Heterogeneous Leach in 3-dimensional Wireless Sensor Network using gateway

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ABSTRACT

Wireless Sensor Networks are those networks in which communication is carried out through a wireless channel. A sensor network is a group of specialized transducers intended to monitor and record conditions at diverse locations. These parameters are temperature, humidity, pressure, speed, intensity, vibration-sound intensity, PIV, etc. The numbers of towers in the area act as sensors are called nodes in wireless sensor networks. Thus, from one node to another, communication is carried out without any physical link. A network consists of numbers of nodes with one as a source and one as a destination. This paper proposed A-LEACH protocol and cluster member-elect cluster head to avoid excessive energy consumption. Cluster Head is responsible for creating and manipulating a TDMA schedule & sending aggregated data from nodes to the BS where this data is needed using CDMA. Gateway is a network point that reduces the distance between CH and BS in WSNs. This paper proposed a multiple hops data transmission and make energy-efficient and energy conservative protocol design to increase the data rate.

Keywords— *Wireless Sensor Network, A-Leach, Heterogeneous network, Cluster head*

1. INTRODUCTION

A network consists of numbers of nodes with one as a source and one as a destination. Wireless sensor networks consist of spatially distributed sensors to monitor physical or environmental area. A wireless sensor network is made of nodes from few to several hundred nodes, where each node is connected to a sensor. Data is transmitted through node to node where distance determination is necessary. In short distance and efficiency are inversely proportional to one another i.e. if distance is large then it will consume a large amount of energy and thus efficiency decreases and vice versa. [7]

Wireless sensor networks combine sensing, computation, and communication into a single tiny device. A WSN having a ten to thousand node that communicate through wireless channels for information sharing and cooperative processing. A sensor node in wireless sensor network is typically equipped with a transducer, a radio transceiver, small micro-controller and a power source deployed in phenomena intended to monitor at diverse locations. Sensor node is capable of sensing many type of information from the environment including temperature, light, humidity, pressure, wind direction and etc. They usually transmit the acquired data through RF channel to the base station or gateway. Wireless sensor networks are formed by small devices communicating over wireless links without using a fixed networked infrastructure. Because of limited transmission range, communication between any two devices requires collaborating intermediate forwarding network nodes, i.e. devices act as routers and end systems at the same time. [3]

One of the advantages of wireless sensor networks is their ability to operate unattended in harsh environment in which manually human monitoring schemes are inefficient and risky. Communication efficiency depends on the distance between communicating nodes.[8] In short distance and efficiency are inversely proportional to one another i.e. if distance is large then it will consume a large amount of energy and thus efficiency decreases and vice versa. Sensor network requires the efficient and robust distributed protocols and algorithms with properties such as:

a) Scalability: - Able to operate in extremely large networks composed of huge numbers nodes
b) Efficiency: - Efficient with respect to both energy and time
c) Fault Tolerance: - Network should be able to operate despite of any failure of any nodes[3]

- **Sensor Node:** It is the core component of wireless sensor network. It has the capability of sensing, processing, routing, etc.
- **Cluster Head:** The Cluster head (CH) is considered as a leader for that specific cluster. And it is responsible for different activities carried out in the cluster, such as data aggregation, data transmission to base station, scheduling in the cluster, etc.

- **Base Station:** Base station is considered as a main data collection node for the entire sensor network. It is the bridge (via communication link) between the sensor network and the end user. Normally this node is considered as a node with no power constraints.
- **Cluster:** It is the organizational unit of the network, created to simplify the communication in the sensor network. [6]

2. A-LEACH (ENHANCED LEACH PROTOCOL)

Clustering is an energy efficient method for wireless sensor networks. In clustering, the network is divided into many clusters; each cluster consists of cluster head and many other member nodes. [9] LEACH protocol is one of the clustering protocols. The operation of LEACH is divided into rounds and each round consists of two phases:

- cluster setup
- Steady data transmission. In the cluster setup phase, clusters are formed and the cluster head is generated randomly. In steady data transmission phase, other member nodes send data to the cluster head; cluster head fuses the data and sends it to the sink1. [12]

To overcome the inefficiency of the LEACH in the neglect of residual energy of the nodes and the non-distribution of the cluster heads, in Enhanced LEACH, both the residual energy and the location is considered for choosing the cluster head. [1] The routing technique followed is multi hop routing. The network is uniformly plotted to clusters. Each cluster consists of cluster head and many member nodes. N nodes are randomly distributed in S×S region space. The sink is located far from the monitoring area. [7] [14]. In this scheme, operations are performed in respective stages: area partition, cluster head generation and data transmission.

2.1 Impact of heterogeneity on wireless sensor networks

Placing few heterogeneous nodes in the sensor network can bring following benefits:

- Decreasing latency of data transportation: Computational heterogeneity can decrease the processing latency in immediate nodes and link heterogeneity can decrease the waiting time in the transmitting queue. Fewer hops between sensor nodes and sink node also mean fewer forwarding latency.
- Prolonging network lifetime: The average energy consumption for forwarding a packet from the normal nodes to the sink in heterogeneous sensor networks will be much less than the energy consumed in homogeneous sensor networks.
- Improving reliability of data transmission: It is well known that sensor network links tend to have low reliability. And each hop significantly lowers the end-to-end delivery rate. With heterogeneous nodes; there will be fewer hops between normal sensor nodes and the sink. So, the heterogeneous sensor network can get much higher end-to-end delivery rate than the homogeneous sensor network. [2]

3. LITERATURE SURVEY

Jyoti Rathi and M S Dagar (2016), Advancement in Single Node Data Transfer Energy Protocol using Gateways in Wireless Sensor Networks proposed a growing utilization of Wireless Sensor Networks (WSN) in more and more areas; data transfer security becomes an important issue in research area. The secret key cryptography is not capable to offer security in WSN provided the nature of deployment area in the most applications This paper introduces a new version of LEACH protocol known as V-LEACH which targets to decrease energy consumption throughout the wireless network. We measure both LEACH and V-LEACH by extensive simulations employing OMNET++ simulator which indicates that VLEACH performs better as compared to LEACH protocol. [1]

AnishaSomani, et.al (2016), Comparison of Heterogeneous Leach in Two Dimensional and Three-Dimensional Wireless Sensor Networks proposed a comparison that has been shown between the implementation of Heterogeneous Low Energy Adaptive Clustering Hierarchical (LEACH) protocol in two-dimensional plane and three-dimensional space, considering three-dimensional sensor node deployment as more practical to the real world. Wireless Sensor Networks, being used for sensing, processing and communicating about the ambient conditions, find numerous applications in different areas. In most of the applications, two dimensional deployments of wireless sensor nodes are assumed, where height is considered negligible like in terrestrial networks but in practical scenarios, three-dimensional deployment is more feasible and realistic in ocean column monitoring, under-ground tunnels and other space applications. [2]

Sheenam (2015), G-DEEC: Gateway based Multi-hop Distributed Energy Efficient Clustering Protocol for Wireless Sensor Networks proposed a multi-hop DEEC routing scheme i.e. G-DEEC for heterogeneous networks where deploy rechargeable intermediate nodes called gateways in-between cluster heads and base station for minimizing energy consumption by sensor nodes in each processing round thereby increasing the network lifetime and stability of wireless sensor networks unlike DEEC. Many hierarchal routing schemes for saving the transmission distance have already been proposed for wireless sensor networks but still Cluster Head still suffers long distance transmissions. So here proposed a multi-hop routing protocol using intermediate rechargeable transmission devices known as gateway nodes between cluster head and base station as a defence mechanism for energy constraint battery powered sensor nodes prolonging the processing time of sensor nodes and also reducing the average transmission distance between sensor nodes and Base station. [3]

SupriyaDhauta and Ripul Rishi (2015), Review on LEACH-Homogeneous and Heterogeneous Wireless Sensor Network proposed an increased adoption of Wireless communication and sensor technology, wireless sensor networks are presently employed in variety of applications from medical to military and from home to industry. The major challenge of WSN is as Sensor nodes are battery operated, energy utilization is the main issue which requires special attention. Previously sensor nodes are considered to be homogeneous in which each node has the same energy, processing capacity and functionality but in order to prolong network lifetime researches has been develop to implant heterogeneity in wireless sensor network in which different energy level is

provided to some nodes. This paper enlightens a current survey on basic clustering technique for Homogeneous and Heterogeneous wireless sensor network.

Pratistha Sharma and Abhishek Gupta (2014), Wireless Energy Protocol Advancement using Multi-cast data transmission for Enhancing Lifetime of Network proposed a multi node approach for data routing. However, nodes in network are typically considered to be homogeneous in nature since the researches in the field of WSN, have been evolved but in real world, homogeneous sensor networks hardly been considered for research. Thus, require a clustering technique which will work in heterogeneous environment which are more closely relates with real life environment. This consumes a less energy in long distance communication. Proposed intermediate gateways which lie between cluster heads and main station so will consume less energy than previous single hop protocols which also help in reducing distance between Tx node and Rx station, as distance decrease the energy consumption by nodes for transmission decreases so lifetime also get enhanced. [6]

Lalit Kumar and Madhusudan (2014), Advancement in Single Node Data Transfer Energy Protocol using Gateways in Wireless Sensor Network proposed a new data forwarding approach to improve the lifetime of wireless sensor network using gateways. Gateways reduce the distance between the cluster head and base station in WSNs. So we know if distance decrease between the cluster head and base station it means node life time increases and WSNs lifetime also increase. This consumes a less energy in long distance communication. Simulation results show the protocol offer a batter performance. This article uses Matlab2010a as simulation platform to emulate LEACH protocol and the improved protocol (A-LEACH), the improved algorithm aims at balancing the total energy consumption of nodes and extending the network's survival time. So measures the improved protocol performance from two aspects: the lifetime and the total energy consumption of the network. [7]

N. Javaid, S. Faisal, Z. A. Khan, D. Nayab and M. Zahid in 2013, Measuring Fatigue of Soldiers in Wireless Body Area Sensor Networkswas proposed. Wireless Body Area Sensor Networks (WBASNs) consist of on-body or in-body sensors placed on human body for health monitoring. Energy conservation of these sensors, while guaranteeing a required level of performance, is a challenging task. Energy efficient routing schemes are designed for the longevity of network lifetime. In this paper, we propose a routing protocol for measuring fatigue of a soldier. Three sensors are attached to soldier's body that monitor specific parameters. Our proposed protocol is an event driven protocol and takes three scenarios for measuring the fatigue of a soldier. [13]

Chunyao fu1, zhifang JINGI, Wei WE12 and Ang WEI*3 in 2013, An Energy Balanced Algorithm of LEACH Protocol in WSN is proposed, study the in wireless sensor networks (WSNs), due to the limitation of nodes' energy, energy efficiency is an important factor should be considered when the protocols are designing. As a typical representative of hierarchical routing protocols, LEACH Protocol plays an important role. In response to the uneven energy distribution that is caused by the randomness of cluster heads forming, this paper proposes a new improved algorithm of LEACH protocol (LEACH-TLCH) which is intended to balance the energy consumption of the entire network and extend the life of the network. The new algorithm is emulated by Matlab simulation platform; the simulation results indicate that both energy efficiency and the lifetime of the network are better than that of LEACH Protocol. [14]

HarneetKour in 2012, Hierarchical routing protocol in wireless sensor network was proposed. Due to recent advancement and changes in wireless sensor network, various routing protocols have emerged. Hierarchical-based routing is a cluster-based routing in which high energy nodes are randomly selected for processing and sending data while low energy nodes are used for sensing and send information to the cluster heads. This property of hierarchical-based routing contributes greatly to the network scalability, lifetime and minimum energy. In this paper, we will discuss various hierarchical routing protocols in wireless sensor networks. [15]

Rajesh Patel Sunil Pariyani Vijay Ukani in 2011, Energy and Throughput Analysis of Hierarchical Routing Protocol (LEACH) for Wireless Sensor Network were proposed. Wireless Sensor Networks (WSNs) have gained increasing attention from both the research community and actual users. The efficient utilization of energy source in a sensor node is very important criteria to prolong the life time of wireless sensor network. Wireless sensor networks have explored to many new protocols specifically designed for sensor networks where energy consideration is very crucial. Most of importance, given to hierarchical routing protocols based on clustering has better scalability. As sensor nodes are generally battery-powered devices, the critical aspects to face concern how to reduce the energy consumption of nodes, so that the network lifetime can be extended to reasonable times. There are several energy efficient hierarchical routing protocols among this LEACH is famous protocol, we have simulated LEACH in NS2 and analyzed performance of LEACH in terms of energy, throughput and lifetime. [16]

Neda Enami*, Reza Askari Moghadamv in 2010, Energy Based Clustering Self Organizing Map Protocol for extending Wireless Sensor Networks lifetime and coverage were proposed. Work on lifetime, Cluster based routing protocols are well known schemes for extending Wireless Sensor Networks lifetime. However, there are several energy efficient cluster-based protocols in the literature; most of them use the topological neighbourhood or adjacency as main parameter to form the clusters. This paper presents a new centralized adaptive Energy Based Clustering protocol through the application of Self organizing map neural networks (called EBC-S) which can cluster sensor nodes, based on multi parameters; energy level and coordinates of sensor nodes. We applied some maximum energy nodes as weights of SOM map units; so that the nodes with higher energy attract the nearest nodes with lower energy levels. Therefore, formed clusters may not necessarily contain adjacent nodes. The new algorithm enables us to form energy balanced clusters and equally distribute energy consumption. Simulation results and comparison with previous protocols (LEACH and LEA2C) prove that our new algorithm is able to extend the lifetime of the network, while it can insure more network coverage in its lifetime through distributed death of nodes in network space.

4. SIMULATION AND RESULT

Simulation of our protocol is done in MATLAB. The improved protocol (A-Leach) aims at balancing the total energy consumption of nodes and extending the network's survival time. So, we measure the improved protocol performance from two aspects: the lifetime and the total energy consumption of the network. The lifetime of network means the time from the beginning of simulation to the time when the last node died. As the energy of WSN is limited, so the energy consumption in its lifetime is a meaningful indicator to measure the performance of it.

Table 1: Simulation Environment Parameter

| Parameters	Value
Simulation Round	2500
Sink Location	(200,200)
Network Size	(400,400)
Number of Node	100
Number of Gateway Nodes	16
Cluster Head Probability	0.1
Fusion Rate (cc)	0.1
Initial Nodes Power	0.5 joule
Node Distribution	Nodes are uniformly distributed
Control Packet Size	500 bits
Data Packet Size	4000 bits
Energy Dissipation	10*0.000000000001 joule
Energy for Transmission	50*0.000000000001 joule
Energy for Reception	50*0.000000000001 joule
Energy for Data Aggregation	50*0.000000000001 joule
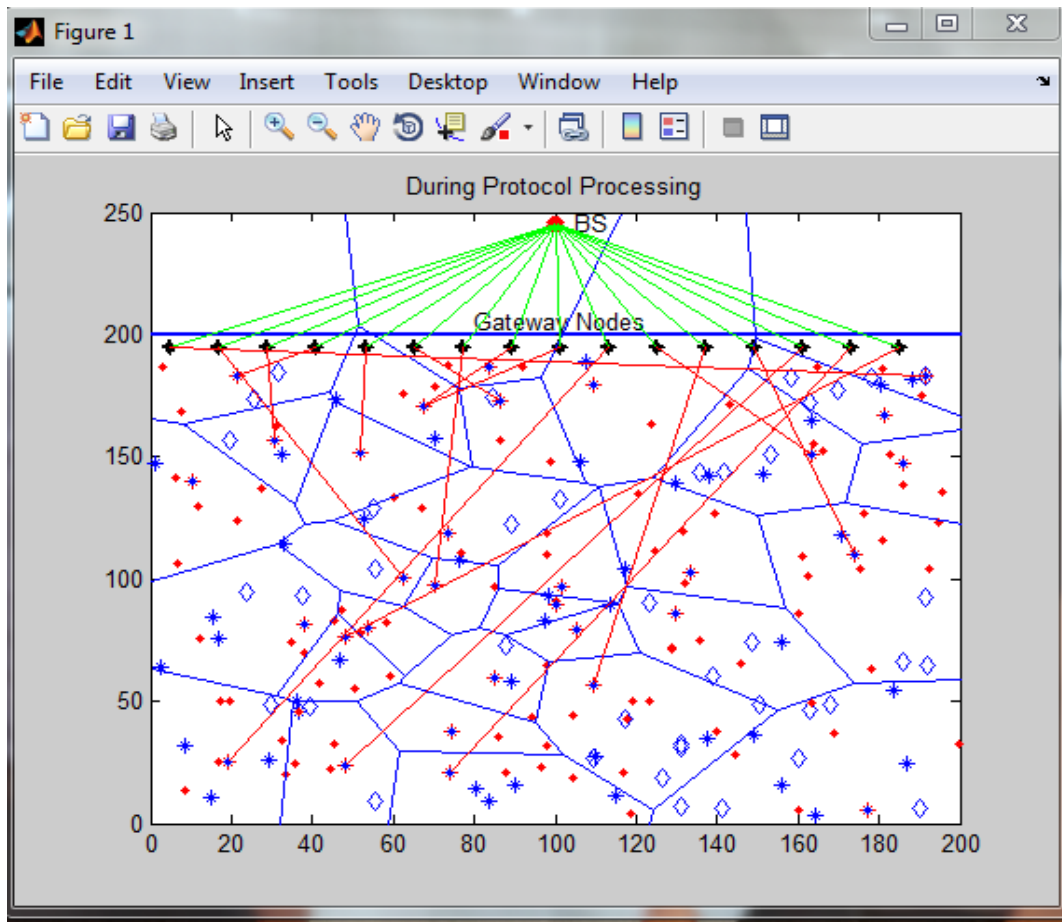
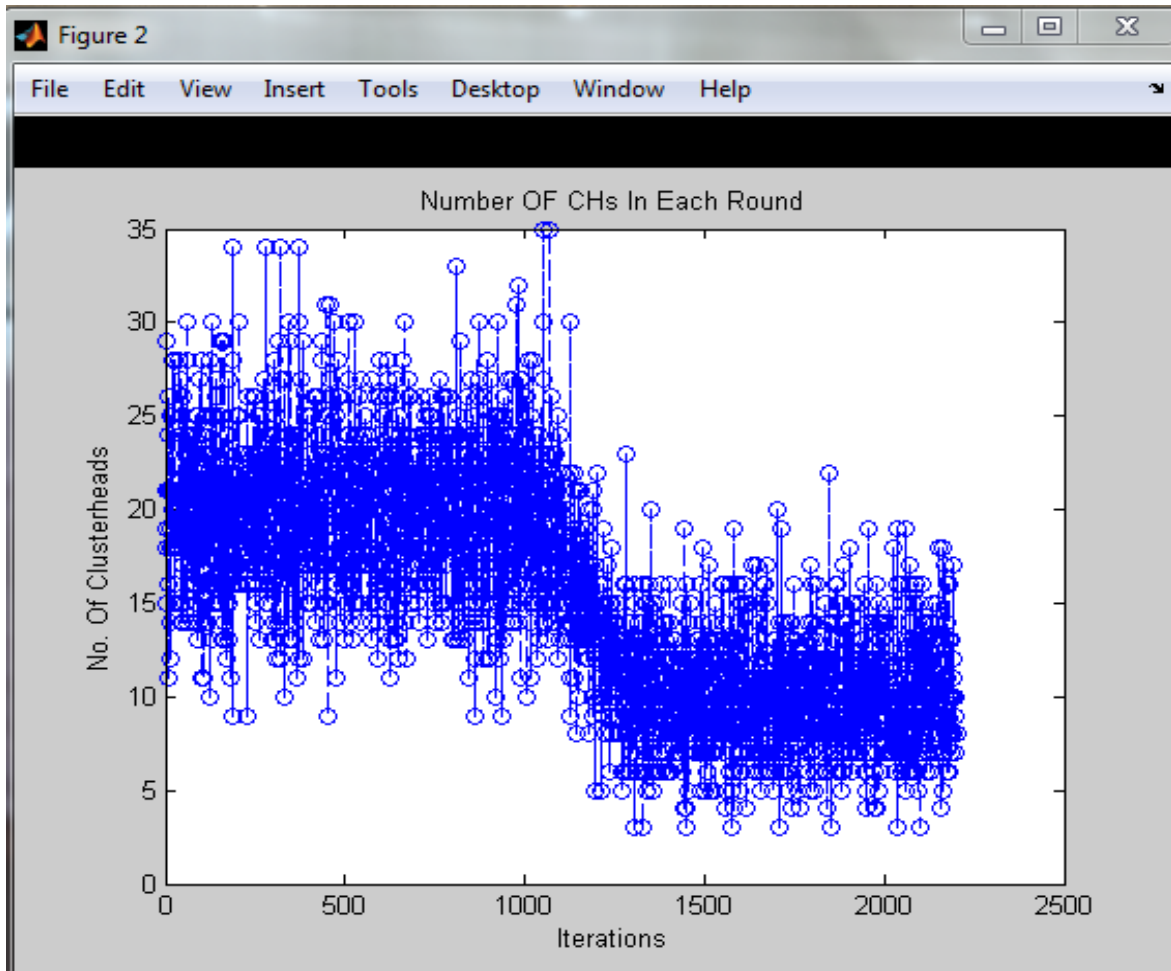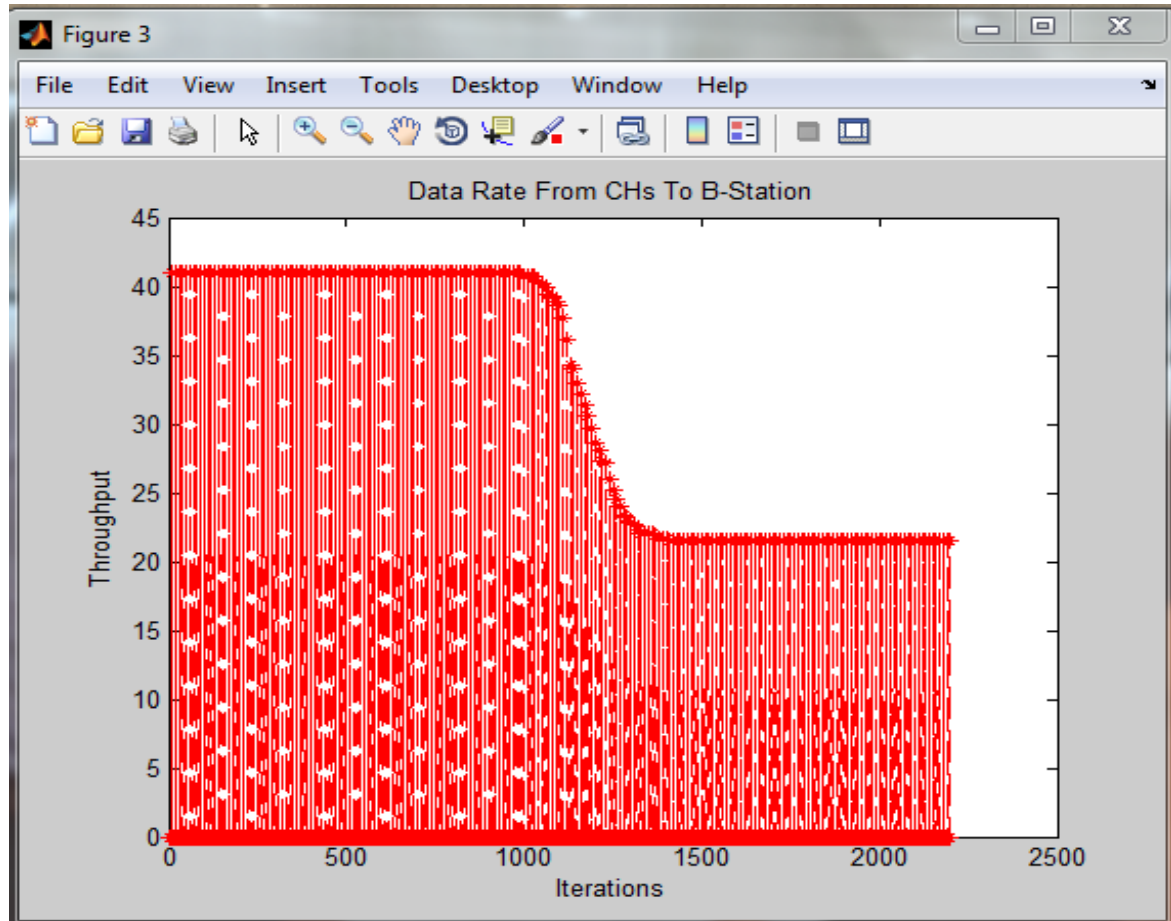**Fig. 1: During Protocol Processing**

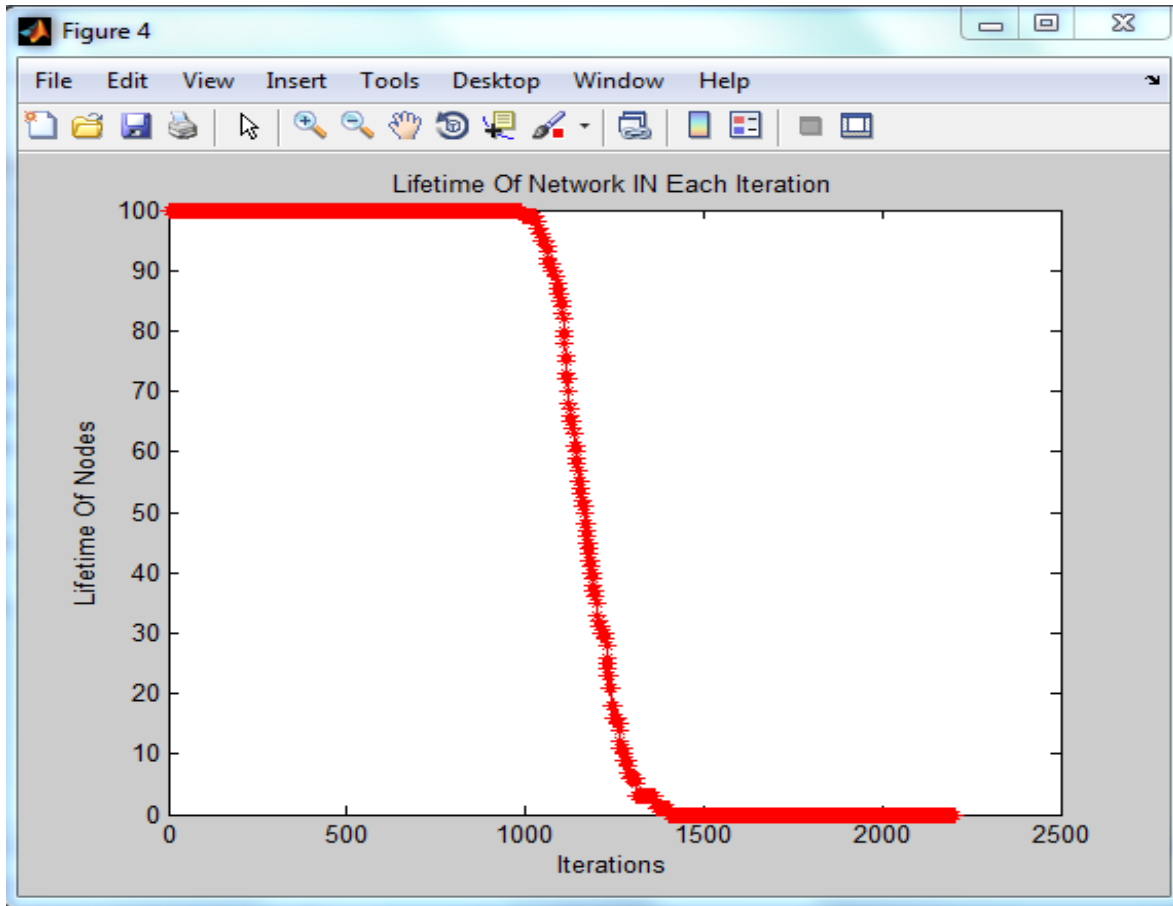**Fig. 2: Number of Cluster Head**

Fig. 3: Through-put
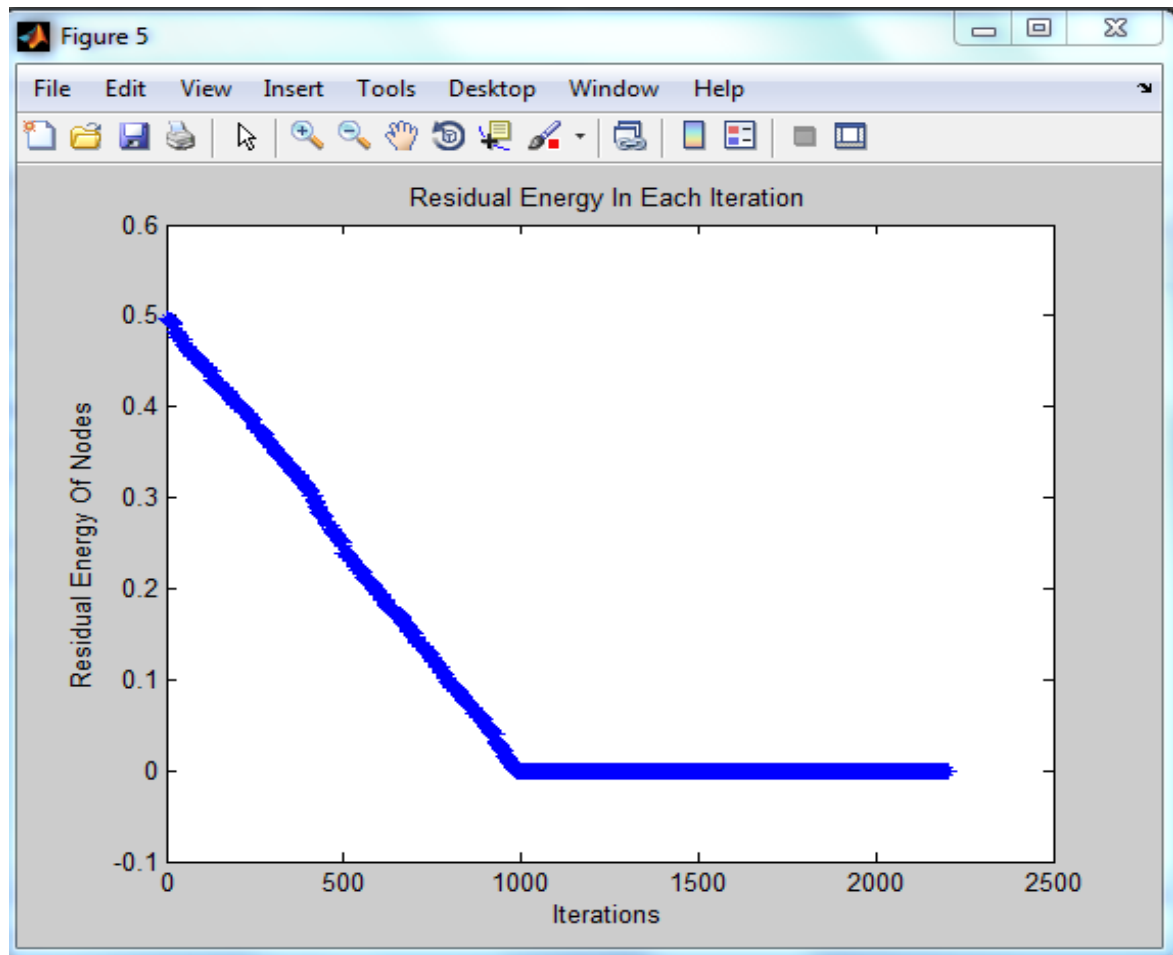
Fig. 4: Lifetime of Network

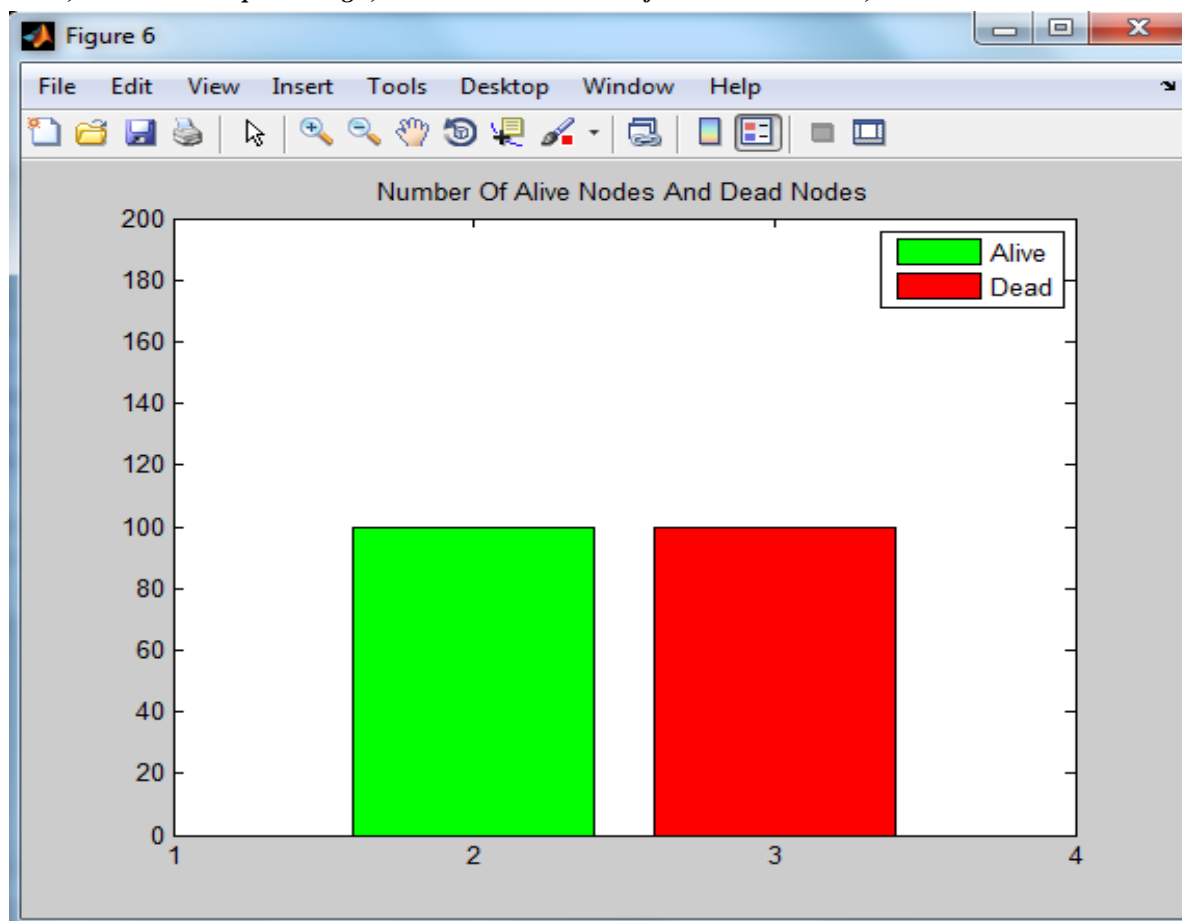

Fig. 5: Residual Energy of Node

Fig. 6: Dead or Alive Nodes

5. CONCLUSION
This paper describes the multi hope routing to increase data rate. The technique that use for the minimization to reduce the time delay with fast data transfer consume the less energy and able to transfer multimode data. Here propose gateway nodes which lie between cluster heads and main station so will consume less energy than previous single hop protocols. Because the distance between cluster heads and base station is reduced by adding gateway nodes.

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