

Performance Analysis & Evaluation of Wireless Sensor Network using LEACH & HEED

Angeeta Hirwe¹, Ravi Sindal², Nitin Kumar Jain³

¹⁻²Institute of Engineering & Technology, DAVV Indore, India

Email: angita.hirwe@gmail.com, rsindal@ietdavv.edu.in

³IPS Academy, Institute of Engineering & Science Indore, India

Email: engg.nitin81@gmail.com

Abstract— In Wireless sensor network (WSN) lifetime of sensors is a critical issue because the sensor nodes having limited power. Therefore, organization of nodes in a proper manner (clustering) becomes one of the major techniques to expand the lifetime and improve the throughput of the network. In this paper we propose a Hybrid Energy Efficient Distributed Protocol (HEED) for clustering in Sensor Network to improve the lifetime of network. The simulation result show that the propose scheme has higher network throughput in terms of higher data packets received than existing LEACH protocol.

Index Terms— WSN, Cluster Head (CH), LEACH, Network Lifetime, Heterogeneity.

I. INTRODUCTION

Day by day advancement in technology has brought the world really closer. Any information about any place in the entire world is accessible now. Wireless sensor network is one of the best approaches which give information about the remote areas. The network is made up of a number of small sensor nodes, working together to serve their desired purpose. The network of nodes can be either a homogeneous system or a heterogeneous system; based upon the initial energy of the nodes. In a homogeneous system all nodes have got same energy where as in a heterogeneous system a category of nodes have got different energy levels.

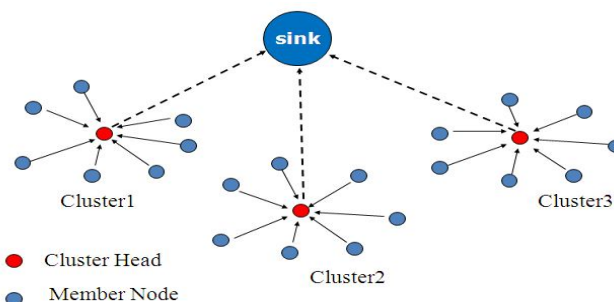


Fig.1. Clustering in wireless sensor network

Today, WSN uses different technological advancements in low power communications and VLSI to support communications, sensing and processing. WSN are used in many applications like environmental monitoring, health care, and also defense related applications [1].

Clustering has been proved by past researches to be an efficient way of energy utilization. Various clustering algorithms have been proposed to support the above statement. At initial level, cluster heads are elected as shown in Fig. 1. Then the other nodes join the cluster of their nearest cluster head. Now for the cluster, the cluster head is responsible for collecting data from the other nodes, aggregate them, check for data redundancy and then this data is sent to the base station. This is considered to be an efficient method for transmission and reception because otherwise all nodes will be sending their data to the BS. This shall lead to redundancy as well as faster energy depletion of all the nodes. Now here, since only the cluster head is sending the data to the base station; the energy of the other member nodes is not used so much as compared to the head.

II. RELATED WORK

In this paper a clustering-based protocol LEACH (Low-Energy Adaptive Clustering Hierarchy), has been proposed [1]. The operation of LEACH is achieved by rounds. Each round begins with a set-up phase (clusters are selected) followed by steady-state phase (data transmission to BS occurs). The node (n) decides by choosing a random number between 0 and 1. If this random number is less than $T(n)$, the nodes become a CH for this round. The threshold is set as follows.

$$T(n) = \begin{cases} \frac{P}{1 - P * (r \bmod \frac{1}{P})} & \text{if } n \in G \\ 0 & \text{else} \end{cases} \quad (1)$$

Where, P = desired percentage of CHs, r = current round

G = set of nodes that have not been CHs in the last $1/P$ rounds

DEEC, PEGASIS, and SEP etc. The protocols like LEACH, DEEC and SEP have been compared, on the basis of different comparison parameters namely heterogeneity level, cluster stability, energy efficiency, cluster head selection criteria and network lifetime. The cluster head selection have been compared between the different protocols according to which CHs in LEACH protocol are selected periodically and energy drains periodically. In DEEC, sensor nodes are independently elected as CHs based on initial and final energy [2]. The network following SEP deals with initial and residual energy for the cluster head selection [3]. It introduces the concept of normal and advanced nodes. In this paper the advanced nodes are given more priority over the other normal nodes to be the cluster heads more frequently as their energy level is more than the others.

In HEED (Hybrid Energy-Efficient Distributed clustering [4]) cluster heads periodically select according to a hybrid of the nodes, residual energy and a secondary parameter, for evaluating sensor networks lifetime is a key characteristic, however it has not a simple and general accept definition.

In [5] author proposed a centralized LEACH algorithm. In this approach nodes are automatic configure and make a clusters. Initially, every node transmit its residual energy and location related information base station, where this data is utilized to form the clusters. Many things affect the life time of wireless sensor networks, such as residual energy of battery, routing algorithms.

III. PROPOSED METHODOLOGY

A. The Objectives of our research work can be pointed as below.

- To improve the performance of WSN with the help of Cluster head selection process
- Energy Optimization of Wireless Sensor Network.
- To enhance the life time of Wireless Sensor Network.

B. Proposed Algorithm

The objective of wireless sensor network is to increase the lifetime. Clustering (Structured approach) has been found to be an effective method for the lifetime improvement due to the implementation of data redundancy and data aggregation which is done at the cluster head selection for each cluster formed. Clustering is an important mechanism in large multi-hop wireless sensor networks for obtaining scalability, reducing energy consumption and achieving better network performance [6-12].

To maximize lifetime of the network Clustering is one of the efficient technique. We use advanced Hybrid Energy Efficient Distributed Protocol which uses efficient distance management system for inter/intra cluster

communication. Figure 2 shows the setup and steady state phase of proposed algorithm. Firstly, In setup phase formation of clusters are take place and then the cluster head being chosen on the basis of residual energy of node. In steady state phase data has been collected by CH and forwarded to Base Station (BS).

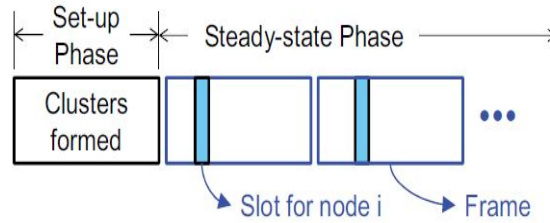


Fig. 2. Cluster formation and operation

IV. SIMULATION RESULTS

In this simulation we assume the heterogeneous sensor network, where all the nodes are randomly distributed in the $100 \times 100\text{m}^2$ area as shown in fig. 3 The BS is assume at the centre of the topology. Minimum probability of cluster head selection is 0.0001 and initially the cluster head probability for all the nodes is 0.05. The simulation parameters are listed in Table 1. Residual energy of nodes with the increasing the number of round for LEACH algorithm is depicted in Fig. 4. Furthermore, Residual energy of nodes with respect to number of rounds for different sets of nodes like 25,50,100 is shown in Fig. 5. It shows that when the number of node increases the life time of network is also increases. Moreover, Fig. 6 is depicted the comparative analysis in between heed and leach in terms number of packets received by BS. Figure clearly shows that heed outperform the leach.

TABLE I. SIMULATION PARAMETERS

Network Size	100mX100m
Initial Energy	0.5 J
Number of Round	100
Randomly deployed nodes	100
Size of Packet	4000 bits
ETX	50nJ/bit
RTX	50nJ/bit
Position of Sink node	(50,50)
Threshold distance, d_0	70 m
Cluster Radius	25 m

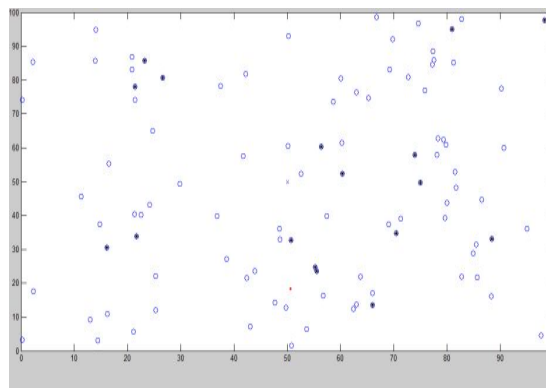


Fig.3. 100 nodes are randomly deployed

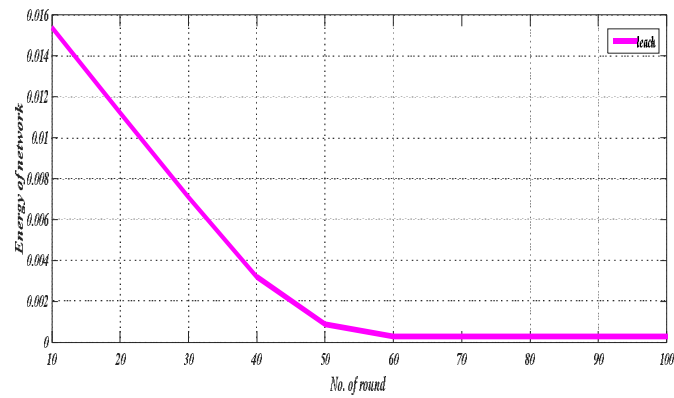


Fig. 4. Total Residual energy with respect to number round

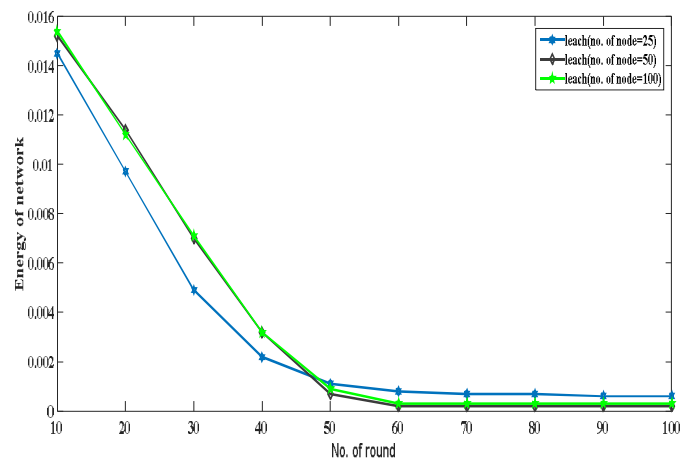


Fig. 5. Comparison of total residual energy on different number of node

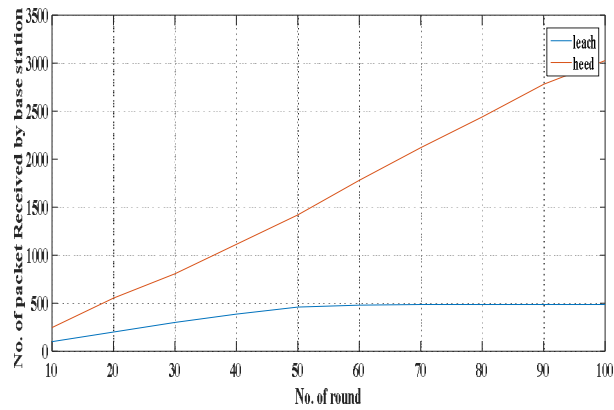


Fig. 6 Comparison of total residual energy on different number of node

V. CONCLUSION

The sensor nodes in WSN is deployed in hostile environment. Therefore, it is hard to maintain the network throughput and network lifetime in such a harsh environment. This paper proposed a improved Hybrid En-ergy Efficient Distributed Protocol (HEED) scheme for clustering wireless sensor network to improve the throughput of the WSN. The simulation result show that the proposed scheme has higher data packets re-cieved than existing LEACH protocol for the same number of round.

REFERENCES

- [1] Heinzelman W. R., A. Chandrakasan, and H. Balakrishnan, Energy-efficient communication protocol for wireless microsensor networks(2000)
- [2] Anitha1 A., M. Selvi2, Dr. N. Saravana Selvam Life Time Enhancement techniques in Wireless Sensor Network: A Survey International Journal of Emerging Technology and Advanced En-gineering. (2013).
- [3] Smaragdakis G., I. Matta, A. Bestavros SEP, A stable election Protocol for Clustered Heterogeneous Wireless sensor network,(2004).
- [4] Younis, O., Fahmy, S.: "HEED: a hybrid, energy-efficient, distributed clusteringApproach for ad hoc sensor networks". IEEE Transactions on Mobile Computing(2004)
- [5] Srinivasa Rao D., B.J.M. Ravi Kumar, Performance Evaluation of Genetic Based Dynamic Clustering Algorithm over LEACH Algorithm for Wireless Sensor Networks International Journal of Soft Computing and Engineering.(2011).
- [6] Weiqiang Xu., Yushu Zhang, Qingjiang Shi, , and Xiaodong Wang, Energy Management and Cross Layer Optimization for Wireless Sensor Network Powered by Heterogeneous Energy Sources .IEEE Transactions. (2010)
- [7] Heinzelman, W.B., Chandrakasan, A.P. ; Balakrishnan, H. , An application-specific protocol architecture for wireless microsensor networks, IEEE Transactions on Wireless Communications (2002)
- [8] Islam O., Hussain, S, Genetic algorithm for data aggregation trees in wireless sensor networks, IEEE Third IET Int. Conf. on Intelligent Envi,(2007)
- [9] Jin-Shyan Lee, Senior Member, IEEE, and Wei-Liang Cheng, , Fuzzy-Logic-Based Clustering Approach for Wireless Sensor Networks Using Energy Predication IEEE sensor journal.(2012)
- [10] Kim J., S. Park, Y. Han, and T. Chung, CHEF, Cluster head election mechanism using fuzzy logic in wireless sensor networks, Int. Conf. Adv. Commun. Technol, (2008)
- [11] Ran G., H. Zhang, and S. Gong, Improving on LEACH protocol of wireless sensor networks using fuzzy logic, J. Inf. Computer. Science.(2010)
- [12] Trong T., Hong-Nhung Phan-Thi, Anh-Vu Dinh-Duc, Cong Hung Tran , Prolong the Network Lifetime by Optimal Clustering based on Intelligent Search Algorithms in Wireless Sensor Networks" (2014)