International Journal of Enhanced Research in Management & Computer Applications, ISSN: 2319-7471
Vol. 3 Issue 5, May-2014, pp: (4-9), Impact Factor: 1.147, Available online at: www.erpublications.com

Comparison of Networks Clustering Protocols in Wireless Sensor Networks

Rasneet Kaur[1], Mr. Madan Lal[2]
[2]Asst. Professor, Computer Engineering Department, University College of Engineering, Punjabi University, Patiala, Punjab, India
[1]M.Tech. Scholar, Computer Engineering Department, University College of Engineering, Punjabi University, Patiala, Punjab, India

Abstract: This paper concerns the comparisons of networks clustering protocols in wireless sensor networks. Wireless sensor networks are an emerging technology for monitoring physical world. The energy constraint of Wireless sensor networks makes energy saving and Prolonging the network lifetime become the most important goals of various routing protocols. Clustering is a key technique used to extend the lifetime of a sensor network by reducing energy consumption. This paper surveys different energy efficient clustering protocols for wireless sensor networks and compares these protocols on various points like, packet delivery, number of Alive nodes and power consumption by using the software MATLAB (Matrix laboratory) aiming to find the best method for the lifetime of the network.

Keywords: WSN, clustering protocol, energy efficient, LEACH, HEED, PEGASIS.

1. INTRODUCTION

Wireless Sensor Networks (WSNs) are composed of large number of low-cost and tiny sensors. It is a distributed and self-organized network where sensor nodes will locally carry out sensing, processing and transmitting operations in an autonomous and unattended manner. WSNs have broad applications such as military surveillance and tracking, environment monitoring and forecasting, healthcare etc. Wireless Sensor Networks consists of individual nodes that are able to interact with their environment by sensing or controlling physical parameter; these nodes have to get together in order to accomplish their tasks as usually, a single node is incapable of doing so; and they use wireless communication to enable this collaboration [1]. The definition of WSN, according to, Smart Dust program of DARPA (Defence Advanced Research Project Agency) is: "A sensor network is a deployment of massive numbers of small, inexpensive, self powered devices that can sense, compute, and communicate with other devices for the purpose of gathering local information to make global decisions about a physical environment" [1].

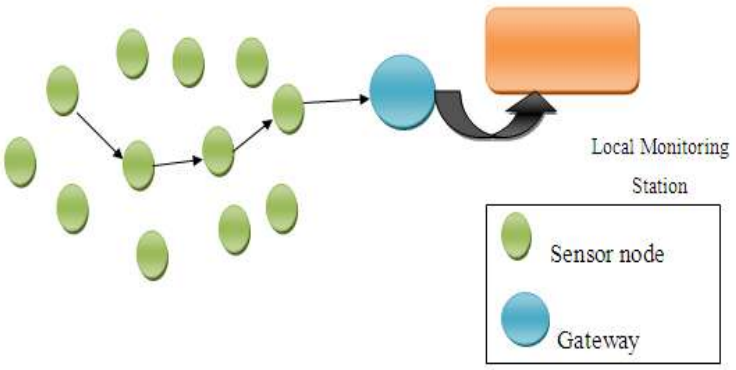

Figure 1. Wireless Sensor Networks

2. LITERATURE SURVEY

Zheng Gengzhong et al. explained about the topology of wireless sensor networks based on small world network model. A Small world network is one of the most important properties of complex networks, which has the characteristics of small average path length and maximum cluster coefficient. Construct small world network in WSNs(wireless sensor networks) can significantly reduce the average path length and improve the energy efficiency of the WSNs. This makes a survey on the topology of WSNs based on the model of small world, draws a comprehensive and clear outline for the studies of small world in WSNs [2].

I.F. Akyildi et al. described the concept of sensor networks which has been made viable by the convergence of microelectro- mechanical systems technology, wireless communications and digital electronics. In this the the sensing tasks and the potential sensor networks applications are explored, and a review of factors influencing the design of sensor networks is provided. Then, the communication architecture for sensor networks is outlined, and the algorithms and protocols developed for each layer in the literature are explored [3].

Jamal N. Al-Karaki et al. explained about the routing protocols used for WSN's. Many routing, power management, and data dissemination protocols have been specifically designed for WSNs where energy awareness is an essential design issue. The routing protocols which might differ depending on the application and network architecture. Various routing protocols are explained based on the underlying network structure: flat, hierarchical, and location-based routing. Furthermore, these protocols can be classified into multipath based, query-based, negotiation-based, QoS-based, and coherent-based depending on the protocol operation[4].

Ashwani Kumar explained the observation that for any densely deployed sensor network, high redundancy exists in the gathered information from the sensor nodes that are close to each other. For some physically proximate sensor nodes that are monitoring some environment, e.g. temperature, it is most likely that their sensory data are very similar. It exploited the redundancy and various routing protocols to secure different kinds of data aggregation [5].

Nikolaos A. Pantazis et al. explained about the energy efficient routing protocols are classified into four main schemes: Network Structure, Communication Model, Topology Based and Reliable Routing. The routing protocols belonging to the first category can be further classified as flat or hierarchical. The routing protocols belonging to the second category can be further classified as Query-based or Coherent and non-coherent based or Negotiation-based. The routing protocols belonging to the third category can be further classified as Location-based or Mobile Agent-based. The routing protocols belonging to the fourth category can be further classified as QoS-based or Multipath based. The most important feature of a routing protocol, in order to be efficient for WSNs, is the energy consumption and the extension of the network's lifetime [6].

Jia Yunjie et al. (2008) proposed an improved clustering routing algorithm LEACH-KED on the basis of the uniform clustering, and proceeds simulation analysis. The results show that the improved algorithm is effective in extending the network life cycle [7].

Poonam Lohan et al. (2012) proposed a Geography-Informed Sleep Scheduling and Chaining Based Routing (GSSC) algorithm in wireless sensor network. Since sensor nodes are energy constraint, so aim is to maximize the network lifetime by utilizing the energy of nodes very efficiently. GSSC conserves energy by finding out equivalent nodes from routing perspective by using their geographical information i.e. the nodes which sense almost same information and then turning off unnecessary nodes to remove data redundancy [8].

Hairong Zhao et al. proposed to improve of setting up cluster and data transmission route. A timer is introduced to make sure of electing the optimal sensor node as cluster head in process of setting up cluster. During data transmission, using single hop and multi-hop hybrid routing to communicate can utilize energy more effectively and evenly. A simulation example is provided to demonstrate the usefulness of the algorithm which extended the network lifetime and reduced energy consumption greatly compared to LEACH algorithm [9].

3. PROBLEM FORMULATION

This proposed chain clustered communication protocol for wireless sensor networks designed utilizes the distributed approach extended by Khemka. The aim is efficient transmission of all the data to the base station so that the lifetime of the network is maximized in terms of rounds, where a round is defined as the process of gathering all the data from sensor

nodes to the base station, regardless of how much time it takes. Direct transmission is a simple approach for this problem in which each node transmits its own data directly to the base station. However, if the base station is far away, the cost of sending data to it becomes too large and the nodes will die quickly. In order to solve this problem, three protocols LEACH, HEED and PEGASIS have been extended and give improved results over. In LEACH, the key idea is to reduce the number of nodes communicating directly with the base station and is achieved by forming a small number of clusters in a self organizing manner, where each cluster-head collects the data from nodes in its cluster, fuses it and sends the result to the base station.

In HEED protocol reduces the number of nodes communicating directly with the base station through intra-cluster communication. In PEGASIS protocol reduces the number of nodes communicating directly with the base station through one node by forming a chain passing through all nodes where each node receives from and transmits to the closest possible neighbour. The data is collected starting from each endpoint of the chain until the randomized head node is reached. The data is fused each time it moves from node to node. The designated head node is responsible for transmitting the final data to the base station. These protocols are simulated using MATLAB and it reduces the overheads (communication to base station) as compared to LEACH, HEED and PEGASIS. This protocol improves considerably the overall lifetime of the network.

4. RESULTS

CLUSTER FORMATION OF HIERARCHICAL PROTOCOLS

We describe the network model. Assume that there are 100 sensor nodes, which are randomly dispersed within a 100m*100m square region as shown in figure

Simulation Parameters:

Parameters	Values
Energy consumed in the electronics circuit to transmit or receive them signal, Eelec	50 nJ/bit
Energy consumed by the amplifier to transmit at a short distance, Efs	10 pJ/bit/m2
Message Size	4000 bits
Number of Nodes	100
Initial Energy, E0	0.5 J

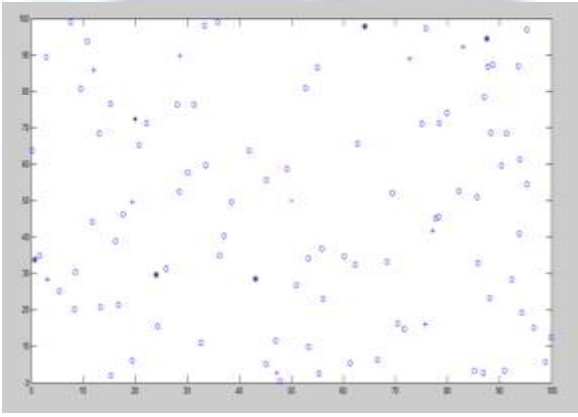

Figure 2.: Cluster Formations by LEACH Protocol

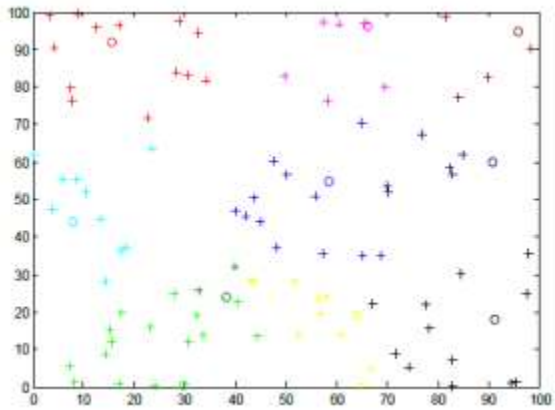

Figure 3.: Cluster Formations by HEED Protocol

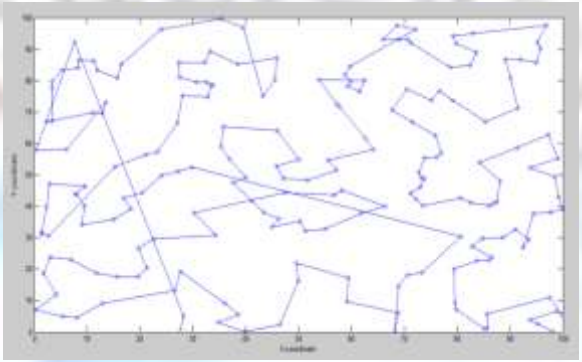

Figure 4.: Cluster Formations by PEGASIS Protocol

Comparison of LEACH, HEED and PEGASIS on the basis of Packet Transmission

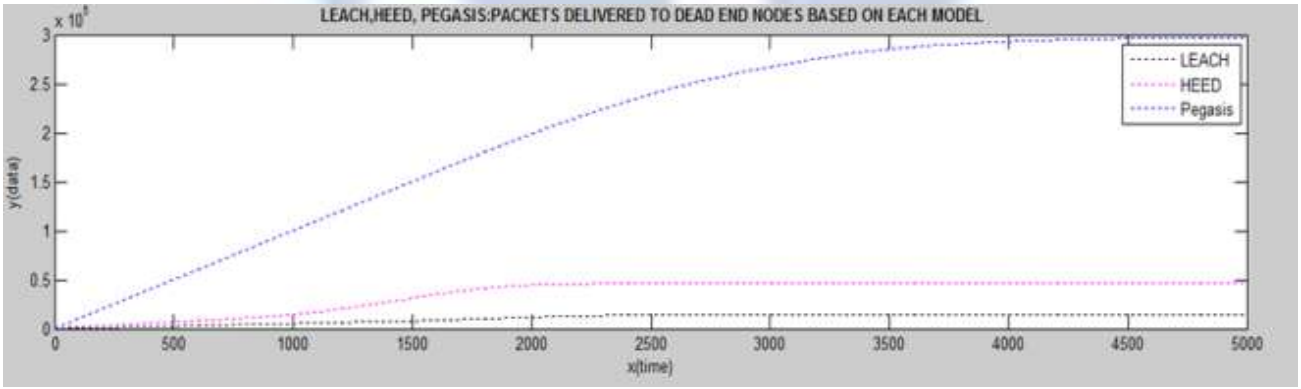

Figure 5.: Comparison of Packet Transmission of LEACH, HEED and PEGASIS

- **NUMBER OF PACKETS**

Larger would be better. PEGASIS is best performer in the class. It has the maximum capacity to route the packets in the given time than other two i.e. LEACH AND HEED.HEED is second best performer and LEACH is at number three.

Comparison of LEACH, HEED and PEGASIS on the basis of Energy Consumption

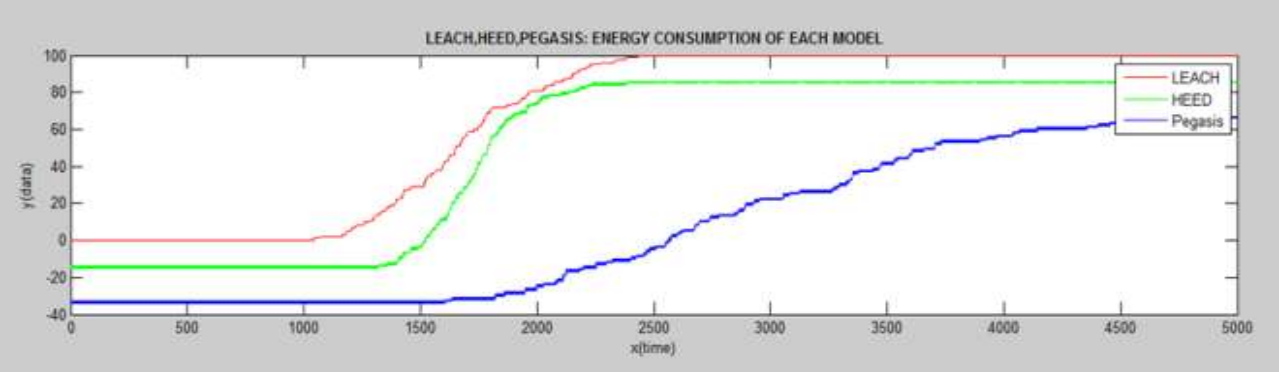

Figure 6.: Comparison of Energy Consumption of LEACH, HEED and PEGASIS

- **ENERGY CONSUMPTION**

Lower is better.
In comparison over Energy consumption, PEGASIS is best among others. It consumes approximately 33% less from LEACH and approx 19% from HEED.

This is the formula for the amount of energy consumption by data transfer:

The energy being dissipated to run the transmitter: E_{elec}=50nJ/bit

The energy being dissipated of the transmission amplifier:$\varepsilon_{amp} = \frac{100\,pJ}{bit}/m2$

Transmission Costs: $E_{Tx}(k,d) = E_{elec}k+\varepsilon_{amp}\ kd^{\varphi}$

Receiving Costs:$E_{Rx}=E_{elec}k$

Where k is the length of message in bits
d is the distance between nodes and
φ represents the path-loss exponent

Comparison of LEACH, HEED and PEGASIS on the basis of Number of Alives Nodes

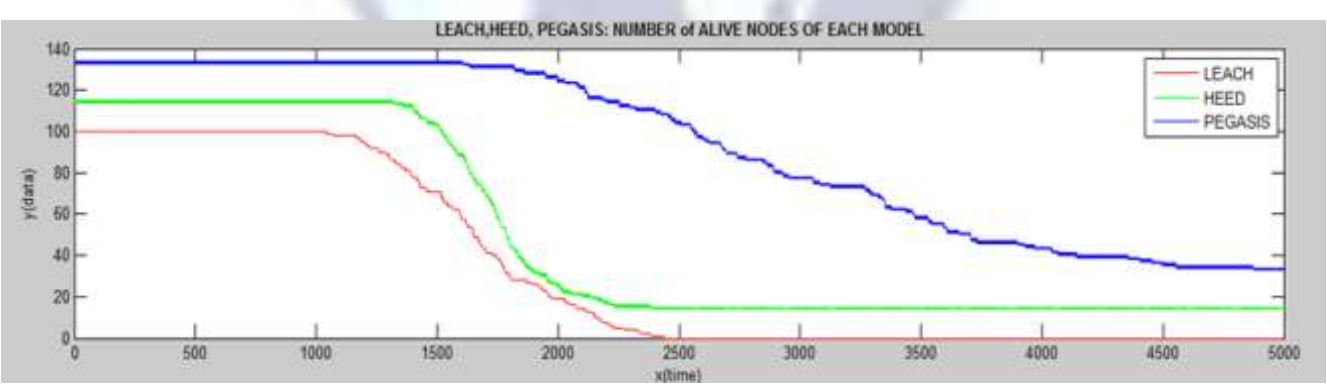

Figure 7.: Comparison of Number of Alives Nodes of LEACH, HEED and PEGASIS

- **ALIVE NODES**

Higher is Better.
Every protocol must be able to run all its nodes. No node should show remain down in the whole simulation. In this simulation all of the protocols are good to run the nodes. All of the running all of the nodes in the simulation.

PROTOCOL NAME	NUMBER OF PACKETS TRANSMITTED	ENERGY CONSUMPTION	MAXIMUM NUMBER OF ALIVE NODES
LEACH	13401	100	100
HEED	43891	86	100
PEGASIS	293982	67	100

5. CONCLUSION AND FUTURE SCOPE

Finally it is concluded from the survey that, still it is needed to find more scalable, energy efficient and stable clustering scheme, for data gathering in wireless sensor networks. After the comparing, it is observed that the PEGASIS routing protocol is more energy efficient routing protocol for wireless sensor network as compared to LEACH and HEED protocols in the form of energy consumption and packet transmission. Further in future the movable nodes can be used to compare and analyze these protocols.

6. REFERENCES

[1]. Stephan Olariu, "Information assurance in wireless sensor networks", Sensor network research group, Old Dominion University.
[2]. Zheng Gengzhong, Liu Qiumei, "A Survey on the Topology of Wireless Sensor Networks Based on Small World Network Model", IEEE, 2nd International Conference on Future Computer and Communication, 2010, Vol.1, pp.67-71.
[3]. I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey, Computer Networks 38 (2002),pp.393–422.
[4]. Jamal N. Al-Karaki ,Ahmed E. Kamal, "Routing Techniques in Wireless Sensor Networks: A Survey", pp.1-37
[5]. Ashwani Kumar, A Survey On Routing Protocols For Wireless Sensor Networks", Ijaer, 2011, Vol.No.I.
[6]. Nikolaos A. Pantazis, Stefanos A. Nikolidakis and Dimitrios D. Vergados , "Energy-Efficient Routing Protocols in Wireless Sensor Networks: A Survey" IEEE COMMUNICATIONS SURVEYS & TUTORIALS, 2013, VOL. 15, NO. 2, pp. 551-591.
[7]. Jia Yunjie, Liu Ming, Zhu Song, Dong Pengtao "A clustering routing algorithm based on energy and distance in WSN" IEEE, International Conference on Computer Distributed Control and Intelligent Enviromental, 2012, pp. 9-12.
[8]. Poonam Lohan , Rajni Chauhan "Geography-Informed Sleep Scheduled and Chaining Based Energy Efficient Data Routing in WSN" IEEE, Conference on Electrical, Electronics and Computer Science 2012.
[9]. Hairong Zhao, Wuneng Zhou, Yan Gao "Energy Efficient and Cluster Based Routing Protocol for WSN" IEEE International Conference on Computational Intelligence and Security, August 2012, pp-107-111.