

Efficient Data Transmission using PSO Algorithm in Wireless Sensor Networks

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Abstract— A Wireless Sensor Network is made up of a large number of small, low-power sensor nodes that are randomly or manually distributed across an uncontrolled target region. However, the WSNs' main constraint is the sensor nodes' restricted power sources. As a result, energy saving at sensor nodes is the most difficult barrier for WSNs' long-term functioning. Clustering and low-energy routing are two well-known optimization tasks that have received a lot of attention in the quest to extend the life of wireless sensor networks (WSNs). In a periodic data gathering application, the Particle Swarm Optimization (PSO) technique is employed to overcome this problem. Sensors monitor the environment on a regular basis and send data to the base station (BS), which analyses the data and draws conclusions about the field activities. A cluster is used to send the data to the base station. A cluster head receives data from sensor nodes and transmits it to the cluster head, which combines the information and sends it to the base station. The packet delivery ratios and throughput have both been enhanced. As a result, total energy consumption is reduced

Index Terms— Wireless sensor networks, Packet Delivery Ratio, Cluster, Base station, Network lifetime, PSO

I. INTRODUCTION

The project's goal is to make data transport in wireless sensor networks more energy efficient. The major goal is to extend the network lifetime, reduce node energy consumption, and ensure that all data packets are delivered to the target node. The primary concept is to create a cluster that allows data to be transported efficiently and without loss. Every cluster's cluster head will be picked from among those that send data to the target nodes.

II. PROBLEM STATEMENT

When a sensor node runs out of power, we consider the network to be dead because some areas can no longer be

monitored. The construction of scalable, energy efficient clustering algorithms is required for periodic data collection applications in large scale sensor networks. The use of centralised control in large-scale sensor networks is impractical. The huge scale and restricted battery capacity appeal to an autonomous algorithm. In data gathering applications, acquiring data is the ultimate aim. Because power is the most limited resource available to sensors, it is preferable to reduce control overhead in order to extend data collection time. In addition, load balancing is a crucial aspect of WSN clustering. This is especially relevant when the sensor nodes are not spread evenly, as all sensors have the same capacity and are energy constrained, necessitating energy saving. Network traffic is another major issue in wireless sensor networks that can be mitigated through cluster formation. Furthermore, while an optimization approach necessitates a reasonable amount of memory and processing resources, good results are required.

III. LITERATURE SURVEY

A. Leach-Low Energy Adaptive Clustering Hierarchy

In existing systems like LEACH[1], cluster chiefs are chosen at random (Low Energy Adaptive Clustering Hierarchy). LEACH is a hierarchical energy-efficient protocol that balances energy costs, saves node energy, and thus increases network lifespan. LEACH is the first wireless sensor network protocol to use hierarchical routing to enhance the network's life cycle. Local clusters are formed by the nodes in a network, with one node functioning as the cluster leader. Non-cluster head nodes deliver data to the cluster head, which receives it from all cluster members and processes it (e.g., data aggregation) before sending it to the remote base station [4]. Wireless sensor network energy efficiency in smart spaces and harsh environments is a critical consideration. Cluster-based communication protocols play an important role in energy conservation in hierarchical wireless sensor networks. In this system, a cluster head (CH) serves as a relay sensor node, transferring data packets from other clusters to the data sink. As a result, each node will have the same number of CH roles as relay roles for the duration of the network. In many cases, a node's position in the network makes it more appropriate to work as a CH, therefore this is inefficient in terms of energy efficiency.

B. Seech: Scalable Energy Efficient Clustering Hierarchy Protocol In Wireless Sensor Networks

In smart spaces and harsh environments, the utilization of distributed wireless sensor networks necessitates a high level of energy efficiency [2][3]. Cluster-based communication protocols play an important role in energy conservation in hierarchical wireless sensor networks. A cluster head (CH) is also a relay sensor node in most traditional clustering algorithms, delivering data packets from its cluster and neighboring clusters to the data sink. As a result, each node will have the same number of CH roles as relay roles for the duration of the network. This is inefficient in terms of energy utilization because, in many cases, a node's network position makes it more appropriate to act as a CH and/or a relay. Based on the eligibility of nodes, this technique selects CHs and relays individually. As a result, high and low degree nodes, respectively, are used as CHs and relays. A few earlier studies looked at CHs and relays individually, but their main goal was to lower the energy burden on CHs, which is something that the suggested mechanism already done [5].

C. Drawbacks Of Existing System

1. The cluster leader is chosen at random, with no criteria.
2. The cluster head and the sink node are separated by a greater distance. As a result, this method is inefficient in terms of energy use.
3. The cluster head is not distributed properly over the network. In the network, there is a significant volume of traffic.
4. It is unclear where cluster heads are located in the network, and the location of the cluster head is uncertain.

IV. PROPOSED SYSTEM

The proposed concept is particle swarm optimization, which employs a variety of techniques to choose the cluster's leader. All of the sensor nodes in this area sense local data and communicate it to their respective CH. The CHs then combine the local data and send it directly to the base station (BS). It permits data aggregation at the cluster head, allowing redundant and uncorrelated data to be discarded. As a result, the sensor nodes save energy. Routing can be more readily handled because only CHs are responsible for maintaining the local route setup of other CHs, necessitating the usage of minimal routing data. As a result, the network's scalability is greatly improved. It also saves communication capacity because the sensor nodes only communicate with their CHs, avoiding the interchange of redundant messages.

A. System Architecture

The following Figure 1 diagram illustrates the sending the data to the receiver via cluster head.

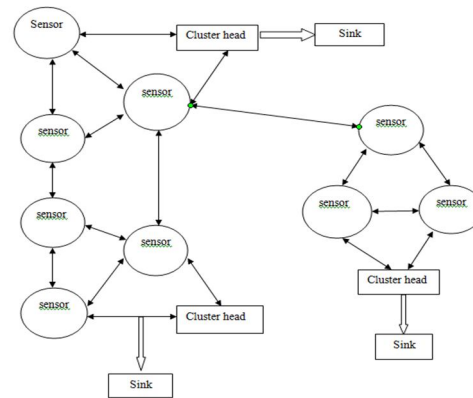


Figure 1 system architecture of the wireless sensor network

The architecture is made up of cluster heads and sensor nodes. Sensor nodes are manually put in the wireless network region. The sensor nodes continuously scan the environment for data and send it to the destination. This is accomplished through the use of Cluster. According to the PSO algorithm, each cluster has a cluster head. The cluster head is a node that is located near to the target node. The remaining nodes in the area form a cluster. These sensor nodes send the packets to the cluster head. The packets are subsequently gathered, aggregated, and sent to the destination nodes by the cluster head.

B. Implementation

The cluster head can collect the IDs of sensor nodes and other heads within their communication range before sending the local networking configuration to the base station. Routing and clustering techniques are now implemented using the network's received data. It's worth noting that after running the routing algorithm, the nodes use the final route setup to construct the cluster properly. When the routing and clustering is complete, all nodes are informed of their next hop relay node toward the destination, as well as the ID of the cluster head to which they belong.

Sensor nodes are deployed in the network region once their position is defined by supplying their XY co-ordinates. The network area has a flat grid topography. The source and destination nodes are manually selected, and communication between them is started at the specified time and speed. The UDP protocol is used to connect the source and sink nodes. Various clusters are formed by grouping the nodes together. The signal intensity and transmission distance of neighboring nodes are used to build each cluster. Colors are used to distinguish the clusters.

The PSO algorithm is used in the system. This algorithm is used for cluster formation and cluster head selection. The fitness function for each and every sensor node will be determined first. The transmission distance between the nodes is implied by the fitness function. The fitness function is calculated for each node, and the node with the shortest distance to the target node is deemed to be the best. All of the nodes go through the same procedure. Finally, the cluster head is chosen as the node with the shortest transmission distance to the sink (i.e., the best fitness function). For simulation, the transmission speed is manually set for all nodes..

When this approach is implemented, the following factors improve: network lifetime, throughput, packet delivery ratio, and energy consumption.

C. Modules

1. CLUSTER

- In this module, we create CWSN. Clusters of sensor nodes are formed, with a cluster-head (CH) sensor node situated near the cluster's destination node. Based on the strength of the received signal, leaf (non-CH) sensor nodes form a cluster and communicate data to the BS via CHs to save energy.
- At a relatively high energy level, the CHs execute data fusion and transfer data directly to the BS. We assume that nodes are manually deployed and have a finite amount of energy.

- The cluster head combines and sends the data packets to the appropriate destination node. This cluster was created using the particle swarm optimization technique. The throughput of its neighbors is determined by the node that uses the fitness function. The approach used to choose the cluster head is based on this information. CH=1 if the cluster head is assigned a sensor node; otherwise, CH=0.

The first node gathers input from the other sensor nodes in order to decide which sensor node is closest to the destination node. The cluster head will be assigned to the suitable node if it is closed

2. ENERGY MODULE

- All the nodes in the network are configured according to the protocol. Each and every node is initialized with 50J of energy. The nodes are given specific transmission and reception powers.
- The sleep power is also specified. The connection between the source and the destination nodes are made using UDP protocol. This protocol is used because the destination node will not send back the acknowledgement to the source node. As a result, it will save some extent of energy.

$$E = TE + RE + SP$$

TE: transmission energy

RE: reception energy

SP: sleep power

3. ROUTING

- In order to extend the network life time, the routing algorithm for Wireless Sensor Networks takes into account the energy consumption of the sensor nodes.
- The routing establishes a balance between the CHs' energy usage and the time it takes to forward data packets.
- it determines a path from all gates to the base station that is shorter in overall distance and has fewer data forwards.
- The Adhoc on Demand Distance Vector routing protocol is used to implement routing. The shortest path or distance between the source and destination nodes is determined using this approach. Each node gathers information from its neighbors and updates it in the router.

V. RESULTS AND DISCUSSIONS

On the network area, the nodes are being organized. This configuration is based on the topology supplied. As indicated in Figure 2 the sensor nodes are placed in the network region using the XY coordinates indicated in Figure3

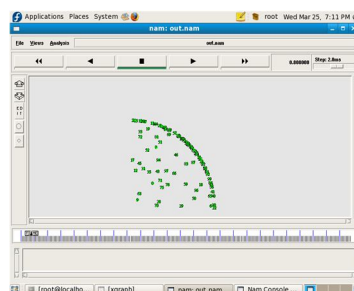


Figure 2 Arrangement of nodes

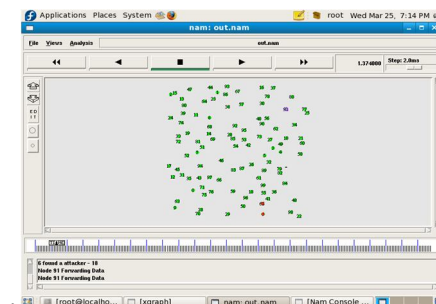


Figure 3 Position of sensor nodes.

A. Detection Of Information

Once the position is arranged after that the information can be detected shown in Figure4 and also the sensor nodes identify the attacking nodes that cause disruption during data transfer shown in Figure 5

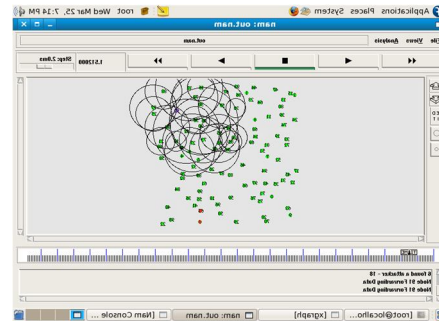


Figure 4 Detection of information.

1. Identifies The Attacker



Figure 5 identifies the attacker

B. Formation Of Cluster

Based on the signal strength the cluster is formed in Figure 6 and each cluster senses the data present in the environment and sends it to its corresponding cluster head in Figure 7

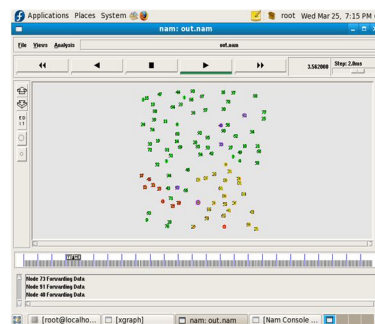


Figure 6 Formation of cluster

.C. Final Cluster

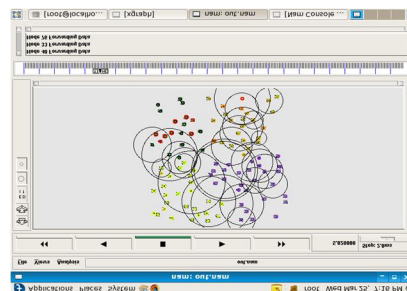


Figure 7 Final cluster

D. Energy Calculation

The average energy is calculated that is being consumed by the sensor nodes in Figure 8

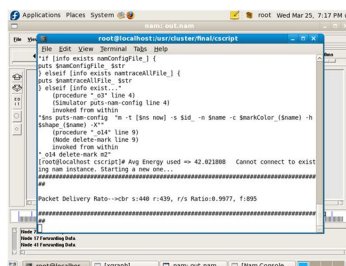


Figure 8 Energy calculation

E. Energy Graph

The existing and proposed algorithms are compared and the energy is used efficiently in our proposed algorithm in Figure 9

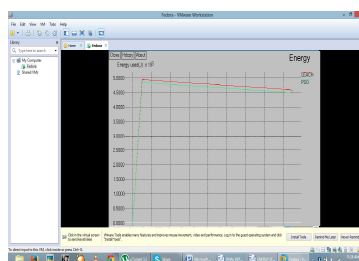


Figure 9 Energy graph

F. Network Lifetime

The lifetime of the network is improved and remains stable throughout the transmission.in Figure 10

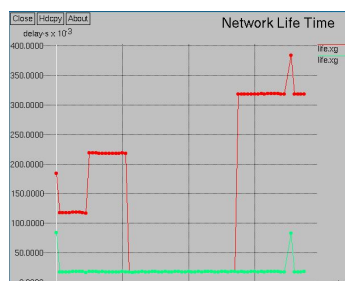


Figure 10 Network lifetime

G. Packet Delivery Ratio And Throughput

The performance of the packet delivery ratio also increased and throughput also decreased with existing algorithms in Figure 11 and 12

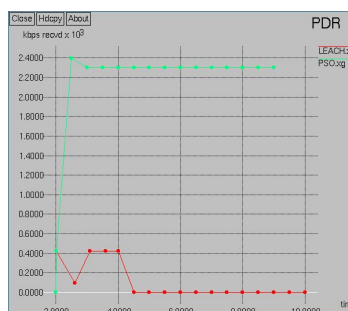


Figure 11 Packet delivery ratio

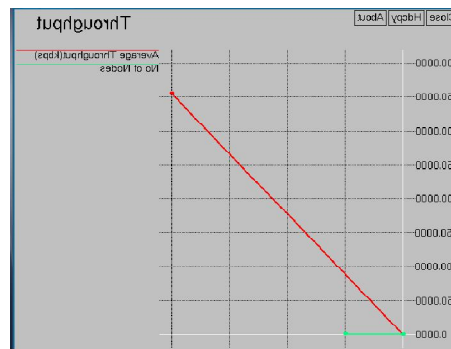


Figure 12 Throughput graph

VI. CONCLUSION

The cluster generated by the PSO algorithm in the wireless sensor network for data transmission aids us in reducing energy usage. The data load is balanced among the cluster nodes during the clustering phase to save energy. The distance between the cluster head and the sink nodes is cut in half. Because it should not consume more than the required power, all CHs are signed with a smaller number of sensor nodes. As a result, the CHs' energy consumption is greatly balanced, and the network's lifetime is extended. The results reveal that the suggested algorithms outperform existing methods in terms of network life, throughput, and efficiency.

FUTURE ENHANCEMEN

This system can be developed with several numbers of nodes. The system can be implemented by choosing the cluster head based on different criteria. The same idea can be applied in different fields such as defense and surveillance, forecasting the data in WSN, network lifetime. This application can be adapted to various other platforms

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