Novel Routing Algorithm using Genetic and Leach in Wireless Sensor Networks

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***Abstract*- The popularity of Wireless Sensor Network has expanded hugely because of the immense capability of the sensor network to interface the physical world with the virtual world. Since these devise hand-offs on battery control and might be set in unfriendly condition supplanting them dull undertaking. This venture gives network techniques to clustering and cluster head selection in Wireless Sensor Network to enhance vitality effectiveness. The genetic algorithm is utilized for selection of cluster head. The genetic algorithm is utilized for clustering in wireless sensor network that utilizations LEACH convention as its benchmark. In this convention single hop communication is utilized inside cluster and cluster head to base station. MATLAB test system is utilized here to judge the execution of the new algorithm and the reproduction result demonstrates that its working outperforms that of LEACH convention.**

***Index Terms*- Leach, Genetic, Wireless Sensor Network,Clusters**

I. INTRODUCTION

A Wireless Sensor Network or WSN is supposed to be made up of large number of sensors and at least one base station. The sensors are autonomous small device with several constraints like battery power, computation capacity, communication range and memory. They also are supplied with transceivers to gather information from its environment and pass it on up to a certain base station, where the measured parameters can be stored and available for the end user.

As a new information acquisition and processing technology, Wireless Sensor Network has a wide range of application in military, environment monitoring, smart furniture and so on.[15]In most cases, the sensors forming these network are deployed randomly and left unattended to and are expected to perform their mission properly and efficiently. As a result of this random deployment, the WSN has usually varying degree of node density along its area. Sensor networks are also energy constrained since the individual sensors, which the network is formed with, are extremely energy-constrained as well. The communication devices on these sensors are small and have limited power and range.

Both the probably difference of node density among some regions of the network and the energy constraint of the sensor nodes cause nodes slowly die making the network less dense. Also it is quite common to deploy WSNs in harsh environment, what makes many sensors inoperable or faulty. For that reasons, these networks need to be fault-tolerant so that the need for maintenance is minimized. Typically, the network topology is continuously and dynamically changing, and it is actually not a desired solution to replenish it by infusing new sensors instead the depleted ones. A real and appropriate solution for this problem is to implement routing protocols that perform efficiently and utilizing the less amount of energy possible for the communication among nodes.

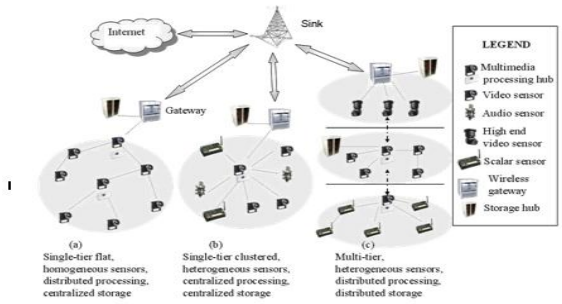

Figure 1 Wireless Sensor Network

The WSN consist of different component

1. Sensor Node
2. Base Station

1.1 Sensor Nodes

Sensor nodes are typically built of sensors and a unit as showing fig.1.2. A Sensor is a device which senses the information and passes it on to mote. Sensors are typically used to measure the changes in physical environmental parameters like temperature, pressure, and heart beats. MEMS based sensor has found good use in sensor nodes. A mote consists of processor, memory, battery A/D convertor for connecting to a sensor and a radio transceiver for forming and ad-hoc network. A mote and a sensor together form a Sensor Node. A Sensor network is a wireless ad-hoc network of Sensor nodes.

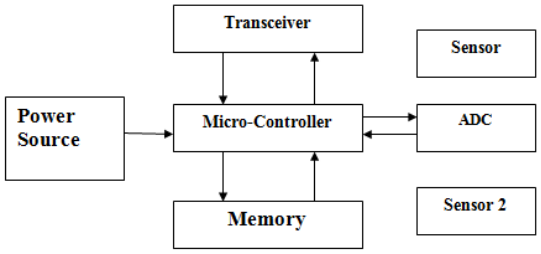

Figure 2 Block Diagram of Sensor Node

1.2 Base Station

A base station links the sensor network to another network. It consist of a processor, radio board, and antenna and USB interface board. It is preprogrammed with low-power mesh networking software for communication with wireless sensor nodes. Deployment of the base station in a wireless sensor network is very important as all the sensor nodes handover their data to the base station for processing and decision making. Energy conservation, coverage of sensor nodes and reliability issues are taken care of during deployment of base station in sensor network. Generally base stations are assumed static in nature but in some scenarios they are assumed to be mobile to collect the data from sensor nodes.

Problem Statement

The objective of this research work is to analyze existing energy-efficiency protocol for Wireless Sensor Network (LEACH) and make some improvement for increasing network lifetime. There are energy efficient clustering technique already been developed and gives improved result but still there are some problem which need to be improved. Although many of existing clustering technique look promising, there are still many challenges that need to be solved in sensor network. This work basically focuses on the improvement of the clustering using genetic algorithm making it to work to extend the lifetime of the sensor network.

2.1 Motivation

Wireless sensor network represents a new generation of real-time embedded system with significally distinguish communication constraints. As these devices are deployed in huge amounts they will necessary the ability to assist each other to communicate data back to centralized collection tip. The integration of the sensor, coupled with unceasing electronics miniaturization. It will make possible to generate extremely cheap sensing device. Sensor nodes are extremely tiny devices which are collected of sensing unit, a radio, a processor and a bounded battery power. In WSN there are several challenges. The core challenges are how to afford highest lifetime to network and how to offer a secure communication to network. As sensor network totally relay on battery power the main aim for maximizing lifetime of network is to conserve battery power or energy.

In sensor network the energy is mainly consumed for three purposes: data transmission, signal processing and hardware operation. So for maximizing the network lifetime the process of data transmission should be optimized. Data transmission can be optimized by using efficient routing protocols and effective ways of data aggregation.

Moreover, the energy required to transmit the message is about to receive the message is about twice as great needed to receive the message. The

routing objectives are tailored by the application require minimal network delay. While application performing statistical mechanism require maximized network lifetime, hence different routing mechanism has been proposed for different application and different application and for increase the time period and reduces the energy consumption genetic algorithm concepts used in this.

Research Methodology

A key component in the design of routing protocol is through knowledge and understanding of the factors that influence the specific network for which the routing protocol is intended, therefore a through a literature study was done to identify and investigate the factors that influence the design of WSN routing protocol. The literature study includes an investigation into available WSN routing protocol, in order to identify common problem faces by these protocol. The developed protocol was simulated to verify its functionality against other protocol to verify its improvement in network lifetime over this protocol.

Literature Survey

Author (Yu Yang, Bhaskar Krishnamachari et al.)[1], have emphasized on the design constrained for sensor nodes in a cluster based approaches. The issues mentioned by the researchers are to dynamically determine the membership of the nodes in the cluster and hence requires the need for an efficient mechanism for maintaining the cluster related information at the cluster head. The research further proposes techniques for energy efficient allocation. The goal is to maximize the lifetime of a cluster till the first node fails. A 3 phase heuristic approach is used where phase 1 involves the partitioning of tasks among nodes with a specific order of execution. In phase 2, to find the assignment of the groups of tasks, a greedy policy is used. In phase 3, the voltage and communication activities are adjusted.

(Vinay Kumar, Sanjeev Jain et al.)[2], have discussed the various clustering routing algorithm to preserve the energy consumption in a sensor network .They focus on maximizing the network lifetime of the WSN. It is achieved by selecting the path is minimized. The goal of their research is to aware the users of different clustering algorithm discovered in the lifetime of wireless sensor network.

(Giuseppe Anastasi, Marco Conto et al.), have examined some of the aspects concerning with how to reduce the energy consumption in a network to increase its lifetime. They have discussed the working of the sensor network and then highlighting some of the general approaches which are used to conserve energy in network. They have identified three main techniques which are duty cycling, data driven approaches and mobility. Their hierarchical classification and their impact on the network and further explained.

(Yun Li,Nan Yu,Weiyi Zhang)[4], Welliang Zhao, Xiaohu You, Mahmoud Daneshmand, Published a paper on "Enhancing the performance of LEACH protocol in Wireless Sensor Network". The LEACH is a well-known routing protocol for cluster base wireless sensor network in terms of lifetime and throughput. The reasonable number of frames in a LEACH rounds is deduced to prolong the lifetime and increase the throughput.

(Muruganathan et al)[5] , published a paper A Centralized Energy –Efficient Routing Protocol for Wireless Sensor Network in 2000 entitled developed a protocol that creates clusters of the similar size and uses multi-hop routing between cluster-head and base station. The cluster head which forward the last hop is selected randomly from the set of cluster heads to minimize the load of cluster head which are located nearest to the base station.

Kiran Maraiya, Kamal Kant, Nitin Gupta published a paper on Efficient Cluster Head Selection Scheme for data Aggregation in Wireless Sensor Network in 2011[6].In this paper they have proposed the most favourable Algorithm for the efficient cluster head selection in which no need to select cluster head periodically, so lots of energy is saved in the wireless sensor network.

Heinzelman et al paper "Energy- Efficient communication Protocol for Wireless Micro –sensor Network "[7] which describes a clustering –based protocol called LEACH. They compare the performance of LEACH with direct communication and MTE. They use a pre-determined optimal number of clusters(5% of the total numbers of nodes) in their simulation.Heinzelmine that the optimal number of clusters for a 100 node network to be 3-5 by using a communication and communication energy model;however, determining the optimal

number of cluster-heads depends on several factors such as position of the sink ,densities etc.

Methodology

Step 1: Initialize the parameter of the sensor field like transmission energy, reception energy, sink location.

Step 2: Set the parameter of the genetic algorithm such as Ps ,Pc, Pm,then set counter (r) to zero.

Step 3: BS constructs the sensors set by selecting sensors nodes that have residual energy equal or larger than the average energy of all live sensor nodes in the sensor field.

Step 4: Apply GA by setting randomly Ps initial bits binary chromosomes and set the counter of generations (gen) to zero.

Step 5: Calculate the objective function F(X) for all CHs chromosomes.

Step 6: Increase the counter of generations by one (gen=gen+1).

Step 7: Select the best CHs chromosomes based on the fitness value (1/F(X)) using roulette wheel selection.

Step 8: From each pair of CHs parents, take Nc children by crossover operation based on the crossover rate pc.

Step 9: Apply the mutation to all genes of each child generated from step 7 based on probability of mutation pm.

Step 10: Calculate the objective function F(X) for new CHs chromosomes. Pool for the next generation.

Step 11: Select the best Ps chromosome from parents and children to be population pool for the next generation.

Step 12: Has stopping criterion met? If yes, then go to step 13. Otherwise, return to step 6 and continue through step 16.

Step 13: display the number of Chs and their

Step 14: Assign the members nodes of each CH.

Step 15: Steady state phase, when the sensed data transfers to CHs and collects in frames; then these frames transfers to the BS.

Step 16: Has the energy of all nodes equal or less than zeros? If yes, then stop. Otherwise, increase number of rounds by one and return to step 3 and continue through step 16.

Simulation

In this chapter, firstly MATLAB software used for deploying WSN is presented. Secondly, simulation of Energy-Efficient routing protocol using genetic algorithm for WSN are discussed in detail.

6.1 Introduction

Today most of the research is done to develop ultra-low powered WSN which is only possible only if the overall network lifetime increase, energy consumption decreases and the network run with high stability and reliability. To achieve this, many algorithms have been implemented. They are called Energy-efficient algorithms. These algorithms in their basic form have already been implemented on various network protocol including LEACH, AODV, TEEN etc. However, these algorithms need further research for increase network lifetime and energy efficiency.

Specific Requirements

Hardware Requirements

Computer/Processor : Any Intel Processor or AMD Processor

Operating System: Windows: 7

Memory : Windows: 1024 MB (RAM)

Disk Space : 3 GB (MATLAB)

Software Requirement: MATLAB 7.8

6.2 MATLAB Environment

The simulation is carried out using custom Built Iterative based simulator in MATLAB 7.8.0347(R2009a)which simulates the sending, receiving ,dropping, and data forwarding etc.MATLAB is a high-level technical computing language and interactive environment for algorithm development ,data visualization, data analysis, and numeric computation .using the MATLAB product, technical computing problems can be solved faster than with traditional programming language, such as c/c++ .It is used in a wide range of application, including signal and image processing, communication, control design, test and measurement, financial modeling and analysis. MATLAB provides a number of feature for documentary work. MATLAB code can be integrated with each other language and application, and give out various new algorithm and application. Its features include:

- High-level language for technical computing.
- Development environment for managing code, files, and data

- Interactive tools for iterative exploration, design and problem solving
- Mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization and numerical integration.
- 2-D and 3-D graphics function for visualizing data. Tools for building custom graphical user interface.

6.3 Implementation

Simulations are conducted using MATLAB 7.8.0347(R2009a) and to get precise plots, confidence interval is taken. Sensor nodes are deployed in random manner and made homogeneous wireless sensor network. The wireless channel is used because the nodes deployed in the network are communicating wirelessly based on their distance, transmission range etc. Simulations show the throughput, network lifetime, location of base station and initial energy of sensor nodes in LEACH protocol. MATLAB 7.8 has been used for the implementation of routing protocols. It provides the real time environment to the vehicular ad hoc network. We are using this version of MATLAB in our project for implementation.

6.4 Project work

The work done in this project in mentioned below steps:

1. Deploy WSN by initializing the parameter.
2. After deploying the network, it is worth-noting to use appropriate topology for that network.
3. Selecting the cluster-head in the sensor network using LEACH protocol.
4. Initializing the communication by sending the data packets.
5. Implementing LEACH, a routing protocol for homogeneous WSN to find the optimal solution
6. Evaluating the performance and observing the analysis for different parameter.
7. Selecting the optimum cluster-head in the sensor network using Genetic Algorithm
8. Initializing the communication by sending the data packets.
9. Implementing proposed protocol, homogeneous WSN to find the optimal solution.
10. Evaluating the performance and observing the analysis for different parameter.

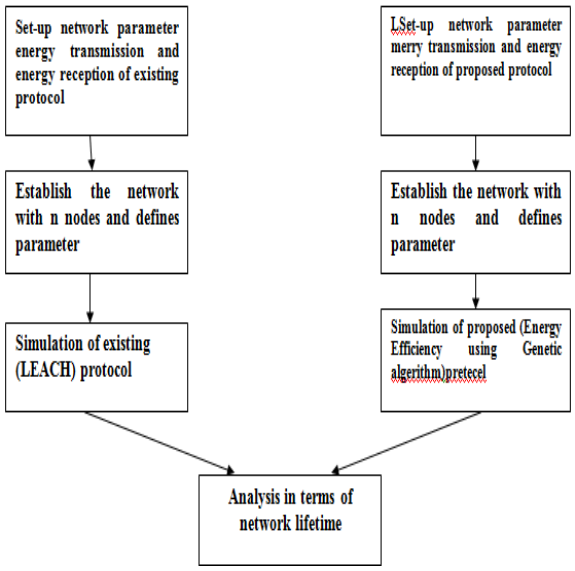

Figure 3: Flow chart of Research Design

Result and Discussion

Figure and Table Captions

Homogeneous Network

Firstly, homogeneous WSN were created and simulation were obtained for LEACH protocol in the network. After considering the assumption, the simulated environment execution consists nodes describing their energy level as in the following figure. Further proposed protocol, for WSN was simulated. It represents the improved network lifetime of WSN. the result and analysis conclude that proposed protocol simulated on MATLAB prologs the lifetime of the WSN.

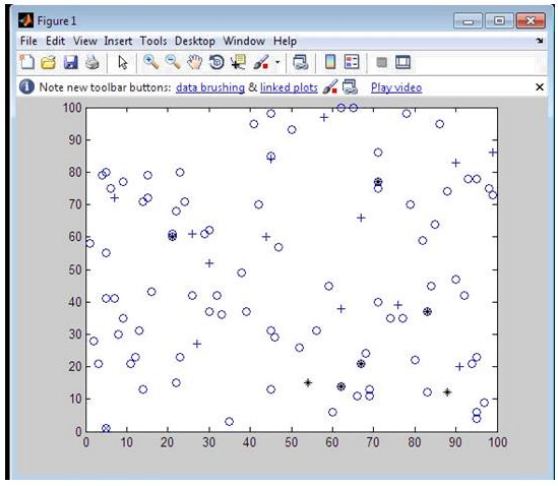

Figure 4 Homogeneous WSN

7.2 Simulation Results of Existing(LEACH) Protocol

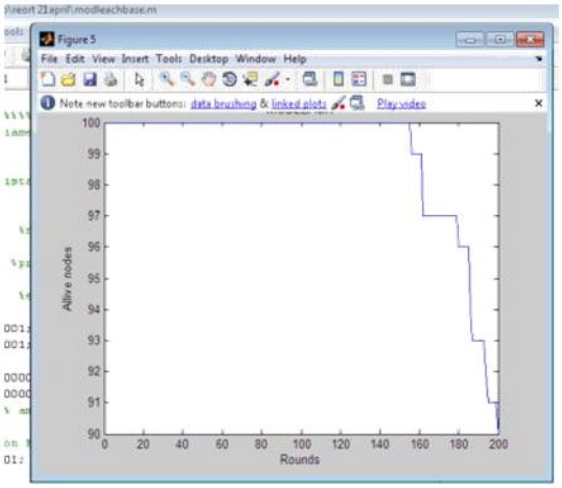

Figure 5: Round vs alive node(LEACH)

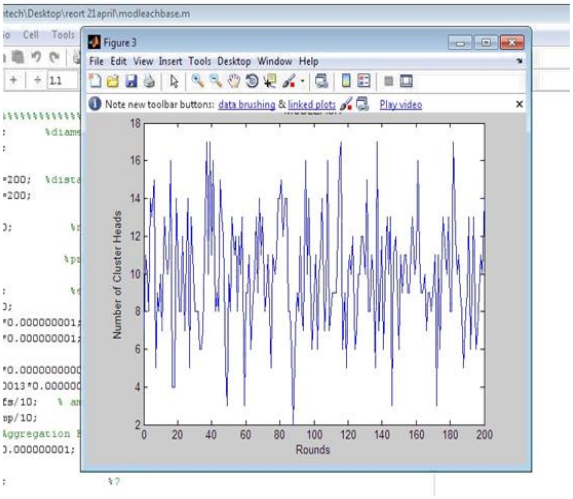

Figure 6: Round vs Number of cluster head(LEACH)

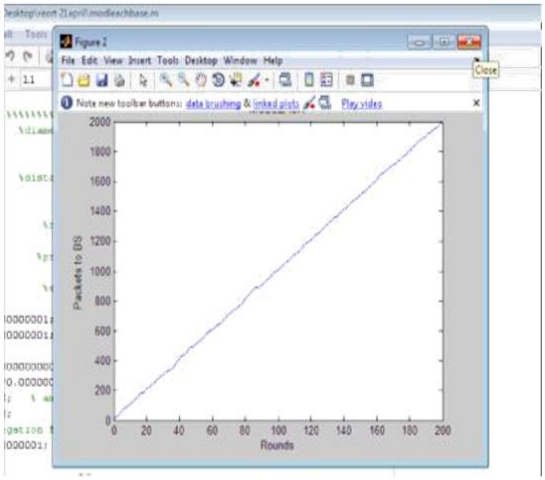

Figure 7: Round vs packet to BS(LEACH)

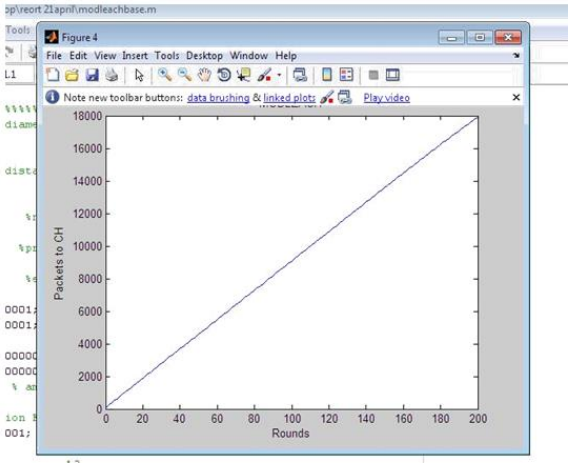

Figure 8: Round vs packet to CH(LEACH)

7.3 Simulation Result Of Proposed Work

In order to analyze the algorithm we implemented it in MATLAB, simulated the algorithm for a sample and compared it with LEACH for the same network.

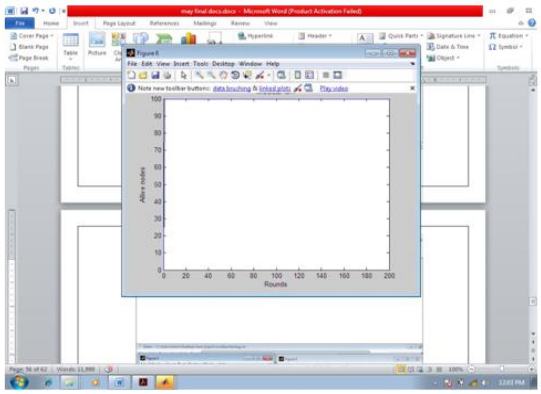

Figure 9: Round vs alive node

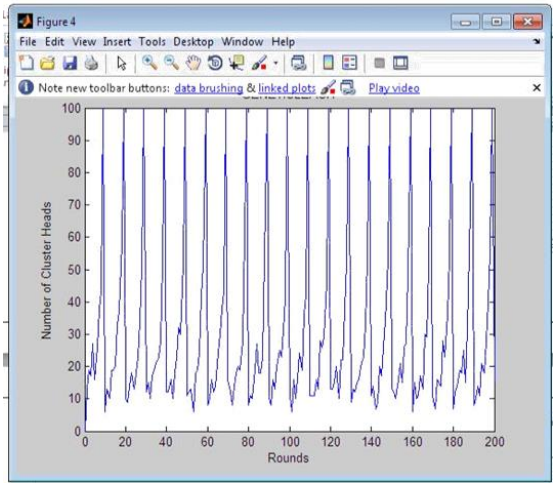

Figure10: Round vs number of cluster head

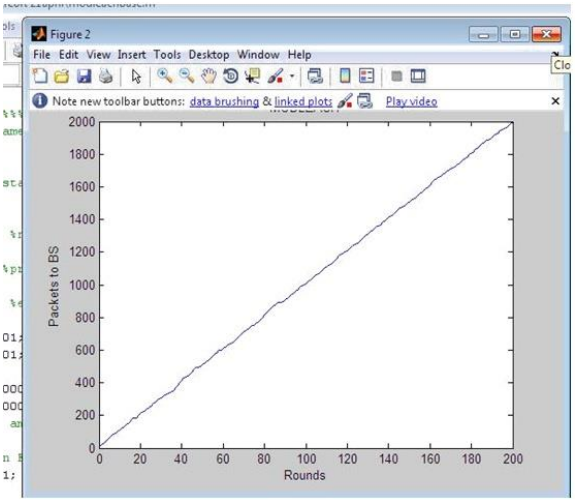

Figure 11: Round vs Packet to Base station

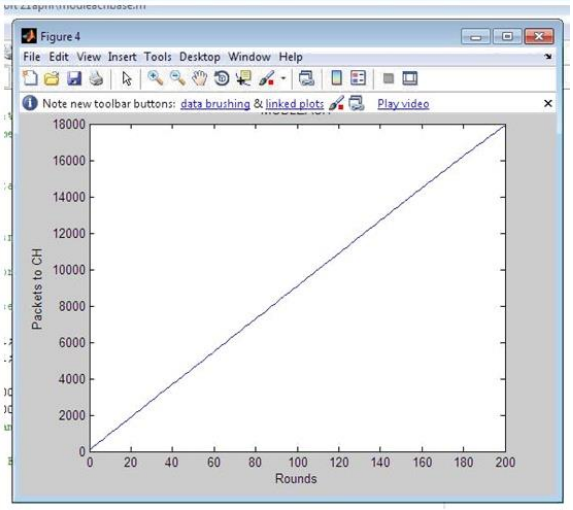

Figure 12: Round vs Packet to Cluster Head

Our Proposed Work is more energy efficient because the node will last till the last round.

Conclusion and Future Scope

8.1 Conclusion

Our project work included the study of clustering, cluster head selection and other energy efficient communication protocols for WSN, since it was earlier proposed that clustering improves the network lifetime. Keeping the routing polices in mind we proposed a genetic based approach for choosing clustering head and proposed a new method for cluster head selection having less computational complexity. In this approach various conditions are considered which would provide a more accurate outcome. In this proposed approach cluster head is elected on the basis of fitness value. Routing is a significant issue in wireless sensor network.

In this thesis , a new approach energy efficiency protocol using genetic algorithm is proposed reduces energy consumption by using clustering technique therefore increases system lifetime .The performance evaluation in terms of network lifetime using MATLAB .This work proposed a genetic algorithm based new approach for clustering for wireless sensor network .Protocol consider proposed algorithm is for the homogeneous network which uses genetic algorithm for cluster-head selection and in this base station selects the cluster head from the candidate cluster head using genetic algorithm. The proposed technique has improved the performance in terms of network lifetime by comparing with LEACH.

In WSN , a very critical task for clustering protocol is to select the cluster head so that least energy is consumed, and hence prolong the lifetime .In the presented work ,we simulate the LEACH algorithm. Mat lab simulation results showed that the proposed protocol is more energy efficient .proposed work increase the energy efficiency in terms of network lifetime.

8.2 Future Work

1. This proposed work can be used for heterogeneous wireless sensor network.
2. Next improvement can be possible by considering sink mobility and to ensure successful delivery of data.

The future work can include some more level of hierarchy and mobility in the network.

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