10].

J. Yu et al. [1998] proposed an Electroabsorption Modulated Laser (EML) that can be linearized by reversal of the non linear distortion using EML inside an optoelectronic interferometer [12].

Prabhpreet Kaur Bhatia et al. [2014] founded that three Tone direct modulated transmission system using VCSEL with external modulator have better performance of CSO  $> -4.5$  dBc and CTB  $> -8.2$  dBc at three frequencies 62.5 MHz, 125 MHz and 187.5 MHz. [9]

C. Du et al. [2007] DFB has an optical grating which can select its wavelength; and VCSEL use vertical lasing axis which cavity is much shorter than that of FP. However, DFB LD has the largest threshold current, power consumption and physical size (5 times of VCSEL, 2 times of FP), which may cause serious problems for large number elements of RF coil array applications. [13]

C. Cox et al. (1996) The second order and third order distortion were suppressed by the optical linearization techniques in CATV applications. [14]

## III. SIMULATION SETUP

In fiber based CATV transmission system use single wavelength for transmission on which multiple RF analog channels are modulated. In digital communication system BER is the most common performance metric while a distortions measurement is

critical matrix in analog transmission systems. We can produce these results through simulations in Optsim.

The two generated sine-wave frequencies are summed. These two frequencies are at 500 MHz and 525 MHz. Frequencies are modulated onto a direct modulated VCSEL at a wavelength of 1550 nm. This is then propagated over 80 km of single mode optical fiber to a PIN-based optical receiver. Distortions such as composite second order (CSO) distortion can be viewed in spectrum analyzer by RF spectra, which are due to new frequencies generated at  $f_1 + f_2$  and  $f_2 - f_1$ . Figure 2 shows the RF spectra with power at frequencies 1025 MHz and 25 MHz. Modulation distortions at  $2*f_1$  and  $2*f_2$  at 1000 MHz and 1050 MHz respectively are also shown. These two frequencies are then modulated onto 1550 nm wavelength by Laser and then propagated onto single mode optical fiber cable to PIN based optical receiver.

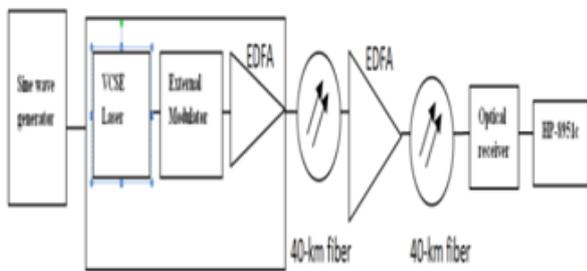


Fig 1. Two tone directly modulated with VCSEL CATV transmission system.

Spectrum analyzer is used to view the RF spectra, fig.2, to measure the CSO and CTB distortions and other distortions in the system.

Then two tones direct modulated CATV transmission system

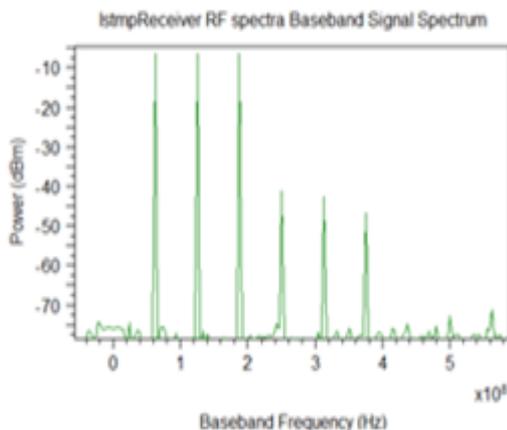
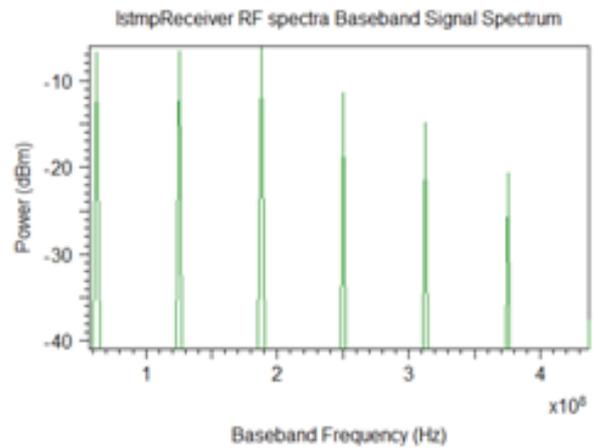


Fig 2. RF spectra for directly modulated CATV transmission system using VCSEL

is considered, fig.3. In this transmission system single Sine-wave frequency generator is used to generate a combination of two frequencies. These two frequencies are then modulated. DM Laser is used by the system and then signal is propagated onto 80 km single mode optical fiber cable to PIN based receiver. The distortion of the signal in CATV transmission is due to the deviation of the signal from the linearity which is known as intermodulation distortion such



as Composite second order distortion (CSO) and Composite triple beat distortion (CTB). Non-linearity in the propagation characteristics of the fiber transmission produces the new frequencies of the  $f_i + f_j$  and  $f_i - f_j$ . These frequencies lie in the transmission bandwidth and distorted the signal. The power level of the second and third order distortion known as Composite second order and Composite triple beat distortion, for specific channel are normalized to the carrier power of the channel and measured in dBc units.

If  $f_1$  and  $f_2$  are frequencies of two tones, then third order distortion products are occurring in both sides of these tones at  $2f_2 - f_1$  and  $2f_1 - f_2$ . Assuming the power levels of two tones is equal. IMD3 is the difference of power of fundamental signals and third order products. It is defined as following:  $IMD3 = P_o - P_{o3}$ .  $P_{o3}$  is the power level of output third order product.  $P_o$  is the power level of one the fundamental tone. Intercept point of output third order product can be calculated by:

$$O/P = IMD3/2 + P_o = 1/2(3P_o - P_{o3}) \text{ db}$$

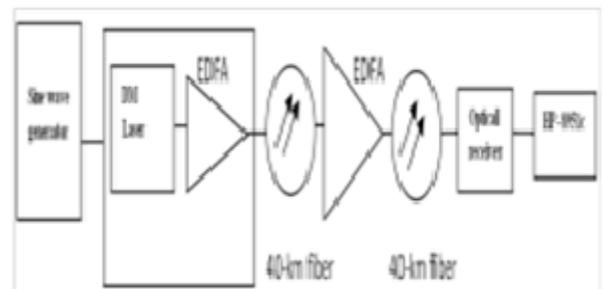


Fig 3. Two tone directly modulated with DM Laser in CATV transmission system.

#### IV. RESULTS AND DISCUSSION

Two frequencies at 500MHz and 525 MHz are modulated onto a laser at a wavelength of 1550 nm. It is propagated over 40 km of single mode optical fiber to PIN-based receiver. New frequencies generated at  $f_1 + f_2$  and  $f_2 - f_1$  can be viewed in the spectrum analyzer in order to measure distortion. Figure 2 shows the RF spectra with power at frequencies 1025 MHz and 25MHz. Also shown are the modulation distortions at  $2*f_1$ . In above example, there are two

electrical sine-wave frequencies generated and summed.. These frequencies are then modulated onto laser output at a wavelength of 1550 nm using a Mach-Zehnder modulator. This is then propagated over 40 km of single mode optical fiber to a PIN based optical receiver. The RF spectra can be viewed in the spectrum analyzer to measure the distortions such as composite second order (CSO) distortion, which are due to new frequencies generated at  $f_1 + f_2$  and  $f_2 - f_1$ . We found that CSO distortions are lesser in case of VCSEL.

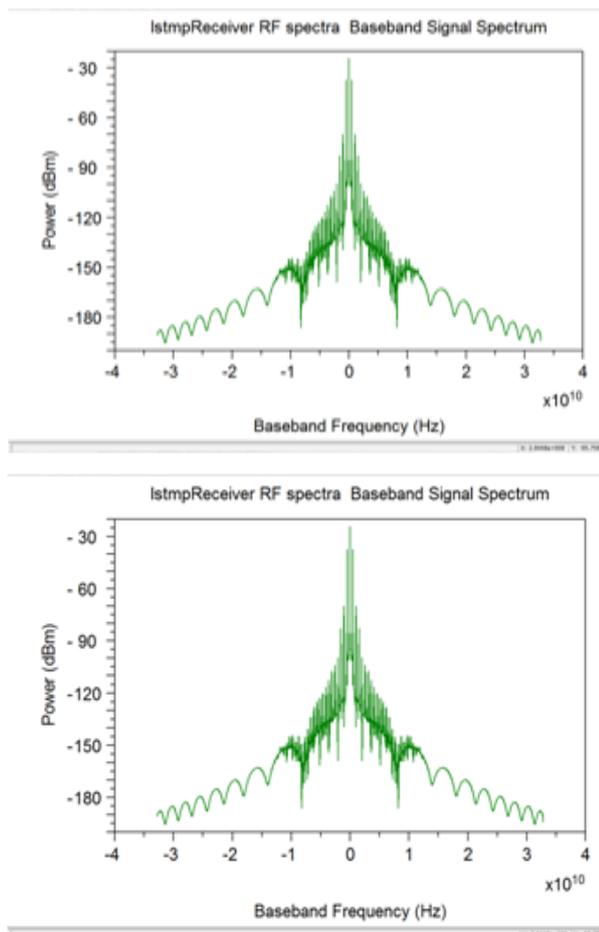


Fig 5. RF spectra for directly modulated CATV transmission system using VCSEL laser. CSO = -8.2dbc

From above spectra we analysed that VCSEL exhibit lesser CSO distortions than DFB laser.

## V. CONCLUSION

Intermodulation distortion in optical fiber based CATV transmission system is recognized by the second and third order harmonic sidebands in power spectra. In optical fiber based CATV transmission system distortion is much less than Coaxial based CATV transmission systems. Optical attenuator and FP filter is very effective in optical fiber based CATV transmission systems in order to decrease the intermodulation distortion such as CSO and CTB. Here we find the results of CSO and CTB distortions through simulations in Opt-Sim. We find that the Two Tone direct modulated transmission system using VCSEL with external modulator have better performance. However, DFB Laser has the largest threshold current, power consumption and physical size. VCSEL is a better choice for multi-channel optical fiber.

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# Channel Modeling and Modulation Techniques in Free Space Optical System

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**Abstract-** Free Space Optics (FSO) is an emerging technology in the field of communication. It has some major issues which are explored time to time. Two of the major areas of research in FSO are channel modeling and modulation techniques. Channel modeling is done so as to minimize the affect of atmospheric turbulence on the wireless optical signal and modulation is done so as to transmit the signal in efficient way. This paper focused on different channel modeling and modulation techniques used in the research field of free space optics.

**Keywords-** Free Space Optics, Channel Modeling, Modulation, Turbulence, Scintillation

## I. INTRODUCTION

Optical communication is a branch of telecommunication in which light is used as signal. Traditionally, the signals through the circuits used to be electrical signals. The need of faster data transfer and large bandwidth became the mother of invention of optical communication, which provides efficient transmission of data over long distances. Fiber is used as the medium in conventional optical communication system. Fiber optic communication has some disadvantages. First of all, fiber optic communication requires large amount of revenue. The additional components such as electrical to optical converters and vice versa, add to the system cost. Moreover, installing fiber over large network is a tedious job and requires municipal and government approval to lay the fiber underground by digging along road side and across the road where ever required. It may cause damage to the road. Optical fibers are very delicate, so have to be handled with care. A little more stress may cause damage to the fiber which results in loss of data. The repair of the damaged sectors is very difficult as it would require digging up the location of that sector again.

This led to the invention of Free Space Optics (FSO) which is wireless optical communication system. Along with the solution to a number of above said issues, this technology introduced a number of more advantages and applications. The capital investment for the installation of FSO system is less than a fifth as compared to ground based fiber optic technology. So, it is affordable easily. Moreover, they can be installed much more quickly. Some common applications are metro network extensions, last-mile access, enterprise connectivity, fiber backup, backhaul, service acceleration etc [1].

The characteristics of the channel play a vital role in designing, implementation and operation of a free space optical communication system. The outdoor channel of a FSO system is usually the atmosphere which is a complex dynamic environment. The optical beam can be affected by this environment resulting in losses and turbulence induced amplitude and phase fluctuation. A number of models to characterize the statistical nature of the atmospheric channel are designed by scientists who take into account different atmospheric situations such as fog, haze, rain etc. Apart from this, various modulation techniques have been invented. In section II, channel modeling and modulation techniques are discussed according to their hierarchy of inventions and improvements. It is followed by conclusion in section III and references.

## II. FREE SPACE OPTICS

FSO communication system is a vast field in the area of research and development. There are a number of issues related to this communication system. Two of the important issues are channel modeling and modulation techniques:

### A. Channel Modeling

Channel modeling is a vital issue in wireless communication system, especially in outdoor FSO link where information carrying light beam gets deteriorated by adverse environmental conditions. With the help of channel modeling system performance is tried to improve. For this different channel models are invented and implemented. The light travelling through the atmosphere attenuates due to two factors viz. absorption and scattering. Beer's law gives the value of received power after passing through the atmosphere. This law involves the attenuation coefficient which is the combination of molecular and aerosol scattering coefficient and molecular and aerosol absorption coefficient.

It is given by[1]:

$$T = \frac{P_r}{P_t} = \exp[-\psi_t(\lambda)L] \quad (1)$$

Where  $T$  is transmittance of atmosphere at wavelength  $\lambda$ ,  $\psi_t$  is the total attenuation coefficient ( $m^{-1}$ ),  $L$  is the length of channel,  $P_t$  and  $P_r$  are the transmitted and

received optical powers. The value of total attenuation is given by [1]:

$$\psi_t = \alpha_{ml}(\lambda) + \alpha_{al}(\lambda) + \beta_{ml}(\lambda) + \beta_{al}(\lambda) \quad (2)$$

Where  $\alpha_{ml}$  and  $\alpha_{al}$  are absorption coefficients of molecules and aerosols respectively and  $\beta_{ml}$  and  $\beta_{al}$  are scattering coefficients of molecules and aerosols respectively.

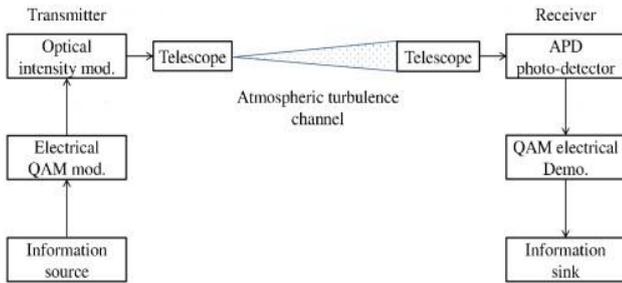


Fig 1. FSO system with atmosphere as channel

A light photon is absorbed and scattered by a molecule. Due to scattering, the incident light gets deflected from its initial direction causing spatial, angular and temporal spread [2]. The scattering effect depends on the radius of the particles (fog, haze, rain etc.) that come in the way of beam propagation. A size parameter is calculated using the radius of particle and the wavelength. If this parameter size is less than 1 then the scattering is said to be Rayleigh scattering[3], if it is equal to 1 then it is Mie scattering[4] and if it is more than 1 then the scattering process can be explained using diffraction theory or geometric optics[5]. FSO transmission is unaffected due to rain and snow as the particle size is much larger than the transmission wavelength. The atmospheric attenuation is almost independent of wavelength between 785 and 1550 nm for fog; however, it is wavelength dependent in case of haze. Fog has the particle size between 1 and 20  $\mu\text{m}$  where as haze has the particle size between 0.01 and 1  $\mu\text{m}$  which means that the beam is wavelength dependent in case of haze condition[4]. Air refractive index varies along the transmission path due to in-homogeneities in the temperature and pressure caused by solar heating and wind due to which the received signal contains random fluctuations in amplitude and phase. It is known as scintillation or channel fading[7]. Its effects are more severe in case of long transmission. The atmospheric turbulence is characterized into three parameters viz. inner  $l_0$  and the outer  $L_0$  scales of turbulence and the index of refraction structure, also called as turbulence strength. The Kolmogorov theory gives  $L_0$  is the largest cell size before the energy is injected into a region and  $l_0$  is the smallest cell size before the energy is dissipated as heat.  $L_0$  has negligible effect on turbulence[7]. Hufnagel-Valley is a model which says that the refraction structure parameter  $C_n^2$  is altitude dependent. Its value is larger at lower heights as there is significant heat transfer between air and surface and smaller at higher altitudes. For horizontally propagating field it is constant. The table

containing values of  $C_n^2$  for different weather conditions is given as[8]:

Table 1: Different values of  $C_n^2$  for different weather conditions

Weather Condition	$C_n^2 \times 10^{-14} \text{ (m}^{-2/3}\text{)}$	V (km)
Clear	2	> 10
Light Haze	1.8	4-10
Haze	1.5	2-4
Thin fog	1	1-2
Light fog	0.5	< 1

Several channel models have been proposed for the distribution of turbulence induced fading in FSO system, namely, log-normal, gamma-gamma, negative exponential, I-K distribution etc. Log-normal model is meant for weak turbulence conditions. It was derived based on the first-order Rytov approximation. It is deployed for short range systems in urban areas[2]. Another model named negative exponential model used Rayleigh distribution for strong turbulence regime[9]. A doubly-stochastic scintillation model called Gamma-Gamma model is there in which the received intensity is a product of two Gamma random variables X and Y, which are irradiance changes arising from large and small scale turbulences respectively[7]. Double Generalized Gamma model gives more accurate results than Gamma-Gamma distribution and can be used while propagating spherical wave in strong turbulence and plane wave in moderate turbulence regime [10]. Since the fog particle distribution is not available with meteorological data, therefore, fog induced attenuation is predicted using empirical models such as kruse model, kim model and naboulsi model. Koschmieder law is used to measure the fog density on the basis of visibility and defines the visibility as the distance to an object at which the visual contrast or transmittance of an object drops to a certain value of the transmittance threshold  $T_{th}$  level of the original visual contrast[11]. Kruse (1962) developed a model in which he linked visibility with transmittance, attenuation coefficient, wavelength and a particle size-related coefficient  $\delta$ . He assigned  $\delta$  three different values for visibility ranges above 50 km, between 6 and 50 km and between 0 and 6 km. The disadvantage of this model was that it was developed for dense haze and is not suitable to study the effect of fog for visibility equal to 1 km. Kim (2001) developed another model in which he divided the distance of 0 to 6 km into three parts and assigned three different values of  $\delta$  each. Kim further says that in moderate-to-dense fog conditions, the attenuation coefficient is wavelength independent and therefore use of higher wavelengths is inappropriate. Naboulsi (2004) gave a contradictory model to kim's model which says that attenuation due to fog is wavelength dependent and is higher at 1550 nm than at 785 nm for visibility greater than 0.5 km. The difference between Kim model and Naboulsi model can be seen for wavelengths higher than 900 nm and shows similar results for wavelength range of 500 nm to 900 nm and for visibility of 1 km[2].

## B. Modulation

Modulation techniques play an important role on the performance of FSO communication link. Some of the

important work on modulation techniques in FSO is as under:

On-Off keying modulation scheme is the simplest one. The modulated data is represented by the presence or absence of a light pulse in each symbol interval. At the receiver, dynamic thresholding need to be done for optimal signal detection[12]. A concept called channel state information is used to estimate channel fading at the receiver according to which some training pilot symbols are sent from the transmitter, based on which the receiver estimates the same. The disadvantage of this scheme is the loss of transmission rate[13]. Maximum likelihood (ML) is a concept which can be used in a case if the full knowledge of instantaneous channel fading coefficient is not available. In that case, a symbol-by- be decoded with error[17]. Overlapping PPM (OPPM) is a concept in which multiple pulses can occupy adjacent slots, thus

PPM performs better. Pulse Width Modulation (PWM) is more advantageous than PPM. PWM requires lower peak transmit power, has better bandwidth efficiency and lesser Inter-symbol interference but at the cost of higher average power requirement for a large number of slots per symbol[15]. Ghassemlooy et al (1998) and Mahdiraji et al (2006) gave the concept of Digital Pulse Interval modulation (DPIM) is a technique in which after a number of empty slots, a pulse is sent. To avoid sending a long sequence of “on” pulses, a guard slot is sent. PPM and PWM are synchronous modulation schemes whereas DPIM is an asynchronous modulation scheme. DPIM is more bandwidth efficient than PPM and PWM. The problem in DPIM is the possibility of error propagation in signal demodulation at the receiver i.e. if an off slot is read as on, all the upcoming symbols in frame will modulation (SIM) is a concept in which the source data modulates an RF signal and then the resulting signal is

Table 2. Different modulation techniques and their characteristics

Modulation Scheme	Comment
OOK	Needs dynamic thresholding at receiver
PPM	Optimal in terms of energy efficiency
MPPM	Lower PAPR and more bandwidth efficient than PPM
PWM	Needs lower peak power, better spectral efficiency, more resistant to ISI than PPM
PPMPWM	Power and bandwidth efficiencies in mid-way between PPM and PWM
DPIM	No need to symbol synchronization, more bandwidth efficient than PPM and PWM
DPPM	Simpler symbol synchronization and improved bandwidth efficiency than MPPM
OPPM	More bandwidth efficient than PPM
Multilevel PAM	Higher bandwidth efficiency than PPM, requires dynamic threshold at receiver
SIM	High capacity, cost effective implementation, low power efficiency
Pol. Mod.	High immunity to laser phase noise and modular nonlinearity
CAP	Higher energy efficiency and simpler implementation than PPM

increasing bandwidth efficiency but increasing the chances of error. Differential PPM (DPPM) is a concept in which empty slots in PPM symbol are removed to increase the bandwidth efficiency and improve symbol synchronization. PPMPWM scheme is the combination of PPM and PWM. OPPM, DPPM and PPMPWM have the disadvantages of reduced energy efficiency, higher demodulation complexity and higher chances of error propagation in detecting a received frame of symbols[15]. Subcarrier intensity symbol ML detector can be used to improve detection performance but at the cost of very high complexity[14]. OOK has poor energy as well as spectral or bandwidth efficiency. Energy efficiency is the maximum achievable data rate at a target BER for a given transmit energy and bandwidth efficiency is the information transmission rate for a given bandwidth[15].OOK scheme is followed by Pulse Position Modulation (PPM) scheme. PPM has better power efficiency than OOK but at the cost increased bandwidth requirement and increased complexity[16]. PPM does not require dynamic thresholding for optimal detection as in the case of OOK scheme[13]. PPM scheme was proposed to be used for deep space communication by Hemmati in 2006. Multipulse PPM (MPPM) was then power ratio (PAPR) than conventional PPM. MPPM performs introduced which has capacity almost double to that of better in conventional PPM scheme and has reduced peak-to-average case of a limited peak transmit power and in case of limited average transmit power,

used to change the intensity of an optical source[18]. Combination of SIM and Orthogonal Frequency Division Multiplexing (OFDM) gives high capacity and lesser cost of implementation[19]. The main drawback of SIM is poor power efficiency. Polarization shift keying (Pol-SK) is a technique based on extraction of Stokes parameters of transmitted light.

The advantages of Pol-SK is high phase noise immunity and high atmospheric turbulence-induced fading. Therefore, Pol-SK can be used for long range FSO systems[20]. The concept of multi-level modulation schemes such as the combination of PAM and OOK, Q-ary PAM etc. helps to obtain higher bandwidth efficiency at the cost of higher complexity[21]. In another multi-level scheme called Carrier-less amplitude and phase (CAP) modulation two orthogonal multi-level signals are considered by means of special pulse shaping and without the use of carrier. It has the advantage of higher energy efficiency and simpler implementation.

### III CONCLUSION

From the above discussion it is concluded that in Free Space Optics channel modeling and modulation techniques are two vast areas of research. A lot of work has been done but still the perfection needs to be achieved. In channel modeling, different models have been developed to reduce the effect of atmospheric turbulence losses. Some of the important models are log-

normal, gamma-gamma and negative exponential models. In modulation techniques, OOK technique is the most researched technique due to its simplicity. Some other techniques such as multilevel schemes, Pol-SK scheme etc. are also in trend for betterment of the FSO system.

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# Comparative Analysis of Modulation Formats under Gigabit Passive Optical Networks

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**Abstract-** In this paper we are discussing the performance of various file formats namely RZ (Return to Zero), CRZ and NRZ (Non Return to Zero) on GPON network. A 2.5 Gbps downstream network is investigated by varying the optical fiber length and the number of users. In this we check the performance of the above mentioned modulation formats on GPON network viz Eye diagram and BER value.

**Keywords-** RZ, CRZ, NRZ, GPON

## I. INTRODUCTION

FTTH (fiber to the home) is highly recommended these days due to its high bandwidth advantage over the various networks. FTTH is a passive network which minimizes the maintenance and installation cost and eliminates FTTH is very efficient for long distance system communication [1]. FTTH networks exhibits low attenuation (0.2-0.6db/km) and high bandwidth (>30,000 GHz) in single mode optical fiber. It can provide triple play services i.e. voice, data and video in one single network [2].

PON Network is generally used to provide triple play service from central office to the end users. There are four main PON technologies that are most commonly used in FTTH that is Broadband PON (BPON), Gigabit PON (GPON), Ethernet PON (EPON or GEAPON) and Wavelength Division Multiplexing Passive Optical Network (WDMPON) [3]. In this paper we are primarily focusing on GPON technology. GPON is basically used as a bidirectional point-to-multipoint system connects one central unit to multiple users at the receiver end [4]. The main characteristic of PON is that it is backward compatible and uses the passive optical splitters in the network [5]. GPON (Gigabit Passive Optical Networks.) is defined by ITU-T recommended series G.984.1 through G.984.4 series. GPON can handle various types of traffic like Ethernet, ATM and TDM (PSTN, ISDN, E1 and E3). The main components of GPON Network are optical line termination (OLT) and optical network unit (ONU) or optical Network termination (ONT). GPON supports triple play services, high bandwidth, used for long distance transmission and many more. GPON is compatible with various data rates both in case of upstream and downstream communication. In GPON there is only one SMF (single mode fiber) that is connected to a passive optical power splitter near user end .Splitter simply divides the optical power into N parts in order to distribute that power to end users. In this the number of paths may vary. When we transmit optical signal in long distance,

absorption of signal takes place. In order to improve this absorption of signal the optical amplifier is used. EDFA (Erbium Doped Fiber Amplifier) is preferably used as an Optical amplifier because in the low pass window of silica, the EDFA is capable to provide gain at 1550 nm [9]. In GPON an encryption Algorithm is used in order to secure the data. Security is mainly needed in case of downstream traffic management. Two types of switching are used for protection in GPON networks that is Automatic switching and Forced Switching. Automatic Switching is used when loss of signal or loss of frame occurs. Basically this is used for fault detection. Forced Switching is used when you want fiber replacement etc [10].

## II. LITERATURE REVIEW

Gayatri et al. investigated GPON system using various advanced modulation formats. They evaluated the system using 8 users at 2 Gbps bit rate. The Q factor and BER are used to study the variations in values by employing different modulation formats. They had shown by simulative analysis that by combining these modulation formats with Erbium Doped Fiber Amplifier (EDFA) the transmission distance can be maximized up to a certain level. Sumanpreet, Sanjeev Dewra studied all the PON standards and compared their performances considering different parameters like there compatibility with previous versions of PON standards, technology used in them and many more. In this paper they studied out ATM, APON, BPON, EPON and GEAPON. The architecture and working of GPON is explained thoroughly by the author. In GPON transmission Downstream and Upstream GPON Frame format, Dynamic Bandwidth Allocation (DBA), Optical splitters and techniques of manufacturing optical splitters was explained. Jagjit Singh Malhotra, Manoj Kumar, Ajay K. Sharma investigated the downstream configuration of WDMPON based FTTH access network with a bit rate 2.5 Gb/s. The system supports the triple-play i.e. voice, video and data. The FTTH layout of this PON network was with 32 end-users. The performance metrics used are BER, Q factor and eye opening. Dense wavelength division multiplexing (DWDM) has been incorporated for bandwidth optimization. Simulative results show that high  $Q^2$  and low BER authorize the long reach bandwidth optimized 32 channel DWDM FTTH link employing triple play services.

## III. SYSTEM ARCHITECTURE

A PON consists of an optical line terminal (OLT) at the service provider's central office and a number of optical network units (ONUs) near end users. PON is a shared network, as the OLT sends a single stream of downstream traffic that is seen by all ONUs. The signal with 2.5gbps data rate is transmitted through the single mode fiber to the ONTs'. For Video Optical transmission, two analog signal generators having different wavelengths are enumerated to form a single signal. This enumerated electric signal is fed to the Directly Modulated LASER. These lasers are low in cost as well as consume very low power as compared to other lasers. The electrical signal is now metamorphosed into optical signal which is further fed to the pre amplifier. For Data/VOIP signal, a pseudo random binary data is fed to the electric generator, transforming the data into an electric signal. This signal is provided as input to the direct modulated laser and then followed by the pre amplifier. The wavelength range used in case of downstream direction is 1480-1500 nm and the wavelength range 1550-1560 nm is used for downstream RF video distribution. The optical signal from both the pre-amplifiers is multiplexed using Optical multiplexer and transmitted over the Single Mode Fiber (SMF) via multiport fork. The optical signal is further fed into optical vortex making the helical wave fronts focus into a twisted light. Due to twisting the light waves at the axis cancel out each other [6]. Using this multiport fork the multiplexed optical signal is coupled into the single mode fiber. This optical signal is further amplified using the black box EDFA which boosts the signal in order to transmit the

signal to longer distances. Once the signal has reached the end of the SMF the optical signal power is evenly divided into 96 ONT's using the optical splitter Each ONT only reads the content of those packets that are addressed to it. Encryption is used to prevent eavesdropping on downstream traffic. Output from the fiber trunk reaches through the 1:96 splitter and then to the individual users. As there is only a single receiver at OLT, ONU transfers its data turn wise to the OLT. Optical splitters split the received signal from fiber trunk into two parts, one is for voice/data and other for video. This differs from Active Ethernet, which requires a separate cable run for each user port which requires 96 individual cable runs and 96 active ports to provide the same number of ports as a single fiber run. Optical filters are devices that selectively transmit the light of different wavelengths. Electric filters are analog circuits which perform the signal processing functions, precisely to remove unwanted frequency components from the signal or in some cases to enhance wanted ones. The video signal receiver comprises of optical filter, receiver and electrical filter while the voice/data receiver consists only of optical filter and receiver [3]. PIN photo detector detects the electrical signal at receiver side [5]. Measuring instruments viz. Eye diagram analyzers and BER Testers have been engaged to estimate the link's performance using different line coding schemes. The eye analyzers are used to study out the effect of different line coding techniques. The more the width of the eye opening more precise are the results obtained. The smaller the slope of eye better will be the results.

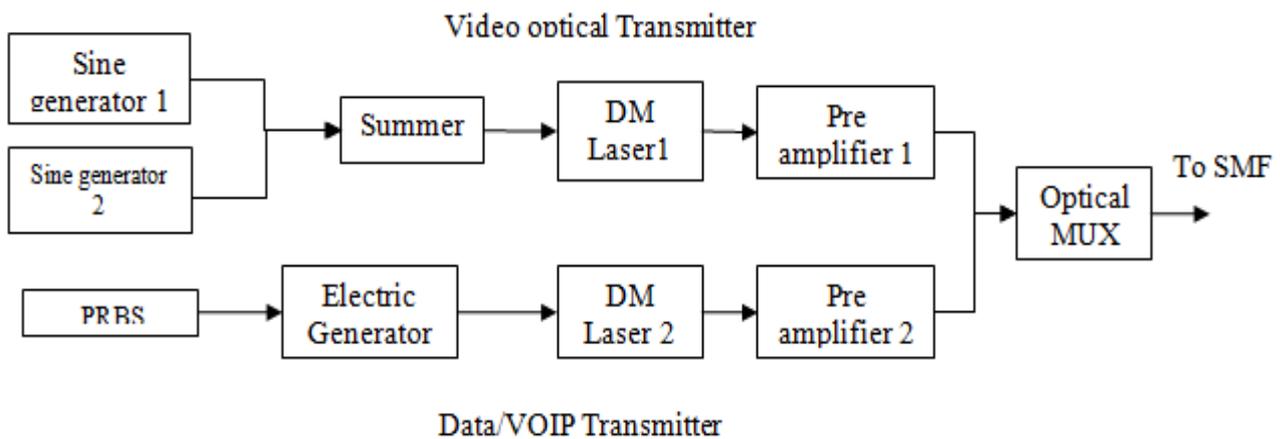


Figure 1: Video Optical Transmitter

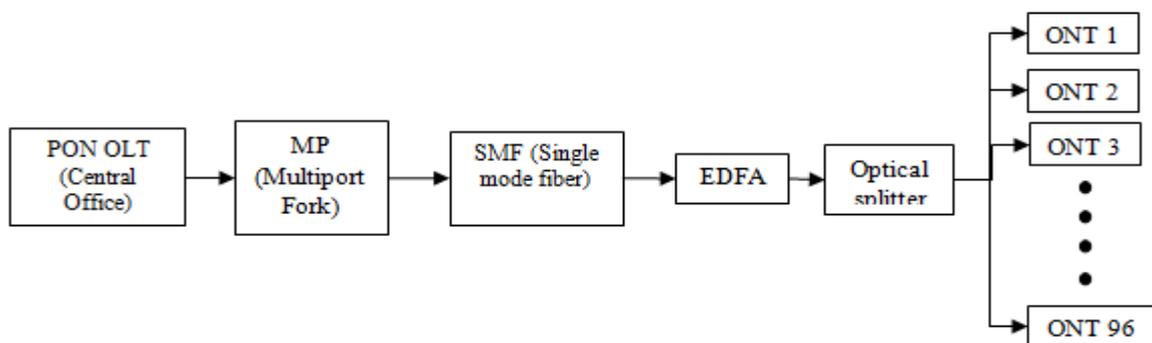


Figure 2: Video Optical Receiver

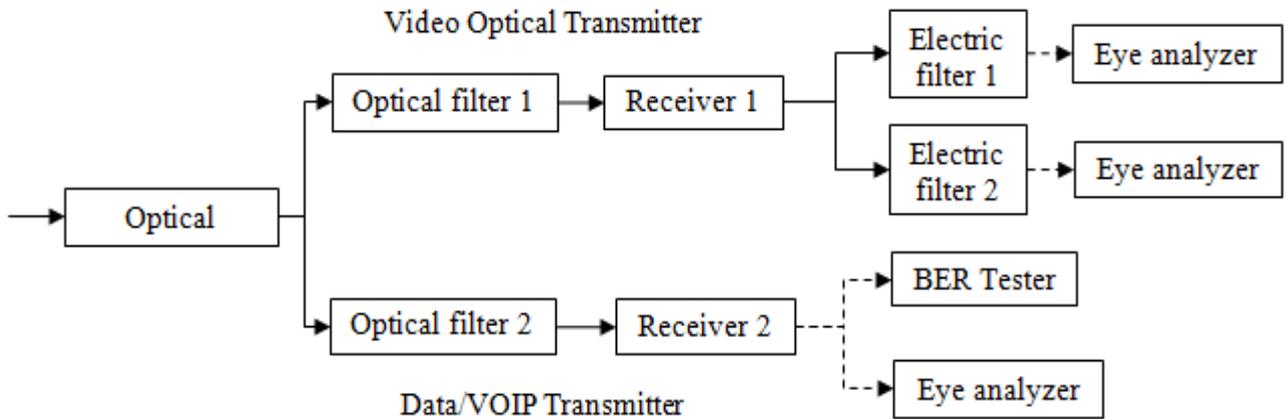


Figure 3: Video Optical Receiver

IV. RESULT AND DISCUSSION:

The graph shows the changes in BER value when we increase the fiber length for different modulation formats. In this we measured the BER value and change in eye diagram characteristics at different fiber lengths i.e. 20, 40, 60, 80 and 100 km. The results are independent of the number of users as we examined the BER values for 32, 64 and 96 users. The above graph is for 96 users. The Data rate for this GPON system is 2.5 Gbps. In case of NRZ modulation format, the variation in the fiber length has not much affected the BER value. It almost remains constant resulting in wastage of bandwidth on large scale. In RZ case, we get optimal values of BER up to 80km as shown in figure. Beyond that the signal starts degrading as the BER obtained is less than  $10^{-9}$ . While in case of CRZ we get optimal values of the BER for all the values of fiber length.

Figure 4: BER Analysis for different modulation Techniques

The eye diagrams for RZ, NRZ and CRZ are as follows:

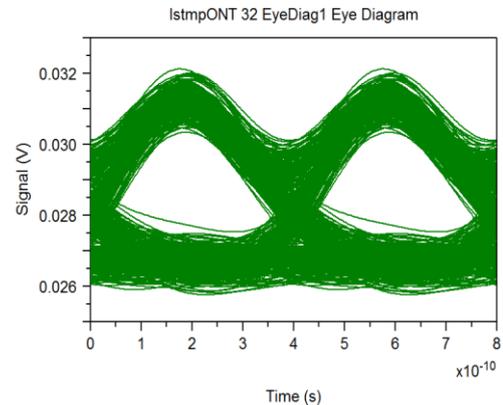


Figure 5: Eye Diagram using CRZ Modulation

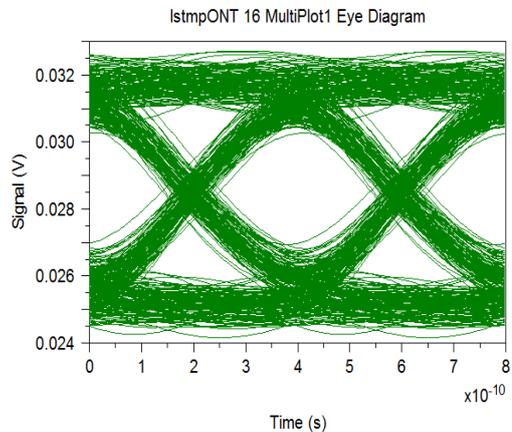
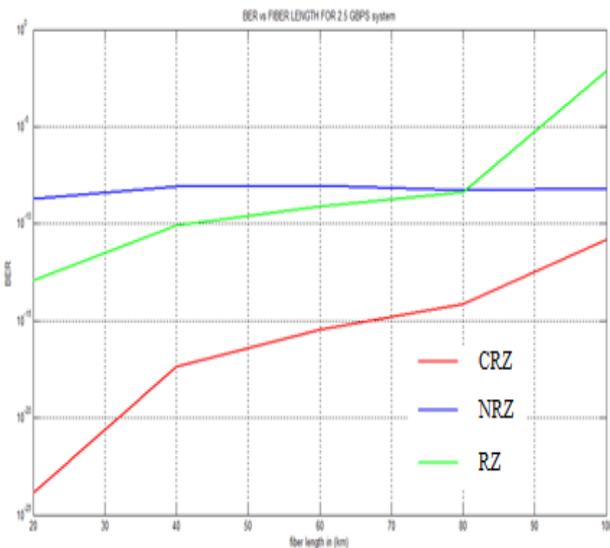


Figure 6: Eye Diagram using NRZ Modulation



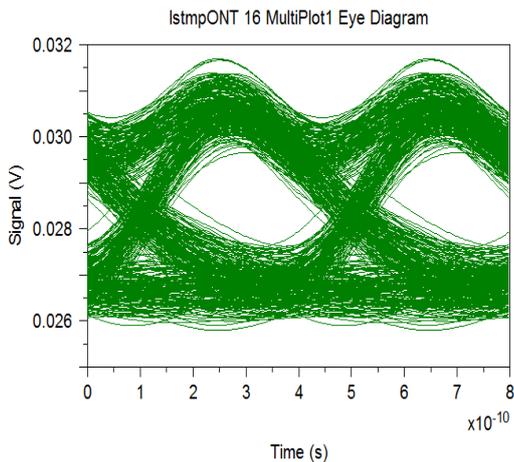


Figure 7: Eye Diagram using RZ Modulation

## V. CONCLUSION:

The RZ format is not compatible at higher values of fiber length i.e. 80km and beyond. The BER values obtained are independent of the number of users but vary for different modulation formats. CRZ as compared to other formats i.e. NRZ and RZ has very good results for the GPON network. CRZ modulation format can be further optimized in future.

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## **Track-1**

### **Technical Session 4 - (A & B)**

**SOFTWARE ENGINEERING/ CLOUD  
COMPUTING/ DATA MINING**



# A New Chaotic Pseudorandom Number Generator using Chaotic Logistic and Tent Map Functions

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**Abstract:** Chaotic functions are used in cryptographic networks and variety of engineering applications because of their unique complex properties. They individually provide security to cryptographic algorithms. Combining the chaotic functions can provide much more security with additional unpredictability of data. This paper describes chaotic pseudorandom number generator formed by combining two chaotic one dimensional function, Tent and Logistic Map. Statistical analysis of proposed chaotic pseudorandom number generator has also been done to validate its performance.

**Keywords:** Chaotic Functions, Tent Map, Logistic Map, Chaotic Pseudorandom Number Generator, FIPS 140-2, NIST.

## I. INTRODUCTION

The word chaos means disorder. In cryptographic network chaos increases the security of data by creating confusion. The data after using chaotic functions appears more like a noise and less like a data and can create confusion to the intruder that whether it's data or some noise. Chaotic functions have some unique properties such as sensitivity to initial values, ergodicity, system complexity and mixing property, sensitivity to system control parameter [1,2,3]. Sensitivity to initial values means a deviation in the initial value of the function would lead to a considerable change in the output making intrusion hard. This sensitivity to initial conditions is so high that even if we make a change after 3<sup>rd</sup> decimal place then it causes a noteworthy change in the output [1]. Chaotic functions individually provide security to many algorithms. Combining these functions would not only increase the security of algorithms but also make them much more complex for various cryptographic networks [4].

Pseudorandom generators play major role in variety of applications like cryptography algorithms, communication protocols, simulations of physical systems, finite state machines and entertainment [3,5]. Pseudorandom generators are different from true random generators as they don't depend upon any physical source such as thermal noise, atmospheric noise, cosmic noise and many more [3]. Pseudo-random generators rely on initial values and from these initial values they generate a very long random sequence [3]. The security of cryptographic algorithms depends upon the pseudo-random number generators (PRNG), which further depends upon the

functions from which PRNGs have been generated. If PRNGs generate sequences with poor randomness then cryptographic algorithms using these PRNGs can be intruded easily. PRNGs are periodic in nature but their periods are hefty which make them difficult to get predicted [5]. PRNGs are constructed from chaotic maps to generate binary sequences which can be used for strong encryption of the signals [6]. Chaotic pseudo-random number generators (CPRNG) are the PRNGs constructed using chaotic maps [3].

In the first section introduction to two chaotic functions which have been combined has been given. In second section proposed chaotic pseudorandom number generator's (CPRNG) construction using two functions and transformation T has been given. In third section statistical tests and entropy calculations of proposed CPRNG have been done. In fourth section results and discussions have been given. In last section conclusion has been drawn.

## II. INTRODUCTION TO TWO CHAOTIC FUNCTIONS

The two chaotic one dimensional functions which have been considered for constructing CPRNG are Tent and Logistic map function. One dimensional function has been used because of their simplicity. Out of all one dimensional functions only tent and logistic functions have been considered because cryptographic algorithms mainly use these two functions [7]. These chaotic functions have been discussed as under:

### A. Logistic Function

Logistic function is a one dimensional function given by the expression:

$$g(x(n))=X_{n+1}=A.X_n.(1-X_n), n=1,2,3,..N \quad (1)$$

where A is the system control parameter having value in the interval [0, 4],  $X_n$  is the initial condition of the function with value in the interval [0, 1] [1]. For the values of  $A < 3.7$  the system provides expected behavior and for values  $3.7 < A < 4$  the system shows chaotic behavior [1].

### B. Tent Function

Tent map and Logistic map are topologically conjugate to each other [8]. Tent map is another one dimensional map given by the expression:

$$h(y(n))=Y_{n+1}=r.(1-|1-2Y_n|), n=1,2,3..N \quad (2)$$

Where  $r$  is the control parameter which can have value between 0 and 1,  $Y_n$  is the initial condition such as  $0 < Y_n < 1$  [2]. For  $0.99 < r < 1$ , system shows chaotic behavior [2].

### III. PROPOSED CHAOTIC PSEUDO-RANDOM NUMBER GENERATOR

Tent and logistic functions individually perform well in their applications [4]. To make the algorithms more secure and to create more confusion with additional complexity in algorithms both these functions have been combined [4] using Transformation T [3]. The proposed CPRNG has been named as Tengistic CPRNG. The block diagram of proposed CPRNG has been shown in Fig.1.

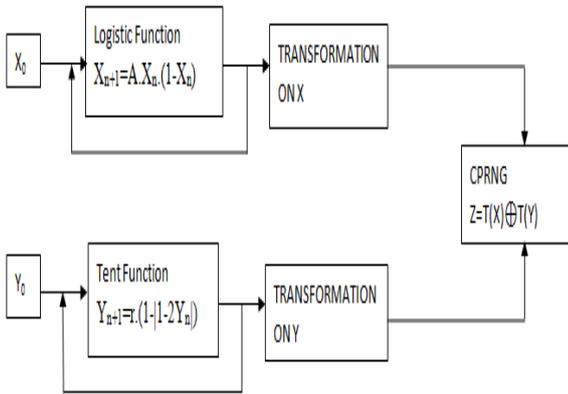


Fig.1: Block diagram of Proposed Chaotic Pseudo-random number generator (CPRNG).

In the block diagram shown in Fig.1  $X_0$  and  $Y_0$  have been taken as the initial values for logistic and tent mapping in the interval  $[0, 1]$ . Both the functions have been iterated to produce function values. Then the transformation has been applied on the produced function values in following manner: X corresponds to logistic function, Y corresponds to Tent function. X and Y can be given by [3]:

$$X = \{x(n), n = 1, 2, 3, \dots, N\} \quad (3)$$

$$Y = \{y(n), n = 1, 2, 3, \dots, N\} \quad (4)$$

The chaotic sequence given by equation (3) has been transformed into key streams using transformation  $T_1$  defined over  $\{0, 1, 2, \dots, 255\}$  [3].

$$T_1(X) = \text{mod}(\text{round}(L(X - \min(X)/(\max(X) - \min(X))), 256) \quad (5)$$

$$T_2(Y) = \text{mod}(\text{round}(L(Y - \min(Y)/(\max(Y) - \min(Y))), 256) \quad (6)$$

The value of L has been taken as  $10^{16}$  [3].

$$T(X) = \text{dec2bin}(T_1(X)) \quad (7)$$

$$T(Y) = \text{dec2bin}(T_2(Y)) \quad (8)$$

The values obtained from equations (5) and (6) have been converted into decimal values using the formula given by equations (7) and (8). The two sequences obtained from equation (7) and (8) have been combined

using XOR operation to obtain the Tengistic CPRNG (Z) [3].

$$Z = T(X) \oplus T(Y) \quad (9)$$

$\oplus$  represents the XOR operation between two sequences. The final sequence has been obtained by using XOR operation because it proficiently covers the information in the sequences [9].

### IV. STATISTICAL ANALYSIS

The generated CPRNG has been analyzed by making use of statistical tests like correlation value test [4] and FIPS140-2 test [3, 10]. After these tests the most rigorous and most popular NIST statistical test suite for randomness has been applied [2, 11].

#### A. Correlation value tests:

The correlation analysis also checks for the randomness of pseudorandom sequences [4]. The three methods which have been used for correlation analysis are: Pearson's Correlation Coefficient, Hamming Distance and Auto-Correlation Function.

1) Pearson's Correlation Coefficient  
The Correlation has been analyzed for the two sequences obtained from equations (5) and (6). The correlation coefficient b/w two sequences (TX and TY) is given by [4]:

$$C(s1, s2) = \frac{\sum_{i=1}^N (xi - \mu(x))(yi - \mu(y))}{\sqrt{\sum_{i=1}^N (xi - \mu(x))^2 * \sum_{i=1}^N (yi - \mu(y))^2}} \quad (10)$$

where  $x_i$  is the sequence of 1's and 0's corresponding to equation (5),  $y_i$  is the sequence of 1's and 0's equation (6),  $\mu(x)$  and  $\mu(y)$  are the means for the sequences given by:  $\mu(x) = \sum_{i=1}^N x_i / N$ ,  $\mu(y) = \sum_{i=1}^N y_i / N$ , N is the number of terms that have been taken for calculation [4]. The correlation coefficient for a random sequence should be 0. The values having value  $\pm 1$  are said to be highly correlated [4].

#### 2) Hamming Distance

Hamming distance is the minimum number of bits by which the two sequences differ [4]. It is given as:

$$d(s1, s2) = \sum_{i=1}^N (s1 \oplus s2) \quad (11)$$

Where d is the distance which represents the number of bits by which two sequences (S1 and S2) differ, N is the number of terms that have been taken for calculation. Since in equation (9) XOR of two sequences has already been calculated so it can be directly applied on equation (9). For a random sequence the value of d should be near about half of its length [4].

#### 3) Autocorrelation Function

This test finds the correlation within the binary sequence [10].

$$A(d)=\sum_{i=1}^{N-d-1}(s_i \oplus s(i + d)) \quad (12)$$

where d is a fixed integer such that  $1 \leq d \leq N-1$ , N is the number of terms that have been taken for calculation [10]. The formula used for analyzing correlation given by A(f) is:

$$A(f)=\frac{2(A(d)-(\frac{N-d}{2}))}{\sqrt{N-d}} \quad (13)$$

The value of autocorrelation function (A(f)) should lie between  $\pm 1.96$  for significance level of 5% [10].

#### B. FIPS 140-2 Test:

FIPS test includes 4 tests: Monobit test, Poker test, Run test and Long Run test [10]. These tests are performed on a sequence of length 20,000 bits and the sequence to be random should pass all the tests [10].

#### C. Nist Statistical Tests

NIST consists of 15 tests [12]. The tests are: Frequency (Monobit) Test, Frequency Test within a Block, Runs Test, Longest-Run-of-Ones in a Block, Binary Matrix Rank Test, Discrete Fourier Transform (Spectral) Test, Non-overlapping Template Matching Test, Overlapping Template Matching Test, Maurer's "Universal Statistical" Test, Linear Complexity Test, Serial Test, Approximate Entropy Test, Cumulative Sums Test, Random Excursions Test and Random Excursions Variant Test [12]. Null hypothesis ( $H_0$ ) that the sequence is random one has been made. A significance level ( $\alpha$ ) has been chosen for all the tests. The value of tail probability called p\_value has to be calculated [12]. If p value  $\geq \alpha$ , the null hypothesis comes to be true so sequence is random. If p-value  $< \alpha$ , null hypothesis is rejected and sequence is said to be non-random [12].

#### D. ENTROPY

Entropy provides uncertainty and can be given by the equation [11].

$$H = -\sum_{i=1}^n P_i \cdot \log P_i \quad (15)$$

where  $p_i$  is the probability of variable. It finds the randomness of the sequence [12]. The more value of uncertainty means it will be more unpredictable in nature and hence more will be the security [12].

### V. RESULTS AND DISCUSSION

A sequence of 20,000 bits has been taken for performing all the tests. These tests have been implemented on MS Excel and p-value calculation using incomplete gamma function [12] has been done in MATLAB. The calculated values for all the tests have been given in tabular form. Table I shows the values of correlation analysis tests. The value of Pearson's Correlation Coefficient has been calculated to be -0.00235 which lies in the proximity of 0. The calculated value of hamming distance test has been calculated to be 10023

which is near the half value that is 10,000 of binary length sequence of length 20,000.

Table I: Results of Correlation Analysis Tests

BINARY SEQUENCE SIZE	TEST	Calculated Value	RESULT
20,000	Pearson's correlation coefficient	-0.00235	SUCCESS
	Hamming Distance	10023	SUCCESS
	Autocorrelation Value (d-value =9500)	-0.2147	SUCCESS

The calculated value of Autocorrelation test has been calculated to be -0.2147 which lies in the range  $\pm 1.96$ . As per the explanation given in section 4 it can be concluded that the proposed CPRNG has passed all the correlation analysis tests.

Table II: Results of FIPS 140-2 Test

Test Names	FIPS 140-2		Standard $\alpha = 0.0001$					
	Required intervals	Accepted intervals	Obtained values for different initial conditions					
Monobit	9,725~10,275	9,725~10,275	10023	10050	9911	10044		
Poker	2.16~46.17	2.41~44.26	21.677	9.395	6.3616	6.1504		
Long Run	<26	<26	0	0	0	0		
Run	K	K						
	1	2,315~2,685	1	2,362~2,638	2474	2514	2472	2449
	2	1,114~1,386	2	1,153~1,347	1257	1240	1262	1312
	3	527~723	3	556~694	609	613	600	596
	4	240~384	4	264~361	312	312	332	337
	5	103~209	5	122~191	155	160	163	139
	6	103~209	6	122~191	133	134	130	124
	+		+					

Table II shows the calculated values of FIPS 140-2 test. The values have been calculated for the 4 different initial conditions. The required and accepted interval values have been given in the table 2 [3]. Table II clearly shows that the calculated values are within the required and accepted interval. It can be concluded that the proposed CPRNG has passed the FIPS 140-2 test.

Table III shows the summary of all calculated values of NIST test suite. The p\_value for all the tests have been taken at 1% significance level. The sequences which have p\_value  $< 0.01$  and will be considered non-random [12]. Table 3 shows that the p\_value for all the tests is greater than 0.01.

(i) The frequency test has been implied and the p-value obtained in this test is 0.7499. (ii) Block Frequency test has been implied for which  $M=250$  and  $N=80$  has been

considered. The p-value obtained from this test is 0.3109. (iii) Runs test have been implied for which p-value obtained is 0.5179. (iv) For Long Run of One's test the p\_value obtained is 0.6886. (v) For Serial test two p\_values are computed p1=0.0742 and p2=0.1318. (vi) For Binary Matrix Rank test the p\_value obtained is 0.9869. (vii) For Approximate Entropy test the p-value obtained is 0.6890. (viii) For Discrete Fourier Transform test the p-value obtained is 0.0422. (ix) For Non-Overlapping Template Matching test the p-value obtained is 0.0190. (x) For Overlapping Template Matching test the p\_value obtained is 0.1214. (xi) For Maurer's Universal Statistical test the p\_value obtained is 0.0262. (xii) For Linear Complexity the p\_value obtained is 0.8293. (xiii) For Cumulative Sums test the p\_value obtained is 0.2464. (xiv) For Random Excursions test 8 p\_values are obtained which are 0.5702, 0.5549, 0.7649, 0.9875, 0.0195, 0.0500, 0.5683 and 0.1321. (xv) For Random Excursions Variant test 18 p\_values have been computed which are 0.7150, 0.8194, 0.8910, 0.7814, 0.6156, 0.5529, 0.6812, 0.9635, 0.8551, 0.7841, 0.7150, 0.6480, 0.6156, 0.6156, 0.5529, 0.4935, 0.4652, 0.4652.

Table III: Summary of NIST Test Suite.

TEST	Obtained p_value	RESULT
1.Frequency(monobit)	0.7449	SUCCESS
2.Block Frequency	0.3109	SUCCESS
3.Runs	0.5179	SUCCESS
4.Long Run	0.6886	SUCCESS
5.Serial(p1,p2)	0.0742,0.1318	SUCCESS
6.Binary Matrix Rank	0.9869	SUCCESS
7.Approximate Entropy	0.6890	SUCCESS
8.Discrete Fourier Transform	0.0422	SUCCESS
9.Non-Overlapping Template Matching	0.0190	SUCCESS
10.Overlapping Template Matching	0.1214	SUCCESS
11.Maurer's "Universal statistical	0.0262	SUCCESS
12.Linear Complexity	0.8293	SUCCESS
13.Cumulative Sums	0.2464	SUCCESS
14.Random Excursions	0.5702,0.5549,0.7649,0.9875 0.0195, 0.0500,0.5683,0.1321	SUCCESS
15.Random Excursions Variant	0.7150,0.8194,0.8910,0.7814,0.6156, 0.5529,0.6812,0.9635,0.8551,0.7841 0.7150,0.6480,0.6156,0.6156,0.5529, 0.4935,0.4652,0.4652	SUCCESS

The p\_values have been computed for different initial values for all the 15 tests to examine the distribution of p\_values. To interpret the empirical tests p\_values have been calculated and plotted to ensure the uniformity of p\_values [12]. The uniformity can be checked by plotting the histogram of values [12].

Fig.2 shows the histogram of calculated p\_values. The interval [0, 1] has been divided in to 10 subintervals shown on x-axis and the p\_values have been counted according to the sub-interval in which it lies shown on y-axis and histogram has been plotted depending on the count [12]. The histogram obtained in fig 2 has the uniform pattern. It can be concluded that proposed CPRNG has passed NIST tests and has also shown the uniformity of p values.

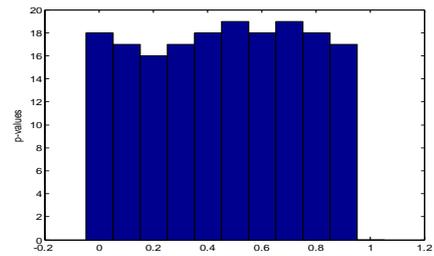


Fig2: Histogram of computed p-values.

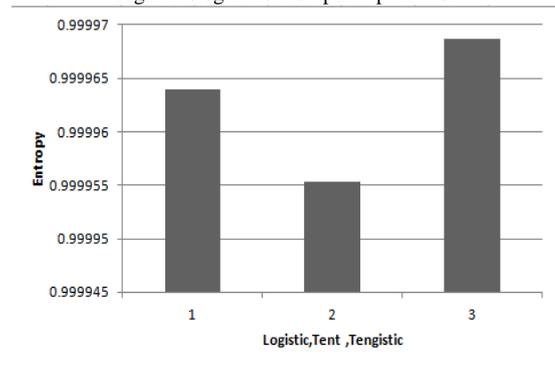


Fig3: Comparison of Logistic, Tent and proposed CPRNG.

Fig3 shows the comparison of three generators on the basis of the parameter Entropy. Entropy determines the uncertainty of the data. The more value of uncertainty means it will be more unpredictable in nature and hence will be more secure.

## VI. CONCLUSION

In this paper the two chaotic functions, Logistic and tent map functions have been combined to propose a chaos based pseudorandom generator (CPRNG) named Tengistic CPRNG. The CPRNG has been constructed using simplest one-dimensional maps which provided high speed CPRNG. The generated CPRNG has been statistically analyzed by using correlation analysis, FIPS 140-2 test, NIST test and entropy evaluation. The proposed CPRNG has passed all the tests.

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# Computational Intelligence Described by Swarm Intelligence and its Algorithms

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**Abstract-**This paper gives you the overview of soft computing and the subfield of artificial intelligence which is called as “SWARM INTELLIGENCE”. This is so called because it is named after the inspiration taken from the working behavior of the swarms. The term “swarm” denotes the group or aggregation of insects or animals or birds which works together so as to complete the difficult tasks in an efficient manner which are not possible to be completed as an individual entity. This working behavior of swarms has influenced the researchers to solve their problems in robotics, telecommunications, computer science, networking and various other technical fields. Apart from it, algorithms have been proposed to solve various complex problems which are having resemblance to swarm intelligence, in their working behavior. In this paper, a brief description of the working of these algorithms is given.

**Keywords-**Swarm, Swarm Intelligence, Stigmergy, Pheromone, Paradigm, Fuzzy Logic, Neural Network

## I. INTRODUCTION TO SOFT COMPUTING

Soft computing differs from conventional (hard) computing in that, unlike hard computing, it is tolerant of imprecision, uncertainty, partial truth, and approximation. In effect, the role model for soft computing is the human mind. The guiding principle of soft computing is: Exploit the tolerance for imprecision, uncertainty, partial truth, and approximation to achieve tractability, robustness and low solution cost. The inclusion of neural computing and genetic computing in soft computing. At this juncture, the principal constituents of Soft Computing (SC) are Fuzzy Logic (FL), Neural Computing (NC), Evolutionary Computation (EC) Machine Learning (ML) and Probabilistic Reasoning (PR), with the latter subsuming belief networks, chaos theory and parts of learning theory. Soft computing may be viewed as a foundation component for the emerging field of conceptual intelligence.

The complementarity of FL, NC, GC and PR has an important consequence: in many cases a problem can be solved most effectively by using FL, NC, GC and PR in combination rather than exclusively. A striking example of a particularly effective combination is what has come to be known as "neurofuzzy systems." Such systems are becoming increasingly visible as consumer products ranging from air conditioners and washing machines to photocopiers and camcorders. Less visible but perhaps even more important are neurofuzzy systems in industrial applications. What is particularly significant is that in both consumer products and industrial systems, the employment of soft computing techniques leads to systems which have high MIQ (Machine

Intelligence Quotient). In large measure, it is the high MIQ of SC-based systems that accounts for the rapid growth in the number and variety of applications of soft computing. The conceptual structure of soft computing suggests that students should be trained not just in fuzzy logic, neurocomputing, genetic programming, or probabilistic reasoning but in all of the associated methodologies, though not necessarily to the same degree. At present, the BISC Group (Berkeley Initiative on Soft Computing) comprises close to 600 students, professors, employees of private and non-private organizations and, more generally, individuals who have interest or are active in soft computing or related areas. At Berkeley, BISC provides a supportive environment for visitors, postdocs and students who are interested in soft computing and its applications. In the main, support for BISC comes from member companies.

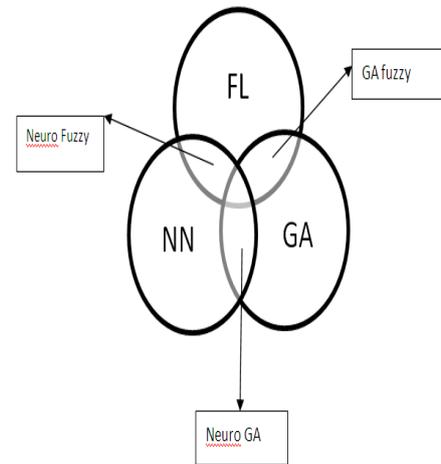


Fig 1 Conceptual Framework

### A. Optimization:

It is the process of making something better. Optimization is the process of adjusting the inputs to find the minimum or maximum output or result. The Optimization Process is shown in figure 1.2. Optimization is the mechanism by which one finds the maximum or minimum value of a function or process. This mechanism is used in fields such as physics, chemistry, economics, and engineering where the goal is to maximize efficiency, production or some other measure. Optimization can refer to either minimization or maximization; maximization of a function  $f$  is equivalent to minimization of the opposite of this function  $-f$ .

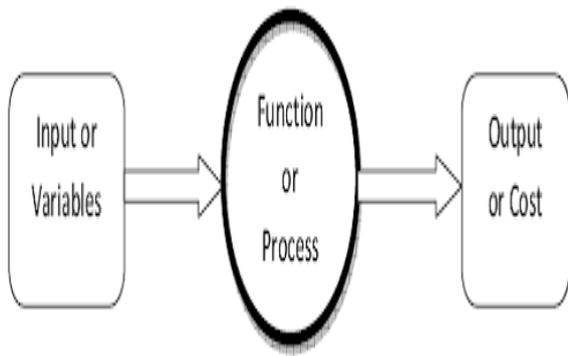


Fig 2 Optimization Process

### B. Combinatorial optimization techniques:

Testing problem belongs to the some type of combinatorial optimization problems. The techniques used to tackle combinatorial optimization problems can be classified in two general category, firstly, the exact methods and secondly the approximate (heuristic) methods. Although exact methods granted solution to the problem in hand but not appropriate for real life problems as it requires large computation time seek because of their complex nature, hence theresolution by exact methods is not realistic for large problems, justifying the use of powerful heuristic and meta-heuristics methods. For practical use heuristic methods seek to find high quality solutions (not necessarily optimal) within reasonable computation times. Another type of methods is meta-heuristics which have been applied successfully on large and real life complex problems

### C. Techniques Of Soft Computing

- Neural Networks (NNS)

There are millions of very simple processing elements or neurons in the brain, linked together in a massively parallel manner. This is believed to be responsible for the human intelligence and discriminating power. Neural Networks are developed to try to achieve biological system type performance using a dense interconnection of simple processing elements analogous to biological neurons. Neural Networks are information driven rather than data driven. Typically, there are at least two layers, an input layer and an output layer. One of the most common networks is the Back Propagation Network (BPN) which consists of an input layer, and an output layer with one or more intermediate hidden layers.

- Genetic Algorithms (GAs)

Genetic Algorithms (GAs) is a soft computing approach. GAs are general-purpose search algorithms, which use principles inspired by natural genetics to evolve solutions to problems. As one can guess, genetic algorithms are inspired by Darwin's theory about evolution. They have been successfully applied to a large number of scientific and engineering problems, such as optimization, machine learning, automatic programming, transportation problems, adaptive control etc. GA starts off with population of randomly generated chromosomes, each representing a candidate solution to the concrete problem being solved and

advancetowards better chromosomes by applying genetic operators based on the genetic processes occurring in nature. So far, GAs had a great measure of success in search and optimization problems due to their robust ability to exploit the information accumulated about an initially unknown search space. Particularly GAs specialize in large, complex and poorly understood search spaces where classic tools are inappropriate, inefficient or time consuming.

- Fuzzylogic

Fuzzy logic is one of the techniques of soft computing which can deal with impreciseness of input data and domain knowledge and giving quick, simple and often sufficiently good approximations of the desired solutions. Computational methods tolerant to suboptimality, impreciseness (vagueness) and partial truth and giving quick, simple and sufficiently good solutions. The guiding principle of these methods is perfectly adapted to the way in which reasoning and deduction have to be performed in forensic science (for searching hidden traces in a mostly chaotic environment, traces never identical with known specimens in a reference base), i.e. on the basis of partial knowledge, approximations, uncertainties and conjectures.

### D. Swarm intelligence:

Nature provides inspiration to computer scientists in many ways. One source of such inspiration is the way in which natural organisms behave when they are in groups. Consider a swarm of ants, a swarm of bees, a colony of bacteria, or a flock of starlings. In these cases and in many more, biologists have told us (and we have often seen for ourselves) that the group of individuals itself exhibits behavior that the individual members do not, or cannot. In other words, if we consider the group itself as an individual – the *swarm* – in some ways, at least, the swarm seems to be more intelligent than any of the individuals within it.

This observation is the seed for a cloud of concepts and algorithms, some of which have become associated with swarm intelligence. Indeed, it turns out that swarm intelligence is only closely associated with a small portion of this cloud. If we search nature for scenarios in which a collection of agents exhibits behavior that the individuals do not (or cannot), it is easy to find entire and vast sub-areas of science, especially in the bio-sciences. For example, any biological organism seems to exemplify this concept, when we consider the individual organism as the 'swarm', and its cellular components as the agents. We might consider brains and nervous systems in general, as a supreme exemplar of this concept, when individual neurons are considered as the agents. Or we might zoom in on certain inhomogeneous sets of bio-molecules as our 'agents', and herald gene transcription, say, as an example of swarm behaviour.

Since it is described that, problem solution which is inspired by the collective behavior of swarms is defined as swarm intelligence. Thus, such an intelligent and autonomous systems are required that are able to solve complex tasks with self-organizing nodes that are not having central control (means distributed approach).

Swarms are broadly categorized into:

- Ants
- Honey bees
- Termites
- Particle

#### A. *Ant Swarms*

Ants as individuals are not smart or intelligent enough to do their daily tasks of finding food source or finding shortest path to that location if source is found, dividing their work into short tasks and assigning these tasks to multiple ants so as to complete a task as a whole. Foraging is one of the examples that can describe the behavior of ants, and their working as colony. In the foraging process,

- Ants are free to move in any direction in search of their food location.
- Once they found a destination, they come back to their actual starting position by leaving a chemical substance which is volatile and attractive in nature and is called as pheromone.
- For coming back to actual location, an ant may follow any direct or indirect path.
- All other colony members will follow the same path where they found pheromone.
- Now, in order to move through the shortest path, path that will constitute more number of ants to follow the same path in same interval of time will be the shortest path.
- And for this shortest path obviously the concentration of the pheromone will be more as more number of ants will follow the same route leaving the chemical substance behind them.
- As the concentration of that route will increase since more number of ants will follow it, thus the path that is comparatively longer will soon disappear. This is because of the volatile nature of the pheromone and of least concentration of the substance over that path.

#### B. *Honey Bee Swarms*

Honey bees are one another swarms' type that seems very helpful in solving the complex tasks by their working manner in an efficient, effective and intelligent way. They have tendency to do typical tasks by dividing them into smaller tasks. Their daily tasks involves forging, storing, retrieving and distributing honey and pollens, communication and most precisely their ability of adaptation for the change in the environment. Several algorithms have been designed which work in the same manner as that of the working behavior of the honey bees. The concept of forging in honey bees can be explained as:

In the hive there are two types of bees named as:

- worker bees(scouts), and
- forager bees

The tasks that are to be performed by the worker bees are maintenance and management activities like collecting and

storing food, removing the dead bees from the hive, keeping proper ventilation and guarding the hive etc. the foraging process involves:

- First of all, the scout bees are sent to various directions randomly so as to find the food source.
- Scouts move from one flower patch to another so as to find promising food source that may have the quality rated above the pre-defined quality threshold deposit their nectar or pollen.
- After finding this, the scout bees move to the dance floor to perform a kind of dance so as to indicate the type of quality food detected to other bees.
- This kind of dance that scout bees perform on the dance floor for communication to other bees is known as waggle dance.
- This dance basically helps the other bees to know the direction of patch, distance of patch, and quality rating.
- After getting this information, forager bees are sent to that patch.
- Higher the quality of food at the patch more will be the number of bees at that patch.

Thus, in this way bee colony is able to get good quality of food effectively and efficiently.

#### C. *Particle Swarms*

In particle swarm method, the way by which the researchers got influenced is the working criteria of the birds and their ability to find their food. The foraging process in particle swarm can be described as:

- It is supposed that the flock of birds is searching for food in some particular area.
- And there is only a single piece of food in that area.
- Now, to get the exact location where the food actually laying, each bird will flew in the direction in which the bird nearest to the food is flying.
- An algorithm is being designed in such a way that locally and globally best positions of the birds are being calculated and velocity after each iteration is modified.

In this way, the bird swarms (particle swarms) are helpful in order to find solution to the complex problems.

#### D. *Termite Swarms*

Termites are known for building hills by using pebbles. And the way they collect the pebbles, the way they do it effectively by using shortest path method by the use of pheromone substance has major influence on the researchers to use an algorithm based on this intelligence. The process is as described:

- Each termite moves on the way where it finds the pheromone substance in order to collect the pebbles.
- But if no pheromone is detected by the termite then, it will follow a random path so as to search a pebble by its own.
- During the way to search a pebble, if it caught any pebble it will took it up.
- A termite can carry on one pebble at a time.

- And during its path again if it found any other pebble, then it will drop the already carrying pebble at that new location and infuse that pebble with pheromone so that other termite can detect it easily.
- And this pebble will act as the building site of the hill of pebbles. That means all other termites will get a location to drop their own pebbles at that location so as to build a hill there.

## II. APPLICATIONS

Since there are many algorithms that can completely fit into the working of various areas of working of several technical fields. Thus according to those several principles of working, we are having with applications in which Swarm Intelligence is useful.

Some of the fields are as follows, Robotics, data Mining, Communication networks, Fuzzy Systems, Military Applications, Traffic Patterns and many more resembling fields that can have their solution with the help of this Swarm Intelligence.

## III. ALGORITHMS

Algorithm is a kind of procedure or formula that is to be followed step by step so as to calculate or process a particular problem.

Various algorithms were designed that have their working similar to the working behavior of the above given swarm types. Few of the algorithms are listed below as:

- PSO( Particle Swarm Optimization)
- ACO(Ant Colony Optimization)
- BFO(Bacterial Foraging Optimization)
- PPSO(Perceptive Particle Swarm Optimization)

### A. Particle Swarm Optimization

Particle Swarm Optimization (PSO) was inspired by the behavior of the birds that fly around and search space, for the best location. Each particle either directly or indirectly communicates with the one another for the directions. Each particle moves through the multi-dimensional space sampling an objective function at various positions. Best solution is extracted out and is plotted and is seeded with an initial velocity. The velocity of the particle is continuously updated so that it may experience the best position of itself or best position that is experienced by its neighbor in the swarm. The performance of the particle can be evaluated with the help of fitness function. The technique might have the problem of adjusting the parameters but is easy to implement.

### B. Ant Colony Optimization

The ants used to communicate through the use of chemical substance termed as pheromone. This pheromone is a substance that has the property of attracting other ants towards it so that the ants of the swarm might follow the same path only. This all process of communication via the use of chemical substance is termed as trail-laying and trail-following. The algorithm based on this concept, uses a technique of positive feedback in which the concentration of

the pheromone goes on increasing with the number of ants passing through the same route and the path that have lesser number of ants or least concentration of pheromone will disappear soon.

### C. Bacterial Foraging Optimization

Bacterial Foraging Optimization algorithm is a kind of evolutionary computation algorithm. It is based on the foraging behavior of Escherichia Coli (E. coli) bacteria that resides in human intestine. This method is used for locating, handling and ingesting the food in the intestine. During its foraging phase, it can exhibit two different states: tumbling or swimming. The modification in the orientation of the bacterium is due to the fact of tumbling action possessed by the bacterium. And the swimming action is responsible for the movement of the bacterium in the current direction. After a certain number of complete swims, the best half of the population undergoes the reproduction and eliminating the rest of the population. In order to escape local optima, an elimination- dispersion event is carried out where some bacteria are liquidated at random with a very small probability and the new replacements are initialized at random locations of the search space.

### D. Perceptive Particle Swarm Optimization

Conventional particle swarm optimization relies on exchanging information through social interaction among individuals. However for real-world problems involving control of physical agents (i.e. robot control), such detailed social interaction is not always possible. Recently, the perceptive particle swarm optimization (PPSO) algorithm was proposed to mimic behaviors of social animals more closely through both social interaction and environmental interaction for applications such as robot control. In this study, we investigate the PPSO algorithm on complex function optimization problems and its ability to cope with noisy environments.

### Advantages Of Swarm Intelligence

- Scalability: SI systems are highly scalable; their impressive abilities are generally maintained when using groups ranging from just sufficiently few individuals up to millions of individuals up to millions of individuals. In other words, the control mechanisms used in SI systems are not too dependent on swarm size, as long as it is not too small.
- Adaptability: SI Systems respond well to rapidly changing environments, making use of their inherit auto-configuration and self-organization capabilities. This allows them to autonomously adapt their individual's behaviour to the external environment dynamically on the run-time, with substantial flexibility.
- Collective Robustness: SI Systems are robust as they collectively work without central control, and there is no single individual crucial for the swarm to continue to function (due to the redundancy of their individuals). In other words, the fault-tolerance capability of SI systems is remarkably high, since these systems have no single point of failure. A single point of failure is a part of any system that puts the entire system into risk of a complete failure, if it ceased to function.

- **Individual Simplicity:** SI systems consist of a number of simple individuals with fairly limited capabilities on their own, yet the simple behavioral rules at the individual level are practically sufficient to cooperatively emerge a sophisticated group behaviour
- **Disadvantages Of Swarm Intelligence:** The potential of swarm intelligence is indeed fast-growing and far-reaching. It offers an alternative, untraditional way of designing complex systems that neither requires centralized control nor extensive pre-programming. That being said, SI systems still have some limitations, such as:
- **Time-Critical Applications:** Because the pathways to solutions in SI systems are neither predefined nor pre-programmed, but rather emergent, SI systems are not suitable for time-critical applications that require (i) on-line control of systems, (ii) time critical decisions, and (iii) satisfactory solutions within very restrictive time frames, such as the elevator controller and the nuclear reactor temperature controller. It remains to be useful, however, for non-time critical applications that involve numerous repetitions of the same activity.
- **Parameter Tuning:** Tuning the parameters of SI-inspired optimization techniques is one of the general drawbacks of swarm intelligence, like in most stochastic optimization methods, and unlike deterministic optimization methods. In fact, however, since many parameters of SI systems are problem-dependent, they are often either empirically pre-selected according to the problem characteristics in a trial-and-error manner or even better adaptively adjusted on run time.
- **Stagnation:** Because of the lack of central coordination, SI systems could suffer from a stagnation situation or a premature convergence to a local optimum.

#### IV. CONCLUSION

In this paper, we have discussed several types of swarms that can influence the working behavior of researchers. Nature has inspired problem solving techniques have been found to be an intelligent and efficient way for this. Apart from it, this paper is giving a reference to few of the commonly known algorithms of swarm intelligence. The working steps of these algorithms are mentioned that how the ants as a collective team behave efficiently in order to process complex tasks that are not possible to be carried out as an individual.

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# An Effective Proposed Approach to Round Robin Algorithm using Dynamic Time Quanta of Geometric-Harmonic Mean and its Performance Improvement Over Harmonic Mean Quanta

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**Abstract**— Round robin is a distinctive approach to the CPU scheduling algorithm. It is based on technique that allows a fair share to all the processes that are waiting in the ready queue to get executed. A fixed time period called as time quantum is defined for each individual process. In traditional round robin no process is granted the CPU for more than one time quantum, so even if a fraction of time is left for a process to complete its execution, the process is sent back to the ready queue and kept waiting for its turn. Its disadvantages are its Longer Average Waiting Time, Higher Context Switching and Higher Turnaround Time. Various variants of Round Robin have been proposed. Round Robin using harmonic mean quanta is one of them but it still faces problem of larger turnaround ,waiting time. In this paper we have proposed new approach that will eliminate the challenge faced by traditional round robin variant and improves performance by reducing average waiting time, average turnaround time and number of context switches.

**Keywords**— Round Robin, Geometric Mean, Harmonic Mean, Turnaround Time, Waiting Time

## I. INTRODUCTION

In multi programming systems where several applications are executed simultaneously there should be a fair scheduling algorithm to share the CPU between processes. In Real-Time multiprogramming systems there are different methods to schedule processes . There are several scheduling algorithms in operating systems. Round Robin is one of the most widely used CPU scheduling algorithms. The main problem in Round Robin algorithm is selection of appropriate time quanta. If the quantum size is very small, the number of context switches increases and if the quantum size is very large it leads to increase in waiting time. For the quantum time being static, context switching is less if the time quantum is high and context switching is high if quantum time is less. Increased context switching leads to higher average waiting time, higher average turnaround time which is an overhead and degrades the system performance. Considering these facts, the algorithms should calculate appropriate value for the quantum time. Two main classes of algorithms are defined to calculate the quantum size that include static and dynamic methods. In static methods , quantum time is fixed during the scheduling. In Dynamic algorithms there occurs change in value of

quantum time in each cycle. The proposed method calculates quantum time based on geometric and Harmonic Mean considering the process with shortest remaining time runs first. By executing the processes we have shown that average waiting time, average turnaround time and number of context switches are reduced.

## II. CPU SCHEDULING CRITERIA

Defined set of criteria is established against which various scheduling policies may be evaluated.

- CPU Utilization : It is the average fraction of time, during which the processor is busy .
- Throughput : This is a measure of work being performed per unit of time.
- Turnaround Time: The interval of time taken between the submission of a process to the time till the process gets completed.
- Waiting Time : This is the sum of the time spent waiting in the ready queue by the processes to get into memory.
- Response Time :This is the time from the submission of a request till the first response is received.

## III. PERFORMANCE METRICS

- Turnaround Time(TAT)= Finish Time(FT)-Arrival Time (AT)
- Waiting Time(WT)=Start Time(ST) of process - Arrival Time(AT)
- Context Switch(CS)=Number of Switches between the processes.

For the algorithm to work better Average turnaround time, Average Waiting Time , Number of context switches must be less.

## IV. RELATED WORK

Rami J. Matarneh [1] founded that quantum value can be calculated by using the median of burst times for the set of processes present in ready queue. This method reduces the number of context switches.

Behera, H.S, Mohanty, R and Debashree, N [2] developed an algorithm that arranges the processes in the

ready queue in ascending order of their burst times. For finding an optimal quantum size, it takes into consideration the median of the processes in the ready queue. The time quantum is again calculated by taking the remaining burst time into consideration after each execution cycle.

Lalit, K, Rajendra, S and Praveen, S [3] developed an algorithm that arranges the processes in ascending order of their burst time, and then calculate the time quantum by taking the average of the burst times. And it assumes that all processes arrive at the time  $t=0$ .

Sanjaya Kumar Panda, Sourav Kumar Bhoi [5] proposed variant of RR algorithm called Min-Max Round Robin (MMRR) scheduling algorithm. The idea of this algorithm is to make the Time Quantum repeatedly adjusted using Min-Max dispersion measured in accordance with remaining CPU burst time. Experimental analysis shows that proposed algorithm performs much better than RR algorithm against the parameters like average turnaround time, average waiting time and number of context switches.

Abdul Kadir Khan, Manish Kumar Mishra [7] proposed The improved Round Robin (IRR) CPU scheduling algorithm. It allocates the CPU to first process for a time interval of single time quantum. Then it checks the remaining CPU burst time of the running process. If the remaining CPU burst time of the presently running process is less than single quantum value, the CPU is again allocated to the currently running process for left over CPU burst time. But, if the remaining CPU burst time of the currently running process is larger than quantum size, the process will be put at the end of the ready queue. The CPU then selects the next process in the ready queue.

Mohd Abdul Ahad[9] proposed the algorithm that works by finding the left over burst time of the processes in the last but one turn of the quantum cycle. Based on this assumption, we have divided the processes present in the ready queue into two categories. The processes available in the first category are those for which we modify the time quantum and the processes in the second category are processed according to simple round robin algorithm.

Soraj and Roy, K.C [10] presented a new algorithm that arranges the processes in ascending order of burst time, and then it chooses the smart time slice, which depends on the number of processes in the ready queue. It is equal to the burst time of the middle process in case the number of processes are odd and average of the processes burst times in case the number of processes are even. This algorithm assumes that all processes arrive at the time  $t=0$ .

Debashree Nayak, Sanjeev Kumar Malla, Debashree Debadarshini [6] proposed an algorithm that uses optimal time quantum assigned to each processes and is recalculated taking the remaining burst time into consideration after each cycle. This procedure is repeated on until the ready queue gets empty.

Manish Kumar Mishra, Dr. Faizur Rashid [16] gave improved.

Round Robin CPU scheduling algorithm with varying time quantum (IRRVQ) which combines the features of SJF

and RR scheduling algorithms with varying time quantum. Initially the processes present in the ready queue are arranged in the ascending order of their left over burst time. CPU is then allocated to the processes using RR scheduling with quantum value equal to the burst time of first process in the ready queue. After each cycle of execution, processes present in the ready queue are arranged in the ascending order of their remaining burst time and CPU is allocated to the processes using traditional RR scheduling with quantum size equal to the burst time of first process in the ready queue.

D Praveen Kumar, T. Sreenivasula Reddy, A. Yugandhar Reddy [15] proposed a technique using integer programming (IP) problem that decides a worth that's neither large nor too small such each method has affordable response time and therefore the throughput of the system isn't cut as a result of unnecessarily context switches. This method depends on ever changing time quantum (CTQ) in every round over the cyclic queue.

Sandeep Negi [12] proposed the new algorithm on the basis of threshold value which is assumed to be one fourth of the quantum size. If the remaining time of a process in its last turn is found out to be less than this threshold value then the process is not preempted in its second last turn unless it completely finishes its entire remaining execution time.

Pallab Banerjee, Probal Banerjee, Shweta Sonali Dhal [8] proposed approach to enhance performance of Round Robin by taking a dynamic Time Quantum which is the mean of the summation of the average and the Maximum Burst time.

## V. PROPOSED METHOD USING GEOEMTRIC-HARMONIC MEAN

In this method time quantum is calculated based on geometric-harmonic mean using shortest remaining time first. We consider the arrival time of processes and burst time is considered as heterogeneous. Steps in algorithm:

- Calculate Geometric mean of burst time of all processes and use as quantum value and processes are run according to their arrival time.
- Calculate remaining time of processes.
- Calculate Harmonic mean of processes using remaining time and use it as time quantum for cycle 2.
- Process having shortest remaining time is run first.
- Calculate Geometric mean of further remaining execution time and run processes according to shortest remaining time first.

The same process is repeated over till all processes get finished. The processes are run using geometric-harmonic mean combination in an alternative fashion. This algorithm reduces average waiting time, average turnaround time and number of context switches as compared to processes with harmonic mean only.

## VI. PROPOSED APPROACH ANALYSIS

Geometric-Harmonic Mean (GHM) Round Robin Algorithm

Suppose that we have n processes with burst time  $t_1, t_2, \dots, t_n$ .

Harmonic mean of these values is shown in equation 1 and geometric mean of these values is shown in equation 2.

$$\text{Harmonic Mean} = n / (1/t_1 + 1/t_2 + \dots + 1/t_n) \quad (1)$$

$$\text{Geometric Mean} = \sqrt[n]{t_1 * t_2 * \dots * t_n} \quad (2)$$

For example, we consider four processes P1, P2, P3, P4 and P5 arriving at time 0, 15, 30, 40, 10 with burst time 40, 60, 20, 55 and 5 respectively. The geometric mean of these burst times is 26 in the first cycle and harmonic mean of the remaining running time of processes is 33 in cycle 2. Considering arrival time, remaining burst time, alternative combination of geometric-harmonic mean gives Gantt Chart as follows:

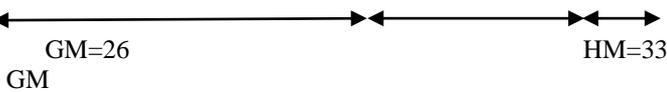
Table I. Processes arrival order with their burst time

Process No.	Arrival Time	Burst Time
P1	0	40
P2	15	60
P3	30	20
P4	40	55
P5	10	5

(i) Calculate dynamic time quantum based on the combination of geometric mean and harmonic mean used in alternative manner.

GANTT CHART:

P1	P5	P2	P3	P4	P4	P1	P2	P2
0	10	15	30	50	76	105	135	168
180								

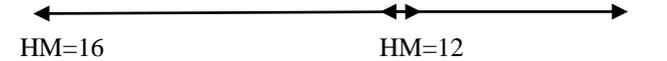


Average Waiting Time= 61  
 Average Turnaround Time= 76  
 Number of context switches =8

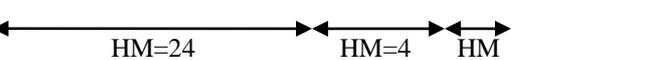
(ii) Calculate dynamic time quantum based on Harmonic mean only considering the same above table.

GANTT CHART:

P1	P5	P2	P3	P4	P3	P1	P4	P2
0	10	15	30	46	62	66	78	90
102								



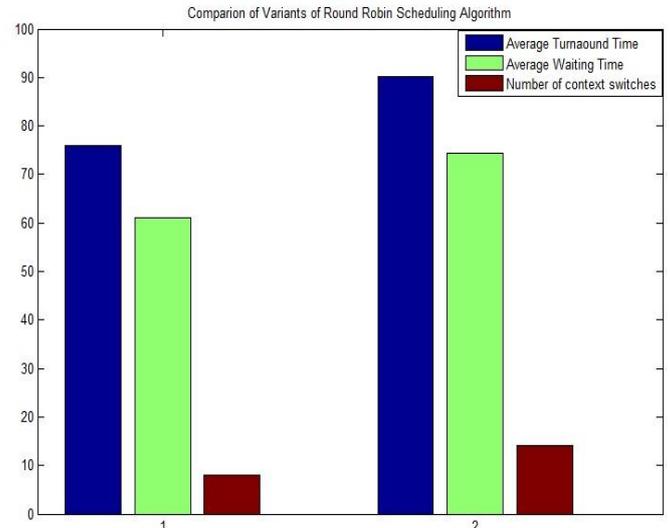
P1	P4	P2	P4	P2	P2
102	120	144	168	171	175
180					



Average Waiting Time=74.4  
 Average Turnaround Time=90.2  
 Number of Context Switches =14

## VII. COMPARATIVE ANALYSIS

The comparison of the two different methods has been made using MATLAB R2012b and graphs for comparison are shown in Fig.1. and table for comparison is shown in Table II.



1. Calculate time quantum using geometric-harmonic mean used alternatively 2. Calculate time quantum using Harmonic mean

Fig.1 Comparison of variants of Round Robin algorithm

Table II. Comparison of proposed method and harmonic mean method

Method used	Average Waiting Time	Average Turnaround Time	Number of context switches
Geometric-Harmonic Mean	61	76	8
Harmonic Mean	74.4	90.2	14

## VIII. CONCLUSION

In this paper we proposed a new algorithm using dynamic time quantum that is based on Geometric-harmonic mean (GHM) using shortest remaining burst time. We consider the arrival time of processes. In the first pass, Geometric mean of all processes is calculated and used as time quantum and processes run according to their arrival time. Then harmonic mean of remaining time is calculated and process with shortest remaining time process is run first. Again in the third pass, processes are run with geometric mean of remaining time and run according to shortest remaining time process first. The same process is repeated over till all processes get finished. This algorithm reduces average waiting time, average turnaround time and number of context switches as compared to processes with harmonic mean only. For future work we can implement priority to given algorithm and analyze new algorithm.

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# Implementing Data Mining Techniques for Churn Prediction and Analysis

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**Abstract**-Customer churn is one of the biggest problems faced by the telecommunication industry now days. Churn analysis is the process of identifying the possibility of a user changing a given network. The prediction is mostly done by mining the data generated by the telecommunication industry using appropriate data mining techniques. Decision tree is one such data mining technique which is widely used for churn analysis and prediction. Using decision trees a customer dataset is evaluated until a leaf node is obtained and leaf node is assigned the value of cherner or noncherner. We can use basic information of customer like call detail data and customer data for accurate prediction of churn. Decision trees are found to give good prediction accuracy. In this paper we use J48 algorithm for predicting Churn and study the algorithm for the accuracy it gives.

**Keywords**- Data Mining, CRM, Churn Prediction, Decision Trees, J48 algorithm

## I. INTRODUCTION

Data mining also known as Knowledge Discovery in databases (KDD) is the process of mining data to discover knowledge (information). It is the process of extracting and analyzing relationships, patterns and useful information from massive databases. [2] It usually involves four classes of tasks which are the classification, clustering, regression and association rule learning.[1] There are two main types of data mining: verification-oriented (the system verifies the user's hypothesis) and discovery-oriented (the system finds new rules and patterns autonomously) [2] [6].

Telecommunication industry is an ever increasing industry and with each passing day it is becoming more and more competitive. As a result of this competition more options are available to customer, with the customers switching from one network provider to another very frequently. This switching of customers from one network provider to another is known as Customer Churn or Customer Attrition. Customer loss is very closely related with customer loyalty. [5] 'Churn management' is a term that describes an operator's process to retain profitable customers [3][8].

Section II explains what churn mean in the telecommunication industry and types of churn. Section III explains how decision trees can be used for prediction of churn in telecommunication industry and implementation of J48 algorithm over sample data. Section IV contains the literature survey done in this filed and final Section gives a conclusion of the paper.

## II. UNDERSTANDING CHURN AND ITS TYPES

Churn Prediction is a phenomenon which is used to identify the possible before they leave the network. This helps the CRM department to prevent subscribers who are likely to churn in future by taking the required or appropriate action to attract the likely churners and to retain them. Thereby, the potential loss of the company could be avoided. Churn is very closely related with customer loyalty, which the telecommunication companies have to consider when they aim to predict churn. This study utilizes data mining techniques to identify the churners. [2]. Before we predict churn we must be familiar with the types of churn and some common terms used in churn analysis. A Person who churns from one network to another is called a Churner. Two categories of churners are voluntary and involuntary churners: These are explained below [7] [5] [6] [9]:

- A. *Involuntary churners* are customers that the company decides to remove from its list of subscribers. This category includes people that are removed for non-payment (customers with credit problem), frauds (customers who cheat), and under-utilization (customers who don't use the phone).
- B. *Voluntary churn* occurs when the customer terminates the service. We recognize two types of voluntary churn: incidental and deliberate churn.
  - *Incidental churn* occurs, not because something happened in customers lives and not because the customers planned on it. For example: change in financial condition churn, change in location churn, etc.
  - *Deliberate churn* occurs due to reasons of technology (customers wanting newer and better technology), economics (price and charges), service quality, social or psychological factors, and convenience reasons. Deliberate churn is the problem that most companies try to solve.

### C. Postpaid and Prepaid Churn

In case of postpaid churn, the deactivation date, i.e. the date when the customer is disconnected from the network, is equal to the churn date, because the customer stops using the operator's services on this date. However prepaid users do not have any contract with the telecom operator, so it is difficult to define churn in case of prepaid users. In Prepaid churn, the deactivation date may not match the churn date

[7][10]. Generally it takes a long period of time before a prepaid customer is disconnected from network. In many cases customers may have churned long before they are disconnected from network. This is the reason why the deactivation date is not suitable indicator for prepaid churn [4].

### III. PROPOSED MODEL

The model we use consist of four steps. These steps are identifying the problem domain, scanning data set, dividing data into test and training data and Classification. The classification step produces two types of customers (churners and non-churners)

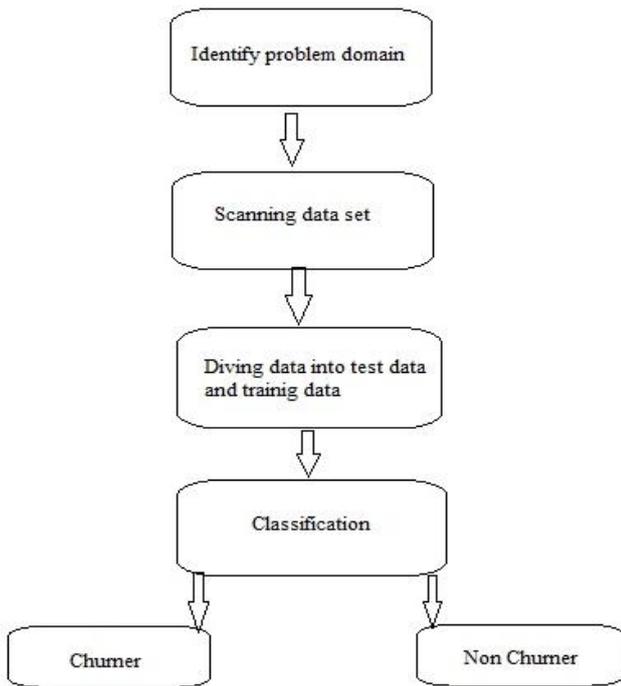


Fig 1. Steps of Proposed Model

For our case study we use an open source Data Mining tool called WEKA (Waikato Environment For Knowledge Acquisition) and a sample data set of 100 instances. The data set is divided into 2 parts, a training data (12 instances) and a testing data (88 instances).

#### A. Data Preprocessing

14 attributes are used in our data set and a brief description about each is given in table 1. Churn attribute specifies whether customer will churn from network or not. If churn=Yes, then it means customer may leave the network and if churn=No, then it means that customer will not leave the network.

When we open our tool and load our database into it, the first thing we need to do is to convert our string attribute into nominal because WEKA does not support String data type. For this we use String to nominal filter over desired attributes.

Then we implement the decision tree method for churn prediction and analysis.

#### 1) J48 Decision Tree Technique

We use the decision tree method for churn prediction in our study. Decision trees are made in the form of a tree where

each node terminates into child-nodes and continues until each branch reaches the terminal node. Decision tree has three types of nodes: root node, internal nodes, and terminal or leaf nodes. In decision tree, the terminal node is assigned a class label and the non-terminal nodes, contain the test conditions to separate the instances that have different characteristics [11].

Table 1. Attributes of Data Set

Attribute	Data Type	Description
Customer No	Numeric	It is customer's unique id number.
Customer Name	String/Nominal	It is the name of the customer.
Phone number	String/Nominal	It is the mobile number of the customer.
Address	String/Nominal	It is the address of the customer.
Voice mail plan	{ Yes, No }	It Specifies whether the customer is using voice mail feature or not.
Total Outgoing Call Minutes	Numeric	It is the number of minutes which the customer calls in a day, it is sum of day, evening and night minutes
Total day minutes	Numeric	It is number of minutes customers uses during the day
Total evening minutes	Numeric	It is number of minutes customers uses during evening
Total night minutes	Numeric	It is number of minutes customers uses during night
Total intl minutes	Numeric	It is number of international minutes customers uses
Outgoing Messages	Numeric	It is number of messages customers sends.
International plan	{ Yes, No }	It Specifies whether the customer is using international plan or not.
Data plan	{ Yes, No }	It Specifies whether the customer is using data plan or not
Churn	{ Yes, No }	It Specifies whether the customer will churn or not.

The attributes of our data set are denoted by the internal nodes of the decision tree and the possible values of these attributes are depicted by branches between the nodes, and the final value of the attribute to be predicted is given by the terminal nodes. Here we wish to predict the dependent variable (Attribute churn in this case) by using the values of

other attributes in our data set. The decision tree is constructed by using the values of other attributes of data.

After the decision tree has been made a matrix will be generated where rows of the matrix define actual values and columns define predicted values.

		Predictive result	
		0	1
Actual result	0	A	B
	1	C	D

Fig 2. Elements of Confusion Matrix

HERE:

- A. Are the customers which were predicted to churn and they churn actually.
- B. Are the customers who are predicted not to churn but churn actually.
- C. Are the customers which were predicted to churn but don't churn actually.
- D. Are the customers who are predicted not to churn and don't churn actually.

#### IV. RESULTS

##### A. J48 Implementation Result

Using Weka tool, the classification algorithm is used to perform the experiments on the telecommunication churn data set. From the given data set by using J48 algorithm, the following rules were generated on the basis of the data

=== Classifier model (full training set) ===

J48 pruned tree

```

total_Outgoing_Call_Minutes <= 292
| total_intl_minutes <= 0
| | voice_mail_plan = Yes: No (2.0)
| | voice_mail_plan = No
| | | total_day_minutes <= 20: No (6.0)
| | | total_day_minutes > 20
| | | | total_Outgoing_Call_Minutes <= 199: Yes (10.0/1.0)
| | | | total_Outgoing_Call_Minutes > 199: No (4.0)
| | | total_intl_minutes > 0: Yes (5.0)
total_Outgoing_Call_Minutes > 292: No (61.0)
    
```

Number of Leaves : 6

Size of the tree : 11

Fig 3. Rules Generated

On the basis of these rules the following tree was generated for our data set

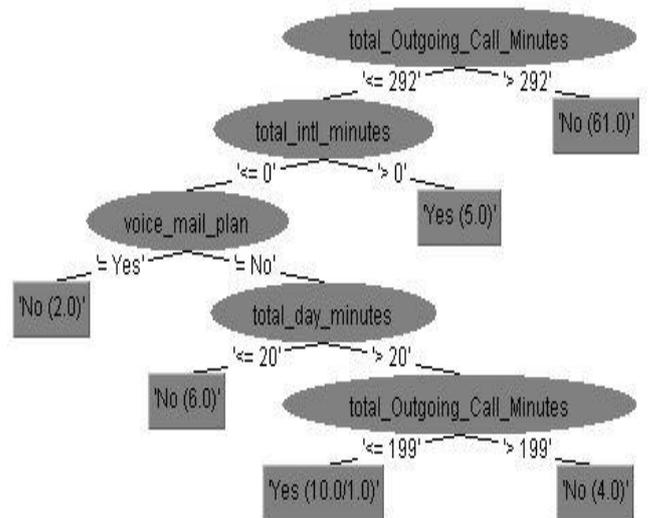


Fig 4. Decision Tree generated

##### B. Confusion Matrix

In classification, confusion matrix gives the actual and the predicted classification information. The numbers in the rows and columns of confusion matrix indicate the number of records against each combination of actual predicted and values. The performance of classification systems can be judged by observing the data of the matrix.

```

=== Confusion Matrix ===
 a  b  <-- classified as
 6  8  | a = Yes
 9 65  | b = No
    
```

Fig 5. Confusion Matrix

Accuracy and Precision of the algorithm for our case Study is shown below:

```

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances      71          80.6818 %
Incorrectly Classified Instances    17          19.3182 %
Kappa statistic                    0.2983
Mean absolute error                 0.1715
Root mean squared error             0.3534
Relative absolute error             62.6222 %
Root relative squared error        96.3586 %
Total Number of Instances          88

=== Detailed Accuracy By Class ===

TP Rate  FP Rate  Precision  Recall  F-Measure  ROC Area  Class
0.429    0.122    0.4        0.429  0.414     0.831    Yes
0.878    0.571    0.89       0.878  0.884     0.831    No
Weighted Avg.  0.807    0.5        0.812    0.807  0.809     0.831
    
```

Fig 6. Detailed Accuracy of the algorithm on Data

#### V. DISCUSSION OF RESULTS

In this analysis, we used J48 classification techniques on 100 instances of telecommunication industry customers in which 71 were non-churn customers and 17 were churn

customers. J48 algorithm gave accuracy of 80.68% in predicting churn accurately.

## VI. CONCLUSION

Customer retention or customer churn is greatest problem faced by telecommunication industry. Customer loss is very closely related with customer loyalty which is directly related to company's profit hence it is very important for a telecommunication company to reduce customer churn so as to maximize its profit. Data mining techniques like decision trees can be used to study the churn pattern for the customers of a particular operator and predict the possible churners so as to take necessary steps to avoid it. In this paper we aim to help telecommunication industry to know their customers and also the behaviour of their customers for predicting churn. We describe a simple model based on Data Mining techniques. A data set of 100 instances was used to study customer behaviour and J48 decision tree algorithm was applied to it. Of the 88 instances of test data 17 were found to be non churners and 17 were found to be churners with an accuracy of 80.68%. The result of our paper focuses on the implementation of J48 decision tree, and concludes that we can predict the customers who may churn using confusion matrix. It is assumed that, with a better understanding of the characteristics and behaviour of customers, telecommunication industry can develop a specialized method to monitor and manage customer churn activities and hence take necessary measures to avoid churn.

## ACKNOWLEDGMENT

First of all I express my sincerest debt of gratitude to the Almighty God who always supports me in my endeavors.

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# An Overview of Cloud Computing: Threats with Proposed Security Architecture Design

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**Abstract**—Cloud computing technology has changed the scenario in computing power world. The computational needs of end user, business man and developer have been now moved to a cloud which is metaphor of Internet. All computational users will act as a client to access cloud and complete the process of application computation is called cloud computing. So the multiple users demands computational recourses online and access it independent of geographical location. This research has identified many issues in cloud computing among which security issue is of great concern. So some measures have been suggested to overcome these issues. This paper purposes design for secure cloud architecture for cloud computing based applications. It has two components front end and back end, containing various phases integrated with security techniques which if mitigate in private and public clouds of cloud computing architecture can result in resolving of many security issues. Hence if this proposed design will be considered by cloud service provider in the cloud computing services and also in software development lifecycle of the application software that are deployed on the cloud, then forsore the security threats can be reduced to some extent.

**Keywords**— NIST, CSP, SAAS, PAAS, IAAS, EC2, RAID, SDLC

## I. INTRODUCTION

Cloud Computing is a great revolution in the IT Industry and in its development trends. According to the National Institute of Standards and Technology (NIST) Cloud Computing is model for enabling on-demand network access to a public cloud which is collection of shared configurable computing resources like networks, servers, storage, applications and services that can be rapidly provisioned and released with minimal management effort or service provider interface [1, 9]. There are three types of users, among which first is End User who need Application Software to do job, second is business man who needs infrastructure to run website and third is developer who needs platform to develop software. So to move these computational needs at one place has been now called as cloud..

These users now access the cloud to perform their computational needs is known as Cloud Computing. Cloud Computing is the internet based development by using computer technology. The Fig. 1 describes the meaning of cloud computing

## II. BENEFITS OF CLOUD COMPUTING

The major benefits of using cloud computing are:

- Users have to pay only what user uses. So, user accesses according to the requirement.

- Users can access cloud from anywhere that cloud computing does not depend on specific geographical location.
- Users need not to deploy services/infrastructure, they can access it online.
- In cloud computing users will be connected to servers with high speed and low cost.
- It saves memory of computer because the whole data is saved on the cloud servers (online).

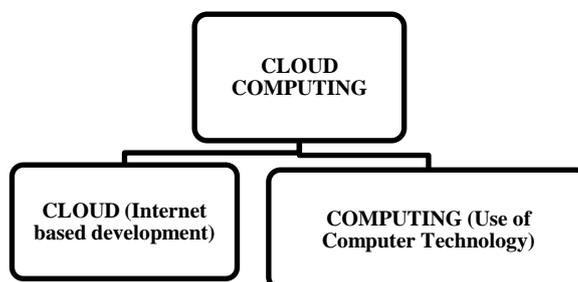


Fig. 1 Meaning of Cloud Computing

## III. WHY WE NEED CLOUD COMPUTING

The cloud computing is needed because of many reasons which are described in following figure Fig. 2.

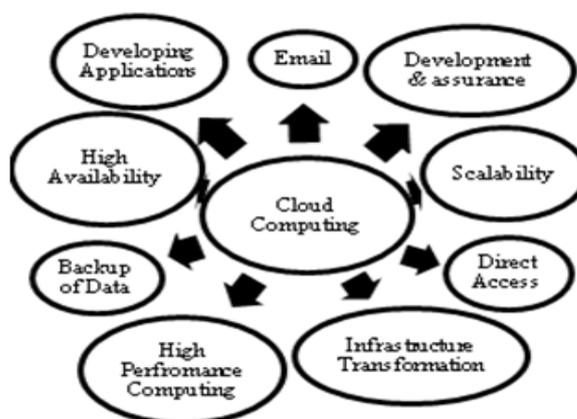


Fig. 2 Reasons for need of Cloud Computing

## IV. HOW CLOUD COMPUTING WORKS?

Cloud computing model has shared computing resources such as servers, application services, networks, storage etc. that can be access on demand networks. This cloud mode is composed of three service models and four deployment models [3, 10]

A. Cloud Service Models

There are three types of cloud service models described as below [6].

- SAAS (Software as a Service): Its consumer is end user who runs existing online applications such as online spreadsheet, power point access by Microsoft office and Google, Pixlr for photo editing etc. Advantage of SAAS is the applications it provides are free or paid via subscription can be accessed from any computer, but disadvantage is the generic applications are not always appropriate for business purpose.
- PAAS (Platform as a Service): In this service model the users can create their own cloud applications using cloud service provider tools and applications. So, PAAS gives the platform for IAAS and uses IAAS to develop software for example Google App Engine, Window Azure Platform provided by Microsoft, Sale-force allows users to build and run their applications for free of cost. PAAS pros are it allow rapidly developed online applications at low cost and can be used privately. PAAS cons are it limits language and tools to develop application and risk of vendor lock in.
- IAAS (Infrastructure as a Service): The user can select hardware and configuration requirement of their own choice in IAAS. So, by using IAAS user can run applications on clouds suppliers' hardware. Its advantage is that it provides caching facility, cloud hosting of applications, but it lacks in security of the applications build on cloud. The examples of IAAS are Amazon Elastic Compute Cloud (EC2), Rack-space and Gogrid.

B. Cloud Deployment Models

This model represents a specific type of cloud environment, characteristic by ownership, size, and right to use. There are four common cloud deployment models [7, 8] are described below.

- PUBLIC CLOUD: This cloud is available over internet which contains unlimited resources but it is not secured.
- PRIVATE CLOUD: This cloud is particularly available to organization only. So, the access to the limited resources in this cloud is possible but it is secured and provides finite infrastructure and services.
- HYBRID CLOUD: It is combination of private and public cloud. It has composition of security feature of private cloud and scalability feature of public cloud.
- COMMUNITY CLOUD: It is for special purpose group that is not public but composed of more of private cloud. In this group users together make their own cloud.

V. CLOUD SECURITY ISSUES AND MEASURES

The security principles applied to protect data, applications and infrastructure associated within the cloud computing technology is called as cloud security. Cloud computing vulnerability is the weakness in security system

which can be improved by applying cloud security measures [5]. The Fig. 3 describes the main two types of attack that can be occurred in cloud computing and these are passive and active attacks.

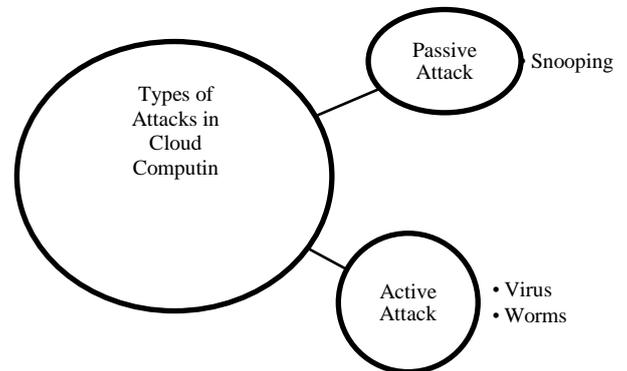


Fig. 3 Types of Attacks in Cloud Computing

The security issues [2, 11, 12, and 13] in cloud computing have been resolved using some counter measures which are described in the Table I.

TABLE I. Security Issues with Measures

Sr. No.	SECURITY ISSUES	MEASURES
1)	Recovery	To get recovery of accidentally deleted data from cloud servers, Redundancy Technique is used. Redundant Array of Inexpensive Disks (RAID) duplicates the data on servers to enhance availability of data on the cloud system or in applications hosted on it.
2)	Confidentiality with Efficiency	Cryptography is used to protect public networks in conjunction with Physical Isolation Technique which splits data into segments and distribute the segments to multiple providers. So, this measure not only provides privacy but improves the efficiency of CSP.
3)	Privacy	Privacy steps are recommended for cloud system designers, architects, developers and testers. <ol style="list-style-type: none"> <li>1. Delicate information sent to and stored in cloud must be minimized.</li> <li>2. Protect delicate information in the cloud.</li> <li>3. Allow user preference of security alternatives.</li> <li>4. Specify and limit the purpose of data usage.</li> <li>5. Feedbacks taken by users should be implemented.</li> </ol>
4)	Data Integrity	Digital Signatures if used will test the integrity of data in the cloud that is it will check if modification in data has been done by authorized user or not. Digital Signatures if applied on file system will prevent from data loss also.

5)	Control	There must be central cloud service provider called hypervisor with efficient and effective access control over data and resources and make it available to clients.
6)	Audit	Audit cloud means to keep check on cloud system. If it is added as an additional layer above the operating system hosted on virtual machine to provide facilities which keep check on what has happened in the system.
7)	Data Loss	The data loss can be prevented if Backup of data on the different locations is done. Also rate of data loss will be reduced if there will be restricted unauthorized access by using Identity Management in which authenticated users can avail cloud services and access to data on the basis of some credentials.
8)	Active attacks like Snooping	There must be Centralized Management that is centralized monitor server must be at CSP location to check these kinds of attacks.
9)	Passive attack like virus, worms	CSP must provide Notifications in the form of Email, message authentication codes must be dropped to user account.

## VI. PROPOSED CLOUD SECURITY ARCHITECTURE DESIGN

The proposed cloud security architecture shown in Fig. 4 includes two most significant components that is the Front End and Back End component. The Front End component is computer user and it includes client's network and applications with interface to access cloud. The Back End component is the cloud itself which includes servers, several computers and data storage devices. The security issues in these components have been mentioned and its solutions are given in the following modules:

### A. Network Security

- The front end component first layer includes network layer and its security can be ensured by adopting following steps.
- Install antivirus software for security against malware.
- There must be dual encrypted communication between cloud service provider and user.
- Data Encryption with Key Management mechanism must contain following points:
- Key generators of secured cloud must spawn key in secure environment.
- Keys should be stored in servers in an encrypted form.
- Cloud storage should have a backup on different locations for restorable purpose on loss of keys.
- Distribution of keys by cloud service providers should have authentication and confidential management.
- The access to customers key should not be in hands of cloud administrators.
- Cloud administrators must have a check on keys on regular intervals.

- Keys which are no longer required must be destroyed in secure manner by cloud administrators.

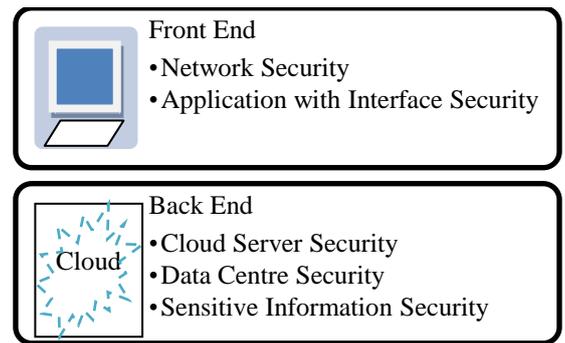


Fig. 4 Proposed Cloud Security Architecture

### B. Application With Interface Security

- Multiple customers run their software at the common platform on PAAS which should includes application interface security as described below.
- Guidelines must be provided by the CSP to the customers to create secure applications.
- Codes developed by customers must be checked by CSP at regular intervals using automated review tools. Therefore during Software Development Lifecycle (SDLC) process security should be basic necessity.
- Secure application migration and execution technology. In this gateway can transfer cloud based application to sandbox for its execution. The sandbox blocks access to data done by unauthorized person. By using these sandbox applications which can be transferred from cloud and can be executed safely.

### C. Data Centre Security

- In private and public cloud following are basic requirements is to maintain data centre security.
- In this video monitoring system, movement sensors, alarm system can be used to ensure permanent monitoring of access from data centre that is from cloud servers.
- Redundancy facility for sensitive data on other locations should be provided by CSP in case of unintentional deletions or loss of data.
- Internet connection, hardware requirements should be design to be redundant in case of failure of these resources.
- Authentication for access to the data centre such as password, fingerprint or security token techniques can be used.

### D. Cloud Server Security

- Cloud Server security is prominent which can be achieved in following ways:
- Technical measures like host firewalls, host based intrusion detection system [4] should be implemented to detect attacks like failed login attempts, Trojan horse virus made at application or operating system level.

- For server virtualization there must be control measures to grant access to shared resources like implementing locking protocol.
- Virtual machines provided to customer by CSP must be secured i.e. unnecessary services should be disabled, providing secured operating system.
- Data traceability technique can be applied on cloud server. In this the information flowing in and out from the cloud can be tracked by using information gateway. In this technique CSP can use logs that are obtained from data traffic and thus can check the unauthorized users who access and modify the information.

#### E. Sensitive Information Security

- To maintain data integrity on sensitive information travelled through transport layer of network protocols, following techniques must be implemented to protect sensitive information.
- CSP should manage data backups in case of data losses.
- There must be agreement of customer data deletion and it must be deleted in secured manner.
- Whenever access to the sensitive data is done by intruder, it should be indicated to the user via E-mails or by text messages.
- On deleting or updating sensitive data there must be some security measures applied like some security questions should be asked before updating or deleting of data.
- Data masking technique can be applied on data in which information gateway allows only the authorized data to be passed and saved securely in servers and control the modification in data before it is transmitted to an external cloud. This technique also detects the deletion of the confidential data by unauthorized users.

### VII. CONCLUSION

The cloud architecture comprises of various cloud components which communicate with each other over application programming interface. The organization which uses this cloud architecture must ensure security and privacy controls which should be implemented correctly in the system software lifecycle. This research paper analyzed various security issues and its measures for cloud computing. Also in this research paper the proposed design of secure cloud architecture will try to cater to all the issues arising from all directions of the cloud. So every model in this proposed security architecture will analyze each and every component in the cloud and these components are data, server, network, application and platform. The issues in these elements are analyzed at macro and micro level and an integrated solution are designed to secure cloud computing environment. In future the algorithms for this cloud secure architecture can be designed to make it practical implementation possible.

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# Classification Variant Analysis in Data Mining

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**Abstract**—The Data Mining is extracting or mining knowledge from large volume of data. Classification technique is used in different-2 application. Classification is used in every field of our life. In this paper a comparison among two classification’s algorithms will be studied, these are (Naïve Bayes and K-nearest neighbor ) algorithms. The paper will find the strength ,correctness and accuracy of each algorithm for classification in term of performance efficiency and time complexity required.

**Keyword**—Data Mining, Classification,Naïve Bayes, Bayesian Network, Naïve Bayes Updatable

## I. INTRODUCTION

Data mining finds these patterns and relationships using information analysis tools and techniques to produce models. There are 2 data mining models in data processing. One is predictive models i.e the task where a model consists or choice to attempt to best predict chance of AN result.. Another is descriptive models, is simply a mathematical procedure that relate real-world events and also the relationships between factors responsible for them. The definition of data Mining, also referred to as knowledge Discovery in Databases (KDD) describes the nontrivial extraction of implicit, potentially useful and previously unknown info from data in databases [1].

There are a few information mining strategies are preprocessing, association, classification, pattern recognition and clustering, [7]. Classification represents a supervised learning method as well as a statistical method for classification. classification algorithms use different techniques for finding relations between the predictor attributes' values and the target attribute's values in the build data..

### A. Data Mining Tasks

Data mining may involve six classes of tasks in common:

- *Anomaly detection* – It is identification of unusual data records that might have errors and are un-interesting.
- *Association rule learning* (Dependency modeling) – It is the process of searching relationships between variables in provided database.
- *Clustering* – It is the task of discovering groups and structures in the data that can be similar in some way or another, without using any known structures.
- *Classification* – It is the process of generalizing known structure to apply to new data.
- *Regression* – It attempts to find a function that create model of data with the minimum errors.

- *Summarization* – It is process of creating a compact representation of the data set, including report generation and visualization.

## II. CLASSIFICATION

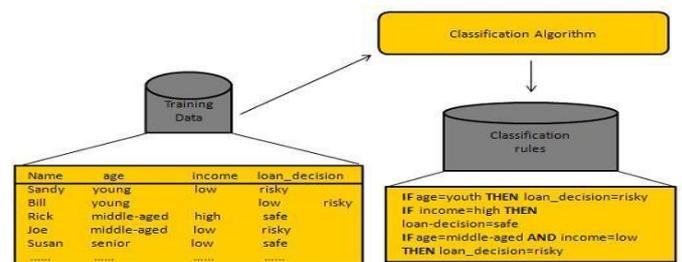
Classification is made of predicting a few outcome predicated on specific input. Classification is a data mining function that assigns items in a group to a target classes or categories. The target of classification is to obtain predict the target class for every case in the information. The algorithm attempts to discover relationships between the attributes that will allow it to be possible to predict the outcome.

Classification is an essential data mining technique with wide applications . It will be used to categorize each and every item in a set of data into one of predefined group of classes or categories . Classification algorithm performs a significant role in document class . In this research , we have analysed two classifiers namely Bayesian and lazy. In Bayesian classifier, we have analysed two classification algorithms namely Bayes Net and naïve bayes, in lazy classifier we have analysed three classification algorithms such as IBL, IBK and Kstar.[2]

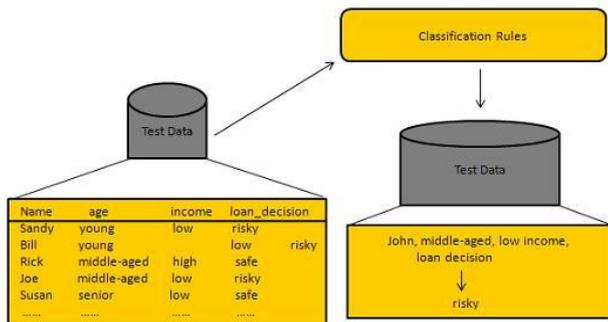
### A. Classification—A Two-Step Process

**Model construction:** identifying a set of predetermined classes. Each and every tuple/sample is assumed to belong to a predefined class , as determined by the class label attribute. The group of tuples used for model development . The model is represented as classification rules , decision trees , or mathematical formula .

**Model usage:** for classifying future or unknown objects. Estimate accuracy of the model. The known label of test sample is compared with the classified result from the model. Accuracy rate is the percentage of test set samples that are correctly classified by the model. Test set is independent of training set, otherwise over-fitting will occur.



Classification process(1): Model Construction



Classification process(2): Use the Model in Prediction

### III. ALGORITHMS

Algorithm is a formula for solving a problem. There are different type of algorithm present in classification technique .But in this paper only Bayesian classification and lazy classification discus.

#### A. Algorithms for Bayesian classification

The Bayesian Classification presents a supervised learning technique along with a statistical procedure for classification .associate primary probabilistic model and it allows us to capture uncertainty about the model in a very principled manner by identifying likelihood of the results . It may solve diagnostic and predictive issues. Bayesian classification can provide easy learning algorithms and prior information and determined knowledge may be put together. Bayesian Classification delivers an important perspective for understanding and evaluating several learning algorithms [3].

- Bayesian network[10,11]:

Bayesian network ( BN ) can also be known as belief networks , is a graphical model for probability important relationships among a set of variables features , This BN contain two parts . Initial part is basically a directed acyclic graph ( DAG ) in which the nodes in the graph are labeled the random variables and the edges between the nodes or random variables presents the probabilistic dependencies among the corresponding random variables . Next part is a set of parameters that describe the conditional probability of each variable given its parents . Bayesian network consists of a structural model and a set of conditional probabilities . The structural model is a directed graph in which nodes represent attributes and arcs represent attribute dependencies . Attribute dependencies are quantified by conditional probabilities for each node given its parents.

- Naïve bayes[9]:

The Naïve Bayes Classifier strategy is dependent on the so-called Bayesian theorem which is especially suitable when the Trees dimensionality of the inputs is higher . Despite its ease , Naive Bayes might outperform more sophisticated classification methods . Estimate unique probabilities for hypothesis , among the most practical methods to certain kinds of learning problems .

- Naïve Bayes is better than Bayes network Because

- 1) Naïve Bayes is a fast execution speed algorithm.[9]

- 2) The naive Bayes model is tremendously appealing because of its simplicity, elegance, and robustness. It is one of the oldest formal classification algorithms, and yet even in its simplest form it is often surprisingly effective. [10]

#### B. Algorithm for lazy classification

Lazy learners store the training instances and do no real work until classification time. Lazy learning is a learning method in which generalization beyond the training data is delayed until a query is made to the system where the system tries to generalize the training data before receiving queries.

- IBL(Instance based Learning):- Instance-based learning methods such as nearest neighbour and locally weighted regression are conceptually straightforward approaches to approximating real-valued or discrete-valued target functions. Instance-based methods can also use more complex, symbolic representations for instances.

- IBK(K-nearest neighbor):- IBK is a k-nearest-neighbor classifier that makes use of the equivalent distance metric . The variety of nearest neighbors is generally specified explicitly in the object editor or identified quickly using leave-one-out cross-validation focus to an higher limit given by the specific value .

- KSTAR:- The K\* algorithm can be defined as a method of cluster analysis which mainly aims at the partition of „n“ observation into „k“ clusters in which each observation belongs to the cluster with the nearest mean.

K-NN is better than other lazy classification because:-

- a) K-NN is easy to understand and easy to implement classification technique. It is also suit for multi class[5].
- b) K-NN give a more accurate result as compare to other lazy classification[6].

### IV. NAIVE BAYES CLASSIFIER INTRODUCE

The Naive Bayes Classifier technique is based on the so-called Bayesian theorem and is particularly suited when the Trees dimensionality of the inputs is high. Despite its simplicity Naive Bayes can often outperform more sophisticated classification methods[3].

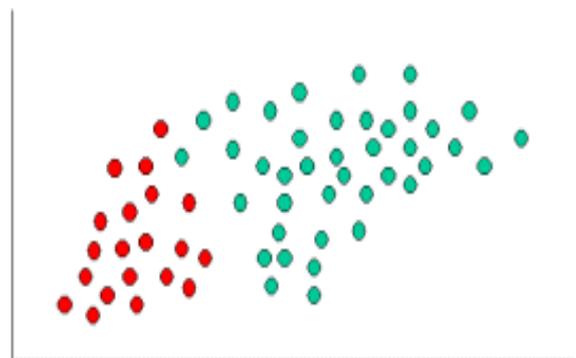


Fig 1

To demonstrate the concept of Naive Bayes Classification, consider the example displayed in the illustration above. As indicated, the objects can be classified as either GREEN or RED. Our task is to classify new cases as they arrive, i.e., decide to which class label they belong, based on the currently existing objects. Since there are twice as many GREEN objects as RED, it is reasonable to believe that a new case (which hasn't been observed yet) is twice as likely to have membership GREEN rather than RED. In the Bayesian analysis, this belief is known as the prior probability. Prior probabilities are based on previous experience, in this case the percentage of GREEN and RED objects, and often used to predict outcomes before they actually happen.

- Algorithm :Given the intractable sample complexity for learning Bayesian classifiers, we must look for ways to reduce this complexity. The Naive Bayes classifier does this by making a conditional independence assumption that dramatically reduces the number of parameters to be estimated when modeling  $P(X|Y)$ , from our original  $2(2n - 1)$  to just  $2n$ .
- Definition: Given random variables X,Y and Z, we say X is conditionally independent of Y given Z, if and only if the probability distribution governing X is independent of the value of Y given Z; that is

$$(\forall i, j, k) P(X=xi/Y=yj, Z=z_k) = P(X=xi/Z=z_k)$$

Example:- consider three Boolean random variables to describe the current weather: Rain, T hunder and Lightning.

We might reasonably assert that Thunder is independent of Rain given Lightning. Because we know Lightning causes Thunder, once we know whether or not there is Lightning, no additional information about T hunder is provided by the value of Rain. Of course there is a clear dependence of T hunder on Rain in general, but there is no conditional dependence once we know the value of Lightning.

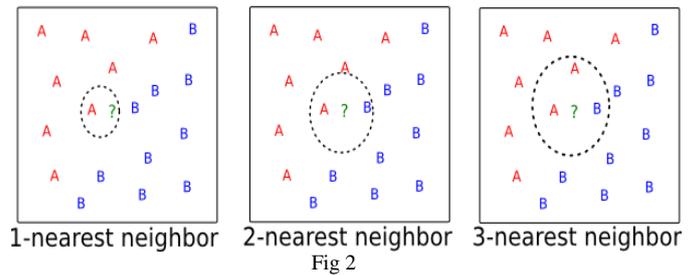
### V. K-NN CLASSIFIER INTRODUCE

k-Nearest Neighbor (kNN) algorithm is one of the most popular learning algorithms in data mining. The K-NN algorithm for continuous-valued target functions Calculate the mean values of the  $k$  nearest neighbors using Euclidean distance . K-NN is a lazy learning technique based on voting and distances of the  $k$  nearest neighbors.

Table 1: Evaluation of Naïve Bayes and Lazy Classifiers with HO

Algorith m	Correctly Instance (%)	Incorrectly Instance (%)	Accuracy			
			TP Rate (%)	Recall (%)	Precision (%)	F-measure (%)
Naïve Bayes	79.6196	20.3804	79.6	0.796	0.803	0.798
K-NN	98.913	1.087	98.9	98.9	98.9	98.9

### 1st, 2nd, and 3rd Nearest Neighbors of a Test Instance



- A. Required three think:-
- The set of store record.
  - Distance metric to compute the distance between record:-
    - Using Euclidean distance.
    - Determine the class from nearest neighbor list take the majority vote of class labels among the  $k$ -nearest neighbors.
    - Weight the vote according to distance  
weight factor,  $w = 1/d^2$
  - The value of  $k$ , the number of nearest neighbors to retrieve. choose value of  $k$ :-
    - If  $k$  is too small, sensitive to noise points
    - If  $k$  is too large, neighborhood may include points from other classes.
    - Formula for choose  $k$  value  $k < \sqrt{n}$  .

### VI. RESULT USING WEKA TOOL

- WEKA  
In 1993, the University of Waikato in New Zealand started development of the original version of Weka (which became a mixture of TCL/TK, C, and Make files). **Weka** (Waikato Environment for Knowledge Analysis) is a popular suite of machine learning software written in Java, developed at the University of Waikato, New Zealand.

Data set used:-

- HO
  - Titanic Dataset
- Result of K-NN and Naïve Bayes

Table 2: Evaluation of Naïve Bayes and Lazy Classifiers with Titanic Dataset

Algorithm	Correctly Instance (%)	Incorrectly Instance (%)	Accuracy			
			TP Rate (%)	Recall (%)	Precision (%)	F-measure (%)
Naïve Bayes	77.8283	22.1717	77.8	77.8	77.2	76.4
K-NN	79.055	20.945	79.1	79.1	<b>82.1</b>	75.9

## VII. CONCLUSION

In this paper we conclude K-NN is best algorithm to other classification algorithms because k-NN is based on nearest neighbor and fast execute technique as compare Bayesian.

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# Comparison of Simple Task Allocation Algorithm and Heuristic Based Model for Load Balancing in Cloud System

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**Abstract-** Cloud computing is a buzzword which has gained a lot of attention in the field of information technology. Although it's attractive features have completely replaced conventional computing, but it's dealing with some many issues and challenges. Load Balancing is one of the major challenges in cloud computing. This paper compares a simple task allocation algorithm and heuristic based model for load balancing. The results show that the heuristic model offers more promising results than task allocation model.

**Keywords**—Cloud Computing; Load Balancing, Challenges, Task Allocation Algorithm, Heuristic Based Model

## I. INTRODUCTION

Cloud computing is a dynamic computing environment. The number of users may increase or decrease dynamically at any time. This dynamically varying of users has impact on the whole system. Therefore, it requires that dynamic load must be handled quickly and intelligibly so that the issue is addressed without impact on performance. Load balancing in the cloud system ensures reduced response time, low turnaround time and high throughput.

### A. Cloud Computing Characteristics:

#### 1. Large pool of resources:

It offers the users with a pool of resources and allows the users to acquire it according to the requirement.

#### 2. Resources on demand:

Users need not require any resource initially, but if need develops later on, he may have it on demand.

#### 3. Rapid elasticity:

Large no of users join or leave the cloud system, so it is elastic enough to grasp the change.

### B. Challenges in Cloud Computing

Although cloud computing has gained a lot of popularity, but still it requires a fundamental research in various areas such as [1]:

#### 1. Load balancing:

In cloud system, it is required that load must be balanced across the virtual machines in order that

high resource utilization and high throughput is achieved.

#### 2. Security

The data on cloud suffers from various threats such data theft during transmission, failure of storage media.

#### 3. Authentication:

It ensures that only the authenticated user is allowed to enter the cloud system. Most of the attacks are directed through the screen such as replay attacks, brute force attacks which login breach the security of a user's private data.

#### 4. Trust management:

There is no standard definition of what actually trust is? It is the most important. There are various trust models developed by researchers for building trust systems [2].

## II. REVIEW OF LOAD BALANCING

Load balancing is an optimization technique to balance the workload across the nodes in the network. It is done to ensure that each node does an equal amount of work and thereby high resource utilization and high user satisfaction. Load balancing is beneficial at both the ends i.e at the cloud provider level as well as the user level. It provides the cloud provider with almost full utilization of his expensive resources and also user is satisfied as his work is done in a couple of seconds. Consider the case if load balancing was not done. Some machines may be overloaded with abundant work and some machines may be ideal or doing little work, but both of these types are consuming power and this is which we call as ineffective utilization of existing resources. Thus, load balancing algorithms were developed and still more are being developed to address the issue [3] [4] [5].

### A. Types of Load Balancing Algorithms

Load balancing algorithms are classified as static and dynamic [6] [7].

#### 1. Static load balancing algorithms:

These algorithms are static in the sense that they do not consider the current state of cloud system for load balancing. Round robin load balancing algorithm and First Come First Serve (FCFS) algorithm is static in nature.

## 2. Dynamic load balancing algorithms:

These algorithms are dynamic in the sense that they consider the current state of cloud system and perform load balancing accordingly. Honey Bee algorithm, Biased Random Sampling, Active Clustering algorithm is dynamic in nature.

### B. Dynamic Load Balancing Algorithms

The dynamic load balancing algorithms are classified into two types [8]:

#### 1. Distributed Approach:

In this approach, load balancing is performed by all the nodes together. Every node participates in the process of load balancing in two ways: cooperative or non-cooperative. In case of a cooperative, all the nodes cooperate with each other to reach a common goal, and in case of non-cooperative, every work independently performing different task.

#### 2. Non-distributed Approach:

In this approach, load balancing is performed by a single central node. This approach can work in two ways: centralized and semi-distributed. In centralized form, there is one central node executing the load balancing algorithm. In semi-distributed form, all node group themselves into clusters and each central node in cluster executes load balancing algorithm at local level. The central node is responsible for the load balancing and controls all other nodes.

### C. Quantitative metrics for Dynamic Load Balancing Algorithms

#### • Selection policy:

It selects the task which is to be transferred to some other node for load balancing.

#### • Triggering policy:

It defines the time period when the load balancing process starts to manage the load [9].

#### • Information policy:

It finds out what type of information is required for load balancing and when it is required.

#### • Load estimation policy:

It gives an estimate about the total load on the system.

### D. Policies for Dynamic Load Balancing Algorithms

- **Throughput:** It calculates the no of tasks which have completed their execution. For a load balancing algorithm to be efficient, throughput should be high.
- **Response time:** It is the time after which user's task is completed. It is calculated as subtracting total execution time from the start time. It should be minimized for better performance.
- **Fault tolerance:** It is the ability to recover from failure. Thus the load balancing algorithm should be highly fault tolerant [10].

- **Scalability:** It is the ability of an algorithm to perform load balancing for a finite number of nodes. In cloud system, no of users may increase or decrease dynamically and correspondingly the load is dynamic. Therefore the load balancing algorithm should be highly scalable.

## III. SCHEDULING MODEL FOR LOAD BALANCING

Cloud architecture consists of three abstraction layers: Application, Platform and Infrastructure. The application layer is employed for user interaction. Users send their requests and receive results via application layer. The platform layer consists of a set of resources and allows user applications to be deployed, run and monitor. Infrastructure layer consists of virtualised physical resources [11].

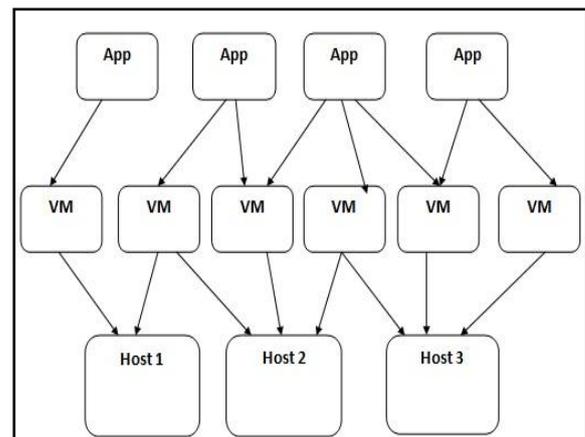


Fig.1 Scheduling model

Fig.1 shows a scheduling model which is two level scheduling model. At the first time, a scheduling of the user's task to the virtual machine takes place and at the second level, scheduling of virtual machines to the host resources takes place. At first level, scheduler creates the task description based on their demand such of resources such as storage resources, network resources and some other resource. At the second level, scheduler finds the appropriate resources for the virtual machine in the host resources according to the task's description. Load Balancer finds the appropriate virtual machine depending upon the user's requirements. This scheduling model is used to get the exact number of resources requested by the user. The resources allocated are neither more nor less and thus prevents wastage of resources, reduces waiting time and improves response time.

## IV. A SIMPLE TASK ALLOCATION ALGORITHM

In this algorithm, the cloudlets are submitted to the virtual machines by first come first basis. When the cloudlets reach the virtual machine, they are scheduled accordingly and when all are virtual machines are processing the task, so they are made to wait in a FIFO queue. When any virtual machine completes the task, then it's given the next task, a task which is waiting in the FIFO queue. Thus, it does not consider the underlying capacities of the VMs. Moreover, there may be some shorter tasks which suffer from starvation if some longer task is executing as it has reached earlier.

## V. HEURISTIC BASED LOAD BALANCING MODEL

In this algorithm [12], all the cloudlets are scheduled initially according to the arrival time. The task which arrives earlier is allocated the VM earlier. Now, when all the VMs are busy then the next task coming is allocated to the VM which has a lower value of power. This algorithm takes into account the underlying capacities of VMs. This algorithm aims at utilizing the full capacity of the VMs i.e. effective utilization of resources and which in turn reduces the response time and turnaround time. In case of ties the cloudlets are scheduled according to First Come First Serve (FCFS) basis. Here the number of processing elements (PE) required by the cloudlet and the cloudlet size in MIPS is considered as load. Initially, all the VMs are allocated power zero. When the cloudlets are submitted, the load balancer finds the virtual machine  $k$  which is more powerful in terms of processing capacities and allocated that VM to the  $i^{\text{th}}$  cloudlet  $r_i$ . After the successful completion of cloudlet, load balancer updates the power  $PW(k)$  of VM using (1).

$$PW(k) = PW(k) + CPU(r_i) * Size(r_i) / CPU(n_k)$$

$$RT = FT - ST$$

Where,

$CPU(r_i)$  – no. of processing elements required by the  $i^{\text{th}}$  cloudlet

$Size(r_i)$  - length of cloudlet

$CPU(n_k)$  – no. of processing elements required by the  $k^{\text{th}}$  virtual machine.

RT = Response time

FT = Finish Time

ST = Start Time

```

Input: Unmapped Requests (cloudlets)

Output: Turnaround Time, Response Time

Load Balancing Algorithm ( )
{
1- Submit cloudlets having different lengths and CPUs required for their execution.
2- Determine VM 'nk' which is powerful in terms of processing capacity
3- for each cloudlet
{

```

## VI. COMPARISON AND RESULTS

It is observed that proposed heuristic algorithm is performing better than the simple task allocation algorithm in terms of response time and turnaround time. Fig. 2 and Fig. 3 show the variation of response time. Fig. 4 shows the variation of turnaround time.

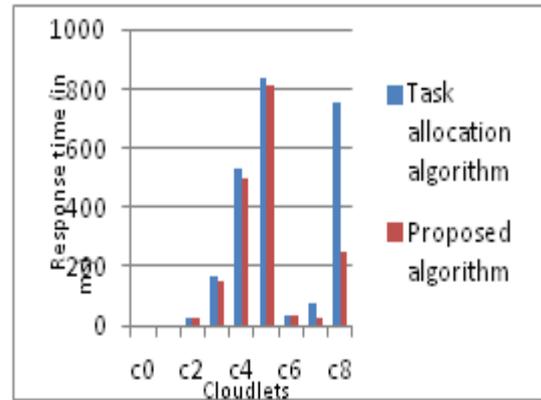


Fig.2 Comparing response time of each cloudlet

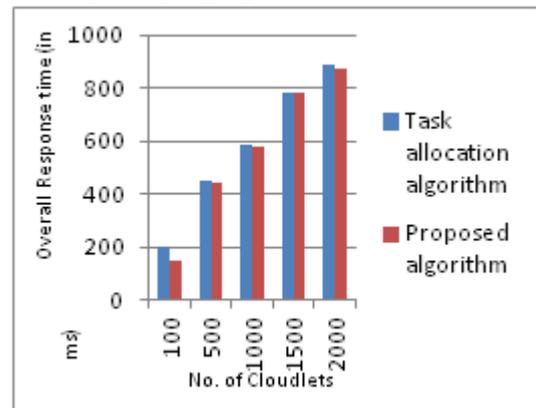


Fig.3 Overall Response time v/s No of Cloudlets

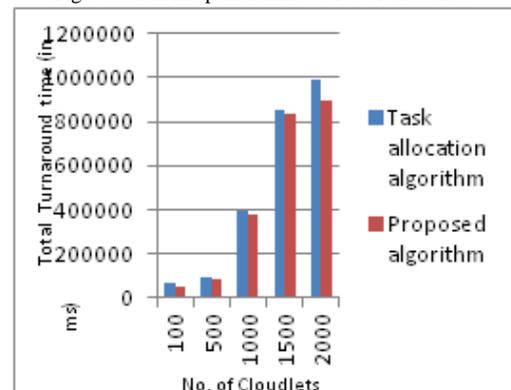


Fig.4 Total Turnaround time v/s No of Cloudlets

Observations:

- It can be seen in Fig.2 that initially for cloudlet c0, c1 and c2, there is little difference between the response times but as the load increases, it can be seen that heuristic algorithm is performing better than task allocation algorithm.
- The other two figures show that heuristic based model is performing better as compared to task allocation algorithm in terms of response time and turn around time. Thus, load balancing is performed by which resources are being effectively utilized.

## VII. CONCLUSION AND FUTURE WORK

Cloud computing is an emerging paradigm in the field of information technology. We have discussed about load balancing which is one of the major issues in cloud computing. The paper is a comparison of a simple task allocation model with the heuristic based model. We have seen that heuristic based load balancing model gives better results. The future work focuses on Of parameters of load balancing such cost, MIPS and throughput.

## ACKNOWLEDGMENT

I would like to express my sincere thanks to my guide for his exemplary guidance, monitoring and constant encouragement in regard to research. My thanks and appreciation also goes to my friends and college mates for their support and suggestions.

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# Review on Mitigation of Cross Site Scripting Vulnerabilities for Secure Web Applications

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**Abstract-** The development of web applications is becoming very popular in all fields like military, medical or financial. The security risks associated with web applications during development and deployment phases are taking less attention which becomes the reason for increase in vulnerabilities. Thousands of vulnerabilities exist but Cross site scripting (XSS) is one of the major security problem of web applications where an attacker injects script in client side that steal its important information. In this review paper, survey of client side security has been considered i.e. DOM based XSS an important security aspect. As researchers have stated many solutions to this XSS but still vulnerabilities exist in Web Applications due to lack of awareness about security in most developers, unavailability of Proper approach for secure software development, insecure coding techniques and poor design. These are the big reasons why security bugs generated and remain undetected. Overall study shows the strength and weaknesses of current approaches available for mitigation of XSS vulnerabilities.

**Keywords**—Cross Site Scripting, DOM based XSS, Mitigation of DOM Vulnerability, XSS Trends by OWASP, Approaches to Mitigate

## I. INTRODUCTION

Nowadays World Wide Web is a critical asset for mankind. Web applications security is accepting a great deal of consideration from government, research and corporate group. Designing a safe web application is a very challenging task.

Attacker finds the vulnerabilities in the framework and exploits it to pick up the data of the victim. Serious vulnerabilities permit hackers to increase direct access to databases so as to agitate sensitive data. The center of this paper is to do literature review on the above issue which is the top web application security vulnerability called Cross Site Scripting as mentioned by OWASP 2013 report [18]. During the study, few review papers related to mitigation of Cross Site scripting vulnerabilities are studied and analyzed. This review paper will help us to understand current situation of research in mitigation of XSS vulnerabilities.

The XSS assault is performed by changing the logic, semantics or language structure of a HTML tag. A client side scripting code is infused into dynamically produced trusted website pages for exchanging sensitive information to the attacker's side .XSS is sort of assault conveyed at application layer of network hierarchy that generally

influences victimized person's web program on the customer-side.

This review work exploits list of XSS vulnerabilities and follows a better picture of significant issues, challenges and possible solutions. Essentially, the objective of this research work is to prevent a web application from DOM (Document Object Model) based XSS vulnerability. DOM based is one of the forthcoming injection problems on the ground that these days, most of the issues related to other type of XSS problems are being cleaned up on major websites [6].

This paper is organized in the following sections. In section II, existing work regarding to review/survey of XSS attacks and its prevention is mentioned briefly. In Section III, the concepts of Cross Site Scripting and its impact as well as types are described briefly. In Section IV XSS metrics is shown. In section V the types of XSS vulnerability i.e. DOM based is discussed. In section VI the research method for conducting the review is described briefly. Section VII concludes the review work.

## II. RELATED WORK

In literature, the problem of cross site scripting vulnerability has been addressed widely but very few works have been observed regarding prevention of XSS attacks. A survey had been carried out on all the strategies those have been utilized to detect XSS by Z. Su et al. [1]. They arranged various investigations to assess performance of those techniques. One significant work found in the literature is performed by Xiaowei Li et al. [3]. This paper reviews the zone of web application security, with the point of systematizing the current systems into a master plan that advances future examination. An idea is proposed for prevention of DOM based vulnerability by S.D Ankush [5]. In his work, the creator created server side response sifting API that will permit benevolent HTML to go through it yet pieces unsafe script and yielding output with low reaction time and high fidelity. A.K. Baranwal [7] has provided a itemized review of different sorts of SQL injection, XSS attacks and approaches to detect and prevent them and after that provides a comparative analysis of different approaches against these attacks. Suman Saha [4] has introduced a static taint analysis for distinguishing DOM-based XSS gaps from alterably produced blunder pages, which specifically addresses the unlucky deficiency of of built-in filter function. Jayamsakthi Shanmugam[16] et al. have

performed survey on XSS vulnerabilities with the current arrangements. Classifications of arrangements are taking into account the area (customer side or server side), investigation sort (static, element, and source code, control and data flow graphs), method like reverse engineering, discovery testing, intermediary server and intrusion recognition sorts.

The above contributions demonstrate that although various approaches of survey and literature work are available in literature but a systematic and disciplined literature review work of mitigation especially in the context of XSS is not found.

### III. WHAT IS CROSS SITE SCRIPTING?

CROSS-SITE SCRIPTING ATTACKS are those in which attackers infuse malicious code, essentially client-side scripts, into web applications from outside sources. Cross-site scripting is positioned among Top 10 vulnerability list of OWASP (Open Web Application Security Projects) [18].

Cross site scripting (XSS) is sort of attack deployed at application layer of network hierarchy. A class of scripting code is infused into dynamically produced pages of trusted sites so as to permit attackers to get secret and confidential information. XSS typically influences exploited person's web program on the client-side where as SQL injection vulnerability is included with server side. In this way, it turns into an issue for web application administrator to follow the XSS gaps.

XSS is a threat emerges because of web security weaknesses of different client side advances, for example, HTML, JavaScript, VBScript, ActiveX and Flash. Presence of weakness in these innovations is a fundamental purpose behind the exploit.[12]

A few factors add to the event of XSS vulnerabilities that are:

- First, the hardware and programming necessities for XSS are least: XSS presents un-trusted input by influencing web applications.
- Secondly most programming dialects of web applications give a dangerous default to passing un-trusted information to the customer.
- The third factor is legitimate approval for un-trusted information is hard to get right, principally in view of the numerous, frequently browser-particular, methods of conjuring the JavaScript interpreter [22].

#### A. Types of XSS Attacks

XSS attacks are characterized into three classes that are [4]:

- Non-persistent/Reflected XSS Attack
- Persistent /Stored XSS attack
- DOM based XSS attack

#### B. Effect of XSS Attack

Effect of XSS attack completely relies on upon the affectability of the information took care of by vulnerable

site. It may go from simply low to amazingly high. The different effects of XSS are as per the following:

- Stealing of cookies and hacking accounts
- Falsehood
- Denial of Service
- Misuse of programs

### IV. XSS TRENDS

With XSS, every input and output has the potential to be an attack vector, which does not occur with other vulnerability types. If we want to see the development of different attacks, then OWASP is the best option. OWASP releases Top Ten list after every three years. Figure 1 shows the Top Ten web application attacks from year 2004 to 2013.

	2004	2007	2010	2013
A1	Unvalidated Input	Cross Site Scripting	Injection	Injection
A2	Broken Access Control	Injection Flaws	Cross Site Scripting	Broken Authentication and Session Management
A3	Broken Authentication and Session Management	Malicious File Execution	Broken Authentication and Session Management	Cross-Site Scripting
A4	Cross Site Scripting	Insecure Direct Object Reference	Insecure Direct Object References	Insecure Direct Object References
A5	Buffer Overflow	Cross Site Request Forgery	Cross Site Request Forgery	Security Misconfiguration
A6	Injection Flaws	Information Leakage and Improper Error Handling	Security Misconfiguration	Sensitive Data Exposure
A7	Improper Error Handling	Broken Authentication and Session Management	Insecure Cryptographic Storage	Missing Function Level Access Control
A8	Insecure Storage	Insecure Cryptographic Storage	Failure to Restrict URL Access	Cross-Site Request Forgery
A9	Application Denial of Service	Insecure Communications	Insufficient Transport Layer Protection	Using Known Vulnerable Components
A10	Insecure Configuration Management	Failure to Restrict URL Access	Unvalidated Redirects and Forwards	Unvalidated Redirects and Forwards

Figure 1: OWASP Top Ten from 2004 to 2013[15]

Cross Site Scripting attacks become more prevalent and severe in the year 2013. If we see the Distribution of Attack Techniques (in percentage) in 2013 as per Cenizic report, then again Cross Site Scripting has highest percentage (25%) among all techniques as shown in figure 1.3. So, there is a need to stop XSS before they stop you.

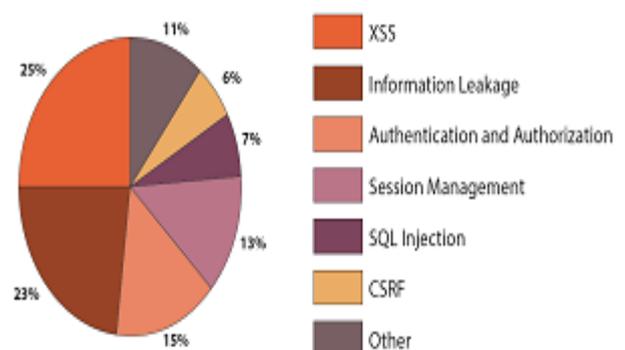


Figure 2: 2013 Web Application Vulnerabilities Found Trend [Cenizic 2013]

### V. DOM BASED XSS VULNERABILITY

DOM Based XSS basically implies a Cross-site scripting vulnerability that shows up in the DOM (Document Object Model) rather than a piece of the HTML. In reflective and stored Cross-site scripting attacks you can

see the vulnerability payload in the response page but in DOM based cross-site scripting, the HTML source code and reaction of the assault will be precisely the same, i.e. the payload can't be found in the reaction[6]. It must be seen on runtime or by researching the DOM of the page.

This vulnerability exists inside customer side pages. For example, if any URL demand parameter is gotten to write its data in the HTML body or perform any DOM-based operation without accepting, a DOM-based XSS gap will probably be introduced, since this written information will be re-translated by programs as a HTML archive that could incorporate extra customer side scripts. As opposed to sending information to server, this XSS may alter DOM environment in the customer side to exploit. Thus, the server stays out of degree to handle this kind of cross-site scripting [4]. As an outcome, acceptance on client include in the server side can't stop DOM-based XSS abusing. To handle DOM-based XSS, there is a need to focus on customer side HTML pages instead of server-side pages.

## VI. EXISTING APPROACHES TO PREVENT DOM VULNERABILITY IN XSS:

In order to prevent DOM based XSS vulnerabilities following approaches can be used

### A. *Browser-Enforced Embedded Policies Approach*

The browser is provided with a white list of all the benign scripts to protect user it from malicious code [8]. It was a good idea to allow only the provided scripts to run; but still there is a lot of difference in the parsing mechanism of different browsers a successful filtering system of one browser may not be successful for other.

Disadvantage: The problem of scalability comes into existence from the point of view of web applications.

### B. *Taint Propagation Approach*

Dynamic and static kind of methodologies uses this investigation to track development of data stream from beginning to end. There are a few presumptions in this approach: The application is secure if a sanitization operation is performed from beginning to end in all the ways [9].

Disadvantage: It is not viewed as a smart thought to have confidence on client's filter and not to check the sanitization function in light of the fact that there are a few Cross-Site Scripting assault vectors which can undoubtedly sidestep numerous filters thought to be solid. Thus, a solid security component is not given here [1].

### C. *Proxy-based Solution*

Noxes, a web proxy shields against exchanging of delicate data from exploited person's website to outsider's webpage [19]. It blocks and detects malware due to the feature of firewall in it. Client is given fine control over every association that is coming to or leaving from local machine.

Disadvantage:

1. In the event that any association is crisscrossed with the firewall's standards then firewall prompts the client to choose whether the association needs to be blocked or permitted. Almost similar approaches apply in [20].

2. This technique doesn't show any method to identify the errors and therefore it needs watchful configuration [21].

There are likewise tools that help designers make secure web applications without much additional work. A few tools recorded are:

The Dominator Tool - A commercial tool based on the Firefox browser with modified Spider-monkey JavaScript engine that helps testers identify and verify DOM based XSS flaws. Dominator Pro is an open source tools for removing XSS flaws stated by MindedSecurity. [<https://dominator.mindedsecurity.com/>]

Cross site scripiter (aka XSSer): A programmed structure to recognize, endeavor and report XSS vulnerabilities in web applications. It contains a few alternatives to attempt to sidestep certain filters, and different unique strategies of code infusion [[www.xsser.sourceforge.net](http://www.xsser.sourceforge.net)]

OWASP Enterprise Security API (ESAPI): The ESAPI library is an execution of routines, including whitelisting , that process client enter securely. It is accessible in various present day programming dialects, for example, JavaEE, PHP, .NET, Cold Fusion, Python and others. [[https://www.owasp.org/index.php/Category:OWASP\\_Enterprise\\_Security\\_API](https://www.owasp.org/index.php/Category:OWASP_Enterprise_Security_API)]

## VII. CONCLUSION

Cross-site scripting (XSS) is a sort of PC insecurity weakness commonly found in Web applications, for example, web programs which rupture the security that empowers assailants to inject customer side script into Web pages saw by different clients [17].

In this work, our entire focus is on mitigation of XSS attacks to enhance the security of web application. This work deals with the prevention of DOM based vulnerability to prevent injection of malicious code at client side. The proposed solution is achieved through filters or open source tools .Research in the field of cross site scripting can add its wider significance in the security of web applications. In this review paper nothing new is implemented, instead of this overall review of research papers has been taken in study of mitigation of vulnerabilities of XSS.

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# Ant Colony Optimization Approach to Minimize Makespan Time of Job Shop Scheduling Problem

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**Abstract-** This paper presents an application of the Ant Colony Optimization, a meta heuristic approach to the Job Shop Scheduling problem which specifically manages the idea of a memory in trying to focus the best route, and minimal schedule for predetermined set of jobs. Research on optimization techniques of the Job shop Scheduling Problem (JSP) is one of the most significant and promising areas of an optimization. Instead of the traditional optimization method, ACO technique is used to optimize Job Scheduling Problem (JSP), in which ideal jobs are assigned to resources at particular times. For the minimization of production run, this scheduling deal with minimizing make span time, which is modeled using an Ant Colony Algorithm by stimulating the behavior of ants. In the natural environment, the ants have a tremendous ability to team up to find an optimal path to food resources. The key aspect of An Ant Colony algorithm used in this work is to stimulate the behavior of ants and to minimize the makespan time (Maximum flow time) of a given set of jobs for uniformly related parallel machines in Job Shop scheduling and generate optimal or near optimal results.

**Keywords-** Ant Colony Optimization Algorithm, Job Shop Problem ,Pheromone, Makespan

## I. INTRODUCTION

With an aim to minimize parameter like minimizing makespan time of tasks is always a key decision of the management of available resources. In the real world, the system for scheduling jobs onto the machines is all that much regular and has been scrutinized by number of researchers. The problem which is selected is quite significant as it is close to the problems of real world.

This paper examines the problem Job Shop Scheduling Problem (JSSP) which typically consists of a finite number of general purpose machines, as opposed to special purpose machines which would typically happen in an assembly line. In this the variety of jobs consisting of operations have been processed and sequenced by machines to find the minimal total makespan time and both the nature and demand of jobs is unpredictable. Makespan time is the total length of work schedule (That is completion time of all the jobs) and is objective function in our case with the aim to minimize it using an ACO approach.

Ant Colony Optimization (ACO) is a probabilistic technique, and heuristic optimization method inspired by biological systems. It is a multiagent approach designed to find, generate or select a lower level procedure that may provide a good solution to a difficult combinatorial optimization problems. In the ACO, the main idea is

determining the interaction of colony of agents based on biological material named pheromone which is a kind of distributed numeric information, as it is the medium through which ants communicate with each other to follow a particular route, that effectively frame a solution by various stepwise decisions until the goal has been achieved.<sup>[1]</sup>

The remaining paper is coordinated as follows. In Section II a literature review for JSSP and enforced algorithms has been conferred. Section III illustrates the formal description of Job Scheduling Problem and ACO algorithm. In Section IV, problem definition and methodology is proposed. In Section V Experiments and Results are computed and Finally, Section VI makes the conclusion remarks together with some conceives about the future research.

## II. LITRATURE SURVEY

Numerous authors have contemplated the JSSP and have been viewed as N-P hard.. With the utilization of ACO procedure, a few systems were proposed by authors to tackle this scheduling issue and among those routines that have achieved best results are: In 1989, carlier and Prinson have added to a technique limb(branch) and bound that have been satisfactorily applied to items for the enhancements of best arrangements. In 1988, Adams added to a Simulated Annealing system for greater issues like (TS) Tabu Search. In 1985, Davis proposed Job Shop Problem with the application of Genetic Algorithm. There are numerous such works alongside the application of advancement techniques. Shortest Processing Time (SPT) cross breed heuristic strategy has been proposed by Zhon and Feng for taking care of scheduling issue. Viable pheromone adjustment procedure for development of essential ant framework which helps in investigation of the arrangement space is proposed by Zhang.J.<sup>[1]</sup> Total Make span time of set of jobs is minimizing by using the heuristic technique of SPT (Shortest Processing Time) and procedure of LMC (Largest Marginal Contribution) by Aftab.M.T.<sup>[3]</sup> In 2012, Selvi.V has proposed an examination concerning the utilization of an ACO to streamline the JSP, by minimizing make span time.<sup>[4]</sup> In 2013, Edson.F have proposed the Elitist Ant System Algorithm to optimize JSP.<sup>[5]</sup> In 2014, Abidia.M.H proposed Combined Shifting Bottleneck and ACO technique to solve JSP to reduce the make span and total weighted tardiness of jobs by generating the initial solution.<sup>[6]</sup>

### III. JOB SHOP PROBLEM

In computer science and operation research, JSP is an optimization problem in which ideal jobs are assigned to resources at particular times. The ideal answer for problem including  $n$  jobs must be transformed on  $m$  machines, decides the example of landing of jobs on each one machine so as to finish all the jobs on all the machines in the base aggregate time emulating the same handling operation request when passing through the machines with no priority demands. [4] The issue is to discover the ideal jobs groupings, setup times on the machines in least time by utilizing the ACO calculation. A job shop typically consists of a large number of general purpose machines, as opposed to several purpose machines which would typically happen in a assembly line. Each job depending upon its technological requirements, demands processing on machines in a certain order. The JSP should be an extremely perplexing issue. Numerically, the greatest no. of conceivable successions with  $n$  jobs and  $m$  machines is  $(n!)^m$  i.e. greatly substantial. The issue is typically explained by close estimation or heuristic strategies.

### IV. ANT COLONY OPTIMIZATION (ACO) ALGORITHM

Getting a motivation from this organic aspect for the real ants, algorithm based on artificial ants was created and named as Ant Colony Optimization (ACO) to fathom an extensive variety of optimizing issues in the academia as well as in the real world. The principal calculation utilizes the standard of the ACO meta- heuristic is the ANT COLONY SYSTEM (ACS) where the ant iteratively create solutions and adding pheromones the suitable way to the solution. Stochastic (having an arbitrary probability dissemination or example that may be examined statistically however may not be anticipated exactly) way determination is a methodology which includes two parameters:

The estimation of pheromone and heuristic value. Pheromone value gives an indication of the quantity of ants that choose the path frequently skipped, while the heuristic value relies on problem and have an alternate shape in distinctive cases. ACO Algorithms has been focused around emulating idea; every way emulated by the ant is connected with the given issue. At the point when the ant takes after a path, the measure of pheromone saved on that path is corresponding to the nature of the comparing competitor answer for the target issue. At the point when ant passes through two or more paths, the path with bigger measure of pheromone has more noteworthy likelihood of being picked by the ant. Subsequently, the ants in the long run unite to a shorter way, assuredly the ideal or any close ideal answer for the target problem [2].

### V. PROBLEM DEFINATION AND METHODOLOGY

JSSP is an extraordinary kind of scheduling issue. It consists of ' $n$ ' number of jobs let say  $a=1.....n$  and ' $m$ ' number of machines  $M_1.....M_m$ . Each job  $a$  consists of set of operations  $O_{ab}(b=1.....n_a)$  with the deterministic processing times  $p_{ab}$ . Each operation has been processed on machines  $m_{ab} \in \{M_1.....M_m\}$  in an uninterrupted processing form and each job processed in the same sequence on ' $m$ ' machines, having individual flow of patterns.

In This exploration work, ACO calculation is applied to minimize the aggregate make span time in the Job Shop Scheduling.

Pseudo code for basic ACO procedure:

Generate the set of solutions over the search space.  
Select the best  $K$  elements among the set of solutions as the set of ants.

Repeat

Build pheromones from ants in  $S$   
Create new solutions according to pheromones information  
Take the best  $K$  elements among  $S$  and the new solution as new  $S$

Until Termination criterion is met.

### VI. EXPERIMENTAL STUDY

While going for implementation part, we solve the JSP by taking a scenario of ' $n$ ' number of jobs where  $n=4$  and ' $m$ ' number of machines, where  $m=3$ . Each job having  $m=3$  operations and has applied ACO approach on it to find optimal results.

Table1. Matrix of Jobs, Operations and Machine

Jobs	1			2			3			4		
Operations	1	2	3	1	2	3	1	2	3	1	2	3
	1	5		2			7			3		
Machine	2		10		3			9			2	
	3			9				7		3		18

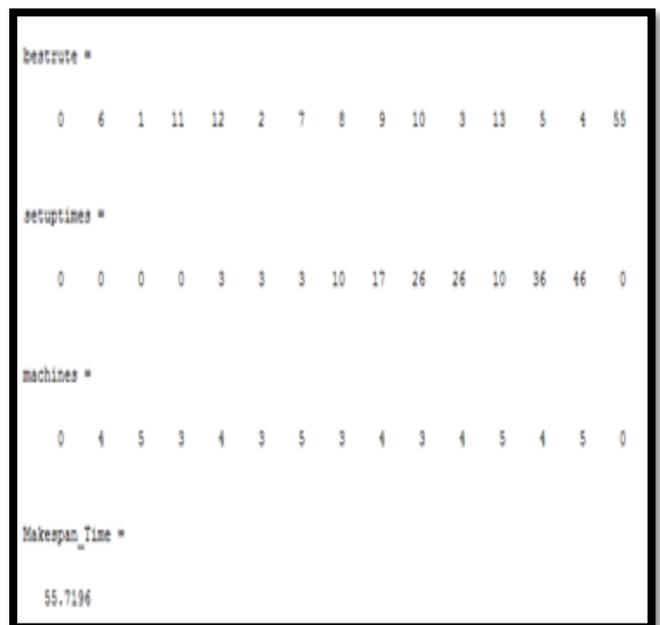


Fig.1. The results generated by ACO algorithm for the given problem in MATLAB.

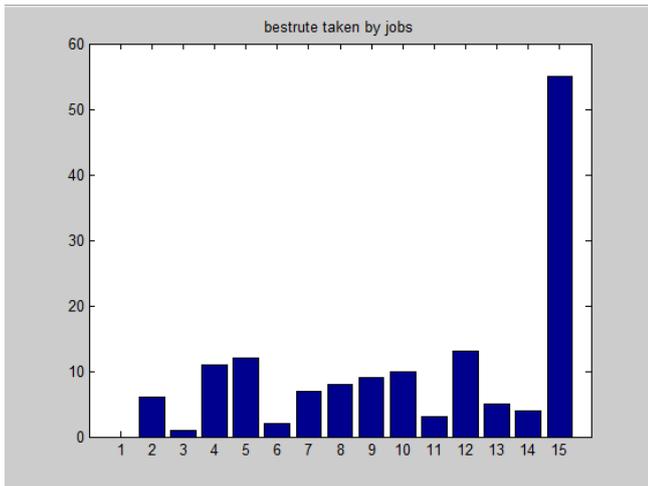


Fig.2. The optimal result of besttrute taken by the jobs

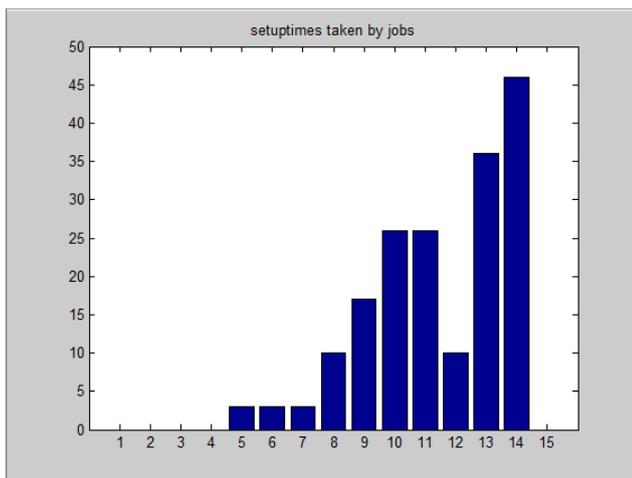


Fig.3. The optimal result of setuptimes taken by jobs

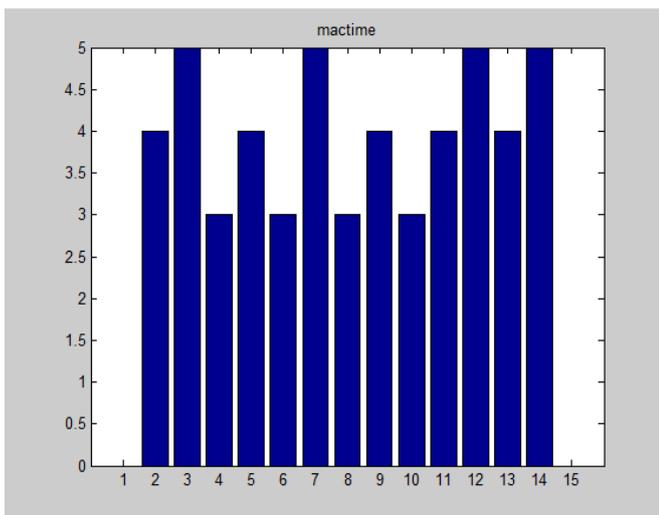


Fig.3. The optimal result of machine time taken by jobs

## VII. CONCLUSION AND FUTURE SCOPE

In this paper an effective adjustment of the metaheuristic ACO for a JSP to minimize the aggregate make span time of given set of jobs is displayed. As conclusion land at concerning the utilization of normal ants to tackle the Job Scheduling Problem with the ACO

methodology is better and hence fit for discovering the ideal or close to ideal arrangements. In future work we can solve this problem by using hybrid heuristics techniques such as PSO (Particle Swarm Optimization) and GA (Genetic Algorithm) and TS (Tabu Search).

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# Applications of Chaotic Functions

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**Abstract:** The more crave for new technologies and internet facilities require more security of data. Chaotic functions with their inimitable properties have come forward in every aspect to enhance the security in a cheap and effective way. Chaos based techniques provide new methods to enhance security. Their analogy with cryptography bonded them with cryptography. Their noise like appearance and unpredictability make them a nominee for constructing pseudo-random number generators and in various encryption algorithms. In this paper chaotic functions and their applications have been discussed in detail.

**Keywords:** Chaotic Functions, One-dimensional Chaotic Functions, Chaotic Pseudo-random Number Generator, Substitution Box

## I. INTRODUCTION

The rapid development in technology, dependency on electronic products and internet usage has increased the demand for more security and privacy. The word security deals with confidentiality, authentication, integrity and non-repudiation [1]. The techniques for providing security must be cheap, effective, flexible and robust [2]. Chaos-based systems have been proved as a boon in providing security and privacy. The word chaos means disorder. When the system's nature is not predictable it is said to exhibit chaos. Chaotic functions with their promising properties and embedment in to the cryptographic networks have gained much more interest. The properties of chaotic functions are [3,4,5]: Sensitivity to system control parameter: chaotic functions are sensitive to control parameter value. Its value changes the shape of chaotic function's map.

- Sensitivity to initial conditions: A small change in the input value of the chaotic function would lead to a perceptible change in the output. When the initial value is changed after third decimal place there is a significant change in the output value [4].

Both of these properties are analogous to diffusion with small changes in plaintext of cryptography [6].

- Ergodicity: chaotic functions are ergodic in nature. Ergodicity means that chaotic variables go across each of the state without repeating any value for a certain range [7]. This property is analogous to confusion of cryptography [6].
- System complexity: This property is analogous to algorithm complexity of cryptography [6].
- Mixing property: This property is analogous to diffusion with a small change within one block of the plaintext of cryptography [6].

These properties have increased the versatility of chaotic functions. Chaos describes the behavior of mathematically complex non-linear dynamical discrete or continuous systems that shows unpredictable behavior due to sensitivity to initial conditions [4,8]. This feature has been defined as chaos theory [4]. The first person who clearly defines the word chaos by making use of spheres was Poincare [9]. The output produced by chaotic systems appears like random noise not like a signal preventing the system from intrusion [4, 9]. The unpredictability, complexity and random nature of chaotic functions made their applicability in cryptographic networks, encryption algorithms, pseudo-random generators, constructing block ciphers with more security and speed [9].

In first section chaotic functions have been discussed. In second section role of chaotic functions have been discussed. In last section conclusion has been drawn.

## II. CHAOTIC FUNCTIONS

Chaotic functions are one dimensional, two dimensional and three dimensional in nature. One-dimensional chaotic functions have been implemented in various algorithms and pseudorandom generators due to their simplicity and ease of implementation [10]. The speed of encryption of ciphers depends upon the number of iterations [9]. The simplest chaotic functions will have less number of iterations providing encryption with much more speed [9]. From the literature survey the one-dimensional functions that have been used widely for different applications are Logistic map, Tent-map function, Sawtooth map, Piece-wise linear map.

### A. Piece-Wise Linear Chaotic Map (PWLCM)

A PWLCM is one of the simplest chaotic functions since the number of chaotic iteration involved in it is less, confined to multiplication/division, additions/comparisons [9]. It has uniform and invariant density and hardware, software realization and implementation is very simple. These features enhance the use of PWLC for various applications [9]. A PWLCM is a map formed by combining multiple linear segments and can be given as [9]:

$$F[x(n-1)] = \begin{cases} x(n-1) * \frac{1}{p}; & 0 \leq x(n-1) < p \\ [x(n-1) - p] * \frac{1}{0.5-p}; & p \leq x(n-1) < 0.5 \\ F[1 - x(n-1)]; & 0.5 \leq x(n-1) < 1 \end{cases} \quad (1)$$

Where p is the control parameter that can have value in the interval [0, 0.5] and x can have value in the interval [0, 1] [9].

### B. Sawtooth Map

The piece-wise linear and non-continuous map of unit interval is known as saw-tooth map [11]. It is also called Bernoulli map,  $\lambda$ -way Bernoulli shift or the shift-map [11]. Saw-tooth map in iterative form has been given as:

$$X_{n+1} = \lambda \cdot X_n \cdot \text{mod} 1 \quad (2)$$

where  $n=0,1,2,3,\dots N$  defines the number of iterations and the initial condition  $0 < X_0 < 1$ . For  $\lambda < 1$  map has constant point  $X=0$ . For  $\lambda > 1$  chaotic behavior is shown by the map and for  $\lambda = 1$ ,  $X_n = X_0$  for all  $n = 1, 2, \dots, N$  [11].

### C. Logistic Map

The logistic map is one of the simplest one-dimensional function [5] and is given as:

$$F(x) = A \cdot x \cdot (1-x) \quad (3)$$

where  $0 < A < 4$ ,  $0 < x < 1$

In iterative form the function has been given as:

$$X_{n+1} = A \cdot X_n \cdot (1 - X_n) \quad (4)$$

Starting with initial condition  $X_0$  the function keeps on iterating depending upon the number of iterations ( $n$ ) required. The system control parameter  $A$  controls the shape of the map [4]. For  $A < 3.7$  the shape will show different patterns and for  $3.7 < A < 4$  the system shows chaotic behavior [4].

### D. Tent-Map function

Tent-map and logistic map are topologically conjugate to each other [5]. Tent map is a continuous piecewise-linear map. Tent map in iterative form can be given as:

$$X_{n+1} = r \cdot (1 - |1 - 2X_n|) \quad (5)$$

Where  $r$  is the control parameter such that  $0 < r < 1$ ,  $0 < X_0 < 1$ ,  $n$  is the number of iterations [5]. For  $r > 0.5$  the map's shape depends on the initial values. For  $0.99 < r < 1$  the map will show chaotic behavior [5]. The sequences produced by tent-like map have the best autocorrelation properties [12]. It occurs because the tent-like maps generate sequences using half of the existing numbers [12]. With this property these functions have been used in telecommunication applications. Using half of the numbers may create problem for generating pseudo-chaotic sequences [12].

## III. ROLE OF CHAOTIC FUNCTIONS

Chaotic functions have been utilized in encryption algorithms such as: image encryption and text encryption, in cryptographic algorithms and various other applications in chaotic pseudo-random number generator form and as a substitution box. Both of these have been discussed in detail.

### A. Chaotic Functions As Chaotic Pseudo-Random Number Generator

Chaotic functions are very useful in constructing pseudo-random number generators (PRNGs) because of their random nature [13]. The pseudo-random generators using chaotic functions are called chaotic pseudo-random number generators (CPRNGs) [8]. The PRNGs uses the avalanche property of chaotic functions which means that a small change in the input would create a large change in the output [13]. PRNGs found application in many areas like

cryptography, entertainment, finite state-machines, statistical mechanism, numerical simulation [8,13,14]. PRNGs are not true random generators as the sequences generated by them depend upon initial conditions rather than any physical source such as thermal noise, atmospheric noise [8]. These show periodicity but the periods of PRNGs are extensive one [14]. CPRNGs can be constructed using digital and continuous chaotic maps [9]. The digital one will be confined up to  $2^N$  values making functions periodic and degrading the ergodicity property [9]. This can be resolved using higher finite precision, perturbing chaotic system and combining chaotic systems [9]. CPRNGs that have been generated by combining chaotic functions would increase security as well as system complexity [13]. Various CPRNGs have been constructed using Logistic map, Tent map, PLCM, Saw-tooth map and combining these. CPRNGs can be constructed by applying some Transformation (T) and different functions can be combined using XOR operation. With the usage of XOR the information in the signal can be covered with more efficiency [2].

The security of CPRNGs has been ensured by applying any one from the various statistical tests to them. The first test suite is Federal Information Processing Standard (FIPS) 140.2 published by the National Institute of Standards and Technologies (NIST) [15]. The FIPS test comprising 4 tests has to be performed on 20,000 bits generated using CPRNG. The four tests are: Monobit Test, Poker Test, Runs test and long run test. The second test suite is DIEHARD randomness test suite consisting 18 tests [16]. The tests are: Birthday spacing, Runs test, Craps test Overlapping permutations, Ranks 31x31, 32x32, and 6x8, Monkey test on 20 bit word, Monkey test on OPSP, OQSO, and DNA, Count the 1's in a stream of bytes, Count the 1's in specific bytes, Parking lot test, Minimum distance test, Random sphere test, squeeze test, overlapping sums [16]. The third test suite is NIST statistical test suite consisting of 15 tests [17]. The NIST tests have been divided in to two categories: parameterized and non-parameterized [17]. The parameterized tests are: Frequency test within a block, approximate entropy test, linear complexity test, Maurer's universal statistical test, Serial test, Non-overlapping template matching test, Overlapping template matching test [17]. The non-parameterized tests are: Frequency (monobit) test, Runs test, Test for longest run of ones in a block, Binary matrix rank test, Cumulative sums test, Discrete Fourier transform (spectral) test, Random excursions test, Random excursions variant test [17].

B. Chaotic Functions In Designing Substitution-Box  
Substitution box (S-box) is the main element of block ciphers which encrypts the data [18]. According to Shannon the security of block ciphers relies over two main properties which are diffusion and confusion [19]. Diffusion means to conceal the bonding of plain text with the cipher text [19]. Confusion means to conceal the bond of cipher text with the secret key [19]. S-box has been mainly employed in block cryptographic algorithms such as DES (Data Encryption Standard) and AES (Advanced Encryption Standard) [18]. S-box is a matrix to which any  $m$ -bit input can be give to have  $n$ -bit output [3,19]. The ease of implementation, more security and reliability allow them to be used in constructing

substitution box (S-box) of block ciphers [1]. The S-box constructed using these functions are dynamic in nature, which have been employed over the static s-box of various algorithms such as DES and AES [1]. The non-linearity of chaotic functions has been used to construct the S-box [3]. The security of these algorithms has been enhanced by using different s-boxes for encryption and decryption of data [1]. Block ciphers have been designed using dynamic s-boxes [18]. The block ciphers designed using chaotic functions are both secret key and plaintext dependable [1]. This dependency has reduced the risk of vulnerability to plaintext attacks [19]. Various methods have been proposed for designing the S-boxes using chaotic functions [1,3, 18, 20]. The performance evaluation of s-boxes has been done using various tests. The tests are Bijection, Nonlinearity, strict avalanche criterion, Differential approximation probability, Linear Approximation Probability, bit independence criterion [1,3,18]. S-box has been implied to various applications such as image encryption, text encryption [19].

#### IV. CONCLUSION

With the innovations in techniques of sharing information the innovation in security is also required. Chaotic functions fit the best in this situation. The functions create confusion by their noise like appearance feature. These functions are showing their efficiency for encryption in every field. All applications are using these functions in 2 manners such as CPRNG, S-box design. In future these functions would be the most widely used in engineering application.

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# Data Mining Techniques Used for Thyroid Disease Prediction

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**Abstract**— Thyroid prediction and thyroid diagnosis are the two medical applications which pose challenge to the researchers. The use of the data mining has revolutionized the whole process of thyroid prediction and thyroid diagnosis. Whereas the thyroid is further been classified into two categories that is the hypothyroidism in which the thyroid gland does not produce the enough of the hormones. The second category is hyperthyroidism in which the thyroid gland produces the excessive amount of hormones. Thus the problem falls mainly under the classification problem. This study paper summarizes the various review and technical articles on the thyroid prediction and thyroid diagnosis. In this paper there is an overview of the current research being carried out using the data mining techniques to augment the thyroid prediction and thyroid diagnosis.

**Keywords**—Thyroid, Hypothyroidism, Hyperthyroidism, Data mining

## I. INTRODUCTION

The thyroid disease is becoming very frequent these days. Knowledge of the implication of this disease is essential for all anesthetists as these patients are frequently encountered and may be at risk of complications at any stage, preoperatively, intra-operatively, or postoperatively [3]. The thyroid disease if not treated well may result fatal. The finest way to deal with any disease is to detect it as earliest. Early diagnosis requires a precise and consistent diagnosis procedure that allows the physician to predict the thyroid without any problem. And also differentiate the hypothyroidism and hyperthyroidism appropriately. The objective of these predictions is to assign the patients into the “yes” group suffering from the disease and the “no” group that is the patients not suffering from the thyroid disease. As well as to handle cases in which the patient is suffering from the thyroid disease and to predict under which phase of the disease the patients is suffering. Thyroid research is generally clinical in nature so the common complement is the data driven statistical research. Predicting the outcome of the disease is one of the most fascinating and challenging tasks where to develop data mining applications. As the use of computers power-driven with automated tools, large volumes of medical data are being collected and are provided to the medical research groups. As a result, the knowledge discovery process has become a well-liked study tool for medical researchers to spot and exploit patterns and relationships among large number of variables, and make them able to predict the outcome of a disease using the historical cases stored within datasets.

The objective of this paper is to summarize various review and technical articles on prediction and diagnosis of the thyroid disease.

## II. THYROID DISEASE: AN OVERVIEW

The thyroid disease is very familiar these days. The thyroid disease is related to thyroid gland which produces thyroid hormones which help in the regulation of the body's metabolism. The primary function of the thyroid hormone is to the production of the hormones triiodothyronine ( $T_3$ ), thyroxine ( $T_4$ ) and calcitonin [3]. The abnormalities of producing thyroid hormones are divided into following categories:

### A. Hypothyroidism:

The thyroid is unable to make and secrete adequate amounts of thyroid hormones to maintain a euthyroid stated [24]. Goitrous or Hashimoto's thyroiditis and atrophic thyroiditis result in hypothyroidism [2]. The occurrence of hypothyroidism varies with the level of iodine in the diet. The depression is experienced by the patients [3].

### B. Hyperthyroidism:

The thyroid is no more under the normal pituitary-hypothalamic control and produces and secretes excessive amounts of thyroid hormones [24]. One of the most common cases is Grave's disease. Grave's disease happens when the body makes protein that constantly tells the thyroid to make more thyroid hormones [9].

## III. DATA MINING PROCESS

In knowledge discovery process the data mining methods are for extracting patterns from data. The patterns that can be discovered depend upon the data mining tasks applied. Data mining is believed to be very helpful tool in the business applications such as increasing profits, and targeting customers. The idea behind data mining is the non-trivial process of identifying valid, novel, potentially useful, and ultimately understandable patterns in data. Data mining procedures serve three main purposes: Knowledge discovery, Predictive modeling, and Forensic analysis [23]. Data mining can be done on data that are quantitative, textual, or multimedia forms. It is used in various applications such as market analysis, risk evaluation, crime detection [20]. Data mining in medical field, bioinformatics is very much in trend. As in healthcare activities vast and intricate volumes of data are generated so because of this huge data the un-automated analysis has become unfeasible.

The data mining can be used to explore the information and can find the various patterns in the data that were earlier unknown.

Data mining applications in medical field:

- Treatment effectiveness;
- Healthcare management;
- Improving customer relationship management;
- Deception and abuse detection;

The famous data mining techniques are discussed below.

#### A. Decision tree:

A decision tree is a tree where a test or decision is represented on the considered data item by every non terminal node. Decision tree algorithm include CART (classification and regression tree), ID3 (iterated dichotomized 3) and c.5) [22].

#### B. Support Vector Machine:

SVM is used to tackle issues in nonlinear classification, function estimation. It was introduced within the context of statistical learning theory and structural risk minimization [11]. It bolsters both classification and regression tasks and handles different continuous and nominal variables.

#### C. Classification rule mining:

The goal of the classification rule mining is to locate a set of decision rules which are suitable to describe the target data set. The methodology includes getting rule sets by means of rule discovery algorithms, and thus discovering the accuracy rate via validation [21].

#### D. Genetic Algorithm:

GAs operates iteratively on a population of structures. A randomly generated set of string are generated from which the GA starts its search. Three basic generators guide the search are selection, crossover and mutation [6].

#### E. Clustering:

Cluster analysis is an unsupervised learning method frequently used in exploratory data analysis to make a preliminary assessment of the data structure, to discover hidden structures in the data sets and to extract/compress the information by drawing data prototypes [4].

#### F. Association Rule Mining:

Association rule mining is a famous data mining technique. Basically, in this each association rule filling the minimum support and confidence are extracted [20]. The support is the percentage of instances that contain all the items included in the association rule. The confidence in association rule mining is a fraction that shows how frequently B occurs among all the instances containing A [7].

#### G. Neural Networks:

An artificial neural network or Simulated Neural Network, is an interconnected group of artificial neurons, that use mathematical or computational models for information processing based on a connectionist approach to computation [19]. Neural networks have remarkable ability to derive meaning from complicated or imprecise

data and can be used to extract patterns and detect trends that are too complex to be noticed by either humans or other computer techniques. These are well suited for continuous valued inputs and outputs. Some applications are radial basis function network, neural classification, gene regulatory networks, fuzzy recurrent neural networks, etc [1].

#### H. Fuzzy logic:

The fuzzy logic handles the concept of partial truth values that is between “completely true” and “completely false”. Its basic aim is to provide a computational framework for knowledge representation and inference in a n environment of uncertainty and imprecision. Fuzzy logic is effective when the solutions need not to be precise [16].

## IV. RELATED WORK FOR DATA MINING IN THYROID DISEASE PREDICTION AND DIAGNOSIS

The various common methods used for predicting the thyroid disease are fuzzy sets, support vector machines, clustering. The results obtained from these data mining techniques are used to recognize the patterns which are meaningful to help the doctors for classifying the occurrence of thyroid disease. This section comprises of the review of the various technical and review articles on data mining techniques in thyroid disease.

In [4] Ahmad Taher Azar et al. provided a comparison between the hard and fuzzy clustering methods for thyroid diseases dataset so as to locate the optimal number of clusters. In this the visualization results demonstrated that the fuzzy algorithms performed better for the thyroid disease dataset creating better differentiated and meaningful clusters with high compactness while the hard clustering algorithms performed just as well but with less compactness.

In [5] Wei-Chang Yeh have constructed the rule based classifier design method using the simplified swarm optimization (SSO) algorithm for thyroid gland dataset. An elite concept is added to the proposed method to improve solution quality, close interval encoding is added to represent the rule structure efficiently and the orthogonal array test to prune the rules so that the over fitting of the data set can be avoided. The performance of the improved SSO is evaluated by performing the computer simulations on the thyroid gland data set.

In [6] Fatehmah Saiti et al. have focused on separating the hypothyroidism and hyperthyroidism as for proper diagnosis these are very important to be separated. They have used the Support Vector Machine and Probabilistic Neural Network (PNN) for classification. In this paper it is stated that the classification accuracy obtained are better than the previous researches. The SVM and PNN they both produce the efficient results but in some other dataset the SVM proves to be better than PNN.

In [7] David Tian, Ann Gledson et.al. have proposed a Bayesian rule mining algorithm (BAR) in which it is combined with the Apriori association rule mining algorithm. BAR performance have been evaluated by using

two datasets from the UCI repository: Thyroid disease and Diabetes. The results show that BAR finds the best rules having the highest Bayesian confidence, Bayesian lift and very high support confidence and lift.

In [8] E.I. Papageorgiou\*, N.I. Papandrianos, et al. have focused on the new method for medical decision making tasks with the soft computing technique of FCMs, producing an improved FCM decision support system. This approach is then implemented for thyroid disease diagnosis. It is formulated that the results of this method are better than the other methods such as multilayer perceptron (MLP) with back propagation (bp) algorithm, radial basis functions (RBF), conic section function neural network (CSFNN), learning vector quantizer (LVQ), probabilistic neural network (PNN), etc.

In [9] Feyzullah Temurtas have focused on the thyroid disease diagnosis by using a comparative study on different forms of neural networks. The neural network classification models used in this paper are Multilayer neural network (MLNN), Probabilistic neural network (PNN) as well as learning vector quantization neural network (LVQ-NN). The UCI machine learning database is used to perform the study. The comparisons are performed and after performing the comparisons the probabilistic neural network was found to give the finest classification accuracy for thyroid disease dataset.

In [10] Esin Dogantekin et al. have developed the automatic diagnosis system based on thyroid gland (ADSTG) for thyroid diagnosis. They have used the Principle Component Analysis (PCA) method to perform the feature reduction, the Least Square Support Vector Machine (LS-SVM) classifier to perform the classification and the classification accuracy, k-fold cross validation and confusion matrix methods are used for the performance evaluation of the ADSTG method. The classification accuracy obtained is about 97.67%.

In [11] Hui-Ping Cheng et al. In this paper have combined the support vector machines with an artificial immune system as the diagnostic classifier which is known as the AIS-based machine learning classifier. The results are evaluated on the basis of the various parameters like mutation rate, stop rate, constant of clonal rate  $K$ , etc. results are compared with various other algorithms in the previous studies. The classification accuracies are evaluated and it is found that the classification accuracy is about 99.87%.

In [12] V. Prasad et al. in this paper have used a hybrid architecture design by combining the artificial intelligence techniques, rough data set theory and machine learning languages. Hybrid architecture as the expert advisory system is constructed which determine the optimistic levels of the disease growth. This system has an accuracy of at most 99 to 100% in predicting the optimistic levels for known data sets.

In [13] Canan Senol et al. in this paper have developed a hybrid structure by combining the neural network and fuzzy logic. The implementation is done on a medical problem with clinical data for thyroid and breast cancer

disease diagnosis. The implementation is done on the thyroid disease and the breast cancer datasets. In the end it is formulated that the proposed hybrid structure gives better performance.

In [14] Jagdeep Singh Bhalla et al. in this paper have used an artificial neural network technique. Levenbergh – Marquardt propagation and Scaled Conjugate gradient back propagation algorithms are the two artificial neural network techniques that are used for the thyroid disease diagnosis. In the end the future scope is also discussed in which it is said that the current neural networks can be enhanced and modified to get better simulation results.

In [15] Lale Ozyilmaz et al. in this paper have used techniques such as Multilayer Perceptron (MLP), Radial Basis function (RBF), and Conic Section Function Neural Network (CSFNN) in order to predict the thyroid disease. 3-fold cross validation technique is used to validate the results and the maximum classification accuracy is obtained by the MLP.

In [16] Saeed Shariati et al. focused on the thyroid and hepatitis disease diagnosis and prognosis by generating a self organized fuzzy system. Along with the prediction of the disease the type and the phase of the disease are also identified. The results of this system are compared with the artificial neural networks and the Support Vector Machine (SVM). The good accuracy levels are obtained.

In [17] Anupam Shukla et al. focused on the thyroid disease by using the artificial neural networks. Three algorithms have been used namely the Back Propagation algorithm (BPA), the Radial Basis Function (RBF) Networks and the Learning Vector Quantization (LVQ). After the implementation in MATLAB the accuracy and the training time is calculated. The best model is evaluated by comparing all the three algorithms. The LVQ Network is evaluated to be the best and its accuracy is 98%.

In [18] Takumi Ichimura et al. focused on the extraction of the various rules from the artificial neural networks. In case to find the effectiveness the proposed method is applied on the thyroid disease and the medical diagnostic system of thyroid. The developed system has the classification accuracy of 94.2%.

## V. CONCLUSION

This paper provides a study of a variety of technical and review papers on thyroid disease prediction. It explores different data mining techniques that present great promise to expose patterns unseen in the data that can assist the clinicians in the decision making process. From the previous study it is observed that the accuracy various applied data mining classification techniques is highly suitable and can aid the medical professionals in decision making for early prediction, diagnosis in the case of the thyroid disease. The improved way is by inheriting and combining the best features of defined models. The best technique can be obtained by building several dissimilar types of models and by trying diverse technologies and algorithms.

## ACKNOWLEDGEMENT

This paper has been made possible with the help and support of everyone including teachers, family, and friends. They were great source of encouragement. We thank them all and wish them all the best for their future.

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# A Review: Biogeography Based Optimization

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**Abstract-** Biogeography based optimization is recently conceived bio inspired optimization technique. It is subset of biogeography which means study of science. In biogeography, we can study geographical distribution of species over time and space. This technique introduced by Dan Simon in 2008. Biogeography based optimization basically the nature oriented concept. There are two main concepts which we can study under the biogeography based optimization algorithms –migration and mutation. In migration we can study various migration techniques like immigration and emigration. This paper considers the various extensions of biogeography based optimization and also how it differs from other optimization methods.

**Keywords-** Biogeography based optimization; Suitability Index variable ;Habitat suitability index

## I. INTRODUCTION

Meaning of optimization in layman terms is to find the best solution from a set of solutions. Biogeography based optimization [17], introduced by Dan Simon in 2008, derives the concept from the geographical distribution of biological organisms. As in case of biological organisms, it is the geographical area which provides facilities for the survival of organisms is more suited than the geographical area having less facilities for the survival of organisms. Conditions for survival such as rainfall, diversity of topographic features, temperature, land area etc. can be correlated to the term Habitat Suitability Index (HSI). Suitability Index Variables (SIV) is used to characterize habitability. Organisms migrate from low HSI to high HSI. The problem can be in any field such as business, economics, engineering and its solutions are characterized by HSI. High HSI is a good solution and low HSI is a poor solution. Solutions can also share features and this process is known as mutation.

BBO algorithms described as follows:

- 1.Firstly we can initialize the bbo parameters like maximum species count, maximum migration rate, maximum mutation rate etc.
- 2.Initialize all random set of habitats each corresponding to given problem solution.
- 3.For each habitat, map the HSI to the number of species, the immigration rate, and the emigration rate
4. After mapping of HSI, migration is done which includes the modification of SIV of the selected habitat.
5. Then, probability of species count is updated.
6. Go to step 3. loop is repeated for a predefined number of generations or till the desirable solution match.

Survey has been done to explore the various extensions to the original BBO and shown in this paper. Rest of paper is organized as Section II gives various extensions of BBO and after that paper is concluded in Section III

## II. EXTENSIONS OF BIOGEOGRAPHY BASED OPTIMIZATION

### A. Blended Biogeographical Based Optimization For Constrained Optimization:

Blended Biogeography-Based Optimization [5] in which migration operator is modified by using blended operator which is motivated by blended crossover operator in genetic algorithm. In original BBO, migration includes the replacement of old SIV with new SIV. The blending of new and old SIV value in the migration process. Due to which a new compromised value of SIV forms. This will prevent the degradation of the solution. The blended migration operator is as follows.

$$H_i(s) = \alpha H_i(S) + (1-\alpha) H_j(s)$$

One drawback of this technique is decrease in time per iteration as there is increase in blending operator.

### B. Markov Models For Biogeographical Based Optimization:

This paper drives the Markov model for bbo [10] includes selection, migration and mutation operators. Migration operators involve multinomial theorem. In this model we can find the probability of population distribution for a given problem. Markov is basically random series of states. The probability of transition from state  $s_i$  to  $s_j$  shown by  $p_{ij}$ . Its transition matrix size  $(n+N-1)$ , here  $n$  be the cardinality search space and  $N$  be the population size. the reduce the size of matrix we need to combine various states together and also not allowing duplicate individuals in population. Markov model extension of variation of bbo includes partially immigration based bbo, totally emigration based bbo, totally immigration bbo etc. The development of Markov model related to binary problems in which solution feature is bit. Here the future work done, when the problem regarding solution feature is integers and real numbers. Simulated results are done for Markov model of bbo.

### C. Distributed Learning With Biogeographical Based Optimization:

In this paper, we present evolutionary algorithm biogeography based optimization having extension distributed learning [9]. Distributed learning in which each individual work separately and does not depend upon

centralized computer. BBO and DBBO having similar nature. In distributed learning we can optimize robot control algorithm. In distributed learning not only use theoretical and simulation results, but we also use experimental results. In case of centralized bbo we can get better result as compared to new distributed learning bbo. In distributed learning allows user to find the less optimal solution while avoiding the need of centralized bbo. In this paper we also introduced the robot control algorithms real world problem.

*D. A Hybrid Differential Evolution with BBO:*

In this paper, DE/BBO [11] introduced which is the combination of differential evolution and BBO. It concentrates on improving the searching capability of differential evolution algorithm by using effectiveness of BBO. It is the combination of migration operator of Biogeography based optimization and mutation, crossover, selection operator of differential algorithm which in turn generates very promising solutions. The proposed algorithm gives the better quality solutions while providing better robustness and convergence characteristics as compared to original BBO with the help of 23 benchmarks functions. Future work is done for constrained optimization problems.

*E. A Dynamic System Model of Biogeographical Based Optimization:*

We introduce Markov theory of biogeographical based optimization to drive a new model that is dynamic system model [7]. As we know in Markov model consists of process of states which is random, having population distribution in each state regarding given problem. In dynamic system model having states different from Markov model. In this paper, we introduce dynamic system in which state means the proportion each individual in population. Due to which dynamic system is used to large sized problems. Dynamic system model extend to GAGUR (genetic algorithm global uniform recombination) and GASP (genetic algorithm single point crossbar). We compare dynamic system model with BBO, GASP, GAGUR. We conclude from this paper that bbo performs better than genetic algorithms when mutation rate is low and it is used to solve real world problems.

*F. Hybrid Biogeographical Based Optimization:*

In this paper, hybrid biogeographical based optimization [1] which is the combination of several evolutionary algorithms. It consists of two types of hybridization that is algorithm level and iteration level hybridation. It is the information exchange mechanism to improve the performance of biogeography. Our proposed hybrid bbo is used for travelling salesman problem and better than algorithmic level hybridation. The new hybrid evolutionary algorithms are generally robust to tuning parameters.

*G. A Real Coded Biogeographical Based Optimization with Mutation:*

In this we extend the original bbo and propose a new real coded biogeographical based optimization [12]. In RCBBO each individual having real vector parameters. Diversity of population improved with the help of real coded bbo and exploration ability. In this paper we also introduce three

mutation operators: Gaussian, Cauchy and levy mutation. 27 benchmarks functions used to improve the performance of RCBBO. Experimental results gave an idea that real coded biogeographical based optimization can give better performance for continuous optimization problems.

*H. Oppositional Biogeographical Based Optimization For Combinatorial Problems:*

Oppositional based learning [15] is used for solving combinatorial optimization problem. In previous papers oppositional learning is used for solving continuous domain optimization problems. In this paper we introduce two methods of oppositional. Open path in which graph last node is not connected to the first node. It is used in graph coloring problems. Closed path in which last node connected to first node, it is used in travelling salesman problem. We can improve the performance of BBO using simulation of TSP opposition method.

Table 1: Key Features Of Various BBO Extensions

<b>BBO Extensions</b>	<b>Operators/Algorithms</b>	<b>Features</b>
Blended BBO	Migration operator modified using blended operator	New compromised value of SIV, prevents the degradation of solution
Markov models BBO	Selection, migration and mutation operator	Partial immigration based bbo
Distributed learning BBO	Migration, mutation, elitism operator	To solve Real world problems To optimize Robot control algorithms
DE/BBO	Migration operator bbo Selection, mutation, crossover operator of differential algorithm	Good at exploring the search space and exploiting the solutions.
Dynamic system model BBO	Genetic algorithm global uniform recombination Genetic algorithm single point crossbar	Large sized problems solve
Hybrid BBO	Iteration level hybridation Algorithmic level hybridation	High convergence speed
Real coded BBO	Gaussian, cauchy and levy mutation operators	To improve diversity of population Continuous optimization problems
Oppositional BBO	TSP oppositional methods to improve bbo	To solve combinatorial optimization problems

III. CONCLUSION

This paper gives the idea about the BBO and its term migration and mutation. The various extensions described in

this paper having its improvement over original BBO. Future work has done under the extensions of BBO .

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# A Proposed Add-on “PBIN” to reduce the risk of Online Card Based Payment Fraud

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**Abstract**—In today’s scenario of online payment transactions using bank cards (Credit or Debit), the issue of online bank card holder’s/user’s authentication is on highest peak. Payee authentication is another most important topic that brings in a new level of security for consumer level in business-to-consumer internet commerce. For bank card holder’s/user’s transaction authentication held by using various techniques like 3D Secure, Verified by VISA (VBV) / MasterCard SecureCode, OTP (One Time Password) Checkout, Netsafe, Securepay password, Card Verification Value 2 (CVV2), Address Verification Service (AVS) etc. But the bank’s online payment gateway webpage authentication is nearly impossible for card holder/user. In this paper, purpose an add on where card holder’s/user’s authenticate the online payment gateway webpage on the basis of an added parameter in the bank’s database.

**Keywords**— Bank’s Card Payment Gateway Webpage, Client, Consumer, Ecommerce, Intellectual property theft, Phishing, Personal Bank’s Identification Number (PBIN), Payment transaction gateway

## I. INTRODUCTION

A payment is the transfer of an item of value from one party (such as a person or company) to another in exchange for the terms of goods, services or both, or to fulfill a legal responsibility. Online payment refers to money that is exchanged electronically. In this computer networks, the internet and digital stored value systems plays significant role. With the increase of human demands from life, the payment through cards also rose dramatically. In the earlier human age the payment is done between payer and payee using the exchange of resources and services, shell money, precious metal coins, leather and paper money etc. Late 1994’s with the spreading of Information Technology, the paper/plastic currency notes swapped by the Plastic Cards with smart chips or magnetic strip (Debit card, Credit card, etc). Later on for online payment these cards are used for ecommerce by transacting the card related details like card number, card expiry date, card owner’s name, card owner’s date of birth etc with owner banks. There are various online payment methods using card are as follows:

a) Credit Card - A credit card is a payment card issued to users as a system of payment. This allows the card-

holder to pay for purchased goods and services based on the card holder’s promise to pay for them. The card issuer bank creates a cyclic account and grants a credit line to the consumer (or the user) from which the user can borrow money for payment to a merchant.[1]

- b) Debit Card – A magnetic striped card issued by a bank through which bank clients may access their account to withdraw cash or pay electronically at merchant locations or online for goods or services.
- c) Commercial Cards – A common terminology for any card product used by organizations for the purpose of making electronic payments online for goods or services.
- d) Prepaid Cards - A debit-based card in which card transaction amounts is deducted from a funded account; can be re Gift/ Loyalty Cards

## II. ONLINE CARD PAYMENT TRANSACTION PROCESS

Figure 1 reflects the online card payment transaction process, which contains following steps:

*Step 1:* Client/ user send request for online payment transaction to the merchant’s webpage.

*Step 2:* Then merchant’s webpage forward the client/user to bank’s online card payment gateway webpage.

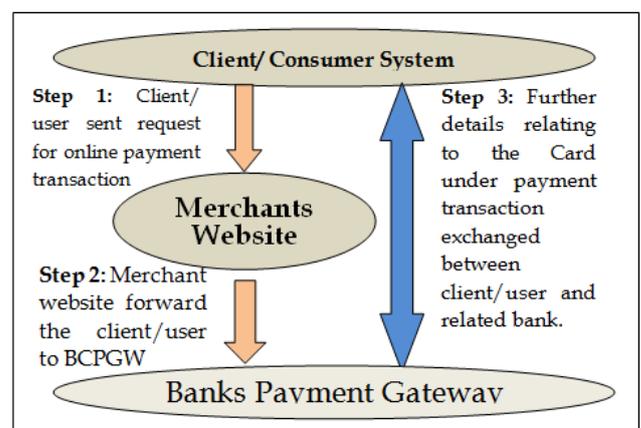


Fig.1. Online Card Payment Transaction Process

*Step 3:* Then the communication is directly settled between client/user system and bank’s online card payment gateway webpage, where all the card related details like Card number, Month/Year of Expiry, Name on Card, CVV

number has been provided by user/client to the payment gateway webpage. On the basis of provided details by card holder to payment gateway webpage, the bank authenticates the user/client card and authorizes the payment transaction.

*Step 4:* Then further communication done between Merchants website and banks gateway webpage about transactional success.

### III. ONLINE CARD PAYMENT TRANSACTION FRAUDS

Pagejacking - Pagejacking does not mean taking over a page on the original site. In this, the original site is also completely unaware about the theft has occurred. Pagejackers tap the traffic indirectly through the search engines. The stolen pages are copied or near-copied as original pages.[3]

- Counterfeit - Duplicating the original credit cards for fraudulent activities.
- Card Not Present - Unauthorized usage of credit card information for fraudulent activities over the internet.
- Skimming – In this type of card fraud data is copied electronically from the card which further used for making counterfeit cards.
- Fake Popup windows/advertisements - When you click on some of these pop-up advertisements, it may also lead your webpage for downloading "spyware" or "adware" or it moves towards a fake bank webpage.
- Key logging – Key-Logging software can record everything that is typed on a computer and send the information to an outside party for fraudulent activity.[1]
- Application Fraud – in this type of fraud a professional person falsifies an application to acquire a credit card information.[2]
- Merchant Collusion - This type of fraud occurs when merchant owners and/or their employees conspire to commit fraud using their customers' (cardholder) accounts and/or personal information. Merchant owners and/or their employees pass on the information about cardholders to fraudsters.[2]
- Triangulation - Triangulation is among the type of fraud which is done and operates from a website. Triangulation includes products or goods that are offered at heavily discounted rates and are being shipped before payment. The phenomenon initiate by the customer while browse the site and if he/she likes the product he/she place the online information related to valid credit card. However, when the fraudsters got details, they shop goods from a related site using details stolen credit card. Further, after this, fraudster use credit card information for purchasing the products/goods. [6]
- Site Cloning - Site Cloning is where fraudsters clone an entire site or just the pages from which you place your order. The cloned or spoofed site will receive these details, which may further lead fraud.

### IV. VARIOUS TECHNIQUES FOR COMBATING ONLINE CARD TRANSACTION FRAUDS

While fraudsters are using sophisticated methods to gain access to credit card information and new technologies are available to help merchants to detect and prevent from fraudulent transactions. Fraud detection technologies enable merchants and banks to perform highly automated and sophisticated screenings of incoming transactions and flagging suspicious transactions.

The various fraud prevention techniques are discussed as below:

- Manual Review – This is a manual method in which reviewing every transaction for signs of fraudulent activity [2].
- Address Verification System - This technique is applicable when card not present. The address verification technique matches the any few digits of the address and the ZIP code of information given for purchase delivering/billing with the card details[2].
- Card Verification Methods - The Card Verification Method3 (CVM) consists of a 3- or 4-digit numeric code printed on the card but is not embossed on the card and is not available in the magnetic stripe. The purpose of CVM is to ensure that the person submitting the transaction is in possession of the actual card, since the code cannot be copied from receipts or skimmed from magnetic stripe [2].
- Fraudulent Merchants - Both MasterCard and Visa publish a list of merchants who have been known for being involved in fraudulent transactions in the past. These lists (NMA - from Visa and MATCH - from MasterCard) could provide useful information to acquirers right at the time of merchant recruitment preventing potential fraudulent transactions [2].
- EMV(Euro Master Visa) card - The EMV Integrated Circuit Card Specifications for Payment Systems are global payment industry specifications that describe the requirements for interoperability between chip based consumer payment applications and acceptance terminals to enable payment. The specifications are managed by the organization EMVCo. named after the original organizations that created the specification, Europay, MasterCard and Visa. The distinguishing feature of EMV is that the consumer payment application is resident in a secure chip that is embedded in a plastic payment card, often referred to as a chip card or smart card, or in a personal device such as a mobile phone. The chip provides three key elements - it can store information; it can perform processing; and because it is a secure element, it is able to store secret information securely, and perform cryptographic processing. These capabilities provide the means for secure consumer payments [4].
- Authorizing Card Payments with PINs – The cards acts as Hard-Keys and their related Personal Identification Number (PIN) acts as Soft-Keys. The

combinational results of both hard and soft keys raise transactional security [5].

- Negative and Positive List (N/P L's) - Negative List (NL) is a database used to recognize high-risk transactions based on specific data fields. For example, negative list would be a file containing all the card numbers that have formed charge backs in the past, used to evade further fraud from repeat offenders. Likewise a merchant can put up negative lists based on billing names, street addresses, emails and internet protocols (IPs) that have resulted in fraud or attempted fraud, effectively blocking any more attempts. An acquirer could form and maintain a list of high-risk countries and decide to review or confine orders originating from those countries. Positive files/List (PL) represents a vital tool to prevent unnecessary delays in processing valid orders [6].
- Payer Authentication - Payer authentication is an emerging technology that promises to bring in a new level of security to business-to-consumer internet commerce. The Verified by Visa (VbV) or Visa Payer Authentication Service (VPAS) program is based on a Personal Identification Number (PIN) associated with the card, similar to those used with ATM cards, and a secure direct authentication channel between the consumer and the issuing bank.[6]
- Lockout Mechanisms - Automatic card number generators represent one of the new technological tools frequently utilized by fraudsters which are easily downloadable from the Web, are able to generate thousands of 'valid' credit card numbers.[6]

## V. PROBLEM IDENTIFICATION

Above we had studied about nearly all the facts relating to card transaction frauds and its security. One loophole we have identified that, when a user/client wants to do an online transaction using card through related bank's payment gateway webpage. At that moment user/client is very prone to the frauds like online intellectual property theft, phishing, fake popup windows/advertisements, triangulation, site cloning, false merchant sites etc. During these attacks user/client is not able to authenticate the genuineness of the bank's payment gateway webpage. This may lead towards fraudulent payment transaction.

Proposed add-on Personal Bank's Identification Number (PBIN)

In this paper, I proposed an add-on namely Personal Bank's Identification Number (PBIN) to the any available online card payment transaction anti-fraud technique that each card holder must holds an another secret security code PBIN like ATM-cum-Debit card secret Pin Number or Password which should be provided by bank to the card holder at the time of card issuing. Once this PBIN security code is given to user/client then it is only changed after the personal/ written request to bank. This PBIN security code is must be as secret as other security code like ATM-cum-Debit card Pin number. This PBIN security code is used to

authenticate the online payment transaction gateway webpage.

In the earlier online payment transaction through gateway webpage, the user/consumer has to feed in all the card related details without assurance of payment gateway webpage genuineness, which may leads fraudulent payment transaction.

But in my technique, whenever user/consumer wants to do an online transaction using card through related bank's payment gateway webpage, firstly the user feed card related minimum details like card number. Then the payment gateway webpage display the PBIN secret security code (either Pin number or Password) related to the provided card number which has retrieved from the banks database. If user/consumer validates the displayed PBIN security code with already available PBIN security code, then it authenticates the genuineness of bank's payment gateway webpage. By this way user/client may manually compare the displayed PBIN security code with his/her available PBIN. After verification of bank's payment gateway webpage genuineness, user/client may further move for providing details to the bank's payment gateway webpage. This technique may reduce the risk of providing payment card related details which may leads towards online transaction frauds like Online intellectual property theft, Online Identity theft, Phishing, Skimming, fake Popup windows/advertisements, Triangulation, Site cloning, False merchant sites.

There is a proposed add-on technique for online card payment transaction process, which contains following steps:

*Step 1:* Client/ user send request for online payment transaction to the merchant's webpage.

*Step 2:* Then merchant's webpage forward the client/user to bank's online card payment gateway webpage.

*Step 3:* Then the communication is directly settled between client/user system and bank's online card payment gateway webpage, where minimum card related details like card number only provided by user/client to the payment gateway webpage

*Step 4:* The related banks database return the PBIN security code to payment gateway webpage which displayed on same webpage.

*Step 5:* Then user/client may manually compare the displayed PBIN security code with his/her available PBIN security code and authenticate the genuineness of payment transaction gateway.

*Step 6:* After ensuring the genuineness of payment transaction gateway, user/client further provide the card related details like Month/Year of Expiry, Name on Card, CVV number, Pin number etc to the payment gateway webpage for the payment transaction authorization.

*Step 7:* Then further communication done between Merchants website and banks gateway webpage about transactional success.

## VI. CONCLUSION

This paper tried to propose a new add-on for raising security based on personal observations. By using this technique, we may reduce the risk of the fake online payment gateway webpage fraud.

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# Big Data in Health

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**Abstract**—One of the biggest issue in India is healthcare. Those people who are living in big cities or metro cities have obtained the opportunity to use the benefits of efficient health care as compared to those living in rural parts of the country and are facing more difficulties of insufficient provisions in healthcare industry. Although some parts of the country have more access to the sufficient facilities but still, we are very slow to delve into this advancement as compared to other countries. According to some experts and policy makers, there is a huge chink in skills and knowledge about the innovations in public and private health financing and delivery. The incompetent and inequities in the health care access in India have pushed ahead the necessity for productive and innovative solutions to strengthen the same. The troubles prevailing in the industry of health care yields an important and apparent calls for the need to alter the existing structure of the present health care services by applying big data analytics. This paper identifies the huge shortage of sufficient health care facilities and addresses how to use big data in providing greater access to primary health care services in India. Further, it also addresses the critical computing and analytical ability of Big Data in processing huge volumes of transactional data in real time situations. The intent of this paper is to provide a definition of big data and to present the transforms in the health care sector and boosts the discussions on how government can hitch up the innovations in the big data analytics to upgrade the health care system.

**Keywords**-Big Data Analytics, HealthCare, EHRs, Tele Medicine, Electronic Medical Report.

## I. INTRODUCTION

India is an innovative nation having more than billion population, one of the fastest growing country, economically as well as in the terms of number of population. This increase in the population saddle the health care industry of India. Health care in our country is capitalized by government. But, for those living in rural areas accessing primary health care is still a challenge. For the developing countries like India, one of the most important issue to emphasis is the healthcare to provide better health care access to the priceless human resources, which in turn can make the India healthier. The exponential rise[1] of data over the last ten years has brought a new domain in the era of information technology and data science called Big Data. The term Big data is often used to define a large amount of data (both structured and unstructured) that is massive in volume and very hard to process using traditional database management techniques. As the health care production is engulfed with massive volumes of data which needs authentication and investigation, Big Data Analytics can be applied. Big data has the ability to execute critical computing and analytical ability towards the processing of the massive volumes of transactional data. Data is rising rapidly [2] than healthcare organizations can digest it, approximately 85% of health data

is unstructured and clinically relevant. This data is located in multiple places like individual EMR's, lab ,genomics and imaging data, claims, CRM systems, PRO's and finance. In addition, the conversion from paper medical records to EHR systems has led to an exponential growth of data. The health industry is on the peak of its most exciting period to date and entering into the new era where technology is starting to tackle big data, fetching about unlimited potential for statistical extension. Big Data analytics are helping to realize the goal of diagnosing ,treating, helping and healing all patients in need of healthcare, with the terminating goal of this domain being improved HealthCare Output(HCO), or the quality of care that healthcare can provide to end users(i.e. patients).However, the scope of this study will be a research that uses data mining in order to answer questions throughout the various levels of health. In addition to aggregate the huge quantity of data, there's the challenge of maintaining the records of the patient's privacy. Healthcare organizations are leveraging big data technology to capture all of the information about a patient to get a more complete view for insight into care coordination and outcomes-based reimbursement models, population health management, and patient engagement and outreach. Successfully harnessing big data unleashes the potential to achieve the three critical objectives for healthcare transformation:

- Build sustainable healthcare systems
- Collaborate to improve care and outcomes
- Increase access to healthcare

With the adoption of big data in healthcare [7], security and primary concerns of the patients is increasing significantly the detail information of the patients is recommended to be stored in data centre's with different levels of security. According to the health insurance acts, EHR security must be taken to the highest priority to ensure safety This paper is structured as follows: in section II, we explain the existing health care in India, section III discusses about big data and its characteristics, section IV focuses on the problems in the existing healthcare system, section V provides the innovative ideas to provide better health care to people of India, section VI presents the big data analytics in health care system and section VII concludes the work.

## II. EXISTING HEALTHCARE IN INDIA

Healthcare is the right of each and every person but absence of standard infrastructure, lack of qualified medical functionalities, and non- access to basic medical aid and facilities thwarts its reach to 65% of population in India. Those parts of the country where the condition of medical facilities is disgraceful, a shocking number of 700 million



different sources and forms, it can be sourced out from e-mails audio and videos. In big data, the variety of data has risen up, boosted by the use of cloud computing [10]. Variety makes big data really big. Big data comes from a great variety of sources and generally it consists of three types: structured, semi structured and unstructured. Structured data interpolates data warehouse that is already tagged and easily sorted but unstructured data is random and hard to handle. Semi structured data does not obey to fixed era but includes tags to isolate data elements .[8]

- Veracity:

Veracity refers to the biases, noise and abnormality in data. Is the data that is being stored, and mined meaningful to the problem being examined [12]. It is the great challenge in analytics of big data when compared to other attributes like volume and velocity It can create a problem, if the data coming in large volume is not correct, and is of no use. So, it should be correct.

#### IV. PROBLEMS IN EXISTING HEALTHCARE SYSTEM

The health system [18] of India includes public and private hospitals as well as specialized Ayurvedic hospitals. Health insurance only covers hospitalization and emergency costs. India is one of the most populated country in the world, the healthcare infrastructure that is over-burdened with this ever increasing population, a set of the following challenges that are unique to India arise.

- Economic lack in the bigger segment of population outcomes in poor access to health care and poor educational status in India, leads to lack of utilization of primary health services and results in the growth of risk factors.
- The twin epidemic of transpiring infectious diseases as well as chronic degenerative diseases is faced by India.
- Deficiency of education, gender discrimination and explosive rise in population contributes to rising burden of diseases resulting in the challenge to the health sector.
- The most important from the government side is, Expenditure on health by the Government continues to be low. It is not viewed as an investment but rather as a dead loss.

The various types of data can be anticipated from the health care system from different health science data sources include data from drug research, social media, patient records, gene sequencing, test results, claims, home monitoring mobile apps etc.,

- a) Clinical data including unstructured documents, prescriptions and images.
- b) Day to day research publications and medical references
- c) Huge amounts of genomic data for analyzing the behavior of various .
- d) Web and social networking data on healthcare issues

- e) Streamed data from home monitoring, Telemedicine, hand held and sensor based wireless device data.

Thus the need for BDA (Big Data Analytics) arises, which provides clinical decision support through large amounts of data, personalized care by early detection and diagnosis before a patient develops disease symptoms, clinical operations with great accuracy, fraud management in the health sector.

#### V. INNOVATIVE IDEAS TO FIX HEALTHCARE IN INDIA

Now, we are going to suggest some ideas [9] to fix rural health care in India and bridge the gap between quality and affordability in government hospitals. These ideas will enable us to access the services on par with the private super specialty hospitals. Further, the implementation of these ideas will provide cheaper, better and easier health care facilities to the citizens of India.[22]

##### A. e-Health File:

The creation of an e-Health care file for each patient, where all health care providers and patients themselves were able to submit information (with the consent of the patient). To overcome the information overload from the massive amounts of data, Big Data Analytics could be employed for the processing of the data and obtain the desired results with great accuracy in reasonable time.

##### B. Creating awareness with chronic diseases:

The system must identify and create awareness among the people with the common chronic diseases at particular areas, through which we can prevent diseases. These chronic diseases are responsible for the 75% of health care spending due to lack of awareness and prior care.

##### C. e-Prescribe:

Paper based prescriptions are archaic and lead to several miseries each year due to errors in But if every doctor is provided with prescription. an electronic prescription system, it would improve safety by making prescriptions easier to read and providing instant checks on drug interactions, dosages, and a patient's medication history.

##### D. Stop Unnecessary Treatments:

Doctors should avoid trial and error type of medication. The problem must be examined thoroughly by performing the required diagnostic tests during the preliminary days of disease. The right treatment should be suggested at the first visit only which avoids the disease to become more critical. Most of the issues are arising with the misdiagnosis and wrong treatment during the early stages.

##### E. Electronic Medical Records:

Medical Experts agree that electronic medical records (EMRs) are a must for the better health care in India.

#### VI. APPLYING BIG DATA ANALYTICS IN HEALTH CARE

We reside in the age of big data. The quantity of data generated in the world upto and including 2005 is now generated every two days. Big data is a platform for importing, storing and analyzing data to uncover data not which is known earlier. This outburst of the data alter the

thought process of the people about everything. However, the health care has not kept pace with big data. Big Data Healthcare is the force to capitalize on growing patient and health system data availability to give rise to healthcare innovation. By forging smart use of the ever-increasing quantity of data available, we discover new awareness by reviewing the data or merging it with other information [14]. In healthcare this means not just mining patient records, medical imagery diagnostic reports etc., for insights, diagnoses and resolution support machine, but also continuous analysis of the data streams generated for and by every patient in a hospital, at home and even while on the move via mobile devices. Even today, most of the health care analytics is executed by doing monthly data refreshes in relational databases that generate pre-processed reports. A fair gap is often absent lab test is often 45 days old, as the data flow proceed from batched data sector to real time sectors from transactional systems and streaming data from analytical modeling devices. This old model of analytics will not succeed. Analysis will require to be done on that spot moment not in the pre-processed structure. Data revives need to be done in real-time not once in a month. The data analysis tools of nowadays are likely yellow pages phone book in the era of Internet Search Engine. They are becoming more outdated with each passing day. The traditional health care analytic devices are built on devices enhanced by IBM in 1970, more than 40 years ago. If all the three parties (payer, provider, pharmaceutical company) work collectively and distribute data/insight, disease management programs will become cost-effective and bring improved patient results at a scale that will furthermore optimize overall health-care cost structure. The term “e-health” [15] defined by WHO: “a new term used to describe the integrated use of electronic communication and information technology in the health field”. e-health is the main driver for three significant changes within the health care environment[15]:

- A. Patients to become better informed
- B. Patients to become more active and empowered in their health care
- C. Healthcare to become more efficient.

Big data solutions [16] attempt to cost effectively solve the challenges of large and fast-growing data volumes realize its potential analytical value. For instance, trend analytics permits you to find out what happened, while root cause and predictive analytics enable understanding of why it occurred and what it is likely to occur next. All healthcare constituents – patients, payers, providers, groups, researchers, governments etc. – will be impacted by big data, which can predict how these payers are likely to perform, encourage desirable performance. These applications of big data can be tested, refined and examined rapidly and inexpensively and will radically alter healthcare delivery and research. The healthcare domain has not been a difficult aim for people who pursue easy money by using fraud means [17]. Healthcare fraud is expected to proceed to rise as people live longer. A big data platform has potential to filter through a large quantity of historical records in relatively lesser extent of time, so that the production transactions can use fraud discovery on real time. Though, the big data analytics in healthcare plays a crucial role to provide better health care services, generate analysis on the historical data to expose

hidden data, the big data analytics has the challenges like Heterogeneity and Incompleteness of data, scale, timeliness, confidentiality and Human Collaboration [17]. The later research is all about to defeat the challenges and use big data analytics in healthcare to expose the understanding from the raw unstructured data.

## VII. CONCLUSIONS

Big data analytics in healthcare is yielding into a promising sector for providing awareness from very large data sets and upgrading results for minimizing costs. In this paper, an outline of the problems encountered by the rural community living in remote areas of the country in obtaining the primary health care is described specifically. It is also explored how the big data analytics are valuable to change rural healthcare by gathering awareness from their clinical and other data repositories and make informed conclusions. This paper discusses about the big data, its characteristics, methods challenges and suggests how to get rid of the underlying issues being encountered by the health care industry. It also introduce the big ideas to rectify the healthcare system in India. The implementation part of this paper can be done using HDFS (Hadoop File System) for the storage of large data and Hadoop Map Reduce with Amazon Web Services. The usage of big data analytics over the healthcare organization and healthcare industry will mine the doctor's lab transcript's using text mining and co-relation to patient results and location aware application analytics for increasing customer experience. Attaining better results at inferior costs has become very essential for health care which can be achieved through the implementation of this paper using Hadoop HDFS and Map Reduce to uncover the data lying in big health data sets.

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# Metrics for Project Size Estimation in Software Engineering: A Review

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**Abstract**– Size estimation is a necessary part of the planning process. Accurately estimating software size is the one of the biggest challenge in the area of software engineering. The most important activity in software project management is Software development effort or size estimation. Incomplete software information causes inaccuracy in software size. The estimation of effort and cost depends on the accurate prediction of the size. Software metric provide measurement for the development of software involving software requirement documents, designs, programs and tests .This paper describes software metrics used for software project size estimation .This summarizes existing literature on software project size estimation. Early software size estimation is essential for good project management.

**Keywords**– Function point, Line of Code, Object Point, Size Estimation, Use-Case Points

## I. INTRODUCTION

Software engineering is the branch of systems engineering deal with the development of large and complex software intensive systems. Software engineering is the study and application of engineering to the design, development, and maintenance of software. Software engineering, a layered technology is responsible for the software development product in software industry. [1] Software engineering has as one of its primary objectives the production of programs that meet specifications, and are accurate, developed on time, and within budget. [2] The Goals of Software Engineering are:

- Many programmers don't do what the end user wants because they do not understand user needs. Hence it becomes important to understand the needs of end user and accordingly software should be developed or produced.
- The software product should be cost effective. Maintenance of software is an activity that can be done only after delivering of software to customer. Any small variance in software should not cause restricting of whole software. This indicates that design of software has poor quality. [3][11]The remainder of this paper is organized as follows. Section 2, presents the project size estimation. Section3 highlights the Metrics for project size estimation. In Section 4, overviews related work. Section 5 highlights the comparison of software metrics. Open issues and future scope are presented in section 6. In the end the conclusion is made in Section 7.

## II. PROJECT SIZE ESTIMATION

Estimating the size of a software system is a critical development process activity. The size of the software system means the amount of work to be performed in a project development. Project size is a measure of problem complexity in terms of time and effort needs to develop the products. Size is one of the most important attributes of a software product. It is a key indicator of software cost and time; it is also a base unit to derive other metrics for software project measurements, such as productivity and defect density.[4] The software size is the most important factor that affects the software cost. According to Boehm 's survey on cost estimation approaches, size metric is used as an essential input for most of cost estimation models. The software estimates are difficult to obtain due to incomplete software information is available in the early phase of software development process.[15] Size of software is important for the following reasons :

- It shows that how big is the software.
- We can measure effort by using size. We can estimate that how much effort is more required to complete the project.
- What is the quality of our project as compared to other projects?
- Software size is helpful in benchmarking the productivity. What is our productivity as compared to others?

Two main ways you can estimate product size are:

- By analogy: Estimate the total size of the new project by adding up the estimated sizes of each of the pieces. An experienced estimator can produce reasonably good size estimates by analogy if accurate size values are available for the previous project and if the new project is sufficiently similar to the previous one.
- By counting product features and using an algorithmic approach such as Function Points to convert the count into an estimate of size. Macro-level "product features" may involve the number of methods/functions. [11].

## III. METRICS FOR PROJECT SIZE ESTIMATION

Metrics are measurement methodologies whose main Objective is to estimate the size of software system and assist, as an indicator, the project management of software system development. Currently, there are several metrics of size estimation and it is difficult to select the most

appropriate for the size of a software project in an organization. [14]

#### A. Lines of Code

Lines of code (LOC) or source lines of code (SLOC), is a software metric used to measure the size of a computer program by counting the number of lines in the text of the program's source code. LOC is the metric which measure the size of project by counting the number of instructions in the developed program. While counting the number of source instructions, lines used for commenting the code and the header lines are ignored. In order to estimate the LOC count at the beginning of a project, one would have to make a systematic guess. So sometimes project divided into modules and sub modules until sizes of different modules can be approximately predicted or estimated [8][7]. Lines of code (LOC) only measures the volume of code, one can only use it to compare or estimate projects or programs that use the same language, and is coded using the same coding standards. To change one is to change or variance the volume of code. A better method to compare without regard to direct volume is to measure the complexity of the software [6][10]. Lines of code could be defined either: Physical SLOC, Logical SLOC

#### B. Function Point

The mostly used metrics are "Functionality" metrics. These metrics predict the size of software in terms of functionality from the users' point of view instead "length" metrics, which are from the developer's point of view. In 1979 At IBM Function Point FP defined by Allan Albrecht, is a unit of measurement to express the amount software functionality [5] [13][12]. Function point analysis (FPA) is the method of estimating the size of software. The advantage is that it can ignore source code error when selecting different programming languages. FP is programming language independent, making ideal for applications using conventional and nonprocedural languages. Early in the evolution of project, it is based on data that are more likely to be known. Function types are as:

- External Inputs
- External Outputs
- External Enquiries
- Internal Logical Files
- Eternal Interface Files

Steps for calculating FP:

- In first step evaluate the Unadjusted FP Count (UFP) Function types are ranked according to their complexity: Low, Average or High.

Table I: Refinement of function point entities

Type	Simple	Average	Complex
Input	3	4	6
output	4	5	7
Inquiry	3	4	6
Number of files	7	10	15
Number of interface	5	7	10

- After calculating UFP, evaluate the Total Degree of Influence (TDI). This step includes assessing the environment and processing complexity of the project .In this step, the impact of 14 general system characteristics is rated on a scale from 0 to 5
- In next step, Value Adjustment Factor (VAF) is evaluated. The value adjustment factor indicates the general functionality provided to the user of the application. Insert the TDI into the following equation to produce the value adjustment factor.  $VAF = (TDI * 0.01) + 0.65$
- Now, the adjusted function point count is calculated as,  $FP = UFP * VAF$ . [9]

#### C. Object Point

Object-oriented analysis and design concepts are well known in today's software development environment. It measures the size from a different dimension. This measurement is based on the number and complexity of the following objects: screens, reports and 3GL components. This is a new measurement and it has not been famous. But because it is easy to use at the early phase of the development cycle and also measures software size reasonably well. [9].Steps for calculating OP:

- Count number of screens, reports and 3GL components.
- Classify object as simple, medium and difficult.
- Weight the number in each cell using the following scheme. The weights reflect the relative effort required to implement an instance of that complexity level as given in the following table.

Table II: Weight value by object complexity

Object type	Simple	Medium	Difficult
Screens	1	2	3
3GL			10
Reports	2	5	8

- Calculate object points by add all the weighted object instances to get one number, the object point count.
- Estimate percentage of reuse you expect to be achieved in this project. Compute or estimate new object points to be developed as

$NOP = (Object\ Point) * (100 - \%reuse)/100$  where, %reuse is the percentage of screens, reports, and 3GL modules reused from previous applications.

- Determine a productivity rate.

Table III: Productivity

	Low	Lowest	High	Highest
PROD	4	7	25	50

- Determine the estimated person-months as,  $Person\ Month = NOP/PROD$ ,

#### D. Use-Case Points

During early phases of an object-oriented project UCP are counted that captures its scope with use cases. Each use-

case is scaled as easy, medium, or hard to generate the point count. The use-case points can be also adjusted for project's technical and personnel attributes, and directly converted to the hours in order to obtain a rough idea of a nominal project schedule. The UCPs are related to functional, technical and environmental complexity of the software project .Steps for calculating UCP:

- we must first calculate or evaluate the complexity of actors and use cases in the system to quantify the variables Unadjusted Actor Weight (UAW)  

$$UAW = \text{Actor Weight} * \text{Actor type.}$$

Table IV: UCP Actor Weights

Category	Description	Factor
Simple	GUI	1
Average	Interactive	2
Complex	API	3

- In second step ,Evaluate Unadjusted UC Weights (UUCW)

$$UUCW = \sum UC * UCW$$

Table V: Complexity of Use Cases

Category	Number of transactions	Weight
Simple	3 or less	5
Average	4 to 7	10
Complex	Greater than 7	15

- Determine the Unadjusted UC Points (UUCP) .The UUCP can be calculated as,  

$$UUCP = UAW + UUCW$$
- Technical and Environmental Factors can be calculated as  

$$TEF = \sum W * AV$$
- Evaluate Adjusted UCP (AUCP) .It can be calculated as  

$$AUCP = UUCP * (0:65 * (0:01 * TEF))$$
- Final Test effort Test effort using UCP can be calculated as a multiplication of the AUCP with a conversion factor: Effort = AUCP \* Conversion Factor  
 The conversion factor defines the test effort need for a language/technology combination.

#### IV. COMPARISON OF SOFTWARE METRICS ADVANTAGES AND DISADVANTAGES

Metrics	Advantages	Disadvantages
Line of Code	It is easy to measure and there is a chance for automation of counting .	Implementation of a specific logic differs based on the level of experience of the developer. Hence, number of lines of code differs from person to person.
Function Point	It can compute non-coding activities like as documentation and also measure non-coding defects in requirements and design.	Function Point counting requires good deal of experience. Function point counts are unreliable for those projects that are below 15 function points in size as[16].

Object Point	It come out to be able to differentiate simple from complex Object point projects	This metrics have no conversion rules to lines of code metrics and lack automation.
Use Case Point	Process can be automated	Estimate cannot be arrived until all of the use cases are written.

#### V. LITERATURE SURVEY

Çigdem Gencel [2005] described to examine the conceptual and theoretical differences of Functional Size Measurement methods to examine the improvement opportunities of these methods and to develop a new FSM method. [5]

Vu Nguyen [2010] described the effort estimation model was calibrated to the data set using a number of techniques including the linear regression, Bayesian, and constrained regression. Constrained regression approaches are favorable in terms of improving the estimation performance in calibrating the COCOMO model. [4]

Saleem Basha, Dhavachelvan P [2010] described that SEER and machine learning techniques were reliable good at predicting the effort. But however they are not accurate because all the model lies in the term prediction, prediction never comes true is proved in this estimation models.. Finally this paper concludes that the no model is best for all situations and environment [12]

Prasad Reddy P.V.G.D, Sudha K. R[2011] described several algorithmic cost estimation models and also described Fuzzy using TMF (triangular membership function) is better than Fuzzy method using GBellMF or Intermediate COCOMO.

Iman Attarzadeh, Siew Hock Ow[2011] presented a paper and The objective of this research was to examine the application of applying fuzzy logic as soft computing techniques in software cost estimation that can perform more accurate result and handle uncertainty of software attributes.[15]

Prabhakar, Maitreyee Dutta [2013] presented a paper and defined Artificial Neural Network (ANN) and Support Vector Machine (SVM) have been used using China dataset for prediction of software effort in this work. The performance involves Sum-Square-Error (SSE), Mean-Square-Error (MSE), Root-Mean-Square-Error (RMSE), Mean-Magnitude-Relative-Error (MMRE), Relative-Absolute-Error (RAE), Relative-Root-Square-Error (RRSE), Mean-Absolute-Error (MAE), Correlation Coefficient (CC), and PRED have been used to compare the results obtained from these two methods.

Luís M. Alves, André Sousa [2013] presented a paper which describes a case study with 104 students grouped in seven teams that developed a software system for a real costumer. In this study they used a model based on Use Case Points (UCP) to estimate the resources needed to develop a software system. [14]

Jyoti G. Borade [2013] presented a paper that focus on the existing software estimation methods and software

metrics to be used for effort and cost estimation. No model can estimate the cost of software with high degree of accuracy. Furthermore; this paper also described test effort estimation. In fact, testing activities make up 40% total software development effort. [9]

Alaa F. Sheta and Sultan Aljahdal[2013] defined inefficient information about the size and complexity results in an ambiguous estimates that cause many losses .The author explored the use of fuzzy logic as a soft computing technique which can simplify the modeling process of the effort [13]

## VI. OPEN ISSUES AND FUTURE SCOPE

- Function point is hard to automate and difficult to compute and ignore the quality of output.
- LOC measure correlates poorly with the efficiency of the code. Larger code size does not necessarily imply good quality or higher efficiency and Sometimes between two programs with equal LOC count, a program having complex logic would require much more effort to develop than a program with very simple logic.
- The OO metrics have not yet been applied to testing.

Many applications will be designed which have expected to have less size or effort so that software complexity can be reduced. The future work is to study new software size estimation methods and models that can be help us to easily understand the size estimation process of software.

## VII. CONCLUSION

Software size, risk estimation is a difficult process but an important part of a successful software development. One of the important challenges in software project management is accurate and reliable estimation of software size, effort, cost in the early phase of software development. It is very difficult to decide which metric is better than to all other metric because every metric has an own significance or importance. No metric can estimate the size of software with a high degree of accuracy. Poor estimates have not only led projects to exceed budget and schedule but also, in many cases, be terminated entirely.

## ACKNOWLEDGEMENT

We would like to thank the almighty for his constant blessings. Then we like to thank our family and friends for helping and supporting us throughout the making of this paper.

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# Clustering: A Review on Data Mining Approach

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**Abstract**— Cluster investigation or grouping is the undertaking of collection an arrangement of articles in such a route, to the point that protests in the same gathering (called a group) are more like one another than to those in different gatherings (groups). It is a principle assignment of exploratory information mining, and a typical method for measurable information examination, utilized as a part of numerous fields, including machine learning, example acknowledgments, picture investigation and bioinformatics. This paper dissect the three noteworthy clustering algorithms: K-Means, Hierarchical grouping and Density based grouping calculation and think about the execution of these three noteworthy clustering calculations on the part of effectively class insightful cluster building capacity of calculation. With every calculation, we give a portrayal of the calculation, survey flow and future research on the calculations. Execution of the 3 methods is analyzed utilizing a clustering device WEKA.

**Keywords**— Data Mining Algorithms, Weka Tools, K-means Algorithms, Hierarchical clustering, Density based Clustering Algorithm

## I. INTRODUCTION

Data mining is the utilization of mechanized information examination systems to uncover beforehand undetected connections among information things. Data mining frequently includes the examination of information put away in an information stockroom. Three of the significant information mining systems are relapse, arrangement and bunching. In this examination paper we are working just with the grouping on the grounds that it is most vital methodology, on the off chance that we have an expansive database and it is a dynamic examination point for the scientists .The goal of clustering is to segment the comparable item are assembled in one group and divergent are gathered in other cluster. I am utilizing weka instruments for clustering. The valuable grouping calculations have been produced for expansive databases, for example, K-MEANS, Hierarchical clustering calculation, Density based clustering calculation .I am utilizing Weka information digging apparatuses for this reason. It gives a player interface to the client than think about the other data mining apparatuses.

## II. WHAT IS CLUSTER ANALYSIS?

Cluster examination was started in humanities by Driver and Kroeber in 1932 and acquainted with brain research by Zubin in 1938 and Robert Tryon in 1939and broadly utilized by Cattell starting as a part of 1943 for characteristic hypothesis order in identity brain research.

Cluster analysis[1] gatherings objects (perceptions, events)based on the data found in the information portraying the items or their connections. Cluster is a gathering of articles that fit in with the same class. The objective is that the articles in a gathering will be comparative (or related) to one other and unique in relation to (or random to) the items in different gatherings. Clustering is a methodology of parceling an arrangement of information (or articles) into an arrangement of important sub-classes, called clusters. A decent grouping system will deliver amazing groups in which:

- The intra-class (that is, intra-group) comparability is high.
- The between class comparability is low.

## III. DBSCAN CLUSTERING ALGORITHM

Density based clustering calculation is one of the essential routines for clustering in information mining. DBSCAN (for thickness based spatial clustering of uses with commotion) is an information grouping calculation proposed by Martin Ester, Hans-Peter Kriegel, Jorge Sander and Xiaowei Xu in 1996 The clusters which are shaped in view of the thickness are straightforward and it doesn't restrain itself to the states of groups. The thickness based gathering of clustering calculations speak to an information set in the same way as apportioning routines; changing over an occurrence to a point utilizing the information traits of the source set. A standout amongst the most surely understood thickness based grouping calculations is the DBSCAN[9]

DBSCAN differentiates information focuses into three classes:

- Core focuses: These are focuses that are at the inside of a cluster.
- Border focuses: A fringe point is a point that is not a center point, but rather it falls inside the area of a center point.
- Noise focuses: A commotion point is any point that is not a center point or a fringe point.

To locate a group, DBSCAN begins with a subjective occurrence (p) in information set (D) and recovers all occasions of D concerning Eps and Min Pts. The calculation makes utilization of a spatial information structure(R\*tree) to find focuses inside Eps separation from the center purposes of the groups [2]. Another

density based calculation OPTICS is presented in [3], which is an intuitive clustering calculation, lives up to expectations by making a requesting of the information set speaking to its thickness based clustering calculation. It did grouping through developing high thickness range, and it can discover any shape if bunching (Rong et al.,2004).

The idea of it was:

- $\epsilon$ -neighbor: the neighbors in  $\epsilon$  semi estimation of an article
  - kernal article: particular number (Minp) of neighbors in  $\epsilon$  semi estimation
  - To a thing set D, if object p is the  $\epsilon$ -neighbor of q, and q is bit object, then p can get "prompt thickness reachable" from q.
  - To a  $\epsilon$ , p can get "quick thickness reachable" from q; D contains Mint articles; if an arrangement  $P1, p2, \dots, pn, p1=q, pn=pq$ , then  $i \square 1 p$  can get "direct thickness reachable" from  $i p, pi \in D \leq i \leq n$
  - To  $\epsilon$  and MinP, if there exist an article  $o(o \in D)$ , p and q can get "direct thickness reachable" from o, p and q are thickness joined.
  - Advantages:
  - DBSCAN does not oblige one to indicate the quantity of clusters in the information from the earlier, instead of k-mean.
  - DBSCAN has an idea of clamor, and is vigorous to exceptions.
  - Disadvantages:
- a) DBSCAN is not by any stretch of the imagination deterministic: fringe focuses that are reachable from more than one cluster can be a piece of either group. Luckily, this circumstance does not emerge frequently, and has little effect on the grouping result: both on center focuses and commotion focuses, DBSCAN is deterministic.

#### IV. K-MEAN ALGORITHM

The essential venture of k-means clustering is straightforward. Initially we focus number of cluster K and we accept the centroid or focus of these groups. K-means clustering is a system for cluster examination which intends to parcel n perceptions into k clusters in which every perception fits in with the group with the closest mean. At that point the K means calculation will do the three stages underneath until meeting Iterate until stable (= no article move cluster):

- Focus the centroid coordinate
- Focus the separation of every article to the centroids
- cluster the article in view of least separation

##### A. Algorithmic for k-means clustering

Let  $X = \{x1, x2, x3, \dots \dots \dots, xn\}$  be the arrangement of information focuses and  $V = \{v1, v2, \dots \dots \dots, vc\}$  be the arrangement of focuses.

- Randomly select "c" cluster focuses.
- Calculate the separation between every information point and cluster focuses.

- Assign the information point to the group focus whose separation from the cluster point is least of all the cluster points..
- Recalculate the new group focus utilizing: where, "ci" speaks to the quantity of information focuses in ith group
- Recalculate the separation between every information point and new got cluster focuses.
- If no information point was reassigned then stop, generally rehash from step 3).

Example:-If our class (choice) trait is tumor Type and its values are: threatening, favorable, and so on - these will be the classes. They will be spoken to by cluster1, cluster2, and so on. Be that as it may, the class data is never given to the calculation. The class information can be utilized later on, to assess how accurately the calculation characterized the.

Table.1.K-Means example

	Curvature	Texture	Blood Consump	Tumor Type
X1	0.8	1.2	A	Benign
X2	0.75	1.4	B	Benign
X3	0.23	0.4	D	Malignant
X4	0.23	0.5	D	Malignant

↓

	Curvature	Texture	Blood Consump	Tumor Type
X1	0.8	1.2	A	Benign
X2	0.75	1.4	B	Benign
X3	0.23	0.4	D	Malignant
X4	0.23	0.5	D	Malignant

The way we do that, is by plotting the objects from the database into space. Each attribute is one dimension

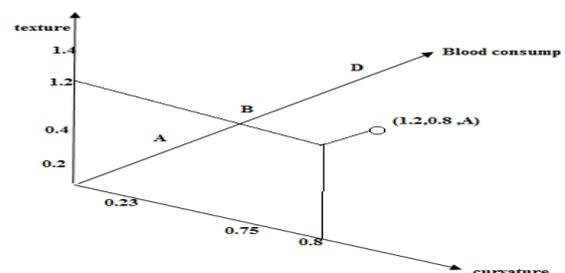


Fig.1(a).K-Means value showing in 3-D

After all the objects are plotted, we will calculate the distance between them, and the ones that are close to each

other – we will group them together, i.e. place them in the same cluster.

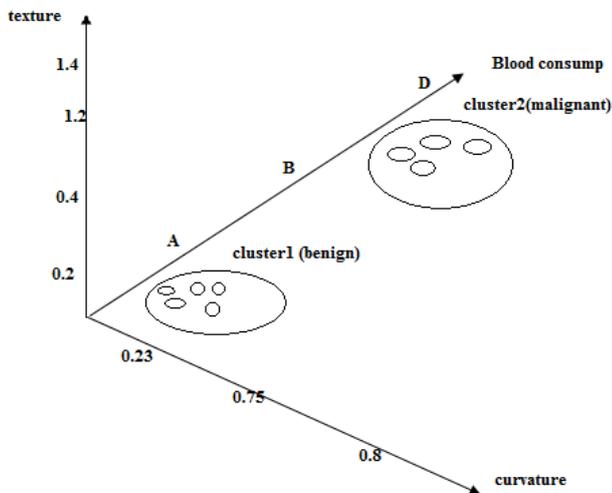


Fig.1.(b). K-Means makes a cluster in different groups

- **ADVANTAGES :**
- a) K-Means produce more tightly groups than progressive grouping, particularly if the clusters are globular.
- **DISADVANTAGES:**
- a) Difficult to anticipate K-Value.
- b) With worldwide group, it didn't function admirably.

#### V. HIERARCHICAL CLUSTERING ALGORITHM.

Hierarchical clustering strategies have pulled in much consideration by giving the client a most extreme measure of adaptability. In data mining, hierarchical clustering (likewise called various leveled cluster examination or HCA) is a technique for group investigation which tries to construct a pecking order of groups. Methodologies for hierarchical clustering for the most part fall into two sorts:

- **Agglomerative (bottom up)**
- a) Begin with 1 point (singleton).
- b) Recursively include two or more proper groups.
- c) Stop when k number of groups is attained to.
- **Divisive (top down)**
- a) Begin with an enormous group.
- b) Recursively separates into littler groups.
- c) Stop when k number of groups is attained to.

In the general case, the unpredictability of agglomerative grouping is , which makes them too moderate for huge information sets. Divisive grouping with a comprehensive inquiry is , which is far and away more terrible. Be that as it may, for some uncommon cases, ideal effective agglomerative techniques (of many-sided quality ) are known: SLINK for single-linkage and CLINK for complete-linkage clustering. For example. Assume this information is to be grouped, and the Euclidean distance is the separation matric. Cutting the tree at a given tallness will give a parceling clustering at a chose exactness. In this illustration, cutting after the second line of the dendrogram will yield clusters {a} {b c} {d e} {f}. Cutting after the third column will yield

clusters {a} {b c} {d e f}, which is a coarser bunching, with a littler number however bigger groups.

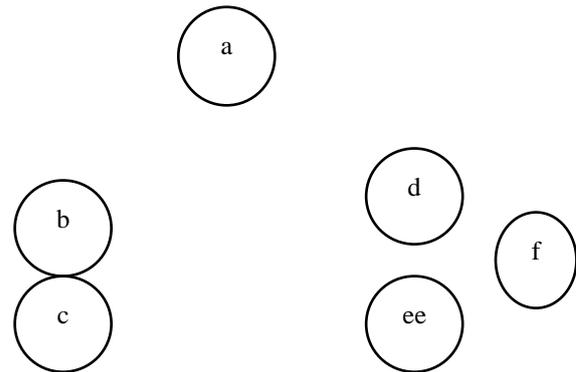


Fig.2(a). different clusters in hierarchical clustering

- **Raw data**
- The hierarchical clustering dendrogram (from Greek dendron "tree" and gramma "drawing") is a tree chart regularly used to represent the game plan of the clusters delivered by various leveled grouping. Dendrograms are frequently utilized as a part of computational science to represent the grouping of qualities or tests. would be accordingly:

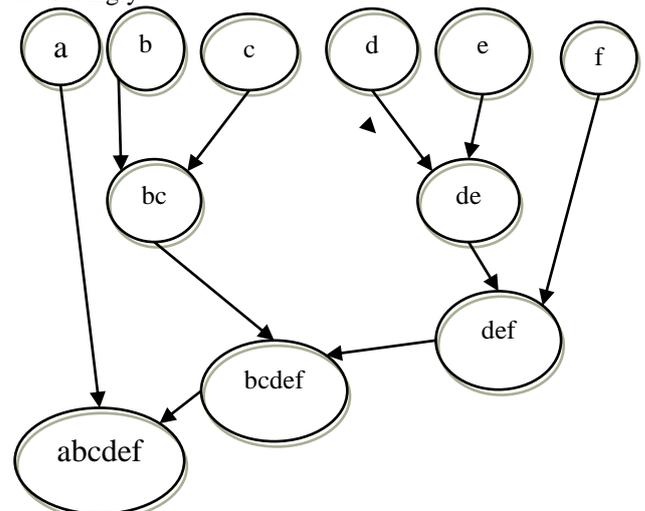


Fig.2(b).Clusters makes a group in hierarchical order

- **Advantages**
- a. Does not oblige the quantity of groups to be known ahead of time
- b. No data parameters (other than the decision of the (dis)similarity)
- c. Computes a complete pecking order of groups
- d. Good result visualizations incorporated into the metho
- **Disadvantages**
- May not scale well: runtime for the standard systems:  $O(n^2 \log n)$ , No unequivocal bunches: a "level" ,part can be determined subsequently (e.g. through a slice through the dendrogram or end condition in the development)
- **Problems and limitations:**
- When a choice is made to join two bunches, it can't be fixed.
- a. No target capacity is straightforwardly minimized.

- b. Different plans have issues with one or a greater amount of the accompanying:
- c. Sensitivity to commotion and exceptions.
- d. Difficulty taking care of distinctive estimated clusters and curved shapes.

## VI. RESULT USING WEKA TOOL

### A. Weka

In 1993, the University of Waikato in New Zealand began improvement of the first form of Weka (which turned into a mixture of TCL/TK, C, and Makefiles)[4]. Weka (Waikato Environment for Knowledge Analysis) is a mainstream suite of machine learning programming written in Java, created at the University of Waikato, New Zealand. Weka is free programming accessible under the GNU General Public License. Information mining [4] isn't exclusively the area of huge organizations and extravagant programming. Truth be told, there's a bit of programming that does all the same things as these costly bits of programming the product is called WEKA. For working of weka we not require the profound learning of information mining that is reason it is extremely prevalent information mining device. Weka likewise gives the graphical client interface of the client and gives numerous facilities[6,7].It is also platform-independent.

### B. Dataset

For performing the correlation examination we require the past undertaking datasets.Credit and Zoo2\_x information archives give the past task information. This ought to have been taken the distinctive diverse nature. These storehouses are exceptionally accommodating for the

### E. Result of K-mean ,Hierarchal and Density Based Algorithms.

Table 2: Comparison result of algorithms using Credit dataset

Algorithm	No.of cluster	Cluster instances	No.of iterations	Sum of squared errors	Time taken	Log likelihood
<i>K-Means</i>	2	0:213(43%) 1:277(57%)	7	1455.87	0.1	
<i>Hierarchical</i>	2	0:489(100%) 1:1(0%)	7		0.41	
<i>Density</i>	2	0:178(36%) 1:312(64%)	7	1455.87	0.06	-35.113

Table 3:Comparison result of algorithms using Zoo2\_x dataset

Algorithm	No.of cluster	Cluster instances	No.of iterations	Sum of squared errors	Time taken	Log likelihood
<i>K-Means</i>	2	0:41(41%) 1:60(59%)	2	370	0.02	
<i>Hierarchical</i>	2	0:100(99%) 1:1(1%)	2		0.07	
<i>Density</i>	2	0:41(41%) 1:60(59%)	2	370	0.03	-8.801

scientists. We can specifically apply this information in the information mining instruments and anticipate the outcome.



Fig.3. View of WEKA tool

### C. Methodology

This methodology is exceptionally straightforward. The past undertaking information from the vaults and apply it on the weka. In the weka diverse distinctive clustering calculations and foresee a valuable result that will be exceptionally useful for the new clients and new specialists.

### D. Performing clustering in weka

For performing group examination in weka. For the weka the information set ought to have in the arrangement of CSV or .ARFF document group. On the off chance that the information set is not in arff group we need to be changing over it.

## VII. CONCLUSION

This paper concludes that in clustering algorithm k-mean is better than other algorithms because k-mean is a simple and fast process it is easy to implement and it takes less time to execute. All the algorithms have some ambiguity in some data when clustered. Density based clustering algorithm is not suitable for data with high variance in density. Hierarchical clustering algorithm is more sensitive for noisy data.

## ACKNOWLEDGEMENT

The authors would like to express their cordial thanks to CT group of Engg., Mgmt & Tech. in research field. The authors are also grateful to thanks and computer science research group for their support and incisive comments in making this study a success

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# 6<sup>th</sup> Sense: Wear Ur World-WuW

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**Abstract-** This paper deals with the ubiquitous and augmented technology called Sixth sense technology. It has a wearable gesture interface which intangible digital information into the tangible physical world and its objects, making your computer the entire world. Smart phones pc and tablets helps us to interact with the digital world. But in this concept, we can see videos access, change and move data simply without using mouse, keyboard. We can also define Sixth Sense as it can obey our natural hand gestures. Gesture is that in which we can able to express our ideas with the movement of part of the body, especially a hand or a head. The fantastic Sixth sense technology is a combination of many exquisite technologies. In this paper we explained about the Sixth sense technology its history, working component, generation of idea, technologies related to sixth sense and applications of the sixth sense.

**Keywords-** Wear Ur World-WuW, Six Sense, Gesture recognition, Augmented Reality

## I. INTRODUCTION

Sixth Sense technology is the science of tomorrow allows the user to interact with any information surrounding us using natural hand gestures, by eliminating the hardware devices. We attach sensors to common objects to realize smart objects, which will help us to know more precisely and rapidly what is happening in the surroundings. [2] The device helps us to take right decisions by providing the admissible information. This technology depends on our natural hand gesture recognition, processing, and manipulation etc. Now a days, we all use our devices (computers, smart phones, tablets, etc.) to access to the internet and get information according to our need. But the device that we will use in Sixth Sense is tiny and have more functionality in size as compare to the current cell phones [5]. Sixth Sense is blend of data obtained from Radio Frequency Identification (RFID) based sensing with information from different sources such as calendar to naturally draw conclusions about the interaction among objects, peoples, and workspaces [9]. The potential object detection problem is a challenge in smart phones that use of sensors and sensors has its faults. Meanwhile if there is no sensor attached the object can't be detected. The potential object detection problem is the biggest challenge in smart space research.

## II. HISTORY

Steven Mann (born 1962, father of the sixth sense) is an inventor who first recommend the wearable computer (which is containing neck worn projector and a camera) in 1990. The name 'Sixth Sense' for this was not published

until 2001. Now, his work carried forward by Pranav Mistry, 28 year old, who is a PhD student in a fluid interface group at the MIT media lab. He won the "Invention of the year 2009" by popular science. He invented 'Sixth Sense/WUW (Wear Ur World) using the many different technologies in it like augmented reality, gesture recognition, computer vision to make a bridge between the physical worlds with digital world for exchange the information.

### A. Creation of Idea of Wear Ur World-WuW

WuW was the name first proposed for this technology by Pranav Mistry, Pattie Maes and Liyan Chang. Mistry did simply experiment computer mouse, shown in fig 1. Firstly, he put two roller into one mouse and then he observe that data and guide movement of mouse, two rollers not worked properly. Then he took 4 rollers, he get ideas from 4 rollers that he could use same idea on fingers and that what he next moved on [1].



Fig 1: Mouse with two rollers & first hardware of sixth sense

### B. Why built six sense technology?

Information acquire by the humans from the senses is insufficient for the right decisions so, using internet we can collect a huge number of information to make a good decision in minutes. Sixth Sense also has vast application in the Artificial Intelligence field [5].

### C. Necessary components for sixth sense

- Camera

Camera is work as an input device for Sixth Sense system, act as a digital eye of the system which recognizes (captures) physical objects around it and tracks user's hand gestures using computer vision based technology. [5] It Captures user's hand gestures and movements and It capture the scene in front of us when we perform a framing gesture.

- **Projector**

Projector component is used in this device for visualize information onto a larger screen or wall and augments the physical objects and related information from the internet [7].

- **Mirror**

User can manually change the location of the projection by tilting the mirror. The projector hangs pointing downwards from the neck so the usage of the mirror is relevant [6]. Projections coming out from the projector are regressed by mirror and thus we can project anywhere in desired objects like wall or person [3].

- **Mobile-Component**

It uses the mobile computing device as a processing device in user's pocket like Smartphone, PDA's and laptops etc. , which transmit and receive data and voice from anyplace to anyone using mobile internet. Microphone, Projector, Camera all are connected to this mobile computing device is connected to 3G network or wireless connection [5]. With the help of the coloured markers smartphone searches the web. Basic processing works on computer vision algorithms [1].

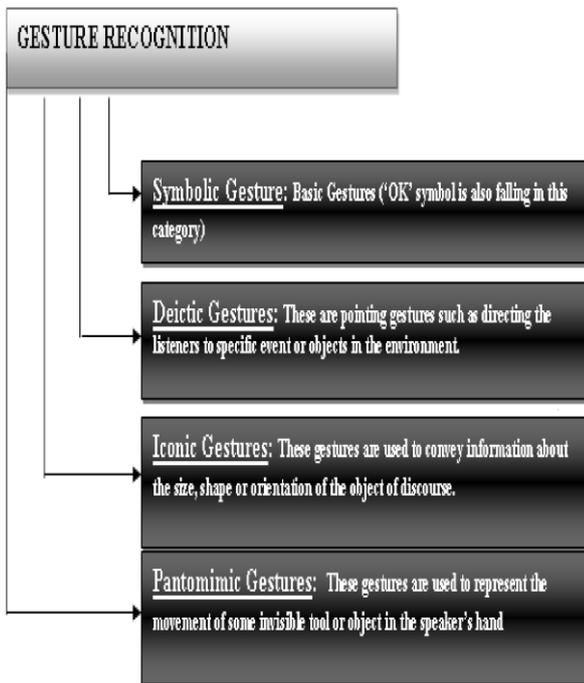


Fig 2: Types of Gesture recognition

a) **Color Markers**

There are red, yellow, green, and color markers arranged at the user's finger tips. With the help of these color markers webcam recognize the hand gestures of user. User can do the 'framing' for capture the image, color markers help in this framing [3].

b) **Microphone**

It is the optional component in sixth sense device. When we use paper as an interface then we attach a microphone with paper it sense the sound signal of user touching the paper combining with tracking information about the user fingers to computing device a touch interface is created.

[1] **Working of Sixth Sense device**

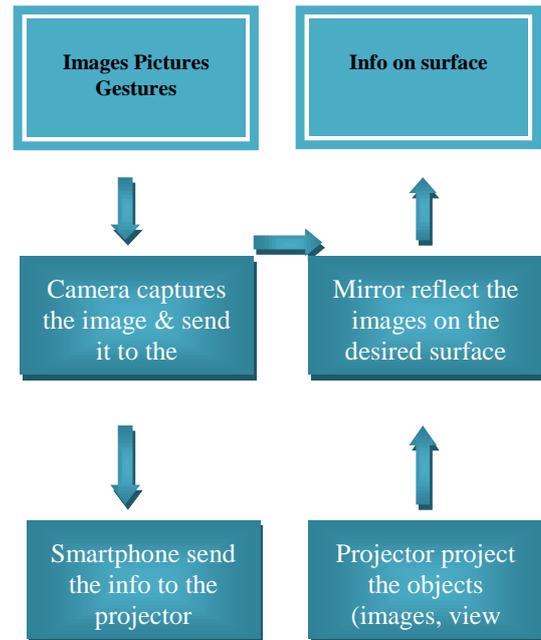


Fig 3: Working of Sixth Sense

D. **Technologies related to sixth sense**

- **Gesture recognition**

The main objective of gesture recognition is implication of human gestures via mathematical algorithms. Gestures can emerge from any state or body motion but commonly originate from the head and hand [4]. It does not require any mouse, joystick, keyboard or track pad so that it is better graphic user interface [6]. Gesture recognition is related to sixth sense because it is the first technology that understands the human motions. Currently, gestures made by the colored marked fingers of users' are used for webcam recognizes [7]. These can further be classified according to their functionality [9], fig 2.

- **Augmented Reality**

Augmented Reality is the superimposing of the virtual world over the digital world. It somewhat destroys the barrier between the two worlds. It is for the live of a physical real world either in a direct or indirect view [1].

E. **Applications**

- **Source of Information**

Using this technology we can get information about anything instantly without being connected to internet. For example, students can get the information about result, online submission status, project status etc. [8].



Fig 4: Unlock the door using sixth sense

- Provide Security

Without use of key & lock we can lock or unlock our home doors, shown in fig 4, or others. It is only possible with sixth sense technology

- Making Calls

This device used to protect the keyboard into your palm and we can make calls using that virtual keypad, shown in fig 5. Using the other hand fingers we can type the number and call.



Fig 5: Virtual keypad

- Capture Photos using finger gestures

Using this technology any person can simply use make a frame of image with their hands on the wall and capture pictures.

- Gaming

By using new commands and strategies in 3D games, there is no need of hardware's like mouse and keyboard at any point of time. For this the neural network and sixth sense is used, shown in fig 6. 3D games will embellish game capabilities in gaming world because 3D games better feel and good look.

- Provide Product/Person Information

Sixth sense uses marker technology to recognize pick up products and feed us information regarding those products. Moreover, system will also project relevant information about a person such as regarding his work, designation and so on [6].



Fig 6: Proper touch and less rigidness (user play the game using sixth sense)

### III. CONCLUSION

By spreading this technology at everywhere like in education field, hospitals etc., many hardware components could be reduced and it will also save the time of the students, teachers, doctors and researchers which they

spent in huge research work and other miscellaneous activities. Sixth sense work as a fifth sense for blind peoples so that they could be able to read books and also recognize objects. To oversee the agricultural lands it could be implemented. Sixth sense framework implements assorted other applications that demonstrate usefulness, availability and flexibility of the system. Portability is the main circumstance of this technology and others are it is easy to carry, user friendly interface, gesture control wearable computing device.

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# A Comparative Study of Load Balancing Algorithms in Cloud Computing

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**Abstract-** Cloud computing is very popular paradigm in the field of computer science where heterogeneous services such as applications, servers and storage are delivered to an organization's computer and devices through the Internet. It also known as internet based computing. It offers the users with on demand access to resources through different service models such as cloud Infrastructure as a service, cloud software as a service, cloud platform as a service. As cloud computing is spreading rapidly, load balancing has become one of the important issues in the area of research. The main goal of load balancing is to distribute the load over the different nodes in such a way it provides better resource utilization and response time. This paper is a brief discussion of existing load balancing algorithms in cloud computing.

**Keywords-** Cloud Computing, Load Balancing, Existing Load Balancing Algorithms

## I. INTRODUCTION

Cloud computing is spreading globally in the internet world. Cloud computing is associated with internet computing that offers services to different peoples on the pay per use basis. Cloud computing is an emerging technology and very successful because of its feature like reliability, speed, communication among different networks. It is also called ubiquitous computing. Cloud term is used for the cloud service provider that holds all types of resources for storing, accessing the data. There are mainly three service models that are provided by cloud [1]. First is infrastructure as a Service (IaaS), which provides the hardware to users on rent basis for various purposes. In case of platform as a Service (PaaS), environment is provided to the client so they can develop, debug, deploy the applications on this platform. In case of software as a service, users don't need to install or upgrade any software. They can use software directly and generate from the cloud. Cloud computing is selected by corporate world. However, there are some issues such as load balancing, trust management, security and management of energy.

## II. LOAD BALANCING

Load balancing is a technique of removing tasks from overloaded virtual machines and assigning them to under loaded virtual machines in the cloud computing. Load balancing is done to ensure that all the nodes are equally loaded. This leads to better resource utilization and improved response time [1,3].

### A. Goals of Load Balancing Algorithms

Some of the goals of load balancing algorithms are:

- a) To have a backup plan in case system fails.
- b) To improve performance substantially.
- c) To allow future modification in the system.
- d) To maintain system stability.

### B. Classification of load balancing algorithms

They are of two types based on classification:

- a) *Static*: The algorithm does depend upon the current state of the system. So prior knowledge of the system is not needed.
- b) *Dynamic*: The algorithm depends upon the current state of the system. It varies as the state of the system changes.

## III. LOAD BALANCING ALGORITHMS

### A. Round Robin Algorithm

It is one of the simplest scheduling techniques that utilize the principle of time slices. Here the time is divided into multiple slices and each node is given a particular time slice or time interval i.e. it utilizes the principle of time scheduling [2]. Each node is given a quantum and in this quantum the node will perform its operations. The resources of the service provider are provided to the requesting client on the basis of this time slice. The following figure shows how round robin works. The following figure shows that each user request is served by every processor within given time quantum. After the time slice is over, the next queued user request will come for execution.

*Algorithm:*

- 1) Load Balancer maintains an index of VMs and state of the Vms (busy/available). At start all vm's have zero allocation.
- 2) The data center controller receives the user requests/cloudlets. The requests are allocated to Vms on the basis of their states known from the VM queue. The load balancer will allocate the time quantum for user request execution.
- 3) The load balancer will calculate the turn-around time, of process and also calculate the response time and average waiting time of user requests.
- 4) It decides the scheduling order.
- 5) After the execution of cloudlets, the VMs are de-allocated by the Load Balancer.
- 6) The Data Center Controller checks for new /pending/waiting requests in queue.
- 7) Continue from step-2.

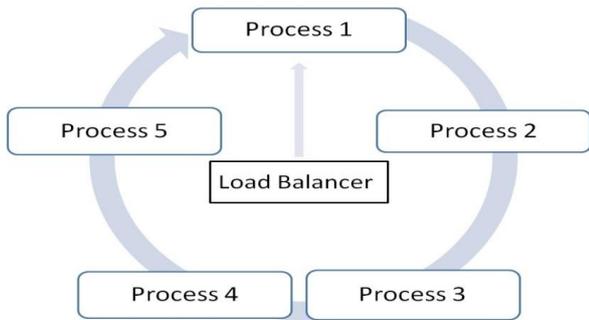


Fig.1 Execution of process within Time Quantum in circular Queue

**B. Honey BEE Foraging Algorithm**

Honey bee algorithm is derived from the behavior of honey bees for finding and reaping food. The class of bees called the scout bees which forage for food sources, after finding one, they come back to the beehive to advertise this using a dance called vibration dance/tremble dance/ waggle dance. The display of this dance gives the idea of the quantity or quality of food and also its distance from the beehive. Forager bees then follow the scout bee to find the location of food and then began to reap it. Then they return to the beehive and do a vibration dance/tremble dance/ waggle dance that gives an idea of how much food is left.[3]

The tasks are the honey bees and VMs are the food sources. Task are removed from over-loaded VM, upon submission to the under-loaded VM, the task will update the number of various priority tasks and update the load of that particular VM to all other waiting tasks. The disadvantage of honey bee is Low priority Load become stay continuously in the queue.

*Algorithm:*

- 1) Find the capacity of VM and Load on VM. Check the system is balanced or not.
- 2) Finding Overloaded Group. if current load of vms is greater than maximum capacity the load balancing is not possible.
- 3) Group the VM based on Low Loaded VM(LVM),Over Loaded VM(OVM), Balanced
- 4) VM (BLM).
- 5) We find the overloaded VM and remove task from overloaded VM and find Best VM to queue the removed task and find the task priority.

**C. Equally Spread Current Execution Algorithm**

Equally spread current execution algorithm process handle with priorities. It assigns the load randomly by checking the size and transfers the load to that virtual machine which is lightly loaded or could handle that task easier and take less time, and give maximize throughput. It is a spread spectrum technique in which the load balancer spreads the load of the job in hand into multiple virtual machines.

*Algorithm:*

- 1) Find the available VM
- 2) Check for all current allocation count is less than max length of VM list allocate the VM

- 3) If available VM is not allocated create a new one
- 4) Count the active load on each VM
- 5) Return the id of those VM which is having least load.
- 6) The VMLoadBalancer will allocate the request to one of the VM.
- 7) If a VM is overloaded then the VMLoadBalancer will distribute some of its work to the VM having least work so that every VM is equally loaded.
- 8) The Data Center Controller receives the response to the request sent and then allocate the waiting requests from the job pool/queue to the available VM & so on.
- 9) Continue from step-2.

**D. First Come First Serve (FCFS)**

First Come First Serve chooses and processes them according to the right order of jobs getting into the system. In this, the user request which comes first to the datacenter controller is allocated the virtual machine for execution first. The implementation of FCFS policy is easily managed with FIFO queue. The data center controller searches for virtual machine which is in idle state or underloaded. Then the first request from the queue is removed and passed to one of the VM through the VMLoadBalancer.

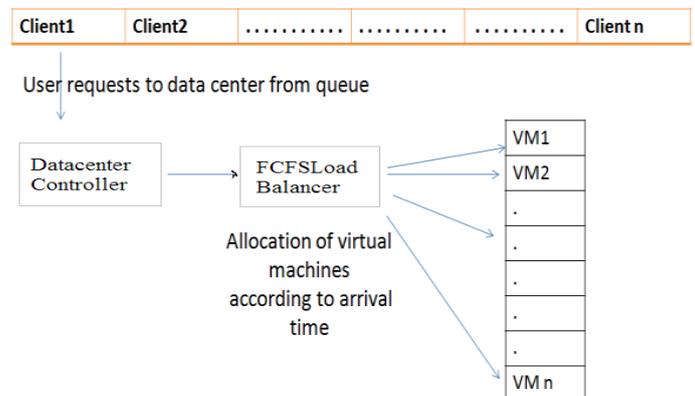


Fig. 2 FCFS Scheduling Process

*Algorithm:*

- 1) FCFS load Balancer maintains an index table of virtual machines & number of requests currently allocated to the VM. At start all have zero allocation.
- 2) a) The load balancer allocates the cloudlets/user requests to the available VMs on the basis of requests sent by the data center controller.  
b) The data center controller stores the user requests in a queue on the basis of their arrival time.  
c) The first request according to the arrival time is allocated to the VM which is under loaded or free by FCFS load Balancer.
- 3) The FCFS Load Balancer will execute the cloudlets and calculate the turnaround time, avg. waiting time and response time. After that it will display the result.
- 4) The data center controller receives the response to the request sent and then allocate the waiting requests from the job pool/queue to the available VM & so on.

5) Continue from step-2.

#### E. Min min Algorithm

Min-min scheduling is based on Minimum Completion Time (MCT) that is used to assign tasks to the resources having minimum expected completion time. It will work in two phases, in the first phase, the expected completion time will be calculated for each task in a metatask list. During the second phase, the task with the overall minimum expected completion time from metatask list is chosen and assigned to the corresponding machine then this task is removed from metatask list and the process is repeated until all tasks in the metatask list are mapped to the corresponding resources.

##### Algorithm:

- 1) for all submitted tasks in meta-task  $T_i$
- 2) for all resource  $R_j$
- 3) compute  $C_{ij} = E_{ij} + r_j$
- 4) While meta-task is not empty
- 5) Find the task  $T_k$  consumes minimum completion time.
- 6) Assign task  $T_k$  to the resource  $R_j$  with minimum execution time.
- 7) remove the task  $T_k$  from meta-tasks set
- 8) update  $r_j$  for selected  $R_j$
- 9) update  $C_{ij}$  for all  $i$ .

Where  $r_j$  represents the ready time of the resource  $R_j$  to execute a task.

$C_{ij}$  and  $E_{ij}$  represent the expected completion time and execution time of the tasks.

#### F. Max min Algorithm

This algorithm is a static load balancing algorithm which works similar to the min-min algorithm. The only difference is that the task with maximum execution time is assigned at first to the processor and the task with minimum execution time is assigned at last. The major disadvantage of this algorithm is that shorter tasks suffer starvation due to larger tasks taking lot of time.

##### Algorithm:

- 1) For all submitted tasks in Meta-task;  $T_i$ 
  - a) For all resources;  $R_j$   
 $C_{ij} = E_{ij} + r_j$
- 2) Find task  $T_k$  costs maximum execution time (Largest Task).
- 3) Assign task  $T_k$  to resource  $R_j$  which gives minimum completion time (Slowest resource).
- 4) Remove task  $T_k$  from Meta-tasks set.
- 5) Update  $r_j$  for selected  $R_j$ .
- 6) Update  $C_{ij}$  for all  $j$ .
- 7) While Meta-task not Empty
  - a) Find task  $T_k$  costs maximum completion time.
  - b) Assign task  $T_k$  to resource  $R_j$  which gives minimum execution time (Faster Resource).
  - c) Remove Task  $T_k$  form Meta-tasks set.
  - d) Update  $r_j$  for Selected  $R_j$ .
  - e) Update  $C_{ij}$  for all  $j$ .

#### G. Throttled Algorithm

In this algorithm the client first requests the load balancer to find a suitable Virtual Machine to perform the

required operation. The process first starts by maintain a list of all the VMs each row is individually indexed to speed up the lookup process. If a match is found on the basis of size and availability of the machine, then the load balancer accepts the request of the client and allocates that VM to the client. If, however there is no VM available that matches the criteria then the load balancer returns -1 and the request is queued.

##### Algorithm:

- 1) Throttled Vm Load Balancer maintains an index table of VMs and the state of the VM (BUSY/AVAILABLE). At the start all VM's are available.
- 2) Data Center Controller receives a new request.
- 3) Data Center Controller queries the Throttled Vm-Load Balancer for the next allocation.
- 4) Throttled Vm Load Balancer parses the allocation table from top until the first available VM is found or the table is parsed completely.  
If found:
  - a) The Throttled Vm Load Balancer returns the VM id to the Data Center Controller.
  - b) The Data Center Controller sends the request to the VM identified by that id.
  - c) Data Center Controller notifies the Throttled Vm-Load Balancer of the new allocation.
  - d) Throttled Vm- Load Balancer updates the allocation table accordingly.If not found:
  - a) The Throttled Vm- Load Balancer returns -1.
  - b) The Data Center Controller queues the request.
- 5) When the VM finishes processing the request, and the Data Center Controller receives the response cloudlet, it notifies the Throttled Vm- Load Balancer of the VM de-allocation.
- 6) The Data Center Controller checks if there are any waiting requests in the queue. If there are, it continues from step 3.
- 7) Continue from step 2.

## IV. CONCLUSIONS

Load balancing is one of the most challenging area in cloud computing. It is a technique in which it distributes the workload across all the nodes in the cloud. This will avoid the situation where some nodes are heavily loaded while others are idle or doing little work. This paper discusses about cloud computing, load balancing, various existing load balancing algorithms.

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# Association Rule Mining: A Review

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**Abstract--** Association rule mining which is most importance and use is one of a vital technique for data mining. Main between the association rule mining techniques having Apriori and many more approaches having introduced with minute changes to Apriori however their basic concept remainder the same i.e use of support and confidence threshold(s). This paper introduces a Association rule mining (ARM) and Apriori Algorithm with example. In this paper the user are easy to understand the concept of association rule mining and the concept of Apriori Algorithm. Apriori algorithm by using average support (supavg) instead of minimum support (supmin) to produce probabilistic item-set instead of large item-set.

**Keywords--** Data Mining, KDD Process, Association Rule Mining, Apriori

## I. INTRODUCTION

Data Mining is defined as extracting information from huge firm of data. In another words, we handing that data mining is the procedure of mining knowledge from data [10]. Data Mining is the procedure to detect the knowledge or hidden pattern from large databases. Data Mining, also known as Knowledge Discovery in Databases (KDD), assign to the nontrivial are faction of implicit, already unknown and potentially helpful information from data in databases. As data mining and knowledge discovery in databases (or KDD) are often treated as alternative, data mining is concretely part of the knowledge discovery process. The following (Figure 1) display data mining like a step in an iterative knowledge discovery process.

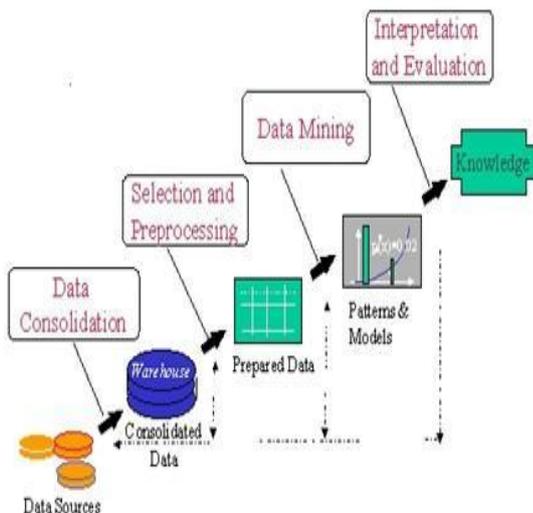


Fig 1. Data mining is the core of Knowledge discovery process.

In its easy form, data mining automatic to detection of incidental patterns in a database, using defined arrival and

algorithms to detect current and historical data that can certainly analyzed to foreshow future tendency. So far as data mining tools foreshow future tendency and behavior by reading via databases for hidden patterns, they permit organizations to design proactive, knowledge-driven decisions and query so that were previously too time-consuming to determination.

## II. ASSOCIATION RULE MINING

Association Rule Mining [1] is a data mining function which discovers the potentiality of co-occurrence of items at transactional database introduced by Rakesh Agrawal in 1993. Association rule mining, one of the most important and safely researched techniques of data mining. Its goal to extract interesting correlations, frequent patterns, associations or casual structures among sets of items in transaction databases or other information repositories.

There are two important fundamental scales for association rules, support(s) and Confidence(c).

Through the database is big and users thought regarding only those mostly purchased items, ordinarily thresholds of support and confidence are pre-defined by users to still those rules that are not so interesting or useful. The two thresholds are called minimal support and minimal confidence serially, extra constraints of interesting rules also can be specified by the users. The two fundamental parameters of Association Rule Mining (ARM) are: support and confidence.

Support(s) of a association rule is defined like the percentage or fraction of transactions in D in order to contain  $X \cup Y$ . Support(s) can be calculated by the following formula:

$$Sup(X \cup Y) = \frac{\text{count}(X \cup Y)}{\text{count}(D)}$$

Confidence is an scale of strength of the association rules. Confidence is defined at percentage or fraction of the number of transactions in D that contain X also contains Y. 'IF' component is Antecedent and 'THEN' component is consequent. It can happen calculated by dividing the possibility of items decrescent together to the possibility of occurrence of antecedent. Confidence(c) is calculated by the following formula

$$\text{conf}(X \Rightarrow Y) = \frac{\text{sup}(X \cup Y)}{\text{sup}(X)}$$

e.g. we are provided with a database D (Table 1) with some set of transactions,  $\text{supmin}=66\%$  and  $\text{confmin}=70\%$

Table 1. Database,D

Transaction	Itemssets
11	(B,C),(B,D), (C,D), (B,C,D)
12	(A,B), (A,C), (B,D), (A,B,C)
13	(B,C), (B,D), (A,D), (C,D), (B,C,D)

Step 1:

Ethically the first sub-problem we have to search the candidate item-set from the given database previous to generating the large/frequent item-set. So, to the database, D the following candidates are taken at all with their support (Table 2) using Eq no.(1).

Table 2: Candidate Item-set

Candidate Set	Support	Candidate Set	Support
(A,B)	33%	(B,D)	100%
(A,C)	33%	(C,D)	67%
(A,D)	33%	(A,B,C)	33%
(B,C)	100%	(B,C,D)	67%

As, we are provided with  $\text{supmin}=66\%$ , Large item-set would be (Table 3).

Table 3: Large Item-set

Large Itemset	Support
(B,C)	100%
(B,D)	100%
(C,D)	67%
(B,C,D)	67%

Table 4: Possible Rules with Confidence

Large Itemset	Rules	Confidence
(B,C)	$B \Rightarrow C$	$100/100=100\%$
	$C \Rightarrow B$	$100/100=100\%$
(B,D)	$B \Rightarrow D$	$100/100=100\%$
	$D \Rightarrow B$	$100/100=100\%$
(C,D)	$C \Rightarrow D$	$67/100 =67\%$
	$D \Rightarrow C$	$67/100 =67\%$
(B,C,D)	$(B,C) \Rightarrow D$	$67/100 =67\%$
	$(B,D) \Rightarrow C$	$67/100 =67\%$
	$(C,D) \Rightarrow B$	$67/67 =100\%$

Step 2:

Next Step is to find the Association rules that can be generated from large item-set. In order to we have to find when possible set of rules and their confidence (Table 4) using Eq no (2).

And using given  $\text{confmin}=70\%$ , Association Rules would be (Table 5).

Table 5: Association Rules

Large Itemset	Support
$B \Rightarrow C$	100%
$C \Rightarrow B$	100%
$B \Rightarrow D$	100%
$D \Rightarrow B$	100%
$(C,D) \Rightarrow B$	100%

### III. APRIORI ALGORITHM

The Apriori algorithm [4] produce the candidate itemsets to be compute in a pass by use only the itemsets found large in the previous pass sans considering the transactions in the database. The underlying intuition is that any subset of a large itemset must be large. So, the candidate itemsets having k items can be produce by joining large itemsets having k-1 items, and remove those that contain someone subset that is not large resulting in generation of a too smaller number of candidate itemsets. Algorithm 3 is the Apriori algorithm. The first pass of the algorithm just counts item event to determine the large 1-itemsets. A subsequent pass, say pass k, consists of two phases. First, the large itemsets  $L_{k-1}$  found in the (k-1)th pass are used to generate the candidate itemsets  $C_k$ . Next, the database is scanned and the support of candidates in  $C_k$  is counted. For rapid counting, we need to proficiently determine the candidates in  $C_k$  that are implied in a given transaction t.

- Algorithm Apriori(large 1 itemsets)
- $L_1 = \{\text{large 1 itemsets}\};$
- **for**( $k=2; L_{k-1} \neq \emptyset; k++$ ) **do begin**
- $C_k = \text{apriori-gen}(L_{k-1});$  //New candidates
- **forall** transactions  $t \in D$  **do begin**
- $C_t = \text{subset}(C_k, t);$  //Candidates contained in t
- **forall** candidates  $c \in C_t$  **do**
- $c.\text{count}++;$
- **end**
- $L_k = \{c \in C_k \mid c.\text{count} \geq \text{minsup}\}$
- **end**
- $\text{Answer} = \bigcup_k L_k$

Algorithm 1.1: Apriori Algorithm [6]

### IV. EXPERIMENTAL RESULTS

To evaluate the efficiency of Apriori algorithm. The algorithms are implemented using Weka in Java API and run on a 2.13 GHz Intel Core i3 CPU with 2 GB of RAM and 500 GB Hard Disk running the 62-bit Windows 7 Home Premium operating system. The parameters for Apriori would be:

- Minimum, Maximum & Average confidence
  - Time consumed
  - Number of Rules generated
- Total
  - With confidence $\geq$ 0.9
  - With confidence $\geq$ 0.8
  - With confidence $\geq$ 0.7
  - With confidence $<$ 0.7

The Test Database to be used by us for the objective of comparison with the Apriori algorithm is Authentic and recognized i.e. Monk Problem Dataset, Contact - Lenses Dataset. We use these datasets for the experiment.

## V. MONK'S PROBLEM DATASET.

The Monk's Problems were the basis of first international comparison of learning algorithms. Monk's Problems Datasets are three datasets since which we are use the first Monk's Problem Dataset.

Table 6: Monk's Problem Dataset Results.

Monk's Problem Dataset	Apriori			
	min sup=0.06	min sup=0.07	min sup=0.08	min sup=0.09
Confmin	0.1029	0.1029	0.1029	0.1029
Confmax	1.0	1.0	1.0	1.0
Confavg	0.3543	0.3616	0.3666	0.3709
Total Rules	2924	4330	5348	6132
Time Required (ms)	298	87	83	55

Table 7: Number of Rules (Monk's Problem Dataset)

Monk's Problem Dataset	Apriori			
	min sup=0.06	min sup=0.07	min sup=0.08	min sup=0.09
Rules with conf $\geq$ 90	44	64	78	90
Rules with conf $\geq$ 85	19	23	25	27
Rules with conf $\geq$ 80	14	23	28	32

## VI. CONTACT-LENSES DATASETS

The Dataset helping to know that passive had better fitted with hard contact lenses, soft contact lenses or none. The Contact Lenses Problems is summarized in Cendrowska, J. "PRISM: An algorithm for inducing modular rules", International Journal of Man-Machine Studies, pp-349-370.

Table 8: Contact-lenses Dataset Results

Contact-lenses Dataset	Apriori			
	min sup=0.06	min sup=0.07	min sup=0.08	min sup=0.09
Confmin	0.0666	0.0666	0.0666	0.0666
Confmax	1.0	1.0	1.0	1.0
Confavg	0.3545	0.3720	0.3821	0.3887
Total Rules	2682	3648	4614	5586
Time Required (milliseconds)	278	48	54	57

Table 9: Number of Rules (Contact-lenses Dataset)

Contact-lenses Dataset	Apriori			
	min sup=0.06	min sup=0.07	min sup=0.08	min sup=0.09
Rules with conf $\geq$ 90	44	64	78	90
Rules with conf $\geq$ 85	19	23	25	27
Rules with conf $\geq$ 80	14	23	28	32

## VII. CONCLUSION

In this paper study the association rule mining (ARM) and Apriori algorithm with the help of proper illustrated example. A Reader can understand association rule mining and apriori algorithm in an elaborated and easy way. The paper uses Monk's Problem Dataset and Contact – lenses datasets to find the accurate results using the Average confidence, Maximum confidence, Minimum confidence, time required and Total number of rules. We are also been able to find the Accuracy of rules based on the minimum confidence chosen. From the review and reading we came to know that in Apriori we have to choose minimum support to get required number of rules.

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# The Future of IT Outsourcing & Cloud Computing

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**Abstract-** Cloud computing acts as a major paradigm shift for online services, where it provides resources and applications as a service via Internet as per user's request. It has the ability to make optimal use of computing resources with minimal costs at high speed and also provides users with a range of services, applications, and infrastructure and storage of large amount of data. It was found that Cloud Computing is changing the way we provision hardware and software for on-demand capacity fulfillment and changing the way we develop web applications and make business decisions. This paper introduces the concepts of cloud computing, its characteristics and models as well as various security threats that threaten computing. It also sheds light on some security issues and challenges in the cloud.

**Keywords-** Cloud Computing, Threats, Challenges, Issues, IT Platform

## I. INTRODUCTION

Cloud computing is one of the most emerging technologies due to its ability to reduce costs associated with computing while increasing flexibility and scalability for computer operations [1]. It takes technology, applications and services that are similar to those on the internet and turns them into self service utility [2]. Security of cloud computing in general is related to the important aspects of confidentiality, integrity and availability; so they become building blocks to be used in designing secure systems. The important aspects of security are applied to three broad categories of assets which are necessary to be secured, software, hardware and data.

## II. CLOUD COMPUTING

National Institute of Standard and Technology (NIST) defined cloud computing as a model for enabling convenient on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or interaction of service provider[3]. NIST referred to five essential characteristics: broad network access, on-demand self service, measured service, resource pooling and rapid elasticity.

### A. Cloud Development Models

There are four main cloud development models that can be shown below:

- **Public Cloud:** In public cloud, anyone can buy a service from any service provider. Thus, the vendor will be taking care of all security concern. The public clouds are mainly used by small and medium sized company. So, we have to

pay what you have used. Flexi scale and Amazon EC2 are examples of cloud vendors [4].

- **Private Cloud:** Private Cloud is one in which the services and infrastructure are maintained on a private network. Unlike public cloud, private cloud is owned and managed privately and access can be limited to a single business or a part of it. Private cloud computing is good in terms of privacy, stability, security and data persistence [6]. Private cloud has the same benefit of public cloud such as scalability, self service and elasticity [5].
- **Hybrid Cloud:** Hybrid cloud uses resources from both public and private. For example, XYZ Company wants to host their website in a public cloud but prefer to keep the customer data within its own data center [7].
- **Community Cloud:** Community cloud is a group of several organizations where they have similar requirements and share the same infrastructure can benefited from cloud computing. It is more expensive as compare to others but offer high level of privacy, security or policy compliance. It also makes use of the principles of Digital Ecosystems to provide a paradigm for clouds in the community that offers an alternative architecture for the use cases of cloud computing [5].

### B. Cloud Services Models

Once a cloud computing is established, its services are deployed in terms of business models that can differ depending on requirements and needs. Cloud service delivery is divided among three archetypal models [8]. The three fundamental classifications are often referred to as the SPI Model, 'S' refers to Software as a service, 'P' to Platform as a service and 'I' to Infrastructure as a service.

- **Software as a Service:** SaaS is a complete operating environment with applications and the user interface. The application is provided to the client through a thin client interface and the customer's responsibility begins and ends with entering and managing its data and user interaction. In SaaS, the application down to the infrastructure is the vendor's responsibility [2].
- **Platform as a Service:** PaaS provides virtual machines, services, transactions, development frameworks, operating systems and applications. The client can deploy its applications on the cloud infrastructure or use applications that were programmed using languages and tools that are supported by the PaaS service provider. The cloud operating system, infrastructure and the enabling software are managed by the service provider.

The client is responsible for installing and managing the application that it is deploying [2].

- **Infrastructure as a Service: IaaS** provides virtual machines, storage, infrastructure and other hardware assets as resources that clients can provision. IaaS service provider manages the entire infrastructure while the client is responsible for all other aspects of the deployment. The applications, operating systems and user interactions are included in this system [2].

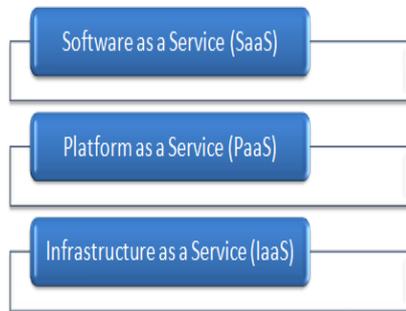


Figure 1: Cloud Computing Models

### C. Top Nine Threats In Cloud Computing Security

Cloud Security Alliance has identified the top nine cloud computing threats for 2013. The report reflects the current consensus among industry experts surveyed by CSA that focus on the threat specifically related to the on-demand and shared nature of cloud. Samson explains these threats according to CSA as following [10]:

- **Data Breaches:** The challenge in addressing this threat of data loss and data leakage is that the measures you put in place to mitigate one can exacerbate the other. So we should encrypt the data to reduce the impact of a breach. If we have lost our encryption key, we will lose your data. If we opt to keep offline backups of our data to reduce data loss, we can increase our exposure to data breaches.
- **Data Loss:** Data Loss is the prospect of seeing your valuable data disappears without a trace. Malicious hacker might delete a targets data out of spite but you could lose your data to a careless cloud service provider or a disaster such as a fire or earthquake. So encryption of data toward theft can backfire if you lose your encryption key [6].
- **Account Hijacking:** If an attacker gains access to your credentials, eavesdrop on your activities and transactions can be done. Hence, the account or services instances may become a new base for the attacker. They may leverage the power of your reputation to launch subsequent attacks.
- **Insecure APIs:** IT admits rely on interfaces for cloud provisioning and monitoring. Insecure API's are integral to security and availability of general cloud services. The organizations and third parties are known to build on these interfaces and injecting add-on services. It may introduce the complexity of the new layered API and also increases risk.
- **Denial of Service:** DoS outages can cost service providers customers and prove pricey to customers who

are billed based on compute cycles and disk space consumed. An attacker may not succeed in knocking out a service entirely which may still cause it to consume so much processing time that it becomes too expensive for you to run and you will be forced to take it down yourself.

- **Malicious Insiders:** In an improperly designed cloud scenario, malicious insider can wreak even greater havoc. From IaaS to PaaS to SaaS, malicious insider has increasing levels of access to more critical systems and eventually to data. The situations where a cloud service provider is solely responsible for security, the risk is great. Even if encryption is implemented, the keys are not kept with the customer and are only available at data-usage time; the system is still vulnerable to malicious insider attack. [9].
- **Abuse of Cloud Services:** The challenge here is for cloud providers to define what constitutes abuse and to determine the best processes to identify it.
- **Insufficient Due Diligence:** Organizations embrace the cloud without fully understanding the cloud environment and associated risks. The basic advice for organizations is to make sure they have sufficient resources and to perform extensive due diligence before jumping into the cloud.
- **Shared Technology Issues:** Cloud service providers share infrastructure and applications to deliver their services in a scalable way. It is the underlying components that make up this infrastructure that were not designed to offer strong isolation properties for a multi-tenant architecture, re-deployable platforms or multi-customer applications, the threat of shared vulnerabilities exists in all delivery models [11].

### D. Security Issues In Cloud Computing

There are numerous security issues for cloud computing as it encompasses many technologies including networks, databases, resource scheduling, operating systems, load balancing, transaction management, memory management and concurrency control. Security issues for many of these systems and technologies are applicable to cloud computing [11]. Here are some of the important security requirements: Confidentiality, Availability, Non-repudiation, Integrity, Data sanitization and Physical security [12]. Cloud Computing security related issues can be classified into the following five categories as shown in Figure 2:



Figure 2: Cloud Computing Security

- **Network security:** Network has a number of security threats to deal with, such as confidentiality and integrity in the network and maintaining security against the external third party threats should be considered while providing network level security

[13]. Network security issues are network security configurations, proper installation of network firewalls, Internet protocol vulnerabilities and Internet dependence [14].

- **Access Control:**

Access control manages users, files and controls user's privileges to files or resources. In access control systems, various steps like identification, authorization, authentication and accountability are taken before actually accessing the resources or the object in general [15]. The major issue are account and service hijacking, authentication mechanism and browser security.

- **Infrastructure Security:**

The security challenges at various levels namely host level, network level and application level are not specifically caused by cloud computing, whereas they are exacerbated by its use [16]. Infrastructure security issues are insecure interface of API, sharing technical flaws, quality of service, reliability of suppliers and security [14].

- **Data Security:**

Data security is a significant task with a lot of complexity. The data owner does not know where the data is stored and data hosts cannot be considered as completely reliable. So, data security is the most important concern amongst cloud clients [17]. Cloud-based services use the Internet for storing data in the cloud can be risky and can mean less control over your data. Data redundancy, data loss and data recovery are the major data security issues

- **Privacy:**

Cloud model increases the privacy concern because the service provider has access to all the user data that resides in their premises. It may deliberately or accidentally uncover it or misuse the user data. [18]. The following tips are recommended privacy practices for cloud system designers, testers and developers: protect personal information in the cloud, minimise personal information sent to and stored in the cloud, allow user choice, maximise user control, specify and limit the purpose of data usage, and provide feedback [19]. The cloud computing security categories and their related issues are summarized in Table 1:

Table 1: Cloud Computing Security Issues

Security Category	Issues
<b>Network</b>	<ul style="list-style-type: none"> <li>✓ Proper Installation of network firewalls</li> <li>✓ Network security configurations</li> <li>✓ Internet protocol vulnerabilities</li> <li>✓ Internet Dependence</li> </ul>
<b>Access Control</b>	<ul style="list-style-type: none"> <li>✓ Account and service hijacking</li> <li>✓ Malicious insiders</li> <li>✓ Authentication mechanism</li> <li>✓ Privileged user access</li> <li>✓ Browser Security</li> </ul>
<b>Infrastructure</b>	<ul style="list-style-type: none"> <li>✓ Insecure interface of API</li> <li>✓ Quality of service</li> <li>✓ Sharing technical flaws</li> <li>✓ Reliability of suppliers</li> <li>✓ Security misconfiguration</li> <li>✓ Multi-tenancy</li> <li>✓ Server location and backup</li> </ul>

<b>Data</b>	<ul style="list-style-type: none"> <li>✓ Data redundancy</li> <li>✓ Data loss and leakage</li> <li>✓ Data location</li> <li>✓ Data recovery</li> <li>✓ Data privacy</li> <li>✓ Data protection</li> <li>✓ Data availability</li> </ul>
<b>Privacy</b>	<ul style="list-style-type: none"> <li>✓ Minimise personal information sent to and stored in cloud</li> <li>✓ Protect personal information in the cloud</li> <li>✓ Maximum user control</li> <li>✓ Allow user choice</li> <li>✓ Specify and limit the purpose of data usage</li> </ul>

### E. Security Challenges in Cloud Computing

Securing computer systems have not been an easy task. Cloud computing and cloud service providers need to address a number of challenges that affects security in the cloud. The challenges that need to be addressed are as follows:

- **Loss of Governance:**

By using cloud services the client passes control to the provider [20]. This passing off, of control to the provider, results in loss of control over a number of issues which in turn may affect the security posture of the client data and applications [21].

- **Malicious Insider:**

It is usual for a provider to hide his/her own company policy on recruiting employees and what level of access it provides to them, but with higher level of access an employee can gain access to confidential data and services [22].

- **Management Interface Compromise:**

cloud service providers seek to differentiate themselves based upon the controls they offer to users, and the degree to which users can operate controls [23]. As the interface to cloud services is Internet based and allows for remote access to resources by the use of web browser, this increases the risks of malicious activity remotely.

- **Insecure or Incomplete Data Deletion:**

What happens when a client requests to delete a cloud resource? Is there possibility of partial deletion? How timely is the deletion made? Given the nature of cloud computing, these questions have no straight answers and in case of hardware re-use the risks are very high to clients [21].

- **Data Interception:**

Given the distributed nature of cloud computing architecture, the amount of data in transit is increased greatly as opposed to conventional computing environment. This makes cloud computing more susceptible to attacks such as: replay attacks, man-in-the-middle attacks, sniffing and spoofing [21].

Moreover there are other challenges that may impact cloud computing security though they may not be directly related to it. These challenges are such as: network breaks, modification of network traffic, management issues of cloud resources such as congestion, misconnection, and non-optimal use of resources.

### III. CONCLUSION

In brief, the most important goal of the cloud is to provide high-performance cloud computing for customers with a low cost without relying on the infrastructure of their own. Despite the security threats that are mentioned in the cloud computing are present in the traditional computing model, they are more influential in the cloud computing. There are many researchers conducted with reference to security issues of the cloud computing. These researches have proposed several methods and monitoring tools to eliminate security threats in the cloud and provided an integrated security framework to solve the security issues at different levels.

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# A Survey on Differential Evolution Approaches for Large Scale Optimization

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**Abstract**—Differential evolution is an interesting approach which provides better solutions for wide range of optimization problems. Large scale optimization problem is one of the optimization problem which appears in areas like neural network, power minimization etc. This review paper presents large scale optimization problems, various differential evolution approaches proposed by various researchers to handle such problems and issues which are under research.

**Keywords**— Differential evolution, GaDE, GODE, large scale problem, Optimization, SOUPDE;

## I. INTRODUCTION

From long time, many nature motivated algorithms have been introduced to solve the wide range of optimization problems. some of these algorithms are: EA, Genetic Algorithms [1] [2], Evolutionary Programming [3][4], Evolution Strategies [5], Genetic Programming, [6], Particle Swarm Optimization [7], and the Differential Evolution algorithm [8] etc. Among all these optimization approaches, DE has proved to be very simple but effective approach. DE and its variants are able to solve problems that may be Continuous single objective, multiobjective, constraint optimization, large scale optimization. [9]

Various optimization algorithms perform well for small scale optimization problems but do not provide optimal solutions when the dimension increases, this is because with the increase in dimension, search space increases and leads to more fitness evaluation steps. This results in fall of performance [10]. Standard DE is mostly inefficient for solving LSOPs [11] but due to its flexible structure, DE can be modified to solve large scale optimization problems. In this review paper, we will review the various DE variants introduced for solving large scale optimization problems. Rest of the paper is organized as follows. In section II classical differential evolution algorithm is described. Section III describes related work of various DE approaches to solve large scale optimization. In section IV, future scope is described. Final section gives conclusion of the paper.

## II. DIFFERENTIAL EVOLUTION ALGORITHM

In 1995, storn and price [8] proposed differential evolution algorithm. For real parameter optimization problems, DE is a simple, flexible and very influential evolutionary algorithm. It uses mutation and crossover techniques to generate new vectors and selects the fit vector by replacement process [12]. The algorithm iteratively

applies mutation, crossover and selection until a stop condition is fulfilled. It uses three control parameters (F, CR, and NP) to accomplish optimization [13]. The following gives the stages of DE.

### A. Initialization of the population

Initially when no knowledge of solution space is known, random population vectors are generated. If  $i$  represents the population,  $D$  represents the dimension of the search space and  $G$  represents the generation in which the population belongs then,

$X_i G = (X_{i1}, G, X_{i2}, G, \dots, X_{iD}, G)$ , where  $i=1, 2, \dots, NP$  is the solution vector. [14]

### B. Mutation

In this stage, new population vector  $V_{I(G+1)}$  is generated by using one of the following mutation schemes

Some of the most frequently applied mutation strategies are [8] [15]:

DE/rand/1-

$$V_i(G+1)_{rand/1} = X_{p1}(G) + F \cdot [X_{p2}(G) - X_{p3}(G)] \quad (1)$$

DE/rand to best/1-

$$V_i(G+1)_{rand\ to\ best/1} = X_i(G) + \lambda \cdot [X_{best}(G) - X_i(G)] + F \cdot [X_{p1}(G) - X_{p2}(G)] \quad (2)$$

The indices  $p1$ ,  $p2$ , and  $p3$  are mutually exclusive integers generated within the set  $\{1, \dots, NP\} \setminus \{i\}$ . The scaling factor  $F$  is a positive control parameter for scaling the difference vector.  $X_{best}(G)$  is the vector with the best fitness value in the population at generation  $G$  [17]. The classical DE uses DE/rand/1 mutation scheme [8].

### C. Crossover

In this stage, mutant vector exchanges its genes with parent (target) vector to generate a trial vector. It depends upon the value of crossover rate (CR) which is a user defined constant whose value lies in  $[0, 1]$  interval. Crossover can be done in two ways: binomial crossover and exponential crossover. [17]

In exponential crossover, the trial vector  $U_i(G+1)$  can be given by [16]:

$$U_i(G+1) = [u_{i,1}(G+1), u_{i,2}(G+1) \dots \dots, u_{i,D}(G+1)] \quad (3)$$

$$u_{i,j}(G+1) = \begin{cases} v_{i,j}(G+1); & j = \text{mod}(n-k+1, D) \\ x_{i,j} & \text{otherwise} \end{cases} \quad (4)$$

Where  $k=1, 2, \dots, r$  and value of  $r$  lies in the interval  $[1, D]$ . The parameter  $r$  shows the number of genes that will be exchanged among donor vector and the target vector.

In case of binomial cross-over scheme, the cross-over is performed on each of the  $D$  genes, when the uniformly generated random number is less than the cross-over rate (CR) [7]

$$u_{i,j}(G+1) = \begin{cases} v_{i,j}(G+1); & \text{rand}(0,1) < CR \\ x_{i,j}(G); & \text{elsewhere} \end{cases} \quad (5)$$

The classical DE utilized the binomial crossover [8].

#### D. Selection Operation

In this stage, each trial vector of trial population is compared with corresponding target vector in current population. If trial vector is the one with high fitness value, then it will enter into the next generation, otherwise, target vector will be selected for next generation. [8]

$$X_{i,j}(G+1) = \begin{cases} U_i(G+1); & \mathfrak{F}(U_i(G+1)) < I(X_i(G+1)) \\ X_i(G); & \mathfrak{F}(X_i(G)) < I(X_i(G+1)) \end{cases} \quad (6)$$

### III. RELATED WORK

Considering the importance of large scale optimization, various researchers suggested DE approaches as mentioned below:

#### A. Shuffle Or Update Parallel Differential Evolution (SOUPDE)

M. Weber, F. Neri and V. Tirronen [17] proposed Shuffle Or Update Parallel Differential Evolution (SOUPDE). In this, population was decomposed into  $m$  subpopulations and two operations shuffling and update were performed. Performance of algorithm was evaluated on 5 dimensions ranging from 50 to 1000 by performing 25 independent runs of algorithm on 19 test functions. It was observed that SOUPDE performed comparable to DE on small dimension but performed better than classical DE for higher dimensions.

#### B. Role Differentiation and Malleable Mating for Differential Evolution

C. Garcia-Martinez, F. J. Rodriguez and M. Lozano [18] proposed this approach. It utilized DE with two mechanisms: role differentiation and self adaptive mutation operation, DE/malleable-mating/1. Role differentiation mechanism allowed to allocate different roles (placing, leading, receiving and correcting) to vectors in population and malleable – mating mutation operation allowed the placing solution to choose better mating scheme. Here mating trends of placing vectors were controlled by self adaptation rather than by DE control parameters (F, CR, and NP). It showed statistically better results than other algorithms in various performance evaluating tests.

#### C. Opposition-based differential evolution (ODE)

S. Rahnamayan, G. G. Wang [19] evaluated the performance of DE and ODE. In ODE, while evaluating a solution to a given problem, simultaneously its opposite solution was also evaluated. These criteria provided a further chance for finding a candidate solution closer to the global optimum. The evaluation was on the basis of solution accuracy on the 7 test functions and ODE gave better performance on all 7 test functions in comparison to DE.

#### D. Generalized opposition-based differential evolution (GODE)

H. Wang, Z. Wu and S. Rahnamayan [20] introduced GODE. It presented enhanced ODE algorithm based on generalized opposition-based learning (GOBL) to get superior solution. On evaluating GODE on test functions, it performed superior than DE and other large scale optimization algorithms.

#### E. Generalized adaptive DE (GaDE)

Z. Yang, K. Tang and X. Yao [21] suggested this adaptation based approach. In this, the values of parameters F and CR were not fixed but were taken different for every individual in each generation according to a probability distribution. Only those parameter values were chosen who allow the vectors to go into the next generation and allow these values to update the earlier probability distribution. This method was repeated for whole evolutionary process. In terms of performance and scalability, GADE was proved to be better than standard DE.

#### F. jDElscope

J. Brest, M. S. Maucec [22] proposed this self adaptive de approach in which three strategies jDEbin, jDEexp, jDEbest were used and a population size reduction mechanism in which on first half population jDEbin strategy and on rest of half individuals, jDEexp strategy was applied and control parameter  $f$  sign-change mechanism. The analysis done on 19 benchmarks functions proved that jDElscope gave better performance than conventional DE.

#### G. Lsade

X. Pan, Y. Zhao, X. Xu [23] proposed DE approach that utilized a local search operator based on Cauchy mutation in order to raise the fitness value of best individual. For this purpose it used 3 criteria according to which population size was reduced by removing the worst or the population was raised by adding new individual. But on evaluation, it did not provide good solutions for all test cases.

#### H. DEwSAcc

A. Zamuda, et al[24] provide DEwSAcc that used DE with log-normal self adaptation for parameters value and cooperative co-evolution which allowed division of population into sub-parts, optimize them and then combine the optimized results. Statistical tests gave an evidence of improved performance with the introduction of cooperative co-evolution.

Table. 1 Comprehensive Summary of LSO Algorithm

Paper	Proposal	Remarks
Shuffle or update parallel differential	Introduced an algorithm having DE	Researchers reported that on

evolution for large scale optimization [17]	logic with two mechanisms. The first, shuffling, involved rearranging the individuals randomly over the subpopulations and the second consisted of updating the scale Factors of the sub-populations.	comparing the performance of SOUPDE, SDE CHC,G-CMA-ES by wilcoxon signed-rank test and the Holm procedure, it has been concluded that SOUPDE has better performance than others for all dimensions .
Role differentiation and malleable mating for differential evolution: an analysis on large scale optimization [18]	Introduced DE-D40+Mm, DE approach with 2 mechanisms: role differentiation DE-D40 and malleable mating Mm .	Researchers accounted that by evaluating DE-D40+Mm, SDE, RC-CHC, G-CMA-ES through tests, it has been concluded as best ranked approach and statistical analysis finds major distinction with respect to all algorithms.  For future work, researchers expect the study of more control techniques for the parameters. They will also analyze the impact of introduced two mechanisms on recent DE approaches and other EA's in future.
Solving large scale optimization problems by opposition-based differential evolution (ODE)[19]	Researchers evaluated the performance of ODE on large scale problems.	Researchers examined that ODE has better performance than DE on test functions. They wished-for ODE to be chosen for inspecting other DE methodologies and also look forward to propose cooperative co-evolution ode in future.
Enhanced opposition based differential evolution for solving high dimensional continuous optimization problems [20]	Proposed a DE algorithm rooted in generalized opposition-based learning (GOBL) to increase the probability of discovering better solutions.	Researchers concluded that in statistical comparison of GODE with CHC, DE, G-CMA-ES ,GODE declared as best approach amongst the four algorithms. But not suitable for all test problems.  Researchers look forward to embed GOBL on other

		algorithms and to investigate its applications .
Scalability of generalized adaptive differential evolution for large-scale continuous optimization[21]	Researchers proposed a generalized parameter adaptation scheme, and used it to propose a new adaptive DE variant, GADE.	Researchers reported that GADE performs well for unimodel as well as for multimodel non separable functions.  Future work includes solving a problem of getting solution away from global minima.
Self-adaptive differential evolution algorithm using population size reduction and three strategies[22]	Proposed jDElscoop, a variant of DE with self-adaptive mechanism. It used three strategies : jDEbin, jDEexp, jDEbest and a population size reduction procedure.	Statistical tests proved that the jDElscoop algorithm did better than the CHC and DE algorithms .
Adaptive differential evolution with local search for solving large-scale optimization problems.[23]	Proposed LSADE to find best solution by utilizing a local search operator based on Cauchy mutation.	Researchers reported that LSADE gave better results for most of the test functions.  In future, they look forward to use LSADE with different strategies in order to make LSADE to perform better on every test problem.
Large scale global optimization using differential evolution with self-adaptation and cooperative co-evolution[24]	Proposed DEwSAcc which was based on DE with log-normal self adaptation and cooperative co-evolution.	Researchers stated that DEwSAcc did not give best results on every test problem .  enhancement in DEwSAcc is a work to be done in future.

#### IV. FUTURE SCOPE

It is evident after analyzing and comparing different approaches of DE that there is a great scope in this field. Considering the merits and opportunities available in the approaches, future scope has been presented:-

For future work, other EA's can be studied. Any EA which may be able to overcome the drawback of De may be found. Further hybridization of these EA's with DE may be done.

#### V. CONCLUSION

This paper has taken stock of the current activity in the area of large scale optimization. After suggesting a definition, this gives the brief introduction of the differential

evolution. Various proposed work of differential evolution approaches are reviewed. It describes the various issues and solution to issues of each DE approach and further it provides shortcomings of each DE approach.

#### ACKNOWLEDGMENT

We would like to thank almighty for his constant blessings. Then we would like to thank our families and friends for helping and supporting us throughout the making of this paper.

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# Secure Hybrid Data Mining Approach in Cloud

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**Abstract-** The continuous development of cloud computing is giving way to more cloud services, due to which security of cloud services, especially data privacy protection, becomes more critical. This research work explores the basic features of data mining techniques in cloud computing and securing the data. The status of the development of cloud computing security, the data privacy analysis, security auditing, data monitoring and other challenges that the cloud computing security faces have been explored. The recent researches on data protection regarding security and privacy issues in cloud computing have partially addressed some issues. The implementation of data mining techniques through cloud computing encourages the users to extract meaningful hidden predictive information from virtually integrated data warehouse that reduces the costs of storage and infrastructure.

**Keywords—** Cloud Computing, Data security, Knowledge Discovery

## I. INTRODUCTION

In this era of Internet, e-Commerce and social activities information and data are growing at a phenomenal rate. With the rapid growth of a variety of Internet services and applications, there are usually huge amounts of data; the need for quickly and efficiently manipulating the datasets in a scalable and reliable way is exceptionally high. Data mining applications and techniques are very much useful in the cloud computing model. Cloud computing denotes the new trend and practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer. Data mining in cloud computing is the process of extracting structured information from unstructured or semi-structured web data sources. The data mining in Cloud Computing allows organizations to centralize the management of software and data storage, with assurance of efficient, reliable and secure services for their users.” The implementation of data mining techniques through Cloud computing will allow the users to retrieve meaningful information from virtually integrated data warehouse that reduces the costs of infrastructure and storage [1]. Secure data transformation on internet has been a dream since the emergence of internet. Steganography [2] is one of the solutions to securely transmit data by hiding data in data. Data used to hide data in Steganography can be text or image.

## II. DATA MINING

As we are into an information technology driven society, knowledge has proved to be an invaluable asset to any

individual, organization or government. The business environment faced by all organizations has changed a lot with customers becoming more demanding in terms of their needs and in terms of products and services that they require. Since the format of the data is not predictable there comes a need to refine the data so as to get the most important and useful information in the company data warehouses.

Data mining, also known as knowledge discovery in databases, has been recognized as a promising research area to efficiently extract implicit, understandable, previously unknown and potentially useful information from large databases. Knowledge Discovery in Databases has become one of the most active and exciting research areas in the database community. In recent years, data mining has been used in all kinds of areas of science and engineering, for instance in bioinformatics, genetics, medicine and electrical power engineering. Also people from business find more and more applications for data mining, most applications are found in finance and insurance, retail, telecommunication and security. Keeping all the customer challenges in point of view companies mainly focuses on large amount of data that is supplied on daily basis. One of the prime motives of data mining is to “discover previously unknown relationships among the data, especially when we have different sources of database.”

The KDD process includes an iterative sequence methods [3], [4]:

- Selection: The KDD process includes selecting the data needed for data mining process & may be obtained from many different & heterogeneous data sources
- information to model or account for noise, accounting for time sequence information and known change.
- Preprocessing includes finding incorrect or missing data. It also includes removal of noise or outliers, collecting necessary s.
- Transformation is converting the data into a common format for processing. Some data may be encoded or transformed into more usable format. Data reduction, dimensionality reduction & data transformation method may be used to reduce the number of possible data values being considered.
- Data Mining is the task being performed, to generate the desired result.

- Interpretation/Evaluation is how the data mining results are presented to the users which are extremely important because the usefulness of the result is dependent on it.

### III. CLOUD COMPUTING

The Cloud computing has emerged as a new computing paradigm which aims to provide reliable, customized and dynamic computing environments for end-users. Many companies have begun to attempt to use cloud computing services. In cloud computing, the term "cloud" is used as a metaphor for the Internet and cloud computing is a type of distributed computing paradigm where different services such as servers, storage and applications collectively known as configurable computing resources are rapidly equipped and released with minimal management efforts.

Cloud computing allows individuals and businesses to use software's and hardware's that are managed and hosted by third parties at remote locations. The cloud computing model allows access to information and computer resources from anywhere provided a network connection is available.

The main goal of cloud computing is to combine the distributed resources to achieve higher throughput, high resource utilization and be able to solve large scale computation problems. The cloud computing has many potential advantages in comparison to traditional IT model. But the major barrier for the adoption of cloud computing are the security concerns. Security control measures in cloud are similar to ones in traditional IT environment.

Cloud service delivery is divided among three service models- Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS)

### IV. SECURITY OF DATA IN CLOUD

Security is a key barrier to the broader adoption of cloud computing. The real and perceived risks of providing, accessing and controlling services in multitenant cloud environments can slow or hinder the migration to services by IT organizations [12]. Although cloud computing promises lower costs, rapid scaling, easier maintenance, and service availability anywhere, anytime, a key challenge is how to ensure and build confidence that the cloud can handle user data securely. To make the cloud computing be adopted by users and enterprise, the security concerns of users should be rectified first to make cloud environment trustworthy.

The development of new services bring along new opportunities and challenges. At present, almost all IT enterprises are involved in cloud storage by services provision. But while provision of services, we must take into account the problems emerging from the storage operations in cloud. When the data store on personal devices, users have the highest privilege to operate on them and ensure its security. But once the users choose to put data into cloud, they lose their control over the data [9].The user's authentication and authorization is needed to access the data so as to prevent stealing other user's data through service failure or intrusion.

The data in the cloud may be divided into the data in IaaS environment and the data in PaaS or SaaS environment

related to cloud based applications. The data stored in the cloud storages is similar with the ones stored in other places and needs to consider three aspects of information security: confidentiality, integrity and availability. The common solution for data confidentiality is data encryption. To ensure the effect of encryption, the use of both encryption algorithm and key strength are needed to be considered. As the cloud computing environment encompasses large amounts of data transmission, storage and handling so there also needs to consider processing speed and computational efficiency of encrypting large amounts of data. In such cases, symmetric encryption algorithm is more suitable than asymmetric encryption algorithm. The major issue about data encryption is key management. The major issue considered in key management is as who will be responsible for key management. Ideally, the data owners are responsible for managing the key. As the cloud providers need to maintain keys for a large number of users, key management become more complex and difficult [6].

### V. STEGANOGRAPHY

Steganography is the process of hiding the one information into other sources of information like text, image or audio file, so that it is not visible to the natural view. There are varieties of steganographic techniques available to hide the data depending upon the carriers we use. In steganography the message is kept secret without any changes but in cryptography the original content of the message is differed in different stages like encryption and decryption. Steganography supports different types of digital formats that are used for hiding the data. These files are known as carriers. The main file formats that are used for steganography are text, images, audio, video, protocol. Images are the most popular cover objects used for steganography.

### VI. MOTIVATION

The major concerns of users or companies, which put their information on the cloud is they are having no idea what's happening to it. When they will have audit of when their information is approached, who access the data increase to strengthen the confidence that their information is being handled properly. Cloud repository purposes an on-demand information service model, and its reputation increasing because of its scaling down and less repair capital properties. Even, safety measure involvement arises when information repository is overcome to third-party cloud companies. This is essential to able cloud users to check their integrity of the important information on cloud, if the information has corrupted or attacked [9].Cloud infrastructure is multi-holder, with various applications which are sharing physical framework. That gives aid of much capable resource using. Even there is no physical barriers between them, it is necessary to create and maintain balance safety measure controls to lesser the effect of malwares to distribute via cloud [14].Companies taking cloud services need to understand the involvement for maintaining the confidentiality of owners or other critical business information. The major attention is how the physical location of information affects its use. Ensure only specific users and

devices can see sensitive information. One of the biggest concerns for companies coming to contact with cloud computing is confidentiality. In fully-managed public cloud service, confidentiality and aloofness risks are often likely to change accordingly to the provider's aloofness policy.

## VII. PROPOSED SCHEME

The paper aims to Implement secure cloud system using CloudSim simulator and java. In this First Data mining is performed on the dataset and a data mining report is generated which can encrypt into an image and an encrypted image is generated. And this image is migrate to cloud.

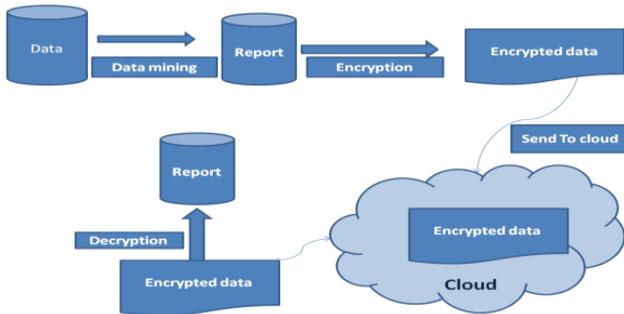
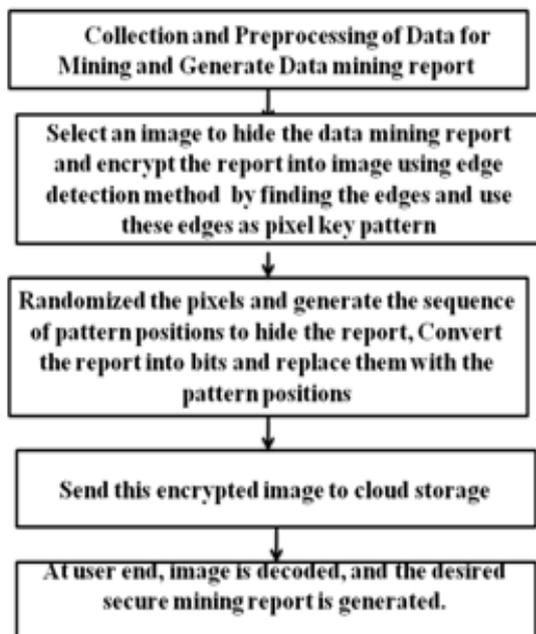


Fig.1 Secure Hybrid Data Mining approach in Cloud

When this report is required it can be decrypted at user end.

The proposed methodology is as :



The proposed solution is to be implemented in CloudSim simulator and Java Eclipse.

The Eclipse Platform [15] is designed and built to meet the following requirements

- Support the construction of a variety of tools for application development.

- Support an unrestricted set of tool providers, including independent software vendors (ISVs).
- Support tools to manipulate arbitrary content types (e.g., HTML, Java, C, JSP, EJB, XML, and GIF).
- Facilitate seamless integration of tools within and across different content types and tool providers.
- Support both GUI and non-GUI-based application development environments.
- Run on a wide range of operating systems, including Windows and Linux
- Capitalize on the popularity of the Java programming language for writing tools.

## VIII. CONCLUSION

In an emerging discipline, like cloud computing, security needs to be analyzed more frequently. With advancement in cloud technologies and increasing number of cloud users, data security dimensions will continuously increase. Cloud computing security needs consider both technology and strategy, including: audit, compliance and risk assessment. Both the Service providers and the clients must work together to ensure safety and security of cloud and data on clouds. Mutual understanding between service providers and users is extremely necessary for providing better cloud security. In our paper we are laying stress on the security issue in the cloud.

## ACKNOWLEDGMENT

The paper has been written with the kind assistance, guidance and active support of my department who have helped me in this work. I would like to thank all the individuals whose encouragement and support has made the completion of this work possible.

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# Systematic Review on Soft Computing: A Brief Case Study

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**Abstract-** Soft Computing deals with imprecision, uncertainty, partial truth and approximation to achieve practicability, robustness and low cost solution. This paper also describes the process of genetic algorithm which generates the population of chromosomes. Recent trends tend to involve evolutionary and swarm intelligence based algorithms and bio-inspired computation. This paper gives the overview of broader field of soft computing and application areas of soft computing techniques and machine learning process.

**Keywords-** Soft Computing, Techniques, Applications

## I. INTRODUCTION

Soft Computing is branch in which it is tried to build intelligent and wiser machines. Intelligence provides the power to derive the answer and not simply arrive to the answer.[1] Principle of Soft Computing is exploit the tolerance for imprecision, uncertainty, partial truth and approximation to achieve tractability, robustness and low solution cost. Principal constituents of Soft Computing are Fuzzy Logic, Neural Computing, Evolutionary Computation, Machine Learning and Probabilistic Reasoning.

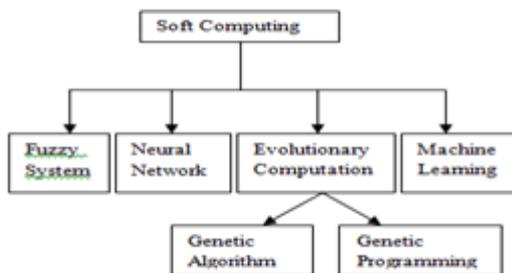


Fig.1. Concept of Soft Computing

Soft Computing is blend of methodologies designed to solve the real –world problems which are difficult to solve mathematically. Ultimate goal of soft computing is to emulate human mind as closely as possible [2]. Soft Computing is the modern approach for constructing a computationally intelligent system. Soft computing is the use of inexact solutions to computationally hard tasks such as the solution of NP- complete problems for which there is no known algorithm that can compute an exact solution in polynomial time [5].

## II. TECHNIQUES OF SOFT COMPUTING

Soft Computing is basically optimization technique to find solution of problems which are very hard to answer.

Soft computing is a consortium of methodologies that works synergistically and provides in one form or another flexible information processing capability for handling real-life ambiguous situations.

### A. Artificial neural network

Main characteristic of artificial neural network is their ability to learn. A neural network is an artificial representation of human brain [3].The main aim behind the development of neural network is to acquire human ability to adapt to changing circumstances and the environment. Artificial neural network is an interconnected group of artificial neurons [4, 15].Neural networks can be divided into different architectures on the basis of learning algorithm for gene prediction including supervised and unsupervised learning algorithm. Artificial Neural Network is mathematical model or computational model that tries to simulate and functional aspects biological network networks [9].

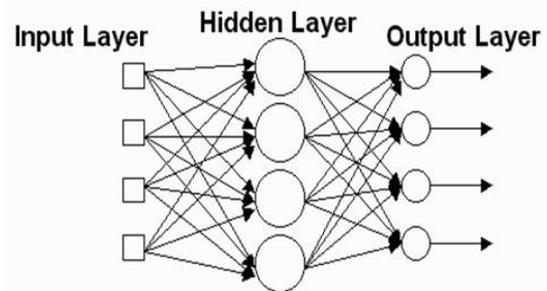


Fig.2. Neural Networks

### B. Genetic Algorithms

Genetic algorithm is an optimization technique which can be applied to various problems like NP-hard, travelling salesman problem, knapsack problem and other optimization techniques to. Genetic algorithm is adaptive search procedures which were introduced by John Holland in 1975 and extensively studied by Goldberg (1989). Genetic algorithm is consisting of chromosomes and each chromosome consists of genes. Foundation of Genetic algorithm lies on the concept of the survival of fittest into a solution space [3].

Genetic algorithm are heuristic search algorithms based on the process of natural evolution [5].Generic algorithm often encode a candidate solution as a fixed-length bit string called chromosome. Genetic algorithm mainly used to find optimal solution to an optimization problem. First attempt of genetic algorithm for gene prediction was made in 2011 [6].

- Genetic Algorithm Process

The process of Genetic Algorithm is as follows:

- The Genetic algorithm generates the population of chromosomes.
- Now the test suits are given to each chromosome [14].
- The population of chromosomes is selected on the basis of fitness function.
- Now the genetic operator starts its functioning. It performs the crossover and mutation.
- If optimized solution is not obtained it will repeat the step 3 and 4 and reproduce the new population through crossover and stop the process [11].

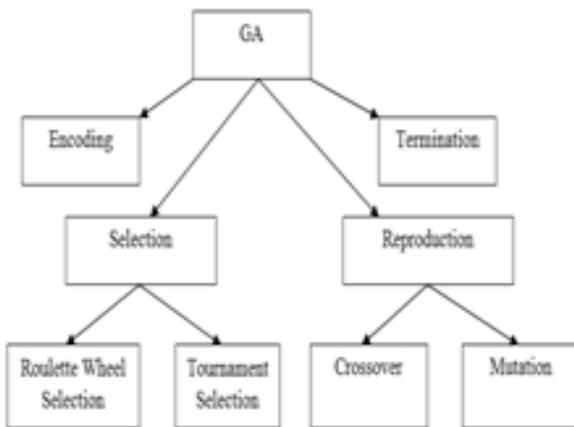


Fig.3. Genetic Algorithm Architecture

### C. Probability Reasoning

The aim of probabilistic logic is to combine the capacity of probability theory to handle uncertainty with the capacity of deductive logic to exploit structure. Result is richer and more expressive formalism with a broad range of possible application areas. Probabilistic logics attempt to find a natural extension of traditional logic truth tables and the results are derived through probabilistic expressions instead [10].

- Probabilities are expressed in a notation similar to that of predicates in First Order Predicate Calculus:[18]  
 $P(R) = 0.7$   
 $P(S) = 0.1$   
 $P(\neg(A \wedge B) \vee C) = 0.2$
- 1= certain ; 0s= certainly not

### D. Machine learning

Machine learning deals with designing and developing algorithms to evolve behaviors based on empirical data. Key goal of machine learning is to able to generalize from limited sets of data. Machine learning focuses on the development of computer programs that can teach themselves to grow and change when exposed to new data. Machine learning is type of artificial intelligence that provides computers with the ability to learn without being explicitly programmed. Machine learning uses that to improve the program own understanding. Machine

learning programs detect patterns in data and adjust program actions accordingly [12].

For example, face book’s News Feed changes according to the user’s personal interactions with other users. If a user frequently tags a friend in photos, writes on his wall or “likes” his links, the News Feed will show more of that friend’s activity in the user’s News feed due to presumed closeness.

### E. Hybrid

Hybrid system integrates two or more technologies to solve a problem like: neural network combined with genetic algorithm or neural network combined with fuzzy logic. Fuzzy logic based on multi-valued logic that allows multiple values to be defined between conventional values like 0 and 1. It provides a technique to deal with imprecision and uncertainty [1]. Main idea behind fuzzy logic is to approximate human decision making language terms instead of quantitative terms [8]. Some common examples of hybrid systems are neuro fuzzy and neuro genetic. In neuro-fuzzy systems fuzzy input is provided to the neural network. In neuro-genetic systems neural network calls a genetic algorithm to optimize its structural parameters [6].

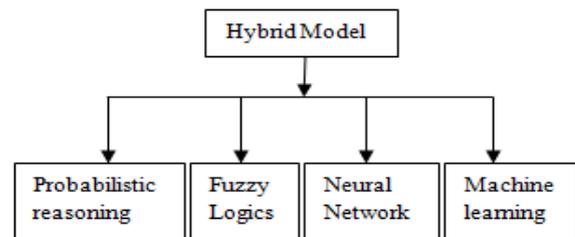


Fig.4. Concept of Hybrid Model

## III. APPLICATION AREAS OF SOFT COMPUTING

Soft computing techniques have become one of promising tools that can provide practice and reasonable solution. Soft computing techniques are used in different fields. Soft computing application approximate reasoning, imprecision, uncertainty and partial truth in order to mimic remarkable human capability of making decisions in real-life. [2]

### A. Biomedical Application

Biomedical Application field seeks to close the gap between engineering medicines. Biomedical application is a design concept to medicine and biology. This field seeks to close gap between engineering and medicine. It combines the design and problem solving skills of engineering with medical and biological sciences to advance healthcare treatment including diagnosis, monitoring, treatment and therapy [20].

### B. Process Control

Process Control enables automation with which small staff of operating personnel can operate complex process from central control room. It is extensively used in industry and enables mass production of continuous processes such as oil refining, paper manufacturing, chemicals, power

plants and many other industries. Process control is statistics and engineering discipline that deals with architectures, mechanism and algorithms for maintaining output of specific process within a desired range [3].

### C. Image Processing

Image Processing is any form of signal processing for which the input is an image such as photograph or video frame; the output of image processing is set of characteristics or parameters related to the image. Most image processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it [11].

### D. Feature Selection

Feature Selection techniques are subset of the more general field of feature extraction. In machine learning and statistics, feature selection also known as variable selection, attribute selection or variable subset selection. Variable subset selection is the process of selecting a subset of relevant features for use in model construction [11].

### E. Pattern Recognition

Pattern Recognition generally aim to provide a reasonable answer for all possible inputs and to perform “most likely” matching of the inputs, taking into account their statistical variation. Pattern recognition is studied in many fields including psychology, psychiatry and ethnology, traffic flow and computer science.

### F. Fault-Tolerance

Fault-Tolerance is particularly sought-after high-availability or life critical systems. If its operating quality decreases, the decrease is proportional to the severity of the failure as compared to naively- designed system in which even small failure can cause total breakdown [19]. Fault-Tolerance is the property that enables a system to continue operating properly in the event of the failure of its components.

### G. Signal Processing

Signal Processing is an area of systems engineering, electrical engineering and applied mathematics that deals with operations on or analysis of signals or measurements of time-varying or spatially varying physical quantities. Different types of signals are sound, images and sensor data, for example biological data such as electrocardiograms, control system signals and telecommunication transmission signals [13].

## IV. CONCLUSION

In this paper, we review the applications of soft computing techniques are discussed. Soft Computing techniques, neural networks, appear to be powerful tools for pattern recognition and pattern matching. In this paper, we have discussed Genetic algorithms and hybrid techniques give promising results but they are applied in a very limited fashion. We also review that GA has the capability to solve many problems for example travelling salesman problem, Knapsack problem etc. Hybrid technique can handle uncertainties more effectively than an

individual technique. The successful applications of soft computing and rapid growth suggest that the impact of soft computing will be felt increasingly in coming years.

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# The Internet of Things- A Review

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**Abstract**—Now a days, the Internet of Things (IoT) is an emerging global Internet-based information architecture facilitating the exchange of goods and services. The Internet of Things (IoT), sometimes also referred to as the Internet of Objects. The IoT has the purpose of providing an IT-infrastructure facilitating the exchange of “things” in a secure and reliable manner, i.e. its function is to overcome the gap between objects in the physical world and their representation in information systems. As we are moving towards the Internet of Things (IoT), the number of sensors established around the world is growing at a fast pace. The IoT will serve to increase transparency and enhance the efficiency of global supply chain networks. Smart connectivity with existing networks and context-aware computation using network resources is an imperative part of IoT. The objective of this paper is to make you familiar with IoT and understand its potential to change everything we know to be true today.

**Keywords**--Internet of Things, Constrained Application Protocol, Smart Cities, testbed and trials

## I. INTRODUCTION

The internet of things is the network of physical objects and things embedded with electronics, software, sensors and connectivity to enable it to achieve greater value and service by exchanging data with the manufacturer, operator or other connected devices [1] as shown in Fig. 1.

Everything in actual turns to virtual, which signifies that, every person and things has its own place with a particular address on the Internet. These virtual characteristic things can generate and make utilize facilities and cooperate to a standard objective. Various remarkable barriers persist to manage the internet of things insight, amid certainty and safety. The users on the internet always face different threats continuously and the developing wealth crowded with the business models that erode the Internet’s moral use which emphasis on exploiting the prevalent version’s foundational delicacy. This does not predict well for IoT, which assimilate many constrained devices. The trial is to avert the growth of such models or to reduce their impact. Encountering these challenges needs better understanding the entities and the technologies that empower them. Mobile applications already attracting customers with this platform and the sensor devices are also in progress to provide multitude extent of information to enhance the user experience. [2].

## II. WEB OF WIRELESS THINGS

Roschell, J. ud al [5] observes the prospective of wireless mobile learning devices to attain large-scale influence on learning because of reliability, low cost and smart communication characteristics. This eagerness in

education is shared but there are three raising challenges ahead. First ‘Wireless Mobile Learning’ is an indistinct Explanation of what it needs to capture to connect learners and their devices in an inventive manner. Research requires generating a more precise grasping of the attributes of wireless networking that encounter pedagogical requirements. Second, ‘pedagogical applications’ raised perceptions about technology and easy simple views of social practices. More research is needed that explains the productive pedagogical practices emerging out of simple wireless and mobile technologies. Third, ‘large scale’ impacts the availability of the pedagogically rich application platforms. ‘Wireless mobile technologies for education are astonishing and absurd; to achieve a standardized scale, some incredible formulated executable sights are needed, that reduce the marketplace fragmentation.

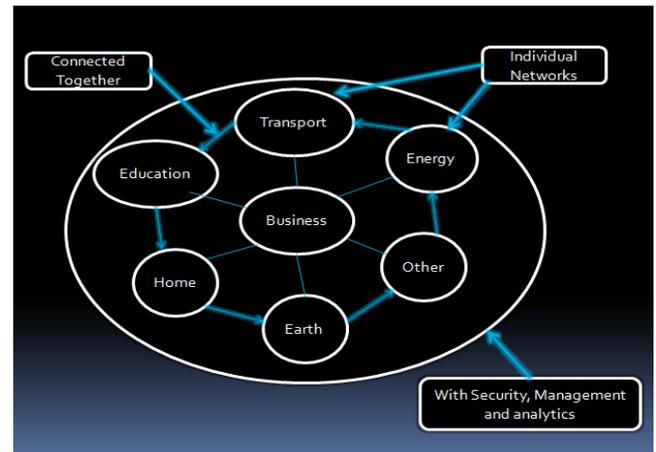


Fig.1.IoT- Networks of networks

## III. PROTOCOL STACK FOR INTERNET OF THINGS

Palattella, M.R. et al [4] introduces the wireless communications stack, the industry must trust to approach the major criteria of power-efficiency, portability and network connectivity. Industrial utilities have been the prior assumer of this stack, which has happen the defacto level, thereby bootstrapping advance IoT progress with earlier thousands of wireless nodes established. .IP Smart Objects Protocol Suite is shown in fig 2.A modular quality approach, using latest developments are given below:

- In the IEEE 802.15.4 and IETF working groups, is the only way forward. They initiate the power-efficient

IEEE 802.15.4-2006 PHY layer, the power saving and reliable IEEE 802.15.4e MAC layer.

- The IETF 6LoWPAN adaptation layer authorize universal Internet connectivity, the IETF ROLL routing protocol permits the availability, and finally the IETF CoAP validates seamless transfer and support of Internet applications.
- The protocol stack suggested in the present work meets towards the standardized notations of the ISO/OSI and TCP/IP stacks. Building a clearly stated, Internet compliant stack specifies the extreme limitations of IoT networks are commencing to become actuality.

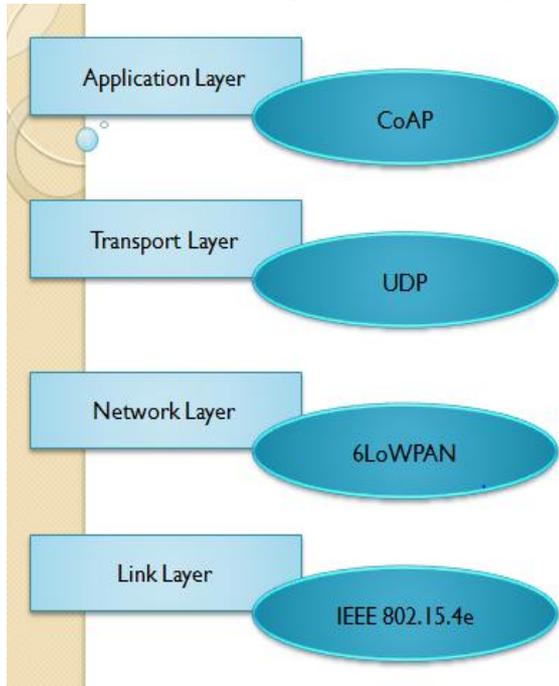


Fig.2.IP Smart Objects Protocol Suite

#### IV. EXPLORING MAZOR ARCHITECTURAL ASPECTS:

Pérez, I.C. et al [9] describes the various technological investigation lines around the practicality and utility of the Internet of Things as shown in Fig 3 [14]. Some of the challenges are related to the sensor devices and the productive smart objects or actuator devices.

The Pros of placing heterogeneous ecosystems in the connectivity order are:

- It presents the Web of things that depicts the principles of Internet of things.
- The opportunity of generating new services and utilities has driven research towards proposals that sum up the standalone standards into the web.
- Internet of things offers the integration of various smart things or devices onto web.
- The main objective of this platform is to open the functionalities of sensors and actuator devices with their information model to be retrieved from the web as a set of utility services.

Roman, R. et al [2] conclude that in the Internet of Things vision, every physical object has a virtual component that can produce and consume services. Such extreme interconnection will bring unprecedented convenience and economy, but it will also require novel approaches to ensure its safe and ethical use.

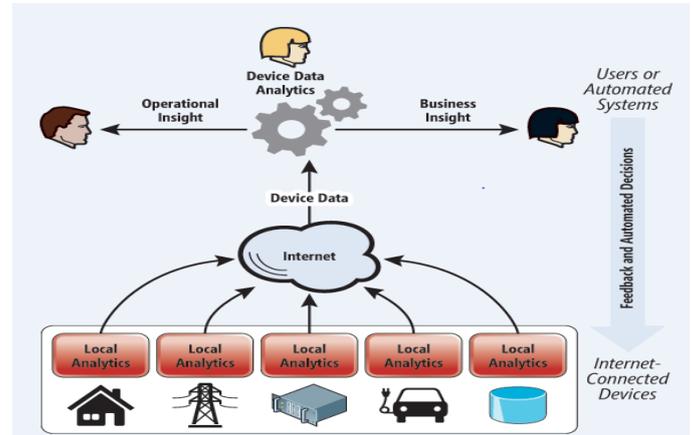


Fig.3.Typical Architecture for internet of things application [14]

#### V. ARCHITECTURAL ELEMENTS FOR FUTURE USE

Gubbi, J. et al [6] observes that in the modern day living, Ubiquitous sensing allowed by Wireless Sensor Network (WSN) technologies cuts across many areas.

This presents the capacity to measure, understand and deduce environmental indicators, from intricate ecologies and natural resources to urban environments.

As shown in Fig. 4, the growth of these things in a communicating-actuating network creates the Internet of Things (IoT), wherein, sensors and actuators combine seamlessly with the scenario around us, and the information is shared across platforms in order to generate a common operating picture (COP).

Powered by the recent alteration of a variety of allowing wireless technologies, embedded sensors and actuator nodes, the IoT has walked out of its infancy and is the next revolutionary technology in converting the connectivity network into a fully integrated Future Internet. The Cloud centric sight is must to use for implementation of Internet of Things in worldwide.

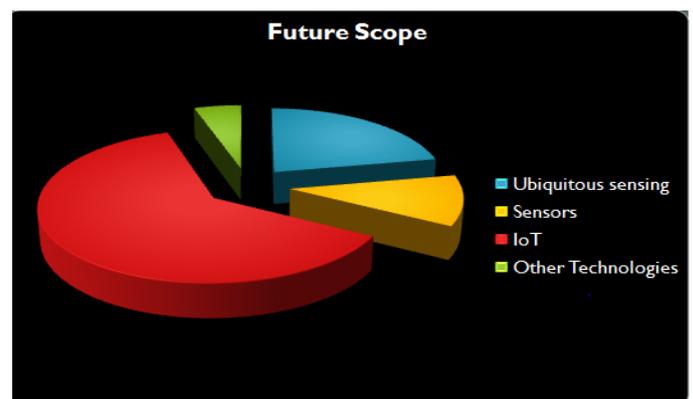


Fig.4.Future Scope for architectural elements of IoT

## VI. INTERNET OF THINGS FOR SMALL CITIES

Zanella, A. et al [3] focuses particularly to an urban Internet of Things system that featured by their specific application environments. Urban IoTs are created to maintain the Smart City sight, which goals at utilizing the most advanced communication technologies to attain added-value services for the administration of the city and citizens.

In this respect, the IoT sight can become the building block to realize a unified urban scale ICT platform, therefore unleashing the potential of the Smart City vision [11], [12].

## VII. MEETING THE FUTURE CHALLENGES

Kranenburg, R.V. et al [8] traces the challenges and nature of the impacts relied upon the developments termed the 'Internet of Things (IoT)'.

The Internet of Things consist of

- A number of technological protocols that goals to connect devices to other devices, to databases and to individuals.
- The speed with which the program of connecting communicating objects has taken over the complete highest range of connectivity protocol (IPv6).
- Hardware (from cheap sensors to mini laptops, smart phones, iPads, android mobiles, tablets that are full blown computers).
- Software (either present or used from the cloud or collaborative open source)
- Utilities (ranging from global or local location based services that connect up to social networks to your vehicle linked to a specific brand network).
- Services (from car sharing smart sensors and GPS connectivity with RFID (Radio Frequency Identification), to enhance texting your service layer that they are out of battery power (Designer) is determined by the whole power of the internet. They outline the Internet of Things' recent history, technological challenges and policy ecology.

Framework for understanding its impact in four domains:

- The path where all objects can be tracked, logged and traced.
- The service layer that can be built upon this.
- The smart city layer.
- Its ultimate limit and scope of the Sensing Planet notion that aims to get natural processes by globally distributed sensor grids to have counterparts in the cloud.

They sketch the two basic policy and industry approaches:

- A reactive approach that asks IoT is manageable and non disruptive.
- A proactive approach that works back from connectivity to find the key moments in policy tools and commercial products.

As shown in Fig. 5 [15] IoT chooses various platforms to set infrastructure as well as for novel functions to show its importance in social life.



Fig.5.Future Internet of things [15]

## VIII. TAKING THE IOT TO THE NEXT LEVEL

The IoT is reaching a tipping point. Although the idea, the terminology and the technology have been around for at least a decade, the IoT is beginning to become an important action point for the global business community. More than three-quarters of global companies are exploring or using the IoT in their business to some extent, and around two in five CEOs, CFOs and other C-suite-level respondents have a formal meeting or conversation about the IoT at least once a month.

Counted measures:

- Green shoots of growth: One-quarter of businesses (25%) surveyed are currently not doing anything around the IoT. If the survey is a judge, that number will fall to under 5% within three years.
- Developing skills: If organisations are going to make the most of the IoT they will need a workforce with the proper skills. According to survey respondents, a shortage of employees with IoT-related skills.[11]

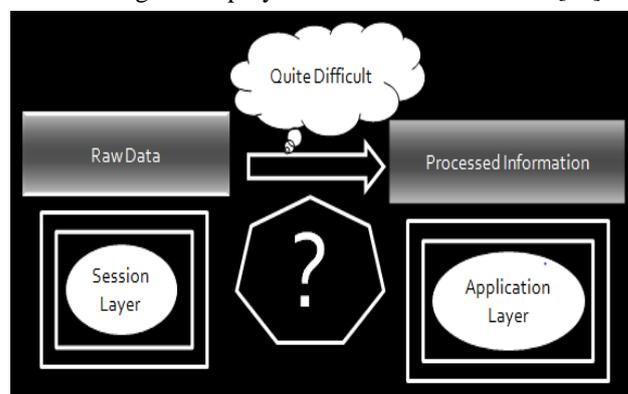


Fig.6.Future Problems

## IX. FUTURE ISSUES

Tsai, C. et al [10] discover that internet of Things (IoT) and the technologies related to it. It attracts the attention of researchers towards it from the aspect of academia, industry and government. The needs and desires of the IoT are quite

different from what the platform offered by the internet today, various innovative methods have been gradually progressed and sum up into IoT, which is stated as Future Internet of things. But to convert the raw data to processed information from session layer to application layer is quite difficult and a big issue as shown in Fig. 6.

## X. CONCLUSION

Over the last few years, the IoT has gained significant attention. In this reviewed paper, we analyse:

- Context aware computing research efforts to determine how the challenges in the field of context-aware computing have been tackled in desktop, web, mobile, sensor networks.
- This work focuses on the essential networking and backend support technology to implement the vision of the IoT.
- In future work, we want to take security aspects into consideration.
- The expansion of devices with communicating-actuating capabilities is bringing closer the vision of an Internet of Things, where the sensing and actuation functions logically blend into the background.
- New capabilities are made possible through retrieval of new information sources.
- The evolution of the next generation mobile system will depend on the innovation of the users in drafting new applications.
- IoT is an emerging technology that influences the users by providing new evolving data.
- IoT also make possible processing of computational resources for creating comprehensive apps.

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# Student's Performance Prediction and Analysis using J48 Decision Tree Algorithm

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**Abstract**— Success of any educational institute depends upon the success of the students of institute. Student's performance prediction and its analysis are essential for improvement in various attributes of students like final grades, attendance etc. This prediction helps teachers in identification of weak students and to improve their scores. Various data mining techniques like classification, clustering, are used to perform analysis. In this paper we will use J48 decision tree algorithm for student's performance prediction and analysis. The WEKA tool is used to perform evaluation. To evaluate the performance 10 fold cross validation method is used. Main aim of this implementation is to predict students end semester marks.

**Keywords**— Data Mining, EDM, Decision Tree, J48

## I. INTRODUCTION

### A. Data Mining and Educational Data Mining(EDM)

Data mining is a process of taking out useful information and patterns from large amount of data. Data Mining is used for solving problems by analyzing data that is present in the databases. [1]

Educational Data Mining (EDM) is a process which is concerned with developing various techniques or methods for extracting the different types of data that come from educational settings, and use of those methods for better understanding of students. Main uses of EDM include student performance prediction and studying students learning to suggest improvements in current educational practice. [2]

### B. Student Performance Prediction and Analysis

In student performance prediction, we predict the unknown value of a variable that defines the student. In educational sector, the mostly predicted values are student's performance, their marks, knowledge or score. Student's performance prediction is very popular application of DM in education sector. Different techniques and models are applied for prediction and analysis of student's performance like decision trees, neural networks, rule based systems, Bayesian networks etc. This analysis is helpful for someone in predicting student's performance i.e. prediction about student's success in a course and prediction about student's final grade on the basis of features taken from logged data. [2][3]

This paper is organized as follows: In section II we present work related to student performance prediction and analysis. In section III we present implementation of J48 decision tree algorithm. Conclusion is presented in section IV. In section V we discuss future scope.

## II. RELATED WORK

Considering the improvements required in students grades or scores, literature survey has been surveyed based on student performance prediction and analysis using decision tree algorithms.

Brijesh Kumar Baradwaj, Saurabh Pal [5] (2011) have discussed that students performance is examined by internal marks and final results. Data set of 50 students was used in this study which was taken from MCA department of VBS Purvanchal University, Uttar Pradesh. Information like previous semester marks, attendance, and assignment and class test marks from previous database of students. They have used decision tree algorithms for student performance prediction and analysis. This overall study will help faculty members in improving student's scores for future examinations.

R. R. Kabra, R. S. Bichkar [11] (Dec. 2011) collected data from S.G.R. college of engineering and management, Maharashtra. They collected data from 346 students of engineering first year. Evaluation was performed using J48 algorithm by 10 fold cross validation. The accuracy of J48 algorithm was 60.46%. This model is successful in identifying the students who are likely to fail. So it will be helpful for increasing performance of students.

Surjeet Kumar Yadav, Saurabh Pal [6] (2012) conducted analysis on 90 students of engineering department (session 2010) from VBS Purvanchal University, Uttar Pradesh. ID3, C4.5 and CART decision tree algorithms were used for evaluation. Evaluation was performed using 10 fold cross validation method. It has been found that C4.5 has higher accuracy 67.7778% than ID3 and CART algorithm. Model's True Positive rate for class Fail is high 0.786 for ID3 and C4.5 which means it will successfully identify the fail students. This study will be helpful for those students that need special attention from teachers.

Manpreet Singh Bhullar, Amritpal Kaur [10] (2012) have taken data set of 1892 students from various colleges for student performance prediction and evaluation. J48

algorithm was chosen for evaluation using 10 fold cross validation. Success rate of J48 algorithm was 77.74%. In this way it will be helpful in identifying weak students so that teachers can help them before failure.

Mrinal Pandey, Vivek Kumar Sharma [4] (Jan. 2013) compared J48, Simple Cart, Reptree and NB tree algorithms for predicting performance of engineering students. They have taken data of 524 students for 10 fold cross validation and 178 students for percentage split method. It has been found that J48 decision tree algorithm achieved higher accuracy 80.15% using 10 fold cross validation method. By using percentage split method higher accuracy 82.58% is achieved by J48 algorithm. From this comparison it has been found that J48 performs best than other algorithms in both the cases. J48 decision tree algorithm will be useful for teachers in improving performance of weak students.

Anuja Priyam, Abhijeet, Rahul Gupta, Anju Rathee, and Saurabh Srivastava [12] (June 2013) compared ID3, C4.5 and CART decision tree algorithms on the basis of students data. Evaluation was performed using 10 fold cross validation method. It shows that the CART algorithm has higher accuracy 56.2500%. Model's True Positive rate for class Fail is high 0.786 for ID3 and C4.5 which means it will successfully identify the fail students. So this model will help teachers in reducing failure rates.

Ramanathan L, Saksham Dhanda, Suresh Kumar D [14] (June-July 2013) performed analysis on 50 students data. They were used naïve bayes, J48 and proposed algorithm (Weighted ID3) for evaluation. It shows that WID3 has higher accuracy 93% than J48 and naïve bayes. In future you can made user friendly software using WID3 which will be very helpful for teachers.

Kalpesh Adhatrao, Aditya Gaykar, Amiraj Dhawan, Rohit Jha and Vipul Honrao [7] (September 2013) performed analysis on data set of 182 students using ID3 and C4.5 decision tree algorithms. When they performed bulk evaluation on data set of 173 students both algorithms have same accuracy of 75.145% and when they performed singular evaluation on data set of 9 students then both algorithms have accuracy 77.778%. For 182 students accuracy was approximately 75.257.

Mrs. M.S. Mythili, Dr. A.R.Mohamed Shanavas [9] (Jan. 2014) compared J48, Random Forest, Multilayer Perception, IBI and decision tree algorithms using data set of 260 students from various schools. 10 fold cross validation was chosen for evaluation. It has been found that Random Forest has higher accuracy 89.23% and less execution time amongst all other algorithms. This study will be helpful for educational institutions.

Jyoti Namdeo, Naveenkumar Jayakumar [13] (Feb. 2014) collected 51 students data from MCA 2007 batch. Decision tree algorithms used in evaluation were Naïve Bayes, Multilayer Perception, J48 and Random Forest. These algorithms were trained on 2007 batch data and tested on 2008 batch data. Evaluation was performed using training, cross validation, percentage split and test on 2008 data. After testing on 2008 data it has been found that naïve bayes has higher accuracy 31.57% amongst other

algorithms but this accuracy is not according to requirement.

Azwa Abdul Aziz, Nor Hafieza Ismail and Fadhilah Ahmad [8] (September 2014) conducted analysis on 399 records of students using naïve bayes, rule based and J48 decision tree algorithm. They have used cross validation and percentage split method for evaluation. In cross validation 3, 5, 10 fold cross validation was performed and in percentage split method training: testing 10:90, 20:80, 30:70, 40:60, 50:50, 40:60, 30:70, 20:80, 10:90 percentage split were used. After comparison of 3 classification algorithms it has been found that rule based and J48 decision tree algorithm has higher accuracy 68.8%.

### III. DATA MINING PROCESS

Success of any educational institute depends upon the success of the students of institute. Student's performance prediction and its analysis are essential for improvement in various attributes of students like final grades, attendance etc.

#### A. Data preprocessing and selection

The data of 89 students of Master's degree students is collected from university. The data is collected by form filling procedure. The students enter their previous semester marks, class test grades, attendance, seminar performance, category, end semester marks.

The attributes are given below:

Sr.No.	Attribute Name	Possible values
1	PSM	First (>60%) Second (>45% and <60%) Third (>35% and <45%) Fail (<35%)
2	Attendance	Poor, Average, Good
3	SEMP	Poor, Average, Good
4	CTG	Poor, Average, Good
5	ASS	Yes, No
6	LW	Yes, No
7	Category	General, SC, OBC
8	Gender	Male, Female
9	ESM	First (>60%) Second (>45% and <60%) Third (>35% and <45%) Fail (<35%)

Values for Attributes are described below:

- PSM: previous semester marks obtained by students. These are divided into 4 classes: First (>60%), Second (>45% and <60%), Third (>35% and <45%), Fail (<35%).
- Attendance: 70% attendance is compulsory for end semester marks. Attendance is divided into three classes: Poor (<60%), average (60-75%), good (>75%).
- SEMP: seminar performance of students. Seminars are conducted each semester to check student's presentation and communication skills. It is divided into three classes: poor (both presentation and communication skills are weak), average (either

presentation or communication skill is weak), good (both presentation and communication skills are good).

- CTG: class test grade of students. Every semester two class tests minor1, minor 2 are conducted and average of these becomes internal of students. It is divided into three classes: poor (<40%), average (40-60%), good (>60%).
- ASS: assignments of students. It is divided into two classes: Yes (if assignments are submitted), No (if assignments are not submitted).
- LW: lab work of students. It is divided into two classes: yes (if lab work is complete), no (if lab work is not complete).
- Category: it is the category of student. It is divided into three classes: general, SC, OBC.
- Gender: it is divided into two classes: male (for boys), female (for girls).
- ESM: end semester marks of students. It is divided into four classes: First (>60%), Second (>45% and <60%), Third (>35% and <45%), Fail (<35%).

### B. Data Mining

In data mining process WEKA tool is used for student performance prediction and analysis. CSV file was used for storage of student's data. J48 decision tree algorithm was used to perform prediction and analysis. Decision tree algorithms are mostly used for classification task. Decision tree is a tree like structure where root node will be the attribute that has highest information gain value. Decision tree contains several branches and leaf nodes will be the class labels. Widely used decision tree algorithm is J48.

### C. Model construction

From data stu.csv file was created and it is loaded into WEKA explorer. WEKA explorer contains preprocess panel, by clicking on this you can see the open file tab; by clicking on it you will load the file in WEKA. Now click on the classify panel then click on trees option. There are number of algorithms, choose j48 decision tree algorithm from them because we are using J48 to perform evaluation.

### D. Results obtained

#### 1) Generated decision tree

The decision tree generated from stu.csv is shown in Fig.1. The accuracy of the model is 61.7978%. PSM is the most important attribute for predicting and analyzing students performance other attributes like gender, category, SEMP have less importance.

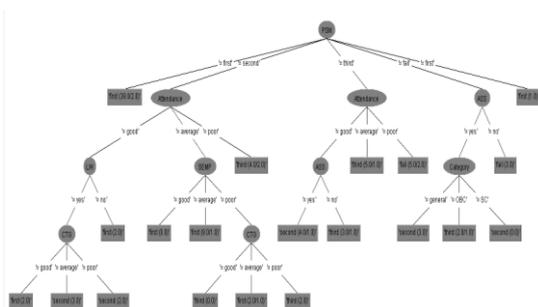


Fig. 1. Decision tree of student performance prediction

#### 2) Rules generated

Rules generated by J48 are shown in Fig. 2.

```
J48 pruned tree
-----
PSM = first: first (38.0/2.0)
PSM = second
  Attendance = good
  | LW = yes
  | | CTG = good: first (2.0)
  | | CTG = average: second (3.0)
  | | CTG = poor: second (2.0)
  | LW = no: first (2.0)
  Attendance = average
  | SEMP = good: first (0.0)
  | SEMP = average: first (8.0/1.0)
  | SEMP = poor
  | | CTG = good: third (0.0)
  | | CTG = average: first (2.0/1.0)
  | | CTG = poor: third (2.0)
  Attendance = poor: third (4.0/2.0)
PSM = third
  Attendance = good
  | ASS = yes: second (4.0/1.0)
  | ASS = no: third (3.0/1.0)
  Attendance = average: third (5.0/1.0)
  Attendance = poor: fail (5.0/2.0)
PSM = fail
  ASS = yes
  | Category = general: second (3.0)
  | Category = OBC: third (2.0/1.0)
  | Category = SC: second (0.0)
  ASS = no: fail (3.0)
PSM = first: first (1.0)
```

Fig. 2. Rules generated by J48 algorithm

#### 3) Confusion matrix

Confusion matrix given in Fig. 3 shows that out of 50 first students 45 are correctly classified as first. Out of 17 second students 5 are correctly classified as second. Out of 14 third students 3 are correctly classified as third. Out of 8 fail students 2 are correctly classified as fail.

```
=== Confusion Matrix ===
      a  b  c  d  <-- classified as
45  4  1  0  | a = first
 4  5  5  3  | b = second
 3  6  3  2  | c = third
 0  2  4  2  | d = fail
```

Fig. 3. Confusion matrix

#### 4) Accuracy

Accuracy is defined as the number correctly classified instances. Accuracy of this model is 61.7978%. There are total 89 instances out of which 55 are correctly classified instances and 34 are incorrectly classified instances. It is clear from confusion matrix that model is TP rate for class first is 0.9, which means model is successful in identifying the students who are likely to first. Fig.4 shows the accuracy of the model.

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances      55          61.7978 %
Incorrectly Classified Instances    34          38.2022 %
Kappa statistic                    0.3688
Mean absolute error                 0.1941
Root mean squared error            0.3795
Relative absolute error             62.3687 %
Root relative squared error        96.6218 %
Total Number of Instances          89

=== Detailed Accuracy By Class ===
```

	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
	0.9	0.179	0.865	0.9	0.882	0.886	first
	0.294	0.167	0.294	0.294	0.294	0.6	second
	0.214	0.133	0.231	0.214	0.222	0.649	third
	0.25	0.062	0.286	0.25	0.267	0.707	fail
Weighted Avg.	0.618	0.159	0.604	0.618	0.611	0.778	

Fig. 4. Accuracy of model

#### IV. CONCLUSION

Educational data mining's (EDM) importance is increasing day by day as the student's performance prediction and analysis requirements are increasing for improvement of student's academic performance. Survey done in the section II will be helpful to various researchers that are working in the field of student's performance prediction and analysis using decision tree algorithms.

Most frequently used decision tree algorithms are studied and found that J48 decision tree algorithm is best than other algorithms. Using j48 decision tree algorithm accuracy of the model is 61.7978%. It is clear from confusion matrix that model is TP rate for class first is 0.9, which means model is successful in identifying the students who are likely to first.

#### V. FUTURE WORK

For growth of any educational institute, student's academic performance is main contributor. If students perform well academically then institution growth rate goes high. It is necessary in these days to focus on the student's results so there is a wide scope in this field. To increase student's performance, student performance prediction and analysis is used. For this purpose decision tree algorithms are used mainly. We have done implementation using only J48 algorithm.

In future researchers can enhance the research by comparing large number of algorithms using large size data sets. So there is a wide scope for researchers in this field.

#### ACKNOWLEDGMENT

First of all I express my sincerest debt of gratitude to the Almighty God who always supports me in my endeavors.

I would like to thank Prof. Neena Madan for their encouragement and support. Then, I would like to thank my family and my friends. I am thankful to all those who helped me in one way or the other at every stage of my work.

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# Review on Software Quality and Quality Assurance System

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**Abstract-** In this paper, we survey the current software quality assurance technologies, described their various methods and discussed the maintenance of software quality system. For most software development organizations, ensuring quality means dealing with defects. The main generic ways to deal with defects include defect prevention, defect detection and removal and defect containment. We also addressed QA issues for software development. The central activities for quality assurance can be viewed as to ensure that few defects may remain in the software system which needs to be catered before delivering the product to its customer.

**Keywords-** *Software Quality (SQ), Software Quality Assurance(SQA), Software Assurance(SA), Six Sigma*

## I. INTRODUCTION

Quality is not absolute. The quality of a product or service is the degree to which the product or service meets the customer's expectations — the degree to which it is fit for purpose. Traditionally, a quality product is defined in terms of its fitness of purpose. That is, a quality product does exactly what the users want it to be. For software products, the fitness of purpose is usually in terms of satisfaction of requirements laid down in SRS document. In today's Modern era, quality plays a prominent role in any kind of business.[1] To obtain a respectable position in global market in IT industry, a company must have to produce very high quality products.

Quality Assurance as a planned and systematic pattern of actions necessary to provide adequate confidence that the item or product conforms to established technical requirements. The purpose of this is to provide the assurance that the procedures and techniques used during product development and modification are adequate

The quality management system on which the software system is created is normally based on the following standards:

- MMI
- Six Sigma
- ISO 9000

## II. SOFTWARE QUALITY ASSURANCE:

The main role of software quality assurance (SQA) is to maintain the quality of software products. Basically, the task of quality assurance is delivered to the skilled

workers team called software quality assurance personnel who are distinct from the software development team.

The main factors include a good software quality are:

### A. *Correction:*

The extent to which a program satisfies its specification and fulfills the customer's mission objective.

### B. *Reliability:*

The extent to which a program can be expected to perform its intended function with required precision.

### C. *Efficiency:*

The amount of computing resources and code required by a program to perform its function. The response time of the program must be less.

### D. *Integrity:*

The Extent to which access to software or data by unauthorized persons can be controlled.

### E. *Usability:*

The effort required to learn, operate, prepare input and interpret output of a program.

### F. *Maintainability:*

The effort required to locate and fix an error in a program

### G. *Flexibility:*

The effort required to modify an operational program.

### H. *Testability:*

The effort required to test a program to ensure that it performs its intended function.

### I. *Portability:*

The effort required to transfer the program from one hardware and software system environment to another.

### J. *Reusability:*

The extent to which a program can be reuse in another application related to the packaging and scope of the functions that the program performs.

### K. *Interoperability:*

The effort required to couple one system to another.

SQA team serves to emphasize three important points:

- Software requirement: They are the foundation from which the quality is measured.

- **Specified Standards:** a set of development criteria that guide the manner in which software is generated. If the criteria are not followed, lack in quality will surely result.
- **Implicit requirements:** Implicit requirements represent the desire for ease of use and good maintainability. If software conforms to its explicit requirements but fails to meet implicit requirements, software quality is suspected.

The purpose of SQA is not only to maintain the final product but it is used in every phase of Software Development life Cycle so that to check the quality of intermediate also, ultimately team members are interested in delivering the quality product.

### III. SOFTWARE QUALITY SYSTEM

The system which possesses the factors of quality is called software quality system. It is also known as Quality Management System. It is consisted of managerial structure, responsibilities, activities and resources to ensure that the acquired software should have the desired quality. Software Quality System has the following activities:-

- Reviews of the qualities of projects
- Developing skill set of staff
- Developing standards and procedures and guidelines

#### A. Standards:

A standard is instruction of how a project document or program code is to be displayed.

#### B. Procedures:

A procedure is a step-by-step set of instructions describing how a particular software activity is to be carried out.

#### C. Guideline:

A guideline consists of advice on best practice.

### IV. SOFTWARE QUALITY ASSURANCE METHODOLOGIES:

SQA encompasses the entire software development process, which includes processes such as requirements definition, software design, coding, source code control, code reviews, software configuration management, testing, release management, and product integration. SQA is organized into goals, commitments, abilities, activities, measurements, and verifications [6]. Quality assurance is concerned with the consistency, readability, usability, maintainability, reliability and other attributes of the completed system and the work products produced throughout the project life cycle. Quality is assured through multiple review points with the customer to identify errors, inconsistencies, misunderstandings and omissions in each interim work product.

#### A. Peer Reviews:

Peer reviews are internal reviews conducted on products prior to external formal customer reviews. Peer

reviews are conducted on all deliverable documents and plans as well as selected units of source code and system user interface screens. Peer reviews are conducted using a review checklist specific to the type of product being reviewed. Once a product has been reviewed, corrections are made and a remedial or follow-up review is conducted[4]. After the reviewer evaluates the product as “Accepted” it can then be reviewed by the customer and prepared for submission to configuration management as the latest baseline of the product. Review can be formal or informal. Informal reviews are referred as walkthrough and formal as Inspection.

1) *Walkthrough:* Method of conducting informal group/individual review is called walkthrough, in which a designer or programmer leads members of the development team and other interested parties through a software product, and the participants ask questions and make comments about possible errors, violation of development standards, and other problems or may suggest improvement on the article, walkthrough can be pre planned or can be conducted at need basis and generally people working on the work product are involved in the walkthrough process. The Purpose of walkthrough is to: - Find problems - Discuss alternative solutions - Focusing on demonstrating how work product meets all requirements.

2) *Inspection:* An inspection is a formal, rigorous, in-depth group review designed to identify problems as close to their point of origin as possible. Inspection is a recognized industry best practice to improve the quality of a product and to improve productivity, Inspections is a formal review and generally its need is predefined at the start of the product planning. The objectives of the inspection process are to

- Find problems at the earliest possible point in the software development process.
- Verify that the work product meets its requirement
- Ensure that work product has been presented according to predefined standards
- Provide data on product quality and process effectiveness
- Inspection advantages are to build technical knowledge and skill among team members by reviewing the output of other people
- Increase the effectiveness of software testing.

#### B. Testing based QA Methods:

1) *Black box testing:* not based on any knowledge of internal design or code. Tests are based on requirements and functionality.

2) *White box testing:* based on knowledge of the internal logic of an application’s code. Tests are based on coverage of code statements, branches, paths, conditions

3) *Unit testing:* the most ‘micro’ scale of testing; to test particular functions or code modules. Typically done by the programmer and not by testers, as it requires

detailed knowledge of the internal program design and code. Not always easily done unless the application has a well-designed architecture with tight code; may require developing test driver-modules or test harnesses

4) *Incremental integration testing*: continuous testing of an application as new functionality is added; requires that various aspects of an application's functionality be independent enough to work separately before all parts of the program are completed, or that test drivers be developed as needed; done by programmers or by testers

5) *Integration testing*: testing of combined parts of an application to determine if they function together correctly. The 'parts' can be code modules, individual applications, client and server applications on a network, etc. This type of testing is especially relevant to client/server and distributed systems

6) *Functional testing*: black-box type testing geared to functional requirements of an application; this type of testing should be done by testers. This doesn't mean that the programmers shouldn't check that their code works before releasing it (which of course applies to any stage of testing)

7) *System testing*: black-box type testing that is based on overall requirements specifications; covers all combined parts of a system

8) *End-to-end testing* : similar to system testing; the 'macro' end of the test scale; involves testing of a complete application environment in a situation that mimics real-world use, such as interacting with a database, using network communications, or interacting with other hardware, applications, or systems if appropriate

9) *Sanity (Smoke) testing*: typically an initial testing effort is made to determine if a new software version is performing well enough to accept it for a major testing effort. For example, if the new software is crashing systems every 5 minutes, bogging down systems to a crawl, or corrupting databases, the software may not be in a 'sane' enough condition to warrant further testing in its current state

10) *Regression testing*: re-testing after fixes or modifications of the software or its environment. It can be difficult to determine how much re-testing is needed, especially near the end of the development cycle. Automated testing tools can be especially useful for this type of testing

11) *Acceptance testing*: final testing based on specifications of the end-user or customer, or based on use by end-users/customers over some limited period of time

12) *Load testing*: testing an application under heavy loads, such as testing of a web site under a range of loads to determine at what point the system's response time degrades or fails.

13) *Stress testing*: term often used interchangeably with 'load' and 'performance' testing. Also used to describe such tests as system functional testing while under unusually heavy loads, heavy repetition of certain

actions or inputs, input of large numerical values, large complex queries to a database system, etc.

14) *Performance testing*: term often used interchangeably with 'stress' and 'load' testing. Ideally 'performance' testing (and any other 'type' of testing) is defined in requirements documentation or QA or Test Plans

15) *Usability testing* : testing for 'user-friendliness'. Clearly this is subjective, and will depend on the targeted end-user or customer. User interviews, surveys, video recording of user sessions, and other techniques can be used. Programmers and testers are usually not appropriate as usability testers

16) *Install/Uninstall testing*: testing of full, partial, or upgrade install/uninstall processes

17) *Recovery testing*: testing how well a system recovers from crashes, hardware failures, or other catastrophic problems

18) *Failover testing*: typically used interchangeably with 'recovery testing'

19) *Security testing*: testing how well the system protects against unauthorized internal or external access, willful damage, etc; may require sophisticated testing techniques

20) *Compatibility testing*: testing how well software performs in a particular hardware/software/operating system/network/etc. environment

21) *Exploratory testing*: often taken to mean a creative, informal software test that is not based on formal test plans or test cases; testers may be learning the software as they test it

22) *Ad-hoc testing*: similar to exploratory testing, but often taken to mean that the testers have significant understanding of the software before testing it

23) *Context-driven testing*: testing driven by an understanding of the environment, culture, and intended use of software. For example, the testing approach for life-critical medical equipment software would be completely different than that for a low-cost computer game

24) *User acceptance testing*: determining if software is satisfactory to an end-user or customer

25) *Comparison testing*: comparing software weaknesses and strengths to competing products

26) *Alpha testing*: testing of an application when development is nearing completion; minor design changes may still be made as a result of such testing. Typically done by end-users or others, not by programmers or testers

27) *Beta testing*: testing when development and testing are essentially completed and final bugs and problems need to be found before final release. Typically done by end-users or others, not by programmers or testers

28) *Mutation testing*: a method for determining if a set of test data or test cases is useful, by deliberately introducing various code changes ('bugs') and retesting with the original test data/cases to determine if the 'bugs'

are detected. Proper implementation requires large computational resources

## V. CONCLUSION

From this paper we can conclude that giving explicit attention to characteristics of software quality can lead to significant savings in software life-cycle costs. Software quality assurance (SQA) is a planned and systematic pattern of actions necessary to provide adequate confidence that a software product conforms to requirements during software development. SQA consists of methodologies and techniques of assessing the software development processes and methods, tools, and technologies used to ensure the quality of the developed software. SQA is typically achieved through the use of well-defined standard practices, including tools and processes, for quality control to ensure the integrity and reliability of software. The current software state-of-the-art imposes specific limitations on our ability to automatically and quantitatively evaluate the quality of software. We believe that the study reported in this paper provides a clear, well-defined framework for assessing the often slippery issues associated with software quality, via the consistent and mutually supportive sets of definitions, distinctions, guidelines.

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# A Survey on Improvements in Classical Apriori Algorithm

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**Abstract-** Exploring Frequent Itemset has been considered an important task in Data Mining Research. Apriori algorithm is one of the most promised algorithms for frequent item set mining. Idea behind this algorithm is to find hidden patterns between datasets for developing Association Rules. A Number of efforts have been done in field of frequent itemset mining for improvement of this algorithm as the simple version has many drawbacks. There are efficient methods for generating Association Rules from large databases. This paper describes methods for frequent itemset mining and further various improved approaches in the classical algorithm Apriori for frequent item set generation which will be useful in developing new Apriori based algorithms.

**Keywords-** Association Rules, Apriori Algorithm, Frequent Itemset Mining

## I. INTRODUCTION

Data Mining is an analytic process designed in order to explore data to find out consistent patterns and relationships between variables and further applying detected patterns to new datasets so as to validate the findings. Data mining is basically to extract hidden predictive information from large databases and it helps organizations to focus them on most important information of their warehouses. Databases are increasing at high rate in the fields like business, sports, education, finance and IT etc .It is better to read only wanted data as there is huge database for a particular user who is just looking for just a particular pattern not for complete data in the database. Basically the wanted data and other advantage using data mining technique is that only useful pattern may be explored from large database with in less time. As there are large databases, the need of extracting efficient pattern from database is increased for better results. Association rule mining using apriori algorithm is utilized for this purpose [1][2].

This paper is organized as follows. In section II Association Rule Mining has been discussed. In section III Apriori algorithm is presented. In section IV various improvements in Apriori are pointed giving direction to emerging researchers and section V gives a conclusion of the paper.

## II. ASSOCIATION RULES

Association rule mining is a popular and well researched method for finding out interesting and valid relations between variables in large databases. Association Rule mining techniques is applied to the records in order to

discover the patterns that are likely to cause high severity defects [3]. The discovered patterns are then helpful to predict the subsequent actions that may result in high severity defects. The concept of association in mining software engineering data is based on set of strong rules. The computational cost of association rules mining in software development can be reduced by reducing the number of passes over the database, sampling the software database, adding extra constraints on the structure of patterns, through parallelization [4]. Association rules are used to uncover relations between abundant unrelated data in a relational database. Association rules are based on two basic things support and confidence. Support is the number of transactions in which the association rule holds [5]. The aim of association rule is to discover all relationships problems having support and confidence not less than the given value of threshold. Any item set is in frequent item set if the support and confidence of that item set of database is more than minimum support and confidence. The problem of finding the Association Rules can be divided into two parts:

- A. *Find all frequent item sets:* Frequent item sets will occur at least as frequently as a pre-determined minimum support count i.e. they must satisfy the minimum support.
- B. *Generate strong association rules from the frequent item sets:* These rules must satisfy minimum support and minimum confidence values.

## III. APRIORI ALGORITHM

There are different algorithms implemented for finding out association rules. The first algorithm for mining all frequent itemsets and strong association rules was the AIS algorithm by [6]. After that, it was improved and named Apriori. Apriori algorithm is the most basic and useful algorithm for mining frequent itemsets. It is based on simple fact that any subset of a large itemset is large and any subset of frequent item set must be frequent. Apriori works on iterative approach known as breath-first search in which k-1 item set are utilized to obtain k item sets. Two main steps that Apriori uses are join and prune. The candidates are produced by joining the frequent item sets in each level and discard items set if support is less than minimum threshold or if its subset is not frequent. It is clear that apriori algorithm successfully provides the needed frequent items from the database. As the size of the

database increase with the number of items, search space need and I/O cost will increase. Database scan increases as results, candidate generation will increase which further increases computational cost. A number of variations have been performed in the apriori algorithm to cut down the above drawbacks which occur because of tremendous increase in size of database. These subsequently proposed algorithms adopt for almost similar scan of database which is also level-wise as in apriori algorithm, while the approaches regarding generation of candidate and pruning, support counting and representation of candidate may differ. The algorithm can be improved further by reducing passes of transaction database scan, shrinking number of candidate, facilitate support counting of candidates. It will result in improving efficiency and reducing complexity of Apriori.

#### IV. IMPROVEMENTS IN APRIORI

##### A. *Distributed Apriori Association Rule:*

Distributed data mining systems are helpful in providing efficient use of multiple processors and databases which results increasing the execution time of data mining and also enable data distribution [7]. Grid computing is used to give organizations and developers the ability to create distributed computing platform that can utilize computing resources whenever needed. Therefore, it reduce the cost of computing networks by decreasing data execution time, optimizing resources and distributing workloads and speed up efficiencies thus allowing users to get faster results on huge database operations at very low costs. The database is mined using distributed apriori association rule on which is based on grid environment and the knowledge obtained is interpreted and we can compare classical apriori with distributed apriori.

##### B. *Improving set size frequency:*

To neglect non significant candidate keys the improved algorithm introduces issues such as size of item set and set size frequency .These issues can reduce candidate keys in effective way. The modified algorithm for apriori takes for the set size which is simply the count of items in any transaction and set size frequency. It is basically number of transactions having at least set size items. Initial database is given with size of set and next database is of set size frequency of the previous database. Removing the items which having frequency less than the minimum support value initially and determine initial set size to get the highest set size whose frequency is greater than or equal to minimum support of set size[8]. Set size are discarded having value not greater than or equal to minimum set size support. Ideal start size of the combination size required for pruning candidate keys is not given which is one of the short coming of this approach.

##### C. *Optimization using Ant Colony Optimization:*

ACO was first introduced by Dorigo, there after evolved significantly in the last few years. Many organizations have collected massive amount data which is stored on storage database systems. Problems such as reducing unwanted attributes and objects so as to get the minimum subset of attributes ensuring a better

approximation of classes and good quality of classification arise in the analysis and study of the information systems. Another, representing the information system in form of decision table which provides dependencies among minimum subset of attributes and particular class numbers without repetition of data. ACO can solve numerous hard optimizations such as the travelling salesman problem. It contains two rules, local pheromone update rule which is used in constructing solution and global pheromone update rule which is helpful in ant construction. ACO algorithm includes two more mechanisms, namely trail evaporation and optionally deamonactions.ACO algorithm is helpful in the specific problem of reducing the number of association rules [9]. Apriori algorithm is provided with transaction data set and uses a user interested value of confidence and support which gives the association rule set. These association rule set is discrete therefore, weak rule set are required to prune the items.

##### D. *Memory Utilization in Apriroi:*

Memory utilization can be achieved by efficient pruning operation. The improved algorithm only needs to search Lk-1 one time to complete the deletion and the remaining of each element X in candidate key list. Ik used to represent k-dimensional itemset. If the number of (k-1)-dimensional subsets of all (k-1)-dimensional frequent itemset Lk-1, which contains Ik, is less than k, then Ik is not a k-dimensional frequent itemset. So the given algorithm just needs to match up the count of each element of Lk-1with the count of every element (X) of candidate key list. If the number of the element X equals to k, X is kept otherwise, X is deleted. I/O speed can be increased by neglecting the transaction records which are of no use. The item that is not found in Lk-1 will no longer be seen in Lk. Thus we can revise all items to null in the transaction dataset. Then we can pay no attention to these data information in any search work to D. Side by side delete the transaction records of which the number of valid data is less than k which helps in reducing the dataset which is our main goal[10]. Then the candidate set Ck is generated by latest D. The deletion of D will affect the number of transaction records which results in boosting the speed of the algorithm. At the end, efficiency and I/O speed of algorithm is upgraded.

##### E. *Bottom-up Approach Based Apriori:*

Apriori can be implemented by using Bottom up approach using reduced transactions and matrix. The proposed algorithm composed of two phases named Probability Matrix Generation and bottom up approach to find bigger item sets. In initial phase, for he given dataset, an Initial matrix M1 is generated. Rows represent transaction and Columns represent items. Each position in matrix is given the value either 0 or 1 according to presence or absence of item in particular transaction. Matrix M2 is generated from M1 based on probability where entry value of 1will is replaced by the probability of occurrence of corresponding item to the total number of transactions and two more columns are added to the M2 which are used store the total probability and count of elements in each row. Then M2 will be arranged in descending order of

Total Probability which leads to the formation of Sorted Probability Matrix M3 [11]. In second phase, non-zero entries in Sorted Probability Matrix will be replaced by 1 to the generate Sorted Probability Matrix M4. Select first transaction from M4 and compare its total probability and count with next transaction total probability and count respectively. If the current transaction total probability and count greater than the next transaction probability then AND operation is performed between the transactions, increase the support count of first transaction item set by 1 if the resultant is equal to first transaction structure. This process is repeated till it satisfies the condition of first transaction total probability, count is less than or equal to next transaction further checks the total support count if its greater than the required support count extract the item set of that transaction and all its subset and move it to frequent item set until it finds unseen transaction in the given data set. In the end it will reduce the complexity.

#### F. Attribute Utilization:

Tanagra Tool is used for finding frequent item set by applying apriori algorithm on given dataset. Difficulty in finding out all association rules which satisfy minimum support and confidence thresholds given by users. Study shows that Association rule mining face several problems like it only tells whether item is present in database or absent. Treating all present or absent items equally is also big problem[12]. Prior algorithm does not consider importance of item to user or business perspective and it fails to associate frequent items with objectives related to user and business. These short coming can be tackled by using new attributes such as profit, quality and frequency of items which will give important information to user and business.

#### G. Transaction Reduction:

Method proposed to improve the efficiency of apriori Algorithm using Transaction Reduction [13]. Classical apriori Algorithm generates a large set of Candidate sets depending upon the size of dataset. Modified apriori cuts the size of dataset which leads to reduced I/O cost. A new attribute Size of Transaction has been used which stores number of items in individual transaction in database. Transaction will be deleted according to the values of pass number. For any value of pass number, algorithm searches for the same value in database, when size of transaction is equal to pass number, that particular transaction is removed from database accordingly. In this way performance of apriori algorithm is improved by mining associations from huge database faster and in more efficient manner.

### V. CONCLUSION

In most of the apriori based algorithms the main aim is to get all frequent items by generating smaller candidate key set. The paper presented most recent and effective work done in the field of finding association rules using different versions of apriori such as transaction reduction and use of matrix in apriori. The methods and approaches which are used for improving the classical algorithm are explained and further can be taken up to next level using two or more approaches in combination. There is still scope of

advancement in the apriori algorithm. A number of improvements are needed basically on pruning step in apriori so as to increase efficiency of algorithm. The optimization related frequency of items in database is also a bright area to work on for future researchers.

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# UML Class Model Comparison using Database Approach

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**Abstract**—Programming languages in isolation cannot provide static aspects and dynamic aspects, so models are created using modeling languages during the development cycle of software. As the model keeps on changing it becomes important to study the changes to understand the current state. Change documentation of software is not enough to study the changes in versions of software. This paper presents the approach for UML class model comparison. This technique can extract out syntactical similar and different elements of two class models. Related work in the field of model comparison has been highlighted in this paper. The areas of research where this model comparison technique can be utilized have also been presented.

**Keywords**—Class model, UML, Model Comparison

## I. INTRODUCTION

Model Driven Engineering is the new approach becoming prevalent in software engineering industry where software is developed during development cycle using software models [3]. Models are designed to visualize the structure of the software the company desires. The static and dynamic view of software provided by models helps to create good quality software. Modeling languages helps to specify the system requirements, structure and behavior of the system for better understanding [9]. UML (Unified Modeling Language) is the modeling language specified by OMG (Object Management Group) to specify, visualize, interpret, organize and document the software system to be developed by the organization [14], [17]. OMG introduced the concept of MDA (Model Driven Architecture) through which design model can be transformed into executable source code [7].

Software system undergoes changes with time, to adapt new emerging technologies in the market. To fulfill the current demand, it becomes important to bring the new technological innovation as early as possible. To save the time it is important for software developer to analyze the already existing software and enhance the current features. Existing modern programming concepts support reuse but do not implement model changes and model evolution [6]. Model Evolution is the list of changes the model undergoes from existing to reach the current version [19]. Documentation about the changes helps to analyze the model for model evolution but this approach of model evolution does not provide accurate results [13]. Work has been done to extract out the similarities and differences of the versions through model comparison techniques automatically. We will present the approach for UML class model comparison in this paper. The rest of the paper is

structured as follows. Section 2 presents the previous research. Section 3 describes the approach for model comparison and Section 4 discusses the application of UML class model comparison. Section 5 concludes the paper.

## II. RELATED WORK

This section provides an overview of some existing approaches for model comparison.

Ohst et.al [12] detected the differences in UML diagrams using the structurally object oriented DBMS known as H-PCTE. Model data of UML diagram is represented in H-PCTE using fine grained model. Meta model of fine grained model containing all the details is used for comparison of differences. The differences are detected by traversing the spanning tree of the object graph. 2-way differences are represented using different colors.

Xing and Stroulia [18] take as input the two class models obtained by reverse engineering the two code versions of Java software to UML Diff algorithm for the detection of the differences between the UML models. UML Diff algorithm outputs the structural changes pointing the changes to the attributes of classes, relationship between the classes, insertion, deletion, moving and renaming of packages, classes, interfaces model elements based on the similarity of their names and structure. The tool presents the results to the user as a tree of structural changes in an Eclipse tree view.

Stephan and Cordy [11] surveyed the existing techniques for the comparison of the multiple types of models, behavioral or data flow models and structural models on the basis of specific approach/tool used for comparison matching strategy used for comparison and the area of application of these techniques such as model versioning and model merging.

Petri Selonen [15] summarized the five comparison approaches, each differ with the methodology for comparison and support different tool. The model comparison technique accuracy and precision is evaluated by taking the real world examples.

## III. OUR APPROACH

The basic approach followed for comparison of two class models is summarized below:

- First, the UML class models are modeled using the Magic Draw CASE tool.

- Then the UML class models are exported to the standardized XMI file format using the built in facilities Of Magic Draw CASE tool.
- The XMI files of both class models are then exported to MS access database using Altova XML Spy 2011.
- The MS Access Database is transformed to SQL Database using MySQL Migration Tool.
- Then comparison algorithm for comparison of both class models is implemented using Netbeans IDE 6.0
- At last GUI report is generated showing the details of similarities and differences in terms of classes, attribute, operations, association and generalization relationship of the two class models. Fig1 shows the methodology for model comparison.

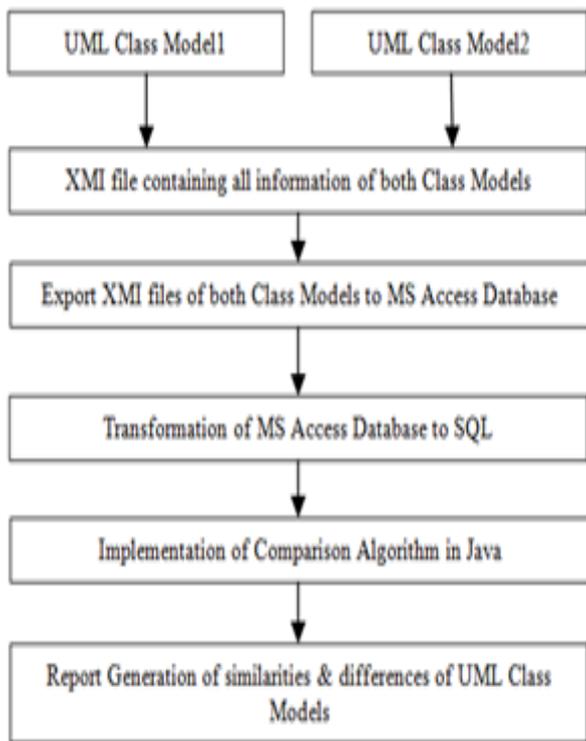


Fig.1. Methodology for Model Comparison

Model Comparison extract out the similarities and differences in terms of matched and unmatched classes and relationship in response to input class model [10]. The two elements in the two class models are similar if they represent similar concept and the two elements differentiate if they do not represent same concept.

The generic approach for class model comparison:

1. Extract out the relevant elements for comparison from the class models.
2. Represent the extracted out elements of class model in data structure for comparison.
3. Compare the class models and output the similarities and differences of the class models after comparison.

Fig 2 shows the generic approach for model comparison.

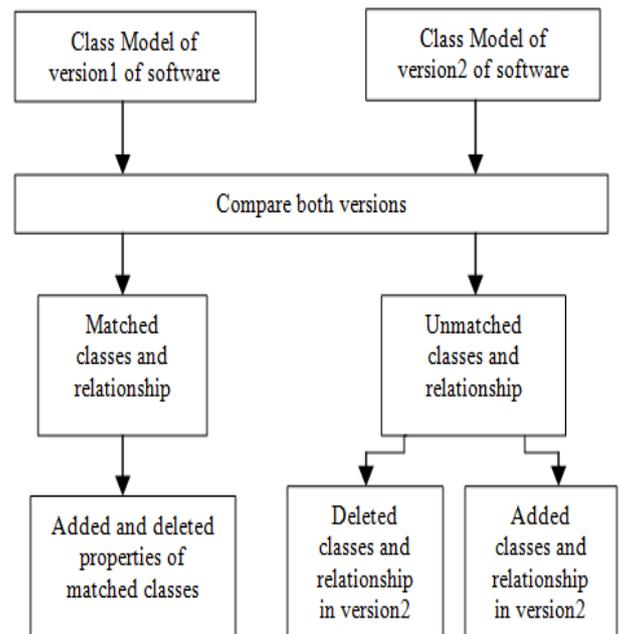


Fig.2. Approach for Model Comparison

#### IV. ALGORITHM

Class model consists of various classes, attributes, operations, generalizations and association relationship. So to compare two class models we have to choose granularity for comparison. We have chosen class as granularity for comparison, and then we proceed for comparing attributes, their data type, operations and their return type.

The algorithm used is explained below

1. while (class! =null)
2. if(classname1= = classname2)
  - goto step3
  - goto step7
  - else
  - class doesnot match
3. while(attribute!=null)
4. if (attributename1= = attributename2)
  - goto step 7
  - else
  - attribute not matched
5. if (datatype1= = datatype2)
  - datatype matched
  - else
  - datatype not matched
6. while(operation!=null)
7. if(operationname1= = operationname2)
  - goto step8
  - else
  - operation not matched
8. if (returntype1= = returntype2)

returntype matched  
else  
returntype not matched

### V. CASE STUDY

Results of the model comparison approach have been shown with the help of case studies. The relevant information of the class models is stored in sql tables [16] and is input to the comparison algorithm. The model comparison algorithm generates output showing the GUI report in the terms of matched, added and deleted elements of the class models. Fig3 and Fig4 show the class models of version1 and version 2 of college management system respectively.

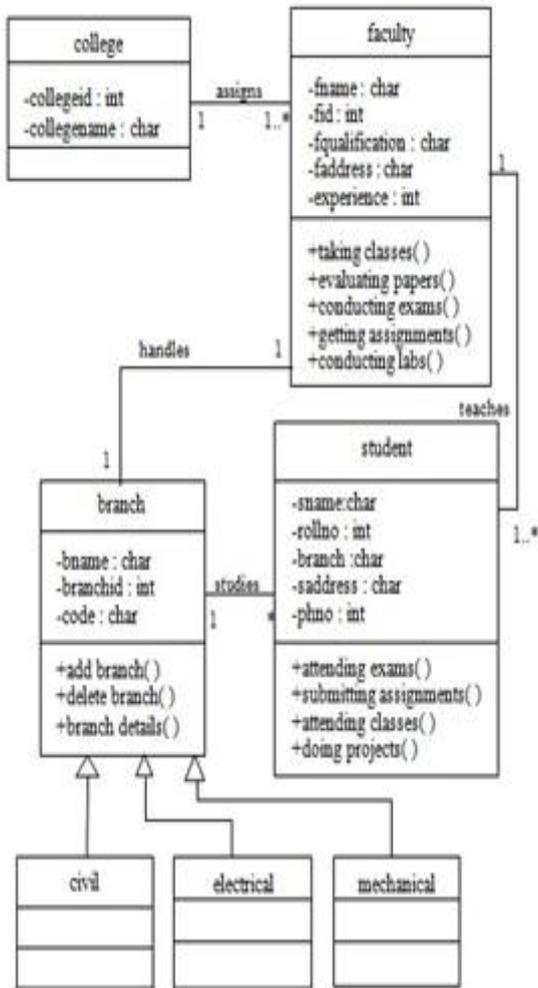


Fig.3. College management class model1

The elements of class models selected for comparison are:

- Classes
- Attributes and their data type
- Operations and their return type
- Operations parameter and their return type
- Association relationship between classes
- Generalization relationship between classes

Table 1 summarizes the results of Fig 3 and Fig 4 of college management system.

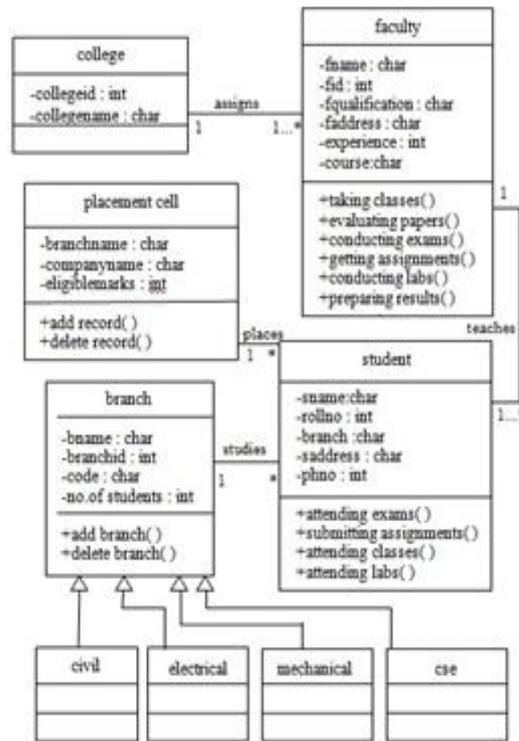


Fig.4. College management class model2

TABLE I. Results of Comparison of College Management System

S.No	Elements for class model comparison	Value
1	Total matched classes	7
2	Total classes added	2
3	Total classes deleted	0
4	Total no.of attributes matched in corresponding class	14
5	Total no.of attributes added in corresponding class	2
6	Total no.of attributes deleted in corresponding class	1
7	Total no.of methods matched in corresponding class	10
8	Total no.of methods added in corresponding class	2
9	Total no.of methods deleted in corresponding class	2
10	Total no.of generalisation relationship matched	3
11	Total no.of generalisation relationship added	1
12	Total no.of generalisation relationship deleted	0
13	Total no.of association relationship matched	3
14	Total no.of association relationship added	1
15	Total no.of association relationship deleted	0

### VI. APPLICATION

Model comparison technique is used in following areas:

#### A. Model Merging

Model merging is defined as extracting out the similarities and dissimilarities from the two versions of

models and grouping together the information from several models into a single model [1]. For finding out the overlapping and contradicting information of two models, model comparison techniques are used.

### B. Model Clone Detection

Model clones are similar fragments replicated by programmers at several locations to reduce the effort and time for the development of software [8]. To detect the clones in models, model comparison techniques can be used [2].

### C. Model Transformation Testing

Model comparison is prerequisite for the model transformation testing to test whether the source model has been transformed into target model [4]. Expected model after transformation is compared with actual outcome of transformation.

### D. Model Versioning

Model comparison helps to analyze the evolution of models from the point of view of their logical design [20]. Through this we can maintain the records of changes the software has gone.

## VII. CONCLUSION

In this paper we have presented an approach for syntactic comparison of class models, through which a model can be analyzed automatically for comparison and saves time of the programmers. It compares the two class models and outputs the similar and different elements of the input class models by transforming UML class models into database and then applying the comparison algorithm developed in java. This technique can be applied in other fields such as model transformation testing, software model evolution etc.

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# Web Data Security in E-commerce Against Various Vulnerabilities

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**Abstract-E-commerce Security is a part of the Information Security framework and is specifically applied to the components that affect E-commerce that include Computer Security, Data security and other wider areas of the Information Security framework. E-commerce security has its own particular touch and is one of the highest visible security components that affect the end user through their daily payment interaction with business. E-commerce security is the protection of E-commerce assets from unauthorized access, use, alteration, or destruction. E-Commerce offers the banking industry great opportunity, but also creates a set of new risks and vulnerability such as security threats. Information security, therefore, is an essential management and technical requirement for any efficient and effective Payment transaction activities over the internet. Still, its definition is a complex Endeavour due to the constant technological and business change and requires a coordinated match of algorithm and technical solutions. In this paper, e-commerce and its dimensions of security are described. Various issues and threats are explored. It is obvious that E-commerce will continue to grow in spite of barriers and rising threats.**

**Keywords-E-commerce, Security Issues, Threats, Cross Site Scripting, SQL Injection**

## I. INTRODUCTION

### A. E-commerce

E-commerce security is a part of the information security framework and is specifically applied to the components that affect E-commerce that include computer security, data security and other wider sphere of the information security framework. E-commerce plays vital role in today's business, and that will continue to grow in future. With the development of information technology and communication technology and the popularization of the Internet, E-Commerce is sweeping through all walks in world with an irreversible trend[1]. E-commerce security has its own particular variations and it is one of the highest visible security components that the end user through their daily payment interactions with business. Privacy and security are major concern for electronics technologies. With the development of information technology and communication technology and the popularization of the internet, E-commerce holds many advantages for the commercial world , For example efficiency and convenient and also unfortunately have some disadvantages as security issues are emerging and have become the bottleneck of E-commerce development. E-commerce will not be successful without protecting the consumers' right especially in the area of information security. The downside to this is that while online, all Internet-based electronic commerce is vulnerable to

misuse either by unauthorized users penetrating the system or by authorized users abusing their privileges [2]. Privacy concern reveals a lack of trust in the variety of contexts, including commerce, electronic health records, e-recruitment technology and social networking, and which directly influence users. Security is one of the principal and continuing concerns that restrict customers and organizations engaging with E-commerce [3]. Web E-commerce applications that handle payments have more compliance issues, are at increased risk from targeted than other websites and there are greater consequences if there is data loss or alterations. Online shopping through shopping websites having certain steps to buy a product with safe and secure .The E-commerce industry is slowly addressing security issues on their internal networks. Trojan horse programs launched against client systems pose the greatest threat to e-commerce because they can bypass most of the authentication and authorization mechanisms used in an e-commerce transaction.

### B. Dimensions of security

E-commerce security is the protection of e-commerce assets from unauthorized access, use, alteration, or destruction. While security features do not guarantee a secure system, they are necessary to build a secure system. Security features categories:

- **Authentication:** Verifies who you say you are. It enforces that you are the only one allowed to logon to your Internet banking account.
- **Authorization:** Allows only you to manipulate your resources in specific ways. This prevents you from increasing the balance of your account or Encryption: Deals with information hiding. It ensures you cannot spy on others during Internet banking transactions.
- **Auditing:** Keeps a record of operations. Merchants use auditing to prove that you bought a specific merchandise.
- **Integrity:** prevention against unauthorized data modification
- **Non repudiation:** prevention against any one party from reneging on an agreement after the fact
- **Availability:** prevention against data delays or removal.

## II. SECURITY THREATS

E-Commerce security requirements can be studied by examining the overall process, beginning with the consumer and ending with the commerce server.

Considering each logical link in the “commerce chain”, the assets that must be protected to ensure secure e-commerce include client computers, the messages travelling on the communication channel, and the web and commerce servers, including any hardware attached to the servers. While telecommunications are certainly one of the major assets to be protected, the telecommunications links are not the only concern in computer and E-commerce security[4,5].

#### A. Client Threats

Table I Client threats with their definitions

Threats	Definition
1.Active Threats	Java applets, JavaScript, and VBScript are programs that interpret or execute instructions embedded in downloaded objects from a Web/commerce server.
2. Malicious codes	Computer viruses, worms and Trojan horses are examples of malicious Code.
3. Server Side Masquerading/Spoofing	Sending a message that appears to be from someone else. Impersonating another user at the —name(changing the—Fromfield) or IP levels (changing the source and/or destination IP address of packets in the network)

#### B. Communication Channel Threats

Table. II Communication channel threats and their definitions

THREATS	DEFINITION
Confidentiality	It is the prevention of unauthorized information disclosure. It requires sophisticated physical and logical mechanism to implement. Theft of sensitive or personal information (e-mail address, credit card number) is a significant danger in e-commerce
Integrity	Also known as active wiretapping. Unauthorized party can alter data such as changing the amount of a deposit or withdrawal in bank transaction over the Internet. A hacker can create a mechanism such that all transactions from a Web site redirects to a fake location
Availability or Necessity threats	Also known as delay or denial threats. The purpose of availability threats is to disrupt normal computer processing or to deny processing entirely.

#### C. Server-Side Threats

Table III. Server side threats and their definitions

THREATS	DEFINITION
Web Server	The more complex a Web server software becomes, the higher the probability that errors exist in the code - security holes through which hackers can access
Commerce Server	It responds to requests from web browsers through HTTP protocol and CGI scripts.

Database	E-commerce systems store user data and retrieve product information from databases connected to the web-server. If someone obtains user authentication information, then he or she can reveal private and costly information
Communication Gateway Interface(CGI)	CGIs are programs that present a security threat if misused. CGI programs can reside almost anywhere on a Web server and therefore are often difficult to track down
Password Hacking	The simplest attack against a password-based system is to guess passwords. Guessing of passwords requires access to the complement, the complementation functions obtained.

### III. COMMON VULNERABILITIES

#### A. SQL Injection

SQL injection is a phenomenon with which malware author insert SQL characters in field of user input. Through which that queries are executed at the back-end of database. If the e-commerce website is vulnerable to such attacks, they have the power to attack even the restricted areas of website. Depending upon the knowledge of the attacker, they may steal sensitive data viz. credit card numbers, transaction details, etc. The tendencies of getting such an attack via log in page are common.

#### B. Price Manipulation

This is vulnerability where the total payable price of the goods purchased is stored over a hidden HTML field, which is dynamically generated by web page. With use of some tools, the modification of payable amount is changed.

#### C. Cross-site Scripting

It is because of lack of proper input/output validation by the web application that such circumstances are faced by the websites driving commerce. The forms which are present on such website which are basically for feedback or suggestion about the products, here the malware author can induce his own content and make a whole new script running on the victim’s system. This way they steal sensitive information and session ID’s. It leads to stealing credential of users again.

#### D. Weak Authentication and Authorization

The Authentication mechanisms are simple criteria to breach into the target system by malware authors. Some of system which does not limit the failed login often gets to face the circumstances of stealing away the credentials of users or even sometimes leading to fake online purchase being some other person. This way there is huge risk to authentic user’s credentials[2].

### IV. RELATED WORK

#### A. Sql Injection:

Debabrata Kar [6] proposed a lightweight approach to prevent SQL Injection attacks by a novel query transformation scheme and hashing in which SQL queries

are converted into their structural form and then applying MD5 hashing to generate unique hash keys for each legal query collected during normal use. This approach minimizes the size of the legitimate query repository and facilitates fast and efficient searching at run-time using a primary index. This approach does not require major changes to application code and has negligible effect on performance even at higher load conditions due to low processing overhead. Experimental results show that this approach can effectively prevent all types of SQL injection attempts except second order SQL injection which can be researched in future.

Srinivas Avireddy [7] proposed a solution to the problem of SQL injection by preventing it using an encryption algorithm based on randomization. It has better performance and provides increased security in comparison to the existing solutions. Also the time to crack the database takes more time when techniques such as dictionary and brute force attack are deployed.

Liban [8] enhanced SQL-injection vulnerability scanning tool for automatic creation of SQL-injection attacks (MYSQL Injector) using time-based attack with Inference Binary Search Algorithm. It considers four types of blind SQL injection attacks, true/false, true error, time-based and order by attacks. This tool will mechanize the process of the blind SQL injection attacks to check the blind SQL injection vulnerability in the PHP-based websites that use MySQL databases. They tested 44 susceptible websites and 30 non susceptible websites to make sure the accuracy of the tool. The result shows 93% accuracy for detecting the vulnerability while MySQL injector performs 84%.

- Denial Of Service

Yan[9] introduced Notified Credit Card Payment System (NCCPS) that provide a unified Web service for Merchants to request for credit card payment, instead of using different protocols developed by different banks. They show how to use the alert mechanism and Web service technologies to integrate a security credit card online payment system. The NCCPS further integrates with the customer service call center with the same platform. They explain the significance of the alert mechanism and how various technologies help.

- Cross Site Scripting

A.Monika [10] presents the initial client-side resolution called Noxes, to moderate XSS attacks. It works as a web proxy and utilizes both automatically and manually generated rules to block cross-site scripting attacks. it is the first client-side solution that provides XSS protection without relying on the web application providers. It supports mitigation mode of an XSS that appreciably decreases the count of relationship attentive prompts. Vibhakti Mate, Milind Tote, Abdulla Shaik [11] proposes client-side solution to the cross site scripting. we dynamically track the flow of sensitive values (e.g., user cookies) on the client side by modifying the web browser. Whenever such a sensitive value is about to be transferred to a third party(i.e., the adversary), the user is given the possibility to stop the connection. With this combination of dynamic and static techniques, protection is provided against XSS attacks in a reliable and efficient

way. They tested the enhanced browser on more than one million web pages by means of a crawler that is capable of interpreting JavaScript code. The results demonstrate that only a small number of false positives is generated.

- User Enumareation

Jyoti Chhikara Ritu Dahiya Neha Garg Monika Rani [12] paper gives brief information about phishing, its attacks, steps that users can take to safeguard their confidential information. This paper also shows a survey conducted by Netcraft on phishing after responses from over 630,790,500 web sites and concluded that Taobao draws the second highest number if phishing attacks next to Facebook.

## V. OPEN ISSUES AND FUTURE SCOPE

Many security solutions are available for different threats in e commerce but they do not work for every type of web applications so there is need to propose new algorithms or to combine various existing algorithms in order to provide security against all types Vulnerabilities in every application in E-commerce.

## VI. CONCLUSION

E-commerce is widely considered the buying and selling of products over the internet, but any transaction that is completed solely through electronic measures can be considered e-commerce. Many of the indicators promise a bright future for E-commerce. In essence, E-commerce has become a reality, and its prospects and capabilities do not stop at an end. In E-commerce, security, trust and privacy are very significant to achieve E-commerce success In this paper, e-commerce, various issues and threats of ecommerce are presented. various solutions to different threats are also discussed.

## ACKNOWLEDGMENT

I would like to thank almighty for his constant blessings. Then I would like to thank my teacher, family and friends for helping and supporting me throughout the making of this paper.

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# Efficiency Improvement of A-Priori Algorithm over Dense Databases

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**Abstract**— Data mining is a process that uses various data analysis tools to discover relevant pattern and correlations among data items. Association rule mining is a standout amongst the best methodology for data mining. A-priori is the classic algorithm of association rule, which finds the entire frequent item sets. This calculation when applied to dense data, its performance declines because of expansive number of examples. This review paper emphasis on the efficient building of association rules by generating rules in some way that is efficient in time and memory, thereby reducing the number of scans to enhance the searching of any data-item in the given data-set. This leads to improving the efficiency of A-priori algorithm.

**Keywords**—Data Mining, Association Rules, A-priori Algorithm, Efficiency Improvement, Methodology Choice

## I. INTRODUCTION

As Information Technology is developing nowadays, databases made by the associations like in the field of banking, marketing, telecommunication etc are getting to be immense and massive. To extract valuable data, databases need to be explored more completely and effectively. Data mining is characterized as the extraction of concealed predictive important data from far reaching databases or archives. The terms data mining and knowledge discovery and databases are utilized synonymously.

The principle point of this idea is to concentrate the meaningful connections and examples among the arrangement of things in database that would remain hidden otherwise and change it into a reasonable and justifiable structure for further utilize.

### A. Association Rule Mining

Association rules problems were first brought out by Aggarwal in 1993[1]. He find out all possible rules that help in capturing relations among data items in a transactional data base. Association rule mining is the methodology of discovering regular set with least support and confidence values. It has two parts “Antecedent” and “Consequent”.

For instance,

{bread} => {milk}.

Here bread is the antecedent and milk is the subsequent. The item that found in database is known as antecedent, and consequent is the thing that found in blend

with the first. During the search of frequent patterns, association rules are being generated.

Formal definition [3]: Let  $I = \{i_1, i_2, \dots, i_n\}$  be an arrangement of items. Let  $D$  be an arrangement of relevant data transactions where every transaction  $T$  is a situated of things such that  $T \subseteq I$ . A special TID is connected with every transaction. Let  $A$  be an arrangement of things. A transaction  $T$  is said to contain  $A$  if and if  $A \subseteq T$ . An association rule is ramifications of the structure  $A \Rightarrow B$ , where  $A \subset I$ ,  $B \subset I$ , and  $A \cap B = \text{invalid}$ .

There are two stages in the issue of data mining association rules.

- 1) Discover all frequent thing sets
- 2) Produce solid association rules from the frequent thing sets.

After the substantial thing sets are determined, the relating association rules can be determined in a generally clear way. Discovering regular sets with least support and confidence is the essential point of the algorithm.

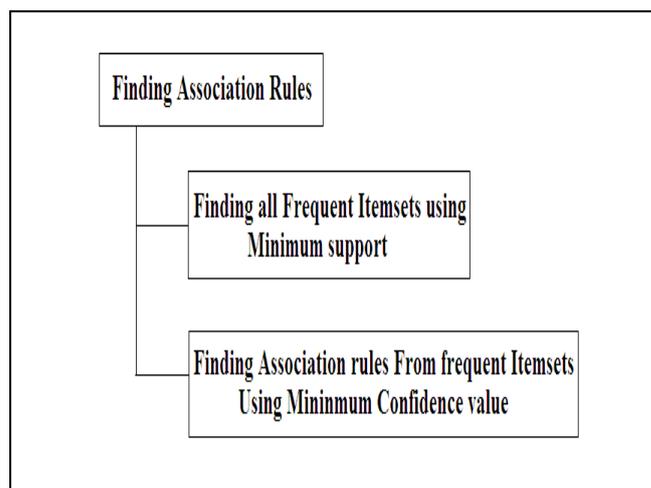


Fig 1: Generating Association Rules[9]

The center of this paper is to do literature review on the issue of efficiency of association rules by using A-priori algorithm. During the study we observed few review papers related to increasing the efficiency of algorithms for large amount of data. This review paper will help us to comprehend the current situation of research in improving efficiency of association rules. In this study, standard

journals related to efficiency improvement have been selected.

In this diverse methods are used to find the candidate items for frequent patterns but there are two primary issues with frequent pattern mining techniques. Initial one is that the database is to be scanned a number of times, and the other one is complex candidate generation process with too many candidate item set generated. These two issues are efficiency bottleneck in frequent pattern mining.

Our motivation of doing this review is to review the techniques for improvement of frequent pattern mining. This paper surveys the past work done on increasing the efficiency. This study shows the strengths and shortcomings of current approaches and tools available for increasing the efficiency.

For the improvement in efficiency of frequent pattern mining, many algorithms such as A-priori Algorithm, Partition algorithm, ant colony optimization, etc are utilized that further aides as a part of discovering helps frequent sets related with association rules. Here we are applying A-priori algorithm to the dataset to discover the frequent sets and with the assistance of the algorithm we are going to increase efficiency to find frequent item sets in least time.

This paper is organized in the following sections. In a section II, existing works related to review/survey of improving the efficiency of A-priori algorithm and improved and classical A-priori algorithms are mentioned briefly. In Section III, the concepts of A-priori Algorithm and association rules are described briefly. In section IV, survey on different upgrades of A-priori algorithm is shown. In Section V methodologies or tools to be adopted for the improvement of efficiency is explained. Section VI concludes the paper.

## II. RELATED WORK

In literature, the problem of efficient data has been addressed widely and several algorithms have been observed but out of them A-priori is most widely used algorithm in the history of association rule mining that uses efficient candidate generation process, such that large Item set generated at  $k$  level are used to generate candidates at  $k+1$  level[17]. On the other hand, it scans database multiple times as long as large frequent Item sets are generated. A survey had been done on all the improved algorithms and as per report, Gurneet Kaur[4] proposed an enhanced algorithm of association rules, the classical A-priori algorithm whose outcomes demonstrates that the enhanced calculation is sensible and compelling, can remove more profitable information[4]. One significant work found in the literature is performed by Rehab H. Alwa et al. [1] that has described a novel approach to improve the A-priori algorithm through the creation of Matrix- File that showed a very good result in comparison to the traditional A-priori algorithm. An idea is proposed by Shelly Ahuja et al. [8] that rule mining is a vital part of data mining. To discover regularities/patterns in data, the most effective class is association rule mining [8]. Mining has been used in many application domains. In this work,

an efficient mining based algorithm for rule generation is presented. By using A-priori algorithm we improve the precision and recall and F-measure value [8]. Dr. Kanwal Garg et al. [7] considers bank information and tries to get the outcome utilizing Weka an data mining instrument. In this paper author uses A-priori to find association rule. Here author consider three association rule algorithms: A-priori Association Rule, Predictive A-priori Association Rule and Tertius Association Rule. Author compares the result of these three algorithms and presents the result. As per the result obtained using data mining tool author find that A-priori Association algorithm performs better than the Predictive A-priori Association Rule and Tertius Association Rule algorithms [7]. Jaishree Singh et al.[5] proposed an Improved A-priori calculation which decreases the checking time by chopping down superfluous transaction records and lessen the redundant generation of sub-items during pruning the candidate item sets, which can structure specifically the arrangement of frequent item sets and take out applicant having a subset that is not frequent[5].

Goswami D.N., et al. [2] delivers in their paper three distinctive frequent pattern mining methodologies (Record channel, Intersection and Proposed Algorithm) are given taking into account traditional A-priori algorithm. In these methodologies, Record channel demonstrated better than traditional A-priori Algorithm, Intersection approach demonstrated better than Record channel and lastly proposed algorithm exhibited that it is much better than other successive example mining algorithm [2]. Jaio Yabing[4] proposed an enhanced calculation of association rules, the established A-priori calculation. The enhanced calculation is executed and the outcomes demonstrate that the enhanced calculation is sensible and powerful, can remove more esteem data. Mohammed Al- Maloegi et al. [8] indicated the limitation of the original A-priori algorithm of wasting time for scanning the whole database searching on the frequent item-sets, and presented an improvement on A-priori by reducing that wasted time depending on scanning only some transactions.

A-priori Algorithm is the classical algorithm for association rule mining. From the above reviews it has been observed that A-priori Algorithm is basic and easy to implement yet it has a few disadvantages such as it requires multiple scan of the database. In addition for candidate generation process, it consumes more memory space and time. The rules generated comprise of items which are unessential. If there should arise an occurrence of extensive databases, redundant rules are produced. Additionally, the A-priori Algorithm works only on a single value of confidence and support throughout the algorithm. Thus it is not suitable for dense databases [13].

## III. ASSOCIATION RULES AND A-PRIORI ALGORITHM

Association rule mining is a standout amongst the best methodology for data mining. It finds out connections among traits in databases, delivering if-then explanations concerning characteristic qualities [4]. In association rules discover the co-events among item sets through

discovering the substantial thing sets. It involves extracting out the unknown inter-dependence of the data and finding out the rules between those items.

In a database of transactions  $D$  with an arrangement of  $n$  binary attributes (items)  $I$ , a standard is characterized as an

$$X \rightarrow Y$$

$$\text{where } X, Y \text{ and } X \cap Y = \phi \quad [12]$$

The arrangement of items  $X$  and  $Y$  are called antecedent and subsequent of the rule respectively. The support,  $\text{supp}(X)$ , of an item set  $X$  is characterized as the extent of transactions in the data set which contain the item set.

The confidence of a standard is characterize

$$\text{Confidence} = \text{Supp}(X \cup Y) / \text{Supp}(X) \quad [4]$$

Association rules (ARs) are implication rules that educate the client about items destined to happen in a few transaction of a database [1]. They are being utilized on the grounds that they are basic and don't make presumptions of any models. Their mining requires to satisfy a client determined least support and confidence from a given database in the meantime. To accomplish this, association rule era is a two-stage handle that are:

- 1) Minimum support is connected to discover frequent item-sets in a database.[1]
- 2) These frequent item-sets and the minimum confidence limitation are utilized to structure.[1]

#### A. A-PRIORI ALGORITHM

A-priori[1] was proposed by Agrawal and Srikant in 1994. A frequent set is searched by algorithm in the database  $D$ . The algorithm is a base inquiry, moving upward level, it prunes number of the sets which are unrealistic be frequent sets, thereby saving any extra efforts. A-priori requires an earlier information to generate the next generation of candidate item sets, i.e., it produces the candidate  $(k+1)$ -item sets from the frequent  $k$ -item sets. In addition, it depends on the *A-priori fact*: “all the subsets of a large item set are large too” A-priori discover the frequent item sets in database to a few emphasis. Emphasis  $i$  processes all regular  $i$  thing sets (thing sets with  $i$  elements). Each cycle has two stages

**Candidate Generation:** Given the set of all frequent and the support of these new candidates is determined [12].

**Pruning:** The pruning step evacuates the augmentations of  $(k)$  frequent, from being considered for counting support. For every transaction  $t$ , the figure out which candidates are contained in transaction  $t$  and after the last transaction are handled; those with support not exactly the minimum support are not considered.

A-priori uses breadth-first search and a tree structure to count candidate item sets in an appropriate manner. It generates candidate item sets of length  $k$  from item sets of length  $k - 1$ . Then it cuts down the candidates which have an infrequent sub pattern. In accordance to the downward closure lemma, the candidate set consist of all frequent  $k$ -

length item sets. After that, it looks into the transaction database to find out frequent item sets among the candidates.

**Advantage**

- It is simple and basic algorithm.
- Its usage is simple [11].

**Disadvantage**

- It does different scan over the database to create candidate set.
- The quantity of database passes are equivalent to the max length of of frequent item set.
- For candidate generation process it takes more memory, space and time that reduce its efficiency.

#### IV. VARIED IMPROVEMENTS ON A-PRIORI ALGORITHM

A few enhanced algorithms have been proposed to manage the downsides of A-priori algorithms in a few ways. Here shows separate methodologies that face the normal disadvantage.

- Change in view of set size recurrence

To kill non critical candidate keys the altered algorithm presents certain angles, for example, set size and set size frequency. These issues can decrease candidate keys in a more capable manner.

- Change by diminishing candidate set and memory use
- This calculation acquaints a more compelling technique with attain to the pruning operation. The algorithm just needs to research  $L_{k-1}$  one time to finish the cancellation and the staying of every component  $X$  in  $C_k$ . Eventually this will expand productivity and I/O rate of algorithm.

- Algorithm in light of frequency of items

To beat the weakness of the conventional association rules mining, both the frequency and noteworthiness of item sets is considered in association rule mining based on weights [14]. It is helpful in recognizing the most significant and high offering things which help more to the organization's event. This approach proposes a viable technique concentrated around essentially weight component and utility for mining of high utility examples.

**Disadvantage:** At first classical algorithm is utilized. To improve capability some change could be conceivable on pruning for speedier working.

#### V. METHODOLOGIES TO BE ADOPTED

The data mining innovation has pulled in heaps of specialists and associations for its splendid prospects of utilization. On account of much research on it, a number of utilizations have been raised and numerous models have been delivered from GTE and AT&T. Speaking to the accomplishments of the current data mining innovation, these frameworks include the exploration in different ranges, for example, expert systems, machine learning, databases. A few them have been put into practice in business fields. A portion of the association rule mining apparatuses used nowadays are given underneath.

- 1) ARMiner, a data mining framework focused around association rules and a segment in ARMiner, by coordinating the research and business necessities on the association rules together. The objective of the ARMiner is to create data mining tools for insightful POS frameworks and to bolster choice making in information warehousing. ARMiner gives mining calculations and preprocessing API functions for its redevelopment.[<http://www.cs.umb.edu/~laur/ARMiner/>]
- 2) Arules, an an augmentation bundle for R (R Development Core Team 1905) gives the framework expected to make and control data information sets for the mining algorithms and for examining the resulting item-sets and rules.
- 3) WEKA: An important data mining tool is WEKA (Waikato Environment for Knowledge Analysis) [<http://www.cs.waikato.ac.nz/ml/weka/>]. Weka is a get-together of machine learning calculations for data mining assignments. The use of the calculation could be possible straightforwardly to a dataset or could be possible from a Java code. Additionally, it is appropriate for creating new machine learning schemes.
- 4) RapidMiner It is an open-source heritage and has first-rate support services. RapidMiner is effectively the most capable and intuitive graphical user interface for the design of analysis processes. [<https://rapidminer.com/>]
- 5) KNIME is easy to use graphical work bench for the entire analysis process: data transformation, data access, initial investigation, visualization and reporting [<https://knime.com/>]. KNIME gives the ability to make reports concentrate on data or computerize the utilization of new knowledge once more into generation frameworks. KNIME Desktop is open-source and available under GPL permit.
- 6) Rattle (the R Analytical Tool to Learn Easily) is a graphical data mining application written in and giving a pathway into R [<http://rattle.togaware.com/>] R offers a broadness and profundity in measurable figuring past what is available in business closed source items. Rattle is utilized for showing information mining at various colleges and is in day by day use by experts and information mining groups around the world. It is one of the few open source tools. An extensive parcel of these instruments are additionally straightforwardly accessible inside R (and hence Rattle) through bundles like RWeka.

## VI. CONCLUSION

Mining frequent patterns from extensive scale databases has developed as a critical issue in data mining. A-priori algorithm has been proposed to this issue. With the time various changes has been proposed in A-priori to improve the execution in term of time and number of outputs.

In this work, our whole center is on enhancing A-priori calculation by pruning the thing sets which does not fulfill the conditions, subsequently upgrading the algorithm by decreasing the extent of candidate set, henceforth expanding the effectiveness of algorithm in term of decrease in checking time to discover the frequent item set.

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# Study on Information Security Issues

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**Abstract-**Information security has become the major issue from some years. A lot of information is updated daily so question arises that “Is this information remains safe or not”? Information security includes some goals like integrity, confidentiality, consistency and availability of data. But these goals are in risk from some years. Information security is breached by cyber-attacks, botnets, hacktivism, phishing, baiting. In this paper, we will discuss some issues regarding information security.

**Keywords-** Cyber-Attacks, Botnets, Hacktivism, Phishing, Baiting

## I. INTRODUCTION

Information is hard hit by the attacks in some years. Most organizations suffer from the attacks that are not expectable. The security of millions of deployed computer systems is terrible. A competent attacker could destroy most of the information on any of these systems or steal it from any system that is connected to the network and attackers can do this to millions of systems in one action [1]. A complementary approach, proposed more than thirty years ago, is to track and regulate the information flows of the system to prevent secret data from leaking to unauthorized parties. Information security mechanisms or failures can also create, destroy or distort other markets such as digital rights management (DRM) in online music and commodity software markets is a good example [2]. But securing information is a difficult task as there are various ways to breach the security. Several changes in the IT practices make hard hitting attacks easier.

## II. ISSUES OF INFORMATION SECURITY

### A. Cyber Attacks

Cyber-attacks is an activity of exploiting the computer systems or damage the functioning of the system. Cyber-attack is an attack on computer that affects the confidentiality, integrity and availability of data that resides on it. Cyber-attacks uses malicious code to alter the computer code, logic or data, results in disruptive consequences that compromise with data and results to cybercrimes such as password sniffing, identity theft etc. It is also called computer network attack. Many government sectors and computer organizations are affected by the cyber attacks. The ubiquity of mobile devices has increased citizens' reliance on cloud services to store personal and business data, making them more productive but at the same time, more vulnerable. While phones and tablets have become the most common devices to connect to the Internet, interconnected devices—the so-called Internet of

Things—promise to deliver greater control and understanding over our lives, but at the same time raise privacy concerns [3]. Victims of cyber attacks include some well-known brands such as eBay, Target, Michaels Stores, the University of Maryland, NATO, JPMorgan Chase, Adobe, and Living Social.

### B. Botnets

Botnets are the killer applications which are managed by hackers or some smart workers. Botnets Mould the many threats into one. Botnets uses some stolen bandwidth in order to make money from internet activity. It is not a virus but it is a virus of viruses. The botnet can be designed to download different modules and exploit the specific things found on the victim. Botnet attacks are targetable and they are made to target. The hacker can target a market or a company to steal the information and this information can be used against the company or market. Botnets are developing at a very fast rate .Thus it is difficult to detect and recover from their side effects [4].

### C. Malware Explosion on Android

Now a days, people all around the world are using smart phones. In Android or iOS phones, some malware is detected by clicking on links of some websites if mobile security software is not installed on the device. This may be come from the messages, emails, websites etc. Android and iOS support in-application billing that allows the user to purchase a virtual item from an application by using the payment account that is associated with the Android market or Apple App Store. With its growing popularity, in-application billing could be a possible target for the future. The in-application billing protocols could include bugs that allows the malware to charge users for items without their approval. The In-application billing protocols could include bugs that allow malware to charge users for items without their approval, shown in fig.1. Malicious applications allow or phishing attacks to trick users into accidentally or unknowingly approving in-application purchases [6].

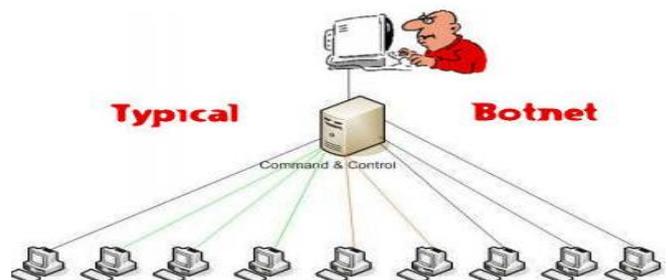


Figure 1 Unsuspecting web user destroy the data on computers.

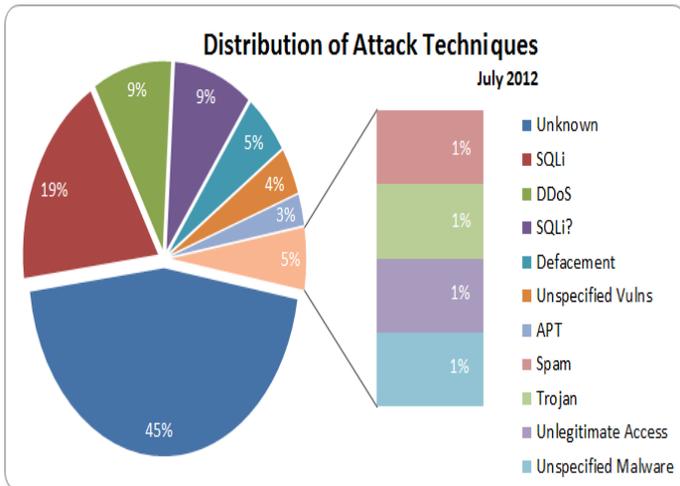


Figure 2 Distribution of attacks

#### D. Hacktivism

Hacktivism is an activity of hacking, or breaking into a computer system, for a politically or socially motivated purpose.

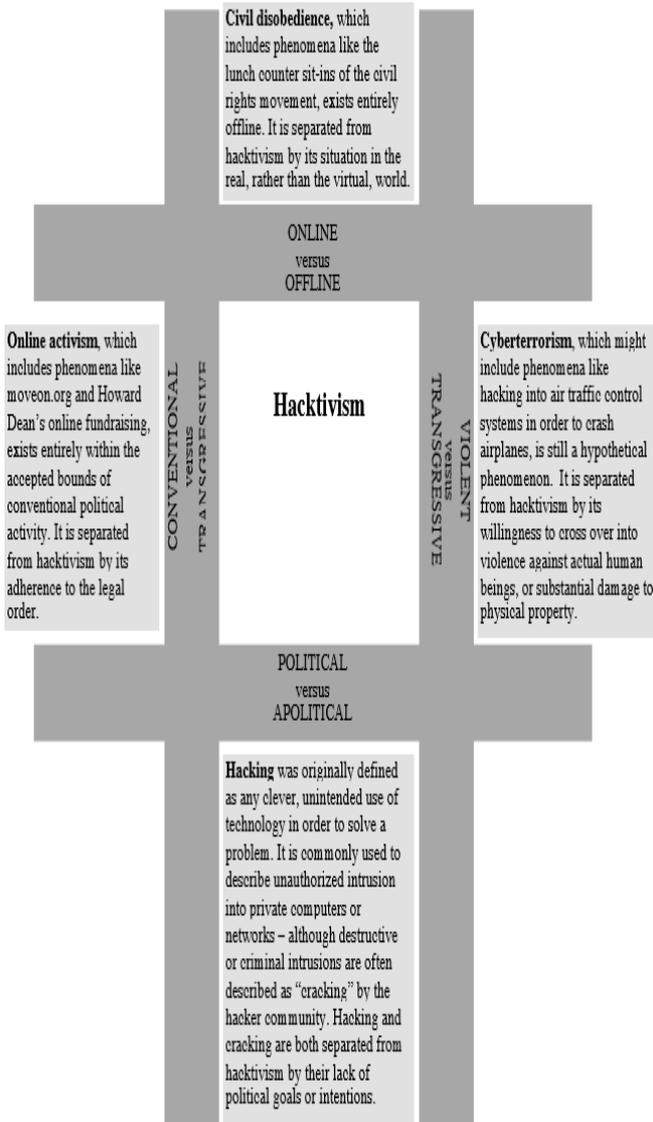


Figure 3 Boundaries of Hacktivism

The individual who performs an act of hacktivism is said to be a hacktivist. Hacktivism has some boundaries like online activism, civil obedience, cyber-terrorism and hacking. Online activism includes the phenomena like online fundraising. Cyber-terrorism includes phenomena like hacking into air traffic control systems in order to crash airplanes. Hacking means to use any clever or illegal use of technology in order to solve a problem, fig.3. It is commonly used to access unauthorized data from the private community by hackers [6].

#### E. Security Breach

It is an activity from outside the organization that bypasses the security policies, practices and procedures. Security breaches, shown in fig.4, may occur due to viruses, worms, Trojan horses, shown in fig.1, when user and password may no longer be secret, or hacking confidential data by hackers or smart workers. Some techniques that are used today for security breach are:-

- Phishing –Phishing refers to using fake emails to trick a person to reveal important information like passwords and user names.
- Spear phishing –It is a personalized and direct version of phishing that uses fake emails that appear like it come from some common social sites like Facebook and make the victim sure that it is trustworthy.
- Vishing –Vishing refers to using internet based mobile phone systems to avoid tracing and caller id to reveal the information.
- Baiting – It refers to using removable media such as CD-ROMs that plug into the computer which results to produce virus in computer.

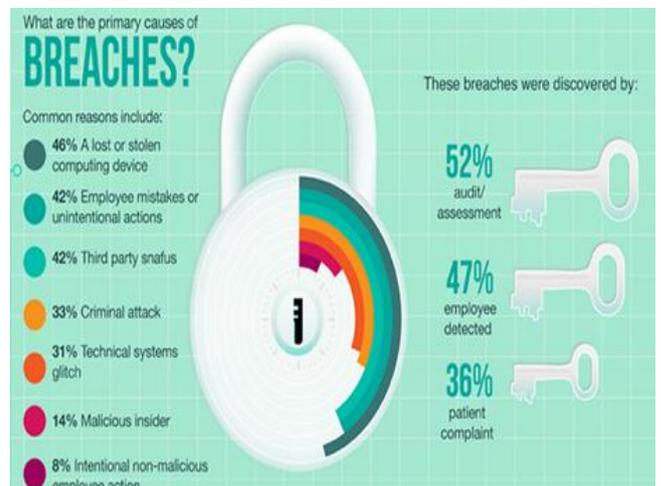


Figure 4 Primary causes of breaches

#### F. No Root Cause Analysis

Now a days, organizations work on detection, blocking or cleaning up the results of malicious software infections but does not work on root cause analysis. Root Cause Analysis (RCA) is a popular and most often-used technique that helps people answer the question of why the problem occurred. It seeks to identify the origin of a problem using a specific set of steps, with associated tools, to find the primary cause of the problem, so that you can:

- Determine what happened.

- b. Determine why it happened.
- c. Figure out what to do to reduce the likelihood that it will happen again.

Thus, by using this technique, it is possible to identify that what is happened with information and what is the reason behind it instead of only solving the threats [5].

### III. CONCLUSION

At last, it is concluded that there are several issues of information security that must be solved. Our information is not safe; it can be hacked by hackers or smart workers. So in future, there is a need to develop the efficient techniques and methods to protect the information from attacks. Information security breach is not only limited to computer systems but also affect the mobile phones and other smart devices.

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# Computer Aided Artificially Intelligent Primary Medical Aid for Patients in Remote Areas

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**Abstract:** This work introduces a system that will analyze and evaluate the disease of the patient residing at remote sites where provision of a qualified medical doctor is not available. This system is based on Fuzzy Logic, adopting Mamdani model as the fuzzy inference mechanism, list of medical diseases and a list of medicines that may be required for primary health maintenance as metrics for evaluating the disease and providing primary medical aid. It is based on relevant inferences from field experts and exploration of the available literature from the books, research papers and the web. This is user friendly, GUI based system that enables even early developers to analyze the disease and its primary medical aid. The advantage of the system is that it provides 24X7 primary medical aid at remote locations with the pre-defined medical metrics.

**Keywords:** Medical, OPD, Remote, Fuzzy Logic, Fuzzy inference model, Mamdani Model, De-fuzzification

## I. OBJECTIVE

‘That service is the noblest which is rendered for its own sake’[1]. The main Aim of the system is to provide medical Aid for the patients who reside in remote areas where people fall prey to quacks, as due to some reasons deploying a well-qualified doctor is not feasible. We cannot even imagine a world full of sick people unable to get a cure. Doctors are very important to our society because they help when people are sick, and sometimes they even save their lives. They are a huge part of the miracle of life as well. A doctor prescribes medicines that give relief to the patients.

## II. THEORY

The system will accept input in form of some parameters as symptoms, local climatic conditions, living conditions etc. and will provide output, which will help to find out the disease and give prescription to the patient.

Innovativeness and usefulness/Practical aspect The main motive to plan the system is to serve the mankind and fully exploit the computer technology to help people dwelling at remote sites where qualified medical aid is not approachable.

Patients must be able to trust doctors with their lives and health. To justify that trust you must show respect for human life and make sure your practice meets the standards expected of you in four domains.

### A. Knowledge, skills and performance

- Make the care of your patient your first concern.
- Provide a good standard of practice and care.
- Keep your professional knowledge and skills up to date.

- Recognize and work within the limits of your competence.

### B. Safety and quality

- Take prompt action if you think that patient safety, dignity or comfort is being compromised.
- Protect and promote the health of patients and the public.

### C. Communication, partnership and teamwork

- Treat patients as individuals and respect their dignity.
  - a) Treat patients politely and considerately.
  - b) Respect patient’s right to confidentiality.
- Work in partnership with patients.
  - a) Listen to, and respond to, their concerns and preferences.
  - b) Give patients the information they want or need in a way they can understand.
  - c) Respect patient’s right to reach decisions with you about their treatment and care.
  - d) Support patients in caring for themselves to improve and maintain their health.
- Work with colleagues in the ways that best serve patient’s interests.

### D. Maintaining trust

- a) Be honest and open and act with integrity.
- b) Never discriminate unfairly against patients or colleagues.
- c) Never abuse your patient’s trust in you or the public’s trust in the profession.

As it is a well-known fact that “to err is human” thus a Doctor being a human being may over sight or due to emotions feels it tough to follow some of the mentioned guidelines. Whereas the computer will work as it is programmed.

Two core facts have been introduced in this project:

- Theoretical framework of decision making (if-then) system for defining the proper design of object oriented software.
- The basic concept of fuzzy logic.

### E. Theoretical framework:

Online primary medical aid symptoms evaluation implies pointing out of those symptoms that are relevant for the analysis of disease and then infer from the database/rulebase the possible disease. Hence the framework is comprised of three metals:

- Dataset for the symptoms.

- Design principles.
- Relevant inference.

#### A. Fuzzy logic:

The term Fuzzy logic is method to compute a solution based on "degree of truth" instead of classical "true or false" (1 or 0) Boolean logic upon which even today's computers are based. The concept was first taken up by Dr. Lotfi Zadeh of the University of California at Berkeley in the 1960s. Dr. Zadeh was going through the concept of computer understanding natural language, which is not obviously translated into the discrete terms of 0 and 1 [2]. (To mention everything in binary terms is a philosophical question of great concern.)

Fuzzy logic includes 0 and 1 as horizons of truth (or "the state of matters" or "fact"), it also includes the various states of truth in between, for example, the result of a comparison between two things could be not "tall" or "short" instead it is ".38 of tallness."

Fuzzy logic appears to be very near to the way the human brains work [3]. Human brain collects the data and form a number of partial truths which it aggregate further into higher truths that in turn, when certain thresholds are exceeded, cause certain further results. It may help to see fuzzy logic as the way reasoning really works and binary or Boolean logic is simply a special case of it.

#### B. Assigning weight:

Weighting factors [4] are estimated values indicating the relative importance or impact of each item in a group as compared to the other items in the group. The purpose of assigning weighting factors is straightforward they help us establish work priorities. There are a number of different statistical packages available and each has different methods of adding weights to the data. The simplest way is to consider a standard fixed weight to your data set according to the specified criteria. Each individual response can then be compared to this standardised weight.

ASSIGNING: A →

Low=3

Med=2

High=1

Adding up all the values of "n" inputs of symptoms

We divide the sum by "n" to get the average value.

Output weights from assigned inputs

$$O[w] = \frac{\text{VALUES}[\text{SYMPTOM 1} + \text{SYMPTOM 2} + \dots + \text{SYMPTOM n}]}{n}$$

Now comparing O[w] with A (set) we may virtually qualify the symptom as:

HIGH.

MEDIUM.

LOW.

The structure of a fuzzy rule can be divided into two parts: an if-part (also referred to as the antecedent part) and a then-part (also referred to as the consequent part);

IF<antecedent>THEN<consequent>

The antecedent describes a condition whereas consequent describes a conclusion.

The last step in the fuzzy inference process is the defuzzification. Fuzziness helps to evaluate the rules, but the final output of the fuzzy system has to be a crisp number. De-fuzzification is used to transform fuzzy inference results into crisp output. The standard de-fuzzification [5] methods fail in some applications. It is, therefore, important to select appropriate de-fuzzification methods depending on the application. De-fuzzification is the process of producing a quantifiable result in fuzzy logic, given fuzzy sets and corresponding membership degrees to determine the proper metric suite for object-oriented software, it is required that the system produce a crisp result, i.e. precise decision rather than vague interpretation. For this reason, different de-fuzzification (produces non fuzzy output) techniques may be explored:

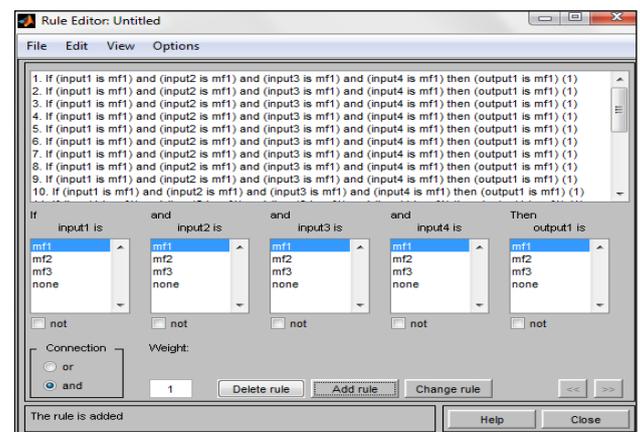


Fig. 1 Rule Base

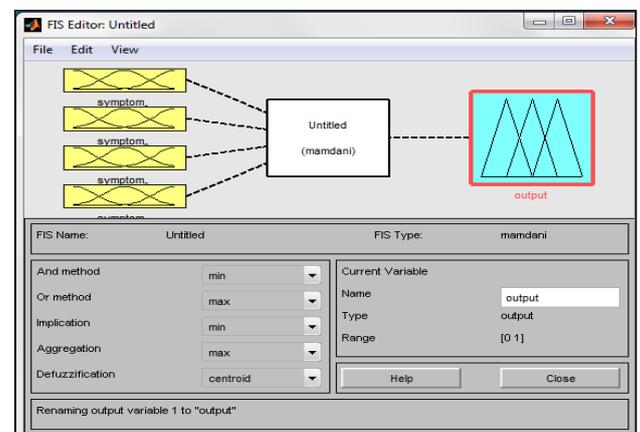


Fig.2 Fuzzy Inference System

#### C. Centroid Method (COA)

The value obtained from the formula tell us not only the strength of relationship between the intuitionistic fuzzy sets, but also whether the intuitionistic fuzzy sets are positively or negatively related. The most prevalent and physically appealing [7] of all the de-fuzzification methods [Sugeno, 1985; Lee, 1990].

– Often called

- Center of area
- Center of gravity.

It calculates the weighted average of a fuzzy set.

$$y = \frac{\sum \mu_A(y_i) * y_i}{\sum \mu_A(y_i)}$$

In this system centroid method has been used. Centroid defuzzification returns the center of area under the curve. If you think of the area as a plate of equal density, the centroid is the point along the x axis about which this shape would balance. In the system, we will use a list of parameters that can help in giving accurate current health status along with history of an affected person. This is an easy and logically effective way to evaluate the possibilities of disease and hence advice the patient, the best drug.

Development: From research study so many factors were found for analyzing the current health status and possible diseases, from which some important parameters have been kept under consideration to analyze health hiccups and help the patient. These are:

Lump, Head ache, Sore throat, Back ache, Leg pain, Swollen joints fever, Jaundice, Loss of consciousness, Swollen legs, Swollen belly, Flank pain, Abdominal pain, Numbness and tingling, Cough, Fatigue, Excess sweating, Flushing, Chest pain, Seizures, Itching and shortness of breath etc. Limitations: Actual physical view of the Doctor is not available to the patient so there may be a sort of mental dissatisfaction. The system would be helpful for OPD cases only.

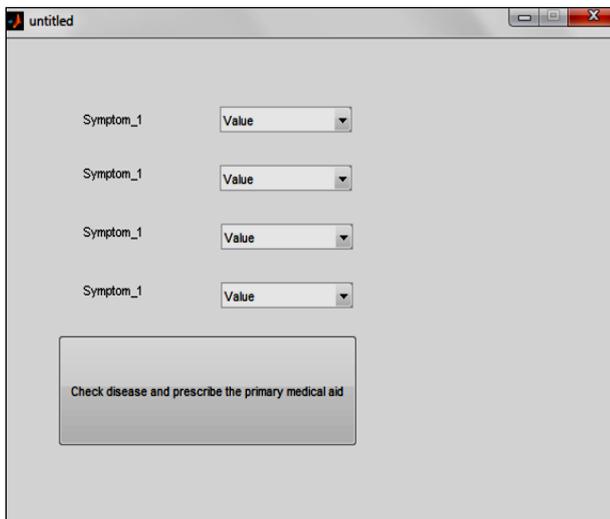


Fig.3 GUI of the system

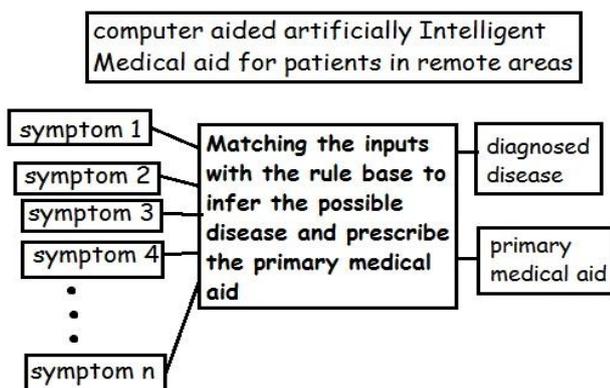


Fig. 4 Graphical layout of the working of the system

### III. FUTURE WORK

The work will become a strong foundation for the hard workers who will aim at defining negative features of any system so as to improve existing system and produce the best for future. There may be addition of video conference in required cases, X-RAY scan, blood pressure monitor analogous to mercury Sphygmomanometer, temperature monitor analogous to mercury thermometer and if the threshold value of the disease reaches beyond toleration limit then the whole case file may be reported to the qualified doctor for expert advice.

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# A Review and Comparison of Various Classification Techniques in Data Mining

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**Abstract-**Classification is the data mining technique. It is used to predict group members for data objects. It is the most supervised technique in data mining. These algorithms can be used to predict and demonstrate bandwidth usage pattern to improve efficiency. In this, we define the basic classification techniques [1]. Various major kinds of classification methods are decision tree, fuzzy logic technique, rough set theory, genetic algorithm, case-based reasoning and k-nearest neighbor. The goal of this review paper is to provide the review on various classification technique of data mining.

**Keywords-** Classification, Bayesian Network, Decision Tree, Case-Based, Rough Set, Genetic Algorithm, Fuzzy Set Approach, K Nearest Neighbor

## I. INTRODUCTION

Data mining is a process to explore the large amount of data to find the patterns and relationships between variable [2]. It is the process of extracting the hidden information from large database using various techniques and algorithms. It also involves other processes i.e. data cleaning, data integration, data transformation, pattern evaluation and data presentation. It is also known as Knowledge Discovery Database (KDD). These processes are further used in fraud detection, market analysis, production control, science exploration, customer retention etc. Classification is the derivation of a function or model which determines the class of an object based on its attribute. A set of objects is given as the training set in which every object is represented by a vector of attributes along with its class. Such a classification function or model can be used to classify future objects and develop a better understanding of the classes of the objects in the database.

## II. CLASSIFICATION ALGORITHMS

### A. Bayesian Classification

It is based on Bayes' theorem. It predicts the probability of class membership using graphical method. This method is used to classify the objects belong to particular class. Bayesian networks are the probabilistic graphical representation and it is also called as belief network, Bayesian network, and probabilistic network. It allows the class conditional independencies between subset of variable. The nodes represent the attributes and the arc represents the direct dependencies. The complexity is measured by the density of arc. BN has two main components that are Direct Acyclic Graph and Conditional Probability Table.

In Direct Acyclic Graph each node represents a random variable, it may be discrete or continuous valued. These

variables may have close similar to actual attributes given in the data [3]. Each variable represents a probabilistic dependence. Conditional probability is used to quantify the relationship between nodes. The conditional dependencies in the graph are estimated by various methods [4]. All the possible combinations are made of values of those parent nodes and specifies the probability that the child will take each of its value. Suppose take the example of wet grass. Grass could be wet by sprinkling of water or when it is raining.

### B. Genetic Algorithm

Genetic algorithm follows the steps inspired by the biological process of evolution. It follows the theory of Darwin that is the "Survival of the Fittest". It is a search technique used for classification to find true solution to optimization and search problems. It is a natural selection process. Genetic algorithm follows some steps to find the appropriate solution. These steps are initializations in which individual solutions are randomly generated to form an initial population, then the fitness function can apply on that population. To find the individual solution the selection process can be done. Now to find the second generation population the crossover and/or mutation process can be applied on the individual solution. These processes can be done until we cannot reach at the termination condition.

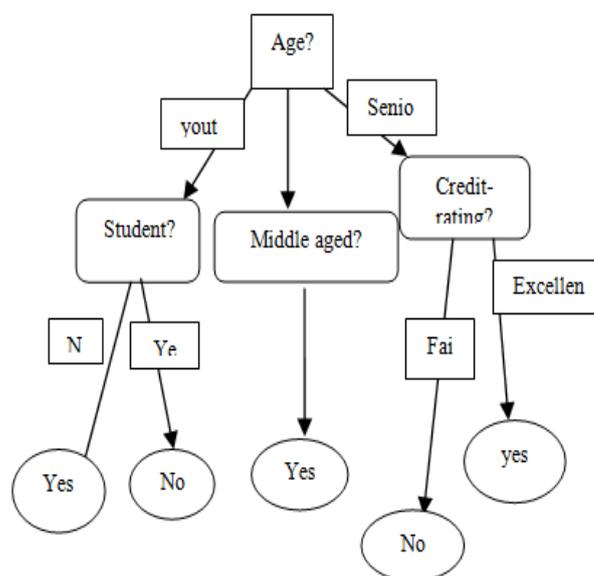


Fig. 1 Decision Tree

### C. Decision tree

Decision tree is a structure which is used as a model to classify a new record by following the path in the tree. The decision tree is a hierarchy structure that consists of root node, leaf node and branches. It is a top down model and used to improving the prediction and classification accuracy by minimizing the over fitting. Each internal node or decision node or root node represents attributes and specifies a test on a single attribute whereas leaves node represents the class and indicates the value on the target attribute. It is based on recursive partitioning strategy for growth of tree. The most useful attribute is selection for classifying, to test at each node. If the information is obtained then all the attributes separated according to their target classification. This range is used to select another participant attributes at each step while growing the tree. It does not require any domain knowledge, easy to assimilate by human [5]. Example of decision tree. shown in fig 1. as follows:

### D. K- Nearest Neighbour

K-NN is instance based algorithm. An object is classified by majority vote of its neighbours. Every sample shows a point in an n-dimensional space [6]. Nearest neighbor classifiers are also known as lazy learners in which they store all training samples and do not build a classifier until a new (unlabeled) can be found. KNN has a variety of applications in various fields such as Pattern recognition, Image databases, Internet marketing, [imp]. The training samples are defined by n dimensional numeric attributes. Every sample shows a point in an n-dimensional space. All of the training samples are stored in an n-dimensional space [7]. When given an undefined sample, a k-nearest neighbor classifier find the space for the k training samples that are nearest to the unknown sample. K-nearest neighbor algorithm, selecting an appropriate k value is important [8]. If the value of k is too small, it is affected to over fitting and would not classify some traditionally easy to classify situations. A value of k that is very small it is important to select a value that isn't very much large as it can also lead to misclassification. [9]

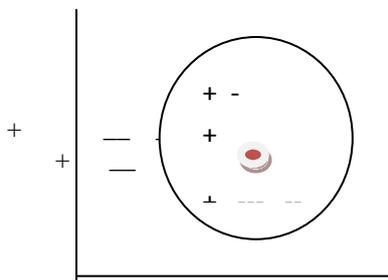


Fig. 2 K Nearest Neighbour

- 1 nearest neighbour is plus
- 2 nearest neighbour is unknown
- 3 nearest neighbour is minus

### E. Rough set approach

Rough set theory is a mathematical approach to data analysis and data mining. Its methodology is concerned with the classification and analysis of uncertain, incomplete or precise information and knowledge. It is derived from

fundamental research on logical properties. Rough set approach can be used to discover the structural relationship with in imprecise and noisy data. This approach can only be applied on discrete-valued attribute. It is considered as one of the first non statical approach in the data analysis. The fundamental approach behind rough set approach is the approximation of lower and upper space of set. It can be used for feature selection, feature extraction, data reduction, decision rule generation, and pattern extraction, etc. it offers the mathematical tools to discover the hidden pattern in data. There are some classes in the real world attributes. Then we can use the rough set approach to roughly define those classes.

Table I. Example of Rough Set Approach

Patient	Attribute		
	Headache	Temperature	Viral
1.	No	High	Yes
2.	Yes	High	Yes
3.	No	Normal	No
4.	Yes	Very high	Yes

Above table consists of objects and attributes. It is used in the representation of data that will be utilized by rough set, where each object has a given number of attributes.

### F. Fuzzy Set Approach

Fuzzy set is also known as possibility theory. This theory allows us to work at a high level of abstraction. It is any set that allows its members to have different grade of membership in the interval of [0, 1]. It is a super set of Boolean values that takes the concept of partial truth, which is truth values between completely true and completely false [10].

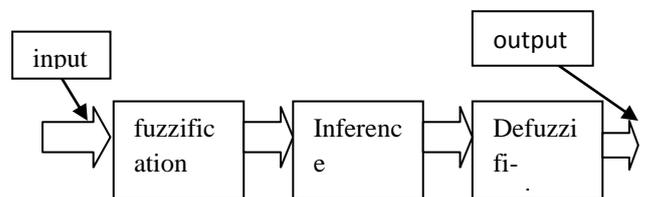


Fig. 3 Fuzzy Set Approach

There are mainly two phases involved i.e. clustering and classification. In first phase we use rough set theory for clustering and in second phase fuzzy logic can be used to classify the result of the clusters.

### G. Case Based Reasoning

Case based reasoning is an artificial intelligence technique in which we use old experiences to solve the new current problems. Case base reasoning basically means to solve and understand the new problems by using old

experiences. In case based reasoning we use the previously gained

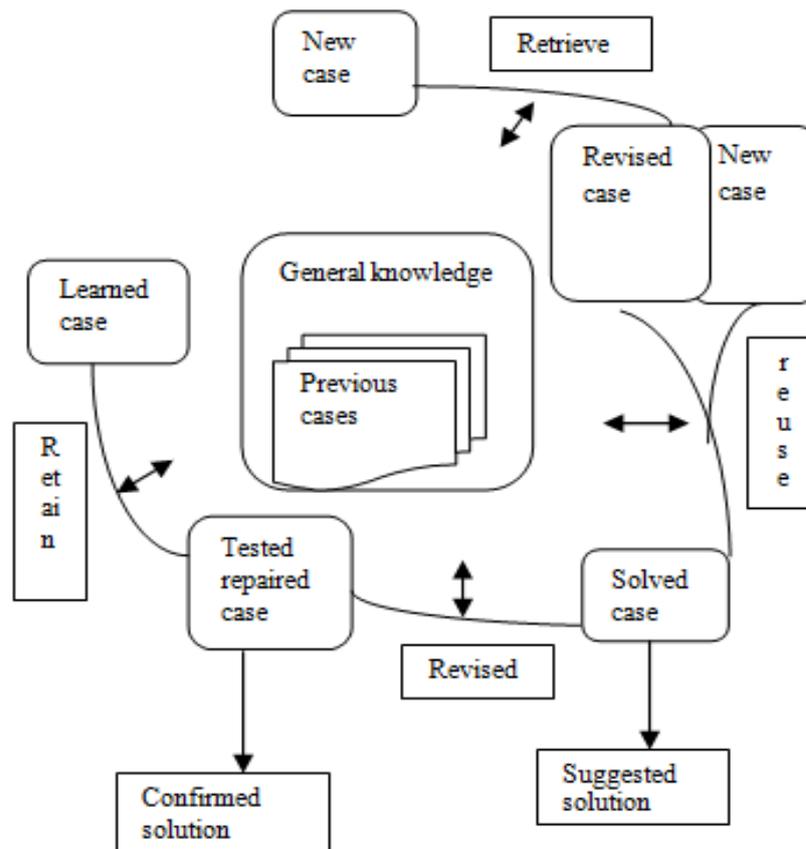


Fig. 4 Case based reasoning

Table II Comparison Between Various Classification Technique in Data Mining

Parameters	K-NN	Case-based reasoning	Genetic Algorithm	Fuzzy set Approach	Rough set Approach	Decision tree	Bayesian classification
Efficiency	Not Efficient	Efficient	Efficient	Efficient	Efficient	Efficient	Bayesian Classification
Ease to Understand	Difficult	Difficult	Easy	Easy	Easy	Easy	Great Efficiency
speed	Slow	Fast	Slow	Fast	Slow	Fast	Easy
Flexibility	Not So Flexible	Flexible	Flexible	Flexible	Flexible	Flexible	Fast
Time	More Time	Time Consuming	Less Time Require	Take More Time	Take More Time	Less Time Require	Flexible
							More Time Require

knowledge to solve the current problems. It is similar to the human problem solving methods. There are three types of case based reasoning that are structural, textual and conversational. In case based reasoning mainly four concepts are used i.e. retrieve, reuse, revise and retain. In retrieve we use the similar past cases. In reuse, we use old solutions to solve the current case. Then next is the revise, in which we create the new solutions and then save the current solution in retain phase.

### III. CONCLUSION

Data mining is the process in which we find the pattern and relationship between the variables. It is used to find the hidden patterns from the large database using various classification techniques. During the review of various classification techniques we found that the decision tree classification technique is more useful as comparative to another classification technique. It is efficient, take less time, fast in speed and more reliable than others.

### ACKNOWLEDGEMENT

I express my sincere and deep gratitude to my guide Ms. Kanwalpreet Kaur, Assistant Professor, Computer Science & Engineering Department, CT Institute of Technology and Research, Jalandhar for the invaluable guidance, support and encouragement. She provided me all resources and guidance throughout the work. I am heartfelt thankful to Mr. Sangram Singh, Head of Computer Applications department, CT Institute of Management and Information Technology , Jalandhar for providing us adequate environment, facility for carrying out work.

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# Security Issues Concerning Next Generation of Cloud Computing and its Current Status

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**Abstract---** In this computerized and computing era, Cloud Computing is the one of the topmost ongoing platform of work these days whose strong impact can be observed in almost all the fields with its IT services over the internet. As every new technology brings some new risks and vulnerabilities with it, security is one of those threats to the cloud sector. Although, security in cloud has been much improvised from the time when companies feared from moving to the cloud but it is still a question. This paper presents an analysis on the various security issues that are still considered as the biggest hindrance on the pathway to complete establishment of cloud sector in all the fields with coverage of its current web analytics, some countermeasures to resolve these issues, various estimations predicted till now by market researchers and others in this field and various upcoming measures to deal with these issues. However, Cloud Computing is itself a big working and upcoming approach in near future so it becomes very important to be aware about the current issues and challenges related to it.

**Keywords-** Cloud Computing, Cloud Security, Security Concerns, Cloud Web Analytics

## I. INTRODUCTION

It is a technology that provides on-demand network access to shared pool of resources that includes networks, servers, storage, applications and services. It is set of services provided to users. We all know what is cloud computing, its system models, its deployment models, it's laid out security challenges and issues, its benefits and problems. So what we are going to govern out next. First lets learn, what's next generation of cloud computing is getting up with according to a report by Ahmed Banafa. [23]

- A. Intelligent Systems
- B. InterClouds, Large Hybrid Cloud Adoption
- C. IOT, IOE, BYOD, BDaaS, SDN
- D. Graphics, Healthcare and other cloud Services
- E. Open Source Cloud software's demand

So, we are going to discuss various security concerns regarding these upcoming technologies of cloud computing. As why to discuss it, because still security issues are governing in this sector as Apple's iCloud is still suffering security issues as indicated by Forbes recent news[26], so governing these issues must be regulatory to meet up to customer's expectation and confidence in cloud. No doubt Cloud is approaching to somewhat higher and higher grades daily in IT sector but it is still away from all commodities of

world. If it will be able to cover up one-fourth of the total world's population, it can create a magical world all around. And if vendors want this kind of cloud adoption in world, it's all issues and challenges are need to be covered up soon. Security of one's data is most important asset for everyone so it has to be strong enough to handle strong hackers and attackers and need to be furnished adequately with every next move of hackers.

## II. SECURITY CONCERNS REGARDING NEXT GENERATION OF CLOUD COMPUTING

### A. Endpoint Security

With the increasing demand of infrastructure and multiple platforms, Security threats are constantly increasing in number and hence are affecting the infrastructure endpoints to a large extent. It's completely a thought that only large organizations are being targeted, whereas it's really spreading throughout all kinds of businesses, through various scans and bots. According to an IBM report [11], at most 60,000 times every day, the average mid-sized company's IT infrastructure is attacked. Hence it becomes very important to safeguard the endpoints against its vulnerabilities. Endpoints refer to servers, PCs or laptops, specific devices & mobile devices. Some of the security threats include [11]:

#### 1) Configuration Errors:

Misconfigurations or configuration errors can lead to high security vulnerability threat to any organization and even the bigger names like Skype, Amazon, azure and others, are even not left behind facing this threat.

#### 2) Missing Patches:

Patches are nothing but software updates or code changes that must be applicable at regular intervals to fix security problems. However missing patches can make the systems or devices working improperly and behaving poorly. So Patch management is strongly required to provide security. Many IT companies like Kaseya, GFI and many others has launched products in market for patch management.

#### 3) Compliance Gaps:

Compliance issues relates to governing laws and industry regulations that must be followed by vendors to move data onto cloud. These compliance gaps between vendors and government regulations however prove to be big restriction in adoption of advanced level of security mechanisms.

These can result to various problems like service interruptions, compromised data and inadequate compliance which can prove hindrance to normal flow of an organization. Traditional Measures like firewall are not able to tackle these problems so there is a need to combat the proliferation and expanding sophistication of these attacks without compromising performance requirements. There have been introduced many risk resistant IT security software's which automatically fix vulnerabilities, provide continuous compliance and provides real time security. Although many endpoint security software's like IBM Endpoint Manager Solution [24], have been introduced in market but enhanced threats need enhanced security endpoint manager model. So we can conclude like complete pre-control is provided but it makes us to put some questions like

- Is it being able to provide endpoint security with existing solutions to SMB's with enhanced level of security with introduction of everyday's newer attacks by hackers without compromising performance? Or new solutions?
- If possible, what is the guaranty that the complexity of security software's does not affect or degrade the level of performance?
- And what about the affordability capacity of mid-sized business??? Isn't the increased cost, if any, at the security end wouldn't affect the overall budget of particular company?

### III. SECURITY CONCERNS IN HYBRID CLOUD

Today Companies are creating new opportunities to drive innovation in hybrid cloud and they are more committed to help enterprise customers realize the tremendous benefits of cloud computing across their own systems, partner clouds and others and in this way clients will now gain unprecedented access to their various leading middleware's and will have an even greater level of choice over the tools that they use to build and deploy their cloud environments. Recently on 22 Oct 2014, IBM and Microsoft announced that they are working together to provide their respective enterprise software on Microsoft Azure and IBM Cloud. As adoption of hybrid cloud computing accelerates, clients, partners and developers will get more choice in the cloud and they can drive new business opportunities, spur innovation with reduced costs and agility. Other than its benefits, many enterprises does not want to commit to it because they trust existing internal security measures over the ones employed by cloud service provider are better option.

As we know, a single security hole in working security model of an enterprise could result in vulnerabilities for all users so still wide adoption of hybrid cloud is a question. No doubt hybrid cloud enables users to have on-premise and off-premise access to data but with this, 3rd party threat can't be neglected at all.

### IV. CLOUD OF CLOUDS OR INTER CLOUD SECURITY

Inter cloud has been emerged as a new model in cloud computing sector for making the availability of enhanced

cloud services faster to customers. The main idea is based on combining many different individual clouds into one seamless huge mass in terms of on-demand operations [22]. This will help providers to re-use their existing contracts to provide enhanced services to customers even beyond their original capability of providing cloud services. Although service outages and security incidents affecting individual clouds problems are minimized with the use of heterogeneous environment of interclouds, but the main context relies in:

- 1) Compatibility among each other or with public clouds in intercloud if not enforced properly, can pose various security threats. A large number of faults and security threats are expected to encounter.
- 2) Decentralization and shared use needs higher security and integrity mechanisms and vendor lock-in problems should not occur.
- 3) Enhanced Encryption algorithms must be designed to handle increasing brute-force attacks, botnets, malware's and advanced attacks.
- 4) So Question arises, is it being able to meet customer large demand of resources with upcoming intercloud services with that much level of security?

### V. BIG DATA AS A SERVICE (BDAAS) SECURITY

Big data as a service is a service that refers to a cloud hosted service over the internet, which is used to handle large and complex data sets up to zeta bytes of structured, semi-structured and unstructured data by offering analysis of these data sets. It offers services as SaaS and IaaS. These regular analytics can prove a biggest natural asset to an organization but BDaaS can be a security threat to an organization as company has to share its all information with other party or automated software to make these analyses. Even more, cloud storage can add additional impact too with it. BDaaS is being preferred over in-house staff in terms of better, continuous and fast data access management, better and more refined data analytics, automation, agility, more performance enhancements and many other benefits. That's why demand for CDO's will be going to have a hike in near future according to the expertise of this field. However missing values, high level data breaches, 3rd party indulgence are still security issues in this sector which needs to cope up with soon.

### VI. IOT THREATS

Oxford defines the Internet of Things as "a proposed development of the Internet in which everyday objects have network connectivity, allowing them to send and receive data" [25]. As with the emerging devices as a part of IOT, IOT threats can't be ignored at all. Although this technology has been estimated to have a big jump in coming years earning billions and trillions of market by various researchers and surveying organizations but very few have indicated security threats related to this sector. With devices gaining more and more web access, more potential's are being given indirectly to hackers to attack these devices as none of the inventors of IOT think of providing that much level of security in that invented IOT device. As expected, IOT will start transforming operations in coming years, as solutions

combining intelligent machines, big data analytics, and end-user applications [23]. With the advent of IOT, more innovations and more solutions are expected in IOT emerging market but what about physical security of IOT devices and network security?? For example, if health monitoring device got hacked, individual's personal information about one's location, health gets leaked which could prove to be a dangerous factor if some known party is trying to have intentionally access to that's individual data. Cyber security issues must be handled with end to end reliable security measures.

## VII. MOBILITY AND BYOD ISSUES

The concept of "bring your own device" (BYOD) in IT sector is gaining much popularity these days. Companies highly feel the need of its exposure with the increased demand of smart devices, BYOD and enhanced mobility. But with this high exposure by companies, probability of attacks also gets increased. As the growth of mobile devices is increasing, people want more enhanced mobility features. But with introduction of new enhanced mobility features, security needs to be bucked up, even in case of on-premise cloud access too. As personal cloud access demand is increasing with BYOD, security mechanisms need to be invented soon which matches or governs all mobility and personal data management issues with BYOD. As individual has less control on data security parameters as compared to organization or 3rd party involved, there is great lack of regular monitoring and auditing logs and extra security mechanisms like usage of other measures to inform individual about its current activities.

## VIII. LICENSING, REGULATORY AND COMPLIANCE ISSUES FOR EVERY NEW MECHANISMS

Licensing, Regulatory and Compliance issues are big hurdles in implementing higher levels of data security and are responsible to a large extent for loss of data security.

## IX. OPEN SOURCE CLOUD COMPUTING SECURITY

Demand for open source cloud computing services pose many security threats to this developing and growing sector. Open source PaaS include CloudFoundry, Cloudify, OpenStack, latest IBM Bluemix and many others. The integration of these is also widely opted.

## X. APPLICATION'S SECURITY

A growing industry of cloud in graphics, healthcare and many other services demand high security levels to be implemented for their wide adoption. As data breaches and other threats found in healthcare cloud model hinders the growth of its applications and services worldwide. So applications and cloud services are demanding more and more security enhancements in near future.

## XI. SOME LATEST SUGGESTED REMEDIES

### A. Super Computers

Super Computers can be used to invent better security models by putting security considerations, models and all data related to security in them. Such innovations should be

tried by the companies to get benefit of the smart computers. For example, IBM smart computer IBM WATSON has been introduced this year to provide 3 service modules. Recently, Watson-based cloud computing service Watson Discovery Advisor is introduced to help researchers from different fields who want to analyze the gigantic volumes of data to find out the result pattern for developing the research ideas [23]. Its other module is for healthcare advises for assisting medical field.

### B. Trusted And Reliable Networks

Trusted and Reliable network's implementation in working scenario can reduce IOT network attacks and prove beneficial to BDaaS networks too. Network security solutions such as IDS and IPS (Intrusion Detection and Prevention Systems), firewall, web security, cloud-based Internet intelligence and more are introduced and upgraded at regular intervals are required to maintain strong network security model for all cloud services.

### C. Monitoring and Automated Auditing

Monitoring and auditing facilities should be provided to cloud customers so that customers will remain in touch with their activity logs. And if it will be automated and regular, it will become just as "icing on the cake" to it.

### D. Data Dispersion

With the use of data dispersion, we can control thefts and attacks to a minimum level. As in case of BDaaS, if data is dispersed over multiple locations or can say at different data centers, probability of losing all important stuff of an organization at once will be reduced and even more dispersed data can't be attacked so easily by an attacker or hacker. Moreover, if theft detection mechanisms are strong at each level, it can be controlled at any level.

### E. Advanced Encryption Algorithms-DDOS

Advanced encryption algorithms must be implemented by organizations to prevent DOS (Denial of Service) or DDOS (Distributed DOS) attacks. They can be enhanced with better solutions and other security protocols too.

### F. Role Based Access Control and Identity Management (RBAC and IM)

RBAC and IM techniques can reduce attacks by malicious insiders, so better identity management schemes should be proposed time to time rather than previous old ones of retina and fingerprint scanning or other measures. Access privileges should be granted to user at role level. Hypervisor security needs to be tightening up. For example, to address BYOD security issue, Cloud Security is developing a proprietary Mobile Security suite of products that will provide a robust mobile device management solution that will deliver role-based management, configuration, security and support for corporate and employee-owned devices.

### G. Role of SDN with Cloud

As with the emergence of SDN (Software Defined Networking) with cloud, is expected to decrease network security issues to a large extent. Use of cloud based NFV (Network Function Virtualization) with SDN can prove to be a magical factor for increasing network security and

providing customers to have centralized and optimized assets, resources and architecture, leading to the faster development of differentiated, profitable solutions. The SDN can help to achieve greater security at data centres but it should be provided with improved automation, performance and multi-vendor support. Some companies are even moving towards SDI (Software Defined Infrastructure).

## XII. CURRENT CLOUD WEB ANALYTICS AND ESTIMATIONS BY MARKET RESEARCHERS AND SURVEYING ORGANIZATIONS

- a) An online survey gleaned results from 418 survey respondents in September by Tech Pro Research indicates IT security would be a major factor for company's IT department over the next three years.
- b) Current Market Scenario estimation by 2017 by IBM REPORT 2014 indicates that market is expected to reach more than \$200 billion by 2017 and if Public clouds will take so much rise by next few years, probably new technologies will lead to new security challenges to deal with.
- c) Rajkumar Buyya includes Cloud Security as one of the open challenges in Cloud Computing.
- d) According to Gartner, IOT, Cloud Computing, advanced analytics, smart machines, SDN will continue to dominate market next year too.

## XIII. CONCLUSION AND FUTURE SCOPE

As we have come across various security issues that can be faced by next generation of cloud computing and various countermeasures too. Some suggestions are also provided to enhance security mechanisms. But it should be kept in mind that these security innovations and enhancements should bring enhanced security scenario with optimal costs and without compromising of performance issues. It has been found by an IBM report that "75% security leaders expect their cloud security budget to increase dramatically over the next 3-5 years". So Capex and Opex should be maintained with inventions of advanced security mechanisms in cloud because it should be remembered that Cloud has been emerged to decrease these costs. The future scope will be relying on invention of advanced security solution with this kind of portfolio.

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# Comparative Analysis of Core Schedulers of Hadoop

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**Abstract- Hadoop MapReduce is the most powerful data processing platform for academic and industrial applications. It is a platform for large scale processing. In this paper, we will discuss architecture of Hadoop and Hadoop MapReduce Programming Model along with its implementation aspects and the importance of scheduling algorithm in Hadoop map reduces also in this paper we discuss various scheduler and their pros and cons.**

**Keyword- Hadoop, MapReduce, Capacity Scheduler, Fair Scheduler, FIFO Scheduler, RDBMS**

## I. INTRODUCTION

The current trend of use of internet in everything, Terabytes and Petabytes of data is generated and need to be analysed. At the end of 2015, CISCO estimated internet traffic will reach 4.8 Zettabytes a year. It is one of the most popularly used such technique for handling the Big Data. The parameters of Big Data are variety (Data comes from the varied sources that can be of structured-data type, unstructured-data type and semi-structured-data type), Volume (defines size of the data how much the data is large), Velocity (defines the motion of the data), Variability (inconsistency) and Veracity (Noise in data). Hadoop is an open-source software framework and a platform for distributed large-scale data processing. Basically Hadoop consists of two typical components i.e. Hadoop Distributed File System (HDFS) and Hadoop's Map Reduce.

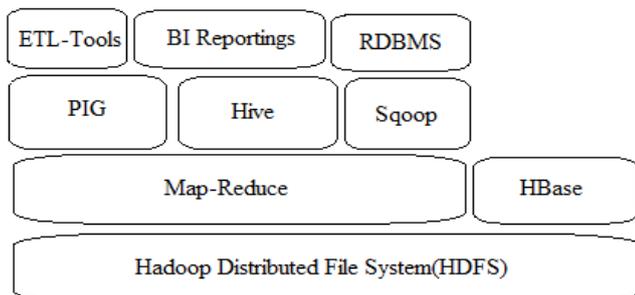


Figure1. Architecture of Hadoop

In HDFS (Hadoop Distributed File System) the data is stored in blocks (i.e. 64mb) are known as chunks. It comprises of Name Node and many Data Nodes. The name node has metadata for the Name Node. Name Nodes keeps track of state of Data Nodes. HDFS is based on the principle that Moving Computation is much cheaper than Moving Data. It has high-bandwidth, self-healing, clustered storage system that provides optimization, redundancy, reliability

and distributed file system. Map Reduce is a software framework for distributed processing of large data sets on computer clusters. Hadoop was first developed by Google. After being strongly Promoted by Google, it has also been implemented by the open source community through the Hadoop [1] project, maintained by the Apache Foundation and supported by Yahoo! And even by Google itself. Map Reduces simplify the processing of vast amounts of data in parallel on large clusters of hardware in a reliable, fault-tolerant manner. There are mainly two steps in Map Reduce are Map and Reduce functions. In the Map function, the master node divides the input problem into smaller sub-problems, and dispatches them to computing nodes. Some computing nodes on Map function might do the dividing procedure again. In the Reduce function, all the answers to the sub-problems are collected and combined into the correct answer output.

HBase is an open source, non-relational distributed database that allows for low-latency and quick lookups in Hadoop. It is written in Java and runs on the top of HDFS. Pig is a Hadoop-based language developed by yahoo. Pig is a high level data processing system where the data sets are analyzed. Hive is a Hadoop-based data warehousing-like framework. It was originally developed by Facebook. Sqoop is a platform used for transferring data between relational databases and Hadoop file System. Hadoop includes Job Tracker and Task Tracker

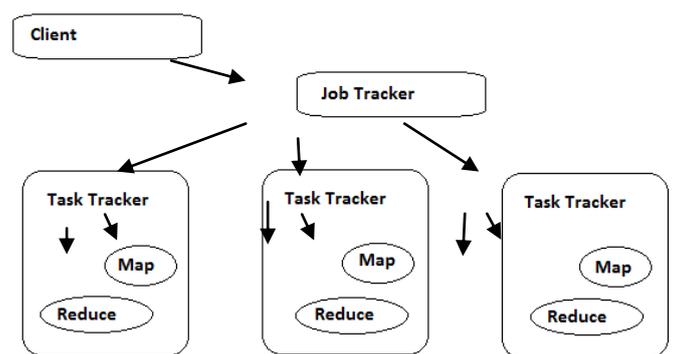


Figure 2. Job and Task Tracker Working

In Figure 2 Job Tracker and Task Tracker. Here the client gives request to Job Tracker. Job Tracker further assigns the job to the Task tracker.

Map Reduce is only a programming model, in Google, it's running on GFS (Google File System)[2]. In this model, there are four basic components of a map reduce java class.

The first the map component is map class that extends the imported Mapper class. Mapper class has four formal parameters (i.e. Input-key, input-value, output-key and output-value). Map Reduce always works with key/value pairs. Within the Mapper class, you reference the map () method. The input key and input value are passed to this method. This method also provides an instance of context which is used to write the output key and output value pair. Rather than using built-in java types, the Mapper class and the reducer class uses Hadoop provided data types, which are optimized for network serialization. For example, instead of a java long it uses long writable and instead of a java string it uses text. The second component is reduce component. Reduce class that extends the imported reducer class. Reducer class also has four formal parameters (input-key, input-value, output-key and output-value). Within the reducer class, you reference the reduce() method. The input key and input value are passed to this method. Normally, it y define the input value as iterative so that it can easily process all of the values for a particular key. This method also provides an instance of context which is used to write the output key/value pair.

The third component is combiner component and it is optional. The idea behind combiner function is to do some data reduction at the Mapper node and thus reduce the amount of data that needs to be transferred to the reducer node. The fourth component is main method. The main() method that runs the code specifies which class is to be used as the Mapper, which class is to be used as the reducer, and whether combiner is going to be used or not. The application also needs to know where to find input data. That information can be hardcoded or can be accessed through a parameter passed to the application. The input data can reside in a single file or in many files contained in a directory.

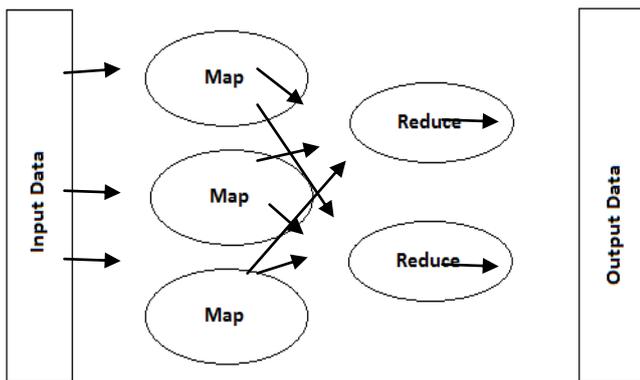


Figure3. Programming model (Map Reduce)

## II. SCHEDULING ALGORITHMS AND RELATED WORK

The issues that are described above in scheduling issues are the critical aspect of Map Reduce. Many algorithms are used to address these problems with different and approaches. Some algorithms are used to improve the data locality and some are used to make efficient synchronization. The LASA algorithm [3] to use weight of

data interference to provide data locality-aware resource assignment in Hadoop scheduler.

### A. FIFO Scheduling Algorithm

In the earliest Hadoop Mapreduce computing architecture, the essential job sort is massive batch jobs that a single user submits the job, thus Hadoop use inventory accounting (first in 1<sup>st</sup> out) rule in early planning algorithm.

The jobs of all users are brought up just in one queue. According to the priority level and also the time sequence when they are submitted to the task tracker, the complete job queues are scanned, and then a satisfactory job is chosen to execute. FIFO is simple; the value of the scheduler in the entire cluster planning method is very less. Only single type of job is basically designed for FIFO so when multiple users at the same time run multiple sorts of jobs, performance of the cluster is going to be comparatively low. As the usage rate of Hadoop platform is progressively high, the demand is additionally magnified [5]. According to FIFO algorithmic rule which tends to decrease the general performance of the platform and the utilization of system resources, and generally even affect the implementation of jobs. It is clear from the figure that job2 is blocked until job1 is completed



Figure 4. FIFO scheduler

### B. Fair Scheduling Algorithm

Fair scheduling could be a technique of assignment of resources to jobs such every job gets, on average, an equal share of resources over time [6]. If there Is single job running, the scheduler uses the complete cluster. Once alternative jobs are submitted, empty task slots are appointed to the new jobs, so every job gets nearly identical quantity of the CPU time. It lets short jobs complete among an inexpensive time whereas not starving long jobs [7]. The objective of honest scheduling rule is to try and do a equal distribution of compute resources among the users/jobs within the system [8]. The scheduler organizes jobs in the resource pool and shares resources fairly between them. By default, there is separate pool for every user. The true scheduler will limit the number of synchronal running jobs for a single user and for a single pool. Also, it will limit the quantity of coincidental running tasks per pool [9] tao et al introduced an improved truthful scheduling formula, that takes under consideration job characteristics and information locality, that decreases both information transfer and therefore the execution time of jobs. Fair scheduler covers some limitation of FIFO such as: it will works well in each small and large clusters and fewer complicated. This algorithm doesn't consider the duty weight of every node, that this is often a crucial disadvantage of it.

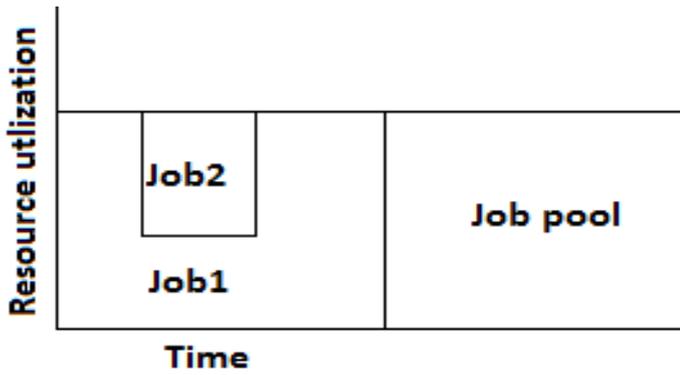


Figure 5. Fair scheduler

The figure shows how the jobs do their work with the single queue. Fair scheduling is done with queues also.

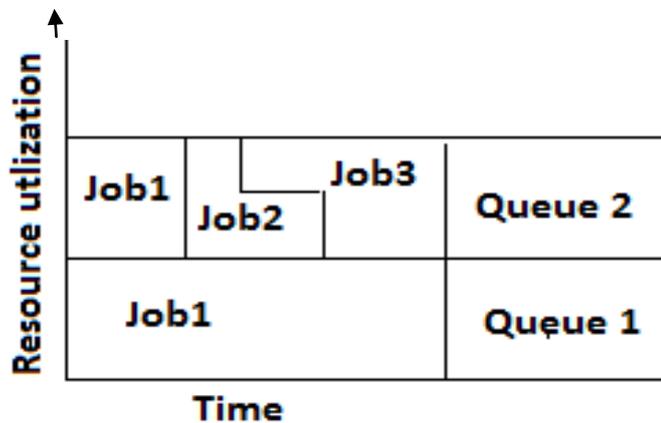


Figure 6. Fair sharing with queues

Queue1 starts the job and allocates all its resources to it. Since there is no demand for queue2, it also allocates all its resources to job1. After sometime we can see a job1 is using half the resources it was using earlier. Now when job2 enters, resources of the two queues will be shared fairly among the two jobs. The result is that resources are fairly shared among the jobs.

### C. Capacity scheduling algorithm

Fair scheduler and capacity scheduling algorithm is very similar but capacity scheduler used queue instead of job pool. Each queue is assigned to associate. Organizations divide resources among these queues. Capacity scheduling puts jobs into various queues or hierarchy of queues in accordance with the conditions, and allocates bound to system capacity for every queue. It also supports hierarchy of queues and resources are shared among the sub queues and each user has the limit of some percentage to use the resources. If a queue has serious load, it seeks unallocated resources, then makes redundant resources allotted equally to every job [10]. It re-allocates the resources for empty queues to queues exploitation for maximizing resource. Once jobs come to that queue, running tasks are completed and resources are given back to main queue. It also allows priority primarily based programming of jobs in associate

degree organization queue [11]. Queues are not created automatically, for this we need to know about systems information.

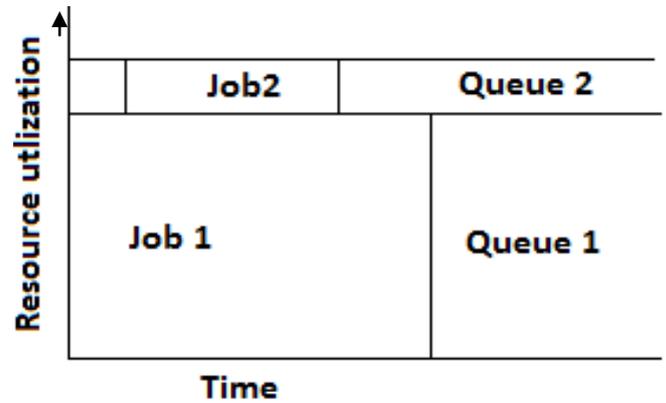


Figure 7. Capacity scheduler

From the diagram, we can see resource utilization with time while running large job and small job under capacity scheduler. A single job does not use more resources than its queue but the capacity of the queue can be increased using the property of elasticity. Capacity scheduling algorithmic program addresses the FIFO's disadvantage like low utilization rate of resources. Queues are monitored and are assigned more free resources beyond its capacity if needed. The foremost advanced among iii schedulers is a vital drawback in capability algorithm [12].

### III. CONCLUSION

In this paper, we have described Hadoop's Architecture. We have discussed about the three schedulers FIFO, fair and Capacity because these schedulers are used worldwide. Comparison between the schedulers has been done.

Table 1 Hadoop Core Schedulers Comparison

Schedulers	Preemption	Working	Taxonomy
Fifo Scheduler	No	Better with small Cluster	Non-adaptive
Fair Scheduler	Yes	Better with small cluster	Adaptive
Capacity Scheduler	Preemption is there when job fails.	Better with large cluster	Adaptive

The performance of different schedulers depends upon a particular situation. FIFO scheduler is best for small cluster. Fair Scheduler works well with both small and large clusters. It also divides the resources equally among the job pools. Capacity scheduler utilizes the resources efficiently.

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## **Track-1**

### **Technical Session 5 - (A & B)**

# **WIRELESS NETWORK & MOBILE COMPUTING**



# Highway Propagation Modeling using DYMO, FSR & GSR under VANET's

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**Abstract-** Vehicular Ad-hoc Network (VANET) is an uncommon indication of MANET which is a vehicle to vehicle & vehicle roadside remote correspondence framework, where hubs in VANET incorporate them as servers or customers for exchanging & offering information. There are various difficulties that need to be tended to until a wide sending of vehicular impromptu networks (VANETs) gets to be conceivable. In order to support Intelligent Transportation System (ITS) service, one of those critical issues consists of the design of scalable and stable routing algorithms that are robust to frequent path disruptions caused by vehicles' mobility and buildings' shadowing effect in urban environment. This paper is generally proposed to upgrade the Quality of administrations (QOS ) in vehicular Ad-hoc Network by separating parameters like throughput, End-to-End Delay, Average jitter, etc and in traditions like DYMO, FSR and GSR by using the Qualnet 5.0.1 test framework.

**Keywords-** ITS, DYMO,FSR, GSR & VANETs

## I. INTRODUCTION

VANET is basically expected to give security related information, action organization, and infotainment organizations. Security and development organization oblige steady information and this passed on information can impact basic decisions. Direct and practical security instrument is the huge issue of passing on VANET in wide sunshine. Without security, a Vehicular Ad Hoc Network (VANET) system is completely open to different strikes, for instance, inducing of false advised messages furthermore disguise of bona fide forewarning messages, hence bringing on mischance. This makes security a segment of genuine concern in building such orchestrates. VANET are of prime importance, as they are inclined to be around the first business procurement of uncommonly designated framework development. Vehicles are the bigger piece of every single one of centers, which are prepared for forming self dealing with frameworks with no previous learning of each other, whose security level is low and they are the most helpless some bit of the framework which could be way layed adequately. The cutoff of VANET [1]innovation is high with a broad mixture of orders being passed on in backing of clients, business establishments, for instance, toll courts, beguilement associations and furthermore law prerequisite forces. Then again, without securing these frameworks, mischief to life and property could be completed at a more great degree, so security structures adeptly send and acknowledge road information, for instance, events, continuous development information, or

surface condition. In this appreciation, the reasonable coordinating framework should be delineated with including such components tagged beforehand. Such a controlling framework should surety a steady and strong part over Vanets. Existing directing traditions, which are usually proposed for MANET, don't make use of the characteristics of Vanets. As to's turf, the inventor should consider that autos in assorted ways move at different speed, go down in differing bearing. In such a component framework, particular correspondence associations may not be a dependable and the guiding ways that move constantly are unreliable. In this paper, the execution appraisal is differentiated and separated and a couple of traditions like DYMO, FSR and GSR for VANET and the parameters like throughput, Average End-to-End Delay, Average jitter is gotten. The graphical customer interface unit of VANET is sent to make the effective circumstance in the reenactment programming, in this way all the examination is smoothly and perfectly done [2].

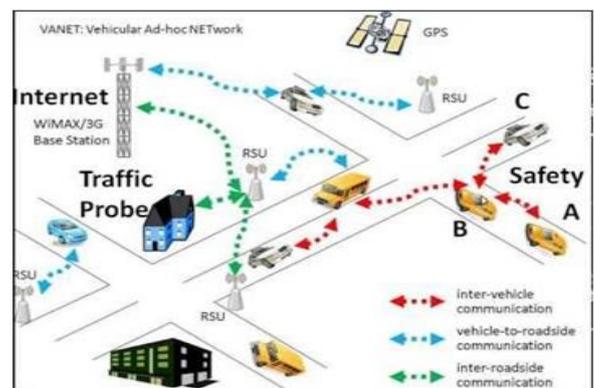


Fig1:- Vehicular ad-hoc networks and some possible applications [5].

## II. PROTOCOLS ANALYZED IN THIS PAPER

- GSR
- DYMO
- FSR

### A. GSR

GSR steering was proposed to manage difficulties confronted by GPSR in city environment. There are two primary issues in the city environment, one is managing high portability issue in the city and other is topology structure of a city. In GSR position based directing is utilized that backing the city outline. Vehicles have route

framework introduced so getting guide of city is ordinary. GSR use responsive area administration to discover the physical area for hub. RLS is utilized for position disclosure as a part of responsive position-based directing. In RLS a source hub show "position demand" with some recognizable proof for the obliged hub[1]. At the point when the hub with that distinguishing proof gets the position demand, it reacts with "position answer" containing its present physical position. The sender hub achieves the destination by utilizing the street topology map and the above data. At the end of the day in GSR the source hub finds the most brief way to destination on the chart utilizing basic diagram calculations and imprint the bundle with destination's area. In this the parcel ventures out through intersections to achieve the destination.

### B. FSR

Fisheye State Routing (FSR) convention is a proactive (table driven) impromptu steering convention and its systems are taking into account the Link State Routing convention utilized as a part of wired systems. FSR is a comprehended progressive directing convention. It decreases the course discovering overhaul overhead in substantial systems by utilizing a fisheye strategy. Fish eye can see the items better when they are closer to its point of convergence that implies every hub keeps up precise data about close hubs and not all that exact about far- away hubs. The scope of fisheye is characterized as the situated of hubs that can be arrived at inside a given number of jumps. The quantity of levels and the sweep of every degree will rely on upon the measure of the system. Sections proportional to hubs inside the littler extension are proliferated to the neighbors with the most elevated recurrence and the trades in littler degrees are more regular than in bigger. That makes the topology in arrangement about close hubs more exact than the data about more distant hubs[3]. FSR minimized the expended data transfer capacity as the connection state redesign bundles that are traded just among neighboring hubs and it figures out how to decrease the message size of the topology data because of evacuation of topology data concerned far-away hubs. Regardless of the possibility that a hub doesn't have exact in grouping about far missing hubs, the bundles will be running frightened effectively on the grounds that the course data gets to be more precise as the bundle gets closer to the destination. This implies that FSR adjust well to substantial versatile specially appointed systems as the overhead is controlled and upholds high rates of portability . The FSR idea begins from Global State Routing (GSR). GSR can be seen as an unique instance of FSR, in which there is scarcely one fisheye degree level and the range is vast. Subsequently, the whole topology table is traded among neighbors that devour a lot of data transmission when system size gets to be huge.

### C. DYMO

DYMO convention may be a direct and snappy steering convention for multi jump systems. It decides uni-cast courses among DYMO switches at interims the system in AN on-interest an alternate receptive

convention, giving enhanced joining in dynamic topologies in an exceptionally organize. To affirm the rightness of this convention, Digital marks and hash capacities range unit utilized [4]. The principal operations of the DYMO convention zone unit course revelation and course administration. Firstly, course revelation is that the system for making a course to a destination once a hub seeks a course to that. When a supply hub needs to talk with a destination hub, it starts a Route Request (RREQ) message. Inside the RREQ message, the supply hub incorporates its own location and its arrangement go that gets increased before its added to the RREQ.

## III. PERFORMANCE EVALUATION

The Protocol execution is investigated utilizing the Qualnet test system form 5.0.1. The simulation parameters utilized for simulating the situation of Vehicular Ad-hoc Network is demonstrated in the Table 1.

Table 1 Simulation Parameters

Parameter	Value
Coordinate	2200 X 1500 M
Application	CBR
Version	Qualnet 5.0.1
Routing Protocol	DYMO, FSR & GSR
Network	IPv4
Mac	IEEE 802.11e
No of Nodes	20 to 100

## IV. SIMULATION SCENARIO

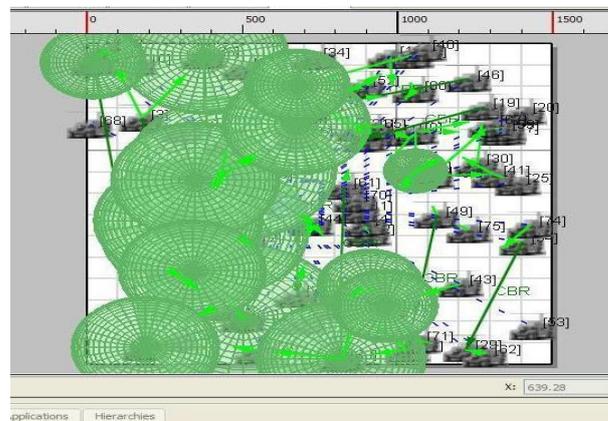


Fig.2 Simulation Scenario

## V. SIMULATION RESULTS

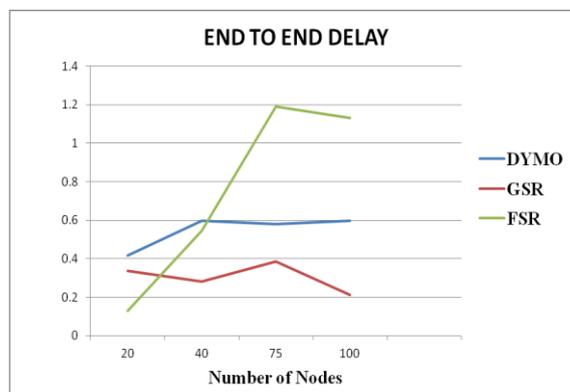


Fig.3 Analysis of End to End Delay

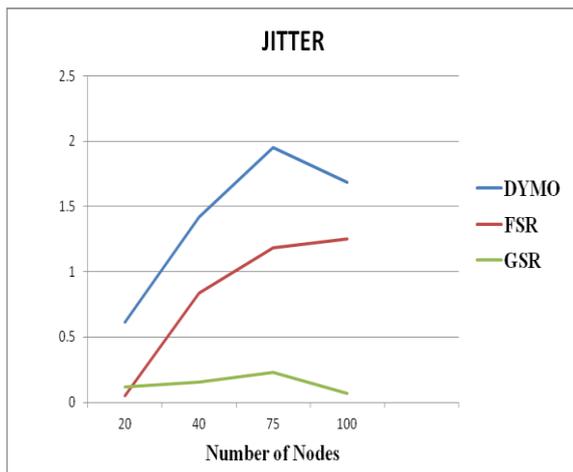


Fig:4 Analysis of Jitter

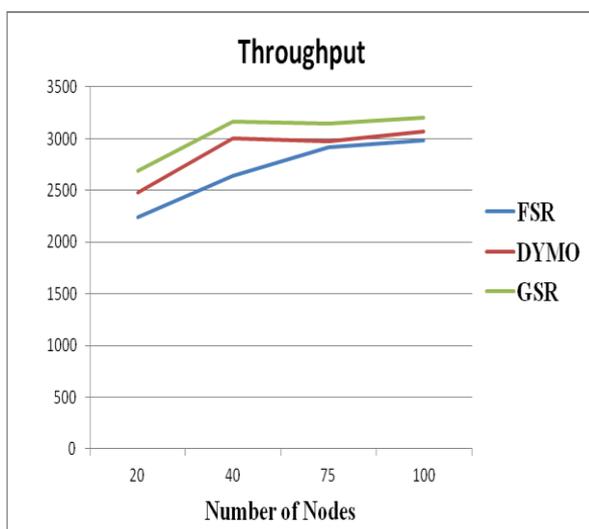


Fig:5 Analysis of Throughput

## VI. RESULTS & DISCUSSION

### A. Average End to End Delay

Fig. shows average end to end delay with number of nodes (vehicles) varying from 20 to 100 for DYMO, FSR and GSR protocol. The basic difference between DYMO and GSR is very less throughout the nodes variation. Average end to end delay of FSR is higher than both DYMO and GSR. But after number of nodes increased by 30, GSR is giving lesser end to end delay than DYMO. In case of FSR, initially it is giving lesser end to end delay as compared to DYMO and GSR.

After number of nodes increases 30, there is consistently increment in the value of end to end delay. In FSR protocol routes discovery is slow. Inter- Zone routing (IERP) is responsible for this work. If link is broken during route instead of using an alternative path, it uses the local route repair to form a new route as in some reactive protocol. In some cases this route can be pretty long (in number of hops) and continues to send the data packets along the long route. Therefore, the end-to-end delay increases for these data packets, resulting in increased average end-to-end delay for all data packets.

### B. Jitter

Fig. shows Jitter with number of nodes varying from 20 to 100 nodes for DYMO, FSR and GSR routing protocol. Jitter of GSR is lesser than both FSR and DYMO. As the number of nodes is increasing, the value of jitter is also increasing for both DYMO and FSR.

### C. Throughput

Fig. shows throughput with number of nodes varying from 20 to 100 nodes for DYMO, FSR and GSR routing protocol. Throughput of GSR is better than FSR and DYMO. As the number of nodes is increasing, the value of throughput is also increasing which shows that GSR supports scalability in highway scenario. DYMO also shows higher throughput as compared to FSR. After 50 nodes there is slightly difference in the throughput in all the protocols. So GSR routing protocol which supports scalability as the numbers of nodes are increasing its throughput also increased as compared to others.

## VII. CONCLUSION

Initially, various routing protocols are surveyed in this paper. Keeping challenges and issues of VANETs in our mind, we have selected three routing protocols to be compared based on their simulation performance. In this paper, the performance of GSR, FSR and DYMO is evaluated using QUALNET 5.1 simulator on urban highway scenario in which nodes are moving in two way direction. The performance of the protocols was measured with respect to metrics like jitter, end to end delay and throughput on the basis of varying number of nodes. Simulations were carried out with identical topologies and running different protocols on the moving vehicles. The results of the simulation indicate that performance of the GSR protocol is superior to both FSR & DYMO protocols. It is also observed that the performance is better especially when the number of nodes is increased.

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# Power Consumption Analysis of Static Wireless Sensor Networks with Different Modulation Techniques

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**Abstract-** A Wireless Sensor networks are nowadays largely used in areas with radio disturbances, due to electrical and electronic appliances, devices and wireless systems and other networks sharing with the same frequency bands. Wireless Sensor Network (WSN) is an ad-hoc network. WSN is a network that contained battery-powered nodes which route the data from sensor node to sink node. Therefore, power management is a major issue for both static and mobile wireless sensor networks with modulation techniques such as MSK and OQPSK16. In this paper power measurement is reported for both modulation techniques in static wireless sensor networks. Experiment is performed for 802.15.4 physical layer energy consumption with modulation type (MSK & OQPSK16), number of nodes and distance between them.

**Keywords-** Power Management, Converge-cast Routing, Static Nodes, modulation types (MSK & OQPSK16), Route Floods Intervals and Sensor Networks

## I. INTRODUCTION

Wireless sensor networks consist of large numbers of sensors that act cooperatively to provide “usable chunks of predigested information rather than a confusing wash of number”. A WSN provides refined information, i.e. it processes the raw data collected by individual sensors before presenting it to the user. IEEE 802.15.4 low data rate- wireless personal area network standard is of particular interest to wireless sensor network (wsn) research community because it is the first wireless communication standard built around devices with constraints on power consumption rates. Thus IEEE 802.15.4 will play a major role in WSN applications with various types of network topologies.

In the wireless sensor network (wsn), the sink node cyclically queries a set of sensor nodes. In the converge-cast routing all the sensor nodes send the short data unit (frame) containing the information acquired by the sensor node to sink node. The transmission between sensor node and sink node is performed inside the 2.4 GHz ISM band, at 250kbps with modulation types (MSK, OQPSK16) [13] and exploiting one of the 16 channels. For each sensor node of the network, the sink node dedicated with the frame time interval. It is the time between two frames (data unit) and the value of this frame time interval is affect the power consumption of whole network.

The paper is organized as follow: section I give general introduction to wireless sensor network while section II describe system description and simulation scenario with modulation types. In last the conclusion has given in section V.

## II. SYSTEM DESCRIPTION

The simulation model implements physical and medium access layer defined in IEEE 802.15.4 standard. The OMNet++ is used for developing 802.15.4 wireless sensor networks (WSNs).

A number of routing schemes have been proposed that attempt to maximize the efficiency of WSNs. Although many schemes are derived from a combination of others, they can be loosely grouped into the categories of minimum hop routing, minimum energy routing, load balancing routing and potential based routing. In this paper power measurement has been done for Converge-cast routing with modulation techniques such as MSK and OQPSK16. Since the energy required for transmission and the transmission distance, a longer sequence of small hops may require less energy than a short sequence of long hops [2]. In the converge-cast routing [11], all the sensor nodes send the data to the single Sink node. In this routing, the data packets, frames are routed through the network to reach the sink node. The frames are not continually sent over the network, they have some time delay between them. The time between two frames is also varies the power consumption of the wireless sensor network and this time is known as Route Floods Intervals. After the threshold value of Route Floods Intervals (RFI), the power consumption of the whole network will be minimized and constant. In case of optimal path routing an intermediate sensor node that used by the number of sources it will expire quickly [4] while non-optimal path routing, to route the data toward sink node, the number of intermediate node will increased. To solve this problem and to control the power consumption, converge-cast routing and minimum RFI can be used to maintain the energy balance [6][5] in this scenario.

The sink node coordinates all the sensor nodes in star, tree or hybrid topology. In this paper we investigate the power consumption on each sensor node. In the figure.2 a

typical wireless sensor network is shown with converge-cast routing and minimum RFI with OmNet++ for 10 nodes.

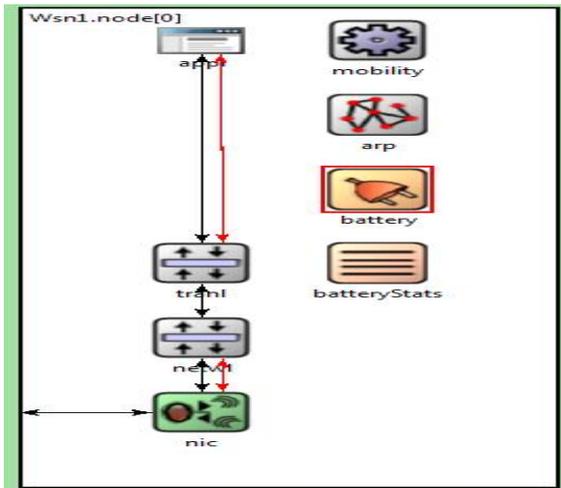


Fig 1. Sensor Node

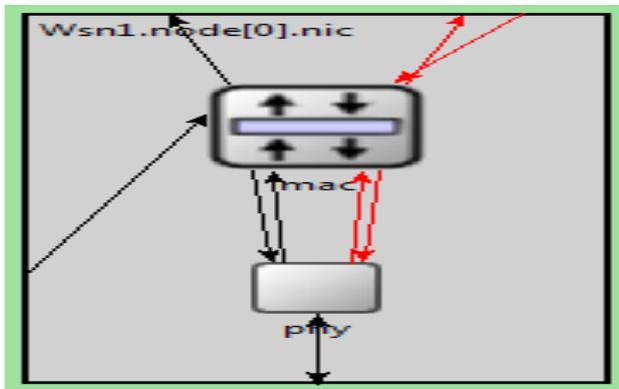


Fig 2. Sensor Node

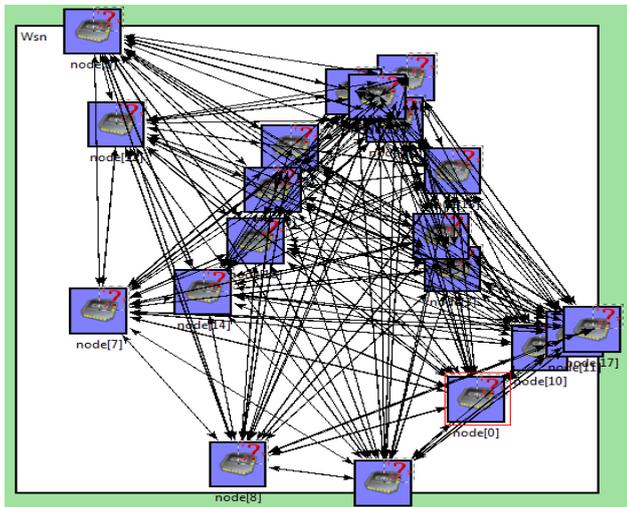


Fig 3. Wireless Sensor Network

### III. POWER CONSUMPTION FOR STATIC NODES WITH OQPSK16

The power consumption on each static sensor node is shown in figure.4 and table no.1 with simulation time of 10 seconds and 20 nodes in the wireless sensor network (wsn). This simulation is run with Offset Quadrature Phase Shift Keying (OQPSK16) type modulation format.

Table 1 Power consumption for Static Sensor node OQPSK16

No. of nodes	Simulation time (s)	Route Floods Interval (s)	mobility speed	APC (mW)	Modulation type
20	10	1	0	498.94	OQPSK 16
20	10	2	0	520.31	OQPSK 16
20	10	3	0	474.59	OQPSK 16
20	10	4	0	331.94	OQPSK 16
20	10	5	0	388.34	OQPSK 16
20	10	6	0	444.74	OQPSK 16
20	10	7	0	501.14	OQPSK 16
20	10	8	0	557.54	OQPSK 16
20	10	9	0	87.12	OQPSK 16
20	10	10	0	87.12	OQPSK 16
20	10	11	0	87.12	OQPSK 16
20	10	12	0	87.12	OQPSK 16
20	10	13	0	87.12	OQPSK 16
20	10	14	0	87.12	OQPSK 16
20	10	15	0	87.12	OQPSK 16
20	10	16	0	87.12	OQPSK 16
20	10	17	0	87.12	OQPSK 16
20	10	18	0	87.12	OQPSK 16
20	10	19	0	87.12	OQPSK 16
20	10	20	0	87.12	OQPSK 16

The power consumption [1][12] of the sensor node, it's depends upon that how many time that sensor node route the data and the time interval between two conjunctive frames that has been routed by the nodes. This time interval is known as route floods intervals (RFI) and is measured in seconds. The route floods intervals (RFI) is affect the power consumption of whole network .As we increases the RFI, the power variations are random up to the threshold value of RFI. Also the power consumption is dependent on routing [7] type that is optimal path and non optimal path routing [3].

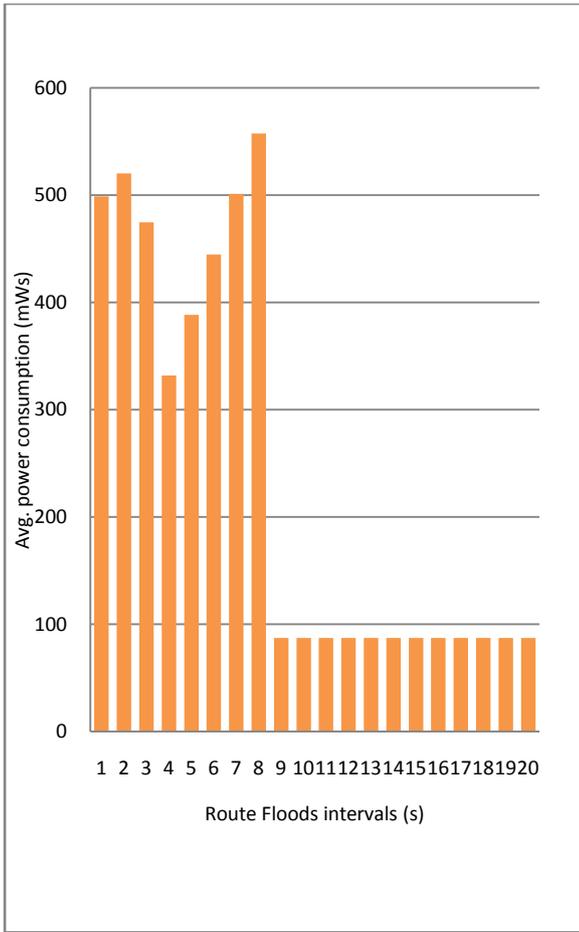


Fig 4. Power consumption with OQPSK16

It has been depicted from figure 4. There is large variation in the power consumption as we increase the number of node and route floods intervals between two frames or more . The numerical values of consume power is tabulated in table 1.

#### IV. POWER CONSUMPTION FOR STATIC NODES WITH MSK

The power consumption on each static sensor node is shown in figure.5 and table no.2 with simulation time of 10 seconds and 20 node in the wireless sensor network (wsn). This simulation is run with minimum shift keying (MSK) type modulation format.

The power consumption [8] of the sensor node, it's depends upon that how many time that sensor node route the data and the time interval between two conjunctive frames that has been routed by the nodes. This time interval is known as route floods intervals (RFI) and is measured in seconds. The route floods intervals (RFI) is affect the power consumption of whole network .As we increases the RFI, the power variations are random up to the threshold value of RFI. After the threshold value the power consumption is minimum and constant as shown in figure 5.

Also the power consumption [9] is dependent on routing type that is optimal path and non optimal path routing .

Table 2 Power consumption for Static Sensor node MSK

No. of nodes	Simulation time (s)	Route Floods Interval (s)	mobility speed	APC (mW)	Modulation type
20	10	1	0	495.55	MSK
20	10	2	0	498.1	MSK
20	10	3	0	457.06	MSK
20	10	4	0	297.17	MSK
20	10	5	0	353.5	MSK
20	10	6	0	409.9	MSK
20	10	7	0	466.3	MSK
20	10	8	0	522.7	MSK
20	10	9	0	67.13	MSK
20	10	10	0	67.13	MSK
20	10	11	0	67.13	MSK
20	10	12	0	67.13	MSK
20	10	13	0	67.13	MSK
20	10	14	0	67.13	MSK
20	10	15	0	67.13	MSK
20	10	16	0	67.13	MSK
20	10	17	0	67.13	MSK
20	10	18	0	67.13	MSK
20	10	19	0	67.13	MSK
20	10	20	0	67.13	MSK

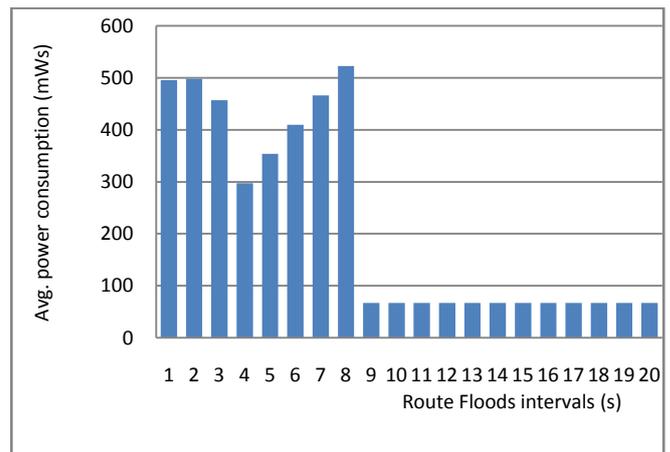


Fig. 5. Power consumption with MSK

#### V. CONCLUSION

Simulation has been performed to find the optimal value of the IEEE standard 802.15.4 physical layer energy consumption and it has been reported that how it is affected by the physical layer, number of nodes, RFI and distance between them. It has been analyzed that at the threshold

value of route floods intervals (RFI) is same for the both modulation formats that MSK and OQPSK16. But with the Minimum Shift Keying (MSK) modulation format the wireless sensor network (WSN) consume less power as compare to Offset Quadrature Phase Shift Keying (OQPSK16) modulation format.

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# Development of Maximum Power Point Tracking Algorithm: A Review

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**Abstract-** This paper information the improvement of a maximum power-point tracking method for photovoltaic systems using optimization techniques. Intelligent method of maximum power point tracking using fuzzy logic control for separate photovoltaic system has been presented. The proposed firefly algorithm is simple computational steps, faster convergence. Photovoltaic generation systems have become an attractive option among renewable energy sources because they are clean, maintenance-free and environmental friendly. Maximum power point tracking techniques are working in photovoltaic systems to make full consumption of PV array output power which depends on solar irradiation and ambient temperature. The objective is to improve the efficiency of a standalone Solar energy system consisting of a Photovoltaic panel.

**Keywords-** Maximum Power Point Traction (MPPT), Fuzzy Logic (FL), Firefly Algorithm,(FA) Photovoltaic (PV), Artificial Neural Network(ANN), Particle Swarm Optimization (PSO)

## I. INTRODUCTION

Renewable sources of energy acquire growing importance due to massive consumption and exhaustion of fossil fuel.

Studies of photovoltaic (PV) generate on systems are actively being promoted in order to cope with environment issues such as the green house effect and air pollution. [1] PV generation systems have two big problems that the efficiency of electric-power generation is very low, especially under low irradiation states, and the amount of the electric power generated by solar arrays is always changing with weather conditions, i.e. the intensity of the solar radiation. A maximum power point tracking method, which has quick response characteristics and is able to make good use of the electric power generated in any weather, is needed to cope with the former problem.[2] The photovoltaic power generation has seen a rapid growth in the last few years leading to extensive use of solar energy; a PV system has the advantages of low maintenance cost, absence of moving or rotating parts and freedom from environmental pollution. Many countries provide generous financial schemes such as feed-in tariff, subsidized policies leading to rapid growth of PV power generation systems. Due to high initial cost of PV power generation systems and its low energy conversion efficiency, a PV system is generally operated to extract maximum power from the PV source. In order to optimize the utilization of PV systems, maximum power-point tracking is generally employed, which requires power electronic interfaces such as dc–dc

converter and/or inverter. The objective of MPPT is to extract maximum power generated by the PV systems under varying condition of temperature and solar insulation. [3]

When climatic conditions vary, the MPP of the PV system also changes its position and several methods have been presented for tracking the MPP. These methods include perturb and observe, incremental conductance , short circuit current , open circuit voltage , load current/load voltage maximization technique , fuzzy control , neural network- based schemes .PV modules receive different solar insulation due to shadow of building, moving clouds, and other neighbouring objects.[4]

In general there is only one maximum power point curve on the P-V curve, it operates with maximum power efficiency, produces its maximum output power. In partial shading conditions, MPPT is an important concept for PV systems.[5] The performance of MPPT techniques is compared on the basis of desirable features like difficulty, speed, hardware accomplishment, sensors required, cost, range of value and efficiency of the system The location of MPP is not identified, but can be calculated either through calculation models or by search algorithms.

## II. METAHEURISTICS & OPTIMIZATION

### A. Firefly Algorithm

#### 1) Behaviour of Fireflies

The sky filled with the light of fireflies is a spectacular sight in the summer in the moderately temperature regions. There are near to two thousand firefly species, and most of them produce short and rhythmic flashes. The pattern observed for these flashes is unique for most of the times for a specific species. The rhythm of the flashes, rate of flashing and the amount of time for which the flashes are observed are together forming a kind of a pattern that attracts both the males and females to each other. Females of a species respond to individual pattern of the male of the same species. We know that the intensity of light at a certain distance  $r$  from the light source conforms to the inverse square law. That is the intensity of the light  $I$  goes on decreasing as the distance  $r$  will increase in terms of  $I \propto 1/r^2$ . Additionally, the air keeps absorbing the light which becomes weaker with the increase in the distance. These two factors when combined make most fireflies visible at a limited distance, normally to a few hundred meters at night, which is quite enough for fireflies to communicate with each other [6]

## 2) Structure of Firefly Algorithm

In firefly algorithm, there are two important variables, which is the light intensity and attractiveness. Firefly is attracted toward the other firefly that has brighter flash than itself. The attractiveness is depended with the light intensity [7].

## B. Firefly Based MPPT

Firefly algorithm is a new meta heuristic algorithm inspired by a flashing of fireflies, for optimization problems. It was introduced in the year 2009 at Cambridge University by Yang. In this algorithm, randomly generated solutions will be considered as fireflies. Brightness is assigned depending on their performance on the objective function. One important rule of this algorithm is all fireflies are unisex. It means that regardless of sex, any firefly can be attracted to any other brighter one. Second rule is that flashing light is determined from the objective function. Light intensity at a particular distance 'r' from light source obeys inverse square law. Attractiveness is directly proportional to brightness and it decreases with distance[8][9].

## III. FUZZY LOGIC

The proposed MPPT controller builds upon the simplicity of the P&O technique but eliminates the resulting steady state oscillations by adaptively modifying the reference voltage perturbation step-size C using a fuzzy logic controller. The proposed control scheme takes the absolute power slope Sa of the PV panel curve and the old voltage perturbation step Cold as its inputs and calculates the change in the new P&O step size C. The two inputs will be fuzzified by using normalized fuzzy sets with three triangular membership functions (MFs): Small, Medium, and Large as shown in Fig. 6. The output variable consists of a normalized fuzzy set with triangular MF: Negative Big (NB), Negative Small (NS), Zero (ZO), Positive Small (PS), and Positive Big (PB). After the fuzzification of the crisp inputs, the resulting fuzzy sets have to be compared to the rule-base. The rule base is a set of "If premise Then consequent" rules constructed according to the designer system knowledge and experience. Depending on the value of the absolute power slope, the PV panel curve (Fig. 2) can be divided into three regions. Given the old reference voltage and perturbation step Cold, the controller will determine the change to the new step in order to reach the MPP.

## A. FLC based MPPT

Fuzzy logic based MPPT does not require the knowledge of the PV panel. It has two inputs and one output. Mamdanis method is used for fuzzy inference and centre of gravity method for defuzzification and the duty ratio is computed.[10]

## IV. ARTIFICIAL NEURAL NETWORK BASED MPPT

The three layer RBFN NN is adopted for implementing the MPPT. The number of input units in the input layer is three while the hidden layer has nine input units and the output layer has one unit. To control the duty cycle of the switch, PWM pulses are generated using PV module.

Enhancement of weight of links and adjustment of parameters used for learning will enhance the performance of the system. ANN based methods is suitable for the systems that can get sufficient training data [11].

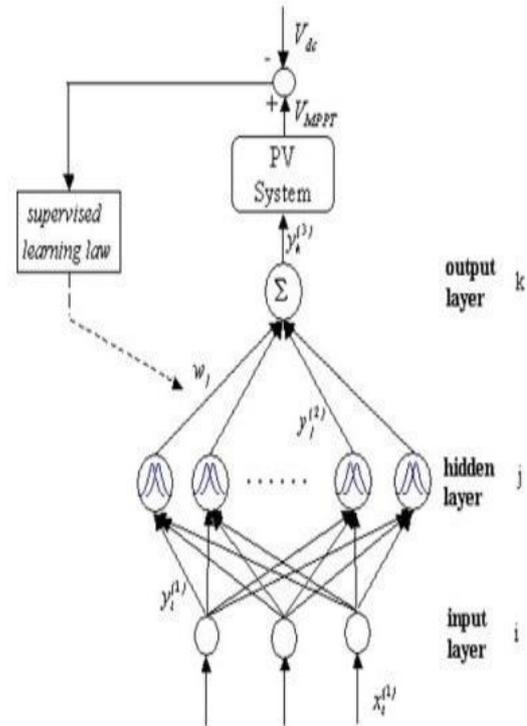


Fig 1. ANN BASED MPPT

## V. PSO BASED MPPT

To demonstrate the application of PSO for MPPT, a solution vector of duty cycles with  $N_p$  particles is to be determined. The algorithm transmits three duty cycles  $d_i$  ( $i=1,2,3,4,\dots,N_p$ ) to the power converter. The value of duty cycle is approximately a constant after subsequent iteration and hence the operating point will be maintained. PSO method is efficient for non-uniform irradiance conditions but its convergence depends on the initial place of the agents [12].

## VI. CONCLUSION

The intensive and massive use of energy from the solar cell is essential for providing solutions to environmental problems. Implementing the MPPT algorithm through digital controllers is easier if it is possible to minimize error functions. The differences between the various MPPT techniques are very slight and they can be evaluated according to the situation. This paper has presented a new MPPT algorithm based on a colony of fireflies for quickly tracking GMPP in partially shaded PV array. The FFA not only includes the self improving process with the current space, but it also includes the improvement among its own space from the previous stages. Also Firefly is better than PSO in terms of the time taken for the optimum or near optimum value to be generated provided certain high level of noise where the difference in time taken becomes more evident with the increase in the level of noise. Firefly algorithm also suitable is used for the high dimensional and nonlinear problems [13] [14].

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# CSPEGASIS: Centralized Sink Power Efficient Gathering in Sensor Information System

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**Abstract**— The wireless sensor network is consists of a large number of sensor nodes. These sensor nodes sense the physical data and transmit the necessary information to the end user in response to user's specific requests. As wireless sensor nodes have limited amount of battery power. Therefore, sensor nodes should consume less battery energy for receiving, transmitting and processing the collected data. It is a big challenge for the research community, how to collect and transmit the data in an efficient manner so as to prolong the network lifetime. In this paper, we mainly focus on how to increase the sensor nodes lifetime by reducing energy consumption during data transmission. The basic idea behind the Centralized Sink Power Efficient Gathering in Sensor Information System (CSPEGASIS) protocol is to see the effect of changing the position of the base station in the network performance. Simulation results show that CSPEGASIS protocol performs better against existing PEGASIS routing protocol in terms of network lifetime. We observe that the network lifetime gets increases, when we fixed the position of base station at the center of the network.

**Keywords**—Wireless Sensor Network, Chain, Position, Network Lifetime

## I. INTRODUCTION

The wireless sensor network is a network that consists of thousands or millions of small sensor nodes. These small nodes of wireless sensor network are operated with the limited battery power. These small sensor nodes embedded with different types of sensors to monitor the environmental or physical conditions viz., sound, temperature, pressure, vibration at different locations. To transmit and receive sensed data over the network, each sensor node consumes some amount of battery energy. The network lifetime depends how much energy spent in each and every single data transmission.

The wireless sensor network uses small sensor nodes which have the capabilities of sensing, computation and to collect and deliver the sensed data. The main concern lies in consuming the significant amounts of the battery power while transmitting and receiving data from nodes to base station or vice-versa.

The main problem is how to collect the sensed data from the far located base station. Because due to large distance each of the nodes takes more power for transmission and network depleted energy very quickly. Therefore, it is necessary to develop a suitable routing protocol which can manage the effective use of valuable energy supplied by exhaustible battery power.

## II. RELATED RESEARCH

In the recent past, many routing protocols have been developed for wireless sensor networks. The different routing protocols are preferred for different situations and applications. Some of the developed protocols enhanced the quality of service and minimizing the time duration for transmission.

### A. Types of Routing Protocols:

In general, routing protocols can be classified in following categories [3]

- Flat-based routing protocol
- Hierarchical-based routing protocol
- Location-based routing protocol

In flat-based routing protocol all sensor nodes have the same role and they collaborate together to sense the information and able to perform multi-hop transmission. Hence these routing protocol based on flooding which has many demerits, like routing overhead and more energy consumption.

In the hierarchical based routing protocol the small sensor nodes collaborate together to collect the information in form of cluster and a head node selected to aggregates the collected information and transmits these aggregated data to the sink.

In Location-based routing protocol each and every node would have the knowledge of its own location and a neighboring sensor node's location prior to sensing and collecting the information data. The knowledge of location between sensor nodes and its neighboring nodes can be calculated on the basis of strength of the incoming signal. The main goal of routing protocols in wireless sensor network is to minimizing the consumption of energy to ensure the larger lifetime duration of the whole network.

### B. PEGASIS Routing Protocol:

The hierarchical based routing protocols are mostly used due to their good expandability and high efficient energy consumption. PEGASIS (Power Efficient Gathering in Sensor Information System) routing protocol based on hierarchical approach. The greedy algorithm for PEGASIS is a chain based routing protocol as shown in Fig 1.

In PEGASIS, every node transmits and receives data from or to close neighboring sensor node and at the end of chain one head leader node transmits data to the BS [1]. Every node gets a chance to become the leader node once,

this approach helps to distribute the energy uniformly in network and maintain the load balance among the sensor nodes in the network field. We initially distribute the nodes randomly over the sensor field and also assume that every  $i^{th}$  node is placed at a random position. Further, greedy approach is used to construct a chain starting from farthest node. Alternatively, the BS (sink) can compute the chain and communicates with the leader sensor node.

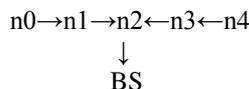


Fig. 1. Chain construction in PEGASIS

The leader node is selected based on the threshold energy. A sensor node chooses a random number,  $r$  between 0 and 1. Let us assume  $p$  is probability to become a leader node and  $T(n)$  is the threshold value:

$$T(n) = p / [1 - p \times (r \bmod p^{-1})] \dots \dots \dots (1)$$

If the selected random number is less than the threshold value  $T(n)$ , the node can become a leader node for the current round. The threshold value is calculated based upon the equation (1).

### III. PROPOSED PEGASIS PROTOCOL

In basic PEGASIS routing protocol the sink is located at far end, the cost for transmission and reception from any sensor node is large and nodes energy deplete very quickly. If we fixed the sink at the centre, then the cost for data transmission and reception is less and hence, the network can operate for longer time. We assume following properties for our proposed network field:

- The position of BS (sink) is located at the centre of network field.
- All the sensor nodes are homogeneous in nature and have uniform energy distribution.
- The energy cost for transmitting a packet is equal to the energy cost for receiving a packet.

#### A. Network Model:

Consider a homogeneous wireless sensor network with 100 sensor nodes are distributed randomly in the 100 x 100 m<sup>2</sup> area. We assume the following properties for sensor network model as:

- All sensor nodes are randomly distributed in the square sensor field network.
- All the sensor nodes are fixed or static. They are not supposed to be move anywhere in network.
- Every sensor nodes have uniform initial energy distribution and have equal capabilities for data processing, data fusion and data transmission.
- BS is fixed at the center of the sensor square field

#### B. Radio Model:

Here, we use the general radio model to compare the performance of the basic PEGASIS routing protocol with the proposed CSPEGASIS routing protocol. The variables used in this paper defined below as [3]

Table 1. Variables

Type	Parameter	Value
Transmitter Electronics	$E_{elec}$	50 nJ
Transmit Amplifier	$E_{amp}$	100 pJ
Data bit	$k$	2000 bit
Energy for Aggregation	$E_{agg}$	5 nJ
Receiver Electronics	$R_{elec}$	50 nJ

For transmitting a  $k$ -bit message at a distance  $d$  we have the following equation [2]:

$$E_T(k, d) = E_{elec}(k) + E_{amp}(k, d) \dots \dots \dots (2)$$

$$E_T(k, d) = E_{elec} * k + \epsilon_{amp} * k * d^2 \dots \dots \dots (3)$$

At receiving end, we can expand the radio equation as:

$$E_R(k) = E_{elec}(k) \dots \dots \dots (4)$$

$$E_R(k) = E_{elec} * k \dots \dots \dots (5)$$

Suppose we have the packet length  $k$  of 2000 bits which is to be transmitted over network. The energy consumed in the amplifying part should be equal to the energy consumed in the electronic part and hence, the cost for transmitting a packet would be equal to the twice of the cost to receiving a packet.

Therefore a fixed amount of energy is consumed in transmitting and receiving a packet in the electronic part and an additional amount of energy consumed in amplification part which is proportional to  $d^2$  for transmitting a packet. There is also a cost for data fusion i.e. 5 nJ/bit/message.

#### C. Data Transmission

The key idea for CSPEGASIS is to consider the location of sink for receiving and transmitting the data packets. The base station located inside the sensor field. Therefore, we can save the large amount of energy which was wasted to transmit packets to far end base station. The approach for constructing the chain formation is same like the basic PEGASIS.

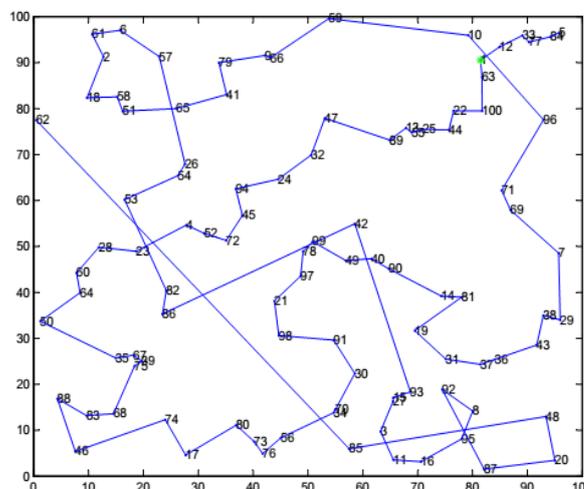


Fig. 2. Chain construction in CSPEGASIS

Each node gets data from the neighboring node and then current node aggregate its own data with receiving data in the same length. This process is called data fusion or data aggregation. After the data fusion, current node

transmits the packet to the next sensor node, this process is keep on going till it reaches to the BS. At the end of chain the leader node collect the fused data and transmit it to the BS. For maintaining the energy balance in the network, in every round a different leader node is selected based on the threshold energy level. We use token passing scheme for data transmission from source to destination.

#### IV. RESULTS AND SIMULATION

In this section, we use 100 randomly distributed nodes for our experimental simulation with same parameters used in PEGASIS routing protocol. We fixed the position of sink at the centre of sensor field, our BS is located at (50, 50). So, the head node transmits the aggregated data to centralized sink. We use the MATLAB software for simulation to get performance graph. Lifetime is the criterion for evaluating the performance of routing protocols in sensor networks. In this work, we measure the lifetime in terms of the round when the all the nodes die. We compare the alive nodes, dead nodes and total residual energy as follow:.

##### A. Comparison of Alive Nodes

Fig. 3 indicates that in PEGASIS all nodes remain alive for 800 rounds, and in CSPEGASIS the number of nodes remains alive for 1300 rounds, which is more than PEGASIS. This clearly shows that CSPEGASIS extended the network lifetime by the factor of 60% against PEGASIS. The nodes dies in CSPEGASIS very slowly in starting but at end nodes deplete quickly. This shows a good balance of energy utilization for alive nodes.

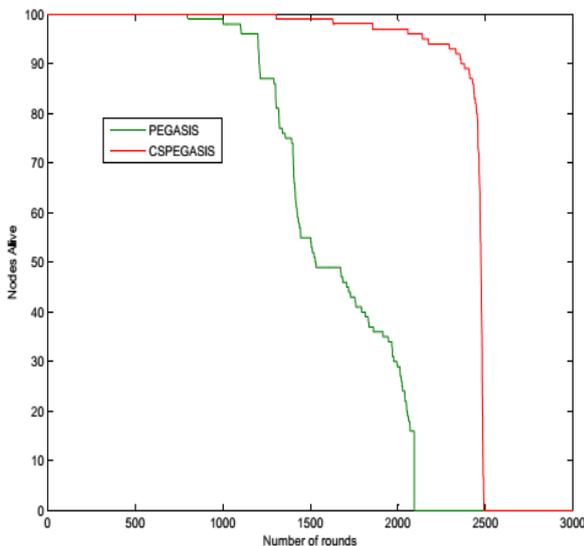


Fig. 3. Number of nodes alive over time

##### B. Comparison of Dead Nodes

Figure 4 shows that the number of dead nodes over the number of rounds. In PEGASIS, nodes start to die before the CSPEGASIS. So, it shows that the proposed protocol is able to work for more number of rounds. As we shows that CSPEGASIS is able to work near about 2500 rounds till last node dies but in basic PEGASIS it hardly completes 2000 nodes till all node dies. Therefore we got improvement factor near about 25% for all nodes dead.

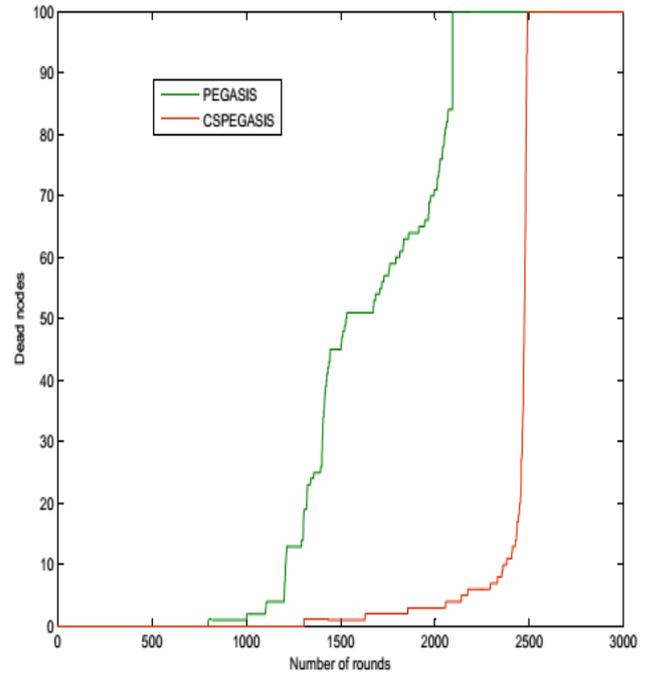


Fig.4. Number of nodes dead over time

##### C. Comparison of Total Residual Energy

Figure 5 show the results of total residual energy for both PEGASIS and CSPEGASIS. The residual energy shows the energy remains inside the nodes after each round. The total residual energy of CSPEGASIS is constantly decreases and completes 2500 rounds which show a good balance of energy consumption during data transmission against the existing PEGASIS protocol which completes only 2000 rounds. Its confirms a good improvements for energy consumptions.

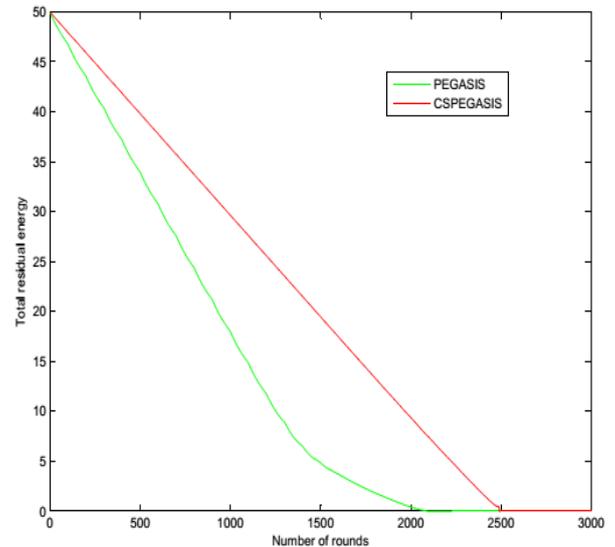


Fig. 5. Total residual energy over time

#### V. CONCLUSION

In this paper, we have presented an energy efficient CSPEGASIS protocol to enhance the network lifetime. The energy drain rate of battery source is less in CSPEGASIS as compared to PEGASIS protocol. Based upon the simulation results, the proposed protocol has confirmed that

it provides a longer network lifetime as compared to existing PEGASIS protocol.

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# Review of Network Layer Unicast Routing Protocols based on Link Stability in MANETs

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**Abstract-** The ad hoc network is a decentralized type of wireless network. It is infrastructure less as there is no fixed infrastructure required in ad hoc network like base stations. In MANET each device is free to move independently in any direction. When we transfer data from source to destination problem of link failure occurs. Due to problem of link failure the performance of system decreases. Routing should be done with minimum overhead and bandwidth consumption. Routing in MANET is a difficult task. In this paper, we present a review of different routing protocols which are based on link stability. This paper will provide a summary of link stability based protocols to the researchers highlighting the key features of the protocol.

**Keywords--**MANETs, Link stability

## I. INTRODUCTION

MANET is a type of ad hoc network which is used for mobile communication. It is a robust infrastructure less wireless network. The nodes change their positions and organize themselves. To connect to various networks MANETs use wireless connections because they are mobile. Wireless connection can be anything such as wi-fi connection. MANET is a mobile adhoc network. MANET is self-changing network in which mobile devices are connected without wires. In MANET each device is freely to move individually in any direction.

To connect with different networks, MANETs use wireless multihop connections.

Based on the application of the network MANETs are connected to the internet and some are connected to LAN. When they are not connected to any wireless router then they change network by their own. As, in case of a VANET (Vehicular Ad Hoc Network), it vehicles to communicate with roadside equipment. If the vehicles do not have internet, the roadside equipment which is wireless can be connected to the internet which allows the data from the vehicles to be sent. The vehicle data can be used to measure traffic conditions. Because MANETs are dynamic in nature what data is sent over a MANET should be known because it is not secure.

The major characteristics of MANET are the mobility of nodes in the network. The major types of stability are as follows:

### A. Node Stability

Link failure stems from node mobility and lack of network resources. The mobility of the nodes is complex factor that affect performance of routing protocols. Stability factor is calculated based on self and neighbor node stability.

### B. Link Stability

The link stability means the remaining lifetime of a link. In this paper we discussed different routing protocols based on link stability.

### C. Route Stability

The route stability means through which nodes we travel from source to destination [4].

## II. CLASSIFICATION OF ROUTING PROTOCOLS

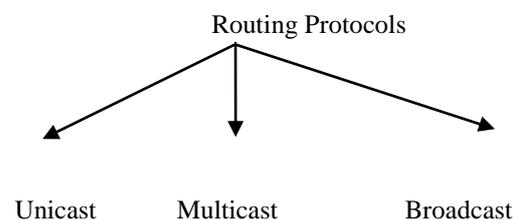


Fig. 1. Classification of Routing protocols

### A. Unicast Protocols:

Unicast means one to one communication. It means one source transmits data packets to single destination.

### B. Multicast Protocols:

Multicast means when one node sends the same packet to multiple destination.

### C. Broadcast Protocols:

Broadcast means when a single message is transmitted to a group.

Another classification can be on the basis of routing mechanism:

- Proactive Routing Protocol (Table-driven)
- Reactive Routing Protocol (On- demand)
- Hybrid

### A. Proactive Routing Protocol:

Proactive protocol contains fresh list of the route and their destination from source. In this type of protocol one node contains more than one table for each node in the network. All the nodes are updated regularly. If the topology frequently changes than update information propagate to every node of the network and update table.

**B. Reactive Routing Protocol:**

It is on-demand protocol. It is lazy approach in which all the node are not contains the information of the all the nodes and maintains table only on demand. To find the path route discovery process is follow. Reactive routing protocols are bandwidth efficient. In this, routes are built as and when they are required.

**C. Hybrid:**

Hybrid protocols inherit the features of both proactive and reactive routing protocols.

**III. CLASSIFICATION OF PROTOCOLS BASED ON LINK STABILITY**

The protocols are classified into two types based on link stability.

**A. Distance Based:**

If the distance between two nodes is small then the probability of nodes to remain in each other's transmission range for a long period is more. The distance between nodes is calculated using localization systems.

**B. Based on Node's Mobility:**

It estimates the stability value of links such as direction of movements of nodes, their speed and probability of remaining in the area for longer period.

Probabilistic methods include methods based on calculating degree of probability that mobile node will remain in neighbor of another node.

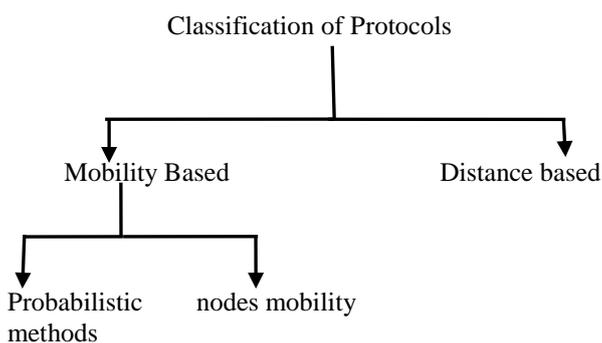


Fig. 2

Unicast routing protocols based on link stability are as follows:

**1) OLSR Protocol**

The protocol is based on link state algorithm and is proactive. It makes use of hello and topology control messages to maintain routes. OLSR works in distributed and does not rely on any central activity. Due to proactive nature, the routes are already decided. In this protocol, all

the links with neighbor nodes are declared and flooded in the network.

**2) ST\_OLSR Protocol**

ST\_OLSR is stable OLSR. It is based on two principles for the collection of information on the global state of the network. The two principles are mechanism of MPR and topology control messages. In this protocol integration of the SND and FND mechanisms in the OLSR protocol. This creates a more stable network topology compared to OLSR. The new protocol arising from the integration of SND and FND mechanism is called ST\_OLSR. SND is stability of nodes. It is node on its neighbor to estimate the durability of the connection. FND is fidelity of node. It defines the degree of reachability.

**3) SSOD Protocol**

SSOD is reactive protocol that uses distance between the nodes to evaluate the link stability. SSOD generates RREQ route request packets. These route request packets generate two fields. SL\_min and SL\_max. These fields are used in path stability. During the travel of RREQ packet from source to the destination node, the intermediate nodes note the minimum value and the maximum value of the stability. It considers the path which has low value of SL\_min. The link stability value between two nodes is calculated by signal quality of packets exchanged between them. The link is stable if signal strength is stronger.

**4) TBP Protocol**

The Ticket Based Probing (TBP) routing provides a heuristic approach to solve the routing problem. It satisfies two objectives delay constraint and low cost. This protocol establishes paths by generating probes carrying tickets that travel in the network. Two types of tickets are defined yellow and green. The yellow tickets are sent from a source towards a destination passing intermediate nodes. The green tickets are sent based on the low path cost. If a neighbor node is allocated at least one ticket a probe carrying all the tickets is allocated to this neighbor node. The best path is selected with lowest cost.

**5) TBP-SE Protocol**

TBP\_SE protocol is the improvement of the TBP protocol. The major disadvantage of TBP protocol is the stability and durability of the installed paths. Goal is to select among the feasible paths the more stable. The change is based on the principle that more the distance between two neighbor nodes is smaller the more these two nodes still in the vicinity to each other for a long period.

**6) LSEA Protocol**

LSEA protocol is when the source node want to communicate it broadcast a RREQ route request. The neighboring nodes decide to forward the route request. It decides based on its expiration time of the link with the RREQ sender.

**7) SDR Protocol**

SDR protocol is a collection of hardware and software technologies that enable re-configurable system architectures for wireless networks and user terminals. It

aim is to change the analog components and hardwired digital VLSI devices of the transmitter receiver as possible with programmable devices. SDR can easily be integrated with ad hoc network antennas or nodes and can be changed using programming logics.

8) *RMQR Protocol*

RMQR protocol is an on demand QoS routing protocol based on link stability. There are two metrics RET and Path BW for calculating the best path. The RET denotes route expiration time and path BW represent the total bandwidth of the path. The RET is the minimum of LET (link expiration time) of the links that form the path. The best path has the largest RET value with a minimum number of hops. In this MAC layer is implemented using the CDMA-over-TDMA channel model. In CDMA-over-TDMA multiple sessions can share the same TDMA slot with CDMA. The CDMA can be used to solve the hidden terminal problems.

Table 1. Protocols based on link stability

S. No	Protocol	Link Stability mechanism used	Routing Metric	Proactive or Reactive	Single or multipath
1	OLSR	Probabilistic Methods	Link Stability	Proactive	Single
2	ST_OLSR	Probabilistic Methods	Link Stability	Proactive	Single
3	SSOD	Distance Based	Link Stability	Reactive	Single
4	TBP	Distance Based	Delay, Low Cost, Link Stability	Reactive	Single
5	TBP_SE	Distance Based	Delay, Low Cost, Link Stability	Reactive	Single
6	LSEA	Nodes Mobility	Energy And Link Stability	Reactive	Multipath
7	SDR	Nodes Mobility	Link Stability	Reactive	Single
8	RMQR	Nodes Mobility	Bandwidth And Link Stability	Reactive	Multipath
9	SWOP	Nodes Mobility	Energy And Link Stability	Reactive	Multipath
10	SAR	Probabilistic Methods	Energy, Congestion State And Link Stability	Reactive	Single

9) *SWOP Protocol*

SWOP is stable weight based on routing protocols. It uses basis to select the path. First one is based on expiration time of path, second is based on the number of errors and last is based on the number of hops. The weighted sum of these three factors is calculated by using function. The synchronization of nodes and parameters of motions are calculated by localization system such as GPS.

10) *SAR Protocol*

SAR protocol is state aware routing protocol. The SAR protocol has the three properties. First property is that for each mobile node energy is limited. Second property is that each node is constantly moving and last property is

each node has limited capacity for the queue for the packets during the transmission. Each node in the network collects the information of its remaining energy, moving speed and queue utilization.

IV. CONCLUSION

It is very difficult to sustain a link in a dynamic scenario of MANET. So it is one of the major challenging issues. Increase in stability of links increases packet delivery ratio, improves throughput and reduces delay. So it is important to explore various mechanisms which provide link stability in MANETs. In this paper, description of such routing protocols and various algorithms used by them to provide link stability is discussed. Further enhancements can be done in these protocols to provide stable network inspite of the adverse conditions of MANETs.

ACKNOWLEDGEMENT

I express my sincere and deep gratitude to my guide Ms. Kanwalpreet Kaur, Assistant Professor, Computer Science & Engineering Department, CT Institute of Technology and Research, Jalandhar for the invaluable guidance, support and encouragement. She provided me all resources and guidance throughout the work. I am heartfelt thankful to Mr. Anurag Sharma, Head of Computer Science & Engineering Department, CT Institute of Technology and Research, Jalandhar for providing us adequate environment, facility for carrying out work.

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# A Survey on Energy Aware Protocols for WSN

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**Abstract**—Wireless Sensor Networks (WSNs) consist of thousands of low-cost, low power sensor nodes. As sensor nodes have limited energy resources, so to extend the lifetime of the sensor networks, energy has to be managed carefully. To overcome this problem and to improve the performance there is a need to minimize total energy consumption and balance WSN load. This study highlights different routing protocols; a survey is given regarding the analysis of advancement in routing protocols on the basis of various parameters.

**Keywords**—IGSTEB, GSTEB, LEACH, PEGASIS

## I. INTRODUCTION

WSN supplies a connection between the actual, physical and virtual worlds. WSN is established of “nodes” from several to hundreds or several thousands, where each node is connected to different sensor nodes. Sensor nodes might vary in proportions from that of shoebox because of the length of dust particles. Each sensor network node has several parts as a radio transceiver having an interior antenna or connected to yet another antenna. Just one more distinctive characteristic of sensor networks could function as cooperative effort of sensor nodes. Sensor nodes are fixed having an onboard processor. These sensor nodes converse over short distance employing an instant medium and bond to execute a regular task, for instance, environment monitoring, military surveillance, and industrial process control. [1]

Notwithstanding the several applications of WSNs, these networks have numerous restrictions, e.g., limited energy supply, limited computing power, and limited bandwidth of the wireless links connecting sensor nodes. The main element aim of WSNs is always to execute data communication while trying to offer enough time of the network and avoid connectivity degradation by utilizing aggressive energy management approaches. The design of routing protocols in WSNs is subjective by many risky factors.

Taking under consideration the limited energy capabilities of someone sensor, an alarm node can sense to tiny area, so an instantaneous sensor network comes with a massive amount sensor nodes organize in great density which reasons for rigorous problems such as for example scalability, redundancy. Reducing the total level of communication by eliminating redundant sensed data and through the energy-saving link would save massive amount energy, this means time of the WSNs gets increased.

Generally, WSN may produce quite a fantastic amount of data, so if data fusion could be properly used, the throughput might be reduced. Because sensor nodes are deployed densely, WSN might generate redundant data from multiple nodes, and the redundant data might be combined to scale back transmission. Plenty of the protocols implement data fusion, but approximately them consider that how big is the message transmitted by each relay node be permitted to be constant. PEGASIS, PEDAP and TBC are representative protocols based with this particular consideration and perform superior to LEACH and HEED in this case. Another dynamic protocol, GSTEB prolongs time of WSN by further balancing energy consumption. Hence, several advanced techniques that eliminate energy inefficiencies that might condense enough time of the network are highly essential. Such constraints and also a normal deployment of massive amount sensor nodes pose many challenges to the style and management of WSNs and necessitate energy-awareness at all layers of the networking protocol stack. [2]

## II. RELATED WORK

Rajesh Patel et al. simulated LEACH in NS2 and analyzed performance of LEACH in terms of energy, throughput and lifetime; figured by varying exactly how many cluster heads values of these mentioned parameters vary. The efficient using energy source in a alarm node is critical criteria to prolong living time of wireless sensor network. Wireless sensor networks have explored to varied new protocols created especially for sensor networks where energy consideration is fairly crucial. Most worth addressing, partial to hierarchical routing protocols predicated on clustering has better scalability. As sensor nodes tend to be battery-powered devices, the critical aspects to take care of concern how exactly to scale back the vitality usage of nodes, which means that your network lifetime might be extended to reasonable times. [3]

Parul Bansal et al. In this paper, Low Energy Adaptive Clustering Hierarchy (LEACH) and Power Efficient Gathering in Sensor Information System (PEGASIS) hierarchical protocols are analyzed. This work analyzes these protocols on the cornerstone of total energy consumed, overheads, and sensors lifetime and supplies a contrast of LEACH and PEGASIS and demonstrates PEGASIS performs much better than LEACH i.e. 100% sensor node death in LEACH is earlier in comparison to PEGASIS regardless of density of network. [4]

Zhao Han et al. proposed a General Self Organized Tree based Energy Balance routing protocol (GSTEB) which builds a routing tree having an activity where, for every single round, BS assigns a root node and broadcasts this selection to all or any or any sensor nodes. Subsequently, each node selects its parent by considering only itself and its neighbor's information. Thus, make GSTEB an energetic protocol. GSTEB prolongs time of WSN by further balancing energy consumption. [5]

M.Sengaliappan et al. proposed a an account tree based routing protocol which builds a routing tree having an activity where, for every single round, BS assigns a root node and broadcasts this selection to all or any or any sensor nodes. Subsequently, each node selects its parent by considering only itself and its neighbors' information, thus making an energetic protocol. The proposed approach performs much better than other existing approaches (GSTEB and EHCT) when put next on following parameters: throughput, load balancing factor, packet dropping ratio. [2]

### III. ANALYSIS

In table 1, the comparison between LEACH and PEGASIS is given, which shows that the performance of PEGASIS is better than LEACH. 100% sensor node death in case of LEACH is earlier than that of PEGASIS.

Table I Percentage of Sensor Node Death with Number of Simulation Rounds

Sensor node death %	Number of rounds (approx.)	
	LEACH	PEGASIS
1	600	1250
10	1000	2100
100	1500	2700

Table II Number of Nodes vs. Number of Rounds

Number of nodes	Number of rounds (approx.)	
	LEACH	PEGASIS
200	300	950
300	200	800
400	100	780
500	10	700

Also, the performance of PEGASIS is better in case of dense network as well.

In table 2, comparison between different schemes based on lifetime of network is given where GSTEB outperforms all the other routing protocols.

Table III Network Lifetime of Different Schemes

A) Comparison of first node dead

Routing protocol	Round a node begins to die	
	Energy 0.25J/node	Energy 0.5J/node
LEACH	118	209
PEGASIS	246	485
TREEPSI	267	532
TBC	328	589
GSTEB	389	730

B) Comparison of last node dead

Routing protocol	Rounds all nodes are dead	
	Energy 0.25J/node	Energy 0.5J/node
LEACH	243	435
PEGASIS	568	1067
TREEPSI	611	1123
TBC	629	1165
GSTEB	677	1330

In table4, comparison of IGSTEB, GSTEB, EHCT is given on the cornerstone of varied parameters like throughput, load balancing factor, packet dropping ratio is given, where, IGSTEB outperforms one other routing protocols.

Table IV Comparison of Routing Protocols

Routing protocol	IGSTEB	GSTEB	EHCT
Throughput(in mbps)	0.90	0.82	0.80
Load balancing factor	60	40	30
Packet dropping ratio (approx.)	900	2300	4800

### IV. CONCLUSION

The key challenges in the design of routing protocols for the wireless sensor networks, is energy efficiency as a result of limited battery life or energy resources of sensor nodes. The energy usage of the sensor nodes is dominated by data transmission and reception. The key aim of energy efficient cluster based protocols is always to

efficiently maintain the energy usage of sensor nodes by involving them in multi-hop communication in just a particular cluster. Clustering plays a significant role for energy saving in wireless sensor networks. With clustering in wireless sensor networks, energy consumption, lifetime of the network and scalability could be improved. In this paper the energy efficient cluster based protocols are compared i.e. LEACH, PEGASIS, TREEPSI, TBC, GSTEB and IGSTEB, where GSTEB outperforms all the previously used protocols and IGSTEB outperforms GSTEB in following parameters-Throughput, Load balancing factor and Packet dropping ratio.

#### ACKNOWLEDGEMENT

This research is supported by Dept. of Electronics and communication of Guru Nanak Dev University, RC Jalandhar. We wish to express our gratitude for this support.

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# Evolution of Gi-Fi Technology in Wireless Networks

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**Abstract**— This paper presents some of the present and future applications and features of the Gi-Fi technology. The technology and data transmission scenario is changing at very rapid rate, the size of files is increasing, so there is a need of a transmission technology which can cater to all these needs. Earlier wired transmission was replaced by Bluetooth and Wi-Fi technology which were very much successful in terms of range but data transmission rate was not that much high. This led to introduction of a new, more up to date technology for high exchange rate at very low cost and power consumption i.e. Gi-Fi

**Keywords**— Gi-Fi, CMOS, HD, Wi-Fi

## I. INTRODUCTION

Gi-Fi is the first transceiver integrated on a 5x5mm single chip which operates at the frequency 60 GHz on the CMOS (complementary metal-oxide- semiconductor) process. It will allow transferring wirelessly audio and video data with the data rate of upto 5gbps, it is 10 times the present maximum wireless transfer rate, at 1/10th of the cost, usually within the range of 10 meters. Gi-Fi is the wireless technology which is 10 times faster than Wi-Fi and it is expecting revolution networking in offices and homes by implementing high speed wireless environment. It utilizes 5mm square chip and 1mm wide antenna requires less than 2mW of power to transmit data wirelessly over a short distance much like Bluetooth technology. Gi-Fi technology provides many features such as enabling the future of information management, ease of deployment, high speed of data transfer, small form factor, low power consumption etc. with growing consumer adoption of HD(High-Definition)televisions, low chip cost and many other interesting benefits and features of this new technology, the predictions can be made that the worldwide market for this Gi-Fi technology is going to be vast.

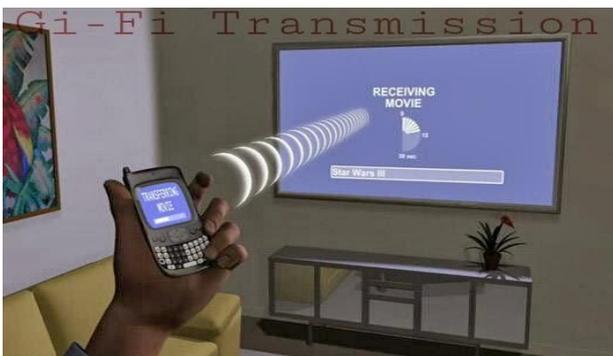


Fig 1 High speed local data transmission

It allows full length HD movie to be transferred between two devices in few seconds to the higher mega-pixel count on our cameras, the increased bit rate of our music files, the higher resolution of our video files. Within 5 years it is expected to be the dominant technology over the present wireless technologies i.e. Wi-Fi and Bluetooth. At that time it will be fully mobile technology, as well as providing low cost and very high speed. large files swapping within seconds and will develop wireless home and office of future and high broadband access. Gi-Fi has potential to bring wireless broadband to an enterprise in an entirely new way. Enhancements to next generation gaming technology is one of the other benefit of this technology.

Theoretically the Gi-Fi technology can transfers GB's of High Definition (HD) movie in just a blink of an eye. So this technology can be considered as a challenger to Bluetooth technology rather than Wi-Fi and could find applications ranging from smart phones to every consumer electronics.

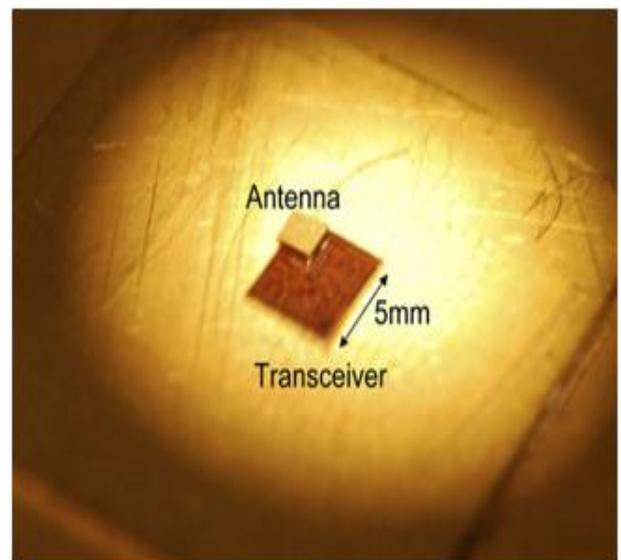


Fig 2 Chip of Gi-Fi

The Gi-Fi technology is good news for personal area networking as there is no infrastructure available to cop it up with so efficiently. It have a range of 10 meters. The usable prototype of Gi-Fi may be less than a year away. With the help of a Gi-Fi chip the video sharing can be possible without any hurdle. The Gi-Fi chip is one of the Australia's most lucrative technologies [1]. The chip size is shown in fig.2 i.e. 5x5mm.

## II. FEATURES OF GI-FI

### A. Capacity of High Speed Data Transfer

The data rate transfer of Gigabit wireless technology is in Gigabits per second. Speed of Gi-Fi is 5gbps; which is 10 times the data transmission of the existing technologies. Providing higher data transfer rate is the main invention of Gi-Fi. An entire HD movie could be transmitted to smart phones in a few seconds, and the smart phone could then upload the movies to HD LED display or personal computer at the same speed. The basic and the basic difference between the Gi-Fi technology and the Bluetooth technology is the speed of data transmission and the range of both the technology is nearly about 10 meters.

### B. Low Chip Cost

Gi-Fi chip uses only a 1mm wide antenna and consumes less than 2mW of power. The low cost chip allows technology to be easily embedded into multiple devices. The chip in Gi-Fi would likely cost about \$10 or less to built [2]. The small design of chip would allow smart phones and other small devices to incorporate the technology without much significant rise up in the price, according to the company. It is based on an open, international standard and works in unlicensed frequency band. Mass adoption of standards, and the low cost, when chips will be mass produced, will bring cost down dramatically and it will be very less in comparison to present technologies.

### C. Security

The security has always been the factors that have held back enterprise the uptake of wireless LANs outside green field sites and lack of performance compared to wire network like Ethernet is also the issue. About 70 per cent of firms are still using the old WEP protocol and have deployed their WLAN in a secure firewall zone, which does not protect the application layer effectively, so better encryption technique is urgent need. Secure encryption technique in Gi-Fi ensures privacy and security of content and files. This means that unauthorized access and hacking of this infrastructure will be difficult and the military applications could be enhanced with this.

### D. Simplicity

The complexity of the system is always the issue with wider system designs. the wires and cables system were very complex for connection but Gi-Fi chip's simplicity is very significant feature. This result in the better consumer experience .the technology will be easily handled by large no. of consumers. The chip provides multi gigabit wireless technology which will remove the cables from consumer electronics completely. Moreover it is 100 times faster than the present technology available for short range wireless transmission Such as Wi-Fi and Bluetooth. There is very high level of frequency reuse in this technology, this will satisfy the more number of customers for their communication needs within a short geographical area.

This helps in transmission of uncompressed high definition videos or content over a range of 10 meters without any kind of Interference. The portability is another noticeable

point by technology, with this the network can be constructed anywhere or everywhere .the complete system can be made on single silicon chip that make it cost efficient and it is operated in unlicensed 57-64 GHz band. Gi-Fi technology has a flexible architecture.

### E. Power Consumption

It is one of the very important feature of Gi-Fi technology. The technologies such as Bluetooth and Wi-Fi normally consume 5 mW and 10 mW of power respectively, but the small sized antenna and chip of Gi-Fi requires a power of less than 2 mW which is very less as compared to Bluetooth and Wi-Fi. While comparing it with Bluetooth which covers same area but the power consumption is high in comparison it justifies the domination of new technology over older one.

## III. APPLICATIONS OF GI-FI

### A. GI-FI Access Devices

There are many devices which can be used for Gi-Fi access. Some of them are shown in fig below. These access devices may include printers, radio modules integrated internally, interface cards, termination units, computers or laptops and household appliances [3].The modern smart phones could be a greater platform for development of different applications using this technology and the peak performance could be taken from the chip[4].

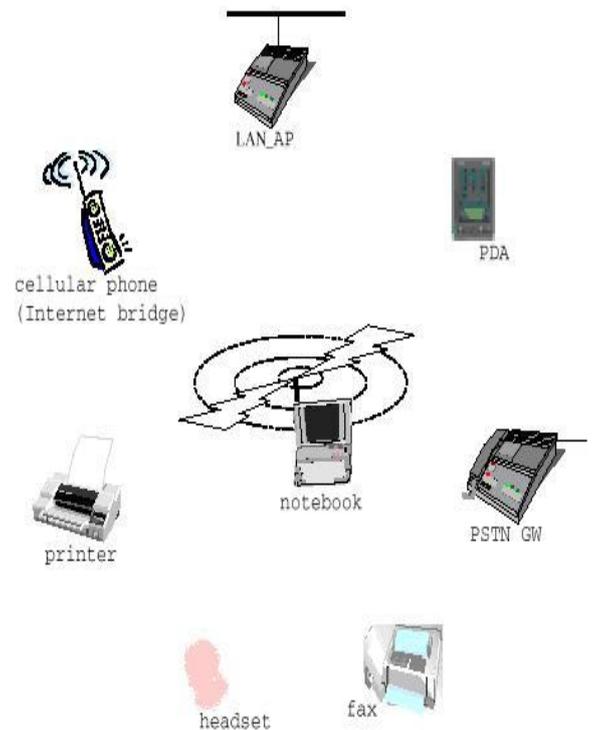


Fig 3 GI-FI Access Devices

### B. Broadcasting Video Signal Transmission System

The temporary broadcasting network can be constructed easily and immediately, these networks can be used in sports stadium in which the high definition video from inside the ground can be broadcasted to the screen

outside the stadium without any delay and compromise to quality of video [5]. The more no. of people could be served at the same place with this.

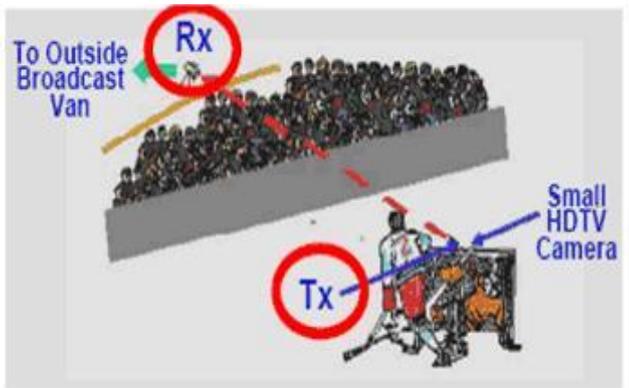


Fig 4 Sports Stadium

### C. Office Appliances

The Gi-Fi technology ensure the high speed data transmission hence the office work will become easy and it will become easy and it will also provide information from internet with high quality and high speed[6].

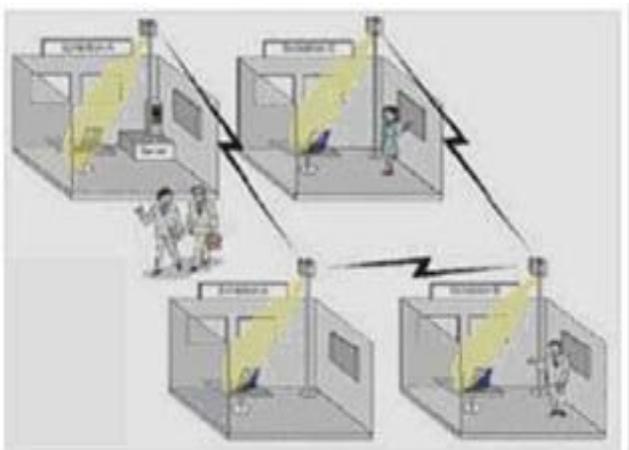


Fig 5 Office

### D. Video Information Transfer

With present technology the large sized files takes hours to swap from one device to another, but with Gi-Fi the data transmission rate will be 5 Gbps which ensure large data transmission at blink of eye [7].

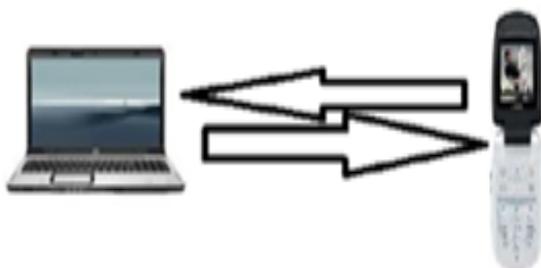


Fig 6 Video Transformation

### E. Inter Vehicle Communication System

The further enhancement in Gi-Fi can make it possible to exchange data between vehicles by adhoc network .the connections will be spontaneously between vehicles and as per the need, they can organize themselves without external help[8].

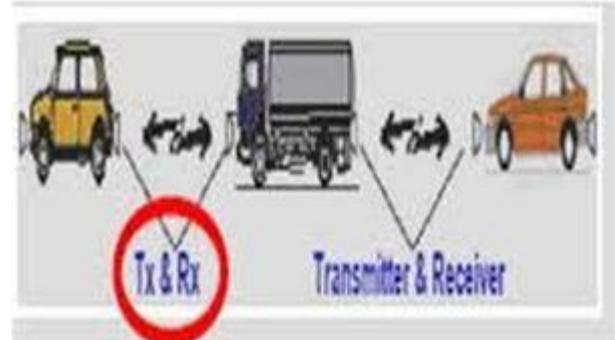


Fig 7 Inter Vehicle Communication System

## IV. FUTURE SCOPE OF GI-FI

Gi-Fi chip is the first chip in the world which is fully integrated transceiver fabricated by CMOS technology which ensure high speed .it operates on 60GHz frequency that lie in microwave range band .the antenna for transmission is also integrated with CMOS technology which is completely new for antenna fabrication .the Gi-Fi technology has a very huge potential to serve the electronics customers .it has the capability to completely change the way in which the home electronic devices are communicating presently. The developers of Gi-Fi are looking for commercializing its chip with the growing demand of customer for high definition video and television .the low cost of chip fabrication and various other features of this chip can easily predict that the demand of this technology is going to be vast worldwide. In coming years we are expecting it to be the most dominant technology which is commercialized for wireless networking .this chip is providing the very essential features like low cost, high broadband access of 57-64GHz which results in swapping of large size file from one device to another within seconds. it will develop a completely wireless office and home of future. The very small size of this chip is another significant feature, it ensure that it can be easily embedded into different devices. This brings a breakthrough for networking homes and offices to be completely wireless. This technology is going to kill the wires from the world.

NICTA is planning to launch Gi-Fi chips in coming years. The low cost factor of this chip is attracting the other companies to launch the chips .the potential of Gi-Fi chip to transmit data at ultra fast rate is prompting many companies like Sony, Samsung, LG, Panasonic, Intel etc to form wireless high definition. This states the goal of wireless connectivity for streaming high definition videos from one device to other

## V. CONCLUSION

In this paper we came to know the present and future applications of Gi-Fi technology. As world is moving to

digitalization the bit rate of our music, the size of our photos and video files is increasing, there is a need of such technology through which we can share large sized data at very high speed within seconds. Gi-Fi is the future of data transmission at short range. Other features of this chip like low power consumption, low cost and security with high data rates makes it very reliable for future devices and systems, there is a need of more research to be done on this technology and future modifications should be made so that it could be available to everyone who have any concern with wireless technology. The data exchange in smart phones could also be emphasized with this technology, the high definition video support of smart phone led to urgent need of exchange technology which can transfer those big video files in less time

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# Performance Investigation of OFDMA System under Multiuser Environment

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**Abstract**— The data in the Orthogonal frequency Division Multiplexing (OFDMA) based communication systems transmit through the subcarriers since the high data rate stream can be divided into the number of low rate data streams. QPSK, M-array phase shift keying and QAM can be combined with OFDMA for better data transmission with advantage of both OFDMA & the various high rate modulation techniques. The quality of the system degrades with the varying network conditions and with the increase number of users in the system. In the present work, the performance of the OFDMA system is evaluated in the multiuser environment under varying network conditions. The performance is evaluated for various modulation schemes such as BPSK, QAM & QPSK. The simulations are performed for varying number of users over dispersive channels and the bit error rate of the system is investigated.

**Keywords**—BER, Multiuser, BPSK, OFDMA, QAM, QPSK

## I. INTRODUCTION

In OFDMA, the multiple sub carriers are so closely spaced that is used for parallel transmission which is assigned to many users. OFDMA technique is special kind of frequency division multiple access technique. The spacing between the carriers is orthogonal to each other. Therefore they do not need of guard bands and that's why multi-users can transmit there information without any interruption or collision. Multiuser system can also increase the system throughput. OFDMA divides the available bandwidth into orthogonal rate subcarriers .OFDMA is an extraordinary part of transmission in which a multicarrier transmission is directed to single stream which is communicated over 'n' number of lower rate subcarriers [8]. OFDMA was selected as the ground basis for the new 5-GHz standard by the standardization society in July 1998 that focuses on a range of data flow from 6 up to 54 Mbps. The standard is the foremost to use based communications as compared to OFDMA's limited access to continuous transmission systems till now. OFDMA has been of great importance for researchers all across the globe. It has been implemented in several wireless systems, such as Digital Audio Broadcast (DAB) and wireless LAN. It is also used in wired communication systems such as ADSL, Mobile Multimedia Access Communication (MMAC) Systems and High Efficiency LAN [7]. As Data rate is the fundamental of Broadband, the new standard specifies bit rates up to higher data rate imposes large bandwidth, hence demanding carriers for values higher than UHF band. OFDMA is basically a modulation technique or multiplexing

technique. It eliminates the effect of frequency selective fading or narrowband interference. A single fade can cause the entire link to fail in a single carrier system, but in a multicarrier system, a parallel narrow-band subcarriers is used unless of a single wide-band carrier are used to transport information, hence resulting in only a small percentage of the affected subcarriers. So, effected error subcarriers can be corrected by using Error correction codes. OFDMA leads to high peak to average power ratio and is responsive to phase noise and frequency offset

In an older parallel data communication system, the total signal frequency bandwidth was divided into 'N' number of Non-overlapping frequency sub-channels. Every sub channel was modulated with a individual symbol and then the 'N' number of sub channels were frequency-multiplexed. It was considered advantageous to nullify the spectral overlap of channels so that interchannel interference can be eliminated. However, this led to inefficient utilization of the available spectrum. To deal with the inefficiency, the ideas were proposed to use the parallel data communication and FDM scheme with overlapping sub channels [7]. However, there are several practical problems with OFDMA. To maintain the orthogonality between the sub-carriers, carrier frequency synchronization has to be accurate and the guard period between consecutive OFDMA symbols has to longer than the channel impulse response. Furthermore, OFDMA signals suffer from a high peak-to-average power ratio (PAR), which puts high requirements on the power amplifiers and the dynamic ranges of digital-to-analog and analog-to-digital converters (DAC and ADC). In the present work, the performance of the OFDMA system is evaluated in the multiuser environment under varying network conditions. The performance is evaluated for various modulation schemes such as BPSK, QAM & QPSK.

## II. RELATED WORK

The OFDMA are significantly researched in the present world and has been seen greatly advantageous as it can lead to greater and better communication across wireless channels Zhou et al [1] Analyzing the scheme for simultaneous wireless information and power transfer (SWIPT) in receiving frequency when more than one user in OFDM systems, where the users gather energy for crops and decoding the received signal containing information at a fixed access point (AP). They used TS (time switching) at the receivers for the TDMA based systems and for information transmission they employ PS (power splitting) at

the receivers. B.M et al [2] Order to mitigate inter-cell interference, various techniques had been proposed. They showed one group of these techniques, static frequency reuse. They presented a comprehensive comparison Reuse-3, fractional frequency reuse (FFR), and soft frequency reuse (SFR), with varying input parameters, such as inner radius and power ratios System simulation is used to evaluate the overall system performance in terms of throughput and SNR. Lodaricheh et al[3] examine for energy efficient resource allocation scheme that is designed for orthogonal frequency division multiple access (OFDMA) cellular wireless networks with multiuser cooperation. The optimization problem is a mixed integer nonlinear program (MINLP), which is in general very difficult to solve in its original form the energy efficiency metric is a fractional and nonlinear function, which complicates the problem further. They provide novel framework to solve such non-linear and non-convex optimization problems. The Carrier Interferometry Orthogonal Frequency Division Multiplexing (CI OFDMA) system expands each transmitted symbol across all 'N' number of sub-carriers using the orthogonal Carrier interferometry spreading codes and shows how it is advantageous to reduce of PAPR (peak to average power ratio) and frequency diversity gains without facing any loss in the communication output The precoded multiuser OFDMA (PMU-OFDMA) system recently introduced how to reduce multi-access interference (MAI) because of the carrier frequency offset (CFO) to a null amount by following the information for the individual user with a codeword which is stipulated from either even or odd Hadamard-Walsh codes [7]. Tried to utilization of energy and entanglement of a multiband orthogonal frequency-division multiplexing (MB-OFDMA) ultra wideband (UWB) system can be implemented by designing from pulsed UWB systems. The approach is the enhancement proposed used pulses with duty cycles minor to 1. Digital OFDMA symbols spread the spectrum of the received modulated signals in the frequency domain, result to achieve proportional the contrary duty cycle of the pulsed subcarriers [11]. Two altered OFDMA formats that enhanced signaling characteristics of OFDMA are precoded orthogonal frequency-division multiplexing (OFDMA) and constant-envelope OFDMA (CEOFDMA). They accept the implementation by discrete Fourier transform and the insertion of guard gaps to counteract channel dispersion [9]. Unique word orthogonal frequency

division multiplexing makes use of the deterministic sequences, the so-called unique words (UWs) that replace cyclic prefixes (CPs). The UWs are developed by loading a set of redundant subcarriers [10]. OFDMA-based Broadband and Wired Communication (BWC) systems reside upon the time domain synchronous OFDMA (TDS-OFDMA as it has higher spectral efficiency which suffers from critical performance and loss over high frequency mobile channels [6]. A distinct OFDMA-based transmission scheme called time-frequency training OFDMA (TFT-OFDMA) proposes that every TFT-OFDMA symbol has containing information present for both the time and frequency domains respectively. Bit error rate performance based on BPSK-based modulation under AWGN and Rayleigh channel conditions from comparison study observes that the OFDMA- BPSK modulation does not succeed over the conventional BPSK modulation scheme using AWGN channel but OFDMA-BPSK modulation using AWGN channel has great successful advantageous role over OFDMA-BPSK modulation in Rayleigh fading channel. Hence, it is found that both OFDMA-BPSK and conventional BPSK have small bit error rate probability than that of the Rayleigh fading based BPSK system [5].

### III. METHODOLOGY

The Multi-User OFDMA system is being developed and its simulation has been done on MATLAB simulink. The channel performance of MULTI-USER transmission in OFDMA system is analyzed. In this system, multiple transmitters are used with same binary source at different modulation schemes (such as QPSK, BPSK, QAM,) which are given to the single receiver under common dispersive channel. The different channel coding will be used such as convolution coding and evaluate the effects on the performance and analysis will be done. The BER will be based on the MULTI-USER transmission using different schemes in OFDMA environment.

### IV. OFDMA SYSTEM

Orthogonal frequency division multiplexing (OFDMA) is an extraordinary part of transmission in which a multicarrier transmission is directed to single stream which is communicated over 'n' number of lower rate subcarriers. The general architecture of the OFDMA based communication system has been presented in Fig 1.

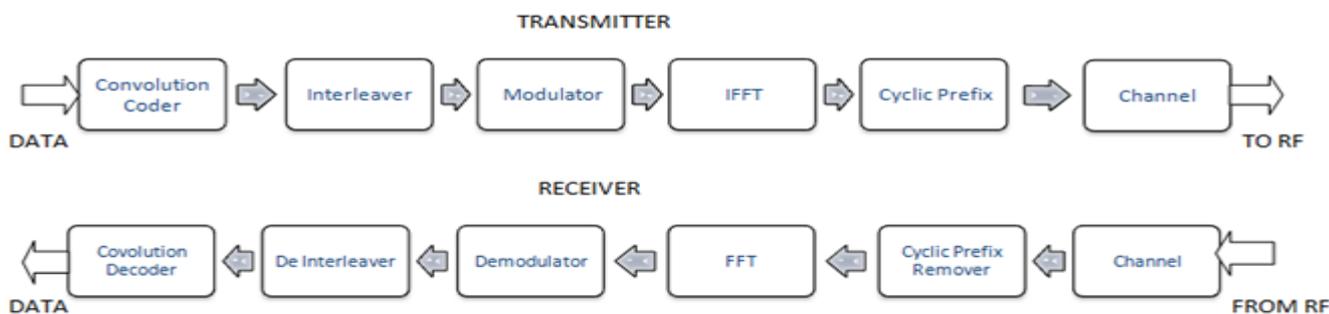


Fig 1 OFDMA Architecture

The word orthogonal specifies the practical relationship about all the frequencies of the data carriers in the OFDMA

system. In OFDM system, the numbers of carriers are spaced apart in a way that the data streams can be received using

filters, demodulators and can be decoded by decoders [4]. Introduction of the receivers, guard bands among the distinct carriers and into the frequency domain, which will lead to the low spectrum efficiency. However, the carriers in an OFDMA signal is so arranged that the sidebands of the different and individual carriers overlaps and adjacent carrier interference is received from the signals. Make this happen mathematically, the carriers should be orthogonal in nature. Demodulators, translating each carrier down to DC at the receiver end signal are integrated above a symbol period for the recovering of the data. Thus, all the further carriers strike the frequencies that are present in time domain, having T as a symbol period which is whole number of cycles. Finally the integration process results in zero for all the other carriers. The carriers are linear (orthogonal) and also the carrier spacing between them is a multiple of 1/T. The transmitter performs the conversion of input data from a serial stream to parallel sets. Each data set contains only a single symbol, Si, for each subcarrier. For example, a series of three data would be [S1 S2 S3]. The receiver performs just opposite operation of the transmitter [4]. The amplitude and phase of the subcarriers are then picked out and converted back to digital data. In Orthogonal Frequency Division Multiplexing, multiple sinusoidal with frequency separation 1/T is used

where T is the active symbol period. The information  $g_k$  to be send on each subcarrier k is multiplied by the corresponding carrier  $g_k(t)$ ,

$$g_k(t) = \frac{1}{\sqrt{T}} e^{\frac{j2\pi kt}{T}} w(t) \tag{1}$$

Where,  $k=0, 1, 2, 3, 4, \dots, N-1$  corresponding the frequencies of sinusoidal and  $w(t) = u(t) - u(t-T)$  is a regular window over  $[0, T]$ . Since OFDMA uses multiple sinusoidal having frequency separation 1/T, therefore each sinusoidal is modulated by independent information. Mathematically can be written as:

$$\begin{aligned} S(t) &= \delta_0 g_0(t) + \delta_1 g_1(t) + \dots + \delta_{N-1} g_{N-1} \\ &= \sum_{k=0}^{N-1} \delta_k g_k(t) \\ &= \frac{1}{T} \sum_{k=0}^{N-1} \delta_k e^{\frac{j2\pi kt}{T}} w(t) \end{aligned} \tag{2}$$

Where, is the kth symbol in the message symbol sequence for k in  $[0, N-1]$ , N is the number of carriers.

The simulation environment for the multiuser OFDMA system is presented in Fig 2-Fig 6.

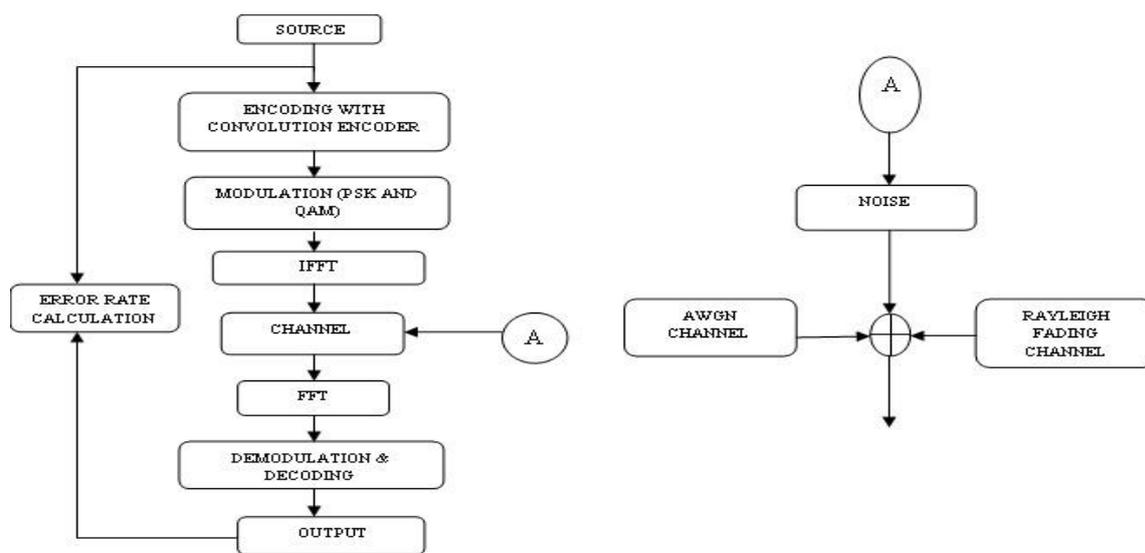


Fig. 2 Flow Chart for OFDMA System

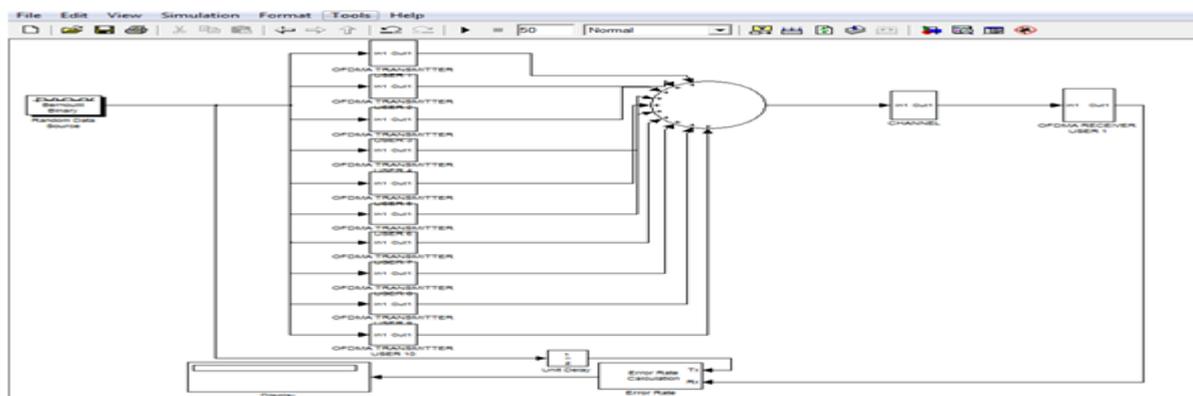


Fig.3 Multiuser OFDMA Simulation mode

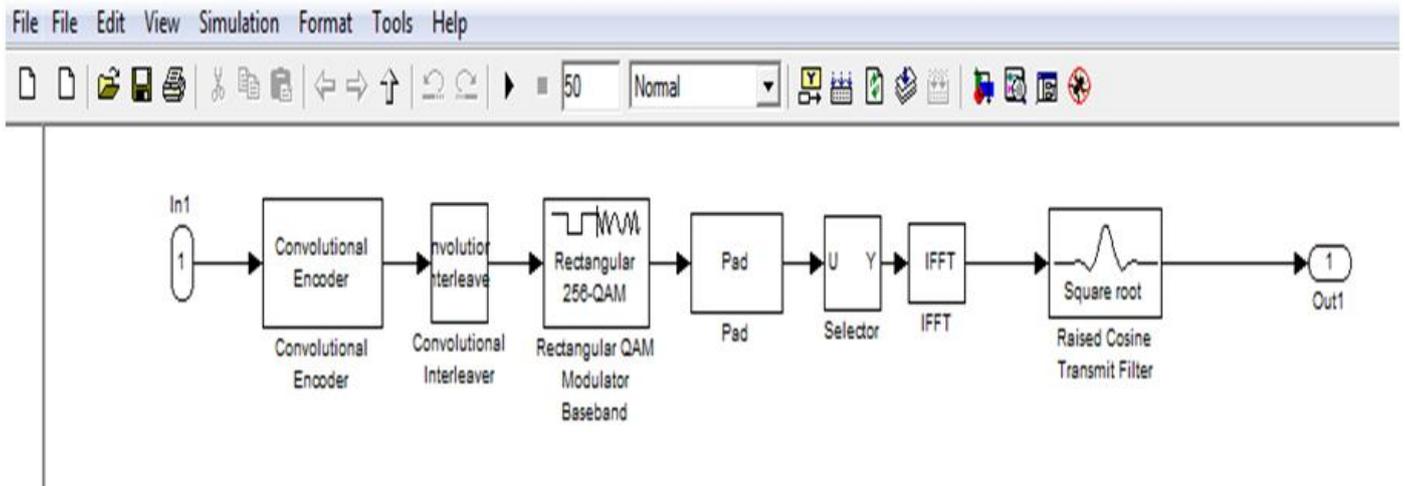


Fig. 4 Multiuser OFDMA Transmitter

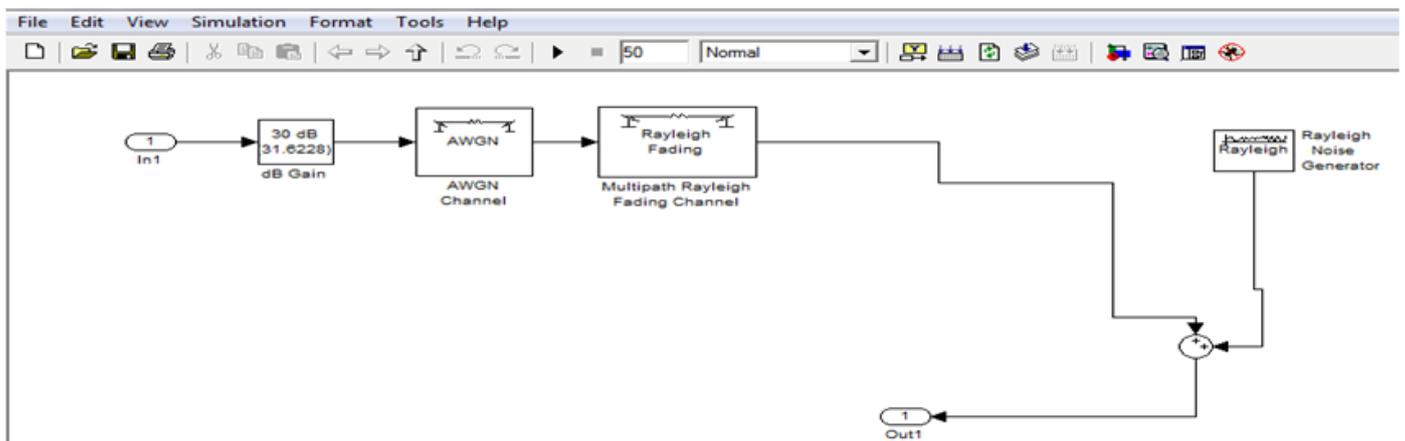


Fig.5 Multiuser OFDM Channel

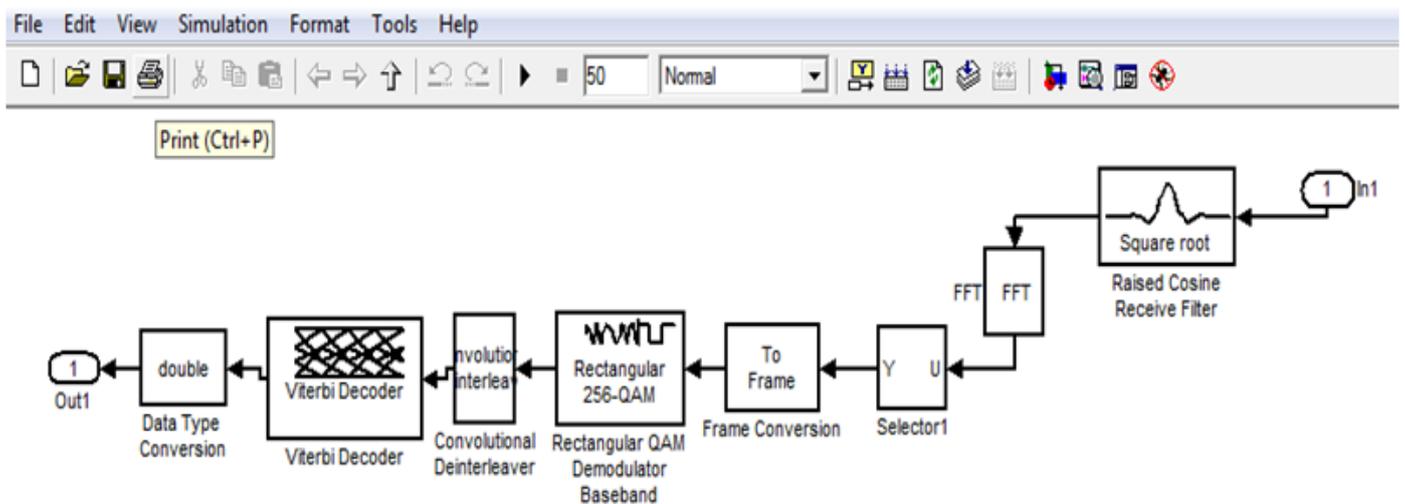


Fig. 6 Multiuser OFDM Receiver

## V. SIMULATION RESULTS

The performance analysis results of multiuser OFDMA based wireless communication system have been presented in Fig. 7- Fig.9. The simulation results are analyzed at different values of SNRs under dispersive environment (frequency selective fading is added to the AWGN channel).

The performance of the multiuser OFDMA system has been evaluated for varying number of user such as 4, 6 and 10 users for different modulation schemes (QAM 64, BPSK and QPSK). The results presented in Fig. 7 to Fig. 9 indicate the quality of the signal degraded as the number of users increased in the system. The performance of the QAM64

modulation is better as compared to the other simulated modulations for multiuser OFDMA system. It is observed that the QAM64 based multiuser OFDMA based wireless system gives much better results under the dispersive channel conditions with the convolutional coding as the BER reaches to  $10^{-3}$  to  $10^{-2}$  for increased number of users, which is acceptable for the communication.

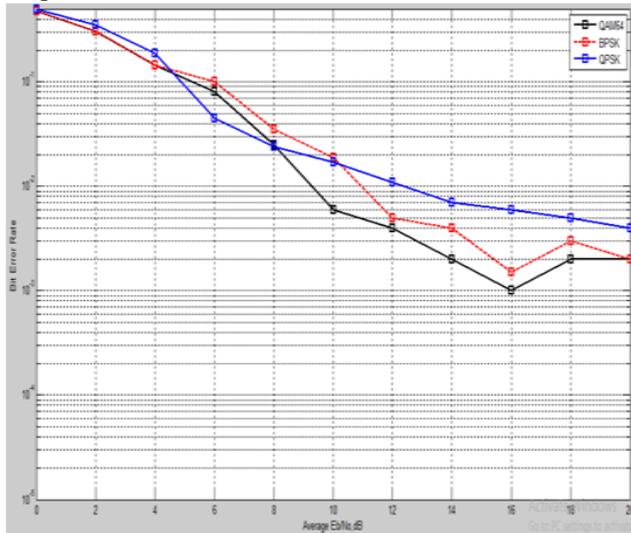


Fig.7 BER for OFDMA 4 users

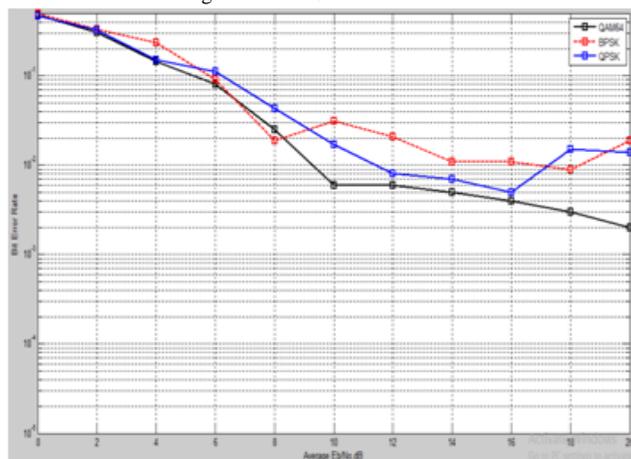


Fig.8 BER for OFDMA 6 users

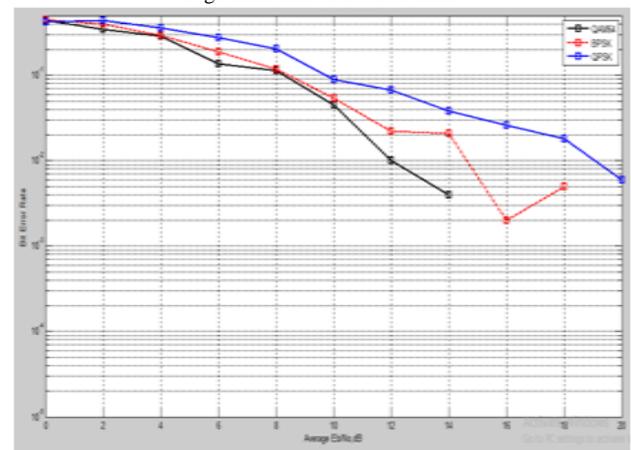


Fig.9 BER for OFDMA 10 users

## VI. CONCLUSION & FUTURE WORK

The performance of the multiuser OFDMA based communication system has been analyzed for various modulations techniques. In PSK modulations, bandwidth increases as the value of M such as number of bits in symbol increases. But lower order modulation techniques are preferred over higher order modulation techniques as the communication range increases between a transmitter & receiver. It is observed that the QAM64 based multiuser OFDMA based wireless system gives much better results under the dispersive channel conditions with the convolutional coding as the BER reaches to  $10^{-3}$  to  $10^{-2}$  for increased number of users, which is acceptable for the communication. In future, the performance of the multiuser OFDMA system will be analyzed for higher order M-QAM under various fading channels such as Rician and Nakagami fading channels.

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# Survey of Different Attacks on Wireless Sensor Networks - Roadmap

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**Abstract**—Today wireless communication technique has become necessary tool in any application that needs communication between more than one sender and multiple receivers. Wireless Sensor Networks (WSNs) have gain quite more popularity over precedent few years. Because of its openness and operating nature in wireless channel security is the mainly difficult aspects in it. The survey of wireless networks security is infinite with various attack models and counter measures proposed by researchers. We have explained different attacks that destroy the functioning of the system and corrupt the performance of network. Among the various attacks of different layers black hole and worm hole attack along with combination of others attacks is the most trendy attack because of its composite nature and tough to detect. In this survey paper we have shown various types of attacks and along with their actions. Moreover this paper covers all those attacks that are more vulnerable in case of wireless sensor network.

**Keywords**—Wireless Sensor Networks, Denial of Service Attacks, Sybil Attacks, Wormhole, Blackhole

## I. INTRODUCTION

A wireless sensor network sometimes called a wireless sensor and actor network are spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. WSNs have inherent and unique characteristics compared with traditional networks. It consists of light-weight, low power and small size sensor nodes (SNs). They have ability to monitor, calculate and communicate wirelessly. Sensor nodes should send their collected data to a determined node called Sink. The sink processes data and performs appropriate actions. Nodes using routing protocol determine a path for sending data to sink. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on. A wireless sensor network is a group of specialized transducers with a communications infrastructure that uses radio to monitor and record physical or environmental conditions.

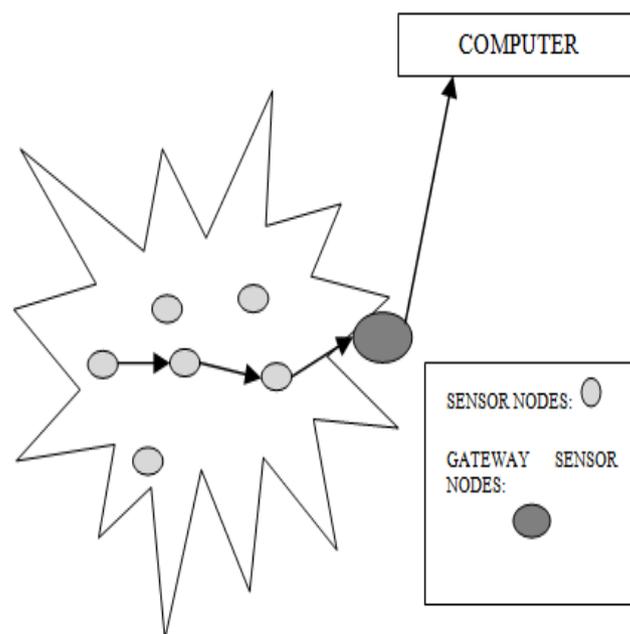


Fig.1.:Architecture of Multi-hop Wireless sensor Network

Most of the WSN's routing protocols are easy and straightforward because of this reason they are vulnerable to attacks. The Denial of Service attack is considered particularly as it targets the energy efficient protocols that are unique to wireless sensor networks. So we start by considering such characteristics of the network and giving their impact on the security of the network. By preventing a single device from sending traffic or by preventing the communication between the network, DoS attacks target availability of services to the users. In this paper we present a survey of attacks on WSN, discuss about the various DoS attacks, and the impact of DoS on the performance of the system.

Wireless sensor networks was concerned by battlefield surveillance; now these networks are developed in industrial process monitoring and control, machine health monitoring and so on. Wireless sensor nodes have insecure wireless communication are easily vulnerable by threats. Reliable and secure communication, as a main aspect of any wireless networking environment, is an especially significant

challenge in wireless networks. The mission critical nature of sensor nodes imposed many attacks such as:

- 1) Attacks on authentication
- 2) Attacks on data integrity.
- 3) Attacks on data availability.

The deployment of sensor nodes may have intelligent adversaries intending to subvert damage or hijack message exchanged in the network. This may lead to degrade performance in the network and change the overall topology of network. Hence, Security is the important and critical issue in the wireless networks due to its operating nature.

## II. ATTACKS ON WIRELESS SENSOR NETWORK

Most of the WSN's routing protocols are easy and straightforward. Because of this reason they are vulnerable to attacks. There are different types of network layer attacks in WSNs which can be categorised as following:

### A. Denial of Sleep Attacks

The most energy consumption attack in wsn is denial of sleep attack in which attacker consumes the sensor nodes energy by making it nodes wake even when there is no traffic to hold. In this way sensor nodes energy is consumed totally and sensor nodes die. Due to which the lifetime of the wireless sensor network decreases by causing the radio of the receiver ON draining the battery in only few days. Energy is wasted due to Collision, Overhearing, and Control packet overhead and Over -emitting. When the receiver node receives more than one packet at a time collision occurs and has to be discarded and retransmitted which increases the energy consumptions. Overhearing occurs when the node receive a packet destined for other node which causes the receiving node energy consumption by keeping its radio on. The third energy consumption problem is control packet overhead where the minimum number of control packets are send for the data transmission as the staying the node wake for control packets consume the battery life. Control packets are RTS (request to send) and CTS (clear to send).The last reason for energy consumption is caused by the transmission of the message when the destination node is not ready to receive.This energy consumption attacks are performed on Data link layer. Data link layer are divided into LLC (Link layer control) and MAC (medium access control) layer. MAC layer is used to overcoming this energy consumption attack.

### B. Selective Forwarding Attacks

The selective forwarding Attack was first described by Karlof and Wagner. Selective Forwarding Attack is a network layer attack. In this type of the attack compromised nodes drop particular sensitive messages and forward the rest. It is difficult to identify the compromised node in the whole network. Selective forwarding attacks are most effective when the attacker is explicitly included on the path of a data flow. Selective forwarding and black hole attacks are very disastrous attacks for sensor networks if used with sinkhole attack because the intruder can drop most of the important packets. Further classification of this attack is inside attack and outside attack. Inside attack occurs within the network through compromised nodes and outside attack

occurs from outside of the network by jamming the communication channels between uncompromised nodes.

### C. Sinkhole Attacks

In a sinkhole attack an intruder compromises a node or introduces a counterfeit node inside the network and uses it to launch an attack. The compromised node tries to attract all the traffic from neighbor nodes based on the routing metric used in the routing protocol. When the compromised node manages to achieve that, it will launch an attack. Sinkhole attacks are a type of network layer attack where the compromised node sends fake routing information to its neighbors to attract network traffic to itself. Due to the ad hoc network and many to one communication pattern of wireless sensor networks where many nodes send data to a single base station, WSNs are particularly vulnerable to sinkhole attacks. Based on the communication flow in the WSN the sinkhole does not need to target all the nodes in the network but only those close to the base station.

### D. The Sybil Attacks

Sybil attack as a malicious device illegitimately taking on multiple identities. We refer to a malicious device's additional identities as Sybil nodes. This node will affect to the network by modifying network resource and collapse the network. The node replicates itself to make many copies to confuse and Collapse the network. The system can attack internally or Externally. External attacks can be prevented by authentication but not the internal attacks. There should be one to one mapping between identity and entity in WSN. But this attack violates this one-to-one mapping by creating multiple identities.

### E. Wormholes Attacks

Wormhole attack is one of the Denial-of-Service attacks effective on the network layer, that can affect network routing, data aggregation and locate on based wireless security. [3] The wormhole attack may be launched by a single or a pair of collaborating nodes. In commonly found two ended wormhole, one end overhears the packets and forwards them through the tunnel to the other end, where the packets are replayed to local area. In case when they only forward all the Packets without altering the content, they are helping the network to accomplish transmission faster. But in majority of the cases, it either drops or selectively forwards the packets, leading to the network disruption. Wormhole attack does not require MAC protocol information as well as it is immune to cryptographic techniques. [4] This makes it very difficult to detect. A number of approaches have been proposed for handling wormhole attack. Some approaches only detect the presence of wormhole in the network, while some approaches also focus on avoiding or preventing the wormhole attack. Majority of the techniques presented require additional hardware support, tight time synchronization, localization information or may be confined to specific routing algorithm.

### F. Spoofing Attacks

Due to the open-nature of the wireless medium, it is easy for adversaries to monitor communications to find the layer-2 Media Access Control (MAC) addresses of the other

entities. Recall that the MAC address is typically used as a unique identifier for all the nodes on the network. Further, for most commodity wireless devices, attackers can easily forge their MAC address in order to masquerade as another transmitter. As a result, these attackers appear to the network as if they are a different device. Such spoofing attacks can have a serious impact on the network performance as well as facilitate any forms of security weaknesses, such as attacks on access control mechanisms in access points [16], and denial-of-service through a de-authentication attack [17]. A broad survey of possible spoofing attacks can be found in [7], [10]. To address potential spoofing attacks, the conventional approach uses authentication. However, the application of authentication requires reliable key distribution, management, and maintenance mechanisms. It is not always desirable to apply authentication because of its infrastructural, computational, and management overhead. Further, cryptographic methods are susceptible to node compromise—a serious concern as most wireless nodes are easily accessible, allowing their memory to be easily scanned. It is desirable to use properties that cannot be undermined even when nodes are compromised. We propose to use received signal strength (RSS), a property associated with the transmission and reception of communication (and hence not reliant on cryptography), as the basis for detecting spoofing. Employing RSS as a means to detect spoofing will not require any additional cost to the wireless devices themselves—they will merely use their existing communication methods, while the wireless network will use a collection of base stations to monitor received signal strength for the potential of spoofing.

#### G. Blackhole Attacks

Black hole attacks are one such attacks in WSNs. A black hole attack is an attack that is mounted by an external adversary on a subset of the sensor nodes (SNs) in the network. The adversary captures these nodes and reprograms them so that they do not transmit any data packets, namely the packets they generate and the packets from other SNs that they are supposed to forward. These term re-programmed nodes as black hole nodes and the region containing the black hole nodes as a black hole region.

#### H. Collision Attacks

In the collision attack [2], the adversary sends his own signal when he hears that a legitimate node will transmit a message in order to make interferences. In theory, causing collisions in only one byte is enough to create a CRC error and to cripple the message. The advantages of a collision attack are the short power energy consumed and the difficulty to detect it (the only evidence of collisions attacks is incorrect message). In fact, such an attack can target specially the ACK control message causing an exponential back-off in some MAC protocol. According to attack attributes, first the intention of the collision attack is to exhaust the battery by using the channel of communication indefinitely. Then in the movement class, the attacker does not really need particular technical capabilities and it can be launched by anyone in the network, the vulnerability is the data integrity requirement and the layer used is the link layer. The target is general logical and can be at the same

time against internal service like power management and against provided services, for example the communication service. Finally the result can be partial degradation if the attack is launched in certain region in the network or total degradation if the attack is applied in multiple precise locations in the network.

#### I. Eavesdropping

It is an attack made in WSN for recording the packet flow. This will help in reusing the packets in order gain access to sensitive information of the network. The encryption mechanisms also can't prevent this kind of attacks as it is able to record and play the packets on the fly. This is the reason this attack allow illegal access to sensitive data.

#### J. Replay Attacks

It is an attack made in WSN for recording the packet flow. This will help in reusing the packets in order gain access to sensitive information of the network. The encryption mechanisms also can't prevent this kind of attacks as it is able to record and play the packets on the fly. This is the reason this attack allow illegal access to sensitive data.

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### III. CONCLUSION

We have elaborated various attacks that destroy the functioning of the network and corrupt the performance of network. Among the different attacks of various layers, wormhole attack and black hole along with combination of others attacks are hard to detect. Wormhole attacks can significantly slow down the network performance and hamper network security. Countermeasures have been taken for the detection of these types of attack but still there is lot to do more in order to bring such a security that cannot degrade the performance of wireless network. I hope by going through this paper the readers can have a better observation on security requirements with attacks and their countermeasures on different layers in Wireless Sensor Networks.

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# Effect of Time to Live (TTL) to Epidemic, Prophet, Spray and Wait Routing Protocols for Delay Tolerant Networks

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**Abstract**--The performance analysis of different Delay Tolerant Networks (DTNs) routing mechanisms plays a key role in understanding the design of DTNs. It gives the capacity to describe the conduct and execution of routing protocols, which encourages one to choose proper routing protocol for the application or the system under control. DTNs routing protocols have differ in the knowledge that they use in making routing decision and the number of replication they make. In this paper we analysis the effect of Time to Live (TTL) to different DTNs routing protocols like Epidemic, Spray and Wait (SaW), Probabilistic Routing Protocol using History of Encounters and Transitivity (Prophet). The first two routing protocols do not require any knowledge about the network. The latter one protocol use some extra information to make decisions on forwarding. As the results illustrated in graphs show that the delivery ratio steadily increased with the increasing TTL in the case of SaW routing protocol. . Simulation results also show that 20%-25% L copies of the total number of nodes in the network gives better delivery ratio and less overhead with minimum average delay in SaW.

**Keywords**- Delay Tolerant Networks, Epidemic, Prophet, Spray and Wait, Opportunistic Network Environment (ONE)

## I. INTRODUCTION

A Delay Tolerant Networks (DTNs) is a sparse dynamic wireless network where mobile nodes work on ad hoc mode and forward data opportunistically upon contacts [1], [2]. Since the DTN is sparse and nodes in the network are dynamic, the irregular connectivity makes it difficult to assurance an end-to-end path between any nodes pair to transfer data and long round trip delays make it impossible to provide timely acknowledgements and retransmissions. The communication of nodes can only be made possible when they are in the communication range of each other. When a node has a copy of message, it will store the message in the buffer throughout the network in hops until forwarding the message to a node in the communication range which is more appropriate for the message delivery. In these challenging environments the traditional ad-hoc routing protocols such as Ad hoc On Demand Distance Vector (AODV) [3] or Dynamic Source Routing (DSR) [4] do not work well in DTN because they require fully connected path between source and destination for communication to be possible. DTNs allow people to communicate without network infrastructure; they are widely used in battlefield, wildlife tracking, and vehicular communication etc. where setting up network infrastructure is almost impossible and costly [5]. In recent years, with the propagation of social network applications and mobile

devices, people tend to share texts, photos and videos with others via mobile devices in DTNs.

In this paper we have analyzed the effect of TTL on different DTN routing protocols (Epidemic, Spray and Wait (SaW), Probabilistic Routing Protocol using History of Encounters and Transitivity (Prophet)). These protocols were analyzed on three different metrics namely Delivery Probability, Average Latency and Overhead Ratio. The performance metrics is given in section III. The remainder of paper is organized as follows: section II briefly gives the introduction of the DTN routing protocols. Section IV gives the details of simulator and section V gives the simulation setup used to carry out the work. Section VI discusses the results. Section VII concludes the paper and lists the directions for future work.

## II. ROUTING PROTOCOLS IN DTN

The DTN routing protocols taxonomy is based on whether or not a protocol creates replicas of messages. The routing protocols that never replicate a message are considered as forwarding-based routing whereas the protocols that do replicate messages are considered as replication-based routing [6]. There are both advantages and disadvantages of each type of the routing protocols. Forwarding-based schemes cost generally much less network resources as only a single copy of a message exists in the storage in the network at any given time [7]. The protocols which generate just single copy [8] (e.g., First Contact [9], Direct Transmission/Delivery [8]), Furthermore, when the destination has received the message, no other node can have a copy of it. It can eliminate the need for the destination to provide feedback to the network for indicating the outstanding copies can be deleted. Unfortunately, forwarding-based approaches cannot ensure sufficient message delivery rates in many DTNs [10]. Replication-based schemes, on the other hand, are able to have greater message delivery rates [1], because multiple copies exist in the network while only one copy will reach the destination. However, the tradeoff is that these protocols will consume large valuable network resources. Furthermore, many flooding-based protocols are inherently not scalable. Some protocols, such as SaW [10], attempt to compromise by limiting the number of possible replicas of a transmitted message.

### A. Replication-based Routing

Epidemic routing [11] is flooding based in nature, as nodes continuously replicate and transmit messages to newly discovered contacts that do not already possess a copy of the message. In the simplest case, epidemic routing is flooding. However, more sophisticated techniques can be used to limit the number of message transfers. Epidemic routing has its roots in ensuring distributed databases remain synchronized. And other techniques such as rumor mongering can be directly applied to routing.

Burgess et al. [10] presented SaW; an n-copy routing protocol with two phases of SaW routing protocol: the spray phase and wait phase. In the spray phase when new message is created at the source node, n copies of that message are initially spread by the source and possibly received by other nodes. In wait phase, every node containing a copy of message and simply holds that particular message until the destination is encountered directly. There are two versions of SaW: normal mode, a node gives one copy of the message to each node encountered that does not have same copy. In Spray and Wait Binary mode (SaWBinary), half of the n copies to the first node encountered and that node transmits half of the copies to the one it encounters first this process is continue until one copy is left with the node.

Prophet (Probabilistic Routing Protocol using History of Encounters and Transitivity); an unlimited-copy routing protocol or flooding-based in nature [12]. It estimates probabilistic metric called delivery predictability. This routing protocol based on the probability of node's contact with another node. The message is delivered to another node if the other node has a better probability of delivering it to the destination.

Table 1 Summarize the DTN routing protocols and there characteristics.

Table 1.DTN Routing Protocols

Routing Protocol	Abbreviations	*-copy	Estimation-based
Direct Delivery [8]	DD	Single-copy	No
First Contact [9]	FC	Single-copy	No
Epidemic [11]	Epidemic	Unlimited-copy	No
PRoPHET [12]	Prophet	Unlimited-copy	Yes
MaxProp [5]	Maxprop	Unlimited-copy	Yes
Spray and Wait [10]	SaW Normal / SaW Binary	n-copy	No

### III. PERFORMANCE METRICS

This section characterizes the measurements that are regarded in this study to look at and assess the performance of different DTN routing protocols. The DTNs routing

protocol need to tolerate delays resulting from the tested environment and the main requirement of such protocols is that the messages are reliably delivered. Hence, performance metrics for evaluating the performance of DTN protocols are delivery probability and delivery latency [13]. Overhead in transmission of the messages results in additional energy consumption. As the mobile nodes in DTNs are energy constrained, the overhead is considered as another important metric. In this study, the performances of various DTN protocols are evaluated based on the metrics like delivery ratio, average delivery latency and overhead ratio under different scenarios. Besides these metrics, the buffer utilization is observed and the impact of buffer size on performance is also examined. These metrics are defined as follows:

A. *Delivery Probability*: It is defined as the ratio of the number of messages actually delivered to the destination and the number of messages sent by the sender.

$$\text{Delivery Probability} = \frac{\text{no of message delivered to destination}}{\text{no of message sent by sender}}$$

B. *Average Latency*: It is defined as the average of time taken by all messages to reach from source to destination.

$$\text{Average latency} = \text{Average (Time taken by all messages to reach from source to destination)}$$

C. *Overhead Ratio*: This metrics is used to estimate the extra number of packets needed by the routing protocol for actual delivery of the data packets.

$$\text{Overhead ratio} = \frac{\text{no of relayed message-no of delivered message}}{\text{no of delivered message}}$$

### IV. THE SIMULATOR

The majority of researcher use simulator which easily allow for a large number of reproducible environment-conditions. Simulation plays an important role in analyzing the behavior of DTN routing protocols. There are various simulators available like NS-2 (Network Simulator, 2000), DTNSim (Delay Tolerant Network Simulator), OMNet++, OPNET and The ONE. The ONE is preferred among the simulators because the NS-2 simulator lacks full DTN support. It only supports Epidemic routing whereas DTNSim lacks in movement models. OPNET and OMNet++ are tailored to specific research needs and hence have fairly limited support for available DTN routing protocols. The ONE simulator is a discrete event based simulator. It is a java-based tool which provides DTN protocol simulation capabilities in a single framework. A detailed description of The ONE simulator is available in [14] and ONE simulator project page [Available: <http://www.netlab.tkk.fi/utkimus/dtn/theone,2009>] where source code is also available. The overview of ONE simulator with its elements and their interaction are shown in Fig 1.

### V. SIMULATION SETTING

Simulation scenarios are created by defining simulated nodes and their characteristics. The simulation parameters are set as mentioned in Table 2. The simulation is modeled

as a network of mobile nodes positioned randomly within an area (4500 x 3400 m<sup>2</sup>).

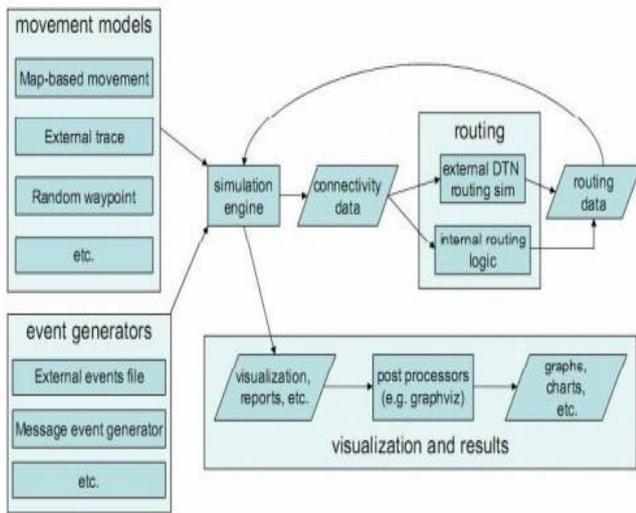


Fig 1. Overview of the One Simulator Environment

Table II. Simulation parameter setting

Parameter	Values
Total Simulation Time	12 hrs
Transmission range	10 m
Transmission Speed	250kbps
Routing Protocol	Epidemic, Prophet, SaW
Number of hosts (N)	126
Speed (m/s)	Min =0.5 m/s Max=1.5 m/s
Packet Inter arrival time	200-300 sec
Buffer Size	10 MB
msgTTL	60, 120, 180, 240, 300, 360
Number of copies (n) in SaW	6
Movement Model	Shortest Path Map Based Movement (SPMBM)

## VI. RESULT AND ANALYSIS

The effect of varying TTL on different routing protocols like Epidemic, SaW, and Prophet Protocols are evaluated. The results of performance metrics are presented in the form of graph.

### A. Delivery Probability

From Fig 2, it is evident that the delivery probability of SaW routing protocol of in the considered scenario is high as compared to the delivery probability of Epidemic and Prophet routing protocol. The delivery probability of Epidemic and Prophet routing protocol is very high with increase of message TTL form 60 to 120 minutes, after that the value these protocol is abruptly decreases with increasing of the message TTL from 120 to 360. The delivery probability of SaW routing protocol increases (from 0.2 to 0.8 approximately) with the increase in message TTL. (from 60 to 360 minutes)

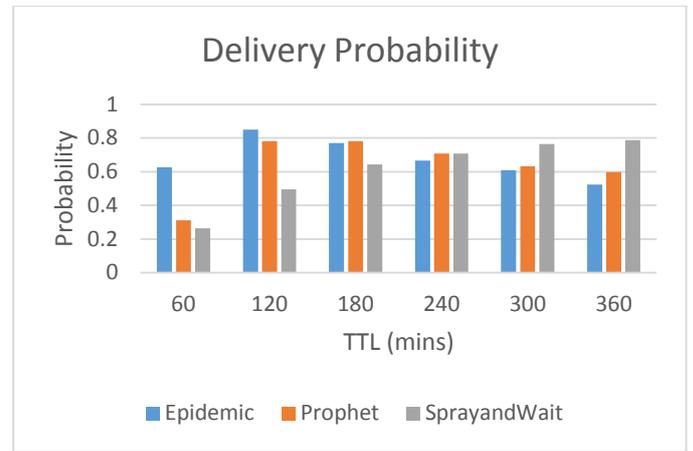


Fig 2. Delivery probability v/s varying message TTL

### B. Overhead Ratio

Overhead ratio of SaW routing protocol decreases slightly from 18 packets to approximately 6 packets (Fig 3.), whereas the overhead ratio of Epidemic and Prophet routing protocol increases as the message TTL is increased. Overhead ratio of Epidemic and Prophet routing protocol is higher than SaW routing protocol when the message TTL is increase from 60 to 360 minutes. But as the message TTL increases the overhead ratio of SaW routing protocol decreases. In complete scenario the overhead ratio of SaW routing protocol is approximately 60%-70% less than the Epidemic and Prophet routing protocols.

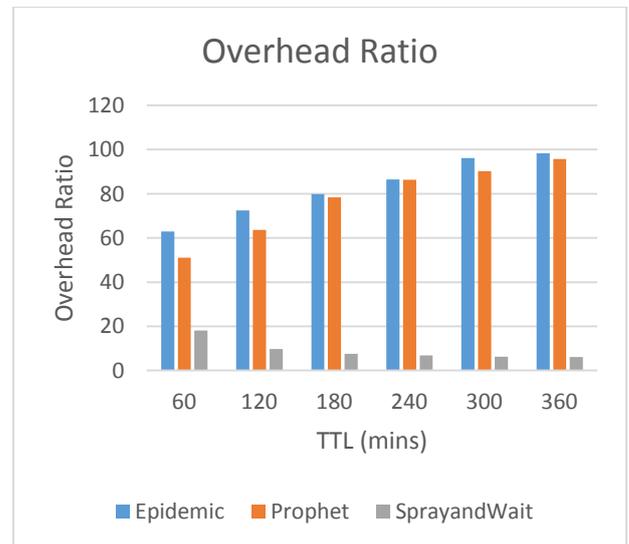


Fig 3. Overhead ratio v/s message TTL

### C. Average Latency

It is illustrated form Figure 4, it is evident that the average latency experienced by the packets in all the three considered routing protocol is same and increases with the increase in the message TTL. This is because as the lifetime of the packet increases the packet has to wait more and more in the buffer before it is either delivered to the destination node or it is being discarded due to lifetime expiry. So the overall latency increases with the increase in the lifetime of the message (i.e. message TTL).

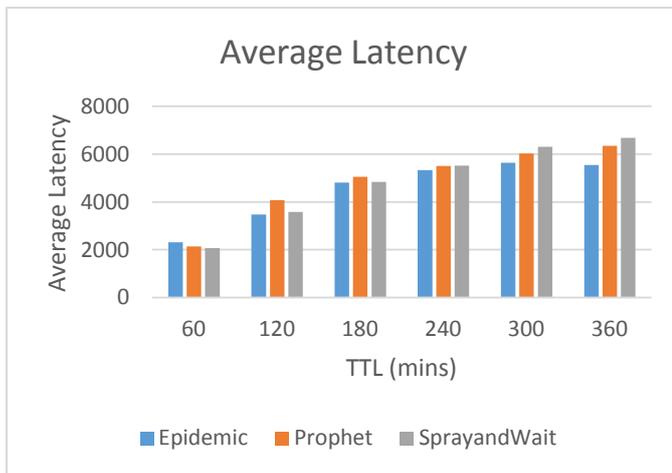


Fig 4. Average latency v/s message TTL

## VII. CONCLUSION

In this paper we have analyzed the performance of three DTN routing protocols (Epidemic; Prophet; and SaW) by varying the message TTL. The analysis clearly shows that the SaW routing protocol gives best results for delivery probability and overhead ratio under the considered scenario whereas the Average Latency being experienced by the messages is almost comparable in all the three considered routing protocols. So among the considered routing protocols the SaW routing protocol gives the best performance in the given set of conditions and considered scenario.

In future we would like to further explore the performance of other routing protocols. Also it will be interesting to see the effect of non-cooperative nodes on the performance of these routing protocols.

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# Data Aggregation Schemes for Wireless Sensor Networks

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*Abstract*--In the application based wireless sensor networks, energy and bandwidth of the sensors are valued resources and essential to consume proficiently. Data aggregation at the base station by individual nodes causes flooding of the information which results in maximum energy consumption. To diminish this problem a new data aggregation technique was proposed called ERA that has improved the performance of the WSNs by using the cluster based data aggregation. In this paper, it has been shown that this technique of data aggregation is not very much efficient. Therefore paper ends with future scope to enhance this technique.

**Keywords** - WSN, Data Aggregation, ERA

## I. INTRODUCTION

In recent years, Wireless sensor networks (WSNs) have gained worldwide attention due to the development of smart sensors. A smart sensor node consists of a warning unit, an ADC (Analog to Digital Converter), a CPU (Central processing unit), a power unit plus a communication unit. Wireless sensor network (WSN) comprises of number of low-power multi-functional sensor nodes that work in an unattended environment and comprises of sensing, computation and communication capabilities. Sensor nodes are micro-electro-mechanical systems (MEMS) that create calculable reaction to a modification of some physical condition like temperature and pressure [1]. The main function of Sensor is to sense or calculate the physical data with the area to become monitored. The repetitive analog signal sensed through the sensors is digitized by an analog-to-digital converter and brought to controllers for further processing. In order to make sensors independent and adaptive towards environment, sensor nodes are made up of smaller size and they use external low energy and are operated in high volumetric densities.

The spatial density of sensor nodes within the field could be around 20 nodes/ m<sup>3</sup>. As wireless sensor nodes are generally smaller electronic gadgets they may only be ready having a limited power source. Some reasons for power consumption in sensors are: (a) signal sampling and conversion of physical signals to electrical ones (b) signal conditioning (c) analog-to-digital conversion [1, 2].

## II. DATA AGGREGATION TECHNIQUES

In typical WSNs, sensor nodes are generally resource constrained and battery-limited. To save resources and energy, data is needed to be aggregated to prevent overwhelming number of traffic within the network. The

purpose of data aggregation is to eliminate redundant data transmission and enhances the duration of energy in wireless sensor network [3-6]. Data aggregation decreases the amount of data packets for transmission and relieve burden from sensor nodes. The wireless sensor network consists of several types of nodes: Simple regular sensor nodes, aggregator nodes and querier nodes. Regular sensor nodes sense data packet all the way through the environment and send towards the aggregator nodes. Basically these aggregator nodes collect data from multiple sensor belonging to the network, aggregates the information packet using some aggregation functions like sum, average, count, max min after which sends aggregates lead to upper aggregator node or perhaps the querier node that generate the query[4].

It could possibly be the base station or sometimes an additional user who having permission to communicate with the network. Data transmission between sensor nodes, aggregators combined with the querier consumes lot of energy in wireless sensor network. The below Fig.1 contains two models, the initial one is data aggregation model and the second is non data aggregation model. In this figure, sensor nodes 1, 2, 3,4,5,6 are regular nodes that collect data packet and report towards the top of nodes where as sensor nodes 7, 8 are aggregators which perform sensing and aggregating along exactly the same time. In this kind of aggregation model, 4 data packet travelled through the entire network and a specific data packet is transmitted towards base station (sink) along with other non data aggregation model. Moreover, 4 data packets travelled around the network and data packets are delivered to the base station (sink) by utilizing data aggregation process. This process leads to decrease in the total amount of data packet transmission and furthermore it also saves energy in the sensor node inside wireless sensor network [3, 4].

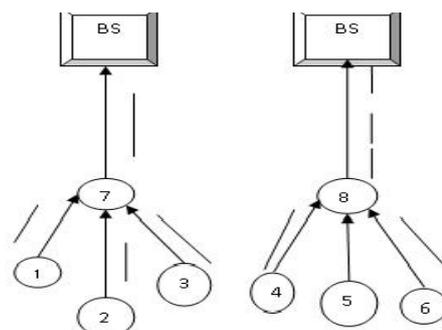


Fig.1: Data aggregation model and Non-data aggregation model [3]

By making usage of data aggregation, the duration of the wireless sensor network is enhanced. Sink possess a data packet with energy-efficient manner and with minimum data latency. Data latency is important factor in wireless sensor network for instance environment monitoring, health monitoring, etc. In order to develop energy-efficient data-aggregation algorithms, network lifetime should be enhanced. Various data aggregation approaches in WSN are:

**A. Cluster-Based Approach:**

In energy-constrained sensor networks of enormous size, it could be inefficient for sensors to deliver the data immediately to the sink. Cluster based approach is hierarchical approach. In cluster-based approach, whole network is divided into many clusters as presented in Fig.2. Each cluster possesses a cluster-head [5, 6]. Cluster-head acts as an aggregator which aggregate the data received from cluster members.

**B. Tree-Based Approach:**

The tree based approach is defining the aggregation by constructing an aggregation tree as presented in Fig.3. The type of tree is minimum spanning tree in which sink node is considered to be a root and source nodes considered as leaves. Information flows from leaves nodes to root means sink or base station [5]. The negative effect of this strategy is that wireless sensor network usually are not clear of total failure. In case, there is data packet loss at any higher level of tree, the results will probably be lost and not limited to single level however for whole sub tree as well. This strategy is acceptable for designing optimal aggregation techniques.

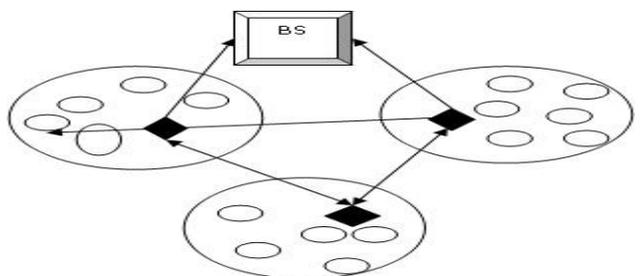


Fig.2: Cluster based sensor network [5]

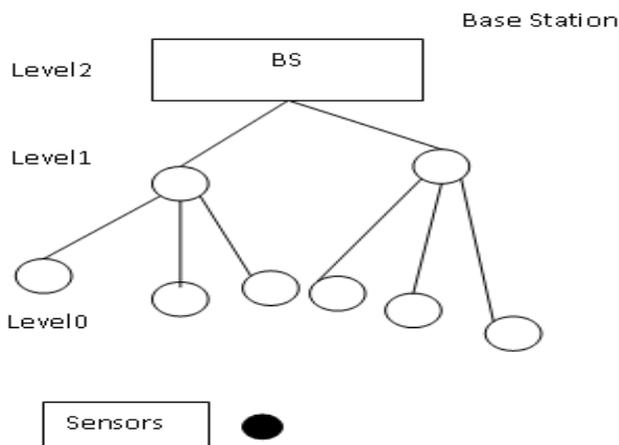


Fig.3: Tree-based Data aggregation in WSN [5]

**C. Hybrid-Based Approach:**

Hybrid approach followed with tree and cluster based scheme [5]. Within this, the aggregation structure can adjusted in accordance with specific network situation and by some performance statistics

**III. ENERGY AWARE ROUTING**

Energy Aware Routing (ERA) is another routing protocol for prolonging the lifetime of a WSN. The algorithm is based on clever strategy of cluster head (CH) selection, residual energy of the CHs and the intra-cluster distance for cluster formation .To facilitate data routing , a directed virtual backbone of CHs is constructed that is rooted at the sink. ERA uses among multiple paths between a source node to the information sink with a certain probability so the duration of the entire work is increased. The experimental results show that the algorithm outperforms other existing algorithm in terms of network lifetime, energy consumption and other parameters [6].

The algorithm includes two phases, namely clustering and routing

- Clustering:

Sensor nodes are grouped into clusters as follows. Each sensor node sets its own timer independently before it starts the campaign for CH selection.

- Routing:

To route the information to the sink, a Directed Virtual Backbone (DVB) of the CHs rooted at the sink is constructed as follows. Initially, the sink sends a route request message RREQ to the CHs in the number 2R. The message contains its ID, level (L) and location information .The amount of the sink is assumed to be at zero such as  $L(\text{sink}) = 0$ . Whenever a CH  $u$  receives the message then the node increments its level to 1 higher compared to sink such as  $L(u) = L(\text{sink}) + 1$  and sets the sink as its parent node (PN) such as  $PN(u) = \text{sink}$ . Put simply, all the CHs within the number 3R to the sink are designated as level one. Recursively, node  $u$  broadcasts an altered RREQ message to the CHs in the number 3R. The message includes its ID,  $L(u)$ ,  $E_r(u)$  and location information. In case, CH  $v$  receives the message and if its level is equal or less than the degree of the node  $u$ , then it really discards the message. Otherwise, it updates its level to 1 significantly more than the degree of node  $u$  and sets it as one of many PNs such as  $PN(v) = u$  Recursively, all the CHs broadcasts the RREQ to complete the procedure of forming DVB [6].

**IV. LITERATURE SURVEY**

Karlof, et al. [2] proposed security goals for routing in sensor networks and showed how attacks against ad-hoc and peer-to-peer networks can be adapted into powerful attacks against sensor networks. Authors introduced two classes of novel attacks against sensor networks sink holes and HELLO floods, and analyzed the protection of the entire major sensor network routing protocols. They

described crippling attacks in opposition to them and suggested counter measures and design considerations. This was the first analysis of secure routing in sensor networks. Akyildiz, et al. [7] proposed a novel paradigm for UWSNs, known as underwater wireless hybrid sensor networks (UW-HSNs), which also introduced the idea of hybrid communication. UW-HSNs united the best of both worlds, i.e., the practicality of underwater acoustics and the high-performance of radio communication. The idea was to utilize radio communication for sustained traffic and traditional acoustic methods for smaller volume of data. Moreover, they introduced TurtleNet, an architecture based-on UW-HSNs concept, and they also proposed an asynchronous and distributed routing protocol for TurtleNet. Based on the nodepsilas state, the protocol decided which communication channel to be utilized. TurtleNet had been simulated using the NS-2 simulator. Simulation results revealed the promising performance for TurtleNet, and hence validate the UW-HSNs concept. ShaoJie, et al. [8] investigated the optimum routing strategy for the static sensor network. Moreover they proposed a number of motions stratify for the mobile sink(s) to gather real time data from static sensor network, with the objective to maximize the network lifetime. They considered a more realistic model where the moving speed and path for mobile sinks were constrained. The extensive experiment showed that their scheme could significantly prolong entire network lifetime and reduce the delivery delay. Rabindra, et al. [4] proposed a novel private data aggregation scheme for WSNs. The proposed scheme had been applied the additive property of complex numbers in order to unite sensor data and protect data privacy during transmissions to the query server. The author showed from their analytical performance evaluations that their scheme was more efficient than the PDA scheme in terms of communication and computation costs. Zanjani, et al. [9] discussed that among critical issues in WSN, some required more limitations over the style and implementation of an optimum WSN like channel capacity, resiliency, energy saving as a result of the limited accessibility to energy in wireless nodes, data privacy and confidentiality. A widely employed energy-saving technique worked with data aggregation. Data aggregation reduced numerous transmitted packets within the network and prolonged the battery life. In exchange, data redundancy had necessity for secured transmission and privacy in interference limited and noisy environment. A highly secured data aggregation method for WSN had been proposed which ensures that information of live nodes within the network has been accessible within the sink node with the minimum redundancy. In this, data of live nodes stored in the sink has accessible within the sink if the wireless channel had been polluted with noise and interference. Hasenfratz, et al. [10] revealed that energy harvesting had been steadily gaining interest in the WSN community. In place of minimizing the energy consumption and maximizing a networks operational time, the main challenge in energy harvesting sensor networks

was to maximize the utility of the application susceptible to the harvested energy. The major challenge was to maximize the information delivery rates by exploiting the spatial variations of environmental energy. While there exists a multiplicity of energy-aware routing protocols for sensor networks without energy harvesting capabilities, only a tiny amount of routing protocols had already been published which explicitly account fully for energy harvesting. In this, they analyzed and compared three state-of-the-art routing algorithms. Raju, et al. [11] presented the WSN for environmental monitoring with optimized lifetime. The node designed with multimode sensors for sensing different environmental parameters. An efficient utilization of power had been essential site to be able to networks for long duration, hence it was often needed to cut back data traffic inside sensor networks, reduce number of data that require sending to sink. The purpose of studying different strategies to maximize the WSN lifetime, including routing, data aggregation, data accuracy and energy consumption had been discussed. The main idea defined a multi-metrics protocol that considered the residual energy within sensor nodes, data aggregation and data accuracy. Nie, et al. [12] represented that limited energy had been among the countless principal challenges in WSNs. In the effective utilization of Structural Health Monitoring (SHM), overwhelming data provision had another big problem. Data aggregation condensed raw data into useful information and reduced redundant data transmissions. Thus, significant energy and data storage saved, and completed the tasks more efficiently. Though, it features a nontrivial problem to arrange the many data aggregation techniques into an integrated architecture on a distributed WSN. Cluster-based data aggregation architecture proposed to facilitate application development for efficient SHM. Cluster-based data aggregation mechanism saved energy and optimized the distribution of computing tasks. Mathapati, et al. [13] presented a new energy efficient routing protocol called an Energy Efficient Reliable Routing Protocol (EERDAT) for WSN by data aggregation technique. Data aggregation had been utilized to gather and aggregate data in an energy-efficient manner so that network lifetime had been improved. Data aggregation protocol eliminated redundant data transmission. Power consumption came with an important feature to be viewed in the information aggregation which included a limited resource and perhaps they're irreplaceable. Besides power consumption, reliability in addition had major concern within data aggregation. Eu, et al.[14] proposed an adaptive opportunistic routing (AOR) protocol for multi-hop EH-WSNs that achieved high throughput using a regioning scheme that adapts to network conditions and energy availability. They also evaluated AOR using extensive simulations incorporating experimental results from the characterization of different types of energy harvesters. The results showed that AOR increased throughput in both monitoring and event-driven WSNs with different node densities and energy harvesting rates compared to

traditional opportunistic routing protocols and other non-opportunistic routing protocols. They also implemented AOR on a test bed of 20 energy harvesting sensor nodes and results showed that AOR works well in EH-WSNs. Said, et al. [15] explained that sensor networks had problems with incomplete dependence on protocols that deliver sensor data in an energy-efficient manner to the sink. The technique gathered sensors data in a size packet fit for transmission. A fresh Effective Data Aggregation Protocol (DAP) had been proposed to cut back the energy consumption in WSNs, which prolong the network lifetime. This work had been utilized in network aggregation method of distributing the processing everywhere within the aggregation path to avoid unbalanced power consumption on specific nodes until they run out. Mantri, et al.[16] utilized the available bandwidth efficiently in terms of reduced packet delivery ratio and throughput. Bandwidth Efficient Heterogeneity aware Cluster based Data Aggregation (BHCD A) algorithm presented the solution for the effective data gathering with in-network aggregation. It considered the network with heterogeneous nodes in terms of energy and mobile sink to aggregate the data packets. It embodied the optimal approach by Intra and inter-cluster aggregation on the randomly distributed nodes with variable data generation rate while routing data to sink. It used the correlation of data within the packet for applying the aggregation function on data generated by nodes. BHCD A had shown significant improvement in packet delivery ratio (67.66 % & 19.62 %) and throughput (37.01 % & 17.16 %) as compared with the state-of-the-art solutions, two tier Cluster based Data Aggregation (TTCDA) and energy Efficient Cluster based Data Aggregation (EECD).

Javaid, et al. [17] proposed a protocol designed for the characteristics of reactive homogeneous WSNs, HEER (Hybrid Energy Efficient Reactive) protocol. In HEER, Cluster Head (CH) selection had its basis on the ratio of residual energy of node and average energy of network. Moreover, to conserve more energy, they introduced Hard Threshold (HT) and Soft Threshold (ST). Finally, simulations showed that their protocol has not only prolonged the network lifetime but also significantly increased stability period. Bansal, et al. [18] exhibited the force of remote sensor systems was based on the capability to obliterate vast amount of little hubs that amass and design themselves. It included the blending of information from different sensor and halfway hubs and transmission of the totaled information to the beds base station (sink). In remote sensor system bargained sensor hubs contorted the honesty of totaled information by sending false information reports and infusing false information amid information conglomeration. Sharma et al. [19] proposed a between group data accumulation framework which execute for HEER (Hybrid Energy Efficient Reactive) tradition to handle the problem of flooding at base station or sink. They resolved the problem of unflinching quality, imperativeness use and data amassing for running computations. It centered on the deformations of present HEER for the greater execution. They proposed the

IICDAHEER tradition which minimizes the imperativeness usage by fitting pile of high center points to put it on to the reduced essentialness centers. By the instance of the maker, it improves the framework lifetime and relentlessness period. T. Amgoth et al. [16] proposed a power aware routing algorithm for cluster based WSNs in this paper. The algorithm depended on a brilliant strategy of cluster head (CH) selection, residual energy of the CHs and the intra-cluster distance for cluster formation. To facilitate data routing, a directed virtual backbone of CHs was constructed which will be rooted at the sink. The proposed algorithm demonstrated to balance energy consumption of the CHs during data routing process. They proved that the algorithm achieved constant message and linear time complexity. They also tested the proposed algorithm extensively. The experimental results revealed that the algorithm outperforms other existing algorithms when it came to network lifetime, energy consumption and other parameters.

## V. CONCLUSION AND FUTURE SCOPE

The review has shown that the most of the existing techniques has neglected the use of the effects of the failures in the most of the energy efficient protocols have been ignored. The effect of compressive sensing i.e. data fusion to remove redundant data from sensor nodes, has been neglected by the most of the researchers. The effect of the scale in the sensor field dimensions has also been ignored in the most of the existing research. Therefore in near future, an algorithm will be proposed to overcome these issues by using fault tolerance and compression technique.

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# Study of Impact of Nodes Failure on VoIP over WiMAX Network using Voice codecs G711

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**Abstract**— WiMAX is a Worldwide Interoperability for Microwave Access that provides high throughput broadband connection over long distances. In this Paper, we analyze the impact of nodes failure over our WiMAX Network is being analysed and how it effects the working of Voice over IP (VoIP), It is analyzed for two transmitter techniques MIMO and SISO. The performance is analysed by using OPNET Modeller. The performance is compared in terms of Load, Delay, End-to-End Delay and Traffic Sent.

**Keywords**—VoIP, Load, Delay, End-to-End Delay, Traffic Sent

## I. INTRODUCTION

WiMAX is Worldwide Interoperability for Microwave Access, it is the latest trend in wireless community, mostly known for its better bandwidth over long range instead of physical location, uninterrupted internet signal facility and better uplink/downlink provision. The 4th generation network WiMAX is designed to meet the needs of large variety of applications that is capable of full interoperability between devices. Voice over Internet Protocol (VoIP) has become a demanding service currently as users are exposed and used the technology to communicate to each other. However, there are few major issues concerning its implementation [7]. In today's world multimedia applications divert the interest of users. Every user demands high and a best internet connection that not only supports real – time applications like Skype, Yahoo or Google Chat but also helpful in utilizing the broadband connection over multiple users. To fulfil this WiMAX helps them by not only providing them a better security features but also required Quality of Services (QoS). A MIMO system with similar count of antennas at both the transmitter and the receiver in a point-to-point (PTP) link is able to multiply the system throughput linearly with every additional antenna. To multiply throughput of a radio link, multiple antennas (and multiple RF chains accordingly) are put at both the transmitter and the receiver. This system is referred to as Multiple Input Multiple Output (MIMO). Today all wireless technologies want to increase their data rates multiple times to satisfy their users need.

In recent years, Voice over Internet Protocol (VoIP) has attracted the attention of the network engineering research and operation communities. Voice is the method of choice for real time communications [4]. The QoS parameters closely connected with user's satisfaction with a received speech quality. VoIP is a technology that gets

more useful and economical when users are on the move. The VoIP industry is therefore constantly in search of wireless platforms. People can make cheap and free VoIP calls using their laptop computers, mobile handsets and phones while on the move through WiMAX. There are numerous software-based VoIP services and applications that people can use on laptops and mobile phones to make free or cheap local and international calls. WiMAX has also other advantages like video streaming, voice application, high speed internet etc. In a VoIP network, there is a signaling protocol and a speech transmission protocol. Both protocols require all information to be carried in IP packets. A VoIP system is divided into three components, namely codec, packetizer, and playout buffer.

To obtain digital format of the analog signal process is utilized which is called encoding and converse is called decoding and both are performed by voice codecs [6]. Codecs are defined as compression and decompression technique for VoIP transform audio signals to video signals.

Now user is mobile mean they are moving not a fixed at a location so problem arises is to fulfil the needs of mobile user. Here mobile users can roam within the service area, so if moving is there then nodes failure can be arise , so our main work is to emphasize the effect of nodes failure on our WiMAX network and how it effect the voice quality and its parameters.

Nodes failure can be occur due to many reasons like battery loss, intentional shutdown by user, error in coding, nodes go beyond the range. Voice over Internet protocol is a vast using concept as it supports multiple real time applications, everyone prefer to make internet phone calls as it is cheap and easy to use and this can be done easily by VoIP, so if there is a node failure occur then how it will affect the VoIP is being analysed in this paper. The analysis is being done by using Opnet14.5 simulator. In this we create different scenarios, for different parameters we take values by taking packet size 13. For this we use different codecs G711, G729, G723 among it G711 is best and we take it for further assumptions. In this paper we emphasize on the effect of nodes failure on various QoS parameters like Load, End-to-End Delay and Traffic Sent on VoIP in a network.

WiMAX is gaining popularity as a technology which delivers carrier-class, high speed wireless broadband at a much lower cost while covering large distance than Wi-Fi

[2]. WiMAX is preferred over Wi-Fi and other wireless technologies as it provides more range, secure network, more bandwidth range and a better usage for multiple users, it also solve the problem of last mile.

## II. LITERATURE REVIEW

In 2008, Emir Halepovic et al.,[3] used experimental measurements to study the performance of multimedia applications over a commercial IEEE 802.16 WiMAX network. Voice-over-IP (VoIP) and video streaming (RealPlayer) applications are tested. Here skype is used as real life example for VoIP. Their results show that WiMAX networks can adequately support currently popular multimedia Internet applications skype, video calling.

In 2008, Shamik Sengupta, et al.,[8] studied real-time services such as VoIP are becoming popular and are major revenue earners for network service providers. These services are no longer confined to the wired domain and are being extended over wireless networks. Although some of the existing wireless technologies can support some low-bandwidth applications, the bandwidth demands of many multimedia applications exceed the capacity of these technologies. The IEEE 802.16-based WiMAX promises to be one of the wireless access technologies capable of supporting very high bandwidth applications.

In 2009, Asharf A.Ali et al, [1] studied about various VoIP codecs over a WiMAX network. Here it gives basic detail about codecs like g711, g722, g729. Here it shows their impact over access network.

In 2012, S. Alshomrani, et al.,[9] examines The impact of various voice codec schemes and statistical distribution for VoIP over WiMAX has been investigated in detail. Through various simulation experiments under realistic networking scenarios, this study provides an insight into the VoIP performance in the WIMAX networks. Parameters that indicate the Quality of Service such as delay, jitter, packet loss and MOS are analyzed in these scenarios. The simulations results indicate that better choice of voice codecs and statistical distribution have significant impact on VoIP performance in the WiMAX networks.

In 2012, Rohani Bakar et al, [7] studied the performance of VoIP over Wimax network. Here they find both technology and users demand that the Quality of Service (QoS) for VoIP system over any network should give the best performance one can get, where users are hoping for a smooth and seamless connection without breaking connection during voice calls.

In 2013, Elechi Onyekachi *et al.* adopted a simulation-based network performance analysis to investigate the effects of the application of different voice encoder schemes on QoS of VoIP system deployed with IEEE 802.16e standard WiMAX network[2].Through different network simulation experiments using realistic network scenarios in OPNET environment, this research provided an in-depth network performance comparative analysis of VoIP over WiMAX using performance parameters which indicate QoS such as voice jitter, voice packet ETE delay,

packet-sent-packet-received, WiMAX network delay, voice packet delay variation and throughput. The obtained simulation experiment results indicated that choice of suitable codec scheme can affect the QoS of VoIP traffic over WiMAX network.

## III. EXPERIMENTAL SETUP

To analyse the performance of VoIP over WiMAX network we have made different scenarios in which different parameters have been taken. In this experiment the Effect of Nodes Failure on VOIP over WiMAX is analyzed by using OPNET Simulator. OPNET Simulator 14.5 [1] was used to analyze the performance of WiMAX. We used OPNET modeller, as OPNET modeller provides a comprehensive development environment supporting the modelling of communication network and distributed systems. OPNET modeller provides better environment for simulation, data collection and data analysis [5].

As shown in the fig 1 the placement of nodes are circular. Within hexagonal cell of radius 2 km. Here the speed of each node is 5m/s.

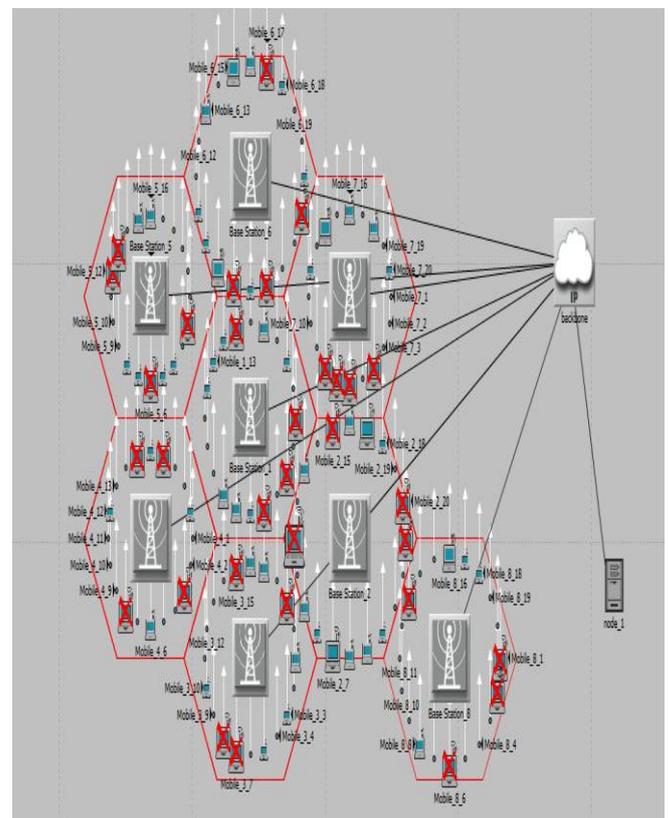


Fig 1 WiMAX Network

The BS connected to the IP backbone via a DS3 WAN 38 link. The base stations are connected to backbone cloud through ppp\_DS3 link. Simulation is done for three minutes.

## IV. SIMULATION RESULTS

This section presents the results for the different scenarios. We plotted graphs for End-to-End Delay, Traffic Sent, Delay and Load in all scenarios by taking voice frame per packet 13 SISO and MIMO in different scenarios.

Packet Size	Voice Codecs	No. Of Nodes Failure	End-to-End Delay (sec)	Traffic Sent (bytes/sec)	Delay (sec)	Load (bits/sec)
13	g711 SISO	0	0.346817	1.29E+06	0.04243	10705100
		1	0.361411	1.22E+06	0.043012	1.01E+07
		2	0.350714	1.16E+06	0.042873	9.64E+06
		3	0.347466	1.10E+06	0.045863	9.11E+06
		4	0.354758	10,49,090	0.037346	87,23,700
		6	0.3511	10,10,010	0.036609	76,80,720
		8	0.348294	801915	0.040212	6.68E+06
		12	0.351202	551119	0.043449	4.60E+06
		16	0.353499	308129	0.040997	2.58E+06
		20	No Graph	0	No Graph	1728.89
13	g711 MIMO	0	0.35	12,90,990	0.047538	10980000
		1	0.373619	1.23E+06	0.047842	1.02E+07
		2	0.427125	1.16E+06	0.064555	9.64E+06
		3	0.363041	1.11E+06	0.025003	9.08E+06
		4	0.356547	10,20,000	0.044364	8.67E+06
		6	0.38	9,00,010	0.045	75,91,340
		8	0.354408	807492	0.026309	6.56E+06
		12	0.354408	568599	0.040887	4.49E+06
		16	0.382991	314518	0.355254	2.63E+06
		20	NO Graph	1	No Graph	1728.89

Fig2 Comparison Table of End-to-End Delay, Load, Traffic Sent, Delay both MIMO & SISO

- b.) Delay: Delay is the overall delay in the network. It is the time from sender to receiver till it receives and read the data. Delay should be minimum, it can be increased up to 100ms but if it exceeds 150 ms then data packet becomes unstable.
- c.) Traffic Sent: it is the bytes/sec that is being sent by all voice applications. As the nodes failure increasing the traffic sent is decreasing.
- d.) End-to-End Delay: it is the total delay, whether network, encoding, decoding or compression or decompression delay in the network.

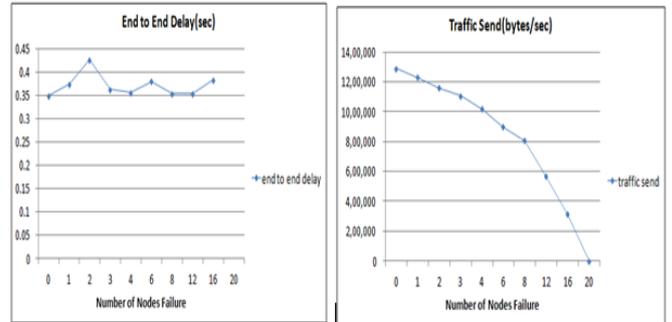
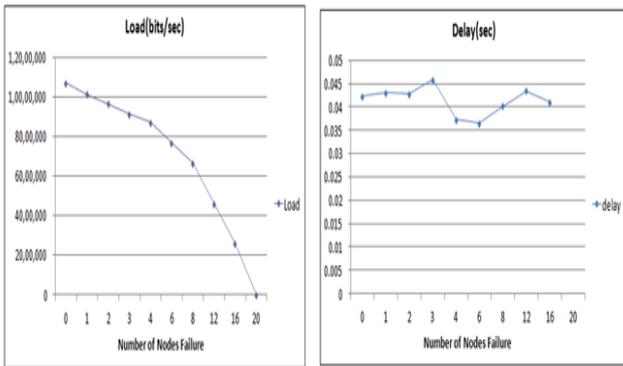
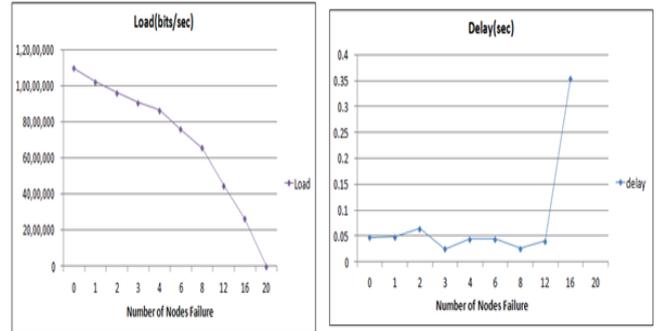


Fig4 Graphs of MIMO End-to-End Delay, Delay, Traffic Sent and Load

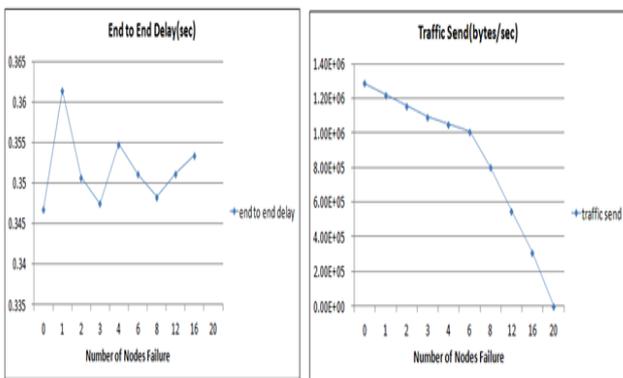


Fig3 Graphs of SISO Load, End-to-End Delay, Delay and Traffic Sent

- a.) Load: Load is the overall load of data packets over a WiMAX network. Here as the number of nodes failure increased the number of data packets is decreasing. As the failure occurs the sender will not send the data packets it saves the packets and as it regains its control it starts sending again.

## V. CONCLUSION & FUTURE SCOPE

In these research analyses of the performance of VoIP over WiMAX by varying no. of nodes failure in terms of Delay, traffic sent, end to end delay and Load is carried out for two types of transmitter techniques STC 2x1 MIMO and SISO . Its aim is to address the performance metrics of QoS for VoIP over WiMAX access technology. We have use voice codec G711 and voice frame per packet is of size 13. The results showed that with increase in nodes failure delay and end to end delay increases and load, traffic sent decreases. The result also shows. The result shows that for SISO Traffic sent is less and delay is more than MIMO. So the performance of MIMO is better than SISO.

In this research analysis the impact of nodes failure on VoIP over WiMAX has been evaluated by taking load, delay and traffic sent, end to end delay metrics. We have done our work on various voice codecs and transmitters.

In future one can analyze the VoIP over WiMAX by varying different parameters like MOS values, varying the number of nodes to be failed, jitter tolerance network area, using different transmitters. One can also evaluate the

performance by varying the properties of nodes failure. Various other modulation techniques can also be used and best can be chosen for practical implementation.

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# Review of Proactive, Reactive and Energy Efficient Protocols in MANETs

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**Abstract---**Ad-hoc networks are temporary networks that are used only for the duration of the communication sessions. Cellular phones, laptops etc are the devices that used for mobile networks. Mobile Ad hoc Network (MANET) allows portable devices to establish communication independent of a central infrastructure. Routing in MANET is a critical task due to highly dynamic environment. Efficient Routing Protocols will make MANET reliable. Protocols in MANETs are of various kinds i.e. Proactive, Reactive and energy efficient. Besides this the power limitation of a route is decided by the node which has the minimum energy in that route. The purpose of this paper is to have a detailed study of different protocols used in Manets.

**Keywords---**MANET, ODBEER, DSR, TORA, Energy Efficiency, OLSR,WRP, DSDV, TEEN, FAR

## I. INTRODUCTION

Recent trends in wireless communications have expanded possible applications from simple voice services in early cellular networks) to new integrated data applications. 4G technology is now new promising application of mobile technology. It is basically new generation of mobile devices. Mobile Ad hoc networks (MANETs) are combination of mobile nodes without existence of any centralized control or pre-existing infrastructure.

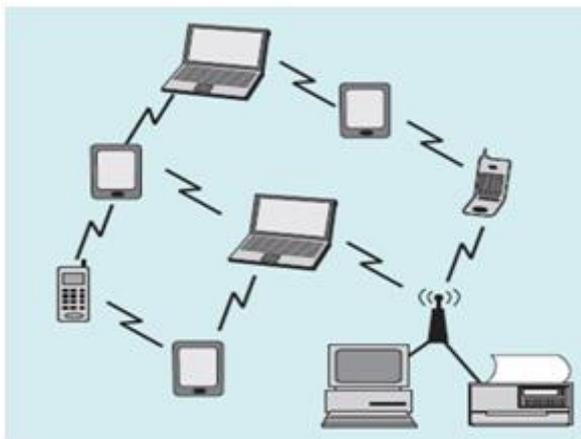


Fig1 Figure showing typical MANET [1].

Such kind of networks generally uses multi-hop paths and wireless radio communication channels .The main characteristics of ad hoc networks are as follows:

- **Dynamic topology:** Because nodes in the network can move arbitrarily, the topology of the network also changes.

- **Bandwidth:** The bandwidth of the link is unstrained, and the capacity of the network is also tremendously variable.
- **Power Limitation:** Power limitation in mobile devices is a serious factor. Because of the mobility characteristics of the network, devices use batteries as their power supply [1].

## II. REACTIVE PROTOCOL IN MANETS

### A. ODBEERP Protocol:

The ODBEERP is a source-initiated, on-demand routing scheme. The main aim of this protocol is to discover the minimum power-limitation route. The power limitation of a route is decided by the node which has the minimum energy in that route. So compared with the minimum node energy in any other route, the minimum node energy in the minimum power limitation route has more energy. In other words, the value of that node's energy is the maximum of all minimum node energy in all selectable routes.

In routing Process of on Demand Based Energy Efficient Routing Protocol (ODBEERP), following assumptions are made:

- A node can find the value of its current energy.
  - Links are bidirectional.
- a) Route Discovery:

In ODBEERP, nodes that are not on a selected path do not maintain routing information or participate in routing table exchanges. The route discovery of the protocol is as follows.

Step1: When the source node wants to send a message to the destination node and does not already have a valid route to that destination, it initiates a path discovery process to locate the other node. The source node disseminates a route request (RREQ) to its neighbors. The RREQ includes such information as destination Internet ID, power boundary (the minimum energy of all nodes in the current found route), destination sequence number, hop count, lifetime, Message Authentication Code (MAC) is for providing certificate authority to the nodes and Cyclic Redundancy Code (CRC) for error detection and correction. The destination sequence number field in the RREQ message is the last-known destination sequence number for this destination and is copied from the destination sequence number field in the routing table. If no sequence number is known, the unknown sequence number flag must be set. The power

boundary is equal to the source's energy. The hop count field is set to zero. When the neighbor node receives the packet, it will forward the packet if it matches [2].

Step 2: When a node receives the RREQ from its neighbors, it first increases the hop count value in the RREQ by one, to account for the new hop through the intermediate node. The creator sequence number contained in the RREQ must be compared to the corresponding destination sequence number in the route table entry. If the creator sequence number of the RREQ is not less than the existing value, the node compares the power boundary contained in the RREQ to its current energy to get the minimum. If the creator sequence number contained in the RREQ is greater than the existing value in its route table, the relay node creates a new entry with the sequence number of the RREQ. If the creator sequence number contained in the RREQ is equal to the existing value in its route table, the power boundary of the RREQ must be compared to the corresponding power boundary in the route table entry. If the power boundary contained in the RREQ is greater than the power boundary in the route table entry, the node updates the entry with the information contained in the RREQ. During the process of forwarding the RREQ, intermediate nodes record in their route tables the addresses of neighbors from which the first copy of the broadcast packet was received, so establishing a reserve path. If the same RREQs are later received, these packets are silently discarded.

Step 3: Once the RREQ has arrived at the destination node or an intermediate node with an active route to the destination, the destination or intermediate node generates a route reply (RREP) packet. If the generating node is an intermediate node, it has an active route to the destination; the destination sequence number in the node's existing route table entry for the destination is not less than the destination sequence number of the RREQ. If the generating node is the destination itself, it must update its own sequence number to the maximum of its current sequence number and the destination sequence number in the RREQ packet immediately. When generating an RREP message, a node smears the destination IP address, creator sequence number, and power boundary from the RREQ message into the corresponding fields in the RREP message.

Step 4: When a node receives the RREP from its neighbors, it first increases the hop count value in the RREP by one  $\text{Hop count} = \text{Hop count} + 1$ . When the RREP reaches the source, the hop count represents the distance, in hops, of the destination node from the source node. The creator sequence number enclosed in the RREP must be compared to the corresponding destination sequence number in the route table entry. If the originator sequence number of the RREP is not less than the existing value, the node compares the power boundary contained in the RREP to its current energy to get the minimum, and then updates the power boundary of the RREP with the minimum. The power boundary field in the route table [3]

#### B. DSR Reactive Routing

DSR is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad-hoc networks of mobile nodes. It allows nodes to dynamically discover a

source route across multiple network hops to any destination in the ad-hoc network. Each data packet sent then carries in its header the complete ordered list of nodes through which the packet must pass, allowing packet routing to be a trivially loop free and avoiding the need for up-to-date routing information in the intermediate nodes through which the packet is forwarded. With the inclusion of this source route in the header of each data packet, other nodes forwarding or overhearing any of the packets may easily cache this routing information for future use [3].

#### C. TORA Reactive Routing:

TORA [4] is a highly adaptive, efficient and scalable distributed routing algorithm based on the concept of link reversal and invented by Vincent Park and M. Scott Corson from University of Maryland. TORA is proposed for highly dynamic mobile, multi-hop wireless networks. It is a source-initiated on-demand routing protocol. It finds multiple routes from a source node to a destination node. The main feature of TORA is that the control messages are localized to a very small set of nodes near the occurrence of a topological change. To achieve this, the nodes maintain routing information about adjacent nodes. The protocol has three basic functions: Route creation, Route maintenance and Route erasure. TORA has a unique feature of maintaining multiple routes to the destination so that topological changes do not require any reaction at all. The protocol reacts only when all routes to the destination are lost. In the event of network partitions the protocol is able to detect the partition and erase all invalid routes. To initiate a route, the node broadcasts a QUERY packet to its neighbors. This QUERY is rebroadcasted through the network until it reaches the destination or an intermediate node that has route to the destination. The recipient of the QUERY packet then broadcast the UPDATE packet which lists its height with respect to the destination [4].

### III. PROACTIVE ROUTING PROTOCOL

Each node in the network has routing table for the broadcast of the data packets and want to establish connection to other nodes in the network. This type of protocols maintains fresh lists of destinations and their routes by periodically distributing routing tables throughout the network.

#### A. OLSR PROACTIVE ROUTING:

The Optimized Link State Routing Protocol (OLSR) is an IP routing protocol optimized for mobile ad hoc networks, which can also be used on other wireless ad hoc networks. OLSR is a proactive link-state routing protocol, which uses hello and topology control (TC) messages to discover and then disseminate link state information throughout the mobile ad hoc network. Individual nodes use this topology information to compute next hop destinations for all nodes in the network using shortest hop forwarding paths. HELLO - HELLO messages are transmitted to all neighbors. These messages are used for neighbor sensing and MPR calculation.

TC - Topology Control/messages are the link state signaling done by OLSR. This messaging is optimized in several ways using MPRs [5].

MID - Multiple Interface Declaration messages are transmitted by nodes running OLSR on more than one interface. These messages list all IP addresses used by a node.

### B. WRP PROACTIVE ROUTING (Wireless Routing Protocols)

WRP uses an enhanced version of the distance-vector routing protocol, which uses the Bellman-Ford algorithm to calculate paths. Because of the mobile nature of the nodes within the MANET, the protocol introduces mechanisms which reduce route loops and ensure reliable message exchange.

WRP, similar to Destination-Sequenced Distance Vector routing (DSDV), inherits the properties of the distributed Bellman-Ford algorithm. To counter the count-to-infinity problem and to enable faster convergence, it employs a unique method of maintaining information regarding the shortest distance to every destination node in the network and the penultimate hop node on the path to every destination node. Since WRP, like DSDV, it maintains an up-to-date view of the network; every node has a readily available route to every destination node in the network. It differs from DSDV in table maintenance and in the update procedures. While DSDV maintains only one topology table, WRP uses a set of tables to maintain more accurate information. The tables that are maintained by a node are the following: distance table (DT), routing table (RT), link cost table (LCT), and a message retransmission list [6].

### C. DSDV Proactive Routing

DSDV is based on the bellman ford algorithm and developed by Charles E. Perkins and Pravin Bhagwat in 1994. In DSDV, packets are transmitted between mobile nodes by using Routing Tables which are stored at mobile node. Each Routing Table, at each of the mobile node contain list of all available destinations and the number of hops to each. Each Route Table entry is tagged with a sequence number (SN) which is originated by the destination node. To achieve the consistency in the dynamically changing topology based network, every mobile node periodically transmits updates and Routing Tables are updated. Routing information is advertised by multicasting the packets which are transmitted periodically and incrementally as topological changes are detected. Consider Node A wants to send a data to Node C as shown in Fig. 1, but Node C is not in the coverage area of Node A. Node A and Node C are in the range of Node B. Hence, Node A has to forward packet to Node B and Routing Table of Node B comes into picture, it will act as routing agency for forwarding packet from Node A to Node C. [7].

## IV. ENERGY EFFICIENT PROTOCOL

Energy Consumption Reduction Using Topology Control Approach. In MANETs, the topology is dynamic not static. Due to the dynamic topology, node consumes more energy while roaming. For this, the topology control approach has been introduced. In this approach, we have considered two cases,

- Energy consumption of the node and routes.
- Link stability and location stability. Transmission power control and load distribution are two approaches to minimize the active communication energy, and sleep/power-down mode is used to minimize energy during inactivity.

A. FAR (Flow Augmentation Routing) Protocol The FAR protocol assumes a static network and finds the optimal routing path for a given source-destination pair that minimizes the sum of link costs along the path. Here, the link cost for link  $(i, j)$  is expressed as  $C_{ij} = x_1 E_i + x_2 R_i + x_3 E_j$ , where  $E_{ij}$  is the energy cost for a unit flow transmission over the link and  $E_i$  and  $R_i$  are the initial and residual energy at the transmitting node  $i$ , respectively, and  $x_1$ ,  $x_2$ , and  $x_3$  are nonnegative weighting factors. A link requiring less transmission energy is preferred ( $C_{ij} < C_{ij'}$ ). At the same time, a transmitting node with high residual energy ( $R_i > R_{i'}$ ) that leads to better energy balance is also preferred. Depending on the parameters  $x_1$ ,  $x_2$ , and  $x_3$ , the corresponding routing algorithm achieves a different goal [8].

B. TEEN (Threshold sensitive Energy Efficient sensor Network protocol) is for reactive networks. It is targeted at reactive networks and is the first protocol developed for reactive networks. In this scheme, at every cluster change time, in addition to the attributes, the cluster-head broadcasts to its members,

- Hard Threshold (H T): This is a threshold value for the sensed attribute. It is the absolute value of the attribute beyond which, the node sensing this value must switch on its transmitter and report to its cluster head.
- Soft Threshold (S T): This is a small change in the value of the sensed attribute which triggers the node to switch on its transmitter and transmit. The nodes sense their environment continuously. The first time a parameter from the attribute set reaches its hard threshold value, the node switches on its transmitter and sends the sensed data. The sensed value is stored in an internal variable in the node, called the sensed value (SV). The nodes will next transmit data in the current cluster period, only when both the following conditions are true:
  - The current value of the sensed attribute is greater than the hard threshold.
  - The current value of the sensed attribute differs from SV by an amount equal to or greater than the soft threshold. Whenever a node transmits data, SV is set equal to the current value of the sensed attribute.

C. MEA-DSR protocol [9] as an extension to the DSR protocol. Here the Route Discovery mechanism of DSR (Dynamic Source Routing) was modified to implement a multipath and energy aware routing. A caching update mechanism through probe packets was included to have 'always' updated information in routing cache and a simple round robin data scheduling among multiple selected routes was implemented in order to balance the traffic load and the energy consumption. With the purpose of having all possible paths between a source-destination pair, the

destination replies to all RREQs that arrive and the source stores all the paths of received RREPs. Among all the stored paths only the node disjoint routes are considered. The paths are ordered by an energetic metric. The energy metric used here is the cost function of the entire path. It is computed while the RREP crosses the network from source to destination and it is sorted in the routing table at the source. The value of this metric is updated for all stored path using cache mechanism. Two paths are considered disjoint if their intersection is empty. Spreading the traffic among multiple routes improves balancing, alleviates congestion, bottlenecks and prolongs connection's lifetime, thereby saving more energy. So multipath routing is utilized here. It was observed that the MEA-DSR wastes less energy compared with MDSR (Modified DSR) and DSR due to round robin scheduling. The data packet delivery ratio is 90% for MEADSR, 85% for MDSR and 80% for DSR. The end to end delay is the least for MEA-DSR due to which it has prolonged connection lifetime. The disadvantage of this protocol is that the overhead is big thereby increasing the energy consumption. MDSR outperforms MEA-DSR in terms of average energy and residual energy.

## V. CONCLUSION

In this paper we have analyzed and investigated the some proactive, reactive and energy efficient protocols in MANETs. We have studied in detail these protocols and analyzed their advantages and limitations. Different protocols work under different routing conditions. TEEN is found to be more energy efficient routing protocol, TORA behaves well under reactive conditions and WRP performs well under proactive conditions.

Future work of MANET routing protocol involves the implementation of new routing protocols by investigating the limitations of these protocols and modifying them.

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# Comparison of Wireless Sensor Network Solar Energy Harvesting Techniques

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**Abstract**—The Sensor nodes that are commercially available are battery driven devices. A number of nodes together consist a network. The battery used in the nodes loses their charge, as days proceed, and subsequently get isolated from the network. Many energy harvesting schemes have been proposed to resolve this problem. The main energy converting techniques are Piezoelectric, Electromagnetic, Thermoelectric, Photovoltaic etc. In this paper comparative analysis of solar energy harvesting techniques are [Thermoelectric & Photovoltaic] has been done.

**Keywords**— WSN, PV, RF, TEG

## I. INTRODUCTION

Wireless sensor network (WSN) is a network that consists of spatially distributed autonomous devices. These devices possess sensor that monitor temperature, sound, vibration motion or pollutants from different locations. These are also used in many civilian application areas, such as environmental, habitat monitoring, healthcare applications, home automation and traffic control. Usually, rechargeable batteries are used to power the sensor nodes. Frequent recharging and replacement of these batteries become a significant maintenance burden in WSN. Recently, the scavenging of energy from the environment in the form of heat, motion, light or other electromagnetic radiation has been actively researched to provide possible solutions to resolve this problem. Exploiting energy sources that are ubiquitous to the operating space of the sensor nodes raises the possibility of infinite lifetime. Achieving this (through harvesting aware design) will lead to a new frontier in the natural progression of energy optimization techniques.

Energy harvesting involves complex tradeoffs due to the interaction of several factors such as the characteristics of the solar cells, chemistry of the batteries used and power management features of the embedded system application behavior, *etc.* It is therefore, essential to thoroughly understand and judiciously exploit these factors in order to maximize the energy efficiency of a solar harvesting module. A wide variety of harvesting modalities are now a day's possible. But, solar energy harvesting through photovoltaic conversion technique provides the highest power density. Due to their characteristics, it can be used to power sensor nodes that consume several mw of energy. Solar power is a form of energy that can be easily tapped. The solar panel used must produce optimum output voltage and power deliverance. Using a solar panel of comfortable output voltage, the rechargeable batteries in the sensor

nodes can be powered for a considerable period. This in turn, prevents frequent manual supervision in the site of network deployment.

## II. ENERGY HARVESTING SYSTEM

Today, the renewable energy sources contribute around 22% to energy production, with traditional biomass and hydroelectric power as the main contributors. Energy harvesting (also known as energy scavenging) is the process of generating electrical energy from environmental energy sources. Energy harvesting systems are made up of three basic components: The energy source, energy scavenger (active component) and external electrical circuit. There exists a variety of different energy sources such as solar energy, kinetic energy, or thermal energy. Figure 1 shows a typical energy harvesting system.

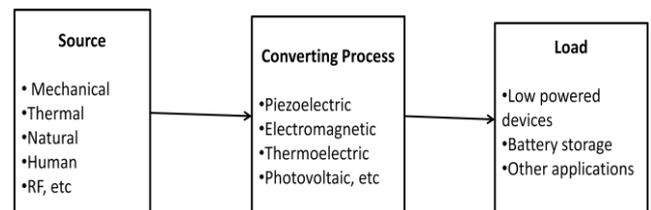


Figure 1 Components of Energy Harvesting Systems

In order to harvest useful electrical energy, these three basic components must be in place at all times.

### A. Energy sources

The most common energy harvesting sources are natural (solar, wind, ocean, etc) energy, mechanical energy, radio frequency (RF), and human (physical) energy. Other types of energy sources include thermoelectricity (temperature variations) and electromagnetic energy.

Energy derived from these natural energy sources is mostly called renewable energy. Close to 13% of the total electrical energy generated in the United States comes from renewable sources.

### B. Converting Process

Ambient energy exists all around us and can be transformed into a useful energy source. This section gives a brief summary of some commonly available energy harvesting methods. Recently, solar and wind power are becoming popular sources of solar energy to harvest. Energy from light (solar power) is directly converted to electrical energy using solar cells (photovoltaic cells). Sunlight is the major source of light for most solar power

generation plants. Some common smaller applications of solar power are portable hand calculators, wrist watches and street lights. Temperature differences between two points can also be used to generate electrical energy. This is commonly known as thermoelectricity. Thermoelectricity is the direct conversion of a temperature difference into electricity. The device used to generate thermoelectricity is called a thermo generator. Thermoelectricity is referred to in some texts as the “Peltier-Seebeck effect” named after Thomas Seebeck who discovered 11 electric current flows between the junctions of two different metals at different temperatures.

1) Thermoelectric: Thermal gradients are one of the oldest techniques for generating electricity. A simple thermocouple is a junction of two dissimilar wires with a temperature difference between the junction and the wire ends. The core of a thermoelectric generator (TEG) consists of an n-type and p-type semiconductor connected by a metal plate<sup>2</sup>. By connecting many PN junctions in series electrically and in parallel thermally, a large voltage output can be produced that is proportional to the heat flow. A thermoelectric generator converts heat flow ( $Q$ ) into electrical power ( $P$ ) with efficiency. Since the heat flow is proportional to the temperature difference, power output is proportional to the  $\Delta T$  maintained across the TEG.

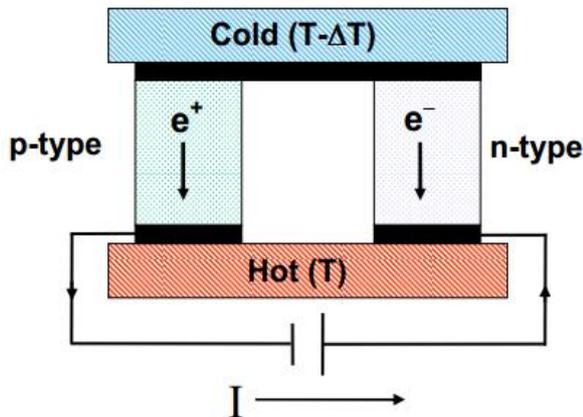


Figure 2: Thermoelectric generator

Solar energy is available in most parts of the world. Further, it is free and in abundant supply in many locations. The power of the sun received on the earth surface is approximately  $1.8 \times 10^{11}$  MW [1]. This is significantly higher than commercial energy sources currently available. Direct solar energy harvesting in modern power generation typically involves either photovoltaic systems or large-scale solar thermal energy installations. Photovoltaic systems rely on the direct conversion of light energy from the sun into electrical energy using solar cells. Photovoltaic, though not very efficient (usually  $\leq 20\%$ ), are very scalable. Therefore, they are widely utilized both in macro and micro power generation. By contrast, solar thermal installations harvest the heat energy of the sun. The heat is then used to drive other mechanical systems for power production. Large scale solar thermal application is well established with thermal efficiencies greater than 80% [2].

The TEG was integrated with a solar collector plate to enhance temperature gradient via the thermal radiation absorption capacity of the device. Solar thermal collectors

were fabricated on copper substrate. Two types of collector plates were examined: a bare copper plate and a selective absorber coating on copper plate. An electro-chemical deposition technique was used to deposit a selective absorber coating consisting of black nickel-tin bimetallic layer. The selective coating significantly improved the ability of the collector to transform incident solar radiation into thermal energy. This was demonstrated by the improved output power of 9.15 mW from the TEG utilizing the selective absorber plate as compared to the base copper plate setup (2.01 mW). The device was produced on a scale that is portable and generates autonomous power useful for powering micro/nano devices. Future work to improve the performance of the system through heat loss reduction is underway. This will include a top glass cover on the collector plate.

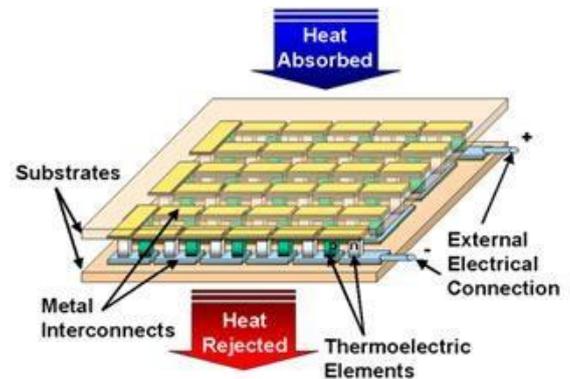


Figure 3: Thermoelectric system

This harvesting method works on the principle of Seebeck effect, the Peltier effect, and the Thomson effect. A thermo generator is a device that generates electricity by converting the temperature difference between two points, a process known as the thermoelectric effect. Thermo generators are usually attached to bodies or devices which have a comparable temperature difference in relation to their surrounding environment. A good example of the thermoelectric effect is a wrist watch powered by electricity generated from body heat.

Advantages:

Thermoelectric devices are advantageous because they are reliable, light in weight, small, quiet, and inexpensive. They will function in environments that are too severe, too sensitive, or too small for conventional refrigeration. These environmentally friendly devices offer precise temperature control, while requiring minimal maintenance because they have no moving parts. Thermoelectric devices are most useful for small cooling jobs where a compressor based system would be impractical. These devices are also useful because they can heat as well as cool depending on the polarity of the power source

- 2) Photovoltaic: The energy of solar radiation is directly utilised in mainly two forms:
  - a) Direct conversion into electricity that takes place in semiconductor devices called solar cells
  - b) Accumulation of heat in solar collectors.

The direct conversion of solar radiation into electricity is often described as a photovoltaic (PV) energy conversion because it is based on the photovoltaic effect. The

photovoltaic (PV) effect is the process through which a photovoltaic cell (solar cell) converts light into electricity. Photons travelling to the surface of photovoltaic cells are absorbed and their energy transferred to make electricity. Solar power is the most common source of light energy harvesting due to its high power density. In addition to natural solar light, indoor fluorescent and tungsten lamp illuminations are also potential sources for harvestable light energy. Much less energy can be harvested from indoor environments compared to outdoor environments since less electricity can be generated by PVs with decreasing light irradiance. PV is constructed using doped silicon. The doped silicon has the special property of being excited by photons. Sunlight is the major source of photons. When the photons hit the doped silicon, it gets excited and the electrons in it are knocked loose from their atoms. The loose electrons now are ready to flow through wires and generate electricity. Photovoltaic systems contain cells that convert sunlight into electricity. Inside each cell there are layers of a semi-conducting material. Light falling on the cell creates an electric field across the layers, causing electricity to flow. The intensity of the light determines the amount of electrical power each cell generates. A photovoltaic system does not need bright sunlight in order to operate. It can also generate electricity on cloudy and rainy days from reflected sunlight.

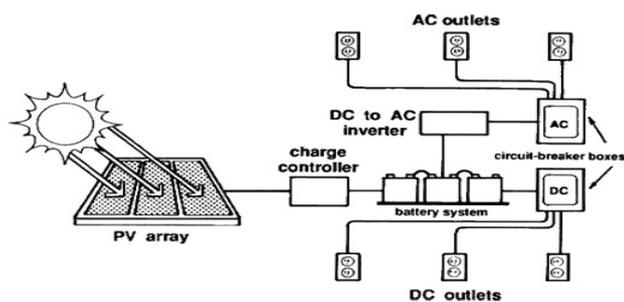


Figure 3: Photovoltaic energy harvesting

**Advantages:**

- Environmentally friendly
- No noise, no moving parts
- No emissions
- No use of fuels and water
- Minimal maintenance requirements
- Long lifetime, up to 30 years
- Electricity is generated wherever there is light, solar or artificial
- PV operates even in cloudy weather conditions
- Modular or “custom-made” energy, can be designed for any application from watch to a multi-megawatt power plant

**Drawbacks:**

- PV cannot operate without light
- High initial costs that overshadow the low maintenance costs and lack of fuel costs
- Large area needed for large scale applications
- PV generates direct current: special DC appliances or inverters are needed in off-grid applications energy storage is needed, such as batteries

**C. Load**

Common use of energy harvesting application is for supplying power to low powered devices. These devices are mostly low powered sensors used in remote or hazardous locations for system monitoring. In harvesting systems where power generated is not constant, battery storage systems are incorporated to store power during peak times to be used later. This is common with photovoltaic systems which typically incorporate batteries for power storage during the day to be used later at night. Other common applications of energy harvesting are solar powered calculators and lamps, thermal powered wrist watches, etc.

**III. COMPARISON OF SOLAR ENERGY HARVESTING TECHNIQUES**

Table 1: Comparison of investment and electricity generating costs for solar energy harvesting technologies

Technology	Generating costs (US cents/kWh)		Investment costs (US \$/W)		Efficiency
	Mean	Range	Mean	Range	
Solar thermal	15.0	12.0-18.0	5.0	4.0-6.0	80%
Solar PV	55.0	30.0-80.0	7.0	6.0-8.0	20%

**IV. CONCLUSION AND FUTURE WORK**

In this paper, we proposed a comparison between thermoelectric and photovoltaic energy harvesting. We aimed to point out the fundamental differences between the two strategies for energy harvesting from sunlight. Although photovoltaic energy harvesting has a greater efficiency compared to the thermoelectric case and it is much easier to get it to work using limited surface heat exchanges. Thermoelectric materials are difficult to implement due to their typically large heat conductivities that drastically decrease the actual temperature gradient, and thus the efficiency and power. Photovoltaic materials do not suffer such a limitation and may work much closer to the Carnot efficiency. But they require a forced heat exchange between the two surfaces of the module, for example using pumping fluids between the hot and cold reservoirs. This latter point is unlikely to fulfill volume constraints where adding pump, fluids and heat exchangers results in bulky and heavy structures, even if the active material can be compact.

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# A Review on Peak-to-Average Power Ratio

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**Abstract—** OFDM is an attractive modulation technique for transmitting large amounts of digital data in wireless standards. Multi-carrier phenomena is considered to be one of the major development in wireless communication and among them OFDM is becoming the important standard. Because it has several advantages such as high number of orthogonal sub-carriers, no inter-symbol interference, high spectral efficiency, tolerance in multipath delay spread, power efficiency, frequency selective fading immunity etc. But one of the challenging issues for Orthogonal Frequency Division Multiplexing (OFDM) system is its high Peak-to-Average Power Ratio (PAPR). OFDM consist of large number of independent sub carriers as a result of which amplitude of such a signal can have high peak values . Several methods have been proposed to reduce the PAPR.

**Keywords—** Orthogonal Frequency Division Multiplexing (OFDM), Orthogonality, PAPR, Signal distortion techniques, Signal scrambling techniques

## I. INTRODUCTION

We have studied the problem of the bandwidth efficiency in FDM & TDM, to overcome this orthogonal frequency division multiplexing was proposed, where the different carriers are orthogonal to each other. With OFDM, it is possible to have overlapping subchannels in the frequency domain, thus increasing the transmission rate. This carrier spacing provides optimal spectral efficiency. One of the main reasons to use OFDM is to increase the robustness against frequency selective fading or narrowband interference. In a single carrier system, a single fade or interferer can cause the entire link to fail, but in a multicarrier system, only a small percentage of the subcarriers will be affected.

## II. ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING (OFDM)

- Modulation  
a mapping of the information on changes in the carrier phase, frequency or amplitude or combination.
- Multiplexing  
method of sharing a bandwidth with other independent data channels.

OFDM is a combination of modulation and multiplexing. Multiplexing generally refers to independent signals, those produced by different sources [3]. In OFDM the question of multiplexing is applied to independent signals

but these independent signals are a sub-set of the one main signal. In OFDM the signal itself is first split into independent channels, modulated by data and then re-multiplexed to create the OFDM carrier [1]. In an OFDM scheme, a large number of orthogonal, overlapping, narrow band sub-carriers are transmitted in parallel. These carriers divide the available transmission bandwidth. The separation of the sub-carriers is such that there is a very compact spectral utilization. As an analogy, a FDM channel is like water flow out of a faucet, a whole bunch of water coming all in one stream; In contrast the OFDM signal is like a shower from which same amount of water will come as a lot of small streams as shown in fig 1[10]

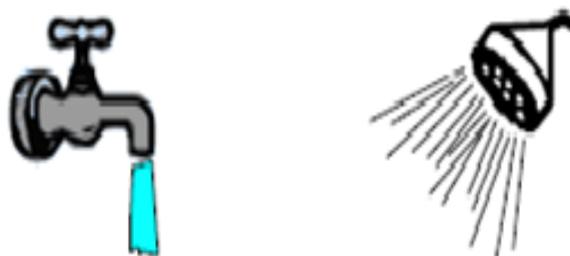


Fig 1:(a)A Regular-FDM single carrier (b) Orthogonal-FDM

### A. Importance of Orthogonality

The orthogonality of the carriers means that each carrier has an integer number of cycles over a symbol period. Due to this the spectrum of each carrier has a null at the center frequency of each of the other carriers in the system. This overlap of spectral energy does not interfere with the system's ability to recover the original signal as shown in fig 2 [13].

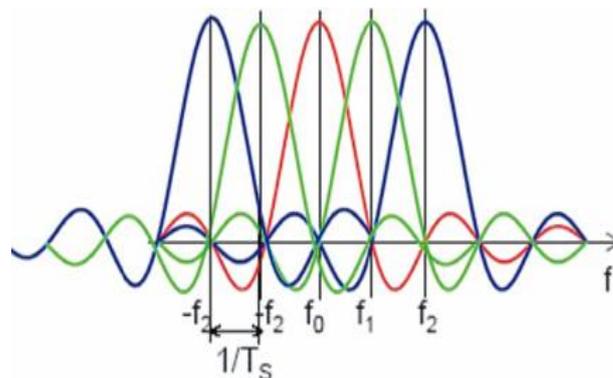


Fig2: OFDM spectrum for 5 orthogonal carriers

### III. THE PROS AND CONS OF OFDM

#### A. Combating ISI And Reducing ICI

When signal passes through a time-dispersive channel, the orthogonality of the signal can be lost. CP (cyclic prefix) helps to maintain orthogonality between the sub-carriers. Before CP was invented, guard interval was proposed as the solution. Guard interval was defined by an empty space between two OFDM symbols. This empty guard time introduces ISI (inter symbol interference) or ICI (inter channel interference). Later, a better solution was found that cyclic extension of OFDM symbol or CP, which is a copy of the last part of OFDM symbol, appended in front of the transmitted OFDM symbol. CP still occupies the same time interval as guard period, but it ensures that the delayed replicas of the OFDM symbols will always have a complete symbol within the FFT interval this makes the transmitted signal periodic. This periodicity plays a very significant role as this helps maintaining the orthogonality.

#### B. Spectral Efficiency:

A better spectral efficiency is achieved by maintaining orthogonality between the subcarriers. When orthogonality is maintained between different subchannels during transmission, then it is possible to separate the signals very easily at the receiver side [20]. Orthogonality makes it possible in OFDM to arrange the subcarriers in such a way that the sidebands of the individual carriers overlap and still the signals are received at the receiver without being interfered by ICI. The receiver acts as a bank of demodulators, translating each subcarrier down to DC, with the resulting signal integrated over a symbol period to recover raw data.

#### C. Immunity to Selective Fading

If the channel undergoes frequency selective fading, then complex equalization techniques are required at the receiver for single carrier modulation techniques. But in the case of OFDM the available bandwidth is split among many orthogonal narrowly spaced sub-carriers [17]. Thus the available channel bandwidth is converted into many narrow flat-fading sub-channels. Hence it can be assumed that the subcarriers experience flat fading only, though the channel gain/phase associated with the sub-carriers may vary. In the receiver, each sub-carrier just needs to be weighted according to the channel gain/phase encountered by it. Even if some sub-carriers are completely lost due to fading, proper coding and interleaving at the transmitter can recover the user data.

#### D. Resilient to Narrow-Band Effects

Using adequate channel coding and interleaving it is possible to recover symbols lost [14]. Channel coding refers to the class of signal transformations designed to improve communications performance by enabling the transmitted signals to better withstand the effects of various channel impairments, such as noise, interference, and fading. FEC is accomplished by adding redundancy to the transmitted information using a predetermined

algorithm. Each redundant bit is invariably a complex function of many original information bits. The original information may or may not appear in the encoded output; codes that include the unmodified input in the output are systematic, while those that do not are non systematic. If Channel coding is applied; the performance of OFDM is expected to be significantly improved through time diversity of channel coding as well as through inherent frequency diversity of the OFDM. In a multipath fading channel, if the data loss in a sub carrier channel occurs due to deep fade, it can be recovered from the coded data in alternative sub carrier channels which may not suffer from the same level of fade distortion.

#### E. Simpler Channel Equalization

An advantage of OFDM is that using multiple sub-channels, the channel equalization becomes much simpler [19]. Inserting an equalizer realized as an adaptive system before the FFT processing, the influence of variable delay and multipath could be mitigated in order to remove or reduce considerably the guard interval and to gain some spectral efficiency. In OFDM, the orthogonal subcarriers can be assumed to undergo flat fading in a frequency selective channel permitting operation without an equalizer especially when differential data encoding is used. However, in OFDM, the data symbols are no longer confined to orthogonal subcarriers and, therefore, an equalizer is required for operation in frequency selective channels.

#### F. Efficient Modulation and Demodulation

Modulation and Demodulation of the sub-carriers is done using IFFT and FFT methods respectively, which are computationally efficient. By performing the modulation and demodulation in the digital domain, the need for highly frequency stable oscillators is avoided. OFDM makes efficient use of the spectrum by allowing overlap.

G. It is less sensitive to sample timing offsets than single carrier systems are [20]. To decode the OFDM signal the receiver has to take the FFT of each received symbol, to work out the phase and amplitude of the subcarriers. For an ideal channel with no delay spread the receiver can pick any time offset, up to the length of the guard period, and still get the correct number of samples, without crossing a symbol boundary. Because of the cyclic nature of the guard period changing the time offset simply results in a phase rotation of all the subcarriers in the signal. Provided the time offset is held constant from symbol to symbol, the phase rotation due to a time offset can be removed out as part of the channel equalization. In multipath environments ISI reduces the effective length of the guard period leading to a corresponding reduction in the allowable time offset error.

H. *Smart Antennas* can be integrated with OFDM. MIMO systems and space-time coding can be realized on OFDM [18]. OFDM is a promising digital modulation scheme to simplify the equalization in frequency selective

channels and provide simpler implementations. MIMO communications technology, can achieve significant increases in the channel capacity. Therefore, the combination of OFDM with MIMO communications, which is MIMO-OFDM systems, can realise high-performance transmissions. Although, multi-path propagation causes frequency selectivity in broadband wireless channels, most MIMO systems are used for channels with flat fading. Therefore, the MIMO-OFDM technique has initially been proposed to use OFDM to alleviate ISI in MIMO systems and found to be a propitious selection for high data rate wireless broadband communications.

### I. Modulation Type Per Subcarrier

Because different modulation schemes will give different performances, adaptive modulation and bit loading may be needed depending on the performance requirement. It is interesting to note that the performance of OFDM systems with differential modulation compares quite well with systems using non-differential and coherent demodulation. Furthermore, the computation complexity in the demodulation process is quite low for differential modulations.

Amongst all attractive advantages of OFDM, there are some disadvantages of OFDM [21]:

- Strict Synchronization Requirement:

OFDM signals are subject to synchronization errors due to oscillator impairments and sample clock differences. The demodulation of the received radio signal to baseband, possibly via an intermediate frequency, involves oscillators whose frequencies may not be perfectly aligned with the transmitter frequencies. This results in a carrier frequency offset. Carrier frequency offset degrade the performance of an OFDM system. When the baseband signal is sampled at the A/D, the sample clock frequency at the receiver may not be the same as that at the transmitter. Not only may this sample clock offset cause errors, it may also cause the duration of an OFDM symbol at the receiver to be different from that at the transmitter. Since the receiver needs to determine when the OFDM symbol begins for proper demodulation with the FFT, a symbol synchronization algorithm at the receiver is usually necessary. Symbol synchronization also compensates for delay changes in the channel.

- PAPR

Peak-to-average power ratio (PAPR) is proportional to the number of subcarriers used for OFDM systems. An OFDM system with large number of subcarriers will thus have a very large PAPR when the subcarriers add up coherently. When in a multicarrier system the different sub-carriers are out of phase with each other. At each instant all the points achieve the maximum value simultaneously; this will cause the output envelope to suddenly shoot up which causes a 'peak' in the output envelope. Large PAPR of a system makes the implementation of digital-to-analog converter (DAC) and

analog-to-digital converter (ADC) extremely difficult. The design of RF amplifier also becomes increasingly difficult as the PAPR increases.

## IV. PAPR IN OFDM

An OFDM signal consists of a number of independently modulated subcarriers, which can give a large peak-to-average power (PAP) ratio.

Problem 1 It increased complexity of the analog-to-digital and digital-to-analog converters.

Problem 2 It reduced efficiency of the RF power amplifier.

### A. Factors Effecting PAPR

- Number of sub carriers:

The peak value possible is N times the individual sub carrier peak, the probability of any value close to that peak occurring is very low. For example, with only 24 sub carriers, the probability of the PAPR exceeding 4dB is 10<sup>-2</sup> and of exceeding 8dB is only 10<sup>-4</sup> [2].

- Modulation Order:

High data bandwidth efficiency may be achieved by using higher order modulations based, for example, on QAM. When the sub carrier's modulation is a higher-order QAM type, the PAPR of the summed OFDM signal is increased by the PAPR of the QAM constellation used.

- Pulse Shaping:

In terrestrial communications it is common to apply pulse shaping to the base band signal [2] to reduce the bandwidth of the transmitted spectrum, but this causes overshoot and could increase the PAPR of the modulating signal by 4-5dB.

## V. PAPER REDUCTION TECHNIQUES

Several schemes have been proposed to reduce the PAPR. These techniques can be divided into two main categories

- Signal Distortion
- Signal Scrambling

### Signal Distortion Techniques

It reduces the peak amplitudes simply by nonlinearly distorting the OFDM signal at or around the peaks.

- Clipping
- Peak window
- Peak cancellation

#### A. Clipping the signal:

The peak amplitude becomes limited to some desired level. By distorting the OFDM signal amplitude, a kind of self interference is introduced that degrades the bit error rate (BER). Nonlinear distortion increases out-of-band radiation

#### B. Peak windowing:

To multiply large signal peaks by nonrectangular window. For minimize the out-of-band interference, ideally the window should be as narrowband as possible. The windows should not be too long in the time domain, because that implies that many signal samples are affected, which increases the bit error rate

### C. Peak Cancellation:

The undesired effect of nonlinear distortion can be avoided by doing a linear peak cancellation technique, whereby a time-shifted and scaled reference function is subtracted from the signal, such that each subtracted reference function reduced the peak power of the least one signal sample. Peak cancellation can be done digitally after generation of the digital OFDM symbols [23].

## VI. SIGNAL SCRAMBLING TECHNIQUES

### A. Block Coding Techniques:

The data is block coded in such a way that only those sets of code words are permissible which do not contain high peak envelope powers. The PAPR is reduced and it also enables reduction of non linear distortion as well as decreased spectral regrowth [25]. The major drawback is that this technique is not suitable for higher number of sub carriers because of exponential rise in complexity as the number of carriers increase

### B. Sub Block Coding Techniques

To reduce PAPR more than 3db sub block coding technique is widely used. But this can be achieved at  $\frac{3}{4}$  code rate [9]. This techniques based on  $\frac{3}{4}$  code rate systematically with added last odd parity checking bit to develop lowest peak envelope power. Large reduction in PAPR can be obtained by the divided large frame into sub block encoded with SOPC.

### C. Selected Mapping (SLM)

In SLM from a set of candidate signals which are generated to represent the same information, the signal with lowest PAPR is selected and transmitted [12]. The information about this selection also needs to be explicitly transmitted along with the selected signal as side information. SLM is can be employed for larger number of sub-carriers with moderate complexity.

### D. Partial Transmit Sequence (PTS)

In partial transmit sequences, initially partitioning of the data block into non-overlapping sub-blocks is done [11]. Then these sub-blocks are rotated with rotation factors which are statistically independent. Subsequently the information about rotation factor, which generates the lowest peak amplitude in time domain data.

### E. Linear Block Codes

In this scheme distinct U signal is transmitted along with transmitted sequence. U distinct signal is used constructed using proper select code-words. Using scrambling codes no needs to transmit side information and received signal can be easily decoded. Main thing is that to select standard array of codes to reduce the PAPR.

### F. Interleaving

PAPR can be reduced if we can break down the long correlation patterns. This technique utilizes data randomization to reduce PAPR while adaptive interleaving (AIL) is employed to keep the complexity at minimum [15]. It is based on finding an early terminating threshold. Hence the search will stop when the PAPR value arrives at the threshold, and all the interleaved sequences will not be searched.

### G. Tone Reservation

This technique contains some set of reservation of tones. This method is used for multicarrier transmission. This technique is depends on amount of complexity [23]. When there is number of tone is small reduction in PAPR may represent non negligible samples of available bandwidth. Advantage of this tone reservation is very positive that no process is needed at receiver end and also do not need to transmit the side information along with the transmitted signal.

### H. Tone Injection

Motivated by the data rate loss of tone reservation, generally used additive method for PAPR reduction [23]. It reduces the PAPR without compromising the data rate. In this method the size of the basic constellation is increased. Hence mapping of original constellation points into numerous corresponding points in the new stretched out constellation becomes possible.

## VII. CONCLUSION

In this, OFDM, peak to average power ratio and its various reduction techniques are reviewed. Orthogonal frequency division multiplexing technique is modulation technique which provides high speed communication in both wired and wireless systems. PAPR is major drawback of Orthogonal Frequency Division Multiplexing technique which degrades the performance of OFDM. As per the information about all above described techniques to reduce the PAPR in OFDM system all techniques is different in their way and using each technique PAPR will be reduced at some level. Research is going on to further improve PAPR reduction and improving the performance of OFDM systems.

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# Ant colony Algorithm Based Solution for Model of VRP

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**Abstract**—Ant colony algorithm is a propelled optimization method which is utilized to take care of combinatorial optimization problems. The significant features of this algorithm are the utilization of mixture of pre-information and post-information for organizing great solutions. Vehicle routing problem (VRP) practical optimization problem used to discover the best achievable route of a vehicle. VRP is generally utilized for sorting the diverse routes of vehicles to give productive administrations to the clients. In this paper we execute the ant colony algorithm on the bus routes of a school to obtain the shortest routes of different buses.

**Keywords**—Component, Formatting, Style, Styling

## I. INTRODUCTION

Vehicle routing problem assumes a noteworthy part in this present reality and is additionally a piece of the logistics framework research. This algorithm is utilization to diminish the administration suppliers working expenses by applying the coherent hunt strategy to enhance the vehicle's way. Selecting the proper transport courses can accelerate reaction time to client needs, enhance administration quality, and improve consumer loyalty with the logistics framework [8]. It is difficult to execute any methodology on VRP to discover the careful arrangement so; consequently the majority of methodologies have heuristics which create almost surmised arrangements. Nowadays' associations are confronting the problem of utilizing productive measured gathering of vehicles such that they can undoubtedly give the administration of pick-up and conveyance of individuals connected with that association. In school transportation framework, understudies are adjusted with the gathering of transports both at morning time and afternoon time for getting the understudies and dropping them by beginning and completion the course of every transport from the school.

## II. VEHICLE ROUTING PROBLEM

VRP was first proposed in 1959 by Dantzig and Ramser. The basic vehicle routing problem finds set of routes for different vehicles where the vehicle end its tour at the same point where it begins without exceeding the maximum capacity of the vehicle. In the VRP each vehicle has to serve each customer only once without any restriction of customer combination selecting the routes of a vehicle, VRP is one of that optimization problem in which as the number of customers increased their feasible solution also increases exponentially.

## III. LITERATURE REVIEW

In my literature survey we had study several papers in which different authors proposed various techniques in ant colony optimization for solving vehicle routing problem. Bell, et.al. (2004) has applied ant colony optimization to different instances of vehicle routing problem. The ant colonies forage for food by some decision-making processes which are similar to swarm intelligence techniques. The author had done some enhancements in the ant colony algorithm while solving travelling salesman problem such that it can search multiple routes for the VRP [9]. Showkat (2011) has modified the ant system algorithm to solve the capacitated vehicle routing problem, to find the optimum routes; the improvement is done in the ant system algorithm by adding pheromone only to the three best feasible solution rather than global best solution only. The author also introduced the concept of stagnation means the repetition of previous solution in the next iteration which can be overcome by artificial ants by finding the global best route with the use of local optimizer. The modified algorithm of ant colony optimization (ACO) meta-heuristics is performed on different standard instances and the results shown are closer to the known optimum routes [5]. Tan, et.al. (2012) has Ant colony algorithm merged with some heuristic approaches to solve the capacitated vehicle routing problem. This algorithm works with evaporation of pheromone where the rate of pheromone evaporation can vary the number of feasible solutions produced by the ants. Some experiments were done on different standad instances which show better solution than ant colony algorithm embedded with only one heuristic [3]. Wang, et.al. (2013) have proposed an Ant Colony Algorithm which is adaptive in nature due to the use of Pareto Local Search algorithm and apply to the Vehicle Routing Problem. The information stored in this algorithm is used for the pheromone updating. The comparison is done by author taking their approach with both basic, advance meta-heuristics and computes the results of proposed approach which generates more optimal solutions [7]. Yousefikhoshbakht, et.al. (2014) have presented a advanced elite ant system (EAS) algorithm called HEAS for solving the VRP. The advanced approach mixed with insert and swap algorithms utilizes better local optimum points to generate feasible solution. In contrast to the classical EAS, the proposed algorithm uses only a global updating which will increase pheromone on the edges of the best route and will at the same time decrease the deposition of pheromone laid on the edges of the worst route [1].

#### IV. OVERVIEW OF ANT COLONY OPTIMIZATION

Ant colony optimization is a meta-heuristic approach where artificial ants are inspired from the biological behavior of real ants in finding the best solution for discrete optimization problems. Ants use a chemical substance for communication with each other is called pheromone trails for finding the shortest path to food. When ants start searching for food it releases some pheromone on the ground, which help other ants for searching the food by following the pheromone trail. Ants which are following the pheromone trail select the trail depending upon the amount of pheromone deposited; more the amount of pheromone deposited there is more chancing of selecting that path. The ants find their path between the two ant colonies very smartly in searching for food source. The pheromone trail start decaying and loses its attractiveness after some time due to evaporation and on long distances the amount of pheromone deposit is less so it quickly evaporates as compare to short distances [2]. Thus a shorter way has more quantity of pheromone deposit and has more activeness to the ants which helps in finding best optimal solutions for the problem. Generally speaking about the algorithm there are three main parts:

##### A. Selection Mechanism

The selection of the path is based on the amount of information given about that path, greater the amount of information on that path greater is the probability of selecting the path.

##### B. Update Mechanism

The density of pheromone on each path will increase as the number of ants walks through the path increases, but with the time the density of pheromone will start decreasing due to evaporation.

##### C. Coordination Mechanism

When In the ant colony algorithm the ants work with each other cooperatively to reach their goal and while searching their food the ants communicate to each other using the pheromone trail. This mechanism gives the ant colony algorithm a strong ability to find optimal solutions.

#### V. ANT COLONY OPTIMIZATION FOR VRP

Most of the Ant colony optimization approaches depends upon three main aspects-1) ACO uses a more aggressive action choice rule than other heuristics , 2) The pheromone is added only to those moves which belongs to global-best solution 3) when each time an ant moves on a path, it removes some pheromone from that path.

##### A. Construction

The first phase of the Ant colony algorithm deals with the tour construction when ant K moves from city I to city j. Ant will choose the city based on two rules. First rule called the pseudorandom proportional rule which is based on exploitation mechanism.

$$J = \begin{cases} \operatorname{argmax}_{l \in N_{ij}} \{ \tau_{xy}(t) [\eta_{xy}]^\beta \}, & \text{if } q \leq q_0 \\ J, & \text{otherwise} \end{cases} \quad (1)$$

Where q is the random variable uniformly distributed in [0,1],  $q_0$  ( $0 \leq q_0 \leq 1$ ) is a parameter and j is a random variable selected according to the probability distribution given by the following formula:-

$$p_{ij}^k = \frac{[\tau_{ij}] [\eta_{ij}]^\beta}{\sum_{l \in N_{ik}(x)} [\tau_{il}(t)]^\alpha [\eta_{il}]^\beta} \quad \text{if } J \in N_{ik} \quad (2)$$

Second rule uses exploration mechanism based on the probability distribution used in AS. ACS algorithm applies global pheromone trail update where only one ant (the best-so-far ant) is allowed to add pheromone after all ants finished constructing their tours.

##### B. Global Pheromone Update

In the Ant colony algorithm only one ant is allowed to add pheromones after completing the iterations. The update is implemented using the following equation:

$$\tau_{i,j} \leftarrow (1-p) \tau_{i,j} + \rho \Delta \tau_{i,j}^{bs}, \quad \forall (i,j) \in E \quad (3)$$

##### C. Local Pheromone Update

Ant colony algorithm applies local pheromone update which occur each time an ant moves on the arc (i, j) to move from city to city, this process will remove some pheromones from the arc to increase the probability of exploring another path. The local update is implemented using the following rule.

$$\tau_{i,j} \leftarrow (1-\epsilon) \tau_{i,j} + \epsilon \tau_0 \quad (4)$$

Where  $\epsilon$ ,  $0 < \epsilon < 1$ , and  $\tau_0$  are the two parameters. The value of  $\tau_0$  is equal to initial value for the pheromone.

##### D. Pseudo-code of Ant Colony Optimization

Compute Visibility

Initialize pheromone

While (maximum iterations not reached)

For each ant i

Select the next customer to visit from tabu list

Perform local pheromone trail update

End for

Perform global pheromone trail update

Save the best route

End while

#### VI. SIMULATION RESULTS

While going for the implementation part, we solve the vehicle routing problem by taking the real world scenario of buses on different routes to pick the students at morning time and to deliver those students at evening time to their perspective stops. The ACO algorithm is implemented in the MATLAB r2011a tool in which all the test and experiments are performed on the real data set of values for the vehicle routing problem using Ant colony optimization technique.

In the ant colony algorithm we are taking these parameters value as  $\alpha = 1$ ,  $\beta = 1$ ,  $\rho = 0.5$ , number of ants = 15 and load capacity = 1000. Table I shows the list of different bus stops

for each bus. Fig1 shows the best path generated by the ant colony algorithm which is shown as-

- 1→2→23→29→22→3→1
- 1→4→33→19→26→10→1
- 1→5→28→30→6→21→16→14→1
- 1→7→34→24→25→17→18→1
- 1→8→12→15→20→9→1
- 1→13→32→11→27→35→1

The optimized distance of the above route is calculated as- 527.517 km which is shown in Fig1

No. of bus stops	Name of bus stop	No. of bus stops	Name of bus stop	No. of bus stops	Name of bus stop
1	School	13	Rose colony	25	Hari singh nagar
2	Guru amardas nagar	14	Ravidass nagar	26	Sham nagar
3	Verka milk plant	15	Laxmipura	27	Kapurthala chowk
4	Greater kailash	16	Sacred heart hosp	28	Subhash nagar
5	Moti nagar	17	Aman nagar	29	Issa nagar
6	Sudarshan nagar	18	Pathankot chowk	30	Ashok nagar
7	Dada colony	19	Dav college	31	Gurdev nagar
8	Industrial area	20	Sodal nagar	32	Hardev nagar
9	Aman nagar	21	National park	33	Hukumchand colony
10	New shetal nagar	22	Anand nagar	34	Bhagatsingh colony
11	Guru nanak nagar	23	Guruamar dass ext	35	Durga colony
12	Shiv nagar	24	Sanjay Gandhi mrkt		

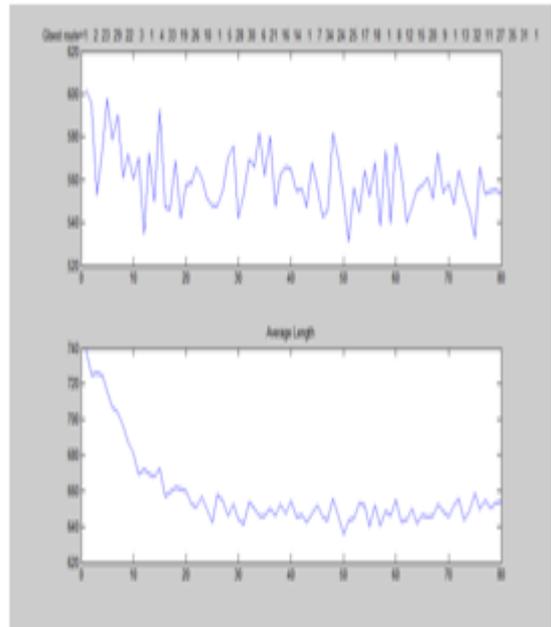


Fig.1. The total best length of buses generated.

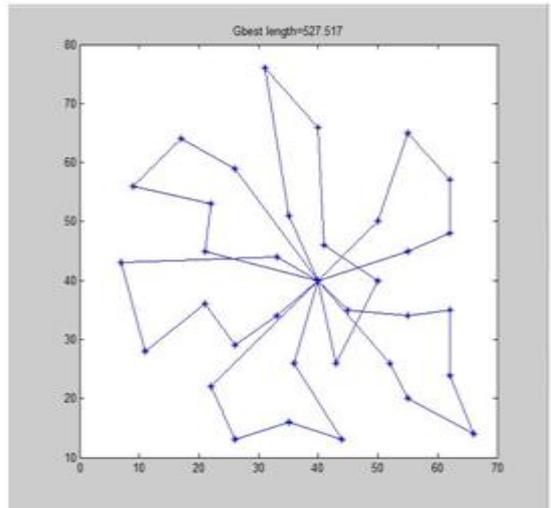


Fig.2. The best shortest route generated for all buses.

## VII. CONCLUSION

In this project we implement ACO algorithm in MATLAB for finding the optimal solution of the vehicle routing problem. This techniques avoid being get trapped in the local optimal solution, hence generates the global optimal solution. This technique can also help us to find the best optimal solution from the generated solutions for the given problem. In our future work, an enhancement is done using the new heuristic function of ant colony optimization algorithm which avoid being get trapped in the local optimal solution, hence generates the global optimal solution.

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# Performance Comparison of AODV and DYMO under Battlefield Monitoring System using Random Waypoint Mobility Model

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**Abstract**—The purpose of routing protocols is to learn about available routes that exist on the network, build routing tables and make routing decisions. Routing is the process of taking a packet from one device sending it through the network to another device in a different network. Communications across the Internet is one of the best examples of routing. The internet helps to move data from your computer, across several networks, to reach a destination network. There are two primary routing protocol types i.e. on demand and distance vector protocols. In this paper, we have compared on demand routing protocols AODV and DYMO under Battlefield Monitoring System. In battlefield monitoring system, Sensor network nodes are limited with respect to energy supply, restricted computational capacity and communication bandwidth. Most of the attention, however, has been given to the routing protocols. The simulation is done with the help of Qualnet 5.0.2. The performance parameters taken for comparison are throughput, Packet delivery ratio ,average jitter and average end to end delay. This comparison reveals the best protocol on the basis of above parameters that need to be taken into consideration for designing better battlefield monitoring system.

**Keywords**— Battlefield Monitoring System, AODV, DYMO, QualNet Simulator

## I. INTRODUCTION

Sensor is also called as mote which is a node in a wireless sensor network that is capable of performing some processing, gathering sensory information and communicating with other connected nodes in the network. WSN should be able to provide fast, secure and reliable multicast communication in military application i.e. Battlefield monitoring system [1].

Sensors are randomly deployed in a surveillance region for the area monitoring. The sensory information observed by each sensor is stored locally at the sensor and passed to the mobile vehicles which are moving inside the area where sensors are deployed. Here two types of devices are used. One is named as Unattended Ground Sensors (UGS) which are ground sensors , and the other is Unmanned Ground Vehicles (UGV) which are moving vehicles.UGV collects the data from the ground sensors i.e. UGS and send it to the Fusion Centre (FC) where the assessment has to be done.

## II. CLASSIFICATION OF ROUTING PROTOCOLS

Routing protocols can be classified into different groups according to their characteristics. Protocols are taken on the basis of On demand and table Driven mechanism

### A. On Demand Routing Protocol

AODV and DYMO share this common characteristic i.e. they both initiate routing activities on an on demand basis. This reactive nature of these protocols is a significant different from traditional proactive protocols. a route is established only when it is required by a source node for transmitting data packets.

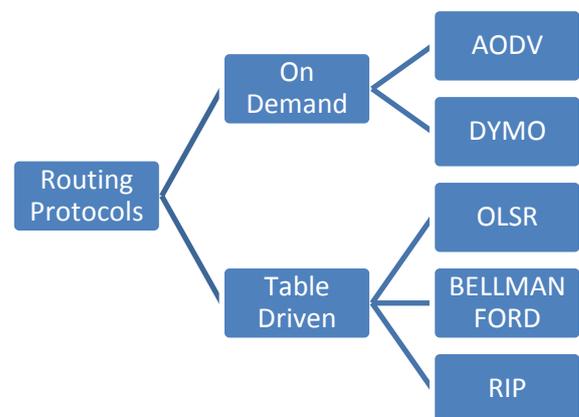


Fig. 1. Classification of Routing Protocols

In an on-demand routing protocol, the source node floods the RouteRequest packet in the network when a route is not available for the desired destination. It may obtain multiple routes to different destinations from a single RouteRequest. When an intermediate node receives a RouteRequest, it either forwards it or prepares a RouteReply if it has a valid route to the destination [2]. The advantage is connection setup delay is lower.

## III. SIMULATION SCENARIO

This scenario demonstrates data collection from ground sensors using mobile vehicles. Sensors are randomly deployed in a surveillance region. The sensors constantly monitor any phenomena of interest in the area

[3]. The sensory information observed by each sensor is stored locally at the sensor. The mobile vehicles are moving inside the area where sensors are deployed [4]. The vehicles have short range communication to sensors and long distance communication to a remote site which is called fusion center in this scenario. Fusion center is node 121.

The sensors send their locally stored data packets to the vehicles which at any time are within their radio range [5][6]. The vehicles then relay sensory data packets to fusion center using long distance communication to that center.

UGS and UGV are both battery-powered devices. Short range communication between UGSs and UGVs has been configured as ZigBee. PHY and MAC protocol is 802.15.4 and routing protocol is Mesh Routing (AODV)

Long distance communication between UGVs and fusion center is configured as WiFi (802.11a) and the routing protocol is OSPFv2. The scenario consists of 100 UGS nodes (nodes from 1 through 100) with linear battery model and micaZ radio energy model 5 UGV [7] (nodes from 100 through 105) with random way point inside the area where sensors are deployed. Simulation is created using Qualnet 5.0.2 simulator.

Table 1. Parameters for simulation

Scenario	Battlefield Monitoring
Simulation network space	500m X 500m
No. of Nodes	50,100
Node placement	Randomly Deployment
MAC protocol	IEEE 802.15.4
User mobility	Random Way Point
User speed	10 m/s
Simulation time	1200 s
Energy mode	MICAZ
Battery model	Simple Linear
Performance metrics	End to End Delay, Jitter, throughput, packet delivery ratio.
Routing protocol	AODV,DYMO

Simulation time for the battlefield is 1200s. Readings are observed by constantly doubling the number of nodes. So results are taken when number of nodes is 50 and 100.

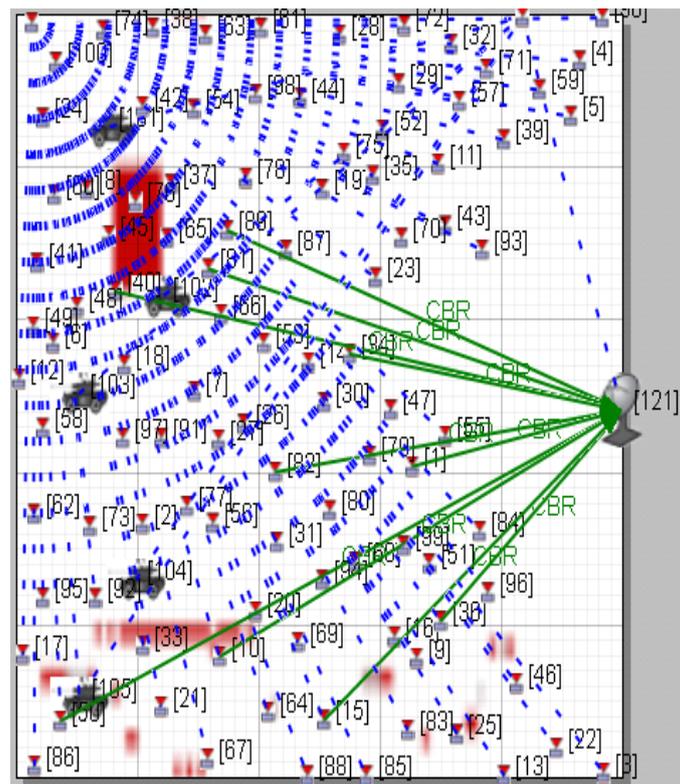


Fig. 2. Battlefield scenario

#### IV. PERFORMANCE METRICS

- 1) *Throughput*: the average rate of successful message delivery over a communication channel. It should be maximum.
- 2) *End to End Delay*: the time taken for a packet to be transmitted across a network from source to destination. It should be minimum.
- 3) *Jitter*: the variation in the time between packets arriving, caused by network congestion, timing drift, or route changes. It should be minimum.
- 4) *Packet Delivery Ratio*: it is the ratio between number of packets received to number of packets sent.

#### V. RESULTS

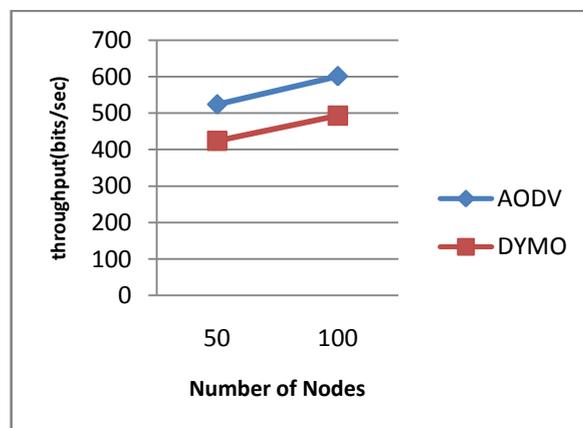


Figure 3. Throughput vs number of nodes

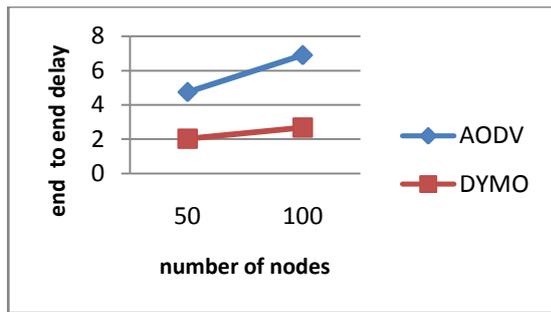


Figure 4. End to End delay vs Number of nodes

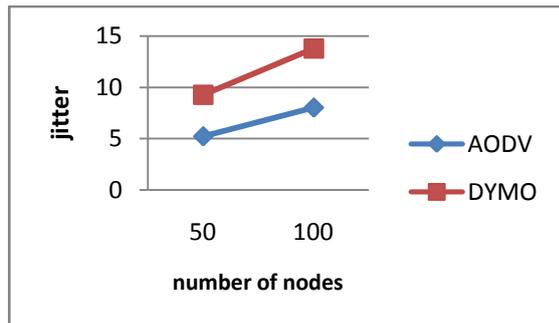


Figure 5. Jitter vs Number of nodes

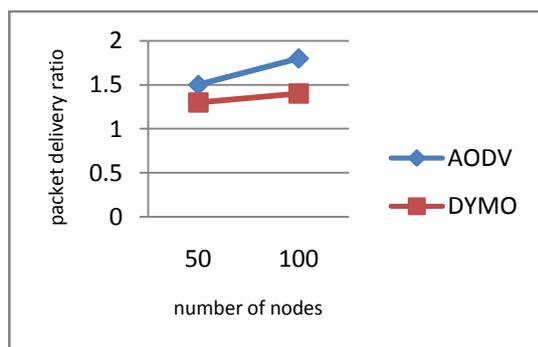


Figure 6. Packet delivery ratio vs number of nodes

## VI . CONCLUSIONS

From the above results, it can be concluded that AODV is best for Battlefield monitoring system. It provides the reliable delivery of messages because it has maximum delivery ratio even when the number of nodes is 100.

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# Performance Analysis of Classical Cooperative Communication using Amplify and Forward Protocols

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**Abstract**—This paper highlights the performance of classical cooperative communication system with and without combining schemes. There is tremendous increase in average and instantaneous SNR of the received signal at the destination node with the aid of combining schemes as compare to the classical cooperative communication without combining scheme. Basic system model of classical cooperative communication system consists of single antenna source, relay and destination. Classical Cooperative system utilizes the concept of spatial diversity and temporal diversity in order to achieve high diversity gain and better performance as compare to SISO system. Source node transmits symbols to destination with the help of relay which uses Amplify-and-Forward protocol and quadrature phase shift keying (QPSK). Further, Maximum ratio combining achieves improved SNR at the destination as compare to the Equal gain combining schemes. But the main drawback of maximum ratio combining is its high complexity which can be overcome by using equal ratio combining scheme whose performance is only marginally inferior to maximum ratio combining.

**Keywords**—Cooperative Communication; Amplify-and-Forward Protocol (AF), Symbol Error Rate (SER)

## I. INTRODUCTION

Wireless communication has made remarkable improvement in the field of communication [1]. As applications based upon wireless communication network has been increased tremendously in past couple of years [3]. Cellular network is one of the important applications of wireless systems with handheld device that enable people to share common platform around the world [2]. Wireless Network users demand more reliability, high data rates along with cost efficiency. But the major issue in wireless communication system is signal fading due to multipath propagation. In order to overcome such problem concept of diversity came into picture. The effect of channel fading is reduced by diversity and it also enhances the reliability of signal transmitted [4]. Diversity technique provides more than one copies of signal at destination in such a fashion that signals are not correlated [5]. It provides better signal quality at very low cost [7]. Diversity can be classified into different categories: temporal, frequency and spatial diversity [6]. In several conditions, however the wireless environment is time-invariant and flat faded. This drive the possibility of positioning more than one antenna at both the

Source and Destination end in order to gain spatial diversity [8]. Multi-Input Multi-Output (MIMO) technology has attracted great attention for wireless communications which fruitfully yields in high data rate, low power consumption and network reliability. Due to size of mobile devices, cost and hardware implementation makes it hard for MIMO technology to be applied in wireless mobile environment. In order to compensate this restriction the concept of cooperative diversity has been introduced where mobile users share their antennas with others users in order to provide spatial diversity gain at destination by forming a virtual array of antenna [9]. In cooperative environment several copies of the source information signals results in improvement of system performance and robustness [10]. Cooperative communication approach results in numerous advantages: increases spectral and power efficiency, improve network coverage and reduce outage probability [11]. Different cooperative diversity protocols have been studied [12]. Cooperative communication uses two major protocols: Amplify-and-Forward (AF) and Decode-and-Forward (DF) [13]. In AF protocol, relay receive the noisy version of signal and amplify it and forward to the destination. AF has less design complexity and achieves full spatial diversity orders for increasing network reliability. In DF protocol relay decode the information send by the source and forward it to the destination.

In this paper, main focus is to study performance of classical cooperative communication system with and without combining scheme using AF protocol. In classical cooperative communication system, concepts of spatial as well as temporal diversity are used without increasing the complexity of the system and number of antennas at source or destination node.

## II. SYSTEM MODEL

For the intention of detailed explanation, a cellular environment is considered in which source sends information to destination via a relay and also there is a direct path between source to destination in order to share information between these stations. Source, relay and destination use single antenna as shown in Fig. 1. The channels between stations are subject to flat fading.

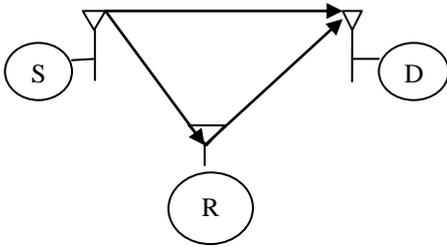


Fig. 1 System model

### III. CLASSICAL COOPERATIVE COMMUNICATION

The transmission process for Classical Cooperative communication can be fractioned into two levels in wireless network [11]. In level 1 each user sends signal to destination as well as to other user (relay) at the same time. In level 2 relay simply amplify the received signal and transfer that signal to the destination. In both levels users forward signal through orthogonal channel by time division multiplexing access (TDMA).

In level 1 source broadcast its signal to both destination and relay.  $y_{s,d}$  and  $y_{s,r}$  received signal from source to destination and source to relay respectively.

$$y_{s,d} = \sqrt{P_1} h_{s,d} \cdot x + n_{s,d} \quad (1)$$

$$y_{s,r} = \sqrt{P_1} h_{s,r} \cdot x + n_{s,r} \quad (2)$$

where  $P_1$  is the transmitted power at the source,  $x$  is transmitted information symbol.  $h_{s,d}$  and  $h_{s,r}$  are channel gain from source to destination and source to relay respectively. Noise terms  $n_{s,d}$ ,  $n_{s,r}$  and  $n_{r,d}$  are related to source to destination, source to relay and relay to destination respectively, prototyped as zero mean complex Gaussian random variable and are assumed to be equal to  $n$ . In level 2 relay amplify noisy version of the signal received from level 1 and forward it to the destination with power  $P_2$ .  $y_{r,d}$  is the received signal from relay to destination.  $h_{r,d}$  is the channel gain from relay to destination.

$$y_{r,d} = \beta h_{r,d} \cdot y_{s,r} + n_{r,d} \quad (3)$$

$$\text{where } \beta = \frac{P_2}{\sqrt{P_1 |h_{s,r}|^2 + N_0}} \quad (4)$$

and  $N_0$  is noise variance and it is related to source to relay path.

$$y_{r,d} = \sqrt{\frac{P_1 P_2}{P_1 |h_{s,r}|^2 + N_0}} h_{r,d} h_{s,r} x + n_{r,d} \quad (5)$$

### IV. RELAY TOPOLOGY

In this section, performance analysis of classical cooperative communication system using parallel and cascaded relay transmission topology is done.

Cascaded relay transmission is employed where the distance between source and destination is very large. In this arrangement, information travels from one relay to another and reaches the destination. Orthogonality between neighboring channels is maintained in order to nullify the effect of interference.

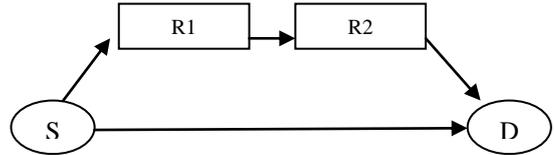


Fig. 2 Cascaded relay Transmission

Parallel relay transmission topology is employed in order to nullify the effects of multipath fading. By using relay in parallel fashion, diversity can be achieved. At the destination, different combining schemes can be used to improve the quality of the signal by increasing the instantaneous and average SNR of the received signal.

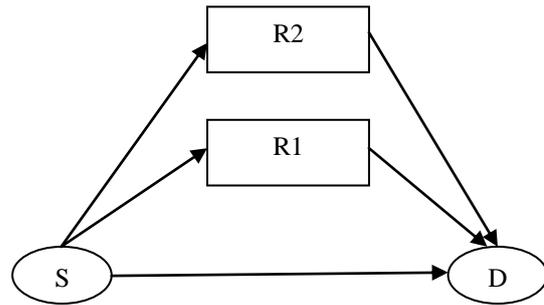


Fig. 3 Parallel Relay Transmission

### V. COMBINING SCHEMES

For classical cooperative communication system Maximal Ratio Combining scheme and Equal gain combining are used in order to detect transmitted symbol. In MRC, signals  $y_{s,d}$  and  $y_{r,d}$  are multiplied by their conjugate of corresponding channel coefficients to estimate the transmitted symbol.

$$y_d = \sum_{i=1}^k h_{i,d}^* \cdot y_{i,d} \quad \text{or} \quad (11)$$

$$y_d = h_{s,d}^* y_{s,d} + h_{r,d}^* y_{r,d}$$

where  $h_{s,d}^*$  is the conjugate of channel gain from source to destination and  $h_{r,d}^*$  is the conjugate of channel gain from relay to destination.

Whereas EGC diversity receiver is of practical interest because of reduced complexity as compare to MRC. If computing time is a crucial point or the channel quality could not be estimated, all the received signals can just be added up in order to improve SNR at receiver. This is the easiest way to combine the signals, but the performance of MRC is quite better than EGC.

$$y_d = y_{s,d} + y_{r,d}$$

## VI. SIMULATION RESULTS

In this section comparison of the performance of Classical Cooperative Communication using MRC and EGC combining schemes with SISO system is done. System specifications: Total number of symbols  $N=10^5$ , total transmitting power is set as unity,  $P_1 = P_2 = 0.5$ . QPSK modulation has been used.

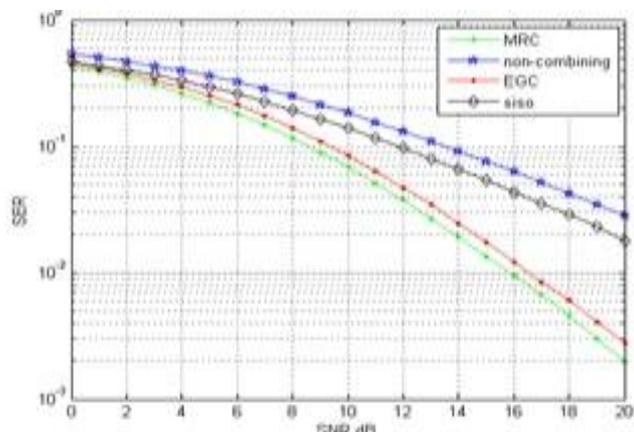


Fig. 4 SER vs SNR for Classical Cooperative Communication using different combining schemes, SISO and non-combining

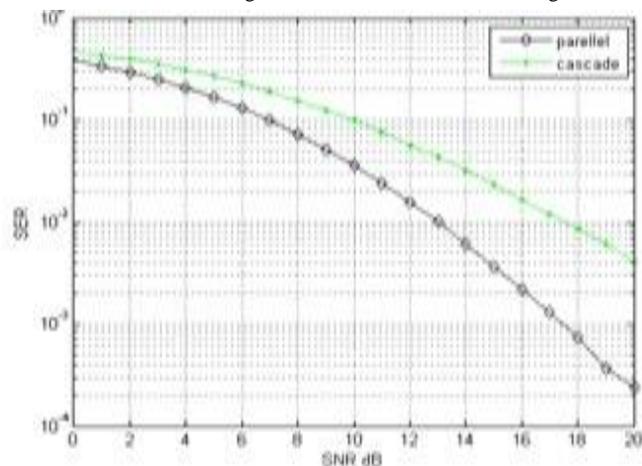


Fig.5 SER vs SNR of different relay topologies

It has been observed from Fig.4 that there is a tremendous improvement in the performance of Classical Cooperative Communication System with MRC as compare to SISO system and Classical Cooperative Communication System without combining schemes that is due to improvement of instantaneous and average value of received SNR at the destination. Fig.5 reveals that parallel relay topology is far better than cascaded relay topology due to increase in the diversity gain which will nullify the effects of multipath fading.

## VII. CONCLUSION

In this paper Classical Cooperative Communication using Amplify and Forward protocol with single antenna source, relay and destination has been studied. Performance of Classical Cooperative Communication with combining has been compared with Classical Cooperative

communication system without combining scheme and SISO system. Average and instantaneous value SNR at the receiver end of Classical Cooperative system using combining schemes are far better than classical cooperative communication system without combining scheme and SISO system. It has been observed that location of relay effects the performance of system. By deploying parallel relay topology, diversity can be achieved which will combat fading in non-line of sight communication.

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# An Failure Adaptive Energy Optimized Multi-Hop DLQAR Routing in WSN

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**Abstract-** A Wireless Sensor Network (WSN) is specialized network defined with restricted resources and constraints. To optimize the network route and network life, under these constraints is always a challenge. In this paper, a multi parameter based hop selection analysis based algorithm is proposed to generate the optimized route over the sensor network based on Residual energy, Failure rate and sensing range using DLQAR protocol. The no. of alive node, dead node, hop count, energy consumption terms are used to analyze the proposed algorithm. These parameter dynamic analyze the network route and change the network route as per requirements. The proposed work uses the threshold value to perform the critical node elimination. The results obtained show that the proposed algorithm is better as compared to existing algorithm in terms of improved the network life and reduced the energy consumption over the network.

**Keywords-** WSN, Routing, Constraints, Failure Probability

## I. INTRODUCTION

A Wireless Sensor Network (WSN) is one of the real time network defined under various restrictions and specification. These specifications include network level constraints, node level constraints and environment level constraints. A sensor network is composed using large number of tiny devices called sensor nodes placed in small network area. Sensor nodes are randomly deployed in remote location where human intervention is difficult or sometimes almost impossible. So it is difficult to replace the battery. These network nodes are having their own environmental and application specific importance. Such as in war zone networks, space network specification, chemical region networks are having the criticalities respective to the network type itself. These networks having the various restrictions in terms of energy, low sensing range, cooperative communication, low power functionality, network size, dense network etc. Due to limited energy, limited hardware resources, low sensing range and critical real time situation increase the failure over the network. A considerable amount of energy is consumed to set up a new path whenever it got break. If path break again and again it consumed more energy to setup new path process. It decreases the overall network life time of WSN. To improve the network life, it is required to generate the optimized route over the network. In this proposed approach, a multi-parameter based hop selection approach is defined to generate the optimized route over the network.

In this paper, a multi-parameter based routing approach is defined to generate the effective and reliable route over the network. Working of the proposed routing approach is similar in nature with Distributed Link Quality Aware Routing protocol. In this work, multi-parameter is considered to generate effective route. In reducing the possible path breaks and improves the network life time and minimizes the energy consumption. In this section, the sensor network constraints and issues are explored respective to the routing phenomenon. In section II, the work defined by earlier researchers is discussed. In section III, the proposed methodology is described along with algorithmic approach. In section IV, the results obtained from the work are presented. In section V, the conclusion obtained from the work is presented.

## II. RELATED WORK

In this section, the work defined by earlier researchers is presented and discussed respective to the routing approaches. Chao Gui[1] has defined an optimized routing approach for mobile network. Author considered multiple routing and physical constraints to generate the effective communication route. These constraints include energy specification, number of hops, route length, energy consumption analysis, load constraint etc. Author defined a framework to analyze these parameters individually and collectively so that effective route selection over the network will be performed. Author defined a subpath based analysis scheme to monitor the network so that optimized routing will be obtained.

Hao Wen[2] has defined region aware routing approach in which the storage space is defined to track the region statistics. Author defined the node tracking under multiple parameters under history specific analysis. This analysis includes the mobility model analysis and model based route monitoring so that the effective and optimized route was identified. Author defined the node stability analysis to generate the effective route over the network.

Jiejun Kong[3] has defined an on-demand routing approach for effective route generation over the critical network. Author provided the routing solution under two main challenges called route anonymity and back flow criticality analysis. Author defined the location privacy effective routing respective to destination approach.

Author defined the optimization to network route under real time scenario.

Kyu-Hwan Lee[4] has presented an authentication effective routing approach to optimize the communication approach under security constraints. Author defined an optimization to the network performance and security. The presented work is the analytical observation to the network nodes so that reliable communication over the network will be obtained.

A thanasios Bamis[5] has presented a mobility sensitive mobile network optimization to generate the effective route over the network. Author defined the network property analysis under mobile network to analyze these nodes under mobility and speed. Author defined key specific authentication to obtain the reliable next hop so that reliable network communication will be performed.

Khaleel Ur Rahman[6] has defined an integrated routing approach to optimize the network communication. Author defined a work on bidirectional infrastructure specific analysis over the mobile network to optimize the network communication and to generate the effective route over the network. Author generated a bridge over the network nodes to select the effective network gateway so that reliable network route will be generated over the network. S.

Satish[7] has presented the optimization to the routing approach using ACO approach. This approach is cache oriented and specific to the source node. This routing is energy adaptive and source initiated. The routing is here defined to generate the optimize network path so that reliable network communication will be performed. Giovanni

Comarela[8] presented a work to defined robotic routing approach using Ant colony optimization approach. Author included the concept of travelling salesman problem to handle the heuristic state space while generating the network path. Author also proved the effectiveness of work by presenting the comparative analysis with some other approaches.

C.D Zouza [9] has presented an energy adaptive performance analysis approach to optimize the network communication critical sensor nodes. Author defined a route selection approach using swarm specification. Author also optimize the network deployment and obtain the route dependency to generate the effective route under performance constraints. These constraints include cost analysis, delay analysis and route length analysis.

Taeso Jun[10] has presented the optimization to the network route by generating the network strength parameters under multiple constraints. These constraints include physical characteristics analysis and communication parameter analysis. Author defined the network utility analysis so that the ACO based optimization will be odne.

Jing Hui Zhong[11] has presented a work to improve the network effectiveness under characteristics analysis so that optimize network route will be generated. Mohsen .

Saffarian[12] has defined an ACO specific agent based approach to generate the reliable and secure routing over the network. Author optimized the route over the network using ACO approach. Author reduced the threats over the network and improves the network reliability.

M.M. Chandane [13] has defined an Distributed Link Quality Aware Routing approach for effective route generation over the network. Author defines a threshold constraints and link quality parameter to generate the network route. The sensor nodes makes decision of routing based on received link, thus the current node avoid participating in routing ,if the strength of received signal is below the threshold value, thereby reducing the frequency of possible link break and ultimately minimizing the energy consumption .

### III. RESEARCH METHODOLOGY

In proposed work, a multi-parameter based hop selection approach is define to generate the optimize route. Sensor node makes decision of routing based on Multi-Parameter. This parameter includes energy, failure rate and sensing range. This parameter dynamically analyzes the communication route and change the route as per the requirement .Working of the proposed routing approach is similar in nature with Distributed Link Quality Aware Routing protocol. In energy Parameter thus the current node avoids to participating in the routing if energy of node is below the energy threshold value. The current node participating in the routing if energy of node is greater than or equal to threshold value. In failure rate Parameter, thus the current node avoids to participating in the routing if failure rate of node is greater than failure threshold value. Thus current node participating in the routing if failure probability of node is below failure threshold value, thereby minimizing the frequency of possible path break and reduce the energy consumption for path set-up process., ultimately it improve the network life. In distance direction Parameter, if distance from the neighbor node to destination node below the distance from the current node to destination node then set the next effective node as the current node. It means indentify the next effective node in the direction of destination.

In this paper, a multi-parameter specific route generation for sensor network is defined under criticality vector. The work is here about to improve the network life. All the network nodes defined here are homogenous with specification of different energy and criticality vectors. The communication parameters on these nodes are same for all nodes. The work is here proposed to optimize the network route at effective hop selection. The route selection phenomenon defined here includes the node association with network route and other nodes respective to different constraints. The parameters considered in this work include sensing range, energy, failure probability and the directional constraints. In this work, all these parameters are analyzed individually, collectively and cooperatively. Based on this cooperative analysis, the effective next hop selection is done and based on this sequential identification of next hops the route over the network is generated. The work is here

defined to perform the effective neighbor selection. The work begins here with the specification of the source and the destination node. The process begins from source node and the neighbor node identification is done at each level under all these parameters till the destination node not occur. This process is repeated till the network path is not generated over the network. The routing algorithm for the work is given in table 1.

Table 1: Routing Algorithm

```

Algorithm(Nodes, N)
/*Nodes is the List of N Nodes defined at random position with
specification of parameters like initial energy, transmission energy,
receiving energy, forwarding energy and failure probability*/
{
1. Define Source Node Src and Destination Node
   Dst
2. Generate Distance Matrix over the network to
   identify the distance between each node pair
3. Define the Sensing Range and Threshold Limit
   for Energy Effectiveness and Failure Probability
4. For I=1 to N
   [Perform Node Blockage Analysis on Each Node]
   {
5. if (Nodes(I).Energy<EThreshold)
   [A Node having lesser energy is not eligible for
   communication]
   {
   Nodes(I).Block=True;
   }
6. if (Nodes(I).FailureProb >FThreshold)
   {
   Nodes(I).Block =True;
   }
   }
7. Set CurNode=Src
   [Set Source as Current Node]
8. While CurNode <> Dst
   [Repeat Step till Destination Node Not Occur]
   {
9. Set Nxt=1
   [Set Nxt as next possible Hop]
10. For I=1 to N
   [Find Neighbors to the CurNode]
   {
11. if (Dist(CurNode, Nodes(I))<SensingNode)
   [If Node is Neighbor Node]
   {
12. if (Nodes(I).Block=False)
   [If Node is a valid node]
   {
13. if Nodes(i).Energy>Nodes(Nxt).Energy And
   Dist(Nodes(i), Dst)<Dist(curNode, Dst)
   [Identify High Energy Node in direction of
   destination
   node]
   {
14. Set Nxt= p
   [Find Next Effective Next Hop]
   }
   }
15. Set CurNode=Nxt
   [Set Next Effective Hop as CurNode]
   }
   }
}
}
}

```

In this proposed work, an optimization to the routing algorithm is presented for sensor network. The sensor network is a small network of large number tiny sensors distributed at random locations. Each sensor node is defined with some energy. As the communication is performed, each participated node to the communication releases some energy. All these vectors collectively affects the data communication performed over the network. Each

associated even gives some energy loss. Because of this there is the requirement of some approach that can reduce the energy consumption over the routing in sensor network. The optimization is here required not only required for energy but also on different parameters. These parameters includes

- Residual energy
- Failure rate
- Sensing range

The optimization is here required to identify the effective route over the network. To identify the effective route, it is required perform the analysis on all possible path. These parameters dynamic analyze the network path it change the path as per requirement. The presented algorithmic approach has provided the effective route generation so that improve the network life time in terms of dead node, alive node, hop count.

#### IV. RESULTS

The proposed work is implemented in matlab environment with specification of following network constraints shown in table 2.

Table 2 : Network Constraints

Parameter	Value
Area	100x100
Number of Nodes	100
Number of Rounds	100
Initial Energy	Random
Transmission Loss	50 nJ
Receiving Loss	50 nJ
Forwarding Loss	10 nJ
Sensing Range	20 Meter

As shown in the table, the work is presented in a generalized network scenario with specification of sensor network constraints. These constraints include the specification of energy consumption constraints over the network so that network communication over the network will be performed. The work is here analyzed under different parameters. The results obtained from this analysis is shown here under

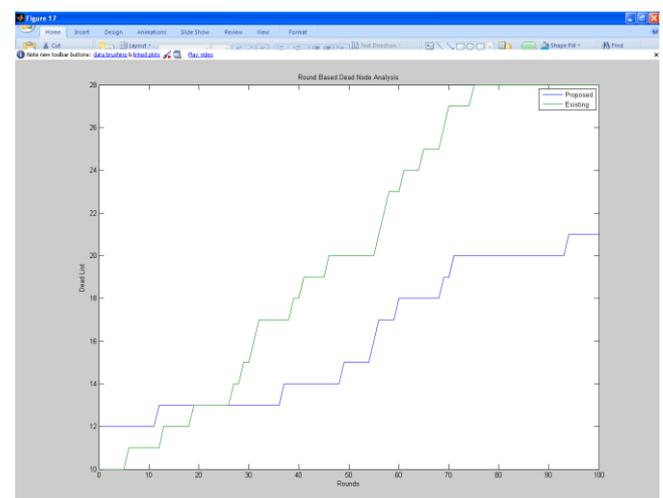


Figure 2 : Dead Node Analysis (Existing Vs. Proposed)

Here figure 2 is showing the analysis of dead node over the network in case of existing and proposed work .The communication is performed for 100 rounds and the analysis of dead nodes is done here. Figure shows that, initially there is no dead node. But as the communication performed, the nodes start losing its energy. Till the end of 100 rounds, there are about 28 dead nodes in case of existing approach and 21 nodes are dead in case of proposed approach.

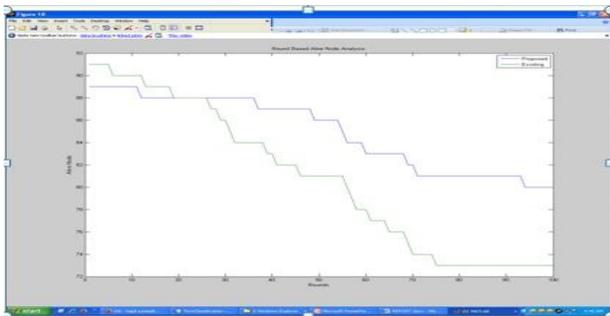


Figure 2 : Alive Node Analysis (Existing Vs. Proposed)

Here figure 2 is showing the analysis of alive node over the network in case of existing and proposed work . As shown in figure, X axis represent the number of rounds and Y axis represent the alive node over the network..Figure shows that, initially all nodes are alive. But as the communication performed, the nodes start losing its energy. Till the end of 100 rounds, there are about 72 nodes left alive in case of existing approach and 79 nodes are alive in case of proposed approach.

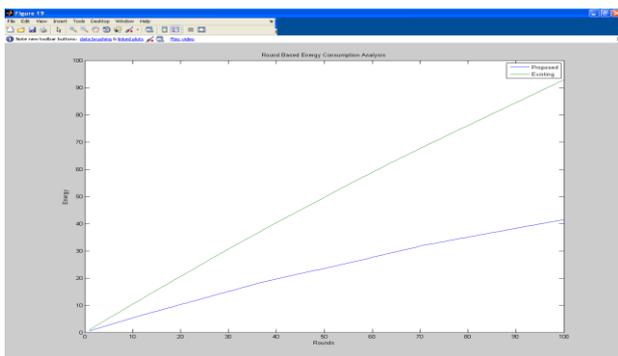


Figure 3 : Energy Consumption Analysis (Existing Vs. Proposed)

Here figure 3 is showing the analysis of energy consumption over the network in case of existing and proposed approach. As shown in the figure, X axis represents the number of rounds and y axis represents the energy consumption over the network. As we can see, the energy consumption in case of existing approach is higher than proposed approach

## V. CONCLUSION

In this paper, a multi-parameter based hop selection algorithm is proposed to generate the optimized route over the wireless sensor network. The route is here generated under multiple parameters including Residual energy, Failure rate, Sensing Range etc. These parameters are dynamically analyze the communication roué and change the route as per requirement .The number of alive nodes ,dead nodes, energy consumption etc are computed and analyzed in this proposed work. The obtained results show that the proposed work has improved the network

life and reduced the energy consumption over the network. The presented work is defined in normal network behavior but in future some specific consideration can be taken about the network characteristics such as congestion.

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# Intrusion Detection Schemes in Wireless Sensor Networks-A Review

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**Abstract**— Wireless Sensor networks (WSN) is an emerging technology and have great potential to be employed in critical situations like battlefields and commercial applications such as building, architectures, traffic monitoring and many more scenarios. The major challenge in wireless sensor networks face today is security. The emergence of wireless sensor networks (WSN) as one of the dominant technology trends in the coming decades has posed numerous unique challenges to researchers. The sensing technology combined with processing power and wireless communication makes it lucrative for being exploited in great quantity in future. The inclusion of wireless communication technology also incurs various types of security threats. This paper will discuss about the various attacks in wireless networks and how intrusion detection handles them.

**Keywords**—DOS,Attacks,Intrusion Detection System, WSN Attacks, Eavesdropping

## I. INTRODUCTION

A typical WSN has network components which are

- Gateway
- Security manager
- Network manager
- Sensor nodes.

Each sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, electronic circuit, a microcontroller and an energy source which could be a battery. Access points or Gateway enables communication between Host application and field devices. Configuration of the network, management of the routing tables, scheduling communication between devices, and monitoring and reporting the status of the network is done by network manager. Security Manager is accountable for the generation, management of keys and storage of keys. The base stations are one or more distinguished components of the WSN with much more computational energy and resources. They play role of a gateway between sensor nodes and the end user as they typically forward data from the WSN on to a server. Routers are designed to compute and distribute the routing table.

## II. ATTACKS IN WIRELESS NETWORKS

Attacks that causes significant threat to group communications over wireless networks are presented .These attacks are categorized based on their impacts, including data integrity and confidentiality, power consumption, privacy, and availability of service.

### A. Eavesdropping

Eavesdropping refers to the unauthorised monitoring of other people's communications. It can be carried out on ordinary telephone systems, emails, instant messaging or other Internet services. As eavesdropping activities do not influence the normal operation of network transmission, both the sender and the recipient can hardly notice that the data has been stolen, intercepted or defaced. As the Internet has become popular, people use Internet services which can be chat rooms, emails and social networking websites for communication. If we do not take appropriate security measures when using these communication tools, clearly the risk of being eavesdropped will increase. An attacker eavesdrops secretly between any two nodes and may collect the necessary information concerning connection such as MAC address and cryptographic information.

### B. Denial of Service (DoS) Attack

A denial of service (DoS) attack is a malicious attempt to make a server or a network resource unavailable to users, usually by momentarily interrupting or suspending the services of a host connected to the Internet. A DoS attack generally aims physical layer applications in an environment where sensor nodes are located. A technique of such attack involves saturating the target machine with external communications requests so that it cannot react to legitimate traffic. It can react slowly also. Such attacks usually lead to a server overload. This attack is executed by forcing the targeted computer to reset or consuming the resources so that it can no longer provide its intended service or obstructing the link between the intended users and the victim so that they can no longer communicate effectively.

### C. Node Capture Attack

This attack is resultant of the combination of passive attack, physical and active attacks. With the aim to initialize or set up an attack, the adversary will collect information about the WSN by eavesdropping on message exchanges, both local or throughout the network .Even if message payloads are encrypted, the adversary can take out information about the network operation and state, effectively learning about the network structure and function. Besides passive learning, the adversary can actively contribute in network protocols, snooping the network for information and maliciously injecting information into the network. Once an enough amount of passive and active learning has taken place, the adversary can actually capture nodes. The gathered information can be used to help out the adversary make an informed decision of which sensor nodes to capture so as to

optimize the performance of the attack regarding a specific attack goal.

#### D. HELLO Flood Attacks

An attacker sends or replays a routing protocol's HELLO packets from one node to another with more energy. It uses HELLO packets as a weapon to persuade the sensors in WSN. In this sort of attack an attacker with a high radio transmission range and processing power sends HELLO packets to a number of sensor nodes that are cut off in a large area within WSN. The sensors are therefore influenced that the adversary is their neighbor. Therefore, while sending the information to the base station, the victim nodes try to go all the way all the way through the attacker as they know that it is their neighbor and are eventually spoofed by the attacker.

#### E. Sinkhole Attack

Magnetizing traffic to a specific node is known as sinkhole attack. The main goal of the adversary is to attract almost all the traffic from a particular area all the way through a compromised node. Sinkhole attacks usually work by making a compromised node look particularly attractive to surrounding nodes.

#### F. Sybil Attacks

A single node replicates itself and presented in the multiple locations. The Sybil attack aims at fault tolerant schemes such as distributed storage space, multipath routing and topology maintenance. A single node presents multiple identities to other nodes in the network in a Sybil attack. Authentication and encryption techniques can stop an outsider to launch a Sybil attack on the sensor network.

#### G. Node Replication Attacks

A node replication attack is quite straight forward. An attacker seeks to add a node to an existing sensor network by copying the node ID of an existing sensor node. If an attacker be able to gain physical access to the entire network, a node duplicated in such method can disrupt a sensor network's performance. Packets can be corrupted or even misrouted. This can consequence in a disconnected network or false sensor readings. By inserting the replicated nodes at specific network points, the attacker can effortlessly manipulate segment of the network, perhaps by disconnect it altogether.

#### H. Jamming (Radio Interference) Attack

Jamming is a technique used to compromise the wireless environment. The major ways for degrading the network performance is by jamming wireless transmissions. The attacker corrupts the transmitted messages by causing electromagnetic interference in the network's operational frequencies and in closeness to the targeted receivers in the simplest form of jamming. An attacker can estimably discontinue the link among nodes by communicating constant radio signals so that other sanctioned users are not allowed to access a particular frequency channel. The attacker can too send legitimate signals initiated by target nodes colliding with jamming radio signals deliberately.

#### I. Replay Attack

A replay attack is a type of network attack wherein a valid data transmission is maliciously or fraudulently repeated or delayed. This is approved by the originator or an

attacker who interrupt the data and retransmits it. However, possibly as part of a masquerade attack by IP packet substitution. An attacker replicates a forwarded packet and later sends out the copies repeatedly and continuously to the victim so as to exhaust the victim's buffers to base stations and access points in order to degrade network performance. Additionally, the replayed packets can crash poorly designed applications or exploit vulnerable holes in poor system designs.

#### J. Unauthorized Routing Update Attack

An attacker attempts to update routing information maintained by routing hosts which could be base stations, access points or data aggregation nodes. The main objective is to exploit the routing protocols which includes to fabricate the routing update messages and to falsely update the routing table. Such type of attack can lead to several incidents which includes some nodes are isolated from base stations, a network is partitioned, a black-hole route in which messages are maliciously discarded is created messages are routed in a loop and dropped after the time to live expires, messages are perversely forwarded to unauthorized attackers and a previous key is still being used by current members because the rekeying messages destined to members are misrouted or delayed by false routings.

#### K. Selective Forwarding

A malicious node can selectively drop some specific message packets. In sensor networks it is assumed that nodes authentically forward received and transmitted packets. Particularly it is considered to be effective when it is combined with an attack. But some nodes might reject to forward packets where neighbors may begin using another route.

### III. INTRUSION DETECTION FOR ATTACKS

It is a type of security management system for computers and networks. An ID system gathers and analyzes information from various areas within a computer or a network to identify possible security breaches, which include both intrusions (attacks from outside the organization) and misuse (attacks from within the organization). ID uses *vulnerability assessment* (sometimes referred to as *scanning*), which is a technology developed to assess the security of a computer system or network.

Intrusion detection functions include:

- Monitoring and analyzing both user and system activities
- Analyzing system configurations and vulnerabilities
- Assessing system and file integrity
- Ability to recognize patterns typical of attacks
- Analysis of abnormal activity patterns
- Tracking user policy violations

ID systems are being developed in response to the increasing number of attacks on major sites and networks, including those of the Pentagon, the White House, NATO, and the U.S. Defense Department. The safeguarding of security is becoming increasingly difficult, because the possible technologies of attack are becoming ever more

sophisticated; at the same time, less technical ability is required for the novice attacker, because proven past methods are easily accessed through the Web.

Typically, an IDS system follows a two-step process. The first procedures are host-based and are considered the *passive* component, these include: inspection of the system's configuration files to detect inadvisable settings; inspection of the password files to detect inadvisable passwords; and inspection of other system areas to detect policy violations. The second procedures are network-based and are considered the *active* component: mechanisms are set in place to reenact known methods of attack and to record system responses.

#### IV. DIFFERENTIATING IDS AND IPS

An IPS is not the same as IDS. However, the technology that you use to detect security problems in IDS is very similar to the technology that you use to prevent security problems in an IPS. It's important to start out with the understanding that IDS and IPS are very, very different tools. Even though they have a common base, they fit into the network in different places, have different functions, and solve different problems.

An IPS is best compared to a firewall. In a typical enterprise firewall, you'll have some number of rules: maybe a hundred, maybe a thousand. Most of those rules are "pass" rules: "allow the traffic through." Thus, the firewall gets a packet off the wire and starts through its rules, looking for a rule that says "allow this packet through." If it gets to the end of the list and there's no rule saying "allow this packet through," then there's a final "deny" rule: "drop everything else." Thus, in the absence of a reason to pass the traffic the firewall drops it.

IPS is like that, but inside out: it has rules, maybe hundreds, maybe thousands. Most of those rules are "deny" rules: "block this known security problem." When a packet shows up at the IPS, the IPS looks through its rule list from top to bottom, looking for some reason to drop the packet. At the end of the list, though, is an implicit "pass" rule: "allow this packet through." Thus, in the absence of a reason to drop the traffic, the IPS passes it through.

Firewalls and IPSes are control devices. They sit inline between two networks and control the traffic going through them. This means that the IPS is in the policy side of your security house. It's going to implement or enforce a particular policy on what traffic is not allowed through.

The obvious affinity of firewalls and IPSes from a topological point of view has led us to the world of UTM, where an IPS is incorporated into the firewall. UTMs let you have both security services (blocking security threats, allowing known good traffic) into a single device. We'll talk about the ultimate in compression of IPS and firewall, the UTM (Unified Threat Management) firewall later.

The main reason to have an IPS is to block known attacks across a network. When there is a time window between when an exploit is announced and you have the time or opportunity to patch your systems, an IPS is an excellent way to quickly block known attacks, especially those using a common or well-known exploit tool.

Of course, IPSes can provide other services. As product vendors search to differentiate themselves, IPSes have become rate limiting tools (which is also helpful in Denial of Service mitigation), policy enforcement tools, data leak protection tools, and behavior anomaly detection tools. In every case, though, the key function of the IPS is a control function.

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# Security Attacks at Network Layer in MANETs: A Review

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**Abstract**— Mobile ad-hoc network (MANET) are multihop wireless networks. Due to its vulnerabilities these are more prone to security attacks. Various internal or external security attacks are possible on network because any node can join or leave the network. Various security attacks are categorized on layers of protocol stack. Among these layers, attacks at network layer are discussed at various phases in routing protocol.

**Keywords**— MANETs, Security Attacks, Network Layer

## I. INTRODUCTION

Mobile Ad Hoc networks are wireless multihop networks. These decentralized networks allow easy adding and removing of countless devices which makes them more scalable. MANETs possess dynamic topology as nodes are free to move that's why it is also called infrastructure less networks. It's cheaper proliferation makes it a fastest growing network. MANETs are featured by attributes like robustness, flexibility, intrinsic mutual trust. Due to highly dynamic nature MANETs are more prone to security attacks. Network layer performs host to host delivery of packets in network. Various attacks are possible at network layer e.g. routing loops, traffic redirection, traffic control, etc.

### A. Applications:

The set of applications for MANETs includes large-scale to small, highly dynamic to static that are constrained by power sources. Devices used for MANETs are small having low battery life e.g. laptops, PDAs, etc. MANETs can be used in conferences for data exchange, in hospitals, battlefield for confidential communication among the soldiers. Some typical applications includes personal area network (PAN), vehicular networking (VANETs) which has now become major research area in vehicular technology, location based services and sensor networks. MANETs are also used in catastrophic situations e.g. in case of flood, war, etc where communication infrastructure is not available and a prompting communication network is required.

### B. Vulnerabilities

MANETs are more vulnerable than wired networks as these multi hop networks work in collaborative way. Every node is expected to work in trusted way and obey rules. Any node can join or leave the network, this leads to adversary inside network like malicious nodes which are sometimes

difficult to detect which leads to internal attacks or external attacks. Some vulnerability is listed as follows:

- Low bandwidth and power supply.
- Dynamic topology
- Cooperativeness
- Lack of resources and centralized management, etc

## II. ATTACKS IN MANETS

Understanding possible form of attacks is necessary before creating any solution. The connectivity of mobile nodes in MANETs is changing over the time due to its highly dynamic nature. Communicating nodes strongly relies on the fact that nodes are trustworthy and behaving in accordance with routing principles of underlying protocol. Attacks can be categorized according to activity performed by attacker. It can be roughly categorized as active and passive attacks as discussed below.

### A. Passive Attacks

A passive attack basically does not make any disturbance in network operation or working of protocol. The attacker is seeking for useful information by listening traffic. It includes Traffic analysis, monitoring.

### B. Active Attacks

Active attack alters basic operations of network. It attempts to modify routing information or attracts packets destined to other nodes e.g. fabrication, modification. Active attacks can be further classified according to layers of network protocol stack, shown in Table I.

Attacker can be insider or outsider across the network. Earlier one is called *internal* attack in which the attacker is already member of the network. This type of attacker is generally difficult to identify as nodes are authorized but compromised. Later one is external attack; attacker who is unauthorized becomes member of network and seeks for the target. Possibility of this type of attack is due to MANET scalability i.e. any node can join or leave the network. Active attacks can be further classified into *fabrication, modification, packet dropping* according to type of operation performed by attacker.

#### 1) Modification

Modification implies the modification of protocol field in the messages and redirect message causing dropping of

network traffic, redirection of data or control packets to different destination or take a long route to the destination increasing communication delays.

## 2) Fabrication

It refers to generating false route error messages degrading protocol performance.

Table I. Attacks on Layers of protocol stack

Layer	Attacks
Application layer	Repudiation, Data corruption, Viruses and Worms
Transport layer	Session hijacking, SYN flooding, Jellyfish attack
Network layer	Wormhole, Blackhole, Byzantine, Flooding, Rushing, Resource consumption, Location disclosure, Sybil attacks
Data link layer	Traffic analysis, Monitoring, Disruption MAC (802.11), WEP weakness
Physical layer	Jamming, Interceptions, Eavesdropping
Multi layer attacks	DoS, Impersonation, Replay, Man-in-the-middle

## 3) Packet dropping

Dropping the packets decreases network overall performance. It is difficult to detect as legitimate nodes may also drop packets time to time in case of congestion or collision. Blackhole and grayhole attacks are possible examples of packet dropping. we will be discuss later in this paper.

## 4) Impersonation

Attacker node masquerade identity of another node and launch attacks. It is also called spoofing attack, in which node misrepresents its identity. Attacker may target network topology which may cause network partitioning sometimes.

### III. NETWORK LAYER ATTACKS

The major responsibility of network layer is source to destination delivery of packets. Routing protocols choose optimum path depending upon credentials chosen by user e.g. shortest route to destination, strongest signal strength or link bandwidth. By attacking the routing protocols, attackers can consume network traffic, enters into the path between the source and destination, and thus control the network traffic flow [6]. As shown in Fig. 1(a), node S and D are source and destination respectively. Node 1 is an intermediate node, node M is malicious one and tries to be part of route. In Fig 1(b) M becomes part of route between source to destination.

Network layer vulnerabilities fall into two categories: routing attacks and packet forwarding attacks [2]. Routing attacks refers to disobeying routing protocol specifications. Attacker can redirect packets to no optimal paths, creating congestion in some areas of network, creating routing loops, etc. Routing operation includes three basic phases. These are route discovery, route maintenance and data forwarding. Possible attacks on these phases are discussed below.

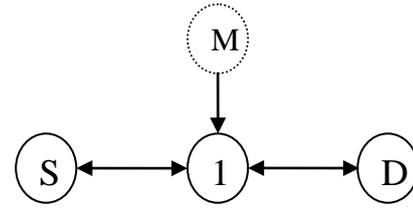


Fig. 1(a)

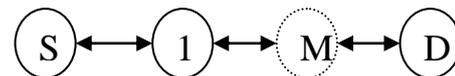


Fig. 1(b)

#### A. Attacks at route discovery phase

Malicious attacks prevent source nodes to select optimum routes by attacking route discovery phase in routing. Acknowledgement flooding, routing table overflow, routing message flooding attacks, hello message flooding, RREQ flooding, routing cache poisoning, and routing loop are simple examples of routing attacks which targets the route discovery phase. Proactive routing protocols are more vulnerable to these attacks and therefore perform worst in cases mention above.

##### 1) Routing table overflow attack

Attacker sends excessive route advertisements to victim node to overflow its routing table. More vulnerable in proactive algorithm as routing tables needs periodically updates. Attacker node sets path between non existing nodes to existing node in the network.

##### 2) Route cache poisoning attack

Attacker alters the route cache of the node. It occurs when node overhears the transmission of the packet, adds route information to its own cache. For example if malicious node wants to alter route cache of a node in network, it broadcast the spoofed packets to victim node via itself; nodes overhearing this transmission will updates their own route cache. In this way malicious node becomes part of route and the traffic redirects to attacker node.

#### B. Attacks at Route maintenance

Attacker node broadcasts false control messages e.g. link broken messages. It causes call of costly route maintenance operation.

#### C. Attacks at data forwarding phase

Attacker node participates in route discovery and route maintenance similar to legitimate node but in data forwarding it does not follow the route table information. It may drop packets contains data, modify data content, flood data packets or replay.

Attacks at different phases of routing operation are summarized in Table II.

Table II. Attacks at various phases of routing

Phase	Attacks
Route discovery	Routing message Flooding( hello message flooding, RREQ flooding, acknowledgement flooding), Route cache poisoning, Routing loop, selfish node behavior, Routing table overflow
Route maintenance	False control messages
Data forwarding	Dropping data packets, Modification, Replay, Flooding, Delay forwarding of time-sensitive data packets selectively, Inject junk packets.

IV. OTHER ATTACKS AT NETWORK LAYER

A. Blackhole attack

It is one of the most common active attacks in MANETs. In blackhole attack, attacker node advertizes itself as it has shortest path to the destination. Blackhole attack owns two properties. First, the node manipulate the routing protocol, to advertise itself as having a valid route to a destination node, even though the route is not genuine, with the intention of intercepting packets. Second, the attacker consumes the intercepted packets without any forwarding. There is a more subtle form of these attacks when an attacker selectively forwards packets i.e. *Selective Blackhole attack*. In this attack, attacker modifies packets originating from some nodes, while leaving the data from the other nodes unaffected. Black hole attack can further be of two types:

1) Single blackhole attack

In single blackhole attack there is only one malicious node. It is easy to detect. Fig. 2 shows single blackhole attack. Source S selects route 1- 3- D to send data to node D. node 3 becomes malicious node and does not forward packets to node D.

2) Cooperative blackhole attack

It is also called multiple blackhole attack. In this attack there are more than one attacker node working in a cooperative manner. Attacker nodes set their location specifically so that more traffic flows through them. Fig. 3 shows working of cooperative blackhole attack. Node S and D are source and destination respectively. Node A and B are malicious and works in cooperative manner. Node B advertises itself as neighbor node of destination. A behaves as normal node and forward packets send by S but node B will perform malicious activity and does not forward packets to node D.

B. Grayhole Attack

More harmful type of attacks in blackhole attack is the grayhole attack [5]. It is another form of black hole attack. The significant difference between attacks is that grayhole attack target specific data in certain time period. A grayhole attack node firstly exploits the route by advertising it has shortest path to the destination node, and then the node can establish the route through it i.e. first step of blackhole

attack. By doing this, it may be able to drop packets from a certain target node for some time duration. However, it acts normal for other nodes to hide its malicious presence for most of the time in the network. In some other case, the malicious node may do attack to some certain data from the target node. Therefore, the grayhole attack becomes more difficult to detect than the ordinary blackhole attack.

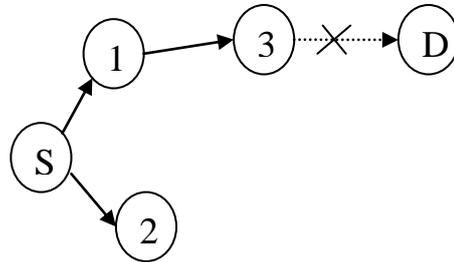


Fig. 2. Single blackhole attack

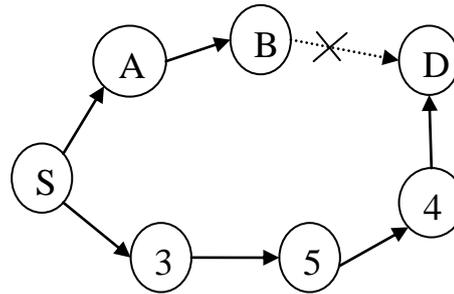


Fig. 3. Cooperative blackhole attack

C. Wormhole Attack

Wormhole attack is also called tunneling attack. Tunnel between two conspiring attackers is referred as a wormhole. A tunneling attack in network is where two or more nodes collaborate to encapsulate and exchange messages between them along existing data routes [2]. Attacker consumes the packets or may modify the data content. Wormhole causes severe threats to MANET routing protocols. For example, when a wormhole attack is used against source initiated routing protocol e.g. DSR, the attack could prevent the discovery of any routes other than through the wormhole [6].

D. Byzantine Attack

In this type of attack set of compromised or malicious nodes tries to create routing loops or routing of the data packets on the nonoptimal routes or selectively drop packets and degrades routing services.

E. Rushing Attack

On-demand routing protocols are more vulnerable to rushing attack. When source node broadcast route request (RREQ) packet across the network, malicious node quickly broadcast same request to all nodes which receives same request before other nodes may react. Nodes that receive the legitimate route request packets assume those packets to be duplicate and send by adversary node and hence discard those packets. Any route discovered by the source node would contain the adversary node as one of the intermediate

nodes. Therefore, it is difficult to choose secure route to destination. Rushing attack can be effective DOS(denial of Service) attack.

#### *F. Selfish Node Behaviour*

This is passive type attack. Selfish node does not participate in route discovery process or in data forwarding as an intermediate node so as to save its own resources, battery life and bandwidth. Though selfish node does not attempt any malicious activity in the network but it decreases overall network performance.

#### *G. Resource Consumption Attack*

It is also known as the sleep deprivation attack. Attacker node sends excessive route discovery packets and tries to consume battery life of the victim node.

#### *H. Location Disclosure Attack*

Most devastating attack in security-sensitive scenarios is location disclosure attack. Attacker node gathers the location information e.g. network map and plans further attack scenarios. Attacker may try to figure out the identities and location of communication parties and analyze traffic to learn the network traffic pattern and track changes.

#### *I. Sybil Attack*

The attacker node generates fake identities of additional nodes and produces itself as a group of nodes instead of single node. Additional fake nodes are sybil nodes. A sybil node may fabricate a new identity for itself or it steals an identity of the legitimate node and disrupts routing protocols by causing nodes to appear to be "in more than one place at once". This effect make difficult to identify a misbehaving node and also prevent fair resource allocation among the nodes in network.

## V. CONCLUSION

MANETs are wireless networks which are more vulnerable to security attacks. We discussed here security issues at network layer. Various possible attacks at phases of routing operation and other miscellaneous attacks at network layer are discussed.

## ACKNOWLEDGEMENT

I express my sincere and deep gratitude to my guide Ms. Kanwalpreet Kaur, Assistant Professor, Computer Science & Engineering Department, CT Institute of Technology and Research, Jalandhar for the invaluable guidance, support and encouragement. She provided me all resources and guidance throughout the work. I am heartfelt thankful to Mr. Anurag Sharma, Head of Computer Science & Engineering Department, CT Institute of Technology and Research, Jalandhar for providing us adequate environment, facility for carrying out work.

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# Comparative Study on Network Layer Protocols for Wireless Sensor Networks: A Survey

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**Abstract-** The wireless sensor networks (WSN) is formed by collection of sensor nodes, which are small energy constrained devices. Due to the limitation of small energy in nodes, the energy efficiency is considered to be very important factor in wireless sensor network. In this paper, comparison of the different hierarchical routing protocols based on network layer has been mentioned. In, this paper we have surveyed and discussed the basic classification of routing protocols Furthermore, this paper compares and summarizes the performances of routing protocols.

**Keywords-** Wireless Sensor Network, Energy Efficiency, Routing protocols, Network Layer

## I. INTRODUCTION

A type of wireless networking which is comprised of number of numerous sensors and they are interlinked or connected with each other for performing the same function collectively or cooperatively for the sake of checking and balancing the environmental factors. This type of networking [1] is called as Wireless sensor networking. Sensor network initially consists of small or large nodes called as sensor nodes. These nodes are varying in size and totally depend on the size because different sizes of sensor nodes work efficiently in different fields.

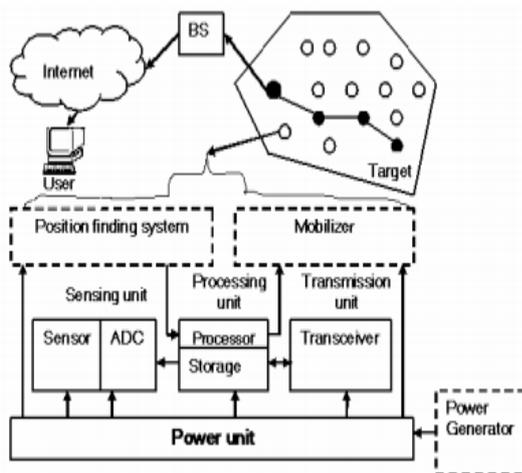


Fig.1. Components of sensor nodes and scattered sensor nodes

A sensor network [2] is a network of many tiny disposable low power devices, called nodes. The tiny sensor nodes,

which consist of sensing, data processing and communicating components. Wireless sensor networking have such sensor nodes which are specially designed in such a typical way that they have a microcontroller which controls the monitoring, a radio transceiver for generating radio waves, different type of wireless communicating devices and also equipped with an energy source such as battery. The entire network worked simultaneously by using different dimensions of sensors and worked on the phenomenon of multi routing algorithm which also termed as wireless ad hoc networking. There are four basic components in a sensor network: (a) an assembly of distributed or localized sensors; (b) an interconnecting network (usually, but not always, wireless-based); (c) a central point of information clustering; and (d) a set of computing resources at the central point (or beyond) to handle data correlation, event trending, status querying, and data mining.

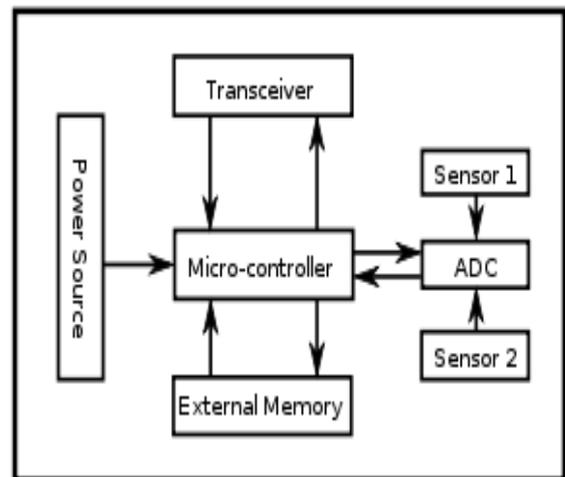


Fig.2. Architecture of Sensor Node

In this context, the sensing and computation nodes are considered part of the sensor network; in fact, some of the computing may be done in the network itself. Because of the potentially large quantity of data collected, algorithmic methods for data management play an important role in sensor networks. Basically, the sensor nodes monitor or collect data from the surrounding environment and pass that information to the nearest base station for remote user access through various communication technologies.

The basic goals of WSN are:

- Determine the value of physical variables from the given location.
- Detect the occurrence of events.
- Classify a detected object.

## II. ROUTING PROTOCOLS IN WIRELESS SENSOR NETWORK

There are many protocols in WSN [3], but most of them were not implemented as they are in developing stage. The task of finding and maintaining routes in WSN is non-trivial due to changes in node status and unpredictable topological changes.

### A. Classifications based on network structure:

Based on network structure routing in WSN can be divided into the following:

- Flat based or data centric routing
- Hierarchical based or cluster based routing
- Location based routing

## III. FLAT BASED OR DATA CENTRIC ROUTING

In flat based routing [4], all the nodes are treated equally and have the same functionality. In this, the sensor nodes join together to perform the sensing task. Due to large number of nodes, it is very difficult to assign the global identifier to each node. This consideration has led to data centric routing, where the base station send queries to various regions and wait for data from sensors which is located in the selected regions.

Flat based routing algorithms or protocols are:

- SPIN( Sensor protocols for information via negotiation)
- DD (Directed diffusion)
- RR (Rumor Routing)
- GBR (Gradient based routing)
- IDSQ ( Information-driven sensor querying) and CADR (Constrained anisotropic diffusion routing)
- COUGAR
- ACQUIRE (Active query forwarding in sensor networks)
- TEEN( Threshold sensitive energy efficient sensor network protocol) and APTEEN( Adaptive Periodic TEEN)
- MCFA (Minimum cost forwarding algorithm)
- SER(Stream enable routing)

## IV. HIERARCHICAL BASED OR CLUSTER BASED ROUTING

Hierarchical routing protocols [5] are found to be the most energy efficient than the other protocols. In a hierarchical routing, higher energy nodes are used to process and send the information while the low energy nodes are used to perform the sensing of the target. Hierarchical routing protocols are mainly two-layer

routing, where one layer is used to select cluster heads and other layer is used for routing. Nodes in hierarchical networks play different roles. Hierarchical routing is an efficient way to lower energy consumption by dividing nodes into different cluster.

Examples of Hierarchical-based routing algorithms or protocols are:

- SHRP (Simple Hierarchical Routing Protocol)
- LEACH (Low energy Adaptive Cluster Hierarchy routing protocol)
- LEACH-C (LEACH Centralized) routing protocol.
- PEGASIS (Power Efficient Gathering in Sensor Information System) routing protocol.
- Hierarchical PEGASIS
- HEAP (Hierarchical Energy Aware Protocol for routing and Aggregation in Sensor networks)
- TEEN (Threshold sensitive Energy Efficient sensor Network protocol) and APTEEN (Adaptive TEEN)
- SMECN (Small MECN)
- HPEQ (Hierarchical Periodic, Event-driven and Query-based)
- SOP (Self-Organizing Protocol)
- GAF (Geographic Adaptive Fidelity)
- SPAN etc.

## V. LOCATION BASED ROUTING

Location based protocols [6] are used to address the sensor nodes with their respective location. Location information is needed to calculate the distance between two particular nodes so that energy consumption can be calculated.

Examples of Location-based routing algorithm/protocols are:

- MECN (Minimum Energy Communication Network) and SMECN (Small MECN)
- GAF (Geographic Adaptive Fidelity)
- GEAR (Geographic and Energy Aware Routing) etc.

## VI. ROUTING PROTOCOLS

### A. LEACH (Low Energy Adaptive Clustering Hierarchy)

LEACH [7] is a self-organizing, adaptive clustering protocol. LEACH randomly selects the sensor as a cluster head and uses the randomization for distributing the energy load among the sensors in the network. LEACH uses a TDMA/CDMA MAC to reduce the inter-cluster and intra cluster collisions. Data collection is centralized. The operation of LEACH is divided into two phases

- Set up phase
- Steady phase

In the set up phase, the clusters are organized and cluster head's are selected and in steady phase, actual data is transfer to the base station. The duration of steady phase is longer than that of setup phase in order to minimize the overhead.

A sensor node choose a random number ,r, between 0 and 1, if this random number is less than that of threshold value, T(n), the node become a cluster head for current round. The threshold value can be calculated by following formula:

$$T(n) = \frac{p}{1 - p(r \bmod (1/p))} \text{ if } n \in G$$

Where, G is the set of nodes that are involved in the cluster head selection.

ADVANTAGES:

- High Scalability
- Highly Energy Efficient
- Very less latency involved
- Throughput is very high

#### B. PEGASIS (Power-Efficient Gathering in Sensor Information Systems)

It is a chain based protocol [8]. Basically, it is used to extend the network lifetime, nodes communicate only with nearest neighbors and then they communicate with the base station. PEGASIS has two main objectives:

- It increases the life time of each node by using collaborative technique and results the network lifetime will be increased.
- It allow only the local coordination between nodes so that the bandwidth should be reduced. PEGASIS is an improved algorithm over the LEACH, unlike LEACH, PEGASIS avoids cluster for and use only one node in a chain to transmit to the base station instead of multiple nodes.

Advantages:

- Increase Life Time of network twice as compare to LEACH
- Decreases the number of transmission and reception by using data aggregation.
- Clustering overhead is avoided.

#### C. TEEN (Threshold Sensitive Energy Efficient Sensor Network Protocol)

TEEN [9] is a hierarchical clustering protocol. In TEEN, a cluster head sensor sends two threshold to its members namely a) hard threshold (HT) b) soft threshold (ST). Hard threshold gives the minimum value of an attribute after which the sensor should turn on its transmitter to give information about sensed data to its CH. So transmission of data is dependent on location of sensed attribute.

When value is greater than hard threshold, it will allow the node to transmit but it has to further check that if there is any change in sensed attribute beyond the value of soft threshold. So in this way number of transmissions are reduced. Important features of TEEN include its suitability for time critical sensing applications.

Advantages:

- Energy saving
- Better for time critical application

#### D. APTEEN (Adaptive Threshold Sensitive Energy Efficient Sensor Network Protocol)

APTEEN [10] is an enhancement to TEEN to overcome its limitations and aims at both capturing periodic data collections (LEACH) and reacting to time-critical events (TEEN). Thus, APTEEN is a hybrid clustering-based routing protocol that allows the sensor to send their sensed data periodically and then react to any sudden change in the value of the sensed attribute by reporting the corresponding values to their CHs. Three different types of queries are handled by APTEEN namely (i) historical query, to analyze the past data values, (ii) one-time query, to take a snapshot view of the network (iii) persistent queries, which monitor an event for a period of time.

Advantages:

- APTEEN guarantees lower energy dissipation and a larger number of sensors alive.
- Consume less energy and network lifetime rather than LEACH.

#### E. SOP (Self Organizing Protocol)

SOP [11] develops the taxonomy of sensor applications i.e. proposed a architectural and infrastructural components used to support the heterogeneous sensors that can be mobile or stationary. Some sensors probe the environment and forward the data to a designated set of nodes that act as routers. Router nodes are stationary and form the backbone for the communication. Collected data are forwarded through the routers to the more powerful base station nodes. Each sensing node should be reach a router if it is a part of network. A routing architecture requires addressing of each sensor nodes. Sensors are identified by the routers is connected to. Algorithm for Self-Organizing and Creation of routing table are:-

- Discovery phase
- Organization phase
- Maintenance phase
- Self-reorganization phase

This algorithm utilizes the router nodes to keep all the sensors connected by forming a dominating set.

Advantages:

- Small cost of maintaining routing tables
- Keeping routing hierarchy strictly balanced
- Energy Savings

#### F. TTDD (Two-Tier Data Dissemination)

TTDD [12] provides the data delivery to multiple mobile base stations. Each source proactively builds a grid structure to support data availability for mobile sinks. Source nodes are stationary and location aware whereas sinks may change their location dynamically.

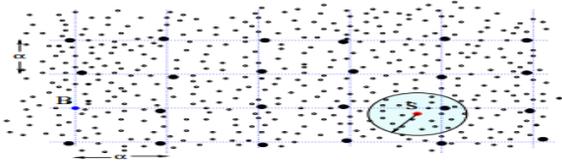


Fig.3. It shows a grid of source B and its virtual grid. The black nodes around each crossing point of the grid are the dissemination nodes.

Advantages:

- Gain in scalability
- The length of forwarding path in TTDD is larger than the length of the shortest path.
- TTDD achieve longer lifetime and data delivery delays rather than direct diffusion.
- Accurate positioning system.

G. HPAR (Hierarchical Power Aware Routing)

The protocol divides the network into groups of sensors. Each group of sensors in geographic are clustered

Table 1. Classification and comparison of routing protocols in wireless sensor network

Protocols	Classification	Power usage	State complexity	Data aggregation	Scalability	Query based	Localization	Query Head	Data delivery model	QOS
LEACH	Hierarchical	High	CHs	Yes	Good	No	Yes	High	Cluster head	No
PEGASIS	Hierarchical	Max	Low	Yes	Good	No	Yes	Low	Chain based	No
TEEN & APTEEN	Hierarchical	High	CHs	Yes	Good	No	Yes	High	Active threshold	No
SOP	Hierarchical	Low	Low	No	Good	No	No	High	Continuously	No
TTDD	Hierarchical	Low	Moderate	No	Low	Feasible	No	Possible	Grid based	No
HPAR	Hierarchical	Low	Low	No	Good	No	No	Low	Zone based	No

VII. CONCLUSION

This research contribution is basically a detail survey in which the focus is on issues on which WSN routing protocols has been categorized or classified and then we have discussed the hierarchical routing protocols which is used to increase the life time of the network. After discussing the various hierarchical routing protocols, we have concluded that it is not possible to develop a accurate routing protocol which is feasible for all applications. Instead we have found that these routing protocols are developed based on the application like TEEN which is very much suitable for time critical application. Our future work will focus on the issues and challenges still exist that need to be solved in the sensor networks.

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together as a zone and each zone is considered as an entity. To perform routing, each zone is allowed to decide how it will route a message hierarchically across the other Zones such that the battery lives of the nodes in the system are maximized. Messages are routed along the path which has the maximum over all the minimum of the remaining power, called the max-min path  $zP_{min}$ . The sensors in a zone autonomously direct local routing and participate in estimating the zone power level. Each message is routed along the zones using information about the zone power estimates.

Advantages:

- It works well with respect to network of large number of nodes

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# A Review of Address Allocation Schemes in MANET

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**Abstract-** MANET is a self-configuring adhoc system through which cellular nodes are free to go and also related to wifi website link. Its system through which each and every node behaves as a router and yes it comes with a transmission between the nodes. The primary functionality would have to deliver the right mail messages between the nodes. As a result, one of the kind targets is furnished to every single node. The idea does not demand bottom station. The idea utilizes a wifi link with connect with a various sites. It's standard peer to peer rather than buyer server. Most of these sites usually are created dynamically by good autonomous technique of cellular nodes which can be related by a way of wifi hyperlinks. There are lots of strategies which usually spend the particular target within MANET.

## I. INTRODUCTION

Adhoc is often a Latin key phrase meaning with the objective or maybe short-lived. MANET is actually a type of adhoc community that can alter the place and also do it yourself setting up community regarding portable nodes attached through wireless inbound links. The idea doesn't call for starting station. The idea uses a wireless link with hook up with various systems. It is common peer to help peer instead of consumer server. Most of these systems are generally created dynamically through a good autonomous method regarding portable nodes that are attached via wireless inbound links. Nodes are generally widely to advance randomly. Perhaps it will perform while stand alone fashion or maybe is usually linked to the larger net. Every node functions like a router. Several applications built into which usually adhoc community are utilized. These are armed forces procedures, catastrophe circumstances and so forth. For your deployment regarding MANET, various redirecting methods help. The main aim of any community is to deliver the complete communication inside the.

### A. Types of MANET

There are different types of MANETs including:

- In VANETs - Intelligent vehicular random systems employ manufactured learning ability to help deal with unpredicted situations such as car or truck impact in addition to accidents.
- Vehicular ad hoc networks (VANETs)- Allows successful conversation with one more automobile or even allows you contact roadside machines.
- Internet Based Mobile Ad hoc Networks (iMANET) – helps you to hyperlink fixed along with cellular nodes.

### B. Issues in MANET:

In contrast to born LAN networks, the place where a transmitted concept is able to get to all nodes about the web page link, this wifi random networks are generally seen as a the variable hop topology. Thus even a transmitted concept ought to be routed via hop in order to hop. That's why conventional vehicle configuration practices just like DHCP along with Zeroconf cannot end up being right pertinent.

An additional problem within MANETs will be the energy, bandwidth constraints and also to supply a exclusive address on the completely new become a member of node from the network. Random nodes have got on the whole confined power along with have to maintain control transmission over head in minimal. This transmitted nature from the wifi method along with the interference among simultaneous communications help make this box loss relatively excessive leading to higher box retransmission and for that reason higher strength along with bandwidth consumption along with higher transmission delays.

### C. MANET Challenges:

A MANET environment has to overcome certain issues of limitation and inefficiency. It includes:

- The wireless link characteristics are time-varying in nature: There are transmitting road blocks including falling, path loss, congestion as well as disturbance that adds to the susceptible behaviour regarding wireless routes. Your stability regarding wireless transmitting is ignored simply by different facets.
- Limited range of wireless transmission – The actual confined radio band brings about diminished info charges compared to the wi-fi systems. For this reason optimal usage of bandwidth is essential by means of maintaining small expense as you can.
- Packet losses due to errors in transmission MANETs experience increased bundle loss on account of elements such as hidden terminals that will brings about collisions, instant funnel difficulties (high bit error rate (BER)), interference, frequent break in pathways attributable to ability to move associated with nodes, greater collisions due to existence associated with hidden terminals as well as uni-directional inbound links.
- Route changes due to mobility- The actual energetic nature connected with multilevel topology results in regular path pauses.
- Frequent network partitions- This hit-or-miss movements regarding nodes often brings about partition

from the system. This specific typically has an effect on the particular more advanced nodes.

#### D. Characteristics of MANET

- Inside MANET, every node behaves as equally web host and router. That is certainly it truly is autonomous inside habits.
- Multi-hop radio relaying- Each time a source node and desired destination node for a meaning will be from the radio assortment, your MANETs are capable of multi-hop redirecting.
- Distributed characteristics connected with operation for protection, redirecting and web host construction. The centralized firewall will be apart right here.
- The nodes may enroll in or maybe get away from your system every time, creating your system topology powerful inside characteristics.
- Mobile nodes are characterised with less ram, electric power and light weight features.
- The trustworthiness, effectiveness, stability and volume connected with instant backlinks will often be far inferior in comparison to born backlinks. This particular indicates your fluctuating url bandwidth connected with instant backlinks.
- Mobile and quickly arranged behaviour which requirements minimal human involvement to be able to configure your system.
- All nodes include similar features with comparable responsibilities and functionality so because of this the idea varieties a totally symmetric surroundings.

#### E. Routing protocols for MANET

It is just a group of policies utilized by the actual router in order to talk between source and also getaway. They just don't go the information between source and also getaway however they up-date the actual course-plotting kitchen table. Routing standards keep the effect of bandwidth, postpone, cost etc metrics with course-plotting kitchen table.

Routing protocols is divided into three categories:

- Reactive protocols (on demand protocols): This characterizes some sort of course of routing practices the location where the path is made as long as the foundation request some sort of route to some sort of location. The path is made through a path breakthrough course of action. If the path can be formed to the location, your path breakthrough course of action concludes. The practices are AODV, DSR, ABR and many others. This helps make some sort of path when it is upon require. This generates a reduced cost considering that the path is established upon require.
- Proactive protocols (table driven): The actual positive practices constantly keep and also up to date the redirecting facts just a multilevel to ensure that when the packet must be transferred this already is aware the paths and also can be utilized instantly. These are appropriate for less number of nodes in sites, because they have to update node items intended for each node inside the redirecting table of each and every node. It benefits additional Routing over head problem. There's consumption of additional bandwidth in redirecting

table. Example involving Hands-on Routing Standard protocol is usually Location Sequenced Long distance Vector (DSDV). It retains the course concerning every host sets all the time. It has classic dispersed shortest-path practices.

- Hybrid protocols: These kinds of practices will be the mixture of both reactive and also practical practices. for example – ZRP.

Variation between the reactive and also practical practices:

Average end-to-end wait or perhaps the time consumed from the info to arrive at the particular destination in the resource is actually changing inside Reactive Methodologies however remains continual inside Practical Methodologies for a given Ad hoc community. The particular delivery involving box info is really a lot more efficient inside Reactive Methodologies in comparison with inside Practical Methodologies. Reactive Methodologies are usually much quicker inside effectiveness in comparison with Practical practices.

Reactive Methodologies are usually a lot more adaptive and also do the job significantly better in a variety of topographies in comparison with Practical Methodologies.

## II. VARIOUS SCHEMES OF ADDRESS ALLOCATION IN MANET

The aim of address allowance inside MANET isn't only to control this address space efficiently in addition to effectively but additionally to handle upward using the scalability, robustness in addition to protection.

It is categorized into three groups

- Best effort allocation
- Leader based allocation
- Decentralized allocation

### A. Best Effort Allocation:

In this approach, the nodes responsible for allocation try to assign an unused IP address to a new node as far as they know. At the same time the new node uses conflict detection to guarantee that it is a free IP address.

- Duplicate address detection:

DAD is required whenever either a completely new node joins a MANET or even separate networks merge. Whenever a completely new node accumulates a sensitive IP address, DAD method decides regardless of whether this specific address can be purchased or even certainly not. Every one of the nodes creating a good IP address attend DAD to guard their own IP address used unintentionally simply by completely new node.

In the event that, immediately after 'n' volume of retries, simply no ACN is actually obtained, the actual node may presume of which address just isn't being used. Utilization of timeouts can result in unreliability in the networks where by concept delays can't be bounded. As a result redundant handles may take place inside MANET. In the event of merging, quite a few nodes often have redundant handles thereby over head in the circle would raise suddenly because of start out involving DAD method for any node.

It is of three types:

a) *Strong dad*

It will allow one or more node to detect redundant soon after it is selected by simply another node. Pretty much it's not at all feasible.

b) *Weak dad*

This specific process stops some sort of bundle coming from staying routed to some completely wrong vacation spot, regardless of whether replicate details really exist. This technique will be that a one of a kind essential for each and every node will be within the direction-finding management packets as well as inside direction-finding kitchen table synonyms. Consequently, imagine in the event that 2 nodes eventually include selected a similar IP address; they might be discovered by means of their particular recommendations. Consequently every node will be discovered by a one of a kind tuple <address, key>. Normally the expert's advice using a node's APPLE PC addresses while their essential.

c) *Passive dad*

This can be an adjustment involving DAD again wherever from the nodes use regular web page link state routing info to help advice additional nodes concerning his or her nearby neighbours. This can be a extremely hectic calculate and hence normally expensive in addition to will result in considerable redundancy, contention, in addition to impact, which leads to help transmit thunderstorm issue.

- *Prophet*

In this structure,  $f(n)$  is utilized which usually include things like haphazard volumes plus the primary state of the  $f(n)$  is termed seeds. A variety of vegetables include several sequences with all the state of  $f(n)$  kept up to date simultaneously. The first node selects the any particular seeds with the overall circle plus the sequence is actually calculated in the area as well as established that for ip tackle. One more node W might get a great ip tackle coming from node Any and also the state worth for the reason that seeds due to the  $f(n)$ . This repetitive with the tackle allocation, whenever a node brings together the particular MANET.

B. *Leader based allocation:*

- DHCP (Dynamic Host Configuration Protocol):

DHCP is designed as a successor to help BOOTP. The following a DHCP server which has been designated allocates system addresses and also provides the many settings details to help dynamically set up personal computers. One of the most good part of DHCP is it's dynamic tackle work, that the DHCP server doesn't need to find out this id from the client with prior. Auto-configuration turns into doable if your DHCP has become supplied with a few obtainable IP addresses.

- DACP (DYNAMIC ADDRESSCONFIGURATION PROTOCOL)

With DACP, leading the way is usually an elected Deal with Power (AA) which sustains their state data with the every one of the nodes within MANET. Then using DAD system a new short-term target is employed to be able to

verify this individuality with the allocated target. The key drawback on this process is due to DAD that triggers over head as well as on account of target power that triggers high regular inundating.

- VASM (VIRTUAL ADDRESS SPACE MAPPING)

The technique of VASM is actually that it works by using the particular digital address area regarding handling brand new nodes that ties together a community. The technique is actually that it roadmaps 1 place of the digital address bed sheet to precisely 1 brand new node. The word "virtual" is utilized to designate that this whole equivalent address area is really a 2d ripped bed sheet along with just about every place in this bed sheet is actually nearly mapped to some node within MANET. Regarding technology associated with address the particular process works by using organize prices. In this process, nodes are usually labelled straight into a number of groups: Allocator: Keep up with the address area. These people allocate brand new addresses regarding getting started with the particular nodes. Initiator: A good second time beginner's node concerning Allocators along with Requester node that swap all emails concerning these.

Requester: It is new node that needs to get IP addressing order to join to the network.

Normal: All other nodes are in this type. Each Allocator in the network contains a disjoint address space. Therefore, address space overlaps between the Allocators is none.

C. *Decentralized Allocation*

- MANETCONF

Manetconf helps prevent concurrent task from the very same deal with by means of maintaining one more part desk pertaining to impending allocations. A whole new node gains an IP deal with by means of broadcasting a new friend query message throughout the community. The existing node does a deal with query throughout the community about the completely new node's account. This kind of deal with part needs a constructive acknowledgment (ACK) by all acknowledged nodes indicating your deal with can be obtained pertaining to make use of. Just about every node within the community also concurs using a partition ID to detect partitioning in addition to merges. A new community partition is recognized when the node undertaking deal with task for a completely new node ceases to obtain ACKs by all nodes within the community. After the diagnosis, your pair of nodes by to whom an ACK had not been received is removed by each node's listing of in-use addresses. These nodes then agree on a brand new partition identifier. When partitioning mix, nodes in a variety of partitioning are needed to alternate their pair of assigned addresses in order that replicates are usually recognized. This drawback is in which substantial building up a tolerance to message failures, community dividing in addition to merges. The edge is so it features low latency in addition to connection overheads.

- AAA (Adhoc Address Auto-configuration)

Cell ad hoc cpa networks, alternatively, would not have a real centralized enterprise capable to use this perform. Due to dynamic topology regarding cellular ad hoc circle auto-

configuration protocols tend to be up against various troubles within ensuring this individuality regarding IP deals with along with within letting circle dividing along with blending. Inside AAA deals with tend to be at random, selected in the address assortment 169.254/16. Replicate address detection (DAD) is performed by simply every node to ensure this individuality from the selected address. During this procedure, some sort of node floods a Deal with Demand meaning inside the circle to be able to query regarding the application of it is sensitive address. If the address has already been utilized, a Deal with Response meaning is unicast time for this asking for node so that a new address may be selected. The particular absence of a Deal with Response indicates this option of this asked for address. The particular problem on this strategy will not consider complex situations including circle partitions along with merges.

- AIPAC

Intelligent IP Deal with Setting inside Mobile Random Communities (AIPAC) can be a project for IP target auto-configuration utilizing a reactive strategy in the IP target job, therefore it ought to take care of copy details; it is usually aimed at retaining this target uniqueness right after network merging a result of the node mobility. Your project features while its goal this supporting with the following top features of random systems: limited sources with the gadgets as well as the unreliability in the wireless channels. Just about every network is recognized with its Net ID. While a couple of systems mix, as well as the combination is continual, this NetID should be one. To achieve that, that uses a continuous fusion system. This gives a new node to help pass from the NetID to an alternative 1, in accordance with network modifications seen because of the node. This process enables a new homogeneous technique to get manufactured in the matter of numerous overlapping systems, in line with the progression in their topologies. This particular project will not ensure this uniqueness with the assigned IP details; nevertheless it helps to ensure that mail messages tend to be sent properly. Just about every node inside AIPAC appreciates it's neighbouring radio, and so the amount of facts stashed because of the node is bound towards nodes inside the radios range.

- DAAP

Active Target Part Process (DAAP) will depend on the concept of handle work by a boss. The leader features is contributed amid most community nodes. If a new node joins the community that turns into the leader before upcoming node joins. TheLeader retains the biggest IP handle inside the ad hoc community and a special identifier is of this particular community. Each and every node stores the biggest IP handle, which can be that will from the boss, along with regularly sends HELLO messages to be able to the next door neighbors. Most of these HELLO messages are the community identifier so that any combining along with partitioning is usually found. If a node obtains the HELLO meaning having a distinct community NO., combining is found, if your node will not have the meaning containing the actual community NO., subsequently after a timeout, the partition is found.

- Dynamic Address assignment (Buddy System)

The idea will depend on some sort of so-called pal method which deals with ability to move associated with nodes while in address project, communication burning, multilevel dividing and also blending. However, the actual IP address allowance can create a higher expense associated with control communications whilst it may a global research plus the address retrieval (to stay clear of missing out on addresses) calls for diffusion communications by the inundating course of action. Furthermore, unification and also partition may incur within high expense as a result of worldwide nature on this process.

- Address allocation scheme for MANET merge and partition using cluster based routing

The Network merge and partition occur in MANET whereas the address auto configuration is a less requirement. It provides the address to the node by using the cluster arrangement. Firstly, we make a cluster on the bases of base value and then desire a cluster head by using a election algorithm and assign a node as cluster head on the basis of weight. In this case, if a node in the route is fails then the cluster head uses another node to forward the packet of active route. If the cluster head is fails, then there is a recreating the path. It provide a better packet delivery ratio and decrease the pause time.

Table I Comparison between these allocation schemes.

Allocation schemes	complexity	uniqueness	Approach
Manet Conf	High	Yes	Statefull
Weak DAD	Medium	No	Stateless
Strong DAD	Very high	No	Stateless
Buddy approach	High	Yes	Statefull
DCHP	Low	Yes	Statefull
Passive DAD	Medium	Yes	Stateless
AAA	Low	Yes	statefull
PROPHET	High	No	statefull

### III. CONCLUSION

This paper has described all possible dynamic address allocation mechanisms considering the duplicate address detection mechanism and also tried investigating the problems of dynamic addressing in a mobile ad hoc network. These summaries of schemes help have an overview of addressing schemes in MANET.

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# Comparative Analysis of Balanced Energy Efficient Protocols for WSNs

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**Abstract**-WSNs are micro sensor systems that are spatially distributed. WSN is a power constrained system as the sensor nodes have limited battery life that shortens the network lifetime. Maximizing the network lifetime depends upon an efficient communication protocol. Energy consumption is, therefore, a critical design issue in WSN. A cluster-based technique is the basic method to increase the scalability, performance, efficiency and lifetime of the network. In this paper, a survey on various clustering protocols has been done. From the survey, it has been concluded that none of the protocol performs better in all aspects. Therefore the paper ends with the future scope to overcome the issues.

**Keywords**-WSN, Clustering, Beem

## I. INTRODUCTION

Clustering techniques in wireless sensor networks aims at gathering data among groups of nodes, which elect leaders among themselves. The leader or cluster-heads has the role of aggregating the data and reporting the data to the BS. The advantages of this scheme is that it reduces energy usage of each node and communication cost. The clustering algorithms that are made is based on homogeneity and heterogeneity of nodes. One of the earliest work proposing this approach in WSNs is LEACH (Low Energy Adaptive Clustering Hierarchy). Recently, there have been lots of other clustering techniques which are mostly variants of LEACH protocol with slight improvement and different application scenarios. DEEC (Design of a distributed energy-efficient clustering), EDACH (Energy-Driven Adaptive Clustering Hierarchy) and EEUC (An Energy-Efficient Unequal Clustering Mechanism) are all clustering techniques proposed with the objective of minimizing energy usage, while extending network life time. Clustered sensor network can be classified into two main types: homogeneous and heterogeneous sensor network. While energy efficiency in WSNs remains a function of uniform distribution of energy among sensor nodes, classifying clustering techniques depends on the objectives in mind. The Optimal clustering technique is the technique for the heterogeneity nodes.

- Cluster Properties
- a) Cluster Count: Cluster heads are prearranged in some of the approaches. So, the numbers of clusters are fixed. Cluster head selection algorithms usually choose randomly cluster heads from the deployed sensors thus yields variable number of clusters.
- b) Intra-cluster topology: A few clustering schemes are based on direct communication between a sensor and its

selected cluster head, but sometimes multi-hop sensor-to-cluster head connectivity is necessary.

- c) Connectivity of cluster head to base station: Cluster heads transmit the aggregated data to the base station directly or indirectly with help of other cluster head nodes. It means there exists a direct link or a multi-hop link.

## II. CLUSTERING TECHNIQUES

### A. Low Energy Adaptive Clustering Hierarchy (LEACH)

LEACH, a hierarchical clustering routing protocol, was proposed by Chandrakasan, Heinzelman and Balakrishnan, in MIT. Leach is a protocol that works well in homogenous networks. In a homogenous network, all nodes have equal amount of initial energy. Basically there are two types of routing protocols in WSNs: Flat routing protocols are those in which the routing condition of each node in the network is the same. There are no special nodes in network and each node has equal status. So, the network traffic is distributed equally among all nodes. Comparatively, hierarchical routing protocols make use of the concept of clusters that divides all nodes into groups or clusters. Nodes in this type of network have different levels. A CH is selected among all the nodes and different hierarchical routing protocols may use different methods of selecting CHs. LEACH is a low energy protocol that may adapt clustering. It is a cluster-based protocol that utilizes the concept of randomized rotation of local cluster-heads and distributes the energy load evenly among all the sensor nodes in the sensing field of the network.

### B. Stable Cluster Head Election (SCHE) Protocol

It is based on LEACH architecture that uses clustering technique. Its goal is to reduce the energy consumption of each sensor node and thus minimizing the overall energy dissipation of the network. SCHE is a source driven protocol based on timely reporting. So the sensor node will always have some data to transmit to the Base station. It also makes use of data aggregation to avoid information overload. It provides an analytical framework to attain the stable probability for a node to be a cluster-head to minimize energy consumption. It is necessary to apply suitable CH election mechanism to minimize energy consumption of each sensor node that ultimately results in reduced energy dissipation. SCHE was proposed where this mechanism was applied by obtaining the optimum value of probability for a node to become a CH and consumes significantly less energy compared to LEACH. It also

reduces consumption by minimizing distance between CH and BS.

### C. Stable Election Protocol (SEP)

There are some drawbacks associated with LEACH such as: single hop routing is used where each node can transmit directly to CH and sink. CHs are elected randomly. Therefore there is a possibility that all CHs will be concentrated in the same area. The concept of dynamic clustering is used which leads to unnecessary overhead due to cluster changes. The protocol also assumes that all nodes have amount of energy for each node. Normal nodes have initial energy  $E_o$ , and advance nodes have initial energy  $(1+a)E_o$ . Where  $(a)$  is the percentage of energy higher than normal nodes. Each node has a probability to become a CH and each node generates a random number between 0 and 1 just like in LEACH. If the number is less than threshold  $T(s)$ , then that node becomes CH in the current round. With increase in number of rounds, the  $T(s)$  also increases and reaches 1 only in the last round. Let  $p_{nrm}$  be the weighted election probability of normal nodes and  $p_{adv}$  be the weighted election probability of advance nodes. Optimum probability of each node to become CH can be calculated by:

$$p_{nrm} = \frac{p_{opt}}{1+am} \quad (1)$$

$$p_{adv} = \frac{p_{opt}}{1+am} * (1+a)$$

'm' denotes the fraction of advance nodes and 'a' is the additional energy factor between advance and normal nodes.

The threshold is given by the formula:

$$T_{nrm} = \begin{cases} \frac{p_{nrm}}{1-p_{nrm} \lceil r \cdot \text{mod} \frac{1}{p_{nrm}} \rceil} & \text{if } n_{nrm} \in G \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

$$T_{adv} = \begin{cases} \frac{p_{adv}}{1-p_{adv} \lceil r \cdot \text{mod} \frac{1}{p_{adv}} \rceil} & \text{if } n_{adv} \in G \\ 0 & \text{otherwise} \end{cases} \quad (3)$$

The total energy of new heterogeneous setting will be:

$$n \cdot (1-m) \cdot E_o + n \cdot m \cdot E_o \cdot (1+a) = n \cdot E_o (1+a) \quad (4)$$

so the total energy of the system is increased by  $(1+a \cdot m)$  times.

In order to optimize the stable region of the system the new epoch must become  $\frac{1}{p_{opt}} \cdot (1+a \cdot m)$  as the system has  $a \cdot m$  times more energy and  $a \cdot m$  times more nodes.

### D. Extended Stable Election Protocol (ESEP)

It is a modified SEP protocol. Instead of two types of nodes, it considers three nodes based on their energy levels. These nodes are: normal, moderate and advance nodes. The goal of ESEP is to achieve a WSN that maximizes the network lifetime and stability period. Also it must reduce the communication cost and deployment cost. The operation to become a CH is same as in SEP by generating a random number and then comparing it with the threshold. In ESEP the moderate or intermediate nodes are selected in two ways either by the relative distance of advance nodes to normal nodes or by the threshold of energy level between advance nodes and normal nodes.

The weighted election probabilities are given by:

$$p_{nrm} = \frac{p_{opt}}{1+p \cdot a + k \cdot b} \quad (5)$$

$$p_{mod} = \frac{p_{opt}}{1+p \cdot a + k \cdot b} * (1+a) \quad (6)$$

$$p_{adv} = \frac{p_{opt}}{1+p \cdot a + k \cdot b} * (1+b) \quad (7)$$

And the total initial energy of heterogeneous network is given by:

$$E_t = n \cdot (1-p-k) \cdot E_o + n \cdot p \cdot E_o \cdot (1+a) + n \cdot k \cdot E_o (1+b)$$

$$E_t = n \cdot (1-p \cdot a - k \cdot b) \cdot E_o \quad (8)$$

The results show that ESEP outperforms SEP and LEACH in terms of stability because of three levels of heterogeneity. However,  $a$  additional energy factor between advance and normal nodes and  $b$  additional energy factor between advance, normal and moderate nodes due to three types of nodes in ESEP, it has different energy levels.

### E. Threshold-Sensitive Stable Election Protocol (TSEP)

The early protocols SEP and ESEP were heterogeneity-aware protocols that improve the stability period and network lifetime but a major drawback of heterogeneity is that the increased throughput eventually decreases the network lifetime. Therefore, to control the trade-off between the efficiency, accuracy and network lifetime, a new protocol TSEP [32] was proposed. It is a reactive routing protocol that senses data continuously over the network but transmits only when there is a drastic change in the value of sensed attributes. The transmission takes place only when a specific level of threshold is reached. It uses three levels of heterogeneity by considering three types of nodes: normal, intermediate and advance nodes. The highest energy nodes are advance nodes followed by intermediate and normal nodes. The intermediate nodes are selected by using a fraction  $b$  of intermediate nodes. The energy of intermediate nodes is assumed to be  $\mu$  times more than that of normal nodes. So, the energy of intermediate nodes is calculated as:

$$E_{INT} = E_o (1 + \mu) \text{ where } \mu = \frac{\alpha}{2} \quad (9)$$

So, total energy of normal, advance and intermediate nodes is

$$n \cdot b (1+a), n E_o \cdot (1-m-bn), \text{ and } n \cdot m \cdot E_o (1+a) \text{ respectively.}$$

So total energy of all nodes becomes

$$n E_o \cdot (1-m-bn) + n \cdot m \cdot E_o \cdot (1+a) + n \cdot b \cdot (1+\mu) = n \cdot E_o (1+ma + b\mu) \quad (10)$$

The optimum probability of nodes to be elected CHs is calculated by:

$$p_{nrm} = \frac{p_{opt}}{1+ma+b\mu} \quad (11)$$

$$p_{int} = \frac{p_{opt}}{1+ma+b\mu} * (1+\mu) \quad (12)$$

$$p_{adv} = \frac{p_{opt}}{1+ma+b\mu} * (1+a) \quad (13)$$

To make sure that the CH is selected in the assumed way, a new parameter threshold is considered. If the generated random number by the nodes is less than the threshold then that node becomes the CH for the current round. The threshold is calculated by the following formulae:

$$T_{nrm} = \begin{cases} \frac{p_{nrm}}{1-p_{nrm} \lceil r \cdot \text{mod} \frac{1}{p_{nrm}} \rceil} & \text{if } n_{nrm} \in G \\ 0 & \text{otherwise} \end{cases} \quad (14)$$

$$T_{nrm} = \begin{cases} \frac{p_{int}}{1 - p_{int} \lfloor r \cdot \text{mod} \frac{1}{p_{int}} \rfloor} & \text{if } n_{nrm} \in G'' \\ 0 & \text{otherwise} \end{cases} \quad (15)$$

$$T_{adv} = \begin{cases} \frac{p_{adv}}{1 - p_{adv} \lfloor r \cdot \text{mod} \frac{1}{p_{adv}} \rfloor} & \text{if } n_{adv} \in G''' \\ 0 & \text{otherwise} \end{cases} \quad (16)$$

Where  $G'$ ,  $G''$  and  $G'''$  are the set of normal, intermediate and advance nodes that have not been elected the CH.

Average number of CHs per round will be:

$$n \cdot (1 - m - b) \cdot p_{nrm} + n \cdot b \cdot p_{int} + n \cdot m \cdot p_{adv} = n \cdot p_{opt}$$

This shows that due to energy heterogeneity, the energy dissipation is reduced in the network. At the start of each round, the process of cluster change takes place in which the CH broadcasts some parameters to the other nodes. These parameters are the report time, attributes, soft threshold (ST) and hard threshold (HT). the nodes keep sensing the environment for change in the values of attributes. When the values of attribute set reaches the hard threshold, the radio is turned on and the data is transmitted to the CH. This sensed value is stored in a variable called Sensed Value (SV). The next time the nodes transmit data only when the sensed value is greater than the hard threshold or if the difference between the sensed value and the value in SV is equal to or greater than the soft threshold. So, these thresholds reduce the number of transmissions as the data will be transmitted only when it reaches hard threshold. Thus, this additional feature of three heterogeneity levels results in increased stability period and network lifetime.

#### F. Hierarchical Based Stable Election Protocol (HSEP)

It is the next level protocol that was proposed after ESEP. The increasing the distance between the CH and the BS results in increasing the transmission energy because most of the energy is consumed in the transmission process. HSEP is proposed which aims at reducing the transmission energy between the CH and BS. It brings into consideration the clustering hierarchy which lowers the transmission cost and hence the energy. In this type of clustering used two types of cluster-heads: primary CHs and secondary CHs. The secondary CHs can be selected from the primary CHs and are elected on the basis of probability from those nodes which had already become the primary CHs. The primary CHs only can choose the secondary CHs. They check distance between each other and the ones that are at minimum distance from them are selected the secondary CHs. It also uses advance nodes and normal nodes. The process of selecting the primary CH is same as in Sep by generating a random number between 0 and 1 and then comparing it with the threshold value. These primary CHs then aggregate data collected from other nodes and transmit it to the secondary CHs which further send it to the BS. Thus, minimizing the transmission distance between the secondary CHs and the BS results in less consumption of energy. Thus HSEP outperforms the other protocols because it is based on clustering hierarchy in which CHs are of two levels. This hierarchical clustering reduces the transmission distance and hence results in less power dissipation. Also the stability period of HSEP is higher as compared to others.

Thus, energy heterogeneity should be one of the key factors to be considered when designing a robust protocol for WSN. The goal is to design a modified protocol that is

more robust and can ensure longer network lifetime while taking performance measures into consideration.

#### G. Energy Consumption Rate Based Stable Election Protocol (ECRSEP)

Clustered sensor networks may be homogeneous or heterogeneous sensor networks. Homogeneous networks are those in which all nodes have same amount of energy. Owing to static clustering in homogeneous networks, the CHs will be overloaded with long distance transmissions and need extra energy for processing. This results into the death of CHs before the other nodes. So, to ensure that all nodes die at the same time, a small amount of residual energy is wasted. One way to do this is to rotate the CH periodically and randomly over all nodes. In heterogeneous networks two or more different types of nodes are used based on their initial energy levels. In ECRSEP, CH selection is based on the energy consumption rate (ECR).

It is defined as the  $ECR = \frac{E_{int} - E_r}{r - 1}$ , where  $E_{int}$  is the initial energy,  $E_r$  is the residual energy and  $r$  is the current round. The CH selection in the next round is based on the ECR of the previous round. A node with less ECR in the previous round is selected as CH in the next round.

Let  $n$  be the number of rounds to become CH for nodes  $S$ . we call it the rotating epoch. Let  $p = \frac{1}{n}$  is average probability to become CH during  $n$  rounds.

We have,  $p = p_{opt} * ECR$  Total number of CHs per epoch is  $\sum_i^N P_i = N p_{opt}$

In two level heterogenous networks,  $p_{opt}$  is replaced by weighted probabilities of advance and normal nodes

$$p_{adv} = \frac{p_{opt} \frac{E_i - E_r}{r - 1}}{1 + am} \quad (17)$$

$$p_{nrm} = \frac{p_{opt} (1 + a) \frac{E_i - E_r}{r - 1}}{1 + am} \quad (18)$$

The results show that ECRSEP has enhanced stability period and network life than other protocols. ECRSEP achieves maximum lifetime of the network. LEACH goes sooner to unstable as it is very sensitive to heterogeneity. SEP extend the stability period by assigning probabilities of CH election weighted by relative initial energy. ESEP has three levels of heterogeneity so it has longer stability period than SEP. HSEP uses hierarchical clustering approach and thus reduces the transmission energy. And above all ECRSEP outperforms all of them.

#### H. BEEM

BEEM is Balanced Energy Efficiency Multihop Clustering Scheme. Balanced Energy Efficiency (BEE) clustering algorithm and its Multihop version (BEEM) exceeds HEED and LEACH in two ways: 1) System operating time: time from the system starts till the last node dies. 2) System operating quality: the sensing coverage maintaining ability. The higher-layer CHs transmit data to the 1-lower layer CHs. Based on the received signal strength, the distance between a sensor and the BS can be estimated from the Log Distance Path Loss Model. In BEE(M), local density and residual power are used as CH

election conditions. BEEM can provide better network coverage and longer overall lifetime

#### IV. LITERATURE SURVEY

Smaragdakis et al. [1] has proposed SEP (Stable Election Protocol) so every sensor node inside a heterogeneous two-level compared to that relating to other nodes. It doesn't require any global knowledge of one's energy each and every election round. SEP is dynamic because they don't assume any prior distribution of the various degrees of energy inside the sensor nodes. Furthermore, the analysis of SEP isn't just asymptotic, i.e. the analysis applies equally efficiently to small sized networks. Finally SEP is scalable as this doesn't require any knowledge from the exact position of every node within the field. Israr, Nauman, and Irfan Awan [2] presented a new cluster based routing algorithm to address the traditional problem of load balancing and energy efficiency in the WSNs. The proposed algorithm makes use of the nodes in a sensor network whose area coverage is covered by the neighboring nodes and marks these nodes as temporary cluster heads. These temporary cluster heads are later used for multihop intercluster communication. Performance studies indicate that the proposed algorithm solves effectively the problem of load balancing across the network and is more energy efficient compared to standard Leach and the enhanced version of Leach algorithms. Guisheng Yin et al. [3] Considering that the nodes of wireless sensor networks have been in the condition of a highly-limited and replenish able energy resource for example electric batteries, computation, and space for storage the vitality efficiency is an essential key point from the network routing designing. In this particular paper, A novel routing algorithm which mixes with hierarchical routing and geographical routing is proposed. Depending on the hierarchical network architecture, the entire process of forwarding packets between the cause nodes inside the target region and the base station includes two phases—inter cluster routing and intra-cluster routing, a greedy algorithm is adopted in the entire process of the inter-cluster routing with an multi-hop routing algorithm depending on the forwarding restriction angle is designed for the intra cluster routing. The analysis and simulation results show that the routing algorithm has better performance when it comes to energy consumption and delay; it would work for the information transmission inside a high-density wireless sensor network. Liu, Wenjun, and Jiguo Yu [4] introduced an uneven clustering mechanism. Cluster heads (CHs) which are closer to the base station (BS) have smaller cluster size than those farther from BS, thus they can preserve some energy for the purpose of inter-cluster data forwarding. For the dynamic cluster head rotation mechanism, the sensor nodes perform cluster head function in turn which balances energy consumption well among CHs. What is more, they proposed an energy-efficient multi-hop routing protocol executed by BS for inter-cluster communication. Their strategy is making the most of BS's energy, so the node energy in the network is saved furthest. Simulation results show that EECR clearly prolongs the network lifetime over some related routing protocols. Park, Min-Woo et al. [5] proposed

an energy efficient concentric-clustering scheme. In scheme, the number of sensor nodes is differently deployed to balance energy dissipation. As the simulation results, scheme can distribute energy dissipation among the whole networks better than the extended concentric-clustering routing scheme. Ishmanov, Farruh, and Sung Won Kim [6] rotation and unequal clustering schemes are proposed. However, rotation schemes are not much energy efficient. Unequal clustering schemes consider only distance and rarely consider overlapping clusters which can seriously affect load balancing. They proposed load balancing and energy efficient clustering algorithm to efficiently distribute distance among clusters considering data volume and set up targeted clusters. In each step of clustering, algorithm estimates load on current cluster, forms next level clusters, and adjusts it with network width. As comparisons showed, the algorithm outperforms other algorithms in terms of network lifetime and load balancing. Wang, Chin-Liang et al. [7] presented a cooperative single-input multiple-output (SIMO) transmission scheme for wireless sensor networks (WSNs), where the number of antennas and the constellation size of modulation are jointly optimized for different transmission distances such that the energy consumption is minimized. As compared to previous cooperative MIMO schemes for WSNs, the proposed one achieves higher energy efficiency and has a smaller critical distance above which cooperative MIMO/SIMO outperforms single-input single-output (SISO). The proposed optimization method is further extended to a clustered multi-hop WSN scenario. Through joint optimization of the number of transmitter antennas, the number of receiver antennas, the constellation size, and the hop length, they derived an energy-efficient clustered cooperative SIMO multi-hop scheme. Numerical results show that the proposed scheme not only reduces the overall energy consumption but also balances the energy consumption among clusters. Ma Chaw Mon Thein et al. [8] Recent advances in wireless sensor networks have resulted in many new protocols specifically made for sensor networks where energy awareness is an important consideration. Clustering is really a key routing technique used to lessen energy consumption. Clustering sensors into groups, to ensure that sensors communicate information simply to cluster heads and then a cluster-heads communicate the aggregated information to the base station, saves energy and thus prolonging network lifetime. Energy efficient cluster-head selection algorithm for adapting clusters and rotating cluster head positions to evenly distribute the energy load among most of the nodes. The proposed model is extended to the LEACH's stochastic cluster-head selection algorithm by modifying the possibility of each node to become cluster-head centered on remaining energy level of sensor nodes for transmission. Simulation results show that proposed model could better implement load balance and prolong the lifetime of the network. Bark and Lillian [9] have prepared focus mostly on extending the WSN lifetime. Lifetime has been extended by creation WSNs redundant by the addition of up extra nodes. The passive (switched off) spares has been made open to become active (be switched on) whenever any active WSN sensor node power exhausted. A latest planned LEACH-SM (LEACH Spare Management)

has modified the famous LEACH protocol by enhancing it by having an efficient organization of spares. Addition of the spare choice phase has been completed in LEACH; this functionality has been named as extra administration features in LEACH-SM. During extra choice phase, every sensor node has been decided in parallel if it could be become an energetic primary sensor node, or an inactive spare node. The nodes decided spares go asleep, whilst the WSN as the entire has been maintained the necessary above-threshold target reporting. (The spares have awakened once the probability that any primary node exhausted its energy reaches an undefined value.) Identification of spares alone has been increased power effectiveness for Network as proved, Decentralized power-efficient extra Selection Technique has been utilized in spare selection phase by spare manger. Reduction in the time scale of the active period for cluster heads has been observed, considered as a part effect. Decreased power consumption by cluster heads has been observed mainly. Meenakshi Sharma et al. [10] Routing protocols like EEE LEACH, LEACH and Direct Transmission protocol (DTx) in Wireless Sensor Network (WSN) and a comparison study of these protocols centered on some performance matrices. Addition to the an effortis performed to calculate their transmission time and throughput. To calculate these, MATLAB environment is used. Finally, on the basis of the obtained results from the simulation, the above mentioned three protocols are compared. The comparison results reveal that, the EEE LEACH routing protocol features a greater transmission time than LEACH and DTx protocol and with smaller throughput. Reetika Munjal et al. [11] This paper studies the difficulties with LEACH protocol and presents improved ideas to choose the cluster head node. The key problem with the LEACH is based on the random choice of cluster heads. There exists a probability that cluster heads formed are unbalanced and may stay static in one section of network making some part of network unreachable. Here the main purpose is to choose a cluster head dependant on its current degree of energy and distance from the sink node. This increases the energy efficiency and hence network lifetime. Chanak, Prasenjit, and Indrajit Banerjee [12] present a new dynamic load balanced routing policy offering a high level of energy efficiency. Unlike existing routing solutions, the scheme is based on a distributed and load balancing scheme. Furthermore, it employs a new fuzzy based node classification scheme to enhance the network life span and coverage of the network. Node decides multi-hop data transmission path according to node efficiency. Therefore, proposed policy distributes routing load throughout the network. Extensive analysis and simulation show that their approach improves many important performance metrics such as: network life span, global energy loss, transmission delay, and packets delivery ratio. Suharjono, Amin, and Gamantyo Hendratoro [13] presented a new scheme for the optimum partitioning area. To improve the scalability, especially for large scale networks, the most recent trend on WSN clustering utilizes the multi-hop communication,. However, there is one negative effect of multi-hop communication that commonly called hot-spot problem, where the closer to base-station cluster-heads (CHs) suffer more load because they must relay data from outer CHs. The goal of the scheme is

obtaining a load-balancing among region by arranging the width of the regions. The evaluation shows that the proposed scheme is more superior than the conventional uniform partitioning. Phung, Kieu-Ha et al. [14] investigated a multichannel communication algorithm associated with routing process (called UMRC - mUltichanneland Multihop clusterRing Communication scheme) for Wireless Sensor Networks (WSN) in order to improve the capacity and network performance with the following features: interference and contention-free, multipath routing, energy efficiency and load balance. They used simulation technique to evaluate and compare the performance of new algorithm to other similar single channel schemes in terms of energy consumption, traffic load balance, number of aliving node and network throughput. The simulation results show that the proposed multi-channel scheme can increase the performance significantly compared to other proposed schemes. Mammu, Aboobeker et al. [15] proposed an cluster based energy efficient routing algorithm (CBER), CBER elects CH based on nodes near to the optimal cluster head distance and residual energy of the nodes. In WSNs energy is mostly consumed for transmission and reception, it is a non linear function of transmission range. In this paper, the optimal cluster head distance which links to optimal energy consumption is derived. In addition, residual energy is considered in the CH election in order to increase the network lifetime. Furthermore, the energy consumption of being a CH is equally spread among the cluster members. Performance results show CBER scheme reduces the end to end energy consumption and prolong the network lifetime of multi hop network compared to the well-known clustering algorithms LEACH and HEED. Xu, Lina et al. [16] proposed a novel algorithm based on HEED, named the Balanced Energy-Efficiency (BEE) clustering algorithm. Experimental results showed that BEE exceeds HEED and LEACH from two perspectives: longevity and balanced sensor distribution. It can guarantee the network coverage for a longer time, compared with HEED and LEACH. They also illustrated the multihop version of BEE, called the Balanced Energy-Efficiency Multihop (BEEM) clustering algorithm, which can further improve the performance of BEE.

## V. CONCLUSION AND FUTURE SCOPE

In this paper, a survey on various clustering protocols has been done. From the survey, it has been found that the use of the hard and soft thresholding has been ignored by the most of the existing researchers. Moreover, in BEEM a node might not become cluster head for a long time so will result in load misbalancing. The effect of the nodes scalability has also been ignored in the BEEM. Therefore, in near future, a improved BEEM will be proposed which will use improved inter-cluster data aggregation to enhance the results further.

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# Technical Study: Attack and Security Issues in Wireless Networking

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**Abstract-** Wireless Sensor Networks (WSN) is an emerging technology and is widely used in critical situations like battlefields, disasters, traffic surveillance and habitat monitoring etc. The designer of this network has to think many times keeping in mind every challenge that can be faced by WSN. So, a solution is also necessary to all problems to make WSN error free technology. A framework is designed that defines the procedure of challenges faced. The first layer of framework defines that what should be protected. It sets the security goals that tell that what should be protected in the network. The second Layer describes all types of attacks that can be a cause of insecurity to WSN in all of the layers of WSN, different layers describes the different attacks. So, this paper discusses goals, attacks of Wireless Sensor Networks.

**Keywords-** Wireless Sensor Network (WSN); Wireless Communication Stack; Denial of Services; Black Hole Attack, Worm Hole Attack.

## I. INTRODUCTION

Basically, Wireless Sensor Networks are comprised of various sensors. Sensor is a type of converter that monitors the physical and environmental conditions such as temperature, sound, pressure etc. and then converts into a signal which can be read by an observer using an instrument. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller etc [1]. Wireless Sensor Network is very vulnerable to various attacks. [2] To create the wireless sensor networks, the hardware and software technology required [4]. A framework can be designed gives security analysis in Wireless Sensor Networks [6]. WSN should be protected by primary goals and secondary goals required [7] hence there is need to summarize possible attacks and security solutions in different layers with respect to ISO/OSI model [8].

## II. WIRELESS SENSOR NETWORK

Wireless Sensor Networks is a type of networks that make use of sensors that examines the physical and environmental conditions and convert this information into signals that is passed through wireless network to main location. The data is passed through multiple hops to controller basically known as 'sink'. The nodes can be stationary or moving [1].

### A. Multi-hop wireless networks:

In multi-hop wireless networks, communication between two end nodes is carried out through a number of intermediate nodes whose function is to relay information from one point to another. Multi-hop wireless networks utilize multiple wireless nodes to provide coverage to a large area by forwarding and receiving data wirelessly between the nodes [1].

## III. WIRELESS COMMUNICATION STACK

Wireless Communication Stack includes the Medium Access Control (MAC), routing and transport layers:

### A. Physical Layer

It is concerned about carrier frequency selection and generation, encryption and decryption, modulation and demodulation, transmission and reception of data. The parameters which are to be kept in mind while designing Physical Layer in Wireless Communication Stacks are: low power consumption, low transmission and reception range, low complexity, low duty cycle (most of the times sensor nodes are switched off), low data rates most of the time and high data rates for short period [4].

### B. Data Link Layer

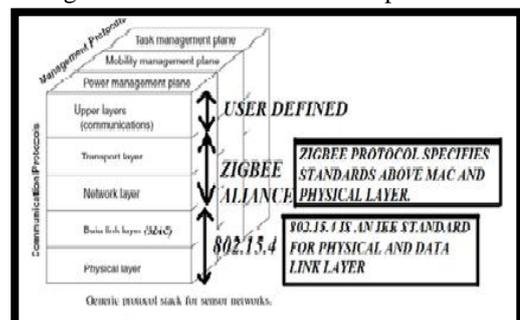
In wireless networks, many nodes compete to use single shared medium. MAC Layer is concerned about to regulate the access to this shared medium in such a way that all nodes are able to get their due. So, the main duty of MAC Layer is to determine the duration during which a particular node can send and receive the data, and control and manage the packets. [4]

### C. Network Layer

Network Layer is concerned about following facts: Every protocol designed should be power efficient, the protocol should support dynamic nature of sensor networks, the sensor network protocols should make sensor network self-configurable, Data aggregation should be performed if it is advantageous, Data centric design is more preferred rather than address centric or location centric architecture.

### D. Transport Layer

Transport Layer is concerned about congestion controlling mechanism to regulate the amount of traffic injected within the wireless sensor networks to avoid packet loss and to guarantee end-to-end reliable packet delivery. [4]



### E. Application Layer

Application Layer has mainly three protocols: Sensor Management Protocol (SMP), Task Assignment and Data Advertisement Protocol (TADAP), Sensor Query and Data Dissemination Protocol (SQDDP). [4]

## IV. SECURITY REQUIRED FOR WIRELESS SENSOR NETWORK.

There are many reasons for the necessity of security. Wireless networks are vulnerable to security attacks due to the broadcast Nature of the transmission medium. There all life scenario of use Of wireless sensor networks where security is crucial issue is as following: Battlefield applications, Disaster applications, Public Safety[2].

### V. HOW SECURITY CAN BE PROVIDED TO WIRELESS SENSOR NETWORKS

To determine what should be protected. A set of general classes of requirements are considered which can be used to structure the set of concrete security requirements. To protect the WSN the various security schemes are applied like primary goals and secondary goals [6].

### VI. ATTACKS ON WSN

Attacks on the wireless networks can be broadly considered into two different levels of views.

- a) Attacks against security mechanism.
- b) Attacks against basic mechanism (like routing mechanism) [8].

### VII. ATTACKS IN PHYSICAL LAYER

#### A. Device Tampering Attack:

The ability of the attacker to access the internal state of the sensor node is called node capture attack. Node capture attack has significant impact on WSN. It can be classified into three categories:

- a) Invasive Attack: This requires access to chip's internals and they typically need expensive equipment's used in semiconductor manufacturing and testing.
- b) Semi Invasive Attack: This requires much less time and cheaper equipment's than invasive attacks.
- c) Non Invasive Attack: It is the easiest of all of the attacks.

Most of the invasive and many of the semi invasive attacks also require destruction and physical destruction of the sensor nodes.

#### B. Denial of Services:

A Denial of service attack is an explicit attempt to prevent the legitimate user of a service or data. The basic types of attack are: consumption of bandwidth or consumption of processor time, obstructing the communication between two machines, disruption of service to a specific system or person, disruption of routing information, disruption of physical components etc. As an example at physical layer the DoS attacks could be jamming and tampering [8].

## VIII. ATTACKS IN DATA LINK LAYER

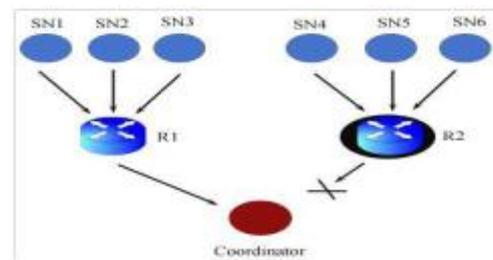
Due to openness of wireless channels, the coordination's between the sensors based on MAC protocol are subjected to malicious manipulations. The coordination rules can be disobeyed and adversaries produce malicious traffic to interrupt network operations in the data link layer to rules can be disobeyed in which Traffic manipulation, jamming, and collision.

## IX. ATTACKS IN NETWORK LAYER

WSNs are vulnerable to different network layer attacks. These are explained as follows:

### A. Black hole attack:

Black hole attack occurs when one or more nodes of the WSN are compromised by attacker and those nodes act as black hole region. In other word it means that traffic or data coming to affected node is absorbed by the node rather than forwarding it to the base station or server [8]



### B. Worm Hole Attack:

Wormhole attack is one of the Denial-of-Service attacks

Effective on the network layer, that can affect network routing, Data aggregation and location based wireless security. In this attack, an attacker records a packet or bits of the packet at one location in the network, tunnels the packet to another location, and replays it there. The wormhole attack places the attacker in a very powerful position, allowing them to gain unauthorized access, disrupt routing, or perform a

Denial-of-Service (DoS) attack [5].

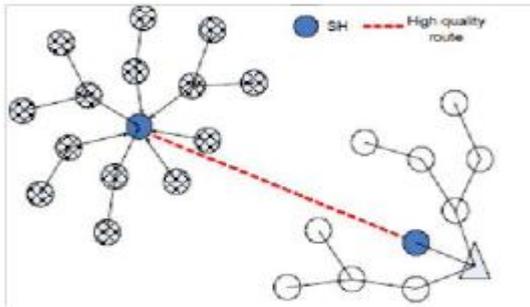
Types of Worm Hole Attack:

- Wormhole using Out-of-Band Channel: In this two-ended wormhole, a dedicated out-of-band high bandwidth channel is placed between end points to create a wormhole link
- Wormhole using Packet Encapsulation: Each packet is routed via the legitimate path only, when received by the Wormhole end, gets encapsulated to prevent nodes on way from incrementing hop counts.
- Wormhole using High Power Transmission: This kind of wormhole approach has only one malicious node with much high transmission capability that attracts the packets to follow path passing from it.
- Wormhole using Packet Relay: Like the previous approach, only one malicious node is required that replays packets between two far nodes and these way fake neighbors are created.
- Wormhole using Protocol Deviation:

The malicious node creates wormhole by forwarding packets without backing off unlike a legitimate node and thus, increases the possibility of wormhole path getting selected [5]

### C. Sink Hole Attack:

In a Sinkhole attacks typically work by making a compromised node look especially attractive to surrounding nodes with respect to the routing algorithm. Sinkhole attacks are difficult to counter because routing information supplied by a node is difficult to verify. A compromised node attracts all the traffic from its neighbors by telling its neighbor that it has shortest route to reach to the base station.



Sinkhole is created using wormhole. As shown in above figure, one malicious node attracts all the traffic and make a tunnel with another malicious node to reach to the base station [10].

### D. Sybil Attack:

In this malicious node attracts network traffic by representing multiple identities to the network.

#### Types of Sybil Attacks:

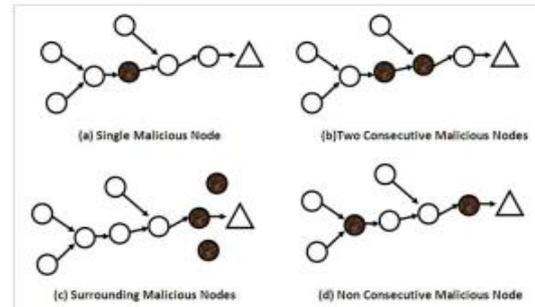
- **Distributed Storage:** In peer to peer storage systems, Sybil Attack nullifies fragmentation and replication mechanism.
- **Routing:** There are two vulnerable mechanisms. One is multipath or disparity routing and another is Geographic routing.
- **Data Aggregation:** Reading of the sensors can be aggregated in sensor network protocols to save energy rather than returning individual readings. By Sybil Attack, malicious node tries to alter the reading. Few malicious nodes reporting incorrect sensor readings will not affect the computed aggregate.
- **Voting:** Sybil attack helps to “stuff the ballot box”. The outcome of any vote depends on the number of identities the attacker owns. This helps in performing blackmail attacks in which it is assumed that the legitimate node is misbehaving.
- **Misbehavior Detection:** If a particular type of misbehavior is detected by a network. Some false positives occur in any such misbehavior detector. An attacker with many Sybil nodes could “spread the blame”, by not having any one Sybil identity misbehave enough for the system to take action [3].

### E. SELECTIVE FORWARDING ATTACK:

In multi-hop WSN, the nodes send packets to the neighboring nodes thinking that they forward messages to destination faithfully. In Selective Forwarding attack, malicious nodes legitimately refuses some packets and drops

them. A simple form of this attack is when a malicious node acts like a black hole and drops all the packets passing through it. However in such an attack, the nodes can detect the attack and can exclude attacker from routing. A more refined of this attack is when a malicious node selectively drops/forwards packets [9].

#### Categories of Selective Forwarding:



## X. ATTACKS IN TRANSPORT LAYER

De-synchronization occurs at transport layer. This attack tries to disturb an existing connection. An adversary continuously swindles packets to an end host. This host then demands retransmission of dropped frames and hence energy of nodes is wasted, therefore degrades performance [9].

## XI. ATTACKS IN APPLICATION LAYER

Attacks in this layer have knowledge of data semantics, and thus can manipulate data to change the semantics. As the result, false data are presented to applications and lead to abnormal actions [6].

## XII. HOW TO PROTECT THE WIRELESS SENSOR NETWORKS?

To protect the Wireless Sensor Networks, we use the Security Mechanisms. Security mechanisms are used to detect, prevent and recover from the security attacks. Security Mechanisms are of two types: Low Level and High Level [3].

### A. Low Level Mechanism:

- **Privacy:**  
Wireless Sensor Networks should ensure privacy techniques.
- **Secrecy and Authentication:**  
Secrecy and Authentication is required against eavesdropping, injection and modification of packets i.e. provided by Cryptography.
- **Key Establishment and Trust Setup:**  
Cryptographic keys should be established but sensor devices have limited computational power and public key cryptographic keys are very expensive. So, Key Establishment techniques are scaled to hundreds or thousands of nodes.
- **Robustness to Communication Dos:**  
It is a way to disrupt the network’s operation by broadcasting a high-energy signal.
- **Secure Routing:**  
An attacker might launch denial of service attacks on the routing protocol, preventing communication.

## B. High Level Mechanism

- Secure Group Management: We can make the sensor nodes to work in groups. Thus, the group key can be transmitted to base station i.e. sink.
- Intrusion Detection: The wireless sensor network is highly susceptible to intrusion. The Secure Group Management can help in intrusion detection easily.
- Secure Data Aggregation: For example, the system may average the temperature of a geographic region, combine sensor values to compute the location and velocity of a moving object, or aggregate data to avoid false alarms in real-world event detection. So, Data aggregated should be secure [3].

## XIII. CONCLUSION AND FUTURE SCOPE

The use of sensor nodes in unattended area makes the level of vulnerability high for security of Wireless Sensor Networks. Wireless Sensor Networks are widely used for military, health and disasters applications where highly confidential and accurate information is required. So, risk of false alarms or inaccurate information cannot be taken. This paper summarizes all the security goals, types of attacks and security schemes in Wireless Sensor Networks to make the emerging technology more efficient by overcoming all the challenges of Network. This research paper will hopefully motivate future researchers to come up with the smarter and safer Network by challenging the challenges of Wireless Sensor Networks.

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# RFID Technology Enables Self-Regulating Movement of Visually Impaired People

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**Abstract** - Radio frequency identification is the next wave in the evolution of computing. It is often known as “Internet of Things”. The RFID (Radio Frequency Identification) [1, 2, 3] market is in a hyper growth phase. Via RFID technology, objects can be connected to Internet or databases in such a way that they can be easily tracked. The benefits of RFID technology in different fields are fairly convincing. RFID technology has the potential to help visually impaired people up to such an extent that they can walk independently in buildings which even they are not familiar with. It is for sure that in the coming future the market for RFID products and services is set for a huge leap. But if we view the other side of the coin, there are certain hurdles that are faced during effective implementation of RFID technology. RFID systems now have been in existence since many years but the technologies use in medical field has been initiated recently. In this research paper we illustrate how the technology may help visually impaired people and build up confidence in them so that they can make themselves socially active and make their presence felt by keeping the feeling of disability aside. In the process, we take an in-depth look at how this technology would work and issues that needs to be considered for its effective use. Therefore the purpose of this paper is to analyze how people with visual, hearing and physical impairments can interact with and benefit from the RFID.

**Keywords** – Braille display, Blavigator System, GIS, GPS, RFID

## I. INTRODUCTION

The term RFID refers to Radio Frequency Identification, a technology which uses radio waves to automatically identify items or people [1, 2]. RFID has extended its applications to identify a wide variety of items, including things like consumer goods or construction machinery. RFID is an automatic identification like bar codes, smart cards, and voice recognition etc., used to help machines identify objects. But unlike bar codes line of sight signals are not required for operation of RFID. This technology makes use of automatic data capture systems to identify objects and capture information and transfer them into computer without data entry.

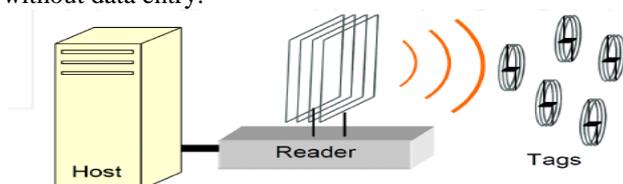


Fig. 1. Working of RFID

Fig. 1 shows a typical system that uses RFID technology. The host machine uses one or more RFID readers to retrieve digital information stored in RFID tags

and processes the information according to the needs of one or more applications. In general, a RFID tag contains a globally unique identification (UID) as well as data fields organized in a standard way. A RFID based object locator only needs the UID information; other data fields are not used. No matter whatever is the orientation of the tag, the tag can be read easily. It do not requires line of sight. The RFID technology has now bust the myth that it does not work around water or metal.

## II. RFID FOR VISUALLY IMPAIRED

The RFID is a technological revolution in computing and communications. It depicts a world of networked smart devices, where everything is interconnected and has a digital entity. Everyday objects transform into smart objects able to sense, interpret and react to the environment thanks to the combination of the Internet and emerging technologies such as Radio-frequency Identification (RFID), real-time localization and embedded sensors. This technological evolution enables new ways of communication between people and things and between things themselves. Visually impaired people face unique challenges navigating in unfamiliar public locations. Twenty-five percent of the visually impaired people travel through public locations without assistance other than a walking stick. A visually impaired person can obtain a sense of where they are based on their proximity to walls, doors, and other obstacles through the use of a walking stick. While this can help navigate to a destination, this can lead to longer routes and wasted time. Using a walking stick relies on trial and error, particularly in unfamiliar locations. Current navigation tools for the visually impaired focus on travelling from one location to another. In this research paper our focus is on concentrating on a system for visually impaired people that is comfortable to use and can help with travelling independently. We strongly believe that the Internet of Things can offer people with disabilities the assistance and support they need to achieve a good quality of life and allows them to participate in the social and economic life.

There are 285 million people worldwide that have some level of visual impairment. Visual function can be classified by four tiers: normal vision, moderate visual impairment, severe impairment, and complete blindness. Legally blind refers to a person who has less than 20/200 vision in either eye, or a limited field of vision. While not all visually impaired individuals are completely blind, many use walking sticks and guide dogs to navigate from place to place and to gain a sense of their surroundings. For this visually impaired population, the goal is often to

complete tasks in the least obstructive method, rather than the most efficient method, including the use of guide dogs and walking sticks. A guide dog is trained to steer its users away from objects and barriers. When a visually impaired person is using a walking stick, they gain a sense of their surroundings by waving their walking stick and striking obstacles ahead of them. Public locations, such as a crowded shopping malls, airports, train stations, and bus stations, can be difficult to navigate and can become disorienting for those with visual impairments. Imagine having to navigate to a terminal at an airport without the ability to see. After checking in bags and getting through security, one would still need to walk to the terminal listed on their ticket. Without asking others for help, these tasks can be difficult. These public spaces contain various sensory distractions such as traffic noise and other people. For a visually impaired person, it can become difficult to determine what direction to travel without some form of guidance. Navigating through unfamiliar public locations has long been a source of difficulty for the blind [3, 4].

Nowadays, navigation systems are widely used to find the correct path, or the quickest, between two places. These systems use the Global Positioning System (GPS) and only work well in outdoor environment since GPS signals cannot easily penetrate and/or are greatly degraded inside of buildings. Several technologies have been proposed to make navigation inside of buildings possible. One such technology is Radio-Frequency Identification (RFID). In the case of outside environments, some hybrid systems have been proposed that use GPS as main information source and RFID for corrections and location error minimization. In this research paper we propose a navigation system that uses RFID as the main technology to guide people with visual impairment in unfamiliar environments, both indoor and outdoor, complementing the traditional white cane and providing information about the user's geographical context.

While assistive technology has contributed to the improvement of the quality of life of people with disabilities, with major advances in recent years, people with visual impairment still face enormous limitations in terms of their mobility. The task of moving from one place to another is a difficult challenge that involves obstacle avoidance, staying on street walks, finding doors, knowing the current location and keeping on track through the desired path, until the destination is reached. Most navigation systems are designed to be used by users without any major disability and are based on information systems which are mainly focused on road navigation (outdoor) and commercial and tourist destinations. In recent years, several approaches have been made to create systems that allow seamless tracking and navigation both in indoor and outdoor environments. This paper proposes a prototype which uses RFID technology to provide location-based services and navigation to the blind, or visually impaired.

### III. NAVIGATION SYSTEMS FOR VISUALLY IMPAIRED PEOPLE USING BRAILLE DISPLAY

#### A. Braille Display

Reading your electronic documents using your hands instead of your eyes may sound almost impossible.

However, this is actually what many blind persons do. This is done through a device known as a Braille display. Braille displays are hardware that enables users to read in Braille the text displayed on the computer screen. Using this device, blind people can navigate through the computers desktop, create and edit documents, and browse the Internet. The user has to connect the Braille display to the computer or any other device via a USB connection. Braille displays may also use other types of connections. Most of the time, the user does not have to install a driver for the Braille display. This is because there aren't many types of Braille displays, and screen readers can support most of them. Once connected to the computer, the Braille display will acquire the currently highlighted text on the screen. The screen reader will then translate the text in Braille and the device will display it on its built-in Braille cells. To create the Braille dots in each cell, Braille displays use metal or nylon pins. Braille displays are refreshable. This means that when the user moves to a specific line of text, the device displays the text's Braille equivalent. And when the user moves to another line, the device automatically displays that new line in Braille. Most Braille displays have eight dots in each cell. The six dots are for the actual Braille character, while the two dots at the bottom are normally used to denote the cursor, or the format of the text, for example highlights.



Fig. 2 Figure shows people working with Braille device

#### B. EPC Global

The Electronic Product Code, or EPC, forms the bridge between GS1's barcode-based identifiers and the world of Radio Frequency Identification (RFID). The supply chain visibility provided by EPC/RFID item tagging enables greater inventory accuracy, traceability, and more. It allows you to identify products – capture and read their data in bulk from up to 10 metres away – and achieve read rates of up to 500 tags per second. This is also been effectively implemented for developing helping aids for visually impaired.

#### C. Infrastructure of Braille Display System for Visually Impaired

The system under study uses tactile signals for giving information rather than acoustic signals, and contributed better power source for the operation of the system. This system is based on RFID passive tags, reader, control unit, Braille display and lithium and solar power source. A reader incorporated in white cane reads the information from the passive tags, then retrieves data from memory and

transfers this information to the Braille display so that the visually impaired can read it. Passive RFID tags can be installed on roads, Braille blocks, street lamps, buildings or other signs and location indication boards. Reader can read the information from tag, analyze the data and pass the information to the control unit. Control unit helps in presenting the useful information to the blind people through Braille display. This system is cost effective and easy to implement [5, 6].

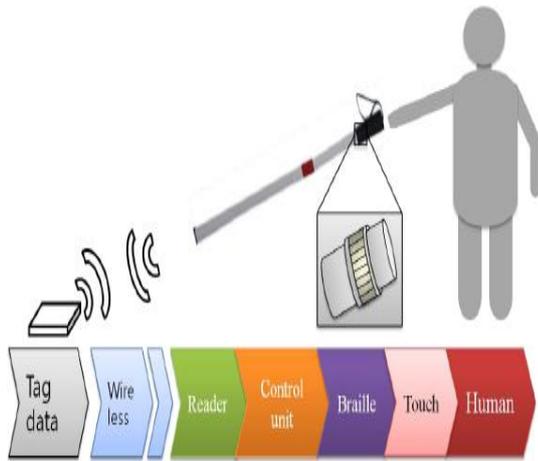


Fig. 3 System Configuration

Table 1: Company prefix

Company Profile (20 bits)	
Company Code	Direction Code
18 bits	2 bits

As shown in Table 1, company prefix is divided into two parts; company code (18 bits) and direction code (2 bits). 260 thousand building names can be defined using 18 bits of company code. 2 bits of direction code are used to represent relative direction of tag and building. The code values of right and left directions are 00 and 11 respectively, and that of forward and backward direction are 10 and 01. This formation will facilitate figuring of direction in the protocol.

Table 2: Location Reference

Location Reference (21 bits)		
Main road	Sub road	Path
6 bits	7 bits	8 bits

Generally, the address definition of building is based on the road layouts. Roads can be categorized into three

Table 4: Tag Sample

Tag	Tag code									
A	M shop	Right	0	Y sub road	0	No 2	Forward	0	0030	M shop
B	N company	Right	0	Y sub road	0	No 4	Right	Entrance	0060	N company
C	N company	Right	0	Y sub road	0	No 4	Forward	Crosswalk	0070	N company
D	W office	Right	0	Y sub road	0	No 6	Back	Crosswalk	0071	W office

types as shown in Table 2: main road, sub road and path. 6, 7 and 8 bits are respectively allotted to these road categories. Up to 2 million pathways can be defined in the tag code.

Table 3: Extension Component Allocation

Extension Component (41 bits)			
Building number	Direction	Road Condition	Serial number
10 bits	2 bits	5 bits	23 bits

In extension component part (Table 3), the first bit value is 1. Next 10 bits are allocated to building numbers. Building numbers are allotted from the start of the road, with odd numbers assigned to the left side and even numbers assigned to the right side, as shown in Figure 4.

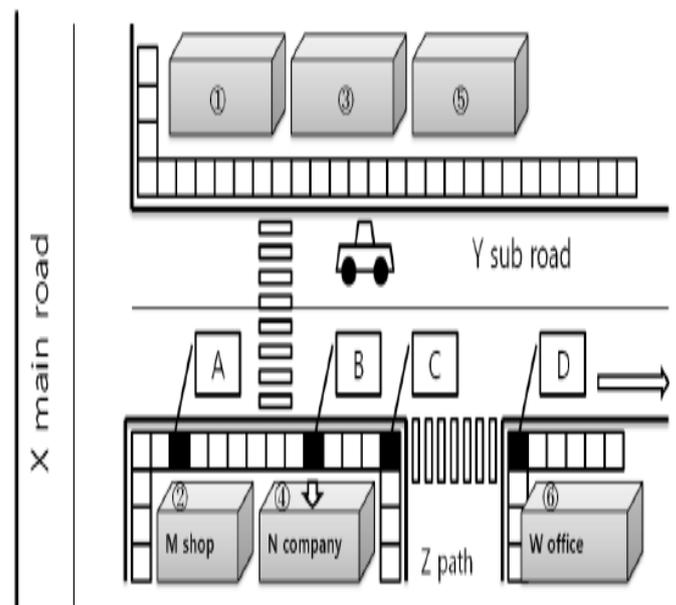
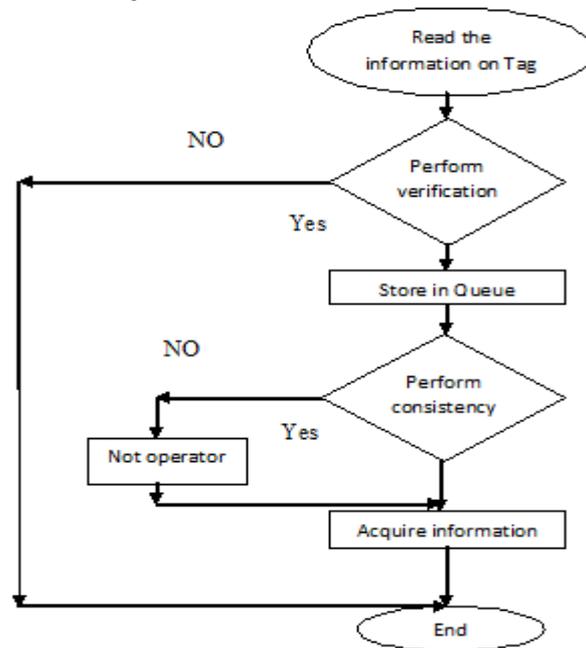


Fig. 4 Actual road condition and Tag arrangement

We used 2 bits to indicate the direction of road conditions and the other 5 bits to mark that road condition. Road conditions may refer to several detailed information to help blind pedestrians, like building entrance, stairs, pedestrian crossings, traffic light, turn etc. Remnant 23 bits are used for defining passive tag serial number. These serial numbers increase with respect to the right-hand side of the road and assume this direction to be positive. When a pedestrian walks on Y sub road from left-hand side to right-hand side, the tags are read sequentially and data from them is stored in memory stack in reader.

The flowchart 1 below depicts the entire working of the system. Whenever the reader comes in contact with installed passive tag, the tag is verified and its data is stored in reader's memory stack. Tags serial number is compared with the previous entry of stack. We assume that tag serial number is increasing on the right side of the road. If the pedestrian is walking in the positive direction, serial numbers read by the reader increases in value. The reader

retrieves information and sends message to the pedestrian. When the pedestrian walks from negative direction, the system can judge the pedestrian direction by decrement in serial numbers. In this case, the system would convert the company prefix and extension component directions in Table 1 to their opposite values by not operation



Flowchart 1: Flowchart shows working of Braille System for visually impaired people

#### D. Smart Cane

Class 1 (Gen 2) UHF based reader can be deployed in smart cane, because of its large range of reading. Smart cane is able to communicate the information received by the reader to the user. It uses Braille for transferring the information to the user. Braille communication system for blind people is developed by Louise Braille and is the most popular among existing navigation systems for blind. In this system characters are exhibited in a pattern of six (or more) dots having two columns of three dots, known as Braille cell.

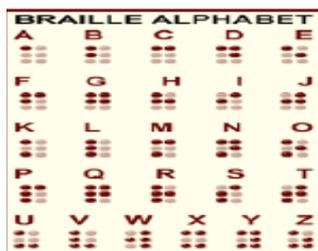


Fig. 5 Braille cell

For conveying information to the user, Braille display on smart cane uses two lines for displaying the characters. First line will give indication of nearby building, road, street or any other important location around. The second line will provide information about any specific place around that location, like the presence of any pedestrian crossing, community services (elevator, washrooms, etc) and telephone booth. Directions of these places are also shown on the second line.

Braille display works on selection of dots and electromechanical switching. Any dot in display system can be chosen to be raised to represent a dot or can be lowered to act as an empty place. In our system reader gets information about location from the passive tags installed and transfers it to a control unit. This control unit is responsible for the mechanism of displaying message on Braille display. The control unit consists of a microcontroller unit (MCU) which can be programmed to facilitate selection of dots using decoders and buffer based on the commands by the MCU. Electrical signals from decoders and buffers can operate electromechanical switches which can raise or lower metallic or plastic pins. By using this simple layout, we can represent data on our Braille display.

#### IV. BLAVIGATOR SYSTEM FOR VISUALLY IMPAIRED PEOPLE

##### A. Blavigator system

Another system that has been developed for making life of visually impaired people easy is given the name of Blavigator system. This system is been developed by the University of Trás-os-Montes and Alto Douro (UTAD). The primary aim of the project is to develop a cheap and easy to use mobile navigation system that helps visually impaired people to navigate, providing ways to get to a desired location and, while doing so, providing contextual information about obstacles and points-of-interest (POI) like zebra-crossings, building entrances, etc. The system is built in a modular structure, combining several technologies, as seen in Figure 6.

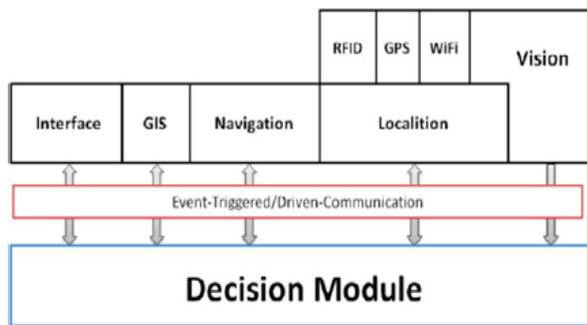


Fig. 6 Modular structure of Blavigator system

It is the responsibility of the Decision Module for managing and establishing communication between all the available modules. It is this module that receives inputs from the user and makes decisions on what information the user should get from the system. The Location Module is responsible for providing regular update and current geographic coordinates to the Decision Module. To provide this information both in indoor and outdoor environments, this module uses different technologies:

- Global Positioning System (GPS) for outdoor environments
- Wi-Fi for indoor environments.
- Radio-Frequency Identification (RFID) and Computer Vision are used in both indoor and outdoor environments and they are based on the detection of landmarks placed in the ground.

Each location technology has a specific accuracy and the location Module always chooses the one with the best accuracy from the ones available in each moment. In terms of hardware, the RFID reader is placed in the white cane which is connected via Bluetooth and the camera is chest-mounted. The GPS antenna and Wi-Fi antenna are built-in components of the mobile computer. The Navigation Module is responsible for route planning and for providing information about surrounding points-of-interest (POI). It communicates with the Decision Module and requests two different data inputs: GIS data and location data. To get the GIS data, the Decision Module queries the GIS server in order to get maps and POIs. The user location is fed from the Location Module. After analyzing the requested data, the Navigation Module feeds back the Decision Module with navigation instructions. The amount and accuracy of the GIS data stored in the GIS server is critical in order to feed the blind user with the most appropriate and accurate instructions. The Computer Vision Module provides orientation instructions by detecting known landmarks in the ground and keeping the user within safe routes. Using a stereo vision system, disparity information is extracted from the captured image frames and can be used to create a depth map. This information is useful to know the distance between the user and detected landmarks. So, in addition to giving orientation instructions to the Decision Module, with distance information the Computer Vision Module has the ability to feed the Location Module with location information. Finally, the Interface Module provides user interface using two outputs and one input. The two outputs are text-to-speech software and vibration actuators. Since the hearing sense is very important to blind users, the vibration actuators are used for navigation instructions and the voice interface is used for menu interaction and to provide POI

information. The user gives inputs to the system by using a small four-button device to scroll between the menus, apply changes and go back to previous menus. The user interacts directly with the Decision Module through the Interface Module and all the other modules are independent. This way, the user can get the required information even when some modules are not available, or cannot provide accurate information. For example, if GPS is not available or if the user is in an indoor environment, the Location Module can get information from the RFID tags, Wi-Fi or Computer Vision modules. Redundancy is, therefore, a very important factor to increase the overall reliability and accuracy of the system [7, 8].

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# Hierarchical Routing Protocols in Wireless Sensor Networks- A Survey

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**Abstract**-Energy-efficient routing protocols for wireless Sensor Network is the key issue required to be focused. Routing protocols can be categorized as proactive protocols or reactive protocols, depending on when the routing structure is constructed when a routing request is issued from a source node. Routing protocols can also be categorized as flat routing protocols and hierarchical routing protocols. From this basic ideas, the advantages, disadvantages and applications, the article introduces several typical hierarchical routing protocols in detail, which are analyzed and compared based on performance metrics or parameters, and finally summarizes the important details of routing protocols and research direction in future keeping important metrics in consideration.

**Keywords:** *Wireless sensor network, Routing protocol, Energy Efficiency, Life Time*

## I. INTRODUCTION

Wireless sensor networks are usually composed of collection of autonomous nodes or terminals that communicate with each other by forming a multihop radio network and maintaining connectivity in a decentralized manner. These tiny smart sensing devices that are small, inexpensive, resource constrained performs three essential functions: sensing, communications, and computation (hardware, software, algorithms).

The development of wireless sensor networks was motivated by the military surveillance, but now-a-days are used in many other applications like vehicle motion control, earthquake detection, patient monitoring systems, pollution control systems. The first wireless network that bore any real resemblance to a modern WSN is the Sound Surveillance System (SOSUS), was developed United States Military in the 1950's to detect and track Soviet submarines [1]. After this it became a great research area and it started developing year by year including more new characteristics thus, showing improvement in this field. The figure below describes the WSN technology transitions [21]:

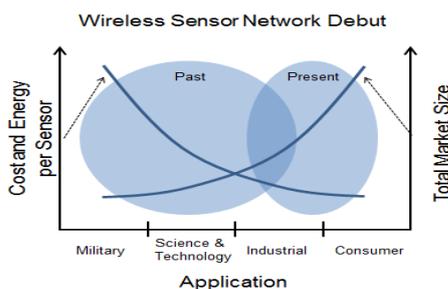


Fig. 1

The emergence of wireless sensor networks attracted worldwide attention. Wireless sensor networks are a new generation of sensor networks, have a very wide range of applications, their development and application will bring about far-reaching impact in human life and production of all areas[1]. The applications where we use these sensing network devices are distinct, a single routing protocol can not meet the needs of these distinct applications hence this requires major attention by the researchers.

Also each Sensor Node which contains a sensor, embedded processor, limited memory, low-power radio and is normally operated with a battery. Various parameters that constrain the nodes are:

- Energy supply
- Bandwidth
- Low power consumption requirements

So the aim while considering these networks must be to find ways for energy-efficient route setup and reliable relaying of data from the sensor nodes to the sink so that the lifetime of the network is maximized required attention by the researchers. For the purpose we need to understand the structure and architecture of the WSN carefully, Figure 1 shows the generalized view of WSNs, which consists of a BS, Cluster Heads(CHs) and SNs deployed in a geographical region [22] and figure 2 gives sensor architecture design[23]

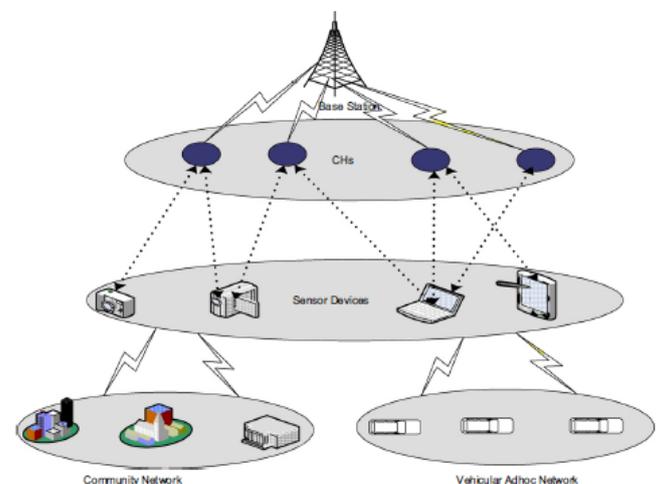


Fig. 2

Hence in this paper we try to analyze or Study Hierarchical Routing Protocols for distinct applications with lifetime

maximization along with keeping in view key design issues like Fault tolerance, Scalability, Production cost, Hardware constraints, transmission media. During protocol design Power efficiency remains the key metric among all categories of sensor routing protocols because sensor nodes contains limited battery backup and no renewable or recharging mechanism can be made after deployment of nodes in the field. Various categories of routing protocols are as

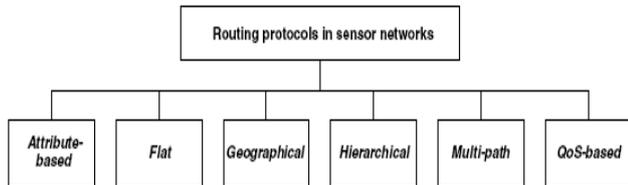


Fig. 3-Categories of sensor routing protocols

Among all these categories we will be focusing on Hierarchical Routing Protocol.

## II. STUDY OF HIERARCHICAL ROUTING PROTOCOLS

Hierarchical routing as the name suggests, class of routing techniques crates a virtual hierarchy among the nodes of sensor networks and this hierarchy may be based on division of entire network so called zones, node functionality or location of nodes. In other words wireless sensor networks are usually divided into several clusters. Each cluster consists of a cluster heads(CH) and a number of node members of each cluster. Multiple cluster heads form the network at higher-level. In the higher-level network, wireless sensor networks can be divided into clusters, which form a higher level of network again until highest level sink node. Hierarchical routing protocol has become the focus of the routing technique with the advantages of convenient topology management, high-efficiency energy use, and simple data fusion[2], so as to be designed to make maximum use of hierarchy patterns.

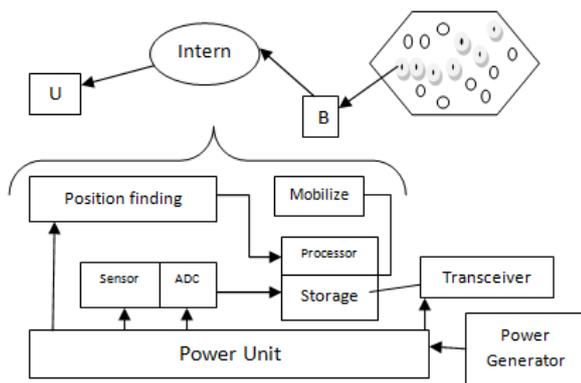


Fig 4

### A. LEACH

LEACH (Low-Energy Adaptive Clustering Hierarchy) [3] is the first hierarchical protocol of wireless sensor networks based on data fusion or a simple clustering mechanism by which energy can be conserved since cluster heads are being used for data transmission. LEACH plays an

important role in routing protocol of wireless sensor networks, other cluster-based routing protocols such as LEACH-C, TEEN, APTEEN, PEGASIS, ATCEEC are largely evolved by the LEACH. In order to balance the energy load of the network, the idea is cluster head node generated by randomize rotation so as all nodes takes on collective responsibility in order not to drain the battery of single node (optimally 5% of total nodes considered for CH), and reduces energy consumption and prolongs network lifetime. These selected cluster heads serves as routers to the data sink A cycle LEACH operation is a "Round", each one round contains the set-up phase and steady phase. During the set-up phase of current round, cluster head generated randomly, the random number is selected in a range between 0 and 1 in each sensor node, if the number selected is less than threshold  $T(n)$ , then the node is select as the cluster head. Formulae of  $T(n)$  as follows:

$$T(n) = \frac{p}{1 - p * (r \bmod 1/p)} \quad \text{if } n \in G$$

Where,  $p$  is the percentage of the number of cluster head and the total number of nodes in network,  $r$  is the current round number,  $G$  is the cluster node set except cluster head of the last  $1/p$  rounds. Then, the cluster head node broadcasts the message of it becoming cluster head, based on the strength of information received each node of networks decides to join which cluster, and respond to the corresponding cluster head. Then in the next phase, each node uses the method TDMA to transmit data to the cluster head node, the cluster head aggregates the data received from nodes of cluster and send all data to the sink node. Between the clusters, each cluster competes communication channel with CDMA protocol. After a period of steady phase, the network enters the next round of cluster head selection again. The method of cluster head selected randomly avoids excessive consumption of energy, improves the network lifetime, data fusion reduce the traffic effectively, but the protocol still uses the hop communication, although the transmission delay is small, nodes require a high power communications, expansion is poor, it is not suitable for large-scale networks; even in smaller networks, the nodes farther away from the sink node communicating with each other in high power can lead to a shorter survival time; frequent selecting cluster head will lead to the traffic costing of energy[12]. To conclude LEACH have properties like Dynamic clustering for increasing lifetime, single hop routing from node to CH, Distributiveness with additional overhead of CH calculations leads to energy inefficiency.

### 1) LEACH-C

It is an extension to the LEACH protocol and is known as LEACH-centralized which improves the performance of the previous one. It also works in rounds and instead of randomly selection of CH in each round, the sink or Base station (BS) in LEACH-C performs the centralized algorithm. In this sink collects the location of all nodes and elect CHs based on energy level of a node and its distance from BS and inform back to all nodes about which node will act as CH. Another advantage is it guaranteed required no of cluster heads will be created and distributed evenly among the nodes in the network and appropriate cluster

sizes can be formed, hence reduces energy dissipation. But here Every node may not get a chance to become CH, as same node might becomes CH for the next rounds as BS uses centralized algorithm. In this Life time of network will be more compared to LEACH. Start up energy dissipation and Data signals received at BS will be more compared to that of LEACH, but total energy dissipation will be less as compared.

As LEACH follows probabilistic method of selection, uneven distribution of cluster heads may be possible sometimes which leads to sudden increase in energy dissipation. The performance of LEACH i.e network life time is better than LEACH-C only when uniformly distributed clustered network is formed and it does not assure about desired number of cluster heads and consideration of overall network parameters like residual energy of every sensor node in the network etc., while making decisions about clustering.[13]

LEACH-C, on the other hand, can be chosen when centralized and deterministic approach for clustering is required, where as other advantages are mentioned above But, disadvantage of LEACH-C is that it increases overhead on BS . hence we can say LEACH-C proposes transmission of location awareness and energy levels by each sensor node to base station and sensor nodes with energy level above predetermined threshold are chosen to become cluster heads by base station itself[13].

### B. PEGASIS(Power-Efficient Gathering in Sensor Information Systems)

#### 1) PEGASIS

PEGASIS protocol (Power-Efficient Gathering in Sensor In-formation Systems) [4] is established based on the LEACH routing protocol, uses dynamic select the cluster head. As in this instead of cluster chain has been formed and each node can receive and transmit data with neighbors only which avoids communication consumption. Using the greedy algorithm (as each node knows the location of other nodes, find the closest neighbor nodes to send and receive data), each node becomes chain head in turn. All data collected by the chain head is transmitted to the sink node after aggregation, then a new round of selection and transmission is begun over again. Figure, any node R was selected as the chain head using greedy approach broadcasts chain head flag to the around nodes, node P receives the chain head flag and sends data to the node Q; Node Q aggregates the data of node P and its own data generated, sends the data to the chain head; Similarly others nodes also complete the procedure with other neighboring nodes. After Node R receives the data of two neighbors , Integrates the collected data and its own data, and sends the data to sink node ultimately.

The protocol avoids the communication cost caused by LEACH protocol effectively, reduce the number of data transmission and communication volume through the chain of data aggregation; nodes use the mode of low power, only communicate with the nearest neighbor, use energy efficiently, and improve the network lifetime[paper name]. But the selection of chain head of single-chain to be the key, and its failure will lead to efficiency failure, all nodes

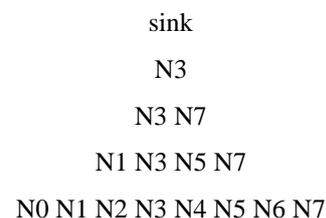
need to have the ability to communicate with the sink node, if chain is too long, the data transmission delay will increase, hence not suitable for real-time applications. Here nodes also need to know the location of other nodes, which costs energy usage.



Data transmission along chain

#### 2) Layered PEGASIS

Layered PEGASIS protocol[5] is an extension of PEGASIS, mainly solves the problem of whose delay is too much in data transmission caused by long chain. Two methods used for avoiding node conflict and data interference. One method is combination of signal coding, such as CDMA and second method is only part in which nodes are allowed to transmit data in the same time. The nodes construct a layered transmission node tree, select a upper story node to communicate in each layer to achieve parallel transmission of data and reduce delay[12]. As Shown in Figure, N3 is cluster head selected in the chain, it will Integrate and transmit all the data to sink node. So it is the top level, number of layers is begin from 0. Transmission, each node sends its information to the right neighbor node, the node who receives the information sends the data to the right after integration, when it reaches the second layer, leaving only the N3 and N7, the N3 is a cluster head, N7 should send data to N3, finally to the sink node[12].



Data transmission along chain in Layered PEGASIS protocol

Above said details shows that this protocol differs from Leach as it uses multihop routing and one node is selected to transmit data to sink. Hence reduction in overhead due to dynamic clustering, and reduction occurs when i) due to transmission distance of non leader nodes are minimized, ii)one transmission to sink after aggregating, iii)Number of transmission between nodes reduced leads to energy efficiency.

### C. TEEN and APTEEN

#### 1) TEEN

TEEN protocol (Threshold sensitive energy Efficient sensor Network protocol)[6] uses clustering algorithm similar to the LEACH, but the TEEN is reactive type routing protocols for wireless sensor networks. In this clusters are formed at different levels and elected Cluster Heads communicate between each other and data sink. This protocol is designed to for sudden change in sensor attribute with data centric mechanism.

During the establishing phase of cluster, CH in TEEN protocol broadcast two thresholds data or parameter to all nodes known as hard and soft threshold, reduces the amount of data transmission through the one possible way of filter. The hard threshold is the minimum possible value of attribute based on which node will be transmitting data to sink or BS. In this if the value sensed by node is greater than the threshold than only data will be transmitted to cluster head hence enabling the network to handle relevant data only. The soft threshold value specifies the change value of data detected. After monitoring the hard threshold the first time nodes send data to the cluster head, and sets new hard threshold. Then during next sensing, the sensed value will be checked for hard threshold and then node checks if the difference in the current and previous value is more than the soft threshold, only then new value is transmitted. The protocol reduces the amount of data transfer significantly, which can monitor a number of unexpected events, but the threshold prevent from some data, not suitable for the application where periodic sensing is required.

## 2) APTEEN

APTEEN protocol(the adaptive Threshold sensitive Energy Efficient sensor Network protocol)[7] is the extension protocol of the TEEN protocol, which aims response to time critical events and capturing of periodic data. Protocol adjust the parameters issued by the cluster head, which can change related parameters according to the needs of users or the use of type, including a set of physical attributes expressed that users expect to get; hard and soft threshold; operation mode (TDMA); counting time (CT), the most time period represented successful data transmission of a node[paper name]. APTEEN handles data query of three types: i)historical ii)one time iii)persistent hence give advantage over TEEN.

## D. TTDD

TTDD protocol(Two Tier Data Dissemination)[8] is applicable to multi-sink node and the sink node moving in the network. When multiple nodes detect events, a source node is selected among other nodes to send data. The source node set itself as a cross-point of grid to construct a Grid network[paper name], Here the source node calculates the location of adjacent cross-point, using greedy technique requests for closest node to become a new cross-point, the new intersection process continues the request expired or reaching the edge of network. Intersection saves the event and information of the source node. For the purpose of Data query, the sink node use flooding to request the nearest cross-node, then the query request transmitted in the cross-point, and source node receives a query request ultimately, then data will be send back to the sink node. Sink node can continue to move waiting for data, and using agent mechanisms to ensure reliable data transmission. The protocol uses a single path, and extends the network lifetime compared with the Diffusion; but the node must know its location, the node density is high, and the position of the common node can not be moved, and the subnet structure is complex, and the cost of computing and maintenance in Grid is more large[12].

## E. Data Aggregation-Exact and Approximate Algorithm[20]

Here the aim is to develop in-network data processing scheme and good data aggregation scheme for energy efficient sensor networks. It focuses on less packet transmission, reduce redundancy and increasing lifetime.

The protocol uses two different levels of network hierarchy. Backbone routing architecture on which first data aggregation and routing will be created using selection of Local Aggregators nodes(LA). Then Master Aggregator will be selected from the set of LA's to perform the second level of aggregation.

For identifying optimal MAs Inter linear program is developed. Three near-optimal algorithms which serves dual purposes of LA selection and routing to external traffic sink are proposed having different aggregation approach: i) Performing aggregation at optimal network points rather than arbitrary points, ii)Both routing and aggregation carried out simultaneously, iii)No additional over heads due to dynamic clustering and topologies.

Along with the said one other different protocols, HVE-Mobicast, ECPC,DECROP, L-PEDAP are being used based on different aggregation techniques.

In DECROP[14],Distributed and effective cluster routing Protocol, cluster based routing technique having four steps, i)Initialization ii)Distributed cluster forming iii)Data Transmission and iv)Route maintenance. Initialization process a tree network with base station as root, after nodes's neighbor reaches a threshold, it declares itself as cluster head during cluster forming. This technique operates on neighbor node position hence communication overhead can be reduced.

In L-PEDAP[15]Localized-Power Efficient Data Aggregation Protocol, route computation is based on Local minimum Spanning tree and Relative neighborhood graph. Three phases are there; Topology computation, Data gathering and route maintenance. In first phase sparse and energy efficient topology is being calculated then routing tree formed by flooding based tree construction algorithm[15].

## F. EDETA[16]

Energy-Efficient Adaptive Hierarchical and Robust Architecture, Protocol based on two levels, cluster formation and dynamic tree formation. It forms its clusters randomly and recalculates the achieved network structure after certain number of rounds. This protocol supports more than one sink node so as to provide scalability and fault tolerance to some extent. Selection of cluster head is based on random number that must be less than the calculated threshold so as to perform adequate distribution of cluster head population. A node can become cluster head if randomly generated number is lower than calculated threshold and remaining energy must be more than the mean of remaining energy of other possible CHs that are near the node. This protocol is time constrained protocol as duration of its phases that is Initialization phase and normal operation phase are time constrained.

### G. EA-FSR[17]

Energy-Aware Fisheye Routing , Protocol is the advancement of Fisheye State routing in which is table driven implicit hierarchical routing protocol, uses fish eye technique[18] i.e. fish eye captures more details near focal point, hence maintaining accurate distance and best quality path about immediate nodes in variably maintains topology information of each node. FSR uses Dijkstra algorithm on topology table to forward data packets, with may cause selection of same node for transmission which increases energy consumption of selected node and decreases the energy of other nodes causes energy imbalance.

To avoid energy imbalance EA-FSR being used, it uses energy as metric for selecting neighbor node rather than shortest path. The node with more residual energy as compare to all neighboring nodes will be selected for transmission to sink node. Hence this protocol is more useful where successful message delivery and life time is more crucial then timely delivery.

### H. ATCEEC[19]

Application aware Threshold-based Centralized Energy Efficient Clustering, Based on advance central control algorithm where base station selects the Cluster Heads based on any of the metrics like residual energy, average energy, relative distance between base station and nodes. As we know that each previously mentioned protocols have restrictions, some are good in homogeneous environment but efficiency decreases in heterogeneous environment but all those becomes the basis for improved versions. As in ATCEEC based on the fact that a node can sense two different values may be temperature and humidity and enhance efficiency.

Protocol operates in rounds and each round further divided into Network setup phase(NSP) and Network transmission phase. It contain three types of nodes in energy terms as normal, advance and super nodes. Complete network area is divided into three equally spaced rectangular regions; LER-low energy region, MER-Medium energy region and HER-high energy region where normal, advance and super nodes are homogeneously spreaded[19]. Communication phase of the protocol is different from all other, in this each node is responsible to periodically transmit data at defined interval as in proactive technique. In case of drastic variation in any metric or parameter nodes immediately transmit the data to BS via cluster heads. In this protocol data sent to BS is relatively less and hence increases the energy saving alias life time of wireless sensor networks.

## III. COMPARISON OF HIERARCHICAL ROUTING PROTOCOLS

In the present day scenario in which technology is being upgraded day by day the standard traditional network routing protocols available can not meet the challenges of most upcoming and emerging field of Wireless sensor networks. For the purpose, routing protocol of wireless sensor networks throws new features and requirements so that demanding applications needs can be met to serve the humanity. These features are:

- energy priority, because the limitation of node energy, becomes the most important goal in the design of routing protocol to extend the network lifetime.
- data- based, to minimize data transmission, reduce redundancy through data aggregation.
- topology information, to save communication energy, use multi-hop communication. As we know the node can not store large routing tables, so routing mechanism must be simple and efficient enables routing calculation must be as simple as possible.
- scalability, dynamic network topology, routing protocols use distributed operation mode, easy to expand;
- robustness, if there happens node failure due to various causes, routing mechanism must have some fault tolerance;
- for the purpose of fast convergence, routing algorithm must be simple, may able to adapt to the dynamic topology change, reduce communication costs and improve the transmission efficiency;
- security, routing protocol should have good security.

Described above is mainly based on hierarchical routing protocol which relevant to applications and difficulty of wireless sensor, the protocol is difficult to say which is more superior. Based on the performance requirements above, here are the comparison of routing protocols described in the text.

Table 1. Comparison of routing protocols

	Classification	Proactive	Energy conservation	Network life time	Data based	Data aggregation	Multi path	Optimal path	Scalability
LEACH	Hierarchical	yes	Very good	Good	no	Yes	No	No	Good
LEACH-C	Hierarchical	Yes	Very good	Very Good	No	Yes	No	No	Good
PEGASIS	Hierarchical	Yes	Very good	Very Good	yes	Yes	No	No	Good
LAYERED PEGASIS	Hierarchical	Yes	Very good	Very Good	Yes	Yes	No	No	Good
TEEN	Hierarchical	Yes	Good	Very	Yes	Yes	No	No	Good

				Good					
APTEEN	Hierarchical	Yes	Good	Better	Yes	Yes	No	No	Good
TTOD	Hierarchical	Yes	Good	Good	Yes	No	No	No	Common
DCROP	Hierarchical	Yes	Good	Good	Yes	Yes	No	Yes	Good
L-PEDAP	Hierarchical	yes	Good	Good	Yes	yes	No	Yes	Good
EDETA	Hierarchical	no	Very Good	Better	No	Yes	Yes	Yes	Very Good
EA-FSR	Hierarchical	Yes	Good	Very good	Yes	Yes	No		Good
ATCEEC	Hierarchical	Yes	Very Good	Very good	No	Yes	No	No	Good

#### IV. SUMMARY AND CONCLUSION

Above said algorithms give complete inside out of the generalized and some special routing protocols which are based on the key issues for wireless Sensor Networks mainly focused on energy efficiency and life time maximization. In addition to the above said typical algorithms, many researchers are putting consistent effort to develop and propose many improved versions of algorithms. In the problem of high effective and dynamic clustering, it is to consider more effective cluster head selection algorithm and cluster head load balancing algorithm[paper name]. Apart from Energy constraints of cluster head selection, we must also consider the node location, the distance to the base station, mobility and computing power, in the complex and specific application.

In future studies, it is required to solve the problem of QoS for real time applications where each node have to be the part of more than one type of sensed data, video and image data. In Hierarchical routing energy-aware QoS has been required to be focused more and more, it will be applied in real-time tracking goal and other important aspects of applications, which guarantee to meet the stringent requirements of bandwidth and effective use of energy efficient path. Along with this, focus must also be on the development of sensor hardware will also have a significant impact to the routing protocols design. Security is an other important research area to be focused as in real time applications may have sensitive data to be processed.

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ISBN : 978-81-929077-2-7



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