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Enhanced MODLEACH Using Effective Energy Utilization Technique For Wireless Sensor Network

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Abstract: As wireless sensor network applications are the emerging trend for the recent technologies. The wireless sensor network works on the backbone of the network called sensor nodes, a tiny device having different components, a sensor unit, an ADC (Analog to Digital Converter), a CPU (Central Processing Unit), a power unit and a communication unit. A wireless sensor network (WSN) consist of hundreds to thousands of low power multi-functional sensor nodes work in an unattended environment and have sense, computation and communication ability. The main aim of the sensor nodes is data communication, means transfer of data packs from one node to other with in the network. This communication is done using clustering and average energy of a node. Each cluster selects a leader called cluster head. The cluster heads CHs are selected on the basis of average energy and the probability. There are number of clustering protocols used for the cluster Head selection, The main concept is the life time of a network which depends upon the average energy of the node. In this work we proposed a model, which uses the residual energy for cluster head selection and LZW compression Technique during the transmission of data packets from CHs to base station. This technique improves the throughput and life time of network and saves the energy of node during transmission and helps to transfer more data in less energy consumption. The Proposed protocol is called COMPRESSED MODLEACH.

Keywords: WSN, LEACH, MODLEACH, Clustering, LZW Compression, Residual energy.

1. Introduction

A wireless sensor network (WSN) consists of hundreds to thousands of low power multi-functional tiny devices called sensor nodes and have sense, computation and communication ability. To handle these properties there are some basic components, which are a sensor unit, an Analog to Digital Converter, a Central Processing Unit, a power unit and a communication unit [1]. Sensor sense or compute the physical data of the area to be monitor. The frequent analog signal sense by the sensors is digitized by Analog to Digital Converter and sends to controller for further processing. Wireless micro-sensor networks represent a new paradigm for extracting data from the environment. These sensor nodes are very expensive and require large amounts of energy for operation. The most difficult resource constraint to meet is power consumption in wireless sensor networks. The use of wireless sensor networks is increasing day by day and at the same time it faces the problem of energy constraints in terms of limited battery lifetime. As each node depends on energy for its activities, this has become a major issue in wireless sensor networks [2],[3]. The failure of one node can interrupt the entire system or application. Every sensing node can be in active, idle and sleep modes. In active mode, nodes consume energy when receiving or transmitting data. In idle mode, the nodes consume almost the same amount of energy as in active mode. While in sleep mode, the nodes shutdown the radio to save the energy. A wireless sensor network platform must provide support for a suite of application-specific protocols that drastically reduce node size, cost, and power consumption for

their target application. There are number of technique in wireless sensor network to handle these problems associated with in the network. Clustering is one of technique in WSN to handle such problems. Number of clustering protocols are invented LEACH protocol is a best example, but further some limitations are still there. In this paper we represent a new method to improve the life time of network and storage space during transmission which increases the capability of network to select best clusters heads among nodes over LEACH and MODLEACH. Then we compare the result with LEACH and MODLEACH. The main objectives of this paper are

- To achieve the better Cluster head selection by using residual energy concept with threshold energy.
- To achieve more packets at base station and sink.
- To use compressing technique for better data transfer.
- To improve the overall WSN life time and energy consumption.

2. MODLEACH

In this section we present the brief concept of MODLEACH and its working. This clustering protocol is the modified version of LEACH protocol [10]. As LEACH gives birth to many new protocols. The procedures of this protocol are simple and well coped with homogeneous sensor environment. As LEACH works in rounds, this protocol, elects new cluster head for every round and hence new cluster formation is required. This leads to excessive use of limited energy. If a cluster head has not utilized much of its energy during previous round, than there is probability that some low energy node may replace it as a cluster head in next cluster head election process.

When a node act as a Cluster head, routing protocol informs it to use high power amplification and in next round, when that node becomes a cluster member, routing protocol switches it to low level power amplification. Finally, soft and hard threshold schemes are also implemented in MODLEACH that gives better results [10].

MODLEACH performs better considering metrics of throughput, network life time, and optimized cluster head formation of network. MODLEACH is further improved by using the concept of soft and hard threshold [10].

3. Data Compression

This Section gives the overall idea about the data compression and LZW compression. Data compression is the branch of information theory in whose primary objective is to minimize the amount of data to be transmitted[6]. Data compression is Technique used to reduce the number of bits required of particular information during transmission of data sets. The main function of data compression is to eliminate the redundancy in a data set which reduces its size. It plays an important role in data transmission and storage. The data compression is referred as coding. It used less usage of resources such as memory space or transmission capacity. It involves the bit rate reduction and is done in encoding and decoding of data, which uses the less number of resources during transmission[6],[7].

In wireless sensor networks data compression technique is used for compression of data packets of sensor nodes which improves the energy levels of sensor nodes and helps in transmitting more data in less energy. The compression technique also helps in selecting the cluster head whose energy is efficient and increases life time of network.

Data compression is classified into lossless and lossy compression. Lossless compression is used for text and eliminating statistical redundancy. Whereas lossy compression is for image and reduces bits by removing unnecessary or less important information given in the sets.

3.1 LZW(Lempel-Ziv Welch) Compression

In 1980, Terry Welch invented an algorithm called LZW algorithm which became the popular technique for general purpose compression systems. LZW algorithm is just like a greedy approach and divides text into substrings. LZW algorithm works in both compression and decompression techniques[4]. LZW compression is one of the Adaptive Dictionary techniques. The dictionary is created while the data are being encoded. It takes each input sequence of bits of a given length in bits and creates an entry in a table called a "dictionary"[4],[9].

LZW compression is divided into encoding and decoding.

- **Encoding:**

The algorithm works on the input string in dictionary and on scanning the input string for successively longer substrings until it finds one that is not in the dictionary. When such a string in the

dictionary is found, then it retrieves the index for the string without the last character (i.e., the longest substring that is in the dictionary) from the dictionary and sent to output, and then the heads to the new string (including the last character) is added to the dictionary with the next available code. The last input character is then used as the next starting point to scan for substrings. The following steps accomplished during the processes [7],[8],[9].

1. Initialize the dictionary which contain all strings of length one.
2. Then find the longest string W in the dictionary that matches the current input.
3. Avoid the dictionary index for W to output and remove W from the input string.
4. Then Add W followed by the next symbol in the input string to the dictionary
5. Go to Step 2

This whole compression process is using for compressing packet data of the sensor nodes. Then all data transferred from cluster member to the cluster head have been compressed and sent to the cluster head (CH). This concept uses only less amount of energy of cluster head to transfer the given data [9].

- **Decoding**

In case of decoding phase the compressed data during the compression phase will be transferred from the cluster head to the base station and then the base station will perform the decoding process. Here the received binary data will be back converted in to the character or string. After undergoing all these process we will get the actual data which is sent from the cluster member. The main goal of this LZW compression is to improve the lifetime of the cluster head (CH) and network [8],[9].

4. Proposed Technique

This section represents the overall idea about the proposed method used, which is improving techniques of Wireless Sensor Network.

The working flow is given below:

Step1. Initially generate WSN nodes (N) having average energy, based on average energy concept and set rounds.

Step2. Select cluster head (CH) on the bases of probability and average residual energy.

Step3. Check the residual energy of node if condition satisfies then

Set the node as Cluster head (CH).

Otherwise

Set the node as normal node.

Step4. Collect the data from cluster members (CM).

Step5. Use the LZW compressing technique based on minimum threshold distance value, and collects the compressed data and sends it to base station (BS) with standard threshold distance value if the distance is less than CH.

Step6. Link broadcast average energy information to WSN structure.

5. Result and Discussion

In this section the comparison of Proposed technique LEACH, and MODLEACH is discussed. The comparison will show the improvement on network life time and throughput of network effected with the help of residual energy and compression.

The evaluation of different routing protocols and their performance in the network is simulated in MATLAB. The simulation has been peformed in the network of 100 nodes and are placed randomly in the network. The nodes are in the diameter of field 400m x400m. The Comparison and the performance of the protocol MODLEACH, with proposed protocols (RESIDUALMODLEACH and COMPRESSEDMODLEACH) is implemented.

The different value of parameters used in the network is shown Table 1 the comparison of different metrics of the protocols are dead node evaluation, alive node evaluation, packets to CH, packets to BS and number of cluster heads.

Table 1: Parameters used

Parameter	Values
Area (x, y)	400,400
Base station (x, y)	200,200 or mobile
Nodes (n)	100
Probability (p)	0.1
Initial Energy	0.5J
Transmitter energy	$50*10^{-9}$
Receiver energy	$50*10^{-9}$
Free space(amplifier)	$10*10^{-12}$
Multipath(amplifier)	$0.0013*10^{-12}$
Effective Data aggregation	$5*10^{-9}$
Maximum lifetime	2500

After applying the residual energy technique and lzw compression on packet transmission the energy levels of the node changes. Figure 5.1 shows

network the network life of the dead nodes. The proposed technique RESIDUAL AND COMPRESSED MODLEACH changes the throughput, network lifetime and cluster head selection and is better improved by using soft and hard threshold.

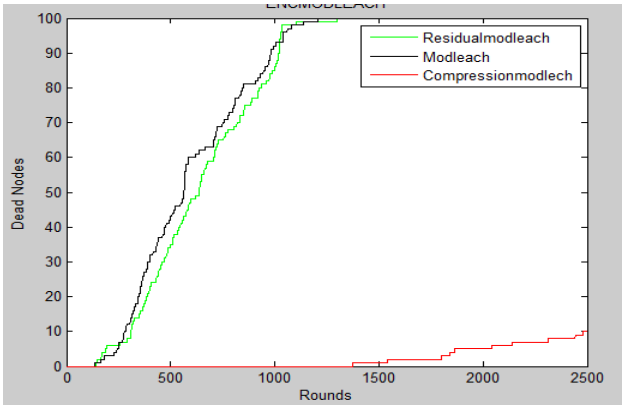

Figure 1: Compressions of dead nodes of the network

Figure 2 shows that the alive node evaluation by applying the residual energy technique and lzw compression on packet transmission. Thus, the performance of COMPRESSEDLEACH is better than MODLEACH.

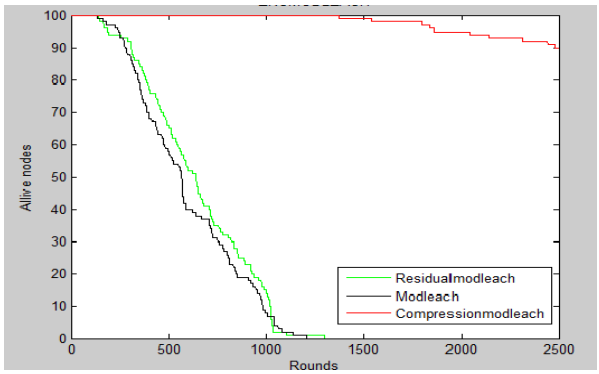

Figure 2: Comparison of Alive nodes of the network

Figure 3 shows that the number of cluster heads during the network life time which effects the energy parameters of the network and shows better performance of the network COMPRESSED MODLEACH has better result as compared to MODLEACH.

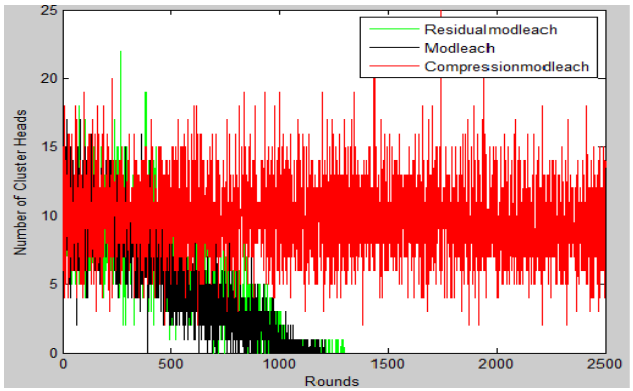

Figure 3: Comparison of number of cluster heads

The comparison of packet to CH between the MODLEACH , RESIDUALMODLEACH and COMPRESSEDMOTLEACH is shown in figure 4, which shows better performance of the network for different rounds.

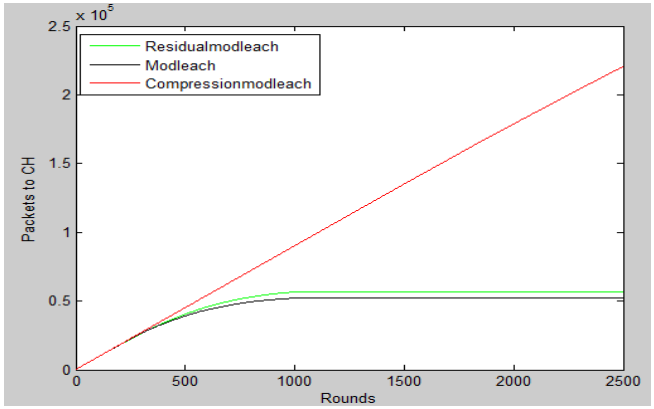

Figure 4: Comparison, Packet to CH

Figure 5 shows comparison for packet to BS.

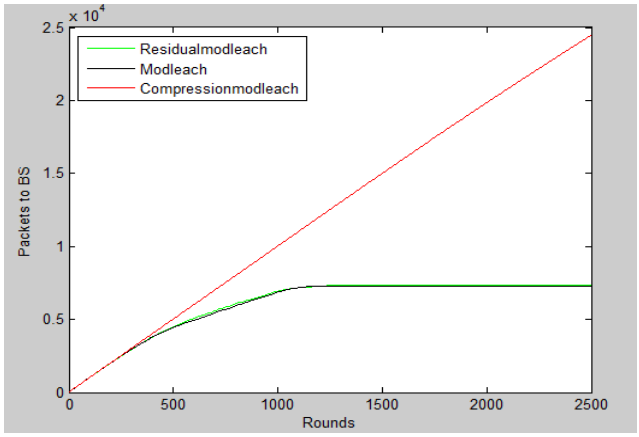

Figure 5: Comparison for packet to BS

6. Conclusion

This work gives a brief discussion on the effective energy utilization for the cluster head selection in wireless sensor networks. In this work a new version of MODLECH is proposed called

compressed MODLEACH for the cluster head selection and data transmission. This Compression type of MODLEACH uses the residual energy technique and Lzw compression technique to minimize the packet size and better transmission route whether for base station, sink or cluster head. This uses the energy efficient cluster head replacement for the better energy consumption of the network and a distance transmission for cluster head to base station communication. Hence, it uses cluster head replacement procedure involves residual energy of cluster head and selection of the CHs is done on the bases of remaining energy of the sensor nodes. Moreover, comparison on the performances of these protocols is considering throughput, network life time and energy utilization which depends further on the soft and hard thresholds are implemented on MODLEACH to give.

In near future, a new and improved cluster based routing protocol can be proposed to enhance the network life time and optimize the energy level of a node for better selection of cluster head.

Moreover, the use of double probability technique at CHs will also be done for better selection of CH with maximum energy of a node.

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