Journal of Information Systems Engineering and Management
2025, 10(31s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Cluster Based Data Transmission Process Using Improved Memetic Algorithm in IoT Enabled Wireless Sensor Networks

J. Saranya [1], Dr. P. Bharathisindhu [2]

[1]Ph.D Research Scholar, Department of Computer Science, Vellalar College for Women Thindal, Erode, Tamil Nadu, India
Assistant Professor, Department of Information Technology, Hindusthan College of arts & Science, Coimbatore, Tamil Nadu, India.
Email: saranyaphd6@gmail.com
[2]Assistant Professor, Department of Computer Science, Vellalar College for Women Thindal, Erode, Tamil Nadu, India

ARTICLE INFO

Received: 30 Dec 2024

Revised: 05 Feb 2025

Accepted: 25 Feb 2025

ABSTRACT

A key part of the Internet of Things (IoT) is wireless sensor networks (WSNs). In easy terms, IoT means that the web is linked to the real world. IOT senses its surroundings, gathers information, and sends it to the Base station (BS). IoT environment routing method is made for WSNs, but WSNs don't work right because the nodes aren't all the same. This kind of network is called an IOT network. It picks up the data and sends it to the base station. The main problem with the network is that the sensor nodes are too small and use too much power. Cluster is improving how well the IoT-enabled WSNs work. The main focus of this study was on a memetic algorithm. The routing system is what the algorithm is based on to make the network work better. The base station is used to receive data and keep the network from splitting up. A programme called NS2 Simulator is used to an assessment of the suggested method. The outcomes are compared with those of supplementary algorithms to show that the suggested scheme works well in terms of Packet delivery ratio, Throughput Analysis, Packet loss, End-to-End delay, and energy Consumption.

Keywords: Clustering, IOT, Sensor Nodes, Memetic Algorithm, Data Collection Phase, Cluster Head (CH), WSN.

INTRODUCTION

A vital part of the Internet of Things (IoT) is WSNs, which allow users to access and make use of valuable data collected from their environments through the use of IoT devices. Today, the Internet of Things (IoT) is finding use in a wide variety of fields, including smart home automation, healthcare, forest fire detection, precision smart agriculture and smart city monitoring. Internet of Things (IoT) devices or sensors in the monitoring area collect data on environmental variables like humidity, temperature, and pressure and send it to the Base Station (BS) through either single or multiple hop communication. One energy constraint in WSNs for the Internet of Things is sensor nodes. Clustering is a method of dividing a wireless sensor network's nodes into smaller groupings. Cluster Heads (CHs) are the leaders of each cluster. The nodes in each cluster gather data and forward it to the central hub. Furthermore, after receiving data, each CH compiles it and sends it to the BS [1]. Equal clustering and uneven clustering are two ways to categorise the clustering process. Clusters in an equal clustering network are nearly all of the same size. Due to the forwarding load on the CHs closest to the base station, the transmission burden on each CH is not spread equally in equal clustering. In an equal clustering experiment, it was shown that all nodes start off with the same amount of energy. However, after a few rounds of sensing and data transfer, the CHs closer to the base station drain their energy faster than the CHs further away from the Base Station. We call this sort of issue the battery power problem. As illustrated in Figure 1, the idea of unequal clustering is used to address the Energy consumption problem. In this approach, clusters closer to the sink have an interior number of CMs, whereas clusters further away from the sink have a substantially larger number of CMs. Figure 1 clearly shows that the number of cluster members (CMs) grows in direct proportion to the distance between CHs and the sink. A new cluster head node selection strategy and stabilized cluster formation technique based on Memetic algorithms are proposed in this study to enable load-balanced clustering in WSN [2].

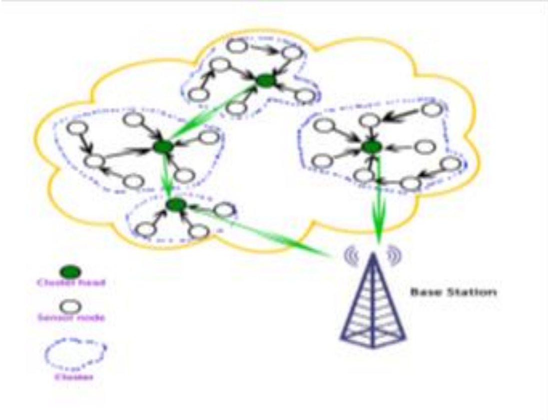

Figure 1: Cluster-based WSN

It is said that the hybrid cluster architecture works like this: the number of sensor nodes in the cluster determines whether sensor nodes are split into equal or unequal groups. Hybrid clustering is the name of the method wants to use in this research work, which is a mix of equal and unequal clustering. In the hybrid grouping method, data is sent and received in two different ways. The first is that when the number of nodes is above or below the maximum, there may be a lot of collisions and traffic in the middle path, which causes more packets to be lost and more energy to be wasted. The packet takes a lengthy time to get to the base station because of this. For the purpose of avoid this, a high-energy member sensor node of the cluster is elect as the CH and data is sent to the base station through the CH. If this member of the cluster is not available, a nearby high-energy member is chosen as the CH to send data to the base station. With this new method, WSN no longer has to deal with high data losses and time delays. Also, when there isn't much traffic, data is sent precisely from the cluster head to the base station (BS). This makes the WSN more scalable and lasts longer. The second way is through both equal and uneven clusters. If the cluster head notices that the number of nodes is low, they send the information straight to the base station. So, packets are lost for no reason, and the right bulk of data is sent in a minimum amount of time. The mixed cluster takes advantage of equal and unequal cluster techniques to handle the larger amount of data that can be gathered in WSN [3]. Several problems with the clustering process, like energy holes and network division, make networks last much less time. Nearby Cluster Head (CH) sensor nodes send more data packets than faraway sensor nodes. This causes the CH adjacentt sensor nodes to die early in the clustering process. In traditional data gathering technique, the sink position is frequently set, and the deployed nodes don't move around much. In order to send data, sensor nodes that are nearer to the fixed base station use additional energy than those that are beyond away. Because of the problem, sensor nodes close to the static sink die a lot quicker than other sensor nodes, which shorten the life of the network [2]. A big worry is the lifetime of the network. When nodes don't have power, connection drops, the network splits up, and stops working. Data collection is an essential concept for sensor networks that use wireless routing. The goal is to mix data from different sources en route to get rid of duplicates and cut down on transmissions, which saves energy. Data aggregation protocols take data packets from sensor nodes and join and summarize them so that less data needs to be sent [3]. It is much easier for heterogeneous nodes to communicate and handle data than it is for collective nodes. But because various hubs are exclusive, it is important to look into how to balance energy use and make networks last longer [4]. It helps stop denial-of-service attacks and keeps track of every movement in the network by storing copies of the data. To keep digital material safe, application layer security needs to include authentication, risk assessment, and data security. This is very important for keeping the environment safe.

Figure 2: IoT Architecture

- **Sensors/Devices**
- **Connectivity**
- **Data Store**
- **Data processing**
- **User interface**

Smart homes, smart gadgets, and other smart systems are booming in popularity these days. One idea, the Internet of Things (IoT), dominates the prevailing perspective on these systems. Anything that can be equipped with the necessary hardware to establish a wireless or wired connection to the Internet is considered part of an Internet of Things (IoT) system. Anyone, anything, or even a mix of the two can be an IoT user. The goal of the IoT aspires to merge the sensing and feelings features in common things faultlessly by using their network capacity to create pervasive information systems. One common component of Internet of Things (IoT) systems is the WSN, which allows for several users to connect to the system via a variety of applications. What follows is an outline of the rest of the paper: The second section of the article provides a summary of the associated work process. In Section III, the Problem Statement is defined. The details of the algorithm and the proposed work are derived in Section IV. Performance Metrics and the Simulation Environment are detailed in Section V. The discussion and results are detailed in Section VI. Section VII delves into the paper's conclusion.

LITERATURE SURVEY

Ado Adamou Abba Ari et al. (2016) proposed a distributed bio-inspired strategy that distributes the load among all sensor nodes within the cluster to prolong the network's lifespan. We determined that the suggested strategy achieved superior results in terms of network lifetime, the number of packets received by the base station, end-to-end delay, energy consumption, and efficiency. **Vrajesh Kumar Chawra and colleagues [2019]** significantly enhanced the load-balanced cluster formation approach and the memetic algorithm-based cluster head selection. **Vrajesh Kumar Chawra and colleagues [2019]** make comparisons between the proposed method and two well-known clustering node methods in terms of energy consumption, residual energy, and network operational time. It has been reported by **Perumal V et al. (2018)** that a hybrid clustering strategy that is based on hierarchical structures has been developed in order to reduce the quantity of network traffic that is directed to the base station. During its primary function, which consisted of delivering and receiving data as well as detecting and collecting it, it consumed less energy than other methods. We will use a mixed clustering approach to gather data from the region. The presented EEBHC algorithm aims to reduce energy consumption, eliminate packet loss, and extend the network's lifespan. **Walid Osamy and colleagues [2021]** propose an Intelligent Proficient Data Collection Approach (IPDCA) to deliver public information to a smart city on a large scale. The IPDCA makes use of public vehicles as mobile data collectors, also known as D-collectors, in order to read data from a large number of access points (APs) and ultimately transmit it to the primary base station (BS). The IPDCA fitness function method, which considers the partial number of D-collectors, storage space, and total distance travelled, aids in optimizing network gain. According to **Chuan Zhu et al. [2018]**, we provide a method of data collection that is both highly available and aware of its location through the use of mobile sinks. Sensor nodes are able to determine the location of mobile sinks through the use of time synchronisation, which results in a reduction in the amount of energy that is required for sensor nodes to accurately update sink locations. If the network employs the high-available data gathering strategy, it will be able to continue collecting data even if some of the mobile sinks are failing to function properly. **Pankaj Bajaj's name is [2017]**. To improve CH selection, Pankaj Bajaj developed a hybrid BFO that integrates GSA into LEACH. Not only does hybrid BFO provide nodes with a longer and more beneficial life than LEACH, but it also ensures that all of them remain alive for a longer period of time. WSN makes use of hybrid BFO, which first locates clusters and then introduces the cluster head that is deemed to be the most effective. The task of delivering data to the database is under the purview of this head. Chunlin Li and colleagues developed CHRA, a clustering routing method for wireless sensor networks, in 2018 with the aim of achieving energy balance and extending the lifespan of networks. HRA and the LEACH routing mechanism, when implemented together, have the potential to make a network more stable and last for a significantly longer period of time. Additionally, it has the potential to significantly reduce energy consumption. Gurbinder Singh Brar and colleagues published an article in 2016 discussing a PEGASIS-DSR routing protocol (PDORP) based on hybrid optimisation. This routing protocol combines the concepts of proactive and reactive routing protocols, specifically the supply and steering gearbox elements. Simulations conducted on the proposed protocol show a reduction in end-to-end transfer delay and bit error rate, without a corresponding decrease in electricity efficiency. **Huang et al. [2018]** say that the ASGRP is a low-energy multi-hop routing strategy for wireless sensor networks (WSNs) and is based on annulus sector grid clustering. The suggested routing approach utilizes less energy overall and minimizes energy consumption for transportation. These routing protocols, such as multi-hop EEBCDA, EEMRP, CAMP, and ASGRP, use energy more consistently, extend the lifespan of networks significantly, and perform more effectively in networks with a large number of nodes of varying sizes and numbers. **Jianhua Huang and colleagues (2017)** showcased a grid-based multi-hop routing system that minimizes energy consumption and prolongs the network's lifespan. When sensor nodes in grids are located in close proximity to the washbasin, they transmit data directly to the washbasin. Sensor nodes located in further away grids transmit data across multiple hops. The implementation of a management mechanism based on CM nodes simplifies the voting procedure. This strategy could eliminate the randomness in CH node selection, improve CH node location, and lower communication costs for member nodes within clusters. The suggested solution outperforms the others in terms of energy consumption, network operational duration, and ease of expansion. **Mbanaso, U. M., et al. (2018)** delved into the risks and limitations of Internet of Things (IoT) systems, crafting a unique policy-based design that adapts to address trust, privacy, and data protection concerns in situations involving a broad device distribution. It has developed a system that enables Internet of Things entities to specify their requirements and capabilities within a comprehensive policy framework. This framework enables these organizations to immediately negotiate their proven characteristics and resources with one another. It not only provides a consistent approach to the resolution of trust, privacy, and secrecy issues; it also provides methods for auditability and dispute resolution, all of which are essential for achieving success in Internet of Things contexts. According to **Moosa Ayati and colleagues [2018]**, reducing the amount of energy that wireless sensor networks (WSNs) consume is significant since it gives the networks a longer lifespan. It is possible to extend the lifespan of a network by clustering its nodes. At the moment, the LEACH approach is the most widely used grouping technique available. Excessive data may cause data bits to collide and lose their information. Consequently, it will be necessary to dispatch the misplaced boxes again. The nodes experience a loss of power as a consequence of these retransmissions. The suggested SCHFTL strategy decreases data loss, duplication, and overhead, thereby extending the network's lifespan. In **2019, Hamidouche Ranida and colleagues Hamidouche Ranida** and colleagues demonstrated a genetic algorithm-based distributed system known as LECR-GA to achieve more efficient energy utilisation. Employing the appropriate chromosomal representation, fitness function, and GA procedures resulted in the system being able to function for a longer period of time, achieving the highest data rate, and reducing the amount of complexity. According to the results of the tests, the proposed algorithms, in terms of throughput and energy consumption, perform significantly better than GABEEC and GAEEP. **Se-Ra Oh et al. (2018)** state that the oneM2M (i.e., Mobius) OAuth 2.0-based security component aims to offer authentication and permission, two crucial security objectives for Internet of Things (IoT) security and ensuring safe platform interoperability among IoT devices. The oneM2M security component will prevent a user who lacks authorization from making a resource request. Conversely, it permits a user with the necessary authorization to initiate a resource request. In 2**018, Yiqun Zhang** and colleagues we introduce Recryptor, a new architecture that takes advantage of both in-memory and near-memory computation to assist cryptographic algorithms in performing massive vector calculations effectively. This design is presented in this study survey. It preserves its programming ability and reduces both the running time and energy consumption by approximately 80%. The Recryptor serves as an excellent example of striking a balance between space, power, speed, and usability.

PROPOSED WORK AND ALGORITHM

Proposed Work:

Internet of Things (IoT) enabled wireless sensor networks describe two distinct phases. A base station-based cluster creation technique utilising the Memetic algorithm constitutes the initial stage. During the cluster formation phase, the Memetic Algorithm is employed to elect CHs in a rigorous memetic fashion. Phase two of the DSR routing protocol involves selecting a path and then updating it. Data collection between sources to destinations is its primary use. There are two steps for data transmission in a WSN with a cluster head. To begin, data is being immediately transmitted to the base station from the sensor nodes at the head of the cluster. The second step is to transmit data from neighbouring cluster heads to the base station. There are two things that must be confirmed for the sensor network every time a data transmission takes place. smaller energy should be required to travel from the source to the destination, and the size of both the sending and receiving messages should be smaller than what is left over.

Algorithm Details:

Cluster using Memetic Algorithm

A method called "clustering" groups sensor nodes into a set of groups known as "clusters." Based on a set of predefined factors, such as encouraging network load balancing, making sure the quality of data transmission from source to destination is high, and using the least amount of energy possible. So, two kinds of grouping techniques are used: homogeneous and heterogeneous networks. Heterogeneous communication network is the name for the clustering method used in the inter-clustering sensor network. This is counting of sensor nodes that can do different things, like have different computer power and sensing ranges.A homogenous network is made up of nodes that can do the same things. Because of this, these networks are used to sense data that is alike. Nodes that are homogeneous are the same. The goal of this step is to find Successful cluster heads in the network that can make deployed nodes use a lot less energy. So, to find the best CH, we use a memetic algorithm, which is an intelligent way to find the best answer in a WSN environment with lots of different types of nodes. A genetic technique is being used to add a local search method. Evolutionary computation is used in this meta-heuristic method. It's a search-based optimization task based on nature and it provides responses that are almost perfect. Optimization is the process of making objective functions bigger or smaller based on the factors that are given.

A genetic algorithm is better than other methods because it can find the best answer for both continuous and discrete functions and it gives you a group of solutions instead of just one that gets better over time. When there are a lot of things to consider, it is a great choice. A memetic method is used to find the cluster head inside the network's nodes. It's split into two parts. It is possible for a node to be in the CH nodes elite if its energy is higher than the average energy of the network's nodes. It is possible to make the first bit string of the chromosome. The value of CH is set to "1," and the values of the other nodes are set to "0." A memetic method is used to choose the CH when the above condition is no longer true. It is called the steady state phase because a fitness function is used during it before crossing and mutation.

The First Steps

The parameters that control how well the network works are chosen. First, a number is given to each of the parameters. The number of sinks, the position of each node, the dimension of the WSN, the number of chromosomes, the size of the population nodes, the crossover rate, the transformation speed, and the group number are all parameters. The weight factors are also set to zero.

Function of Fitness

These are the goal functions that help you find the best way to get the results you want. Then, generations after generations of the iterative fitness function are used to get the chromosomes to better answers. It needs to speed up to the answer quickly and be in line with the goal.

Formation of a Cluster

At first, the x and y coordinates of each node are split into the number of clusters. The cluster elites the middle point to make a group of nodes for making a grid. During the data collection at the base point, it could be a mobile or a fixed one. Out of all the nodes in the cluster, the one in the middle is picked to be the cluster head (CH). The node CH is picked because it has the shortest distance and the most energy in the cluster node.

Algorithm of Cluster Formation

Step 1: Deploy SNs and BS in WSN
Step 2 : For each sensor node 1 to n.
Step 3 : To form a CLUSTERS using distance (eqa-1).
Step 4 : If node energy>optimistic threshold
Step 5 : To Apply the Memetic Algorithm
Select Maximum Energy node and low distance as CH.
CH being assigned a value of '1'
Else
Remaining sensor nodes are Cluster Member (CM)
CM nodes being assigned a value of '0'
Step 6 : End if
Step 7 : CH node collects data and sends to BS.
Step 8 : End procedure

Data Collection and Path Updating using DSR

During the data collection stage, a base station trails the path to a meeting point and then sends out a message for data uploading in transmission range 2R. This message is sent by the base station to the CHs so that all of the network's information can be uploaded. CHs that are all within range of the base station will only be able to accept this message. After getting the word to upload data, the CH checks the state of its buffer. If the CH's present buffer is empty, it doesn't pay attention to the base station data uploading message. If that doesn't happen, it sends a return message to the base station if the CH's buffer is still full. The reply message has the CH ID, the amount of energy that was left over, and the location. The base station gives each replied CH its own time slot when it gets a reply message from the CH. Every CH that talks to the mobile washbasin has a certain amount of time to do so. The CH can only send its answer during the time slot that was given to it. A good scheduling has been done for the CHs in the queue.

The Dynamic Source Routing (DSR) protocol is built on source routing and keeps track of all route information at nodes. Find the shortest route and keep the routes in good shape are the two parts of DSR. Route Reply would not be sent until the message has hit its target node.

This sensor node needs to have a path to the source node command to send back the Route Reply. The path would be used if it is in the route collection of the destination sensor node. The node will change the route based on the route record in the Route Request message header if that doesn't happen. If there is a terminal transmission, the Route Maintenance Phase starts, and at each point, the route error message is sent. The wrong hop will be taken out of the node's route cache, and all routes that contain it will be cut off at that time. Once more, the Route finding part is started to find the best route.

With the help of the improved DSR algorithm, dynamic route paths will be predicted that will be used for data transfer. One problem with changed DSR is that the route maintenance system doesn't fix a broken link in the same place it breaks. It takes longer to set up the link than with table-driven protocols. It also takes longer to compute the updated DSR protocol than the other routing protocols. To fix this, the following measures should be used in the route path discovery step to help find the route path. These are the estimated transmission time, the journey time for each hop, and the delay for each packet pair.

Algorithm: DSR routing protocol

1: Begin

2: If Route path is available in route cache

3: Update the route table based on location of destination nodes

4: Else

5: Broadcast signal to find nodes within range

6: Find Per hop routing trip time

7: Find Per hop packet pair delay

8: Find expected transmission time.

9: Update routing table

10: Find score of each available route path using average weighted sum method Score (path) = (w1*Per hop routing trip time + w2 * Per hop packet pair delay + w3*Expected transmission time) / 3

11: End if

12: Transfer Route Request message to destination node

13: If Node is ready to receive data

14: Receiver node will send back route reply message

15: Else

16: Call for route maintenance

17: Go to step 2

18: End if

19: If message is received from destination node

20: Transmission begins

21: Else

22: Go to step 9

23: End if

24: If transmission is completed

25: End

26: Else

27: Goto step 12

Proposed CBDT - IMA

Initialize the source node and destination node are checking the present Cluster head of the group nodes. The source node is not in synchronous with the target node. The method is used to check the cluster group head after the outcomes have been sent. The Cluster Head node is in the source input, which is the value of the source node. Last, CH is sent to the base station.

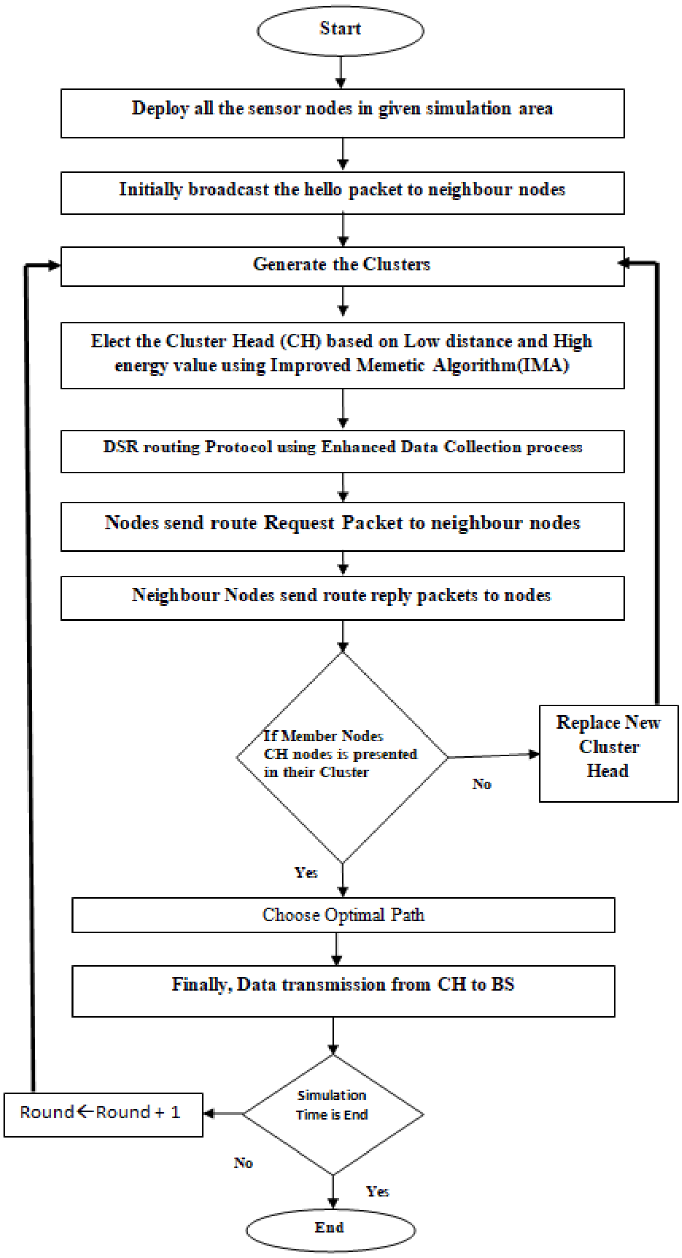

Figure 3: Flow Diagram of Proposed Method

Using minimal and maximum values, a memetic algorithm finds the optimum solution node. Nodes are classified as Cluster Members (CM) if they have less than or equal to the maximum energy, and as Cluster Heads (CH) if they have more. Data transfer to nearby WSN nodes is being coordinated by the CH. This data transmission approach, which is categorized as a memetic algorithm, is used in WSN to conduct energy-efficient clustering in order to follow the local search operation with intra cluster nodes. When it comes to WSN optimization, there are two main types of functions: single objective and multi objective. Using the maximum and minimum intra-cluster nodes as a single objective function, we conducted this study.

Algorithm of CBDT – IMA

Step 1 : Randomly deployed in given simulation Area

Step 2 : Generate the cluster based on distance

Step 3 : To select the CH node based on low distance and high Energy level using IMA Technique

Step 4 : DSR routing using Enhanced data collection process

Step 5 : To check, Route request and reply packets to Neighbour nodes.

Step 6 : If Member nodes and Cluster Head node is presented in their Cluster

Choose optimal path

Else

Replace the new CH node

Step 7 : Data Transmission from CH to BS

Step 8 : To Check the simulation time

If simulation time is end

Then, the process is end

Else

Round→ Round + 1

Then, Follow step to 7

SIMULATION PARAMETERS AND VALUES

Environment / Parameters	Values
Simulator	Ns -2.34
Channel Type	Wireless
Number of Nodes	100
Traffic Model	CBR
Simulation Area	1000m * 1000m
Total Energy	150J
Routing Protocol	DSR
Simulation Total Time	6 sec

The performance of the Memetic Algorithm for IoT enabled wireless sensor networks is the focus of this section. These simulations were carried out with the help of the network simulator (NS-2). For the purpose of carrying out network simulations, the network simulator NS2 is a piece of software that uses discrete event simulation. It is responsible for carrying out the simulation activities involved in the network, which include sending, receiving, forwarding, and dropping packets. Discussion was held regarding a few of the performance measures that the protocol possesses. In order to make comparisons, performance measures are employed,

- Packet Delivery Ratio(PDR)
- End to End Delay(EED)
- Remaining Energy(RE)
- Throughput

Experimental outcomes of planned retrievals are examined in NS2. The simulation area measures 1000 x 1000 metres. Apply 100 nodes to the simulation region. The suggested algorithm is then used on the gathered metrics propagation. The suggested and existing approaches are measured using grouping methods like Enriched Memetic Algorithm and Enhanced Data Collection Phase. These metrics findings from different methods are below.

i.Packet Delivery Ratio

An indicator of network performance, packet delivery ratio (PDR) counts how many packets made it from the sending node to the receiving one. Its primary function is to determine the rate of packet loss that occurs when data is being transmitted.

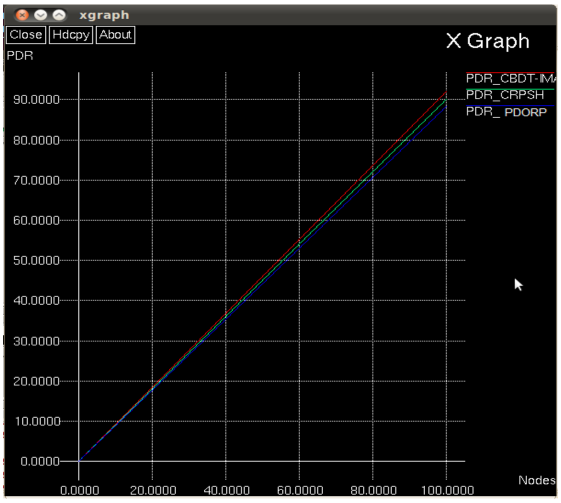

Figure 4: Packet Delivery Ratio

Some packets may be lost or incorrectly routed while transmitting from one node to another; identifying this loss Using the loss rate as a metric, PDR is computed to assess the efficacy and accuracy of ad-hoc routing schemes. In every network, the ideal transmission would be a greater packet delivery ratio.

Packet Delivery Ratio* = *Σ Number of packet receive / Σ Number of packet send

When you use the right routing method, the packet delivery ratio shows Number of packets have to be sent from the sender to the receiver. When compared to the current method, CRPSH comes out at 88.36% and PDORP comes out at 90.85%. The new work that is being proposed is much better than the old job. So the CBDT-IMA method is responsible for the 93.65% packet arrival rate

ii.End to End Delay

The above parameter describes the amount of time it takes for a data to go from its beginning node to its target node.

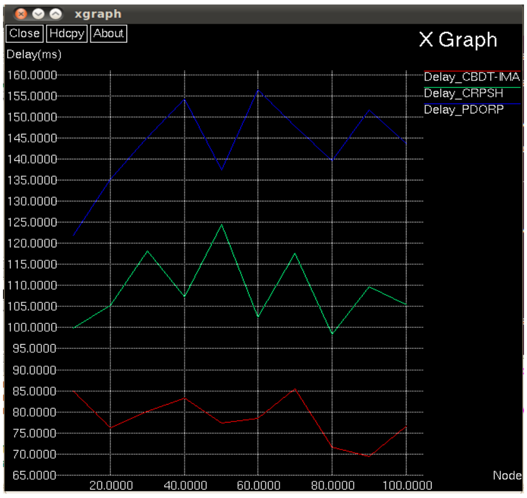

Figure 5: End to End Delay Time

The formula can be used to compute the end to end delay for a packet that was transmitted from node S as a source node and successfully received at node R. This delay accounts for the time it takes the router to search for the path in network usage, network signal delay, data communication delay, and so on

Packet Delay (PD) = Arrive time – Sent time

The CBDT-IMA technique that was proposed is able to cut the average delay time from beginning to finish by 21.32 milliseconds. In comparison to the method that is now being used, the result of CRPSH is 27.86 milliseconds (ms), while the result of PDORP is 24.93 milliseconds. At this point, the work that is being proposed is significantly superior to the work that is currently being done.

iii.Energy Consumption

There is a starting value for the node that represents its energy level at the beginning of the simulation. The initial energy in this equation is what we call it. The term "energy" in the context of the simulation environment denotes the amount of power that a node has at a given moment, whether that power comes from batteries or some other source. When the energy level of a node in the simulation environment drops below zero, it becomes idle and cannot send or receive any more packets.

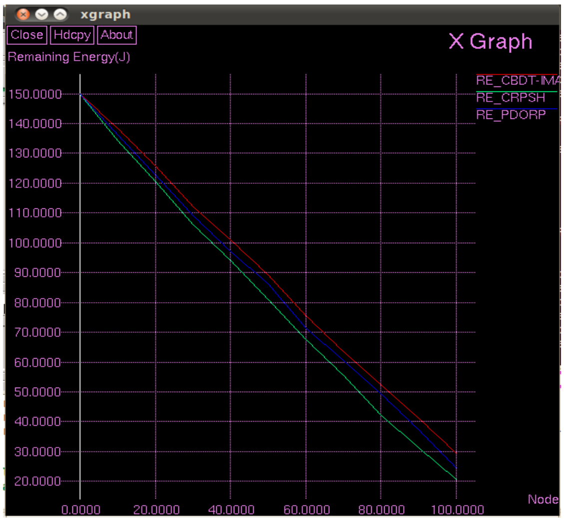

Figure 6: Remaining Energy

$$\textbf{\textit{Remining Energy}} = \textbf{\textit{Total Energy}} - \textbf{\textit{Disptched Energy}}$$

These findings are derived from matching the leftover energy and joule using 100% and 150 joule, respectively, from the current and proposed work. Consequently, the current approach yields PDORP of 14.38% and a corresponding joule of 21.5J, and CRPSH of 17.39% and a corresponding joule of 26.09J. At a remaining energy level of 19.78% and a joule value of 29.67J, the suggested method performs better.

iv.Throughput

The term "throughput value" refers to the total number of packets that are successfully transferred within the allotted time frame, also known as the successful transmission of data within the desired time frame.

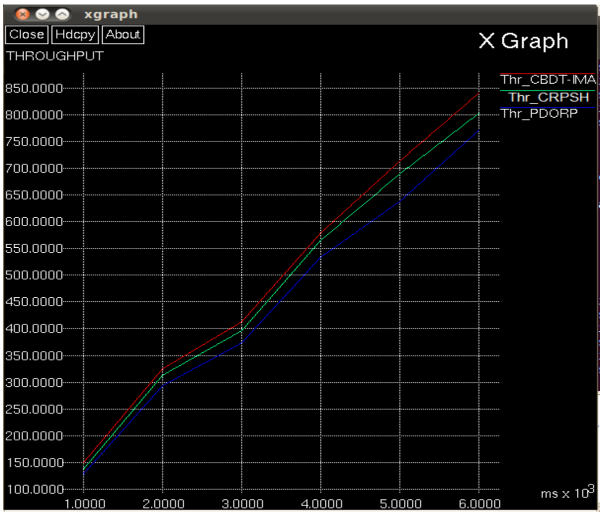

Figure 7: Throughput

It is possible to determine the value of transmission by calculating the average percentage of packets that are successfully transported from the source node to the destination node. Specifically, it is expressed in bits or bytes per second.

$$Average\ throughput = \frac{Sum\ of\ packets\ successfully\ delivered\ -\ Total\ number\ of\ packets}{Transmission\ time}$$

The proposed study proves that the PDORP and CRPSH method outperforms CBDT-IMA in terms of throughput. Compared to more traditional methods, CBDT-IMA achieves a throughput of 847.451 bits per second.

CONCLUSION

We introduced a data collection mechanism based on memetic algorithms for wireless sensor networks that are assisted by the internet of things (IoT) and employ a technique to improve network performance by collecting data from mobile sinks. An innovative clustering approach is part of the suggested method; for CH selection and cluster construction, it employs a memetic algorithm with Powell's conjugate slope techniques. The overhead of messages used to create clusters is drastically reduced. However, in order to limit data transmission energy loss, the memetic algorithm that uses the Powel conjugate slope technique determines the optimal number of CHs. A substantial decrease in end-to-end delay is achieved in the suggested method by having the mobile base station select the optimal data collecting channel to acquire data from many CHs. We have presented a range of simulation results to calculate the performance of the proposed scheme. In comparison to other algorithms, the suggested one achieves better results in several metrics, including throughput, energy usage, packet delivery ratio, packet loss, and network longevity.

REFERENCES

[1] Ado Adamou Abba Ari, Nabila Labraoui, Blaise Omer Yenk and Abdelhak Gueroui "Clustering algorithm for wireless sensor networks: the honeybee swarms nest-sites selection process based approach" International Journal of Sensor Networks, pp(1-15),2016.
[2] Vrajesh Kumar Chawraa and Govind P. Gupta "Load Balanced Node Clustering scheme using Improved Memetic Algorithm based Meta-heuristic Technique for Wireless Sensor Network " International Conference on Computational Intelligence and Data Science (ICCIDS 2019) ,pp(468–476),Elsevier-2020.
[3] Perumal and Dr.K.Meenakshisundaram "An Energy Efficient based hybrid clustering(EEBHC) approaches in Wireless Sensor Network" International journal of Engineering and Technology(IJET), Vol.7(2.31),2018.
[4] Er. Pankaj Bajaj "Efficient Cluster Head Selection in Wireless Sensor Networks using Bacteria Foraging Optimization" International Journal of Engineering Research & Technology (IJERT), Volume.5(11),pp(1-6), 2017.

[5] Walid Osamy , Ahmed M. Khedr, Ahmed A. El-Sawy, Ahmed Salim and Dilna Vijayan “IPDCA: Intelligent Proficient Data Collection Approach for IoT-Enabled Wireless Sensor Networks in Smart Environments” pp(1-28), Electronics – 2021. https://doi.org/10.3390/electronics10090997.

[6] Chuan Zhu, Kangning Quan, Guangjie Han and Joel J.P.C. Rodrigues. “A High-Available and Location Predictive Data Gathering Scheme with Mobile Sinks for Wireless Sensor Networks”, Computer Networks, Vol. 145, November 2018.

[7] Chunlin Li, Jingpan Bai, Jinguang Gu, Xin Yan and Youlong Luo. “Clustering Routing Based on Mixed Integer Programming for Heterogeneous Wireless Sensor Networks”, Ad Hoc Networks, Vol. 172, April 2018.

[8] Gurbinder Singh Brar, Shalli Ra,i, Vinay Chopra, Rahul Malhotra, Houbing Song and Syed Hassan Ahmed. “Energy Efficient Direction-Based PDORP Routing Protocol for WSN”, IEEE Access, Vol. 4, June 2016.

[9] Jianhua Huang, Danwei Ruan and Weiqiang Meng. “An annulus sector grid aided energy-efficient multi-hop routing protocol for wireless sensor networks”, Computer Networks, Vol. 147, December 2018.

[10] Jianhua Huang, Yadong Hong, Ziming Zhao and Yubo Yuan. “An energy-efficient multi-hop routing protocol based on grid clustering for wireless sensor networks”, Cluster Computing, Vol. 20, June 2017.

[11] Mbanaso. U. M and Chukwudebe. G. A. “Requirement Analysis of IoT Security in Distributed Systems”, 2017 IEEE 3rd International Conference on Electro- Technology for National Development (NIGERCON), IEEE, Vol. 5, Issue 7, February 2018.

[12] Moosa Ayati, Mohammad Hossein Ghayyoumi and Atiyeh Keshavarz-Mohammadiyan. “A fuzzy three-level clustering method for lifetime improvement of wireless sensor networks”, Annals of Telecommunications, Vol. 73, March 2018.

[13] Ranida Hamidouche, Zibouda Aliouat and Abdelhak Gueroui. “Low Energy-Efficient Clustering and Routing Based on Genetic Algorithm in WSNs”, Springer, Mobile, Secure, and Programmable Networking, January 2019.

[14] Se-Ra Oh and Young-Gab Kim. “Development of IoT Security Component for Interoperability”, 2017 13th International Computer Engineering Conference (ICENCO), Vol. 12, Issue. 4, February 2018.

[15] Yiqun Zhang, Li Xu, Qing Dong, Jingcheng Wang, David Blaauw, and Dennis Sylvester. “Recryptor: A Reconfigurable Cryptographic Cortex- M0 Processor With In-Memory and Near-Memory Computing for IoT Security”, IEEE Journal of Solid-State Circuits, Vol. 9, Issue. 3, February 2018.

[16] Fuchen Ma , Wanting Sun , Yi Sun “A Cluster Head Allocation Algorithm in Wireless Sensor Networks” International Conference on Computer Systems, Electronics and Control (ICCSEC), pp(1412-1415), IEEE-2017.

[17] Jeng-Shyang Pan , Fang Fan, Shu-Chuan Chu , Zhigang Du and Huiqi Zhao “A Node Location Method in Wireless Sensor Networks Based on Hybrid Optimization Algorithm” Wireless Communications and Mobile Computing,pp(1-14),2020, https://doi.org/10.1155/2020/8822651.

[18] Purnendu Shekhar Pandey, Dr. D. Eswara Chaitanya, Dr. Vinodh Kumar Minchula, D Sreekanth, Dr. V.Premchandran, Dr.Keerthika T “IoT-Enabled Wireless Sensor Networks for Controlled and Safe Routing” International Journal of Aquatic Science(IJAS), Vol.12(2),pp(1712-1718) 2021.

[19] Begum Seema, Nianmin Yao, Anil Carie and Syed Bilal Hussain Shah “Efficient data transfer in clustered IoT network with cooperative member nodes” Multimedia Tools and Applications, pp(1-11),Springer- 2020.

[20] Dhouha El Houssaini , Sabrine Khriji , Christian Viehweger, Thomas Keutel and Olfa Kanoun “Location-Aware IoT-Enabled Wireless Sensor Networks for Landslide EarlyWarning” pp(1-18),Electronics - 2022.

[21] Farman, Haleem, et al. "Multi-criteria based zone head selection in Internet of Things based wireless sensor networks." *Future Generation Computer Systems* 87 (2018): 364-371.

[22] Ahmed, Nurzaman, Debashis De, and Iftekhar Hussain. "Internet of Things (IoT) for smart precision agriculture and farming in rural areas." *IEEE Internet of Things Journal* 5.6 (2018): 4890-4899.