STUDIES ON LIFETIME ENHANCEMENT TECHNIQUES FOR WIRELESS SENSOR NETWORK

UDIT AGARWAL[1]

[1]*Associate Professor, Dept. of Computer Science, RBMI Group of Institutes, Bareilly*

Abstract: **-**A Wireless Sensor Network consists of large number of autonomous sensor nodes. These sensors nodes are small in size and equipped with low power battery. In fact, these sensor nodes are responsible for monitoring the environmental conditions. So, a variety of sensors may be attached to the sensor node to monitor biological, mechanical, chemical, optical, and magnetic fields. Battery is the main source of power supply in a sensor node. If the battery of a node is consumed, the node dies. When adequate number of sensor nodes dies in the network, the network may not be able to perform its chosen task. Thus, to increase the life time of a sensor node is an important task of a sensor network. This paper presents a survey of different techniques to enhance the lifetime of the sensor nodes in WSN.

Keywords: Wireless Ad hoc Networks, Wireless sensor network, sensor node, energy efficient routing, clustering.

1. INTRODUCTION

Wireless communication has been involved its fastest growth due to enabling technologies which allow extensive deployment. There are two different approaches of enabling wireless communication. They are *infrastructure or centralized topology* and *ad hoc or distributed topology*. The first paradigm is to let the existing cellular network infrastructure carry data as well as voice. The second approach is to use Wireless Ad hoc Networks (WANET) which consist of mobile nodes communicating over a shared wireless channel. Opposite to cellular networks, where the nodes communicate with a set of carefully placed base stations, there are no base stations in wireless ad hoc networks. Any two nodes are allowed to communicate directly if they are within each other's communication range, and also nodes use *Multi-hop Routing* to deliver their packets to distant destinations.

Later, the *Mobile Ad hoc Networks (MANETs)* have been developed to support scalability, mobility, adaptability and guarantee network performance. MANET is an autonomous system in which mobile hosts connected by wireless links are free to move randomly and often close to humans. Power consumption is not of main importance in MANETs as its energy sources have high capacity and can be recharged or replaced. In *Ambient Intelligence* many different devices gather and process information from many different sources to both control physical processes and to interact with human users. So, a new class of network namely *Wireless Sensor Network (WSN)* has emerged in the last few years. WSN is a particular type of ad hoc network, in which the nodes are 'smart sensor' which collects information by cooperating with each other. Sensor nodes consist of CPU (for data processing), memory (for data storage), battery (for energy) and transceiver (for receiving and sending signals or data from one node to another). Each of these sensor nodes sense data from environment and send it to the outside world through the external base station. A base station (BS) is a mobile node or may be a fixed node which has a capability of connecting the sensor network to an existing communications infrastructure or to the internet.

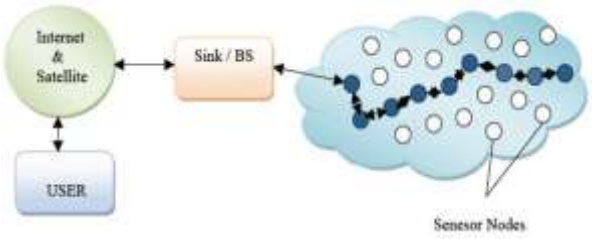

FIGURE 1: Wireless Sensor Networks

The sensor nodes in WSN can sense the physical environments conditions like temperature, humidity, light, sound and vibrations etc. Wireless Sensor Network is very helpful in those crucial and remote areas where human interaction is not possible or very difficult. So, these sensors can substitute the human monitoring in the dangerous situations like earthquake, flood, guarding on the border, monitoring the volcanoes eruption. The applications of wireless sensor networks are growing day by day and simultaneously it faces the problem of energy constraints due to limited battery power.

Every sensor node may be in active mode, idle mode and sleeping mode. In active and idle mode, it consumes almost same amount of energy when receiving or transmitting data while in sleep mode, the nodes save the energy. The following steps may be taken to save energy in wireless sensor networks: [1]

- Proper scheduling the states/modes of the nodes (i.e. transmitting, receiving, idle or sleep).

- Proper shifting the transmission range between the sensing nodes.
- By using well-organized routing and data collecting methods.
- Avoiding the handling of unwanted data

2. CLUSTERING APPROACH

When sensor nodes sense the data/ environment, there are two ways with respect to battery performance. When nodes sense data it can consume some energy and when forwarding those sensed data it also consumes energy. While comparing these two methods, second method absorbs more battery energy.

For that problem, we use *clustering approach* to increase the lifetime by reducing the energy consumption. In this, firstly we select proper **cluster-head** (CH) and then by using efficient routing we can increase the network lifetime of WSN.

Clustering is a way to divide all sensor nodes in network as numerous groups. Formation of cluster is depending on various parameters such as network topology etc., and *cluster head* is selected by accessibility of nodes within the cluster. In general, cluster- head plays the role as a leader and accountable to gather data from all nodes then transfer it to BS.

Figure 2 shows a clustering approach in a wireless sensor network. Here clusters are formed with their respective cluster-head. Cluster heads transmitted the gather/aggregated data to the BS..

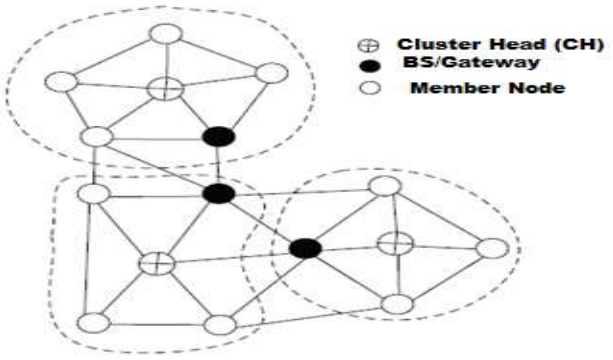

FIGURE 2: Cluster-based network.

In clustering approach, many attributes like the size of the cluster, distance of member nodes from the cluster head, distance of the base station from the cluster head can affect the energy consumption in sensor nodes because larger the distance from the member nodes from the cluster head greater the energy indulgence for the data transmission.

3. SINK- RELOCATION METHOD

In a wireless sensor network, Sensor nodes after sensing the data will deliver it to the sink through multi-hopping routing. If the transmission distance is long then it consumes more power and if it is less than it does not waste in routing and it can preserve the residual battery energy. A node with higher residual energy can be used for a larger transmission distance so as to reduce the routing path, whereas a node with less residual energy can be used in small transmission range to save energy. Thus an adjustable transmission procedure can improve the lifetime of a network. *Sink relocation* ensues that when the energy level of the adjacent sensor node of the sink becomes low, sink will relocate to a new position.

Sink relocation can be implemented by Multiple Sink Deployment, Sink Mobility or Deploying Multiple Mobile Sinks. In Multiple Sink Deployment, the data will always be sent to the neighboring sink. If we deploying multiple sinks, it may decrease the average number of hops messages has to traverse. In Sink Mobility, a sink moves fast adequate to deliver data with an allowable delay. So, the mobile sink collects data from nodes and transports that data. In deploying Multiple Mobile Sinks method, we assume without delay and without initiating buffer overflow, we deployed multiple sinks in network.

4. ENERGY EFFICIENT ROUTING

In the sensor network, energy consumption of the nodes is initiated by two major events. Firstly, at the time of communication between the sensor nodes which is due to the transmission or reception of the packets; and second, during the time spent by the node to listen or detect any event i.e. in waiting mode. Therefore, there are two different approaches for energy conservation. In the first approach, we reduce the communication by *load balancing* during efficient routing and in second approach we reduce the energy consumption by *proper duty-cycling technique.*

In WSN, routing protocols are classified into three categories: *Flat-based routing* (Flooding), *Hierarchical based routing* (Clustering) and *Location-based routing* (Geographic), depending on the network structure in WSNs. Most of the projected protocols accept that the sensors either are equipped with global positioning system (GPS) receivers or use some localization technique [2] to obtain their locations. In energy efficient routing technique, we assume our routing protocols should promise accurate data delivery and able to scale with the network size.

5. NEURAL NETWORK APPROACH IN WSN

The unsystematic distribution of wireless sensors, various variables which influence sensor nodes operation and the vagueness of different algorithms give a fuzzy nature to wireless sensor network. In view of this fuzzy nature and several particulars, a neural network is a perfect tool to be used to cover up these details which are so hard to be explicitly discovered and modeled. Neural networks map a data set of numeric inputs to a set of numeric targets. In neural network, input layer gets input data such as Node ID for routing. These input data should be transferred through sensor network. Status of all interfaces for single router is represented by Interface status. Data can be routed by all active interfaces.

The most significant applications of neural networks in wireless sensor application are sensor data classification, sensor data prediction, sensor fusion, path discovery and nodes clustering. These all show the way to energy conservation and less communication cost in WSNs [3].

Problem of Routing in the mash topology of the sensor network is solved by Artificial Neural Network (ANN). ANN is an intelligent tool to deal with the problems connected with sensing and processing data at the sensor node end, also while interacting with the network of the node. It helps to improve routing and hence helping to reduce energy consumption in network interaction.

Multi-dimensional problems can be solved by three layer feed-forward network with sigmoid hidden neurons and linear output neurons.

6. CONCLUSIONS

This paper discussed about the different techniques for enhancing the lifetime of the wireless sensor network. Clustering technique is used to enhance the lifetime by groups the wireless sensor nodes which are called clusters. In each cluster of sensor nodes, a Cluster Head (CH) is selected to accumulate the information from the cluster member nodes, aggregate it and transmit to the sink. In sink- relocation method, when the residual battery energy of the neighboring sensor node of the sink becomes low than a threshold value sink will relocate to a new location which can amplify the network lifetime. Neural network approach is used for determining the optimal routing path from source to destination.

Based on these approaches, there is significant scope of future work, particularly in the design of energy efficient protocol, its implementation and evaluation.

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AUTHOR

Udit Agarwal is Associate Professor in the department of Computer Science at RBMI Group of Institutions, Bareilly. He has a profound interest in writing text books. He has published a large number of quality papers in national and international journals.