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RESEARCH ARTICLE

Cost Based Efficient Routing for Wireless Body Area Networks

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Abstract- WBAN is an emerging technology and is a sub-field of the existing WSN technology. It provides real-time health monitoring of patients with the ability to provide feedback to the central controlling head or the administrator. In this paper we discuss how the wireless body area networks are used in health care relevance by using multiple sensor nodes. The paper discusses the calculation of energy and cost function. Our proposed cost function computes the reliability of path on basis on factor critical. Simulation result demonstrates that over proposed protocol highest energy stability period and cost effective.

Keywords- WBAN, Multi-hop protocol, Residual Energy, Cost Function, Delay

I. INTRODUCTION

WBAN technology is a sub-emerging field of the existing WSN technology. WSN is a collection of nodes or sensors that are placed on human body at various parts. WBAN can be used in many applications to facilitate the lifestyle of the people such as entertainment, transport system, health monitoring, emergency reliefs and many more. It is an emerging technology that enables wireless sensor nodes to provide real-time health monitoring of patients. In WBAN, wireless sensors are placed on the human body or implanted in the body to monitor vital signs like blood pressure, body temperature, heart rate, glucose level etc. This proves economical and is widely used in hospitals for patients' health monitoring. Patients get better facilities and longer time to be treated, get medicated and taken care of since sensors continuously sense data and forward it to the central controlling head or the administrator. But, various energy constraints are present on these sensor nodes and hence we need to focus on their minimum level of energy and power consumption. The main problem that arises in WBAN is of battery consumption as it is difficult and not feasible to discharge batteries from body parts for charging them from time to time. Since the nodes have to travel along distance to forward their signal to the central device which is done at the cost of their energy level consumption. These factors have made energy the most critical resource in WBAN.

We propose a high throughput, reliable and stable routing protocol for WBAN. We deploy sensor nodes on the body at fixed places and place sink at waist. Sensors for ECG and Glucose level are placed near the sink. Both these sensors have critical data of patient and required minimum attenuation, high reliability and long life hence,

these sensors always transmit their data directly to sink. Other sensors follow their parent node and transmit their data to sink through forwarder node. It saves energy of nodes and network works for longer period.

II. LITERATURE SURVEY

Jocelyne Elias *et al.* had proposed Energy-Aware Topology Design for Wireless Body Area Network [1]. The author addressed the topology design problem for WBANs, proposing a novel and effective model based on mathematical programming that determines the optimal number and placement of relay nodes; the optimal assignment of sensors to relays and the optimal traffic routing, taking accurate account of both the total network cost and energy consumption.

Gill R. Tsouri *et al.* had worked on Increasing Network Lifetime in Body Area Networks Using Global Routing with Energy Consumption Balancing [2]. The author proposed global routing approach which allows WBANs to operate efficiently for longer period of time before recharging of batteries is required. NL is increased as well, decreasing the maintenance requirements even further.

Arash Maskooki *et al.* have proposed Opportunistic Routing for Body Area Network [3]. Author attempt to increase the battery life of the node in WBAN which can lead to more comfort of the user or even a necessity in some cases e.g. implantable sensors where changing the energy resource is invasive. In this work we exploited the motion of the body parts to increase the lifetime of the network. To evaluate the performance of the proposed scheme, the energy consumption of the network per bit for the single hop, multi-hop using relay node and the opportunistic scheme are compared. The results shows that the proposed scheme can increase the life time of the network by decreasing the energy consumption in both the sensor and relay nodes while maintaining the same BER as the other two schemes. By appropriately placing the relay and sink nodes we showed that the energy consumption in the relay node can be significantly decreased by using the proposed opportunistic routing scheme. Decreasing the energy usage of the relay node decreases the overhead energy consumption in the network as the relay node is the major overhead energy consumer in the network.

Q. Nadeem *et al.* had proposed a stable increased-throughput Multi-hop Protocol used Wireless Body Area Networks [4]. In this paper author propose a cost function based on residual energy of node and its distance from sink. Nodes with less value of cost function choose as parent, and other nodes become child nodes. Two critical nodes placed near to sink, so that their energy not deplete early.

III. PROPOSED ROUTING

In paper [3] author presented an opportunistic protocol. In this paper the author deploy sink node at wrist. Whenever sink node is far from node, it uses a hop node to collect data from sensor. In paper [4] the author proposed Multi-hop protocol using cost function for efficient routing. The cost function is based on distance and residual energy, which is not capable of addressing the request when load is higher than residual energy. In our proposed work a cost function is used which computes the reliability of path on basis of factor critical. This also results in enhancing network lifetime and successful delivery of packets. The working of network is as follow:

Initially sink broadcast hello packet to all nodes which contain the position information of the sink. The nodes in form of acknowledgment send ACK packet to sink contain information of node id, energy and distance. These factors help in computing the energy and cost factor.

$$\text{Energy factor (E}_{\text{factor}}) = \text{Residual energy} / \text{Initial power}$$

$$\text{Cost factor} = \text{Distance} / \text{Energy factor}$$

To avoid data collision in case two nodes send data at same time to sink, the sink issue TDMA to all nodes. The TDMA also saves energy as nodes status turns to sleep while TDMA has higher value. Using proposed scheme the performance of routing in all terms has been improved.

IV. RESULTS AND DISCUSSIONS

Number of dead nodes- Figure 1. represents the dead nodes WRT rounds for Old Multi-hop and Proposed Multi-hop. The Proposed Multi-hop has shown much better results as the usage of energy in proposed Multi-hop is uniformly used, Fig1 clearly depicts that proposed multi-hop all nodes dead around in same range rounds

where, as in old Multi-hop 3 nodes are dead at 3000 rounds where as proposed multi-hop there will be no loss at 3000 rounds. There is only one node dead at 4500 round and 6 nodes are dead at 6000 rounds. It shows that each node consumes almost equal energy in each round and all the nodes die almost at the same time.

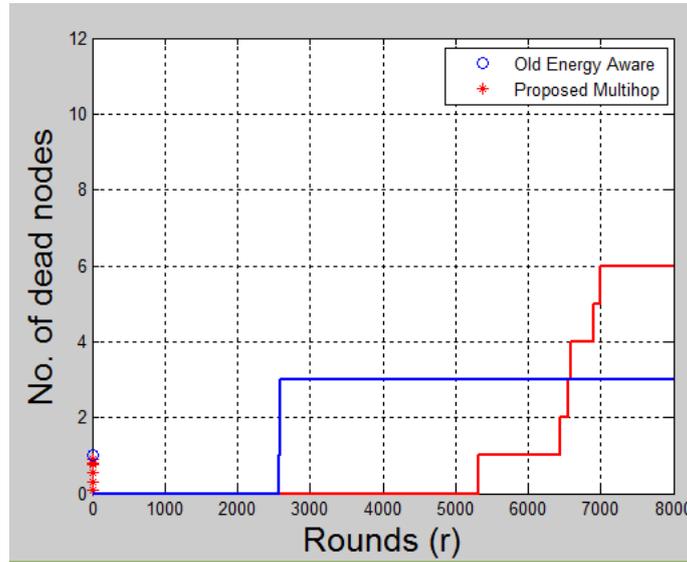


Fig.1 No. of dead nodes

Data sent to Sink: In fig. 2, the data sent to sink has shown for both old energy aware and proposed multihop. It also signify throughput. The proposed Multihop sent lesser data to sink initially as it use energy in uniform manner. Afterward proposed multihop shows great increase than old energy aware because in proposed multihop all the nodes are alive but not in energy aware. Proposed multihop achieve high throughput then old energy aware.

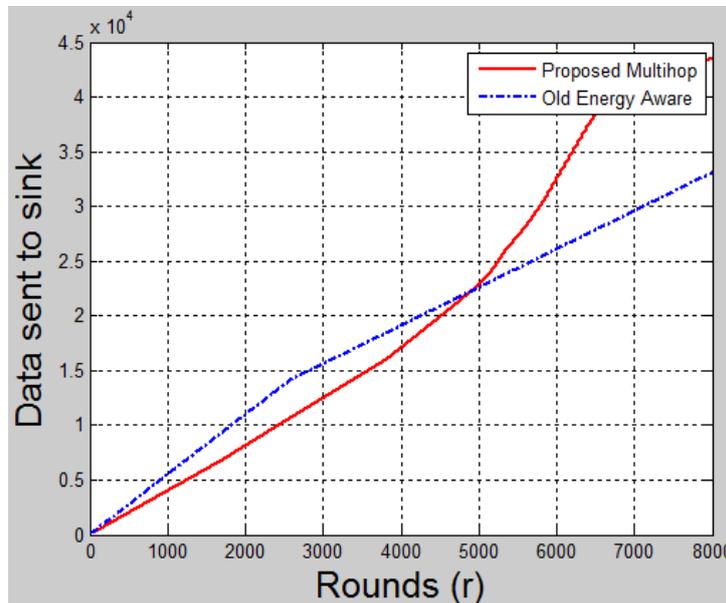


Fig 2: Data sent to sink

Data received at Sink: The data sent to sink in proposed multihop is much higher than old energy aware. The proposed protocol perform better in term of sending data to sink than old energy aware.

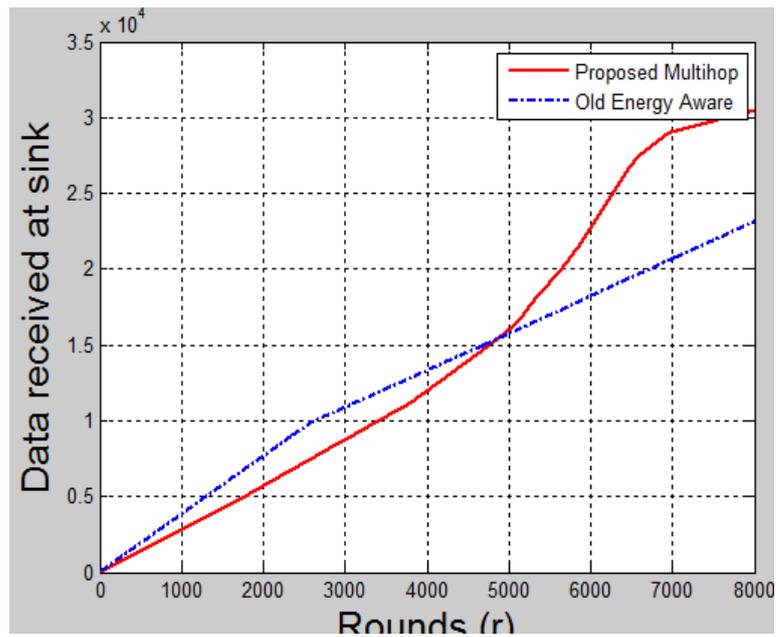


Fig 3: Data received at sink

Data Dropped: The data dropped by proposed multihop is much higher than old energy aware as the compression ratio taken is higher as well as duplicate packets discard is higher.

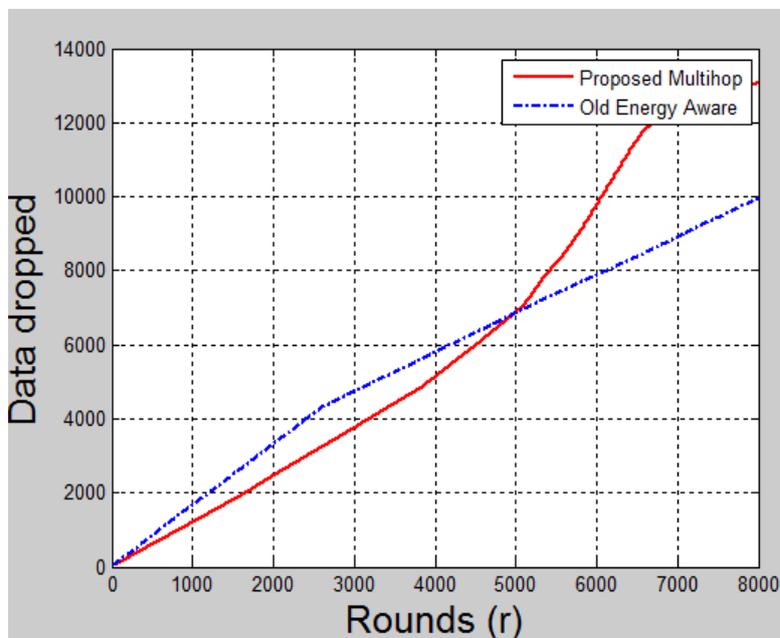


Figure 4: Data Dropped

Residual energy: The proposed scheme use energy in fair way, results in residual energy left in nodes is same at all points. It enhance network lifetime, whwere as usage of energy is not optimal in old energy aware.

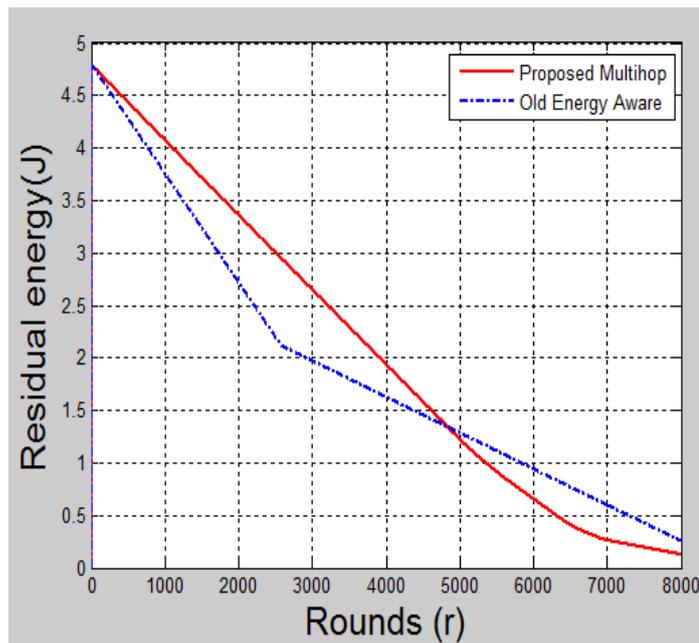


Fig. 5 Residual energy

Delay- The delay for both proposed and old energy aware shown in fig.6. the average delay shown by proposed multihop is much lesser than old multihop. It also signify that throughput of proposed mutihop is better,. The lesser delay justify the efficiency of proposed multihop protocol routing in WBAN.

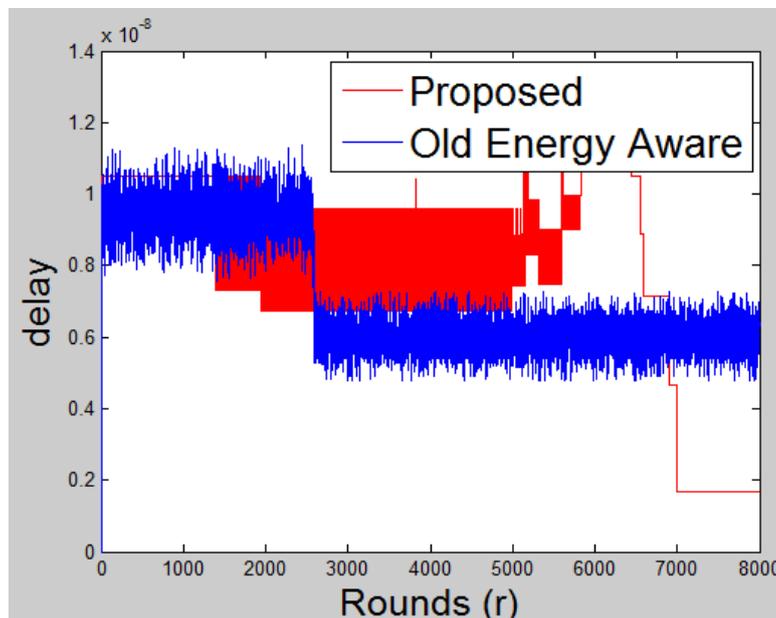


Fig. 6: Delay

Conclusion

In our proposed approach an attempt has been made to enhance the network performance by optimal use of residual energy and enhancing network lifetime. The work done is carry forward from Multi-hop routing protocol [3], which is an efficient way of routing in wireless body area networks. The cost function proposed by the author is depending upon distance and residual energy only. This is major shortcoming in case when data transmission load is higher than left residual energy. In this case the energy is wasted and data transmission fails too. Using our proposed cost function, there is significant improvement in performance of network which is computed on basis of various factors like dead node, residual energy, data packets sent and received to sink and delay etc.

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