DYNAMIC CLUSTERING IN WIRELESS SENSOR NETWORKS USING HYBRID JELLYFISH OPTIMIZATION-LEACH PROTOCOL

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ABSTRACT. WSNs are usually equipped with a large number of sensor nodes that are designed and deployed to distribute and distribute the required data. Although sensors are sometimes deployed in remote environments, it is essential to identify a cluster head(CH) with an energy-efficient technique for transferring data in WSN. Cluster head selection algorithm is becoming a significant and challenging problem in WSN. This research presented a hybrid Leach with jellyfish algorithm for cluster head selection and an energy-efficient Heuristic Moth Search Algorithm (HMSA) to find efficient paths for transferring data to base station(BS).This technique avoids congestion with less guaranteed delays and maintain the energy efficiency of WSNs. The cluster head (CH) determines the residual energy on the basis of an optimum fit function assessed on the basis of strategic parameters such as distance between adjacent nodes and the centre. It can significantly reduce the number of dead nodesand reduce energy consumption. The HMSA method has been used to determine the best route for data transfer to the base station once the CH selection is complete. The entire WSN field is divided into several subdivisions, and each section chooses the designated target by measuring the transmission distance. The proposed approach has been assessed analytically, and results are compared with those related to conventional methods, namely HEED, FACER and EACBM, in terms of WSN Quality of service (QoS). The suggested approach demonstrated better performance in the number of live nodes and energy consumption than conventional algorithms.

Keywords: Jellyfish algorithm, HMSA approach, Cluster head, Routing protocol, WSN.

1. INTRODUCTION

WSN typically contains a vast number of energy-limited sensor nodes (SN). WSN captures various parameters evenly distributed over a specific region and transfers the data to the gateway (BS) to control and monitor the application. The sensor networks were extensively used for surveillance applications, defense, intelligence, public health, etc. Since WSNs are frequently used in hazardous environments, it is difficult to charge or replace SN batteries. Manual network management is also quite difficult in the implementation of WSN. To address this problem, the effective usage of rechargeable batteries by SNs will be seen as a specified aim while experts are designing protocols and hardware architectures [1].

WSN is a set of multiple sensor nodes (SNs) distributed in a specific region. The node of the sensor has a continuous power supply. In general, the sensor is critical, and the periodic replacement of these batteries randomly selected in a limited environment is not carried out. SN can only be relieved until the battery is running out. Battery life can be improved by allowing efficient use of resources for the processing of various tasks. The first WSN nodes that die prematurely due to energy depletion cause a grid problem [2]. In general, the WSN node uses more power during data transmission than processing and sensing [3]. Some techniques have developed communication with several hopes to reduce the distance traveled [5, 6]. Several routing protocols have been

developed to allow multi-hop to operate on various tactics, such as data-centric, regional location-based, cluster-based, and hierarchical [7]. The data-centric protocol enables the transmission of data between a node and the BS via a transmission node [8]. This type of protection detects data and eliminates packet data transmission.

Cluster-based hierarchical routing protocols are reducing WSNs. LEACH (Low Energy Adaptive Cluster Layer) is often recommended, as is the architecture protocol specific to WSN applications. However, the LEACH protocol, a variation of cluster head-based configuration (CH), has the potential to increase network energy consumption [9, 10].The new HEED protocol for non-uniform clusters for the sensor network is expected to improve the network's lifespan. The HEED and the different variants of the existing HEED protocol are performed in energy consumption; the first node dies concerning the cluster radius and the number of live nodes [11].

The selection of optimal cluster head considers four main criteria such distance and residual energy distance between the neighbor node and the central CH. To find the optimal CHs, a new hybrid algorithm integrates the dragonfly and firefly algorithm concept [12]. GWO has been adapted to suit WSN's special CH selection features. The purpose of the proposed formulation function takes into account the average cluster distance remaining energy CH balance factor and sinks distance. It aims to demonstrate a useful method for selecting a CH in WSN to increase network efficiency [13].

Several researchers have researched cluster routing protocol algorithms in past years and made significant advancements in energy consumption and network life. In particular, routing cluster algorithms include LEACH, HEED, FACER and EACBM algorithms, etc. The general premise of cluster routing protocols is to lower the amount of CH data transmissions. LEACH was merged the undisputed access of TDMA with the cluster concept in WSN and proposed a cluster route algorithm [14]. The critical problem in LEACH routing WSN is the effective energy consumption [14].

An effective method for selecting cluster heads and proposing a consistentand energy-efficient WSN protocol. Many cluster-based routing protocols are introduced for WSN. Still, these protocols have inherent drawbacks in defining an accurate radio model for SNs and CHs in the network region. Due to the variable of CH in the network field, the limits of WSN routing protocol were slight interruptions in the base station network area [15].

This article highlights the importance of cluster head selection and efficient path selection and privacy for congestion prevention in the WSN by introducing an HMSA approach that uses a jellyfish approach located in the center of the clock nodes and practically located tentacle nodes. During the first step, efficient clustering and CH selection process was carried out using a hybrid leach with a jellyfish algorithm based on the residual energy factor, and distance between neighbor node and CH. In second step, the destination nodes will send data to the well using the Energy Efficient Heuristic Hybrid Moth Search Algorithm (HMSA) and find efficient path selection with alternative routes. This approach may be sufficient for efficient data routing strategies. These work major contributions are organized as follows.

a. Due to the design of the WSN, we have introduced an Energy Efficient Heuristic Moth Search Algorithm (HMSA) for efficient routing based on the optimum routing route and data packets with less delay.

b. To optimize cluster size and CH selection, we developed a LEACH jellyfish respiration algorithm based on residual energy, distance between sensor nodes, and link quality.

c. The proposed scheme effectively finds the efficient path selection for routing methodology in WSNs. Finally, the proposed system provides numerical results showing that greater capacity and longevity can be achieved than conventional approaches.

The rest of the work is summarized as follows. Related works are described in section 2. The proposed CH selection and routing algorithms described in Section 3. Section 4 shows the performance analysis and evaluation of demonstrated results. Finally, conclusion of work in section 5.

2. LITERATURE SURVEY

Turkey AliAlgamdi [12] presented a new collection model with optimal CH taking into account four basic criteria: energy delay, distance, real-time node analysis, standardized network impact, risk analysis, algorithm analysis, and statistical analysis were performed.Furthermore, the objective characteristics are distance and delay and other limitations relevant to improve performance can be considered. Although adaptive algorithms deem it appropriate to solve the problem of implementing context sensors, the algorithm has an effect on initialization and iterations.

Deepika Agrawal et al. [13] discussed an effective method in RSSF to select cluster heads to increase network life. The Gray Wolf Optimizer (GWO) was used to do this. In this paper, GWO is modified and select CH in WSN. The purpose was to take into account the distance of residual energy from the cluster's average well and the CH equilibrium constant.

PenghuaXie et al. [14] concluded that the LEACH protocol is an integral part is often used, but it also presents many challenges and limitations. The main limitation is that performance and network lifespan is limited. A LEACH-based game algorithm with improved energy efficiency is proposed. The advantages of common algorithms are Cucumber Search Algorithm (CS) Firefly Group Optimization (GSO) and Bacterial Foraging Optimization (BFO).

Mohammed Almazaideh et al. [16] performed efficient load balancing with a predetermined reliability constraint. First, the author presented a mathematical analysis to select relay nodes based on residual power and reliability. Second, maximizes the remaining energy at nodes below the MMREP confidence limit. Third, Introduces entropy function for measuring the consistency of residual energy distribution. The path is selected the entropy of remaining energy.

Jin GU Lee Et Al [17] suggested that the choice of Cluster Manager (CH) is important to ensure energy efficiency in RSSF-based cluster protocols. In many previous studies, after finding the perfect place for CH, the nearest node was selected as CH. The ideal position and the actual position of the CH node can affect energy efficiency.Theenergy-based group head selection and spider monkey-based sampling, which is a CH selection in the actual node position by sample.A modified SMO algorithm obtained by the ideal sampling of CH.

Sai Wang et al. [18] reported that the development of group algorithms is becoming an important and complex topic in UWSN based on instant messaging.To improve efficiency, unlike conventional methods, which are affected by the constant movement of waves and traffic loads in the network, we examine the Voronoi diagram and the grouping algorithm according to node density distribution.Specifically, we proposed an algorithm for the automatic configuration of the "jellyfish" process and sensory nodes to select CH.

Shalli Rani et al. [19] Genetic and meteorological algorithms are dependent on fitness funtion. The enhanced training function can improve the quality of the RSSF service. The target sequence distance vector (DSDV) using the genetic algorithm (GA) and then optimizing the BFO search. The hybrid method is also used in GA-DSDV and DSDV-BFO, proving that the hybrid method was superior to technology alone.

MdEnamulHaque et al. [20] proposed a new Dynamic Energy Conservation Protocol (DEER) that provides message delivery, maximum network life and message flow. DEER Maximum remaining energy exceeds a specified power level sends messages from source to destination using these specific nodes in real time.The proposed method is evaluated using a realistic channel model and compared to the actual hop algorithm of the Dijkstra algorithm and the random / flexible algorithm. The protocol proposed by Kavita Jaiswal et al. [21] improves network performance and service quality by using an OF-based routing method to send data to the source and destination, choosing the ideal route.The protocol takes into account 3 parameters to develop the the ideal route, namely: the life of the node, the intensity and reliability of any traffic.

Liangrui Tang et al. [22] proposed a robust and efficient energy routing algorithm based on the Dempster-Shafer theory (DS-EERA). It identifies 3 distinct indicators such as test, remaining energy, traffic and proximity to shortest route. The following entropy weighting method was applied to accuratelydefine the weight of the three indicators. By setting Basic Probability Assignment (BPA), black theory of the DS bias, and combining BPA with each index value to determine the next step.

SatyajitPattnaik et al. [23] proposed the assimilation of a fuzzy data collection approach and an elephant grazing optimization (EHO) algorithm for efficient management of the MSSR.This paper also considered the separate joints of stationary and mobile wells to decrease energy consumption.

The choice of CH follows a widely accepted approach in terms of residual energy, node centrality and nesting of neighbors.

According to BingZengs [24], one of the best meteorologists to solve this problem is the Harmony Search algorithm. This article proposed a new energy aggregation and based on an appropriate search algorithm for improving WSN's energy efficiency. The suggested procedure consists of two parts: the collection stage and the process stage. First, a new goal function model was created the energy balance and redistribution measures of common nodes.

Tooretal.proposed an effective multi-energy strategy based on high energy efficiency groups (EACBM) has been proposed. This strategy capitalizes on the knowledge of aggregation and stair communication to reduce energy consumption. The recommended program applies to existing routing techniques running on the MATLAB platform. A more advanced system ensures the performance, stability and energy efficiency of heterogeneous networks [25].

Nanda et al. Fuzzy A-Star Economy Routing (FACER) was created for RSSF. The FACER strategy was used from source to node to find optimal path.SN routing is discovered in an uncovered way. The term turbulence is used to select CH. You can use search procedure A to find the shortest path. The proposed structure is appropriate and ideal, as it uses the asterisk method [26].

Priyadarshini et al. Distributed Hybrid Energy Saving Technology (HEED) cited by WSN. In the diagram, the SNs are evenly distributed. The main requirements for a sensor network are extended system life and energy efficiency.The grouped heterogeneous form uses an innovative HEED procedure to lengthen the life of the RSSF system.The proposed HEED compares with several existing protocols that provide better node network performance like packet radius, power loss and large number of active nodes. Improved HEED offers a longer lifespan and higher energy efficiency than other existing methods [27].

2.1 Problem statement

WSN contains sink and many SNnodes. Each node transmits a message to the cluster's CH. Therefore, it takes low congestion, low energy consumption and low latency to move from the transmitter to the receiver. The node of the sink serves as a receiver. It is necessary to choose the shortest path to send a message. Also, there are many other potential links. The route schedule is also necessary to select the shortest route. Efficient Path selections are significant tasks in the routing scheme. The transport node is looking for an alternate route to send messages to the sink node. CH selection and shortest search results are part of the main purpose of the routing method. In order to solve above two issues, a hybrid LEACH with a Jellyfish approach for CH selection and an effective HMSA-based routing algorithm for data transmission is proposed.

3. PROPOSED MODEL

The preferred WSN model involves the group of SNs, clustering, selection of CH and routing. In clustering, CH selection and energy efficiency is essential issue in WSNs. Efficient CH selection and optimal path selection approaches are used to achieve WSN QoS metrics through routing mechanisms. The hybrid Leach with jellyfish breathing process algorithm is used to select CH. This research was to provide WSN with the least amount of energy. They chose CH to reduce SN power consumption for efficient data transmission.In this work, efficient path selection is performed based on the Heuristic Hybrid Moth Search (HMSA) protocol Latency output has been reduced and the throughput have been improved. The overall energy consumption is relatively low and the life of the network will be enhanced. The overall structure proposed is shown in Figure 1.
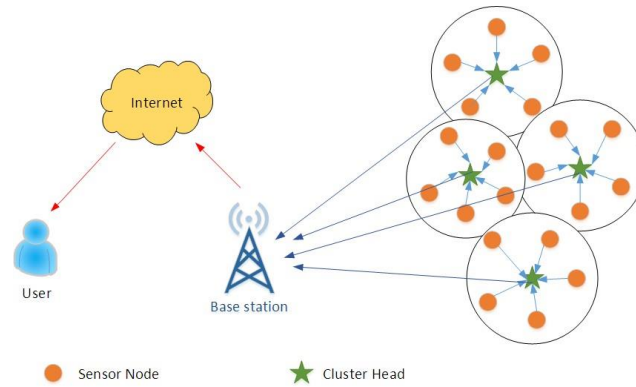

Figure 1: Proposed WSN Architecture

3.1 System model

In this model, three energy utilization parts are considered for n bits transmission of data. The energy transmitter E_{tr}, the energy receiver E_{rxr} and energy packet exchange acknowledgement E_{ack} is described by following equation (1-3)

$$E_{tot} = E_{txr}(n,d) + E_{rxr}(n,d) + E_{ack} \tag{1}$$

At transmitter, the energy consumption is determined as,

$$E_{txr}(n,d) = n.E_{elec} + E_{amp}(n,d) \tag{2}$$

The distance between transmitter and receiver is formulated by

$$E_{txr}(n,d) = \begin{cases} nE_{elec} + n \in_{fs} d^2 if d < d_0 \\ nE_{elec} + n \in_{mp} d^4 if d \geq d_0 \end{cases} \tag{3}$$

Where n= the number of bits and d= distance between transmitter and receiver

During the transmission of the data, E_{elec} represents degenerated energy, E_{amp} is amplification factor of transmission amplifier. Every SN maximum transmission distance is represented by d_0. Its value is identical to $\sqrt{\dfrac{\in_{fs}}{\in_{mp}}}$.

At receiver, the consumption of energy is computed by,

$$E_{rxr}(n,d) = n.E_{elec} \tag{4}$$

The ACK packet transmission utilization energy is formulated by,

$$E_{ack} = r_{ack}(E_{txr} + E_{rxr}) \tag{5}$$

Where $r_{ack} = \frac{l_{ack}}{l}$ is the length of ACK packet. In x*x area , n nodes are equally dissminated with k clusters. It offers the n/k nodes per group. It has$\frac{n}{k} - 1$ non CH nodes and one CH node. The non CH node consumed energy is determined by

$$E_{non-ch}(n,d) = E_{txr}(n,d) = l.E_{elec} + E_{amp}(n,d) \tag{6}$$

The CH node energy consumption is formulated by,

$$E_{ch}(n,d) = E_{txr}(n,d) + \left(\frac{n}{k} - 1\right)n.E_{elec} + \left(\frac{n}{k}\right)n.E_{da} + \left(\frac{n}{k} - 1\right)E_{ack} \tag{7}$$

Where E_{da} is the CH's utilized energy. The cluster overall energy consumption is computed by

$$E_{cluster} = E_{ch}(n,d) + \left(\frac{n}{k} - 1\right)E_{non-ch} \tag{8}$$

The entire system utilization energy is formulated by,

$$E_{round} = \sum_{j=1}^{k} E_{cluster}(j) \tag{9}$$

The sensing field is considered to be a quadratic region in the network model. Currently, we make some essential assumptions as follows:

• All SNs have the same sensing capability, and the battery's initial current cannot be changed. If the sensor decreases its energy, it will be ineffective.

• The ideal position of the nodes is inconsistent and the data is communicated to the dynamics only.

• All nodes are familiar with other nodes through the exchange of information.

• The routing path for all nodes has almost the same communication features as all paths are related to the receiving node.

• The nodes of the sensor change the power according to the communications distance.

Each group has a header for a cluster (CH). All sensor nodes can communicate with the CH. The source path is important when transferring data from source to destination node.

3.2 LEACH Protocol

LEACH protocol is the first clustering routing method adopted by Heinzelman [28], consists of CH and a number of cluster members. Sensor nodes can only transmit via CH. The idea of LEACH is to extend the life of the networkandreduce energy consumption. The establishment phase and steady-state phase. There are two activities to be carried out in the installation phase. One is to select CH and the other is to define a reservation schedule for each group. CH requires more power to clear block activity and send data to the base station.As a result, the LEACH protocol continues to rotate from all sensor nodes to CH so that energy is absorbed evenly.

In each sensor node produces a random digit $R(R \in 0\sim1)$, and if $R \prec T(n)$, it will act as a CH node data. In every round, if $T(n) = 0$, it will be the head node with probability of $T(n)$ isformulated as follows (10),

$$T(n) = \begin{cases} \dfrac{p}{1-[p(rmod(\frac{1}{\beta})]}, & n \in G \\ 0, & other \end{cases} \tag{10}$$

Where P, r represents the ratio of CH nodes and num, $r$mod $(1/P)$ denotes the number of nodes selected over CH, and$G$representsgroup of nodes not selected over CH.

The sensor node communicates only with CH and allows the transmission of data only within the designated time slot calculated according to the CH point. Then the block head can send SN data to the base station. To save energy, each node turns off the RF module while it is within the transmit time slot range, indicating the minimum capacity needed to reach the master node.Also, the CH wants to connect to the nodes in the network at every time.

3.3 Hybrid leach with jellyfishalgorithm for CH selection

A sensor network has been set up to manage a growing volume of work by integrating the WSN nodes into a cluster. An energy-efficient, leach-based communication protocol that involves hierarchical clustering based on the information obtained by BS. The cluster head collects data from different cluster sensors, analyses them and sends them to the BS. The cluster head is selected and the data is sent in each round of the clustering network. The general premise of clustering routing protocol is to reduce the amount of CH transmitting data. The proposed LEACH hybrid jellyfish protocol is proposed for cluster head selection based on three factors such as distance, energy and link quality.This work proposes an assembly protocol that includes two important components. He developed a jellyfish breathing density algorithm to improve the initial cluster size. Secondly, we use the jellyfish algorithm to develop a Leach hybrid-based node tuning to obtain a sufficient number of chosen CHs as shown in Figure 2.
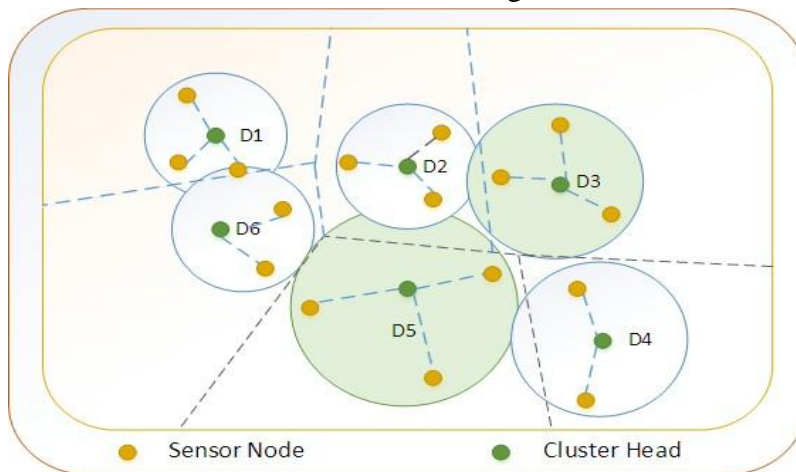

Figure 2: Proposed CH Selection Model

In the LEACH protocol, data fusion and exchange of information are the key components of node energy consumption divided into the TXD phase, the RXD phase and the data fusion phase. To minimize resource depletion through data transmission, the free space model and m-path

attenuation model (energy depletion D2 and D4) are used in the data transmission process by reducing consumption of energy.

It is advisable to classify the network into a predefined number of clusters. Both sensor nodes use CH to transmit information about their location and outstanding energy levels, forming a cluster with the appropriate number of cluster members (CMs) to each.In the next cycle, sensor nodes with large residual energy may become CH. To change the cluster size based on node density, the cluster sometimes runs a jellyfish breathing algorithm.

The number of N_m in circles formed by certain CHs and rearrange the number of redundant nodes by predefined parameters[M_{min}; M_{max}]. If number of CMs N_i in a cluster is smaller thanM_{min}, other normal nodes nearby CH will be allotted to cluster until $N_i$reaches M_{min} and vice versa.

Algorithm : Jellyfish Breathing Process
Input :MNs,CH$_m$, R$_{com}$, M$_{min}$, M$_{max}$
Output : Circle of region D$_m$
Contraction process:
If $N_m > M_{max}$ do
While ($N_1 > M_{max}$) do
$R^m = (1 - a)R^m$;
Update the circle region $D_m usingR^m$
Determine number of MNs $N_m intheD_m$
end while
end if
Extraction process :
If $N_m < M_{min}$ do
While ($N_m > M_{min}$) and $R^m \leq R_{com}$do
$R^m = (1 + a)R^m$;
Update the circle region $D_m usingR^m$
determine the number of MNs $N_m inthecircle$
end while
end if
return Circle region D_m

This paper presents an hybrid LEACH with jellyfish algorithm for CH selection. The improvement consists mainly of optimizing the selection of cluster heads. Initially, select head of the cluster using LEACH protocol. Next, a jellyfish algorithm is used to determine the residual energy, distance, and correlation quality for each group, and the optimal cluster core is selected based on three factors.The distance difference among the cluster node and the cluster header is small. The CH node is responsible for collecting and transferring data from all SNs to the BS. LEACH-explains three considerations for selecting CH with the algorithm for jellyfish.

The SN can reduce energy consumption and extend the life of SN. The input parameters are as follows:

Residual energy: If you select CH in accordance with the remaining energy, E$_i$ is the initial energy of the node. The energy consumed by node E (t) after period t is given by Equ. (11),

$$E(t) = n(n_{tpkts} * \alpha) + (n_{rpkts} * \beta) \tag{11}$$

where n_{tpkts} and n_{rpkts} is the number of packets transmitted and received. α and β are constants in the range of (0, 1).

The E_{res} of a node at time t is calculatedas following Equ. (12),

$$E_{res} = E_i - E(t) \tag{12}$$

After determining the optimal CH location using the jellyfish algorithm, the CH was selected based on the node's residual energy and distance from the ideal location. If the remaining node energy is higher than the average block residual energy and is close to the optimum position, select it at the official cluster header of the optimum position. The average residual energy using the formula given:

$$\text{Average energy} = \frac{\sum_{i=1}^{n} N(i)\_E}{n}$$

Where N(i)_E represents the cluster residual energy.

NC: This determines how centrally the selected CH is in the adjacent CHs of the entire network is formulated by following equation. (13)

$$NC = \frac{\frac{\sqrt{\overline{\sum d^2(C_i, j)}}}{T}}{M} \tag{13}$$

Where d (C_i, j) is he distancesbetween the CH node and its member nodes. T, M represent number of neighbors and dimension of sensing field area.

Distance:

$$f = \alpha_1. std(\sum_{i=1}^{M} D_{iN}) + \alpha_2.D_s \tag{14}$$

Where M represents number of nodes, D_{iN} indicates the Euclidean distance and node i, and $D_s$represents the Euclidean distance among individual and base station. $\alpha_1, \alpha_2 \in$ (0, 1) are constant weight coefficients of the two targets, and $\alpha_1 + \alpha_2 = 1$.

3.4 Heuristic moth search algorithm (HMSA) for routing

This paper presents the Meta-Heuristic Hybrid Moth Search Algorithm (HMSA) approach for efficient path selection in a network with balanced energy distribution consumption. Depending on the properties, the performance of various meta-heuristic (MH) algorithms has been established. The reason for using the meta heuristic (MH) algorithm is that it consists of simplicity, flexibility and regularity. Most MH algorithms are fast, simple to configure, and not too complicated by comparison. This method has a wide range of tools to cover various optimization problems that cannot be solved by conventional algorithms. Ergodicity means that multi-modal search spaces with good diversity can be identified by MH algorithms and local optima can be avoided at the

same time.It uses a synthesis method to increase the accuracy and reliability of the optimization process and reduce the cost of measurement as shown in Figure 3.
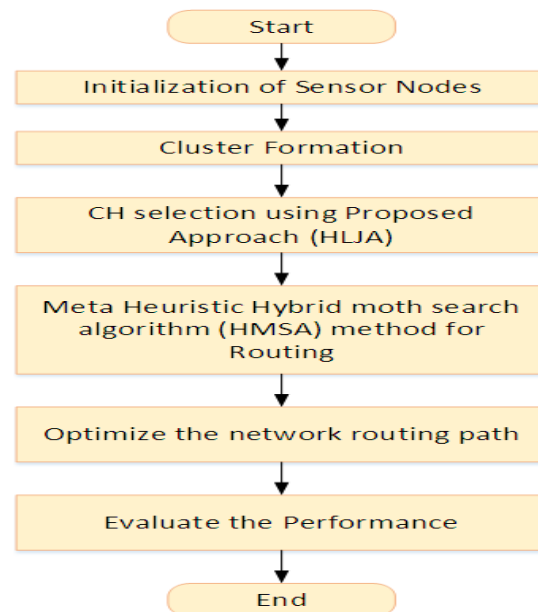

Figure3: Flowchart of Proposed Model

This section describes the process of transferring integrated data for each CH to BS. Here we use HMSA to determine the best route for network data transmission. The HMSA-based routing process involves three steps: the strategy of choosing a start path, and a change in the data transmission path.

3.5 Path Selection

Restrictions on node equipment and the varied quality of wireless networks are significant issues in maintaining a high standard of availability of services, in particular energy consumption. As mentioned above, routing solutions must use a load balancing mechanism to redirect traffic to boost quality standards (reduce latency) and reduce power consumption. In WSN/IoT applications, the major problem with load balancing and fault tolerance is the use of multipath to minimize network traffic across various routes. Multipath nodes use bandwidth aggregation as well as balanced energy usage to improve data transfer efficiency and performance.

3.5.1 Initialization

Depending on your location vectors, the HMSA can look for large-scale solutions. So the population needs HMSA and all accessible paths of CH to sink. In 2-D Cartesian space, ith CH in a path k has its own positions CHi, $k \in \Re$ ($i =1, 2, 3... n$). Each CH position in paths is stored in a matrix and it is formulated by equation (15),

$$CH_{pos} = \begin{bmatrix} CH_{1,1} & CH_{1,2} & \ldots\ldots & CH_{1,n}) \\ (CH_{2,1} & CH_{2,2} \ldots\ldots\ldots\ldots\ldots & CH_{2,n}) \\ : & : & : \\ : & : & : \\ (CH_{d,1} & CH_{d,2} & \ldots\ldots & CH_{d,n}) \end{bmatrix} \tag{15}$$

In Eq. (25), number of CHs is defined as n, d denotes number of paths and the dimension of ith CH is denoted as CHi,j. Each CH fitness function is calculated by Eq(16),

$$fitness\ value\ of\ CH = f(CH) \tag{16}$$

We focus here on three goals:energy, throughput and link quality to prevent SN failures and traffic control. The throughput of CH is expected by equation (17),

$$Th = \sum_{i=1}^{n} CH_i[DS_{CH_i}\ (Loc_{CH_i}, Loc_{BS})] \tag{17}$$

Here, the maximum size (bit / second) of the data transmitted from CH to BS is determined by CHi [DSCHi (LocCHi, LocBS) in the equation (17). CH data transmission speed is indicated by DSCHi, and CH and BS positions are indicated by (LocCHi, LocBS). Instead of estimating the node energy, the CH energy in the path is estimated. The quality of the link is expected according to the RSS (received signal strength) expected from the adjacent CH, and is composed as follows (18).

$$Link_Q = \begin{cases} Very\ efficient & if\ RSS < -10\ dBM \\ Efficient & if\ RSS < -20\ dBM \\ Bad & if\ RSS < -40\ dBM \\ Very\ Bad & if\ RSS < -60\ dBM \end{cases} \tag{18}$$

The CH fitness value is evaluated as follows (19),

$$f(CH) = W_1 \times Th + W_2 \times E_{Res} + W_3 + Link_Q \tag{19}$$

Where, W indicates weight factor, lie between 0 and 1. The fitness value is given by Eq. (20),

$$CH_{fit} = \begin{bmatrix} f(CH_{1,1} & CH_{1,2} & \ldots\ldots & CH_{1,n}) \\ f(CH_{2,1} & CH_{2,2} & \ldots\ldots & CH_{2,n}) \\ : & : & : \\ : & : & : \\ f(CH_{d,1} & CH_{d,2} & \ldots\ldots & CH_{d,n}) \end{bmatrix} \tag{20}$$

The position of BS is given as,

$$BS_{pos} = Loc_{BS}$$

Here, Loc_{BS} indicates the position of the BS.

3.5.2 Path selection strategy

The adjacent CH found, CH_i^{elitte} will be updated with the other CHs $X_{CH_{old}}^i$ and recognize the best path. It is given by equation (21),

$$P_{best} = CH_i^{elite} - \lambda_i \times (r \times (\frac{CH^{elite}+BS_{pos}}{2}) + X_{CH_{old}}) \tag{21}$$

CH_i^{elite} represents the position of newly found CH, and initial CH is denoted as $X_{CH_{old}}^i$, and r represent the random number that lies among 0 and 1. The coefficient at i^{th} iteration is denoted as λ_i is formulated by equation (22)

$$\lambda_i = 2 \times r \times PD \quad (22)$$

Where current density is indicated as PD and it is defined based on the sum of currently available hops is formulated by equation (23).

$$PD = (\frac{N_{CHs}}{N_{CHs}+N_{BS}}) \quad (23)$$

Where the sum of CHs and BS is denoted as $NCHs$ and NBS.

3.5.3 Data communication

Once the best is found, the communication process begins. While sending, it uses energy to send data packets to BS. Therefore, each iteration algorithm regularly monitors the route until data transmission begins. If a node cannot send data, that node will select an alternate path that is excluded from the path. Equation (24) conducts path adjustment.

$$P_{alt} = New_{P_{best}} \qquad\qquad if \ E_{Res}(CH_i) < \min threshold$$
(24)

In equation (32), if the CH energy is below the minimum threshold, a new optimal path is identified from the available path and is described as follows$ERes$ (CHi)< min threshold.Where, min threshold = Eneed (CHi, CHj). The force to move the data from the CH position to the next CH along the way is shown as Eneed (CHi, CHj).

Figure 5 shows the HMSA-based routing method. Finally, the optimal cluster was initialized by the proposed method and the successful CH was selected. This work contributes to improving the life of the network. Creating a cluster in the network area using an inconsistent clustering method according to SN density reduces the risk of creating a void cluster in the network and improves the scope and communication required for effective data transmission. The routing protocols HEED, FACER and EACBM. SN lifetime, throughput, delay, end-to-end delay (E2ED) energy consumption and output parameters of PDR were measured using 250 nodes for other traditional methods.

4 PERFORMANCE EVALUATIONS

The performance analysis of the proposed method will run on NS2 and compare with other conventional routing algorithms such as HEED, FACER, and EACBM. The parameters used during the implementation of the introduced algorithm are presented in Table 1. Analysis of the performance of QoS metrics such as energy consumption, throughput, number of dead node, network life, number of running nodes, and packet transmission rate.

Table 1: Parameter setup

Parameter	Value
Area	1000x1000m
Nodes	250
Range of nodes	30-40m
Initial energy	0.5J
Transmission range	30m
Packet size	512 bytes
Maximum rounds	2500
Clusters	Differ

Network lifetime

The lifetime of the system during which it can perform the dedicated task(s) is known as the WSN lifetime.

$$\text{Network Lifetime} = \frac{\sum_{a=1}^{p} M_{ab} * f_a}{q_b} \tag{25}$$

For *k*-coverage, *qb=k, b=* 1, 2….*n*. where *M,q* indicates coverage value and number of nodes. *f* represent life of Nodes. Figure 4 shows the strategy introduced and the lifetime performance of the existing algorithmic network. It evaluates whether the introduced algorithm can achieve a higher (5500 rotation) WNS lifetime than other algorithms. HEED, FACER and EACBM conventional algorithm systems have a lifetime of 4300, 4800 and 5000 cycles respectively.
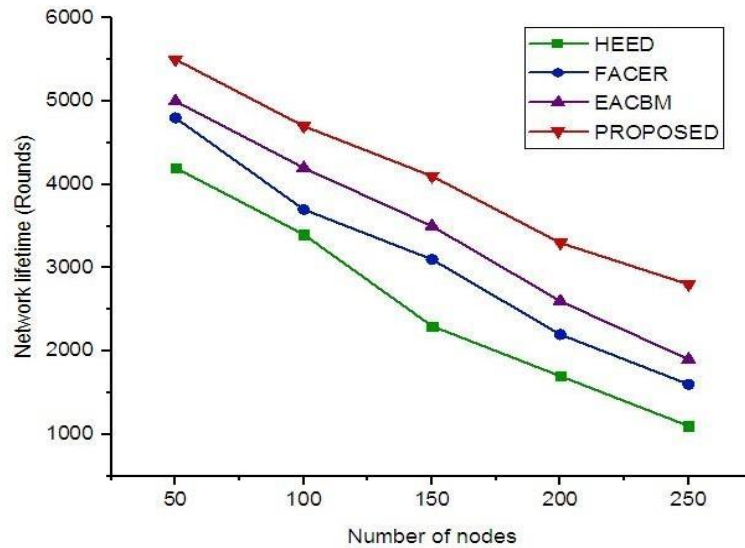

Figure 4: Network lifetime

Energy consumption

The amount of energy used up by the SN of the network, given by Equation (26).

$$Energy\ Consumption = [\sum_{n=1} CH_E(n) + \sum_{m=1} CM_E(m)] \tag{26}$$

Where the energy utilized by CH is described as $CH_E(n)$. Figure 5 shows the force used for different task processing techniques across different node units. When the proposed method consumes up to 2.4mJ of energy modules for 250 nodes, HEED, FACER and EACBM based

schemes use 3.1mJ, 2.9mJ and 2.8mJ of energy for 250 nodes respectively. The energy consumption rate of the proposed method was reduced by 21.9% compared to the 250 node EACBM algorithm.
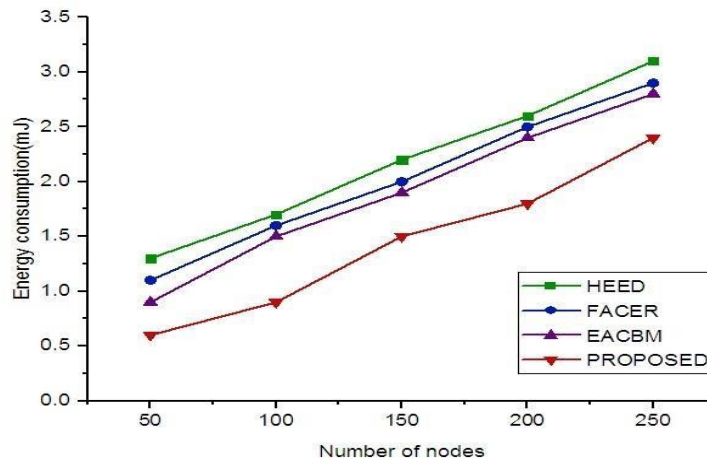

Figure 5: Energy Consumption

Throughput

It is the relationship between number of packets received at receiver and the delay in sending a packet by eq. (27),

$$Throughput = \frac{Number\ of\ packets\ received}{delay} \tag{27}$$

Figure 6 shows the desired procedure and the processing power of an existing system. This figure clearly shows how developed technology is powered by expression. The proposed method achieves a higher (0.85Mbps) throughput than other conventional methods. Throughput improves with increasing number of SNs. The processing power of HEED, FACER and EACBM conventional methods is 0.62, 0.72 and 0.78 Mbps respectively.
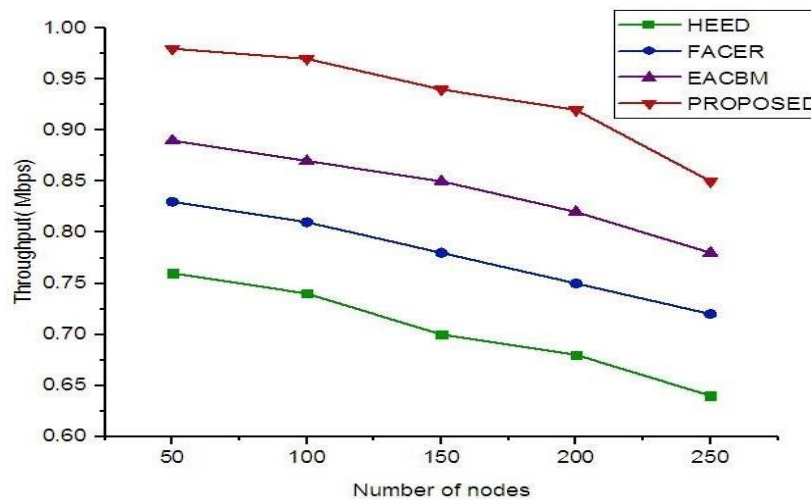

Figure 6: Throughput

Latency

The total time to transfer data from the starting point to the last point is called latency. Figure 7 shows the EACBM, FACER and HEED proposals and delays in existing schemes. The simulations running the proposed system achieved low (12.6 seconds) latency for other methods. As the SN increases, the waiting time increases. The waiting times for HEED, FACER and EACBM conventional methods are 16.3 seconds, 14.7 seconds and 13.2 seconds respectively.
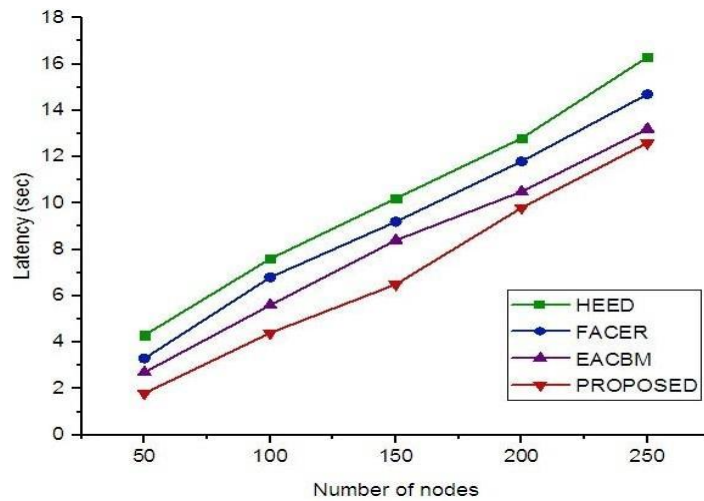

Figure 7: Latency

Packet delivery ratio

PDR is the sum of the packets obtained from receiver with the sum of the packets sent by sender by eq. (28),

$$Packet\ delivery\ ratio = \frac{\sum Number\ of\ packets\ received}{\sum NUmber\ of\ packet\ sent} \times 100\% \qquad (28)$$
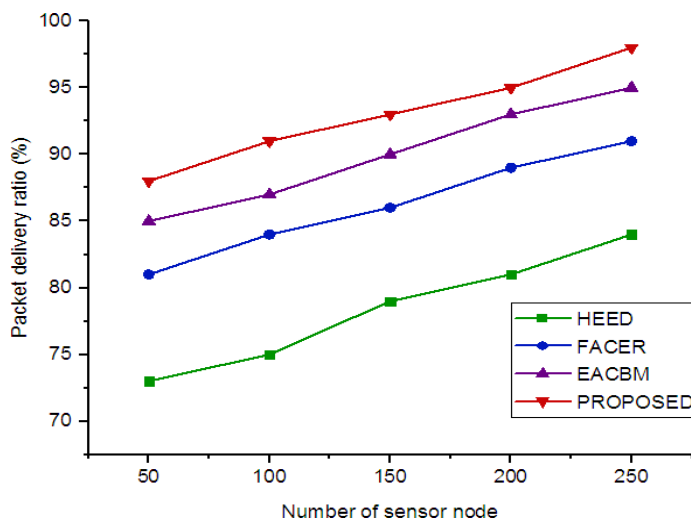

Figure 8: Packet delivery ratio

Figure 8 shows analysis of the proposed and conventional PDR. The proposed method achieved a 99% PDR related to conventional systems. PDR will increase with increasing SN. The PDRs of HEED, FACER and EACBM conventional methods are 90%, 95% and 95% respectively.

Number of dead nodes

This parameter records network node sensor and has no power to operate, it is given by equation (29).

$$N^i_D = E^i_{Res}(n) \leq 0 \qquad\qquad (29)$$

A comparison of network dead SNs while processing a series of rotations using several routingmethods is shown in Figure 9.Normally, nodes within the network stop while processing work. Here, even after handling 2000 cycles, the HMSA-based routing method did not lose nearly 70 nodes, but otherwise, more than 100 nodes were lost in the processing cycle. Upon completion of the 2400 cycle, the number of SNs killed in the proposed scheme was 110 and 160,210,250 in HMSA, EACBM, FACER and HEED respectively.
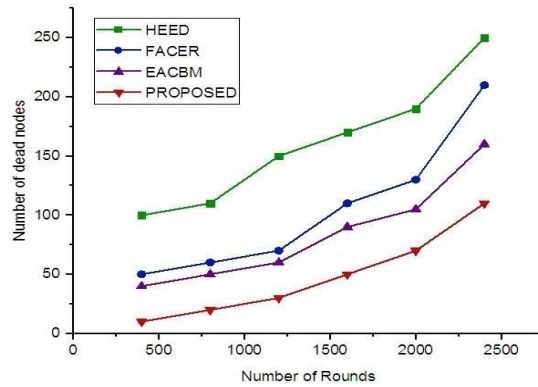

Figure 9: Number of Dead node
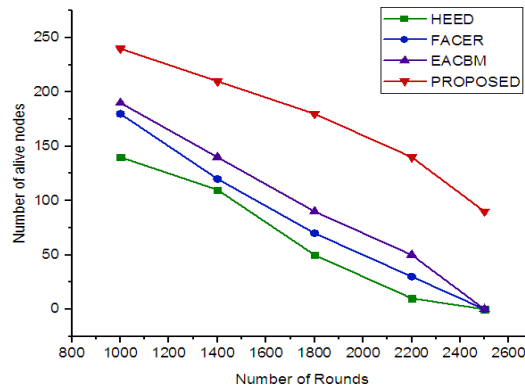
Number of alive node

Figure 10: Number of Alivenode

Figure 10 shows the number of live sensor nodes during multiple rounds. The current HEED algorithm gets a very low active node with 21 active nodes after only 2500 rounds. All of the 1800 rounds were completed and 180 nodes were kept active. After 2500 nodes have been completed, there are 50, 70, and 90 active nodes for HEED, FACER and EACBM, respectively. The incorporated method includes the EACBM model to achieve by about 24,4% over 2500 rounds.

5 CONCLUSIONS

This article proposes a novel approach known as HMSA. Solves short sensor node life in the vicinity of the base station. The poor life time of the sensor node is due to the high traffic movement. Hybrid jellyfish with LEACH algorithms use a non-powered block head selection method based on various purposes such as affordability, cost and residual energy. HMSA is used to select the optimal path for the blockhead pelvic nodule.The performance of HMSA is compared to the optimization-based algorithm. The HSSA routing method showed the results. The quality of service scale is better than the traditional one. The results demonstrated improvements in packet delivery speed, energy efficiency and throughput over other conventional technologies.

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