A Survey of Routing Protocols in Wireless Body Area Networks for Healthcare Applications

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ABSTRACT

Recent advances in electronics and integrated circuits have fostered the development of small and intelligent medical sensors and actuators that are wearable or implementable inside the human body. The main function of these devices is to collect patient’s physiological parameters and forward them to the medical center in an efficient and reliable way. Therefore, routing is a non-trivial task in wireless body area networks (WBAN); sensing the importance of routing in WBAN and the availability of a significant body of literature on this topic are the main motivations that encourage the study and examination of routing mechanisms. This paper proposes WBAN routing approaches. It outlines the design challenges for WBAN routing protocols and sketches out the communication architecture of this type of network. The authors’ main contribution is the classification of the routing techniques into six main categories, which corresponds to thermal aware routing protocols, cluster based routing protocols, cross layers based routing protocols, quality of service (QoS) aware routing protocols, and delay tolerant aware routing protocols. The advantages and performance issues of each routing technique are highlighted. This paper is useful for researchers to make enhancements to the future design of WBAN routing protocols and algorithms.

Keywords: Healthcare, Network, Routing, Wireless Body Area Networks (WBAN), Wireless Sensors Networks

INTRODUCTION

In the last few years, wearable monitoring systems (Cypher, Chevrollier, Montavont, & Golmie, 2006) have gained the attention of various researchers, especially in the healthcare (Rodrigues, 2009). An important task of such systems is to collect physiological parameters like the heartbeat, body temperature, etc.

AWBAN (Moutinho, 2009; Baker, Armijo, Belka, Benhabib, & Bhargava, 2007; Barth, Wilson, Hanson, Powell, Unluer, & Lach, 2008; Chen, Gonzalez, Vasilakos, Cao, & Leung, 2010; Ullah et al., 2010) is made up out of several kinds of low powered miniaturized wireless devices. As shown in Figure 1, the most common devices are the sensors and
actuators. The former measure physiological data, while the latter can undertake a specific action according to the received data from the sensors or via interaction with the user.

The WBAN provides a wireless connection between these devices and a Personal digital assistant (PDA) or a smart phone, which is responsible for the connection with other networks. For example, the obtained data can be forwarded to a hospital server. Therefore, it is clear that forwarding data is an important challenging task in WBANS. These challenges must be taken in consideration and overcome in proposed routing approaches.

Although there are previous efforts for surveying WBANS (Moutinho, 2009; Ali, Sarker, & Mouftah, 2010; Ameen, Liu, & Kwak, 2010; Chipara, Lu, Bailey, & Roman, 2010; Hsua et al., 2010) in many aspects, to our best knowledge, none of them was only devoted to surveying routing protocols. Thus, due to the importance of this topic in such type of network this paper is a dedicated study and classification of the body of literature on WBANS routing protocols. In addition, it illustrates a comparison of these protocols, which reveals the important features that need to be taken into consideration while designing and evaluating new routing protocols for WBANS.

The rest of this paper is organized as follows. In Section 2, we discuss routing challenges and design issues in WBANS. In Section 3, we illustrate the WBAN architecture. A classification and a comprehensive survey of WBANS routing approaches are presented in Section 4. In Section 5, a discussion and a comparative study are elaborated. Finally, Section 6 concludes this paper and highlights the future works that will be carried related to this topic.

2. DESIGN ISSUES OF ROUTING PROTOCOLS

Developing efficient routing protocols in WBANs is a nontrivial task due to diverse characteristics of the WBANs environment. Thus, the design challenges of WBANs routing protocols involve the following main aspects.

- **Limited energy capacity:** Although biosensors can be removed from their operation site to be recharged or recharged by external IR radiation, energy consumption...
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www.igi-global.com/chapter/what-e-mental-health-can-offer-to-saudi-arabia-using-an-example-of-australian-e-mental-health/163829?camid=4v1a

Monitoring and Assisting Maternity-Infant Care in Rural Areas (MAMICare)
International Journal of Healthcare Information Systems and Informatics (pp. 32-43).
www.igi-global.com/article/monitoring-and-assisting-maternity-infant-care-in-rural-areas-mamicare/124118?camid=4v1a