CMR – Clustered Multipath Routing to Increase the Lifetime of Sensor Networks

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Abstract. Routing in wireless sensor network is an important task. This has led to number of routing protocol which utilizes the limited resources. Since wireless sensors are powered by batteries, it is very essential to utilize their energy. Under these constraints many methods for conserving the power have been proposed to increase battery life. In this paper we propose a novel way by using clustered multipath routing (CMR) to increase the lifetime of sensor nodes. It uses multiple paths between source and the destination which is intended to provide a consistent transmission with low energy. The proposed system saves about 23% percentage of energy.

Keywords: sensor nodes, shortest path, energy, multipath routing.

1 Introduction

Recent advances in microelectro mechanical systems, technology and wireless communications have led to small and low cost sensor network. The sensor network may comprise many application areas such as health monitoring, environmental monitoring including temperature, lightning condition, pressure etc. A mobile wireless sensor network consists of tiny sensor nodes which has three basic components: a sensing subsystem for data acquisition from the physical surrounding environment, a subsystem for local data processing and storing a wireless transmission subsystem for data transmission. Furthermore, a battery is critical for a sensor node. The very important issue in this action is energy efficiency. The main contribution of this paper is using a multipath routing to send the data from one cluster to other clusters.

2 Related Work

Wireless sensor networks have attracted much research in recent years. In order to minimize the energy consumption in WSN's several energy efficient routing protocols and algorithms has been developed [1, 2]. The majority of the routing protocols can

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be classified into data centric, hierarchical, location based, network flow. Energy sensor node is assumed to know its own position as well as that of its neighbors which can be obtained with some localization schemes [3] [4]. Multipath routing in ad hoc networks has been proposed in [5], [6], [7], [8]. Partitioning the whole network into smaller areas can turn the network into an easily controllable and manageable infrastructure, and such grouping of sensors is the clustering. Generally, the clustering methods can be categorized into static and dynamic clustering. The static clustering aims at minimizing the total energy spent during the formation of the clusters for a set of network [9]. The dynamic clustering also deals with the same energy efficiency problem like increase the lifetime of nodes, selecting the cluster head as in [10]. In the existing shortest path algorithm [11] the nodes are randomly placed and at some instance of time, collision of data packet, path breaking occurs.

3 Proposed Work

The proposed plan in this article is to find out the neighbour node list and then to find the multiple path from the neighbour nodes. The work is been divided into 4 stages:

3.1 Initialization Stage

In this stage, the node which has more energy is elected as cluster head (CH). The remaining nodes are treated as member nodes of that cluster. The node which has the next energy level to the cluster head is treated as next_CH. In case if the cluster head loses its energy level below the threshold value, then the next_CH will act as the cluster head and the current head goes to sleep mode. The remaining energy of the cluster head is calculated by the formula.

Remaining energy = I.E. – ((No. of packets transmitted * T.E.) + (No. of packets received * E.C.)) where

I.E. – initial energy of the node T.E - transmission energy to transmit the packet

E.C. – energy consumed by receiving a packet

3.2 Finding Neighbour Nodes

Before finding the multipath, create a neighbour list for the source nodes. The steps are as follows:

1. Get the value of maximum nodes in each cluster
2. Get the position of source node
3. Let the source node be with node id =0
4. Find the distance between the source node and all other nodes using the distance formula
5. if(distance<trans_range) then update the neighbours of the source node in the neighbour list

Consider the following fig.1, node1 is acting as the source and node11 is the destination.

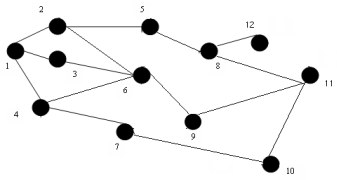

Fig. 1. Network model

3.3 Finding Multipath

By using the neighbour list all possible paths without any repeated node is found out.

Node 1->2->5->8->11 Node 1->3->6->9->11 Node1->4->7->10->11

After finding the path, a RREQ message is send to the destination. Once when the RREP message is reached, the source node can deliver its data to the destination node through the paths.

3.4 Maintenance Stage

When sending the data from the source to destination, there can occur any breakage in the route. The node which discovers the link breakage between two nodes, it sends a route error (RERR) message to the backward direction to the source node. From the neighbour list table, the source node uses an alternate valid route.

4 Simulation Results and Discussions

To validate the performance of multipath, we simulated it in NS2. The clustering of the nodes is performed and one node is elected as CH from each cluster. The data is been transferred from the source node 8 to the destination node 1 through three different routes which is shown in the figure 2.

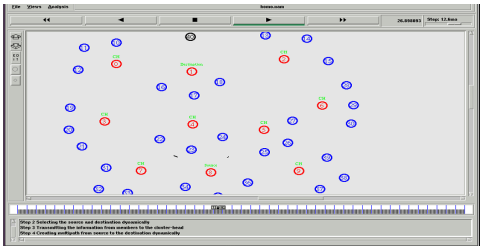

Fig. 2. Data is transferred from source to destination

The proposed system proves that it uses only less amount of energy while sending the data. The fig.3 shows that the total remaining energy is more than the existing energy.

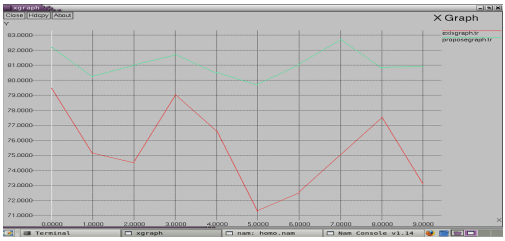

Fig. 3. Remaining lifetime of nodes

5 Conclusion and Future Scope

Here we introduced a novel technique to send the data through cluster multipath routing (CMR). This CMR routing of nodes has saved energy as well time. The simulation results show that the energy has been saved, so that the lifetime of the nodes is also increased. Our future work will be further investigating in multipath routing for larger number of nodes.

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