Low Energy Data Centric Algorithm in Wireless Sensor Network

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Abstract: *Through wireless communication, wireless sensor networks (WSN) have changed the communication media. But limitations in WSN are a result of the difficulties in replacing node batteries. The popular routing algorithm is LEACH has some limitation in conserving better energy levels. In this paper, a new clustering algorithm, Low energy data centric algorithm (LEDCA) is proposed for WSNs to reduce energy consumption and thus prolong the life of the WSNs. The monitoring nodes on schedule basis collects information though hopping mechanism on nodes and creates an energy road map for residual energy to monitor the time to sustain energy in each node. The proposed model is the improved version of Weighted Clustering Algorithm (WCA) and analyzed on the amount of energy packets sent to the monitoring node on various thresholds and calculates parameters for sustaining energy.*

Keywords: **LEACH, WSN, CH, BS, Residual energy.**

Introduction

Wireless Sensor Networks (WSNs) are collection of sensors with limited energy resources. Based on the economical cost of these devices, it is easier to deploy large number of nodes to monitor in a large geographical area. WSNs are widely applied in military surveillance, control and monitoring industries, traffic control, wildfire observation.

Every node forwards its sensed information directly to the Base Station (BS). The nodes that are far away will eventually die , reducing the network lifetime. [7] As node operates with limited energy source and large amount of energy is wasted during transmission to BS. So there is a need for a robust routing algorithm with their strategy reduces the energy consumption. In enhancement to the most popular Cluster based routing protocol (LEACH) the proposed algorithm takes an attempt to increase the lifetime of network. The nodes are located in a cluster and it receives data. Selection of Cluster Head (CH) is done on the different energy level thresholds. [6] The sensor nodes in a cluster-based routing technique are performed during the election of CH. In the cluster, CH receives data from nodes and transfers towards the base station in the form of data packets and energy

packets towards the monitoring nodes that tracks the formation of consecutive CH to prolog and sustain the lifetime of the nodes.

Drawbacks of LEACH Algorithm

LEACH routing algorithm has limitations [7], Cluster heads are randomly chosen without considering the residual energy and distance of the nodes from the base station. CH are selected randomly that lead to more energy consumption and the number of cluster heads is varied for each round. When Cluster head dies, the cluster will become useless as the data gathered by the nodes will not reach its destination [13]. Some of the CH situated at the corner of the cluster causes the using up more energy leading to low performance of the complete network.

Literature Review

Table 1: Study of Paper Published

Paper title	Author	Year	Contribution of authors	Scope of Improvement
Routing Algorithm for Wireless Sensor Network Based on GA-LEACH	Zhixun, L., Yuanyuan, F., Yunfei, Y	2022	Adapted Chameleon algorithm. And then adopted a genetic algorithm (GA) to select cluster heads.	Optimizing using machine learning algorithm.
AE-LEACH: An Incremental Clustering Approach for Reducing the Energy Consumption in WSN	Vasim Babu M, C.N.S.Vinoth Kumar	2022	Proposed AE-LEACH algorithm. where cluster head (CH) is selected through residual energy and reserve distance from the Base Station (BS) .The selected CH predicts the target trajectory using Particle Filter (PA) algorithm and selectively activates from the next round of sensor nodes to continuously track the target	More optimization technique with varying node density can be used to improve the life time of the sensor
Sectored LEACH (S-LEACH): An enhanced LEACH for wireless sensor network	Fadwa Abdul_Bari Mohammed	2022	Sectored-LEACH, splits the communication area into sectors to decrease the transmission distance, hence reducing the overall consumed energy.	Scope of Sectors further grouped and distance will be reduced
Energy Balancing Algorithm for Wireless Sensor Network	Ghassan Samara	2022	Wireless Energy Balancing algorithm (WEB) works on energy balancing distribution by identifying a suitable cluster head with minimum distance and high energy. It uses the knapsack-problem to design the cluster members. The simulation results demonstrate that the WEB algorithm outperforms LEACH by 31% in terms of energy conservation and WSN lifetime exten-	Trying out other dynamic problems for identifying cluster head with the weights as residual energy, distance and so on.

			sion	
On an improved clustering algorithm based on node density for WSN routing protocol	Luyao Chang,Fa Li Xinzheng Niu, Jiahui Zhu	2022	The proposed algorithm selects the cluster heads based on node distribution density and allocating remaining nodes for the defects of cluster head at random election and uneven clustering	Use machine leaning algorithm to get precise knowledge of the distribution desity
Comparison of Different Multi-hop Algorithms to Improve the Efficiency of LEACH Protocol	Madhvi Saxena	2021	proposed Modified Multi hop (MMH) LEACH and Modified Cluster Head (MCH) LEACH in terms of remaining energy for improvement of network energy.	selection of CHs is made such that there is at least one CH in the threshold distance region that could participate in hopping.
Residual Energy-Aware Clustering Transformation for LEACH Protocol	P. Ullas	2021	In The proposed REACT-LEACH algorithm, residual energy-aware clustering transformation protocol is proposed. cluster head (CH) rotation and cluster reformation with residual energy is taken as metrics .	Cluster Head selection can be estimated on the density of and to distribute nodes equally in sectors, machine learning methods can be used.
An Efficient Zone-Based Routing Protocol for WSN	Kamal Beydoun, Khodor Hammoud	2016	Hierarchical Architectural approaches, on zone partitioning to organize network nodes in order to save energy by reduction of traffic overhead	Zone partitioning can be adapted to other architectures and compared.
An Energy Balancing LEACH Algorithm for Wireless Sensor Networks	Haosong Gou and Younghwan Yo	2010	proposes partition-based LEACH (pLEACH), which partitions the network into optimal number of sectors, and then selects the node with the highest energy as the head for each sector, using the centralized calculations.	Reduce the collision in cluster head set-up phase thereby reduces overall l energy consumption
Improvement of LEACH protocol for WSN	Jia Xu; Ning Jin et al	2012	Proposed a revised cluster routing algorithm E-LEACH to enhance the hierarchical routing protocol LEACH. In the E-LEACH algorithm, by changing the remnant power, round time depends on the optimal cluster size. This increases network lifetime at least by 40% when compared with the LEACH algorithm.	Calculating the probability of nodes alive and die and hosting the Cluster Head as such that contribute for network failure

Methodology

Assume the n sensor nodes are randomly distributed in an area and periodically collects data on priority basis. Energy consumption is done by a monitoring node which is based on the schedules to sample the sensors for the current availability of the amount of energy. In order to predict the energy spent, duration of the node at a particular state is to be noted. Let E be the amount of energy spent in a time T and Δe will be the energy spent in a state. Then mathematically, we have amount of energy predicted per state as shown below in the expression.

$$\Delta E = \sum_{i=1}^{n} \Delta e$$

Results

All the nodes are assumed to be in the fixed mode with the limited amount of energy level. They are deployed as shown in the figure 1. The energy of the sink node is assumed to be active till the end of the simulation. The simulation maintains a packet to send energy information to the monitoring node along with packet to sink node. At each node Δe is calculated at every state and then combined to get the total ΔE. In the proposed algorithm it is found that nodes stay alive for more time compared to the WCA algorithm. The energy. The results are estimated through NS2. We have simulated around 32 sensor nodes having 7 cluster heads, one sink node. The deployment of sensor nodes is shown in the Figure 1.

Simulation Analysis

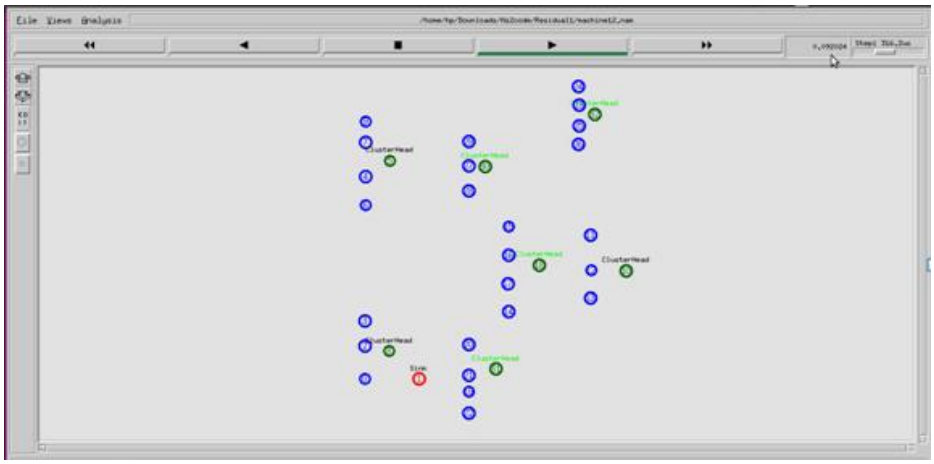

FIGURE 1: FORMATION OF CLUSTERS

The implementation of the LEDCA is done using NS2 simulator. Figure 1 depicts the cluster formation. Packets are exchanged with the CH as shown in Figure 2, as the sink node moves towards the cluster heads. Figure 3 shows the latency at different thresholds

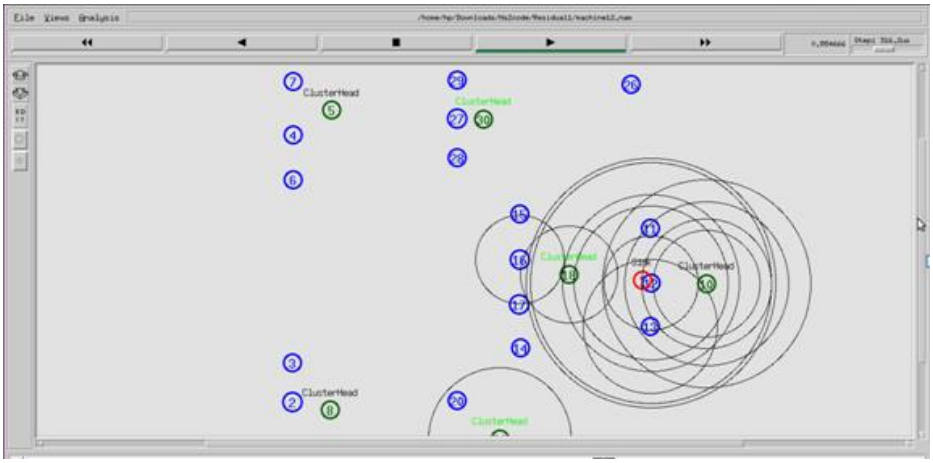

FIGURE 2: DATA TRANSFER TO CLUSTER HEAD

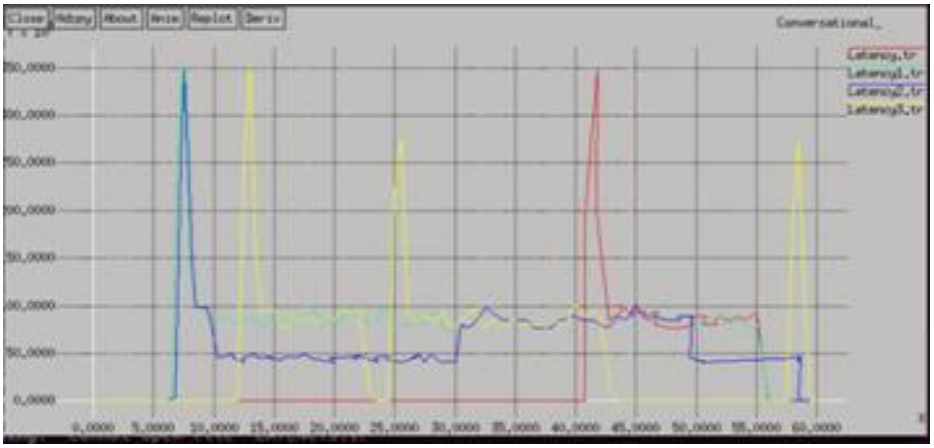

FIGURE 3: Latency Graph

Conclusion

The sensor nodes are deployed over the large area. They have the limited transmission range with the constrained battery. To maintain the lifetime of the battery certain routes to be adopted by the cluster to send data mobilized sink. In our work, LEDCA was introduced where the routes for the next hop was chosen by remaining residual energy at the cluster heads. We have shown the latency graph which provides the apparent view of cluster capability enhancement.

Future work

The proposed work can be extended to the study of 5G features in wireless sensor networks. 5G uses high data speeds of 3GHz to 300 GHz frequency with low latency less than 1ms to 10ms that connects globally with other devices. The future work will be focused on the mechanism of signal transmission that in turn optimizes the cluster-based

WSN to improve the life time of the sensor and study on the spectrum management for or multi-band communication.

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