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Efficient Algorithms for Multicast Tree Construction in randomly placed WSN

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***Abstract*— In wireless sensor networks where nodes are deployed in an environmental field equivalent to a battlefield or positioned at distinct areas where gathering of know-how or resource for difficult task. Construction of Multicast tree is major issue in randomly placed WSN, The Nodes are displayed in static and deterministic manner. Using MATLAB as simulator tool multicast tree construction is studied and constructed for different application study, It is observed that based on the number of nodes and iterations combinations added in the wireless sensor network kruskal algorithm is the most efficient one with less energy consumption for smaller and medium scale network size, WSN with randomly placed nodes are deployed across the network topology and then a source node is selected inturn to find the shortest distance to all the destination nodes in the network. In this paper a different tree construction algorithm is simulated and studied by varying the number of nodes in the mesh based wireless sensor network.**

***Key words*—Wireless sensor networks, Multicast tree, efficient, energy, mesh network**.

I. INTRODUCTION

Efficient design and implementation of wireless sensor networks has become an interesting subject of study in recent years, as a result of the massive expertise of sensor networks that enable the communication of the physical world to the digital world. By networking huge numbers of tiny sensor nodes, it is viable to acquire knowledge about various phenomena that used to be problematic or unattainable to obtain in more traditional methods. Within the coming years, as advances in micro-fabrication technology permit the rate of manufacturing sensor nodes to proceed to drop, growing deployments of wireless sensor networks are expected, with the networks finally developing to massive numbers of nodes. Due to the constrained resources of the sensor nodes, WSNs have been used for numerous functions together with army surveillance, facility monitoring and environmental monitoring.
Multicasting is a major issue randomly placed WSN, The nodes are deployed in static and deterministic way, Different authors have come up with construction of multicast tree using energy efficient algorithms, There is a need to select best multicast tree construction methodology in randomly placed WSN which leads to maximizing the network coverage and efficiency.

II. MULTICAST TREE

The Multicast tree setup is shown in Figure 1 and Figure 2, The source node starts sending checking the

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nearest path to the host group destination address. Then, the source sensor node takes on the responsibility for sending data to all destinations within multicast group. Multicast routers along the path are responsible for ensuring that datagram are transmitted over the appropriate links to ensure they reach the destination node of the multicast group.

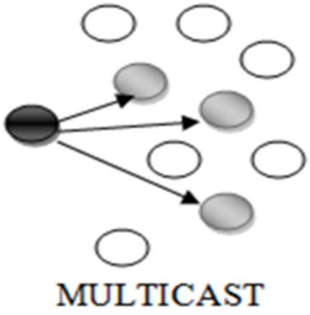

Figure 1. Simple Multicasting

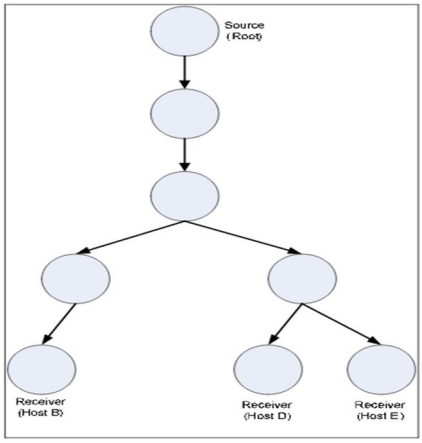

Figure 2 Multicast tree

III. Efficient Algorithms For Multicast Tree Construction

The proposed work is to construct multicast tree using energy efficient algorithms by varying the number of nodes in mesh network and compare the energy efficiency.
The proposed work consists of three Stages.

Stage-1 - is to construct mesh network and deploy static nodes.
Stage-2 - is to find the optimal path and energy for multiple destinations for different set of nodes.
Stage-3 - energy efficiency is observed and analyzed.

The proposed work is divided into three modules. First is network formation and node deployment, Second is use of existing algorithms with appropriate change to create multicast tree construction and Third is to use Energy Efficient Multicast approach to find the optimal path to the same multiple destination. Then analyze figure 3 the Energy efficiency difference between the algorithms for different nodes and iterations

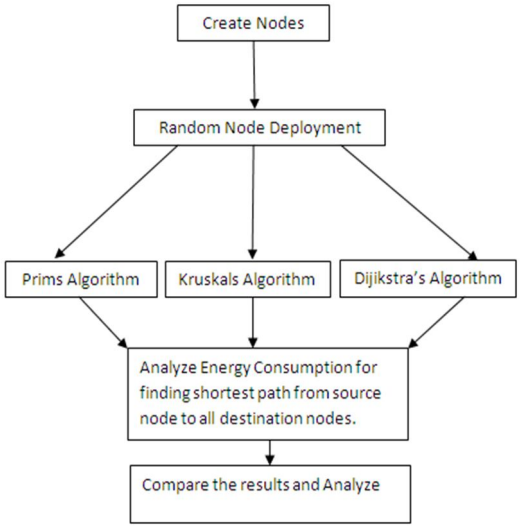

Figure 3 : tree construction and analyze

Stage 1: Network Formation and Node Deployment

The mesh Network is formed and the sensor nodes are deployed in the network. The nodes are deployed in a static manner. The nodes are placed in a defined space in the mesh network. The number of nodes deployed is varied from minimum (50) to maximum (150).

Stage 2: Use of Algorithms

Dijkstra algorithm:

This algorithm is called single source shortest path algorithm. This algorithm finds the the shortest path between that node (source) and every other nodes. In this process of finding shortest path, first it finds the shortest path from the source to a node nearest to it, then second nearest and so on. Dijkstra's algorithm works by solving the sub problem k, which computes the shortest path from the source to nodes among the k closest nodes to the source.

Step 1: Construction mesh network.
Step 2: starting node with a 0.
Step 3: find nearest nodes from starting node and choose the one of least value. Update.
Step 4: Choose the temporary label of least value.
Step 5: Repeat steps 3 & 4 until, destination node and freeze it.
Step 6: Retrace the shortest route backwards through the network back to your start node
Step 7: repeat the above steps for remaining destination nodes.

Prim's algorithm:

Prim's algorithm is a greedy algorithm, minimum spanning tree means to finds a subset that forms a tree that includes every node, where the total energy consumption tree is minimized. The algorithm operates by building tree one node at a time, from an arbitrary starting node, at each step adding the tree to another node.

Step 1: construction of mesh network
Step 2: from the source node, grow the tree by one node at a time, find the minimum-energy consumption for tree.
Step 3: Repeat step 2 (until all destination are in the tree).

Kruskal's algorithm

Kruskal's algorithm is a greedy algorithm, gets a minimum-spanning-tree algorithm which finds a path of the least possible distance between the nodes. it finds a subset and forms a tree that includes every node in the network where the total energy consumption of all the nodes in the tree is minimized.

Step 1: construction of network, Create a set of trees, where each node in the graph is a separate tree.
Step 2: Create a set S containing all the edges in the graph
Step 3: While S is nonempty and F is not yet spanning remove an edge with minimum weight from S, if the removed edge connects two different trees then add it to the forest F, combining two trees into a single tree.

IV. EXPERIMENTAL SETUP

The mesh network is formed with fixed number of nodes 50, 100 and 150 and will vary the number iterations. In this scenario 50, 100 and 150 iteration is taken for consideration for three algorithms Prims, Kruskals, Dijkstras. Appropriate changes are made in the algorithm to suit the approach. This network setup is first implemented using Energy efficient algorithms. The energy consumption is calculated. The energy consumption is compared for various combinations.

In the scenario 50, 100 and 150 nodes are taken into considerations for 50,100,150 iterations for the algorithms Prims, kruskal and Dijkstra, The energy consumed is compared and the reading noted table 1. Nodes are plotted in randomly placed mesh network. Once the nodes are plotted then the source node is given and then the shortest path is found to all the destination nodes. The above figure 5 and Figure 6 clearly explains the plotting nodes in wireless senor networks, Here in the network source node is taken as 1 and then the graph is plotted for all node from the source node, During the process of graph plotting from the source node to each and every other destination nodes shortest possible distance is calculated by the algorithm used and by the nodes and the iteration selected. Once the shortest distance is calculated from the source node to all the destination nodes the energy consumed

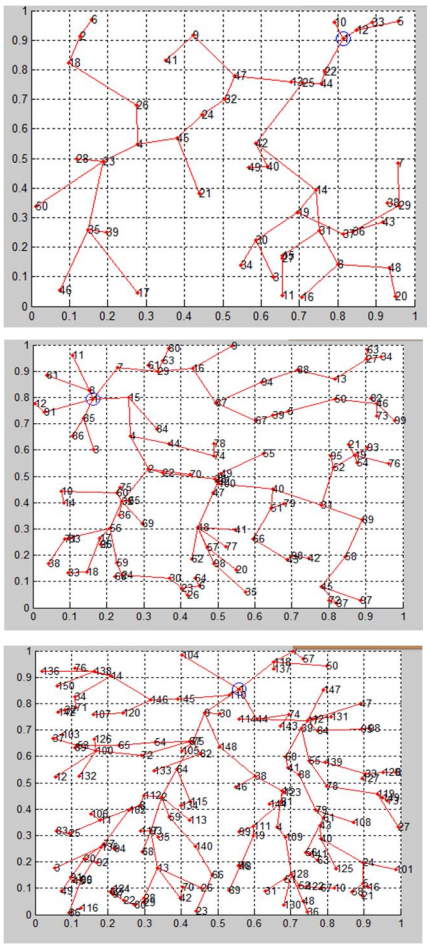

Figure 5 : 50 nodes , 100 nodes , 150 nodes

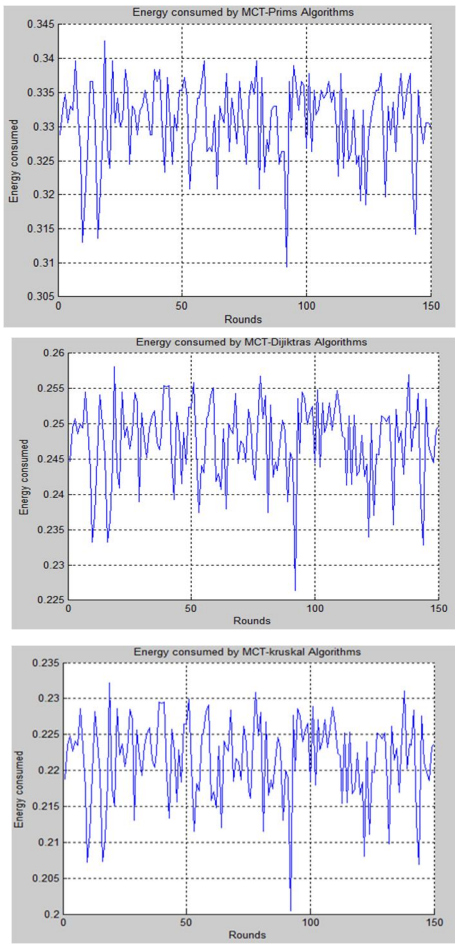

Figure 6. Energy consumption

TABLE I. ENERGY CONSUMPTION

Algorithms	Iterations	Average Energy Consumption in Joules
Prims	50	0.341
	100	0.342
	150	0.343
Dijikstra's	50	0.247
	100	0.248
	150	0.259
Kruskal's	50	0.234
	100	0.235
	150	0.236

V. CONCLUSION

MATLAB tool was used as a simulator for construction and study of multicast tree based on the study, Based on the observation made for various combination of node plotting and iterations selection kruskal algorithm is found out to be the most efficient one, The percentage of increase in energy consumption when the nodes remain the same and iteration is increased is very minimal,

Hence raising a scope for network maximizing without increase in the energy utilization by the senor nodes in the wireless sensor networks.

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