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Data Compression in Wireless Sensor Network

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Abstract

Wireless sensor networks are resource constrain. They are limited power supply, bandwidth for communication, processing speed and memory space. The possible way of achieving maximum utilization of those resources is applying data compression on sensor data. Since processing data consumes less power than transmitting data in wireless medium. So it is effective to apply data compression before transmitting data for reducing power consumption by a sensor node. In this we propose a LZW data compression algorithm particularly suited to be used on available commercial nodes of a WSN, where energy, memory and computational resources are very limited. Since processing data consumes less power than transmitting data in wireless medium. So it is effective to apply data compression before transmitting data for reducing power consumption by a sensor node.

Keywords: *Wireless Sensor Network, data compression***.**

1. Introduction

A sensor network is composed of a large number of sensor nodes, which are densely deployed in a terrain under monitoring. These sensors have the ability to communicate either among each other or directly to an external base-station. A greater number of sensors allows for sensing over larger geographical regions with greater accuracy. Each sensor node comprises sensing, processing, transmission and power units. Sensor nodes are usually scattered in a sensor field, which is an area where the sensor nodes are deployed better understand how the software interacts with the other parts of the system, and what needs to be further developed in a systematical way.

A base-station which is also known as a sink may be a fixed node or a mobile node capable of connecting the sensor network to an existing communications infrastructure or to the Internet where a user can have access to the reported data, applying data compression in each node before transmitting data for reducing total power consumption by a sensor node.

1.1 Data Compression technique

Two types of data compression: Lossless and Lossy compression. Lossless compression technique, as the name implies involve no loss of information. If data have been loss-lessly compressed the original data can be recovered exactly from the compressed data. Lossless compression algorithms usually exploit statistical redundancy in such a way as to represent the sender's data more concisely with fewer errors. Lossless compression is possible because most real- world data has statistical redundancy.

Lossy compression techniques involve some loss of information and data that have been compressed using lossy technique generally cannot be recovered or reconstructed exactly. In return of accepting this distrotion in the reconstruction we can generally obtain much higher compression ratio than lossless compression. Some data compression techniques of wsn are coding by ordering, pipelined in-network, distributed compression etc.

2. Related work

Naoto Kimura [2] discusses that the wireless sensor network are resource constrain off limited power supply, low bandwidth, processing speed. The author says that the possible way of achieving maximum utilization of those resources is by applying data compression on sensor network. Processing data consumes less power than transmitting data in wireless medium. So, it is effective to apply data compression in sensor network before transmitting data for reducing power conception.The algorithms used in this paper are coding by ordering, pipeline-in-network compression and distributed compression and also in terms of power consumption, operation of a wireless sensor node can be divided into three parts: sensing, processing, and transmission. Among those three operations, it has found that the most power consuming task is data transmission. Approximately, 80% of power consumed in each sensor node is used for data transmission. Thus, if we can minimize the size of data by compression, it will reduce transmission power. However, on the other hand by applying data compression more power for processing will be

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required to perform a compression algorithm. In order to reduce total power consumption, the sum of power consumed by transmission and processing has to be reduced. The power consumed by compressing “a” bits data string into “b” bits data string, where a > b, has to be smaller than the power consumed by transmitting “a – b” bits of data string.

Sebastian [3] discusses that the low power sensor nodes are integral parts of large scale wireless sensor networks which find extensive application in domain such as military surveillance and environment monitoring. The author proposes a novel approach of energy consumption trade-off associated with lossless data compression in low power sensor nodes. The author specifically focuses on compression of acoustic signals.The possessing of acoustic signals in digital form and subsequent transmission of the signals across a network that involves significant energy consumption by the transceiver of a sensor node.

Tan minsheng [4] proposes a distributed wavelet- based algorithm which can transform irregularly sample data using haar wavelet-based compression. The distributed data aggregation model based on area is used. Based on this model a novel wavelet-based irregularly sample data compression and data transform model is proposed for sensor network. The system has been evaluated the effectives of the tansform and randomly assign 360 sensor nodes on the square. Sensors are assigned to 3-level hierarchy, with 600, 100, 20 clusters in each of the fine to coarse level. The hierarchy is allowed to form randomly. Based on Voronoi tessellation it has been developed a fully distributed, irregular-grid wavelet transform and protocol for sensor networks that is capable of piecewise-constant multiscale approximation. Theoretical analysis and simulation results showthat the transform model has good performance of nonlinear approximation, and can reduce the amount of transmitted data in the sensor networks.

Raymond [5] proposes that the Distributed wavelet processing insensor network reduces communication energy and wireless bandwidth usage at sensor nodes. Sparsity can be leveraged for processing such as measurement compression, de-noising and query routing and the author also represents a simple wavelet transform for irregular sampling grid. Multiscale algorithms such as distributed wavelet processing hold much promise for sensor network applications. Measurement fields often exhibit high local correlation and more moderate global correlation, leading naturally to a paradigm of local processing at fine scales between spatially approximate nodes and global processing at coarse scales between more distant nodes. The distributed wavelet transform and data harvesting architecture for sensor networks. The transform adapts to irregular sampling grids and piecewise-smooth sensor measurement fields.

Yang [6] proposes the constructing a data gathering tree over a wireless sensor network in order to minimize the total energy for compression and transporting information from a set of source node to the sink. The author also derives the optimal compression strategy for a given data gathering and investigates the performance of the structure for network deployed on a grid. The tunable compression that is capable of tuning the computation complexity of lossless data compression based on the energy availability. The *gzip* program supports up to ten levels of different compression ratio, with larger compression ratio resulting in longer compression time and hence to cost higher energy. The prior works have not considered the application of tunable compression together with routing techniques for data gathering in sensor networks. The construction of a data gathering tree spanning a set of source nodes and rooted at a sink node. Two data compression schemes have been previously investigated: distributed source coding and compression with explicit communication. While practical distributed source coding schemes for sensor networks are being developed, most existing works for data compression schemes are based on explicit communication. It focuses on joint data compression with side information via explicit communication. Therefore, a suitable energy model for tunable compression and a flow-based model to facilitate the tuning of compression over a data gathering tree and the techniques for determining the optimal flow for a given tree structure.

Sayood [7] discusses the compression technique, mathematical preliminaries, information and coding, Huffman coding, Dictionary coding, quantization, differential encoding, mathematical preliminaries for transform, subbands, and wavelet.

Salomon [8] discusses the basic compression technique, statistical method, dictionary method, image compression, video compression and wavelet compression.

Znati [9] discusses the basic of sensor network, network protocols, data storage and manipulation in sensor networks, security features in sensor networks, localization and management, application of wireless sensor network.

3. Different Data Compression technique in WSN

Data Compression technique used in wsn are coding by ordering, Pipelined in-Network Compression, distributed compression etc.

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3.1 Coding by Ordering data compression

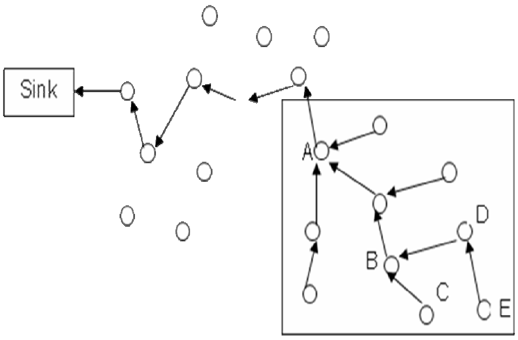

Figure 1

The Coding by Ordering data compression scheme is introduced in [12] as part of Data Funneling Routing. The compression scheme is works as follow. First, a data pass from sensor nodes in the interested region to a collector node is set up as shown in Figure 1. In Data Funneling Routing, some of sensor nodes work as a data aggregation node. For example, node A, B, and D are a data aggregation node. At an aggregation node, sensing data collected by other nodes is combined, and the aggregated data is sent to its parent node. At node D in Figure1, data collected by node E is combined with data collected by node D itself. Then, the aggregated data is transmitted to node B.In coding by ordering 44% data is loss during compression.

3.2 Pipelined In-Network Compression

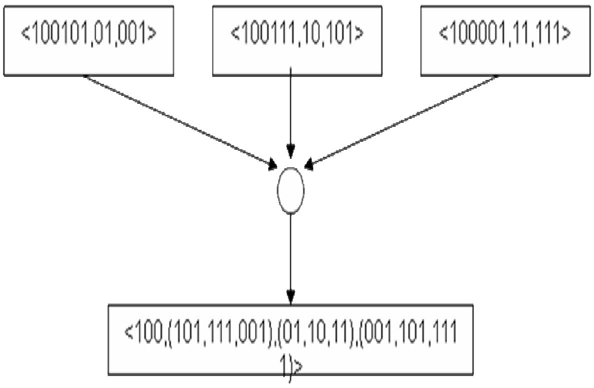

Figure2

The pipelined in-network compression scheme is discussed in [11]. The basic idea is trading high data transmission latency for low transmission energy consumption. Collected sensor data is stored in an aggregation node's buffer for some duration of time. During that time, data packets are combined into one packet, and redundancies in data packets, will be removed to minimize data transmission. For example, each data packet has the following form: <measured value, node ID, timestamp>. Then, the compressed data packet has the following form: <shared prefix, suffix list, node ID list, timestamp list>. The "shared prefix" is the most significant bits, which all measured values in combined data packets have in common. The length of shared prefix can be changed by a user based on the knowledge of data similarity. If the measured values are expected be close to each other, the length of prefix value can be set to relatively long. The "suffix list" is the list of measured values excluding the shared prefix part. The "node ID list" is the list of node identifiers and the "timestamp list" is the list of timestamp.

3.3 Distributed Compression

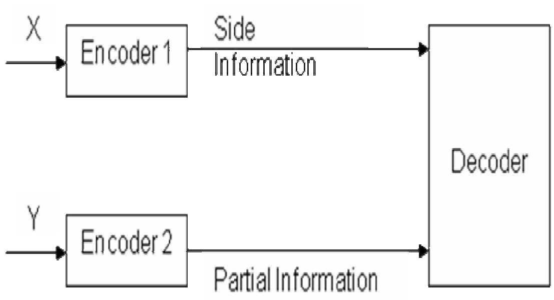

Figure3

The basic idea behind the Distributed Compression scheme, introduce by [13] [4] is using a side information to encode a source information. For instance, there exist two sources (X and Y) as shown in Figure. They are correlated and discrete-alphabet independent identically distributed. Since in a sensor network, sensor nodes will be densely populated in a sensor field, this correlation condition can be satisfied easily. In this data compression technique if we compress 3 bit of data, then only 2 bit of data comes as an output. On the basis of study we can say that there is some disadvantage of the data compression technique

4. Conclusion

It has been proved that people are discussing wide range of application areas for wireless sensor network. In this project of data compression schemes LZW were presented.

The experimental results indicates that their compression ratio and power reduction. They are one possible method to diminish resource constrain of wireless sensor node. The proposed work has been concluded with LZW algorithms. In future we can use the same algorithms with merging with effective routing protocols so that it can achieve more energy efficiency.

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