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Optimized energy-efficient multi-hop routing algorithm for better coverage in mobile wireless sensor networks

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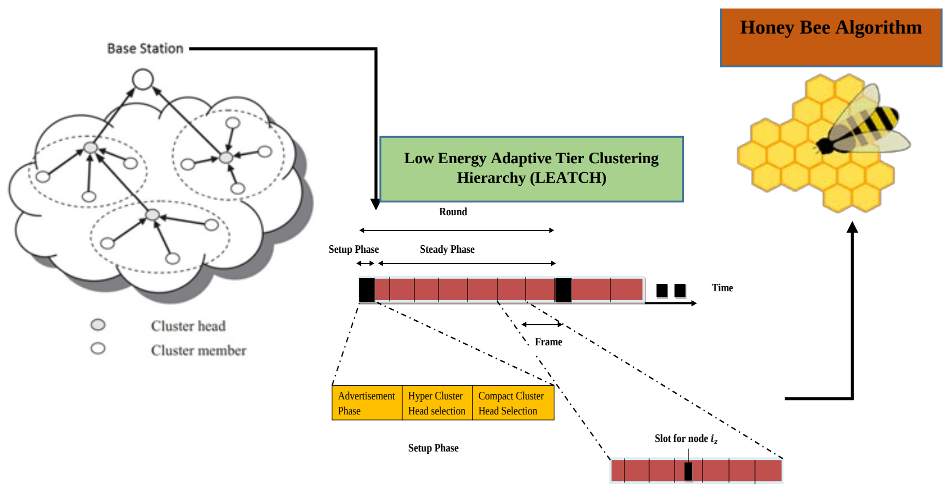
ABSTRACT



The Mobile Wireless Sensor Network (MWSN) comprises transceivers that collect information and transfer it to the access point through other hubs. Both mobile networks and access points can be portable and work apace with stable devices in the network, depending on the application requirements. Numerous studies have been undertaken to develop sensor nodes considering energy and mobility, with LEACH-based routing algorithms providing the best results. However, the Low Energy Adaptive Clustering Hierarchy-based energy-efficient navigation system best suits small-scale systems. Whenever the connection is huge, long-distance transmission between cluster members and the Base Station (BS) consumes much energy. Thus, to overcome it, this research grants an innovative scheduling algorithm that adapts to sensor node transmission to deliver dependable and energy-efficient navigation named Optimized Energy Efficient Routing Algorithm for Better Coverage in Wireless Sensor Networks. Firstly, our research paper presents a unique method called Low Energy Adaptive Tier Clustering Hierarchy (LEATCH), which achieves a reasonable balance of latency and energy usage while addressing various covering concerns in MWSN. Moreover, a novel Honey Bee Algorithm is utilized to find the potential and hyper-cluster heads. As a result, based on power, latency, coverage, stability period, and scalability, the optimized LEATCH protocol outperforms other energy-efficient clustering protocols.

***Keywords**: Sensor Network, Base Station, Low Energy Adaptive Tier Clustering Hierarchy, Honey Bee Algorithm.*

INTRODUCTION

In modern world, power systems, connected cars, and various other technologies are infrastructure networks that interconnect the globe through a shared perception of the internet of things (IoT), using sensors paired with information and communication technology. Many devices are integrated into such systems to broadcast precise sizes and regulation instructions that use dispersed wireless sensor networks.

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Among these significant developments in the Wireless Sensor Network sector has been the creation of the Mobile Wireless Sensor Network, which is far more adaptable than fixed Wireless Sensor Networks since installed mobile networks must be adaptable to variations in communication networks. Armed investigation, ecosystem surveillance, precision farming, health administration, commercial surveillance, and environmental surveillance are some MWSN applications.[1–3] Regarding design, mobility in an MWSN can be provided via mobile sensor nodes and sinks.[4-9] The mobile sensor networks are responsible for preventing and relaying duties, while the mobile drains gather information from mobile networks. Figure 1 depicts the basic structure of Mobile Wireless Sensor Networks.

The majority of sensor nodes include batteries as a power source. In numerous critical circumstances, including submarine transmission, environmental catastrophes, embedded networks, and so on, cells can't be easily changed, terminals can't be swiftly replaced, and standby power can't be provided in any way. It is one of the important performance challenges that necessitates optimizing battery life and energy while maintaining optimal network connection for the system to perform successfully.[11-12] Therefore, reduced power consumption is critical to enhanced WSN efficiency,[13-15] as it maintains the node's energy level. Since the power consumed is less, the battery life is extended, allowing the network to operate more efficiently. A network connection is also important in planning and architecture, determining topologies, and allocating power to nodes. Several researchers have attempted to increase communication links and optimize power consumption theoretically and practically by giving better solutions.

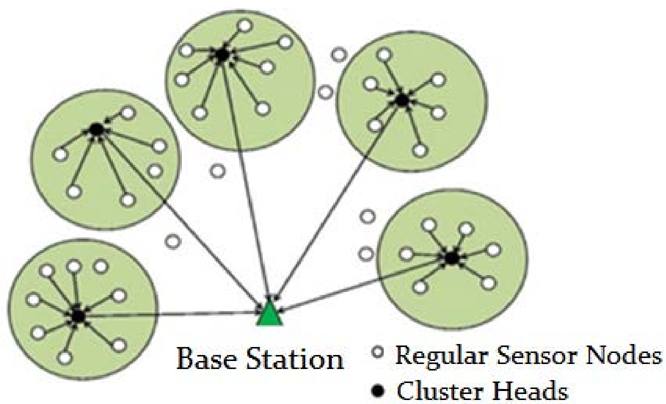

Figure 1. Mobile Wireless Sensor Networks[9]

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MWSNs, on the other hand, have significant design issues, including equipment price, architecture design, storage, cell capacity, computing power, topology changes, device movement, adaptability, positioning, covering, network architecture, and so on.[16-18] Since the point of interaction differs at each occurrence, the grid's major focus in MWSN is to increase stability and maintain energy levels. In this instance, data transmission is crucial since it must be performed properly while simultaneously preserving energy and maintaining connectivity.[19-22] It is the goal of the network model provided in this research. As a result, the proposed routing protocol provides a more dependable terminal and improved Quality of Service in vehicular networks and final connections. In contrast, movement describes sensor node behaviour through their movement pattern. This research study makes the following major contribution:

- In an existing technique, long-distance interaction among member nodes and the base station demands a lot of energy. Therefore, our research introduces an Optimized Energy Efficient Routing Algorithm for Better Coverage in Mobile Wireless Sensor Networks, introducing a novel LEATCH – HBA technique. As a result, energy, latency, and lifetime of scalability are optimized.

LITERATURE SURVEY

Many researchers study wireless sensor networks in diverse environments and analyze various factors. This section contains a selection of relevant works. Broadband service and ad-hoc networks, the common approach to establishing reconfigurable sensor networks, have recently been the focus of many academics.

The proposed approach by Kamalanathan et al.[23] constructs a clustering model using fuzzy logic that can conduct three distinct sorts of groups to accomplish safe in addition to power-alert packet channelling. Clustering algorithms use a distance measure to segment internet traffic trends; thus, the behaviours in one cluster had similar grid properties as patterns in another cluster.

Arun L. Kakhandki et al.[24] introduced a distributed Media Access Control (MAC) optimization approach for certain hop device selection that minimizes energy consumption, increases network lifespan by 86 percent, reduces node latency by 82%, and reduces transmission cost. The approach is also related to other current methods. In complex cloud services, many groups' execution and energy administration are examined. The nodes' mobility, however, has not received much attention.

Tao Yang et al.[25] designed an Energy Optimization Secure Routing Protocol to guard Wireless Sensor Network against negative terminals. It is determined by the trust distribution, residual energy, and journey length. However, the connection of sensor nodes has not been demonstrated.

GayatriSakyaa et al.[26] introduced an energy-efficient Adaptive Multi-channel (ADMC)-Media Access Control protocol that assisted information delivery depending on current traffic circumstances. Two methods are established; the first prioritize the selection of the member nodes with the greatest power, and the next is based on a cluster's switching frequency depending on current transportation situations. It improves your system's total speed and accuracy.

Bharat Bhushan et al.[27] introduced an energy-efficient protected circular scheduling algorithm supporting task scheduling and improving system lifespan. MdEnamulHaque designed a similar acting routing scheme for system durability in this study. However, this research failed to focus on the network connection.

Selvakumar et al.[28] proposed a package routing exceptional capability that improved the identified voltage based on the arithmetic filtering technique. Each hub activity detects the current master and the entire upcoming developments as Access points for improved correlation. It selects the most reliable path for data mailboat transportation.

Vinitha et al.[29] developed a power-ability multi-hop based scheme in Wireless Sensor Network called Taylor-based Cat Salp Swarm Algorithm by adapting C-SSA with the Taylor series to solve the energy issue. It also concentrates on a protection-based multi-hop proposed method and considers safety to be a multi-hop routing. The method was created with a trust model in mind, which includes numerous trust variables such as direct confidence, oblique belief, packet transmission speed, and reliability level.

Haque et al.[30] introduced a new Dynamic Energy Efficient Routing algorithm that ensures data transfer, grid longevity, and data movement. Dynamic Energy Efficient Routing employs on-the-fly nodes with the highest residual energy over a predefined energy level to transfer messages from sender to receiver. On the other hand, DEER could be improved for Energy Harvesting-based Sensor Networks.

Maryam Naghibiet al.[31] proposed a power-ability geographic routing scheme to divide a network into smaller cells regionally. The units are categorized into two parts: single-hop and multi-hop. The latter involves moving numerous wireless sources to collect data from sensor nodes. However, the proposed work does not concentrate on the network connectivity of the mobile sensor sinks at the end.

ParthaSarathi Banerjee et al.[32] established a temperature-adaptable intelligent sleep scheduling technique for wireless sensor nodes called Reinforcement Learning (RL). It is built on machine learning, which means that terminals notice their environment and behave appropriately, such as transferring, monitoring, or resting. However, energy constraints are not focused on in this work.

Dhanalakshmi et al.[33] presented a safe and power-ability routing system based on fuzzy logic and the truest ideals of nodes. In addition, the presented strategy incorporates an additional path, which serves as a backup in the event of a connection failure. The suggested protocol increases fundamental Quality of Service measures like lag, Hop-Count, and Activity Level for every relationship with various paths and forecasts the optimum way to establish clear transmission between them, although the computational cost is higher.

Sachan et al.[34] proposed a novel probabilistic technique for analyzing network connections that consider parameters such as networking capability, product validation, node mobility radius, and total device, among others. The intended site promotes open space, preserves network connectivity and communication sustainability, and uses energy most. The use of probability theory led to the discovery of a suitable mathematical network model. This model has observed and assessed the sensor node variation concerning the detection region. In addition, the association involves primary stakeholders and installed edge devices. However, a detection area has been found.

Almesaeed et al.[35] suggested a unique scheduling algorithm that adapts to sensor node movement and provides safe and power-ability routing. The proposed approach uses dynamic directional routing to manage data movement in the system by optimizing paths to the sink. When related to the Threshold sensitive Low Energy Adaptive Clustering Hierarchy protocol, the Dynamic Directional Routing protocol can increase system lifespan by roughly 13%. When associated with Threshold sensitive Low Energy Adaptive Clustering Hierarchy, it improves packet transmission cost and power usage and maintains smaller pathways to the sink by roughly 33%. But, computational complexity is more in this proposed method.

Nigam et al.[36] have developed an enhanced method known as ESO-LEACH. The sensor networks are initially grouped using metaheuristic optimization augmentation in this study. As a result, the lifecycle of an ESO-LEACH system is nearly twice as high as a system that uses the Low Energy Adaptive Clustering Hierarchy protocol, indicating that the improved suggested methodology is popular, inadequately spreading the system life cycle but also provides excellent vitality effectiveness and lengthier structure lifecycle than traditional Low Energy Adaptive Clustering Hierarchy.

However, various studies have been presented to address the challenges of energy usage and network connection. Despite this, there will be constraints such as not focusing on computational complexity, multi-hop algorithm, and device network placement. A novel routing method was developed and is described in the following portions to solve the problems mentioned earlier.

OPTIMIZED ENERGY-EFFICIENT MULTI-HOP ROUTING ALGORITHM FOR BETTER COVERAGE IN MOBILE WIRELESS SENSOR NETWORKS

Mobile Wireless Sensor Networks have increased in popularity due to their numerous applications in the military, industrial infrastructure, automation, health, transportation, and consumer industries. Numerous studies have been conducted to develop sensor nodes that consider energy and mobility, with LEACH-based routing algorithms providing the best outcomes. However, long-distance transmission among grouped heads and the base station requires a large amount of energy when the grid is large. As a result, the lifespan of WSN would be constrained. Thus, to overcome this, the research presents a novel navigation technique that adapts to sensor node data transmission to deliver stable and power-ability navigation named as Optimized power-ability navigation algorithm for better coverage in Mobile Wireless Sensor Networks. Firstly, our research presents a new methodology called Low Energy Adaptive Tier Clustering Hierarchy that strikes a fair balance between latency and power usage while resolving various penetration issues in MWSN.

Moreover, to find the potential cluster head and hyper cluster head, A Honey Bee Algorithm inspired by the searching activity of honey bees has been used for initially grouping the sensor networks, in which the algorithm keeps its random searching part by sending scout bees to find new potential solutions. As a result, the improved LEATCH protocol outperformed the existing energy-efficient clustering protocols in terms of energy, latency, coverage, network lifetime, and scalability. Figure 2 illustrates the structure of the suggested techniques.

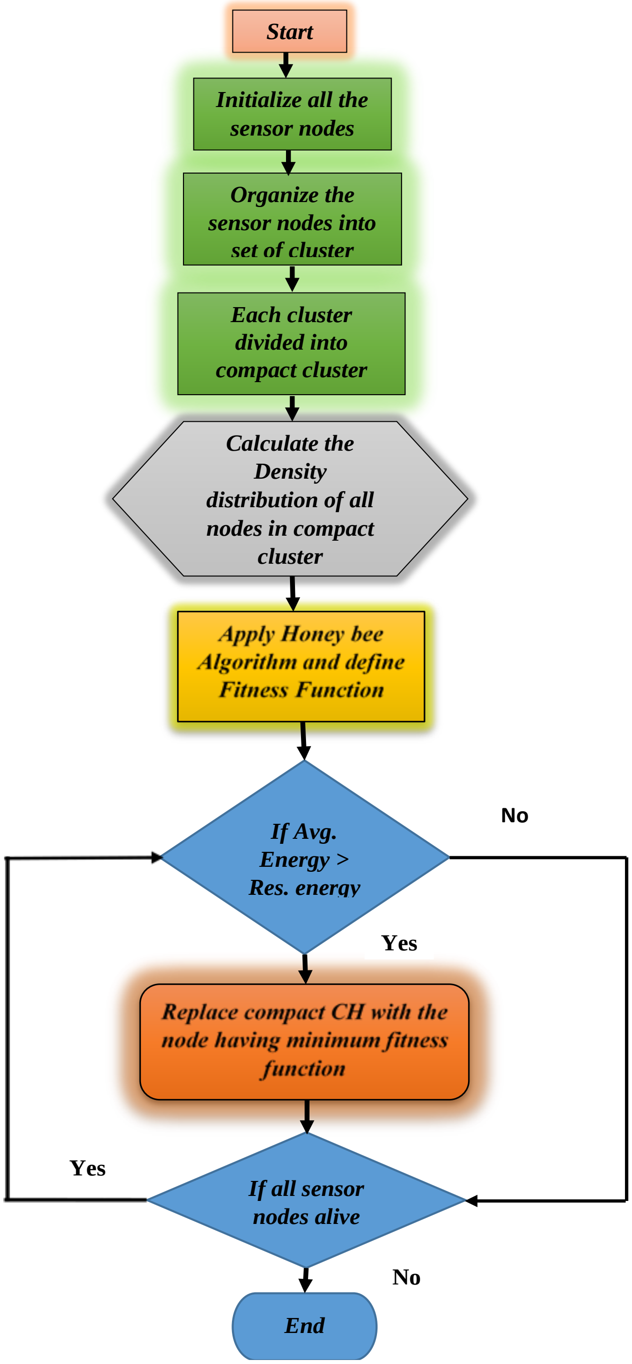

Figure 2. Flowchart of Proposed Method

Low Energy Adaptive Tier Clustering Hierarchy (LEATCH)

Several types of research have been performed to construct sensor nodes that consider energy and mobility, with LEACH-based routing algorithms generating the best results. Alternatively, the power-ability navigation algorithm, depending upon LEACH, is best suited for small-scale networks. However, Long-distance transmission among grouped heads and the Base Station consumes a lot of energy when the network is large. Thus, the proposed approach, namely LEATCH, operates by performing a series of phases, each divided into two stages: the installation stage and the steady-state stage, as shown in Figure 3. Group creation and the assignment of a Time Division Multiple Access arranged by the grouped heads for member nodes occur during the installation stage. The active devices will begin to collect data from their neighbouring atmosphere and also sends the information to the base station utilizing their associated destination terminals in the second stage, which is the packet transmission phase (i.e., Compact Cluster Head (CCH) and Hyper Cluster Head (HCH) in sequence).

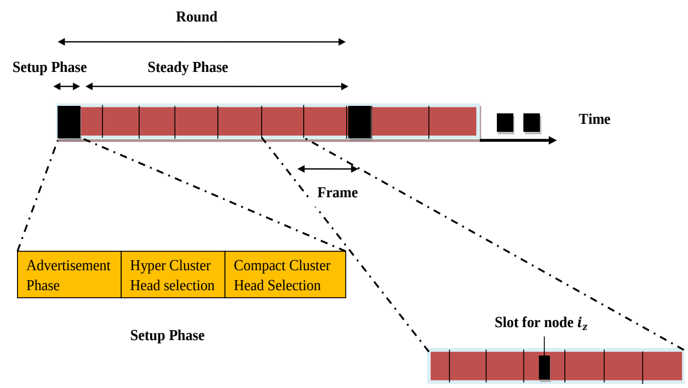

Figure 3. Operation of LEATCH

The main focus of our contributions in the installation stage, where the basic concept is to provide a degradable framework on the web architecture, resulting in a series of reduced sub-nodes. An m_z-level hierarchical clustering would be used to achieve such decompositions. Nodes are aggregated into compact clusters, and compact clusters are clustered into hyper clusters, depending upon several acceptable actions and grades. In addition to hierarchical clustering of the nodes, the grouping method must designate a set of terminals as an entrance point for all groups at any stage to secure data routing throughout the network.

A hyper group is a collection of compact groups regulated through a hyper-group head in such a structure. The latter is a close neighbour of the base station, assisting in transmitting data acquired by the compact clusters to the access point. On the other hand, a compact- cluster corresponds to each logical sub-region of the network and is connected to a hyper-cluster head directly or indirectly. The CCHs construct logical compact clusters depending upon the peers' data. As a result, a compact cluster is a collection of sensor nodes. The CCH is an analyzer of information from their connected IoT devices, sending it to the HCH via multi-hop communication. The HCH then integrates the data sent to CCHs to convey the final information packets to the access points.

The state of the network's nodes is as follows: In the proposed approach, a node can operate as an HCH, CCH, Cluster Member (CM), or ON.

- Hyper-Cluster Head (HCH): These nodes directly communicate with the BS. An HCH is the cluster head of a collection of hyper clusters.
- A Compact-Cluster Head (CCH): It is the group head of a subnetwork (compact group) in a hyper group. These nodes can communicate directly with an HCH or via intercommunication.

- A Member Node (MN): These nodes are a part of a cluster that collects data and sends it to the CCH.
- Orphan Node (ON): a node that is separated and unable to connect to other groups.

During the set-up phase, the following packets have been used:

- START-PACKET: The base station transmits this packet, which is collected from the complete network. Its purpose is to begin off the grid scheme's activities.
- ADVERTISEMENT-PACKET: These packets are sent by all the nodes in the network during the advertisement phase. These packets are useful in constructing the network architecture, as every unit can identify its peer's information.
- ANNOUNCEMENT-PACKET-CCH: In the second stage, these packets were used. The CCH transmits them out, and the free nodes receive them. A Cluster Member (CM) considers itself a CCH if it detects that it is in front of an isolated region. It transmits this packet to surrounding nodes to inform them of its condition.
- ANNOUNCEMENT-PACKET-SCH: When a terminal becomes a Hyper Cluster Head (HCH), it consumes the packet to communicate with the neighbours of its new position.
- JOIN-PACKET: Each terminal determines which CCH or SCH it belongs to and transmits a JOIN-Packet to that MCH.

LEATCH – L SYSTEM

1) Set-up phase: Advertisement phase: The Base Station shows a START packet to initiate network activity. The set of terminals that collect the data would be capable of serving as an entryway to the Base Station. They're termed Hyper Cluster Heads. The nodes begin flooding an ADVERTISEMENTPACKET after receiving this packet, with each node receiving an ADVERTISEMENTPACKET and adding it to its neighbour's table.

2) Set-up phase: Hyper Cluster Head selection: Single networks that have received the START-PACKET from Base Station are allowed to become HCHs. Every network creates a set of numbers (σ_{z1}) during the HCH Selection Phase (Upper Layer). When the timer runs out, the node converts into an HCH and sends an advertisement message. The competition for the HCH role has been dropped by other nodes whose timer has not yet been completed and have received the advertisement packet.

$$\sigma_{z1}(i_z) = \beta_z \times \left[\frac{E_{oz} - E_{iz}(t_z)}{E_{oz}} \times \left(1 - \frac{1}{d_z}\right)\right]$$

With E_{oz} indicating the initial energy of the nodei_z, $E_{iz}(t_z)$ denoting its remaining power, and $d_z$denoting the space among the Base Station and the node i_z .the algorithm has fixed the constant. The timer (σ_{z1}) may exhaust faster for terminals with a greater energy state and a higher probability of being close to the Base Station. As a result, terminals with lower energy levels that are near higher energy levels will have a decreased likelihood of becoming HCH. These nodes would serve as a connection point among the terminals and the Base Station, preventing the formation of unconnected groups that flop to transmit data to the Base Station.

The proposed election approach makes the distance between the node and the BS one of the most important election considerations for SCH nodes, ensuring that the nodes closest to the BS get elected as HCH. Furthermore, rather than using a simple prediction algorithm to select CHs, as LEACH does, a timer ensures that these nodes are distributed evenly throughout the system. When the expiration time has passed, the relevant component changes its category to HCH and transmits a Notification Bundle to its one-hop peer. Non-HCH nodes select the HCH that uses the least amount of transmission energy (based on the transmission power of each HCH message and range).

To construct the 1-level, the node i_z transmits a JOIN-PACKET to its selected HCH. Nodes that previously joined an HCH will continue to identify their neighbours to determine which free nodes they have nearby. If this Member Node notices that some of its peers are FN, it begins declaring itself as a new CCH to serve as a link among terminals and HCH, which constructs the 2-level. The selection approach of these nodes will be discussed in the following section.

3. Set-up phase: Compact -Cluster head selection: If a terminal is in front of a secured area and is a member node, it can be selected as a CCH. During the advertisement phase of the network, each node has a database of its FN peers (FN denotes the non-Member Node (MN). Terminals that connect an HCH or CCH list themselves to their peers. When a terminal i_z receives a JOIN-PACKET from an FN peer to its preferred CCH, and the number of FN numbers in its neighbor's database is updated. An MN i_z can also declare itself as a new CCH if it spots that it is in front of a secured area in the terminal and its neighbor's database has $|FN_{i_z}| > 0$. It effectively starts a timer ∂_{z2} so that it may advertise itself as a distinct CCH, which permits the FNs to connect to the network system instead of having a new group. Only if its neighbors are disconnected does the node assert itself as a unique CCH.

$$\partial_{z2}(i_z) = \beta_z \times \left[\frac{E_{oz} - E_{iz}(t_z)}{E_{oz}} \times \frac{1}{|FN_{i_z}|}\right]$$

Where $|FN_{i_z}|$ denotes the number of FN in the node i_z Peers database.

4. Set-up phase: Schedule Creation: This method practices Code Division Multiple Access to arrange packet transfer and prevent an impact during the first and second phases. It makes use of two timers which are generated based on a variety of variables. After the clusters have been determined, the selected CCH and HCH are in charge of allocating time slots. The predetermined schedule has been sent to cluster members by each CCH and HCH.

5) Steady phase: Data collection and transmission: In LEATCH-L, the continuous phase indicates one of two approaches: Single-hop intra-cluster communication or Multi-hop intra-cluster communication. Single-hop intra-cluster communication is performed in each compact cluster. The data on all CMs in the compact cluster is sent to the relevant CCH. In the supercluster, however, multi-hop intra-cluster data is passed over intermediate CCHs on its approach to the appropriate HCH. Multi-hop intra-cluster communication outperforms single-hop intra-cluster routing to increase sensor network scalability.

Every Hyper Cluster-Head interacts directly with the Cluster-Head and collects its hyper cluster data. In addition, the root node and hyper cluster member selection methods have been improved.

Honey Bee Algorithm

The sensor nodes were first grouped using a Honey Bee Algorithm, which was inspired by the foraging behavior of honey bees. This algorithm keeps its random searching element by dispatching scout bees to find new potential solutions. The idea of advanced nodes and an updated set of criteria for Cluster Head election are used in the proposed framework to reduce the instability of the process.

The Bee Algorithm is based on honey bees' natural foraging behavior to locate the best appropriate response. The pseudo-code for a simple Bee Algorithm is shown below. The algorithm consists of setting up several parameters, including the number of scout bees (n_z), the number of elite bees (e_z), the number of selected regions out of n points (m_z), the number of recruited bees around elite regions, the number of recruited bees around other selected (m_z-e_z) regions, and the stopping criteria. Then, like scout bees, N bees are randomly placed in the search space. In step 2, every bee on the challenge space evaluates the fitness of its field. Scout bees use a natural searching (or scouting) process to find food.

In step 4, the elite bees with the best fitness are chosen and preserved for the upcoming generation. The method then assigns elite bee spots to examine directly around them in neighborhood search (steps 5–7). Other locations are chosen, either the best or stochastically, using a wheel of fortune proportionate to efficiency. The bees seek within the borders for these spots in step 6, and their efficiency is evaluated. More bees will be gathered around elite sites, while fewer bees will be recruited around the remaining selected points. Recruitment is one of the key hypotheses of the bee algorithm, along with the scout bee notion, both of which are used in nature.

Algorithm 1: Honey Bee Algorithm (HBA)

Step 1: Use random solutions to start the population.

Step 2: Assess the population's fitness.

Step 3: While (stopping criteria not met)//Forming new population

Step 4: Choose only the best bees.

Step 5: Make a list of potential venues for a neighborhood search.

Step 6: Attract bees to specific locations and assess their fitness.

Step 7: From each place, choose the fittest bee.

Step 8: Assign the remaining bees to a random search and assess their fitness.

Step 9: end while

In step 7, however, only one sample bee with the best efficiency will be selected for each area. There are no such limitations in nature. Bees are further adaptive, but in terms of optimization and efficiency, selecting only one sample from each site is sufficient. Step 8 will distribute the remaining bees at random around the target region. The algorithm, like honey bees, preserves its random searching characteristics by assigning scout bees to look for new possible alternatives. This procedure will be followed after a certain need is met.

The colony will organize itself at the end of each iteration by dividing its new population into expert bees, representatives from each proposed area, and the rest of the bees assigned to a thorough search. Figure 4 illustrates the proposed flow process of Honey Bee Algorithm.

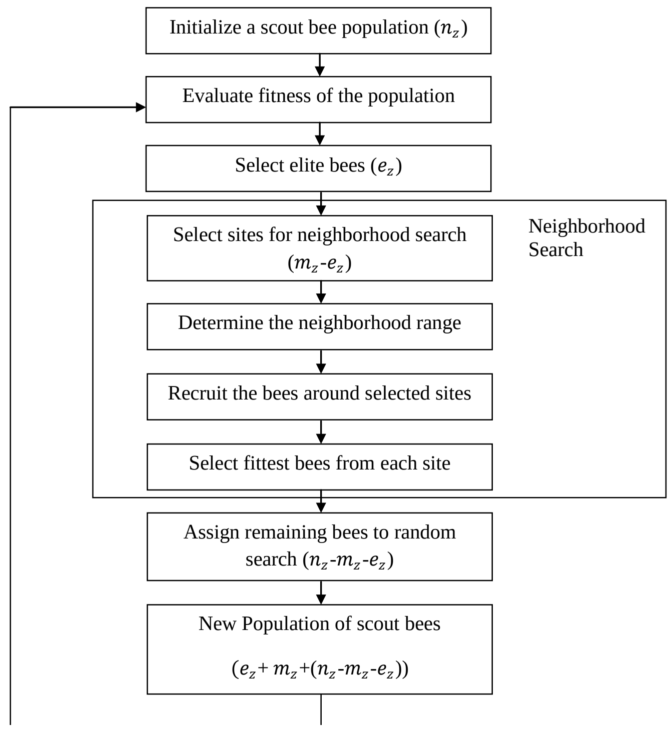

Figure 4. Flowchart of Honey Bee Algorithm (HBA)

As a result, when it comes to energy, latency, coverage, system lifecycle, and scalability, the optimized LEATCH protocol outperforms other existing energy-efficient clustering protocols.

Result and Discussions

This section explains the implementation's outcomes, our proposed system's performance, and comparison results.

Tool	**:** PYTHON 3
OS	**:** Windows 7 (64-bit)
Processor	**:** Intel Premium
RAM	**:**8GB RAM

Deployment of Sensor Nodes

This research proposes Honey Bee Algorithm with Low Energy Adaptive Tier Clustering Hierarchy (HBA-LEATCH) to efficiently use the node's energy. As illustrated in figure 5, some network nodes are sorted out depending on their optimum value, and their information messages are sent quickly to the access points.

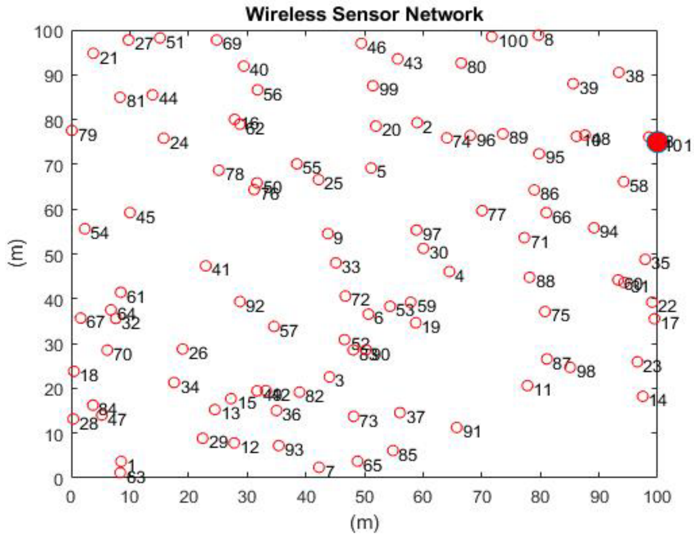

Figure 5. Deployment of Sensor Nodes

In LEATCH, clusters are generated at the BS, and then one CH is chosen from each cluster using a honey bee algorithm. At the same time, the network's residual energy determines inter-cluster communication (CHs to BS). Once all of the nodes are deployed, as illustrated in Fig.4, all of the nodes will provide their position and power data to the Base Station in every round. The Base Station will then send a network broadcast message containing information on the cluster's centroids and ID. All of these nodes are grouped into available clusters.

Total Number of Dead Nodes

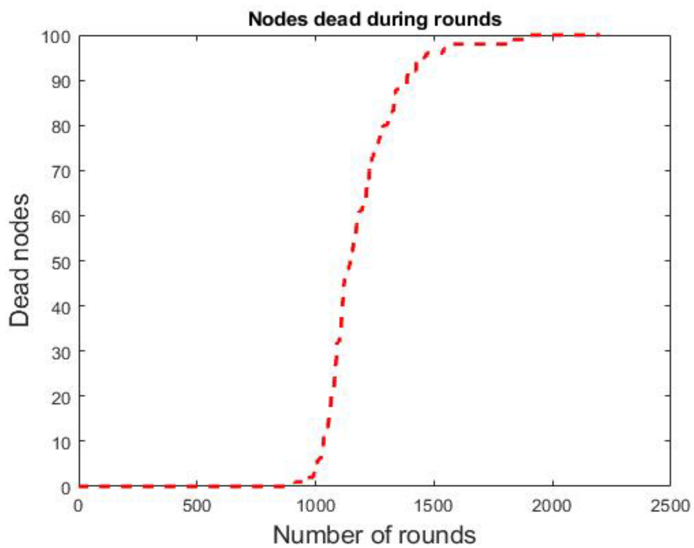

Figure 6. Total number of dead nodes in different rounds

Figure 6 shows the statistics of nodes that have died at various levels. The sensor nodes begin to die after 1000 rounds using our proposed Low Energy Adaptive Tier Clustering Hierarchy technique. As a result, our network's lifetime has increased.

The Lifetime of the Network

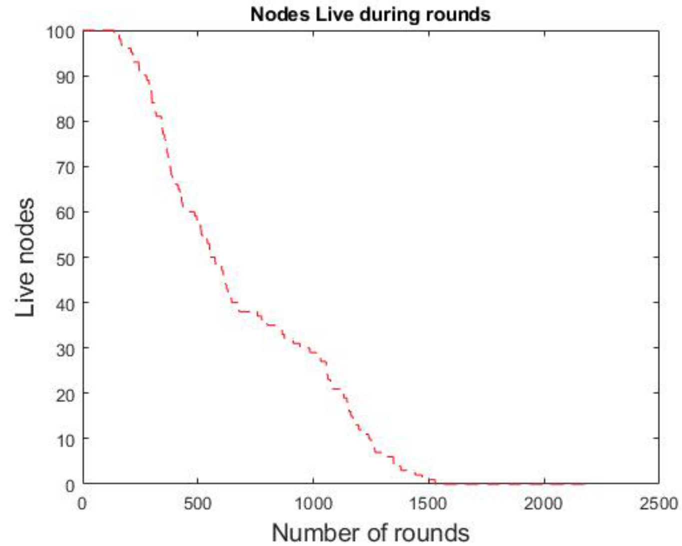

Figure 7. The lifetime of the network

Figure 7 displays the number of live nodes at every level of the sensor network's life. As shown in Fig. 6, the network's lifetime (the time it takes to start networking until the last node dies is around 1500 rounds) demonstrates the proposed approach's effectiveness.

Packets to BaseStation

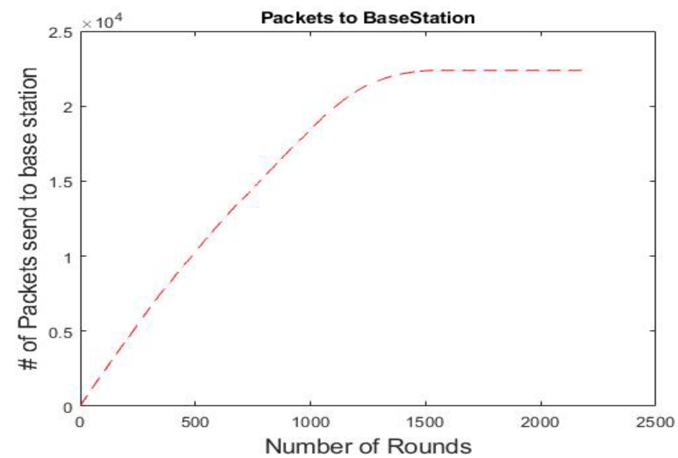

Figure 8. Packets to BaseStation

Figure 8 shows the total amount of packets transmitted at every level at the Base Station. The total number of packets sent to BaseStation utilizing our proposed method ranges from 1500 to 2500 rounds. As a result, using the HBA-LEATCH approach increases the number of packets transferred to the base station.

Packets to Cluster Head (CH)

Figure 9 illustrates the total quantity of data transmitted at the Cluster Head in different rounds. Figure 8 demonstrates improved packets sent to the cluster head in 1000 rounds. Hence, the throughput (the number of packets transmitted to CH) is increased by using our proposed approach.

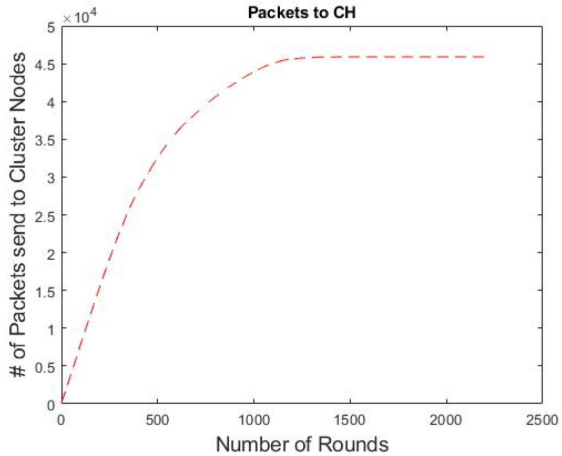

Figure 9. Packets to Cluster Head (CH)

THROUGHPUT

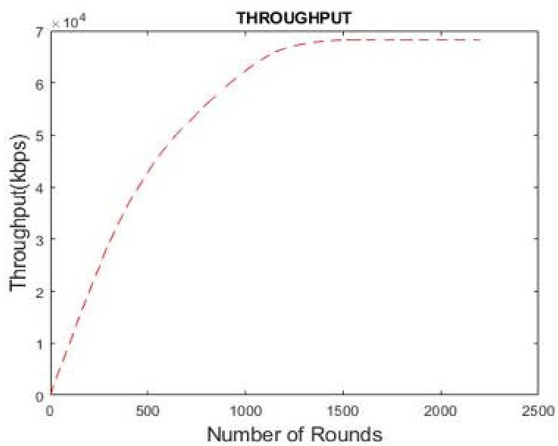

Figure 10. Packets to Cluster Head

The total amount of packets transmitted using our proposed approach in terms of the total quantity of iterations is shown in Figure 10. The proposed approach enhances the amount of network lifetime and the remaining energy of nodes in the system by using energy-efficient CH selection. The proposed algorithm has a greater throughput, improving the deployed network's efficiency.

RESIDUAL ENERGY

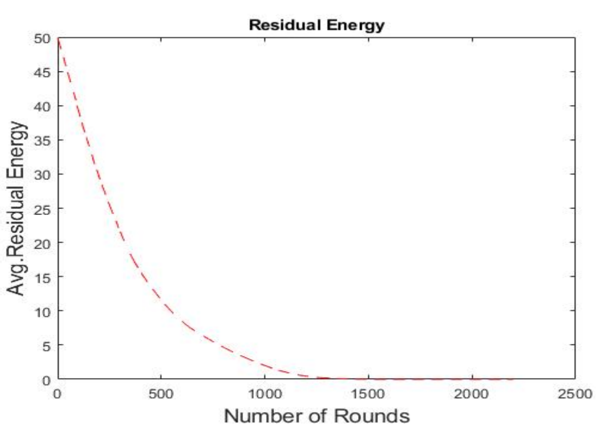

Figure 11. Residual Energy

The average remaining energy of all sensor nodes is 50 J at the beginning. The proposed approach has a significant quantity of average remaining energy over the number of cycles, as shown in Figure 12. The CHs were chosen based on their number of nodes, range from their peers, distance to the Base Station, and remaining energy. It keeps much energy in a sensor network, increasing the remaining energy. It permits the device networks to use their energy best, allowing them to work for longer periods.

OPERATING NODES PER ROUND

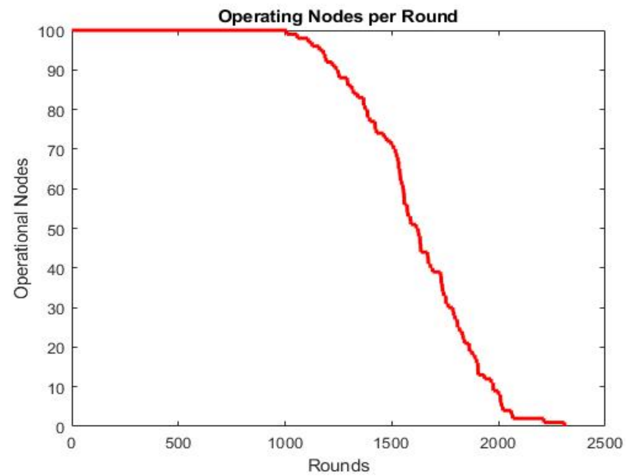

Figure 12. Operating Nodes per Round

Figure 12 shows the operating sensor nodes in each round when the number of initial device networks is 100. The period of instability using the LEATCH approach is 1000 rounds. Thus, our proposed approach can increase network lifetime.

ENERGY CONSUMED PER TRANSMISSION

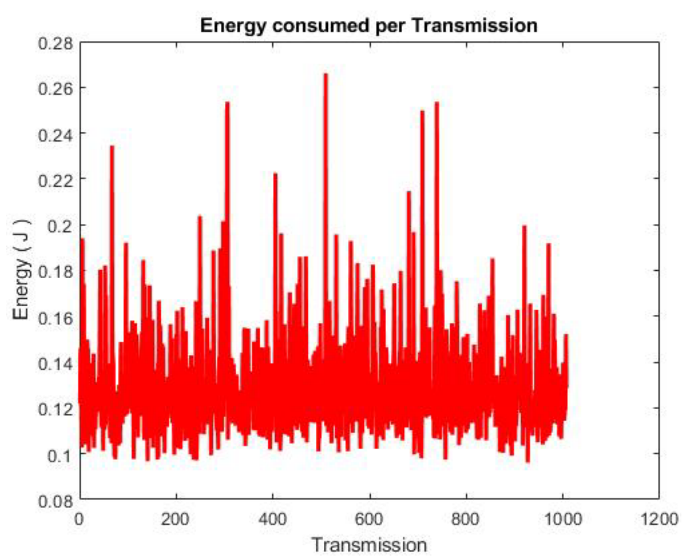

Figure 13. Energy Consumed per Transmission

The overall power usage per transmission is depicted in Figure 13. The proposed method reduces sensor node energy usage by selecting CH nodes with more accessible energy. As a result, all sensor nodes utilize their available energy to the best of their ability, reducing the chances of a node being dead.

Comparison Results

This segment outlines the proposed technique's comparison study, in which our novel method is equated to baseline approaches such as Low Energy Adaptive Clustering Hierarchy (LEACH) [36] and Enhanced Variant of Low Energy Adaptive Clustering Hierarchy (ESO-LEACH) [36].

Table 1: Comparison on Energy dissipation

Methods	Number of Rounds	Energy (J)
LEACH	500	0.061
ESO-LEACH	500	0.048
Proposed Method	500	0.044
LEACH	1000	0
ESO-LEACH	1000	0.025
Proposed Method	1000	0.041
LEACH	1500	0
ESO-LEACH	1500	0.007
Proposed Method	1500	0.037
LEACH	2000	0
ESO-LEACH	2000	0
Proposed Method	2000	0.027

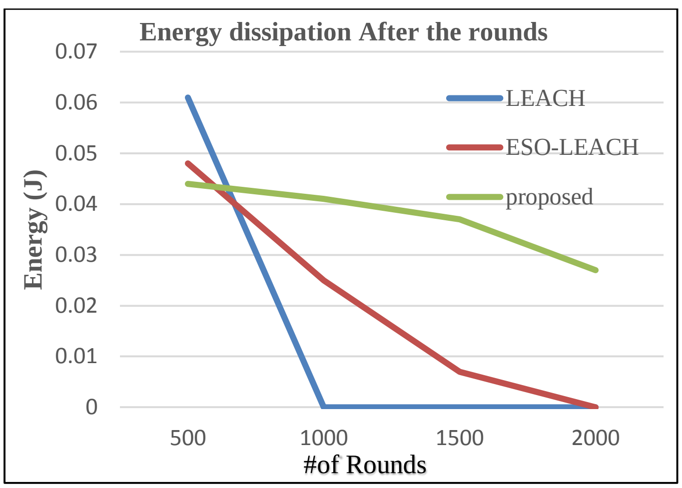

Figure 14. Comparison of Energy dissipation

In Figure 14, the proposed algorithm's energy dissipation is compared to the Low Energy Adaptive Clustering Hierarchy and ESO- Low Energy Adaptive Clustering Hierarchy in terms of the number of rounds. Table 1 shows an estimation of power degenerate in Low Energy Adaptive Clustering Hierarchy, ESO-Low Energy Adaptive Clustering Hierarchy, and the proposed technique during several rounds. The energy dissipation of the proposed technique is higher with the HBA-LEATCH approach. Our proposed approach is compared with the baseline Low Energy Adaptive Clustering Hierarchy[36] and the Enhanced Variant of Low Energy Adaptive Clustering Hierarchy.[36] In contrast, the proposed approach outperforms all existing algorithms, as shown in figure 14.

Table 2: Comparison on Node Lifetime

Methods	Number of Rounds	Lifetime
LEACH	500	100
ESO-LEACH	500	81
Proposed Method	500	100
LEACH	1000	6
ESO-LEACH	1000	45
Proposed Method	1000	100
LEACH	1500	0
ESO-LEACH	1500	18
Proposed Method	1500	60.96
LEACH	2000	0
ESO-LEACH	2000	4
Proposed Method	2000	8

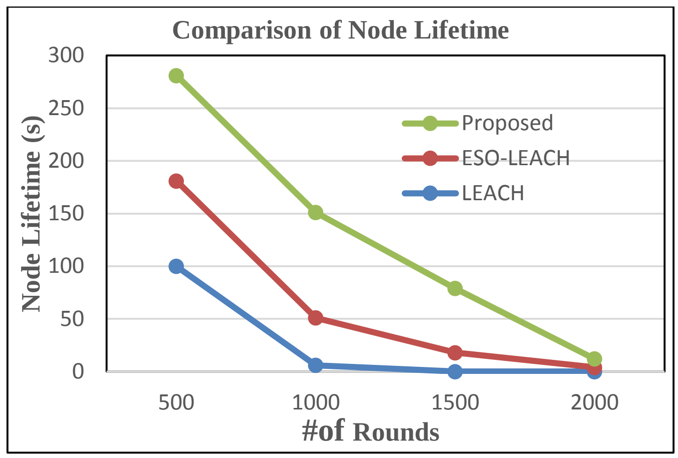

Figure 15. Comparison of node lifetime

In Figure 15, the proposed algorithm's node lifetime is compared to the Low Energy Adaptive Clustering Hierarchy and the Enhanced Variant of Low Energy Adaptive Clustering Hierarchy in terms of the number of rounds. The proposed approach outperforms all existing algorithms, as shown in figure 15. By employing energy-efficient CH selection, the proposed method increases the number of alive nodes and the remaining energy of devices in the system. Table 2 estimates the node's lifetime in LEACH [36], ESO-LEACH,[36] and the proposed technique during several rounds.

Conclusion

The Mobile Wireless Sensor Network (MWSN) comprises sensor devices that perceive information and interact with the access point via other base stations. Manyany researchers are motivated to find the best solutions to the major problems associated with energy usage and network connection in mobile sensor networks. Furthermore, a novel routing protocol, the Optimized Energy Efficient Routing Algorithm for Better Coverage in Mobile Wireless Sensor Networks, is proposed. Hierarchy. In this paper, we suggest the Low Energy Adaptive Tier

Clustering Hierarchy. This novel technique balances latency and power usage while effectively addressing various Mobile Wireless Sensor Network coverage challenges. As a result, the lifespan of a network using the HBA-LEATCH protocol is nearly double that of a network using the LEACH protocol, indicating that the improved proposed algorithm successfully extends network lifespan and provides superior vitality proficiency and longer system lifespan than the traditional LEACH protocol.

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