Sink Repositioning Technique to Improve the Performance of the Wireless Sensor Networks

Prerana Shrivastava and S. B. Pokle

***Abstract*—Wireless Sensor nodes carry limited generally irreplaceable power sources. One of the major problems while handling the wireless sensor network is the limited availability of the power for the sensor nodes. Due to this energy constrain the data needs to be managed wisely in order to extend the lifetime of the network. In many scenarios sensor nodes will have to rely on a limited supply of energy. Replacing these energy sources in the field is usually not practicable. At the same time a WSN must operate at least for a given mission time or as long as possible. Hence the lifetime becomes a very important figure of merit evidently energy efficient way of operation of WSN is necessary. In this paper we have used a sink repositioning technique for elongating the network lifetime. This scheme basically finds the optimal location of the sink and the routing pattern to deliver the collected data to the sink. Moreover the sink can be placed anywhere inside the sensing field network. The sink repositioning algorithm has been simulated in the NS-2.32 environment. The X graph was plotted for both static and mobile sink and it was observed that repositioning the sink improves the performance of the wireless Sensor networks as compared to the static sink.**

***Index Terms*—Wireless sensor networks, energy efficiency, sink repositioning, lifetime**

I. Introduction

Wireless sensor networks have come into prominence because they hold the potential to revolutionize many segments of our life, from environmental monitoring and conservation, to automation in the transportation and health care industries. Wireless sensor networks constitute an emerging technology that has received significant attention from the research community. Sensor networks are typically self-organizing ad-hoc systems that consist of many small, low-cost devices. They monitor the physical environment, and subsequently gather and relay information to one or more sink nodes. Typically, the radio transmission range of the sensor nodes are typically orders of magnitude smaller than the geographical extent of the entire network. Thus, data needs to be relayed towards the sink node hop-by-hop in a multi-hop manner. The energy consumption of the network can be minimized if the amount of data that needs to be transmitted is also minimized [1].

The computational power, battery lifetime, data storage and communication bandwidth are the factors which affect the performance and reduces the efficiency of the WSN. In order to avoid significant energy consumption and to improve bandwidth utilization, it is important to consider in the WSN architecture, the network topology, power consumption, data rate and fault tolerance [2]. The main function of the WSN is to monitor the surrounding environment and to communicate in short distances. The sensor nodes have wireless communication interface through which it can communicate with the other devices in its vicinity. Due to the scarcity of the energy reservoir and due to the fact that the communication is the dominant energy consumer, the transmission range of the sensor nodes is limited for energy efficiency purposes. As a result of limited energy supply, extending the life time of the network is the primary target for the significant amount of research during the last couple of years. One of the most important constraints on sensor nodes is the low power consumption requirement. Sensor nodes carry limited power sources. Therefore while traditional networks aim to achieve high quality of service provisions, wireless sensor network protocols must focus primarily on power consumption.

II. Problem Identification

The wireless sensor node can only be equipped with a limited power source. Sensor lifetime shows a strong dependency on battery lifetime. In multihop sensor network, each node plays the dual role of data originators and data router. The disfunctioning of a few nodes can cause significant topological changes and might require rerouting of packets and reorganization of the network. Hence power consumption and power management take on additional importance.

Energy efficient data routing in wireless networks generally pursue multi hop paths for minimizing the total transmission power which is generally proportional to the distance squared or even higher in order for environment reach with obstacles and interference sources. The basic idea of multi hop network paths is to shorten the distance so that significant power savings can be achieved [11].

But in case of wireless sensor network all the sensors will forward their data to the sink. So the sensors which are nearer to the sink have to take the heavy traffic load because of which they will start depleting their energy faster and soon they will completely deplete their energy. Now the sink will have to rely on the other sensors which are quite far off. This will result in increase in the transmission power. Thus in case of Multi-hop relaying some sensors have to relay a lot of traffic for the other sensors and this gives rise to unbalanced energy expenditure over different parts of the fields. However to provide solution over this problem some methods were proposed where in they tried to solve this

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problem by placing more sensor nodes around the sink. However this resulted in an unbalanced sensing coverage over different parts of the fields. [4][5].

The main aim of the energy optimization in sensor networks is to prolong the life of a single node as well as of the entire network.

III. Methodology

The Multihop relaying and multiple sinks can be avoided by sink relocation which uses a mobile sink which is capable of moving inside geographic region and collects the data from the sensors it passes by.

Relocating the sink during the regular network operation is very challenging. The basic issues that must be considered are when the sink should move, where it should be moved and how the traffic would be handled during its movement. [11].

For this we have used a sink relocation technique and it has been considered for an unconstrained traffic. Once an undesirable situation is detected, the sink will decide to reposition. Then it will look for those sensor nodes that are taking heavy traffic load. Then the optimal position for the sink is found. In order to test for the impact of repositioning the total power transmission of the sensors for the previous and next sink positions is evaluated and compared. Then the power transmission overall gain is checked and if it is more than a particular threshold value then only the sink will be moved to a next position otherwise it won't change its position.

When the sink starts to move towards its next location at each step it will look for those sensor nodes that are just one hop away from the sink in order to check for their connectivity with the sink. If the sink is reachable then the last hop sensor nodes will adjusts its transmission power so that the sink can receive the messages properly while moving to its next intermediate position. On the other hand if the sink goes out of the transmission range of these sensor nodes then it will look for a sensor that can be used for relaying the data further. Such selected sensor should be such that it should be reachable by both the sink and the last hop sensors and should have sufficient amount of energy. If multiple node options are available then the one having the higher energy is selected. After this the sink will update the routing table and broadcast it to the other sensors and then proceed further to the next location.

IV. Algorithm

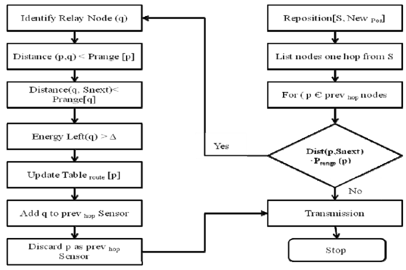
The sink relocation algorithm was used for two scenarios. One with stationary sink and the other with a mobile sink. Both the cases were simulated in the NS-2 environment and then the results were compared in terms of the packet transmission and the network lifetime.

The various steps for sink relocation algorithm in order to improve the lifetime of the WSN are as follows:

V. System Model and Parameters

We have considered a network comprising of varying number of sensor nodes that are randomly placed in a 600 X 600 sq.m.A free space propagation model is assumed with a capacity set to 2Mbps.The sensor nodes is assumed to have an initial energy of 2Joules.The maximum power range for a sensor is assumed to be 50m.A TDMA based MAC protocol is employed.

The sink broadcast the routing table to all the sensors prior to starting or resuming data transmission. Each data packet is time stamped when it is generated to allow the calculation of average delay per packet. In addition each packet has an energy field that is updated during the packet transmission in order to calculate the average energy per packet and to track the remaining energy.



VI. Simulation Results

After compiling our code in ns-2.34 we get a nam file which should be opened in nam console to see the visualization of our wireless sensor network (wsn). Below given are the screenshots of nam console.

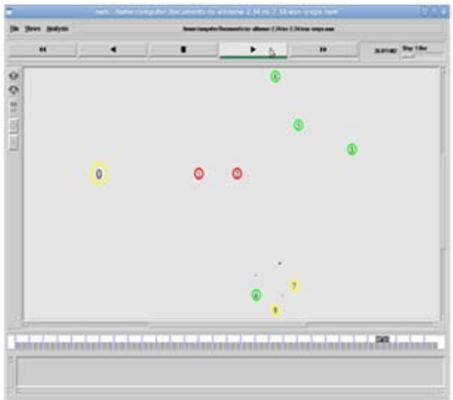


Fig. 1. Output before sink repositioning

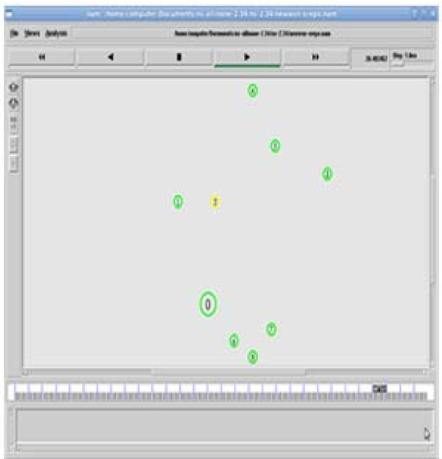


Fig. 2. Output after sink repositioning

The figure below shows the X graph that was plotted for both the scenarios. One for WSN with stationary sink and the other for WSN with mobile sink.

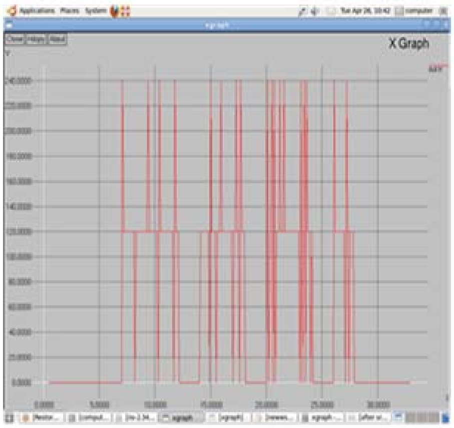


Fig. 3.1. Output before sink repositioning

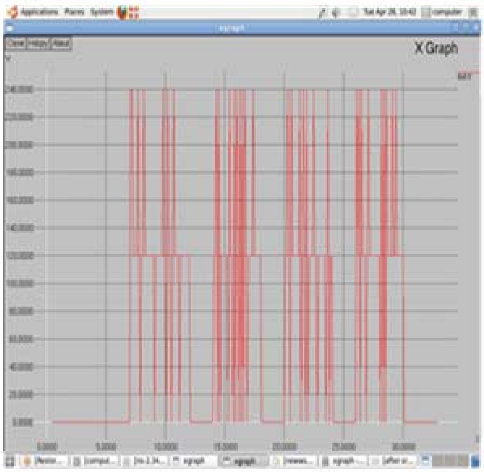


Fig. 3.2. Output after sink repositioning

VII. Conclusion

The drawbacks of multi hop transmission and deployment of multiple sink in wireless sensor networks can be overcomed by making use of sink repositioning. In this paper we have investigated the performance advantage of repositioning the sink node of wireless Sensor networks. Simulation results have shown that when sink has limited speed and mobility the network does not come to a standstill before all the packets are been transferred. Thus the network is efficiently utilized as compared to the base line approach. The work can further be extended for increasing the throughput and reducing the delay for any particular scenario of the wireless sensor network.

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