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A New Energy Efficient Routing Algorithm to Maximize the Wireless Sensor Network Lifetime

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***Abstract*— Wireless Sensor Network (WSN) is consists of large no of sensor nodes. A sensor node has all information of its sensing range. Routing process is used to access the information present in other sensing range . To continuously routing the information to the base station, the sensor network lifetime decreases this arises the routing problem in wireless sensor network (WSN). A route or path is consists of set of sensors that establish a connection between a source node and a destination node (base station). The routing problem is used to check the set of different paths with maximum aggregated lifetime while restrain the life of each sensor by its initial battery life. In WSN, we need an energy-efficient path to send the collected information to the centre base station. The received data at base station are processed further. In this paper, we try to develop the energy- efficient paths to maximize the network lifetime using some selected sensors instead of all sensors. In this dissertation, we give a new energy-efficient routing algorithm for designing these paths to maximize the total network lifetime of wireless sensor networks. The simulation section gives a clear proof of effectiveness of proposed algorithm when compared with some existing approaches.**

Keywords— Wireless Sensor Networks (WSN); Routes; Network Lifetime; Routing problem; Energy –Eficiency

I. INTRODUCTION

Wireless Sensor Network (WSN) is obstructed by the several individual sensor nodes, which are used to data processing and communication in a network. These sensors are deployed in a random fashion to monitor the information present in a network. Number of sensors to be deployed according to the application requirement. Normally, sensors are deployed in large proximity for quality of service (QOS) parameter. Each of these nodes have wireless communication and sensing computing capabilities.

Now a days, due to new technologies, manufacturing of sensor nodes become feasible in both ways economically and technically. All sensors have limited battery life (energy level) and it is necessary to use the energy in an efficient manner to increase the sensor network lifetime. With the available technologies, the batteries of sensors are impossible to replace or renewed. For example, we also place sensors in the wild forest, so it is very dangerous for a human being to replace the batteries of sensors over there, Due to this battery constraint, and sensors must be used in an efficient way so that it will function for long time. Sensor nodes can be used in various applications like Environmental monitoring, Military, Fire detection, Humidity, Medical industry which require unattended operation.

Wireless Sensor Networks is of two types homogeneous and heterogeneous. In homogeneous network all the sensor nodes which are present in the wireless sensor network have same battery life and in Heterogeneous networks, sensors may have different batteries.

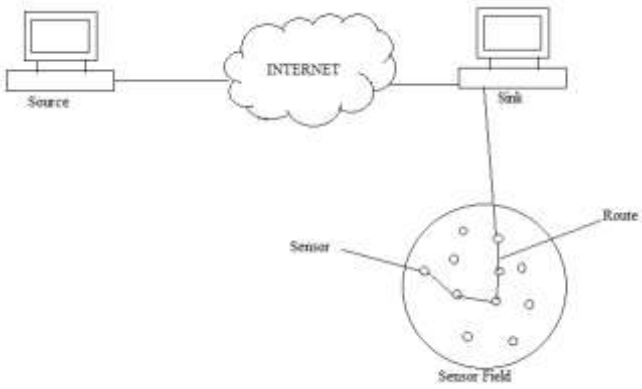

Fig. 1. Wireless Sensor network

As shown in Figure1, these sensor nodes communicate directly to each other or to an external base station called as sink node. A sensor node sends the information to base station (sink node) and at sink node process received data further.

There are two types of algorithms in Wireless Sensor Network: centralized and distributed. In centralized approach, algorithms are always executed at base station and then pass the result to each sensor in the network. In distributed approach, a number of sensor nodes perform the required task and then pass the result to other sensor nodes. Sensor nodes can be of mobile or static. Mobile sensor nodes do not have the fixed location because they are

application requirement. Static sensor nodes have fixed location and location can initialize at starting or they are randomly generated in the network. A sensor has either type of mode active or sleeping. In active mode sensor is used to find a route while in sleeping mode sensors do not involved for finding a route. In large scale sensor network, at a time some sensors are used to find a route and remaining sensors are not used. Therefore, remaining sensors goes to sleeping state until they are not used to find a route.

Sensors can be selected by two approaches: disjoint approach and non-disjoint approach. In disjoint approach, one sensor can participate in only one sensor cover. And, in non-disjoint approach a sensor can participate in more than one cover.

Our objective is to activate/deactivate sensor nodes in a manner so that sensor network will be functional for a long time. One has to do this because it is impossible to recharge the sensor nodes battery. Therefore, in this paper, the proposed heuristic always tries to find maximum number of routes in such a way that total network lifetime can be maximized.

As discussed earlier, sensors are deployed in large proximity. Also, sensors are using limited battery life. So, here main objective is not to activate all of the sensors to route information from source to sink, but design a multiple energy-efficient paths and then alternatively activate these paths to achieve maximum life for the sensor network. There are many existing routing techniques presented by various researchers. This paper reviews all the techniques which can be used in routing and then proposes a new energy-efficient routing algorithm to maximize the sensor network lifetime.

The rest of this paper is organized as follows: Section 2 presents problem statement. Section 3 explains the proposed scheme. Finally, conclusions and future work are given in section 4.

II. PROBLEM DEFINITION

Let the n sensors $s_1, s_2, \ldots s_n$ be randomly deployed to cover objects in given sensor field. Sensor s_i has a battery life of b_i and can cover the objects if it lies within the sensing range of s_i. Routing is the process by which information can be send from one sensor node to another sensor node. So, the main problem is to find the route between the source and the sink node by choosing some intermediate nodes for finding the route in the sensor network. Selection of sensor nodes to participate in a particular route is done in a way so that life of a sensor network should maximize. The path which is selected would be energy-efficient and reliable which delivered the information to the sink node in proper time.

III. PROPOSED METHODOLOGY

This section propose an algorithm which is energy-efficient in nature for solving the routing problem for both heterogeneous and homogeneous network based on the attributes such as reliability and energy-efficiency. This algorithm observe that total lifetime parameter of the sensor network play an important role in getting a better optimal solution. Hence this will prioritize the sensors according to their remaining battery life. There are following phases in the proposed energy-efficient routing algorithm (EER):

A .Generate a Cover

This phase generates a coverage cover by selecting the sensors which are needed to cover all the targets present in the network.

B. Generate a Route

This phase generates a route P by selecting the sensor that is present in the cover which is generated in the above step. Therefore route is constructed by selecting sensors of high priorities from cover till we reach the sink node (base station).

C. Shortest Path

This will find the shortest path between the source node and the sink node from the route P. ***Generate a route*** return a path which is not the shortest path sometimes, so, we use this phase in algorithm to find the shortest path. This gives always the shortest route.

D. Lifetime

After finding the ***shortest path*** which is also energy-efficient, this phase decide the lifetime of that path (means for how much time the path exist). This is denoted by X (P).

E. Update battery

After finding the value of lifetime of a path in above step, this phase will update the battery of all sensor nodes those who are participating in above shortest path. We subtract the value of X (P) from all sensors battery.

IV. EXPERIMENTAL ANALYSIS

The proposed energy-efficient routing (EER) algorithm is implemented in C language for experimental study. This section evaluates the performance of QOS based routing algorithm with energy efficient routing (EER) algorithm. It simulates a stationary network with coordinates [300m, 100m] and [450m, 250m]. Sensors and targets are randomly located in the given area and all the sensors are heterogeneous in nature. All sensors have same sensing range in which they can cover targets. This section shows the comparison of performance of both algorithms in below graphs (Fig. 2 and Fig. 3):

A. Experiment 1

Here the experimentation carried on fixed number of targets (20) randomly located in network and varying the number of sensors from 20 to 60 with an increment of 10, when sensing

range (r) is 50. For a particular value of sensor, EER calculates average lifetime for 5 random problem instances. Both EER and QOS are experimented with lifetime (w) of one route is 1. The following Fig. 2 is showing the results.

B.Experiment 2

Here the experimentation carried on fixed number of sensors (40) randomly located in network and varying the number of targets from 20 to 40 with an increment of 5, when sensing range (r) is 50. For a particular value of sensor we calculate average lifetime for 5 random problem instances. Both EER and QOS are experimented with lifetime (w) of one route 1. The results are shown in Figure 3.

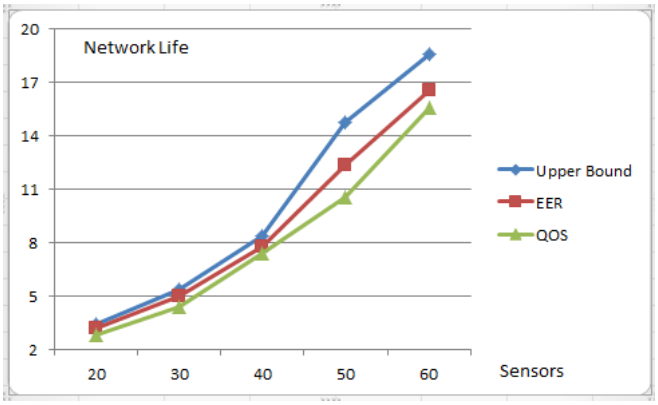

Fig. 2. Sensors versus Network lifetime Graph

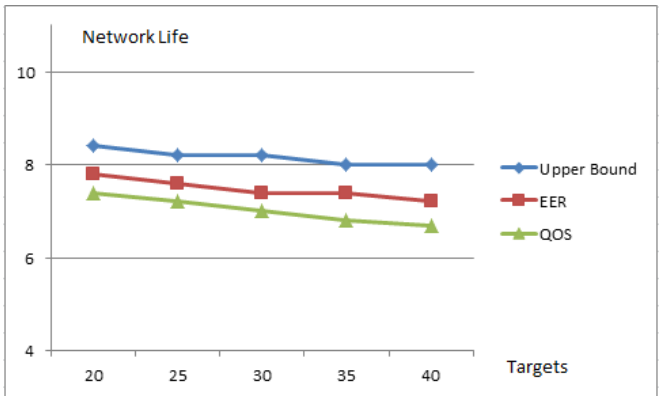

Fig. 3. Targets versus network lifetime graph

V. CONCLUSION AND FUTURE WORK

In our study, we have discussed a hierarchy of techniques briefly in terms of reliability with energy-efficiency and varied research techniques used in past for routing in wireless sensor network (WSN). Our ongoing research is to use the EER algorithm which has been described in section 3 to find a route which is the shortest and energy-efficient path, and we can maximize our sensor network lifetime. By using this EER algorithm, our objective was to somehow maximize the total network lifetime (with battery constraint) while finding routes from source to sink.

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