Chapter 100
Wireless Body Area Network for Healthcare Applications

Danda B. Rawat
Georgia Southern University, USA

Sylvia Bhattacharya
Georgia Southern University, USA

ABSTRACT

Wireless Body Area Network (WBAN) is an emerging field of research which has been progressing rapidly in recent years. WBAN is a network utilized for continuous monitoring of physiological state of the subject, where the patient can perform his regular activities while his body parameters get measured continuously and are accessed by the physician remotely. This chapter provides a thorough survey of current WBAN technologies in the healthcare sector. Besides the recording of physiological parameters, discussions have been provided on remote data transmission to a server called Virtual Doctor Server (VDS). During this transmission, WBAN network uses various technologies namely Ultra Wide Band WBAN, Technology Enabled Medical Precision Observation 3.1 (TEMPO 3.1), J2ME and Bluetooth. Details of several existing WBAN related projects have been discussed along with their applications. The next section of the chapter deals with the use and design of medical sensors in WBAN. Performance comparison between WBAN and WSN (Wireless Sensor Network) has also been provided.

1. INTRODUCTION

WBAN is the joint application of biomedical science and wireless communication systems. The development of this technology will have the impact of drastically reducing the time a patient has to spend in his house or in a medical care center for treatment. This technology utilizes the principles of wireless communication to relay data (such as heart rate, ECG) continuously to remote areas (Mundt et. Al., 2005). The data are measured by sensors in a person's body. Besides drastic development in medical instrumentation, it is now also important to have compact machines like portable blood pressure measurement kits that can be attached to a body and be able to measure the parameters round the clock.

WBAN has a wide range of applications in medical science. Gait analysis, asthma detection, cancer detection, physiotherapy, brain activity analysis, etc. are some of the applications. In these applications, sensors are installed either inside or outside the body to determine the pattern of movement, to compare the result with standard data and to keep records of the physiological parameters of the patient. In this paper, it has been explained thoroughly how each of these physiological parameters are measured with the help of WBAN round the clock.

The recorded data are sent to a server where they are analyzed. These servers are the point from where the physician get access to the report of the patient round the clock. This server is called the Virtual Doctor Server (VDS). VDS performs a number of important responsibilities which includes maintaining records of patient data to build up the history of the patient, keeping track of patients' medicine timing and giving alarm to the patient to take the pills on time, giving advice to the patients assistant according to the physiological performance of the patient's body recorded by the sensors, alerting doctor or calling ambulance in time of emergency, maintaining confidentiality and privacy of patients' data records (Sghaier, et al., 2011).Patient can input his clinical feelings to the VDS system and then the VDS can give instant suggestion or advice based on the patients' history and vital signs. During this transmission, WBAN network uses various technologies namely Ultra Wide Band WBAN, Technology Enabled Medical Precision Observation 3.1 (TEMPO 3.1), ZigBee, J2ME and Bluetooth. Details of several existing WBAN related projects have been discussed in this paper along with their applications. The projects that have been discussed are Life Guard, Code Blue, Medisn, Wriscare, Mob health, WiMoCA, and Care Net (He et. al., 2013).

Biomedical sensors form a huge part of the patient monitoring system. A biomedical sensor is such an electronic device that senses, processes, sends or receives biomedical data. It has three main parts, the sensing unit, the processing unit and the receiving unit. There are micro controller units at the sensor node and a memory (RAM, ROM) to store the data (Lee et. al., 2006).The function of the sensor is controlled by software consisting of operating system. There are large varieties of biomedical sensors having separate functionalities such as electrocardiogram, electroencephalograph, etc. These sensors can be classified into in-body sensors and on-body sensors. Characteristics of each type of sensors are discussed in detail in this paper. Sensor networks have also been discussed extensively. They comprise of a large number of sensors and sink nodes and all of them are connected to each other wirelessly with the help of multi-hop or single hop communication systems. The data flows from the sensor node to the sink node which finally communicates the data to a gateway. The capabilities of the nodes vary with size, cost, battery lifetime, etc.

The security of WBAN is extremely important since it contains recorded data of patients and mishandling of such data may even cause death of the patient. The main factors affecting data security are confidentiality, dynamic integrity assurance, dependability. Security requirement is applicable to each device or communication link as data integrity, data confidentiality, authentication, availability, privacy, access control and non-repudiation. Each of these factors have been discussed in detail in this paper.

The remaining sections are organized as follows. Section II gives a brief idea about the background of WBAN along with a complete description of the process of WBAN. Section III describes the virtual doctor server which is the master server that works on the results obtained from patients body. Section IV describes the various technologies that are used in WBAN and the various ongoing projects in WBAN. Section V describes the sensors used in WBAN followed by a table showing the differences between the general sensor network and the wireless body network. Section VI is very important as it deals with

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