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Energy Efficient Leach Protocol For Wireless Sensor Network

SATHI SATENDRA REDDY[1], R. SANTHI SRI[2]

[1]PG Scholar, Dept of ECE, Prasiddha College of Engineering & Technology, Anathavaram, Amalapuram, AP, India.
[2]Asst Prof, Dept of ECE, Prasiddha College of Engineering & Technology, Anathavaram, Amalapuram, AP, India.

Abstract: Wireless sensor networks are employed in several applications, including military, medical, environmental and household. In all these applications, energy usage is the determining factor in the performance of wire- less sensor networks. In this paper we are implementing an advanced optimizes clustering algorithm to enhance network lifetime. Main concept behind the wireless sensors network is to save energy more and more so that it works last long enough. Consequently, methods of data routing and transferring to the base station are very important because the sensor nodes run on battery power and the energy available for sensors is limited. One of the nodes should be selected as head to receive all members data and to transmit. To ensure this process, multiple algorithms are introduced like LEACH (Low Energy Adaptive Clustering Hierarchy) EELEACH, (Energy Efficient Low Energy Adaptive Clustering Hierarchy), Distributed Energy- Efficient Clustering (DEEC) protocols are implemented and studied in this project. DEEC is designed to cope with nodes of heterogeneous WSNs. For CH selection, DEEC uses initial and residual vitality of nodes.

Keywords: WSN, Clusters, LEACH, EELEACH, DEEC.

I. INTRODUCTION

Wireless sensor networks are composed of small sensor nodes, computation, and wireless communication capabilities. Many routing protocols have now been specifically made for WSNs where energy responsiveness is a significant strategy concern. Wireless sensor network (WSN)[1, 2] consists of hundreds and even thousands of small tiny devices called sensor nodes distributed autonomously to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure and motion at different locations. Energy plays an important role in wireless sensor networks because nodes are battery operated [3]. Consequently many protocols have been proposed in order to minimize the energy consumption of these nodes. Each node in a sensor network is typically equipped with one or more sensors, a radio transceiver or other wireless communications device, a small microcontroller, and an energy source, since in most Wireless sensor network applications the energy source is a battery [4], energy plays an important role in wireless sensor network, and preserving the consumed energy of each node is an important goal that must be considered when developing a routing protocol for wireless sensor networks. Many routing protocols have been proposed in the literature such as LEACH [5]. Leach is considered as the most popular routing protocol that use cluster based routing in order to minimize the energy consumption; in this paper we propose an improvement on the Leach Protocol that further enhance the Power consumption, simulation results bring out that our protocol outperforms Leach protocol in term of energy consumption and overall throughput[6]. In fig.1, the configuration of the WSNs is described, where a sensor network is shown in a cloud that contained the many sensor nodes. These nodes transmit the data to the beds base station or sink node. Sink node aggregates the data from sensor nodes and transmit to the internet. The consumer receives data through internet from sink node.

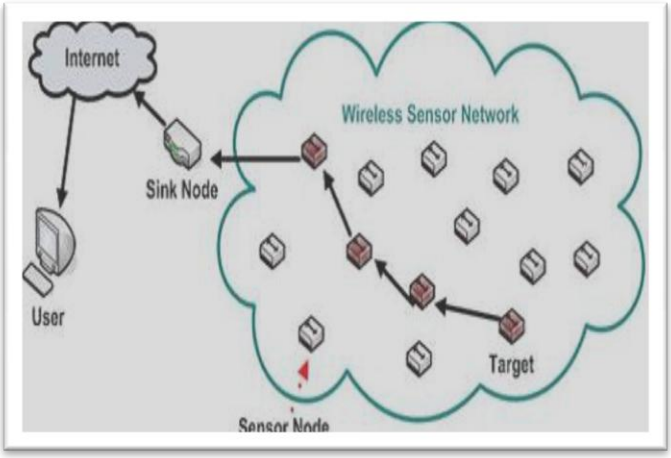

Fig. 1. Configuration of Wireless Sensor Network.

II. LITERATURE SURVEY

A. Leach

Leach is "Energy Efficient Adaptive Protocol for Cluster Hierarchy in Wireless Sensor Networks". This protocol works on the principal that the node with more residual energy having with more chances to be elected as a cluster head in a particular cluster as shown in Fig.2. The energy load should be evenly distributed among all the cluster members of the particular cluster in order improve the life time of a wireless

sensor network. By doing so the energy at a single node or a small set of nodes will not drained out soon[7]. S LEACH is a first energy efficient routing protocol for hierarchical clustering. By implementing LEACH protocol on a sensor network we can make the network more energy efficient. LEACH protocol divides the nodes in a sensor network in the different clusters. Then one node from each cluster is elected as a cluster head (CH) and the other nodes in the clusters are known as cluster members (CM). Cluster member nodes sense the sensing field and get the data. Then the sensed data is transmitted to the cluster heads by the cluster members. The cluster head receives the data and aggregate the data. Now this aggregated data is transmitted to the sink node by the cluster heads.

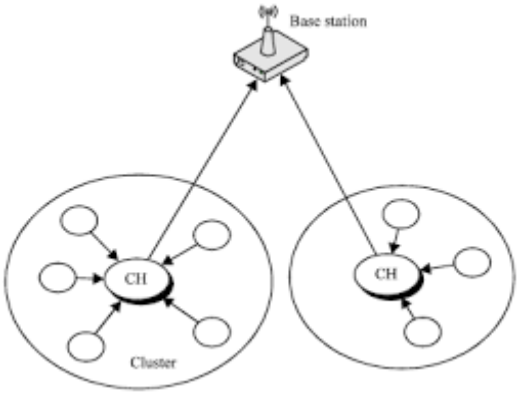

Fig.2. LEACH Protocol Architecture.

There are mainly two phases in LEACH protocol one is Setup phase and other is Steady-state phase. In the first phase that is setup phase nodes in a sensor field are divided into clusters and then the cluster head is elected from these nodes. In steady-state phase, the data is transmitted from cluster member nodes to the cluster head and then again data is transmitted from cluster head to sink node or base station. TDMA scheme that is time division multiple access is used for the efficient communication between the sensor nodes. A particular time slot is provided to the cluster members for transmission of data, in this time slot cluster members can transmit data to the cluster head. This scheme is used to avoid collision that occurs during data transmission. The selection of cluster head is takes place randomly after every round [4] [5] [6].

B. EE-LEACH

EE-LEACH employs the distributed clustering approach as compare to LEACH protocol. The total sensor field is divided into the equal sub-region. The choice of the cluster head (CH) from each sub-region is determined by the threshold approach as in LEACH protocol. The sensor nodes in WSN are having with limited battery life so the main point of improvement of lifetime of wireless sensor networks directly focus on the factor of energy conservation. The networks based on clustering mainly divide the sensing area in the number of clusters and from each cluster one cluster head is selected. Other nodes in the cluster are called as cluster members. LEACH that is first energy efficient protocol used in WSN improves the life time of the network efficiently. This is a clustering based approach. With the number of advantages LEACH protocol also comes with some disadvantages like while choosing cluster head this protocol does not take into account the residual energy of the sensor nodes and also the cluster head distribution is non uniform. The EE-LEACH MIMO scheme provides an improvement over the LEACH protocol.

III. METHODOLOGY

In EELEACH MIMO scheme, the network is divided into sectors of equal angles and the residual energy of sensor nodes also considered while choosing cluster head and cooperative nodes for MIMO system. The clustering is done only for one time. The network is divided into clusters by cutting it from center using an angle of 2π/Kopt Sink inform the nodes to join the cluster nearest to them. The value of is K opt is 5 for implementation of EE-LEACH MIMO scheme. All the operations are managed in rounds. For each round the selection of cluster head and cooperative nodes takes place.

1: Let Ni orNj denote a common node

2: S(Ni) = (N1, N2 .....Nn) denote the set of n nodes

3: E(Ni) denote energy in a node

4: Nxyz denote node location

5: Ci denote a cluster ID

6: CH(Ni) denote a cluster head node.

7: dij denote distance measured from node Ni to Nj

8: thresh (Ni) denote the threshold value of node Ni Initialization

9: Create node Ni

10: Set node position Nxyz Clusters formation

11: Divide the sensor field into equal sub-region Ri

12: Select CH from the each sub-region Ri based on threshold value.

13: if Ni _Ri&& thresh(Ni) < Threshold&&hasnotbeenC H yet then

14: Ni = CH (Ni) for sub-region Ri

15: else

16: Ni =Nj (normal node)

17: end if Send Data to Base station

18: CH(Ni) sends data to Base station Repeat the steps 12 to for different rounds

End of algorithm

A. Distributed Energy- Efficient Clustering (DEEC)

DEEC is designed to cope with nodes of heterogeneous WSNs. For CH selection, DEEC uses initial and residual vitality of nodes. Let ni denote how many rounds to be a CH for node si. PoptN is the optimum quantity of CHs in our network during each round. CH selection criteria in DEEC are based on vitality of nodes. As in homogenous network, when nodes have same amount of energy during each epoch then choosing pi = popt assures that poptN CHs during each round. In WSNs, nodes with high energy are more probable to become CH than nodes with low energy but the net value of CHs during each round is add up to poptN. Pi is the probability for every node si to become CH, so, node with high energy has larger value of pi as set alongside the popt) denote saverage energy of network during round r which may be given as in [10]: In DEEC [3], the election of cluster-heads is performed by way of a probability based on the ratio between residual energy of every node and the average energy of the network. The epochs to be cluster-heads for nodes are different according with their initial and residual energy. The nodes with maximum initial and residual energy can have greater chances to be the cluster-heads compared to nodes with minimum energy. To avoid that each and every node needs to know the global familiarity with the networks, DEEC estimates the ideal value of network life-time, which can be used to compute the reference energy that each and every node should expend during a round. To maximise the DEEC protocol performances, the DDEEC [4] implemented a balanced and dynamic solution to distribute the spent energy more equitably between nodes. It consists two phases

- An energy aware passive clustering approach that reduces clustering overheads and assures uniform energy distribution.
- A node association approach based on residual energy and communication cost of a CH.

The proposed work makes the following assumptions before designing the energy efficient protocol.

- Topology is static
  - All nodes are aware of their location
  - All the cluster members can reach CH in one hop
  - CH can reach the base station in one hop or multiple hops

B. Genetic Algorithm

Genetic algorithm is a method for the optimization and global research. A Genetic Algorithm performs fitness tests to select the best population from the new structure. The quality of the individual is determined by fitness on the basis of the criteria that is defined. The ability of an individual to pass on its genetic material is called as fitness of that individual. Anything that contributes to this ability will also contribute to the organism of overall fitness. This ability of an individual includes the facts that enable it to survive and also further reproduction should be possible. The function that defines the problem evaluates the fitness value in GA. Fate of an individual also depends on fitness value. More the fitness value will lead to the more chances of that individual to survive. GA is mainly used to solve those problems whose mathematical solutions are not possible. For such problems GA provides an optimum solution. Basically process of GA includes five steps. These steps are population, fitness value, selection, crossover and mutation. These steps are described below: 1) Population: A population mainly consists of a group of individuals. These individuals are called as chromosomes and represent the complete solution of a problem which is defined. Each chromosome is represented with a sequence of 0s or 1s. By randomly generating the set of individuals, a set of population can be created. 2) Fitness: The ability of an individual to pass on its genetic material is defined as the fitness value of that individual. Fate of an individual also depends on fitness value. More the fitness value will lead to the more chances of that individual to survive. In GA the function that defines the problem is used to evaluate the fitness value.3) Selection: The selection process used to determine or used to select the chromosomes from the current population that will mate (crossover) to create new population with new chromosomes.

The individuals with the better fitness values will have better chances of selection. 4) Crossover: Recombination of component materials due to mating is known as cross over. It is responsible for the transfer of genetic inheritance. The outcome of crossover depends on the selection of chromosomes from population as performed in last step that is selection process. Crossover is acting on two parents and it is a binary genetic operator. 5) Mutation: As a result of crossover, the new generation introduced will only have the traits of the parents. This can sometimes lead to a problem where no new genetic material is introduced in the offspring. Mutation allows a new genetic pattern to be introduced in the new set of chromosomes. The selection process will retain it if the fitness of the mutated chromosome is higher than the general population, otherwise, selection will ensure that the chromosome does not live to mate in future.

IV. RESULT

Results of this paper is as shown in bellow Figs.3 to 7.

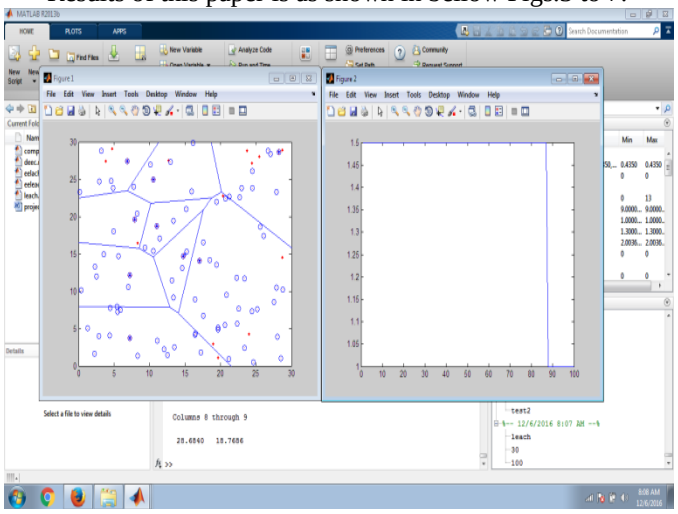

Fig.3.Leach.

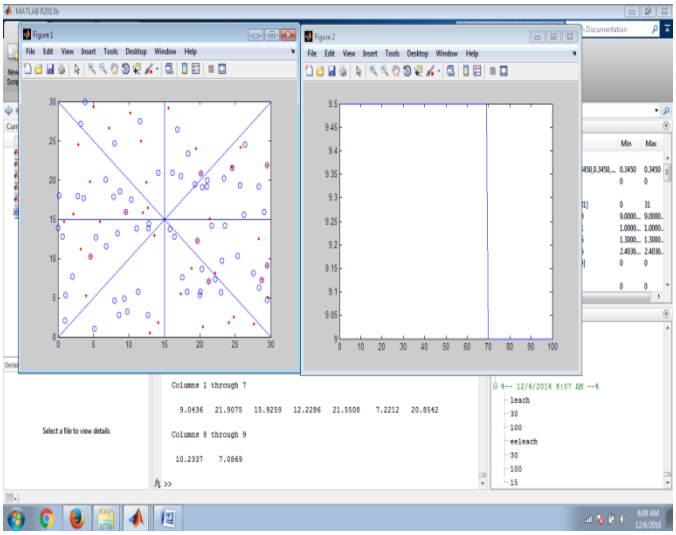

Fig.4.EELeach.

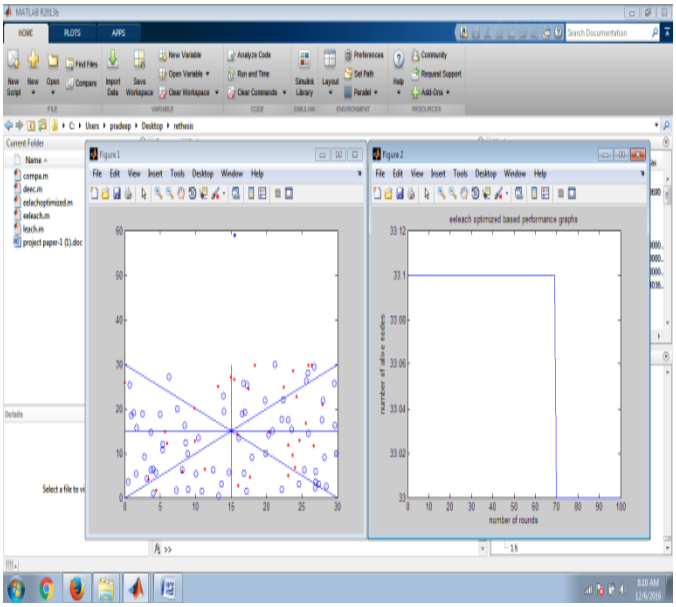

Fig.5. EELeach Optimized.

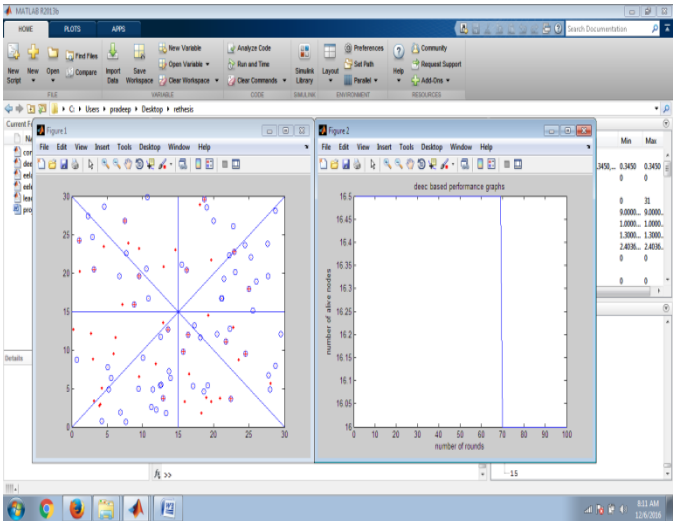

Fig.6. DEEC.

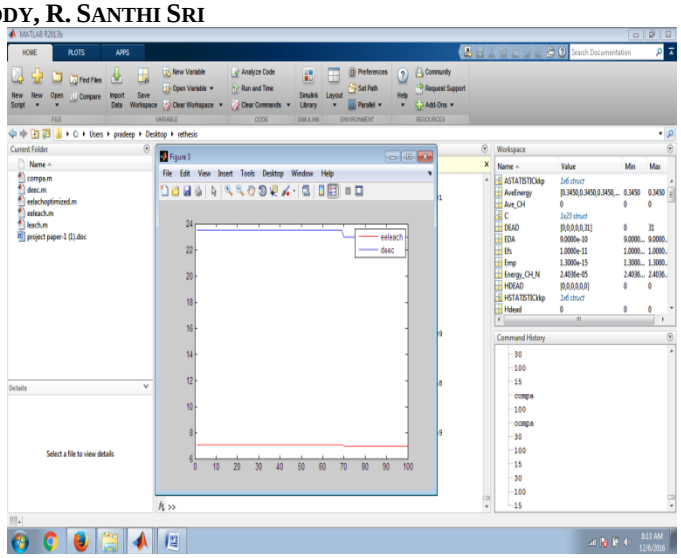

Fig.7.Comparison graph between EELeach optimized, DEEC.

V. CONCLUSION

In WSNs sensor nodes react immediately to sudden and drastic changes in the value of a sensed attribute due to the occurrence of a certain event. The proposed algorithm ensures that the elected cluster-heads are uniformly distributed over the network. Hence, there is no possibility that all cluster cluster-heads will be concentrated in one part of the network. This paper has evaluated and compares the well-known heterogeneous WSNs energy efficient protocols like LEACH, EELEACH and DEEC variants. The simulation results shows that DEEC protocol is very enhanced and efficient routing process for selecting cluster head. The result of simulations conducted indicates that the proposed clustering approach is more energy efficient and scalable and hence effective in prolonging the network life time compared to LEACH based algorithms.

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