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DATA COMPRESSION TECHNIQUE USING HUFFMAN CODE FOR WIRELESS SENSOR NETWORK

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ABSTRACT

A novel compression algorithm based on the principle of Adaptive Huffman Code is proposed in the paper to reduce the number of bits required to transmit the data of particular information. The goal of data compression is to eliminate the redundancy in a data in order to reduce its size. Data compression can either be lossless or lossy. Lossless data compression recreates the exact original data from the compressed data while lossy data compression cannot regenerate the perfect original data from the compressed data. The relevance and importance of data compression has shown a growing trend from the past few years and is expected to continue remaining the same in the coming time. The proposed will provide an overview of popular adaptive data compression methods of general utility. It evaluated these existing algorithms with a newly proposed scheme with improvements to make the algorithm fully complete.

Keywords: Encryption Algorithm, Cryptography,Secrecy,Data compression, etc.

INTRODUCTION

Wireless Sensor Network (WSN) comprises of several autonomous sensor nodes communicating with each other to perform a common task. A wireless sensor node consists of a processor, sensor, communication module powered by a battery. Power efficiency is considered to be a major issue in WSN, because efficient use of energy extends the network lifetime.Web. Compression comes up as an ideal solution that permits to reduce both storage requirements and input/output operations. Therefore, it is useful when transmitting data through a network. Even though compression appeared in the first half of the 20th century, in the last decade, new Huffman-based compression techniques appeared. Those techniques use words as the symbols to be compressed. They do not only improve the compression ratio obtained by other well-known methods (e.g. Ziv-Lempel), but also allow to efficiently perform searchesinside the compressed text avoiding the need for decompression before the search. As a result, those searches are much faster than searches inside plain text. Wireless Sensor Networks are popularly used to monitor a variety of physical environments. The network nodes gather data and process it to provide information in an appropriate manner as demandedby the primary application when required. Sensor Networks have some distinct features such as limited computation, distributed processing and degree of correlation. The gathered information is communicated to gateway nodes or sink nodes. Sensor nodes are designed with a limited battery power and theyneed to be unobtrusive. This mandates that they carry only a small battery, thus limiting the energy available for functioning and necessitating a low- power operation in order to conserve energy to prolong the useful life of the sensor node. Radio communication is often the principal area of energy consumption. The extension of sensor node lifetime is generally achieved by reducing transmission/ receptions of data using data aggregation, compression techniques. The data compression algorithms are needed for these networks to reduce the amount of data communicated to the sink. The objective of the proposed work is to minimize the total number of bits required to be transmitted from the sensor node to reduce the energy consumed by the sensor node. The existence of temporal correlation in sensed data is considered as an advantage.A modified Huffman Data compression algorithm suitable for WSN is proposed in this

synopsis. The proposed algorithm does not require the statistics of the sensed data though however encodes the difference of the current and the previous value of the sensed data. By this algorithm, a good compression ratio for both highly correlated and medially correlated sensor node data has to be achieved. The major problem in wireless sensor networks (WSN) is the limited energy supply. As the transmission of the data is the largest energy consumption, many studies have turned attention on reducing the amount of bits transmitted. The solution consists in data compression.

LITERATURE REVIEW

Mo yuanbin, Qiu yubing, Liu jizhong, Ling Yanxia[1],"A data compression algorithm based on adaptive Huffman code for Wireless Sensor Networks", based on the principle of Adaptive Huffman Code, a novel compression algorithm for WSNs is proposed by making the full use of the phenomenon that the collected temperature data by the sensor nodes are continuous and slow changing in real environment. The Principle of the Adaptive Huffman code and the detailed procedure of the new algorithm are introduced in the paper. Unlike the predecessors to encode the data as a whole, the algorithm encodes the elementary characters in the difference value respectively. Based on the algorithm, compression experiments are carried out with Ambient Temperature Data, and the compression properties under the precision of 0.1, 0.01 and the mixed precision are analysed. S. Renugadevi and P. S. Nithya Darisini [2], "Performance comparison of Huffman & Lempel-Ziv Welch Data Compression for Wireless sensor node application".The compression performance of the Huffman Algorithm & the LZW algorithm using various input data commonly measure by a wireless sensor node has been analysed. For the given testeddata the Huffman Algorithm shows better performance whencompared to the LZW in terms of compression ratio & computation time. From the experiment the Huffman algorithm is able to achieve an average of 43% data reduction. For double compression the LZH could provide up to 9% improvement in terms of data reduction but at the cost of an increase in computation time. Mohamed Abdelaal and Oliver Theel [3], "An Efficient and Adaptive Data Compression Technique for Energy Conservation in Wireless Sensor Networks". The Fuzzy transform has been proposed for a novel local adaptive data compression to minimize the bandwidth, the memory space, and the energy consumed in radio communication. An evaluation of

the compression technique is provided. During this evaluation, the proposed technique is examined using real temperature data. The results have shown that the proposed technique can highly reduce the overall power consumption by up to 90%. Moreover, a modification of the proposed technique is presented which improves the accuracy of the recovered. A disadvantage of proposed technique, though, is the time delay between successive transmissions due to storing and processing the readings. Applications that require knowledge of recent or present measurements must wait for these readings to arrive. Xi Deng and Yuanyuan Yang[4],"Online Adaptive Compression in Delay Sensitive Wireless Sensor Networks".A new adaptive compression technique has been considered for lossless data compression which reduces the amount of data that must be passed through the network and to the sink and thus have energy benefits that are multiplicative with the number of hops the data travel through the network. Possible extensions in this paper, uses RUN LENGTH CODING to compress decompress the data in WSN. Static Huffman coding suffers from the fact that the uncompressed need have some knowledge of the probabilities of the symbol in the compressed files. S. Renugadevi and P. S. Nithya Darisini [5], "Huffman and Lempel-Ziv based Data Compression Algorithms for Wireless Sensor Networks".The effect of the compression on end-to-end packet delay in data gathering in WSNs has been studied in this paper. To accurately examine the effect of compression, author incorporated the hardware processing time of compression in the experiments by utilizing a software estimation approach to measuring the execution time of a lossless compressionalgorithm LZW on microcontroller TI MSP430F5418. While compression increases the maximumachievable throughput, it tends to increase the packet delay under light traffic loads and reduce the packet delay under heavy traffic loads. A.V. R. Maheswari [6], "Efficient Energy based Compression Techniques for Wireless Networks".The compression algorithm implemented in this paper the minimum variance Huffman compression algorithm, adaptive Huffman coding algorithm and variations of Huffman coding algorithm has been compared. From the analysis it is found that Huffman coding techniques are better than LZW techniques for achieving higher compression ratio in wireless sensor network. Among Huffman coding techniques and its variations, minimum variance Huffman coding technique performs better than others. Francesco Marcelloni and Massimo Vecchio [7], "A Simple Algorithm for Data Compression in Wireless Sensor Networks". In this

paper the authors have discussed the use of static Huffman encoding to compress the data from a wireless sensor network. The proposed algorithm exploits the characteristics of high correlation of sensor data to compress the data. The data from the wireless sensor node is given to an ADC. The output of the ADC is digital or binary in nature. This binary output is sent to the entropy encoder which computes the difference between the successive values of the binary input. The difference values are encoded by using Huffman code from the table. The authors have considered the use of data collectors to increase the efficiency of the compression algorithm so that there is no requirement of knowing the statistics of the symbols prior to application of compression algorithms. C.Tharini and P.VanajaRanjan [8],"Design of Modified Adaptive Huffman Data Compression Algorithm for WSN".Authors have discussed the different variants of Huffman coding and advantage of one variant over the other in wireless sensor networks. HuanZhang,Xiao-Ping Fan,Shao-Qiang Liu, ZhiZhong [9],"Design and Realization of Improved LZW Algorithm for Wireless Sensor Networks."LZ 77, LZ78 and LZW algorithms are discussed for lossless data compression. LZ77 is the first of the LZ family and is about data compression when there is no prior Knowledge of source characteristics. The main drawback of this algorithm is its susceptibility to error propagation in the case of channel error. An improvement of LZ78 has the advantage of not transmitting the next non-matching symbol which is not the same with LZ78. LZW algorithm is applied to numeric data from wireless sensor network.

PERFORMANCE ANALYSIS

A compression algorithm can be evaluated in a number of different ways. We could measure the relative complexity of the algorithm, the memory required to implement the algorithm, how fast the algorithm performs on a given machine, the amount of compression, and how closely the reconstruction resembles the original. In this paper we will mainly be concerned with the last two criteria. A very logical way of measuring how well a compression algorithm compresses a given set of data is to look at the ratio of the number of bits required to represent the data before compression to the number of bits required to represent the data after compression. This ratio is called the compression ratio.

ADAPTIVE HUFFMAN CODING

Huffman coding requires prior knowledge of the probabilities of the source sequence. If this knowledge is not available, Huffman coding becomes a two pass procedure: the statistics are collected in the first pass and the source is encoded in the second pass. In the Adaptive Huffman coding procedure, neither transmitter nor receiver knows anything about the statistics of the source sequence at the start of transmission. The tree at both the transmitter and the receiver consists of a single node that corresponds to all symbols Not Yet Transmitted (NYT) and has a weight of 0. As transmission progresses, nodes corresponding to symbols transmitted will be added to the tree and the tree is reconfigured using an update procedure. Considering a simple 4 bit ADC representation for each data, then before the beginning of transmission, a fixed 4 or 5 bit code depending whether the symbol is positive or negative is agreed upon between the transmitter and receiver. The actual code consists of two parts: The prefix corresponding to the code obtained by traversing the tree and the suffix corresponding to 4 or 5 bit binary representation corresponding to positive or negative data respectively. In the process of coding, the probability for the incoming source sequence is assigned as the elements get in to the tree formed. This gives rise to a problem where the elements which come in the initial stages of tree formation having lesser probability hold smaller codes. Thereby, the compression ratio obtained is lesser. The pseudo code for adaptive Huffman algorithm is shown in Fig. 1. Using Adaptive Huffman algorithm, we derived probabilities which dyanamically changed with the incoming data, through Binary tree construction. Thus the Adaptive Huffman algorithm provides effective compression by just transmitting the node position in the tree without transmitting the entire code. Unlike static huffman algorithm the statistics of the sensor data need not be known for encoding the data.

Fig. 1: Pseudo code of adaptive Huffman encoding Algorithm

In the adaptive Huffman coding procedure, neither transmitter nor receiver knows anything about the statistics of the source sequence at the start of transmission. The tree at both the transmitter and the receiver consists of a single node that corresponds to all symbols not yet transmitted (NYT) and has a weight of zero. As transmission progresses, nodes corresponding to symbols transmitted will be added to the tree, and the tree is reconfigured using an update procedure. Before the beginning of transmission, a fixed code for each symbol is agreed upon between transmitter and receiver. When a symbol is encountered for the first time, the code for the NYT node is transmitted, followed by the fixed code for the symbol. A node for the symbol is then created, and the symbol is taken out of the NYT list. Both transmitter and receiver start with the same tree structure. The updating procedure used by both transmitter and receiver is identical. Therefore, the encoding and decoding processes remain synchronized.

IV.1 Update Procedure

The update procedure requires that the nodes be in a fixed order. This ordering is preserved by numbering the nodes. The largest node number is given to the root of the tree, and the smallest number is assigned to the NYT node. The numbers from the NYT node to the root of the tree are assigned in increasing order from left to right, and from lower level to upper level. The set of nodes with the same weight makes up a block. Figure 2 is a flowchart of the updating procedure.
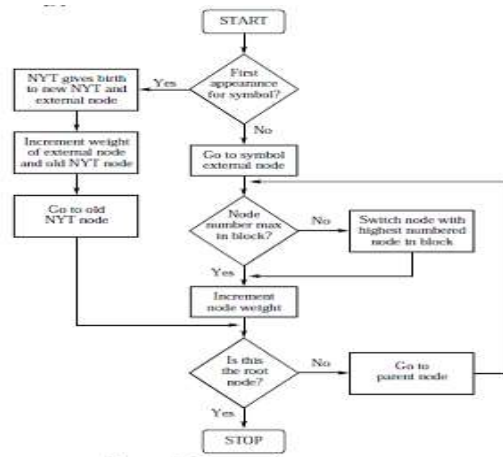

Figure 2. Update procedure

CONCLUSION
The data compression is performed adaptively based on the temporal correlation in the sensor data. This modified adaptive Huffman encoding algorithm effectively combines the advantages of static and adaptive Huffman algorithms to provide effective compressionThe principle of the Adaptive Huffman code and the detailed procedure of the new algorithm are introduced in the paper. Unlike the predecessors to encode the data as a whole, the Algorithm encodes the elementary characters in the difference value respectively. Based on the algorithm, compression experiments are carried out.

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