Survey paper on Real Time Health Monitoring System Using Wearable Devices

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ABSTRACT

Wearable devices are now at the top of just about every discussion related to the Internet of Things. The design and development of wearable biosensor systems for health monitoring has gathered lots of attention in the scientific community and the industry during the last years. Mainly motivated by increasing healthcare costs and driven by recent technological advances in miniature biosensing devices, microelectronics, and wireless communications, the continuous advance of wearable sensor-based systems will potentially transform the future of healthcare by enabling active personal health management and global monitoring of a patient's health condition. These systems can contain various types of small physiological sensors, transmission modules and processing capabilities, and can thus ease low-cost wearable ordinary solutions for continuous all-day and any-place health, mental and activity status monitoring. Recent technological advances in sensors, low-power integrated circuits, and wireless communications have implied the design of low-cost, tiny, lightweight, and intelligent physiological sensor nodes. These nodes are capable of sensing, processing, and communicating one or more fundamental signs, can be effortlessly integrated into wireless personal or body networks for health monitoring. These networks promise to change health care by allowing inexpensive, non-invasive, continuous health monitoring with almost real-time updates of medical records via the Internet.

KEYWORDS - biosensors, microelectronics, non-invasive

I. INTRODUCTION

M-Health can be described as mobile computing, medical sensor, and communication technologies for health-care. This emerging concept represents the evolution of e-health systems from traditional desktop “telemedicine” platforms to wireless and mobile configurations. Current and emerging developments in wireless communications integrated with developments in pervasive and wearable technologies will have a radical impact on future health-care delivery systems. Wearable devices can monitor and record real-time information about one's physiological condition and motion activities. Wearable sensor-based health monitoring systems may comprise different types of flexible sensors that can be integrated into textile fiber, clothes, and elastic bands or directly attached to the human body. The sensors are capable of measuring physiological signs such as electrocardiogram (ECG), electromyogram (EMG), heart rate (HR), body temperature, electrodermal activity (EDA), arterial oxygen saturation (SpO_2), blood pressure (BP) and respiration rate (RR). In addition, micro-electro-mechanical system (MEMS) based miniature motion sensors such as accelerometers, gyroscopes, and magnetic field sensors are widely used for measuring activity related signals. Continuous monitoring of physiological signals could help to detect and diagnose several cardiovascular, neurological and pulmonary diseases at their early

onset. Also, real-time monitoring of an individual's motion activities could be useful in fall detection, gait pattern and posture analysis, or in sleep assessment. The wearable health monitoring systems are usually equipped with a variety of electronic and MEMS sensors, actuators, wireless communication modules and signal processing units. The measurements obtained by the sensors connected in a wireless Body Sensor Network (BSN) are transmitted to a nearby processing node using a suitable communication protocol, preferably a low-power and short-range wireless medium, for example, Bluetooth, ZigBee, ANT Near Field Communications (NFC).

To reduce costs and the anxiety of people with known cardiovascular problems we propose a portable monitoring system that monitors the heart and notifies the person or external party in case of abnormalities. Our monitoring system is meant for patients that have a known cardiovascular disease and need to be monitored around the clock.

Fig 1: Wearable devices

Fig.1[4] shows some wearable devices which can detect the changes in heartbeat of a person wearing it. These devices have different applications. Four popular motion tracker wearable devices wrist worn.

II. HEALTH MONITORING SYSTEM

The health care sensors are playing an essential role in hospitals. The patient monitoring system is one of the major developments because of its innovative technology. An automatic wireless health monitoring system is used to calculate patient's body heat and heartbeat by using embedded technology. The proposed system makes use of both the sensors like heartbeat sensor and temperature sensor. These sensors mainly consist of monitoring the condition of the patient.

III. ARCHITECTURE

The objective is to examine and develop an application where a heart patient is monitored using various types of sensors (ECG, accelerometer, oximeter, weight scale, blood pressure monitor). The sensor information is collected and received by smart phone wirelessly. The solution proposed resolves the ECG and other sensor data on the local device. The heart patient has one or more sensors (e.g. ECG) attached to his/her body. External devices are used, such as a blood pressure monitor or weight scale, to collect regularly health data. The smart phone analyses the sensor data and monitors the patient's comfort, and automatically calls an ambulance to the location of the patient in case of an emergency. It can also warn family members via SMS or phone when the patient is in difficulty.

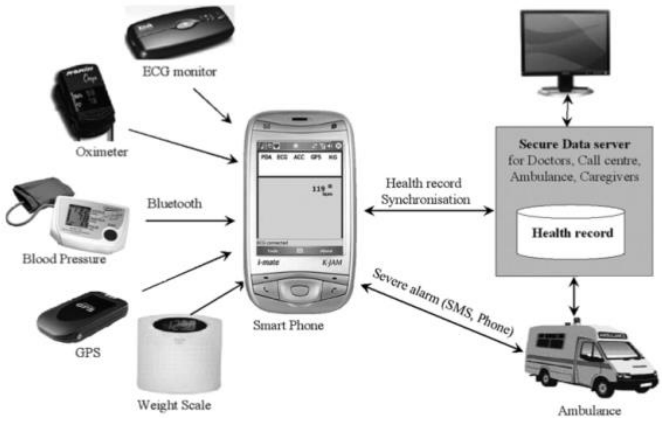

Fig 2: Personalized heart monitoring architecture

Fig.2[5] shows the real working of wearable devices. In the above figure it is shown that whenever there is an emergency message will be sent to an ambulance and family members too. All the data of patient is also recorded so that it can be used in future.

a. Sensors and Smartphone functionalities

Data from each sensor is fetched and processed in the smart phone to create analysis. For high risk cardiac patients the ECG signal is the obvious data that needs to be gathered continuously and should be given main concern over all other sensor data. It is also important to lay up the ECG signal for further analysis by the cardiologist. The altitude of physical activity recommended for a heart patient depends on his/her health condition and health history.

The system also uses a Bluetooth enabled blood pressure monitor and weight scale from A&D Medical [2]. For developing cardiovascular diseases high blood pressure is also important risk factor [1] and regular monitoring is required. Being overweight or obese or having high cholesterol level can contribute to developing cardiovascular diseases and for some heart patients monitoring their weight is chief.

In smartphones the application in them receives the results from the sensors and checks whether an alarm should be ringed. The results of the sensors can be incorrect due to noise and incorrect readings. The monitoring system is only useful if the system knows the quality of the data it receives from the various sensors and the quality of the analysis based on that data. Knowing the quality level system can put mechanisms in place to pay off for the lack of accuracy of certain sensors or get advice from the patient to confirm a diagnosis.

The user can stop the alarm in case of a false alarm. If the user does not respond within a certain time (currently 30 seconds) an emergency call is involuntarily placed. This feature is included since many patients black out or undergo speech and swallowing problems at the time of a heart attack [1]. Moreover, it is important to provide accurate but yet non-devastating information to the patient since this should not cause extra anxiety which would make the situation worse. For this cause system do not show an ECG diagram to a patient since it is learned from discussions with cardiologists that this is a major source of worry, nervousness for cardiac patients. The smart phone application stores organization data and sensor readings in a local database. Depending on the condition of patient, the specialist can constitute one or more sensors to be used to monitor the patient. The organization section is password protected and is only accessible by a medical specialist. An expert determines which sensors should be used and configures the monitoring frequency and threshold levels for each sensor. For example some cardiac patients need to examine their glucose level, whereas others need to examine their weight and blood pressure. Also threshold levels for raising an alarm differ depending on the patient's age and situation.

b. Heart monitoring

The ECG sensor is the most vital component of architecture. ECG signals can be a source of faults which makes it hard to understand arrhythmia correctly. System focuses on two life frightening arrhythmias: Ventricular Fibrillation (VF) and Ventricular Tachycardia (VT). VF is a deadly arrhythmia characterized by rapid, chaotic movements of the heart muscle that causes the heart to stop functioning and leads rapidly to cardiac arrest. VT is an atypical heart beat usually of the rate 150-200 beats per minute. VT may effect in fainting, low blood pressure, shock, or even abrupt death. To detect these arrhythmias system have implemented a beat detection and classifier algorithm as well as a VT/VF revealing algorithm for the smart phone. For the patient to have a chance to live VT/VF, a defibrillator should be applied within 5 minutes. The system detects a VT/VF onset and calls emergency services/caregivers/bystanders within 30 seconds. It therefore increases the possibility that help can be given in time.

c. Fall Detection

In order to accurately detect a fall system needs to standardize the accelerometer. When a patient has attached the monitor to the body he/she will be asked to stand up. This will set the accelerometer to the upright position and after acceleration the algorithm can decide whether a fall has occurred based on the current position of the patient (e.g. horizontal, bent down). Accelerometers are commonly used to monitor human body activity. It has implemented an algorithm developed by Brown [3]. This algorithm uses a state-machine that checks data from a 3-axis accelerometer worn on a waist belt.

d. Location Detection

The system can use GPS to determine the location of a patient in case- of a tragedy. However GPS is only useful outdoors and in clear sight of GPS satellites. Many heart patients will spend most of their time indoors and in order to mechanically determine the location we use WiFi and GSM as a way to decide the location. Since GSM Cell id and WiFi access points are not automatically linked to a location, the user has to relate a specific location with the WiFi/GSM Cell data.

e. Emergency

In case of an emergency the application shows the alarm screen and plays a noisy recorded message notifying the user. The user can stop the alarm in case of a false alarm. Otherwise a first aid message is played constantly on the smart phone instructing (potential) bystanders what to do in case the patient is not capable to speak. Simultaneously an emergency call is sited automatically by the application.

f. Current Status

The apparatus described in this section are fully efficient. For the heart monitoring, the system is now focusing on improving the VT/VF algorithm to increase the sensitivity and specificity levels as well as developing better algorithms to detect premature signs resulting to a heart attack. For fall detection, system is investigating the use of two-way audio webcams to verify the fall and being able to interact with the patient while at home.

IV. CONCLUSION

This paper described a modified health monitoring application using a smart phone and wireless (wearable) sensors. System is able to sense life frightening arrhythmias locally on the smart phone and, if the patient is in threat, he/she can contact an ambulance automatically. In normal conditions, the system monitors and records the sensor data for inclusion in the patient health record which is used for further testing by an expert. This system is considered with personalization in mind. The heart specialist can select one or

more sensors to be used for a particular patient and configure the equivalent threshold levels for that patient. System application generates alarms or warnings when thresholds have been crossed. It practices ECG and other sensor data locally on the smart phone, therefore system is able to manage a patient without being continuously connected to a health-centre. This reduces the workload of medical staff, communication costs and encourages the patient's self-care. The resolution is meant to check the patient constantly and an issue is the battery life of the used devices. The life of ECG sensor battery is of approx 60 hours. The smart phone's battery only lasts for approx eight hours when constantly connected to the ECG Bluetooth device which can be an issue if the wearer is not close to the charger (less than 10 meters). However studies show that a lot of heart patients are inactive and can therefore charge the smart phone while being monitored. Our target audience is patients that have had a heart attack, or are at high jeopardy. It is learned from discussions with cardiologists that these patients are anxious that a heart attack will occur again. They are motivated to wear a device that can monitor and assure them and intrusiveness seems not to be an issue for these patients. It is believe that the system is a step towards promoting patient's independence and by providing personalized monitoring and advice the hope is that it will give the patients more confidence and improve their quality of life.

V. REFERENCES

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