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ENERGY EFFICIENT ENHANCED SPEED ROUTING PROTOCOL USING GENETIC ALGORITHM IN WSN

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Abstract: *Wireless Sensor Network is a class of wireless ad- hoc networks which consists of spatially distributed autonomous sensor nodes to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. at different locations. Energy consumption is the core issue in wireless sensor networks because nodes are battery operated. It is desirable to make these nodes as cheap and energy-efficient as possible and rely on their large numbers to obtain high quality results. Consequently many protocols have been proposed in order to minimize the energy consumption of these nodes. But the genetic algorithms are unconventional explore and optimization algorithms, which impersonate several of the processes of neural evolution. GAs performs aimed at chance searches during an agreed set of alternatives with the aim of judgment the best option with respect to the known criterion of goodness. These criteria are necessary to be uttered in terms of an aim function which is frequently referred as Fitness Function. Also SPEED is the first energy capable routing protocol. It decreases the energy considerably. So, the main goal of this paper is to improve the energy consumption minimization, end delay, packet delivery rate and speed. In this research, the fitness function are applied in genetic algorithm to calculate the average energy of the arrangement and to make sure which block has lesser energy than average energy. The whole simulation is taken place in the MATLAB 7.10 environment. The proposed technique is providing the promising results.*

Keywords: *Wireless Sensor Network, Genetic Algorithm, SPEED Protocol.*

1. INTRODUCTION

Wireless Sensor Networks(WSN) have increased overall consideration as of late because of the advances made in wireless communication, ITs and electronics field [1,2,3,4,5].The idea of wireless sensor networks is taking into account a basic mathematical statement: Sensing + CPU + Radio = Thousands of potential applications [6] . It is an In-situ‖ sensing technology where minor, independent and conservative gadgets called sensor hubs or bits conveyed in a remote region to identify phenomena, gather and procedure information and transmit detected data to clients. The improvement of minimal effort, low-power, and a multi-operational sensor has gotten expanding consideration from different commercial enterprises. Sensor hubs or bits in WSNs are little sized and are fit for detecting, assembling and handling information while speaking with other joined hubs in the system, by means of radio recurrence (RF) channel.

WSN term can be extensively detected as gadgets range from portable PCs, PDAs or cellular telephones to exceptionally small and straightforward sensing devices [7].

Because of the small size of the sensor node in MANETs and its operation in unattended environment have many challenges. The research areas in wireless sensor network are:

Energy efficiency: Energy efficiency is a dominant consideration no matter what the problem is. This is because sensor nodes only have a small and finite source of energy. Many solutions, both hardware and software related, have been proposed to optimize energy usage [8].

Localization: In most of the cases, sensor nodes are deployed in an Ad hoc manner. It is up to the nodes to identify themselves in some spatial co-ordinates system.

This problem is referred to as localization or positioning of the sensor nodes.

Routing: Communication costs play a great role in deciding the routing technique to be used. Traditional routing schemes are no longer useful since energy consideration demand that only essential minimal routing be done [9].

The main objective of this work is to propose an optimal routing for the wireless Adhoc network to minimize the energy or maximizing the life time of the sensor network. To determine the optimal routing, the SPEED protocol is suitably modified to choose the shortest path for the destination, which consumes less energy. The performance of such a SPEED is determined in terms of average energy consumption and speed of nodes using Network Simulator MATLAB 7.10.

So, in this paper, enhanced optimal solution has been implemented by finding out the nodes having high speed than average or relay speed in SPEED protocol using Genetic Algorithm (GA) [10, 11].

2. ROUTING AND DESIGN ISSUES OF ROUTING

Routing is a process of determining a path between source and destination upon request of data transmission. In WSNs the network layer is mostly used to implement the routing of the incoming data. It is known that generally in multi-hop networks the source node cannot reach the sink directly. So, intermediate sensor nodes have to relay their packets. The implementation of routing tables gives the solution. These contain the lists of node option for any given packet destination. Routing table is the task of the routing algorithm along with the help of the routing protocol for their construction and maintenance

In spite of plenty of utilizations of WSN, these systems have a few limitations, e.g., constrained energy supply, restricted registering power, and restricted transmission capacity of the wireless links connecting sensor hubs [12]. One of the fundamental configuration objectives of WSN is to complete information communication while attempting to draw out the lifetime of the system and avert integration degradation by utilizing energy administration procedures. Keeping in mind the end goal to outline a proficient routing procedure, a few testing components ought to be tended to carefully. The accompanying elements are talked about underneath [13]:

2.1 Node deployment

Node deployment in WSN is application dependent as well as influences the execution of the routing protocol. The deployment can be either deterministic or randomized. In deterministic organization, the sensors are physically put and information is routed through pre-determined ways; however in arbitrary hub deployment, the sensor hubs are scattered haphazardly making a base in a specially appointed way. Subsequently, arbitrary deployment raises a few issues as scope, ideal bunching and so forth which should be tended to.

2.2 Energy consumption without losing accuracy

Sensor hubs can go through their constrained supply of energy performing processing's and transmitting data in a remote situation. All things considered, energy monitoring types of communication and processing are fundamental. Sensor hub lifetime demonstrates an in a strong dependence on the battery lifetime. In a multi-hop WSN, every hub assumes a double part as information sender and information router. The breaking down of some sensor hubs because of power failure can bring about noteworthy topological changes and may oblige rerouting of packages and redesign of the system [14].

2.3 Network Dynamics

Most of the network architectures expect that sensor hubs are stationary. How-ever, portability of both BS's and sensor hubs is infrequently essential in numerous applications. Routing messages from or to moving hubs is all the more difficult since course solidness turns into a vital issue, other than energy, data transfer capacity and so on. Also, the detected marvel can be either dynamic or static relying upon the application, e.g., it is alterable in an objective identification/following application, while it is static in forests observing for ahead of schedule fire avoidance. Checking static occasions permits the system to work in a receptive mode, essentially creating activity when reporting [15]. Dynamic occasions in many applications oblige intermittent reporting and hence create noteworthy movement to be directed to the BS.

2.4 Transmission Media

In a multi-hop sensor system, imparting hubs are connected by a remote medium. The customary issues connected with a remote channel (e.g., blurring, high mistake rate) might likewise influence the operation of the sensor system. As the transmission energy differs straightforwardly with the square of separation hence a multi-jump system raises a few issues in regards to topology administration and media access control. One methodology of MAC configuration for sensor systems is to utilize CSMA-CA based conventions of IEEE 802.15.4 that preserve more energy contrasted with conflict based conventions like CSMA (e.g. IEEE 802.11). Along these lines, Zigbee which is based upon IEEE 802.15.4 LWPAN innovation is acquainted with meet the difficulties [16].

2.5 Connectivity

The connectivity of WSN relies on upon the radio coverage. In the event that there consistently exists a multi-hop association between any two hubs, the system is joined. The connectivity is irregular if WSN is apportioned every so often, and sporadic if the hubs are just infrequently in the communication range of different hubs.

2.6 Coverage

The coverage of a WSN hub implies either detecting coverage or communication scope. Commonly with radio communications, the communication coverage is fundamentally bigger than detecting coverage. For applications, the detecting coverage characterizes how to dependably ensure that an occasion can be distinguished. The coverage of a system is either meagre, if parts of the region of interest are secured or thick when the range is totally secured. If there should be an occurrence of a repetitive coverage, different sensor hubs are in the same region [17].

2.7 Data Reporting Model:

Data sensing and reporting in WSNs is reliant on the application and the time criticality of the information reporting. In remote sensor systems information reporting can be consistent, question driven or occasion driven. The information conveyance model influences the outline of system layer, e.g., nonstop information reporting creates a gigantic measure of information consequently, and the routing protocol ought to be mindful of information accumulation.

2.8 Quality of Service:

In a few applications, information ought to be conveyed inside of a certain time of time from the minute it is detected; generally the information will be pointless. Along these lines limited latency for information conveyance is another condition for time-compelled applications. On the other hand, in numerous applications, preservation of energy, which is specifically identified with system lifetime, is considered moderately more imperative than the nature of information sent. As the energy gets exhausted, the system may be obliged to lessen the nature of the outcomes so as to decrease the energy scattering in the hubs and thus stretch the aggregate system lifetime. Thus, energy-aware routing protocols are obliged to catch this necessity [18].

3. PROPOSED WORK

3.1 Methodology

The objectives of this work are to minimize the routing problem. To do so, the route having minimum hop count is selected and hence, these routes are utilized to optimize the fitness function.

The steps for computation can generalized as:

Step: 1 The deployment of the network with width and length.

Step: 2 To Find The Nodes Having More Speed Than The Average Speed Of Transmission

Step: 3 Finding The Source And Destination Node From The List Of The Optimize

Step: 4 To find distance between source and destination

Step: 5 Get Estimation Delay

Step: 6 To Find Distance For The Number Of Hops Which Will Be Used To Calculate The Relay Speed

Step: 7 Nodes Which Are Having Speed Greater Than The Relay Speed

Step: 8 Transferring The Packets Based On The Relay Nodes

Step: 9 Find No. Of Relay Nodes And End Delay

Step: 10 Apply Genetic Algorithm

Step: 11 Calling Fitness Function Using Below Formula

```
Fs=miss_ratio(i);
   Ft=avg_miss_ratio;
   FitnessFunction = @(e)fitness_fn(Fs,Ft);
   numberOfVariables = 1;
   [x(i) fval] = ga(FitnessFunction,numberOfVariables)
```

Step: 12 Evaluate End Delay, Number Of Relay Nodes, Energy Consumption And Packet Delivery Rate.

3.2 Flowchart

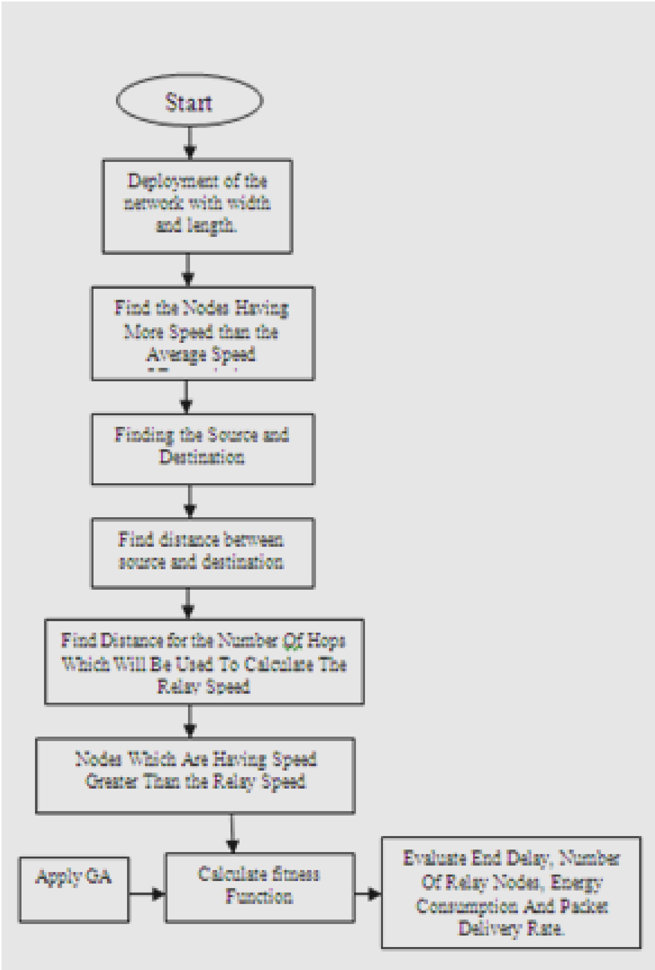

Figure1: Proposed flowchart

3.3 Pseudo Code

```
Start
packet_size=100;
no_nodes=input('ENTER THE NUMBER OF NODES: ');
network_length=input('ENTER THE NETWORK LENGTH: ');
network_width=input('ENTER THE NETWORK WIDTH: ');
net_area=network_length*network_width;
for i=1:no_nodes
{
plot(xloc(i),yloc(i),'*');
xlabel('NETWORK LENGTH');
ylabel('NETWORK HEIGHT');
}
speed_nodes(i)=no_nodes*rand;
avg_speed=mean(speed_nodes);
for i=1:no_nodes
if speed_nodes(i)>avg_speed
speed_nodes(p)=i;
Finding The Source And Destination Node From The List Of The Optimize
s_x=xloc(source);
d_x=xloc(dest);
To obtain distance.
Transmitting Data To Nodes
Source And Destination Nodes Plotted
estimated_delay=2;
Find Distnce For The Number Of Hops Which Will Be Used To Calculate The Relay Speed
relay_speed=distance/estimated_delay;
Plotting Realy Nodes
for i=1:no_nodes
if speed_nodes(i)>relay_speed
relay_nodes(p)=node_id(i);
delay(i)=rand
Transferring the Packets Based On The Relay Nodes
Calculate delay bound
for i=1:length(relay_nodes)
if relay_speed_nodes(i)<set_point
miss_ratio(i)=delay(i)*100;
Find The Recieve Packets By Dividing The Total Packets Drops With Total Lenegth Of The Packets
for i=1:length(relay_nodes)
energy_consume(i)=(energy(i))/length(data_packets(i))*mean(delay);
For Genetic Algo
Configuration of the timestamp for genetic algorithm
for i=1:loop_val
Fs=miss_ratio(i);
Ft=avg_miss_ratio;
FitnessFunction = @(e)fitness_fn(Fs,Ft);
numberOfVariables = 1;
[x(i) fval] = ga(FitnessFunction,numberOfVariables,[],[],[],[],[],[],[],options);
Evaluate parameters
```

4. RESULTS AND IMPLEMENTATION

The whole implementation has been taken place in MATLAB 7.10 environment. Below figures shows the implementation graphs of the proposed work.

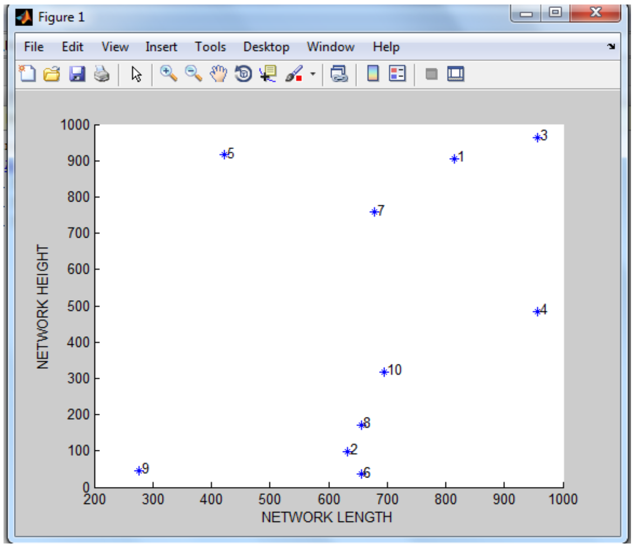

Figure 2: Network Deployment

Above figure shows the chosen number of nodes are to build network are 10. In above figure 1000 * 1000 network deployment has been done. This figure comes after entering the values for no. of nodes, length and height.

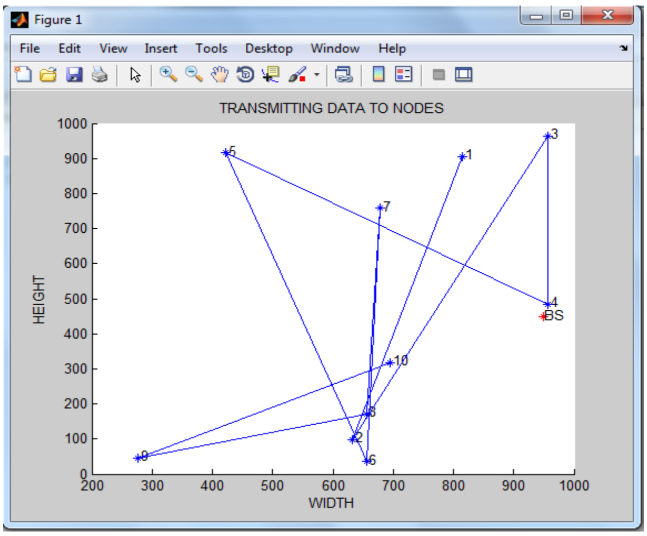

Figure 3: Data Transmission to Nodes

Above figure shows the transmission of data to nodes from node 1 to node 10. In a network, a node is a

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connection point, either a redistribution point or an end point for data transmissions. In general, a node has programmed or engineered capability to recognize and process or forward transmissions to other nodes.

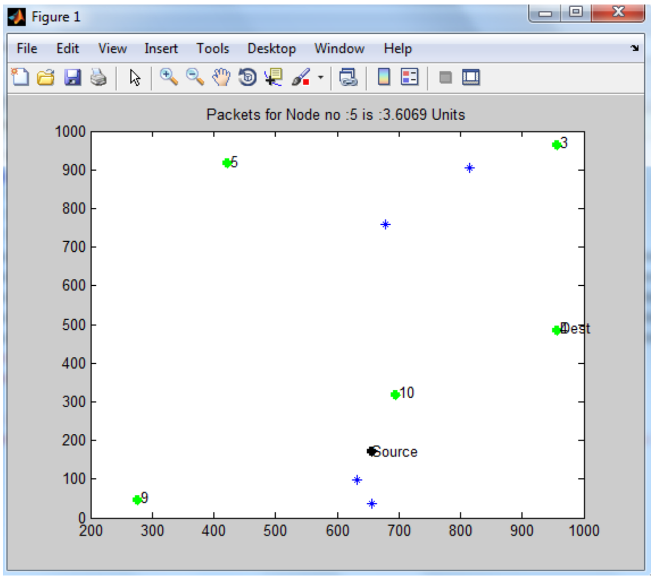

Figure 4: Plotting of Packets

Above figure shows the no. of packets sent from source to destination. Networks are connected to each other via routers. Routers carry traffic from one network/subnet to another. Routers maintain a routing table to decide how to route the packets. Each routing entry consists of the destination address, subnet mask and "route to" field. When a message needs to be routed to an address, source and destination address has been seen.

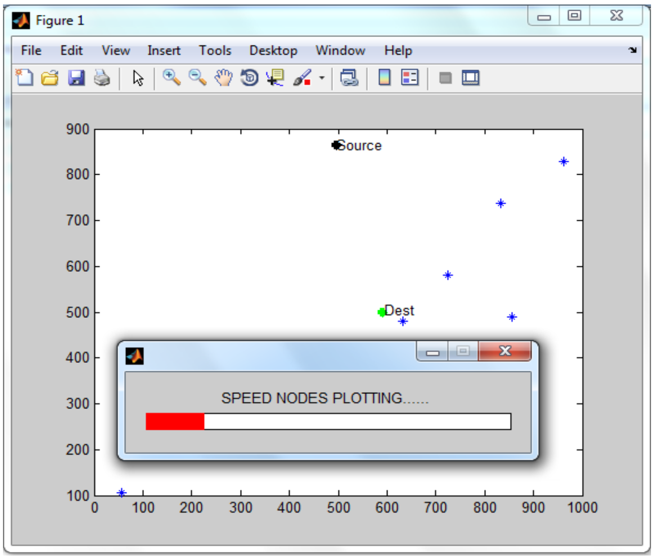

Figure 5: SPEED Nodes Plotting

Above figure shows to find The Nodes Having More Speed than The Average Speed of Transmission.

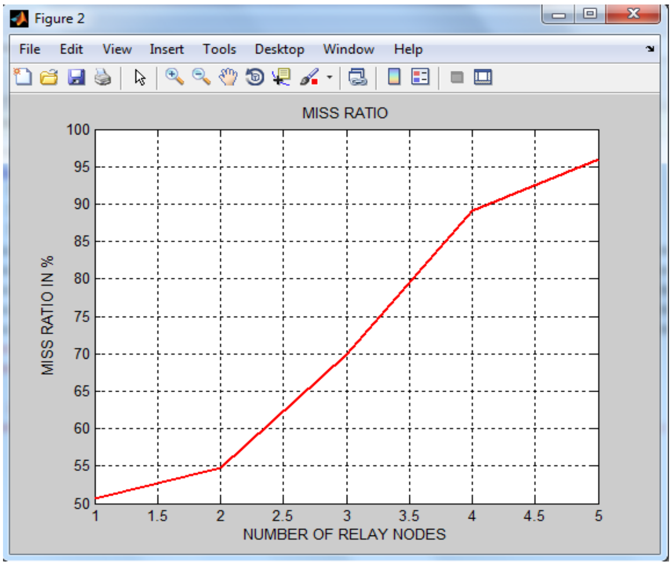

Figure 6: Miss Ratio

Miss ratio as a metric for network quality of service. Above figure shows the miss ratio value for relay nodes and it has been seen that miss ratio is more than 95%. One approach to prolong network lifetime while preserving network connectivity is to deploy a small number of costly, but more powerful, relay nodes whose main task is communication with other sensor or relay nodes.

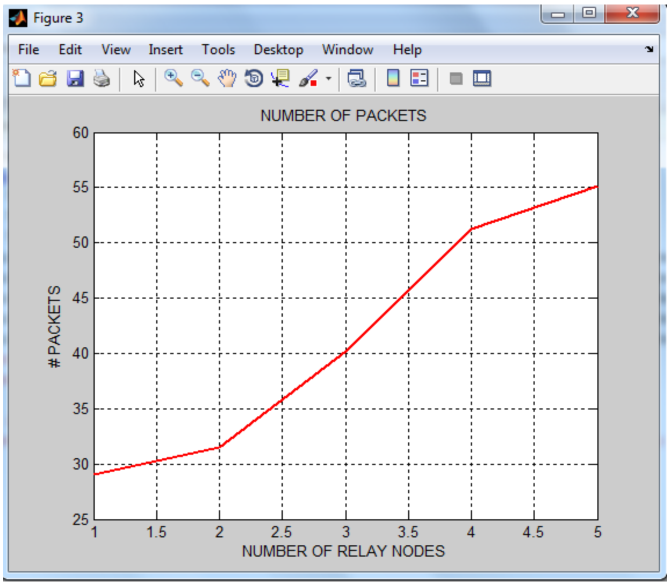

Figure 7: Number of Packets

Above figure shows the number of packets sent over relay nodes and it has found to be 55 in comparison to 5 relay nodes. A packet consists of two kinds of data: control information and user data (also known as payload). The control information provides data the network needs to deliver the user data

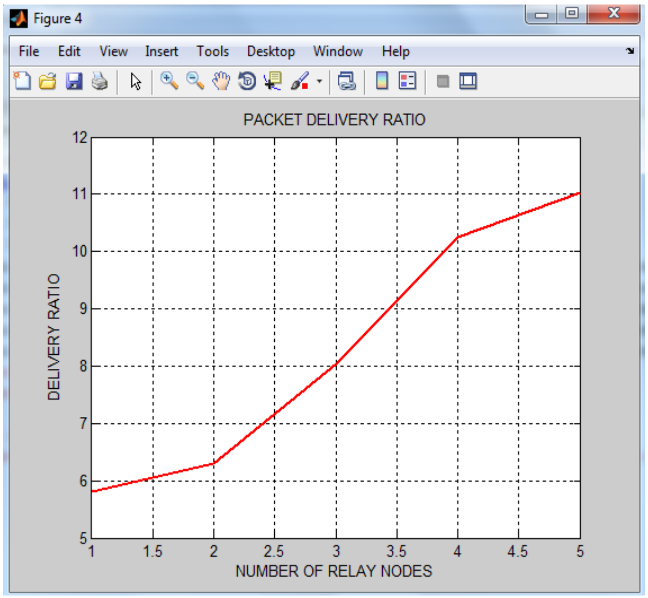

Figure 8: Packet Delivery Ratio

Packet delivery ratio is the number of packets sent/ number of packets given, over the network in given time. Above figure shows the packet delivery ratio value. It has been seen that value of packet delivery ratio is more than 10 packets.

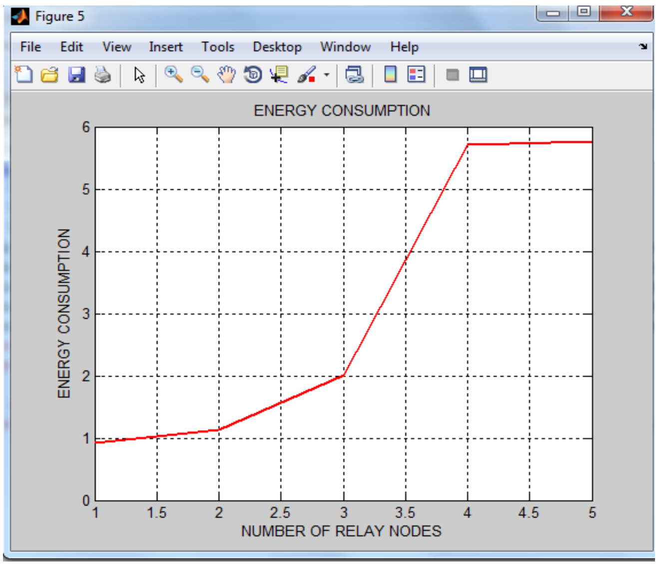

Figure 9: Energy Consumption

Energy efficiency is the efficiency computed over the total energy consumption of the network including the useful energy and the wasted in form of losses during the transmission process. Above figure shows the energy consumption.

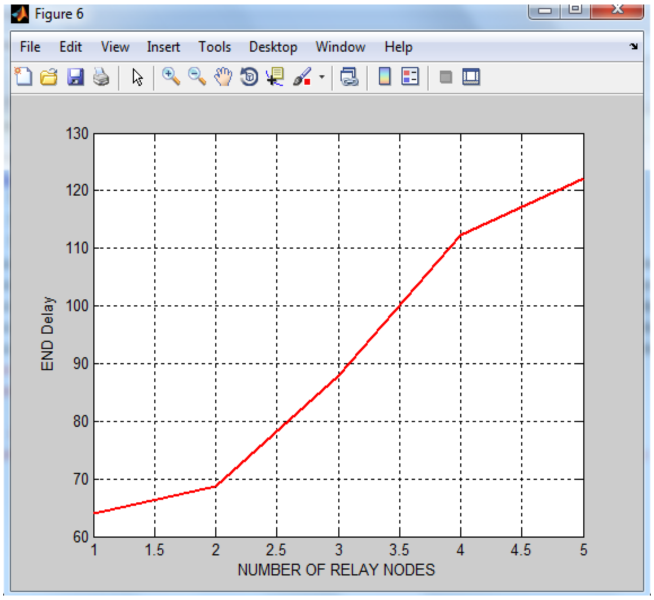

Figure 10: End Delay

The End to End Delay is a significant parameter for evaluating a protocol which must be low for good performance. Above figure shows the delay founds to be 120 no. of packets. This increase in delay is due to the additional nodes through which then passes to the destination node. However increase in the numbers of nodes also increases the difference of delay.

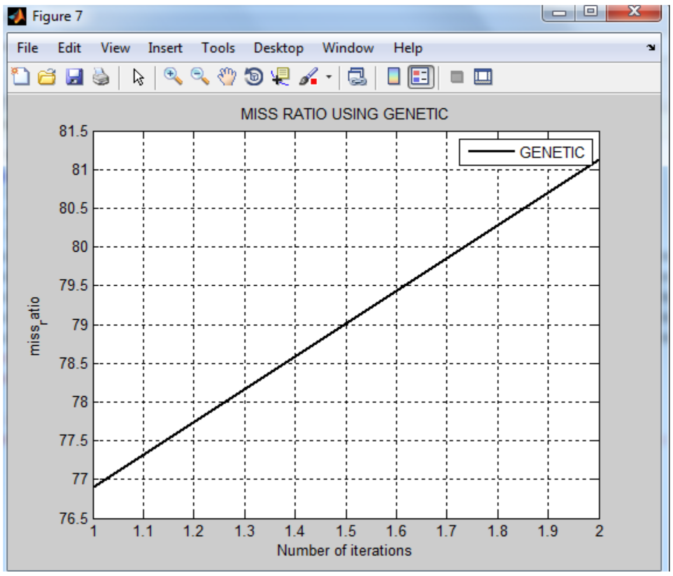

Figure 12: Miss Ratio using GA

Miss ratio as a metric for network quality of service. Above figure shows the miss ratio value for relay nodes and it has been seen that miss ratio is more than 95% without GA and using GA it has been reduced to 82%. One approach to prolong network lifetime while preserving network connectivity is to deploy a small number of costly, but more powerful, relay nodes whose main task is communication with other sensor or relay nodes.

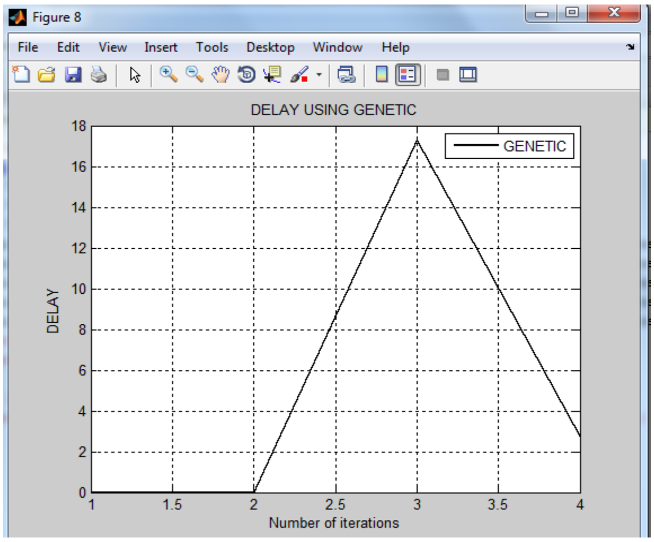

Figure 13: Delay Using GA

The End to End Delay is a significant parameter for evaluating a protocol which must be low for good performance. Without using GA the delay founds to be 120 no. of packets and with use of GA it has been reduced to 17 then again reduced to 4. This reduction in delay is due to the optimization of nodes through which then passes to the destination node. However increase in the numbers of nodes also increases the difference of delay.

5. CONCLUSION AND FUTURE SCOPE

In this paper, an advanced optimizes Genetic Algorithm (GA) algorithm has been implemented to Minimize Energy Usage and other parameters. Main concept behind the wireless sensors network is to save energy more and more so that it works last long enough. This is due to fact that the size of a sensor node is expected to be small and this leads to constraints on size of its components i.e. battery size, processors, data storing memory, all are needed to be small. So any optimization in these networks should focus on optimizing energy consumption to enhance WSN life time. In our proposed algorithm the energy consumption is more balanced as compared to the other optimization algorithms.

The Future scopes of this thesis include the use of leach protocols, as still there are many drawbacks in the basic leach protocol. The protocol can be enhanced for dealing with mobility of nodes. Even effort can be made to decide the number of clusters dynamically and this may give better scalability to the protocol for dealing with very large wireless sensor networks.

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