ENHANCED HEIRARICAL ROUTING PROTOCOL FOR CROP HEALTH MANAGEMENT USING MOVING BASE STATION(UAV)

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Abstract: WSN is the wireless sensor network consisting of multiple sensor nodes. These sensor nodes will communicates to each other to share the data to the base station. This type of network is required for various small applications. Where man less network for collecting the data can be builded. Various heirarical based routing protocols are used for the data interchanging amongst various sensor nodes and the base station. Both stationary and moving base station type of topology is support for the network which is sub divided into various small clusters. Each node part of the cluster communicate to the cluster head and cluster head communicates to the base station. The proposed approach heirarical routing protocol based in Crop Health Management with moving base station is supported. All the performance parameters like dead nodes count, Remaining energy and the total alive node count has been improved.

Keywords: WSN, CROP, MOVING BASE Station.

I. INTRODUCTION

Wireless Sensor Networks (WSN) is the innovation that comprises of expansive number of small sensor nodes placed in a specially appointed way within the network. The sensors are spread widely over a large range. These sensor hubs can perform differently based on its power and capacities. In WSN, the sensor nodes are deployed in a sensor field. The deployment of the sensor nodes can be random, regular or mobile. Sensor nodes coordinate among themselves to produce high-quality information about the physical environment. Each sensor nodes' decision is based on mission, the information it currently has, and its knowledge of computing, communication, and energy resources. Each sensor nodes collect the data and route it to the base station. All the nodes may not be communicating at any particular time and each node can communicate only with a few nearby nodes. The network has a routing protocol to control the routing of data messages between nodes. The routing protocol also attempts to send messages to the base station in an energy-efficient manner.

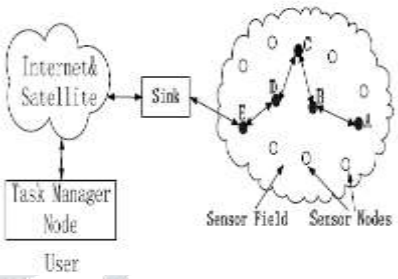


Figure 1: Wireless Sensor Network

The base station is a master node and is the main computer where data from the sensor network will be compiled and processed. The base station may communicate with the Remote Controller node via Internet or Satellite. Human operators controlling the sensor network send commands and receive responses through the base station. The wireless sensor nodes cluster together to form a network with each node that has the capability to process.

Data fusion is also known as data aggregation and is defined as the process of aggregating the data from multiple sensors to eliminate redundancy and provide fused information to the base station. Data fusion can process all the data sensed within the area to get more accurate information.

Mobile agent migrates between different nodes in the network applying the transfer rules, and it can filter data and process them at the node where it stays, so it does not need to transmit mass data to the system, just send and return only necessary data. Therefore, mobile agent can significantly reduce the data traffic on the network, and improve network bandwidth utilization. Also Mobile agent has many other

characteristics, such as robustness, fault tolerance. Mobile agent routing problem is a kind of complex combinatorial optimization problem which solves the optimal path based on the sequence of visited nodes and energy efficiency in WSN. Ant colony optimization (ACO) is put forward to solve migration of mobile agent along with some improved mobile agent route algorithms based on ACO [1]. But the function of algorithm reaches optimum difficultly because its parameters are usually set by experiments that lead the optimization performance of algorithm that is closely related to the client experience. Furthermore, ACO Algorithm has some weakness, such as easy to bring premature convergence and take long computing time. This paper presents an improved ACO in order to strengthen convergence speed and avoid partial optimal solutions. In order to avoid invalid path, a mutation operator is imported [1].

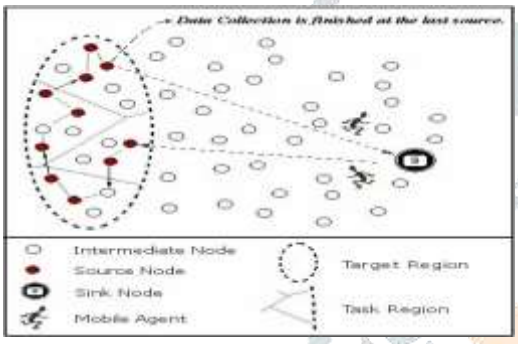


Figure 2:Working of mobile agent[17]

III. RELATED WORKS

Muhammad Aslam et.al.(2016) The author proposed Two-Hop Centralized Energy Efficient Clustering (THCEEC) and Advanced heterogeneity-aware Centralized Energy Efficient Clustering (ACEEC) routing protocols which are derived from Centralized Energy Efficient Clustering (CEEC) routing protocol for three level heterogeneous WSNs to enhance stability period of nodes and network lifetime of WSN. Applying it, WSN became energy efficient and acheive stable elections.

Ben Liu et.al. (2016) This algorithm uses sink side least-square algorithm, which reduces the communication traffic between sink and the monitoring center , on the side of monitoring center, the incident identification accuracy improved in D-S evidence recognition framework, by using the triangular fuzzy membership function for obtaining basic probability assignment value. It Reduces communication traffic between sink and source and identification accuracy is improved in D-S evidence theory recognition framework.

S.G. Santhi et.al.(2015) proposed an algorithm DCHM used for secure and accurate data fusion as well as Accuracy of data fusion results is also improved. It performs well in improving security and accuracy of data fusion by update reputation and trust systems.

Mohammadreza Soltani et.al .(2014) In this research, kalman filters based on data fusion used to reduce the number of active sensor node in large network, in this Only those sensor considered which are inside of the gate validation region, Reduction of network resources, less network load, secure communication.

The application uses in study to track a moving object utilization which has a constant velocity model that includes noise. The centralized architecture for data fusion is considered. In this structure, each node sends its own observation as raw data to the data fusion center for processing. All nodes sense position at constant rate, and measurements are performed at the same time and arrive at the data fusion center at the same time , sensor network is constant over the time. It means that the nodes are stationary and environmental conditions do not change during the observation time.

Jin-gang-cao et.al. (2013) In this research allow ACOE algorithm to find better route. This algorithm reduces the impact of invalid nodes in WSN. Reduce transmission delay, network traffic, prolong the network lifetime and reliability of links**.**

structure of Mobile Agent consists of four sections in this: (i) identification number, (ii)the executing code, (iii)data space and (iv) migration route.

Data fusion theory for WSN, data fusion is to find a route between the sensor nodes and the sink node, and merge to reduce redundant data. Firstly, MA is initialized with the order and number of nodes it will be visited, and then it will be distributed to collect useful information by the sink node. Finally, it will come back to the sink node with data fusion results, it calculates as follows:

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

where e is the connectivity status of wireless sensor nodes, (i,j) and its value is "0" or "1 ", where "1" denotes v(i) and v(j) are connection, and "0" expresses they are disconnection. this calculates minimum distance in network.

Rui tan et.al. (2012): the research defines fundamental limits of coverage based on data fusion models that process noisy measurement of sensor that measured by probabilistic disc model. Result of research allows analysis of existing disc space model and provides key into designing and analyze of WSN adopted data fusion algorithm. It define mobile agent within the coverage area of the network and for better signal coverage and to count total consumption by sensor

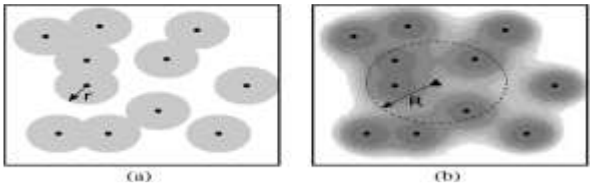


Figure 3.(a)disc space model, (b)probabilistic disc space[12]

to study the coverage of large-scale WSNs.

Yuzhi Wu et.al. (2012) In this work Minimum Spanning tree is used to combine sensor node energy level to layout the routing. Consider data fusion energy and transmission and adapt to adjust mobile and data fusion. Decrease energy consumption, increase network efficiency, it find minimum possible total cost. There is also a need increase the area for large coverage link.

WSN is composed of Processing Element (PE) sensor nodes and communication network. PE is a node that has more power, memory and communication ability. It depends on its network scale to decide mobile agent's best route. Mobile agent begins with PE, goes along with the route that designed firstly, to collect and fuse the useful data, and then returns to the PE.

Huang Lu et.al. (2009) Proposed novel power efficient routing algorithm for hierarchal cluster compared with simple directed diffusion and non-clustering routing algorithm, proposed routing algorithm prolongs the system lifetime for large scale multi-hop transmission WSNs. Results show that, or large scale WSNs, our proposed algorithm performs better than the existing routing algorithms in terms of network lifetime. Future plan includes the improvements for better comparison results, such as changing the position of the BS, and changing the probability of becoming CHs from all sensor nodes.

IV. PERFORMANCE ANALYZER

Topic	Network delay	Cost	Network survivability	Data transmission	Network coverage	Consumption of network resources	Reliability of links	Secure communication
[1]	×	Minimum	Medium	Minimum	×	More	×	×
[2]	√	Minimum	Medium	√	Small	Minimum	√	√
[3]	√	High	√	Minimum	Large	Less	√	×
[4]	More	High	√	Maximum	Large	Less	√	√
[5]	√	High	√	√	Small	Sometimes less	√	√
[6]	√	Medium	Easily	Slow	Small	Less sometimes	√	√
[7]	×	Less	√	×	Small	Maximum	×	×
[8]	√	Less	√	Easily	Medium	Less	×	×
[9]	×	Less	Better	Better	Better	Less	√	√

V. ALGORITHM

Step1 Sub divide the total network area into various smaller parts each small part will be named with cluster number.

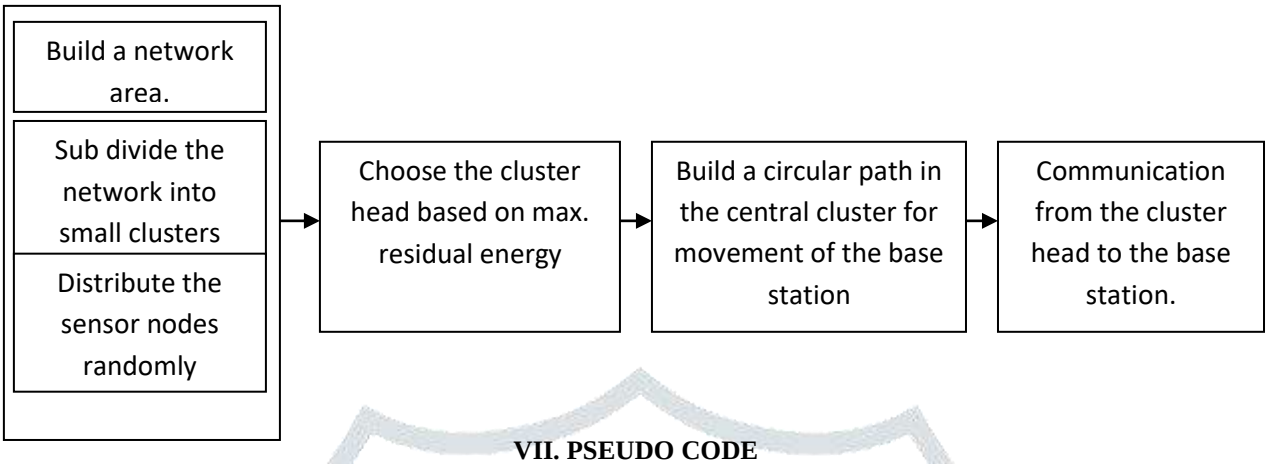
Step2 Distribute the sensor nodes in each cluster randomly.

Step3 Based on the residual energy choose the cluster head. Highest energy node in the cluster will be chosen as cluster head.

Step4 Build a circular path in the central cluster for the movement of the moving UAV.

Step5 All the cluster heads communicates to the moving base station. When the base station has less distance from the cluster head.

VI. FLOWCHART



VII. PSEUDO CODE

Test case set S=θ
For each coverage C do
Find start node, Ns
Repeat
Find 100 neighbours by adding one step into ∑of Nc
Select the best fitness neighbor among the 100 neighbors
If the best fitness neighbor is in userful then
Nc<- the best fitness neighbor
Ekse
Brea
End if
Until satisfy C or reach maximum iteration
S=SU(∑of Nc)
End for

VIII. RESULTS AND DISCUSSIONS

8.1 Multiple Sink nodes based routing routing algorithm

It uses centralized algorithm, designed with the goal that the mobile agent quickly delivers the information during its iterations and adapt the changes in network in order to maximize the survival time of each node in grid.
In the proposed work following assumptions have been taken as shown in the table

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(ε_{mp}, ε_{fs})	(0.0013pj/bit/m ,10pj/bit/$m^{2)}$
8	Data aggregation(E_{DA})	5Nj/bit/signal

Table 2 Parameters

1. Set-up phase:

In set up phase network is divided in small grids –: There are total 100 nodes in the sensor field. each grid contain 10% of total nodes and central grid contain 20% of total network nodes and a base station at center. nodes are static in nature and continuously sensed data. each grid contains unique id. each sensor node send data to the base station directly or indirectly base on energy consumptions.

- 10% of sensor nodes are deployed uniformly in each grid as

$$N1 = 10 * \frac{N}{100}$$

- and 20% of Sensor Nodes are deployed in central grid, (5th grid) as

$$N5 = 20 * \frac{N}{100}$$

8.2 ACO Elite method-: ACO Elite method of data fusion path finding is used in each grid separately to find the minimum path distance to transmit data to base station. It will create a chain in each grid to connect all the nodes, collect data from nodes, and send it to base station. A leader node is required in each grid that collects data from all nodes present in the grid and sends further. Leader node will be chosen using ACO method and leader node will be changed in each iterations**.**

Place the m ants on the n nodes and chain is formed as (equation 1)

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

Compute the length L_k of every ant Update the shortest tour found. Move kth ant to town (j,p) For every edge (i,j), compute

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

Here i is source k is sensor node and j is destination node in a chain.

$p^k(t)$, is probability to form chain.

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

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

For k:=1 to m do

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

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

In this process, a node in a grid will look for a node with minimum distance to send data to the leader node within the grid and further the next node will apply the same method. Therefore, data will be aggregated on the leader node through chaining between multiple nodes. It will take less energy as compare to send data directly.

Mobile agent:-Mobile agent will move around the central grid in a disc drive pattern to receive data from leader node of each grid and send it to the base station. It collects information from each grid by visiting its leader node and delete it after sending the data to Base Station and move on to next grid and so on.

2. Communication phase: Communication between leader nodes and base station is performed in this phase by using mobile agent. Communication between nodes depends on energy that each sensor contains. For data communication, mobile agent will find the point on the path where Leader Node and Base Station are at minimum distance. Ecluidian function is used to calculate distance between nodes and energy dissipation is applied on nodes for data communication leaving dead nodes.

Energy dissipation:-Energy will be dissipated from chain in each grid to base station. It moves from chain to mobile agent then to radius of central grid and at the end to the base station is as follow in equation-III

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

Or

Energy dissipated = Energy dissipated + (ETX * L + Efs * L * distance^4)

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

Check dead node in each grid:-Each node has its initial energy. in grid each node send its energy to base station.the node lost its transmission energy(ETX) ,the node who receive it lost it receiving energy(ERX) as well as transmission energy .fuse the data and send it to further and so on.

So, if energy is less than given threshold then the node is considered as dead node and the previous node send data by bypass the dead node to the another node in the chain and chain reformation is applied.

8.3 RESULTS

8.1 Alive Nodes Comparison for Existing and proposed

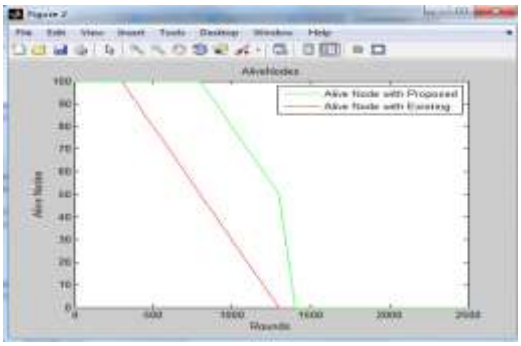


Figure 4 Alive Node in Proposed and Existing Technique

Fig 4 shows the performance comparison on the basis of Alive nodes. in case of proposed approach more number of alive node for the specific number of iterations.

5.2 Dead Nodes Comparison for Existing and proposed

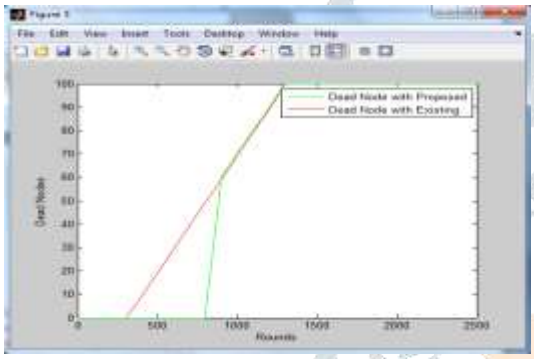


Figure 5 Dead Nodes in Proposed and Existing Technique

Fig. 5 shows the Performance comparison of the Dead nodes count with both proposed and existing. In proposed approach there are less number of dead nodes. for more time period the nodes will stay in the network communication.

5.3 Energy Comparison for Existing and proposed

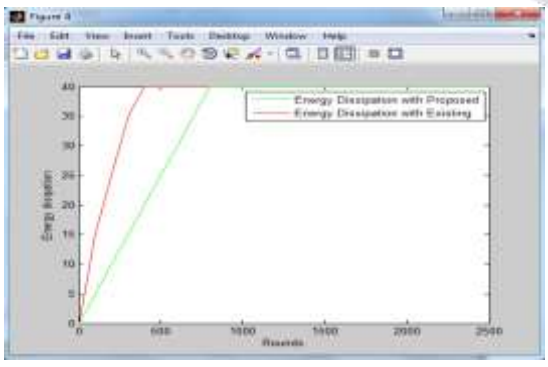


Figure 6 Energy Dissipation comparison for existing and proposed

Fig. 6 shows the Energy dissipation for base and proposed technique. In case of the proposed technique the energy dissipation will be less. That means for life time of the network with moving sink node on the circular route.

IX. CONCLUSION

WSN as wireless sensor network consisting of various sensor nodes. each sensor node has battery to provide the energy. This battery power is limited. Every time sensor node communicates to the cluster head or the base station the energy source will be depleted. For enhancing the life time of the network the utilization of the energy resources should be efficient. For efficiency the total network area will be sub divided into smaller clusters. Each cluster will be having random distribution of various sensor nodes. based on residual energy one node will be considered as cluster head. Moving base station is having fixed path of the movement in the central cluster. So cluster heads communicates to the moving base station. All the parameters in terms of the dead nodes count, alive nodes and residual energy has improved. So the proposed technique having moving base station is more efficient technique than the stationary base station.

X. FUTURE WORK

WSN is the wireless sensor network having various wireless nodes collects the data and transmit that data to the base station. Each sensor node is having limited battery power. So heirarical routing protocol will be required for transmission with some efficiency. In future multiple mobile sinks can be used for enhancing the efficiency further.

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