

Clustering Based Routing Protocol to increase the stability in WBAN

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Abstract- Wireless body area network is a subset of wireless sensor network. In this network sensor nodes are placed in or on the human body to measure the vital signs of the human body. Various energy efficient routing protocols have been proposed for wireless body area network to increase the network lifetime. Clustering is a technique which is used to decrease the energy consumption in the sensor nodes. In this paper we propose a clustering based routing protocol inspired by modleach protocol for wireless sensor network. Routing protocols designed for wireless sensor networks are not directly used in the wireless body area network because the scale of the wireless body area network is limited by the human body (in centimeters).limited no of nodes are placed in or on the human body. In CBR (Clustering Based Routing) protocol eight sensor nodes are placed on the human body. Propagation model is also different than the wireless sensor network. After these changes it is compared with the ATTEMPT protocol designed for wireless body area network. Results shows proposed protocol performs better than the ATTEMPT protocol in terms of increased stability period and throughput.

Keywords – WBAN, routing protocols, matlab, energy- aware routing protocol.

I. INTRODUCTION

A WBAN is a subset of Wireless Sensor Network which consist of small, low power and intelligent nodes that are placed on, in or around the human body. These nodes are used for monitoring a patient's vital signs. Use of WBAN decreases the cost of health care system. These sensors collect data from the body and transmit to the sink. The sink collects the data from the nodes and sends it to the concerned persons. The concerned persons can access the patients' data and issue an advice. WBAN used in health monitoring without affecting the routine activities. [1].

WBANs have many applications including real time health monitoring of patients. The sensors implanted on the body measure different vital signs and send data to the concerned people. Interactive gaming is a growing application of WABNs. The players can physically move their limbs and the sensors deployed on the body send data to the gaming device. It provides enhanced entertainment. WBAN consists of tiny sensor nodes, they have limited energy resource. It is not so easy to replace or recharge the batteries. Therefore, it is necessary to decrease energy consumption in order to increase the network lifetime. It also increases the throughput by sending more packets to the sink [11]

There are various energy efficient routing protocols are designed to increase the network lifetime. Knowledge of routing protocols are very important because they can affect the performance of the network. This paper first analyzes the ATTEMPT protocol then compares the CBR protocol with ATTEMPT. In this work eight sensor nodes are placed at the human body. Two nodes have the important data which is transmitted to the sink directly and the remaining nodes send data to the sink through cluster head.

The remaining paper is organized as follows: In Section 2 Literature Review is given. Section 3 contains brief explanation of our proposed protocol, and Section 4 is provided with the performance evaluation comparison of the proposed technique with existing one. Conclusion is given in Section 5.

II. LITERATURE REVIEW

Single-hop communication is effective to decrease the delay. In this method nodes directly send the data to the sink [2]. Multi hop communication is used in [3]. In multi hop communication nodes send data to sink through relay nodes. This paper focuses on that the nodes which are nearer to the sink consume more energy and that technique increases the delay [3]. SIMPLE protocol is based on cost function. In this protocol all sensor nodes have equal power and sink nodes know all the details of sensor nodes like distance, energy etc. Sink sends this information to all the nodes. In this scheme forwarder node was elected based on cost function at each round. Cost function was the ratio of distance between the sensor node to sink to residual energy which was the difference between initial energy and current energy of node. By electing forwarder node at each round increases the throughput and minimizes the energy consumption [4]. Authors used priority concept. They used priority based tree algorithm for WBAN. They used dedicated channels to transmit the emergency data when the emergency data is transferred successfully then normal data is put forward for transmission. Use of dedicated channels increases the loss of available resources [5]. In ERBAR protocol adaptive route was used which selected based on residual energy. Data is transmitted through this adaptive route. Use of adaptive resource allocation increases the network lifetime [6]. Authors gave the review of routing protocols for WBASNs used in health care systems. They divide the routing protocols into different categories. They also gave the advantages and disadvantages of each category [7]. Review on WBASN standards and protocols is given in [8]. This paper also conducts a study on existing research and the challenges in the field of health care monitoring. CACADA is a cross-layered protocol. It builds a spanning tree and TDMA time slots are assigned in a distributed manner. The result of this is a collision-free channel access and also helps to route the data from nodes to sink. Achieves energy efficiency with small delay by using control as well as data sub cycles [9].

The main motive of this paper is to design a routing protocol with uniform distribution of load and increased network lifetime. There are two modes of communication single hop and multi hop. When single hop method is used it increases the load on the distant nodes and when multi hop method is used it decreases the battery power of the nearer nodes. To solve this problem authors in [12] proposed an Adaptive Threshold based Thermal-aware Energy Efficient Multi hop protocol (ATTEMPT). In this Protocol nodes are placed according to their data rates.

In ATTEMPT protocol [12] nodes use same amplification energy to transmit data from transmitter to receiver whether the distance is more or less between them. There should be a mechanism which decides the required amplification energy for the nodes which communicate to the cluster head or base station. If we use same amplification energy for the nodes which transmit the packet to cluster head and the nodes which transmit the packet to the base station it results in wastage of energy. The solution to this problem is that nodes must have the global knowledge of the network and then decide how much they need the amplification energy. Modleach protocol was designed for wireless sensor network to solve this problem. Same concept is implemented in the proposed protocol for wireless body area network with some modification. It uses two techniques: efficient cluster head replacement and dual transmitting power.

III. PROPOSED PROTOCOL

In CBR protocol sink is placed at the centre of the human body. For transmission of normal data multi hop communication is used and transmission of emergency data transmission single hop communication is used. The technique which is used to select the cluster head is threshold based. If the previous cluster has not spent much energy and still has energy which is larger than the threshold level, it will remain cluster head for the next round. In this way the energy is saved which is wasted to select the new cluster head and route the packet through the new cluster head. If the cluster head has the energy less than the threshold level, it will be replaced by the new cluster head which has larger energy than the threshold level. Minimum amplification energy required for the communication between base station to node and node to cluster is not same. Considering this point different power levels are used for the two types of communication.

For comparison the no of sensor nodes and their locations for two protocols are same. The brief introduction of the steps which are involved in the proposed protocol is given below:

3.1. Step 1. In this step each node in the network knew its neighbors, all possible paths to the sink and the position of sink. Nodes also update their routing table with help of HELLO packet.

3.2. Step 2. The proposed protocol is priority based protocol. The node which has emergency data has highest priority level and the node which has normal data has lowest priority. Nodes which have highest priority send data to the sink and the nodes directly which have lowest priority send data to the sink through the cluster head.

3.3. Step 3. After the routing step sink allocates TDMA time slots to the nodes for data transmission. Once the sink allocates the time slots nodes communicate within the allocated time slots. Sink node receive the data and aggregate it. This process continues till the nodes are completely depleted.

IV.RESULT AND DISCUSSION

We compare the performance of two protocols (ATTEMPT and proposed) with the help of MATLAB simulations. We compare these protocols based on performance metrics. Performance matrices are given below.

1. No of Alive nodes

Alive nodes are very important parameter. By analyzing no of alive node we decide the network life time of the network. It is the time for which the last node dies in the network. In WBAN high network life is required. It is total time in which the network operates.

2. No of dead nodes

Node in the network which has 0 energy remaining is called dead node. It is very important parameter. First dead node decides the stability of the network. Network before the first node dead is called stable.

3. No of packets sent to sink

Throughput is the number of packets successfully received at sink.

4. Path Loss

It is measure signal attenuation between the transmitter and receiver. It is the difference between the transmitted power and received power. It is measured in dB.

Figure (6) shows the results of proposed and ATTEMPT protocol. It shows that the proposed protocol is more stable than the ATTEMPT. Stability period is the time gap from the beginning to the first node dead. In ATTEMPT protocol first node is dead at 2200 rounds and in proposed protocol first node dead at 3200 rounds this happen because in ATTEMPT protocol nodes use same amplification energy to transmit data from transmitter to receiver whether the distance is more or less between them. If we use same amplification energy for the nodes which transmitting the packet to cluster head and the nodes which transmitting the packet the base station it results in wastage of energy. Due to this In ATTEMPT protocol first node die early. In Proposed Protocol two power levels are used that increases the stability period. Network lifetime of the ATTEMPT protocol is more than the proposed protocol. Figure (8) shows the network lifetime analysis of ATTEMPT and Proposed Protocol. Network lifetime of the Proposed Protocol is more than the ATTEMPT Protocol. In Proposed protocol cluster head is selected based on threshold. If the previous cluster has not pent much energy and still has energy which is larger than the threshold level, it will remain cluster head for the next round. In this way the energy is saved which is wasted to select the new cluster head and route the packet through the new cluster in ATTEMPT Protocol. Figure (7) shows the throughput analysis .Throughput is the no of packets received at the receiver. Nodes alive in the proposed protocol for longer duration than the ATTEMPT that increases the no of packets received by proposed protocol increases.

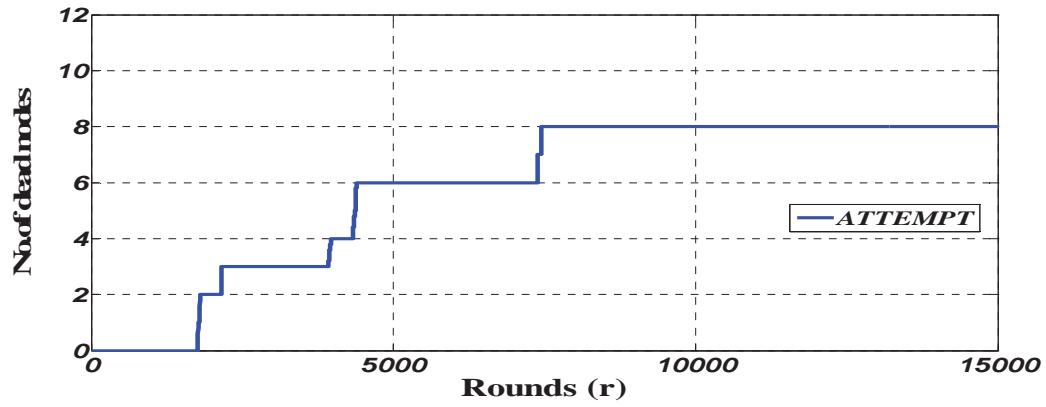


Figure 1. No of dead nodes in ATTEMPT

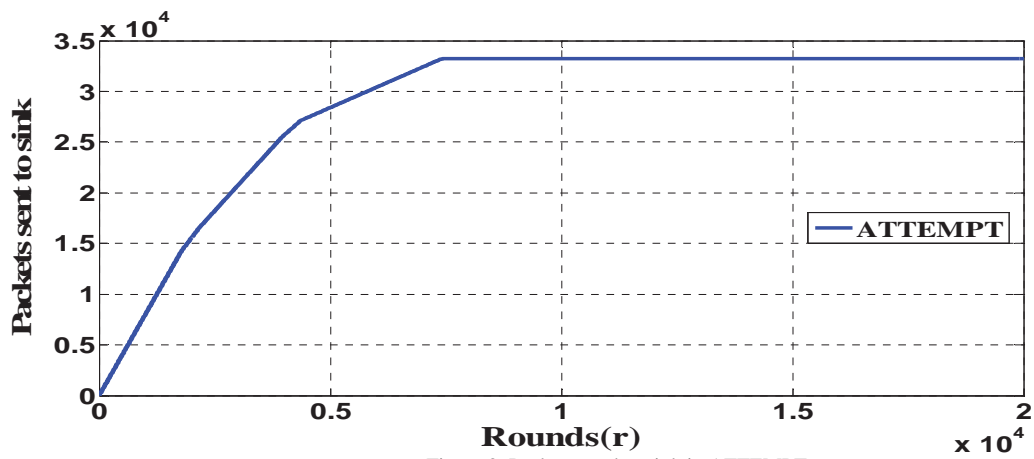


Figure 2. Packets send to sink in ATTEMPT

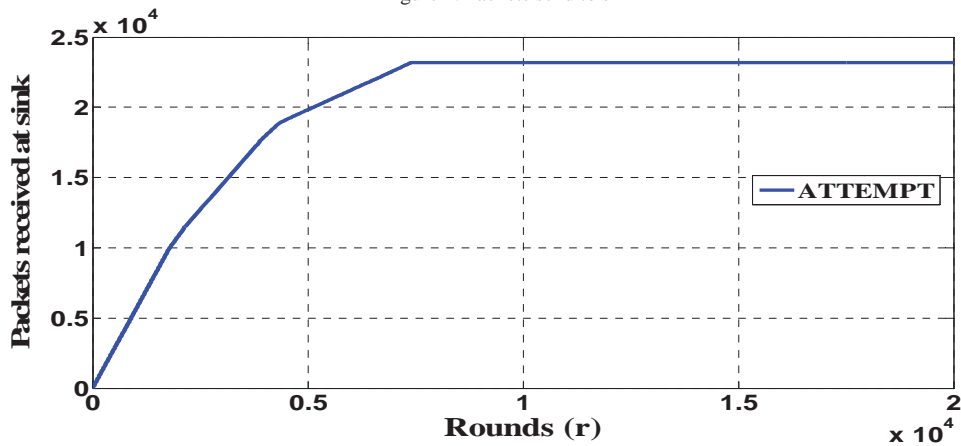


Figure 3. No of Packets received at sink

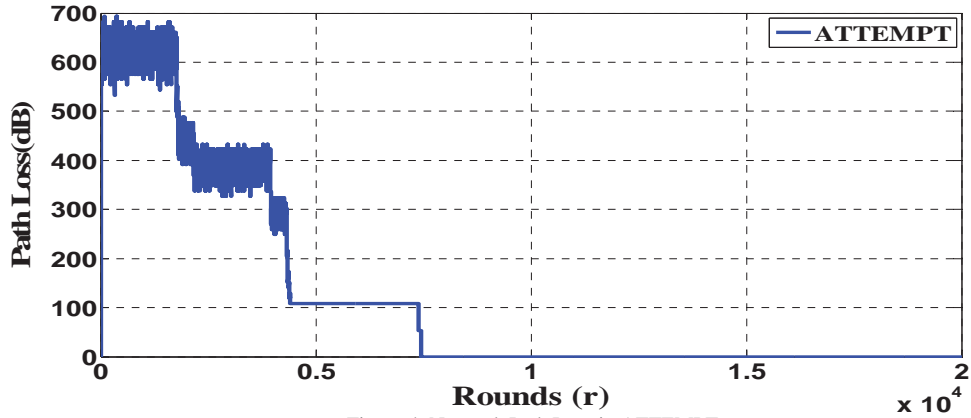


Figure 4. Network Path Loss in ATTEMPT

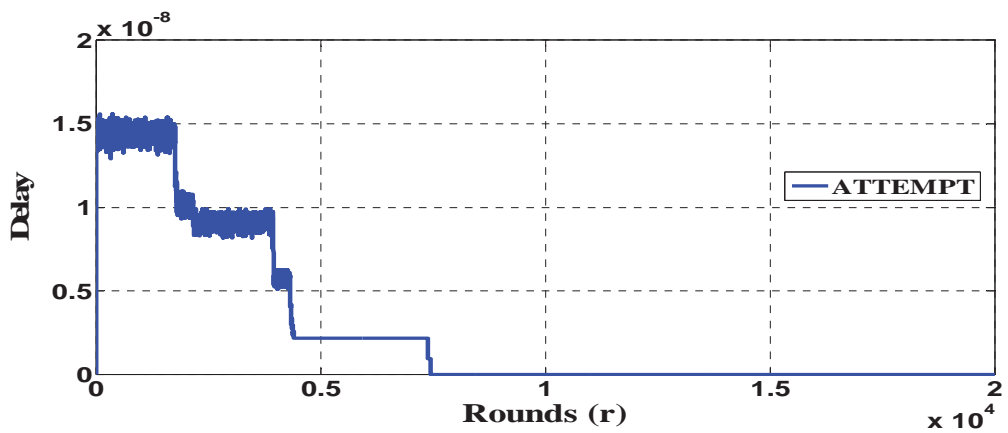


Figure 5 Analysis of Delay

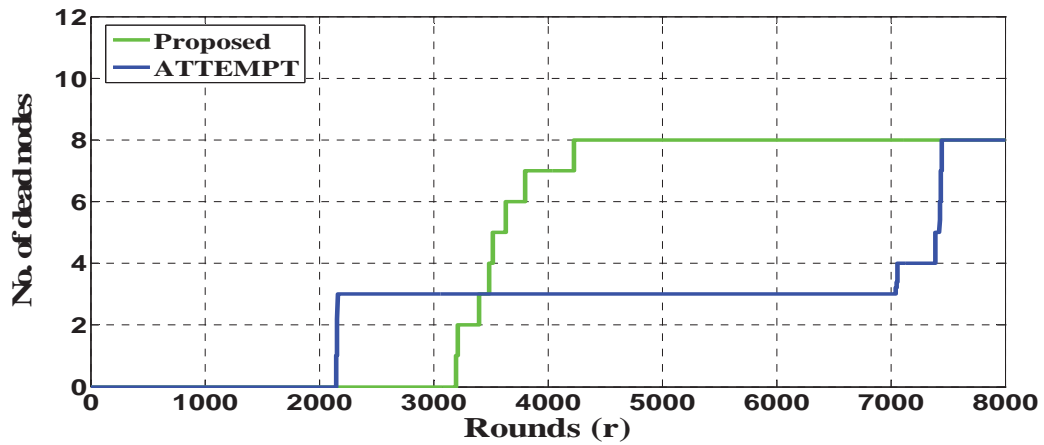


Figure 6.No of dead nodes in ATTEMPT and Proposed

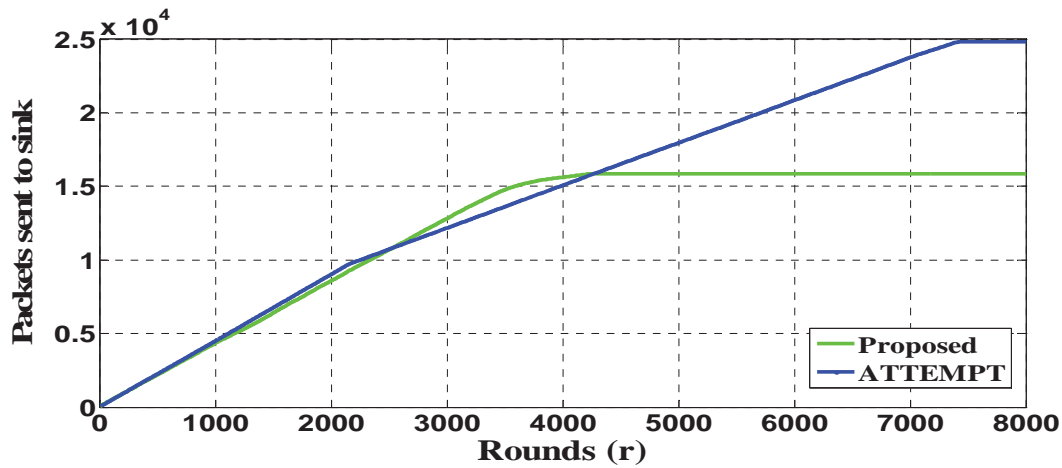


Figure 7. No of Packets received at sink in ATTEMPT and Proposed

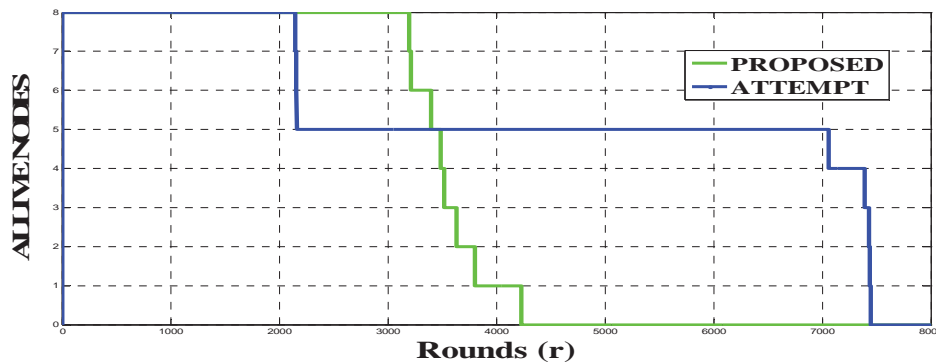


Figure 8. No of Alive nodes in ATTEMPT and Proposed

IV. CONCLUSION

Proposed protocol is based on clustering. At the centre of the human body sink is placed. For transmission of normal data multi hop communication is used and transmission of emergency data transmission single hop communication is used. The technique which is used to select the cluster head is threshold based. If the previous cluster has not pent much energy and still has energy which is larger than the threshold level, it will remain cluster head for the next round. In this way the energy is saved which is wasted to select the new cluster head and route the packet through the new cluster. If the cluster head has the energy less than the threshold level, it will be replaced by the new cluster head which has larger energy than the threshold level. Minimum amplification energy required for the communication between base station to node and node to cluster is not same. Considering this point different power levels are used for the two type of communication.

Simulation results shows that proposed protocol increases the stability period and number of packets delivered to sink than ATTEMPT protocol.

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