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Minimum Clustering based Spanning Tree with Optimal Energy Routing for Wireless Sensor Network - A Survey

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Abstract:- Wireless Sensor Network (WSN) clustering structure offer many features like network scalability, communication overhead reduction, and fault tolerance. When aggregate information is transferred to sink node, it reducing unnecessary redundant data transfer, reduces nodes transmitting and saves energy consumption. In addition, WSN allows scalability nodes, reduces communication overhead, and allows efficient use of WSN resources. Cluster based routing methods manage network energy consumption efficiently. Building spanning trees for data collection rooted at a sink node fundamental data aggregation method in sensor networks. The Minimum Spanning Tree (MST) based clustering approach can identify clusters of arbitrary form by using eliminating inconsistent edges that be addressed MST-primarily based clustering algorithms. In this paper, we present a modified minimum spanning tree algorithm with optimal route discovery for WSN. The proposed algorithm is capable of route data to the destination with maximum throughput, minimum delay and reduces packet loss. Moreover, performs better than existing routing algorithm in WSN.

Keywords:- *Wireless Sensor Network, Minimum Spanning Tree, Transmitting, Clustering and Data Transfer.*

I. INTRODUCTION

The minimum-weight spanning tree problem is a traditional and popular problems of combinatorial optimisation that of ending a spanning tree of an undirected or linked graph and sum of the weights of edges is always minimal. Minimal weight spanning has many real-time applications as listed below.

- Design of direct applications of computer and communication networks, power and leased-line Smartphone networks, wiring connections, links transportation network, piping flow community, etc.
- It offers solution to other problems to which it applies and offers services like network reliability, clustering and classification problems for WSN.
- It divides a complex problem into many sub-problem and determines a sub-problem with optimal solution. This will typically suite in a WSN to discover a optimal energy route during route discovery. Thus, delay can be reduced with maximum throughput.
- It produces effective output in case of real-time applications that rely on WSN.

Clustering in WSN can partition data set into subsets known as clusters and each subset's data do not share unusual properties. Clustering divides a WSN into interrelated substructures referred to as clusters, with cluster having many Sensor Node (SN) headed by means of a CH that is capable of coordinating each substructure. One of the advantages of forming routing as CH and cluster gateways is inter-cluster routing, thereby restricting, creating, and spreading routing records. Local adjustments like nodes changing cluster is updated in corresponding clusters and no update is required for the entire network, which reduces information stored by a cellular node greatly.

In WSNs, generally used paradigm for data fusion is Client–Server (CS) communication; where the sensors Node (SN) sends the collected records to the sink in which processing happens. All SNs send the collected data to the sink via multi-hop routing. This type of communication paradigm has shortcomings. In one hand, it calls for many transactions and cannot easily determine whether its corresponding communication be alive and healthy. Thus, this strategy of communication consumes larger network resources like lifetime and energy of cluster head and all intermediate nodes between sender SN and receiver SN of a WSN.

II. LITERATURE SURVEY

A minimum spanning tree is a spanning tree whose total weight of edges is either less than or equal to the total weight of edges of each different feasible spanning tree of that graph. MST can be used in WSN to discover a route with minimum cost. R.Jothi et.al [1] proposed a fast approximate minimum spanning tree based clustering algorithm using Bi-means nearest neighbor partition and K-means nearest neighbor graph that is bounded by $O(n^{3/2})$. The worst cases extensive analysis of local neighborhood graph was little bit high. Young-jun oh et.al [2] proposed energy efficient and reliable routing protocol for dynamic property based clustering mobile ad hoc network. The

proposed dynamic direction vector hop algorithm sets the cluster using the direction and velocity of the node to determine a routing path between source and sink node.

Niav J. Patel et.al [3] proposed a new technique to solve minimum spanning tree problem namely maximum cost pruning method algorithm that relies on edges in case of directed and undirected graph which produces output in the form of updated weight matrix. Basel et al. [4] worked on a transportation plan in which cable troughs have been shipped from various source places to their destination sites of construction. They were actually minimize the routing cost; however conjointly observe that totally different model tools like excel solver, Lingo/Lindo, MPL/Cplexetc which may result in different shipment allocation. However, all of the fashions hired resulted in an highest quality solution of AED. Charles caied et al. [5] point out Prim`s algorithm for determining minimal spanning problem by designing a local region community. Their approach was able to minimize the total cost of the various university buildings interconnection which changed into represented by using nodes with fibre-optic.

III. PROPOSED ALGORITHM

➢ *Overview*

A modified greedy algorithm with healthy node selection is proposed to decrease power consumption and maximize user satisfaction by taking local decisions to build a healthy route for data transfer in WSNs. The proposed algorithm relies on the following steps to discover a route that is capable of reducing latency and maximize throughput.

- The proposed wireless routing algorithm first checks the healthiness of all nearest neighbours to the sender in terms of power and energy.
- The closest node is determined based on its relative angle to determine shortest route.
- If a node satisfies both conditions then it will be added in the minimum routing cluster.
- The above three steps are repeated until the route establishment reaches the intended destination node.
- Analyzing the running time of the proposed modified greedy based wireless routing algorithm will normally be much easier than for different techniques (like Divide and conquer). For the Divide and conquer method, it is not clear whether the technique is speedy or slow. This is because at each level of recursion the size of receives smaller and the number of sub-issues increases.

➢ *Use of greedy technique*

A greedy algorithm, as the name suggests, always makes the choice that seems to be the great at that moment. The proposed approach makes use of a locally optimal solutions to establish a route for data transfer rather than determining globally optimal solution.

➢ *Determining energy efficient MSTs*

We check the energy consumption for the duration of the tree creation and the data collection. By doing so, we are able to distinguish between (1) the energy consumption induced by control packets that build the tree, and (2) the energy consumption caused by data packets that traverse the tree. We measure the energy consumption of each node relative to the next immediate node and validate its current power. The concept of neighbor classification based totally on node energy level and their distances has been utilized in Energy Efficient Greedy Scheme has been used to cater of the susceptible node trouble. Some neighbors can be greater favourable to choose than the others, not only based on distance, but also based on energy characteristics.

It suggests that a neighbor choice theme ought to avoid the weak nodes. If the geographic forwarding scheme purely based on greedy forwarding attempts to minimize the number of hops by maximizing the geographic distance covered at each hop, it is likely to incur significant energy expenditure due to retransmission on the weak nodes.

On the other hand, if the forwarding mechanism attempts to maximize per hop reliability via forwarding best of shut neighbors with desirable nodes, it may cover most effective small geographic distance at each hop. It would also result in greater energy expenditure due to the want for more transmission hops for every packet to reach the destination. So, in both cases energy is not being conserved to increase the lifetime of the network. Therefore, the strategy used in the proposed Energy Efficient Greedy Scheme first calculates the average distance of all the neighbors of transmitting node and checks their energy levels. Finally, it chosen the neighbor which is alive (i.e. having energy level above than the set threshold) and having the maximum energy plus whose distance is identical to or much less than the calculated average distance among its entire neighbors. Hence, the proposed scheme uses Energy Efficient routing and relative angle optimization to pick the neighbor that has enough energy level and is closest to the destination for forwarding the query.

IV. COMPARING THE PROPOSED ALGORITHM WITH EXISTING ALGORITHMS

➢ *Complexity*

We showed that the lower bound on energy complexity for distributed construction of any spanning tree, subsequently additionally MST is Ω (log n). However, if some additional information such as coordinates of the nodes became given to the nodes, an extra energy efficient algorithm can be developed. We present a distributed algorithm to assemble a spanning tree assuming that each node knows its own coordinates. This spanning tree gives a constant approximation to MST, and the energy complexity of the algorithm is additionally regular.

➢ *Accuracy analysis*

In present approach, accuracy analysis suggested that the Che-MST [18] algorithm the common edge-error of 11.29% and weight-error of 5.88%. Caiming-MST [3] became proposed algorithm MNIST has received average edge error 18.5%. Wang-MST [12] additionally has received average error rate in the direction of Che-MST. The error rate of Zhong-MST [16] turned into proposed set of rules KNNG the average edge-error of 5.5% and 5.7% and weight error of 2.6% and 2.7%. Jothi-mst also has obtained average edge-error 2.6% and weight-error 1.7%. These measures indicate that the proposed modified algorithm MST algorithm would produce optimal route much faster than other algorithms with reduced error rate and maximum throughput.

➢ *Data transfer rate*

As the proposed modified wireless MST based routing algorithm uses healthier node selection and select intermediate nodes that are lie closer to its immediate neighbouring nodes. We ensure that the proposed algorithm would reduce delay to greater extent and maximize throughput rate compare to existing wireless routing algorithms proposed in the past for WSNs.

➢ *Latency*

In existing method latency analysis shows that the Katajainen et al. [15] Proposed the SA-MST set of rules higher than LEACH in the variety of 2.14% to 4.0% and GA in the variety of 0.4% to 23.66%. These all measures indicate that the proposed algorithm produced much quicker than other algorithms that will reduces delay.

➢ *Analysis of existing algorithms*

There have been many algorithms proposed in the past to discover a route for data transfer in WSNs. The main intention of all such algorithms is to reduce delay and increase throughput. Few wireless routing protocols proposed in the recent past are listed in Table 1. Among all, the proposed wireless routing protocol has outperforms in all aspects.

Security features	**R.Jothi et.al [1]**	**Young-jun oh et.al [6]**	**Niav J. Patel et.al [8]**
Proposed algorithm	Bi-means near neighbor partitiong(BNNG) and K-means near neighbor graph(KNNG)	dynamic direction vector-hop algorithm	Maximum cost pruning method algorithm
Category	Reactive	Reactive	Reactive
Accuracy analysis of MST	Low	High	High
Broadcasting	Simple	Simple	Simple
Multiple paths	Yes	Yes	No
Communication overhead	High	High	High
Metrics	Shortest path	Shortest path	Shortest path
Loop freedom maintenance	Source route	Sequence number	Sequence number
Latency	Low	High	High

Table 1

V. CONCLUSIONS

MANETs may be deployed in a wide range of applications like rescue scenarios, military operation and surveillance. Flat network structure suffers from topology maintenance overhead since changes in topology is shared with all nodes. It has an outsized control message overhead when the network size is incredibly large. To reduce the topology maintenance overhead, the network is divided into clusters. In this paper, we proposed a modified MST based wireless routing algorithm for minimizing the delay time and increase the throughput rate compare to existing wireless routing algorithms that suffer from complexity, accuracy, data transfer rate and latency. In addition, the proposed wireless routing algorithm can greatly extent the lifetime of the current WSN.

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