Multiple Event Detection in WSN Using Compressed Sensing: Health Monitoring Perspective

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CERTIFICATE

This is to certify that project report entitled "Multiple Event Detection in WSN Using Compressed Sensing: Health Monitoring Perspective", submitted by Pooja Rani in partial fulfillment for the award of degree of Master of Technology in Computer Science & Engineering to Jaypee University of Information Technology, Waknaghat, Solan has been made under my supervision.

This report has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

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Date: Pooja Rani

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ABBRIVATION

S.No	ACRONYM	EXPANSION
1.	WSN	Wireless Sensor Network
2.	PRNET	Packet Radio Network
3.	CSMA	Carrier Sense Multiple Access
4.	SURAN	Survivable Adoptive Radio Network
5.	NTDR	Near Term Digital Radio
6.	GIOMO	Global Mobile Information System
7.	IETF	Internet Engineering Task Force
8.	PCMCIA	Personal Computer Memory Card International Association Cards.
9.	PILOT	Predefined Intelligent Lightweight Topology Management.
10.	TCP	Transport Control Protocol.
11.	MAC	Medium Access Control
12.	HM	Habitat Monitoring
13.	SHM	Structural Health Monitoring.
14.	RF	Radio Frequency
15.	ECG	Electrocardiogram
16.	EMG	Electromyography
17.	CBM	Condition based Maintenance
18.	CE	Composite Event
19.	CS	Compressed Sensing
20.	ANN	Artificial Neural Networks
21.	WHO	World Health Organization
22.	IMD	Implantable Medical Devices
23.	SOC	System On Chip
24.	PDA	Personal Digital Assistant
25.	MATLAB	Matrix Laboratory
26.	LINPACK	Linear System Package
27.	EISPACK	Eigen System Packet

ABSTRACT

Wireless Sensor Network (WSN) has tremendous growth due to low cost sensors and well planned techniques. Remote sensor systems are considered as expansive systems made of countless hubs with energy to detect the earth and discuss it with administrator. Event detection in remote systems is a method for handling inspected information specifically on the sensor hubs, accordingly, decreasing the requirement for multi-bounce correspondence with the base station of the system.

This research has studied the existing work of event detection as well as health monitoring using WSN. An algorithm has been proposed for route discovery by using trust model and GA (Genetic Algorithm). The relief of the impacts of health monitoring is done by ANN (Artificial Neural System). The assessment depends on QoS parameters, to be specific, Throughput, Energy Consumption, PDR (Packet Delivery Ratio).The comparison is being drawn of the basis of with and without GA. The performance analysis of the network with the scenarios consists of 50 nodes within the area 1000X1000 m^{2}.

CHAPTER 1: INTRODUCTION

1.1 WIRELESS SENSOR NETWORKS

The total life-cycle of Ad Hoc systems can be characterized in first, second, and third generation of Ad Hoc network systems. Currently, ad-hoc systems are deliberated as the third generation[1].The initial generation of wireless Ad Hoc networks are originated in 1972. At that particular time, it was termed as Packet Radio Networks (PRNET). Combining CSMA (Carrier Sense Multiple Access) as well as ALOHA, methodologies for the access control and alsoa kind of distance-vector directing technique, Packet Radio Networks existed be utilized on a test for making available several networking proficiencies within a struggling environment.

Next generation of Ad hoc networks was appeared in later 1980s and the ad-hoc network systems were much better and also executed as a Survivable Adaptive Radio Networks (SURAN) portion and provide a packet-switched network towards the mobile battleground in an environments deprived of arrangement. This program ascertained to be favourable in enlightening the radios' enactment by means of constructing them very much resilient, minor, as well as cheaper, to microelectronic attacks.

In late 1990s, the idea of marketable ad-hoc networks [1] was reached by means of PCs in addition to other practicable communications tools. Simultaneously, the notion of a group of mobile nodes was recommended by lot of research symposiums [2].

Almost immediately afterwards, the subcommittee of IEEE 802.11 standardized a middle access protocol that was established for the collision avoidance in addition to the terminals that are tolerated hidden, creating it functional for constructing mobile ad-hoc systems models from the notebooks and also 802.11 Personal Computer Memory Card International Association cards (PCMCIA) [3]. Wireless local region merchandises (IEEE 802.11, Hiperlan) arrange for in-building wireless access; nonetheless, they are customarily deployed by means of access links solitary, packet transmitting is being executed by traditional bridges or else routers.

Bluetooth is a cheap price technology designed for small range communique; its market place is directed in the direction of appliances, PCs, watches, phones, and so on. It is agreed to numerous nodes to link to each other in a multi-hop pre-arrangement.

Wireless Ad Hoc Networks can be classified into following groups [4]:

i. MANETs (Mobile ad-hoc networks),
ii. WSN (Wireless Sensor Networks),
iii. WMN (Wireless Mesh Networks)

Above described has various application zones; each and every single one of these diverges in the form of capacity with the capabilities of nodes which are usually going to take part in the network.

Wireless sensor networks are distributed over a wide area through a plurality of sensing nodes. They suspects the occurrence of event in the environment with the sensing nodes distributed or placed in accordance with the requirements of the application. The sensor system typically includes a wireless node having a combination of low-functions [5]. They work with others to perform tasks in a favourable environment. With advances in MEMS technology, in addition to digital physics, Wi-Fi device adds big event associated with the detector nodes [6]. This makes it to broaden their horizons associated with WSN for the practical feasibility.

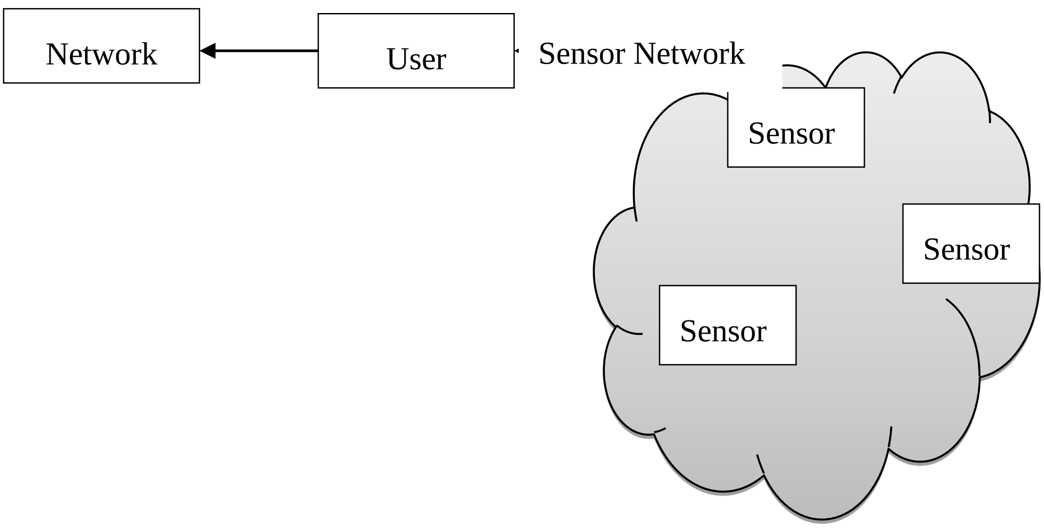

Figure 1: General model of wireless sensor networks

In figure 1, the general model of wireless sensor network is given in which target sensor node sends the data to other nodes to forward the message to sink node which further sends the data to internet to make it available for any user i.e. user can access that specific data from internet as shown above.

i. Nodes: Nodes sense the data and also transfers the relay messages to another node presented in the network.
ii. Sinks: These are the destinations of the data and could collect the data either directly or indirectly by using subsequent nodes. The sinks could utilize data coming from the sensors autonomously or formulate them on the Internet to interested users.
iii. Mobile Data Collectors: These are not the origin or destination, but only the intermediate node that collects data. The mobile data access each node for collecting the data. It may be a mobile receiver or a mobile relay.
iv. Re-locatable nodes: As compared to the mobile node, the node does not carry any information, and network topology changes. Use of predefined during link failures intelligent lightweight Topology Management (PILOT) to re-establish the connection node to the network takes place. When a node is not stable, they serve as a bridge.
v. Mobile Sinks: The mobile node is a destination, having high energy. They move and collect the data. Data can be collected via wireless Internet connection. Path between the node and the sink is not fixed, but varies with time. Path between the node and the receiver is a multi-hop.
vi. Mobile Relays: These are neither the source nor destination of the data, but they are middle nodes utilized for data passing.
vii. Mobile peers: Mobile peer is a common mobile sensor node in WSN-ME. They can be a source or can be used to deliver network messages. Their interactions are symmetric, because the sink itself can be a mobile. When the peer node in communication range, it can send its data, and can move within the sensing area to collect data from other peer nodes.

1.2 Architecture of Wireless Sensor Node

The basic figure of particular wireless sensor node is illustrated in below diagram. It has four elementary modules:

1. Sensing-unit,
2. Processing-unit,
3. Transceiver-unit,
4. Power-unit.

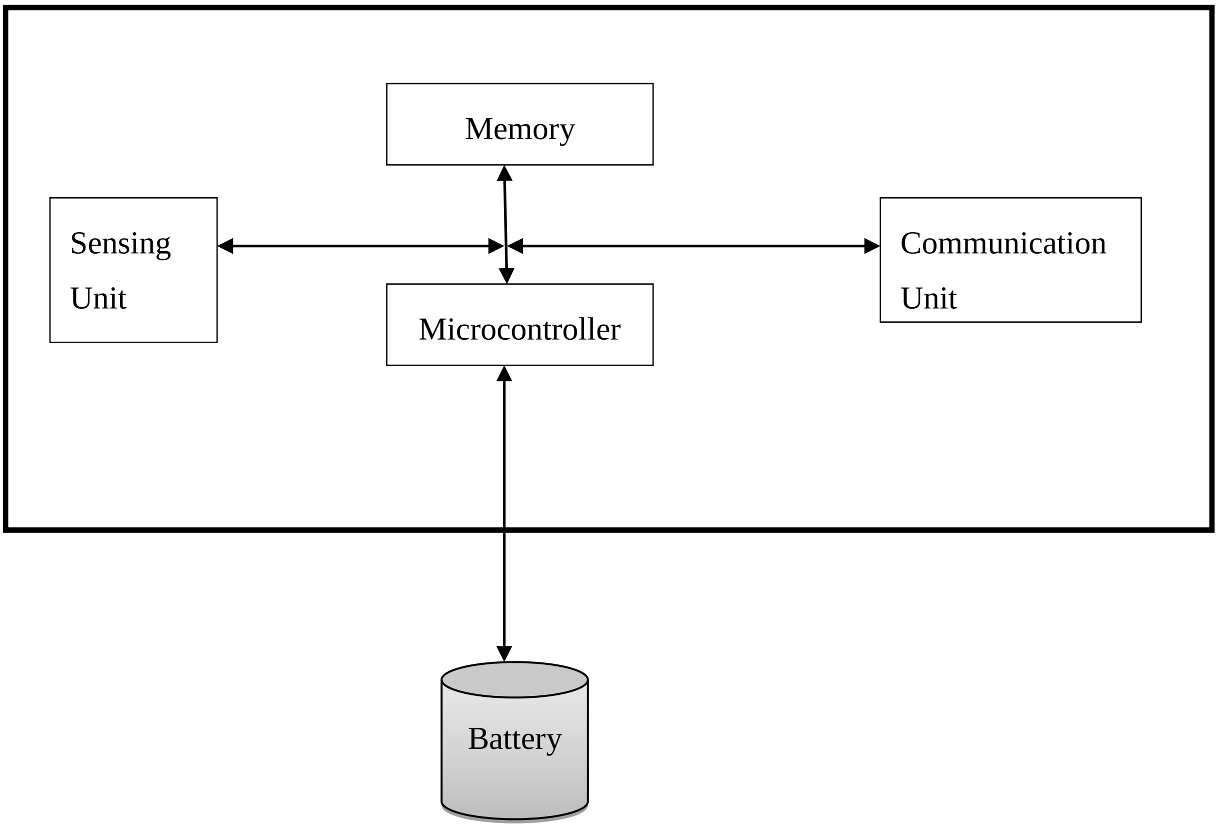

Figure 1: Wireless Sensor Node Architecture

i. Sensing Unit: These are generally made out of two subunits, namely,analog to digital converters (ADCs) and sensors. The sensor is a gadget which is used for making physical phenomena interpretation for electrical signs. The sensors could be either simple or advanced gadgets.

ii. There is a mixed bag for sensors for measuring ecological parameters, like, light force, temperature, sound, magnetic fields, picture etc. The analog signs are produced by the sensors for the observed phenomenon that changed over to digital signals by the Analog to Digital Convertors and latertransferred into the processing unit.

iii. Processing Unit: Most of the processing unit provides information on the sensor nodes. The processing unit includes a microprocessor, which is responsible for controlling the sensor, the sensor information on the methods of communication plays accumulation and signing process. The microprocessor is typically an Intel strong ARM Microchip, Atmel AVR microcontroller and TI MP430 microchip. In fact, it is possible to distinguish substantially four processor states of microprocessors that are off, sleep, idle, and dynamic. In sleep mode, CPU, and most of the internal peripherals are turned on, and should be performed by external events (interference). In idle mode, the CPU is still free, but different peripherals work.

iv. Transceiver Unit: Radio is capable of wireless communication with neighboring nodes and the outside world. It comprises of common 2.4GHz (global ISM band) in a group of unlicensed short-range radio operating at a low rate of a single channel of information, and the 868 to 870 MHz (Europe), 902-928 MHz (USA) or similar. For example, TR1000 series of jobs from RF Monolithic in the range of 800-900 MHz, transmits the power that can gradually move to 1.4 MW, and send up to 115.2 Kbps. Chipcon CC2420 is incorporated in MICAZ bits, are made as IEEE 802.15.4 standard that is agreed for remote LAN individual information rate and at low cost.

v. Battery: The battery gives energy to the total sensor node. It has a basic part in deciding sensor node lifetime. The measure of power drawn from a battery ought to be precisely observed. Sensor nodes are little, light and shabby and the extent of the battery is constrained. AA batteries ordinarily stores 2.2 to 2.5 Ah at 1.5 V. Nonetheless, these numbers change contingent upon the innovation used. For instance, Zinc–air-based batteries have higher limit in Joules/cm3 than lithium batteries.

vi. Besides, sensors must have a lifetime of months to years, since battery swap is impossible for systems with many physically installed nodes. This reason is for the energy utilization to be the most essential calculation for deciding sensor node lifetime.

1.3 Communication architecture of wireless sensor networks

The algorithm developed by wireless ad hoc network cannot used in sensor networks for different reasons. A number of sensor nodes are usually larger than the number of sensor nodes in a typical ad hoc network, prone to premature failure. Furthermore, the sensor nodes generally use a broadcast and point to point communication rather limited power and memory. The computer networks with the sensor node have no global ID, because the typical packet overhead may be too large.

The following diagram illustrates a sensor network protocol stack. The protocol architecture has wireless medium power and network protocols to promote collaboration sensor nodes. Stack consists of a physical layer, data link layer, network layer, transport layer and application layer, by the power management plane, mobility management, task management plane and support plane.

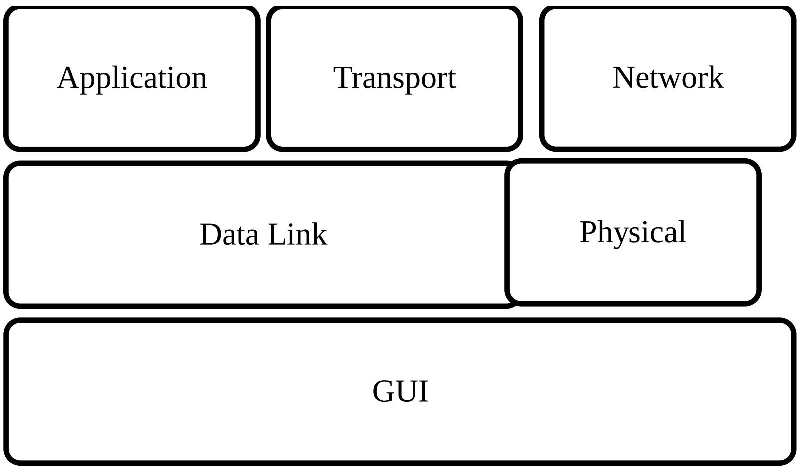

Figure 2: The sensor networks protocol stack

Above figure, shows protocol architecture for sensor networks.

Types of Wireless networks could possibly be categorized into two groups [7]:

i. Infrastructure Network: Infrastructure-based networks, the communication takes place between the nodes and wireless access point. Direct communication is taking place between wireless nodes. In this network, when a node leaves the range of the base station, it enters the range of any other base stations. Examples of web-based network are a cellular network. It is controlled by a centralized system controller such as a router. The main problem with this system is that if the controller fails, the whole system will collapse.

ii. Infrastructure-less Network: In the most trivial networks (such as point-to-point links); some technique/approach is required for routing the packages commencing the source towards the final destinations. This also contains maintenance in addition to discovery of routes together with associated costs.. Access points are much like base stations that are used to keep track of several nodes' authentication, associations or dis-associations, etc. and also regulate the traffic flow amongst their users and between associated access points [8].

1.4 WSN Applications

There are varieties of WSN applications and are classified into two categories: monitoring and tracking. Monitoring includes levels of temperature, humidity level, the level of ultraviolet radiation, stress level, noise level and so on. Movement of objects includes the direction of tracking, object, traveling at speed, the presence or absence of an object. Further, sensor application deployment environment varies. WSN can be deployed into the following environments: the military, the environment, health, public and private. [10].

1)Military Applications Based on Wireless Sensor Networks

Wireless sensor networks can be used for various purposes, such as monitoring of armed movements in remote areas, defense force by the military. Equipped with appropriate sensors, these networks can detect motion of the enemy, the enemy forces and analyzed its movement and progress.

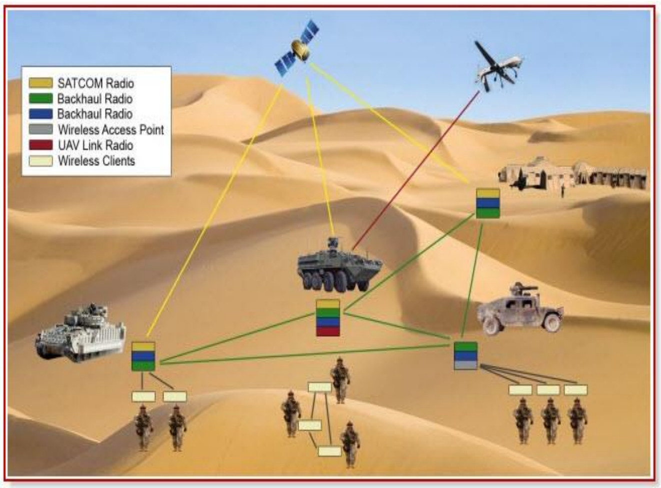

Figure 4 : Military Applications Based on WSN [11]

2) Environment Monitoring System

Environmental monitoring has become an important part of wireless sensor network application. With the recent development of technology, it is becoming more and more prevalent. In general, the environmental monitoring system monitors and controls the temperature, humidity, light and other environmental parameters and pressure [12].

3) Air pollution monitoring

Wireless sensor networks are used in many cities to track dangerous gas concentrations. It can use a wired network instead of the wireless network, which makes them more mobile in different areas of motion.

4)Forest fire detection

Sensor nodes of the network can be installed on forest for fire detection. Node can be equipped with sensors to measure temperature, humidity, and gas generated by the fire or woody plants.

Early detection is critical to the success of the action of the fire; fire department will be able to know when to fire, and how it is spread.

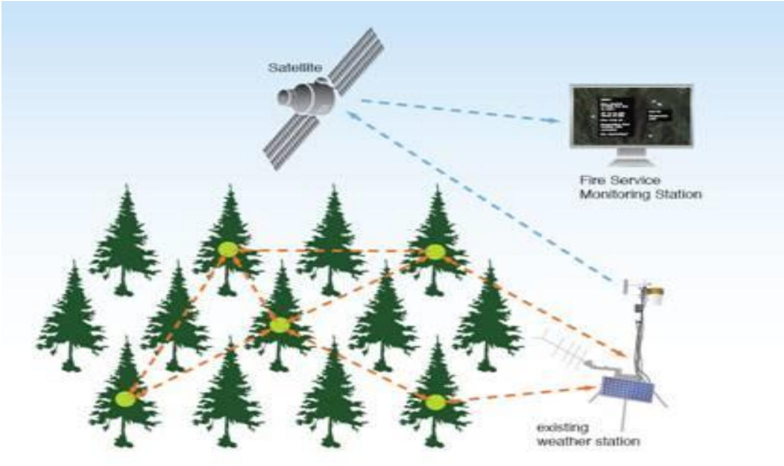

Figure 5 : Fire detection monitoring system[13]

5) Landslide detection

Detecting a change in the ground, and small movements of various parameters may occur before or during the landslide by using landslide detection system by means of wireless sensor network. By collecting data, it is possible to know the future landslides happen before they actually occur.

6) Water quality monitoring

To analyze the properties of water in rivers, dams, lakes and oceans, with the underground water reserves, one can utilize water monitoring. This is possible only with the help of wireless sensor networks.

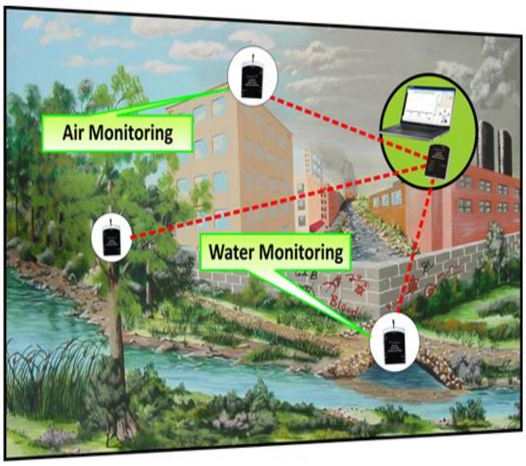

Figure6: Air monitoring and water monitoring using WSN[13]

It can generate an accurate water status, without the requirement of manual data retrieval.

7) Habitat Monitoring

Habitat Monitoring (HM) is an integral part of environmental monitoring. HM is the key to ensuring the animals and plants with no natural disturbances. Pollution caused great negative impact on the ecosystem. WSN is called as network-based system to efficiently manage alerts and pollution data [13].

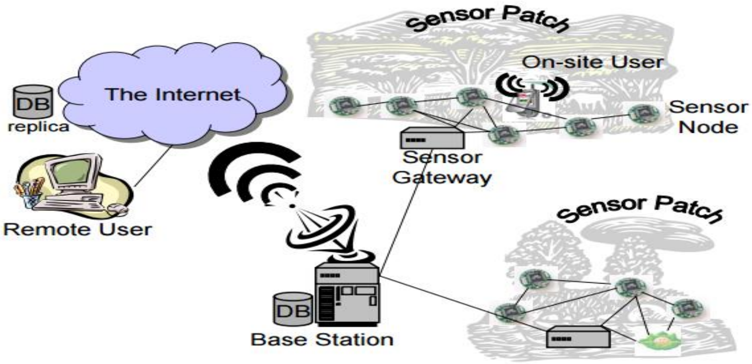

Figure7: System architecture for Habitat monitoring[13]

The lowest level of the sensing application is provided by independent sensor nodes. The small, battery-powered devices are placed in important areas. Each sensor node has two logic components:

1. The general purpose computing module.
2. Application of specific sensing module. This separation makes it more flexible platform, because of the different habitats that requires different sensor suite. Each sensor node collects the environmental data from its surroundings. Due to its proximity to an event of interest, the sensor can usually use smaller and cheaper sensors.

High spatial resolution can be achieved through dense deployment of sensor nodes. Compared with an approach which uses a few high quality sensors with sophisticated signal processing, this architecture provides higher robustness against occlusions and component failures.

8) Medical Applications Based on Wireless Sensor Networks

These days, the system of health care is extremely complex. WSN finds applications in medical field. Using RF technology, WSN monitors the patient’s health. In this scheme, transferring section constantly reads the temperature of patient's body by digital temperature sensor and displays it on the LCD screen and sends it to the processor that transmits the encoded serial data by the air by radio frequency (RF)via RF module. Sensor networks are utilized in various aspect of medical care [14]. By equipping patient with different medical equipment's or one can say with sensors, the physiological position of the patients could be determined. In emergency or in chronic diseases like Heart attack cancer, Diabetic patients, sensor networks could be utilized to track patient status and healthcare personnel as well as location continuously in real-time mode.

Figure 8: Health Application of WSN[14]

In the above figure, WSN is used to measure Body temperature, SPO_2 (oxygen and pulse in blood), breathing (airflow), ECG (electrocardiogram) is used to measure heart rate, Electromyography (EMG) is used to measure dieses related to muscles, GSR (galvanic skin response)-sweating, glucometer, blood pressure (sphygmomanometer) and patient position (accelerometer).WSN helps the researchers, developers as well as artists for measuring biometric sensor data for examination and experimentation purposes.

The healthcare architecture mainly consists of users/Patient, medical sensors and base station [15]. WSN has individual sensor nodes for collecting physical parameters, processes it and transforms the analog signal into digital signal and transmits data to memory for future use. The patient physical parameters are monitored within the hospital ward room using smart phone and laptop.

9)Industrial monitoring

Wireless sensor network technology creates a great potential for industrial applications, especially in the monitoring of pressure, humidity, temperature, flow, level, viscosity, density and vibration aspects of the data. Measurements can be collected by the sensing unit, and the wireless transmission to the host system for processing and management. Wireless sensor network to monitor the process provides greater advantages over conventional cable system.

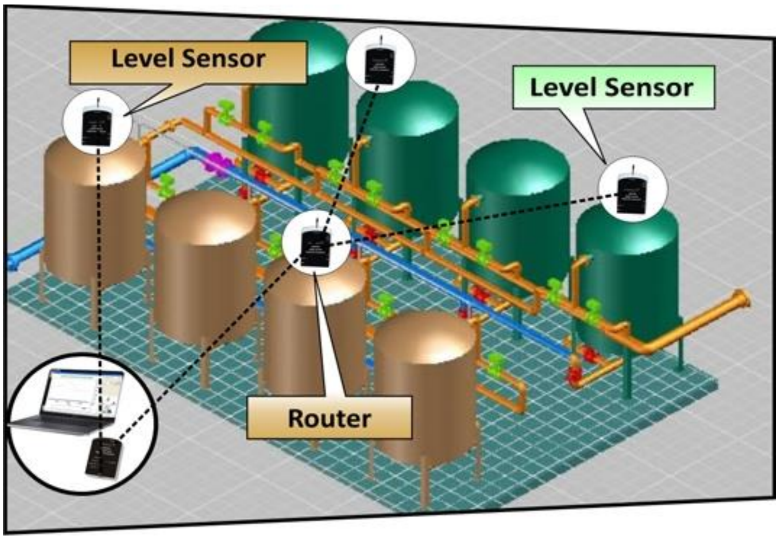

Figure 9: Industrial monitoring system using WSN[16]

10) Machine health monitoring

Wireless sensor networks have been used for CBM (condition-based maintenance), as they can allow significant cost savings and new features. Wireless sensor may be positioned at the position that cannot be reached through a wired system, for example, rotating machinery, and without a towing vehicle [16].

1.5 Event detection

It is the main tasks in WSN. Most of event detection techniques are used to detect simple event occurs in homogeneous WSN. In environmental monitoring, event detection and object tracking application plays an important role. Medical monitoring, military surveillance and vehicle tracking are a few examples of event detection. The reputation of the service is not limited to the application layer. Some wireless sensor network give the desired primitive, eg notification of the event, the event of the discovery could be for a variety of tasks in the application. Event detection is an important way to tap information from large amount of data generation. These events are usually divided into two types, ie simple (atoms) and composite (compound). A single sensor can detect the type of simple events, the sensed value is above / below a predetermined threshold, the composite events (CE) are combination of single event sensor to be noticed. [17].There are various event detection techniques like, Detection of fire in early stage, decrease the rate of damage and loss of life. For detection of fire, one should use a group of sensors and algorithm needed for the detection of some AI techniques used to detect the event [18].

1.6 Architecture of event detection

As the event detection and data processing plays an important role in wireless sensor network, there are different ways to process and transmit data within wireless sensor networks are developed and deployed.

i. Local Detection

The most basic way is the location of detection event. In this way, each node collects data from local sensors and uses algorithms for determining the local events infections. Regardless of data adjacent nodes, signal processing process the entire local node itself. If an event is detected, each node sends the results directly to the sensor network base station.

This method is easy to implement, but the cause of the communication overhead cannot be ignored, only for very simple type of event. An excellent execution could be found in the fence surveillance system given by Kim et al. [19].

ii. Centralized Evaluation

Centralized event detection is widely used in the current real-world deployment. All node sends raw data directly to the base station and calculates an important source of energy. The data to the base station with each sensor node does not understand the semantics of the data collected. However, this method has some advantages, e.g., an excellent detection accuracy of the global knowledge base available, the network does not scale well, and a continuous stream of data quickly exhaust the available energy.

iii. Decentralized Evaluation

Assessment dispersion is centralized way for alleviating the mentioned problems. In this way, a network is clustered into smaller sub-networks and operates autonomously. In each of these groups, the focus is on the collection, exchange and processing of sensory data. A node in the cluster called cluster-heads for the detection of an event or the raw sensor data to be sent by assuming the task communication with a base. Select the cluster head deployment that may incur additional computational and energy resources. For example, communicate directly with the base station via a cellular telephone network. The main advantage of this concept is its reliability, because even the individual sub-network fails, the network is still the main run. Another advantages of the energy savings are: a cluster node when an event occurs needs to exchange and process data to other nodes in the cluster remain in a low power state. The impact of the limitations of this approach will be evident in certain circumstances, because the network through the first cluster head selects the unknowable events.

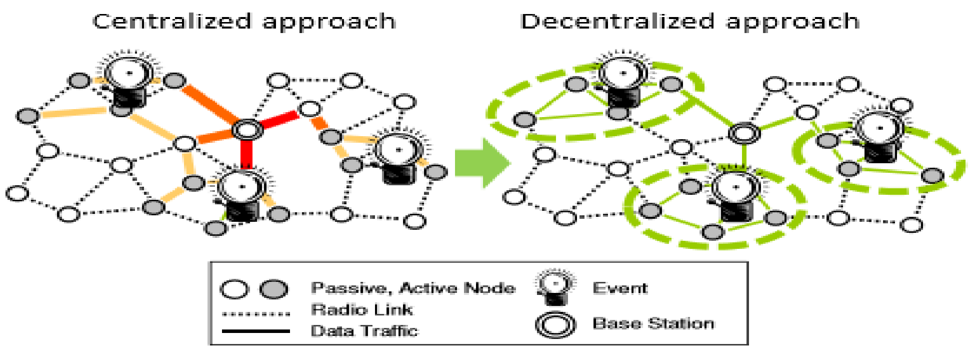

Figure 10: Centralized and decentralized event detection[18]

1.7 Multiple event detection

In simple event only single –mode data is detected. However, single mode data cannot describe the complicated phenomenon in physical word. For example, in military applications, we have to detect various parameters like light intensity, loud sound, smoke density and bomb detection are necessary. Therefore, for detecting more events we use composite event detection using WSN. Multiple event detection is also known as Composite event detection. Event complex is a combination of a plurality of atomic events. For example, the composite can be defined as an event of fire events mixing temperature and light. Only when both the light and the temperature rises above certain predetermined threshold value, the composite event occurs [20].

In the below sections, we expand the concepts around event detection using several multi-modal sensors.

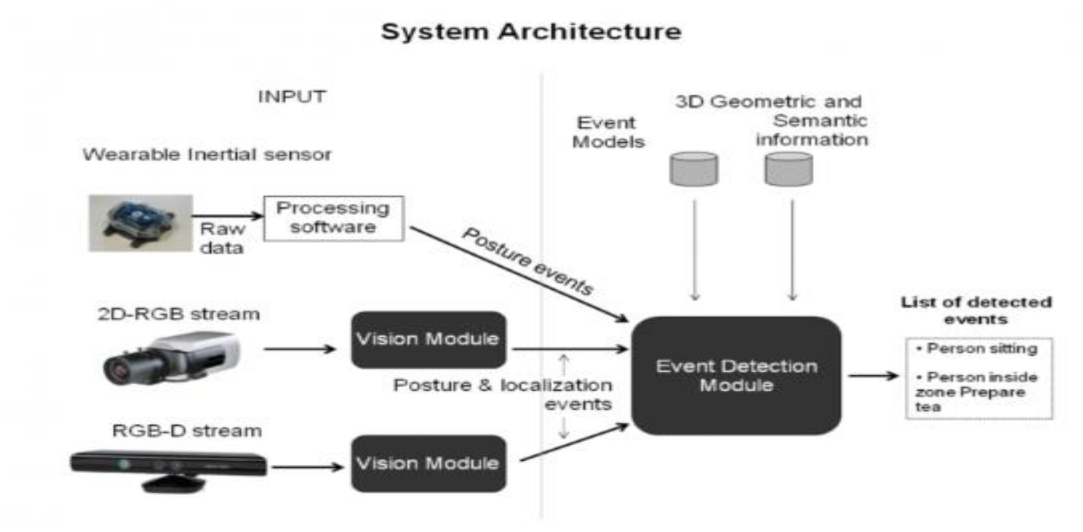

Figure 11: System architecture for event detection [29]

Architecture of event detection consists of various modules that are explained below:

- Event – It is a most important object occurring at a particular instance in time space caused by interaction of an agent with the system. An agent could be a human or any natural phenomenon.

In case of a face recognition system, face detection can be an event where a face is located in a video stream or image. 'face-recognized' can be an event where a face is recognized as a known person whose data is already presented in the system's database.

- **Event detection** – It is known as the identification in real time of the occurrence of an event in time space. The detection of events is made up of discrete signals, in cases such as access ID swipe or a binary on/off smoke detector, etc. where no additional computation may be required. Detection can be on continuous signals too, like in cases of face detection, voice recognition, where real time computation is required for the data stream.
- **Event Model (EM)** – It is a set of events governed by causality with a boundary in time space defining a scenario. A group of events are ordered and can have multiple triggers from the same or different sensors to mark its start state in time space. The events form a state diagram with detections cause a change from one state to another. The finished state can lead to different actions which can be executed depending upon the model.

1.8Event Management in WSN

Monitoring of ICU patients has generated a large amount of data which gives many opportunities but also big challenges. This stored data is very important and required to make a diagnosis, treat and discharge a patient when he/she is in normal condition. This information is present in the form of formats including clinical observations, lab results, scan images, free text notes, genome sequences, continuous waveforms and many more. These analysis, interpretation and presentation of the information are useful in critical care [21].

In wireless ad-hoc mode, data is transmitted from a node known as source node to the node called destination node. Data is being transmitted from the source node to the destination node via number of nodes [22]. These intermediate nodes are used to provide path to the data to move from source to the destination. But if the distance between sources to destination is changed due to the type of topologies used in the network [23], then the optimized use of batteries is necessary in the areas where the power available is less so that the network can work efficiently. If the destination node is away from the source node more battery power is required. Thus, we can say that use of battery power depends upon the distance between the source and node [24]. The battery is consumed in order to perform the following set of operations:

i. Routing
ii. Trafficking
iii. Load Balancing
iv. Event Management

All layers in the ad hoc network [25] require power management. Each layer can provide access to information related to the communication networks of different types, so that variety of power management mechanisms can be used. MAC layer uses local power management information and the network layer take broader way topology or flow characteristics [26].

So, it can be saved by turning off a radio network node. Other power saving mechanisms, such as topology control and power control MAC protocol which is considered as orthogonal, and their advantages get combined [27]. Similar ad hoc network protocols for power management program ranges from protective to reactive. In Protective Power mechanism, all the nodes are active all the times whereas in reactive power management, all the nodes are not active only the working node is active and take power [28].

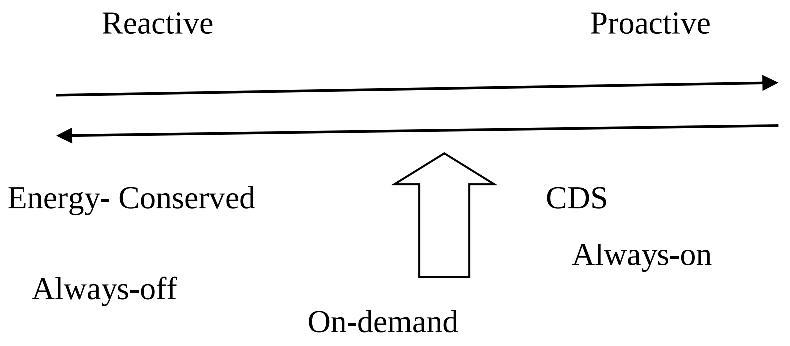

Figure 12: Power management Schemes[28]

Above figure shows the power management system. It is being shown that when the node require energy than the energy is provided by the batteries otherwise they does not consume any power hence the energy will be saved.

1.9 Multiple Event Detection Using Compressed Sensing

Compressed sensing is innovative ideas recently proposed to obtain much lower sampling rate in sparse signal. For large sensor networks, as compared with the number of sources, a relatively small event occurred. Because of the cost of deploying a limited number of sensors, and due to energy constraints, not all of the sensors are always open. The first two challenges occurred due to size and cost constraints, since most applications requires the use of a small and inexpensive sensor nodes, and the third challenge from the physical characteristics of the wireless channel. WSN asymmetric structure uses a compression excitation of the related art, and these techniques are incorporated in the data acquisition system for WSN [30]. Multi-event detection problem still has many fine features that can be utilized. First of all, the entire event monitoring area is relatively small. Second, the incident may have little change in adjacent time.

It is a direct result of a sensor sensing data having a space - time in a correlation characteristic. Event detection in the conventional art, uses the main characteristics of the sensing data. Here, we will use these two functions to deal with the problem detected. For multi-event detection method, called compressive sensing measurements of new advanced technologies (CS) is used.. From this inspiration, if we consider all sources simultaneously as a signal (source signal), the sparse signal in the spatial domain are very few non-zero elements (events). Thus, the sensor measures the signal sources and uses CS recovery algorithms, with high probability of the recovery position and value of the event. In addition, events may not change much, so having a high correlation in two adjacent time signal source is used to improve the detection accuracy [31].

1.10Multiple event Detection and Health Monitoring Perspective

In recent years, the rapidly expanding range of sensor technology and sensor devices has become cheaper. This results in rapid expansion of the monitoring condition system, vehicles,structurewith the machines utilizing sensors. The major factor is the networking technologies like wireless communications and MANET as well as the latest developments of Integrated Device Technology [45]. Challenges in health, even though diabetes is non-contagious, but is considered as the most popular and shocking epidemic. In order to alleviate the patient's pain and discomfort, non-invasive self-monitoring of the IMD (implantable medical devices) and SOC (system on chip) may be a better choice in healthcare, telemedicine more user-friendly, and perform various treatments when life-saving function in case of a possible imminent health threats, providing real-time feedback and direct supervision of a physician [46] to the medical centre. Structural health monitoring (SHM) collects the data on key structural elements and provides good way to structure the diagnosed condition. SHM generally be divided into tasks damage detection, damage location, the degree of damage assessment and life expectancy prediction. This method has many disadvantages, such as slow process personnel operation, high cost, and high risk.

Wearable health monitoring system may be used with variety of miniature sensors, or even wearable implantable. These biosensors are capable of measuring physiological parameters such as heart rate, blood pressure, oxygen saturation, body and skin temperature, respiratory rate, and electrocardiogram. Measurement parameters are transferred to the central node via a wireless or wired link, e.g., a personal digital assistant (PDA) or a micro controller board, then sequentially displayed information or aggregated transmit vital signs to the medical centre on the user interface.

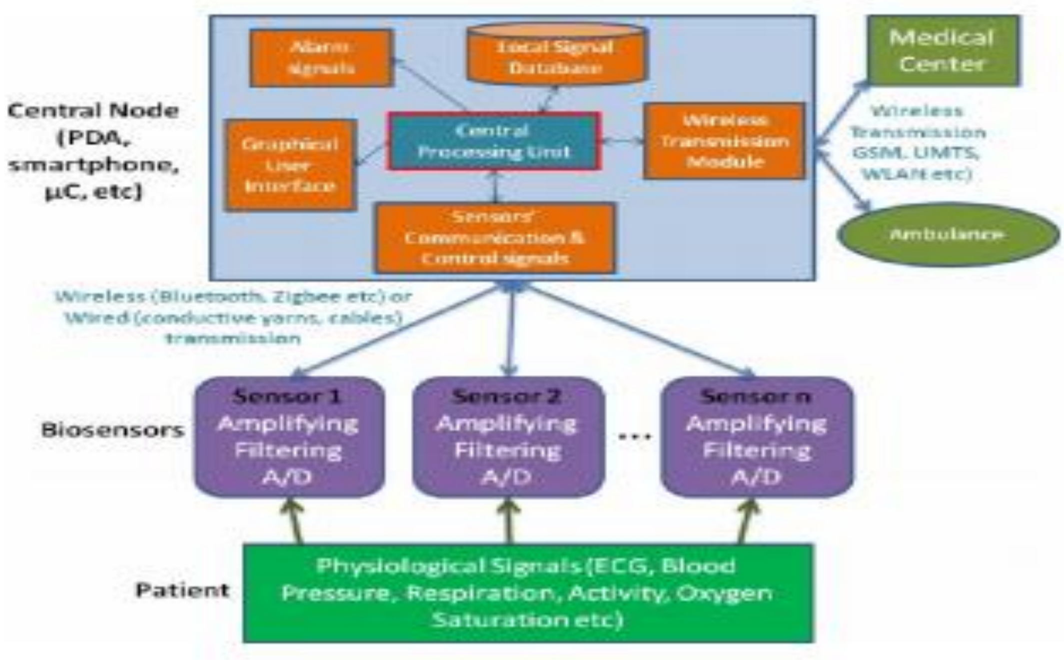

Figure 13: Architecture of a wearable health-monitoring system[15]

1.11Proposed Techniques

Mainly, there are two techniques that we have used in the proposed work. First one is Genetic algorithm and the second is neural network. Both are explained below:

1) **Genetic Algorithm.**
2) **Neural Network.**

1) Genetic Algorithm

GA (Genetic algorithm) is stimulated from the biological evolutions that are effective for searching domain independent methods. These methods can help the user for solving the problems in varied number of application domains. The idea of GA is given by Holland and has two folds:

i. To abstract and define the nature's adaptive process
ii. To design the artificial system software for retaining the nature's important mechanisms.

As per Artificial Intelligence research, the method proposed by Holland gives a better mechanism for learning.

GA is said to be population dependent searching method for maintaining the solutions while searching. A string having fixed bit-length mainly shows the potential outcome. For evaluating that outcome, GA requires payoff/reward/objectives for assigning scalar payoff for the exact outcome.

GA starts searching when the representation scheme and evaluation scheme is decided.

Firstly, GA generates some number, known as population size from the first generation of strings. Next, for evaluating the solution for the first generation, payoff function is used. Good solution has maximum payoffs.

The Genetic Algorithms dependent on the exploration and exploitation as well. These three operators are defined as follows:

i. Selection

The algorithm of Selection is used for assigning every individual a real number, known as rate of target sampling for indicating the expected offspring number that use to reproduce by the time. The algorithm of sampling generally reproduce, dependent up on the rate of target sampling, individual copies for producing the population. There are few differences among an individual's actual sampling probability with the normal value. The dissimilarity is known as Bias.

The selection algorithms are described by explicit fitness remapping and implicit fitness remapping.

ii. Crossover

For exploring other point within search space, the variability is beinggenerated for the intermediary population for several idealized genetic re-combination operators. Crossover is known as mainly the operator of important recombination. One-point crossover is a basic method for selecting two individuals in the population that exchanges the representation portions..

Crossover has two matching investigation abilities. Primarily, it has novel points for testing the hyper planes that are previously shown in the population. Secondly, it has representatives of novel hyper planes in the population.

iii. Mutation

When the users are shown as the bit a string, then the mutation is consists of reversing a bit which is randomly chosen. Let takes an example, when the individuals are taken as binary strings. When the bit is selected for mutation then it would be flipped to match the unique bit value in the bit complement. If x1=101010 and the mutation bits are 4, as the child is y1=101110. Below diagram explains it properly.

If the number has group of bits in the string, minute changes in the values can be followed from such mutations. It prevents the GA from refinement of the solutions after discover the better solutions in its neighbourhood.

2) NEURAL NETWORK

Neural network consists of a simple composition components operating in parallel. Stimulation of these components is through the biological neural system. By its nature, the many components are connected between the main network and defines a specific function.

Typically, the neural network is being trained or adjusted, thus pointing to a particular target output accurate input. Subsequent figures show the situation.

In this regard, in addition to the matching network O / P and the actual target, the network is recognized, depending on the O / P other than target. Typically, the training networks need many such input / Target.

These networks have been trained in the direction of many areas to perform complex functions, these areas include voice, pattern recognition, vision, control systems, identification and classification. It can also trains neural network to solve the challenging issues faced by traditional computer or human..The training criteria of NN can be summarized below:

1. Input is transferred to input neurons.
2. Achieved output response is being compared to input data.
3. Error data is used for managing the weights integrated to neurons.
4. Hidden units discover the errors through back signal.
5. Next, the weights get updated in the end.

There are basically two types of Artificial Neural Network, dependent on the architecture of connections:

1. Back Propagation Neural Network
2. Feed Forward Back Propagation Network

Neural networks are typically organized in a hierarchy. The layer composed of a plurality of interconnected 'nodes' composition, which comprises 'activation function.' Mode 'input layer' presented to the network, 'input layer' one or more 'connected' by a weighting actual processing system 'hidden layer' communication. Hidden layer are then link to 'output layer', where output is the answer:Hidden units

Most Artificial Neural Network contains some 'learning rules' to modify the connection weights based on the input pattern presented. In a sense, ANN can be like their biological objects, like a child learn to recognize dogs from examples of dogs. Although the neural network uses many different types of learning rules, but this presentation relate only to one kind; delta rule. Incremental rule is often called as the most common ANN class 'back-propagation neural network' (BPNN) use. Back propagation is an abbreviation taken for backward error propagation.

CHAPTER 2:LITERATURE SURVEY

2.1 Wireless Sensor Networks

Hetal Rana et.al, 2014 has described WSN which is the fast rising and known as the up-and-coming fields in the field of science and research. It is consider asanad-hoc network that has small nodes with sense, compute and communicate the ability of wireless and these sensor nodes are deployed into the environment of sensor field. The environment can be an Information Technological structure, a physical world, or a biological system. The major objective of WSN is to intellect the crucial data from the environment depending on application type for which it deploys and send the information to its Base Station thus, corrective actions may occur. These Sensor Nodes coordinates with each other by various Routing Protocols. Protocols in wireless sensor networks are broadly categorized as Flat, Hierarchical and Location dependent routing protocols.

Sunita Rani et.al, 2012 hasshown that the Wireless sensor node deploy into the network to monitor the physical or ecological condition like sound,temperature, vibration at varied locations. Each node gathers the information than transmit to the base station. The data is transport over network .Each sensor sends the data and consume some energy in receiving data. The lifetime of the network depend how much energy is being spent in each spread. The behavior of protocol plays the important role, which can minimize the delay for high energy efficiency and long span of network lifetime.

Bipandeep Singh et.al, 2014 has described the energy efficiency in the WSN which is taken as an important presentations Indicator. The sensor networksare disseminated event-based systems that differ from traditional statement network. A sensor web consists of nodes with less battery power plus wireless connections that are deployed for collecting useful data from the field.

L. Malathi et.al, 2014 has described an improvement in the area of electronics and communication for the growth of minute battery enabled sensor nodes. The sensor nodes are arbitrarily organized as a WSN for sensing environment. Mainly, important problem in wireless sensor network is the development of a routing protocol that maximizes the network life time. Every node in a sensor network becomes useless after energy wastage completely as its power totally dependent on the embedded battery.

Weiwei Fang et.al, 2012 has presented the sensible challenge for providing reliable aswell as well-organized communication in WSN (wireless sensor networks). Though, traditional layered protocols are not together designed with the optimization for maximizing the overall network performance for minimizing the energy expenditure.

2.2 WSN applications

MohdFauziOthmana and KhairunnisaShazalib, 2012 hasstudied environment monitoring system using WSN network. In this paper, author has discussed and reviewed WSN applications for monitoring of environments. There are several requirements to be followed, so that, a good monitoring system can be implemented. The systems have less power consumption, low cost and are a well-situated method for controlling real-time monitoring for insecure agriculture and habitat. Furthermore, it could also be organized formonitoring of the indoor living, climate monitoring, greenhouse monitoring, and forest monitoring. Use of WSN can restore the existing method that uses men force for monitoring the environment. Author has proved that with the usage of WSN, the performance of the system as well as its efficiency gets improved.

Mohamed RawideanMohdKassim and Ahmad Nizar Harun, 2016 has proposed hardware architecture of the agricultural environment monitoring system, system architecture and software process control. The author has utilized low-power, low-cost open system, as an appropriate way for checking real-time parameters of agriculture. Agricultural Environmental Monitoring System (AEMS) can be used to improve production efficiency, improve product quality, save energy and protect the environment. In addition; AEMS may be applied to other applications indoor living environment monitoring, climate monitoring and forest monitoring.

Andrés F. Murillo et al. 2012 has presented two applications of WSN given by the protocol of IEEE 802.15.4; the first one is to monitor a mushroom crop and the other one to e-health. Both applications are monitoring-oriented. The realized configuration of the WSN satisfies the requirement within time for application of health, and the coverage and the diminution of resources in the agriculture applications.

Ahmad Jamal Ahmed et al. 2016 has executed safety temperature monitoring system in WSN environment. The authors have captured the animal force attack nodes were actually verified, finally allowed full access to the MSP430 MCU chip. The authors has provided examples of reverse engineering for critical security information, such as encryption keys. The author has provided Secure-BSL software for improving the access password used to mask the MSP430 MCU.

Xiaolin Lu et al. 2016 has presented wireless sensor network (WSN) methods in a recently growing application space in industrial Internet or industry 4.0. This application space focuses on factory automation and field process management which is known as Machine Area Network (MAN) applications. Author has described key requirements, major technical challenges and describes how hardware and software can be combined to address these requirements in MAN. A mechanism that allows machine-to-machine (M2M) direct data sharing using a time synchronous network that utilizes a time-stamping approach is also presented. Author also described key requirements and challenges for deploying WSN for industrial environments. Author has proposed the use of (Time slotted channel hopping) TSCH and described a timestamp mechanism that can enhance M2M communications.

Lukas et al. 2015 has proposed a mixed approach to monitor water level using WSN. Author has developed a system that uses LORA radio receiver acts as a media between sensor hub and nodes.The wireless sensor network provides resolution to reduce the wired communication which costs a lot when two devices are located far apart. On the other hand, IoT is a promising solution to communicate between devices or between device and user not only in local area but in the wider area that has internet coverage. Authors have applied WSN and IoT to monitor water level of troughs, thus cattleman can remotely observe their livestock.

Tariq AL-Kadia et al. 2013 discussed four different solutions for leaks in pipelines using wireless sensor networks (WSNs). The WSN-based solutions are magnetic induction dependent, permanent pressure monitoring, underground towards over ground radio propagation WSiN (wireless signal networks). MI-based sensors have been used both inside and outside the pipes for better leakage detection. Author has used MI based approach to deploy this system in real life application needs much work. Ad-hoc wireless pressure monitoring system which accepted to be an innovative way that uses mobile wireless network technology for leakage detection is discussed. The use of this technique is simple and easy to maintain. It also has low operating price since it has low power consumption.

2.3 Event detection types

FekherKHELlF et al. 2014 has presented and evaluated has proposed multisensory hardware architecture for the detection of objects and events, specifically, designed for wireless sensor networks with low power consumption and higher precision. The authors have proposed a fuzzy logic approach that can improve the mapping between WSN QoS in hardware resources. Each node has two types of sensors, scalar and visual. Scalar sensors for detecting and locating objects, the visual sensor are responsible for monitoring the object. Environmental interests only when the event is only available to analyze the signal collected by the sensor using a different set of fuzzy rules to the rest (data processing and communication) activation of the sensing circuit. Nodes are calculated by energy consumption and efficiency parameters.

ApurvaSaoji and Poonam Lambhate, 2013,has described all important aspects of event detection in WSNwith sensor nodes, WSN architecture, a variety of techniques of detection of event such as machine learning techniques, Event detection by support vector machine (SVM) and event detection by distributed fuzzy logic. Though, the support vector machine and distributed fuzzy logic methods have many pitfalls as compared to AI technique. Machine learning techniques are used for accurate and fast event detection of disastrous events using WSNs, Distributed event detection is considered in machine learning technique. This paper surveyed a number of research techniques in event detection of Wireless sensor network. Comparative study of different methods for event detection is done. Finally, some of the open issues are discussed regarding event detection.

KrasimiraKapitanova et al. 2010 has worked on developing a formal event specification language, designed specifically for sensor networks, and a specification transformation approach that enables the conversion of formal event specification into code. To assure that the demands of the large range of emerging WSN applications, sensor networks provide complicated and robust event services. The propose of this work is to issue and develop event services that are well suited to describe and detect WSN events despite the number of challenges like limited resources, unreliable and inaccurate sensor readings, and the constantly varying physical environment. Author has designed a formal event specification language that allows WSN designers to fully specify the events they are interested in. Author also worked on facilitating and automating the translation from formal specification to code that can be executed by the nodes.

Majid Bahrepour et al. 2010 has presented machine learning (ML) technology in wireless sensor networks distributed event detection, and early detection to calculate its performance and suitability especially residential fire disasters. Authors has proposed a method based on the use of decision tree classifier running on each sensor node detects an event, and vote between the detection of a variety of sensor nodes in order to reach an agreement. Selection of the tree is because of the simplicity with the clarity of forms of expression, as if it meets the needs of WSN resource constraints as required. The simulation results show that the method not only achieves a high detection rate, and have lower overhead and computational time complexity.

Yashwant Singh et al. 2013 has proposed a set of distributed machine learning methods for detecting events. This method is carried out in two stages, in two phases, phase and group phase element, clustering and support vector machine (SVM) methods for the identification and calculation. In order to minimize the transmission delay information, hop tree has been used. These clustering techniques for clustering the signal is the name of a method for clustering data stream (signal), and have different levels of granularity in time series model, and has a linear complexity. In the base station, SVM is used to detect and anticipate events. This approach provides energy efficiency in a distributed environment.

Jayant Gupchup et al. 2009 has presented event detecting wireless sensor network for statistical signal processing techniques applied in environmental monitoring. Principal component analysis (PCA) technique has been used for event detection. Compact model for the observed phenomenon is carried out on the daily and seasonal trend basis. The author uses the difference between the actual measurements and model predictions to detect the presence of the collected data stream of discrete events. Simulation results has shown the mechanism sensitive enough to detect the event, the temperature may be used to model a wireless sensor network that detects the occurrence of the rain event.

2.4 Multiple event detection

Martin Victor K and Mrs. K. Ramalakshmi 2013 have proposed a method for detecting a network in multiple events. By increasing the number of nodes increases the area of the sensor field. Handle multiple events in the network, mainly to save time. Spotlight provides a number of methods, and allows the user to Ping Heng precision time, to obtain the results meet the requirements. The authors have achieved three enhancement ideas to maximize coverage by increasing the size and number of sensor fields. Second, the distribution and detecting a plurality of events; and a high positioning accuracy with respect to time and accuracy takes place. Localization has been found that the location of each sensor node, the method introduces Spotlight design, implementation and evaluation, which is a positioning system for wireless sensor networks. The system is divided into different modules, each handled separately, and finally implemented together. Increasing the plurality of events is detected and the sensor node in the network by increasing the number of nodes, the system area. By a process of detecting multiple events such networks, mainly to save time. Spotlight provide various techniques, and allows the user to Ping Heng precision of time to obtain a customized requirements.

Norman Dziengel et al, 2012 has proposed a variety of system architectures with the algorithms taken for event detection in WSN. In the case,when the platform of AVS-Extrem, the authors has shownthe design having a combination of custom hardware with distributed event detection algorithm to achieve energy detection event.

Torsha Banerjee et al. 2008 has proposed two methods, Problems of event detection region (PERD) and the WSN boundary detection sensor and the fault detection scheme. PERD can simultaneously successfully perceives a single event or multiple events. Through extensive without reducing the performance of detecting a plurality of events PERD. For a single event status, and it may be used directly as PERD event corresponding to the root of the resulting polynomial given all the data values of the event area. For multi-event scenario, the extended PERD not all events corresponding to the given polynomial, and therefore, in a single event scenario, the event area estimation error increased by 6%. However, a slight increase in the percentage of error is negligible, and by extending PERD communication overhead saves 33% or more. Simulation results show that the sensor fault detection scheme has great expandability, with improved accuracy of fault detection node, and the packet overhead is almost unchanged in the node density.

2.5 Multiple event detection using compressed sensing

Yu Liu et al. 2011 has proposed used CS (compressive sensing) multi-event detection program. Similar problems with CS, CS effective recovery algorithm can be used to reconstruct the original signal containing multiple real-time events. In addition, the event may not change much, therefore, the source of two adjacent signal time has a high degree of redundancy. The program has been used to improve the detection accuracy. In the proposed scheme, the value and location of the event can be achieved. Three CS algorithms have been proposed to show the advantages of using a detection probability of detection methods conventional dispersion Bayesian. Simulation results show that the use of CS multi-event detection with higher than traditional Bayesian event region detection probability of detection technology. The authors also discussed the relevance of time event detection problem. Using this detection technology, more accurately the event can be detected.

Wenjie Yan et al. 2011 has analyzed the problem of wireless sensor networks in sparsely detection event. Author has primarily combines the power signal attenuation matrix (considered the measurement matrix); sleep dispersion techniques (using game theory Policy Group [10] split) and compressive sensing theory in W SN to detect sparse events. After that, author has used the sparse events without losing the detection resolution. More importantly, extensive active sensors to detect experiments proved that this algorithm has strong robustness for noise measurement. Through the research work, the CS used in wireless sensor networks has great potential. Compressive sensing technique has been used with the reality of some practical scenes in WSN.

JiaMeng et al. 2009 has focused on solving detects the problem as wireless sensor networks with compressed sensing (CS) issues in the sparse event. Many (Wake Up) sensors can greatly reduce the number of sparse events at the same level, which is far less than the number of sources. Secondly, the author has mentioned the binary nature of the event, and the use of Bayesian detection method. Finally, using the CS algorithm, Gaussian noise has observed the performance. In this article, the first contribution is to develop questions for the compressed sensing sparse event detection in wireless sensor networks. Number (wake-up) sensors can greatly reduce the number of events similar to the sparse level, which is far less than the number of sources. Second, the authors have believed that the event has a binary nature, and Bayesian detection method uses a priori information. Finally, the author has analyzed the Gaussian noise performance compression algorithm perception.

Table 1 : Comparative study of existing technology

AUTHOR	TECHNIQUE USED	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Alrajeh et al.[50], [2013]	Localization technique	A study of the suitability of localization techniques for WSN applications. The deep study of range range-free localization techniques has also presented.	1. Capability to take care of limited resources 2. High energy efficient with less hardware size	1. .Less robustness 2. Less resilient to sensor failures for high critical systems

Salem et al [51],[2013]	Sensor Fault Detection	Anomaly detection algorithm detects the instances and classifies them in normal and abnormal ways by using regression prediction.	3. Quick anomaly detection 4. High detection accuracy 5. Low false alarm rate	1.Less security due to distinctive operational requirements 2. High vulnerability to the attacks
HadiTabatabaee Malazi1 et al.[37], [2011]	Fuzzy logic	Author has described a fuzzy logic call FED for distribute composite event.	1. One of the advantages is to provide a node level abstraction on the meaning of the value. 2. Message passing is considered as the only communication mechanism in JADE and Wireless Sensor N/Ws	Quality of each node is 1/3rd of the network nodes.

Norman Dziengel et al. [41], [2012]	Distributed event detection	Described event detection in WSN comes in different form.	1. Reliability 2. Save energy 3. Robustness' 4. Simplicity	Unable to detect complex event
F. Martincic et al.,[52] [2006]	Distributed evaluation	Event detection has been done using localized push –based strategy.	Detection accuracy was high because distributed version of complex algorithm has been employed.	Energy efficiency was low
Yaghmaet al.[53],[2013	Congestion control	Assign of network bandwidth to the signals from the diverse patients consider the congestion situation in parent / child nodes.	1.Continuous monitoring while movement 2. Mobility support	1.More power consumption 2.Wrong information propagation leads to positional error

CHAPTER 3:PROBLEM STATEMENT

WSN space for independently distributed network of sensors monitors the environment. The main disadvantage is the cost of energy and energy efficient processing in WSN. One of the major cost of energy is depleted with the WSN communication between nodes in energy, and when the sensor is an event of interest, sometimes only transmits data to the gateway node. Sensors may only be opened in the event of communication, save communication costs. Areas of interest for this network, includes monitoring, home automation, disaster relief, traffic management, health care and so on. In the dynamic environment, large amounts of data collected may not be interested in saving even more difficult. To overcome this problem, define a constraint to be relaxed event, usually modelled as a set of thresholds or probability. Event detection is divided into three main categories: threshold-based, supervised and unsupervised.

Wireless sensor networks (WSN) are a spatially distributed network of autonomous sensors. These sensors are deployed to collect data from multiple data points at a given time then that collected data is to be aggregated at any node and some method is to be used for threshold based event detection to measure the change in the data.

CHAPTER 4:PROPOSED SOLUTION

The WSN has greater accuracy and low power consumption for solving the problem of energy and time required for processing. In fact, the solutions proposed are a multi-sensor specific hardware architecture, aimed at mapping between the QoS requirements and to improve the communication process WSN nodes in the available hardware resources. Genetic algorithm along with neural network has been used for composite events detection. The evaluations of the solution are based on QOS (Quality of Service) Parameters and are defined below:

i. Throughput

It is the ratio of total amount of data which reaches the receiver from the sender to the time it takes for the receiver to receive the last packet. It is represented in Percentage (%). In MANETs, throughput is affected by various changes in topology, limited bandwidth and limited power. Unreliable communication is also one of the factors which adversely affect the throughput parameter.

ii. Energy Consumption

The goal is to reduce energy consumption and provides needed energy services products. With Kj units, the energy consumption has become one of the biggest challenges faced by high-performance networking, which is defined as the total energy from the source to the destination transport packets consumption.

iii. Packet delivery ratio

It is the division of packets for successfully delivery to a destination as compared to the packets that are sent by sender.

PDR= No. of packets delivered/No. of packets send by sender

The aim and objectives of the research are defined below:

1) To study the previous work for event detection and health monitoring

.

2) To develop a new algorithm for the route discovery using trusts model and Genetic algorithm.

3) To mitigate the effects of event occurred for health monitoring with the help of ANN.

4) To evaluate QOS Parameters mentioned in the problem statement in order to validate the results.

CHAPTER 5: OBJECTIVES AND RESEARCH METHODOLOGY

1) OBJECTIVE

The aim and objectives of the research are defined below:

1) To study the previous work for event detection and health monitoring.

2) To develop a new algorithm for the route discovery using trusts model and Genetic algorithm.

3) To mitigate the effects of event occurred for health monitoring with the help of ANN.

4) To evaluate QoS Parameters mentioned in the problem statement in order to validate the results.

2) METHODOLOGY

The methodology can be well explained by using the following flow diagram.

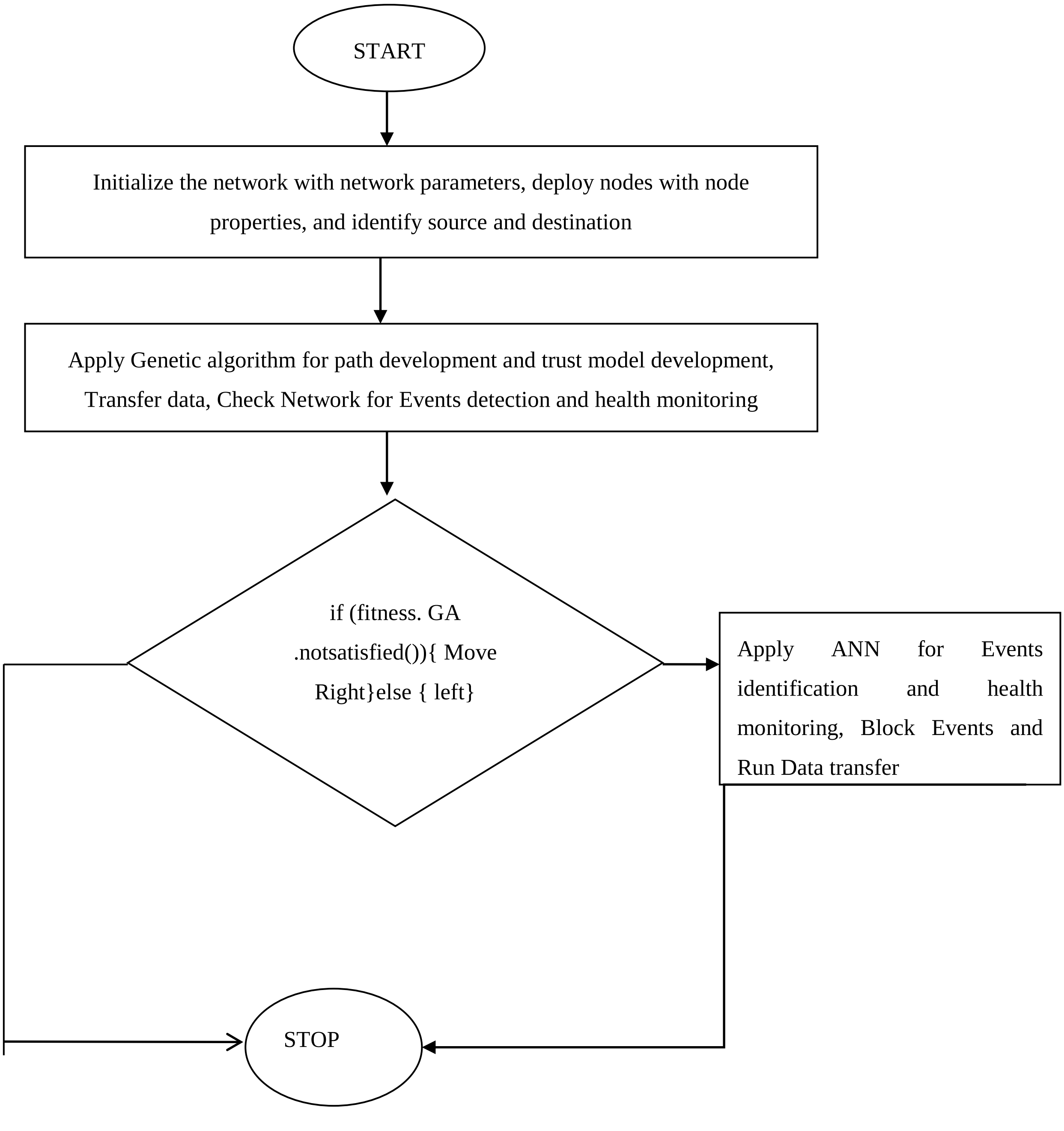

Figure14 : Flowchart of proposed work

Step 1: Design and develop a network area for the simulation of proposed work in WSN with the help of height and width of network.

Step 2: Describe N number of nodes in the network area for simulation work.

Step 3: Define the source and destination node from the N nodes.

Step 4: Initialize coverage area of each nodes including source and destination.

Step 5: Genetic algorithm is used to develop route between source and destination then transfer data and also check for event occurs in the network.

Step 6: If fitness function is satisfied then ANN (Artificial neural network) is applied to identify the event. ANN will block that event and starts transferring the data between nodes. Else the data transferring will be stopped.

Step 7: To check the accuracy and efficiency of the proposed simulation work, we will calculate the QOS parameters like Throughput, Error Rate.

CHAPTER 6 : IMPLEMENTATION AND EXPERIMENT

1. SIMULATION ENVIRONMENT

Table 2 : Tools used

Computer	Core 2 Duo or higher
RAM	3 MB
Platform	Windows 7
Other hardware	Keyboard, mouse
Software	Mat lab 7.0.4

MATLAB represents the name Matrix Laboratory. MATLAB was originally intended to be easily accessed by the LINPACK (linear system package) and EISPACK (Eigen system package) project developed by Matrix Software, MATLAB is a high-performance technical computing language. It integrates computation, visualization and programming environment. In addition, MATLAB is a modern programming language environment: it has a fine data structure that contains built-in editing and debugging tools, and support for object-oriented programming. These factors make MATLAB become a prominent tool for education and research. Compared with traditional computer languages (eg, C, FORTRAN), MATLAB has many advantages for solving technical problems. MATLAB is an interactive system, which is basically an array of data elements not required dimensions. The package has been commercially available since 1984, it is now considered the most global universities and industry standard tools. It has a powerful built-in routines, and various calculations. The graphics command also has an easy to use, so that the visual results immediately available. Specification application collects in the package is referred to in the toolbox. There kit for signal processing, symbolic computation, control theory, simulation and optimization.

After login, the user can enter MATLAB MATLAB by double-clicking the shortcut icon (MATLAB 7.0.4) on the Windows desktop. When a user starts MATLAB, a special window called MATLAB desktop appears. The desktop is other windows contain.

The major tools within or accessible from the desktop are as shown below:

- Command-Window
- Command-History
- Work-space
- Current-directory
- Help-browser
- Start-button

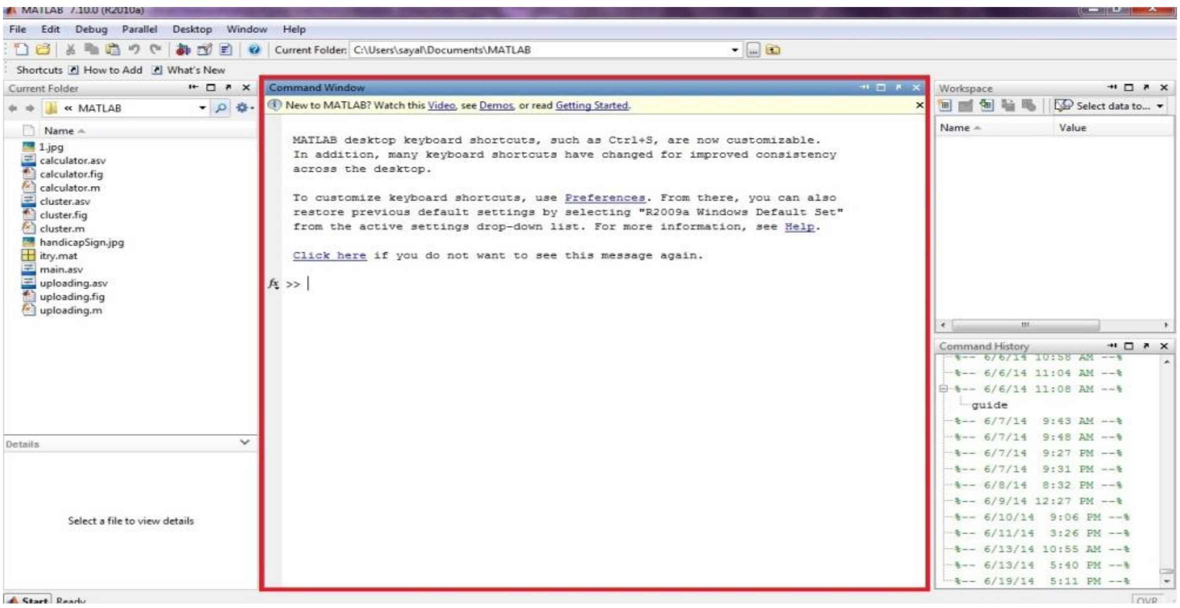

Figure 15 : Command Window

The window where the commands can be written is command window. Non-graphic output is shown in this window. A '>>' displayed that the system that can be used for input. 'Ready' and 'Busy' are displayed on the lower left hand corner windows when the system is calculating or waiting.

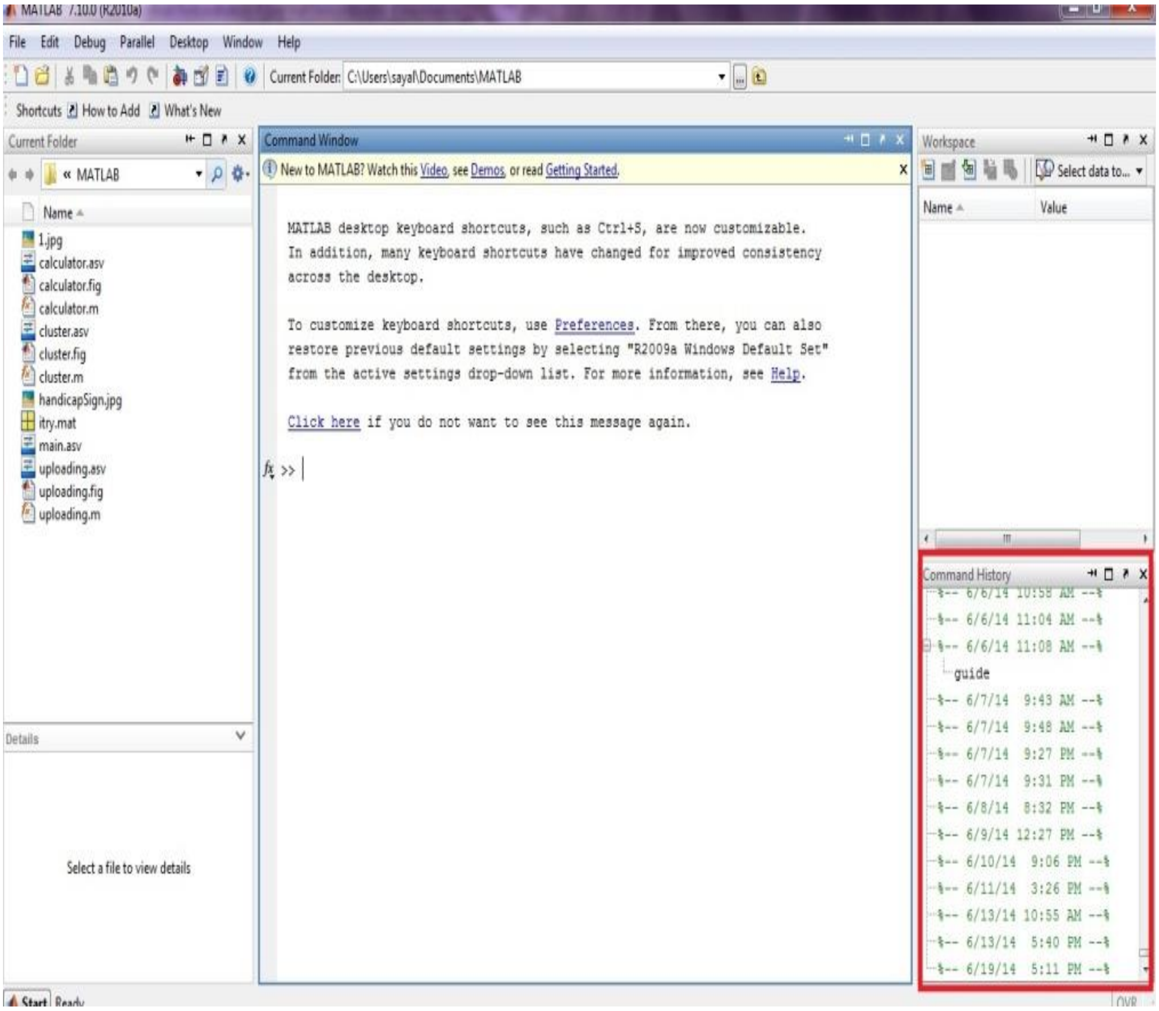

Figure 16 : Command History

Above figure is for the command history that shows the history of the session and the recent sessions. It can also be used for copy/paste or reference commands.

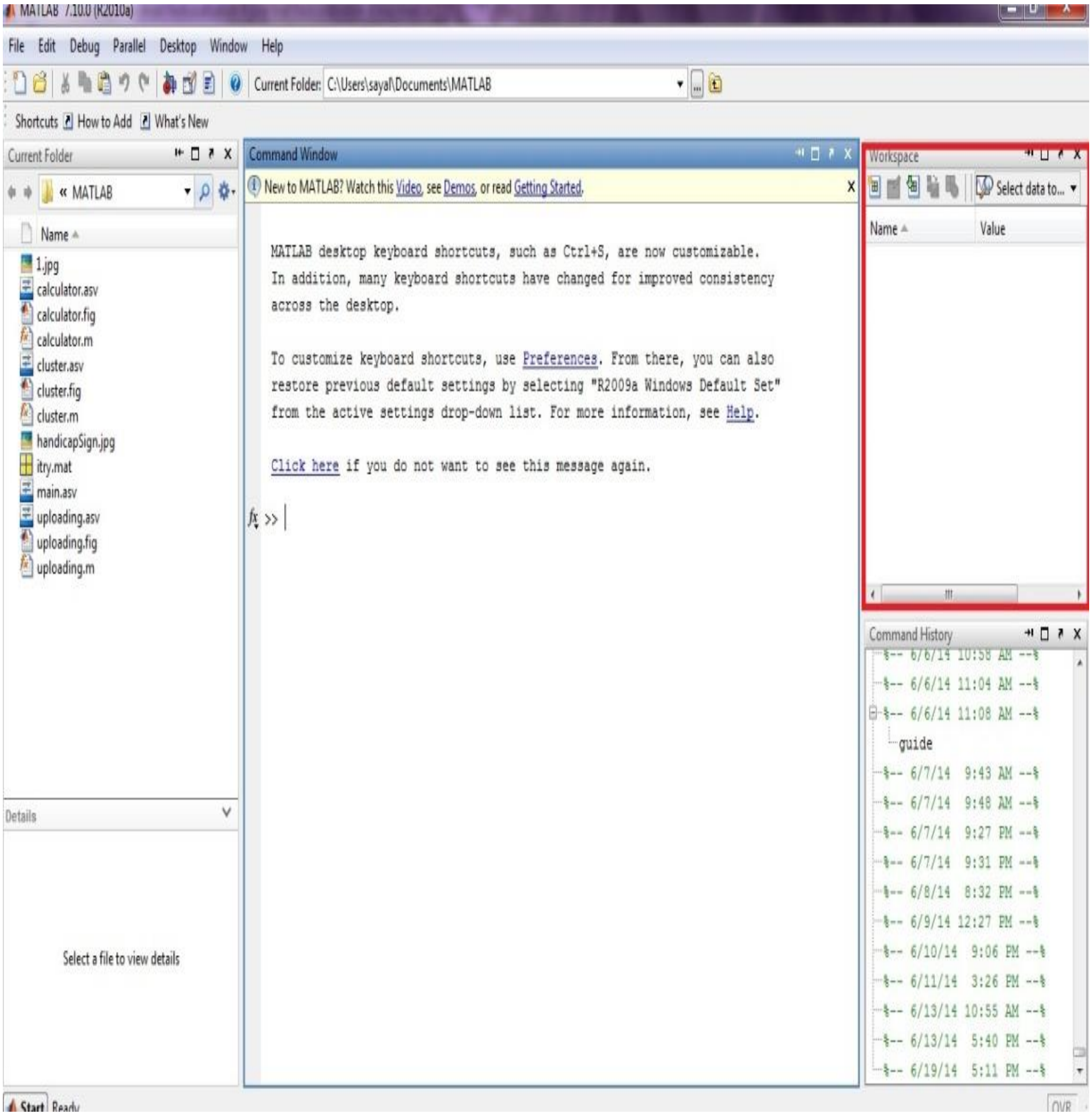

Figure17 : Workspace

The above figure displays the variables that can currently be defined by the user and the basic data of each variable with its minimum and maximum values and the dimensions. The top icons allows the user to create various functions like variables, saving/deleting, creating with plotting etc.

File>Save>workspace command is used for saving the variables from one session to another.

‘.mat’ extension is used for the workspace.

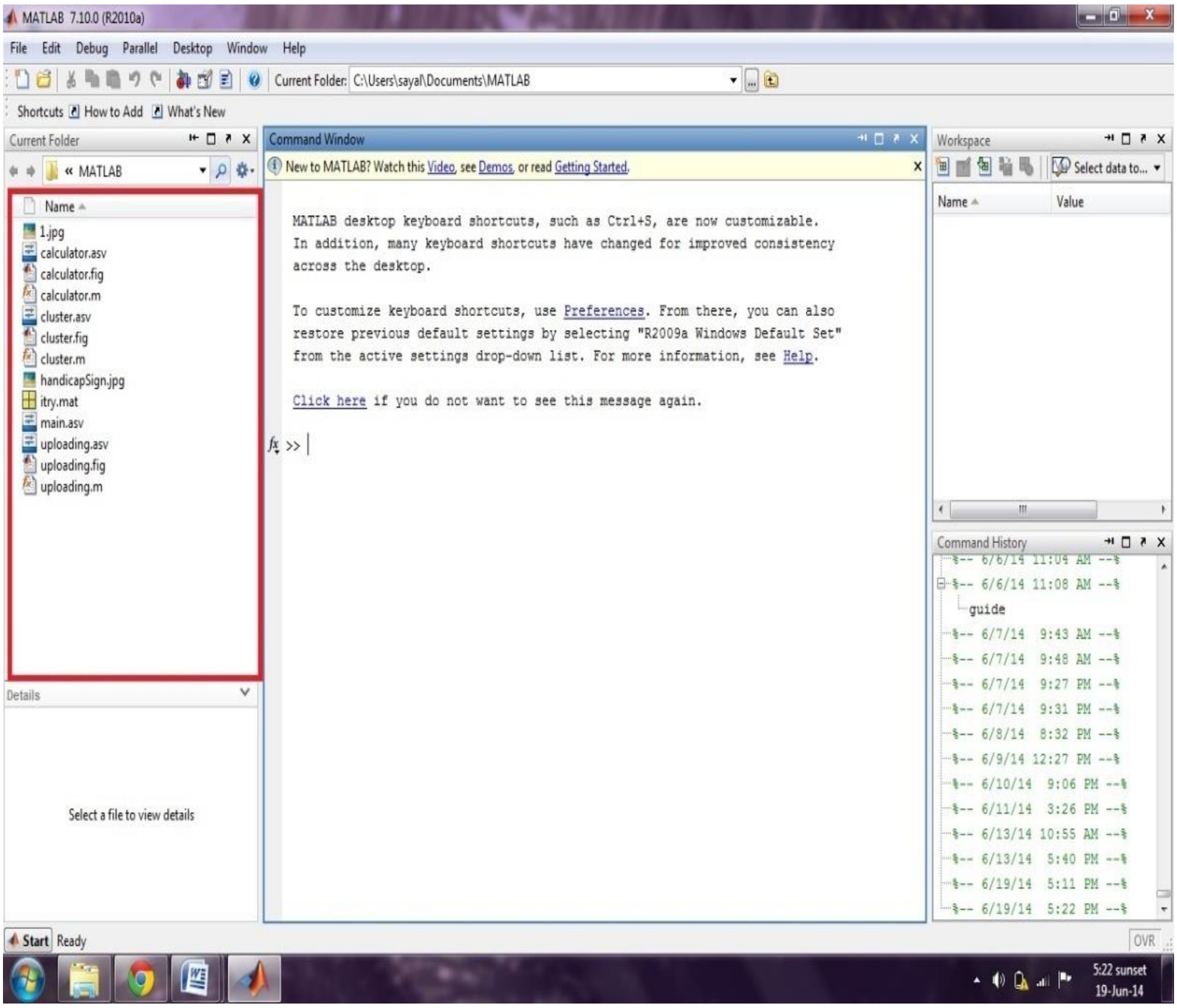

Figure18 : Current Folder

The current folder is the folder on which the MATLAB is currently working in. Anything can be saved by default. The current folder at the centre top can change the directory. It also displays the list of the documents in the existing directory.

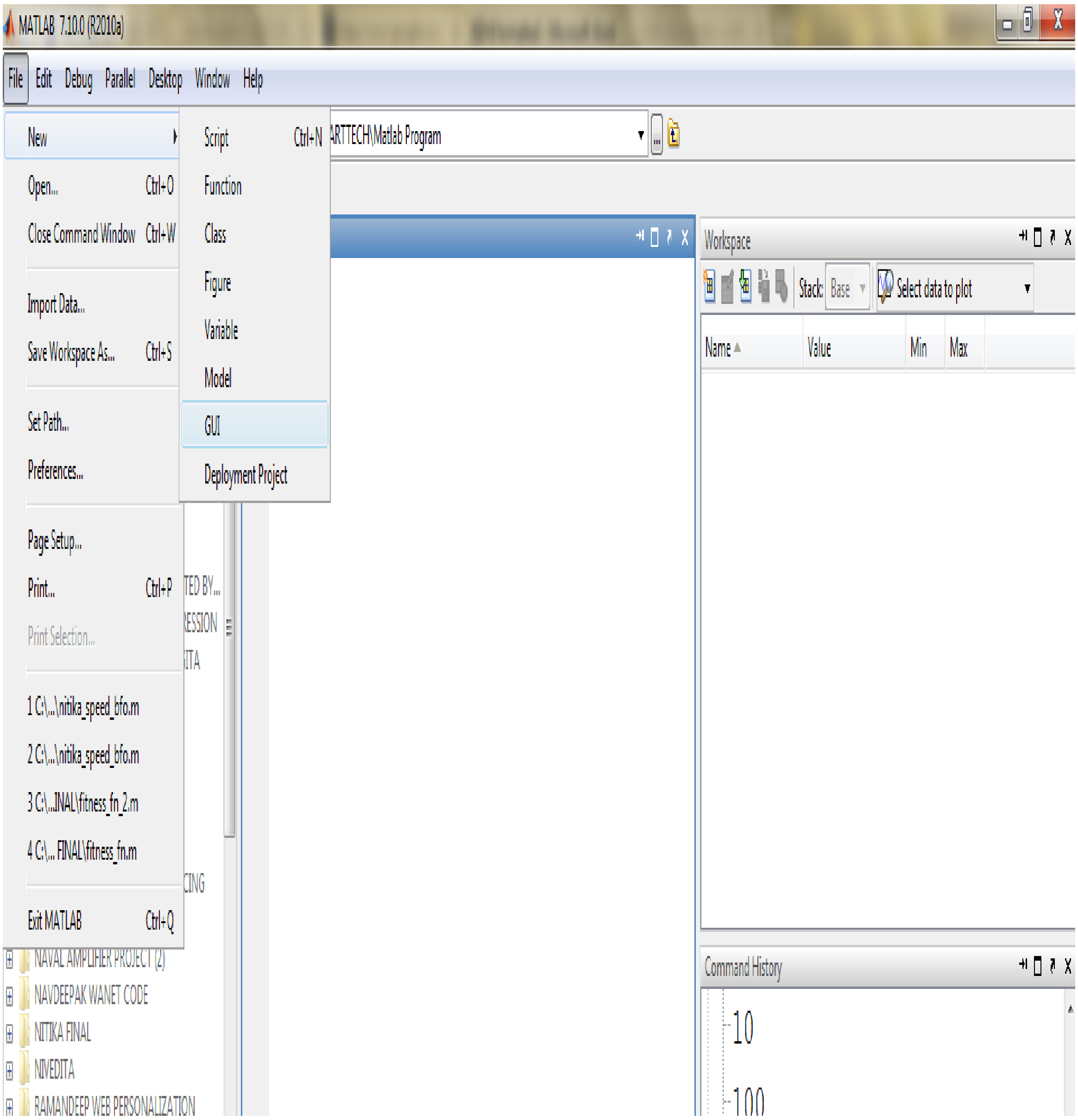

Figure19 : Start GUI

The above figure displays the Start GUI screenshots. By clicking on the new menu from the top icons, a new GUI can be form.

- To open a New Graphical User Interface in the Layout Editor:

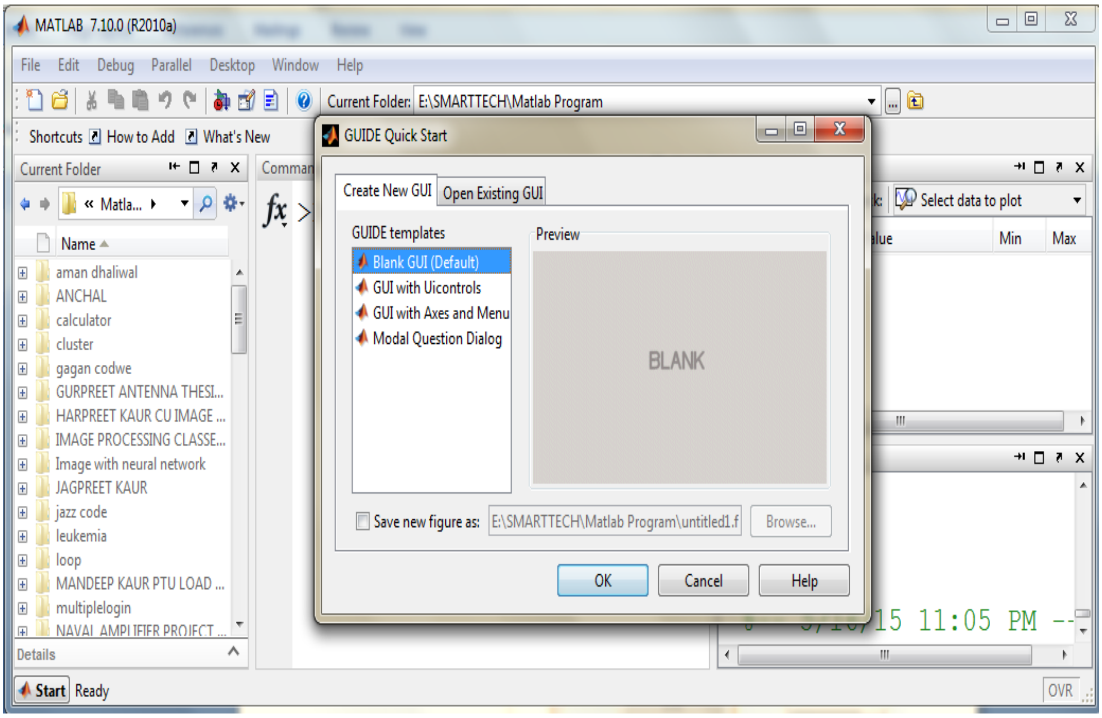

Figure20 : NEW GUI

The above figure describes different options for making GUI. The blank GUI's could be made with several options.

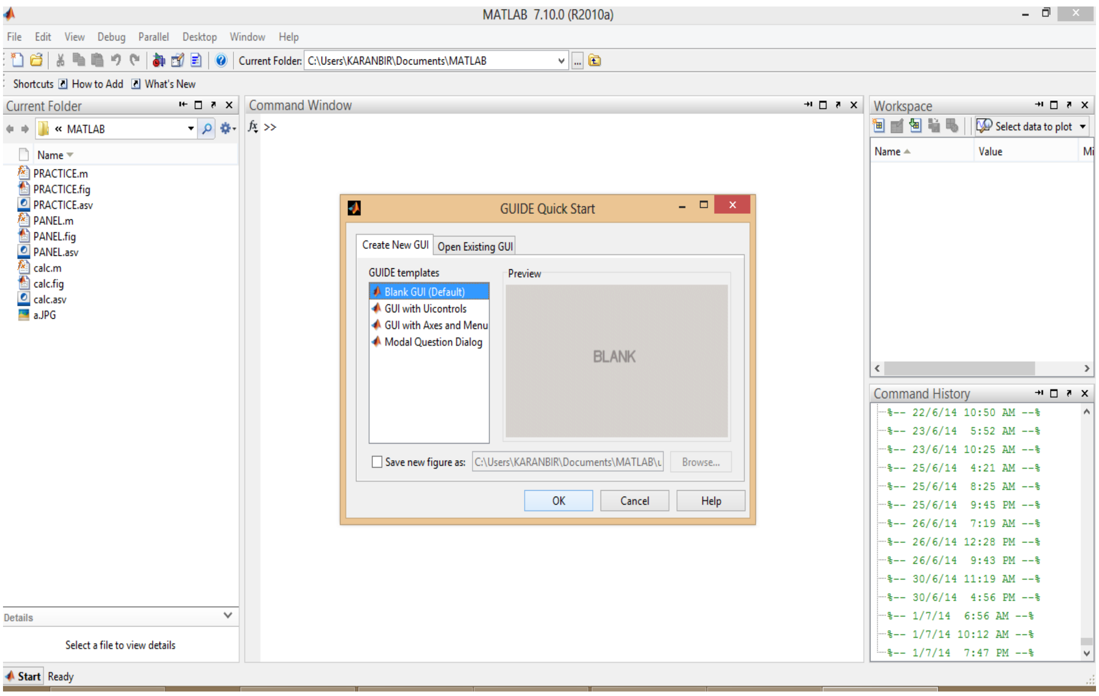

Figure 21 : Other Options for GUI

The above figure has shownthe creation ofnew GUI or to openrelated one. For developingGUI as per user's requirement, one can utilize the blank GUI/default option or else, a number of options be obtainable to utilize predefined GUI.

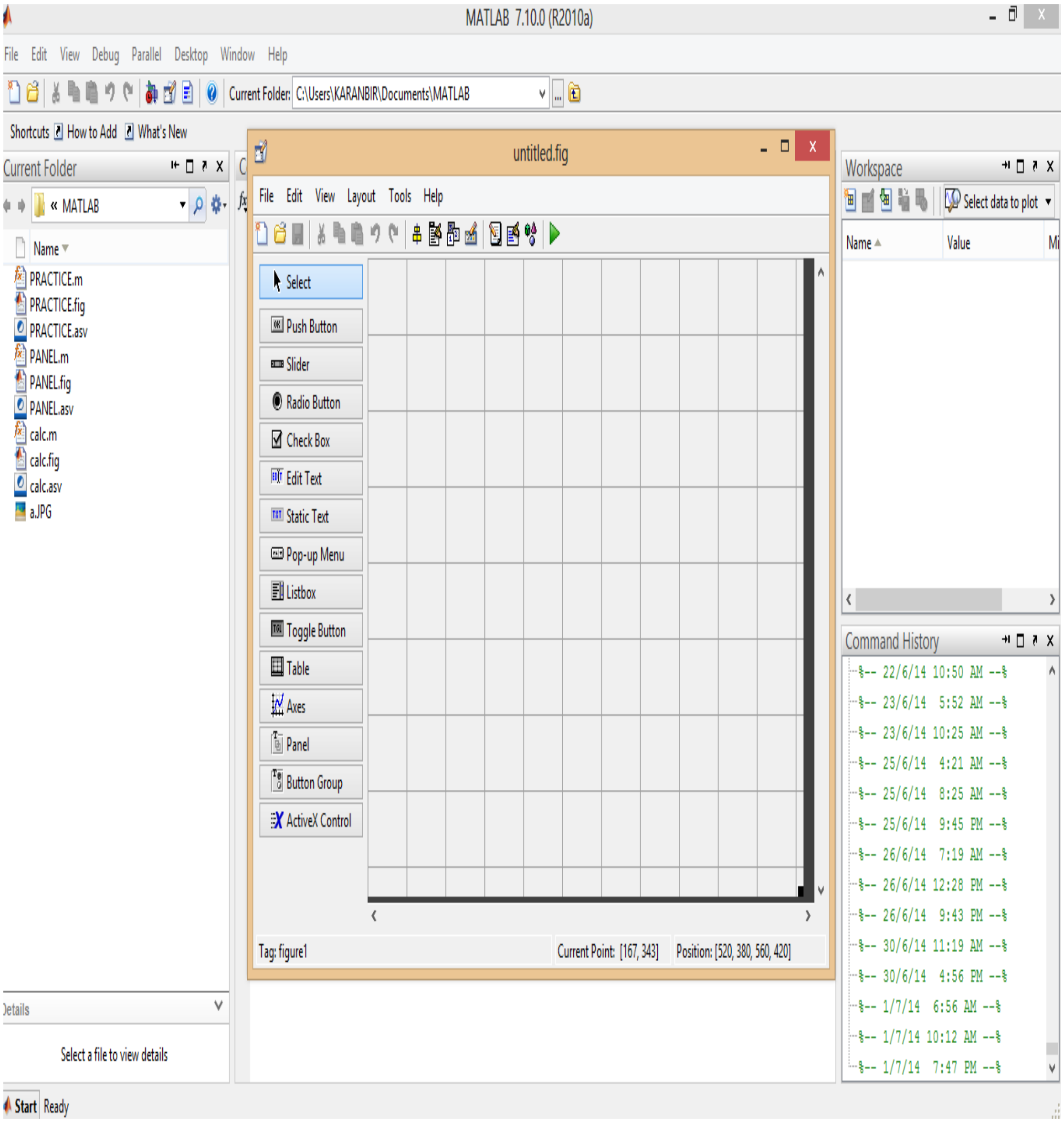

Figure22 : To Draw a GUI

The above figure defines the platform to make GUI. GUI is being saved having '.fig'extension. A number of tools are obtainable to design and controlthe tool properties.

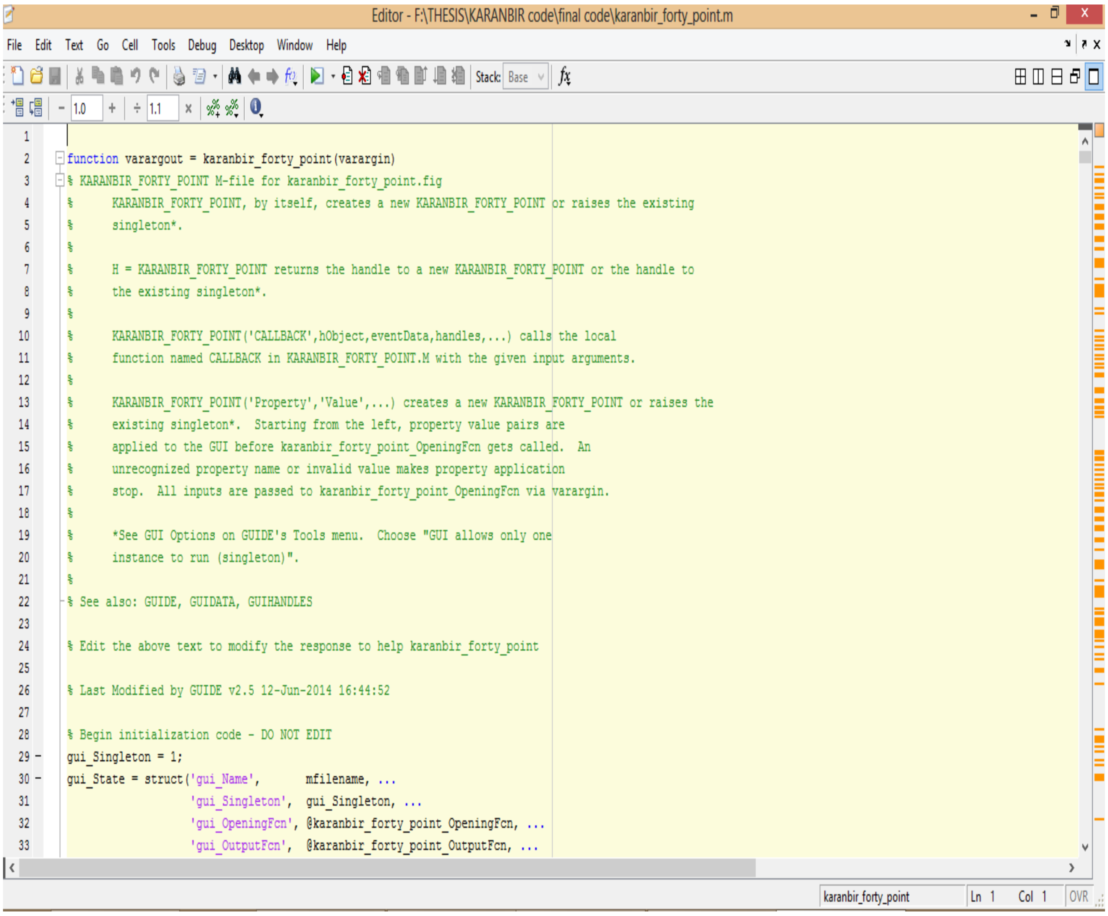

Figure23 : Editor Window

The code can be edit even after saving it in the editor window. The user can edit .m-files; these are the files that have the scripts with the functions that were defined earlier. By typing ‘edit’ command in the command window, the above window can be displayed. By ‘edit myfile’ command, .m file can be open for editing.

1) MATLAB CHARACTERISTICS

- Given by Cleve Moler in 1970's
- It is derivative of FORTRAN subroutines, namely, LINPACK and EISPACK, linear with the system of eigen value.
- Evaluated principally for accessing LINPACK as well as EISPACK.
- Gain its regard as it was not firmly dispersed.
- It is re-written in C in the 1980's with more functionality, which includes plotting routines.

- The MathWorks Inc. was produced (1984) to marketplace and go on with expansion Of MATLAB.

2) STRENGTHS

- MATLAB may be behave as a calculator as well as PL (programming language)
- MATLAB integratescalculation as well as graphic plotting.
- MATLAB is reasonably simple to learn
- MATLAB is interpret (not compiled), error are simple to fix.
- MATLAB is optimized for performing matrix operations
- MATLAB does have fewelements of object-oriented

3) RESULT ANALYSIS

Following are the results obtained after the implementation of the methodology being discussed above.

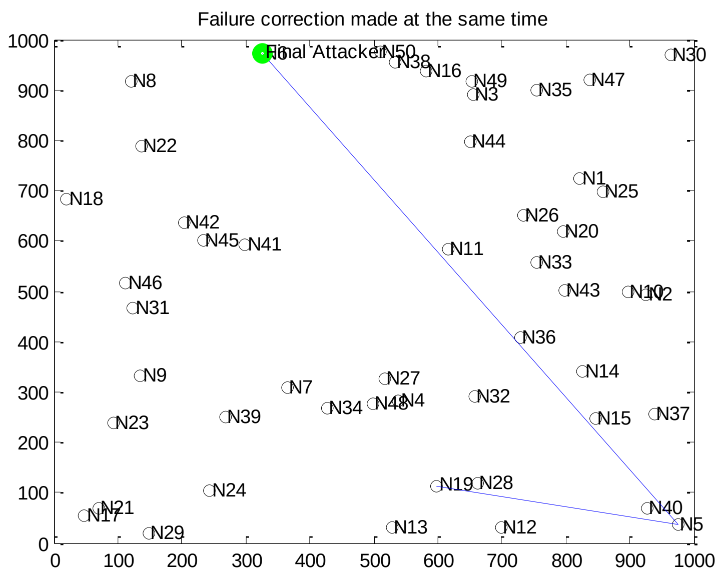

Figure 24 : Network area of the proposed network

The network area of the proposed work consists of area 1000×1000 having 50 numbers of nodes to run the network. The network runs for five times that means five iterations have been applied to run the network so that best results can be obtained.

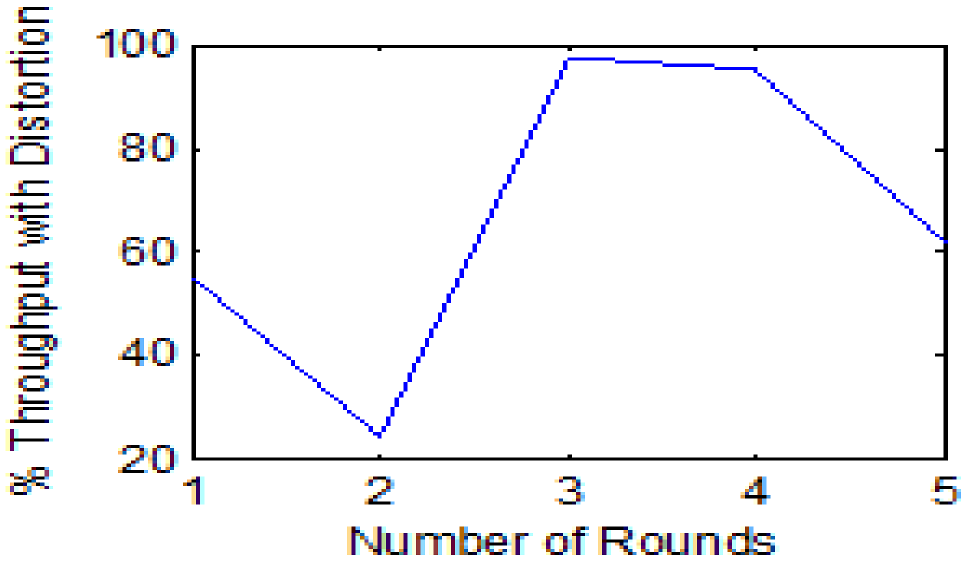

Figure 25 : Graphical depiction of throughput with distortion

As depicted in the figure above, system is being run for five times. At first iteration, approximate value of throughput in %age is obtained as 58%, for the second iteration, throughput value is 25 %.For 3rd, 4ty and 5th iteration the values of throughput obtained are 99%, 96% and 60 % respectively. If we calculate the average value of throughput with distortion then it is 57%.

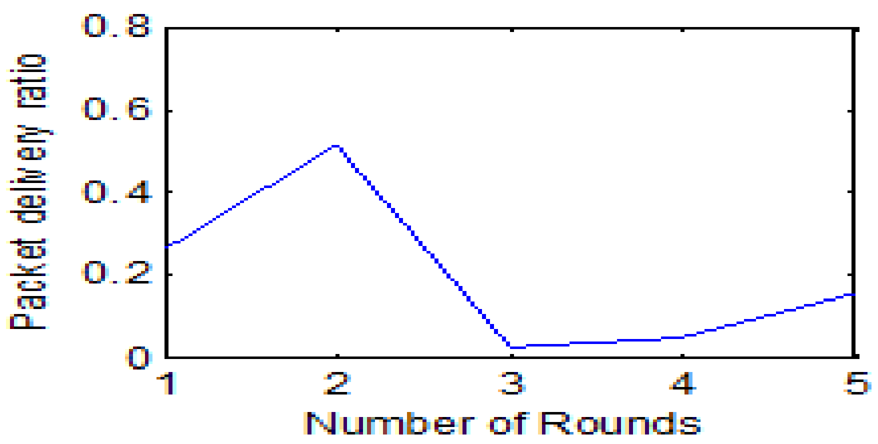

Figure 26 : Graphical representation of Packet delivery ratio with distortion

The above figure depicts the packet delivery ratio obtained for distortion network with five iterations. The average value of PDR (Packet delivery ratio) obtained for the simulated network is approximately 0.23. As we know that Packet Delivery Ratio is the ratio of the packet received and the packet transmitted. So, the value obtained is very less, which depicts that the number of packet received are less as compared to the number of packet transmitted.

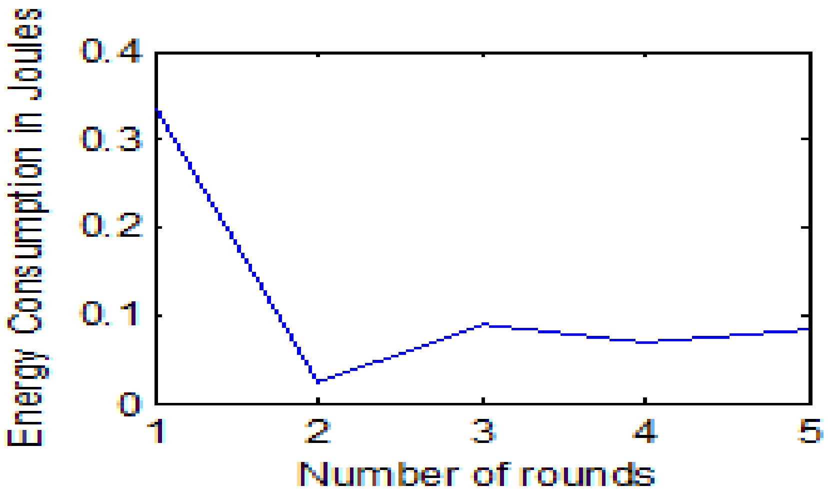

Figure 27: Graphical representation of Energy consumed with distortion

The above figure is depicting the energy consumption for distortion network. The average value of energy consumed by the network is approximately .13J.

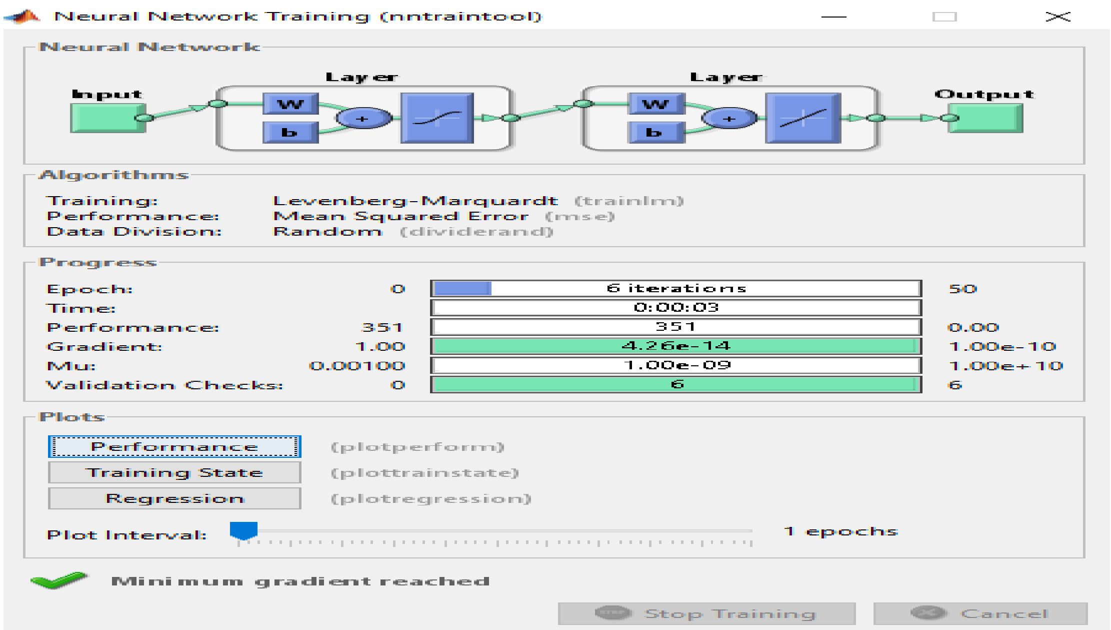

Figure 28: Neural network training

ANN training architecture is being shown in figure 7.14. As shown in the figure, NN has three layers.

i. **Input layer:** The trained data is provided on this layer.

ii. **Hidden Layer:** Processing of the trained data is done in this layer.

iii. **Output Layer:** Classified results are taken from this layer.

The system is not essential to run for all the iterations provided. Training of the Feed Forward Network will only be completed if any of the stopping criteria like Epoch, Time, Performance, Gradient, Mutuation and Validation Checks will meet. After completing its task, Back Propagation Neural Network will cross check it.

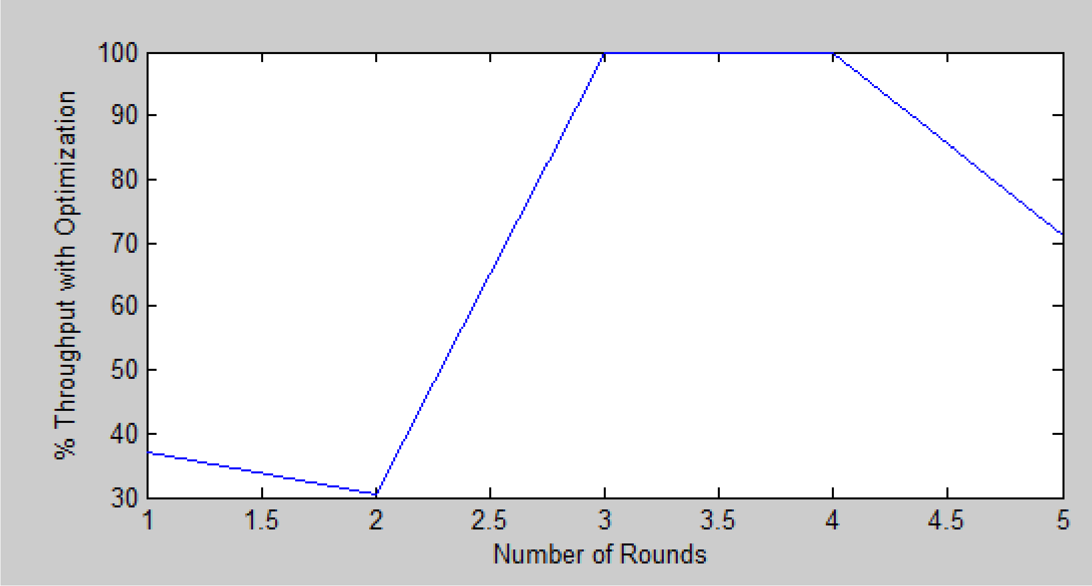

Figure 29: Throughput with optimization

Throughput means the number of outcomes that are passing through the source node towards the destination nodes or it can be said that it is the total number of packets delivered over the total simulation time. Graphical representation of the through put values obtained with optimization is shown in figure 7.15. Here, optimization is done using Genetic algorithm for finding the exact path and the packet for reaching at exact destination. The process is repeated five times toachieve accurate results. Thus, the average throughput values obtained for the network with optimization is 74.6 %.

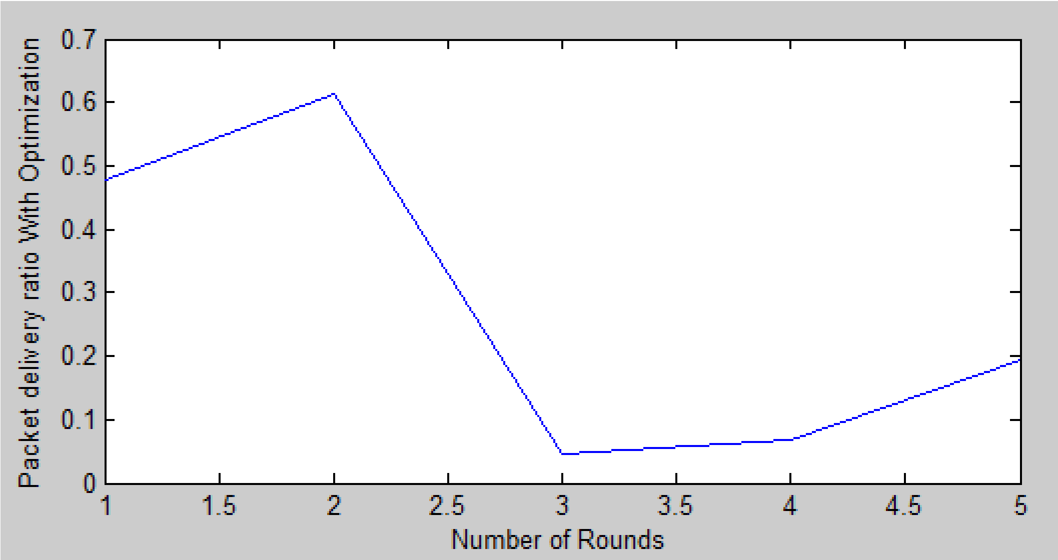

Figure 30: PDR with Optimization

Graphical representation of PDR values, using Genetic algorithm are shown in figure 7.16. The average PDR values obtained for the network with optimization is .26.

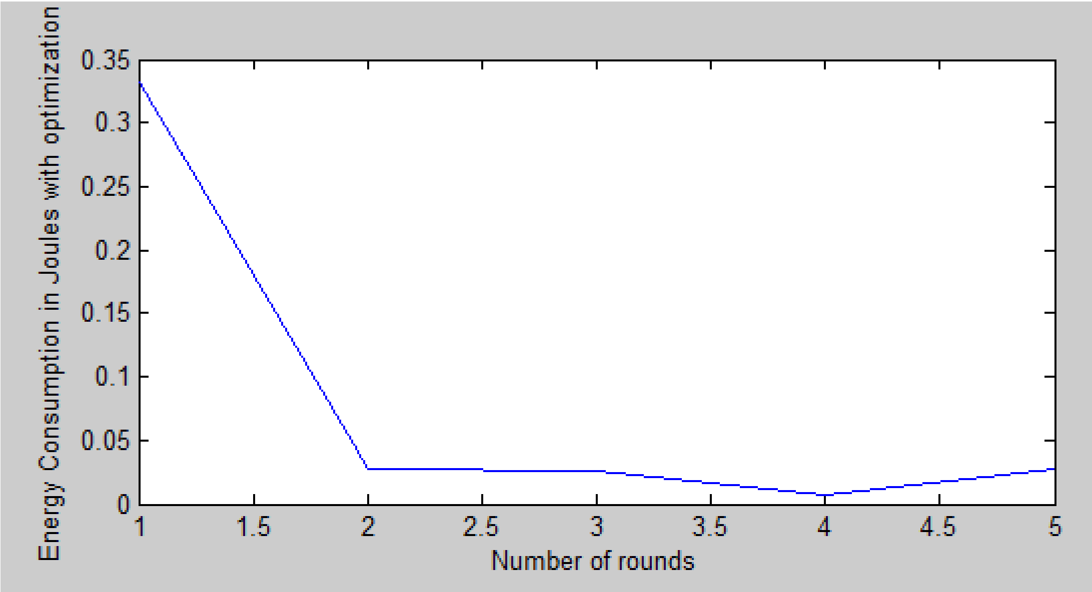

Figure 31: Energy consumption with optimization

Above graph is after the optimization with genetic algorithm. The average value obtained for energy consumed by the network is .1 J which is very small value.

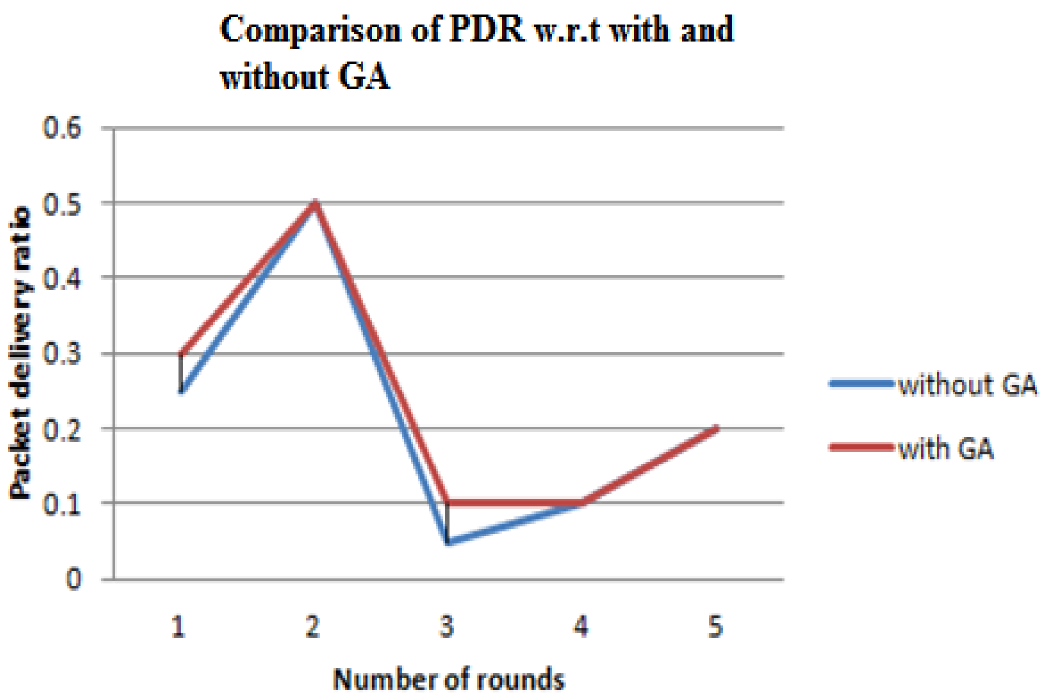

Figure 32: Throughput Comparison

In the above figure, blue colour line indicates the throughput values obtained from the MANET without optimization i.e. no algorithm or protocol is used to reach the packet at the destination node. Whereas, the red line indicates the throughput values obtained for the network with optimization i.e. Genetic algorithm is utilization for finding the accurate path and the packet has to accomplish at exact destination. The process is repeated five times so that accurate results can be obtained. Thus, the average throughput values obtained for the network without optimization is 57% whereas, the throughput values obtained for network with optimization is 74.6%.Therefore, it is clear, that the average value achieved for network having optimization is better as compared to without optimization. Because when optimization is not applied in the network then the data from the source may follow the wrong rout. It may be due to any occurrence of event in the network. Whereas, in optimization network data will follow the accurate path to reach at the destination, therefore, their throughput value increases.

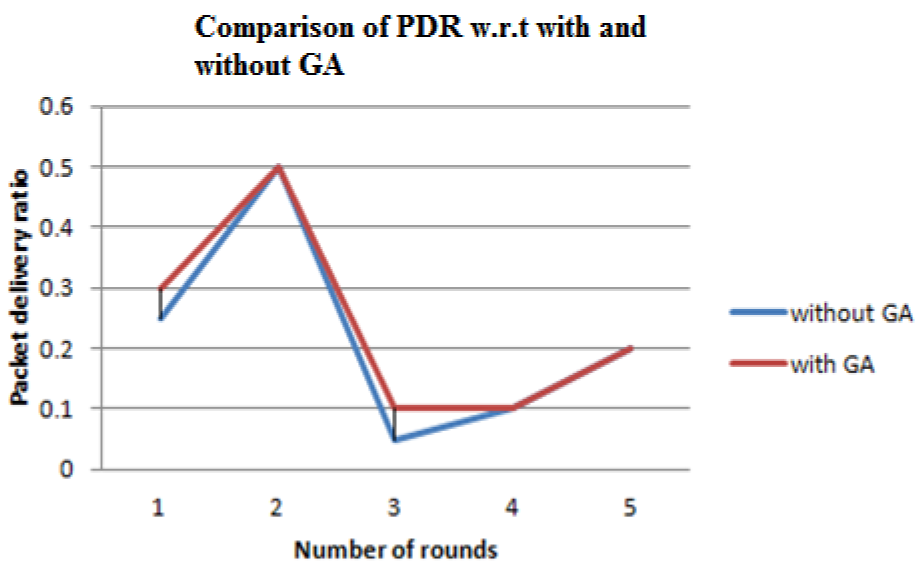

Figure 33: PDR Comparison

From the above figure, it is clear that the PDR obtained for without optimization is less than the PDR obtained for with optimization. Red line indicates the PDR values with GA and blue line indicate the PDR values without GA. Without GA average of PDR is .23 whereas, with GA average value of PDR is .26. Therefore, it is clear that with optimization, better results have been achieved ascompare to without optimization which means that more packets are received when GA is being applied.

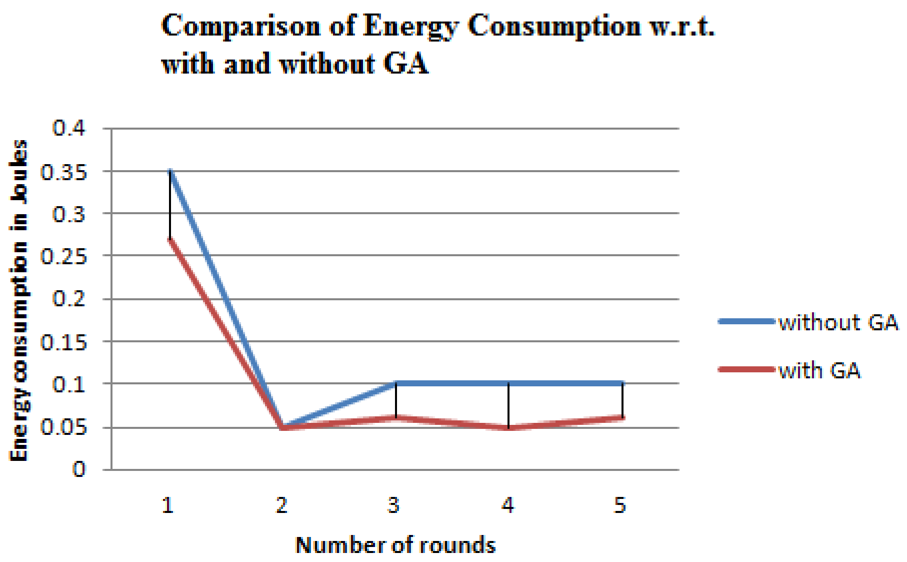

Figure 34: Energy consumption in Joule with and without Optimization in the network

When transmitting signal from one node to another node each node will consume some energy. Ideal node consumes less energy as compared to the busy node. Thus, it is necessary to determine the rout which consumes less power for transmitting the data successfully. Hence, a routing protocol that considers the residual energy will perform better than the protocol that does not. The result obtained when the algorithm is applied to the network is shown in figure 7.20. It is concluded that more energy is consumed when no Genetic algorithm is applied than the GA is applied to the network. Without optimization the average value of energy consumption is 1.3J whereas, with optimization the energy consumption is .1 J.

CHAPTER 7 :CONCLUSION

Use of wireless sensor network (WSN) in medical field is increasing day by day. Byusing WSN, one can transmit information collected from the patient using wireless network. In such a scenario, it is quite difficult to identify any event in the network and to mitigate the effects of the event. The proposed Generic Algorithm not only solves the problem of finding alternative path in case of an wrong event occurred in the network but also identifies the faulty node and takes it back to the base station for recovery. The network performance has been evaluated with the parameters like Throughput, Packet delivery ratio and energy consumption. By considering Energy Consumption as a major parameter for optimization we can find alternative path. Alternative path have been evaluated using Generic algorithm and the mitigation and identification has been done using Neural Network. The average value of throughput without and with optimization is 57% and 74.6%. Whereas, the average value for energy consumption and PDR for with and without optimization are .23 and .26, .13J and .1J respectively.

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