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Optimizing Sensor Energy Efficiency through Enhanced DEEC Approach

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ABSTRACT

A wireless sensor networks (WSN) are less complicated to deploy and maintain than wired networks. A WSN is a broad grouping of small sensor nodes powered by energy-consuming resources. Clustering plays a crucial role in increasing WSN lifespan by distributing the load among nodes. To enhance the lifespan of WSNs, various clustering strategies were considered in this paper. The objective is to devise an effective clustering method aimed to enhance network stability. The existing Distributed energy efficient clustering protocol (DEEC) protocol, is utilized to extend network lifetime, was examined in this paper, utilizing the previously studied literature. This protocol states that in each round just one cluster head (CH) gets hired, consumes less energy than the LEACH protocol, but can be made more efficient by employing numerous Cluster Heads per round, as is done in the proposed work. The DEEC control clustering mechanism based on priority queue has been fully implemented. When compared to current technologies, this method uses less energy. Throughput, energy efficiency and packet drop ratio will be the metrics used to represent the effectiveness of the suggested approach. The outcome demonstrates progress and merits in terms of packet ratio, throughput, and energy efficiency.

***Keywords**: Wireless Sensor Network (WSN), Cluster Head (CH), Throughput, Energy efficiency.*

I. INTRODUCTION

A WSN generally has a number of nodes associated with it. These nodes can be in the form of hardware or software. Nodes that have cheaper prices are generally preferred. However, the problem is that cheaper nodes may not be of high quality and therefore can degrade quickly. An energy-efficient clustering mechanism must be used to resolve software issues. However, hardware issues still persist in WSN. Hardware issues can be resolved if routing protocols are implemented. Distance vector routing, shortest path routing, and many other routing methods are deployable. Although it is simple in nature, shortest path routing has a significant implementation cost. To fix the issue, distance vector routing might be used. The least expensive and most power-efficient routing method is distance vector routing. A distance vector routing strategy should not be implemented because it is difficult. Shortest path routing is employed in the majority of sensor node applications, making the WSN occasionally unstable. The solution of this problem is that, we need to merge the priority queue with the CH.

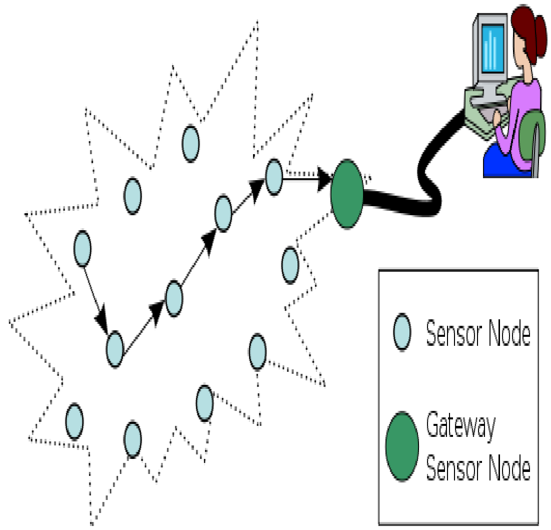

Figure 1:- Structure of WSN

The energy of the CH is deteriorating as it transmits packets to the destination. The CH routing and shifting strategies in each round represent the CH-related energy loss solution. An energy-limited WSN exists. To increase the network's lifespan, some sort of technique is required. Only by clustering the nodes together can the network's lifespan be increased. Depending on how far apart the nodes are, a cluster will form. If the distance is high, then the nodes will participate in some other cluster where the distance will be minimum. Packets will be transmitted from the CH towards the BS. The CH moves each round. The nodes that have the highest energy will be recruited as the CH around.

II. LITERATURE REVIEW

This section presents literature review of the techniques used to achieve energy efficiency. The clustering and highest energy aggregation protocols are discussed in this section.

(Asha et al., 2023) [1] proposed that a DEEC protocol be used for improving the performance of a WSN. Packets to the BS will be improved because the network energy will remain even when a large number of packets are transmitted to the BS. The mathematical concept of Euclidean distance is used here to select the best possible CH. However, choosing one CH per round is a problem. This means that in this case every CH will be overloaded. The overall network throughput will decrease due to applications increasing the load on the CH**.**

(Bamber et al., 2023) [2] proposed a stop and forward approach for packet transmission. The mechanism ensures that packets are transmitted towards the BS only if the channel is available. In case the channel is not available, the packets are buffered. In this case, a multipath channel is considered. However, it is not considered that the energy usage of sensor nodes will result in a decrease in network throughput.

(Gupta et al., 2020) [3] proposed a distributed protocol for transmitting packets towards a BS. A distributed protocol shares the load between the CH. The energy efficiency achieved by this approach is considerable. Aggregate packets on the CH will be transmitted depending on channel availability. A priority queue primary usage is to temporarily store packets. The result is expressed in the form of energy efficiency, packets to the BS, packets to the CH, throughput and network lifetime.

(Gambhir et al., 2020) [4] evaluated LEACH and SEP protocols. The amount of sensor nodes in a WSN is sufficient and the CH is incredibly resource-constrained. The primary goal of CH configuration is to reduce power consumption and increase system lifetime. This paper chose the LEACH protocol to select a CH per round. The single cluster selection problem causes network lifetime to shorten

(Abushiba et al., 2018) [5] proposed to use connectivity to upgrade the arrangement of operations in terms of energy efficiency and information quality for packet aggregation applications. This paper presented a new approach that exploits the spatial relationships between geographically adjacent nodes to increase network throughput. The usage of LEACH protocol is to perform packet aggregation on the CH. The CH will be responsible for transmitting packets towards the BS. The simulation in MATLAB is performed and the evaluator metrics include throughput, energy efficiency, packet to BS, and packet to CH.

(Singh et al., 2017) [6] proposed a DEEC protocol to achieve energy efficiency associated with a WSN. Network throughput will be extremely high. Packets to the BS are also enhanced by DEEC protocol applications. Compared to the LEACH regimen, better outcomes were attained. Overall, a 30% improvement in the packet to BS result was achieved.

(Tiwari & Roy, 2015) [7] proposed an application of an improved distributed energy-efficient clustering protocol for packet transmission towards the BS. One CH will be selected in a round. All neighboring nodes will transmit packets towards this CH. The CH will be responsible for transmitting the packets towards the BS. By using this approach, the throughput will be increased overall. The issue is picking just one CH per round. This implies that a single CH will have a tremendous amount of work. This will reduce the network's total lifetime.

(Kumar, 2014) [8] used the shortest path for routing and an improved DEEC technique. based on the idea that energy has the shortest and smallest distance. This suggests that the overall energy efficiency of this system will decrease. The quantity of packets sent to the BS rises proportionately with decreased power usage. Moreover, network lifetime will increase. To improve this procedure even more, more CHs can be selected in each round.

(Pal et al., 2013) [9] proposed a SEP-based method for choosing a CH. A SEP polls to select a CH. With this method, energy efficiency was obtained. However, the problem lied with the increased load on the CH. Selecting one CH in each round caused additional load on the CH, causing the packet drop rate to increase. Metrics on which evaluation was based were throughput, energy efficiency, packet drop ratio.

(Saini & Sharma, 2010) [10] improved CH selection mechanism using DEEC protocol. The CH workload was reduced in this case. A priority queue was implemented to reduce the load. There is no direct packet transmission from the CH to the BS. The packets are first aggregated at the CH and by selecting the appropriate channel, the packets will be transmitted towards the BS. The advantage of using this mechanism is to reduce the packet drop rate. Furthermore, packets to the BS and packets to the CH will be improved.

III.PROPOSED METHODOLOGY

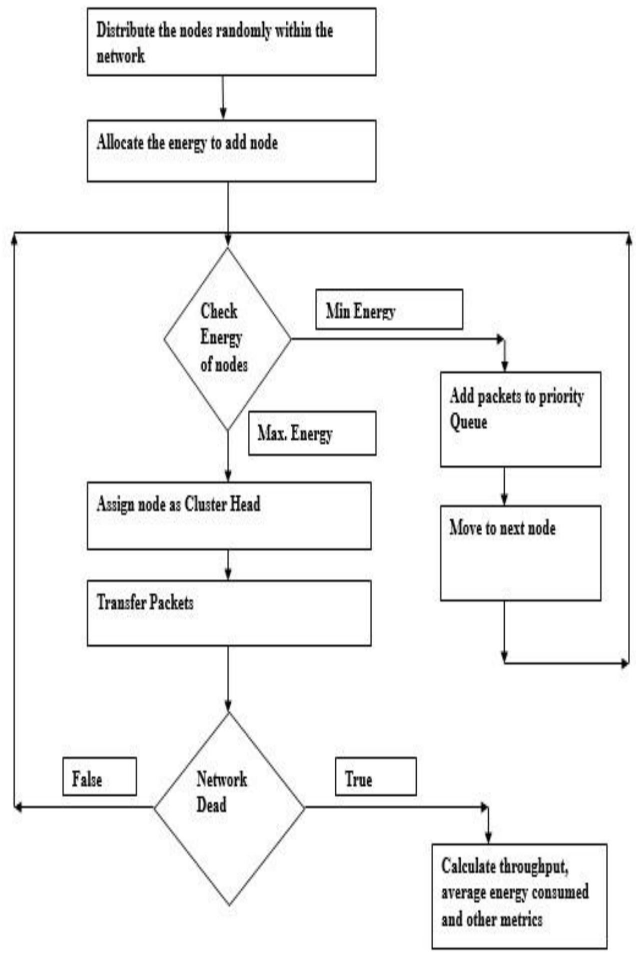

Figure 2:- Flow chart

The proposed study makes use of randomly placed sensors. Clusters are formed from randomly scattered nodes. The close-by nodes will group together as a cluster. The node with the maximum energy will be decided to be the CH. The priority queue will be linked to the CH. Dropped packets will be added to the priority queue. Packets in the queue will be picked up by the CH and forwarded to the Base Station.

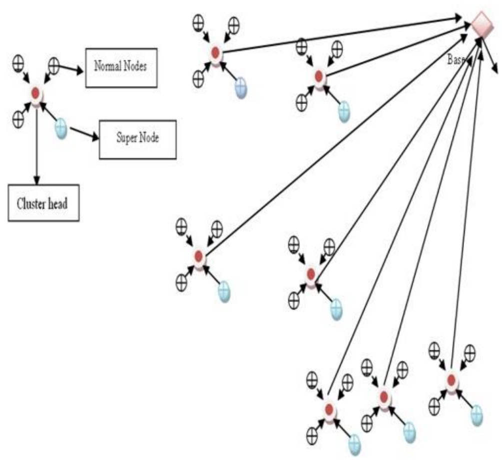

Figure 3:- Structure of Proposed Model

IV. PERFORMANCE ANALYSIS AND RESULTS

On the basis of results, the proposed Enhanced DEEC performs better than the current systems. For evaluation, 1000 rounds on average were taken into account. In comparison to the LEACH protocol's 100 dead nodes per 1000 rounds, the suggested system has 29 dead nodes. A detailed graphical analysis between all the protocols i.e. (LEACH, DEEC, SEP & Enhanced DEEC) with respect to the concerned metric i.e., Number of dead nodes is illustrated in Figure 4.

The packets to Base Station(BS) means finalized packets that reach the BS from the CH. This metric ultimately contributes to the throughput of the network of sensors. The packets to BS for 1000 rounds are highest for Enhanced DEEC. A detailed graphical analysis between all the protocols i.e. (LEACH, DEEC, SEP & Enhanced DEEC) with respect to the concerned metric i.e., Packets to BS. is illustrated in Figure 5.

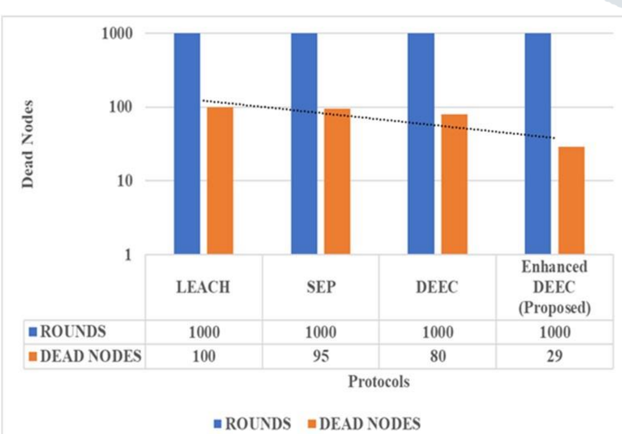

Figure 4:- Comparison in terms of Dead Nodes

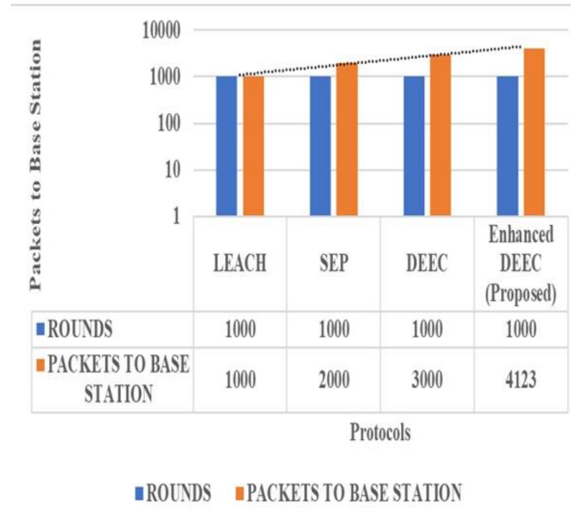

Figure 5:- Comparison in terms of Packets to BS

The metric that needs to be decreased while packets are being transported in the direction of the destination , the energy used. Enhanced DEEC methods drastically reduce energy consumption in comparison to other protocols. A detailed graphical analysis between all the protocols i.e. (LEACH, DEEC, SEP & Enhanced DEEC) with respect to the concerned metric i.e., Energy Consumption in Joules is illustrated in Figure 6.

Throughput is given in terms of total packets reaching out to the base station consuming least amount of energy. Enhanced DEEC method improves the Throughput in comparison to other protocols. A detailed graphical analysis between all the protocols i.e. (LEACH, DEEC, SEP & Enhanced DEEC) with respect to the concerned metric i.e., Throughput is illustrated in Figure 7.

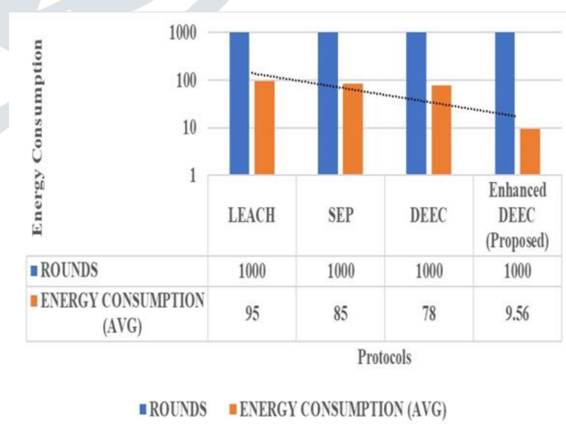

Figure 6:- Comparison in terms of Energy Consumption

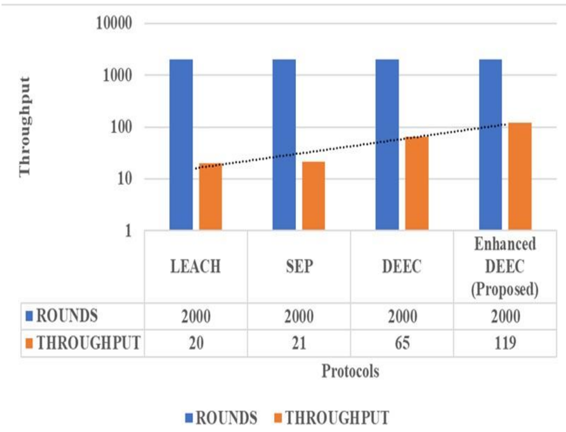

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Figure 6:- Comparison in terms of Throughput

V. Conclusion and Future scope

WSN is a subject of study that was selected since the majority of current work is focused on wireless signal transmission. Sensors have a finite amount of energy attached to them. This indicates that the sensors' energy will fast degrade. This study work provided a novel Enhanced DEEC protocol based on selection of various CHs together with priority queue to address the issue of energy efficiency. Based on the sensors' energy and their distance from the BS, the CH has been chosen. The nodes closest to the chosen CH at the time of selection ,transmit packets in its direction. The transmission of packets to the BS is done by the CH. This CH selection process is applied to multiple nodes in rounds. This means that the pressure of all nodes will not be present on one CH. Additionally, it is possible that even if some CH is dead, packets will not be lost due to the presence of a priority queue.

Enhanced DEEC optimizes sensor energy efficiency through a multi-round CH selection process, distributing the load and minimizing packet loss. This approach leads to a notable reduction in dead nodes, improved energy efficiency, enhanced throughput, and fewer packets transmitted to both the Base Station (BS) and Cluster Heads (CH).

For enhancing the performance of the suggested protocol, compression can be used in conjunction with Enhanced DEEC. The size of packets can be decreased using a compression method. This results in a large reduction in the energy required to transmit packets to the BS. Compression in an Enhanced DEEC can further increase the network's overall throughput.

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