Pigeon Inspired Optimization Based Centroid Selection in TGVFCMS for Energy-Efficient Wireless Sensor Network

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***Abstract*—Wireless Sensor Network (WSN) includes large quantities of sensing node used in various situations to collect data. WSN considers applications to collect data from remote locations, for example in environment surveillance, military, transport protection, etc. An energy efficient routing protocol is essential to handle the discharged electricity of the system and to minimize traffic and upstairs during data broadcast phases to fulfill the sensing, communication and processing tasks of the WSN. The biggest problem in the WSN is that energy resources are small. In this study, an energy-efficient routing protocol improves energy efficiency with the life span of sensor nodes by using optimization algorithm Pigeon Inspired Optimization (PIO). Clustering technique i.e. Total Generalized Variation Fuzzy c-means clustering (TGVFCMS) is used to select the Cluster Head (CH) and CH folds and bandage the information and direct it to the board node. By its fitness feature, PIO helps to initialize the centroid. After MATLAB simulation, the energy consumption rate was reduced to 25.03% while using PIO. Finally, comparisons are made between the work proposed and the existing current work to assess the effectiveness of the work proposed.**

***Index Terms*—Cluster head, data transmission, energy consumption, energy-efficient routing protocol**

I. Introduction

WSN is a series of wireless nodes frequently distributed randomly over vibrant environments in a targeted location [1]. These can sense, procedure, and transmit information to nearby nodes and base stations (BS) [2]. In addition, these gadgets have limited capabilities, including limited memory, limited computation, and limited resources (usually equipped with batteries). To cover a large area, the sensor nodes must be spread out over a large sum of nodes. The sensor is mounted in the node and is sensed by the sensor unit and then sent via the radio to the base station (called sink), i.e., pressure, temperature, humidity and electrical signals [3]. The sink is situated among the user and the network and collects information from the nodes [4].

The WSN was recognized as most significant 21st century knowledge's. The Internet can be connected to controlling and monitoring the surrounding areas, houses, offices, towns and hence forth [5] has built-in sensors, wireless connectivity, and the ability to maintain order on its own [6]. WBAN-Wireless Body Area Network [7] nodes can be put on the crushed (under water), on the body, in the air, in structures, and even in vehicles [8]. To create WSN communication capabilities, researchers and the industry have been working diligently since 2001, using sensors [9] in a diversity of various know-hows such as IEEE 802.11, PDA, VANET, cellular and IoT [10].

Different hierarchical practices have been projected in WSN to make effective use of available resources, especially battery. The aim is to attain energy efficiency and maximize the life of the network [11]. Clustering is the most common method for achieving these goals in hierarchical routing. Researchers have proposed different protocols in the literature, but further research is needed on issues such as energy improvement and charge balancing [12]. Wireless sensor networks route is more demanding, because WSN is restricted by resource [13] various wireless networks. Therefore, new routing mechanisms are being created to address the issues at WSN, taking into account the application requirements design.

Because of frequent topological network changes the maintenance of the routes is an important problem and can lead to high energy consumption if not fully processed. Different routing techniques have been introduced, topological structure, reliable routing scheme and communiqué model arrangement can generally be

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divided into four classes. Fixed and hierarchical protocols are the structure for the network. In flat networks, the multi-hop routing processes with which every sensor node plays the same role cooperate with each other. It is not possible to have a data-centered routing for each node because the BS needs from sensors in a particular region are considered to be flat routing. The flat approach has certain advantages, such as the absence of topology and the provision of quality connections from source to destination. Flooding is a costly energy consumption activity for flat networks, however. In addition, due to redundant messages, the flat network induces a high usage of bandwidth and a high delay in uniform energy consumption.

In hierarchical methods, nodes are grouped and a cluster head, which is accountable for routing, is chosen according to certain parameters. When it comes to hierarchical routing, two-layer systems are the norm, with one layer for the physical environment and one layer for the routing. In addition to sensing, high-energy nodes are employed to capture data, aggregation and transmission. Scalability and effective communication are the most commonly used energy saving techniques. Hierarchical methods based on clusters have some benefit including increasing scalability. Effective data aggregation and bandwidth of the channel are used effectively. The key issue with clustering is non-uniform clustering, leading to high energy dispersion of the sensor node, an increase of entire energy, and a failure to guarantee network connectivity. This work focuses on reducing energy consumption by means of clustering schemes.

The implementation of Swarm Intelligence-based algorithms is a way to fight this situation by developing clustering and routing techniques [14]. Biological performance of swarms will generate collective intelligence. The swarm is a colony of social insects, flocculation of birds and fish education. Each swarm is an independent entity that works together to accomplish certain tasks necessary for the colony's survival. These basic and robust conducts were implemented effectively in the context of WSNs through the identification and modeling of some similarities among the two schemes. Pigeon Inspired Optimization (PIO) is a swarm intelligence optimization technology which uses the stimulus to find the shortest way, recently becoming an attractive other in WSN networks. In this study, TGVFCMS is used for selecting the CH, where PIO is used for initialization. The validation of the research study is conducted with existing techniques are labeled in the results section.

II. Literature Review

Several energy-efficient cluster-based route algorithms were proposed to reduce WSN node energy consumption in [15]. LEACH has grouped the entire clusters [16] of different sensor nodes as one of the conventional schemes. However, no assurance on the location and sum of CHs [17] was given under the LEACH Protocol. Another difficult problem in WSNs is node deployment [18]. The main goal of the Path Development Scheme (NDPDS) proposes a new Mountaineering node implementation scheme [19]. By creating additional tracks, NDPDS prevents the energy hole issue and decreases the broadcast delay.

Optimization methods solve efficient routing problems and some bio-inspired clustering approaches are well investigated.

Duan *et al.* [20] inspiring from PIO, proposed a pigeon-homing behavioral swarm procedure that has achieved remarkable achievements in different areas in recent years, including unmanned air vehicle formation (UAV), swarm control parameters and image processing.

Energy-efficient uneven clustering (EEUCB) was proposed by Jasim *et al.* [21] and makes use of minimum and maximum distance to cut down on unnecessary power use. Moreover, EEUCB has developed a clustering rotation approach with two stages, intra- and inter-clustering procedures, that takes factor-based and UDCH the proposed EEUCB protocol improves lifespan by 57.75%, 19.63%, 14.7%, and 13.06%, respectively.

By analyzing the unique set of characteristics that each SN possesses, Kumar *et al.* [22] projected a method for identifying malicious nodes (MNs) in WSN. By selecting the Cluster Head (CH) based on the sensor's remaining energy, this study not only considers security. In the Malicious Nodes Detection (MND) phase, the MN are detected by the Improved Deep Convolutional method, the Trusted Nodes (TN) are organized into groups, and then the t-Distribution based Satin Bowerbird Optimization (t-DSBO) algorithm chooses a CH for each group based on the residual energy of the nodes in that group. Information from that cluster is sent to the BS through the CH. If the power of the current CH suddenly goes out, the t-DSBO will switch to different CH. Experimental evidence shows that the offered methods successfully detect the MN and provide DT while using minimal energy.

Jain *et al.* [23] introduced Harris hawk optimization (HHO) based techniques, together known as HHO-UCRA, to address the hot-spot problem. First, an HHO-based approach for selecting CHs was presented. The clustering process then makes use of the CH Assignment function, which was derived from it. For both algorithms, we have developed efficient hawk encoding systems and unique fitness functions using the HHO based methodology. All possible WSN situations are simulated, and HHO-UCRA is run in each one, with a different number of sensors and control nodes (CHs). In order to demonstrate the effectiveness of the proposed algorithm in terms of WSN benchmark indicators like network energy consumption, lifetime of network, convergence rate, data packets received by the BS, and the number of a

To extend the life and improve the functionality of networks, Rawat *et al.* [24] presented a protocol for energy-efficient clustering that is based on particle swarm optimization (PSO-EEC). Particle swarm optimization is used in the proposed protocol to choose which nodes would serve as the network's cluster head and relays. The fitness function used in particle swarm optimization to determine which node should serve as cluster head takes into account the nodes' energy ratio (starting energy to residual energy), the nodes' distance from the cluster head, and the nodes' degrees. Using fitness values calculated from residual energy of the cluster head and distance to the base station as inputs, the proposed technique selects relay nodes for multi-hop data transmission to the base station. Energy consumption, network longevity, and throughput are only few of the performance metrics used to assess how well the suggested protocol performs in comparison to other existing techniques.

In this article, Juneja *et al.* [25] creates a protocol called Enhanced Mobile Sink-based Coverage The suggested EMSCOLER solves the coverage restoration problem optimally and keeps network transmission failures to a minimum. Both coverage restoration and Link Stability Estimation based Routing are part of this project's two stages (LSER). When a CH is found in the sensing field, the grid-based Red Deer Simulated Annealing (GRDSA) model relocates the redundant nodes to the hole area. In order to optimize the lifespan of the whole network and offer energy efficient routing, the LSER algorithm calculates an assessment of the connection quality and selects the relay nodes to transmit the data. The suggested protocol is implemented using the MATLAB software. CR, EC, average residual energy (ARE), moving EC, and network lifespan are used to evaluate the outcomes of the proposed EMSCOLER.

To assure the coverage and to extend the lifetime of WSNs, Idrees and Couturier of [26] created Energy-saving Distributed Monitoring based Firefly Procedure (EDiMoFA) Protocol. Each node in the ensuing compact areas runs the EDiMoFA protocol. The Firefly Algorithm (FA) is used for scheduling wireless nodes and is one component of the EDiMoFA protocol along with virtual network partitioning and dynamic distributed virtual region head selection in each area. There is a regularity to the EDiMoFA procedure. There are two phases that make up each period: the steady-state phase and the monitoring phase. During the monitoring phase, the sensing field in each virtual region will be supervised by the best sensor devices schedule generated by the FA.

A. Problem Statement

New developments in research have been guided today by the growth of the WSNs. Technologies for the production of low-cost and small sensors were available via micro electro mechanics (MEMS). However, a number of open problems and constraints remain regarding the delivery of WSNs. Together with small auto regulatory sensor nodes, cost efficient machinery and scalability, WSNs can be utilized for automation, the ubiquitous nature of the method indicates. Our proposed approach presents the major challenges as follows:

1) Battery life and power consumption: A WSN is composed of three main components: microcontrollers, sensors and RF transceivers. Considering that the sensor node battery provides very little energy, it is critical that the sensor node components use very little power. The RF transceiver, which is more powerful than the other components at a sensor node, will be reduced in power consumption in particular to alleviate this issue. It is also possible to suggest a smart energy efficient method to handle this issue.

2) Routing: Various problems may occur as a result of channel spreading caused by a packet crash and restricted bandwidth. Therefore, multi-hops are needed when a WSN is deployed in a large area.

III. PROPOSED METHODOLOGY

Cluster-based routing is techniques of energy efficient routing. This system divides sensor nodes into non-overlapping clusters in order to collect data. There is a CH for each CH. Every cluster's sensor nodes send their data only to its CH. CH constructs the correlated data and transfers them to the sink (aggregates) [27]. Setup and steady steps are part of clustering based routing protocols. CHs are selected and all nodes are linked to the closest CH during the setup process. CHs perform data aggregation through a continuous (communications) process, which reduces the need to transfer additional and unnecessary data. Clustering decreases the route table length which is stored at the certain nodes by limiting the route inside the cluster [28]. In addition, the clustering will maintain bandwidth by restricting the scope of inter-cluster communication to CHs and by avoiding unnecessary messages between sensor nodes. Fig. 1 demonstrates the working flow of the projected technique.

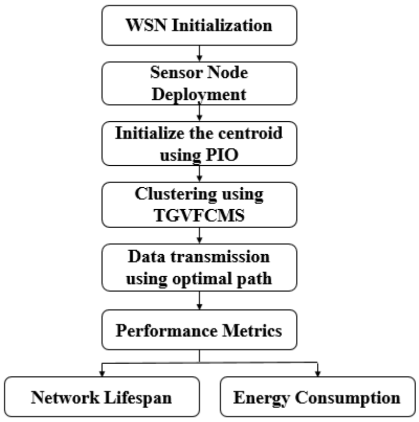

Fig. 1. Work flow of the projected method.

If the collected data packets are adequately correlated in homogenous networks, they are aggregated and sent via a single or multi-hop system to the sink. Although a large sum of low-cost nodes typically occur in heterogeneous wireless sensor networks, while those with relatively greater energy conduct data fusion, movability and transport. Clustering facilitates scalability, multiple gateway topologies and aggregation of data in cluster heads in large-scale networks. The battery life expectancy of each sensor can be extended by implementing optimized management techniques, leading to longevity of the system. For small networks, fewer nodes may contribute to the effective use of energy resources by participating in the data transmission. But the transfer of additional tasks to CHs means that the processing and transmission of data for each cluster will include a higher energy consumption resulting in premature and erratic network depletion [29].

A. Energy Consumption

We use the same model as in [28] for estimating energy usage. The E_{Tx} transmitter energy can be calculated using two separate equations based on its coupling wavelength. The enhancer can be strengthened by various forces that depend on the transmission separation when the transmitter signal is generated. We use two different contact models in this way. If the break-point is below d_0, the free space model is used, then the reusable blurring model is used in order to measure the use of vitality. The vitality of the way l is transmitted is determined by.

$$E_{\mathrm{Tx}}\left(l,d\right)=\begin{cases} lE_{\mathrm{elec}}+l\varepsilon_{\mathrm{fs}}d^2 & \text{if } d<d_0 \\ lE_{\mathrm{elec}}+l\varepsilon_{\mathrm{mp}}d^4 & \text{if } d\geq d_0 \end{cases} \quad (1)$$

where the transmitter and receiver power are signified as E_{elec} . $\varepsilon_{\mathrm{fs}}$ and $\varepsilon_{\mathrm{mp}}$ denote two variance power amplifier uses.

The threshold value d_0 can be considered using the subsequent formula:

$$d_0=\sqrt{\frac{\varepsilon_{\mathrm{fs}}}{\varepsilon_{\mathrm{mp}}}} \quad (2)$$

Then the l bit data is used by energy receiver is computed by

$$E_{\mathrm{Rx}}\left(l\right)=lE_{\mathrm{elec}} \quad (3)$$

The paper proposes the CH selection clustering technique, and the initialization algorithm for the Centroid, to resolve the above problems, which are described:

Recently, PIO algorithms have been exposed to solve numerous optimization issues effectively such as aerial-robot planning, three-dimensional trajectory planning, a PID production controller and an automated method for landings. Pigeon studies indicate that the ability of pigeons to detect various magnet fields is entirely based on the tiny magnetic particles on their beaks. Research shows that the trigeminal magnetite nerve particles are transferred to the brain from the nose. The ability to differentiate between the height of the sun at start and at departure, partly or completely clarified by the ability of the pigeon, is also evident in pigeon navigation. Recent research into pigeon behavior has also shown that pigeons are not direct at their destination but can follow certain big paths like tracks, railways and rivers. Inspired by the pigeon behavior, this article gave a bio-inspired novel on PIO swarming.

We follow the PIO for starting the centroid in this article. Two forms of the PIO are given. The first version or algorithm uses a sigmoid feature to test the dove speed, the second version provides an improved binary version of the basic PIO, using the cosine seamlessness of the dove to calculate the dove speed. On the other hand, each variant has a form representing a pigeon or solution all variations use the same fitness function.

B. Fitness Function

If there is a single function that has no effect on the TPR or FPR, then the adaptation function has failed. Because TPR and FPR are the same, the weights are set to 0.1, 0.15, and 0.45, respectively.

$$\mathrm{FF}=w_1\frac{\mathrm{SF}}{\mathrm{NF}}+w_2\mathrm{FPR}+w_3\frac{1}{\mathrm{TPR}} \quad (4)$$

A. Sigmoid PIO for Initialization

A pigeon vector with length equal to the sum of PIO can be defined as the answer to this equation. A vector whose values of velocity and position vectors are fixed at random in the beginning [0, 1] is characterized as the specific PIO solution for initialization since the basic PIO procedure constantly analyses the dove's position. Pigeons' speed can be measured using Eq. (4), and the sigmoid function can then be used to convert the data into binary form, as in Eq. (5).

As Eq. (3) shows, the cluster intelligence algorithm uses sigmoid function values and random number probabilities to update the location of each dove in its binary files. The ground as the old PIO. It's also possible to use the sigmoid function, which is used to transfer speed, to update the positions.

$$S\left(V_i\left(t\right)\right)=\frac{1}{1+e^{\frac{-\pi_j}{2}}} \quad (5)$$

$$X(t)_{(i,p)}\left[i\right]=\begin{cases} 1, & \text{if } S\left(V_i\left(t\right)\right)>r \\ 0, & \text{otherwise} \end{cases} \quad (6)$$

After initialization, the selection of CH is carried out using proposed clustering algorithm, which is described as follows:

The amount of CH is the chief aspect that affects the performance of the routing protocol in the existing routing protocol. When the CH value is smaller, each CH would have to cover large regions, which can influence the problem that few CH members get away from the CH and consume more resources. In comparison with the general node, communication between the CH and the base station (BS) needs energy; a further amount of CH can improve energy consumption throughout the network and reduce the lifetime of the network. It is therefore necessary to choose CH for lower energy usage. In this research study, TGVFCMS method is used for selecting the CH to avoid high consumption of energy, which is robustness for CH selection. In particular, it's useful tool to pick the cluster head because of the desirable properties of regularization by the TGV up to a certain order of difference. More parameters, such as residual energy and energy consumed for data transmission for an optimization of CH selection process, are needed to guarantee a balanced energy in the network. In this trial the CH was selected, in the smoothing term of our TGVFCMS, the regularization of TGV was adapted. First, let us describe the TGV structure accordingly:

$$\mathrm{TGV}_a^k\left(u\right)=\sup\left\{\int_\Omega u\cdot\mathrm{div}^k v dx \mid v\in\mathbb{C}_c^k\left(\Omega,\mathrm{Sym}^k(\mathbb{R}^d)\right), \left|\left|\mathrm{div}^l v\right|\right|_\infty\leq a_l\right\} \quad (7)$$

where l=0, 1,⋯, k–1, and $k \in N$ designates an order of TGV, and **a**=(a_0, a_1, ⋯, $a_{(k-1)}$) indicates the positive weight to TGV. $\mathrm{Sym}^k(\mathbb{R}^d)$ Shows the location of all the symmetric k-tensors in the space given. The l-divergence (div) of the symmetric k tensor field for apiece component M (k–1) is given by:

$$(\mathrm{div}^l v)_\eta = \sum_{r \in M_1} \frac{l!}{\gamma!} \frac{\partial^l v_{\eta+\gamma}}{\partial x^\gamma} \quad (8)$$

where M_kis the multi-index of order k

$$M_k = \left\{ \eta \in \mathbb{N}^d \left| \sum_{i=1}^{d} \eta_i = k \right. \right\} \quad (9)$$

The ∞- norm is given as:

$$\|v\|_\infty = \sup_{x \in \Omega} \left\{ \left(\sum_{\eta \in M_k} \frac{k!}{\eta!} v_\eta(x)^2 \right) \right\} \quad (10)$$

To pick the CH, we regulate both the first-order gradient and the high-order gradient in Eq. (4) to be sparse.

The second-order TGV is taken into consideration here, i.e.,

$$\mathrm{TGV}_a^2(u) = \sup\left\{ \int_\Omega u \mathrm{div}^2 v dx \left| v \in \mathbb{C}_c^2\left(\Omega, S^{d\times d}\right), \|v\|_\infty \le a_0, \|\mathrm{div}\cdot v\|_\infty \le a_1 \right. \right\} \quad (11)$$

where $\mathbb{C}_c^2(\Omega, S^{d\times d})$ the vector space of symmetric matrices S(dd). It is possible to calculate the definitions of divergence and norms in this way:

$$(\mathrm{div}\cdot v)_i = \sum_{j=1}^{d} \frac{\partial v_{i,j}}{\partial x_j}, (\mathrm{div}^2 v)_i = \sum_{j=1}^{d} \frac{\partial^2 v_{i,i}}{\partial x_i^2} + 2\sum_{i<j} \frac{\partial v_{i,j}}{\partial x_j \partial x_j} \quad (12)$$

and

$$\|v\|_\infty = \sup_{x \in \Omega} \left(\sum_{i=1}^{d} |v_{i,i}(x)|^2 + 2\sum_{i<j} |v_{i,j}(x)|^2 \right)^{1/2}$$
$$\|div \cdot v\|_\infty = \sup_{x \in \Omega} \left\{ \sum_{i=1}^{d} \left| \sum_{j}^{d} \frac{\partial^2 v_{i,j}}{\partial x_j^2}(x) \right|^2 \right\}^{1/2} \quad (13)$$

The equilibrium among the first and second derivatives (via the positive weights α_0 and α_1 ratio) is therefore achieved. Two α_0 and α_1 weights are respectively 0.1 and 0.15 in practical applications. The proposed TGVFCMS can produce results that are robust for selection of CH by means of the concept of second-order TGV.

The following steps are defined for the proposed work:

Step 1: Designing and developing a simulator with the network height and width to simulate the WSN proposed. The simulator area here is 100 m^2 to 100 m^2.

Step 2: In the network area for simulator, describe 'N' sensor nodes.

Step 3: Describe the N number of nodes for the source and destination nodes.

Step 4: Network cluster heads are selected using the method proposed.

Step 5: Initiate each node's coverage area, with source, target and CHs included.

Step 6: Determine the source and the destination node of the route by using the TGVFCMS protocol. When network performance is broken, step 7 is taken.

Step 7: To set up the fitness centroid, start PIO with the fitness function. Data is transported to an actual node that uses less energy next step instead of the more energy-efficient nodes being ignored in the route.

Step 8: Choose of the cluster to optimize the route that is residual energy dependent for each node. Once the best CH has been selected within the network, a credible route with its intermediate nodes is created to store the route. The trusted route concept is introduced so that the search time is minimized if data transfer with fixed nodes is repeated multiple times.

Step 9: Calculate performance characteristics such as flow, PDR, and power consumption rate by storing the best cluster lead's optimized route in the trusted route table. The number of intermediary nodes in the path affects their utilization.

IV. Results and Discussion

Also, Table I presents the test system simulation value, which is used to prove the applicability and presentation of our proposed approach in WSNs in this unit. The effectiveness of this strategy can be assessed using MATLAB's event-based network simulator. To ensure the uniqueness of each participant's experience, this training makes use of a random network to assess the results. When simulating a network, we use nodes that are spread out over a 100-by-100-square-meter area, and which are composed of 50 to 100 randomly distributed nodes.

TABLE I: Parameter Description

Parameter	Value
Energy for data aggregation	5 nJ/bit/signal
Electronics energy	50nJ/bit
Initial Energy	0.25J
Communication energy	10pJ/bit/m^2
Sensing area (M×M)	100m×100m
Sum of sensor nodes (N)	100

The below Fig. 2 shows the initial deployment of the WSNs and how the nodes are created and scattered among the network.

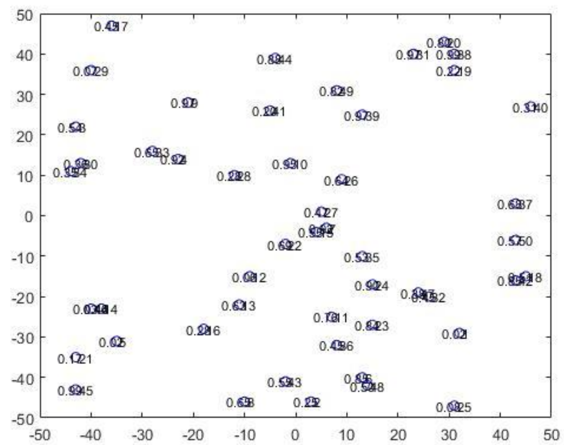

Fig. 2. Sensor node initial deployment.

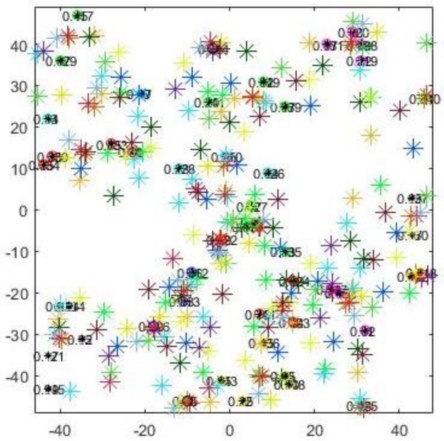

Fig. 3. Clustering using proposed method.

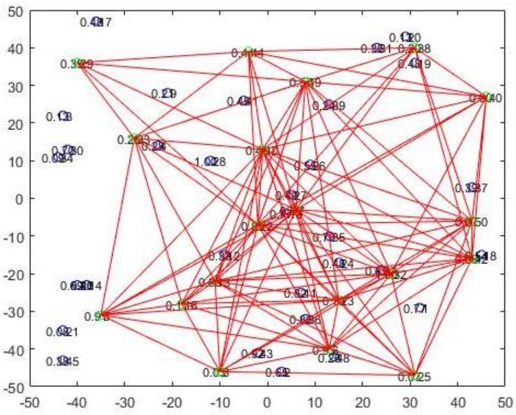

Fig. 4. Available paths in the network.

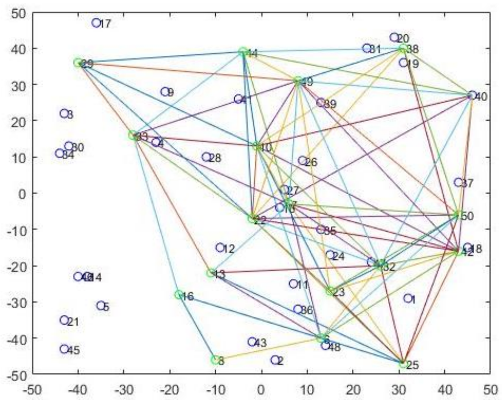

Fig. 5. Path Probabilities.

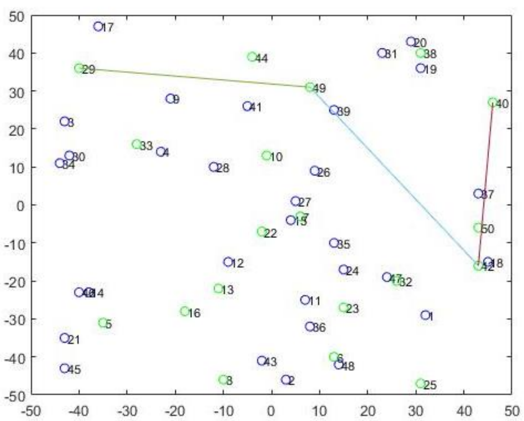

Fig. 6. Optimized Path.

Grouping and cluster formation using TGVFCMS algorithm is shown in Fig. 3. Fig. 4 shows the all the available paths between any node to any other node in the network. From the all the available nodes, path probability to reach the base station is shown in Fig. 5. Fig. 6 shows the best energy efficient and less delay path obtained from all other probable paths. By using the proposed model, the data is transmitted through optimal path (brief explanation of proposed model is given in Section 3).

A. *Evaluation Metrics*

- Indicators of presentation are used in this section to estimate our model's outcomes:
- The total amount of energy expended by the SN network on Jules (J) experiments is referred to as power consumption. In order to determine the node's energy consumption, we use the energy model that was provided.
- The network bandwidth is the total amount of bandwidth available to all destinations. The sum of messages received per second is the output for the destination.
- All of the messages sent to and from the control system. Managing the risks of power outages and oversupply can be expensive.
- This is a measure of the network's overall power consumption as it relates to the size of a data packet and the service information it contains at the receiver node. An advanced EE routing algorithm gives additional sensor data to the consumer unit.
- Energy divergence (ESD) in all nodes is the regular difference in energy use. In order to distribute energy, a network must be used. Distribution of the energy supply. All of the energy is used equally while the communication load is evenly spread between nodes with higher standard deviations.
- For the network, the variance in the mean of N regular energy consumption and the SD of their energy stages, as well as the difference among the total early energy E of the network and the lifetime guess, are used to define.

$$\text{Lifetime prediction} = E - \left(\overline{\mu + \sigma}\right) \tag{14}$$

This definition's goal is to let the algorithm take use of the average node's remaining size by employing a minimal standard deviation. Protocols that determine the exact starting pathways between source and target nodes are called root times. Prior to the discovery of an actual route, this method is employed. We've constructed a variety of dynamic networks of varying sizes to investigate this number and assess how effective the path recognition software.

B. *Performance Analysis*

In these experiments, we perform iterations at two different stages, namely low iteration (i.e., 500) and higher iterations (i.e., 4500), in relation to various parameters with and without an optimization technique. TGVFCMS validation initially was checked by means of low energy consumption iteration in Fig. 7, total packet sending in Fig. 8, dead nodes in Fig. 9, total sum of live nodes in Fig. 10, and throughput in Fig. 11.

Fig. 7 shows the analysis of the proposed TGVFCMS method in terms of energy consumption with an effective optimization system. Fig. 8 shows how the TGVFCMS effectively performs the clustering when compared with the existing ones. Fig. 9 shows the comparison between of number of dead nodes produced by the proposed method and others. Fig. 10 shows the comparison between of number of alive nodes produced by the proposed method and others. Fig. 11 shows TGVFCMS outperforms other techniques by producing better throughput.

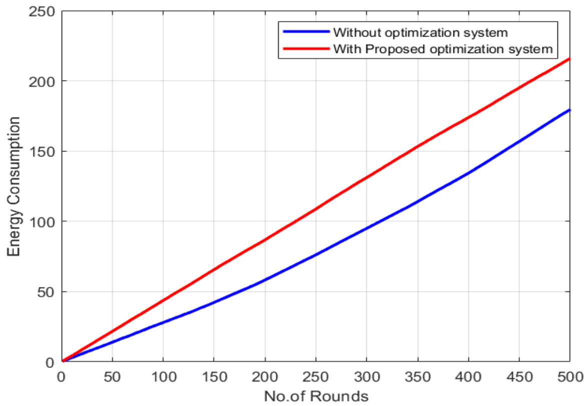

Fig. 7. Analysis of TGVFCMS in terms of Energy consumption.

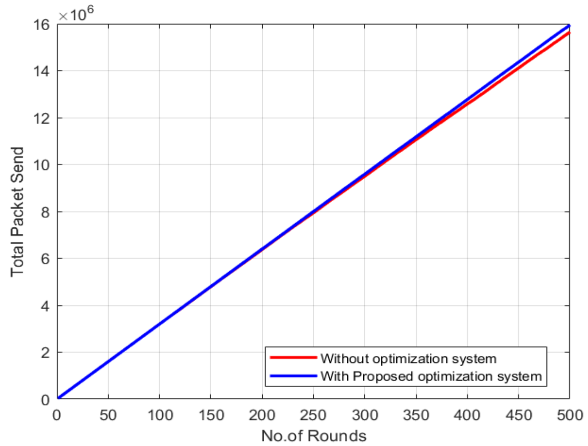

Fig. 8. Analysis of TGVFCMS clustering system.

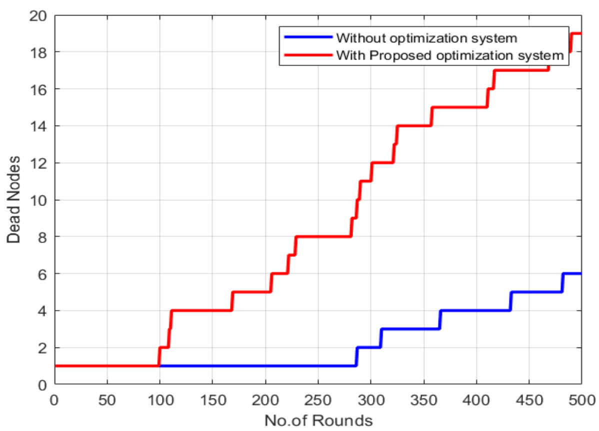

Fig. 9. TGVFCMS method by means of dead nodes.

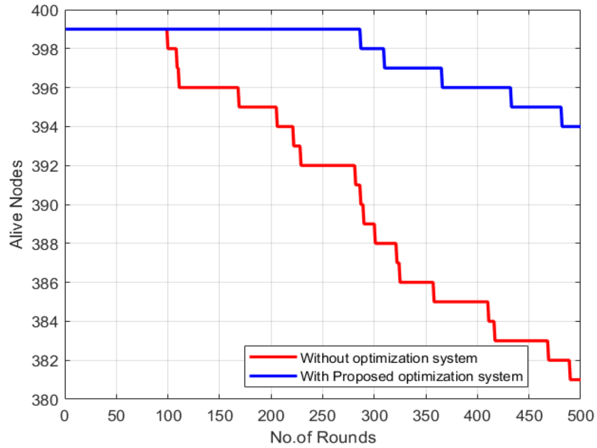

Fig. 10. TGVFCMS method in terms of alive nodes.

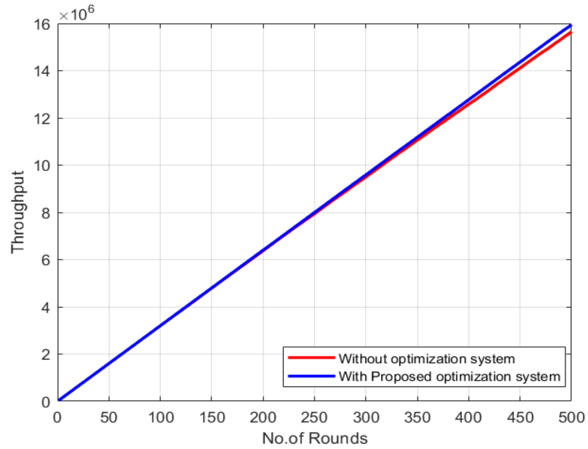

Fig. 11. Validation of TGVFCMS method on the basis of throughput.

It is calculated to be able to modify a large sum of nodes, called scalability, which may be not expected during the initial implementation of the network. The network's ability to handle entire network is a major design problem for such networks. The routing protocols built for a WSN network must also be able to provide the appropriate network scalability. The proposed work will therefore be further expanded to assess the scalability of the proposed process by changing the sum of sensor nodes from nodes, keeping all other design metrics close to the shown test bed. After the number of rounds per scheme, the scalability is calculated by calculating the first node death. In order to disclose the stability of the proposed scheme, total electricity of the signaled network is calculated over several sensor nodes. By ensuring an optimized network life and residual energy, the proposed optimizing approach outperforms. The next experiment is performed using the proposed process, with and without high-level iteration optimization: with regard to energy use in Fig. 12, total packet sending in Fig. 13, total number of dead nodes in Fig. 14, total sum of live nodes in Fig. 15 and efficiency throughput in Fig. 16.

Fig. 12 shows the amount of energy consumed when compared with the proposed TGVFCMS method. Fig. 13 shows the performance analysis of TGVFCMS in terms of clustering. Fig. 14 shows the number of dead nodes is less as the number of rounds increases, when compared to existing techniques.

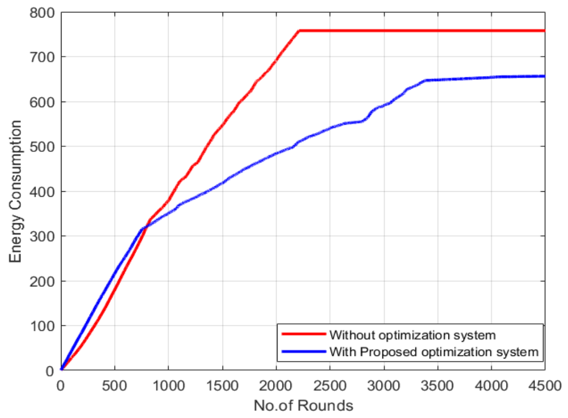

Fig. 12. TGVFCMS method in terms of energy consumption.

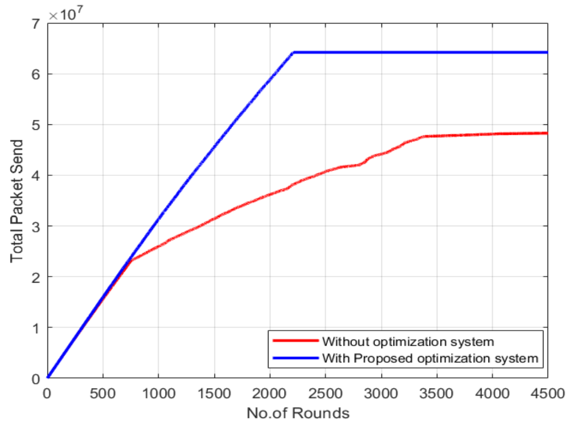

Fig. 13. Performance Analysis of TGVFCMS clustering.

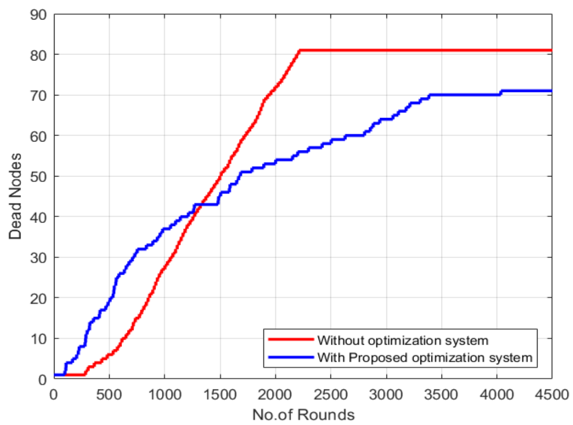

Fig. 14. Validation of TGVFCMS method on the basis of dead nodes.

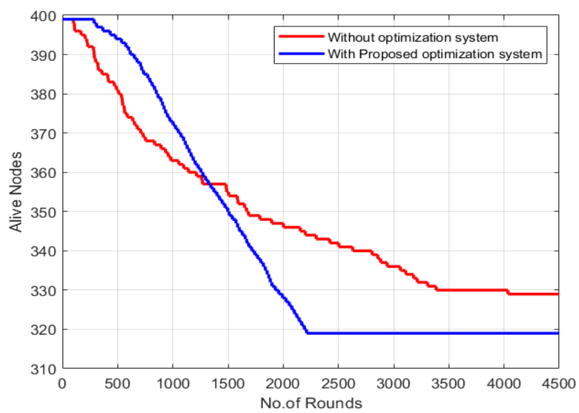

Fig. 15. Graphical representation of TGVFCMS for alive nodes.

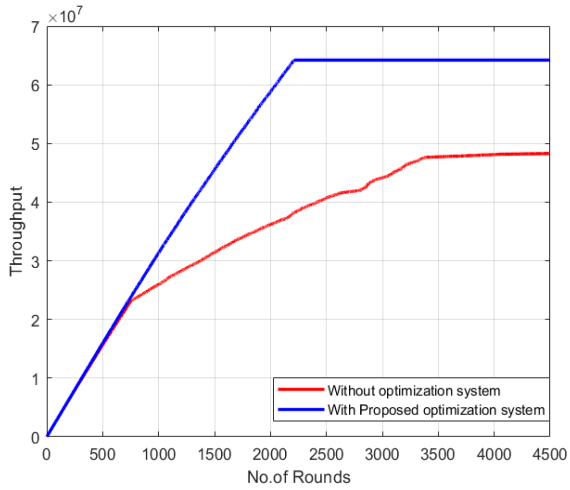

Fig. 16. Validation of TGVFCMS method in terms of throughput.

Fig. 15 shows the number of alive nodes when compared to the existing techniques. Fig. 16 shows better performance of TGVFCMS method in terms of throughput.

The packet is delivered quickly and saves 45 percent simulation time with the proposed routing protocol and energy is lower than the non-optimization protocol, since the cluster for the proposed routing and the best contact knot with more energy is selected. Fig. 12 illustrates energy consumption with the sensor nodes when transmitting data from source to destination. The figures above show that the energy used by the proposed optimized routing procedure is less than the energy used by the proposed route protocol without optimization. Furthermore, the suggested approach offers even higher iterations with better performance.

V. Conclusion

WSNs comprise a large number of low-cost, miniature sensing nodes, scattered randomly within target area without a specific infrastructure, which are far removed from the human scope. Due to its diverse requests such as health tracking, smartphones, army, disaster management and other surveillance systems WSN are one of the most important technologies. Sensor nodes are generally used in large numbers which operate independently in harsh environments without surveillance. These wireless nodes are clustered in clusters for energy efficient communication due to restricted resources, usually low battery power. In the clustering systems considerable interest in reducing energy has been achieved. In order, for example, to establish an efficient path, the authors demonstrated a PIO-positioned TGVFCMS between sensing nodes, outstanding energy, and the sum of neighboring nodes. In order to reach an extended network life, TGVFCMS allows sensing nodes to pass on sensing data for BS through optimal routes with inexpensive energy consumption. The complete assessment shows that TGVFCMS provides 20% more network life than the current technology. TGVFCMS also reveals a 250% increase in network life compared to another current clustered approach.

Conflict of Interest

The authors state no conflict of interest.

Author Contributions

V. Gokula Krishnan and K. Sreerama Murthy created the concept and conducted the research. G. Dhanalakshmi and K. Sankar collected and analyzed the data. S. Venkata Lakshmi and B. Shyamala Gowri performed the simulation part and recorded the results. All authors had read the paper and permitted the final version.

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