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Section A-Research paper

MGC2: ENHANCED ENERGY-EFFICIENT HEAD ELECTION PROTOCOL IN WIRELESS SENSOR NETWORK

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Abstract

Wireless sensor networks (WSNs) have been around for a while, but they are finding new applications in areas as varied as medicine, first aid, and environmental study. Low channel capacities, low energy reserves, and short lifetimes characterize such networks. Given the enormous impact communication costs have on node power consumption, bandwidth is the most significant hurdle for these systems. Reducing energy consumption in WSNs is a top priority, and clustering has been widely employed to achieve this goal. To make the WSN head election protocol more power efficient, we introduced the MGC2 method. A latent awakening algorithm and cluster selection are used in the proposed method. Simulations showed that MGC2 has the potential to extend the time before the first Node in a sensor field fails, making the system more durable and dependable than its predecessors.

Keywords: Cluster Head, Energy Efficiency, MGC2, WSN

I INTRODUCTION

Wireless sensor networks (WSNs) are becoming more popular for use in many areas, including but not limited to monitoring environmental conditions, detecting fires, and surveillance of military installations. Once a cluster of SNs is deployed in an area, they establish a multihop network centered on the Base Station (BS). Compared to other types of stars, SNs typically have limited resources in terms of energy and computational power [1, 2]. Permitting each SN's reading to be forwarded to the BS, maybe via other intermediate nodes, before the data is processed is a simple technique to collect sensed network data. The high price of transmission overhead (or the energy required) renders this alternative impractical [3]. By determining whether or not a node in a distributed system can be trusted, trust and reputation systems provide essential contributions to many different kinds of systems [4]. Everything from social media networks and online marketplaces to networks of wireless sensors falls under this category. Ratings of participants' dependability are continually revised in light of their prior deeds. It must be immune to bias and faults [5]. When individuals in a distributed system have poor trust and reputation scores, it may hurt the whole system's performance, which is why attackers sometimes aim to decrease these ratings. One of the main goals of an attack is to gain credibility and trust via deception [6]. [8].

Some researchers have advocated CH as secure approach for WSNs [10, 11]. Verifying the validity of data acquired by distributed sensors remains challenging despite the growing use of sensor networks. Threat actors may use compromising node assaults to deceive sensors in high-risk locations into providing false information. Assessing data trustworthiness in this context is difficult [13–18]. WSNs will be able to afford hardware capable of implementing more advanced data aggregation, and trust assessment algorithms as the computational power of very low-power processors dramatically increase, primarily due to the demands of mobile computing, and the cost of such technology decreases [19-22]. One such instance is the proliferation of multi-core and multi-processor systems in SNs [19-22].

When nodes use more power than necessary, the network suffers. Insufficient attention has been paid in the literature to issues like overhearing and passive listening. The issues described above are driving the development of a new algorithm, which aims to make the network more resilient and reliable. For this reason, we've implemented a new, more power-saving protocol for WSNs in which the range of each Node's "zone" is limited by their distance from the network's hub, high-performance nodes form a tight cluster, and standard nodes adopt a dormancy strategy that involves state transition. The MGC2 protocol can potentially lessen a network's dependence on external power sources and increase its operational lifetime [23, 25]. This work improves upon a previous one by making the MGC2 process for selecting cluster heads more efficient. MGC2 uses a combination of multipoint-centric and greedy methods to choose cluster heads.

The following is the outline for this part of the paper. Section II focuses on the research around the process of choosing cluster heads. To learn more about the suggested model, please refer to Chapter III. In section IV, we report the results and analyze the implications of these results. Conclusions and Reflections are presented in Section V.

II BACKGROUND STUDY

Anthony Jesudurai, S., & Senthilkumar, A. (2018). [3] The author proposes a method for wireless sensor networks (WSN) called Improved Energy Efficient Cluster Head

Selection, which aims to extend the life and performance of the network while reducing its overall power consumption. The author investigated cluster head selection using data fusion approaches for clustering dual cluster heads in the LEACH methodology. For data transfer and fusion, clustered and selected cluster heads use the clustering process. The two clusters were chosen for data collection, combination, and transfer. Cluster head selection methods were used to reduce communication costs between two clusters. The suggested solution outperforms the present method regarding network longevity, throughput, and energy efficiency.

S. Gopinath and colleagues [8], the most difficult task in WSN is selecting appropriate clusters and prolonging network life. This study presents a solution for safe clustering, energy-efficient network resilience, and data integrity. To correctly begin packet routing, network assumptions were created in the early stages of the study. In the second stage, a connection was chosen for the network depending on how stable the cluster was. To maximize the network's efficiency with its energy supply, the third phase was developing the best possible cluster model. The simulation results provide a more accurate analysis, and the proposed model outperforms the ones that came before it.

K. Guleria et al. [9] Enhanced Energy Efficient Clustering (EEPC) was a strategy for optimizing network routing during data transmission by considering the dynamic nature of SNs. The primary goal of this research was to lengthen the life of sensor networks to aid in better tracking and monitoring in a WSN setting. This research shows how to cluster WSN nodes in a way that uses less power and extends their operational lifespan.

A. Naeem et al. [12] the most critical issues while creating routing protocols for WSNs were optimizing energy usage and increasing network longevity. Cluster-based routing approaches in WSNs boost network efficiency. The selected CH reduces the need for inefficient load balancing, resulting in more consistent energy use across all nodes and hence a longer lifetime for the network. In a CH, data from all clusters are combined. As the lifespan of sensor nodes grows, network stability improves. These findings confirm that DARE-SEP's suggested approach had a more extended period of stability and was energy-efficient. The nodes were randomly placed around the network, resulting in deployments close and distant from the SN. The deployment of nodes has a considerable influence on the network's longevity. These authors want to put a strategy for installing WSN nodes that maximizes network longevity while conserving total network energy.

Nivedhitha, V. et al. [14], through multihop routing, wins save more power and last longer. Clusters may benefit from multi-hop because it evenly distributes traffic to the sink node and allows for more efficient packet routing. Moreover, there was a severe problem with the path's dependability. In this analysis, clusters were built using a network model. To enhance network performance and provide multi-hop routes from SCH to CH and CMs, this model defines the roles of CH and SCH. Three metrics—residual energy, latency, and bandwidth—were considered essential for choosing the cluster head. For both ends of the transmission, the channel capacity model was used to execute the energy model.

M. Sabet and H. Naji (2016). [17] The primary goal of MLRC was to reduce power consumption by planning the most efficient routing tree. When choosing a CH, all feasible nodes are considered, but only those with the most extraordinary residual energy and closest proximity to the BS are chosen. MLRC was a peer-to-peer network protocol, meaning that devices only spoke to others in their immediate vicinity. However, using the suggested method, CHs may get the necessary data about the various paths to the base station (BS) and make an informed choice when making the next hop. As the network's nodes were spread out randomly, MLRC considered CH density while choosing the following relays. The result is that energy consumption within clusters and across clusters is equalized. We built clusters while defining routes simultaneously to control the flood of control packets. As CHs pinpoint the next hop, CMs choose the optimal CH to pair with according to some criteria. Additionally, cluster formation may protect CHs close to the BS against untimely death. It has been shown via theoretical analysis and computer simulations that the author's approach has the potential to vastly improve upon existing methods in terms of both energy efficiency and network longevity.

S. Sankar et al. [18] The Internet of Things (IoT) makes it challenging to save power since it links devices with limited resources. Existing clustering methods are constrained by the network's finite lifetime, unequal load distribution between nodes, and end-to-end latency. This study addressed these concerns by devising a new approach to choosing CH and building clusters. The process has two different steps. The Sailfish Optimization Algorithm was used to determine the CH (SOA). The second is that Euclidean distance was used in creating the cluster.

ISSN: 2063-5346
Section A-Research paper

III MATERIALS AND METHODS

3.1 System Model

This subsection describes the proposed protocol's network topology and energy consumption model.

3.1.1 Network Model

Before network setup, the following assumptions were made:

a) In a network, N is the set of all vertices where ni is a node in N. The neighbours (NH LST) and position (LOCi) of a node ni are given relative to the closest BS or cluster head.

b) The capabilities and power consumption of all network nodes are identical.

c) Every one of the N nodes is placed at random. Once deployed, these nodes do not relocate but function as fixed locations.

d) All network nodes have location awareness capabilities, providing access to the locations of all nodes.

e) Using this data, we can calculate node N's transmission range and the nodes' distances from the closest cluster head or the base station.

3.2 Energy Consumption Model

The study's suggested energy consumption model is consistent with other works in the field. The definition of energy used during data transmission may be found in equation 1.

$$E_t(k,d) = \begin{cases} E_{elec}.k + \varepsilon_{fs}.k.d^2, d < d_0 \\ E_{elec}.k + \varepsilon_{mp}.k.d^2, d \geq d_0 \end{cases} \text{ ------------- (1)}$$

d_0 is expressed as mentioned in equation 2

$$d_0 = \sqrt{\frac{\varepsilon_{fs}^2}{\varepsilon_{mp}}} \text{ --------------------- (2)}$$

$$E_r.(k) = E_{elec}.k \text{ ---------------- (3)}$$

The power required for data reception is given by Equation 4.

$$E_o.(k) = E_{elec}.k \text{ ---------------- (4)}$$

Where $E_{elec}\ (J/bit) - RF$ power spending factor, $\mathcal{E}fs$ – force utilization factor in free gap model, $\mathcal{E}mp$ - Multipath fading model energy use considerations

Using the Received Signal Strength Indicator (RSSI) as a metric, the distance d is calculated as follows.

$$d = 10\ \frac{[RSSI-A]}{10*n} \text{ ------------------ (5)}$$

For a range of 1 metre from the transmitter, RSSI-A uses the Received Signal Strength Indicator (RSSI) and the fading path factor (n) to determine the signal strength.

The total energy consumed by a node n_i is expressed as in equation 6.

$E(n_i) = E_t(kn_i, d) + E_t(kn_i) + E_0(kn_i)$ --------------- (6)

The only energy use occurs during the sending and receiving of data throughout a communication operation. However, unnecessary energy use leads to faster battery drain. Thus this is not desirable.

3.2.1 Distance-Based Residual Energy Algorithm

Since nodes closer to the BS operating as CH would expend more energy transmitting their own aggregated data and relaying sensed data from other CHs to the BS, the minimal

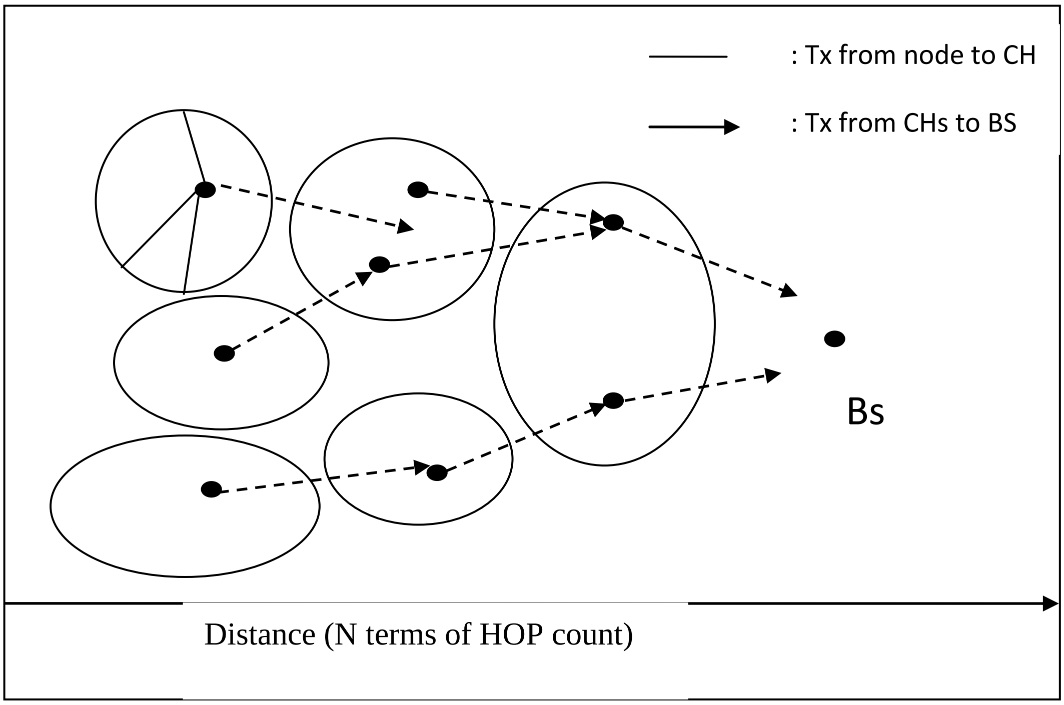

Figure 1: illustration for estimation of the distance between CHs and BS

The communication that happens during the transfer of aggregated data from CHs to the BS is shown in Figure 1.

Because of this, we propose a tweaked version of the LEACH-based CH selection strategy, where nodes are chosen to become CHs according to criteria that predicts the least necessary residual energy in a node based on its distances from the BS. LEACH is what allows for such a near-optimal CH selection. The new approach for selecting CHs is shown in a flowchart (Figure 1), which explains the many steps involved.

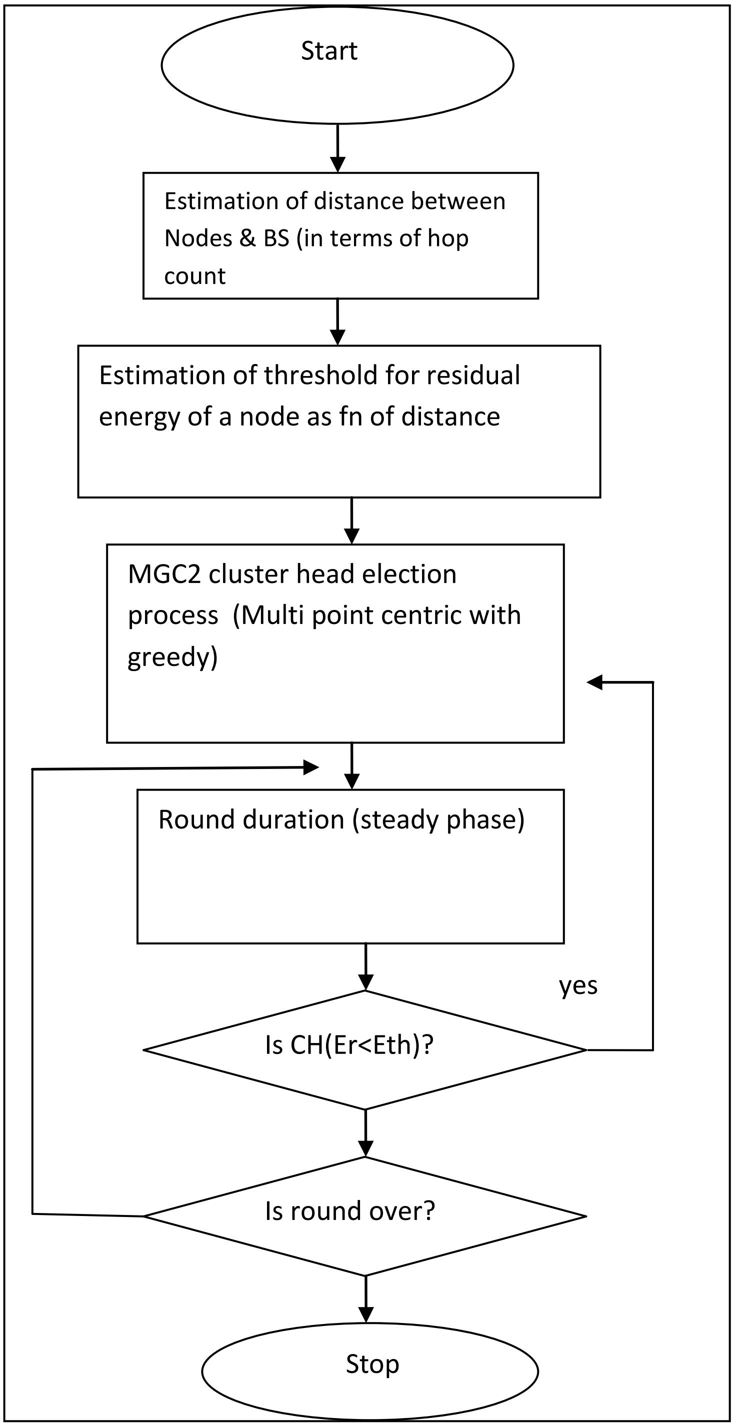

Figure 2 MGC2 Architecture algorithms

For each Node in the network to determine its distance from the BS, the BS first broadcasts a control message, including a reference to the number of hops. As we'll see later, a probabilistic model of LEACH with threshold T(n) was used to pick the initial CHs:

$$T(n) = \begin{cases} \frac{p}{1-px\left(i \times mod\frac{1}{p}\right)} & n \in G \\ 0 & n \in G \end{cases} \text{------------ (7)}$$

ISSN: 2063-5346
Section A-Research paper

Group G is the set of all nodes that have not been chosen as CH in the previous 1/p rounds, where p is the probability that a node will be chosen as CH in that round. When the random number produced for n is smaller than a predetermined threshold, T, the Node is considered a CH (n). Every CH's residual energy is calculated after the first and subsequent rounds, and nodes are only allowed to keep acting as CHs if they have at least ETh(n), as shown by the equation:

$$E_{t\square}(n) = \begin{cases} E_{\max t\square} - (HC_n \times c) & 1 \le HC_n \le 3 \\ 0.6\ E_{\max T\square} & HC_n > 3 \end{cases} \text{----------------- (8)}$$

Where $E_{\max th}$ Is the maximum threshold energy necessary in a node to become CH from the second round, and HC_n Is the hop count distance between a node acting as CH and a BS for data routing to the BS? C is the constant that represents the reduction in energy from the maximum required threshold energy as the nodes' distance from the BS increases. So long as the CH's kinetic energy is less than the threshold energy, we have a working hypothesis. The CHs for the next round were chosen with the same threshold Equation in mind. However, with a few tweaks: When both the Node's random number and residual energy are more significant than the threshold energy depending on its distance from BS, as given in Equation 1, the Node is labelled as CH (5.2). The round duration may be prolonged without clusters by monitoring the remaining energy of a node functioning as CH and its lowest necessary threshold energy.

3.3 MGC2 Algorithm

Comparable to the cunning behaviour of ants, wireless network routing looks for the quickest route from source to destination (food). Naturally, there is a dispersion of wireless sensor networks and optimization strategies.

The creation of "An energy-efficient load-balanced cluster-based routing utilizing MGC2" was driven by the need for long-lasting networks. A weighted method is utilized to choose cluster leaders for the best results in clustering. Multiple factors, including node density, signal strength indication, and residual energy, are employed in the cluster construction process. The relative importance of these features is also calculated. The proposed method also regularly and dynamically selects the best cluster head. As a result, power is saved, and efficiency in the network is improved. By operating MGC2 in a steady state, the most efficient path may be designed for multi-hop data transmission. The suggested protocol has an emphasis on lowering energy usage and increasing the lifespan of networks. The suggested protocol consists of two parts: the initialization of a cluster and the subsequent steady-state or multi-hop data transmission. By using MGC2, we can guarantee reliable multi-hop routing.

As a first step, a starting node will send out an EREQ to its neighbours to collect any unused energy data. The two nodes, the one that started it all and the one that will receive the data, have their energies compared. A sensor node will react with an energy signal if its energy level is greater than that of the initiator node (EREP). Once the CH has been established, the CHADV may be sent to the appropriate sensor nodes. The cluster is formed when all the nodes send a joint request (JREQ) to the cluster hub (CH), which then accepts it and sends back a joint response (JREP) to all the sensor nodes. When surplus energy is in a cluster, the CH picks the Node with the most of it and keeps it active while placing the rest into a dormant state. To verify whether the cluster's remaining energy is above or below the defined threshold, the initiator node sends out an EREQ. If the cluster's energy dips below a particular amount, it will enter a quiescent condition. The clusters in the network will then transfer the information to the sink node.

1. Consider specific nodes in a sensor network as initiator nodes for gathering residual energy information from sensor nodes.
2. Based on the energy data, the initiator I1 chooses the cluster's leader.

    For each neighbour Ni of I1, i=1,2….r

If $RL_i > RL_{ini}$, then,

Si responds with a message requesting power (EREP).

Else

3.Si watches for promotional messages to arrive in his cluster heads (Greedy Clustering).

End For

4. For Ni, CH1 sent out a multipoint greedy.
5. Each each Node Ni makes a request JREQ to CH1.
6. Nodes Ni become part of the cluster after accepting REP from the CH.
7. The cluster opts to keep the Node with the most available energy online while putting the others into a dormant state.

8. Energy requests are sent to clusters from the initiator node I1. A cluster will work if the greedy (cluster) value is greater than the threshold value. Unless action is done, the cluster will be put in a dormant condition.
9. Send the information to the "sink node."
10. End

3.3.1 MGC2 Cluster Head Selection with waking and Latent Algorithm

This section details the steps involved in selecting a cluster head node for load-balanced operation, including how to account for the node remaining energy (ReEn), how to use link RSSI as a measure of acceptable connectivity/coverage, and how to pick a node with a high enough connection density.

A request to set up a cluster is sent from the BS. Nodes will calculate ReEn (Ni) and RSSI for each connection and react accordingly. Determine the cluster head nodes that will fully connect all neighboring nodes. Complete connectivity to all neighbours in an n-node graph is found by computing the set of vertices $NSi = Ni, Ni + 1, Ni + 2, \dots, Nn)$. In addition, there are n ways in which such collections of nodes may be constructed. When NSi is defined $as\, N_i, N_i + 1, N_i + 2, \dots N_n$, then $NS = NS_1, NS_2, \dots\dots NSn$. The remaining energy at the cluster head node minimum set $Wf_1((NS_{i+3})$, the number of load-balanced nodes at the a apex of a cluster minimum set $Wf_2(NS_i)$ $Wf_2(NS_{i+1})$, the RSSI of all links at the cluster head node minimum set $Wf_3(NS_i)$ $Wf_3(NS_{i+1})$ as well as a minimum connection density for load-balanced nodes at the cluster's leader node. The NS_i (Wf) Node Set Cluster head node sets $(NS_i, NS_{i+1}, NS_{i+2}, NS_{i+3}, \dots, NSn)$ are weighted using the factors (Wf1, Wf2, Wf3, Wf4) shown below:

$$|Wf_1(NS_i) \quad Wf_1(NS_{i+1}) \quad Wf_1(NS_{i+2}) \quad Wf_1((NS_{i+3}) \quad \dots \quad Wf_1(NS_n)|$$

$$|Wf_2(NS_i) \quad Wf_2(NS_{i+1}) \quad Wf_2(NS_{i+2}) \quad Wf_2\big((NS_{i+3}) \quad \dots \quad Wf_2(NS_n)\big|$$

$$|Wf_3(NS_i) \quad Wf_3(NS_{i+1}) \quad Wf_3(NS_{i+2}) \quad Wf_3\big((NS_{i+3}) \quad \dots \quad Wf_3(NS_n)\big|$$

$$|Wf_4(NS_i) \quad Wf_4(NS_{i+1}) \quad Wf_4(NS_{i+2}) \quad Wf_4((NS_{i+3}) \quad \dots \quad Wf_4(NS_n)|$$

Select the following values after applying relevant weighting factors: The nodes with the highest ReEn value in set $Wf_1((NS_{i+3}) = V_{\ 1,i}$, the best load-balanced nodes in NSi $Wf_2(NS_i) = V_{\ 2,i}$, the nodes with the highest RSSI all links in NSi $(Wf_3(NS_i) = V_{\ 3,i}$ and the nodes with the highest connection density. After adding weighting factors to each of the ideal Node Sets $Wf_4(NS_i)$ the value Matrix was calculated. The expression for NSn is:

ISSN: 2063-5346
Section A-Research paper

$$
\begin{matrix}
|V_{1,i} & V_{1,i+1}, & V_{1,i+2}, & V_{1,i+3}, & \dots V_{1,n}| \\
|V_{2,i} & V_{2,i+1}, & V_{2,i+2}, & V_{2,i+3}, & \dots V_{1,n}| \\
|V_{3,i} & V_{3,i+1}, & V_{3,i+2}, & V_{3,i+3}, & \dots V_{1,n}| \\
|V_{4,i} & V_{4,i+1}, & V_{4,i+2}, & V_{4,i+3}, & \dots V_{1,n}|
\end{matrix}
$$

The lowest possible ReEn value for each Node Set in a Cluster is shown in the first column of the value matrix. The value matrix's second row displays the minimum load balanced node count for each cluster head node set. The minimal RSSI score for each group of possible cluster head nodes can be found in row 3 of the value matrix. From the perspective of load-balanced network operation, the node connection density of each cluster head node is reflected in Row 4 of the value matrix.

Rule 1:

$$Max[V_{1,i}] -> Min[V_{1,n}] = [Highest, 2nd\ Highest, 3rd\ Highest, \dots..2nd\ lowest, Lowest]$$

Rule 2:

$$Best\_Load\_Balanced\_nodes[V_{1,i}] -> Min\_Load\_Balanced\_nodes[V_{1,n}] = [Highest, 2nd\ Highest, 3rd\ Highest, \dots, 2nd\ lowest, Lowest].$$

Rule 3:

$$Max\_RSSI\_all\_links[V_{1,i} -> Min\_\ RSSI\_all\_links\ [V_{1,n}] = [Highest, 2nd\ Highest, 3rd\ Highest, \dots, 2nd\ lowest, Lowest]$$

Rule 4:

$$Best\_Balanced\_node\_density[V_{1,i}] -> Min\_Balanced\_node\_density\ [V_{1,n}] = [Highest, 2nd\ Highest, 3rd\ Highest, \dots, 2nd\ lowest, Lowest].$$

An Optimal Node Set Selection Matrix is now generated, as illustrated in the table below:

$$
\begin{matrix}
|Wt_{1,i} & Wt_{1,i+1} & Wt_{1,i+2} & \dots.. & Wt_{1,n}| \\
|Wt_{2,i} & Wt_{2,i+1} & Wt_{2,i+2} & \dots.. & Wt_{2,n}| \\
|Wt_{3,i} & Wt_{3,i+1} & Wt_{3,i+2} & \dots.. & Wt_{3,n}| \\
|Wt_{4,i} & Wt_{4,i+1} & Wt_{4,i+2} & \dots.. & Wt_{4,n}|
\end{matrix}
$$

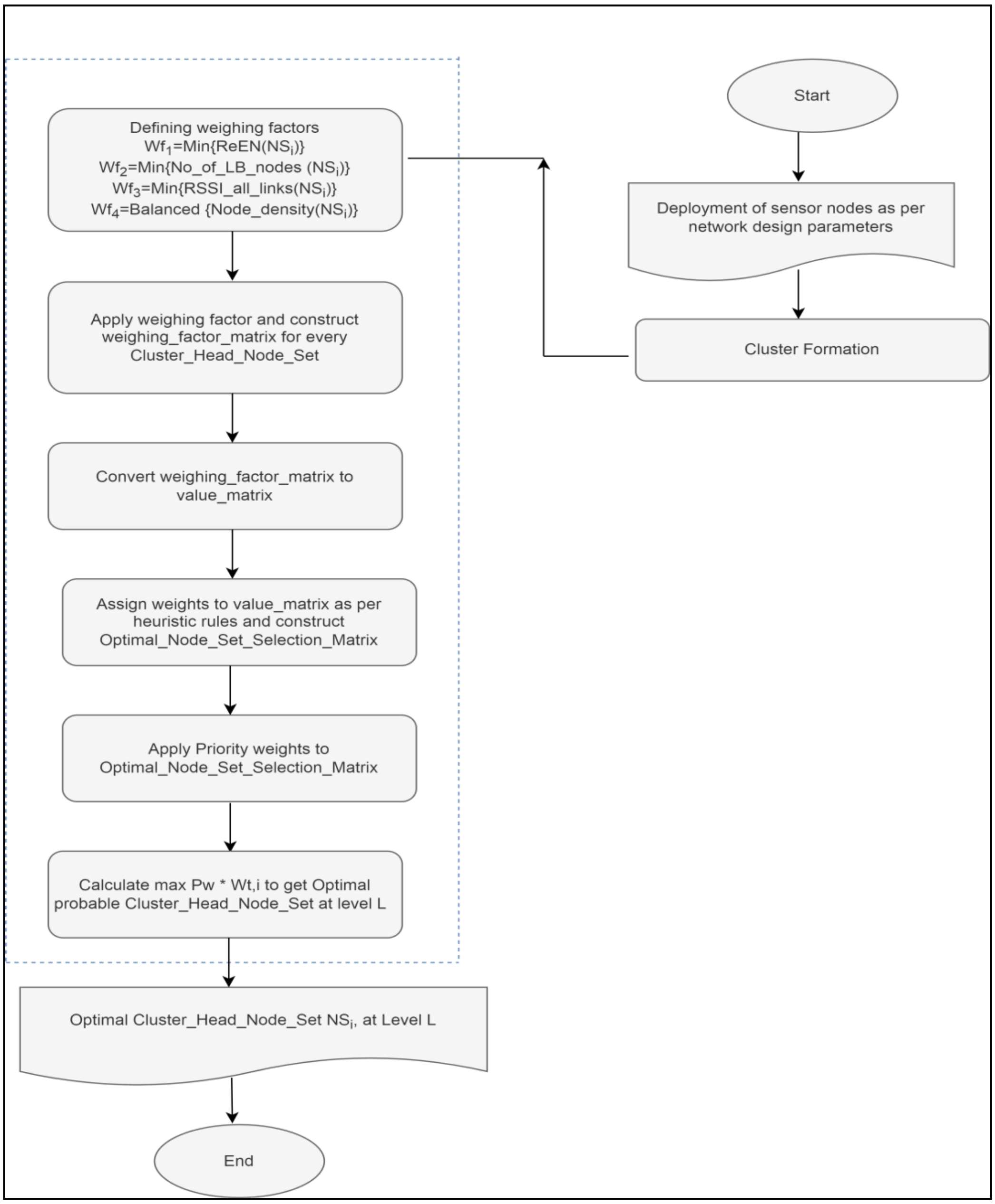

Figure 3: Cluster Formation

ReEn receives 40% of the priority weight (Pwt), LB nodes get 20%, RSSI of connections receives 20%, and node density receives 20%. In the following paragraphs, we'll discuss the process of recreating the best possible Node Set Selection Matrix.

$$\begin{array}{lllll} |P_{wt} * Wt_{1,i} & P_{wt} * Wt_{1,i+1} & P_{wt} * Wt_{1,i+2} & \ldots.. & P_{wt} * Wt_{1,n}| \\ |P_{wt} * Wt_{2,i} & P_{wt} * Wt_{2,i+1} & P_{wt} * Wt_{2,i+2} & \ldots.. & P_{wt} * Wt_{2,n}| \\ |P_{wt} * Wt_{3,i} & P_{wt} * Wt_{3,i+1} & P_{wt} * Wt_{3,i+2} & \ldots.. & P_{wt} * Wt_{3,n}| \\ |P_{wt} * Wt_{4,i} & P_{wt} * Wt_{4,i+1} & P_{wt} * Wt_{4,i+2} & \ldots.. & P_{wt} * Wt_{4,n}| \end{array}$$

Find the best Cluster Head Node Set by summing each column of the matrix as shown in Equation 9.

$\sum_{t=1}^{4} P_{wt} * Wt_{1,i}$, $\sum_{t=1}^{4} P_{wt} * Wt_{1,i+1}$, $\sum_{t=1}^{4} P_{wt} * Wt_{1,i+2}$, $\sum_{t=1}^{4} P_{wt} * Wt_{1,i+n}$, .. (9)

Determine the greatest selection probability of Cluster Head Node Set NSi using the formula 10.

$\max \sum_{t=1}^{4} P_{wt} * Wt_{1,i}$ -------------- (10)

The odds of selecting the best Cluster Head Node Set NSi are thus increased. Repeatedly running the cluster head selection algorithm after the initial time t1 allows dynamic clustering by picking a new ideal Cluster Head Node Set NSi based on the characteristics of the network at that instant. This helps prevent the battery life of individual nodes in the network from draining too quickly. As a result of their relative RSSI values, nodes outside of the cluster head will choose which cluster head to associate with. Figure 3 shows the cluster creation procedure.

IV IMPLEMENTATION AND PERFORMANCE ANALYSIS

The efficiency of the proposed MGC2 clustering strategy is measured via a comparison of load aware and non-load aware techniques in the NS-2 simulation environment. Parameters such as number of nodes, energy consumption, throughput, packet delivery ratio, average latency, etc. are utilized in the NS-2 simulation environment to evaluate the effectiveness of the proposed system.

Table 1 Simulation settings

Parameter	value
Network size	500m x500m
Number of nodes	0-49 nodes
Max Packet	256
Simulation time	300 s
Routing	AODV
Data link (MAC)	IEEE 802.11
Channel frequency	600KHz
Channel bandwidth	100KHz
Initial energy	20 J
Transmit power	33 dbm
Receive sensitivity	-98 dbm
collect threshold	-88 dbm
transmitter model	Omni-directional
most transmission range	100 meters

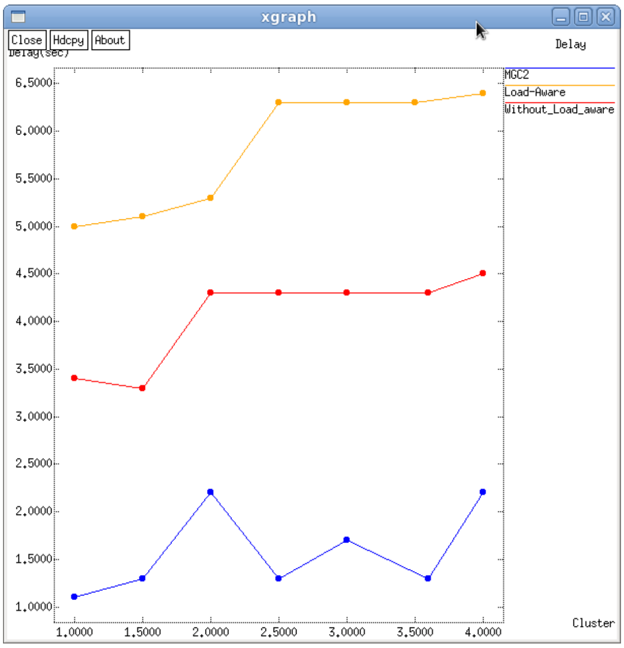

Figure 4: Delay Comparison Chart

To compare the delays, see Figure 4. MGC2's lag slows down communications. Time differences are shown, revealing that the MGC2 has a shorter message delay than both the LOAD AWARE and WITHOUT LOAD AWARE approaches. The cluster is represented by the X-axis and the delay levels by the Y-axis.

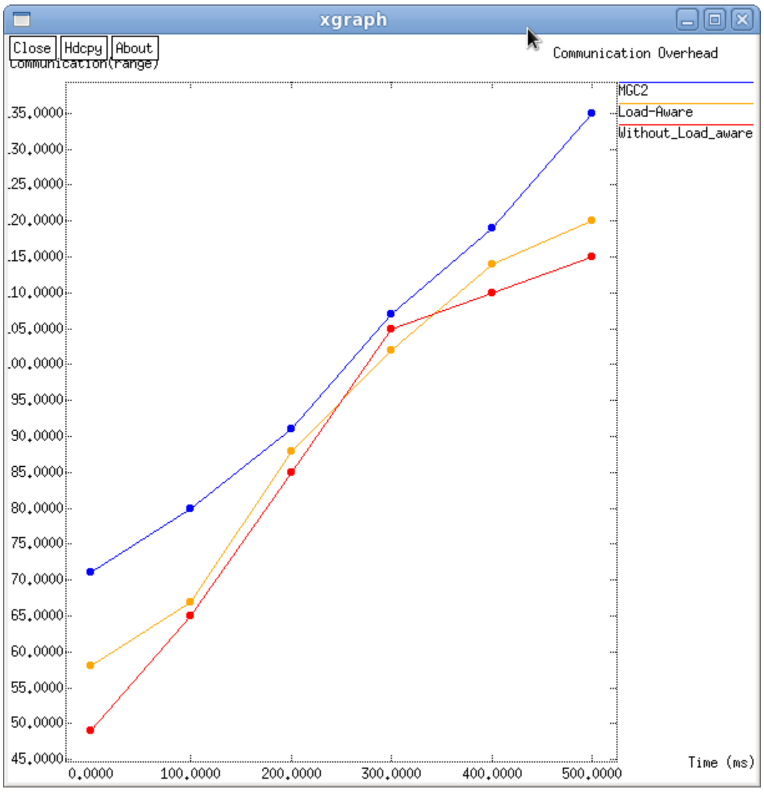

Figure 5: Communication overhead Comparison Chart

ISSN: 2063-5346
Section A-Research paper

Overhead in terms of both routing and communication is shown in a comparative chart in Figure 5. MGC2's accuracy makes for better signal transmission. It evaluates the communication burden and finds that MGC2 is more efficient than LOAD AWARE and without LOAD AWARE. On this graph, time is represented by the X axis, while the Y axis represents the distance covered by a given transmission.

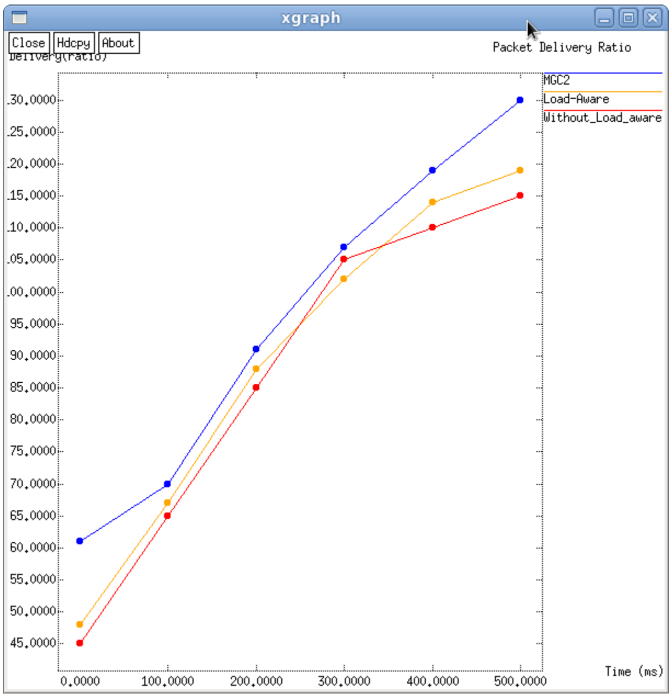

Figure 6: Packet Delivery ratio

Figure 6 demonstrates the MGC2, LOAD AWARE, and WITHOUT LOAD AWARE transmission methods' ability to maintain a modest data flow rate. If you compare the MGC2 technique to others, you'll see that it involves a lot more information exchange. The packets are shown along the y-axis, while the data rate in seconds is shown along the x-axis.

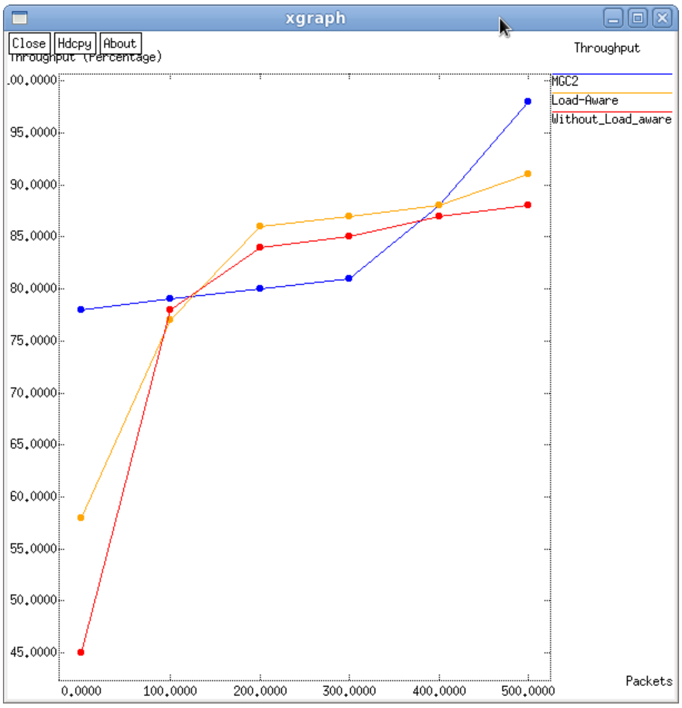

Figure 7: Throughput Comparison Chart

The routing and throughput are shown in Figure 7. MGC2's accuracy makes for better signal transmission. Throughput comparisons are shown, with MGC2 showing greater throughput than both LOAD AWARE and WITHOUT LOAD AWARE approaches. The Y axis represents throughput levels over time, whereas the X axis represents time.

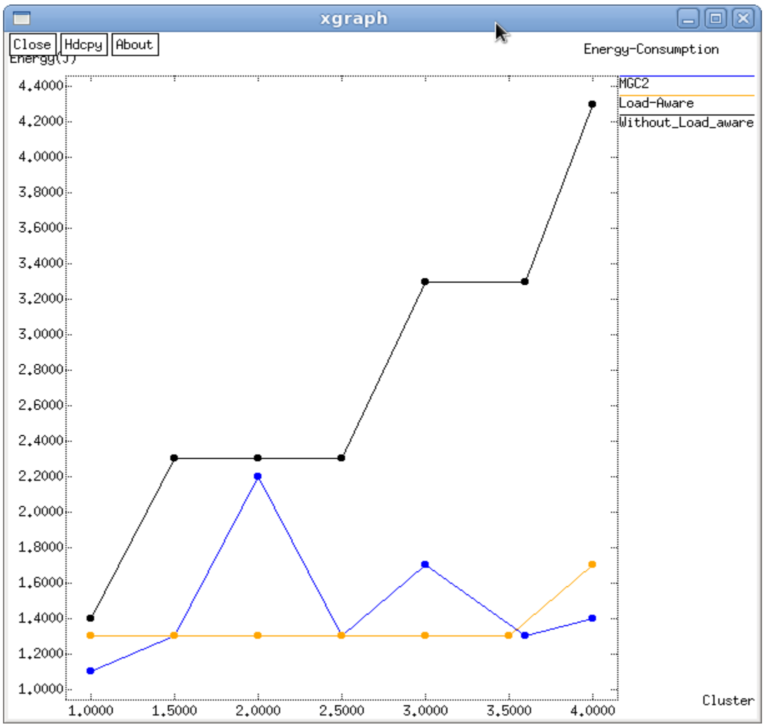

Figure 8: Energy consumption Comparison Chart

Use of time and energy are shown to be in harmony in Figure 8. Low energy consumption is a hallmark of the MGC2 process. Active nodes with substantial energy usage characterize LOAD AWARE and WITHOUT LOAD AWARE procedures. In this diagram, the X-axis displays the locations of the clusters, while the Y-axis depicts the energy level. Some researchers have proposed using the MGC2 algorithm to boost the WSN's functionality. It was evaluated against both the current load-aware algorithm and the non-load-aware approach. All three metrics (energy consumption, delivery ratio, and delay) were shown to improve thanks to the new strategy in simulations. This approach may be used to continuously monitor sensor applications like weather monitoring, and it can decrease power consumption without negatively impacting other critical performance factors like latency, hence extending the lifetime of the network.

V. CONCLUSION

In order to reduce power consumption and increase the lifetime of two-level energy heterogeneous networks, an MGC2 protocol has been developed in this research. To do this, we partitioned the sensing region into three parts. Both high-end and basic nodes were set up separately. Then, we enabled communication between the nodes and the base station using a clustering strategy and a dormancy mechanism. Load Aware's effectiveness was verified by comparing it to the new MGC2 protocol with and without Load Aware enabled. In comparison to other heterogeneous protocols, ours has a longer period of stability and a longer lifespan for the network. It is difficult to instal nodes appropriately in practise due to environmental restrictions. The cluster leaders were selected to be just the best nodes. It is still challenging to solve this problem and get over the constraints of clustering. Network energy efficiency innovation will continue to be a focus, with more practises implemented, and further research into protocols to follow.

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Section A-Research paper

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