Efficient Data Collection in Wireless Sensor Networks using Mobile Elements

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Abstract: Wireless Sensor Network (WSN) is a network which depends on the intermediate node to relay the data so the energy of the nodes near to the sink node is exhausted very quickly, as a result network gets disconnected. To overcome this problem and to prolong the lifetime of the network, we propose zone division hierarchical multiple clustering approaches with multiple moving collectors. Here multiple mobile collectors collect data simultaneously and independently. The sensing field is divided into zones and each having a mobile collector. Each mobile collector collects data from master node, while traversing through their transmission range. Limited amount of battery life time is one of the main limitations in wireless sensor networks, to overcome this clustering topology is used. Data collection latency is another major limitation in sensor network; to overcome this mobile collectors are used. In zone division hierarchical multiple clustering approach we choose a Master Node and Vice master node for regions and sub regions. Simulation results show that fairness of data gathering by the proposed mobility scheme is greatly improve as compared to Spanning tree approach.

Keywords: Mobile Collector, Wireless Sensor Networks, Zone Division Hierarchical Multiple Clustering, Data Collection Latency, Network Lifetime.

I. INTRODUCTION

Wireless sensor networks [1] are used in variety of applications such as military applications, area monitoring [6], health care monitoring, forest fire detection, water quality monitoring and machine health monitoring. Recently, there is many increasing interest on data collection in wireless sensor network. Mobile collector [2] is used to collect data from sensor nodes in wireless sensor network data collection may be one hop or multi-hop. Thousand number of Sensor nodes deployed in form of a network and deployment can be random deployment or self organization. In some cases mobile collector node travel in sensing area and collects data from the sensors and send to the base station for data processing. Taxi, Aeroplane, bus is used for the data collection. A general layout of a sensor network is shown in Fig.1.More specifically, when a node is statically placed, the sensor nodes that are the neighbor of node tend to deplete their energy faster than other nodes. They consume energy to communicate their own data as well as they relay the data of other node [9], [7] and the node gets isolated from the rest of the network due to early death of its neighbors when most of the sensor nodes are still fully operational. This problem, termed as “Node Neighborhood Problem” which leads to a premature disconnection of the network. To overcome this problem we need to make the network dynamic. As sensor network deployed for risk management and disaster management, we cannot make all the sensor nodes as mobile node because we cannot access all sensors for the renewal of energy and it is also not possible to establish a path in order to collect the data.

Fig.1: Wireless Sensor Network (WSN).

A. Energy efficient data collection

In the proposed work we consider large number of sensor nodes placed randomly in the monitored area, for collecting data. Here we assume that nodes have no resource limitation and master node can directly communicate with a subset of one hop reachable nodes. Each sensor node in the network is equipped with a buffer space that is utilized to store data for later retrieval by the mobile node. Before
changing the position, mobile data collector halts for some fixed amount of time to collect the data from the corresponding master node within its range. Before changes its position it broadcast another beacon frame to reset the master node and this master node send reset request to all the sensors come under its cluster. Our proposed work provides the relative random motion of the node by using Travelling Salesman Problem [8]. We need mobile data collector because it resolves the energy efficient data collection in sensor network and overcome the data collection latency [5]. It also avoids the multi hop communications and the threats arise in the multi hop communications [4].

II. ZONE DIVISION BASED CLUSTERING ALGORITHM FOR MULTIPLE MOVING COLLECTORS

A. Architecture

The fig 2 shows proposed system architecture. There the zone division algorithm [7] is used to divide the entire area into four equal regions. In each region master nodes and Vice master nodes are selected by battery power remaining in the node. For each zone [4] a moving collector. The moving collector collect data from master nodes and send data to sink, when two moving collectors come close together. When the master node will be dead the vice master node act as a master node. After finishing the setup phase the steady state phase will start and nodes transmit data. When all the nodes within the cluster finish sending data the master nodes performs some computation on it and sends it to base station using multi-hop communication.

B. Algorithm

Step 1: Senor Node deployment in heterogeneous manner.

Step 2: Divide the deployment area into four equal zones

Step 3: Select master node and wise master node depending on energy

If

Step 4: Check whether all the nodes are covered by master nodes

Else

Continue Step 3

End

Step 5: Give a moving collector to each zone and provide a moving path by TSP

Step 6: Gathered information forwarded to base station via multi hop manner.

III. SPANNING TREE ALGORITHM FOR SINGLE HOP DATA GATHERING PROBLEM

In data-gathering scheme with multiple M-collectors, only one Moving collector needs to visit the transmission range of the data sink. The entire network can be divided into sub networks. In each sub network, a Moving collector [3] is responsible for gathering data from local sensors in that area. The Moving collector forwards the sensed data to other moving collectors, when two Moving collectors come close together. Finally, data can be forwarded to nearest Moving collector that visit the data sink. In this algorithm Polling Point based approach is used. This polling point is may be sensor position or any other point. When the Moving collector comes close to the Polling Point (PP) then it will give data to moving collector. In fig 3(a), 3(b), 3(c)

Fig. 3: Data gathering with multiple Moving collectors.

(a) Build the spanning tree. (b) Decompose the spanning covering tree into a set of sub trees. (c) Find an approximate shortest tour on points of each sub tree. (d) Sensing data collected from sensors are forwarded to the nearest M-collector to the data sink.
and 3(d) shows the steps in spanning tree covering algorithm with multiple moving collectors. In step 1 the Polling points are selected by using spanning tree algorithm and then in step 2 the spanning tree divided into sub trees. In step 3 moving collector provided to each sub tree and in last step the collected data forwarded to base station via multi hop manner.

IV. RESULTS AND DISCUSSION

In analysis result evaluate the performance of proposed work. Here 200 × 200 flat grid topology with 50 sensor nodes and four mobile data collector nodes we analysis these result using NS2 simulator. In fig 4 sensors are deployed in an area 200* 200 m.160 sensor nodes grouped into four zones. Each zone contains 46 sensor nodes. In fig 5 shows how clustering taken place in these scheme.10 nodes grouped as a cluster, and selecting master nodes and vise master nodes from that depending on energy. And this master node and vise master node position will rotate inside the cluster, for load balancing there by life time become increased. In fig 6 shows the complete picture of clustering and we can see that 16 clusters are selected inside the entire network and each cluster select a master node and vise master node. Master nodes are marked in blue color and vise master nodes are marked in red color. In fig 7 shows the selection of moving collectors.4 nodes selected as moving collectors. Each zone contains one moving collector.

<table>
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<tr>
<th>Parameter</th>
<th>Value</th>
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<td>Simulator</td>
<td>NS2.26</td>
</tr>
<tr>
<td>Area of Sensor Field</td>
<td>200 * 200</td>
</tr>
<tr>
<td>No.of nodes</td>
<td>160</td>
</tr>
<tr>
<td>Simulation Time</td>
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<td>Packet Interval</td>
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<td>Background data traffic</td>
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<td>Packet Size</td>
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<td>Topology Used</td>
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<td>Routing Protocol</td>
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</tbody>
</table>

Fig.4: Deploying of sensors.

Fig.5: Selecting master node and vise master node in cluster.

Fig.6: After completing clustering.
In fig 8 presents the data transfer taken place when the moving collector come close to the master node. Then master node transfer the collected data to the moving collector. In fig 9 presents the data transfer between moving collector and sink. Moving collectors come close to the sink and transfer the data to the sink.

Fig.10: Tour length vs. No. of nodes.

Fig 10 presents the tour length when we increased the no. of nodes. It is clear that spanning tree algorithm has high tour length than the proposed zone division hierarchical clustering algorithm. In fig 11 we compare proposed zone division approach and Spanning tree approach based on network life time. The network life time increases in zone division approach compared to spanning tree because the load balancing technique act in it. Fig. 12 presents total packets received by base station when the simulation time is increased. It is clear that Zone division hierarchical clustering algorithm achieves good delivery ratio when compared with the spanning tree scheme.

Fig.11: Network Life time vs. No. of nodes.
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Fig. 12: Total data pkts received by base station vs Time.

Fig. 13: No. of alive nodes vs Time.

Fig. 14: Energy vs Time.

V. CONCLUSION

In the proposed system, zone division hierarchical clustering approach is used instead of spanning tree approach in mobile data collection in wireless sensor networks. This system prolongs the network lifetime and reduces the data collection latency compared to Spanning tree approach. Here the proposed system investigated the overall performance of WSN with mobile collectors by using NS2. Based on analyzes the achievable life time of large-scale WSNs is prolonged compared to spanning tree model.

VI. REFERENCES


