

PERFORMANCE OF ENERGY EFFICIENT NETWORK IN WIRELESS SENSOR NETWORK

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ABSTRACT

The study of the behaviour of different nodes is a remarkable achievement in the wireless sensor networks. Wireless sensor network are hierarchical clustered. Cluster based routing protocols are proven to be energy efficient when compared to other routing protocols. Most of the cluster based routing protocols, especially low energy adaptive clustering hierarchy (LEACH) protocol, follows dynamic, distributed and randomized (DDR) algorithm for clustering. Since there is a lot of randomness present in the cluster process, number of cluster heads generated varies highly from the optimal count. In proposed work, some assumptions are made like a part of sensor nodes used for additional energy. This additional energy is varied in accordance to operation of network. An Advance LEACH MAC protocols can be designed for heterogeneous network. Result demonstrates that the efficiency is improved in comparison of traditional leach process.

KEYWORDS: Wireless Sensor Network; Energy Efficiency; Clustering; Network Lifetime; Protocols; Alive Nodes.

Wireless sensor network has become a topic of great interest due to its widespread applications in health sector, industrial sector, military sector and automation security. One of the major issues in wireless sensor network is the energy efficiency. To deal with this issue here are several energy efficient protocols. Amongst them the most important protocol to deal with network lifetime problem is the clustering based algorithm. In this paper, the energy efficiency problem in the heterogeneous network is discussed.

The architecture of wireless sensor network is shown in Figure1. A sensor network consists of large number of sensor nodes and base station. Sensor nodes are used to sense and collect the information or data and transmit it to the base station from where the end user can access the data with the help of internet. The transfer of data from sink to base station takes place in multi hop pattern. Sensor nodes can vary from hundred to thousands therefore it is essential to make them cheap and energy efficient.

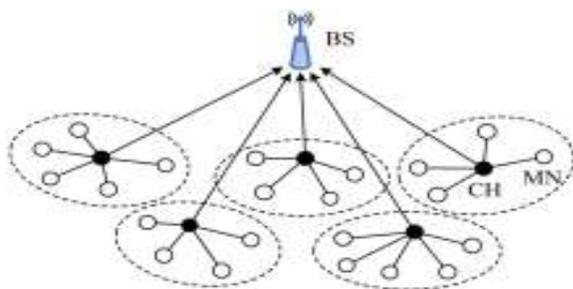


Figure 1: Architecture of wireless sensor network(Ajith et.al , 2007)

The sensor network consists of four basic units such as processing unit, sensor units, transceiver and GPS system. Apart from these units, mobilizer and power unit are also used. Analog to digital converters (ADC) and sensor are employed in sensing units (Kiranpreet Kaur, 2015). First of all signals is applied to ADC then passed through processing unit. The processing unit is a storage unit which used to perform various tasks in sensor network with other sensor node. Further, the power unit is an important component of sensor node to limit the power. However, location finding system is common component in sensor nodes for getting accurate knowledge of sensed data by the use of sensing routing technique.

The protocol stack for the sensor nodes and sink requires five layers of the OSI model, as shown in Figure2 with three cross layer planes. These vertical planes cover all of the basic of the node which are power, mobility and task management planes monitor the power, movement and task distribution among sensor nodes by coordinating the sensing tasks while minimizing overall power consumption.

Sensor nodes are the battery powered devices and most of the batteries cannot be replaced due to the application of limited energy. A huge portion of energy is wasted in the process of data transmission and route discovery. The lifetime of the network is directly affected by the energy consumption of the node. So this is the main problem for the protocol designer to adjust the energy of the nodes so as to increase the lifetime of the network. This paper will address the same problem and

proposes an energy efficient algorithm which will provide the enhancement in the energy efficiency about increased by 40% in comparison to the traditional LEACH protocol. The main problem in the wireless sensor network is optimization of energy.

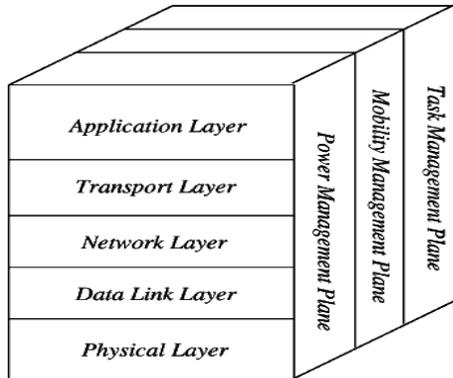


Figure 2: Protocol stack for sensor nodes (A. S. Umamaheswari , 2014)

The organization of present paper is as follow. Section II presents the literature survey which highlights the facts of various researchers. Section III describes the methodology used for proposed work as in this paper modified LEACH protocol is used. Result analysis is presented in section IV following the concluding remarks in section V.

LITERATURE REVIEW

This section will provide the brief description and highlights the contribution, remarks and factors of the work done by the researchers. Many attempts have been made in the past to achieve the maximum throughput while the transfer of optimum amount of energy from source to destination.

P. K. Batra et al. in 2015 demonstrated an efficient approach LEACH's clustering to control the randomness. Network Simulator tool was used to find out the results. Results shows that first node death is 21% and last node death is 24 % over leach and same as 10 % for first node death and 20% last node death over advance leach.

Roslin, S.E. et al. in 2015 presented a hierarchical network using GA. Without disturbing the network properties, network topology was control by this method. Keeping in view the same, two tier wireless sensor network was design using GA to obtain local minima. The comparison was made with the help of simulated annealing for global minima.

A.S. Uma Maheswari et al. in 2014 designed a new phenomenon based on AHYMN and genetic algorithm was used to enhance the performance. From these approaches, cluster heads were selected on the basis of energy. Higher energy nodes were taken as cluster heads.

K. Kaurininin 2015 proposed an effective cluster technique such as EDC-HBO for improving the energy and distance. The result demonstrates that applied technique had been more efficient energy than LEACH.

R. Aiyshwariya et al. in 2014 offered the selection of cluster heads using the efficient energy. The performance parameters were lifetime and energy efficiency. In this paper FAHP algorithm was used to improve accuracy and efficiency.

EbinDeni Rajet et al. in 2012 presented a new protocol based on clustering having maximum lifetime for WSN. The new algorithm EDRLEACH protocols was used for maximum efficiency. LEACH protocols were improved by equal distribution of cluster. Various applications of these protocols to improve the life period of sensor network are discussed.

Nabil Ali Alrajeh et al. in 2007 innovated special security as compare to wire line network. Keeping in view, a protocol was designed in such a way that network provides low energy and low computational power. A new game theory probability approach was presented to restrict the different attacks having utility.

Ioannis Krontiris et al. in 2009 devised a secure mechanism having limited resources of wireless sensor networks. Paper developed a generic algorithm for intrusion detection a new type of IDs was used. Results evaluated the effectiveness of the approach.

Joseph RishSimenthy et al. in 2014 demonstrated security as main criteria for designing of wireless sensor network. The authors also proposed an advanced Intrusion detection system which improves detection rate, efficiency and lifetime of the network.

D. E. Boubiche et al. in 2012 proposed an new intrusion detection system which works on the interaction between the different layers of the system. The authors used the NS simulator to demonstrate the results that the new intrusion detection system maintains the security between the different layers of the OSI model.

P.Sasikumar et al. in 2012 presented clustering as an important issue in wireless sensor network for efficient energy and stability of the network. Authors implemented both the centralized and k means algorithm on the NS simulator platform. Further it has been observed that the clustering algorithm was better in terms of efficiency than that of the centralized algorithm.

G. Anastasi et al. in 2009 demonstrated various techniques of energy conservation in wireless sensor network. It was noticed that more energy is consumed during the data sensing and collection process therefore an energy efficient technique should be used in the processing of data acquisition.

This section has provided the brief review of the work done in past. It also highlighted the factors, contribution and remarks on the achievement.

FRAME WORK FOR IMPLEMENTATION

The main objectives of research work is generation of actual scenario for testing the energy of nodes, the system will utilize the inbuilt mechanisms of the simulation tool for each node in the scenario. Each WSN will be simulated individually. Finally, the evaluation of the performance comparison in terms of various parameters will test the Energy of sensing nodes.

There are three types of routing techniques namely flat, location based and hierarchal. In present work the hierarchal clustering based routing technique is used. Initially, N number of input nodes are generated where each node act asa round. Then random positions are allocated to N number of nodes. Each random allocated node is then assigned a number to identify the neighboring node. Each node has their neighborhood nodes connected to one another. Then a cluster head is selected on the basis of maximum energy. Generally a loop is created on the basis of energy of the different nodes. A cluster head is selected amongst the nodes during each round.

On the basis of different routing position and mode of data transfer routing table is created. These nodes have different dynamic time and have communication from base station to the cluster heads. In proposed work, the comparison of the traditional LEACH protocol is presented. Evaluation is made through the simulation using the MATLAB platform. Energy efficiency is directly related to the lifetime of the network. Therefore, an advanced LEACH protocol is proposed which deals

with the energy efficiency problem. Results analyze that the energy efficiency in comparison to that of traditional LEACH has been increased by the 40%. The proposed flow chart of the process explained above is as shown in Figure3.

The nodes are generated; their positions are randomly assigned and displayed. Once the nodes are deployed, every node uses the neighbor discovery algorithm to discover its neighbor nodes. Using the cluster head selection algorithm cluster heads are selected among the nodes. These cluster heads broadcasts the advertisement message to all its neighboring nodes and thus clusters are formed with a fixed bound size. Each node in the cluster maintains routing table in which routing information of the nodes are updated. Distributed randomized time slot assignment algorithm method is used which allows several nodes to share the same frequency channel by dividing the signal into different time slots. The cluster head aggregates the data from all the nodes in the cluster and the aggregated data is transmitted to the base station.

In present work, complete network is divided into different cluster. Different sensor nodes are assigned the time slot to send the data from the clusters. One is all the nodes have send the data, but the transmit data is synchronized in allotted time interval. When any nodes receive the corresponding data it aggregates it with own data. The aggregates data is forwarding to next level by choose an optimal from its routing table. The routing table is selected by heuristic function is shown in following equation:

$$h = k (E_{avg}/h_{min}) \quad (i)$$

Where k is constant, E_{avg} is average energy of current path, h_{min} is the minimum hop count in the path, t = traffic in the current path. The threshold $T (n_{nrm})$, $T (n_{int})$, $T (n_{adv})$ for normal, intermediate and advanced respectively presented as follows:

$$T(\eta_{nrm}) = \begin{cases} \frac{P_{nrm}}{1 - P_{nrm}^{[rx \bmod (1/P_{nrm})]}} & \text{if } \eta_{nrm} \in G' \\ 0 & \text{otherwise} \end{cases} \quad (ii)$$

From Eq. ii, $n \times (1 - m - b)$ normal node, which ensures that our assumption is exact. Where G' is the set of normal nodes that is not become cluster head in the past $(1 / P_{nrm})$ round r . The same analogy follows for the intermediate and advanced nodes is presented in Eq. iii,

$$T(\eta_{int}) = \begin{cases} \frac{P_{int}}{1 - P_{int}^{[r \times \text{mod}(1/P_{int})]}} & \text{if } \eta_{int} \in G'' \\ 0 & \text{otherwise} \end{cases} \quad \text{(iii)}$$

It has been $(n \times b)$ intermediate nodes; with G'' as the set of intermediate nodes that has not become cluster head in the past $(1/P_{int})$ round

$$r.T(\eta_{adv}) = \begin{cases} \frac{P_{adv}}{1 - P_{adv}^{[r \times \text{mod}(1/P_{adv})]}} & \text{if } \eta_{int} \in G''' \\ 0 & \text{otherwise} \end{cases} \quad \text{(iv)}$$

$(n \times m)$ advanced nodes; with G''' as the set of advanced nodes that has not become cluster head in the past $(1/P_{adv})$ round r .

The average total number of cluster heads per round will be:

$$n.(1 - m - n) \times P_{nrm} + (n.b) \times P_{int} + (n.m) \times P_{adv} = n \times P_{opt} \quad \text{(v)}$$

It will provide the same number of cluster heads compared with the original LEACH setting.

RESULTS ANALYSIS

MATLAB platform has been used to evaluate the results. Some assumptions are made to simulate the results as discussed:

- Starting energy of each nodes is equal
- Nodes are fixed
- Distribution of nodes is homogeneous in nature
- For energy dissipation, limited transmission range is used.
- Data is transmitting through nodes only.

The different parameters used in proposed work are given in table 1. The performance parameters are analyzed using MATLAB 2016a.

The selection of energy efficient routing protocol depends on the applications. Thus, it is necessary to compare the results of different energy efficient routing techniques. Node placement is shown in Figure 4. Figure 4 shows that efficient node placement in wireless sensor network. The wireless sensor network, the sink, alive nodes and dead nodes are presented. The pre location finding theory is applicable for placement of the nodes. As movement of nodes depend upon the alive nodes and dead nodes. Figure 5 presents dead nodes during the each round. Proposed work for heterogeneous network having more no. of dead nodes as compared to traditional LEACH protocols. Dead nodes are increase as area of the

sensor nodes increases. No. of dead nodes are approximately zero up to 225 nodes. After this level it is increase as total no. of nodes increases.

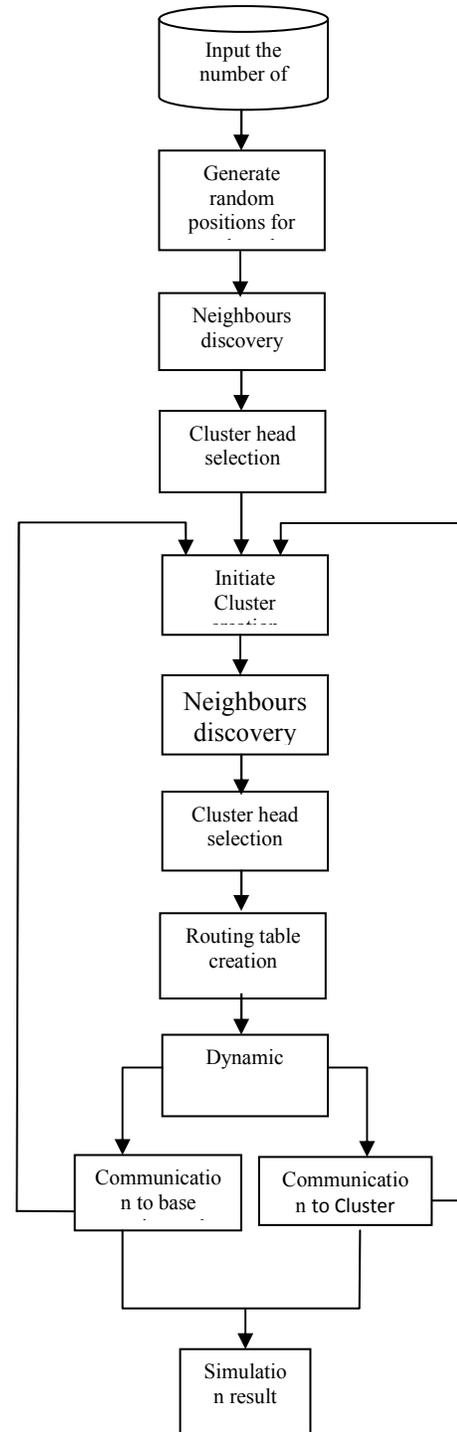


Figure3. Proposed Flow Chart of the Process

Figure6 represents alive nodes during each round. Proposed work for heterogeneous network having more no. of alive nodes as compared to traditional LEACH protocols. Numbers of alive nodes are maximum from 100 to 400 rounds as shown in Figure. After this level alive nodes are decreases because of the enhancement in number of rounds. It has been observed from the results that the energy and the lifetime of proposed work are enhanced by the 40% in comparison to the traditional LEACH protocol.

Table 1: Simulation Parameters for present work

Parameters	Values
No. of sensor nodes	100
Starting node energy	0.1 J
Percentage of CH selection	0.05
Transmitter/Receiver electronics E_{elec}	50 nJ/bit
The energy for aggregation E_{DA}	5 n J/bit/signal

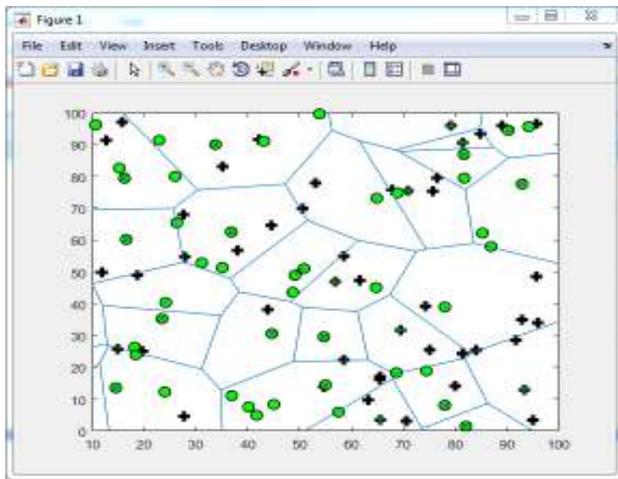


Figure 4: Nodes placement in Wireless sensor Network

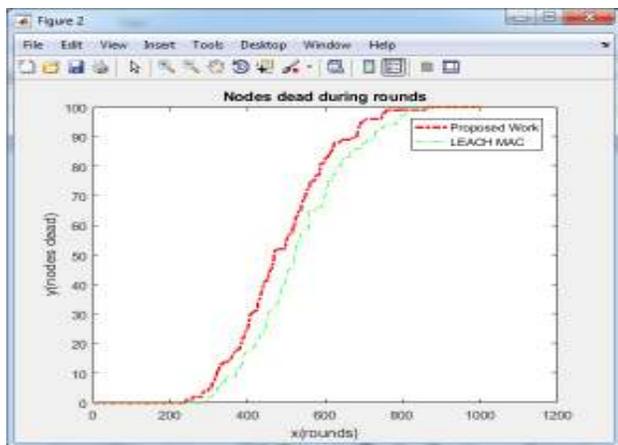


Figure 5: Nodes dead during round

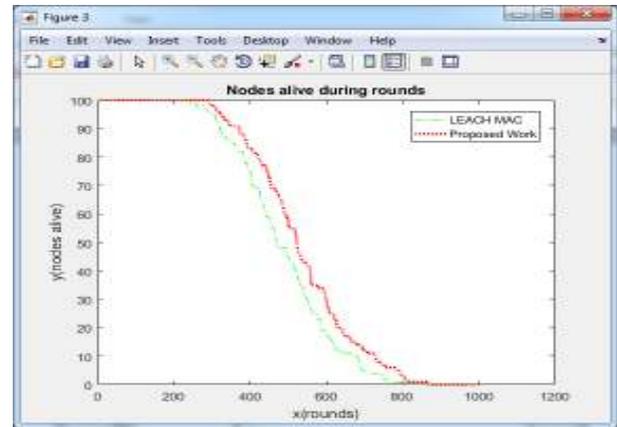


Figure 6: Nodes alive during round

CONCLUSION

The proposed work offers priority to the higher energy node for the selection of cluster head. Simulation results show that LEACH-MAC improves the overall lifetime of the network. This approach has brought down the cluster head variations in the optimal range. Energy efficient algorithm has been proposed for enhancing the energy and lifetime of the network. Results of the energy efficient algorithm have been presented through the simulation using MATLAB platform. The results show that the energy and the lifetime of devised model have been enhanced by the 40% in comparison to the traditional LEACH protocol. In future, advanced LEACH can be applied to the real time environment.

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