ISSN: 1832-5505

*Applied GIS*

Vol-10 Issue-03 July 2022

# Changes in the Long-Term Performance of a LEACH Protocol for WSN

**N.Subash,[1] J. Martin Sahayaraj [2] , S.Jaya Pratha[3]**
Assitance Profrosser[1,2,3]
Sri Indu College of Engineering and Technology,Hyderabad , 501510, T.S,India

**Abstract**: When sending data to a sink in a wireless sensor network (WSN), the main goal of routing is to use as little energy as possible. Although the nodes in WSNs are limited in resources, using less energy with less delay is still an important feature. This proposed design works better in terms of how much energy it uses and how long it lasts. Most people use the LEACH and multi-hop LEACH grouping algorithms. This technique is based on k-means clustering and lets cluster heads talk to each other over more than one hop using the genetic algorithm. That MCR has two parts that fix problems that are already there. The first part is about managing clusters in the sensor area, and the second part is about sending data between the base station and the sensor area. The MCR results show that the network lasts longer and that the energy use of the sensor nodes is balanced when NS2 is used.

**Keywords:** WSN, route, K Means Clustering, Balanced Clustering, Cluster head, and energy use

## Introduction

There are many wireless nodes in a wireless sensor network. These are called sensor nodes, and there may be one or more base stations that act as sinks. Based on how they sense things, these sensor nodes get information from their surroundings. A lot of nodes are set up and work together to make an ad hoc network that can send information to a data collection sink (base station). Wireless sensor networks can be used to track targets, keep an eye on habitats and buildings, and check on people's health.

Improvements in chip size, energy use, and wireless communication have made it possible for new apps built on Wireless Sensor Networks (WSNs) to be created and used. A WSN is an ad-hoc network made up of small devices that don't have a lot of power or processing power. These devices have sensors that measure the real world they are watching. [5]A lot of work has gone into researching WSNs, and many designs and standards have been made.

in Figure 1

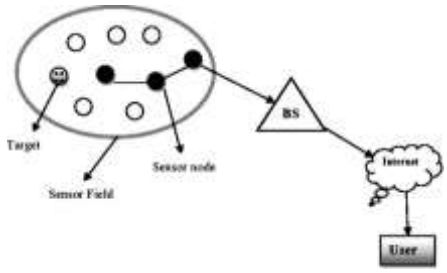



Figure1.Architecture of sensor network

However, one of the major issues in WSNs is the power consumption, due to the fact that sensors are mainly battery powered. For example, a battery-operated sensor device that wakes up once every few minutes to check an environmental parameter needs to consume as little power as possible in order to minimize the battery replacement. In several cases, nodes are deployed in harsh environments, such as underground or underwater, where replacing battery could be an unfeasible operation. Extending the network lifetime is a crucial concern.

A great deal of effort has been made by researchers to find effective strategies in order to increase network lifetime. These strategies encompass network node deployment, routing mechanisms and data aggregation. To select the relay node between sources to destination is known as routing.

ISSN: 1832-5505

Applied GIS

Vol-10 Issue-03 July 2022

## 1. MOTIVATION

Wireless sensor networks generally operate under light load conditions and become active whenever an event occurs. If the corresponding application load is high, it may result in the generation of huge continuous data flows leading to disrupted performance of the network, which may lead to congestion. In such condition, collision occurs in the network, due to which data packets start getting dropped, buffer overflows start happening at the nodes inthe network [3].

Therefore, we can say that the congestion is said to occur in a network, if the speed of the incoming traffic is larger than the data processing rate of the network it. Following are some of the probable causes due to which congestion happens in wireless sensor networks:

- Processing speed of nodes is low
- Incoming traffic arrives at faster rate than it can handle
- If packet collisions happen on data links, leading to alternate routing of packets & excessive re- Transmission of packets

### 2.1 Energy Consumption Model

Sensor node reduces it energy to transfer data to the sink. The energy model that is used in the network that decreases the energy in different operation such as transmission, reception, sensing and aggregation

### 2.2 Markov Model

Markov model has decision parameter to select the future state like as previous example of experience of Purchase car is the decision parameter. Similarly in WSN residual energy of relay and distance is the decision parameter for the future selection of relay node.

### 2.3 Cluster Formation

Figure 2, the initial cluster formation phase is based on the static clustering method. Sink collects the node position information from all the sensor nodes. According to the coordinate positions collected by the sink, the nodes are provided with an id. During the cluster formation, nodes with same id will join the same cluster [3].

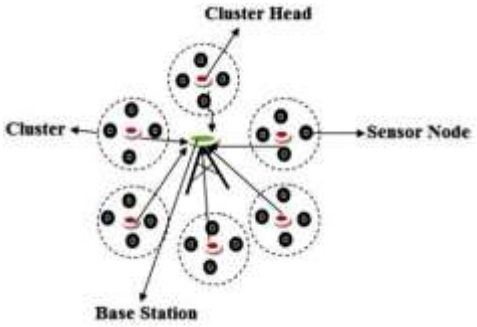



Figure2: Communication between CH to BS

The head election Figure 3 phase is based on timer mechanism initially [9]. Every node broadcasts head advertisement messages to its neighbors. The first timed out node becomes the head. The CH for the next round of operation is selected in the current round itself. A threshold value is set for residual energy of the head nodes, which determines whether the head should be replaced or not.

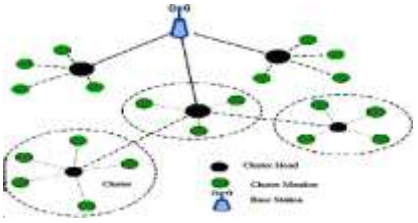


Figure3: Head election

### 2.4 Data Aggregation

Data aggregation is a process of aggregating the sensor data using aggregation approaches [6].The general data aggregation algorithm works as shown in the below figure 4. The algorithm uses the sensor data from the sensor node and then aggregates the data by using some aggregation algorithms such as centralized approach, LEACH(low energy adaptive clustering

ISSN: 1832-5505

Applied GIS

Vol-10 Issue-03 July 2022

hierarchy),TAG(Tiny Aggregation) etc.

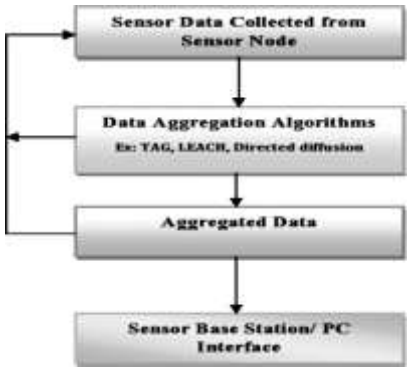



Figure 4: General architecture of the data aggregation algorithm

## 2.RELATED WORKS

**5.** The Hybrid Energy-Efficient Distributed (HEED) clustering method is one of the best known clustering techniques for saving energy [10]. It builds on the basic idea of LEACH by using leftover energy and node degree or density. In HEED, the original chance for each node to become a possible cluster head is based on its leftover energy. The intra-cluster connection cost determines which nodes become the final heads. Each step in the grouping process is called a "iteration," and the process ends after a set number of repetitions. HEED makes sure that cluster heads are spread out pretty evenly across the network. During the data transfer step, each cluster head sends a single-hop message that has been put together by all of the cluster heads.

**6.** Because batteries only hold a certain amount of power, energy constraints slow down the transfer of data across the network. When WSN nodes are spread out closely together, they send duplicate data. The extra energy used to send the repeated data transfers is wasted. The communication system is based on fuzzy logic and gives an expected result based on the nodes' energy and flow. These fuzzy interference systems decide when the sensor nodes go to sleep. It comes from IEEE

**7.**

**8.** 802.15.4 MAC standard, and this method is meant to be used for tracking the surroundings [11].

**9.** This is a [7]Delay Efficient Distributed Data Aggregation (DEDA) Scheduling Algorithm for Wireless Sensor Network (WSN) that uses timeouts to handle the choice between delay and energy in the process of aggregation. First, the paper builds an aggregated tree. Then, it uses the DEDA scheduling method to solve the problem of delay-aware data aggregation and make the system use the least amount of energy possible. A Decision Making Unit (DMU) was created to manage the tradeoff between handle energy and delay and to come up with the timeout idea.

**10.** This study talks about how digital media, data security, and data gathering can work together to improve output in sensor nodes. There is a new idea in this study called LDAT (Linguistic Fuzzy Trust based Data Aggregation and Transmission). It checks the reliability and accuracy of gathered data by figuring out how trustworthy sensor nodes are. In this way, the security and dependability of the data being sent are lowered. Nodes that have been hacked can add fake data, delete all the data, send only certain data to an attacker, copy legal nodes to join route paths, and stop data transfer while the data is being gathered. In the LDAT protocol, the Data Aggregation method is kept safe by using the Linguistic Fuzzy Trust technique to choose the trusted data aggregator.

**11.** We study the issue of how to schedule distributed aggregation in sensor networks and come up with a method that limits delay to $16R + \Delta - 14$.In this case, R is the network radius and $\Delta$ is the highest degree of a node in a WSN's communication tree. This is an almost constant estimate method that cuts the gathering delay by a large amount. This paper compares the new data collection method to the old one, which had a latency limit of 24D+6¥+16 time-slots. Where D is the network width (keep in mind that it can

be as big as 2R).

## 12. Descriptions of the MCR schemes

Our proposed design has better performance in the field of energy consumption as well as increased lifetime compared to LEACH and multi-hop LEACH clustering protocols. This protocol is based on k-means clustering and uses genetic algorithm for multi-hop communication among cluster heads

### 12.1 Multi Hop Clustering Routing Protocol

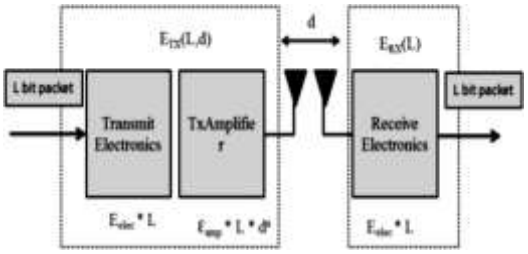
To increases the network lifetime and well balances the energy consumption, we adopt an energy driven method to rotate cluster-head, and propose a Multi-hop Clustering Routing Protocol (MCR) for long range transmission in the wireless sensor networks.

System Model

This protocol mainly includes three stages: Build up the network topology, Data collection and transmission and Cluster-head rotation and network topology rebuild. We make some assumptions about the sensor nodes and the underlying network model:

- There is a base station (i.e. data sink) located far away from the sensing field. Sensorsand the base station are all stationary after deployment.
- Sensors are homogeneous and have the same capabilities. Each node is assigned aunique Identifier (ID).
- Every node is assumed to use the same, fixed power level for intra-clustercommunication (e.g. broadcasting and communicate with CH).
- Links are symmetric. A node can compute the approximate distance to another nodebased on the received signal strength, if the transmitting power is known.
- Energy Model: This energy model [7] is used to evaluate the performance of theprotocol. It is based on the radio model shown in Figure 5.

Figure 5.Radio model




The energy dissipation of transmitting L bit packet over distance d is:

$$E_{TX} = E_{elec} * L + \varepsilon_{fs} * L * d^2$$

$$E_{elec} * L + \varepsilon_{mp} * L * d^2 d \geq d_o \quad (1)$$

$E_{elec}$ is the energy required for processing 1 bit data with the electronic circuits. Thethreshold distance, *do* is calculated as follows:

$d_o$ = root of ( / )

The energy taken to receive a packet is shown in (3):

$$E_{RX} = E_{elec} * L \quad (3)$$

BS also consumes energy for data aggregation as follows:

$$E_{agg} = E_{DA} * L \quad (4)$$

### 12.2 MCR Algorithm

The concrete steps of MCR protocol are as below:

- Build up the network topology
- Gateway nodes selection
- Clustering process
- Each CH node connects its gateway node
- Data collection and transmission

### 12.3 Genetic Algorithm (GeA)

Population: A population consists of several Chromosomes which itself made up ofgenes. First population is generated randomly.

Selection: Parents for generating next generation are determined in selection process. There are several selection methods such as “Roulette Wheel”, “Rank selection” and “Tournament selection.

Crossover: This operation combines the parents to birth children. In this paper a two point crossover is used. Two random points are selected on parents.

Mutation: Mutation operation adds variation to new population. In mutation the value of a randomly selected gene is changed.

## 13. PERFORMANCE ANALYSIS

The simulations results observed that the proposed protocol performs LEACH protocol in terms of network lifetime, energy dissipation. It has balanced energy consumption during network lifetime so that there are live nodes all over the network in 97% of network lifetime. The overall energy consumption, packet drop is very low compared to HEED is varying load. The MCR throughput is very high compare to HEED with respect to the number of sources.

## 14. CONCLUSION

This study tries to find a solution to the problem of wireless sensor networks using too much energy, being slow, having short network lifetimes, sending messages, and not getting enough data flow. The modeling results show that the total nodes in the network use the least amount of energy and have the least amount of delay compared to the current protocols.

We came up with the Multi-hop Clustering Routing Protocol (MCR) to help WSNs send data over long distances. The results showed that using the K means method based on their Euclidean distance made them more energy efficient. The suggested protocol works like the LEACH protocol in terms of how long the network lasts, how much energy it uses, and how many nodes are still alive while it's running in the network. So that there are live nodes all over the network for 97% of the time that the network is up, it uses the same amount of energy at the same time.

## REFERENCES

1. J. Martin Sahayaraj,N.Dhasarathan,"A Novel Data Aggregation Scheme for Energy Efficient Wireless Sensor Networks ",International Journal of Applied Science Engineering & Management, Vol 2, Issue 12,Issn: 2454-9940.
2. J. Martin Sahayaraj, and J. M. Ganaseakar. "Relay node selection with energy efficient routing using hidden Markov model in wireless sensor networks." International Journal of Networking and Virtual Organisations 19, no. 2-4 (2018): 176-186.
3. Luo, J, Hu, J, Wu, D, and Li, R, “Opportunistic Routing Algorithm for Relay Node Selection in Wireless Sensor Networks”, IEEE Transactions on Industrial Informatics, 2015, Vol. 11, Issue 1, pp. 112-121.
4. Srijeevitha, S, Alwarsamy, R. “An Efficient Data Transmission using Relay Node Based Opportunistic Routing”, International Journal of Innovative Research in Advanced Engineering, Vol.3, Issue. 4, April. 2016, pp. 7 – 12.
5. Nisha, P and Vivek, S, “Route Prediction in Wireless Sensor Networks using Markov Model”, International Journal of Computer Science and Information Technologies, 2015, Vol. 6, Issue 2, pp 1493-1496.
6. Giovanni P, “Power Consumption Reduction for Wireless Sensor Networks Using a Fuzzy Approach”, 2016, International Journal of Engineering and Technology Innovation, 2013, Vol. 6, Issue. 1, pp.55-67.
7. Kiran Maraiya, Kamal Kant, Nitin Gupta, “ Wireless Sensor Network: A Review on Data Aggregation” International Journal of Scientific & Engineering Research Volume 2, Issue 4, April -2011 ISSN 2229-5518
8. Nandini. S. Patil, Prof. P. R. Patil, “Data Aggregation in Wireless Sensor Network” 2010 IEEE

International Conference on Computational Intelligence and ComputingResearch

9. Prakashgoud Patil ,,Umakant Kulkarni, “Delay Efficient Distributed Data Aggregation Algorithm in Wireless Sensor Networks”, *International Journal of Computer Applications (0975 – 8887) Volume 69– No.1, May 2013*
10. XiaoHua Xu, ShiGuang Wang, XuFei Mao, ShaoJie Tang, and XiangYang Li,“An Improved Approximation Algorithm for Data Aggregation in Multi-hop Wireless SensorNetworks”
11. G.Y. Park, H. Kim, H.W. Jeong and H.Y.Youn, "A Novel Cluster Head Selection Method based on K-Means Algorithm for Energy Efficient Wireless Sensor Network", IEEE Proc. 27th International Conference on Advanced Information Networking and Applications Workshops, Barcelona, March 2013, pp. 910-915.
12. “An Multi-hop Cluster Based Routing Protocol for Wireless Sensor Networks”, I Yang, Yuxiang Zhuang, Hui Li,-Journal of Convergence Information Technology, Volume 6, Number 3. March 2011.