© August 2018 | IJIRT | Volume 5 Issue 3 | ISSN: 2349-6002

An Improved Energy Efficient Cluster Based Routing Protocol for Wireless Sensor Networks Using Leach Protocol

Y.Venkat Reddy[1], RSVS Aravind[2]

[1]*Pursuing M.Tech (CS) dept. of ECE, Newton's Institute of Engineering College, Alugurajupally, macherla, Guntur dist., AP, India*

[2]*Associate Professor Dept. of ECE, Newton's Institute of Engineering College, Alugurajupally, macherla, Guntur dist., AP, India*

***Abstract*- Wireless sensor networks (WSNs) have been broadly studied with advances in ubiquitous computing environment. Because the resource of a sensor node is limited, it is important to use energy-efficient routing protocol in WSNs. The cluster-based routing is an efficient way to reduce energy consumption by decreasing the number of transmitted messages to the sink node. LEACH is the most popular cluster-based routing protocol, which provides an adaptive cluster generation and cluster header rotation. However, its communication range is limited since it assumes a direct communication between sensor nodes and a sink node. To resolve this problem, we propose a new energy-efficient cluster-based routing protocol, which adopts a centralized clustering approach to select cluster headers by generating a representative path. To support reliable data communication, we propose a multihop routing protocol that allows both intra- and intercluster communications. Based on a message success rate and a representative path, the sensor nodes are uniformly distributed in clusters so that the lifetime of network can be prolonged. Through performance analysis, we show that our energy-efficient routing protocol outperforms the existing protocols up to 2 times, in terms of the distribution of cluster members, the energy consumption, and the reliability of a sensor network.**

1. INTRODUCTION

Sensor networks are a paradigm for gathering data from inaccessible environment.

The nodes in the network are interconnected by wireless communication channels. Each sensor node has capability to collect data from its surrounding area, carry out simple computations, and communicate with rest of the nodes in the network or with base stations (sink) [1]. In these networks the nodes are the energy constrained, once they deployed, it is almost impossible to replace or recharge the node battery.

Wireless sensor network has a tremendous growth over the last few years, in addition to the military applications, environmental applications, and more industrial applications for the sensor networks are found, resulting in an increase in functionality and decrease in implementation cost [4]. These networks are emerging as an important new concept in the information technology for distributed monitoring of environments, which are physically remote, hostile or inaccessible. Advancement in miniaturization allow sensor to have increasing on board processing power which allow for distributed computing application for in place processing of gathered data before transmission [5].

These networks have capability of collecting audio, seismic and other type of data and collaborate to perform a high level task in the network. As for as wireless environment in concerned, basically it consumes significant amount of energy, sensor node should consume as little energy consumption as possible for receiving and transmitting data. Currently, researchers put their efforts in sensor networks focusing on the issues involved in the development of energy efficient protocol, low cost, secure and fault tolerance networks. Wireless Sensor Networks Routing Protocols can be classified into three categories, named direct communication, flat (multi hope) and clustering protocol [6].

In direct communication, sensor nodes send their data directly to the base station. The main drawback of the direct communication protocol is that if the diameter of the network is very large, then the nodes away from the base station will drain their energy very quickly. And another problem is that if the number of nodes increases, collision becomes a significant factor which defeats the purpose of data transmission. In the multihope strategy, once a node has data to send, it may find rout consisting of several hop to base station. Comparing the first two strategies, the clustering protocol have several advantages, the most important is of scalability. Secondly, it could be energy efficient in finding an available route to a destination. In cluster based routing protocols, each cluster has a cluster head (CH), all the nodes in the cluster send their sensed data to cluster head, and then cluster head after aggregation send data to base station[7].

In this paper we consider a network model used in [7] – [8], having properties,

1. All the nodes after deploying are static as for as location is concerned and having same energy level.
2. All the nodes having a power control capability to very the transmitted power.
3. Base station is rigidly fixed.
4. Each node is allocated a timeslot for sensing and sending data to CH.

In this paper, cluster based working is involved. Once the clusters are formed during the network operations, the cluster will never be changed during the whole network life time. This is a static clustering concept. Static clustering eliminates the overhead of dynamic clustering for each round of communication. In this paper we propose a new hybrid technique for cluster head selection by merging the concept of LEACH and LEACH-C [7].

Basically this protocol is an enhanced version of LEACH protocol in terms of energy efficiency. Same concept of data fusion is performed as in LEACH-C [7] is used. Data fusion is a mechanism for combining one or more packets from different sensors to produce a single packet [3]. LEACH uses randomization to rotate the cluster head and achieve major improvements compared to the direct approach before the first node dies [8]. The main difference between the proposed and LEACH protocol is,

1. The proposed protocol utilized a new idea of cluster head selection.
2. It utilizes multihope communication instead of direct communication.

Especially for the case in which the network diameter is very large. So the direct communication fails in such scenarios. So introduces multi hope communication between cluster head to cluster head to rout the packet to base station.

2. RELATED WORK

Hierarchical routing protocols (based on clustering techniques) have been proposed to achieve scalability and reduce the need for global coordination. They also allow for energy saving and thus prolong network lifetime by restricting most of the sensing, data processing and communication activities within clusters. Clustering can also provide load balancing if appropriately configured. Furthermore, it can be naturally combined with data-centric routing to make use of data aggregation techniques. Passive clustering (PC) [3] is a way to perform on-demand clustering to eliminate control messages overhead.

It does not use any explicit control messages to maintain clusters. Instead, it piggybacks the control information on the outgoing data packets. In wireless sensor networks, the PC algorithm was combined with DD in [4], [5] mainly to achieve energy efficiency. To determine a routing path, DD makes use of flooding in its different phases namely: interest propagation and exploratory data sending. Therefore, the main idea of the combination is to save energy in the flooding phases by allowing only cluster heads and gateways to take part in these phases. Ordinary nodes are only allowed to send data messages in the data sending phase. In [6], the selection of cluster heads and gateways are based on residual energy.

They also propose to apply a periodic sleep and awake among cluster members which requires synchronization among nodes. All the previously cited works [4], [5], [6] concentrate traffic on a set of nodes performing flooding. We argue that this concentration can lead to a variance in energy consumption among sensor nodes and is able to cause rapid partition of the network.

To overcome this problem, we proposed in [7] to use the energy consumed rate when selecting the flooding nodes. Although, the simulation results have shown an improvement of 39% in network lifetime when applied with DD, further improvements can be achieved. In this paper, we propose to use a more general energy heuristic, the energy level of nodes.

Our changes applied on DD show that our mechanism outperforms DD and its PC combination proposed in [4] in terms of network lifetime, delay and delivery ratio. The paper is organized as follows. Section II summarizes our proposal, the Energy Level-based Passive Clustering (ELPC). Simulation results are presented in section III before concluding.

3. PROPOSED ALGORITHM

The proposed protocol is self organizing and static clustering methodology is adopted to reduce the overhead of dynamic clustering. The working of protocol is divided into two major phases, the setup phase and data communication phase.

a. Setup Phase: In setup phase some important factor to be considered first are, cluster formation, cluster head selection mechanism and setting up TDMA schedule to each cluster before network operation. The cluster formation is performed by message passing technique used in [3], in which the BS broadcast different messages to sensor field with different transmission power. The BS broadcast n1 different messages with different transmission power, where n is desired number of clusters. By broadcasting the n=1 message all the sensor nodes which listen this message (are in the radio range of this message) set their cluster ID to n and inform the BS that they are member of the cluster n via transmitting a join Request message (Join-REQ) back to the BS[3]. Fig. 1 shows that how the sensor field is divided into n=5 clusters with broadcasting n-1=4 different messages from BS. These clusters will never be changed until the whole network life time. Basically the static clustering reduces the overhead of dynamic clustering [3].

Our proposed protocol architecture selects CH in each cluster in different way. The BS first selects one CH in each cluster randomly only for the first round of communication and broadcast the status of CH to each cluster with TDMA schedule. All the nodes in each cluster send their data with their current energy level to associated CH in their pre allocated time slot. Through this way the CH will get data as well as energy status from all of its members. The CH removes the energy information from the packet and caches it for further processing. After sending the aggregated data to BS it selects the utmost energy level node as a CH for the next round and broadcast its ID to all the associated members. Through this way only CH is responsible for sending data to BS as well as CH selection for the next round.

In this strategy less number of control packets are created for cluster head selection. In this technique BS selects CH in each cluster only for the first round, but after the first round, each CH is responsible for the selection of CH for each remaining rounds.

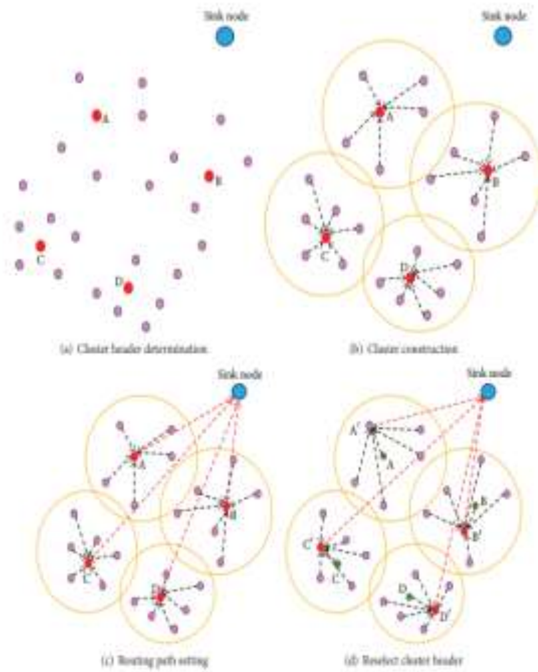

Figure 1: LEACH protocol.

b. Data Communication Phase

Each node in the cluster after sensing data, send its data to CH during its pre allocated time slot. The duration of each slot in which a node send its data is constant, so the time in which a frame is send is totally depends upon the number of nodes in the cluster. For efficient utilizing the energy of each node except CH will be turned off until its allocated transmission time. The CH will awake all the time to receive data from all the nodes in the cluster. Changing of the cluster head (CH) will no effect on the schedule of the cluster operations. The direct communication showed in Fig. 1 c not working properly especially when the network diameter is very large. Because clusters are formed in layered fashion, so when increasing number of layers then the border CH will drain their energy very quickly than that of CH that are closest to Base Station. We propose multihope communication instead of direct communication by considering the scalability factor of the network. The total energy expended in the system is greater using multihope communication but it is best suited in the scenario when sensor field diameter is very small. Same greater advantage multihope show for scalable network and utilized energy efficiently to prolong the overall network life time. It also improves the reliability factor as for as data transmission is concerned.

4. SIMULATION RESULTS

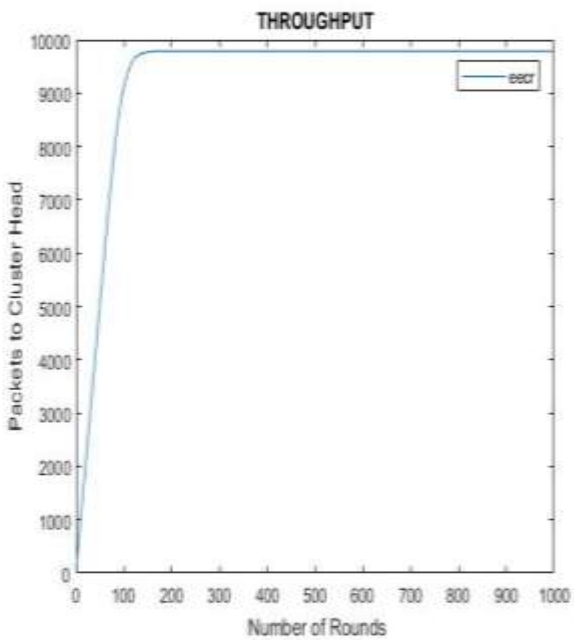

Fig 4.1 throughput

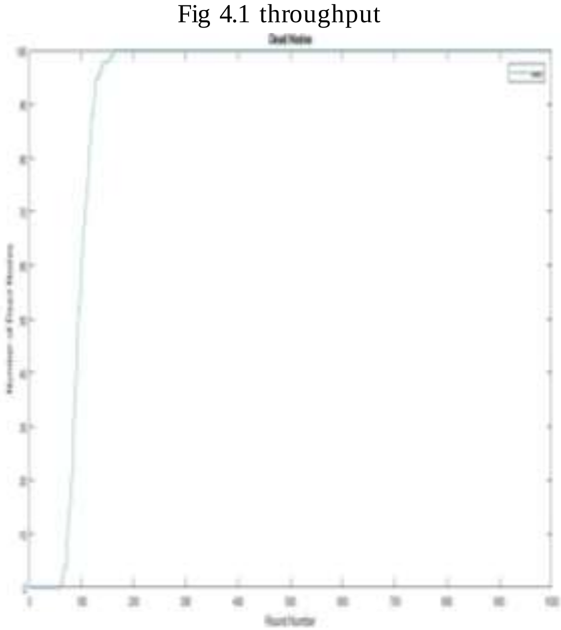
Fig 4.2 Dead Nodes

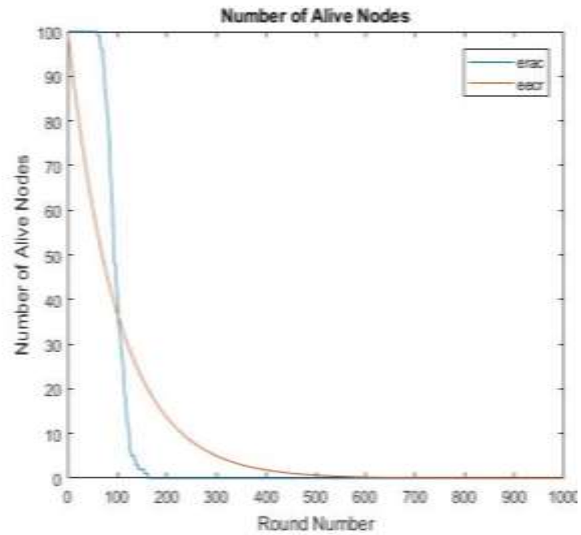

Fig 4.3 Alive Nodes

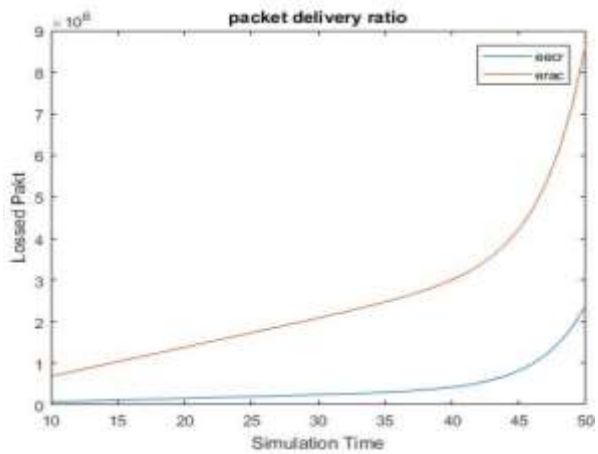

Fig 4.4 Packet Delivery Ratio

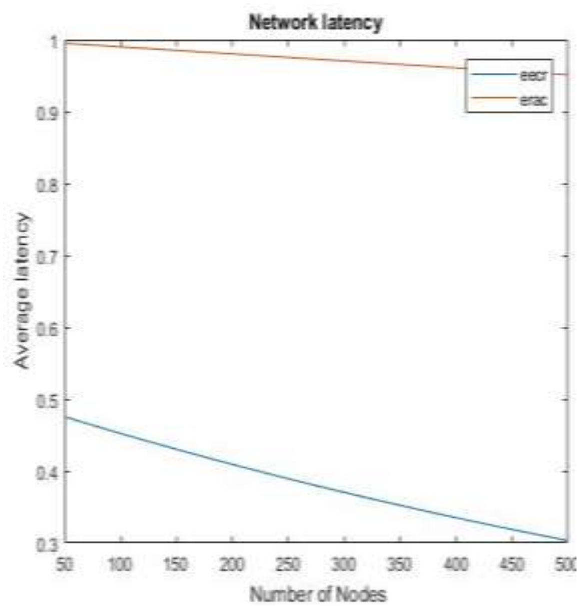

Fig 4.5 Network Latency

The proposed system is to provide the better performance than existing one. Results are analyses based on graphs. This system is used to improve the network latency. First, we evaluate the energy efficiency of the proposed protocol and compare the network lifetime of the proposed one. Figure shows that the number of nodes still alive over the simulation period and it clearly improves the network lifetime. V. Conclusion and Future work In this paper, we proposed a Energy Efficient cluster based routing protocol (EECR) for wireless sensor network. Instead of selecting the cluster heads based on residual energy, buffer size and node distance. The cluster head responsible for data aggregation and aggregated data send to the base station. Simulations shows that the proposed model improve the life time of the network.

5. CONCLUSION

In this paper, we proposed an energy-efficient cluster-based routing protocol for WSNs. Our protocol is based on a centralized clustering approach by using a representative path. A representative path is generated to select cluster headers and to form clusters in a distributed manner. To provide reliable network connectivity, we measure the message success rate of a sensor node when generating a representative path. To increase the lifetime of network, we select cluster headers as nodes having high connectivity. Therefore, the burden of network configuration and routing from sensor nodes can be greatly reduced. From our performance analysis, we show that our routing protocol outperforms both LEACH and MRLEACH, in terms of energy efficiency and network reliability. As a future work, we will study a private data aggregation scheme with the energy-efficient routing protocol.

REFERENCES

[1] Mohammad Reza Mazeri, Maryam Dehnavi, (2012)"Energy Efficient Multi-Path Hierarchical Routing Protocol in WSNs" International Symposium on Computer, Consumer and Control, pp.414-418.

[2] Subhansu Bandyapadhyay ,Sanghita Bhattacharya (2011 IEEE)"A Dynamic Energy Efficient Multi Hop Routing Technique Using Energy Aware Clustering In Wireless Sensor Network"pp.199-202

[3] Lejiang Guo, Weijiang Wang, Jian Cui, Lan Gao , (2011) "A Cluster-based Algorithm for Energy-efficient Routing in Wireless Sensor Networks" Journal of Information & Computational Science 8: 11,pp. 2129–2136

[4] Miloud Bagaa, Yacine Challal , Abdelraouf Ouadjaout(2012) "Efficient Data Aggregation With InNetwork Integrity Control For WSN" J. Parallel Distrib. Comput. 72) pp.1157–1170

[5] Bhawnesh Kumar ,Vinit Kumar Sharma(2012) "Distance based Cluster Head Selection Algorithm for Wireless Sensor Network" International Journal of Computer Applications (0975 – 8887) Volume 57– No.9.pp.41-45

[6] Nandini. S. Patil, P. R. Patil (2010) "Data Aggregation in Wireless Sensor Network" IEEE International Conference on Computational Intelligence and Computing Research pp.362-367

[7] Rajesh Patel, Sunil Pariyani, Vijay Ukani (2011),"Energy and Throughput Analysis of Hierarchical Routing Protocol for Wireless Sensor Network" International Journal of Computer Applications (0975 – 8887)Volume 20– No.4, pp.32-36

[8] Parminder Kaur, Mrs. Mamta Katiyar(2012) "The Energy Efficient Hierarchical Routing Protocols for WSN" International Journal of Advanced Research in Computer Science and Software Engineering 2 (11), pp. 194-199

[9] Mohamed Watfa , William Daher and Hisham Al Azar (2009)"A Sensor Network Data Aggregation Technique", International Journal of Computer Theory and Engineering, vol. 1, no. 1, pp. 19-26.