Comparison of Existing and Enhanced Hierarchical Routing Protocol with Genetic Technique

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Abstract: A wireless sensor network (WSN) comprises multiple sensor nodes that establish communication among themselves to share data with a central base station. Such networks find utility in various small-scale applications, enabling the creation of a MAN-less network for efficient data collection. Data interchange between sensor nodes and the base station relies on hierarchical routing protocols. The network supports both stationary and moving base stations, employing a topology consisting of multiple clusters. Each node within a cluster communicates with the respective cluster head, which, in turn, communicates with the base station. The proposed approach involves the utilization of a hierarchical routing protocol enhanced by a Genetic technique and incorporates a moving base station. This approach has shown significant improvements in performance parameters such as the count of inactive nodes, remaining energy levels, and overall node vitality.

Keywords: WSN, Routing protocol, Moveable, BS

I. Introduction

The WSNs are a technological advancement that encompasses a large number of small sensor nodes strategically placed throughout a network. These sensors are widely dispersed across a significant area. The performance of these sensor nodes varies according to their energy and capabilities. In a WSN, the sensing nodes are placed within a sensor meadow, and their placement may be casual, usual, or portable. The nodes collaborate with one another to gather first-rate data regards the bodily climate. Every sensing node's management -making process relies about its task, available facts, and its awareness of compute, announcement & power property. Consequently, the sensing nodes fetch the facts and transmit it to BS . However, it is important to note that not all nodes communicate simultaneously, and every joint can single establish communication through a limited number of close by joints. The net incorporates a direction-finding protocol responsible for managing the direction-finding of data acknowledgement among nodes. Additionally, the direction-finding protocol aims to ensure the energy-efficient transmission of messages to the base station.

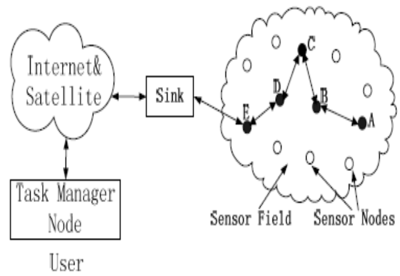

Figure 1: WSN.

The BS serves as the main joint in the wireless sensor network, responsible for compiling and processing data from the sensor nodes. It can establish communication with a secluded organizer node through the Satellite connection. human being operative , who control the sensing network, conveythe message and receive the acknowledgement by BS. The nodes of clusters within the system, with every joint possessing processing capabilities.

Data fusion, also known as data aggregation, involves the aggregation of data from multiple sensors to eliminate redundancy and provide fused information to the base station. By processing all the sensed data within the area, data fusion enhances the accuracy of the information obtained.

A moveable manager goes among unusual joints within the system, apply shift policy and filtering data. It processes the facts on the node anywhere it resides, eliminating the need to transmit large amounts of data to the system. Consequently, a mobile agent significantly reduces facts travel on the system and improves system range consumption. Additionally, portable agents possess personality like strength and error remover. The direction-finding trouble for mobile agents in a wireless sensor network is a complex combinatorial optimization problem that seeks to determine the optimal path.SMO known as Ant colony enhancement is proposed to address this issue, beside other better moveable manager route algo related with SMO [1]. However, optimizing the process's parameters based on experimental results is challenging, as it directly impacts the optimization performance, which is closely linked to the user experience. Moreover, the SMO algorithm has certain weaknesses, like susceptibility to early convergence and long computing times. This paper presents an enhanced SMO algorithm to improve union rate. To prevent illogical paths, a alteration worker introduced [1].

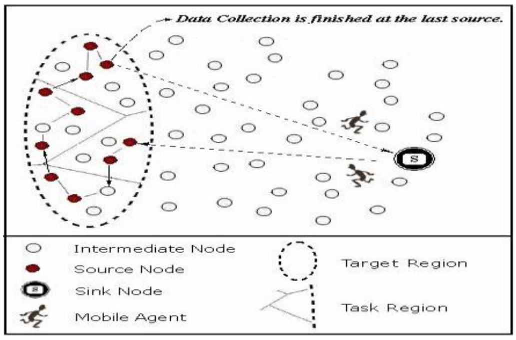

Figure 2: Work of Movable Agent

III. Related works

Muhammad Aslam et al. (2016) Interduce more than one Hop centred power central Energy Efficiency Cluster(THCEEC) &Advance heterogenece-Energy Efficiency Cluster (ACEEC) direction-finding protocol, they are fetch from the CEEC. These protocols were designed for more than two diverse WSNs .The implementation of these protocols resulted in improved energy efficiency and stable elections within the WSN.

In their study, Ben Liu. (2016) utilized a SSLS process to reduce message interchange among the sink and sink node managed midpoint. On the monitoring center, they improved confrontation detection truth .The algorithm effectively reduced message travel among the source and destination while enhancing more detection within evidence theory detection frame .

S.G. Santhi et al. (2015) interduce the DCHM process for robustness of information.This algorithm significantly improves the safety and correctness of data synthesis by updating status and conviction system.

MohammadrezaSoltani et al. (2014) employed filters based decrease the amount of energetic sensing joints in a big system. Only the sensors inside the gate validation region were considered, leading to a reduction in network property, decreased system overhead and enhanced safe message.

The function in the learning involved tracking a moveable entity with a stable rapidity form which involve sound A national design for information combination was adopted, and every nodes convey the data to central unit for computing . The sensing system stay static all the time means are units are stable not moveable , and ecological situation does not effected for the period of the examination .

Jingang-cao et al. (2013) conducted study that introduced the SMOE algorithm to improve routing in wireless sensor networks (WSNs). This algorithm aims to minimize the impact of invalid nodes in the network, leading to reduced transmission delays, network traffic, and increased system effectiveness and durability of network lifetime and reliability of relation of nodes.

The arrangement of the Moveable manager in this research contain four parts (i) recognition figure, (ii) executable text, (iii) facts space, and (iv) relocation path.

In the context assumption for WSNs, facts union involves finding the way among sensing unit and sink unit and combine the facts to decrease the redundancy . The Mobile Agent (MA) is started with the arrangement & quantity of units it will visit, and after that this spared the knowledge which is fetch by sink node . At the end , the MA returns to the sink unit with the final information results, which are calculated according to a specific methodology.

$$min \sum_{i,j\in V} w(i,j) * eij, i \neq j$$

Where*n In the Methodology* e is the compatibility position of WSN's units (i,j) and its rate is "0" or "1 ", where "1" indicate v(i) and v(j) are association, and "0" represent then these are disengagement. The evolution least amount space in system .

In the study conducted by Ruitan et al. (2012), the researchers define the essential restrictions of treatment in wireless sensor networks (WSNs) based on data fusion models. These models process noisy measurements obtained from sensors using a probabilistic disc model. The results of the research enable the examination of offered disc breathing space models and provide insights for design & analyzing WSNs that employ data fusion algorithms. The study also introduces the concept of a movable manager within the exposure field of the system, aiming to improve pointer reporting and calculate the whole sensor utilization.

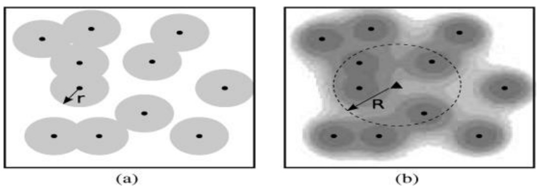

Figure 3 .(a) Model of disc space, (b) probabilistic disc space

to revision for the reporting of wide range WSNs.

In the study conducted by YuzhiWu et al. (2012), the Minimum Spanning Tree (MST) algorithm utilized to merge the power levels of sensor nodes in order to establish a routing layout. The approach takes into consideration factors such as information power and communication, adapting to manage moveable manager and data fusion. The primary objectives are tosave the power consuming enhance the system , effectiveness, and detect cheap rate . Additionally, here requirement to expand the coverage field for larger network links.

The wireless sensor network (WSN) is collection of Processed Element (PE) sensing units and a communication system. A PE node is characterized by higher power, memory, and communication capabilities. The best route for the mobile agent is determined based on the scale of the network. The mobile agent begins its journey from a PE node and follows the pre-designed route to collect and fuse useful data. Finally, the mobile agent returns to the PE node.

In the research conducted by Hang Lu et al. (2009), a novel power-effective routing process for hierarchical clustering is proposed. This algorithm is compared with two other routing algorithms: simple directed diffusion and non-clustering routing algorithm. The aim of the proposed algorithm is to extend the network period of life of wide range multi-hop communication wireless sensor networks (WSNs). The results of the study demonstrate that, for large-scale WSNs. In Future graph involve the effectiveness for better comparison results, such as changing the place of the BS, and alter the possibility of become CHs(head of all nodes) among all sensing nodes.

IV. Performance Analyzer

Topic	**Network Delay**	**Rate**	**Network Survivability**	**Data Transmission**	**Network Coverage**	**Consuming of System Resources**	**Reliability of links**	**Safe Communication**
[1]	×	Minimum	Medium	Minimum	×	More	×	×
[2]	√	Minimum	Medium	√	Small	Minimum	√	√

[3]	√	High	√	Minimun	Large	Less	√	×
[4]	More	High	√	Maximum	Large	Less	√	√
[5]	√	High	√	√	Small	Sometime less	√	√
[6]	√	Medium	Easily	Slow	Small	Less Sometime	√	√
[7]	×	Less	√	×	Small	Maximum	×	×
[8]	√	Less	√	Easily	Medium	Less	×	×
[9]	×	Less	Better	Better	Better	Less	√	√

V. Algorithm

Step 1: The entire network area is divided into smaller sections, referred to as clusters.

Step 2: Sensor nodes are distributed randomly within each cluster.

Step 3: A cluster head is selected based on the remaining energy of the nodes. The node with the highest energy level becomes the cluster head.

Step 4: A circular path is established within the central cluster to facilitate the movement of a UAV (Unmanned Aerial Vehicle).

Step 5: The cluster heads establish communication with the moving base station, which is strategically located in proximity to the cluster heads.

Vi. Flowchart

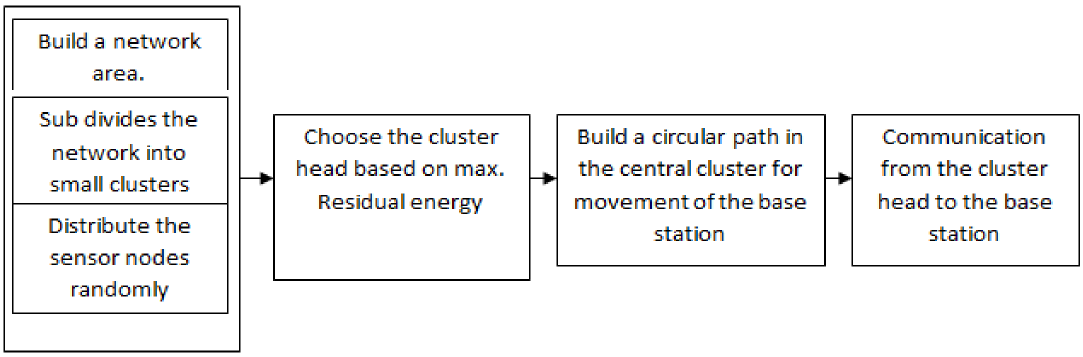

Fig. 4 flowchart

VII. Pseudo Code

Test case:

Set S as an empty set.

For each coverage C in the coverage set, do the following:

Find the initial node, Ns.

Replicate the following steps:

Discover 100 neighbors by insert one step to the sum (∑) of Nc.

Choose the neighbor with the better strength among the 100 neighbors.

If better Strength neighbor is useful,

Set Nc as the better strength neighbor.

Else:

Break the loop.

End if.

Until C is satisfied or the maximum iteration is reached.

Add the sum (∑) of Nc to S (S = S ∪ (∑) of Nc).

End for.

In this test case, the algorithm iterates over the given coverage set. For each coverage, it finds the start node and then repeats a process of finding

100 neighbors by adding one step to the sum (∑) of the current node (Nc). The algorithm selects the neighbor with the better strength between 100 neighbors. If the better strength neighbor is useful, it updates Nc with the better strength neighbor. The loop continues until the coverage is satisfied or the maximum iteration is reached. Finally, the sum (∑) of Nc is added to the set S.

VIII. Results and discussion

8.1 Multiple Sink nodes based routing algorithm.

The provided information mentions the usage of a centralized algorithm in the proposed work, which aims to enable the mobile agent to efficiently deliver facts when its iterations and adjust to modifying in the system. The main objective of this algorithm is to enlarge the working time of every unit in the grid.

Sr. no	Parameters	Value
1	Sensor field	100*100
2	Initial energy(E_0)	0.1J
3	Distance(d_0)	70m
4	Advanced nodes(α)	3
5	Heterogeneity(m)	0.1
6	Energy uses in each network (L)	4000
7	Energy for path loss parameters($\varepsilon_{mp}, \varepsilon_{fs}$)	(0.0013pj/bit/m ,10pj/bit/m$^{2)}$
8	Data aggregation(E_{DA})	5Nj/bit/signal

Table 2 Parameters

1. SET UP PHASE :

During the setup point of the system, the entire network is classified into smaller grids. The following assumptions are made:

1. The network consists of a total of 100 sensor nodes.
2. Each grid contains 10% of the total nodes, so there are N1 = 10*N/100 nodes in each grid.
3. The central grid (5th grid) contains 20% of the total network nodes, so there are N5 = 20*N/100 nodes in the central grid.
4. There is a BS located at the main point of the network.
5. The sensor nodes are static in nature and continuously sense data.
6. Each grid is assigned a unique ID.
7. Each sensor node sends data to the base station directly or indirectly based on energy consumption.

These assumptions provide a structure to the network setup, ensuring a distributed deployment of sensor nodes across the grids with varying densities. The central grid has a higher concentration of nodes compared to the other grids. The base station serves as the central hub for data collection from the sensor nodes.

8.2 SMO Elite method-: In each grid, the SMO Elite method is employed for data fusion path finding. This method aims to determine the minimum path distance for transmitting data from the nodes to the base station. It accomplishes this by creating a chain within each grid that connects all the nodes together. The chain serves the purpose of collecting data from the nodes and forwarding it towards the base station.

To facilitate this process, a leader node is required within each grid. The leader node's role is to gather data from all the nodes within the grid and transmit it further towards the base station. The selection of the leader node is determined using the SMO method. In each iteration, the leader node may change based on the SMO algorithm's criteria.

By implementing the SMO Elite method and utilizing leader nodes in each grid, the data fusion process becomes more efficient and effective in transmitting data from the sensor nodes to the base station.Place the m ants on the n nodes and series is created like (equation 1)

$$p_{ij}^{k}(t)=\begin{cases}\dfrac{[\tau_{ij}(t)]^{\alpha}[\eta_{ij}]^{\beta}}{\sum\limits_{k\in allowed_k}[\tau_{ik}(t)]^{\alpha}[\eta_{ik}]^{\beta}} & \text{if } j\in \text{allowed}_k\\ 0\,, & \text{otherwise}\end{cases}$$

Calculate the length $L_k$of each ant modify the nearest visit found. Goes to kth ant toward civic (j,p) For every edge (i,j), process

$$\tau_{ij}(t+n)=\rho\tau_{ij}(t)+\Delta\tau_{ij}$$

In this Example i is starting point k is sensing node and j is desirable point in a series.

$p^{k}(t)$, is probility to form series .

$\tau(t)^{\alpha}$,is Pheromone in this.

$\eta(t)^{\beta}$, is total nodes .

For k:=1 to m do

$$\Delta\tau_{i,j}^{k}=\begin{cases}\dfrac{Q}{L_k}\, if\,(i,j)\in \text{tour described by tabu}_k\\ 0 \qquad \text{otherwise}\end{cases}$$

$$\Delta\tau_{ij}:=\Delta\tau_{ij}+\Delta\tau_{ij}^{k}$$

Which is shown in equation a node in the group of nodes see for a node which is near to choose a path to send the information to the head node and after that the same information send to the next node and same process applied on all nodes. after complete the process all the processed data integrated at the leader node through the series among the multiple nodes of system .through this method the power is safes compare to pass the data in a direct method .

During the moveable agent's movement within the central grid, it follows a disc drive pattern. The mobile agent's role is to receive data from the leader node of each grid and transmit it to the base station. It collects information by visiting the leader node of each grid, sends the data to the base station, and then proceeds to the next grid in a sequential manner. After the data transmission, the leader node is deleted.

In the contact period, the connection among main node and the base station is facilitated using the mobile agent. The communication between nodes is influenced by the energy level of every sensing node. For data interchange , the moveable agent identifies the position along its way where the head node and the BS are at a least distance . The Euclidean process is used to find the total length of path among nodes, and energy debauchery occurs during data communication, excluding dead nodes.

Energy dissipation occurs from the chain within each grid to the base station. The energy flow begins from the chain, then to the mobile agent, and subsequently to the radius of the central grid. Finally, the energy reaches the base station. The specific equation for energy dissipation is referred to as "equation-III" in the context of the proposed work.

Energy Dissipated Energy = Energy dissipated+ (ETX*L+Efs*L* distance ^2)

or

$\text{energy dissipated} = \text{Energy dissipated} + (\text{ETX} * \text{L} + \text{Efs} * \text{L} * \text{distance}\ \hat{}4$

Here, ETX is transmission power , Efs is aggregate power .

Check every node in Grid :-In the proposed system, each node in the grid has an initial energy level. During the data transmission process, each node consumes energy for both transmission (ETX) and reception (ERX) of data. The energy consumed for transmission is subtracted from the node's total energy, and the receiving node also incurs energy loss during data reception.

When a node's energy level falls below a specified threshold, it is considered a dead node. In such cases, the previous node in the chain bypasses the dead node and sends the data directly to the next active node in the chain. This bypassing mechanism ensures that data transmission can continue despite the presence of dead nodes.

Furthermore, chain reformation is applied after bypassing a dead node. This process involves reorganizing the chain by establishing a new connection between the previous node and the next active node in order to maintain the integrity and efficiency of data transmission.

By detecting and bypassing dead nodes while reforming the chain, the system can effectively handle nodes with low energy levels, ensuring continuous data flow and maximizing the utilization of available energy resources within the network.

8.3 Results

8.1 Comparison of Alive Nodes and Proposed Nodes

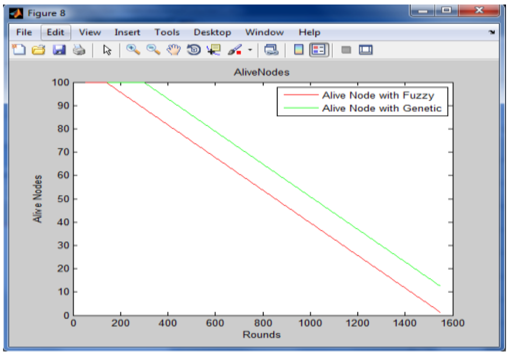

Figure 4 Alive Nodes in Proposed and Existing Technique

Figure 4 displays a performance comparison based on the number of alive nodes in the network. In the study of the new approach, a higher amount of nodes remain live for a exact amount of iterations compared to other approaches or systems being evaluated.

This performance metric indicates the ability of the proposed approach to sustain a larger portion of the sensor nodes in an operational state over a given period of time. Having a greater number of alive nodes is desirable as it ensures better network coverage, data collection, and overall system functionality.

The comparison presented in Figure 4 highlights the effectiveness of the proposed approach in terms of node survivability and network longevity, indicating its potential to improve the overall performance and reliability of the wireless sensor network.

5.2 Comparison of Dead Nodes and Existing and proposed

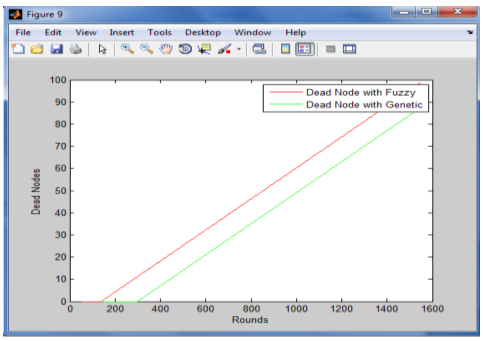

Figure 5 Dead Nodes in Proposed and Existing Technique

Figure 5 illustrates the survival time comparison of the number of died nodes between the planned approach and old approaches. In the new approach, there are fewer dead nodes observed compared to the existing approaches. This indicates that the proposed approach can effectively prolong the lifespan of the nodes and maintain their presence in the network communication for a longer time period.

Having fewer dead nodes is advantageous as it ensures better network connectivity, data transmission, and overall network performance. It suggests that the proposed approach is successful in mitigating node failures or energy depletions, leading to improved network reliability and sustainability.

The comparison presented in Figure 5 emphasizes the superiority of the proposed approach in terms of reducing the number of dead nodes, which ultimately contributes to the enhanced operational time and efficiency of the wireless sensor network

.5.3 Comparison of Existing and Proposed Energy

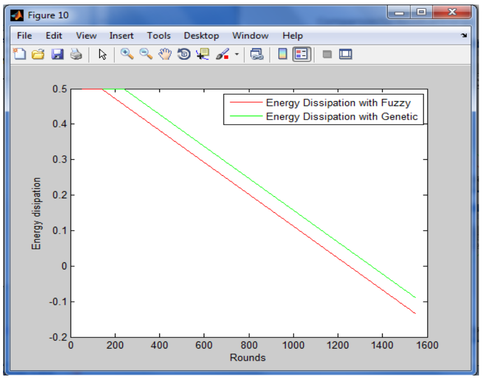

Figure 6 Energy Dissipation comparison for Existing and Proposed

Figure 6 depicts the comparison of power indulgence between the basic technique and the planned technique. In the case of the planned technique, the power dissipation is lower compared to the base technique. This indicates that the proposed technique is more efficient in terms of energy consumption over the lifetime of the network, especially with the presence of a moving sink node following a circular route.

Reducing energy dissipation is crucial in wireless sensor networks as it directly impacts the network's lifespan and overall performance. By minimizing energy dissipation, the proposed technique enhances the network's energy efficiency, allowing sensor nodes to operate for a longer duration without depleting their energy resources.

The comparison presented in Figure 6 underscores the advantages of the proposed technique in terms of energy conservation, which leads to extended network lifetime and improved sustainability of the wireless sensor system.

IX. Conclusion

In a WSN, the energy resources of the sensor nodes are limited, and efficient utilization of these resources is essential to enhance the network's lifetime. To achieve this, the network area is divided into smaller clusters, and each cluster consists of randomly distributed sensor nodes. A cluster head is selected based on the residual energy of the nodes within the cluster. Additionally, a moving base station follows a predefined path within the central cluster.

The communication in this network occurs between the cluster heads and the moving base station. By adopting this approach, several performance parameters such as the count of dead nodes, the number of alive nodes, and the amount of residual energy have shown improvement. This implies that the proposed technique, which incorporates a moving base station, is more efficient compared to using a stationary base station.

With the utilization of a moving base station, the energy consumption is optimized as the base station strategically moves along a fixed path. This dynamic approach allows for better distribution of energy usage throughout the network, resulting in improved network performance and increased overall lifetime.

By implementing the proposed technique with a moving base station, the WSN can achieve enhanced efficiency and prolonged operational lifespan, ultimately leading to more reliable and sustainable network operation.

X. Future work

In a wireless sensor network (WSN), where multiple sensor nodes are deployed to collect and transmit data, efficient utilization of the limited battery power is crucial. To achieve this, hierarchical routing protocols are commonly employed. These protocols establish a hierarchical structure within the network, enabling capable information transfer from sensing node to BS.

The hierarchical routing protocol divides the network into multiple levels or clusters, where each cluster is composed of a group of sensor nodes. These clusters are organized in a hierarchical manner, with one or more cluster heads responsible for aggregating and forwarding the data to higher-level clusters or directly to the base station. This hierarchical approach helps in reducing energy consumption and increasing the network's overall efficiency.

In the future, the efficiency of WSNs can be further improved by introducing multiple mobile sinks. A mobile sink is a mobile device or a moving base station that can collect data from sensor nodes while traversing the network. By incorporating multiple mobile sinks, the network can distribute the data collection task more effectively, reducing the energy consumption of individual nodes and improving overall network performance.

The use of multiple mobile sinks offers several advantages. Firstly, it allows for better load balancing, as the mobile sinks can dynamically adjust their routes to collect data from different areas of the network. Secondly, it reduces the distance between the sensor nodes and the sinks, minimizing the energy required for data transmission. Lastly, it enhances the fault tolerance of the network, as the failure of one sink can be compensated by others.

The integration of hierarchical routing protocols and the introduction of multiple mobile sinks in WSNs have the potential to significantly enhance the efficiency and performance of the network, prolonging the lifetime of the sensor nodes and improving the overall data collection process.

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