Lifetime Enhancement of the IOT WSN Using the Hybrid Optimization Technique

Manjula Gururaj Rao, Sumathi Pawar, H. Priyanka, K. Hemant Kumar Reddy, and G. A. Vatsala

Abstract The term "Internet of Things (IOT)" has been contested because devices only need to be independently reachable and accessed through the Internet, not even the whole Internet. In the IOT the wireless sensor network (WSN) part of it. IOT WSN is used to connect the different sensors. Numerous uses for wireless sensor networks are currently being researched. The sensor network usually operates on the batteries. Reducing energy consumption during data transmission and node communication will increase network lifetime. One of the challenging criteria in the IOT is maintaining the energy level for a longer duration. The energy level of the sensor networks is consumed mainly during Base Station (BS) communication, inter-node communication, and data sensing. The proposed approach is a multimodal approach, creates a meta-heuristic optimization strategy to lower the communication's energy-level consumption of the sensor networks. The suggested model will segment the WSN into various clusters. The proposed approach has the combination of the modified LEACH and Modified Cuckoo algorithm to reduce the energy consumption of the WSN-IOT sensor nodes during communication. The modified LEACH algorithm is used to choose the cluster's head (CH). In order to choose the best route from CH to BS, the Modified CUCKOO algorithm is employed. With an ideal number of clusters, balanced energy dissipation, and low-energy consumption, the proposed model can improve network performance.

Keywords LEACH · CUCKOO · Fitness function · Cluster head (CH) · Energy optimization · Base station (BS) · Wireless sensor network (WSN) · Internet of Things (IOT) · Meta-heuristic · M-LEACH · M-CS · Cluster member (CM)

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1 Introduction

Information interaction between various entities, including people, computers, organizations, agencies, and businesses, is referred to as communications. Data is transferred between numerous computing devices during digital communication. WSNs are a rapidly expanding and exciting area of research that has garnered a lot of attention from scientists. Hundreds or thousands of low-powers sensor nodes (SNs) that can communicate directly with the Base Station (BS) or with each other make up a WSN in most cases with capacity to sense, process, and communicate environmental data. In a variety of settings involving environmental, medical, industrial, home networks, and military, WSNs are used to track and monitor certain physical events as well as to detect and locate specific items.

The wireless sensor network (WSN) is comprised of numerous wireless sensors, forming a wireless network. In the WSN, sensor nodes (SNs) with embedded CPUs are responsible for monitoring and controlling the surrounding environment in a specific area. Within the WSN system, the devices are linked to the primary processing node, known as the Base Station (BS). In order to enable data sharing, the BS of a WSN system establishes connectivity with the Internet. The interconnection between the user, the Internet, and the WSNs is depicted in Fig. 1.

- **WSN Elements Include**:

  1. In a WSN, sensors serve the purpose of collecting data and capturing ambient variables, effectively converting sensor signals into electrical signals.

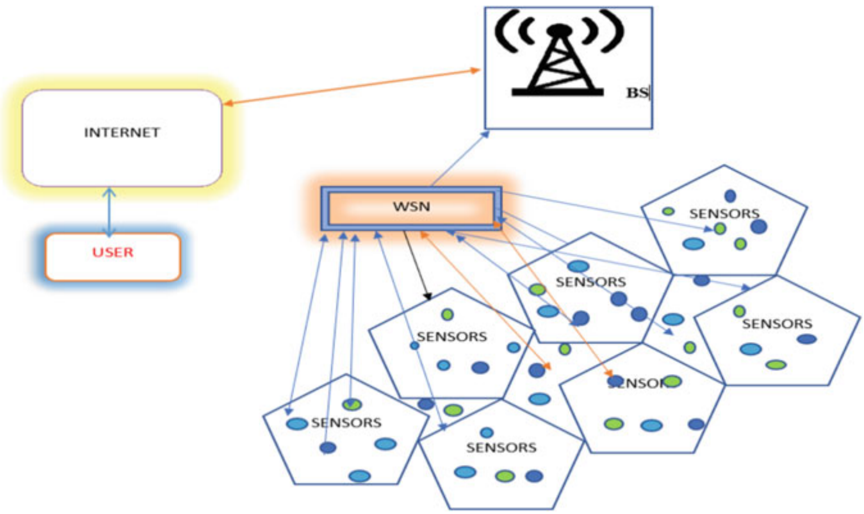

Fig. 1 Depicts the connection of WSN-IOT

2. Radio nodes play a crucial role in receiving and transmitting data generated by the sensors to the WLAN access point. They consist of essential components such as a transceiver, external memory, microprocessor, and power source.
3. The WLAN access point serves as the recipient for wirelessly transmitted data from radio nodes, usually through the Internet connection.
4. The Analysis Software, also referred to as Evaluation Software, is responsible for processing the data received by the WLAN Access Point. It performs data processing, analysis, storage, and mining operations, generating a report that can be utilized by users [1].

In the Internet of Things (IOT) process of connecting devices to the Internet, gadgets excluding PCs, laptops, and smart phones are typically included. A standalone Internet-connected gadget that can be remotely monitored and/or operated is commonly referred to as an IOT device, as reported by Business Insider. The wireless sensor network (WSN) is a component of the IOT [2].

WSNs are typically deployed in specific environments to monitor either static or dynamic events. Measuring static events such as temperature and humidity is relatively straightforward. On the other hand, dynamic events involve sensing the motion of sea animals, for example. In order to function properly, sensor networks must adhere to a specific protocol.

Data collection from every node in a network is defined using attribute value pairs known as attribute-based addresses. These addresses specify how a node can communicate its availability to the entire sensor network. Additionally, each node needs to determine which other nodes it can directly communicate with, and it must have sufficient radio power to maintain the connection. As a result, exploring energy-saving strategies for dynamic event detection, commonly used in the IOT, can be quite challenging.

The widespread adoption of wireless sensor networks (WSNs) and the need for energy-efficient strategies highlight the importance of effective network topology organization to balance the load and prolong the network's lifetime. Research has demonstrated that clustering can be an effective approach in achieving these goals by extending the network's lifetime and providing scalability. One of the challenges in WSNs is the bottleneck phenomenon, where a sensor network loses contact with the Base Station (BS). This leads to the wastage of residual energy resources of functional nodes.

Given the limited energy resources allocated to sensor nodes (SNs), enhancing the energy efficiency of wireless sensor networks (WSNs) becomes crucial. Hierarchical routing, due to its architecture, offers improved scalability and energy efficiency. In this protocol, nodes are selected based on specific criteria, and the entire network is divided into clusters. By forming clusters, the communication between the SNs and the Base Station (BS) is minimized. Nodes in close proximity are grouped together to form clusters, as depicted in Fig. 2.

In hierarchical routing, certain nodes called cluster heads (CHs) play a significant role in the collection, aggregation, and compression of data obtained from neighboring nodes that were previously relaying compressed data to the Base Station

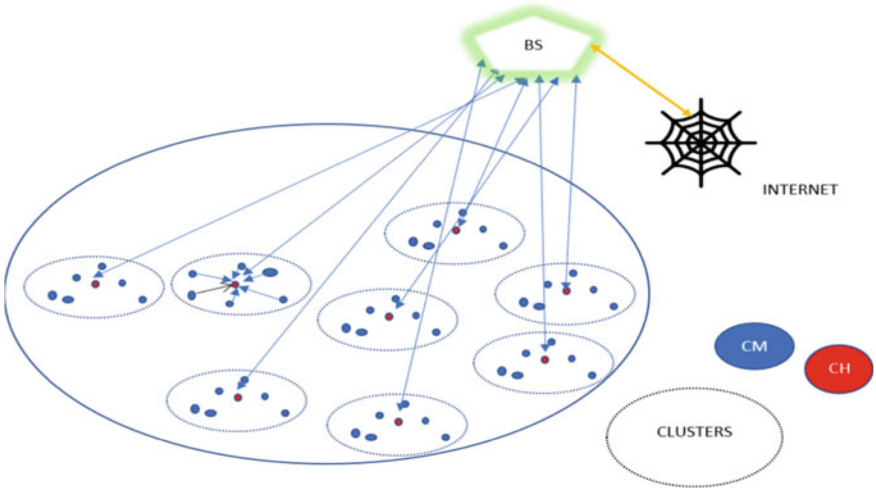

Fig. 2 The connection of cluster and IOT

(BS). In Fig. 2, the red-colored nodes represent the CHs, while the other nodes represent the cluster members (CMs). CHs consume more energy compared to other nodes in the cluster due to the additional services they provide to the other nodes.

To balance the energy depletion within the cluster, a common strategy employed is cluster rotation [3]. Given the inherent design of WSNs, where sensor nodes often rely on limited battery power, the energy budget is severely constrained [4]. The energy level of any SN is determined by Eqs. 1, 2.

$$E_{\mathrm{S}} = E_{\mathrm{D}} + E_{\mathrm{C}} \tag{1}$$

where E_{D} is the energy spent on sensing of the data, E_{C} is the communication energy.

$$E_{\mathrm{C}} = E_{\mathrm{M}} + E_{\mathrm{BS}} \tag{2}$$

where E_{M} is the energy spent during the communication with other members of the cluster; EBS is the energy spent during the communication with the Base Station.

Equation 1 highlights that the primary energy consumption in a sensor network occurs during data sensing and communication. Sensing data itself requires minimal energy usage. However, as shown in Eq. 2, the energy consumption primarily revolves around communication. Therefore, it becomes essential to focus on reducing the energy expended during communication. This energy consumption during communication is influenced by interactions between neighboring nodes and communication with the Base Station (BS). In proposed models, the primary objective is to minimize the energy utilized for communication.

1.1 Clustering in WSN

The technique of clustering involves organizing sensor nodes hierarchically based on their proximity to one another. This clustering approach, known as hierarchical energy consumption, enables an efficient and consistent method of transmitting acquired data from the physical environment to the Base Station (BS) through the sensor nodes.

By grouping sensor nodes together, the routing table can be compressed, facilitating faster discovery phase transitions between nodes. Clustering also allows for reduced communication overhead as it restricts interactions within clusters, limits communication bandwidth between clusters and cluster heads, and minimizes redundant message exchanges among sensor nodes.

Prior to transmitting data to the cluster head (CH), each sensor node checks its route table to identify the CH in its region. The CH then performs a route-finding estimation based on the shortest distance to a recipient CH that is closer to the BS or directly sends the data to the BS.

To maintain the routing table and accommodate changes in energy requirements for data transmission, link information is periodically exchanged between sensor nodes. This ensures the routing table remains up-to-date and accounts for any changes in energy levels of individual nodes.

1.2 Cluster Formation and Rotation

Clustering provides an effective approach for managing sensor nodes and extending their lifespan, considering the evolving trends in the application and management of wireless sensor networks (WSNs). Various clustering formation methods, including the random competition-based clustering (RCC), have been developed in the past.

The RCC technique utilizes a random timer, and the First Declaration Wins Rule is employed to select nodes for cluster formation. According to this rule, when a node initially announces itself as a cluster head (CH) to other nodes within its radio network, it is granted the role of CH. This rule determines the CH selection based on the first node to declare itself as a CH, giving it the governing status within the cluster.

The randomly chosen node in the RCC method is referred to as the initiator. All initiators broadcast a cluster advertisement message to all sensor nodes within the network. If a non-initiator node receives an advertisement message from an initiator within the cluster, it sends a response message back to that specific initiator. Upon responding, the node will no longer accept any additional cluster advertisement messages for that simulation cycle. However, the sensor node will establish a connection with the initiator's cluster.

In contrast, multi-hop broadcasting in RCC utilizes a specific transmission range to propagate the cluster advertisement message to the sensor nodes (SNs). All SNs within the transmission range of a receiving node will continue to receive the cluster advertisement message. Based on the principle of lowest communication energy, the SN that is easiest to reach within the transmission range will become part of the initiator cluster.

Furthermore, dynamic cluster creation involves periodic restructuring of the clusters. This means that clusters can be reorganized or modified over time to adapt to changes in the network, such as node failures or changes in energy levels. This dynamic nature allows for improved network performance and energy efficiency in response to varying conditions.

1.3 Cluster Head Selection

After the establishment of clusters, cluster heads (CHs) are selected to act as the leaders of their respective clusters. The primary responsibilities of the CHs include gathering data from cluster members and routing that information toward the Base Station (BS). However, as the size of a cluster increases, CHs for larger clusters have to handle a higher volume of data compared to CHs in smaller clusters.

This implies that CHs in larger clusters are tasked with the additional workload of receiving, aggregating, and distributing a greater amount of data. As a result, clusters with a larger number of nodes bear a heavier burden compared to clusters with fewer nodes. This disparity in workload distribution is inherent to the clustering mechanism and the size of the clusters within the wireless sensor network.

Initially, the selection of a cluster head (CH) can be random, or it can be based on factors such as the remaining energy of the nodes within the cluster. By considering the energy levels of the nodes, a CH with a higher energy reserve can be chosen to handle the additional responsibilities and workload.

To distribute the burden and mitigate the impact on CHs, a rotation mechanism is employed. The role of CH is rotated among eligible nodes within the cluster. This rotation helps in balancing the energy consumption and workload among nodes, thus extending the usable lifetime of the clusters.

In the proposed model, the Modified Low-Energy Adaptive Clustering Hierarchy (M-LEACH) protocol is utilized for communication between nodes within the cluster and for the selection of the CHs. M-LEACH is an enhanced version of the LEACH protocol, designed to improve energy efficiency and cluster stability in WSNs. It introduces modifications to optimize the clustering process and achieve better overall network performance.

1.4 Data Transmission

As soon as the clusters are created and the TDMA schedule is configured, data transmission can begin. Assuming nodes always have information to provide, they do it during their assigned transmission window to the CH. This communication uses a very small amount of energy. To reduce energy loss at non-cluster-head nodes, the radios of each one is able to be disabled until the node's designated communication time. To receive all data from the cluster nodes, the CH node must keep its receiver on. CH executes the procedures for involving signals to combine all of data into a single signal, after receiving information. CH can beam-form the various signals to create complex signal, for instance. The Base Station receives this hybrid signal. The transmission requires high energy, due to the distance from the BS. This is performed by the LEACH networks during the steady-state. Next each node decides if it should serve as a CH for the consecutive round depending on the priority. The consecutive rounds selection of the CH node will be done after particular time-stamp.

In the proposed model the communication between the CH and the BS is done using the M-CUCKOO algorithm.

To minimize the energy level of the sensors in the WSN-IOT, selection of the correct cluster and the communication between the Cluster Member (CM), CH, and BS are important. Low-Energy Adaptive Clustering Hierarchy (M-LEACH) and the Cuckoo Search (M-CS) algorithm are used in projected model and it is elaborated in Sect. 3. Sections 4 and 5 shows the implementation and the result analysis of the proposed model.

2 Literature Review

Many researchers have done on the energy optimization of the SNs. Energy optimization is done on creation of cluster node and communication protocols.

The Second-Fold Cluster (SFC) algorithm, which is two -fold is proposed by Vimal et al. [5]. Based on zonal residual energy and zonal degree of connection, CH is chosen in first phase. The remaining nodes, also known as solitary nodes, are clumped together in second phase. To make sure that energy is distributed (nearly) equitably among all nodes, CH is chosen based on the zonal degree of connectedness. It is appropriate for IoT integration due of its homogeneity.

To maintain the energy level of the WSN, Pandey et al. [6], proposed the Moth Flame Optimization algorithm. This algorithm increases the life of the WSN in the clustering and routing.

Kanthi et al. [7] propose the CH creation utilizing the improved grey wolf optimization (IGWO) algorithm. Proposed procedure solves the issue of traditional GWO algorithm's premature convergence. The basic foundations of the suggested algorithm are the average intra-cluster distance, sink distance, residual energy, and CH balancing factor.

Shreyas et al. [8] proposes for an energy-efficient routing paradigm makes use of an artificial bee colony (ABC) to minimize latency and packet loss while increasing energy efficiency and throughput in order to extend lifespan of sensor networks.

To increase energy consumption and lengthen lifetime of the network, Elshrkawey et al. [9] suggested methods based on the scheduling of the TDMA. The author suggests an improvement strategy to lower energy consumption and increase network lifetime. To reduce energy loss during network connections, it has been achieved by enhancing energy balancing in clusters among all SNs.

Deepshikha et al. [10] use a CUCKOO-ANN-based optimization technique to reduce the energy consumption of IOT WSNs. Suggested approach is constructed using the ANN's parallel handling capabilities and the CUCKOO method's ability to solve nonlinear problems.

Hameed et al. [11] explain how lifetime optimization in IOT sensor networks using the Cuckoo Scheduling Algorithm (CSA) works. Using the DBSCAN approach, the WSN is clustered, and each CH is then optimized using the CSA method. In order to monitor the cluster region with the fewest possible nodes while maintaining an adequate degree of coverage, the applied CSA assisted to offer the optimal schedule of the SNs inside each cluster. Periodically using the suggested algorithm yields the best results.

For apps that regularly collect data and ensure the network has sufficient coverage and accessibility, Gupta et al. [12] suggested the efficient coverage and connectivity aware data gathering (ECCDG) protocol. By selecting a group of linked active nodes on a regular basis to receive the sensed data from the other SNs, ECCDG lowers and balances energy consumption. The chosen collection of active nodes that are connected serve as relay nodes. Every typical node sends the sensory data that has recorded to the nearest active nodes. One that is active node then sends perceived information to the sink through active relay nodes.

Khabiri et al. [13] projected an energy-aware clustering-based routing protocol in WSNs that may cluster the network and pick the best CHs. This protocol uses the cuckoo optimization method. The intended cuckoo algorithm's CH selection was based on the suggested method's four criteria, which were the nodes' remaining energy, their distance from the BS, their distances inside the cluster, and their distances between clusters.

A fuzzy type-2 logic-based clustering method employing the Cuckoo search optimization algorithm was projected by Mittal et al. [14]. Suggested method makes use of a threshold-based data transmission algorithm for the intra-cluster communication. To decrease energy consumption by CHs for communicating with the BS, an inter-cluster communication multi-hop routing system is used.

Adnan et al. [15] offer a centralized energy-aware clustering approach for WSNs utilizing innovative bio mimetic cuckoo search procedure. Cost function is used to obtain primary parameter, which maximizes network longevity. The intra-cluster distance is used to determine the cost function. The algorithms operate both centralized and decentralized networks effectively.

Dhivya et al. [16] suggested, data from the sensor network are aggregated using the meta-heuristic optimization technique known as CS. In the suggested method, low-energy nodes are organized into subordinate chains (or clusters) for data sensing while high energy nodes are organized into cluster heads for Base Station communication. CS is suggested to improve network performance with balanced energy dissipation, which forms ideal number of clusters with the least amount of energy use.

The sensor nodes regularly perceive the surroundings and use greedy geographic routing to forward the samples they have collected to a sink. The analysis uses both the actual log-normal shadowing model and the idealistic circular coverage radio model. No matter the radio model, Chen et al. [17], findings show that the traffic load often rises as a function of the node's proximity to the sink. Though, two radio models produce very different outcomes just next to the sink. The optimal radio model identifies the presence of a volcano region close to the sink, where the volume of traffic is greatly reduced. Traffic load actually increases at a far higher rate, due to sink, because it uses log-normal shadowing model, which has the opposite effect.

According to thorough study, one of the key factors for the WSN-IOT to take into account is energy usage. The characteristics like data sensing, communication to the BS in the case of the CH, inter- and intra-cluster communication, and cluster communication, all contribute to the WSN's energy usage. We propose a hybrid paradigm that can cluster the WSN effectively and communicate between and within clusters efficiently in view of the rising life span of the WSN-IOT.

3 Proposed Model

The proposed model is a hybrid approach, mainly designed for the energy consumption of the WSN-IOT‘s SN. SN uses its energy to assemble data from ambient and transmit that data to BS. The modules of the hybrid model include the cluster formation and communication modules. The CH to BS communication, as well as inter-cluster and intra-cluster communication, will be divided up under the communication module. Figure 3 displays the design of proposed model.

The preceding provides an explanation of each module of the proposed framework.

3.1 Cluster Formation Module

The near-by nodes will be combined and become a cluster. In the cluster one node will become the head called as cluster head (CH). The sensor node contains information regarding all other SN's present in cluster. SN contains a specialized table. The attributes present in the table are: battery level, SN id, and soon. The choosing and forming of the cluster is done using the M-LEACH protocol.

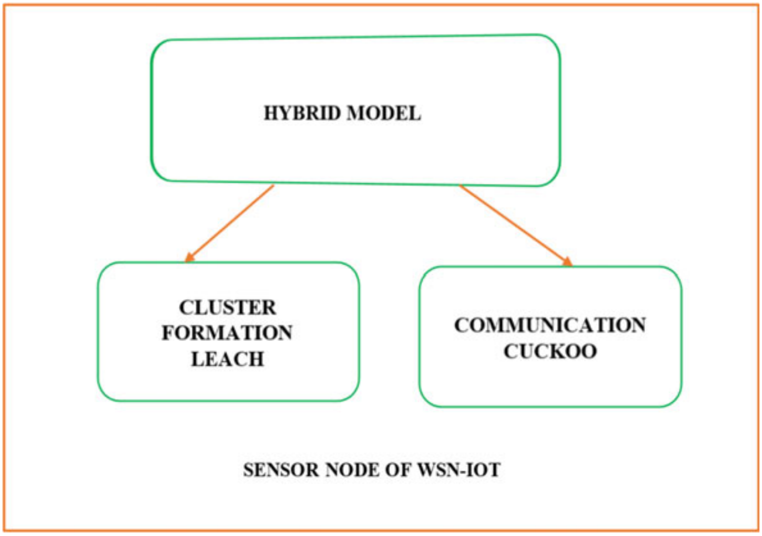

Fig. 3 Depicts the proposed model's schematic representation

3.2 Communication Module

The communication module will choose the optimized path for the data transfer. The Modified Cuckoo (M-CS) algorithm is used for inter and intra-cluster communication. As well, helps to communicate selected CH to communicate with the BS.

3.3 Algorithm of the Proposed Model

Step 1: Initialization and Cluster Formation.

(a) Initialize CH initially randomly and form the clusters based on the M-LEACH algorithm. M-LEACH_C_count as total number of SN present in formed cluster. Increment the TOTAL_CH_WSN-IOT value.
(b) Repeat the procedure until all the nodes in the WSN-IOT is belongs to any one cluster.

Step 2: Find the optimum path in the using the M-Cuckoo algorithm. Start communicating with all the sensor nodes of the cluster.
Step 3: Repeat the Steps 1 and 2 for prescribed time interval.

3.3.1 M-LEACH

For the design of WSNs, this hierarchical clustering-based routing protocol is employed. This protocol randomly switches the cluster heads, and one by one, all the nodes take over as CHs. M-LEACH aggregates data at the cluster head level for robustness, scalability, and employs localized synchronization for the dynamic network. As a result, bandwidth is conserved while fewer data are delivered to the sink or the next hop CH. In the setup step of the clustering system process, all nodes choose CHs using an indicator function. Using then on-persistent protocol, the selected CHs then broad cast an Advertisement (ADV) message that comprises the CH’S id (also called CHID).

Two stages make up the M-LEACH Protocol; they are the initialization, Steady-Round-State phase. During the setup step, the CH is chosen. During the steady-state phase, when the CH is established, data is transmitted between nodes. In the two stages, we proposed the Round-Robin with the priority during choosing of the CH. The priority attribute are energy level and proximity of the SN to the BS. If the energy level is more and the proximity to the BS is less then, the member node will become CH. Else the node relics only as CM. After each sensor node (SN) adding to the cluster is noted by using the variable M-LEACH_C_count and is stored in the CH table information. It will be passed to the newly elected cluster during the initialization stage.

3.3.2 M-CS

The WSN-energy IOT’s usage is influenced by how far the CH node is from the BS. Additionally, the amount of energy needed to transmit each message bit. The Modified Cuckoo Search (M-CS) optimization algorithm is employed to ensure effective communication with the CH and BS. The WSN-CH IOT’s is used by the M-CS method. The CH node, which carries data on the energy level and distance from the BS, will serve as the primary determinants of the optimal path. Fitness function computation is constructed on the node’s communication energy level and distance. Three phases of Basic CS are outlined beneath:

1. Broadly positioned eggs.
2. The best nest with high-quality eggs is chosen and used for the following generation.
3. Likelihood of being found by the host bird nest.

The WSN-IOT’s CS seeks out the most effective route for transmitting messages from the source sensor to the Base Station (BS) by utilizing locally dispersed sensors. Given that the sensor node will only contain one egg, we are presuming the cuckoo in this instance. Here, the cluster’s CH has been chosen as the sensor node. Between the CH and the BS, the data must be sent. The key requirement for performing this is selecting the next CH head that is present in the WSN-IOT for forwarding and transferring the data. The fitness function of each random node must be determined using the equation to determine the optimum CH for message transport is as shown in the Eq. (3).

$$f_n = \alpha_1 f_1 + \alpha_2 f_2 + \alpha_3 f_3 \tag{3}$$

Here α_1, α_2, α_3 are the random values ranges from 0 to 1.

The total values of the constant should be 1.

As shown in the Eq. (4).

$$\alpha_1 + \alpha_2 + \alpha_3 = 1 \tag{4}$$

The fitness function f_1, f_2, f_3 is calculated as follows:

$$f_1 = \frac{1}{M} \sum_{N=1}^{M} \left(\frac{\text{distance}(S, \text{BS})}{M} \right) \tag{5}$$

M = TOTAL_CH_WSN − IOT

M is the overall number of CH nodes in WSN-IOT.

BS is the Base Station. S is the source node/ current node.

$$f_2 = \frac{E_{\text{REQ}}}{E_{\text{CH}}} \tag{6}$$

E_{REQ} is the energy essential to transmission of data from the Source-CH to BS. E_{CH} is the energy level of the CH node.

$$f_3 = \frac{C}{M} \tag{7}$$

where C is the number of Cuckoo nodes.

After calculating each node's fitness function, the best nodes with the highest fitness values are chosen to transmit the message. Equation 6 is used to calculate the best route by comparing the costs of each route. The γ is the constant value.

$$\text{Total cost} = d_1 * \gamma + (1 + \gamma) d_2 \tag{8}$$

The values of d_1 and d_2 are calculated in the Eqs. 9 and 10.

$$d_1 = \left\{ \sum \frac{x(M, S, BS)}{C} \right\} \tag{9}$$

$$d_2 = \sum_{n=1}^{M} \frac{E(M_n)}{E_{CH}} \tag{10}$$

The best cost and best routes are obtained by using the minimum values of d_1 and d_2.

4 Implementation

M-LEACH and M-CS protocol using MATLAB is done. The nodes features were presumptions during node deployment. The BS is located in zone's center. Nodes and clusters are stationary. Within a particular cluster, normal nodes send data directly to their corresponding CH. Multi-hop routing implemented to reach the BS. The selection of the optimal route is done using the M-C. Each node has a uniform nature. With the same beginning energy, all nodes start. [18, 19]. Table 1 displays the list of variables utilized in the simulation.

Equation 11 is primarily responsible for the WSN- IOT's energy consumption.

$$\text{Total Energy Consumption}(E) = E_\text{L} + E_\text{C} + E_\text{D} \tag{11}$$

E_L is the energy consumed during the M-LEACH cluster formation and CH head selection. E_C is the energy consumed during the M-CS protocol. E_D Energy consumed during the sensing of data, which is ignored during the simulation. As we mentioned we concentrate only on the energy consumption during communication.

Table 1 Summarizes the values for the initialization setup

Initial parameters of M-LEACH protocol for simulations	
Parameter	Value
Network field dimensions	200 m × 200 m
Total number of sensor nodes	50, 100,300
Initial energy (E0)	0.5 J
Probability to become CH (P)	0.05, 0.1
A_{FS}	10pJ/ bit/m
A_{MP}	0.0013 pJ/bit/m
Data packet size	4000 bits
Position of BS	(0, 0), (50, 50), (100, 100)
Motion coefficient	20
No. of possible nest	80
No. of cuckoos	5
Max. No. of cuckoos	20
No. of eggs in each nest	2
Radius coefficient	0.05
Cuckoo population variation	1E-10

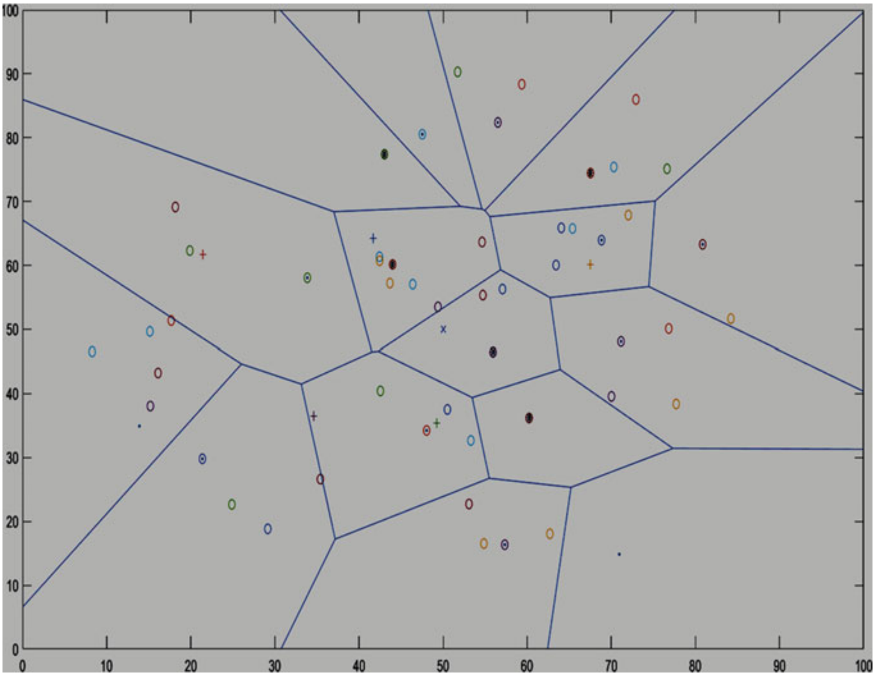

Fig. 4 Different clusters with the CH

In the proposed model, we begin with the M-LEACH algorithm. In this stage, as we mentioned in the above section, the formation of the cluster, and CH is selected.

After the formation of cluster and CH, next step is the communication. In this step, initially the CH has the data to be communicated with the BS. For this communication the optimized route has to be selected. The selected route does the communication between only the CHs of the cluster. For this purpose, the M-CS algorithm is implemented (Fig. 4).

5 Results and Discussion

The proposed model shows the result of the node's life in the cluster after number of rounds. After execution of M-LEACH algorithm, number of alive and dead nodes in system is shown in Fig. 5.

Figure 6 shows the energy consumption of the SN in cluster during different rounds. We observed that the initial state the energy consumption will be less, as number of rounds increases, energy consumption of nodes increases.

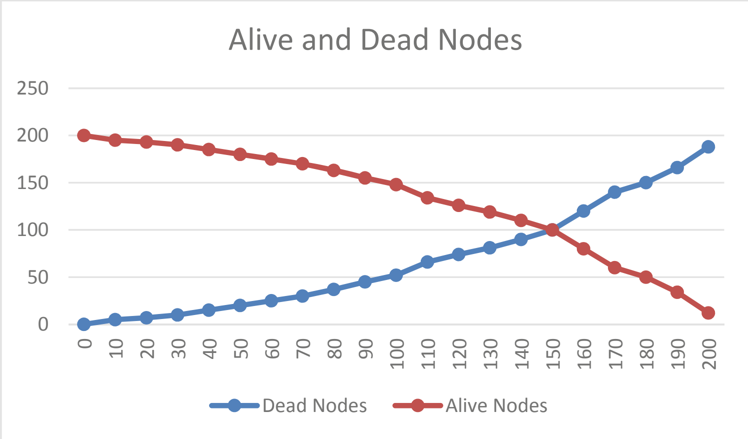

Fig. 5 Status of the dead and alive nodes in the M-LEACH

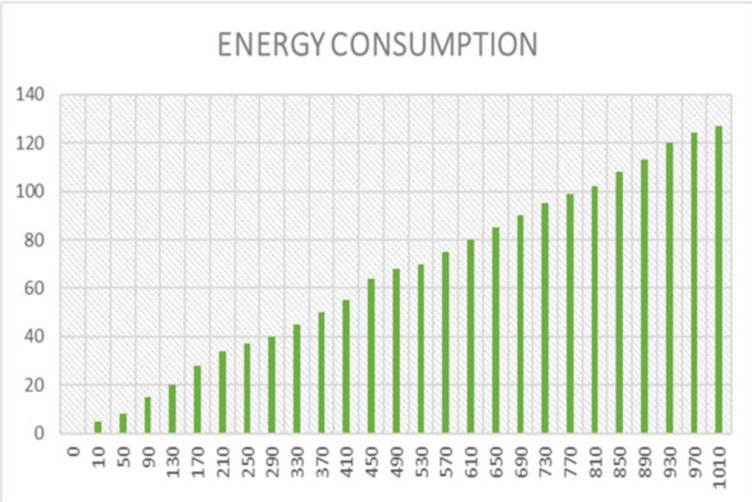

Fig. 6 Depicts M-LEACH protocol-consumption of energy by the nodes

Energy use of the CH nodes during the M-CS protocol is depicted in Fig. 7. The graph displays the total average energy consumption of nodes versus number of rounds.

Total energy consumed by the proposed system is calculated as shown in the Eq. 9. Here we kept the parameter E_D as constant considering the energy required as very minimal amount.

In Table 2, the proposed technique is contrasted with alternative algorithms. Figure 8 presents the graph regarding comparison.

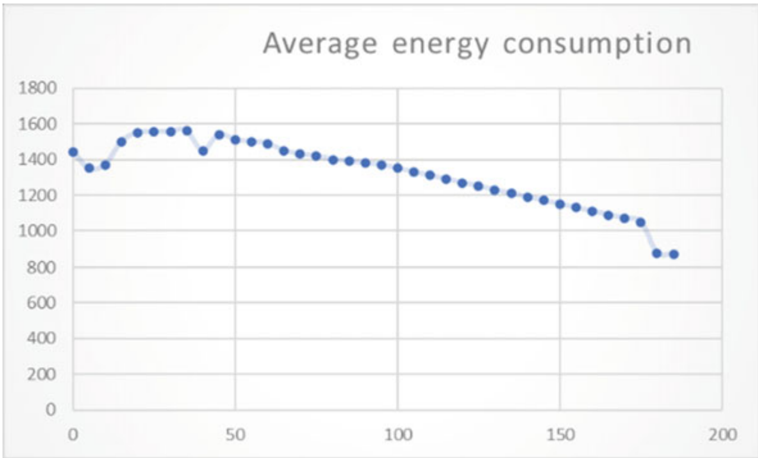

Fig. 7 Depicts energy consumption during M-CS

Table 2 The comparison of algorithms

Algorithm	Accuracy
ANNR	90
QLRRWA	87
WLDCNN	89
ANNCUCKOO	98
GA and LEACH	74.7
M-LEACH + M-CS	93.4

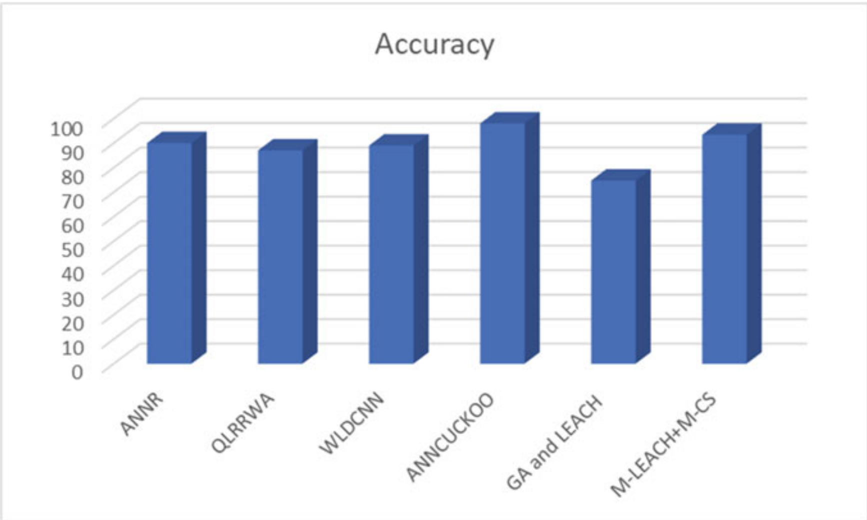

Fig. 8 Displays a comparison of various algorithms

6 Conclusion

Energy consumption is very important factor for determining the network's lifetime. The sensor nodes are energy driven and use very low. The energy resource present in WSN-IOT's lifetime depends on the energy consumption of the sensor nodes. Minimize usage of energy or utilization of energy is the key factor. It depends upon the communication between the BS and sensor nodes and the sensing of the data. The proposed system uses hybrid approach to minimize the data. Uses the cluster formation and selects the CH for the data transfer to the BS, instead of every node directly communicating to the BS. We used the M-LEACH algorithm to perform this. Next the M-CS algorithm is used by the CHs to communicate to the BS by optimizing the path. Proposed system is able to enhance lifetime of senor nodes present in WSN-IOT. We are able to achieve the accuracy of 93.4% during the simulation. The proposed system can be added with the new broadcasting protocol to increase the lifetime of the node.

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