INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN 2278 – 0211 (Online)

An Adaptive Routing Mechanism for Wireless Body Area Network (WBAN)

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Abstract:
Deploying bio-sensors on a human body to measure various biological signals of the body, to form a Wireless Body Area Network (WBAN). WBAN enables an efficient way to continuously monitor all the biological parameters of the body, even brain activities through implanted/body-worn devices. Wireless body sensors are a key technology for unobtrusive health monitoring. Automatically forming a wireless network comprising all sensors attached to the same body is challenging. Reliable communication between the sensors placed on various parts of the body is an important aspect. There is a necessity of a well designed communication for intra WBAN. This paper investigates the two different network topologies used for communication in Intra WBAN , star topology and multi-hop approach , then proposes a new adaptive routing mechanism that automatically adapts the topology according to the connectivity status of the network. Finally it evaluates the energy consumed by the Routing Mechanisms in WBAN. The simulations are carried out by Network Simulator 2.

Keywords*: wireless body area network, star topology, multi-hop, adaptive and energy*

1. Introduction

Wireless Body Area Network has offers many versatile applications in health care, sports and home security. These applications require free movement offered by WBAN. In the patient monitoring, a patient is monitored by placing sensor nodes which measure biological parameters such as heart rate, temperature, ECG, blood pressure. The plus point is that the person need not be immobile, but can walk freely across the house and even move in and around some distance. This improves the quality of life for the patient and reduces hospital costs. In this case the data base gathered over much more period of time gives useful data that be used for anylysis. Further, that can help in diagnosing more accurately in future. Energy is one of the key parameter in WBAN and it is used in optimum. Thus we design an adaptive routing mechanism that fulfills the need.

2. Related Work

WBAN network consists of a gateway node placed usually at the centre of the body and various sensor nodes placed on different parts of the body. The gateway node co-ordinates all the nodes. From gateway node the data involving various parameters measured from the body are sent out. The mechanisms used for Intra WBAN communication are [1]

- Star topology
- Multi-hop

Star topology is the simple basic topology that can be used in WBAN. In Star topology all the nodes transfer the data directly to the gateway and gateway transfers the data directly to the gateway. In case a node cannot contact the gateway or a gateway cannot contact the node, the packets are lost. Star topology uses less energy. In Multi-hop approach the communication between nodes and the gateway takes place through other nodes thus forming one or more hops. Every time gateway and a node communicate, a tree structure has to be set up for routing. It takes time to set up the route and also data overhead increases. Multi-hop approach consumes more energy. Experiments as described in [2], [3] explore the trade-off between using a star and a multi-hop architecture, highlighting their respective performance characteristics. There is no solution that is optimal for all applications of WBANs because of different constraints and requirements. Mac Protocol Is Proposed For WBANs Assuming An Underlying Star Architecture in [4]. A tree-based multi-hop protocol is proposed in [5] in which the routing spanning tree is set up autonomously to route data from the node to the gateway. A common problem of every tree structure in WBANs is that in the case of a node failure or node movement, the tree has to

be reconstructed. To deal with the link unreliability issue and overhead of routing structure reconstruction in the existing multi-hop protocols, presented a multi-hop protocol stack as discussed [6] in which a gossiping strategy is exploited for data dissemination.

3. Adaptive Routing Mechanism

Star topology is very simple but serious problems arise if a single node fails to communicate to the gateway node. In multi-hop approach there is an issue of delay that occurs due to reconstruction of path everytime the nodes communicate to the gateway node. It also consumes more energy. Adaptive routing mechanism addresses the issues faced in fixed star and multi-hop approaches.

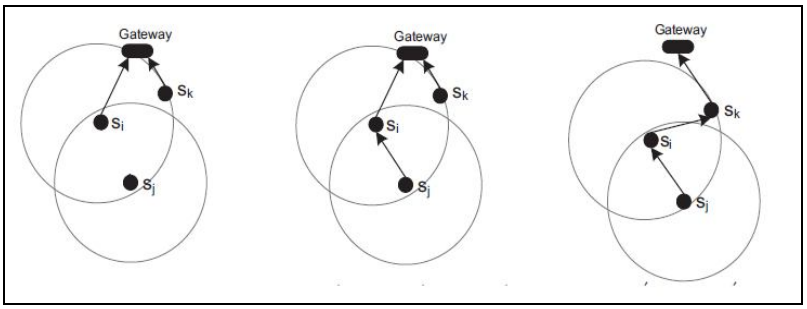

Figure 1: adaptive routing mechanism, [1]

Three nodes in WBAN s_i, s_j s_k and gateway node are as shown in above fig 1. Nodes s_i and $_{sk}$ can communicate directly to gateway but s_j cannot. In this case s_j communicates to gateway through sj, s_k. In case if s_i, cannot communicate to gateway directly, $s_{j\ communicates}$ to gateway through s_i, s_j s_k that is by multiple hops. Thus when a node fails to communicate directly to gateway, it communicates to gateway through other nodes by multiple hops.

4. Evaluation

Simulation is carried out in Network simulator 2. We make certain assumptions There is no interference between the sensor nodes on the body. Mobility is provided for various postures of the body such as lying down, sitting, standing, walking running and random body movement. For nodes MAC layer specification 802.15.4 is used.

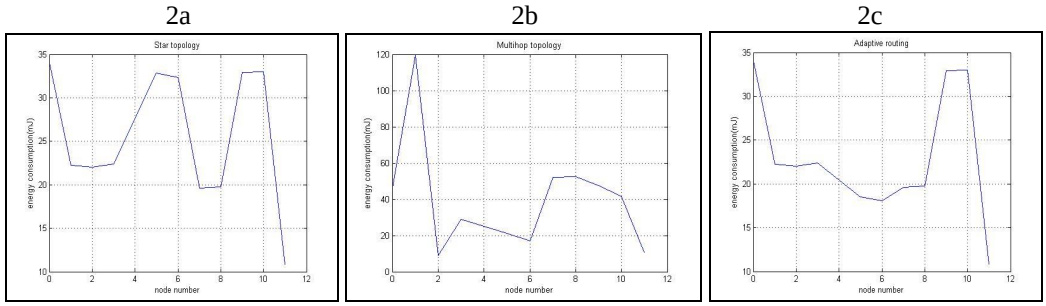

Figure 2

Fig 2 energy consumption in star topology (2a), multi-hop approach (2b) and adaptive routing mechanism (2c)

The obtained energy consumption graphs are plotted for respective nodes for star topology, multi-hop and adaptive routing mechanism. Evaluation from the graphs unveils that adaptive routing mechanism consumes the least energy; next least is the star topology.

5. Conclusion

Simulations are successfully conducted for the fixed star and multi-hop approaches as well as our adaptive routing mechanism. Simulations also indicate that our adaptive routing mechanism is better than star topology and also uses less energy than the fixed approaches. Future work: The similar work can be carried out for MAC layer specification 802.15.6; Interference between the sensor nodes can be introduced. More dynamic human mobility postures can be considered. It can also be extended to the presence of more human bodies.

6. References

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