



## ROLE OF WIRELESS BODY AREA NETWORK IN REMOTE HEALTHCARE MONITORING

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### Abstract:

A wireless network of biomedical sensors that are installed on/in a human body senses the information signal. It is the suitable way to measure biological parameters of human body. The aim of wireless body area network, WBAN is to facilitate continuous recording and monitoring about health condition of a person and transfer it over a long-distance communication network. A sensor system is to be worn or implanted by the individuals for a long duration. This limits the size of the battery and it has made energy the most critical resource in WBAN. The parameters sensed by the individual devices are to be transferred onto a mobile phone or a tablet via wireless network. This data is then gathered, stored and then sent to the doctor for continuous monitoring of health condition. The doctor can then access the health status of patient from remote location and it helps the patient to acquire immediate treatment.

**Keywords:** Healthcare, Wireless Body Area Network (WBAN), Remote Monitoring, Biomedical sensors, Vital parameters.

### Introduction

In the modern era, the rapidly increasing health problems with enormously growing population requires health monitoring for endurance of especially elders, baby and chronically ill patients. Recently, Wireless Body Area Network (WBAN) is growing research area in the healthcare industry across the globe. The difficulty mainly concerns with the delivery of effective and efficient services to a population where chronic and acute diseases are most prevalent. Healthcare services are gradually shifted from delicate hospital care to outpatient care to home care. Home care, typically involves periodic visits by a nurse or other caregivers, and may require the maintenance of detailed records about their diet, and health. This situation results in a drastic change in the availability, accessibility and affordability of healthcare. It needs to be noted that the healthcare providers are in an advantageous position where they can use the best of technology to deliver the requirement. It would be absolutely impracticable though to think that technology alone can fulfill such a persistent need. The patient monitoring market is an expanding and profitable segment in the global healthcare industry which needs to be addressed and captured. The most of the deaths in the world causes due to Cardio-Vascular Disease (CVD, represents 30% of all global deaths. According to World Health Organization (WHO), worldwide about 17.5 million people die of heart attacks or strokes each year; in 2015, almost 20 million people will die from CVD [6].

These deaths can generally be prevented with proper health care. Worldwide, more than 246 million people suffer from diabetes, a number that is expected to rise to 380 million by 2025 [7]. In healthcare system, WBAN monitors patients suffering from chronic diseases such as diabetes to have more precise treatment of medication. Healthcare expenditure is expected to reach 20% of the Gross Domestic product (GDP) in less than 10 years, threatening the well-being of the entire economy in the US. The number of people suffering from diabetics or CVD and the percentage of people in the population age 60 years and older will grow in the future. Even without any further increase in world population by 2025 this would mean a very large number of potential customers. These statistics suggest that healthcare needs a major shift towards more scalable and affordable solutions. WBAN technology can offer the connectivity to sustain the elders in supervising their day after day life and medical condition. The Wearable sensor system for continuous health monitoring is a key technology for helping to more practicable and affordable healthcare. As per American Heart Association, treatment within first 12 minutes of cardiac apprehend brings a survival rate of 48-75%, and this rate drops to 2-4% after 12 minutes. Numerous other examples of diseases would benefit from continuous or prolonged monitoring, such as hypertension, asthma, Alzheimer disease, Parkinson's disease, renal failure, post-operative monitoring, stress-

monitoring, prevention of sudden infant death syndrome etc. WBAN can be well placed to benefit the physiological sensing applications, and bio-kinetic sensing applications are increasing, as athletes and fitness enthusiasts seek to improve human performance. WBAN can deliver the bio-feedback and interactivity necessary for the next-generation fitness and entertainment applications.

### **Challenges In Current Situation**

The health condition of each patient under treatment in the hospital has to be monitored individually. The nurse/doctor or caregiver has to keep a constant check on the health condition of each and every patient in the ward. The problem is that the doctor or nurse or caregiver cannot be present by 24\*7 on patient side. The doctor has no contact to know about the accurate condition of his patients from any remote place. In case of emergency, the doctors cannot be contacted directly in some cases hence valuable time is wasted and medication is delayed and patient under treatment may suffer. Generally a patient's data is stored manually by a nurse or caregiver and only the overview of his illness is stored at the time of his admission and discharge. All the data stored manually is interpreted virtually and accordingly medication is advised. Also, a person taking rest at home cannot be properly and continuously monitored. Remote Health Monitoring using Wireless Body Area Network will help to save the valuable time in case of emergency and provides the medication immediately that saves the life of patients.

### **Remote Sensing**

Remote Patient Monitoring is a concept that has evolved to address the issues rooting from the current healthcare dynamics. The aim to decongest ER, to reduce costs, for both insurance companies and patient, and making healthcare available to all who need it is met. The Remote patient monitoring infrastructure is an all-inclusive term that encompasses a number of high-tech applications that involve providing remote care for people. The applications can range from monitoring a person's heart rate while working out on a treadmill in a fitness club to transmitting a patient's telemetry readings to a nurse over the Internet. There is a wide variation in terms of clinical conditions that can be monitored, how often they should be monitored, and whether they should be monitored real-time or periodically. The patient requiring care is placed in a remote location, typically at home, from where he/she can connect to the wide range of

home care applications which send relevant data to a central server. This central server is in turn accessible to the referring physician who can monitor and diagnose the patient without physical presence near the patient. The action expected from the physician as a result of such monitoring is to make a clinical decision on whether the patient requires:

- Immediate hospitalization
- Urgent doctor visit
- Continuous monitoring

The judgment on which patients can be put into a continuous remote monitoring mode instead of hospitalization is also the privilege of the physician.

### **Plan of System**

The main objective of this plan is to provide easy accessibility of patient's health condition to the doctor from any remote location so that he would be able to proceed for the required actions. This will help to save the valuable seconds in case of emergency.

Several sensors are placed in clothes, directly on the body or under the skin of a person and measure the temperature, blood pressure, heart rate, ECG, EEG, respiration rate, SpO2 levels etc. [1]. Two types of sensors, wearable and implantable that are used for sensing and monitoring in WBANs. The biological parameters are the measure of knowing the health condition of patients. The wearable sensors are used to monitor several physiological parameters. The data gathered from these sensors is sent to a data accumulator. The data accumulator then forwards it to the medical server. The personal server sends out message to the doctor's mobile phone in occurrence of life-threatening circumstances through GSM network.

### **User Classes and Characteristics**

There are three Main users of the system:

#### 1. Care seeker (Patient):

The care seeker is the patient itself who is suffering from diseases. He will have body sensors attached to his body which indeed transfer vital parameter to mobile phones (android phones) over Wireless network.

#### 2. Care taker (Doctor):

He is a person who is capable of his day to day activities and assisting the care seeker. He may be a friend, family member, relative, doctor or a nurse.

#### 3. Administrator:

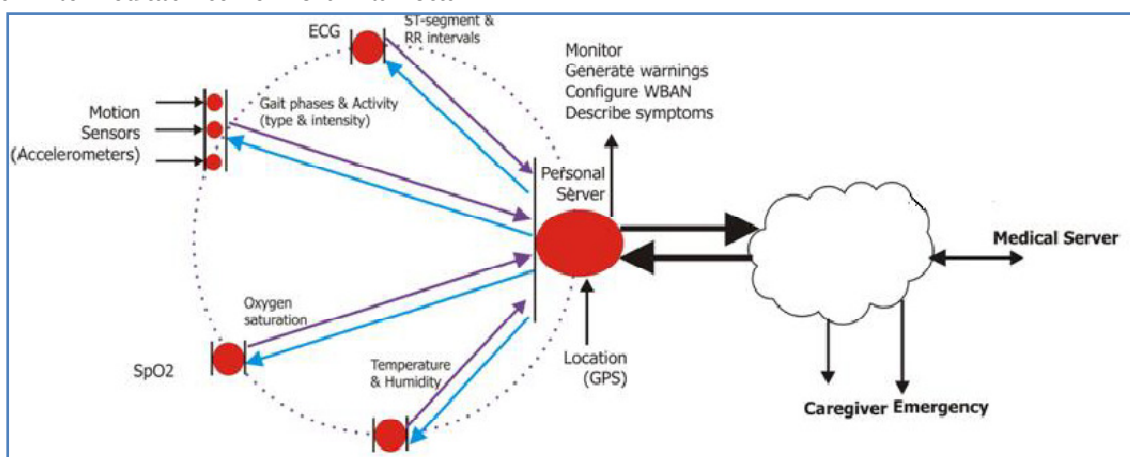
He is the one who will add new patients to the system and also add doctors to it. He is also capable of updating patient and doctor's information.

**Considration for Study**

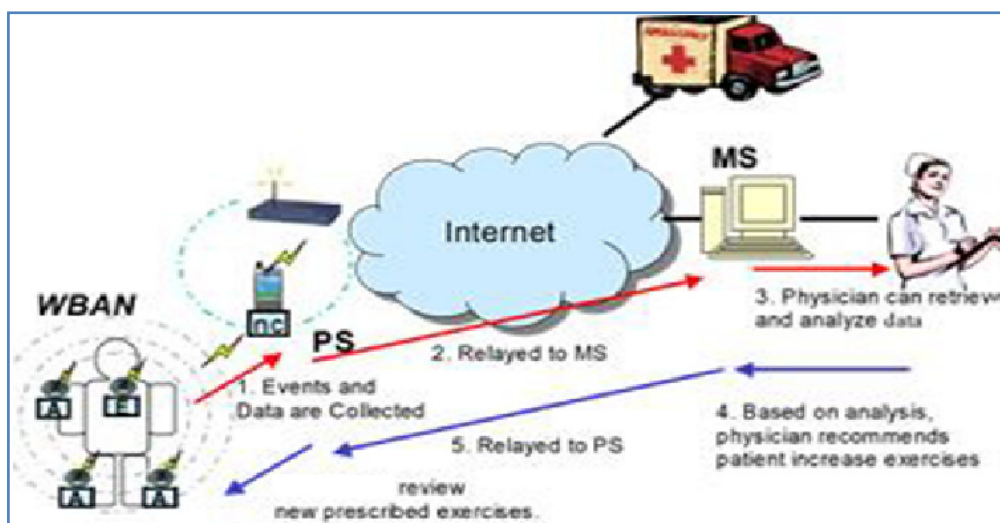
In this section we present a hypothetical case study to illustrate the usefulness of our proposed system. The patient presented is fictitious, but representative of common issues a recovering heart attack patient would face. We discuss the issues and describe how our system can be used to both address the problem and provide advantages over typical present day solutions. Assume that a patient is recovering from a heart attack. He has been under supervision at the hospital. He requires continuous monitoring as his condition is far from better. Our health monitoring system offers a solution for him. WBAN with tiny sensors provide constant observation of vital parameter statistics, estimate induced energy expenditure, and assist patient’s exercise. Tiny electronic inertial sensors measure movement while electrodes on the chest can measure heart activity of the patient. All measuring parameters of a patient are taken onto the personal server/data accumulator. These are then sent to the intermediate server over a local Wi-Fi

Network. In case the parameters are found to be critical, a message is sent onto the doctor’s phone over GSM network with the help of a GSM module. Also, a local alarm is set off to notify the nurse or any attendant present inside the ward. At the same time the parameter values are also stored in the intermediate server. The doctor can access the patient’s health condition at any given moment just by connecting to the server. This will enable him to watch Juan’s progress at any given time with the help of graphs and accordingly he can take decisions regarding medication that needs to be adopted.

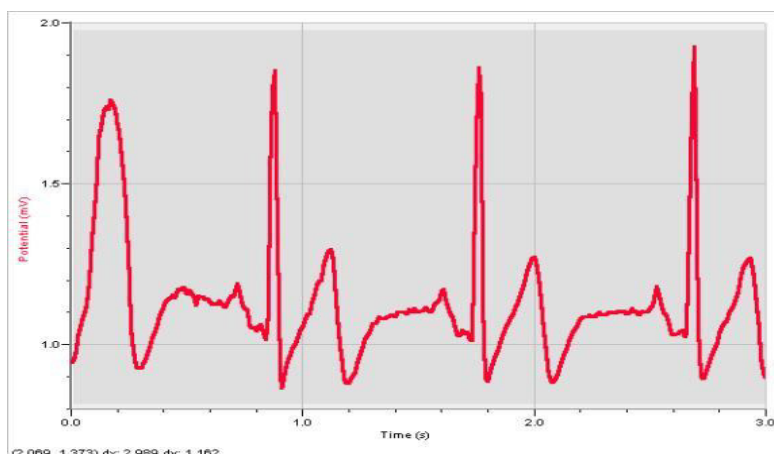
The same can be extended to home monitoring system. Let us assume that patient is being monitored from his home. Here, however, the personal server can directly contact Emergency Medical Services (EMS) if the user subscribes to this service. This cuts healthcare costs and makes better use of the physician’s time. Figure 2 illustrates this example of home monitoring while Figure 3 represents typical ECG signal.



**Figure 1.** Plan of System



**Figure 2.** System flow for home monitoring



**Figure 3.** ECG signal

### Future Scope

Another area of application can be found in the domain of public safety where the WBAN can be used by firefighters, policemen or in a military environment. QR Code (QUICK RESPONSE CODE) can be generated for profile of each patient so that the doctor can directly view the patient's profile. NFC (Near Field Communication) tags can be used so that the doctor can check all the parameters when he is on a round without contacting the server.

### Conclusion

ICT sector is going through rapid transition from fixed or land based connectivity to large bandwidth wireless communication. The wireless technology has penetrated our society. Recently the healthcare system becomes an essential requirement for health monitoring. The continuous monitoring with early detection has the potential to provide patients with an increased level of confidence, which, in turn, may improve quality of life. The continuous monitoring data into medical databases will provide the help for healthcare. The Combination of mobile high bandwidth with miniaturized sensor devices and computers will give rise to new services and applications that will affect the change in the daily life of humans. Patients provided with some form of home-based monitoring have to be hospitalized less, and when they are hospitalized, they are discharged earlier than unmonitored patients. WBAN will be able to deliver healthcare to patients in hospitals, improving the quality of life of patients. Whether the patient is in the hospital, at home or on the move, the patient will no longer need to stay in bed, but will be able to move around freely.

In remote healthcare system, patients and non-patients will be able to get medical advice from a distance called as telemedicine as if they had been taken in a medical center called 'ubiquitous medical care', which means continuous monitoring anywhere and anytime. This healthcare system is certainly helpful and valuable for human life survival.

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