PROCESS SCHEDULING ALGORITHMS: A REVIEW

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ABSTRACT

When the concept of multiprogramming is used in operating system then more than one process resides in computer memory and then it become necessary to decide the order in which that process will be executed for better utilization and throughput of the processor.Processor time is also a resource and it this costlier than other resources and that's why proper attention to paid to use the processor time efficiently. This paper firstly shows that what states a process can have and how process enters from one state to another state. It also describe that what kind of schedulers can be used for selecting the processes. And what kind of scheduling algorithm can be there for better utilization of processor time and in which situation which algorithm is better to use.

Keywords: Operating System, Utilization, Throughput

I. INTRODUCTION

Firstly when operating system came in existence that time single programming concept was used. It means that in main memory at a time only one program can exist and when its execution complete then another program is taken into memory. But with this concept CPU utilization was very low, because if any input/output or interrupt came and process go for input/output that time CPU set ideal. As all know CPU speed is very fast as compare to input/output devices. So for better utilization of processor multiprogramming concept was used. In multiprogramming system more than one program can reside in main memory for execution [1]. But processor can run only one process at a time or can say that only one process will be in running state, other will be in ready and waiting state. When CPU complete one job or CPU is free than a job is to be selected from the ready queue and which job is to be selected it is decided by CPU scheduler.

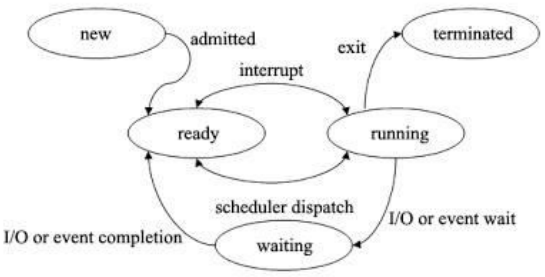


Fig. 1 States of Process

The job of deciding that to which process processor time is allocate is done by the operating system whereas it is system software which manage the all functions of the computer and This type of allocation is called as scheduling. It is a fundamental function of operating system. All computer resources are scheduled before use and processor time is one of them. In other words it can be said that scheduling is a mechanism on basis of that

operating system decides to which process CPU time is allocated next.CPU scheduling is always applied on ready queue and it is done by short term scheduler [2].

II. TYPES OF SCHEDULER

A scheduler is a program which decides that which job is to be selected next. And dispatcher takes that job to the CPU. OS have mainly 3 types of scheduler:

2.1 Long-Term Scheduler

It is also known as job scheduler or high-level scheduler. it is used for selecting the jobs from auxiliary memory and then send to the main memory it can take more time to select the jobs because it's time is not more critical. It selects the jobs which are balanced in CPU and input/output bound. It selects the job from batch queue.

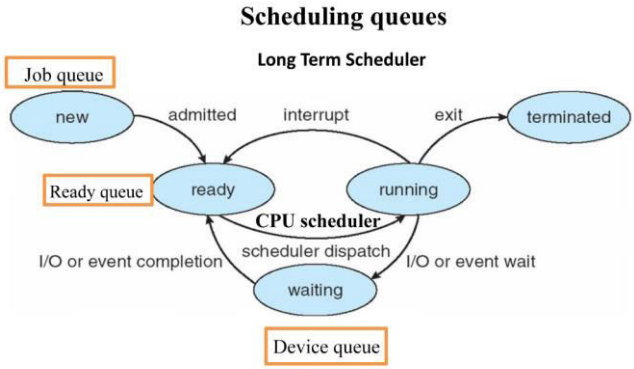


Fig. 2. Long Term Scheduler

2.2 Medium Term Scheduler

When we use multiprogramming concept and sometimes memory become full then some process have to swap out and then again swap in to the memory and started from the last point again or when process go for input/output then also have to remove from the memory and all is done by the medium term scheduler.

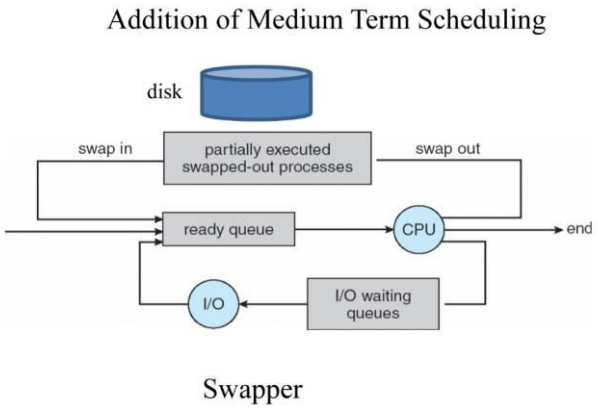


Fig. 3. Medium Term Scheduler

2.3 Short Term Scheduler

It is also known as low level scheduler or CPU scheduler. It is more complex and complicated. It selects the processes from the ready queue. And its main objective is maximizing the CPU utilization. It selects the process from ready queue and allocates CPU to the process.

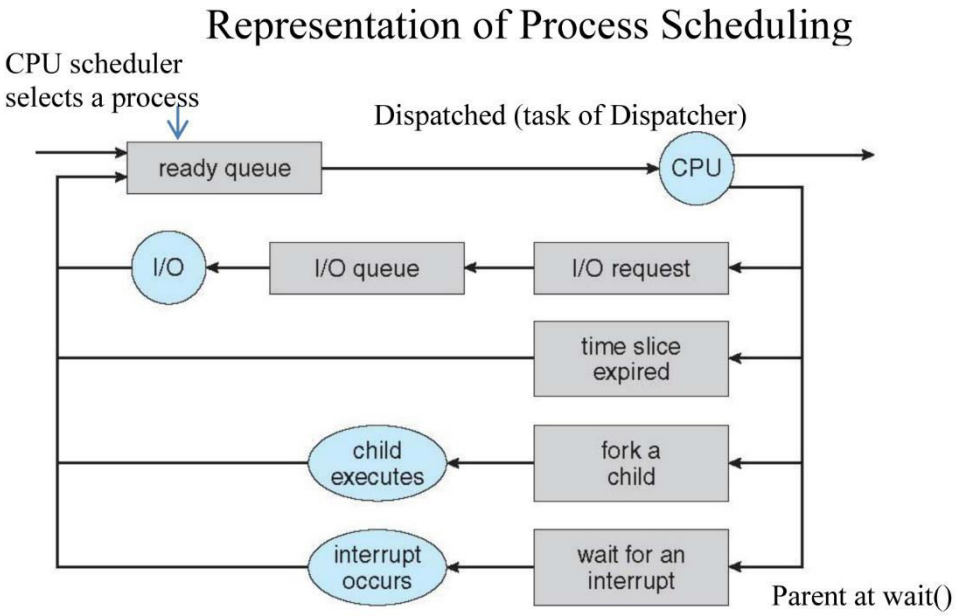


Fig. 4. Short Term Scheduler

III. OBJECTIVES OF SCHEDULING

Its main objective is to maximize the system throughput.

- Be fair to the all users.
- Provide tolerable response or turn-around time.
- Degrade performance gracefully.
- Be consistent and predictable.

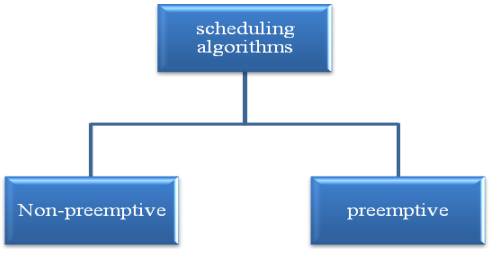
IV. SCHEDULING CRITERIA

There are many CPU scheduling algorithms all have different properties. In which situation which algorithm is to be choosing it's depends upon the situation.

- CPU utilization: CPU should be utilized 100pecent
- Turnaround time: TAT= (process finish time-process arrival time)
- Throughput: should execute maximum jobs in given time
- Waiting time: WT= (TAT-process arrival time)
- Response time: after getting in ready queue when it get the processor time first

V. TYPES OF SCHEDULING

There are basically two type of algorithm:



5.1 Preemptive

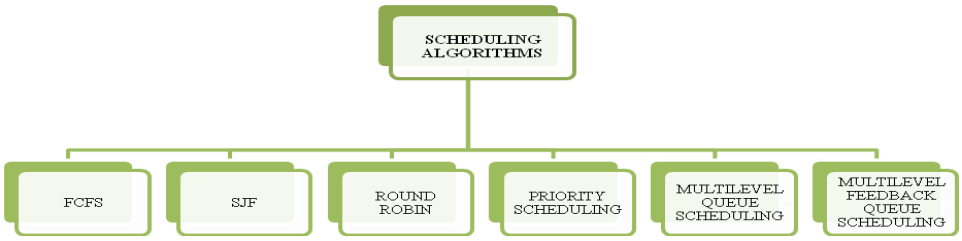
In preemptive scheduling when process is in running state and if it is not completed and any interrupt occurred then it can swap out from the memory and letter can be resumed from the same point. So in preemptive scheduling, scheduling decision can be taken on run time. It proves beneficial where high priority process take more attention. So it is costlier scheduling method but advantageous in deadlock.

5.2 Non-Preemptive

In non-preemptive scheduling process cannot be forced to swap out until it completes it's execution or go for some input/output. In it no preference is given to higher priority process. It treats to the all process fairer but short jobs have to wait for longer jobs to be completed. It is cheaper than preemptive scheduling.

VI. SCHEDULING ALGORITHMS

There are many scheduling algorithms but some are discussed here



6.1 First Come First Served Scheduling

In this scheduling algorithm processor is assigned to the process according to the order in which that process arrived. In this algorithm no preference is given to high priority process and to shortest jobs. It is non-preemptive algorithm. It is also known as first in first out because it uses the FIFO queue. Because of its non-preemptive nature utilization of system is very low and system throughput is also less. It is simplest algorithm and short process has to wait for the completion of long process. Short process have to wait for execution of the long process [6].

Criteria: Arrival time

Mode: Non-preemptive

Example: find out average TAT and WT

Process number	Arrival time	Burst time
1	0	3
2	1	1
3	2	2
4	3	5
5	4	4

Gantt chart:

P1	P2	P3	P4	p5

03 4 6 11 15

Average TAT= (3+3+4+8+11)/5 **average WT=14/5**

=5.8 **=2.8**

Problem of Convey effect:

In FCFS ,if the first process having large Burst time(CPU bound process) then it will have the huge impact on the average waiting time of the remaining process. This effect is called convey effect.

6.2 Shortest-Job-First Scheduling

The basic idea behind this algorithm is that CPU is allocated to the process which has minimum CPU burst time. It is more beneficial over the first come first serve scheduling because in it short jobs does not have to wait for the long jobs. So it reduced the average waiting time of process [3]. CPUthroughput increases because more jobs can be executed in a given time. Main idea behind SJF is that if CPU is free it is allocated to the process having small burst time and if two processes have same burst time then first come first served technique is applied. The shorter the job, the better service it will provide. It is optimal algorithm among the all algorithm because of less average waiting time. But main disadvantage of this algorithm is that CPU burst time should be predicted in advance before running the process. So it proves beneficial in long-term-scheduling.

Types of SJF

Preemptive SJF

Non-preemptive SJF/ Shortest remaining time first

Example: find out average TAT and WT with SRTF

Process number	**Arrival time**	**Burst time**
1	0	8
2	1	4
3	2	9
4	3	5

Gantt chart:

P1	P2	P4	P1	P3

0 1 5 10 17

Average TAT= (10+4+24+7)/4 **average WT=26/4**

=12.7 **=6.5**

Problem of Aging

This problem occur in SRTF because long jobs have to wait for short jobs and if short jobs keep coming then long jobs keep waiting for forever.

6.3 Round Robin Scheduling

In round robin scheduling queue is arranged same like preemptive FCFS. Because jobs are serviced on the basis of first come first served but a limited time is assigned for each job and it is called time slice or time quantum. If process does not complete its job before CPU time expires, the CPU is preempted and it is allocated to the next waiting process. And if any input/output occur then also another process is scheduled to run. The preempted process is then placed at the back of ready queue[4]. Round robin scheduling is effective in time-sharing environments in which the system needs to guarantee reasonable response times for interactive users. But one attention should be pay here that is size of time quantum. Time quantum should be not too short as it increase

the number of context switching and CPU throughput will be decreased and should not be too long as it become FCFS.

Criteria: time quantum/time slice, arrival time

Mode: preemptive

Example: find out average waiting time and average TAT

Process number	Burst time
1	30
2	6
3	8

Gantt Chart:

p1	p2	p3	p1	p2	p3	p1	p1	p1	p1

0 5 10 15 20 21 24 29 34 39 44

AWT=(14+15+16)/ 3average TAT= (44+21+24)/3

= 45/3 **=89/3**

=15 **=29.66**

6.4 Priority Scheduling

In this algorithm a priority is associated with each process and processor is allocated to the process with highest priority. If two processes have equal priority then that are scheduled according to FCFS. Priority can be defined in two ways that is internally and externally. Internal priority are defined by some measurable by some quantities like time limits, memory requirement and the number of open files. And criteria for external priorities are external to the operating system that is based on the type of process, importance of process, run time of the process etc. if we are using non-preemptive priority scheduling then if new process arrives then CPU compares it with running process and if running process has less priority then processor time is preempted from the running process and it is given to newly arrived process.

Type of priority scheduling

Preemptive

Non-preemptive

Example: Find out average waiting time and average TAT with preemptive priority scheduling

Process number	Arrival time	Next burst	priority
1	0	10	5
2	1	6	4
3	3	2	2
4	5	4	0

Gantt Chart:

P0	P3	P2	P1

0 10 14 16 22

AWT= (0+15+11+5)/ 4 **average TAT=(10+21+13+9)/4**

= 31/4 **=53/4**

=7.75 **=13.25**

Problem with Priority Scheduling

In preemptive priority scheduling a problem can be occurred that is if higher priority processes keep coming then lower priority process will never get a chance to run and it will go in indefinite blocking state and it is also called starvation. And waiting time for equal priority processes also increase in it[5]. So handling this problem a mechanism is used that is called aging in this technique if a process does not get its chance then its priority is increased after sometime.

6.5 Multilevel Queue Scheduling

When processes are divided into the group and are executed in that groups differently then multilevel queue scheduling is applicable. For example there can be of two kinds of processes on the basis of their response time requirements, scheduling needs and priorities that is interactive processes and batch processes. This algorithm partitions the ready queue into different queues. And processes are assigned to different queues according to their requirement and that are assigned permanently to the queue. And there will be different scheduling algorithm for each queue that is one is using SJF and another is using FCFS and there will be scheduling algorithm between the queues also. Usually priority scheduling algorithm is used in it. But there can be different ways to manage the queues.

Advantages

In multilevel queue scheduling process are assign in the queue when the entry of new job occur in the ready state according to the nature of the job.

Problem with this Algorithm

In Multilevel scheduling problem of starvation can be occurred because in it mostly priority algorithm is used between the queues. And if higher priority queue keep coming then lower priority job will not get chance.

6.6 Multilevel Queue with Feedback Scheduling

Multilevel queue with feedback scheduling is extension of multilevel queue scheduling. But the basic idea behind it is that process are divided into the groups but like multilevel queue scheduling that are not put permanently in one queue . That process can be moved during execution from one queue to another queue. In it same like multilevel queue scheduling at the time of entry processes are divided into the queue according to their requirement and characteristics but queues are flexible in this algorithm.

Advantages

It is flexible algorithm.

In this algorithm aging technique can be applied

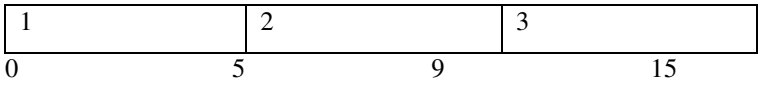
Disadvantages

It is very complex algorithm and special scheduler is required.

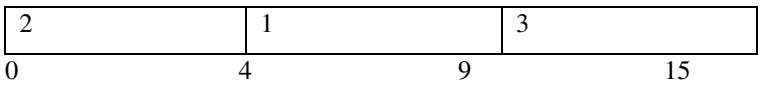
Turnaround and average turnaround time for each scheduling algorithm

Process number	Burst time	priority
1	5	3
2	4	2
3	6	1

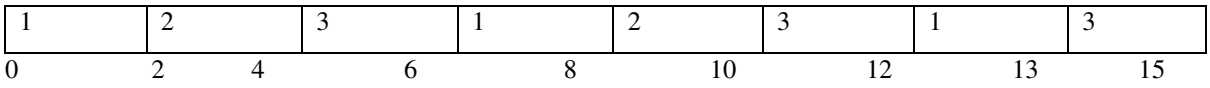
Gantt chart for FCFS:



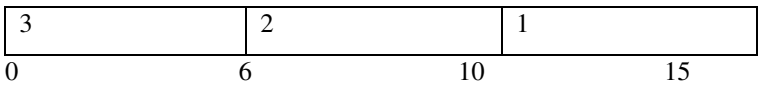
Gantt chart for SJF:



Gantt chart for round robin with time quantum 2 ms:



Gantt chart for priority scheduling:



Turnaround time of all algorithms in table

Process number	**Turnaround time**			
	FCFS	**SJF**	**RR**	**Priority scheduling**
1	5	9	13	15
2	9	4	10	10
3	15	15	15	6
Average TAT	9.67	9.33	12.67	10.33

Waiting time of all algorithms in table

Process number	**Waiting Time**			
	FCFS	**SJF**	**RR**	**Priority scheduling**
1	0	4	8	10
2	5	0	6	6
3	9	9	11	0
Average Waiting time	4.67	4.33	8.33	5.33

VII. CONCLUSION

All CPU scheduling algorithms have some advantages or disadvantages,like FCFS have long average waiting time but fairer for all jobs that every job will get its chance. Shortest job first is also known as optimal algorithm because it decrease the average waiting time but it increase waiting time for long jobs and sometime long process never being served and starvation problem occur. same like priority scheduling give chance to the process which are more important on the basis of some criteria but low priority process never being served and round robin algorithm is better for timesharing and interactive applications but have to take care about time quantum if it is too short then CPU throughput will be decrease and if it istoo long then it became FCFS algorithm. We ourself,cannot do any kind of prediction about the algorithm it actually can be tested on operating system in real time or in real situations.

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DESIGN OF FRACTAL ANTENNA USING CIRCULAR PATCH FOR MULTIBAND

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ABSTRACT

This paper presents a novel on design of fractal antenna for multiband using circular patch. In this design sierpinski gasket geometry is used. Sierpinski gasket geometry uses triangle. Fractal antenna allows smaller size, broadband and multiband performance. This antenna is designed using IE3D software on FR4 substrate having dielectric constant 4.4 and having fed 50 ohms micro-strip line and optimized to operate in multiple bands between 0 – 10GHz.

Keywords: Fractal Antenna, Sierpinski Gasket, Circular Patch, Microstrip Feed Line

I. INTRODUCTION

In modern wireless communication systems and increasing of other wireless applications, wider bandwidth, multiband and low profile antennas are in great demand for both commercial and military applications. Traditionally, each antenna operates at a single or dual frequency bands, where different antenna is needed for different applications. This will cause a limited space and place problem. In order to overcome this problem, multiband antenna can be used where a single antenna can operate at many frequency bands. The combination of infinite complexity and detail and self-similarity makes it possible to design antennas with very wideband performances. One technique to construct a multiband antenna is by applying fractal shape into antenna geometry. Fractal is a concept extension to the microstrip antenna. In many fractal antennas, the self-affinity and space-filling nature of fractal geometries are often quantitatively linked to its frequency characteristics. Fractals are geometrical structures, which are self-similar, repeating at regular intervals of time. The geometry of fractals is significant because the physical length of the fractal antennas can be enlarged while keeping the total area same.

II. FRACTAL ANTENNA

Fractal was first invented by Benoit Mandelbrot [1], and he is known as the predecessor of fractal geometry. He stated, “I devised fractal from the Latin adjective”.Fractal antenna theory is a relatively new area. The geometry of the fractal antenna provides an attractive multi-band solution. Mandelbrot offered the following definition “A fractal is by definition a set for which the hausdorff dimension strictly exceeds the topological dimension”, which the later retracted and replaced with: - “A fractal is a shape made of parts similar to the whole in some way”[2]. Fractals are geometrical shapes, which are self-similar, repeating themselves at different scales.

Fractal offers several advantages such as-

1. Multiband performance is at non-harmonic frequencies.

2. Compressed resonant behaviour.
3. In many cases, the use of fractal element antennas can simplify circuit design.
4. Reduced construction costs.
5. Improved reliability.

Features of fractal are as shown below.

1. Self-similarity feature is useful in designing multiband antenna
2. Small dimension is essentially useful in the design of electric small antennas
3. Increasing the number of iterations enhances the electrical length of an antenna
4. Space filling ability is necessary to miniaturize the antenna size

Disadvantages of fractal antenna

1. They have low gain
2. We have to take care of numerical limitation.
3. Geometry of the antenna is complex.
4. Practically few iterations are possible.

Fractals have no size characteristics and it has self- similarity property. There are some unique geometries which are useful in developing new and innovative design for antennas. These geometries are sierpinski gasket, sierpinskicarpet ,Koch curves. In this paper sierpinski gasket is designed using circular patch. The Sierpinski triangle, also called the Sierpinski gasket or the Sierpinski Sieve, is a fractal named after the Polish mathematician WaclawSierpinski who described it in year 1916 [3]. Sierpinski gasket geometry is the most widely studied fractal geometry for antenna applications. Sierpinski gaskets have been investigated extensively for monopole and dipole antenna configurations [4]. Several structures are derived from the original Sierpinski fractal structure and analyzed in order to get better multi-band behaviour. The generation of this geometry is explained in two ways:

- The multiple copy approach
- Decomposition approach

It starts with small equilateral triangle. Two more copies of this triangle (same size) are generated and attached to the original triangle. This process can be done n number of times, n being the order of the fractal iteration. In the decomposition approach, one starts with a large triangle encompassing the entire geometry. The midpoints of the sides are joined together, and a hollow space in the middle is created. This process divides the original triangle to three scaled down (half sized) versions of the larger triangle[5].

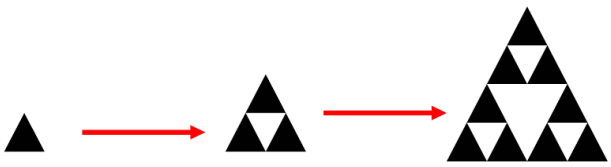

Fig No.1 Multiple Copy Approach

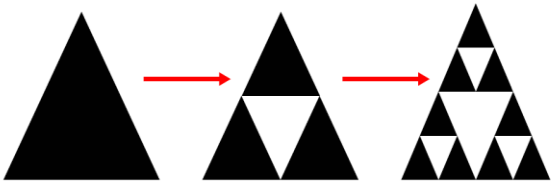

Fig No. 2 Decomposition Approach

III. ANTENNA DESIGN

In this paper sierpinski gasket geometry is used with circular monopole antenna . In this paper decomposition approach is used. But two circles are used with radius R_1= 26mm, R_2= 25mm, h= 1.6mm, ϵ_r= 4.4 and loss tangent= 0.019 with ground plane L_g x W_g = 54mm x 16 mm. The width of the micro strip feed line is calculated and optimized to achieve 50 Ω impedance match. In this paper one large triangle is constructed inside the circle. After that midpoints of the sides of the triangle are joined together and hollow space in the middle is created. This process divides the large triangle into three scaled down version and then three circles are constructed inside that large triangle.

Table No.1 Antenna Configuration

Size of first triangle	50x48 mm
Size of second triangle	25x24mm
Diameter of the circle	8mm

The proposed antenna structure is as shown in the figure below.

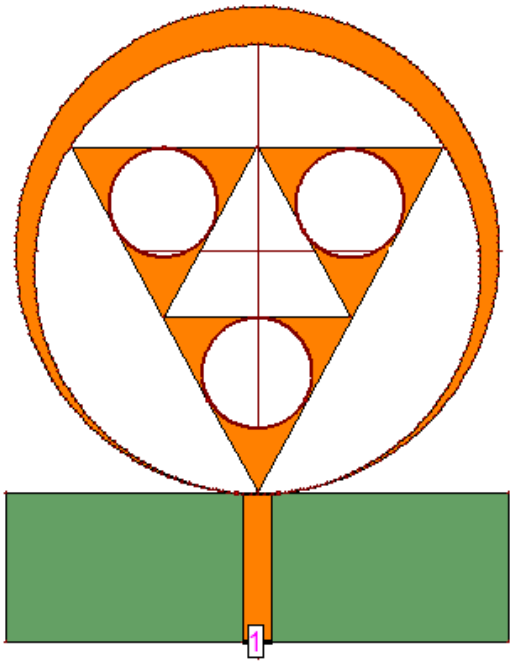

Fig No.3 Schematic of Proposed Sierpinski Gasket Antenna

IV. SIMULATION RESULTS

S11 gives reflection coefficient. The return loss is defined as loss of power in the signal reflected by discontinuity in the transmission line. This transfers happens only when characteristic impedance is matched with input impedance of antenna otherwise reflected waves are generated which results in the degraded performance of an antenna. Ideally reflected waves must be zero.Figure 3 shows the S11 parameter of proposed antenna design. Table no.2 of frequency band is as shown below.

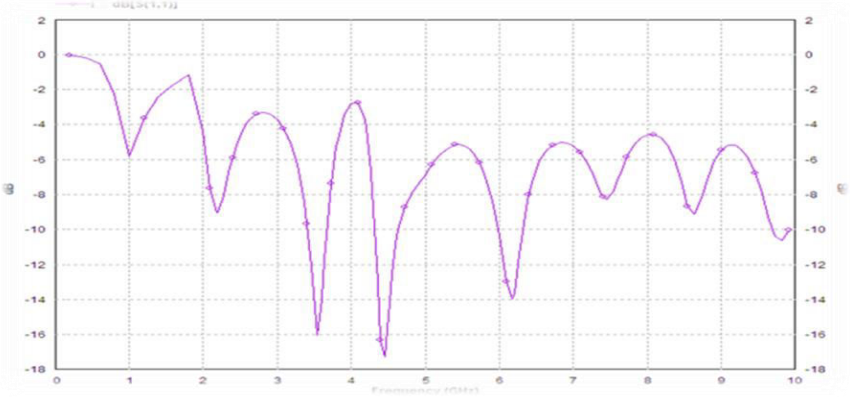

Fig.No. 3 S11 Parameter of Sierpinski Gasket Antenna

Table No. 2 Frequency Band of Proposed Antenna

First band	2.1-2.4 GHZ
Second band	3.3-3.6 GHZ
Third band	4.3-4.6 GHZ
Fourth band	6- 6.3 GHZ
Fifth band	7.3 GHZ
Sixth band	8.4 GHZ

V. CONCLUSION

Fractal antenna with a circular patch using micro strip line for multiband is designed in IE3D and fabricated on FR4. From the simulation results proposed antenna resonates at frequency band 2.1-2.4 GHZ, 3.3-3.6 GHZ and 4.3-4.6 GHZ, 6-6.3 GHZ, 7.3 GHZ, 8.4 GHZ. Sierpinski Gasket geometrical structures have been investigated for multiband applications. By increasing the radius of the patch , ground plane length and width the frequency shifts to the lower side.

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A STUDY OF FACTORS AFFECTING CUSTOMER SATISFACTION LEVELSOF NATIONALIZED BANKSIN MUMBAI

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ABSTRACT

The Indian banking industry has made great stridessince nationalization in 1969.The expertise of nationalized banks lies in servicing big volumes of customers. Manual processes were the order of the day and often resulted in lack of efficiency, non-existent customer relationship and bureaucracy in operations. The second push came in 1991 with globalization and liberalization. The committee headed by M.Narasimham (1993)suggested banking reforms which were far sighted. These measures saw the geography and history of Indian banking change like never before. International best practices and cutting edge technology came with the advent of multinational banks and foreign direct investment in banking.

The customer suddenly became an important person in the bank premises. Indian banks realized their survival would depend on managing change. The reform process needed a robust Central bank with futuristic outlook. RBI provided the power push. Acceptance of change came at all levels, from top management to employees. Even the global meltdown in 2008 could make no impact on the industry, which has recorded exponential growth for the past two decades.

This study attempts to assess customer satisfaction levels among customers of Indian banks. The results are based on structured questionnaire administered to customers of nationalized banks. It uses the opinion of experts to supplement the primary research.

Keywords: Indian Banking, Customer Satisfaction

I. INTRODUCTION

Customer satisfaction is the degree of satisfaction provided by the goods or services of a company as measured by the number of repeat customers. Bolton & Drew (1991)" customer satisfaction is the post purchase evaluation of a service offering. According to Anton (1996) " Customer satisfaction " is a state of mind in which the customer's needs, wants and expectations throughout the product or service life have been met or exceeded, resulting in future repurchase and loyalty" According to Philip Kotler " poor service and product range are a great reason of the churn of customer. The right product offering and communication have a positive impact on satisfaction. The study of a Danish bank which display its products on shelves as though they were physical merchandize is noteworthy. Creating loyal customers requires creating a reward & loyalty program. It may be for the size of the bank account, and also for being the ambassador of the bank in terms of referrals, customer

like to be treated fairly and impartially. They like to use amenities like parking space, token system, comfortable seating, and sometimes a simple acknowledgement of their presence in the premises by the employee.

Banks try to educate their customer on the use of ATM, internet & phone banking. It is a double edged sword as customer tends to move away to either better service providers or those who use combination of technology& interaction more effectively.

Modern customer looks out for high value in varied and often complex services. The advancements have triggered mammoth growth in every sphere of banking. Banking in India is evolving everyday. The trends in banking in recent times are more than pure e-commerce models which were seen as an alternative to traditional banking.

II. LITERATURE REVIEW

Rhett W, Walker & Lester W. Johnson (2005) in a critical examination of existing literature found that banks are employing technology as an alternative to personal interaction in service provision. There was an attempt to find the impact of technology on service provision and the behavioral response of customers. Regular use of technology, however, didn't imply willing or satisfied customer, or that he had some sort of relationship with service provider.(Rhett W. Walker & Lester W. Johnson, Journal of Financial Services Marketing, Sept 2005,10,1; ABI/INFORM complete)

Katariina Maenpaa (2006) found in her study in Finland that three of the consumer clusters do not value service dimension containing experiential factors, but the fourth cluster of youngsters perceived those service dimension as appealing. Young consumers were the biggest cluster, preferred more diversified and even entertaining features.

Rajagopal and Ananya Rajagopal (2007) found that banking is far more evolved in the West, than in India. New practices in financial services, especially banking, help in reaching out to new target customers. It was found that there are increasing returns as banking operation is scaled upwards. Optimizing profits is a consequence of sustained use of new practices.

Castro& Atkinson (2010) found customers have been able to see the benefits of banking& there has been a sharp increase in usage in every sphere of life. It is noteworthy that number of people retiring in Europe, Japan and US will be up from current 243 to 346 per thousand by2030. India also has a forecasted huge retiree population and financial inclusion.

Vinh Sun Chau, Norwich (2000) found that young customers in Norwich U.K. are a focal group for all banks. They have a more positive attitude and behavioral intention towards banking services. Further, it is the positive impact of IBS quality on loyalty and satisfaction of customers.

Al Husseini Salah Zolut (2010) found that new product adoption helps banks to increase current services. It helps to fully utilize their capabilities.

Joshua, A. J. & Koshy, Moli P. (2011) noted that the use of ATMs is most popular, followed by Branch banking, Internet banking and Phone banking in a study conducted in Indian context. Foreign banks have initiated a host of client friendly services, which are well accepted but limited to metros.

III. PROBLEM STATEMENT

India is emerging as a global epicenter of business. The attention is critical as India finds its right place as a developed nation in the next decade. This study is undertaken to trace current customer satisfaction levels in nationalized Indian banks. It seeks to understand the factors that contribute to greater customer satisfaction.

IV. OBJECTIVES

- To understand the current level of customer satisfaction in nationalized banks.
- To identify the factors leading to customer satisfaction in nationalized banks.
- To analyze the growth potential of Nationalized banks in comparison to multinational banks.

V. HYPOTHESIS

- There is no significant relation between technology and customer satisfaction.
- Habit and easiness are the most important factors in banking.

VI. METHODOLOGY

a) TOOLS: Qualitative as well as quantitative method of data collection was used. Analysis was done using structured Questionnaire method to conclude the paper.

b) Sample Size: 140 respondents

c) Sampling Method: Random Sampling

d) Sampling Place: Mumbai, Maharashtra

VII. FINDINGS OF THE RESEARCH

- Majority of the respondents (97%) had an account with a nationalized bank.
- Most of the respondents have more than one bank account More than 70% respondents had an experience of operating an account with a nationalized bank and a private bank at some point of time in their life.
- The respondents who operate current account interacted with their bank on almost a daily basis. However there is shift in branch visit of saving account holders. There is a sharp increase in ATM usage as it is convenient and provides flexibility.
- Convenience and ease of use are the parameters which are of highest importance in the view of the customer. It is the reflection of a growing trend among bankers to provide convenient banking with a 24x7 experience. The hypothesis holds TRUE.
- Online banking is a emerging as a preferred option for youngsters. This response is similar to international studies showing that youngsters' prefer online banking amidst time constraint.
- Low opening balance and no/less quarterly charges were among the top reasons to go for a nationalized bank. Personalized service is not possible due to large volume of clients in nationalized banks. Private banks fare better in terms of being pro-active and client centered.
- Private and transnational banks have greater customization of products and services. The banking experience is one of the many reasons for customers to choose a private bank.

- Aggressive marketing adds to respondent's preference of multinational / private banks. Nationalized banks lack resources and the willingness to change, although they have responded positively to competition in the two decades post liberalization.

VIII. CONCLUSIONS

The study found that respondents most people are happy with ATM and online facility. Turnaround time is also important in business parlance. Private and multinational banks have fared better in many areas due to exposure of best banking practices. However, nationalized banks have turned a new leaf in accepting change and responding to competition after two decades of globalization.

Nationalized banks have huge daily transaction. The volume and quantity of business limits personal intervention. Nationalized banks have been taking care of their customer in a much better way. While resources are deployed better in private banks, there is a change in responsiveness to individual clients in nationalized banks.

Young customers are accepting internet banking and technology as an alternative to brick and mortar location. Banking in India is much evolved owing to the globalization and liberalization of Indian trade.

India is also witnessing a lot of travel and trade abroad. Indian customer is demanding more from nationalized banks. Faster loan disbursement; personalized banking services have become the touch points of quality customer services. Nationalized banks have to realize the personalized and customized products/ services are not limited to multinational/private banks. It leads to greater customer satisfaction.

There is an element of social service and welfare of customers which are important considerations in nationalized banks. Low initial charges and reasonable quarterly maintenance charges are reasons for choosing nationalized banks.

IX. LIMITATION AND SCOPE OF FURTHER RESEARCH

This research is limited to 140 respondents in Mumbai. A broader base of respondents is always desirable. Further research could be conducted on respondents from other metropolitan cities.

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UNDER FREQUENCY LOAD SHEDDING USING ADAPTIVE NEORO FUZZY INFERENCE SYSTEM

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ABSTRACT

In this paper under frequency load shedding method is proposed using adaptive neuro fuzzy inference system. The fuzzy If-then rules govern the functioning of load shedding in different conditions. The system is simulated on fuzzy tools and results are generated. The final result shows a training error equal to 0.0169 which is very close to the tolerance level. Using fuzzy logic control makes the implementation of the system much more practical which is the first & foremost goal.Adaptive Under-Frequency Load Shedding is an accurate method which sheds the right amount of load from the system during instability. Under Frequency Load shedding works when the frequency of the system drops to a value lower than normal.

Keywords: Fuzzy Logic Control, Neural Networks, Training Error, Neuro Fuzzy Inference System

I. INTRODUCTION

1.1 Present Scenario

In today's world there is a great problem of electricity supply meeting the demand of the people thus load has to be shed intentionally in order to reduce burden on the generator end. Intelligent Load shedding helps understanding the problem due to which the load needs to be shed and also gives the exact amount of load to be shed for the proper working of the interconnected systems.There are various technologies proposed for load shedding:

1. Breaker Interlock load shedding
2. Under frequency relay load shedding
3. Programmable logic controller based load shedding, so on and so forth.

1.2 Problem with Conventional Methods of Load Shedding

Problem faced by conventional methods are:

1. There is only one stage of load shedding
2. More load is shed than required
3. Modification to system is costly
4. Slow response time
5. Analysis knowledge is always lost

1.3 Solution Proposed in this Paper

Solution to these problems is an intelligent load shedding method which is proposed in this paper using "NeuroFuzzy Inference System". Technologies utilized in the intelligent load shedding method are:

1. Fuzzy Logic Based System: The if-then rules of fuzzy logic are used. Based.
2. On the rule base the amount of load to be shed is decided.

1.4 Advantages Over Other Systems

Fuzzy logic control is very flexible and the use of adaptive neuro fuzzy logic provides the facility of learning. Here the back propagation algorithm is used which is used to deduce the output. Thus because of fuzzy system the use of other sensors is not important. Fuzzy gives the exact amount load to be shed and the error percentage is very low. The training and testing of data is also possible and the output is given by the trained data.

II. LITERATURE REVIEW

This research paper consist of two important aspect first is automatic under frequency load shedding and other is neuro fuzzy inference system. Power system stability is a very important aspect of power generation, there are various factors on which power system stability depends but here in this research paper we have consider two inputs- (i) Input frequency, (ii) Change in input frequency. Frequency is a continuous changing variable which is a function of the system generation and the supply. Many short circuits, load growth, generation shortages and other faults disturbs the voltage and frequency stabilities of the system. This instability causes the large scale blackouts and done serious damages to the equipment. To prevent such condition certain amount of load is required to be shed so as to keep the frequency in between normal working range.Now the first aspect of our research paper is under frequency load shedding which is defined as the set of controls which results in shedding the load in the power system. To control the frequency drop and maintain the frequency a certain amount of load is shed. Basic principles in the power system operation are frequency and voltage stabilities [1]. So usually under normal condition total generated power is equal to the sum of running load plus all real power losses. Normally load shedding is simply a balance maintaining between demand and generation. In Indian power generation takes place at 50Hz. So to avoid any blackout it is important to maintain the frequency at 50Hz. On the both ends of see-saw there is demand and generation so, when there is a slight increase in demand than generation than there is slight variation in frequency. Now suppose a large portion of generation is removed than there will be large variation of f.0/requency from 50Hz which can cause blackout. Now in these case AUFLS block come into play. So to maintain the balance between demand and generation supply to the AUFLS block is cut till the frequency reaches its normal value. Power system frequency is a continuous changing variable which is a function of generated supply and load demand in the power system. Recently the main challenges of electric power utilities is power system blackouts [2]. Power system blackouts are like chain reaction which runs from one region to other region if they are not controlled. Extreme system disturbances can result in uncontrolled output and isolation of areas causing formation of electrical islands. If such an area is under generated, it will experience a majorreduction in frequency. Unless sufficient generation with ability to increase output is available, the frequency decline will be largely determined by frequency sensitive characteristics of loads [3]. To execute the operation of extended area under frequency load shedding is used. Load shedding scheme is employed to cut-off certain load in order to supply by using the available amount of generation. Under frequency load shedding is a common practice for electric utilities for preventing frequency drop in power

systems following a disturbance [4]. Load shedding schemes can be grouped into three main categories: traditional, semi adaptive and adaptive [5]. Traditional scheme is as its name suggest is simple and used by most utilities. The semi-adaptive method calculates the rate of change of frequency whenever the system reaches a certain threshold frequency. In [6] an adaptive methodology is given for the setting the under frequency based relays, based on the initial rate of change of frequency at the relay. In [7]a method using both frequency and voltage changes is presented. In [8] an adaptive scheme that uses both frequency and the rate of change offrequency measurement to dynamically set under frequency relays is presented.

III. DESIGN ASPECT OF INTELLIGENT LOAD SHEDDING

A. Fuzzy logic based system (main working concept)

Table I. Working Concept

FREQUENCY	PREFERNCES
If frequency is near 47.5 to 49.5	Load needs to be shed according to the frequency range and df/dt

3.1 Input Variables

Frequency and rate of change of frequency (df/dt)

Frequency: (range from 47.5 to 49.5)

Low

Very low

Very extra low

Extra low

rate of change of frequency (-6pu to 6pu)

High positive

High negative

Low positive

Low negative

3.2 Output Variables

The amount of load to be shed i.e. in our case the outputs are as follows:

Small shed

Very small shed

Big shed

Very big shed

3.3 HOW RULES WERE CREATED:

	LOW	V LOW	EXT LOW	VEXT LOW
HN	SSHED	BSHED	BSHED	VBSHED
LN	SSHED	SSHED	BSHED	VBSHED
HP	VSHED	VSHED	SSHED	SSHED
LP	VSHED	VSHED	VSHED	VSSHED

HN means HIGH NEGATIVESSHED means SMALL SHED

LN means LOW NEGATIVEVSSHED means VERY SMALL SHED

HPmeans HIGH POSITIVEBSHED means BIG SHED

LP means LOW POSITIV VBSHED means VERY BIG SHED

Thus 16 rules are formed such that whendf/dt is HN and frequency is low the required amount of shed is (small shed) and so on.

IV. SIMULATION RESULTS

The simulation work is done on the MATLAB fuzzy toolbox. The rule base is defined on the Sugeno with the information of input and output parameters and the learning of the system is done using the ANFIS.

4.1 Various STAGEs in SIMULATION

1.First the input and output parameters are defined.

2. In the second step rules are defined on the Sugeno model.

3. Then by the help of a MATLAB program, simulation of defined rules is done and set of values are generated.

4. These values are utilized to train the system.

1. First stage: defining input and output parameters. First stage of simulation is shown in the Fig1 & Fig2. Here various input and output parameters are defined with their membership functions on FIS.

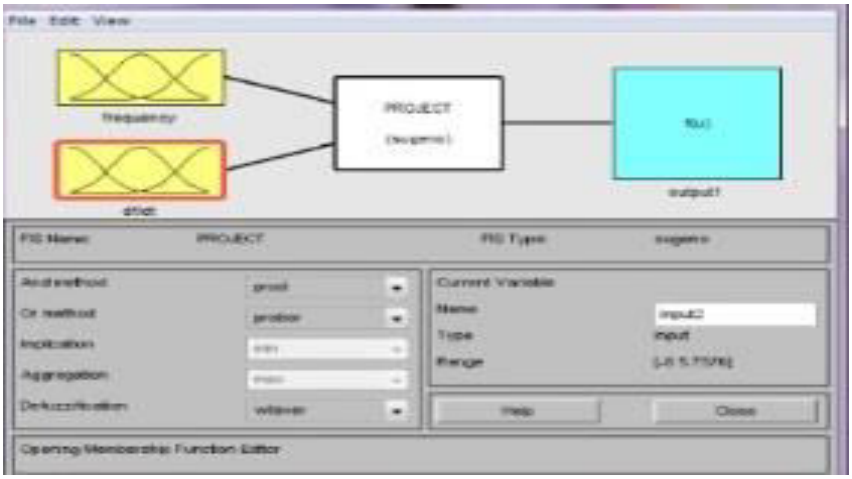

Fig1. Input and Output Parameters

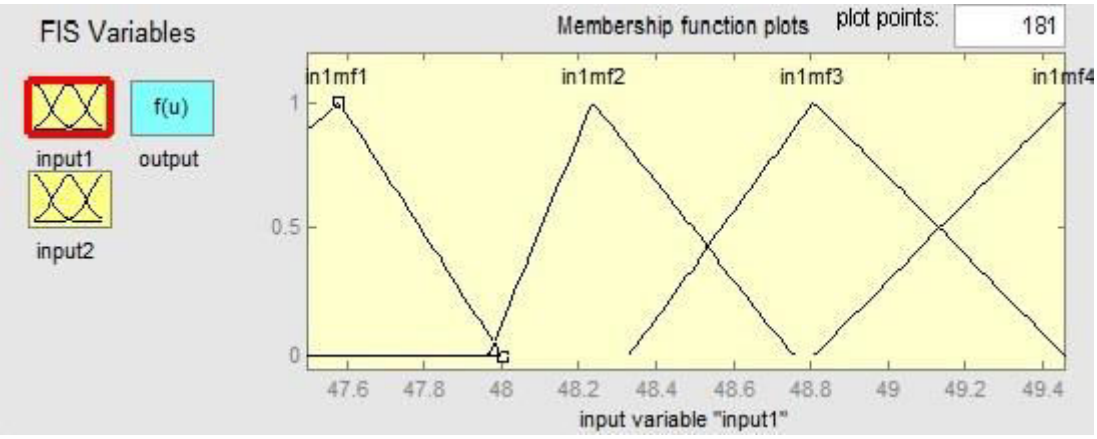

Fig 2. Membership Functions of Input and Output Parameters

2. Second Stage: Defining the rules

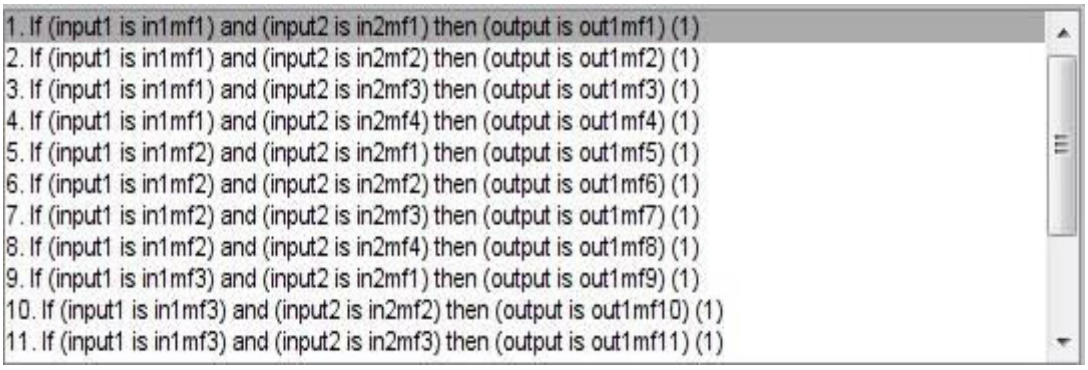

Fig3. Shows the Rule Base Defined on FIS

3. Third Stage: Program simulation on mat lab

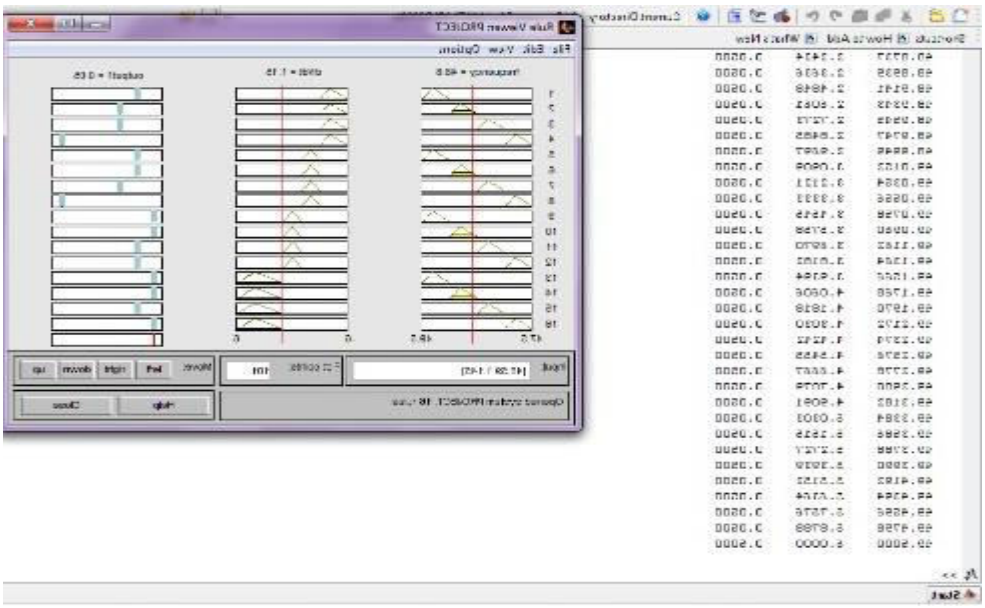

Fig4. Program Simulation Result

4. Fourth stage: Final training &error reduction

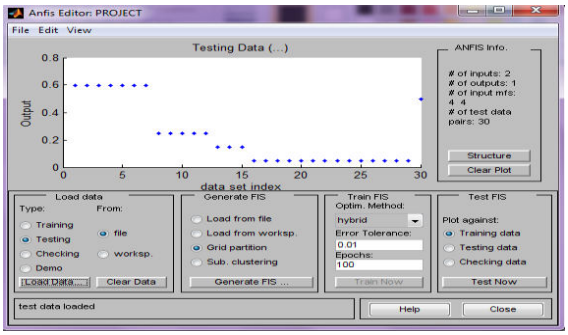

Fig 5. Testing Data

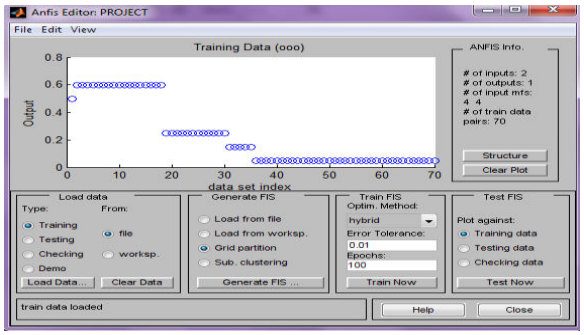

Fig6. Training Data

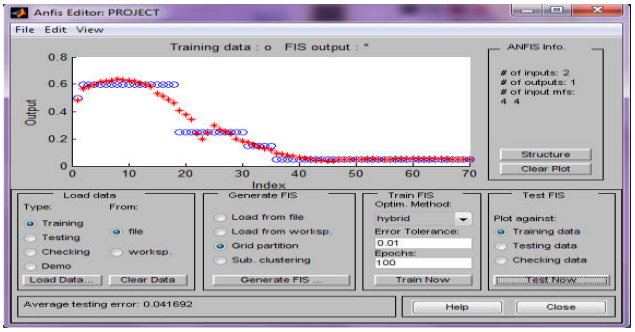

Fig 8. ANFIS info After Training

After testing the following data, comprising of all the information is generated on the MATLAB window:

```
ANFIS info:
    Number of nodes: 53
    Number of linear parameters: 16
    Number of nonlinear parameters: 24
    Total number of parameters: 40
    Number of training data pairs: 70
    Number of checking data pairs: 0
    Number of fuzzy rules: 16


Start training ANFIS ...

    1     0.0416922
    2     0.0418605

Designated epoch number reached --> ANFIS training completed at epoch 2.
```

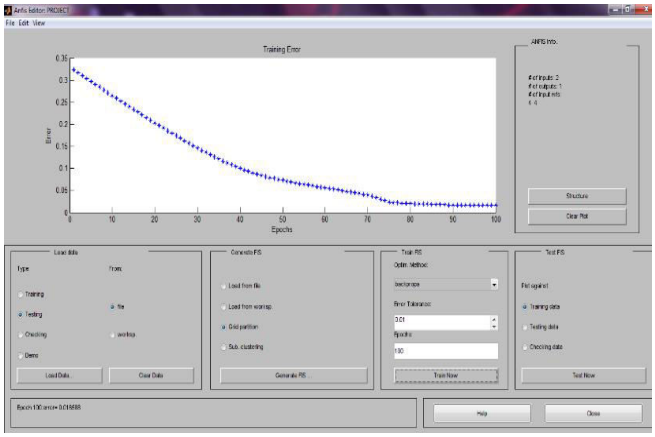

Fig9. Training Error

Figure 9 shows the error generated during the training of the system. The main objective here is to reduce the error by certain modifications such as modifications in rule base or in the generating functions.

Error tolerance: 0.01

Epoch: 100

Error: 0.0169

V. CONCLUSION

India is a highly populated country; frequency variation is the major problem that we are facing today. So due to the shortage of electricity load shedding is very important for proper distribution of power. Now due to the increasing demand of power supply automatic load shedding is important to relieve the loaded instrument before any damage happens to it or tripping of line takes place. So all this can be possible with the help of automatic load shedding. As we can see in our research paper that load shedding can be done by various ways but the most effective way doing it is by using adaptive neuro fuzzy interference system. ANFIS system helps us to digitize the working of a power system. It helps us to understand the change in output with the variation in frequency, so we can easily understand the condition of our system. All this can be impossible with the conventional load shedding methods. Conventional load shedding methods are not that efficient and also a bit slow as compared to ANFIS system.The existing methods such as Breaker inter locking system; Under Frequency Relay Load Shedding and PLC based controllers are used for the load shedding. These methods are time consuming and also shed excess amount of load. Compared to other under frequency load shedding control methods, the ANFIS method shows the advantages like lower value of load shedding, quick response, saving more amounts of energy and benefiting more consumers.

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A FAST CLUSTERING-BASED FEATURE SUBSET SELECTION ALGORITHM

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ABSTRACT

The paper aims at proposing the fast clustering algorithm for eliminating irrelevant and redundant data. Feature selection is applied to reduce the number of features in many applications where data has hundreds or thousands of features. Existing feature selection methods mainly focus on finding relevant features. In this paper, we show that feature relevance alone is insufficient for efficient feature selection of high-dimensional data. We define feature redundancy and propose to perform explicit redundancy analysis in feature selection. A new hypothesis is introduced that dissociate relevance analysis and redundancy analysis. A clustering based method for relevance and redundancy analysis for feature selection is developed and searching based on the selected features will be performed. While the efficiency concerns the time required to find a subset of features, the effectiveness determines the quality of the subset of features. A fast clustering-based feature selection algorithm, FAST, has been selected to be used in the proposed paper. The clustering-based strategy has a higher probability of producing a subset of useful as well as independent features. To ensure the efficiency of FAST, efficient minimum-spanning tree clustering method has been adopted. When compared with FCBF, ReliefF, with respect to the classifier, namely, the tree-based C4.5, FAST not only produces smaller subsets of features but also improves the performances by reducing the time complexity.

Keyterms: Clustering, Feature Subset Selection, Minimum Spanning Tree, T-Relevance, F-Correlation.

I. INTRODUCTION

Data mining uses a variety of techniques to identify lump of information or decision-making knowledge in bodies of data, and extracting them in such a manner that they can be directly use in the areas such as decision support, estimation prediction and forecasting. The data is often huge, but as it is important to have large amount of data because low value data cannot be of direct use; it is the hidden information in the data that is useful. Data mine tools have to infer a model from the database, and in the case of supervised learning this requires the user to define one or more classes. The database contains various attributes that denote a class of tuple and these are known as predicted attributes. Whereas the remaining attributes present in the data sets are called as predicting attributes. A combination of values of these predicted attributes and predicting attributes defines a class. While learning classification rules the system has to find the rules that predict the class from the predicting attributes so initially the user has to define conditions for each class, the data mine system then constructs descriptions for the classes. Basically the system should given a case or tuple with certain known attribute values so that it is able to predict what class this case belongs to, once classes are defined the system should infer rules that govern

the classification therefore the system should be able to find the description of each class [2]. Feature selection involves identifying a subset of the most useful features that produces compatible results as the original entire set of features. A feature selection algorithm is basically evaluated from the efficiency and effectiveness points of view. The time required to find a subset of features is concerned with the efficiency while the effectiveness is related to the quality of the subset of features. Some feature subset selection algorithms can effectively eliminate irrelevant features but fail to handle redundant features yet some of others can remove the irrelevant while taking care of the redundant features. A Fast clustering-based feature selection algorithm (FAST) is proposed which is based on above criterion handling redundancy and irrelevancy. [1] The Minimum Spanning tree (Kruskal's algorithm) is constructed from the F-Correlation value which is used to find correlation between any pair of features. Kruskal's algorithm is a greedy algorithm in graph theory that finds a minimum spanning tree for a connected weighted graph. It finds a subset of the edges that forms a tree that includes every vertex, where the total weight of all the edges in the tree is minimized.

II. EXISTING SYSTEM

Feature subset selection generally focused on searching relevant features while neglecting the redundant features. A good example of such feature selection is Relief, which weighs each feature according to its ability to discriminate instances under different targets based on distance-based criteria function.[9] But, Relief is ineffective in removing redundant features as the two predictive but highly correlated features are likely to be highly weighted. Relief-F [6] is an extension of the traditional Relief. This method enables working with noisy and incomplete data sets and to deal with multi-class problems, but is still ineffective in identifying redundant features. However, along with irrelevant features, redundant features also do affect the speed and accuracy of all the probable learning algorithms, and thus should are also important to be eliminated. FCBF is a fast filter method which can identify relevant features as well as redundancy among relevant features without pair wise correlation analysis. Different from these algorithms, our proposed FAST algorithm employs clustering based method to choose features.

There are different approaches available to perform learning. The wrapper methods make use of predictive accuracy of a predetermined learning algorithm to determine the effectiveness of the selected subsets.[7] The accuracy of the learning algorithms [1] is usually high. The however the generality of the selected features is limited and the computational complexity is very large. Thus the wrapper methods are computationally expensive and tend to over fit on small feature training sets. Wrapper uses a search algorithm for searching through the space of possible features and evaluates individual subset by running a model on the subset. The filter methods [3] are independent of the learning algorithms, and also have good generality. Computational complexity is low, but the accuracy of such learning algorithms is not guaranteed. The hybrid method used in our approach is a combination of filter and wrapper methods, filter method reduces search space of computation that will be considered by the subsequent wrapper.

III. PROPOSED SYSTEM\

The symmetric uncertainty (SU) is derived from the mutual information by normalizing it to the entropies of feature values or feature values and target classes Therefore; symmetric uncertainty is chosen as the measure of correlation between either two features or a feature and the target concept.[8]

The **symmetric uncertainty (SU)** is defined as follows,

$$SU(X,Y) = \frac{2 \times Gain\left(\frac{X}{Y}\right)}{H(X) + H(Y)}$$

Where, $H(X)$ is the entropy of a discrete random variable X. Let (x) be the prior probabilities for all values of X, then (X) is defined by

$$H(X) = -\sum_{x \in X} p(x) \log 2 p(x)$$

Gain (X I Y) determines the amount by which the entropy of Y decreases. It is given by,

$$Gain\ (X|Y) = H(X) - H(X|Y)$$
$$= H(Y) - H(Y|X)$$

Where H(X I Y) is the conditional entropy and is calculated as,

$$H\left(\frac{X}{Y}\right) = -\sum_{y \in Y} p(y) \sum_{x \in X} p(x) \log_2 p(x)$$

Where, X is a Feature and Y is a Class.

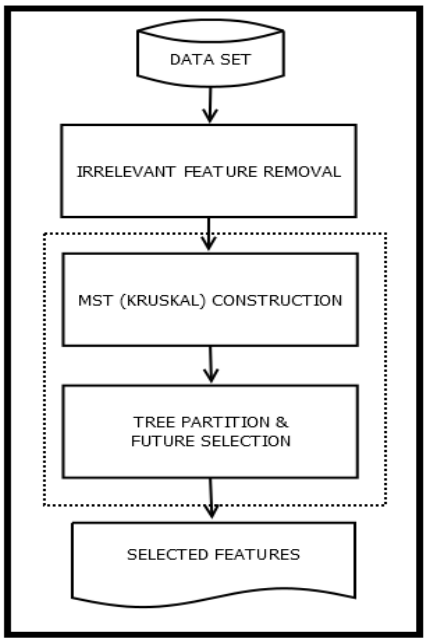

Fig. 3.1: Feature Subset Selection Process

Given that (X, Y)be the symmetric uncertainty of variables X and Y, the relevance T-Relevance between a feature and the target concept C, the correlation F- Correlation between a pair of features, the feature redundancy F-Redundancy and the representative feature R- feature of a feature cluster can be defined as follows.

T-Relevance - The relevance between the feature $F_i \in F$ and the target concept is referred to as the T-Relevance of F_i and C, and denoted by SU (F_i,C). If SU (F_i,C) is greater than a predetermined threshold θ,

Symmetric Uncertainty of each Feature is greater than the T-Relevance threshold(θ) is checked.

$SU(X,Y) > \theta$ *then X is submittedin Feature set S*

Where, $'S'$ is a set of Relevant Features

we say that F_i is a strong T-Relevance feature.

F-Correlation - The correlation between any pair of features and F_j (F_i, $Fj \in F \wedge i \neq j$) is called the F-Correlation of F_i and, and denoted by SU (F_i, F_j).

F-Redundancy - Let S = {F1, F2, F_i, F_k<|F|} be a cluster of features.

If $\exists$ $F_j \in S$, (F_j) $\geq$ SU(F_i, C) $\wedge$ SU (F_i, F_j) >SU (F_i, C) is always corrected for each $Fi \in S (i \neq j)$, then F_i are redundant features with respect to the given F_j (i.e. each F_i is a F-Redundancy).

R-Feature - A feature $F_i \in S$ ={F1, F2, ..., F_k } (k < |F |) is a representative feature of the cluster S (i.e. F_i is a R-Feature) if and only if, F_i = argmax$F_j \in S$ SU (F_j, C).

This means the feature, which has the strongest T Relevance, can act as an R-Feature (Most relevant Feature) for all the features in the cluster.

1) Irrelevant features have no/weak correlation with target concept;

2) Redundant features are assembled in a cluster and a representative feature can be taken out of the cluster. [4]

3.1 MST Construction

With the F-Correlation value computed, the Minimum Spanning tree is constructed. Kruskal"s algorithm is used which forms MST effectively. Kruskal's algorithm is a greedy algorithm in graph theory that finds a minimum spanning tree for a connected weighted graph. This means it finds a subset of the edges that forms a tree that includes every vertex, where the total weight of all the edges in the tree is minimized. If the graph is not connected, then it finds a minimum spanning forest (a minimum spanning tree for each connected component).

Minimum spanning tree using Kruskal's algorithm is constructed and then a threshold value and step size is set. Those edges from the MST, whose lengths are greater than the threshold value are removed. The ratio between the intra-cluster distance and inter-cluster distance is calculated and the ratio as well as the threshold is recorded. The threshold value is updated by incrementing the step size. Every time the new (updated) threshold value is obtained, the above procedure is repeated. When the threshold value is maximum and as such no MST edges can be removed the above procedure is stopped. In such situation, all the data points belong to a single cluster. Finally the minimum value of the recorded ratio is obtained and the clusters are formed corresponding to the stored threshold value.

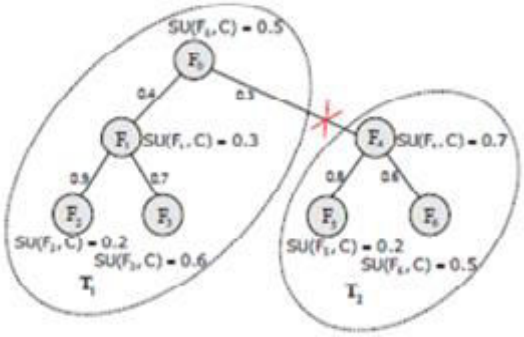

Fig. 3.2: Clustering with MST Construction

1. Create a forest F (a set of trees), where each vertex in the graph is a separate tree.
2. Create a set S containing all the edges in the graph.
3. While S is nonempty and F is not yet spanning.

Remove an edge with minimum weight from S. If that edge connects two different trees, then add it to the forest, combining two trees into a single tree, otherwise discard that edge. At the termination of the algorithm,

the forest forms a minimum spanning forest of the graph. If the graph is connected, the forest has a single component and forms a minimum spanning tree.[1]

IV. PROPOSED ALGORITHM

Features in different clusters are relatively independent; the clustering-based strategy of FAST has a high probability of producing a subset of useful and independent features. To ensure the efficiency of FAST, we adopt the efficient minimum-spanning tree (MST) clustering method.

Algorithm

Inputs: D (F1, F2 … Fm, C) (High Dimensional Dataset).

Output: S-Selected feature subset for searching. [1]

Part 1: Removing irrelevant features:

The features whose SU (Fi,C) values are greater than a predefined threshold(Ø) comprise the target relevant feature subset. Consider feature input dataset (F).

F´= { F_1´,F_2´,…F_k´} (k<=M)

1. for i = 1 to m do

2. T-Relevance = SU (Fi, C)

3. if T-Relevance > θ then

4. S = S ∪ { };

Part 2: Removing redundant features:

The F-correlation SU (Fi´,Fj´) value for each pair of features.

5. G = NULL; //G is a complete graph

6. for each pair of features {F'_i, F'} ⊂ S do

7. F-Correlation = SU (F'_i , F'_j)

8. $F'i$ and/or $F'j$ to with F-Correlation as the weight of the corresponding edge;

9. MinSpanTree = Kruskal's (G); //Using Kruskal's algorithm to generate minimum spanning tree.

Part : Feature selection.

10. Forest = minSpanTree

11. for each edge $E_{i,j}$ ∈ Forest do

12. if SU (F'_i , F'_j) < SU(F'_i ,C) ∧ SU(F'_i , F'_j)< SU(F'_j , C) then

13. Forest = Forest − E_{ij}

14. S = ϕ

15. for each tree T_i ∈ Forest do

16. F_R^j = argmax F_k ∈ SU(F'_k , C)

17. S = S ∪ { F_R^j };

18. Return S.

The algorithm can be expected to be divided into 3 major parts:

1. The first part is concerned with removal of irrelevant features;

2.The second part is used for removing the redundant features and

3. The final part of the algorithm is concerned with feature selection based on the value of the Forest. [1]

Working

4.1 First Step

The data set 'D' with 'm' features F= (F1,F2,…Fm) and class 'C', 'I' compute the T-Relevance '**SU**' (Fi, C) value for every feature $(1 \leq i \leq m)$.

4.2 Second Step

Here the first step is to calculate the *F-Correlation* '***SU***' (F'_i, F'_j) value for each pair of features F'_i and F'_j Then, seeing features F'_i and F'_j as vertices and '***SU***' (F'_i, F'_j) the edge between vertices F'_i and F'_j a weighted complete graph $G= (V,E)$ is constructed which is an undirected graph. The complete graph reflects the correlations among the target-relevant features.[3]

4.3 Third Step

Here, unnecessary edges can be removed. Each tree $T_j \in Forest$ shows a cluster that is denoted as $V(T_j)$, which is the vertex set of T_j . For each cluster $V(T_j)$, select a representative feature whose *T-Relevance* $SU(F_jR, C)$ is the highest. All F_jR $(j = 1...|Forest|)$ consist of the final feature subset $\cup F_jR$.

A clustering tree depending on the domain that the admin selects while uploading the file is created. Proposed system then stores the file in the cluster by using the minimum spanning tree method (MST). While in the searching domain; user passes the query and the results are generated in the required format. i.e. either image result, text result or a file result along with the time complexity. FAST algorithm reduces the run time complexity as compared to the other available Algorithms. It removes the redundant features by calculating the Correlations among the various features. F-correlation is calculated as SU (Fi, Fj).

A threshold value (θ) is defined to calculate the relevance among the selected features. If any feature exceeds a particular threshold value then that feature is treated as irrelevant.

F´= { F1´,F2´,…Fk´} (k<=M) [1]

V. ADVANTAGES

Table 5.1.: Advantages and Disadvantages [5]

SR.NO.	Techniques (or) Algorithms	Advantages	Disadvantages
1.	FAST Algorithm	Improve the performance of the classifiers. The efficiently and effectively deal with both irrelevant and redundant features, and obtain a good feature subset.	--
2.	Consistency Measure	Fast, Remove noisy and irrelevant data.	Unable to handle large volumes of data.
3.	Wrapper Approach	Accuracy is high.	Computational complexity is large.
4.	Filter Approach	Suitable for very large features.	Accuracy is not guaranteed.
5.	Agglomerative linkage algorithm	Reduce Complexity.	Decrease the Quality when dimensionality becomes high.
6.	INTERACT Algorithm	Improve Accuracy.	Only deal with irrelevant data.

7.	Distributional clustering	Higher classification accuracy.	Difficult to evaluation.
8.	Relief Algorithm	Improve efficiency and Reduce Cost.	Powerless to detect redundancy.
9.	Grid based method	Jobs can automatically restart if a failure occurs.	You may need to have a fast interconnect between compute resources.
10.	Model based method	Clusters can be characterized by a small number of parameters.	Need large data sets. Hard to estimate the number of clusters.

VI. FUTURE SCOPE

As a future work, a FAST clustering algorithm for removing redundancy and irrelevancy from feature subset selection algorithm can be developed and implemented. More challenging domains with more features and a higher proportion of irrelevant ones will require more sophisticated methods for feature selection. Although further increases in efficiency would increase the number of states examined such constant factor improvements cannot eliminate problems caused by exponential growth in the number of feature sets. However viewing these problems in terms of heuristic search suggests some places to look for solutions in general we must,

1. Invent more intelligent techniques for selecting an initial set of features from which to start the search.
2. Formulate search control methods that take advantage of structure in the space of feature sets.
3. Devise improved frameworks better even than the wrapper method for evaluating the usefulness of alternative feature sets
4. Design better halting criteria that will improve efficiency without sacrificing useful feature sets.

VII. CONCLUSION

In this paper, we have proposed a clustering algorithm, FAST for high dimensional data. The algorithm includes (i) irrelevant features removal (ii) construction of a minimum spanning tree (MST) from, and (iii) partitioning the MST and selecting the representative features. Feature subset selection should be able to recognize and remove as much of the unrelated and redundant information. In the proposed algorithm, a cluster will be used to develop a MST for faster searching of relevant data from high dimensional data. Each cluster will be treated as a single feature and thus volume of data to be processed is drastically reduced. FAST algorithm will obtain the best proportion of selected features, the best runtime, and the best classification accuracy.

Overall the system will be effective in generating more relevant and accurate features which can provide faster results.

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FINANCIAL LITERACY AND PERSONAL INVESTMENT DECISIONS OF RETAIL INVESTORS IN DELHI

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ABSTRACT

The present study has been undertaken to measure the financial literacy level of retail investors of Delhi. The term financial literacy has evolved over the years and has become a focus area for researchers and policy makers across the globe in the recent years. This study seeks to explore the impact of different demographic factors on financial literacy and also to understand the variation between personal investment decision of the investors of different financial literacy level with respect to short, medium and long term. The data for the purpose of the study has been collected from 100 respondents with the help of a structured questionnaire. The collected data was analyzed with t-test, ANOVA and Friedman Test. The findings of this study indicated that overall, the investors had a medium level of knowledge and skills in financial literacy. Significant difference was observed between financial literacy among various age groups. The study also revealed that investment decisions were related to time period as the preference of investors of same level of financial literacy was different in different time period.

KeyWords*: *Financial Literacy, Friedman Test, Investment Decisions, Retail Investors, T-test

I. INTRODUCTION

A significant change in the social support structures across the world has on one hand increased individuals' responsibility in managing their own finances and securing their financial future and on the other hand has also reduced the role played by governments and employers in managing investments on behalf of individuals. In this changed financial landscape, where the range and the complexity of financial products continue to increase, developing an understanding of the world of finance is of paramount importance. Research around the world reported inadequate financial literacy which rose serious concerns about the ability of individuals to secure their financial well-being. The findings of poor financial literacy and financial outcomes have prompted a serious review of existing financial education programs and launch of new programs. The OECD had implemented various financial literacy (FL) programmes with the main aim of exposing, promoting and encouraging the study of financial education. Higher level of financial education was important as it promotes financial choice and socio-economic independence and enhances credit analysis and budgeting skills.

Investment is referred to as the concept of deferred consumption, which could be in the form of an asset, rendering a loan, keeping the saved funds in a bank account such that it might generate lucrative returns in the future etc. The options of investments are huge; all of them having different risk-reward trade off. It has been established through research that financial literacy has a role to play in making sound investment decisions. Thus, it has become imperative to become financially literate to ensure well-being of individuals.

II. LITERATURE REVIEW

Some literatures were reviewed in the course of this study. These include the previous research on measurement of financial literacy among various target groups, the factors impacting the financial literacy level and the relation between financial literacy and investment decisions. A rich literature on this topic is available worldwide out of which few recent ones have been presented below:

Mahdzan Shehnaz Nurul and Tabiani Saleh (2013) in their paper, tried to examine the influence of financial literacy on individuals saving in the context of emerging market, Malaysia. The researcher conducted the survey of 200 individuals in Klang Valley, Malaysia. Using individual saving as independent variable and financial literacy, saving regularity, gender, age, children, and experience as dependent variables, the author found that there was a positive relationship between gender and the probability of positive saving indicating that men have a higher probability of positive saving as opposed to women, ceteris paribus, so it is important for policy makers to increase financial literacy of households by implementing various financial education programs.

Bhushan Puneet (2013)examined the awareness level and investment behavior of salaried individuals of Himachal Pradesh towards financial products. The author found that only 24.6% respondents had invested in pension funds, which means most of the people do not plan for retirement which is not a very healthy sign. Also 77.7% people had invested in life insurance which means that people are aware about the importance of life insurance. Only 39.1% respondents invest in public provident fund. The researcher concluded that respondents were quite aware about traditional and safe financial products whereas awareness level of new age financial products among the population was low. Majority of the respondents park their money in traditional and safe investment avenues so people must be made more aware about new investment opportunities available in the market.

Ibrahim Mohamed E, and Alqaydi Fatima R. (2013)examined the financial literacy among individuals residing in the United Arab Emirates (UAE). In this study researcher studied eight variables. The first variable, forms of personal debt, represented the dependent variable while the other seven variables represented the independent variables. Researcher used descriptive statistics and sample of 185 respondents was used in the analysis. The multiple regression technique was used for the task of statistically controlling the effect of interrelated variables and revealing the partial contribution of each independent variable to the explanatory power of the model. The results indicated that the average level of financial literacy in UAE was statistically significantly below the average level reported in the literature. However, there were no significant differences between the mean score of males and females. The results also indicated that individuals with strong financial attitude tend to borrow less from credit cards. UAE nationals were more likely to borrow from banks than using credit cards or borrowing from friends or family members.

Vasantbhai, Sakaria, Sima (2013) in their study focused to identify and evaluate the financial literacy among retired persons of Rajkot city. Further, the study aimed to measure the financial awareness and knowledge of the retired persons and also to make suggestions for better investment options to the perspectives investors. With F – Test and Sandler – 'A' at 5% level, the researcher concluded that 88% of respondents were knowledgeable about how to invest and where to invest and 12% of respondents were not aware about the same. The age group and savings were found to affect the issues related to financial literacy. Research also found that market information and skills were necessary in investment decision.

Agarwalla Sobhesh Kumar, Barua Samir, Jacob Joshy and Varma Jayanth R. (2012) tried to understand the financial literacy levels of three important demographic groups, young working adults, retired and students in India. The employed and retired were surveyed on financial knowledge, behaviour and attitude. The students were surveyed only on financial knowledge. The survey involved nearly 3,000 respondents from the three groups distributed across the country. The study adopted the questionnaire developed by the Organization for Economic Cooperation and Development (OECD) to facilitate international benchmarking. The findings suggested that high financial knowledge was not widespread among Indians. The basic principles of money and household finance, such as compound interest, impact of inflation on rates of return and prices, and the role of diversification were not well understood. The financial behavior of Indians appeared positive. Most employed and retired borrowed less and were dependent on their savings. There was desirable attitude towards saving and consumption among Indians. Men were found to be financially knowledgeable than women. Financial knowledge was more widespread among the more educated and the relatively wealthy. The financial behaviour and attitude of women was marginally better compared to men. Married and those with higher incomes tend to believe in planning, saving and consumption. Education and urban background had no influence on the financial attitude. It was found that majority of respondents financially planed for their retirement and started systematic savings early in life. The overall awareness of financial products was reported to be generally low.

Thilakam.C (2012) in his paper, tried to assess the financial literacy of rural masses in India. The researcher has analyzed the socio-economic conditions of the rural masses and the correlation of the income, expenditure and savings pattern, the savings modes and investment avenues and its awareness among the rural masses, the various factors that determine the current savings/investment patterns of the rural masses. The researcher applied summery statistics (mean and standard deviation), CV and CGR to measure the average and distance variances in household savings components like; currency, bank deposits, investment in shares and debentures, investment in government claim, insurance funds, private provident funds and other means. Non-parametric Chi-square helped the researcher to define the association between rural investors' level of awareness towards various savings and investment avenues and their socio-economic status. The author applied Reliability analysis and F-test to prove the fact whether investors have similar or differences of opinion towards their perception on the factors that influenced them to choose a saving medium or investment avenues. Rotation factor analysis was applied to depict a simplified datum on the factors influencing rural householders in selection of savings/investment medium. The author made an empirical analysis of rural investors, who were living in Coimbatore district of Tamil Nadu in India. The researcher concluded that today's financial world is highly complex when compared with that of a generation ago and in comparison to urban people the rural people have low level of awareness on finance matter.

Kumar K. Senthil (2012) analyzed the influence of the financial literacy level on individual investment decisions. The study was also done on the information sources or channels through which the individuals decide their investment on a particular investment product. The impact of individual's personality on their investment decisions was also analyzed. The switching behaviour of the individual if any between the various investment products was also studied. The survey was conducted in both rural and urban paces of Tiruchirappalli district. Findings suggest that except the gender, there was a relationship between the socio-economic factors and the level of financial literacy possessed by the respondents. The female respondents possessed low financial literacy

compared to the male respondents. The rural respondents were behind the urban respondents in the level of financial literacy**.**

Iqbal Bhabha Javed, Khan Shadiullah et.al. (2010) explored the financial literacy of working women as an important factor which affects the saving-investment behavior of female workforce in developing countries like Pakistan. The researchers had used hermeneutics, discourse and heuristic analyses to find the fact about the research questions. A computer based software was also used i.e. ATLAS for data analysis. The researcher found that financial literacy is of particular relevance to emerging economies. As these economies endeavor to improve the financial situation of their citizens by achieving higher economic growth rates, enhancement of financial literacy would help improve the financial well-being of their people even further through sound financial decision making. It was concluded that working-women in Pakistan are financially illiterate; female workers in Pakistan only know that they are depositing money in various institutions in order to get more wealth in name of profit but they don't know what exactly they are doing and they are ignorant about the functions and existence of financial markets.

Kaur Dhillon Lakhwinder (2007)investigated the impact of financial literacy on Individual's financial decision and how much impact gender and age differences have on the level of financial literacy with specific reference to Delhi/NCR region. Through statistical measures such as t-test and chi-square test, it was found that the level of financial literacy is dependent on the stream in which the person has graduated. Gender was not reported to have an impact on the level of financial literacy. It was found that investor type does affect the type of investment and the ability to manage one's own finances is dependent on the level of financial literacy. The author concluded that the level of financial literacy among individuals is low, so there is a need to increase financial literacy and both public and private sector should step in and take initiatives in order to improve the level of financial literacy.

III. RESEARCH METHODOLOGY

This study is descriptive in nature. Descriptive research is an exploration of certain existing phenomenon. It is mostly done when a researcher wants to gain a better understanding of topic. The type of study is quite factual, accurate and systematic. Both primary and secondary data have been collected in this study. Primary data is collected through a survey. The survey is carried out by means of self-administered, structured questionnaire and secondary data is collected from articles, research papers of various journals.

3.1 Objectives of the Study

a) To study the impact of different demographic factors on financial literacy.
b) To study the variation between personal investment decision of the investors of different financial literacy level with respect to short, medium and long term.
c) To study the relationship between financial literacy and personal investment decisions.

3.2 Scope of the Study

The study was undertaken to access the level of financial literacy among the investors, to study the impact of different demographic factors on financial literacy and to study the variation between personal investment decision of the investors of different financial literacy level with respect to short, medium and long term. For this purpose, respondents from Delhi were selected.

Table 1: Summary of Research Methodology

Research Design	Descriptive
Population/ Universe	Retail Investors in Delhi
Sample Size	100
Sampling Technique	Convenience
Project Approach	Survey Method
Instrument Used	Structured Questionnaire
Data Type	Primary and Secondary
Statistical Tools Employed	ANOVA, t-test and Friedman Test

Table 1: Summary of Research Methodology

3.3 Hypothesis

In order to achieve the objectives of the study the following hypothesis were formulated

a) H_{0a}: There is no significant difference between male and female financial literacy level.

b) $H_{0b:}$ There is no significant difference between financial literacy levels on the basis of age.

c) H_{0c}: Investors are indifferent towards investment options for different time periods.

IV. DATA PRESENTATION AND ANALYSIS

Table 2: Demographics of Respondents

Gender	**Number of Respondents**
Male	67
Female	33
Occupation	
Service	30
Professional	9
Student	23
Business	33
Home maker	5
Level of Education	
Secondary School	4
Senior secondary	6
Graduate	29
Post Graduate	50
M.Phil/PhD.	11

Interpretation

Majority of the respondents i.e. 67% were males and the rest 33% were female respondents. Most of the respondents surveyed, belonged to business class (33%), followed by service class (30%), students (23%), professionals representing 9% and the rest 5% respondents were house makers. Nearly half of the respondents were post graduates, followed by 29% graduates, 11% above post graduate level i.e. M.Phil/PhD and rest 10 % consisted of those who were below graduation level.

Table 3: Financial Literacy Score

Interval	Number of Respondents
30-45	18
45-60	71
0-75	11

Figure 1: Financial Literacy Score

Interpretation: Majority of the respondents i.e.71 respondents were in the interval of 45-60 (medium level of financial literacy), 18 respondents were in interval of 30-45 (low level of financial literacy) and 11 respondents were in the interval of 60-75 (High level of financial literacy).

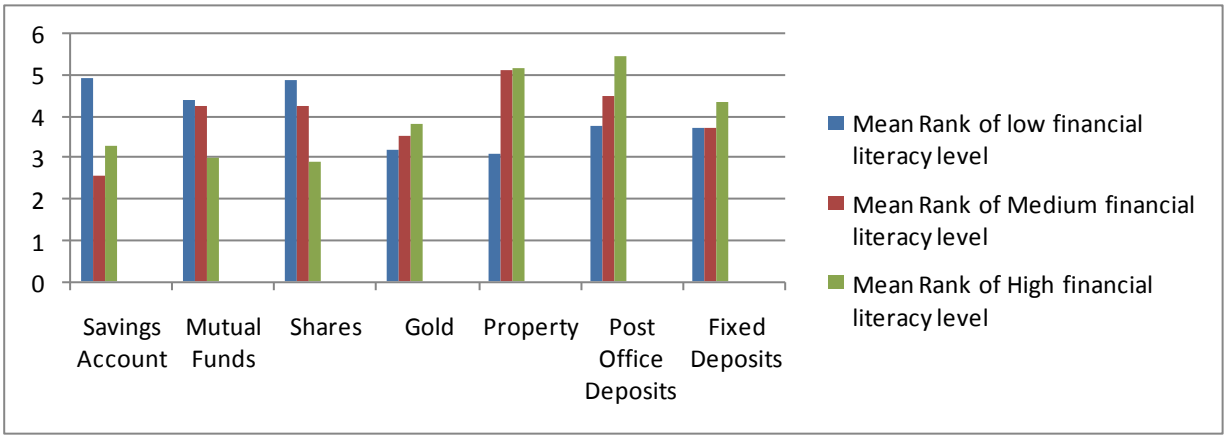

Figure 4: Most Preferred Investment for The Period Up To 1 Month

Interpretation: From fig., it could be inferred that low financial literacy level investors preferred property as the best means of investment because the mean rank value was 3.11 and moderate financial literacy level investors were more inclined towards Savings Account and had mean rank score of 2.56 while investors with high financial literacy level opted for Shares with the mean rank of 2.91.

4.1 Hypothesis Testing

$H_{oa:}$ There is no significant difference between male and female financial literacy level.

Table 4: Descriptive Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
FL	1.00	64	49.4063	6.26332	.78291
	2.00	36	51.2222	7.07152	1.17859

Table 5: Results of t-test

		Levene's Test for Equality of Variances		t-test for Equality of Means			t-test for Equality of Means	
		F	Sig.	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
								Lower
FL	Equal variances assumed	.269	.605	-1.328	.187	-1.81597	1.36737	-4.52948
	Equal variances not assumed			-1.283	.204	-1.81597	1.41493	-4.64128

The mean financial literacy score of males is 49.43and that of females is 51.22 which mean that females score more on financial literacy. The sig (2- tailed) value was 0.187, which is more than the usual threshold value (0.05). This indicates that null hypothesis could not be rejected.

H_{ob}: There is no significant difference between financial literacy levels on the basis of age.

Table 6: Descriptive Statistics for Financial Literacy and Age

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1.00	34	48.2059	5.23843	.89838	46.3781	50.0337	34.00	61.00
2.00	36	51.1389	7.07169	1.17861	48.7462	53.5316	39.00	65.00
3.00	12	47.1667	6.54819	1.89030	43.0061	51.3272	33.00	55.00
4.00	16	54.0000	6.60303	1.65076	50.4815	57.5185	42.00	65.00
5.00	2	48.0000	.00000	.00000	48.0000	48.0000	48.00	48.00
Total	100	50.0600	6.58866	.65887	48.7527	51.3673	33.00	65.00

Table 7: Levene's Test for Homogeneity

Levene Statistic	df1	df2	Sig.
1.155	4	95	.336

Table 8: Results of ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	516.109	4	129.027	3.241	.015
Within Groups	3781.531	95	39.806		
Total	4297.640	99			

Interpretation: The mean financial literacy score is highest for investors belonging to age 46-55 years, followed by those in age 26-35 years and least for those in the age group 36-45 years. The significance value for ANOVA (from TABLE 8) is 0.015 which is less than the usual threshold value (0.05). This indicates that null hypothesis could be rejected in favor of alternate hypothesis.

H_{0c}: Investors are indifferent towards savings account as an investment option for different time periods.

Table 9: Descriptive Statistics (Rank of Savings Account as an investment option)

	N	Mean	Std. Deviation	Minimum	Maximum
SHORTTERM	100	4.2200	2.21373	1.00	7.00
MEDIUMTERM	100	3.8900	1.90637	1.00	7.00
LONGTERM	100	4.6300	1.95740	1.00	7.00

Table 10: Ranks

	Mean Rank
SHORTTERM	1.95
MEDIUMTERM	1.81
LONGTERM	2.25

Table 11: Test Statistics[a]

N	100
Chi-Square	14.185
df	2
Asymp. Sig.	.001

Friedman's test was applied to the example data to see whether there are differences between groups. This test shows that there is a statistically significant finding. The p-value (asymp. Sig. in the TABLE 11 above) is p = 0.001. (A p-value less than 0.05 is said to be statistically significant. Thus null hypothesis could be rejected in favor of alternate hypothesis. Also, it can be inferred that Savings account is preferred mostly by investors in the medium term and short term and not so in the long term period.

V. MAJOR FINDINGS AND DISCUSSIONS

a) It was found that the overall financial literacy level of the respondents was medium as out of 100 respondents 71 were in the range of medium level of financial literacy.
b) It was found that the male and female financial literacy levels do not differ significantly as the t-test (1.328) significance value was 0.181 (p>0.05).
c) The significance value for ANOVA (0.015) was less than the usual threshold value (0.05) which showed there was a significant difference in financial literacy level among various age groups.
d) In short term, the low financially literacy investors preferred property as the best means of investment because the mean rank value was 3.11 and moderate financial literacy level investors were more inclined towards Savings Account and had mean rank score of 2.56 while investors with high financial literacy level opted for Shares with the mean rank of 2.91
e) The study revealed that investment decisions were related to time period as the preference of investors of same level of financial literacy was different in different time period.

VI. SUGGESTIONS AND SCOPE FOR FURTHER STUDY

Researcher investigated relationship between the demographic factors and financial literacy, difference in personal investment decision for different time period. This study was limited to Delhi investors with only 100 respondents so further Studies can be done as extension of the same study with large number of respondents or at the different states of India. Other studies can also focus on different factors like attitude of the investors towards financial literacy.

VII. RECOMMENDATIONS

A majority of the respondents had not only shown better skills in managing their financial budget but were also confident of facing any financial impediments in future. All these developments could be attributed as a result of initiatives taken by the Reserve bank of India, SEBI, NSE, commercial banks, NGO's, SHG's and the government. But the negative side of these pointed by ING consumer resourcefulness survey states that 98% of Indian citizens still do not have a demat account. The country where 48% of the population still lives on day to day earnings cannot dream of savings and life insurance. However these inequalities could be overcome if more and more enthusiastic and coordinated efforts are launched by the aforesaid agencies who are party to financial sector of the country. In this context, the following recommendations are worth notable to increase the financial literacy of the country.

a) Financial Education should be provided at secondary and senior secondary level of education as it was found financial literacy and educational level was related.

b) Government should support financial literacy programs and schemes as it was found that such programs and scheme help investors in improving their financial literacy.

c) Global guidelines and standards for financial literacy initiatives and consumer protection frameworks in financial markets should be formulated.

d) Campaigns for spreading awareness about financial inclusion and financial literacy need to be intensified. This can be done through innovative dissemination channels including films, documentaries, pamphlets and road shows. Stakeholders, including the regulators and policy makers, may launch large scale awareness programmes.

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A MODIFIED VARIABLE STEP SIZE SQUARE CONTOUR BLIND EQUALIZATION ALGORITHM

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ABSTRACT

Wireless communication is one of the useful communication techniques. The high demand for wireless communication services is the capacity of system. Here main target is increasing the capacity. Then most important solution would be to increase bandwidth. For increasing capacity in wireless communications services has led to developments of new technologies that exploit space selectivity. This is done by smart-antenna arrays and the adaptive beam forming algorithms. Smart-antenna systems provide techniques for higher system capacity and improved quality of service among other things. Most of the algorithms can be categorized into two classes according to whether a training signal is used or not. They are Non-Blind Adaptive algorithm and Blind Adaptive algorithm. Adaptive beam forming Algorithm are two types. One is blind beam forming where training signal is not needed. Another is non-blind beam forming where training signal is needed.

Keywords: Smart-Antenna, Square Contour Algorithm (SCA), Variable Step Size Square Contour Algorithm (VSS-SCA), Modified Variable Step Size Square Contour Algorithm (MVSS-SCA).

I. INTRODUCTİON

Equalization [1] is used for removing Inter-Symbol Interference (lSI). Equalizers are of two types: non-blind and blind equalizers. They mainly attempt to achieve equalization by restoring some property of the uncorrupted symbols. Hence, they are capable of saving bandwidth that is wasted by sending training data. One of the earliest efforts in this direction was the Constant Modulus Algorithm (CMA) [2]. CMA is unable to achieve correct phase recovery due to the very nature of its cost function. Hence, a separate phase tracking loop is required along with CMA. The Multi-Modulus Algorithm (MMA) [3] had good convergence properties, but here created an occasional π/4 phase rotation problem. A method is given in [3] to take care of this phase rotation problem of the MMA. The Square Contour Algorithm (SCA) [4] doesn't give any phase rotation problems. But its disadvantage lies in its speed of convergence. Many other schemes [5] were proposed to enhance the speed of convergence of the SCA by incorporating hard and soft Decision-Directed (DD) cost functions. Similarly, variable step size paradigms were also proposed recently [7] for similar purposes, which assigns a step size based on the deviation from fixed square contours around constellation points. The space-division multiple access technique is used for increasing the demand on mobile communication capacity. The smart antenna is used for separating signals which are transmitted on the same carrier frequency. In mobile systems, if capacity is increased then network efficiency and performance will also improve. The capacity is C.

$$C = B * \log_2(1 + \frac{S}{N}) \quad (1)$$

Where B = band width, S = Signal power

II. SMART-ANTENNA

The term "smart antenna" generally refers to any antenna array, terminated in a sophisticated signal processor, which can adjust or adapt its own beam pattern in order to emphasize signals of interest and to minimize interfering signals. Smart antennas generally encompass both switched beam and beam formed adaptive systems. Switched beam systems have several available fixed beam patterns. A decision is made as to which beam to access, at any given point in time, based upon the requirements of the system.

III. THE SQUARE CONTOUR ALGORITHM

The cost function of CMA [2] is

$$J_{CMA} = E[(|y_n| - R_{CMA}^2)^2] \quad (2)$$

For a square

$$max\{|y_{R,n}|, |y_{I,n}|\} = R \quad (3)$$

The real part of the filtered output is $y_{R,n}$ and imaginary part is $y_{I,n}$

$$\max\{|y_{R,n}|, |y_{I,n}|\} = \frac{|y_{R,n}+y_{I,n}| + |y_{R,n}-y_{I,n}|}{2} \quad (4)$$

$$R_{SCA} = 2R \quad (5)$$

The cost function of SCA [4] is

$$J_{SCA} = E[(|y_{R,n} + y_{I,n}| + |y_{R,n} - y_{I,n}| - R_{SCA})^2] \quad (6)$$

The gradient vector

$$\nabla_w J_{SCA} =$$

$$E[(|y_{R,n} + y_{I,n}| + |y_{R,n} - y_{I,n}| - R_{SCA})\{Sgn[y_{R,n} + y_{I,n}] + Sgn[y_{R,n} - y_{I,n}] + j(Sgn[y_{R,n} + y_{I,n}] - Sgn[y_{R,n} - y_{I,n}])\}\underline{x}_n^*] \quad (7)$$

The update weight

$$\underline{w}(n+1) = \underline{w}(n) - \mu[(|y_{R,n} + y_{I,n}| + |y_{R,n} - y_{I,n}| - R_{SCA})\{Sgn[y_{R,n} + y_{I,n}] + Sgn[y_{R,n} - y_{I,n}] + j(Sgn[y_{R,n} + y_{I,n}] - Sgn[y_{R,n} - y_{I,n}])\}\underline{x}_n^*] \quad (8)$$

For perfect equalizer

$y_n = s_n$ & $\nabla_w J_{SCA} = 0$

So,

$$E[(|y_{R,n} + y_{I,n}| + |y_{R,n} - y_{I,n}| - R_{SCA})\{Sgn[y_{R,n} + y_{I,n}] + Sgn[y_{R,n} - y_{I,n}] + j(Sgn[y_{R,n} + y_{I,n}] - Sgn[y_{R,n} - y_{I,n}])\}\underline{x}_n^*] = 0 \quad (9)$$

The R_{SCA} is define in [4]

$$R_{SCA} = \frac{E[(|S_{R,n}+S_{I,n}|+|S_{R,n}-S_{I,n}|)R']}{E[R']} \quad 10$$

Where

$$R' = \{Sgn[s_{R,n}+S_{I,n}] + Sgn[S_{R,n}-S_{I,n}] + j(Sgn[S_{R,n}+S_{I,n}] - Sgn[S_{R,n}-S_{I,n}])\}S_n^* \quad 11$$

The convergence rate of SCA is very slow.

IV. THE VARIABLE STEP SIZE SQUARE CONTOUR ALGORITHAM

The variable step size [9] is

$$\mu = \mu_0(1-exp(-\alpha|e(n)|)) \quad 12$$

α is a constant that defines the constancy or variability of the step size with respect to error term.

The update weight is

$$\underline{w}(n+1) = \underline{w}(n) - \mu[(|y_{R,n}+y_{I,n}|+|y_{R,n}-y_{I,n}|-R_{SCA})\{Sgn[y_{R,n}+y_{I,n}]+Sgn[y_{R,n}-y_{I,n}]+ j(Sgn[y_{R,n}+y_{I,n}]-Sgn[y_{R,n}-y_{I,n}])\}\underline{x}_n^*] \quad 13$$

Where

$$e(n) = (|y_{R,n}+y_{I,n}|+|y_{R,n}-y_{I,n}|-R_{SCA})\{Sgn[y_{R,n}+y_{I,n}]+Sgn[y_{R,n}-y_{I,n}]+j(Sgn[y_{R,n}+y_{I,n}]- Sgn[y_{R,n}-y_{I,n}])\} \quad 14$$

V. THE MODIFIED VARIABLE STEP SIZE SQUARE CONTOUR ALGORITHM

Here the variable step sizes consider for the in-phase and quadrature phase equalizers

$$\mu_R = \mu_0(1-exp(-\alpha|e_R(n)|)) \quad 15$$

$$\mu_I = \mu_0(1-exp(-\alpha|e_I(n)|)) \quad 16$$

VI. RESULT & DISCUSSIONS

First of all we consider AWGN channel. The residual ISI [6] at the output of the equalizer is defined as

$$ISI = \frac{\Sigma_k[|\underline{h}(k)*\underline{w}^*(K)|^2]-max[|\underline{h}(k)*\underline{w}^*(K)|^2]}{max[|\underline{h}(k)*\underline{w}^*(K)|^2]} \quad 17$$

Where $|\underline{\mathbf{h}}(k)*\underline{\mathbf{w}}^*(K)|^2_{max}$ is the maximum absolute value among all values of $\underline{\mathbf{h}}(k)*\underline{\mathbf{w}}^*(K)$. All simulation experiments described in this section employ the equalizer of transversal filter structure with 9 tap weights and the equalizers were initialized with the central tap weights set to one and all others set to zero. '$*$' denotes convolution operation. We see that the MVSS-SCA better than the proposal in [9] and also the SCA, in terms of convergence to a lower lSI in Fig.-1.

Now consider the data symbols are 16-QAM [8]. The noise power is adjusted such that it gives rise to a channel signal-to noise ratio (SNR) of 30 dB We have taken 15,000 symbols to estimate the channel, of which last 2000 are shown in Fig. 2 which shows the received signal and equalized signal constellations of three blind equalizers

after convergence. The results confirm the founding that the MVSS-SCA has superior performance over conventional VSS-SCA & SCA.

VII. CONCLUTION

The MVSSSCA decreases the inter symbol interference (ISI) comparison with Variable Step-size SCA and SCA. The MVSSSCA gives lower ISI and improves the convergence. So The MVSSSCA is better than others algorithm.

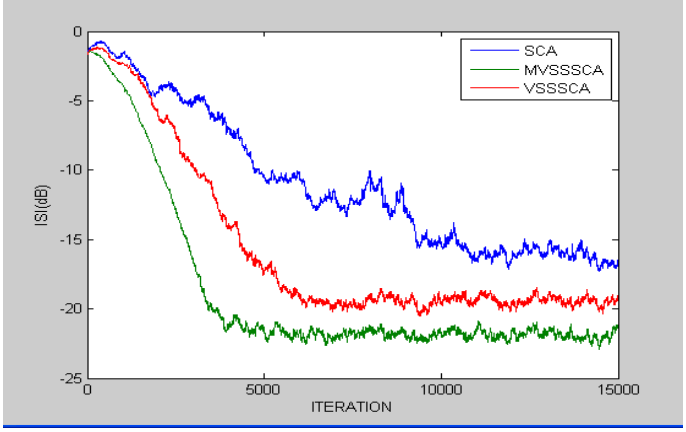
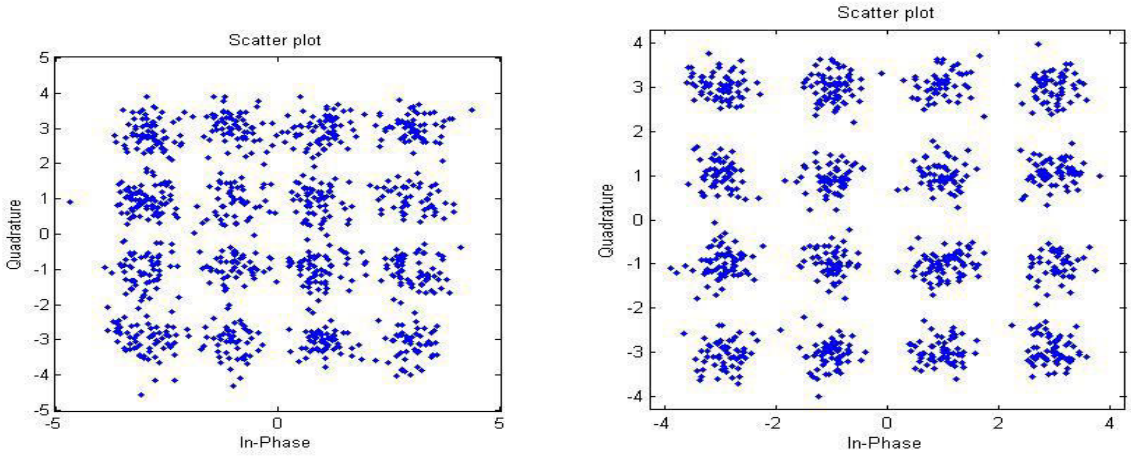
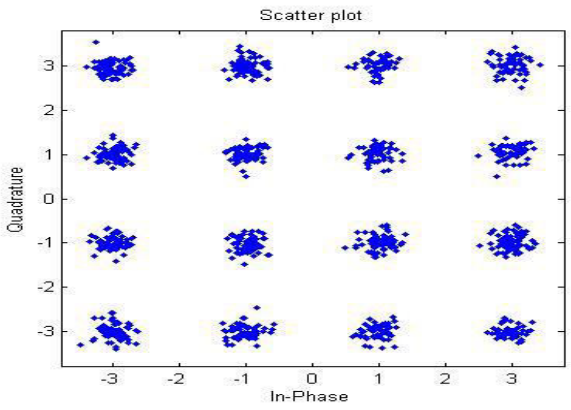


Fig-1 Comparison of Averaged ISI for SCA, VSS-SCA, MVSS-SCA



(a) (b)



(c)

Fig-2 Equalized Signal Constellations (a) SCA (b) VSS-SCA (c) MVSS-SCA

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QUALITY OF SERVICE SUPPORT MOBILE AD-HOC NETWORKS (MANETS): ITS CHALLENGES AND ASSOCIATED ISSUES

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ABSTRACT

A MANET Mobile AD-Hoc Network is a collection of self-configured wireless mobile nodes that form a wireless network independently of any centralized network. MANET are emerging as a very popular technology for future generation of wireless mobile infrastructure. Quality of Service (QoS) is much more difficult and challenging task in MANET. The real time applications like as Multimedia, Video conferencing, disaster recovery etc. can be easily support if Quality of Service can be providing for Mobile Ad-Hoc Network. Quality of Service is usually defined as a set of service requirements that needs to be met by the network while transporting a packet stream from a source to its destination. The provision of QoS in wireless access networks is very challenging because of the movement of the hosts and the characteristics and unpredictable nature of wireless links.

In this paper we focuses on challenges and issues in providing QoS support to MANETs. There are many challenges in Quality of Service provisioning for MANETs like automatically changing in topology, wireless capacity limitations, limited battery power, and Network Configuration, Limited physical security. Several important research issues and open questions need to be addressed to facilitate QoS support in MANETs. In this paper we are going to outline the future issues and challenges related to QoS provisioning in MANETs.

Keywords: MANET, Quality of Service, Wireless Network.

I. INTRODUCTION

There are many types of researches in different fields such as Science, Medicine, Computer science and Information technology. In no other field has these developments been more clear than in field of wireless network technology. Basically, there are two basic types of wireless technologies that are of interest; the cellular network concept and the Ad-hoc network concept. The cellular network concept is basically the same as is used in mobile phone technology (GSM), and is a highly researched area. In 1970s, Ad-hoc network concept has received attention in research. A Ad-Hoc is a Latin word that means "For this purpose". A Mobile Ad-Hoc network is a self-configured, less-infrastructure network of mobile devices connected without the wires[1]. In other words, A MANET is a collection of self-configured wireless mobile nodes that form a wireless network independently of any centralized network. Every node operates as an end system and a router for all other nodes in the network. Nodes in mobile ad-hoc network are free to move and organize themselves in an arbitrary fashion[2]. Each user is free to roam about while communication with others. The path between each pair of the users may have multiple links and the radio between them can be heterogeneous. This allows an association of various links to be a part of the same network.

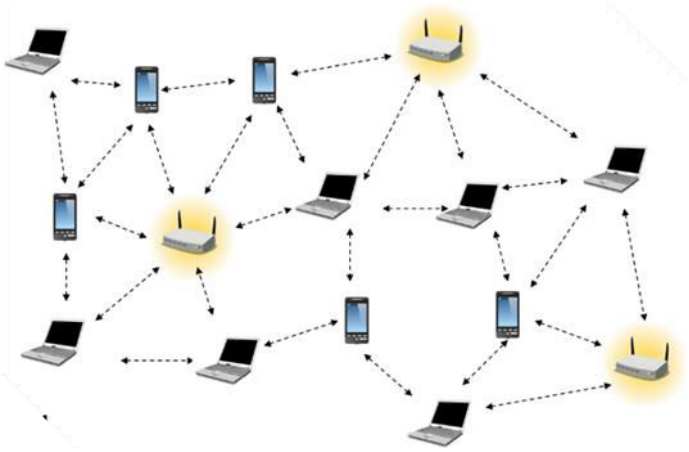


Fig. 1. Mobile Ad-Hoc Network

A Set of services requirements to be met by the network while transporting a packet stream to its destination from its source is known as Quality of Service (QoS). The actual form of QoS and its parameter depends upon the requirement of the specific application. The main goals of QoS are:-

- More Determined network behavior is to be achieved
- Better initialization of the resources of network
- Better network for delivery of information
- Maintenance of end-to-end QoS with user mobility etc.

QoS metrics is also introduced which includes packet loss rate, bandwidth, estimated delay, packet jitter, path reliability and hop count.QoS framework is a structural collections of concept and its relationship between related topics of QoS supportive system which have common disciplines. In this way quantified and identified system of QoS is used for originate the following application process of the services[2].

II. REVIEW OF LITERATURE

Due to the need or requirement of the quality services in internet as well as in traditional wireless network, there is need to conduct number of researchers but even though results are not appropriate in current scenario and quality of services for MANET's are still an open challenge/problem. A number of different terminal challenges are faced in providing suitable QoS for delivery of real-time communication like Video/audio. In this section, regarding the proposed area, several QoS frameworks for MANETs are reviewed.

Essential Services to each users or application are offered by the complete system called framework of QoS. In (Xiao et al., 2000), on the basis of intserv and diffserv model, FQMM presents a hybrid service model for flexible QoS model for mobile Ad-Hoc networks. Combination of the high priority traffic of the reservation procedure with the service of low-priority traffic is done by FQMM. To overcome the problem of scalability or classifying the low-priority traffic into service classes, FQMM provides the ideal QoS for per flow.

The basic problem appeared by QoS framework is addressed by this protocol (Murthy &Manoj, 2004). But other problem cannot be solve by it like:-

- Decision Regarding the classification of traffic
- Allotment of traffic per flow or aggregate services to given flow
- How much amount of traffic belongs to the given flow
- Forwarding or scheduling the traffic by the intermediate rates.

For providing in Multi-hop wireless network, packet of scheduling approach is described [luo., 2004]. To achieve fair and maximum allocation of the shared wireless channel bandwidth is seeked by scheduled disciplines besides the minimum through put and delay bound for each flow, by the introduction of scare and dynamic network resources, the problem is get solved regarding the co-ordination of the adaptation between the order of the different layers of the network, described in [Bharghavan., 1998]

The Concept of QoS ranges, Its adaptively and other mechanisms which helps in providing QoS in wireless environment has been investigated by Mobiware efforts [Angin., 1998]. For providing the QoS in mobile Ad-Hoc network an approach called INSIGNIA protocol is adopted which combines the idea of QoS ranges with light weight signaling carried in the data packet headers [Mirhahhak., 2000]. Highly responsive and lightweight network is designed by using If based QoS framework. Base quality of service is required only a minimum quantitative QoS guarantee (minimum bandwidth) that can also support adaptive services [Lee., 2000]. INSIGNIA integrated with an Ad-Hoc routing protocol is an in-band signaling protocol.

An in-band signaling system supports:

- Reservation andRestoration
- On the basis of Inherent flexibility end to end adaption
- Robustness and scalability which is found in IP networks.

Resources are quickly released at the time of path reconfiguration, this guarantee is given by the soft state reservation scheme which is used in this framework. To support high layer and soft quality of services, a network feedback had made which is based on the link and acceptable throughput measurements.

However this scheme does not considers:-

- Inherent characteristics of MANETs
- Drawback of differentiated and integrated services
- Changing network topology
- Limited resources availability
- Error-prone shared radio channel.

Therefore, an accurate model has to be designed to investigate its applicability for supporting a combination of non-real-time services (data or FTP) and a real time Video/Audio with in the MANETs.

III. CHALLENGES IN MANETs

3.1 Challenges in Mobility Schemes

The mobility management schemes can be divided into personal, and global and local host mobility. With the Session Initiation Protocol (SIP), the location of a user can be tracked and sessions initiated to the current host of the user. With Mobile IP, the location of a host can be tracked on a global scale. The local mobility management schemes can help support host mobility within an administrative domain more efficiently. All these mobility mechanisms can be seen as complementing each other to offer a wide spectrum of mobility support[3].

Mobile IP allows the mobile node to inform other nodes of its current location in the Internet. Because an IP address defines the physical location of a node to the routing infrastructure, a mobile node must, in the common case, change its IP address every time it changes locations. When the IP address changes during a communication session, the new address must be securely indicated to the communicating partner. When the IP address changes, all protocols that keep state information based on the IP address, RSVP, for example, must re-

initiate the states[1]. The more often the IP address changes, the more refreshing of states is needed, usually all the way between the communicating partners.

3.2 Challenges in QoS Architectures

QoS can be provided at different levels of a network node. Figure below presents QoS mechanisms found on different protocol layers. Starting from the lower layers, ATM can be used to provide additional support to any of these QoS mechanisms. When ATM is not used as the link layer technology, Multi-Protocol Label Switching can still be used to support the IntServ and DiffServ architectures, and RTP can be used over these two architectures.

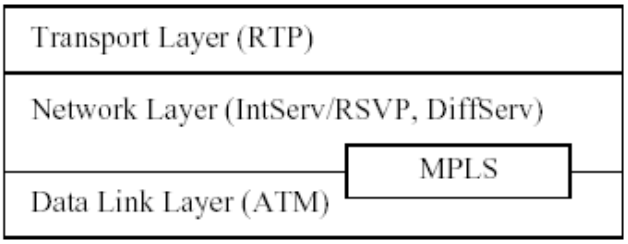


Fig. 2. Classification of Different QoS Mechanisms

Because the QoS mechanisms drive for the same generic goal, it can be argued that once one QoS mechanism, or at most two, is used to provide quality for a packet stream, additional QoS mechanisms only give little gain in the QoS. For example, if an application reserves resources from the network using RSVP (Resource Reservation Protocol), and then sends an RTP-based stream, the flow adaptation mechanisms of RTP would introduce an overhead and consume a portion of the bandwidth with little benefit[4].

The benefits and problems of the two main QoS architectures, the Integrated Services model and RSVP keep the state of the reservations per flow; they can provide a greater level of accuracy and a finer level of granularity on the part of the network to respond to service requests. The service requests of each application are used to generate a reservation state within the network. This state-based model is intended to be exclusionary, where other traffic, for example best-effort traffic, is dropped in order to meet the promised service targets[1]. The architecture also poses some challenges to the queuing mechanisms as there is the requirement to allocate absolute levels of egress bandwidth to individual flows while still supporting an unmanaged low priority best effort traffic class. Moreover, keeping accurate information of reservation states may be quite challenging in a dynamic mobile environment. Some people claim that, due to these issues, RSVP is not able to scale with the traffic, and, thus, RSVP would not be a proper solution in current networks.

One issue that does create problems with RSVP is mobility. RSVP uses the destination IP address of a flow as the session identifier. If the destination addresses changes, the whole reservation must be re-initialized. Thus, when a mobile node is receiving a flow, moves, and its IP address changes, the whole reservation must be requested again. For the upstream, it is possible to request a shared reservation, where all upstream senders share a single reservation, the size of which is the largest of the requested reservations[5]. After a handover, where the IP address of the mobile node changed, the mobile node can send a Path message to update the reservation path.

3.3 Challenges While Interacting Qos with Manet

There are many types of handover conditions between different entities can be identified. It can be ensure within the same access router (AR) including a change of the access point serving the mobile node. This is called an *Intra-AR* handover. Handovers in between access routers and access network gateways (ANG) are called *Inter-AR* and *Inter-ANG*, respectively[6].

Figure –Elucidate the possible handovers while a mobile network node moves within and in between two administrative domains. The different levels of handovers create a variable load of signaling in the access network. The higher the handover is propagated in the access network topology the more time it will take to set routing and QoS allocations in place.

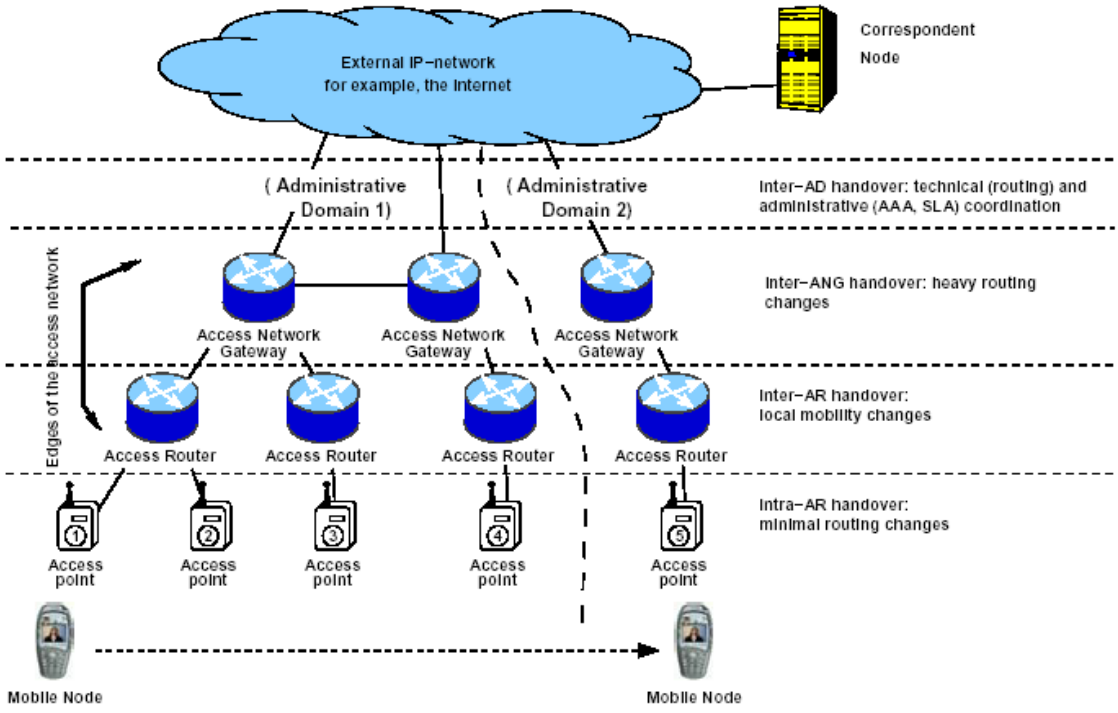
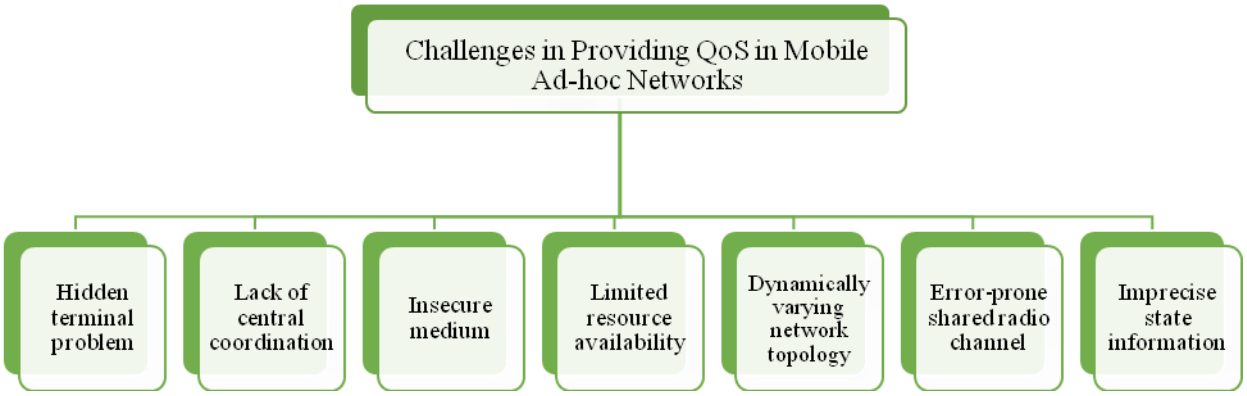


Fig. 3. Example Network Topology Illustrating Different Handover Situations

In this figure, Intra-AR handover would be in between access points 1 and 2. Inter-AR handover would be between access point 2 and 3, and Inter-ANG handover is in between access point 3 and 4. In addition, an Inter-AD handover would be between access point 4 and 5 that would change the whole access point network process. In handover situations RSVP has problems guaranteeing the reservations because updating the reservation, routing and data transmission are independent. RSVP-aware nodes need to send periodic Path and messages for each flow to refresh the end-to-end reservations. When a network route changes, than data packets will receive only best-effort service until the reservation state has been updated on the new path. When there is no any reservation, the refresh messages should be sent instantly after a handover[7]. This process update the location of the mobile node at the intermediate RSVP network Routers. Also, it would be possible to initiate the QoS negotiation with the new access router before the handover with a Context Transfer protocol or if the mobile node can communicate simultaneous over the wireless link with the old and new access router. In an Intra-AR handover, the handover control and handle only radio resources networkif the flows of data will use the same routing paths in between the access router and the access network gateway. This handover is also called a layer 2 handover. If the interface to the mobile devices does not change then the IP layer is transparent. Otherwise, the

handover triggers change internal to the AR. After the changing of interface, the AR will be reallocate on the new interface, if the AR will e changed but ANG still on same interface. At this stage the routing path is similar and the availability of radio resources and resources in the active network is affected. The new AR interface need to carry full authorization and control procedure at the synchronization time based. When the mobile node moves with in huge network or does handover to active network to another network, then the active network gateway is changed. In this situation, A new IP address is allotted to the active mobile nodes.

Overall, the further away the movement of the mobile node is noticed, the more adverse the effect on the QoS provision may be. The frequency of the different handovers depends on the mobility of the node and on the access network structure. For example, it is possible to build quite a large access network supporting thousands of mobile nodes with only one gateway router and a few access routers. Within such a network, no change of gateways would happen, and changing access routers could only happen a few times per Mobile node. Still, with standard RSVP, there is no way to predict before a hand over whether the new access router or gateway can support the service requested by mobile node[8].



VI. ISSUES IN MANETs

An Active research area is providing QoS support in MANET.

4.1 Routing

the issue of routing packets between any pair of nodes becomes a challenging task because of constantly changing in the networks of the topology. Maintenance of the both state information i.e. flow specific and line specific is made possible by the nodes in Ad Hoc wireless network. The link specific state information includes:-

- Delay
- Bandwidth
- Error rate
- Loss rate
- Delay jitter
- Cost
- Stability

And distance value for each link. The flow-specific state information includes:-

- Source address

- Session ID
- Destination address
- QoS requirements of the flow like

a. Minimum bandwidth requirement
b. Maximum bandwidth requirement
c. Maximum delay litter
d. Maximum delay

Due to dynamic changes in network topology and channel characteristics, state information is inherently imprecise. Hence inaccurate route decision results in some of the real-time packets missing their deadlines.

4.2 Security and Reliability

Communication through a wireless channel is highly insecure due to the broadcast nature of the wireless medium. Hence, Security is the main issue in AWNs especially. For the tactical and military applications. Susceptible reason to attack is AWNs such as:-

- Spoofing
- Eavesdropping
- Message distortion
- Denial of service
- Impersonation

It is difficult to provide secure communication guarantees without any sophisticated security mechanisms.

4.3 Quality of Service (QoS)

In constantly changing environment, providing different quality of service levels will be a great challenge. MANET is an inherent stochastic feature of communication quality but to offer fixed guarantee on the service offered by the device is very difficult issue. So, over the traditional resource reservation, an adaptive QoS is to be implemented to support the multimedia services.

4.4 Limited Resource Availability

Limited area of MANETs include:-

- Battery Life
- Band width
- Storage Capacity/Space
- Capability of Processing

Out of the above, very critical resources are namely bandwidth and battery life and availability of these resources significantly affects the performance of provisioning mechanism of QoS. Hence, for the optimum utilization of the scare resources, efficient management system is required.

4.5 Internetworking

Internetworking between MANET and fixed in many cases in addition to the communication with in an Ad-Hoc networking. Harmonious mobility management is a challenge for those mobile devices which have co-existence of routing protocols. The issue of routing packets between any pair of nodes becomes a challenging task because

of constantly changing in the networks of the topology. Maintenance of the both state information i.e. flow specific and line specific is made possible by the nodes in Ad Hoc wireless network[9].

4.6 Power Consumption

For the lean power consumption for the light-weight mobile terminals, the communication related function should be optimized. Power aware routing and conservation of power must be taken into consideration.

Fig. 4. Some Major issues in MANETs

V. CONCLUSIONS

Mobile Ad-Hoc Network is created by a set of mobile devices nodes on a wireless shared network channel, it is also called Multi-hop mobile radio network. This wireless channel is adjustable in highly dynamic topology that are developed from the changing communication channels and the mobility of network nodes. MANETs play a significant role for the development of wireless communication network. Many networks are attractive because of the rapidly growth of such network are active anywhere and anytime without the presence of base station and system administrators. So, MANETs is able to provide QoS for delivery of real time communications (Audio/Video) to each and every mobility nodes.

Many ideas regarding QoS inherited from the wire-based networks can be used for MANETs if we consider various constraints due to the dynamic nature, bandwidth restriction, the limited processing, and capabilities of mobile nodes. Thus, for providing efficient quality of service in mobile ad-hoc networks, there is a solid need to create new architectures and services for routine network controls.

VI. FUTURE WORKS

The development growth of mobile ad-hoc networks gives great chances in various fields including academic, Science, Military, disaster recovery, industrial sectors, and social environment. However, there are many problems that require to be addressed properly. These problems and issues needs to develop systematic routing

procedures, mechanisms for reducing power consumption and extending the battery life, mechanisms for systematic use of limited bandwidth and communication capacity, new algorithms for network security, and making smaller but more high-powered mobile devices.

VII. ONGOING RESEARCH IN SECURING MANETS

7.1 Securing Routing in MANETs

An extension compatible with a variety of existing reactive routing protocols, SRP is designed.For guaranteed acquisition of correct topological information and for combating the attacks that disrupt the route discovery process SRP is introduced.

7.1.1 Ariadne

(on the Basis of DSR- a secure routing protocol) The initiator can be authenticated by the discovery of the target node of route. An intern the initiator authenticate the each intermediate node on the path toward the destination present in the RREP message. From the node list in the AREQ or RREA message, no intermediate node can remove a previous one[10].

7.1.2 Aran

It is known as Securing routing protocol (Conceived as an on-demand routing protocol) that helps in protection and detection of malicious actions. Which are carried out by peers or the third party in the AD-Hoc environment. Following are introduced as a part of the minimal security policy for the Ad-Hoc environment:-

a. Message integrity
b. Authentication
c. Non-repudiation

It Consists of:-

a. Preliminary Certification Process
b. End-to end authentication stage which is mandatory
c. An Optimal second stage which helps to provide secured shortest paths.

7.2 Dealing with selfish and Malicious Nodes

KeyFor detecting malicious nodes by means of combined and monitoring and establishment routes reporting by avoiding nodes which are misbehaving by the introduction of confident [cooperation of Nodes, Fairness In Dynamic Ad-Hoc Networks]. DSR is designed as an extension to a routing protocol, to hold a token in order to participate in the network operation another approach is required which is taken based cooperation enforcement scheme for each node of the Ad-Hoc network. On the basis of the monitoring of the node's contribution to packet forwarding and routing operations, a granted scheme is required called token which work collaboratively with nodes of network[11]. Through a token renewal exchange with its neighbor, each node can be renewed upon expiration of it.

7.3 Key Management and Node Authentication

A Self organized Public-Key management scheme is introduced which is based upon the PGP is introduced for supporting security system of the Ad-Hoc networking routing protocols users issue certificates for each other based on their personal acquaintances. Public key certificate of each node is cooperatively generated by a set of neighbor based on the behavior of the node as monitored by the neighbors is authenticated by polynomial secret sharing.

The Secret digital signature is key used to generate public key certificates is distributes among several nodes by using a group signature mechanism which is based on polynomial secret sharing.

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HIGH SPEED CMOS COMPARATOR

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ABSTRACT

The design & analysis of a latching comparator using dynamic topology for high speed CMOS comparator. The designed dynamic latch comparator is requiring for high speed analog-to-digital converter to get faster signal conversion. This thesis discusses the design and analysis of a high speed dynamic latched CMOS comparator, based on an analytical approach which gives a deeper insight into the associated trade-offs. Simulation results have been obtained by using 90nm technology, considering supply voltage is 1v. The design is simulated by using SPICE tool. Propagation delay is achieved 0.015ns. Power dissipation is 1.1µw, offset voltage is 1.13mv, gain is 55dB achieved.

Keywords: Dynamic Latch, High Speed, Propagation Delay, Comparator

I. INTRODUCTION

This paper present the basic topologies, design decision and the theory needed to understand the latched comparator. The comparator is a critical part of almost all kind of analog-to-digital (ADC) converters. Depending on the type and architecture of the comparator, the comparator can have significant impact on the performance of application. The speed and resolution of an ADC is directly affected by the comparator input offset voltage, the delay and input signal range. Depending on the nature, functionality and inputs, comparators are classified into different four types (1) voltage and current comparators (2) continuous and (3) discrete time comparators etc. Some basic applications of comparators are analog-to-digital conversion, function generation, signal detection and neural networks etc. Comparator is widely used in the process of converting analog signal to digital signals. Low power & high speed ADCs are main building block in front-end of radio-frequency receiver in most of the modern telecommunication system. In the A/D conversion process, it is necessary to first sample the input & then comparator compares the voltages that appears at their input & output a voltage represents the sign of the net difference between them[2].

II. BASIC CMOS COMPARATOR

The schematic symbol and basic operation of a voltage comparator are shown in fig.1. The comparator can be thought of as a decision making circuit. The comparator is a circuit that compares an analog signal with another analog signal or reference and outputs a binary signal based on the comparison. If the +, VP, the input of the comparator is at a greater potential than the -, VN, input, the output of the comparator is a logic 1, where as if the + input is at a potential less than the – input, the output of the comparator is at logic 0.

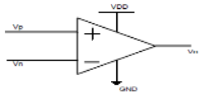

Fig.1: Comparator Operation

This sampled signal is then applied to a combination of comparators to determine the digital to analog signal. Simply we can say that, the comparator can be considered as a 1-bit analog-digital converter. [11],[12].The open-loop comparators are basically op amps without compensation. Regenerative comparators use positive feedback, similar to sense amplifiers or flip-flops, to accomplish the comparison of the magnitude between two signals. A third type of comparator emerges that is a combination of the open-loop and regenerative comparators. This combination results in comparators that are extremely fast. [3],[4].

2.1 Dynamic Latch

Latched means, it uses positive feedback mechanism with one pair of back-to-back cross coupled inverters in order to convert a small input voltage difference to a full scale digital level in less time period. Latched comparator use positive feedback mechanism to regenerates the analog input signal into a full scale digital level output signal.[2]. A dynamic latch is defined as the memory unit that stores the charge on the gate capacitance of the inverter.[1]

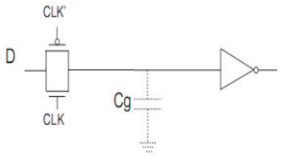

Fig.2 Simple Dynamic Latch

III. LITERATURE REVIEW

Dhanisha N. Kapadia et. al.[13]presented, design of a CMOS charge sharing dynamic latch comparator along with the Buffer stage in 130nm and 90nm technologies. The propagation delay is the time required to the change in output with respect to the change in input. Supply voltage is 1.3v an 0.9v, Propagation delay achieved is 2.13ns & 0.75ns for 130nm & 90nm technology respectively.

Smriti Shubhanand, A.G.Rao et. al.[4]presented, a CMOS comparator that reduces the overall propagation delay & provides higher speed. Here conclude that by using latched comparator design we can increase speed & decrease the propagation delay. Also referring input design circuit, can reduce latch offset voltage & power consumption & hysteresis response. Here, supply voltage is 1v.Propogation delay achieved is 1.787ns.Here 0.25µM technology is used.

Bao-ni Han, Yin-tang Yang, Zhang-ming Zhu et. al.[6]presented, Based on pre-amplifier latch theory, composed pre-amplifier includes positive & negative resistance connected in parallel as its load, a regenerative latch & simple output stage. Multistage open loop comparator is difficult to reach a speed of GSPS (giga sample per second) due to limited bandwidth amplifier. Power supply is 1.8v, maximum offset voltage is 0.6mv and high clock frequency is 1.25GHZ. Here 0.18µM technology is used.

IV. DESIGN PROCESS OF THIS WORK

A high speed latched comparator using positive feedback based back to back latch stage, suitable for pipelined Analog to Digital converter, with reduced delay and high speed is proposed.

During the RESET PHASE, when *Clk* is LOW (*Clk* =0), transistor NMOS_3 is in off state and pmos transistors PMOS_3, PMOS_9, PMOS_4, PMOS_10 are in on state. Transistors NMOS_1 and NMOS_2 are in cut-off mode. Switch transistors PMOS_3, PMOS_9, PMOS_4, and PMOS_10 will charge the drains of transistors

NMOS_ 1 and NMOS_2 and the output nodes Outp and Outn towards *DD V* . During the REGENERATION PHASE, when *Clk* is HIGH (*Clk* =1),

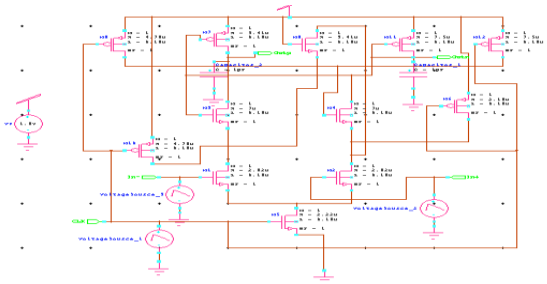

Fig. 3. : High Speed CMOS Comparator

The process starts by turning the transistor NMOS_3 on and immediately an current 'I' starts to flow and the drain of transistor NMOS_3 starts to discharge towards Gnd. In succession the differential input transistors NMOS_1 and NMOS_2 are turned on. The currents of transistors NMOS_1 and NMOS_2 , will start to pull the output nodes Outp and Outn towards Gnd. Due to the difference of voltages between the input signals, the current at the drain terminals of transistors NMOS_ 1 and NMOS_2 will be different. Now in the regeneration mode the output node are discharging Gnd and pmos transistors PMOS_1 and PMOS_2 will come in saturation mode as the voltage at output nodes falls below | | *DD tp V* − *V* . So a strong positive feedback will enhance the output signal. This regeneration process is completed when one Nmos transistor comes in cut off mode. The design is simulated using 90nm CMOS Technology using Tanner EDA Tools. Proposed design exhibits reduced delay and high speed with a 1.0 V supply. This design can be used where high speed and low propagation delay are the main parameters.

IV. SIMULATION RESULTS

The design is simulated in the design is simulated in 0.25µm CMOS Technology using Tanner EDA Tools. Comparator design shows reduced delay and high speed with a 1.0 V supply. Finally simulation results of the comparator are given below, when a differential signal is applied as an input to the latched comparator. The simulated results are shown below

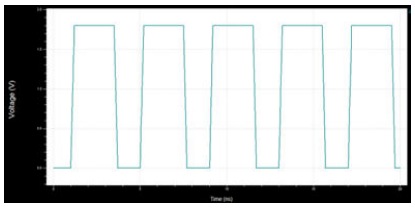

Fig.4 clk

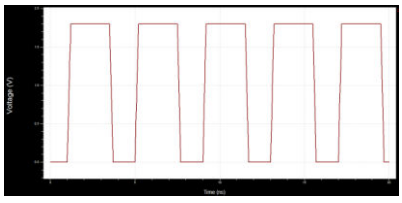

Fig. 5 vin

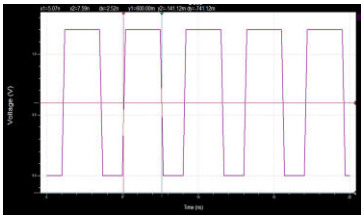

Fig 6 output waveform TLH

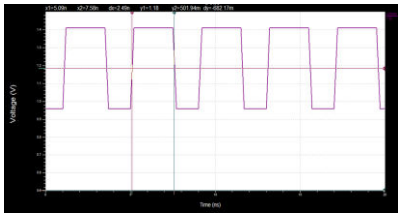

Fig 7 output waveform THL

For, this simulation result, Where TPHL and TPLH are the time difference between 50% of the output and 50% of the input.

tlh = 5.09-5.07 = .02ns, thl = 7.59-7.58 = .01ns

Total propagation delay=0.02+0.01=0.03/2=0.015ns.For this simulation propagation delay is 0.015ns.

V. PERFORMANCE COMPARISON

SPECIFICATION	Present work	Present work	Previous work[1]
Technology	0.18 µm	90nm	90nm
Topology	Dynamic latch	Dynamic latch	Charge Sharing Dynamic Latch Comparator
Input voltage	1.8v	1v	0.9v
Power dissipation	6.6mv	1.1µw	4.89mw
Gain	64db	55db	-
Offset voltage	-	1.13mv	-
Propagation delay	0.56ns	0.015ns	0.75ns

This table gives the comparison between 90nm &0.18µm CMOS technology for respective parameter.

VI. CONCLUSION

This paper presents High Speed Dynamic Latch Comparator fundamentals along with scope of improvement.. One of its features is that, it's using less no. of transistor and improve W/L ratio of transistor. Hence, speed of comparator is increases.

Following Limitations of this are observed:

1. Decrease no. of transistor
2. Improve W/L ratio of transistor

The core focus of this paper is to provide solution to above mentioned limitations for high speed comparator. So to achieve above limitation, different W/L ratio is used according mathematical equation. By using mathematical operation achieved different value of W/L, by simulating that result propagation delay will decrease.

VII. ACKNOWLEDGEMENT

I extend my sincere thanks to Prof. Kehul Shah for providing me the right guidance as well as for their support, encouragement and facilities in completing this work.

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ANALYTICAL STUDY OF ELECTRODE CADMIUM OXIDE NANOPARTICLES

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ABSTRACT

Includes this research, preparation of Cadmium Oxide nanoparticles (NPs) that has been prepared from materials primary using microwave-assisted method. CdO NPs were characterized by X-ray Diffraction (XRD and Scanning Electron Microscopy (SEM) . That the size NPs of CdO were about (17.44nm) as calculated from the Scherrer formula from the most intense XRD peak. In addition to comparison between CdO NPs and CdO Microparticles (MPs) by using the thermal analysis (TG,DTG,DTA). Includes this research, a Cd^{2+}-selective electrode based on poly vinyl chloride (PVC) was prepared by using CdO NPs powders synthesized and di-butyl phthalate (DBP), In addition to a comparison between the specification analytical for CdO NPs electrode and CdO MPs electrode. CdO NPs electrode and CdO MPs electrode give linear rang of (10^{-2}-10^{-5})M and (10^{-2}-10^{-4})M, Nernstain slope of (30.18 mV/decade) and (31.77 mV/decade), correlation coefficient of (0.999) and (0.998), detection limit of ($1.0044x10^{-7}$)M and ($2.8458x10^{-6}$)M, quantitative limit of ($3.348x10^{-7}$)M and ($9.486x10^{-6}$)M, the response time of (6-35) second and (10-33) second, respectively. The lifetime for each of electrode was 13 days. The optimal conditions for each of CdO NPs electrode and CdO MPs electrode were (5.5-7),(20-30 ℃),(10^{-4})M for pH, temperature and concentration of filling solution respectively. In addition to a measurement selectivity of these electrodes using mixed solutions method, the results showed that the selectivity coefficient values for all interferences ions are less than one, and make some applications of these electrodes using direct method and multiple standard addition method.

Keywords*: *Cadmium Oxide, Microwave, Analytical Study, Nps, Cdo Nps Electrode.

I. INTRODUCTION

The term nanotechnology was defined by the National Nanotechnology Initiative as the manip- ulation of matter with at least one dimension sized from (1-100) nm (1nm = 10^{-9} m) [1]. Oxides nanomaterials have physical and chemical properties special are not available when they are in the normal case [2]. Oxide nanomaterials applied as catalysis and starting materials for preparing highly developed structural ceramic [3]. CdO as important semiconductor has promising applications in catalysis [4], sensors [5], solar cells [6], photodiodes [7], phototransistors [8] and transparent electrodes [9]. CdO nanoparticles can be producted by coprecipitation, sol-gel, hydrothermal synthesis [10]. In this paper, we report that preparation of CdO nanoparticles using microwave-assisted method because the method is generally fast, simple, energy-efficient and less time-consuming [11]. An ion-selective electrodes (ISEs) is defined as an electroanalytical sensor with a membrane whose potential indicates the activity of the ion to be determined in a solution [12]. Prefer method of

ISEs on a lot of spectroscopic methods in the analysis processes for being fast, simple, with a range of linear wide, not affect by the color of the sample, not expensive, easy construction and functionality, not affect by the test solution, and portable [12,13].

II. EXPERIMENTAL PART

2.1 Apparatus

Microwave oven (Russell Hobbs-RHM 1714B-England). X-ray Diffraction (XRD)(Shimadzu-6000 Japan). Scanning Electron Microscopy (SEM) (TESCAN-VEGA Easyprobe- USA). Thermal Analysis (Diamond TG/DTA model (SII) Perkin-Elmer). pH meter (HANNA pH meter-211 Germany). Calomel Electrode. Silver/Silver Chloride Elect-rod. Electronic Balance (Sartorius Germany). Ultrasonic bath (DAIHAN Labtech-LUC 405 Korea). Dry oven (Termaks-TS8056 Norway). Muffle (Carbolite-CWF 12/5 England).

2.2 Chemicals

All chemicals used were high purity and were obtained from BDH, Fluka, GCC, Merck and Riedel-dehaen.

2.3 Preparation of Solutions

Use deionized water (DIW) for solvent and preparation of solutions, as follows:

1. 0.05 M of Cadmium acetate dehydrate by dissolving of 0.666 gm in 50 ml DIW. 2. (0.1, 0.4) M of Sodium hydroxide by dissolving of (0.4, 1.6)gm in 100 ml DIW, respectively. 3. 0.1 M of Cadmium acetate dehydrate (Cd^{2+}) by dissolving of 2.664 gm in 100 ml DIW, prepared other solutions (10^{-2}-10^{-6}) M by dissolution with DIW. 4. 0.1 M of Hydrochloric acid in 100 ml DIW. 5. 0.01 M of Potassium chloride (0.1865gm in 250 ml DIW). 6. 0.01 M of Sodium chloride (0.1463 gm in 250 ml DIW). 7. 0.01 M of Nickel nitrate hexahydrate (0.7268 gm in 250 ml DIW). 8. 0.01 M of Magnesium sulfate (0.3008gm in 250 ml DIW). 9. 0.01 M of Zinc chloride dihydrate (0.4309gm in 250 ml DIW). 10. 0.01 M of Cadmium sulfate (0.521gm in 250ml DIW) prepared other solutions (10^{-3},10^{-4}) M by dissolution in DIW.

2.4 Preparation of CdO Nanoparticles

For preparation of CdO NPs, 100 ml of 0.4 M Sodium hydroxide solution and 50 ml of 0.05 M Cadmium acetate dihydrate solution were mixed slowly. The above solution was stirred for 40 min at pH value for solution was (13.1). After that, this solution was put for microwave irradiation in two steps, that is, 700 W for 10 min and 420 W for 20 min. After that, obtained solution was cooled at room temperature and filtered. The obtained white precipitate was washed with DIW (2-3) times. Obtained precipitate was dried at 95 ℃ for 50 min. After complete drying, powder was crushed using mortar pestle. Then, a white powder was calcinated at (400 ℃ for 1 h). A dark yellow precipitate of CdO NPs was characterized using SEM, FT-IR and XRD with Cu Kα (λ = 0.15405 nm) incident radiation. XRD patterns were recorded from 10˚to 80˚(2θ).

2.5 Preparation of Electrodes

Use this method in preparation CdO NPs membrane electrode and CdO MPs membrane electrode for determination Cadmium ions (Cd^{2+}). Firstly, 0.4 gm of Poly vinyl chloride (PVC) dissolved in a mixture composed of 8 ml acetone and 8 ml tetrahydrofuran (THF) by using ultrasonic bath. Then, added to the mixture 0.1 gm of CdO NPs or CdO MPs and mixed thoroughly using ultrasonic bath for 5 min. After that, added 0.45

ml of plasticizer material di-butyl phthalate to the mixture and mixed thoroughly using ultrasonic bath, and then shifted the mixture solution to a glass petri dish (60 mm diameter) and kept at room temperature for about 24h. The solvent was evaporated slowly until a membrane of about 0.3 mm thick was formed. A desired piece of the membrane was cut and then glued to one end of a Perspex tube (15 mm internal diameter and 9 cm long) using THF solvent with carefully. The perspex tube was then filled with an internal filling solution 0.01 M of Cadmium acetate dihydrate (Cd^{2+} ions). The electrode was finally conditioned for 24h by soaking in a 0.01 M of Cd^{2+} ions. A Silver/Silver chloride electrode was used as the internal reference electrode.

The electrochemical cell can be represented as follows: Ag/AgCl | internal filling solution | membrane | sample solution | Hg/Hg_2Cl_2,KCl (sat'd).

2.6 Calibration Curve of CdO Electrodes

20 ml of deferent concentration of Cadmium ions solutions in the range (10^{-1}-10^{-6}) M were placed in series often of 40 ml beakers. Then, the potential was taken of these solutions by using the membrane electrodes prepared of CdO NPs and CdO MPs at concentration of filling solution = 10^{-4} M, pH = (5.5-7) and T = (20˚-30℃) for each of CdO NPs membrane electrode and CdO MPs membrane electrode.

IV. RESULTS AND DISCUSSION

3.1. X-ray Diffraction and Scanning Electron Microscopy of CdO NPs

Fig. 1 shows XRD pattern of CdO NPs. The mean particles size (D) in nm calculated by using Scherrer's formula [14]:

$$D = \frac{0.9\lambda}{\beta \cos\theta} \qquad \text{i.e., (1)}$$

where, λ is the X-ray wavelength (λ = 0.154nm), β is the full width at half maximum (FWHM – in radian) at a selected 2θ. The results XRD of CdO NPs were the peaks at 2θ = (33.0223˚, 38.3136˚, 55.2793˚, 65.919˚ and 69.2915˚) at FWHM = (0.475˚, 0.5171˚, 0.5333˚, 0.4333˚ and 0.58˚) at a selected 2θ respectively. The mean particles size of CdO NPs was about 17.44 nm. Fig. 3 shows SEM of CdO NPs.

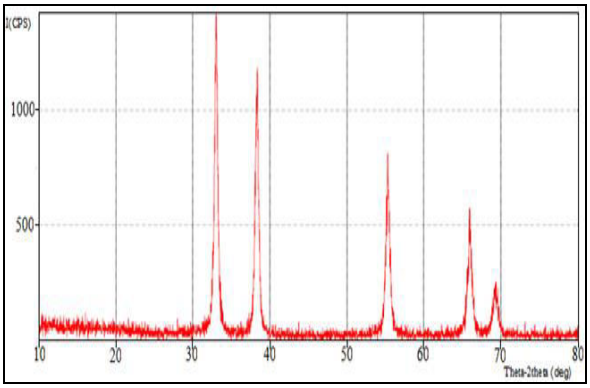

Fig. 2: XRD pattern of CdO NPs

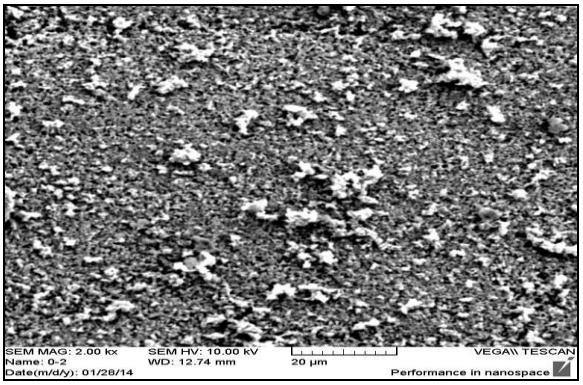

Fig. 3: SEM of CdO NPs

3.3. Thermal Analysis of CdO NPs and CdO MPs

Fig. 4 shows thermal analysis of CdO MPs that has been on several levels. The first level, this level began at temperature (40.32℃) with slight increase in weight of (0.0173 mg) and ended at (112.7℃), this level was accompanied it the emission of high temperature resulted about this increase that appear on DTA curve. The

second level, this level began at (113℃) with sharp decrease and slight in weight of (0.1154 mg) and ended at (225.2℃), this level was accompanied it a sharp peak on DTG curve express about began and ended of this level, accompanied this level an increase in enthalpy that resulting from this change of chemical, increase enthalpy appear on DTA curve. The third level, this level began at (225.5℃) with sharp decrease in weight of (0.2579 mg) and ended at (425.6℃),accompanied this increase a large peak an exothermic on DTA curve and a sharp peak on DTG curve express about began and ended the change of chemical. Then, stabilized the change in weight even (500℃). That the total weight lost in the second level and the third level was (0.3733mg) with percentage (3.27%) of the total weight of oxide MPs. The fourth level, this level began at (500℃) with slight increase in weight of (0.0609 mg) and ended at (911.5℃), accompanied this level more than one peak on DTG curve. Then, came back the weight a decrease even the end of heating. But the Fig. 5 shows thermal analysis of CdO NPs that has been on several levels. The first level, this level began at (28.6℃) with slight decrease in weight of (0.0615mg) and ended at (80℃), accompanied this level an increase in enthalpy that appear on DTA curve and a sharp peak on DTG curve express about began and ended this level. The second level, this level began at (80.38℃) with decrease in weight of (0.2398 mg) and ended at (680℃), express this level about change of chemical an exothermic that showed from a large peak on DTA curve. Then, stabilized the change in weight even (900℃). The third level, this level began at (900℃) with sharp decrease and slight in weight of (0.0656 mg) and ended at (1000℃).

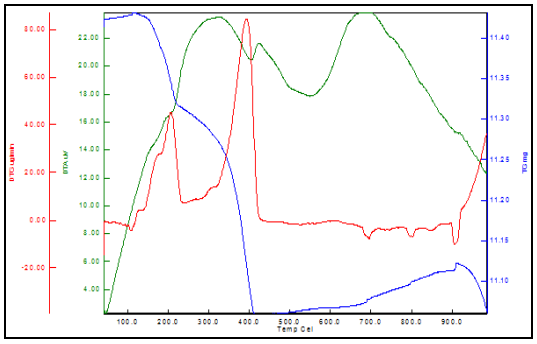

Fig. 4: Thermal analysis curves of CdO MPs

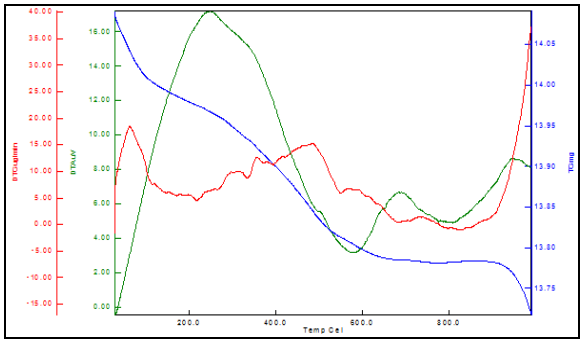

Fig. 5: Thermal analysis curves of CdO NPs

3.4. Experimental Condition of CdO NPs Electrode and CdO MPs Electrode

Fig. 6a,6b and table 1 show concentration affect for filling solution on the electrode response. The concentration 10^{-4} M was a better filling solution for each of CdO NPs electrode and CdO MPs electrode comparison with other filling solutions.

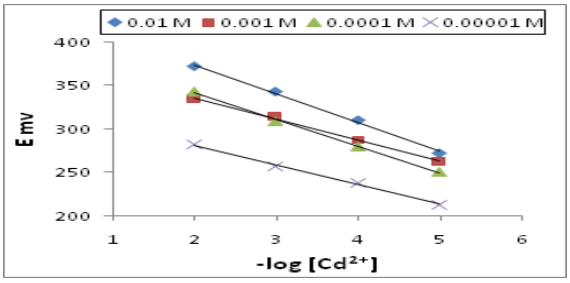

Fig. 6a: Concentration affect for filling solution on CdO NPs electrode response

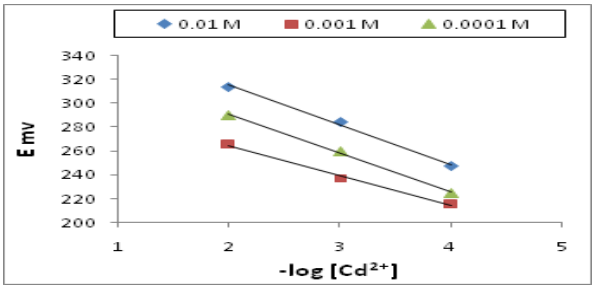

Fig. 6b: Concentration affect for filling solution on CdO MPs electrode response

Table 1: Concentration affect for filling solution of electrodes response for CdO NPs and MPs

parameters	CdO NPs electrode				CdO MPs electrode		
Filling solution (M)	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-2}	10^{-3}	10^{-4}
Slope (mV/decade)	32.9	24.28	30.51	22.6	33.5	25.15	32.35

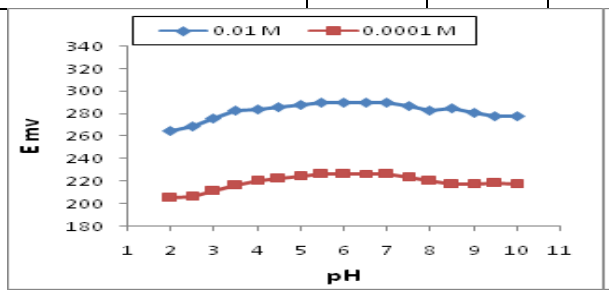

Fig. 7a: pH affect on electrode response of CdO NPs

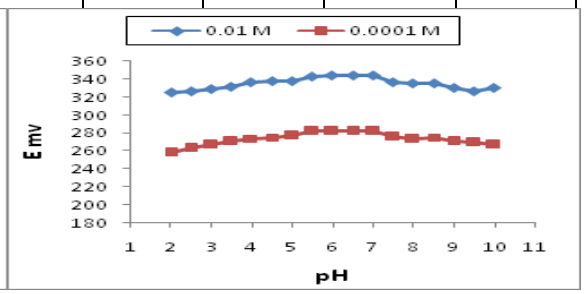

Fig. 7b: pH affect on electrode response of CdO MPs

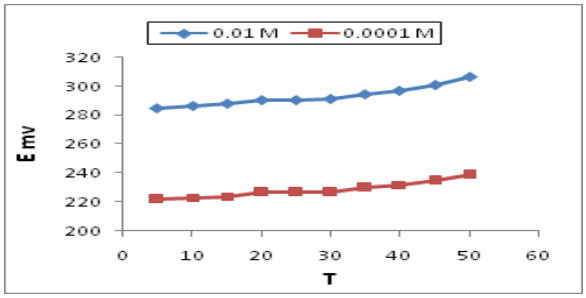

Fig. 8a: Temperature Affect on Electrode Response of CdO NPs

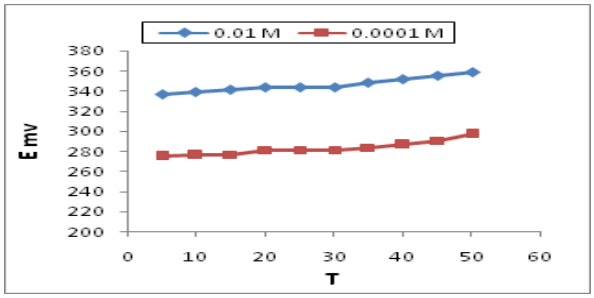

Fig. 8b: Temperature Affect on Electrode Response of CdO MPs

Fig. 7a and 7b show pH affect on electrode response of CdO NPs and CdO MPs.

Fig. 7a and 7b showed the potential keep constant from pH 5.5 to 7 for each of CdO NPs electrode and CdO MPs electrode. The observed potential drift at lower pH (<5.5) may be attributed to the membrane response to H^+ ions and at higher pH values (>7) could be due to the formation of some hydroxyl complexes of Cd^{2+} ions in solution [15]. Fig. 8a and 8b show temperature affect on electrode response of CdO NPs and CdO MPs. The potentials keep constant at temperature (20˚-30℃) for each of CdO NPs electrode and CdO MPs electrode.

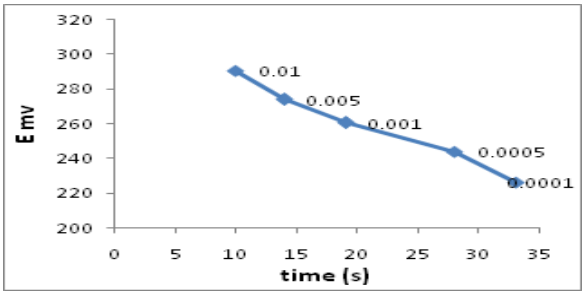

Fig. 9a: Response time of CdO NPs electrode

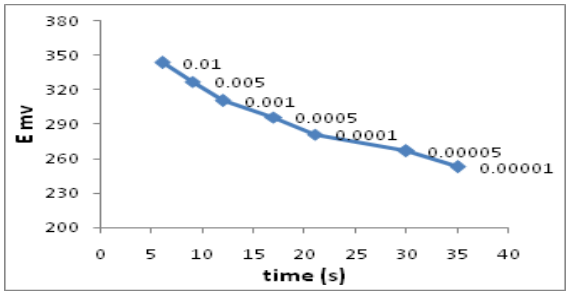

Fig. 9b: Response time of CdO MPs electrode

Fig. 9a and 9b show response time of CdO NPs electrode and CdO MPs electrode.

Fig. 9a showed the response time of CdO NPs electrode at (6-35) second for concentrations at range (10^{-2}-10^{-5}) M was better more than (Fig. 9b) that showed the response time of CdO MPs electrode at (10-33) second for concentrations at range (10^{-2}- 10^{-4}) M.

3.5 Calibration Curve of CdO Electrodes

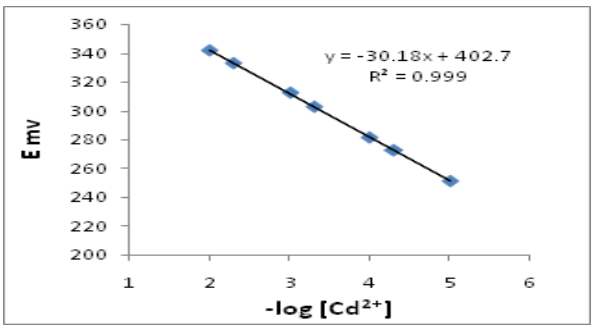

Fig. 10a: Calibration curve of CdO NPs electrode

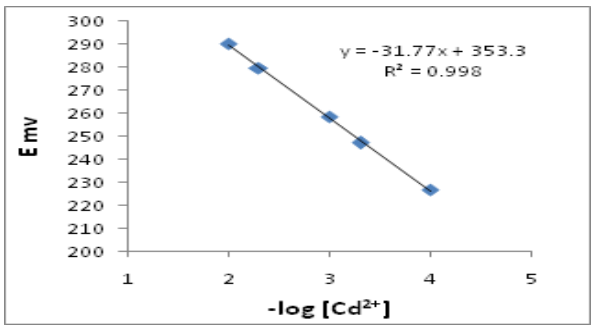

Fig. 10b: Calibration curve of CdO MPs electrode

Fig. 10a and 10b show calibration curve of CdO electrodes for determination Cd^{2+}. Table 2 shows results of calibration curve of CdO electrodes for determination Cd^{2+}. Table 3 shows accuracy and compatibility of results calibration curve of CdO electrodes. Table 4 shows limit of detection and limit of quantitative of CdO electrodes.

Table 2: Results of calibration curve of CdO electrodes

Parameters	CdO NPs electrode	CdO MPs electrode
Linear range (M)	$10^{-2} – 10^{-5}$	$10^{-2} – 10^{-4}$
Nernstain slope (mV/decade)	30.18	31.77
Correlation coefficient	0.999	0.998

Table 3: Accuracy and compatibility of results calibration curve of CdO electrodes

parameters	CdO NPs electrode		CdO MPs electrode	
Conc. of Cd^{2+} (M)	10^{-2}	$5X10^{-3}$	10^{-2}	$5X10^{-3}$
Potential[a] (mV)	341.91	333.3	290.35	279.75
Conc. found (M)	$0.9677\ X10^{-2}$	$5.0172\ X10^{-3}$	$1.0437\ X10^{-2}$	$4.8409\ X10^{-3}$
RSD%	0.2426	0.1809	0.3472	0.3322
RE%	- 3.23	0.344	4.37	- 3.182
Rec%	96.77	100.344	104.37	96.818

[a] Average of seven determinations.

RSD%, relative standard deviation.

RE, relative error. Rec%, recovery percentage.

Table 4: Limit of detection and limit of quantitative of CdO electrodes

Parameters	CdO NPs electrode	CdO MPs electrode
Conc. lower of calibration curve (M)	10^{-5}	10^{-4}
Potential[a] (mV)	251.65	226.9
Standard deviation	0.84252	2.15237

Limit of detection (M)	1.0044×10^{-7}	2.8458×10^{-6}
Limit of quantitative (M)	3.348×10^{-7}	9.486×10^{-6}

[a] Average of seven determinations.

Limit of detection (L.O.D) calculated by the following equation [16] :

$$\textbf{L.O.D} = 3 \times S \times \text{conc.} / X^{-} \qquad \textbf{i.e., (2)}$$

Limit of quantitative (L.O.Q) calculated by the following equation [16] :

$$\textbf{L.O.Q} = 10 \times S \times \text{conc.} / X^{-} \qquad \textbf{i.e., (3)}$$

where, S is standard deviation, conc. is concentra-tion lower of calibration curve, X^{-} is average for series of potentials.

3.6. Selectivity of CdO electrodes

The selectivity coefficient ($K_{A,B}^{Pot}$) of CdO NPs electrode and CdO MPs electrode for determin-ation of Cd^{2+} ions towards different cations and anions were determined by mixed solution method. The concentration of Cd^{2+} ions were $(10^{-2}, 10^{-3})$ M and the concentration of interfering ions were 10^{-2} M. The calculation formula of ($K_{A,B}^{Pot}$) is as follows when the concentration of Cd^{2+} ion and interfering ion are equal [17] :

$$K_{A,B}^{Pot} = \frac{C_{A\,min} \times P}{C_{B\,max} \times 100} \qquad \textbf{i.e., (4)}$$

where, $K_{A,B}^{Pot}$ is selectivity coefficient of sample ion (A) towards interfering ion (B), $C_{A\,min}$ is concentration lower of sample ion, $C_{B\,max}$ is concentration maximum of interfering ion, P is the relative error of sample ion (A) towards interfering ion (B). Table 5 shows the values of selectivity coefficient of CdO electrodes for determination Cd^{2+} ions.

Table 5: Values of Selectivity Coefficient of CdO Electrodes for Determination Cd^{2+}ions

Interfering ion of 10^{-2} M	CdO NPs electrode		CdO MPs electrode	
	Conc. of Cd^{2+} (M)		Conc. of Cd^{2+} (M)	
	10^{-2}	10^{-3}	10^{-2}	10^{-3}
K^{+}	-0.0166	-0.0043	-0.0224	-0.0066
Cl^{-}	-0.0331	-0.0063	-0.0399	-0.0097
Ni^{2+}	0.0199	0.0036	0.0478	0.0041
Zn^{2+}	-0.0232	-0.0055	-0.0253	-0.0052
SO_4^{2-}	-0.0497	-0.0071	-0.0703	-0.0073

From the data given in Table 5, it is obvious that these interfering cations and anions could not affect the selectivity of CdO electrodes for determination Cd^{2+} ions, because the values of selectivity coefficient of these electrodes are less than one. But the values of selectivity coefficient for CdO NPs electrode were better than the values of selectivity coefficient for CdO MPs electrode.

3.7. Lifetime of CdO Electrodes

Fig. 11a and 11b show lifetime of CdO NPs electrode and CdO MPs electrode. The lifetime for each of CdO NPs electrode and CdO MPs electrode were 13 days. After that, CdO NPs electrode and CdO MPs electrode appeared a negative shift, may be attributed to leakage the membrane constants of the polymeric based.

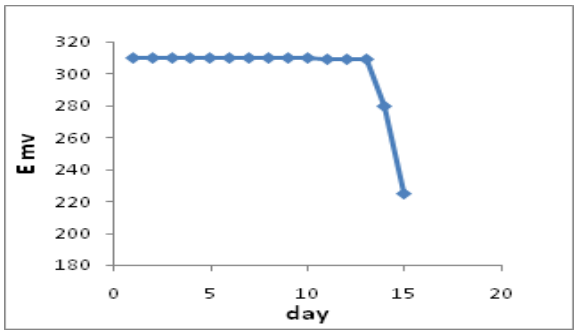

Fig. 11a: Lifetime of CdO NPs electrode

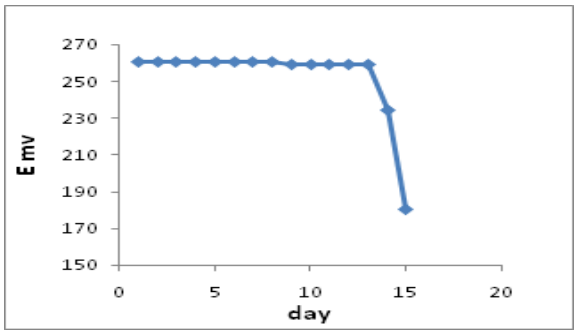

Fig. 11b: Lifetime of CdO MPs electrode

3.8. Analytical applications

Table 6 shows the application results using direct method for determination Cd^{2+} ions in Cadmium sulfate for concentrations (10^{-3}, 10^{-4}) M. The concentration of Cd^{2+} ions in Cadmium sulfate was calculated by linear equation of the calibration curve for each of CdO NPs electrode and CdO MPs electrode.

Table 6: Application Results using Direct Method for Determination Cd^{2+} ions in Cadmium Sulfate

Parameters	CdO NPs electrode		CdO MPs electrode	
Conc. of Cd^{2+} (M)	10^{-3}	10^{-4}	10^{-3}	10^{-4}
Potential[a] (mV)	312.1	282.1	259.3	226.5
Conc. found (M)	0.9954 X10^{-3}	1.00919 X10^{-4}	1.0227 X10^{-3}	1.0205 X10^{-4}
RSD%	0.4149	0.3143	0.4769	0.7328
RE%	- 0.46	0.919	2.27	2.05
Rec%	99.54	100.919	102.27	102.05

[a] Average of seven determination

Fig. 12a,12b and table 7 show the application results using multiple standard addition method for determination Cd^{2+} ions in Cadmium sulfate for concentration 10^{-4} M by using each of CdO NPs electrode and CdO MPs electrode. In this method several addition (0.5, 1, 1.5, 2, 2.5, 3) ml of 10^{-2} M Cadmium acetate dihydrate solution were added to series beakers contain 20 ml of 10^{-4} M Cadmium sulfate, the concentration of the unknown (Cd^{2+} ions of Cadmium sulfate) was calculated by the following equation [18] :

$$\mathbf{C_x V_x = - V_e C_s} \qquad \textbf{i.e., (5)}$$

where, C_x is the concentration of unknown, C_s is the concentration of added Cadmium acetate dihydrate (10^{-2} M), V_x is the volume of unknown (20 ml), V_e is the value (ml) at intercept with X axis (V_e calculated from linear equation of calibration curve of multiple standard addition method when y = 0).

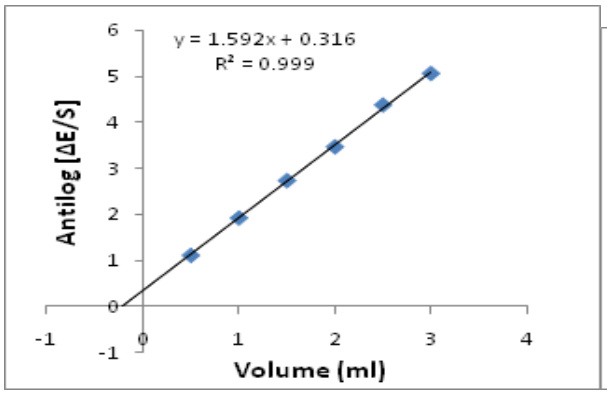

Fig. 12a: Calibration curve by multiple standard addition method for determination Cd^{2+} ions in Cadmium sulfate (10^{-4} M) by using CdO NPs electrode

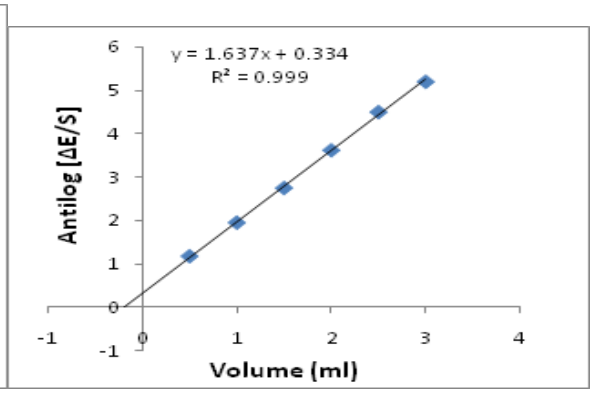

Fig. 12b: Calibration curve by multiple standard addition method for determination Cd^{2+} ions in Cadmium sulfate (10^{-4} M) by using CdO MPs electrode

Table 7: Application Results Using Multiple Standard Addition Method for Determination Cd^{2+} Ions in Cadmium Sulfate (10^{-4} M)

parameters	CdO NPs electrode	Cd MPs electrode
Conc. of Cd^{2+} (M)	10^{-4}	10^{-4}
Conc. found (M)	$0.9925x10^{-4}$	$1.02x10^{-4}$
RSD%	0.4351	0.6605
RE%	– 0.75	2
Rec%	99.25	102

IV. CONCLUSION

CdO NPs have been successfully prepared by using microwave-assisted method. The average particles size of CdO NPs were about 17.44 nm. CdO NPs more thermal stability compared with CdO MPs by using thermal analysis. CdO NPs electrode and CdO MPs electrode have been successfully prepared. The calibration curve and analytical results of CdO NPs electrode were better compared with calibration curve and analytical results of CdO MPs electrode.

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