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Disjoint Route Vector Algorithm for Heterogeneous Wireless Sensor Networks

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Abstract: In a distributed wireless sensor networks,maintaining topology and reducing frame loss is much needed for effective transmission. The wireless sensor network consists of a various number of sensor nodes which used for sensitive data collection like military surveillance. Conventional topology networks are used for homogeneous networks. Whenever a node failure occurs in the network topology, existing protocols initiates route discovery process. However, to find a route, the existing protocol flood the network which is independent of the node location. This also reduces the overall performance of the network with unnecessary packet retransmission. We overcome this problem by making efficient topology network with fault detection. In this paper, we propose an algorithm called disjoint route vector. It is used in a hetero genius wireless sensor networks. In this algorithm, assigning transmission range for each sensor node such that forming p-disjoint paths in heterogeneous networks. So if a node failure occurs it only checks p-1 nodes in the worst case instead of all the nodes in the network. Our simulation results show the time taken for proposed algorithm is relatively less.

Keywords: WSN, disjoint route,transmission range,supernode,sensor node.

I. INTRODUCTION

Wireless sensor networks consist of thousands of nodes with limited energy, storage capabilities naturally. All these nodes are used to collect information from various places. These limited resources utilized efficiently to gather information from the environment. Power efficiency and fault node detection are essential for WSN [1]. To overcome these problems, all sensor nodes work in a distributed manner. Detecting fault node in the topology and recovering from the failure improves the energy of sensor node. Whenever fault occurs in the network, other nodes which are connected in a distributed manner will help to find the fault node. However conventional Retransmission methods causes increase in the delay. So topology control is used to detect and identify the fault node effectively [2]. Consider homogeneous networks which are impractical to exist in the nature. A link failure in this network results in flooding the network to identify at which location the failure occurred. This consumes more energy and unnecessary packet retransmissions. So heterogeneous networks are common in use. Wireless sensor networks generally consist of two types of nodes. One is Super node which acts as actuator. Other is sensor nodes. Super nodes are having more energy and controls the nodes under it. Data gathered from sensors is forwarded to actuators for performing necessary actions [3]. Heterogeneity will improve the average packet transmission rate. It also increases the lifetime of the network if super nodes designed carefully [4]. This paper introduces new algorithm called Disjoint Route Vector (DRV) for constructing efficient topology to route data with detecting fault node in the network. In WSNs, obtaining certain degree of fault tolerance is important and this will be achieved by p-connectivity of the communication graph [2]. Fault node in the network can be detected by its neighbouring node. Topology is tolerant up to p-1 nodes in the worst case scenario. We propose this algorithm to solve problems in efficient way in terms of transmission power assigned to sensor nodes, detecting fault node in the network and sending less number of control messages. This results in effective bandwidth utilization. While finding disjoint paths itself we store the complete path information in order to find fault node and effective routing of data. That path information up to p nodes only according to the transmission range assigned to the nodes. So this results in best path network instead of finding whole network topology. Detecting fault node in this approach does not depend on the global network topology. Using locality of reference to find the effective node in the network.

II. RELATED WORK

In WSNs, controlling the nearer nodes by adjusting the transmission range, selecting nodes to route the data and detecting fault node in the network are comes under topology control [5]. These controlling approaches are divided for two types networks. Namely, Homogeneous and Heterogeneous. Sensors having the same transmission range in the network are said to be homogeneous otherwise heterogeneous.

Most of the topology control methods are developed by adjusting the transmission power of the sensor [6] [7] [8] [9]. Some algorithms use clustering of nodes for maintaining topology control and detecting fault node in the network but these techniques startup with flat topology and end up with layering. Here unnecessary work done for building clusters. We overcome this by making connectivity between supernodes and sensor nodes. The method of clustering does not

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guarantee the p-connectivity of a node in case of fault tolerance since there are different sizes of clusters. Below figure shows how hierarchical clusters tend to form a network but it does not guarantee in discovering fault node since there may be a single node cluster.

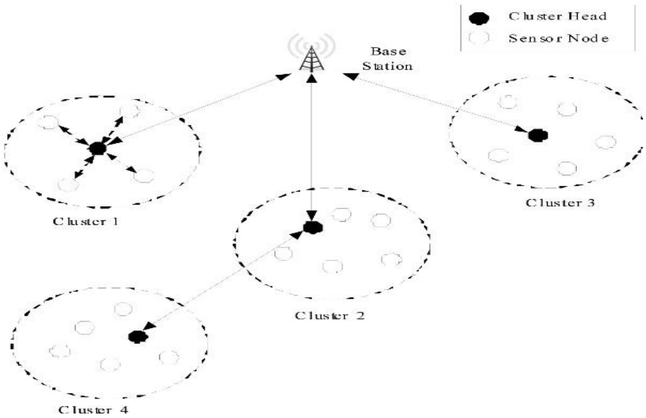

Figure 2.1 Clustering in Wireless sensor networks.

A good work is done in the topology control of wireless sensor networks. There exists an algorithm called distributed anycast topology control algorithm (DATC) [13]. In DATC nodes that are outside of reachability are unknown to discovery process of a node. Because it does not store the full path information from supernodes to sensor nodes. In our approach we store it in local tables. With DATC we cannot find nodes that are a fault because those may be out of range.

III. PROPOSED WORK

We propose a new algorithm called Disjoint Route vector in WSN. WSN's consist of supernodes and sensor nodes. Before introducing an algorithm, we give some necessary definitions.

Definition 1 (Disjoint Routes). Set of paths from a graph in which path has common endpoints but vertices are different.

Definition 2 (p-vertex connectivity). A graph is said to be connected if there is a path from one vertex to another vertex. P-vertex connectivity guarantees that removal of p-1 edges in graph also doesn't result in disconnected [14]. So in WSN removal of p-1 sensor nodes doesn't partition the network [13]. Our algorithm considers sensors as neighbouring sensors if they are within the transmission range of others. So each node measures value and send it to the neighbouring nodes. If there is a change of value in a node of p-connected and the measurements change over the time frequently. It is more likely the sensor fault. Consider this scenario wherein p-connected WSN only a one node sends incorrect result and remaining p-1 nodes sends correct result. From this we can easily identify the node i.e. likely to be faulty.

This algorithm involves five stages mainly.

A. First Stage: Path Information Collection

In this stage, supernode sends a dummy message to collect route information. This message is received by sensor nodes. It updates its table according to the data received. Sensor nodes here calculate the disjoint paths to the root node.

B. Second Stage: Locality of reference

It uses locality of reference module to calculate the set of disjoint routes between sensor nodes. Depending on the range of sensor nodes each sensor nodes set threshold value. The route is discovered within the limits of this value. It is maintained at most n-1 node failure in the worst case.

C. Third Stage: Finding the path

In this stage an info message is sent along with its routing information table to calculate efficient route possible over the network. So that it minimizes the cost of the route by finding the least cost path. So this leads to forming of neighbour nodes list. Now we have a routing table, again a dummy message is sent over the network. Each sensor checks its route table to calculate the efficient route possible.This will calculate the disjoint routes possible in the network.

D. Fourth Stage: Removal of nodes

Neighbour nodes which are not on the table are removed from the list. Since these nodes do not connect to the path.

E. Fifth Stage

In this final stage each node adjusts its transmission range to reach the list of neighbours it has so that it increases theoverall performance.

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Table. 1 Notation List

S	Super node
Sn	Sensor Nodes
rt	Routing table
Sx	Sensor node
pc	Path cost
Min	minimum
Max	maximum
N	Neighbour nodes list
DR	Set of first disjoint routes
Q	List of neighbours of a node
Info	Dummy message
Tr	Transmission range

Algorithm:

Start

1. /*First stage */
2. S.send(info) // sends dummy info message to know the neighbouring nodes
3. While True:
4. If(Sx.receive(info)) // If the message is received by
   Sx.add(S);
5. else
6. temp=Find_Disjointpaths(S)
7. Sx.add(temp);
8. /*Third stage */
9. Setrange(Sx,Tr)
10. If(Sx belongs to Sn)
11. Then Add it to the table Q.
12. /*Fourth stage */
13. Sx.send(info,rt)
14. If(sx.rt has all N) then
15. Find_min_cost(Sx.rt)
16. /*Fifth Stage*/
17. If(N.Sx not in Sx.rt)
18. Remove(N.Sx)
19. Setrange(Sx.rt)
20. Remoove(Sx not in range);

End

IV. RESULT AND ANALYSIS

The above algorithm takes O(Sn+p). Since all the sensor nodes have to send dummy message to discover the path . Sensor lifetime is increased more relative to the clustering method. This analysis is shown in the figure 2.

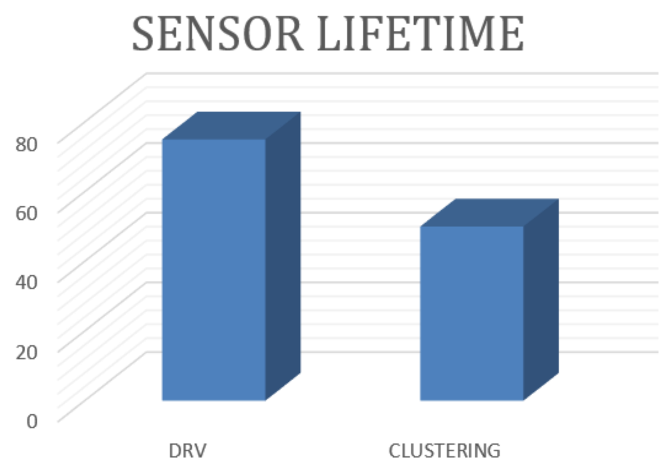

Figure 2

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When fault occurs in a sensor node and that is not reachable from other already working nodes our algorithm works efficiently irrespective of the location of it. In the case of DATC[13] algorithm nodes that are not reachable are unknown to the sensor nodes. As in the case of clustering method and DATC[13], number of transmissions of packets to sensor nodes increasing with respective to the proposed algorithm, DRV. This analysis result is showed in the fige 3.

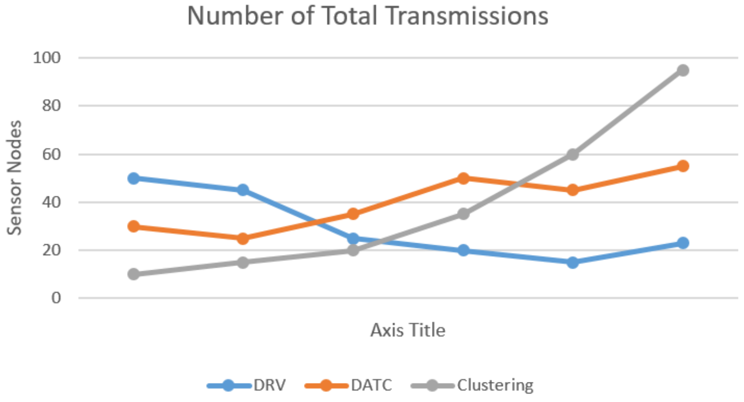

Figure 3

V. CONCLUSION

This paper introduces Disjoint route vector algorithm to increase the performance of sensor nodes. These sensor nodes form the local table to calculate the efficient route that is nearer to respective sensor route node. All the existing algorithms proposed concentrated in power efficiency or decreasing cost of the route but our algorithm concentrates on both factors. In distributed environment achieving fault tolerance is most important. So we build local routing tables so that it can access to locally. The locally optimal solution gives an overall optimal solution. this Greedy technique improves the overall performance of the system. Whenever the link failure occur it takes data from the local table. If that is not available locally it requests neighbouring nodes. Neighbouring nodes in turn request another node to find the required data. This allows easy replication. Now a day's space complexity is not an issue. So data replication is done decent way to recover lost data. Error control is achieved through resending the packets according to the built routing table. This resending of packets routed through only the nodes that are in the table. At last it reduces unnecessary packet retransmissions. In this environment we define the power of sensor to its near reachable sensors only. Thus eliminating unrequired power to reach the furthest node.

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