A MULTI-OBJECTIVE BASED LCF ROUTE SELECTION FOR MAXIMIZATION OF THROUGHPUT IN WIRELESS SENSOR NETWORKS

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Abstract

Wireless sensor networks, also known as WSNs, are made up of small sensor nodes that are able to function and record events in environments that are inaccessible to humans. The data packets that are produced by these networks can be continuous, event-based, or query-driven, and they have a characteristic that is application-specific in character. To avoid wasting any energy, these packets must be transferred to the base station in an effective way. Making ensuring that data packet transport is reliable and energy-efficient is one of the most crucial considerations to make when attempting to enhance the performance of a wireless sensor network (WSN). The conventional method of retransmissions drains the battery of the node and adds to the amount of communication overhead, both of which contribute to network congestion, which in turn hinders the network's ability to transmit data packets reliably. Congestion results in the depletion of the node's energy supply, a decline in the performance of the network, and an increase in network latency as well as packet loss. Clustering is one of the most effective methods for gathering information from several sensor nodes in a time-efficient manner. In this work, we propose an efficient data delivery technique that can help to maximize the network throughput rate without affecting the network performance. In this study, a stable CH selection & link cost function (LCF) based data aggregation approach is developed to increase the throughput & lifetime of a wireless sensor network, CH stability, and energy-efficient data aggregation. The multi-objective parameters such as energy and distance to base station are involved to improve CH stability which improves the data aggregation. Following the selection of the CH, a link cost function (LCF) that is based on relay selection and data aggregation is used in order to find the optimal path between the cluster head and the member nodes for the transmission of data in an efficient manner that uses the least amount of energy. In order to make the most of this time-saving method, the data are consolidated at CHs.

Keywords: WSN, Clustering, Cluster head Selection, Energy efficiency, Data aggregation, Maximize Throughput.

I. INTRODUCTION

A significant number of energy-constrained sensor nodes are often included in wireless sensor networks or WSNs. WSNs are placed in a region at random in order to collect data on a variety of environmental characteristics and then send that data to a base station (BS) for use in monitoring and detecting applications [1]. In recent years [2,3], Because of their ubiquitous use in several industries, including military use, surveillance, human health detection, and others, they have attracted the attention of academics. It is extremely challenging to either recharge or replace the batteries of SNs used in WSNs because these networks are typically placed in high-risk areas. In addition, human operation of the network is quite challenging, which presents certain difficulties in regards to the deployment of WSNs [4–6]. Researchers should prioritize the efficient exploitation of the battery power available in SNs when creating protocols and hardware architectures as a means of mitigating the negative consequences of the restrictions described above [7]. This can be accomplished by maximizing the use of the battery power. In order to make the sensor network more energy-efficient as a consequence, many routing techniques have been proposed [8,9].

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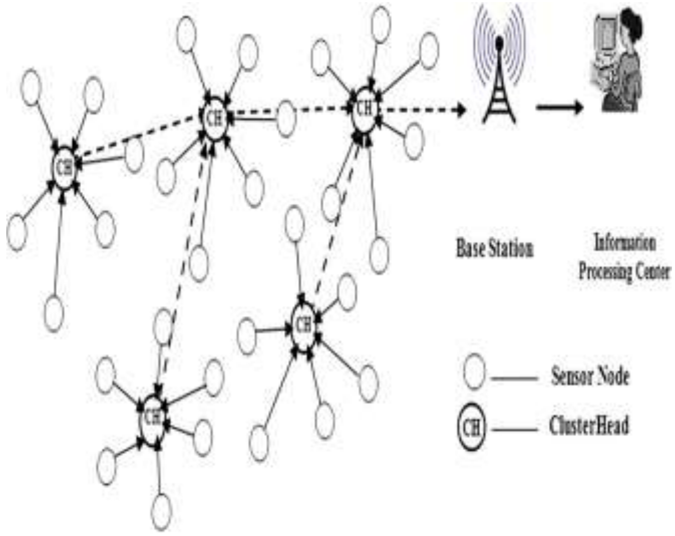

Fig. 1 Clustering is used in a wireless sensor network

The strategies that leverage the formation of clusters and a variety of communication routes in order to transmit data have attracted the most attention. Cluster-based routing strategies have been shown to use the network's SNs more effectively when compared to non-clustering routing algorithms [10]. Get rid of related data to lower the amount of data overall. One of the responsibilities assigned to a cluster leader is sometimes referred to as the cluster head (CH). The CH will then provide the BS with the combined data after that [11–13]. In order to lower the amount of energy needed for long-distance communication, cluster-based routing techniques use the split of SNs into several clusters. The use of clustering techniques might potentially contribute to the mitigation of energy consumption by evenly distributing the workload across all nodes. The notable disparity in the rate of energy dissipation between CHs and other nodes makes this concept plausible. Since clustering increases energy efficiency and extends the life of networks, it is an environmentally friendly and energy-efficient option. Therefore, clustering is a solution that is both eco-friendly and effective in terms of energy utilization. Furthermore, to improve network life and avoid SN death, most clustering methods adopt optimal CH selection [14–16]. This is done to maximize the operational window of the network. This is done to avoid an unexpected network failure.

The significant amount of energy consumption, data loss during data collecting, and inadequate data security are the primary concerns of wireless sensor networks. Every node has a small energy source it utilizes to sense its surroundings, send and receive data, and receive information from other nodes. If a node is subjected to an excessive amount of data, the possibility exists that its energy will be lost at such a rapid rate that it will perish due to a shortage of energy. If many nodes pass away in a short period of time, then the lifespan of the wireless sensor network will be significantly shortened.

Several different architectures were developed in an effort to make the network last longer by extending its lifespan. It was discovered that a clustered architecture of wireless sensor nodes might reduce the amount of energy used by individual nodes, hence significantly increasing the amount of time that the network could remain operational. Within the confines of this clustered architecture, it is possible for adjacent nodes to band together to form a cluster. Either a base station (BS) or sink node controls this cluster formation process. The leadership of each cluster is delegated to a single node, and that node must have a significant amount of spare energy. Sensing nodes that are within a single hop of a cluster head are eligible for membership in that cluster head. Every node in the network ought to be a part of one of the coordinating cluster-head nodes at any given time while the network is operating in its operational mode. The processing of information is shown clustered in Figure 1, which illustrates wireless sensor networks.

It is important that the number of nodes that are attached to a cluster head is ideal so that it does not become overwhelmed with data from individual nodes. Cluster heads have rapid depletion of their energy reserves in response to overloaded conditions, which ultimately results in the cluster head's

premature demise. This results in the formation of a hotspot region, inside which all of the nodes that are connected to the cluster head become separated from the network. The information that was held by this cluster-head has also been lost. In order to steer clear of these trouble spots, it is necessary to optimize, using a threshold level, the density of nodes linked to cluster heads. It is possible for the loss of data caused by these hotspots to be so catastrophic that it cannot be retrieved due to the dispersed nature of the sensor node deployment.
When compared to the energy required for data forwarding across clusters, a less quantity of energy is used since less data is moved during intra-cluster communication. In hierarchical network architectures, cluster-heads that are close to the base station are typically required to handle enormous amounts of data coming from outer-level cluster-heads. This might cause the energy reserve of the node to be depleted.

Contributions of the paper

- The network is clustered for the purpose of effectively aggregating data, and the CHs are chosen on the basis of multi-objective criteria such as energy consumption and distance from the base station in order to improve CH stability.
- Through the application of a multi-objective selection process, the CH's useful life is increased while the frequency of rotation is decreased.
- By choosing the best relay nodes between the cluster head and member nodes and extending their lifetime, the relay selection approach based on the link cost function (LCF) increases energy efficiency.

II. Literature survey

Existing research, which has been developed by a number of different researchers, will be discussed in this part. In particular, survey studies that are connected to the approach that has been provided are taken into account for further development.
Clustering-based power regulation was included in the strategy that Ansari et al. proposed for the public safety network's cluster head selection process. As a method of clustering, the fuzzy C-means clustering approach was used. It resulted in a decrease in the amount of power consumed by the network. On the other hand, it was not appropriate for use with other wireless communication technologies [17].
Zhao et al. introduced an improved and LEACH-based novel cluster-head selection method. This reduced the network's energy load and increased its efficiency. However, the distance between the CH and BS, the distance between a cluster member and their CH, and the prior cycle's energy consumption were considered [18].
A secure method of data aggregation that was low in energy consumption was proposed by Cui et al., and it was created with large-scale WSNs in mind. Its primary purpose was to lessen reliance on available energy sources. In spite of this, a selective forwarding attack was not observed while utilizing this technique [19].
Gharaei and colleagues came up with a plan to equalize the amount of energy consumed by CHs and individual cluster members. The strategy makes use of two mobile sinks, each of which moves along a spiralling path through parallel clusters. They spend a predetermined amount of time in each cluster. As soon as they reach each cluster, the mobile sinks begin moving as quickly as they can between the various stop places in order to equalize the amount of energy that is being consumed by the member nodes of the cluster [20].
Yarinezhad and Hashemi proposed an energy-efficient and energy-balanced cluster-based routing protocol (EB-CRP) for wireless sensor networks. The EB-CRP divides network activities into set-up and steady-state phases. Until the conclusion of the network's lifetime, these steps will continue to be carried out in order. Bootstrapping, clustering, and routing are the three components that make up the set-up stage themselves [21].
EDAGD is a strategy that was presented by Zhang et al. to extend the lifetime of wireless sensor networks and to reduce the amount of energy that is consumed during the process of data transmission.

The EDAGD that has been proposed contains three different algorithms. Entropy-driven aggregation tree-based routing method (ETA), Multihop tree based data aggregation algorithm (MTDA), and Gradient deployment algorithm (GDA) [22].
The Distance Energy Evaluated (DEE) Approach suggested by Salim EI Khediri et al [23]. The DEE technique reduced message complexity, which aided in its practical application. Our goal in using the DEE Approach was to help reduce energy usage in WSNs, particularly during cluster formation and data transfer to the Base Station. We demonstrated that our protocol's performance was greatly enhanced in terms of dependability, lifetime, and energy conservation using simulation findings.
The proposed technique by Anshu Kumar Dwivedi et al [24] was designed to improve the lifespan of wireless sensor networks while providing balanced energy dissipation across the network. The technique was designed to focus on CH selection and cluster formation. CHs were chosen using fuzzy inference methods based on ranks, and then clusters were formed in the WSN. We assessed the performance of our suggested protocol, EE-LEACH, in terms of network lifetime, packet delivery rate, and stability duration. We evaluated the performance of EE-LEACH to that of the current protocols SCHFTL and DFCR.

III. Proposed Model

In this study, a stable CH selection & link cost function (LCF) based data aggregation approach is developed to increase the throughput & longevity of a wireless sensor network, CH stability, and energy-efficient data aggregation. The multi-objective parameters such as energy and distance to Base station are involved to improve CH stability which improves the data aggregation. Following the selection of the CH, a relay selection and data aggregation-based link cost function (LCF) is utilized to discover the ideal route between the cluster head and the member nodes for energy-efficient data transmission. In order to make the most of this time-saving method, the data are consolidated at CHs. Figure 1 represent the block diagram of proposed model.

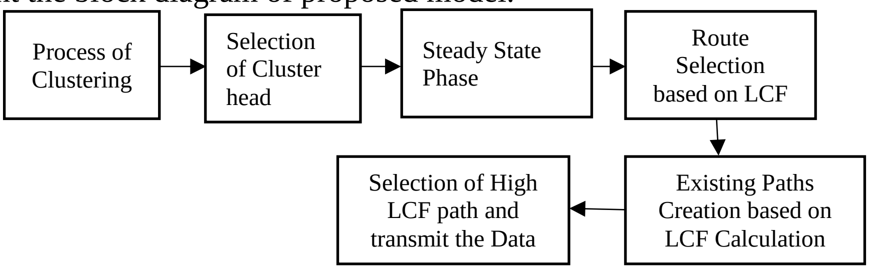

Figure 1. Block diagram for the proposed model

3.1 Formation of Cluster and CH selection of Multi-Objective

The method of unequal node clustering is implemented in order to carry out the process of clustering the network's nodes. A better longevity, scalability, and load balancing are just a few of the many benefits that come with using an unequal clustering strategy. It lessens the amount of intra-cluster communication in the region that is close to BS and stops the overload on the nodes that are adjacent to the sink node.
The sensor nodes must first identify the SNs that are around them in order for the clusters to form. For the purpose of recognizing the nodes that are near to one another, you will require properties such as ID, the location of the node, and the node ID. The Euclidean distance formula is applied in this situation in order to determine the distance, and the formula is presented as an equation below.

$$DIST_{i,j} = \sqrt{(X_i - X_j)^2 + (Y_i - Y_j)^2}$$

In the equation that was just shown, the variables X and Y stand for the coordinates of the positions of nodes $i \ and \ j$ within the network.
The following is an example of how the previously described the sensor nodes and base station node may be calculated using Euclidean distance:

$$Dist_{NtoBS} = POS_N - POS_{BS}$$

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Estimating the next node of the sensor nodes is possible by applying the following expression in conjunction with the aforementioned equations:

$$N_{adj} = sin\left(\frac{DIST_{i,j}}{2}\right) + cos(POS_i) * cos(POS_j) * \left(sin\left(\frac{Dist_{NtoBS}}{2}\right)\right)^2$$

In conclusion, the number of clusters that could form inside the network's boundaries can be expressed using the equation below:

$$N_{CL} = \frac{N}{\sqrt{2\pi}} * \frac{M}{Dist_{NtoBS}}$$

CH selection

A probabilistic strategy is utilized for the selection of CH candidates. It chooses the optimal node in the cluster to act as a CH depending on many criteria, such as its leftover energy and base station distance. Network nodes need energy to perform processes like the gathering, transferring, and receiving of data. Because of transmission, CH nodes in clustered networks consume more energy than other nodes because they receive data from several sensor nodes and aggregate it. Thus, these nodes need more energy to process such tasks. In light of these circumstances, it is necessary that the CH selection process be effective. So, the selection of a stable CHs by utilizing the multi-objective parameter is must needed to improve the data aggregation efficiency.

Parameter 1: residual energy

Calculating the node's leftover energy:

$$E_{res} = E_{total} - (E_C + E_T + E_R + E_A)$$

Here E_{total} is total energy, E_C data collecting involves the use of energy, E_T& E_R are the amounts of energy used for data transmission and reception, respectively and E_A the data aggregation process uses energy.

$$RE = \frac{1}{M} * \sum_{i=1}^{N} E_{res}(N)$$

Parameter 2: Distance from the base station: - Distance between communication nodes affects how much energy they use. Less distance between the CH node and the BS reduces its energy usage. Limiting the average distance between CH nodes and BS as much as feasible, the selection algorithms take care of this parameter as a result. This can be expressed mathematically as follows.

$$DIST_{toBS} = \sqrt{(X_i - X_j)^2 + (Y_i - Y_j)^2}$$

Where X_i& Y_i represent the x and y coordinates of $CH(i)$, and X_j& Y_j stand for the X and Y coordinates of BS.

In order to efficiently handle the trade-off between the parameters, a multi-objective fitness function is built through the use of the Weighted Sum Approach (WSA). On each individual aim, the weight value is multiplied by the value of the objective itself. After the procedure, all multiplied values are added together to create a single scalar objective function. This is done in order to simplify the process.

$$weight(n) = \left(p1\,(E_{res}(n))\right) + \left(p2\,(DIST_{toBS}(n))\right)$$

Here $p1 + p2 = 1$

The node that proves to be most effective in achieving the objective will be chosen for operation as a CH. The CHs will be the nodes with the most energy and coverage at the shortest distance. The selected CH in each cluster is the one that is accountable for aggregation as well as the transmission of the packets to the BS either directly or via additional hops. After choosing the CH for each cluster, the next step is to determine the path that will be taken to send the aggregated data to the CH.

3.2 Relay selection using LCF algorithm

The Proposed method utilizes a link cost function - LCF algorithm as the basis for selecting relay nodes to participate in the network. Estimating the values of the selection parameters allows for the calculation of a cost for each node. In order to identify efficient relay nodes, the LCF method that was suggested takes into account factors such as residual energy, hop count, buffer size of neighbor nodes, and packet holding time. The following is one way to convey it:

$$LCF_n = E_{res}(n) + hop(n) + bf(n) + pht(n)$$

Here, E_{res} stands for the amount of energy that is still left in node n, hop is the number of hops between each pair of nodes, bf refers to the size of the buffer, and pht is the amount of time that node n can hold onto packets.

The criteria for selection are discussed in the following paragraphs:

Residual energy

When it comes to wireless sensor networks, energy is the most crucial resource that must be taken into consideration. When it comes to gathering, processing, and routing data, cluster leaders, which are also nodes, have a higher energy consumption than cluster members. Following is an expression that can be used to calculate the residual energy.

$$E_{res} = E_{init} - E_{consumed}$$

Where, E_{init} & $E_{consumed}$ are the initial energy & consumed energy of the sensor nodes respectively.

Hop count

The term "hop-count" refers to the number of neighbor nodes that must be passed through in order to reach the BS. The next forwarder node that is physically nearest to the base station (BS) is chosen from a list of available nodes based on the hop count. In order to enable communication between the source nodes and the base station after CH selection, a routing path will be constructed. Each node in the network updates its neighbor table with the information of other nodes and then sends a HELLO message to the nodes that are immediately adjacent to it. This HELLO message includes the hop-count information that has been provided. The node in the network that is selected to act as either the next hop node or the relay node is the one that has the hop count value that is the lowest. The syntax that follows is utilized to denote the very bare minimal number of hops necessary to reach the destination node:

$$HOP_{count}(n) = \{\min(HOP_n) | \; n \in \mathrm{N}\}$$

Where, $\min(HOP_n)$ the term "minimum hop count" refers to the smallest number of hops required for neighbor nodes to reach the target node.

Buffer size

The buffer on the nodes that make up a wireless sensor network often has a time-varying value. In the event that the receiver's buffer becomes full and prevents it from receiving the packets, a retransmission will take place in order to finish the transmission. In order for re-transmission to take place, the sensor node must first expend additional energy. So the availability of the buffer & its capacity must be considered to control the retransmission so as the energy consumption to achieve the desired energy efficiency. The buffer size is calculated through following expression.

$$bf_n = \frac{RT_n - RT_{min}}{RT_{max} - RT_{min}}$$

Here, the RT_{max} and RT_{min} the highest and minimum number of re-transmissions from the neighboring nodes are denoted as the maximum and minimum values, respectively. The variable RT_n counts the number of retransmissions between the node and its neighbors.

Packet holding time

Packet retention time refers to the duration for which a packet is retained or held. Upon receipt of a data packet by a transmitting node, the responsibility of storing such packet for a certain duration is with the receiving node. This is called the "packet holding time" or " pht." The duration of this period is contingent upon the number of neighboring entities that the forwarder has, as well as the relative comparison between the initial energy level, denoted as E0, and the final energy level, denoted as Ec. Mathematically, it is written as

$$pht = \frac{N_j}{({E_0}/{E_c})}$$

The above-mentioned modeling of the packet holding time guarantees that a packet will arrive at its destination from its source with a minimal amount of delay, minimal interference, and minimal chance of being lost. By doing so, you reduce the likelihood of these nodes becoming overloaded with data packets, consequently, this leads to an increased likelihood of successful transmission of packets towards the sink. The prolonged retention of packets by these nodes contributes to the occurrence of overload and congestion, eventually leading to packet loss. Moreover, forwarder nodes with lower neighbors will have lesser packet retention time and the same behavior. This is due to the fact that the former experiences far less interference (fewer neighbors) than the later (which has a greater number of neighbors). In addition, the ratio ${E_0}/{E_c}$ is said to be lower for a node that has a greater value for its current energy level as opposed to a node that has a lower value for its current energy level. Consequently, nodes with greater current energy levels are capable of retaining packets for extended durations. This phenomenon may be attributed to the reality that these nodes possess an ample amount of energy, which enables them to continue their presence within the network. A node is responsible for holding a packet while also monitoring the channel to determine when it will become available to send the packet.

The relay selection procedure utilizing the cost function can be summarized as follows:

$$LCF_i = \omega_1 * f_1 + \omega_2 * f_2 + \omega_3 * f_3 + \omega_4 * f_4$$

$$f_1 = max\{residual_{energy}(i)\}$$

$$f_2 = min\,\{HOP(i,j)\}$$

$$f_3 = max\{bf(i)\}$$

$$f_4 = min\,\{pht(i)\}$$

Where $\omega_1, \omega_2, \omega_3, \omega_4$, is the weight coefficient ranging between 0 and 1. $(0 < \omega < 1)$
Calculating the LCF (Figure 2) is repeated for each and every node that is part of the cluster, and the node that ends up with the highest cost factor value is the one that is chosen to be the relay node.

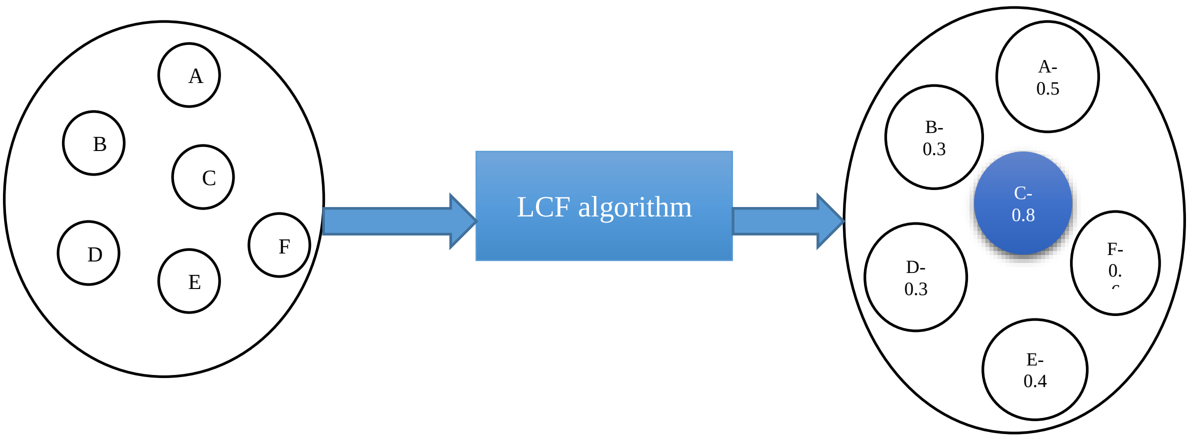

Figure 2. Calculating cost factor

A cluster is formed by the nodes A, B, C, D, E, and f in the preceding example. During the relay selection phase of the LCF algorithm, the LCF equation is used to calculate the weight of each of the nodes in each of the clusters. In the illustration that was just presented, node C has a higher CF value than the other nodes in the cluster. This indicates that node C has a greater amount of leftover energy,

a shorter holding time, fewer hops, and a larger buffer capacity. After that, the selection of node C as the forwarder node for the current round of communication under consideration has been made.
So, for every round of communication, In the relay competition, the node that has the greatest value emerges as the victor and is subsequently awarded the relay task. In accordance with this established sequence, the data is sent from the sensor nodes to the subsequent relay node, which then forwards it to the node that is in closest proximity geographically. This process continues iteratively until the data ultimately reaches the CHs.

Algorithm
RE – Residual energy, $DIST_{toBS}$ = distance to BS, hop - hop count, bf - buffer size, pht- packet holding time
##
For Total nodes n
    Divide the network into 'c' clusters
    For each cluster 'c'
        Cluster head selection using multi-level objective parameters
            For each cluster node
                Calculate $RE, DIST_{toBS}$
            End for
            Calculation $weight$
            If ($weight\ is\ MAX$)
                Select the node as Cluster head
            End if
    End for
    Data transmission
        Relay selection
            Estimate $LCF_n = E_{res}(n) + hop(n) + bf(n) + pht(n)$
        Calculate LCF_n
            If $LCF_n > LCF_{nm}$
                $RELAY = n$
    End for
End for

IV. Result and discussion

Through the use of simulations run in NS2 and a comparison with the LEACH methodology, we determined the effectiveness of the proposed mechanism. In a given area of 1000 meters in width and 500 meters in length, sensor nodes are distributed randomly. Each sensor node is initially assigned an energy level of 100 joules. The network's node count might range from 100 to 500. This number is not fixed. The CBR protocol was used, which resulted in the generation of traffic at a rate that was maintained during the entire transmission. Table 1 presents the experiment's findings, including the parameter values.

Simulation Parameter	Value
Area of Network	1000 m x 500 m
Nodes	50 to 200
Initial energy of Node	100j
Size of Packet	1024 bytes
Routing protocol	AODV
Traffic agent	Constant bit rate

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Cluster Formation
Cluster - 1 : 1 25 30 34 38 43 45
Cluster - 2 : 12 14 16 19 20 27 31 32 33 39 42
Cluster - 3 : 2 4 8 11 22 44 49
Cluster - 4 : 3 5 6 7 9 10 13 15 17 18 21 23 24 26 28 29 35 36 37 40 41 46 47 48

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Figure 3. Clustering of the network is depicted here using this figure. During the course of the experiment, the network was partitioned into a total of four clusters.

```
Node 18 has  energy = 99.995984  at time = 2.000948
Node 18 has  Pkt_hd_time = 1.949526
Node 18 lcf = 0.282795
Node 12 has  energy = 99.996526  at time = 2.000948
Node 12 has  Pkt_hd_time = 1.950062
Node 12 lcf = 0.195794
Node 39 has  energy = 99.996945  at time = 2.000948
Node 39 has  Pkt_hd_time = 1.950476
Node 39 lcf = 0.144520
Node 29 has  energy = 99.995702  at time = 2.000948
Node 29 has  Pkt_hd_time = 1.949231
Node 29 lcf = 0.543048
Node 4 has  energy = 99.995731  at time = 2.000948
Node 4 has  Pkt_hd_time = 1.949259
Node 4 lcf = 0.752130
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Figure 4. The LCF calculation of random nodes that occurred during run time is depicted here in a number of various time intervals.

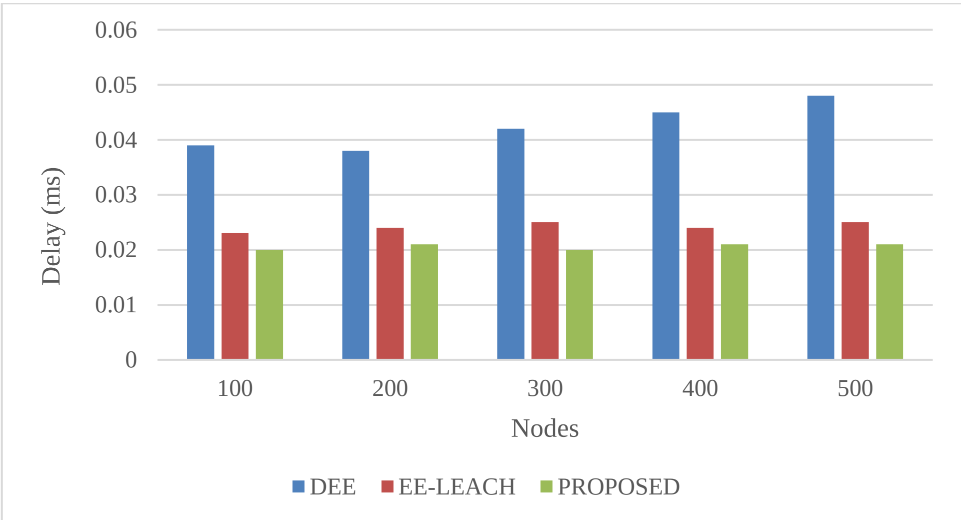

Figure 5. End to End Delay

The figure 5 that can be found up top displays the analysis of the total delay time for the data transfer, which can be read from beginning to end. When the number of nodes in the network was expanded to 500, there was a maximum delay of 0.21 milliseconds experienced, however the minimum average delay that was seen in the network was 0.20 milliseconds. When compared to the other available options, the cost computation chooses the way with the fewest possible hops in order to experience the least amount of delay in terms of both time and distance. The maximum time delay experienced in DEE and EE-LEACH were 0.048 & 0.025ms respectively.

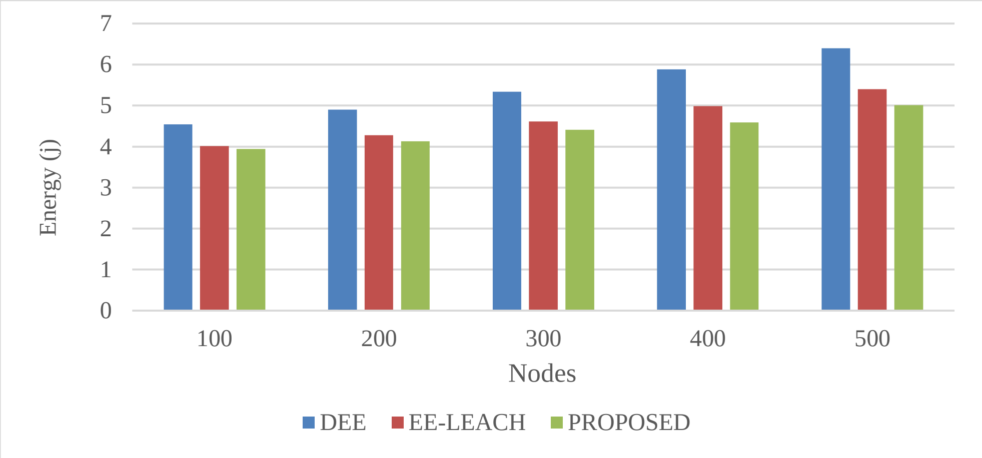

Figure 6. Energy consumption

The previous simulation result demonstrates the rate of energy consumption for both the LEACH approach and the way that was proposed. Initially, each of the sensor nodes is identical, and they all have the same amount of available energy. When you use a network, you will almost always end up consuming some amount of energy in the process. The results (Figure 6) of the experiment indicated that the strategy that was presented required an average amount of energy consumption of 4.416 joules. However, the DEE utilized an average of 5.412 joules and the EE-LEACH utilized an average of 4.658 joules of energy throughout its operation. The low level of energy consumption that was attained was due to the fact that care was given to factors such as residual energy, packet holding time, and minimal hop count.

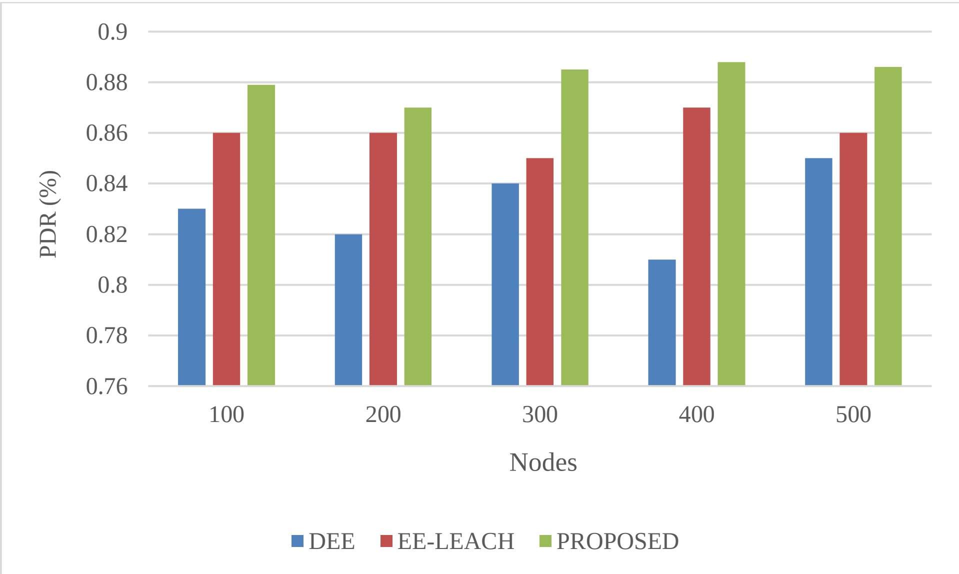

Figure 7. Packet Delivery Ratio

The following figure shows the packet delivery ratio simulation results for DEE and EE-LEACH techniques. PDR stands for "performance data rate," and it measures a network's data transmission rate. In comparison to the DEE strategy that is being used at the moment, which kept a PDR rate of 83% on average, the EE-LEACH method kept a PDR rate of 86% on average, and the proposed method obtained a maximum PDR of 92.2%. The created technique successfully used multi-objective characteristics, including buffer size and lowest hop count, to determine an optimal communication path. As a result (Figure 7), it was able to outperform the methods that were currently being utilized.

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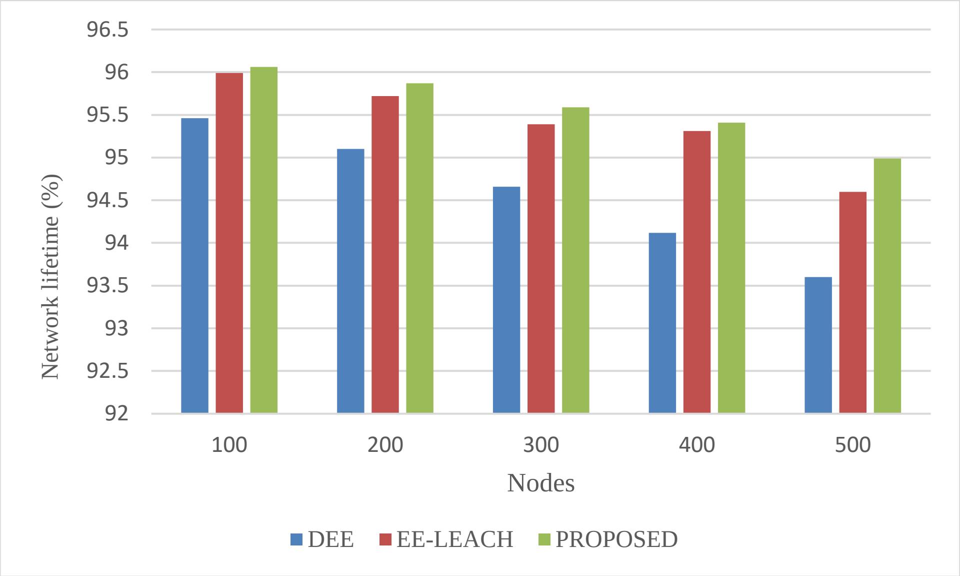

Figure 8. Network Lifetime

The network lifetime parameter is the period the network is active or until the first node's energy supply is drained. According to the findings of our research, the longevity of a network is correlated with the amount of energy that is still present in the nodes after the network has been shut down. A high network lifetime causes high remaining energy. The results (Figure 8) of the simulation of the network lifetime that the network encounters can be seen in the graphic that was just presented. The proposed approach suffered a network lifetime of approximately 95.58%, while the DEE and EE-LEACH methods had a network lifetime of approximately 94.58% and 95.4%.

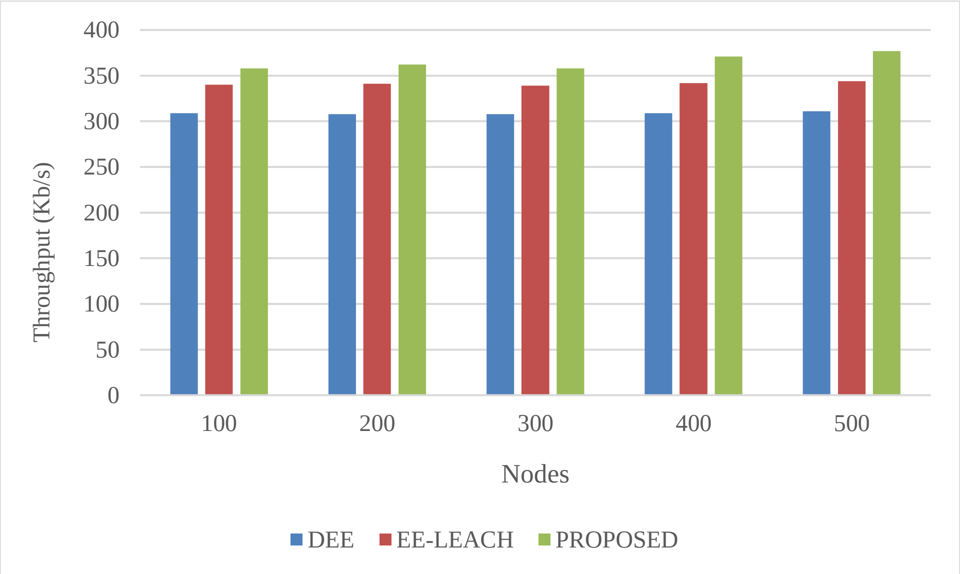

Figure 9. Network Throughput

The simulation results of Throughput are displayed in the graphs above (Figure 9), which compare the proposed method to the LEACH method. The network's throughput is the maximum data transmitted between sensor nodes. A considerable volume of data will be delivered in the event that the throughput is high enough. The chart that was just presented is evidence that the methodology that was suggested offers a high throughput rate in contrast to methods that are already in existence. In the trial, the suggested technique maintained a throughput rate as high as 377 kbps on average, while the DEE and EE-LEACH methods maintained a throughput rate of 311 kbps and 344 kbps as their best possible throughput rate.

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Conclusion

A stable selection of CH and effective energy consumption data aggregation are suggested in this study. This method aims to aggregate data as much as feasible for throughput, longevity, and energy efficiency. The remaining energy and distance to BS were used to stabilize CH. Both of these qualities help increase the aggregation of data, therefore their utilization was necessary. For the purpose of achieving energy-efficient data transmission, an algorithm that was created and given the name link cost function (LCF) or LCF for short was based on the cost function. Because of this, it is possible to determine the best route to take. Following the selection of CH, the link cost function (LCF) is used to determine the most optimal path for the transmission of data between the cluster head and the member nodes in order to minimize the amount of energy used. The experiments show that the recommended method optimizes the network and makes it last longer than current procedures.

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