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Increasing Energy Efficiency in building Wireless Sensor Network using Data Compression Techniques

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Abstract: **Sensor nodes normally very small and powered with irreplaceable batteries: efficient use of energy is paramount and one of the most challenging tasks in designing wireless sensor networks. The main aim of this paper is to improve life of network, using efficient data Compression technique for data transmission from source node to destination (sink node). If any node is having energy less than minimum, that node is not considered in communication path then alternate path is created by routing algorithm AODV. So by using Huffman lossless data compression node energy is saved automatically network lifetime is improved.**

1. INTRODUCTION

A wireless sensor node (or simply sensor node) consists of sensing, computing, communication, actuation, and power components. These components are integrated on a single or multiple boards, and packaged in a few cubic inches. With state-of-the-art, low-power circuit and networking technologies, a sensor node powered by 2 AA batteries can last for up to three years with a 1% low duty cycle working mode. A WSN usually consists of tens to thousands of such nodes that communicate through wireless channels for information sharing and cooperative processing. After the initial deployment (typically ad hoc), sensor nodes are responsible for self-organizing an appropriate network infrastructure, often with multi-hop connections between sensor nodes. The onboard sensors then start collecting acoustic, seismic, infrared or magnetic information about the environment, using either continuous or event driven working modes. Commercially available sensors now include thermal, acoustic/ultrasound, and seismic sensors, magnetic and electromagnetic sensors, optical transducers, chemical and biological transducers, accelerometers, solar radiation detectors, photo synthetically active radiation detectors, and barometric pressure detectors These sensors can be used in a broad range of applications, including acoustic ranging, motion tracking, vibration detection, and environmental sensing.

The above technologies, along with advanced packaging techniques, have made it possible to integrate sensing, computing, communication, and power components into a miniaturized sensor node.

In a sensor network, data compression is tightly coupled to the needs of a sensing task and hence application semantics. Data compression technique introduces the novel idea of improving life time of network using correlation and compression technique by suitable data coding algorithm (Huffman algorithm). In this project we have proposed a Huffman coding based data compression technique for the sensor network. We have shown that network lifetime can be significantly being improved using this technique. Lesser data results in better packet delivery ratio and low bit error rate. This technique can be further improved by integrating with data aggregation mechanisms.

The primary objective of the work is to suggest a suitable data compression scheme for target tracking and transmitting the information about the target. As amount of data to be transferred is very less, design should propose efficient energy saving lossless data compression technique using Huffman coding to improve network life.

2. METHODOLOGY

2.1 Topology Extraction

In case of a sensor network amount of packet length would always be minimum, eliminating the need for battery life and node fail issues. This can be use full in improving network life time by using efficient energy saving lossless data compression technique with Huffman coding algorithm. Further this can be improved by integrating this with data aggregation mechanism.

Topology extraction represents a key issue in wireless sensor network .Most of the case; sensor nodes are deployed in an ad hoc manner and are no prior knowledge of location. It is the node responsibility to identify them in some specific manner and manage communication. One way achieve least erroneous predictive sensor network is to consider the network organized as ad hoc where sensors are located in specific manner. By using Correlation they will exchange Hello packets so as to get information among them. Using lossless data compression method by Huffman coding data transmission takes place. Packet length is reduced nodes battery life is saved for every transmission. Network life time is improved.

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2.2 Setup Phase

Setup Phase represents Initial step after node deployment. It has a dual purpose. The first is to exchange Hello packet. The second is to create a path packet and by sending RREQ from Source Node to the Sink through active nodes calling a function send. After this path creation RREP is sent from Sink to Source node in the same path by calling a function Handle message. If any node is having low battery level and same RREQ, that node is dropped from the path. The path is followed by compressing the data using Huffman coding and data transmission takes place.

Infrastructure in ad-hoc manner. In that infrastructure, position of the sink is also crucial in terms of energy conservation and performance.

2.3 Energy consideration

During creation of an infrastructure, the process of setting up the routes is greatly influenced by energy consideration .Since the transmission power of a wireless radio is proportional to distance squared or even higher order in presence of obstacles, multi-hop routing will consume less energy than direct communication. However, multi-hop routing introduces significant overhead for topology management and medium access control. Direct routing would perform well enough if all nodes were very close to the sink. Most of the time sensors are scattered randomly over an area of interest and multi-hop routing becomes unavoidable.

2.4 Node capabilities.

In a sensor network, different functionalities can be associated with the sensor nodes. In earlier works, all sensor nodes are assumed to be homogenous, having equal capacity in terms of computation, communication and battery life. However, depending on the application a node can be dedicated to a particular special function such as relating, sensing and transmitting the data. Since engaging all these functionalities at the same time on a node quickly drains the battery life (energy) of that node.

2.5 Data Gathering

Since sensor nodes might generate significant redundant data, similar packets from multiple nodes can be aggregated so that number of transmission would be reduced.

Data gathering is the combination of data from different sources by using function such as Correlation (eliminating duplicates). Some of these functions can be performed either partially or fully in each sensor node by allowing sensor nodes to compress the data.

There are some limitations which are given below

a. Misrepresentation of data: In sensor net environment, it is impossible to gather all the relevant data. The physically observable word consists of a set of continuous phenomena in both time and space, so the set of relevant data is in principle infinite. Sensing technologies acquire samples of physical phenomena at discrete points in time and space, but data acquired by the sensor net is unlikely to be a random sample of physical processes for a number of reasons (non –uniform placement of sensor in space, faulty sensor, high packet loss rates, etc).So a straightforward interpretation of the real sensor net readings as a “database” may not be a reliable representation of the real world.

b. Loss less data compression: This compression was done by Huffman coding; all the codes of the encoded data are of different sizes (not fixed length). Therefore it is very difficult for the decoder to know that it has reached the last bit of a code and only way for it to know is by following the paths of the up-side down tree and coming to an end of it (one of the branch).Thus if the encoded data is corrupted with additional bits added or bits missing, then whatever that is decoded will be wrong values and the final data display will be garbage.

3. SYSTEM DESIGN

This work proposes a wireless sensor network where each node can senses information of neighboring nodes by exchanging Hello packets. System is designed to generate information from a node which has information and transmits it to sink seeking information through a series of nodes which defines minimum path, save battery life, so that network life is improved This can be achieved by lossless data compression technique using Huffman coding.

Design Steps

Sensor node wants to send data packet to sink node with data compression

Algorithm: Node has information or Data packet

Step 1: Select a Sensor nodes first i.e. make Sensor node active=1 which are selected.

Step 2: Set up a Sink Node equate to 0.

Step3: Find a Route by using AODV routing protocol in this Hello packets are exchanged by sending Source node RREQ to the Sink Node. If the path is created Sink Node sends RREP in the same path .By exchanging Hello packet (Correlation) they are having information about their neighbors.

Step 4: The Sensor Nodes senses the data.

Step 5: Data Compression is done by Huffman coding.

Step 6: In the Physical layer data packet transmission takes place.

Step 7: If any Sensor node is having Energy less than minimum (Threshold) then Calculate the battery life and drop the Node, by passing Sensor node, again find route.

Step 8: If the Sensor nodes having energy larger than minimum forward the data packet and find the battery life.

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3. IMPLEMENTATION

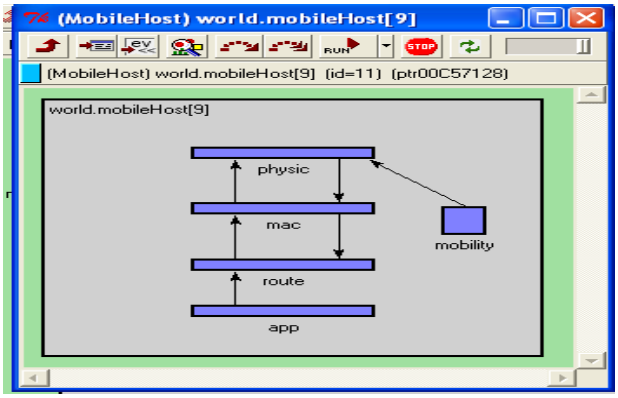

Figure 4.1 :A host's Internal Structure

The nodes use lower 3 layers along with application layers where the physical layer represents the channel capacity through which the data transmission takes place.

Mac layer – Media access control (store and forward the data packets). Routing layer- To route the data packet.

Application layer- The major part of our work is related to application layer,in order to achieve the mentioned objectives we are using network simulator called OMNeT ++. When ever a object is created, an initialization method is called. Here the node which are active needs to send the data and all the nodes which are active are assigned as source=1 and they starts sending or generating the data.

The handle MSG initiates from the application layer, initially sink is zero. The data is sent from current node to sink node .After this application burst is generated to broad cast and the data will be forwarded to the routing layer to generate the route. It sends the data if the route exist other wise it should create RREQ Message is generated.It will call the handle RREQ function, it will check if this node already process this request otherwise it will forward to destination .It generates RREP packet in the same path when RREP is received it will start sending data, for sending a data it will call a function gen data message, inside this function we need to compress the data, calling main functions of Huffman.After the exchange of Hello packet, once the route is created. Data size is reduced from its actual size and this data is transmitted to the destination because of this the node will be able to serve for longer time in network without any loss, until the network life time process.As a result it will improve the network life time.

5.RESULTS

5.1 Output Frame

Fig shows deployment of Sensor nodes in particular field where we want to gather the data regarding like Temperature, Intensity and Humidity.

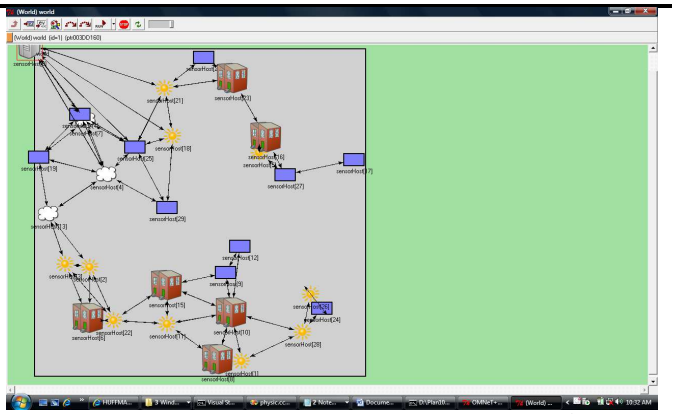

Figure 5.1: Main output Screen Showing Menu and Initialization of N/W

5.2 Simulation Window

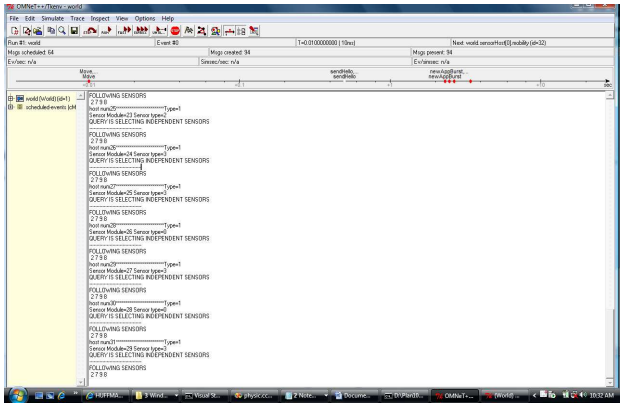

Figure 5.2: Exchanging Hello packets

Fig shows AODV protocol's RREQ and RREP ie. Creating path or Route. From this fig we can identify active source Nodes and type of Sensor node selected i.e. Type=1 as Temperature
Type=2 as Intensity
Type=3 as Humidity

5.3 Actual length and compressed length of Data

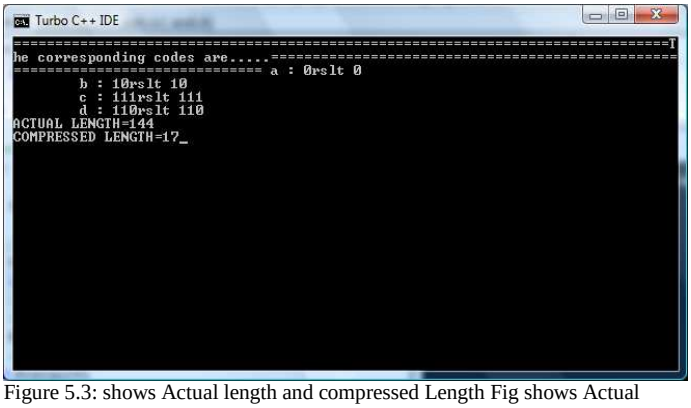

Figure 5.3: shows Actual length and compressed Length Fig shows Actual length and compressed length of data after running Huffman main function

5.4 Network life Time

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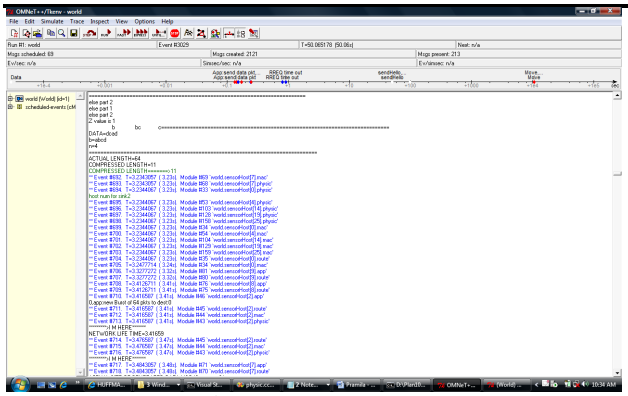

Figure 5.4: Network Life Time

Fig shows after network processing what is the Life Time of network by using Data Compression technique.

6. CONCLUSION

Wireless Sensor Network technology offers significant potential in numerous application domains. Given the diverse nature of these domains, it is essential that WSNS perform in a reliable and robust fashion. There are significant amount of technical challenges and design issues those needs to be addressed in the design of WSN. One of the most difficult design issue is to keep the data rate low so as to save energy in transmission. In this paper we have proposed a Huffman coding based data compression technique for the sensor network. We have shown that network lifetime can be significantly be improved using this technique and also lesser data results in better packet delivery ratio and low bit error rate. This technique can be further improved by integrating this with data aggregation mechanisms and efficiency can be improved by other algorithms like LZW.(Limpel Ziv Welch)
The work can be extended in future to include following facilities.

1) This work considered static sensor nodes but same can be extended for dynamic moving nodes.
2) The technique can be further improved by integrating this with data aggregation mechanisms.
3) Efficiency of Huff man coding can be improve by using Huffman coding with LZW algorithm .(LimpelZiv Welch)

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