Asian Journal of Engineering and Applied Technology
ISSN: 2249 - 6300 Vol. 3 No. 1, 2014, pp. 22-26

Healthcare Measurement of ECG and Body Temperature Signals Using Android Mobile

V. Navaneethan[1] and R.Kavitha[2]

[1]M.E, IIISEM, Department of Software Engineering, [2] Assistant Professor, Department of CSE, University College of Engineering (BIT Campus), Tiruchirappalli, Tamil Nadu, India

E-mail: .....

(Received on 03 March 2014 and accepted on 05 June 2014)

***Abstract* - This project is a step towards the preventative healthcare for cardiac patients. It seeks to develop a smart mobile ECG monitoring system that continuously monitors what is happening around the subject when an arrhythmia event occurs. The problem we are facing now is the unexpected death of our loved ones because of the sudden heart attack. Because of the changing life style the heart attack rate is increasing day by day. The current heart attack death rate is about 25% of the total deaths in India. The main cause of heart attack death is the lack of medical care at the right time. This problem can be avoided by this project. Here I am presenting an android based portable ECG monitor. The patient will be wearing a small device which senses the ECG data. It will send the sensed data to the patient's Android mobile through Bluetooth. The Android mobile will be having an application which will be running a heart attack detection algorithm. If any abnormalities are found the patient will be notified through an audible alarm and first aid techniques will be shown to the patient in the phone's display. This first aid instruction will increase the chance of survival of the patient. A report of the ECG will be send to the patient's doctor through email so that he can prepare himself for the treatment. And also a sms containing patient's location (gps data) will be send to the hospital so that help can be given at the earliest even if the patient is travelling. The goal is to provide early heart attack detection so that the patient will be given medical attention within the first few critical hours, thus greatly improving his or her chances of survival.**

***Keywords :* Electrocardiography, GPRS, Global Positioning System, EEG**

I. Introduction

Electrocardiograms (ECG) have long been used in the hospital environment to diagnose cardiac arrhythmias and screen for heart disease. However, patients had to be tethered to the ECG machine by a few feet of wire [1].The mobile wireless ECG system is an electrocardiogram with wireless ECG system is an electrocardiogram with wireless data transmission capabilities. With this invention patients can now move freely around their environment, allowing their caregivers to easily monitor the patient's status at any location.

The monitoring of vital physiological signals has proven to be one of the most efficient ways for continuous and remote tracking of the health status of patients. Electrocardiogram monitors are often used in many medical service centers and hospitals to diagnose and monitor a person's health status by measuring their cardiac activity. An ECG is a non-invasive monitor, which can be utilized to evaluate the heart electrical activity, measure the rate and regularity of heartbeats, the position of the chambers, identify any damage to the heart and investigate the effect of drugs and devices used to regulate the heart. This procedure is very useful for monitoring people with (or susceptible to) impairments in their cardiac activity. In addition, during surgical procedures, the electroencephalogram (EEG) is measured along with his/her ECG to track the consciousness level of a patient during anesthesia [2]. Other physiological parameters such as oxygen saturation in hemoglobin, electromyography and blood pressure similarly provide vital information about the health of a given person when continuously monitored.

The goal of our project is to design and fabricate a Android based portable ECG monitor to help eliminate the restrictions caused by lead wires in conventional systems used in hospitals by permitting the acquisition and wireless transmission of a signal from sensor to recorder. In hospitals, my device allows a patient's vital signs to be kept track of at all times despite his/her proximity to a bedside monitor.

The device will be battery powered, double insulated and isolated. Audio and visual alarms will also be implemented into the device (Android mobile) in order to warn the user when a measured parameter reaches a critical level. Furthermore it will show the first aid details on the screen.

Problem Statement

Using current electrocardiograms in hospitals can be a time-consuming and unsanitary task [5]. Connecting and disconnecting ECG leads from hospital room to hospital room takes up valuable time that nurses could be using to focus on the patient's ailment. Changing wires also introduces bacteria to the patient, further increasing the risk of infection.

During a heart attack, heart muscle is depraved of oxygen and will literally die if the artery remains blocked. The first few hours are critical in saving much of the dying heart muscle and preventing permanent heart damage. Unfortunately, the symptoms vary and the most common reason for critical delays in medical treatment is lack of early warning and patient unawareness. It is possible to detect the onset of a heart attack and eliminate patient error using this project.

The current systems are very heavy and very costly. Thus a patient can't carry it with him all the time while he is doing his work. The current systems which have automatic diagnosis will cost more than 75K.

Motivation

The number of deaths caused by heart attacks is about 25% of the total deaths in India. This occurs due to the delay in detecting the symptoms or lack of early diagnosis. This can avoided by integrating the mobile computing technologies with healthcare systems. Which will lead to the detection of abnormal heart rhythms and predict heart attack before it occurs.

Project Objective

Project objective is to develop a Portable ECG monitor that will continuously monitor the ECG. It will notify the user and the doctor through email if any irregularities occur. If the signal is above the critical threshold then it will generate alarm and it will also send the GPS location to the hospital so that help can be provided at the earliest. This project will allow a patient to move freely and at the same time can be monitored continuously.

II. Literature Survey

Currently there are a few mobile electrocardiograms being implemented. But they do not have any automatic detection method to diagnose illness. Whenever heart discomfort occurs patient have to press a button which will lead to the generation of ECG and will be send to the physician who have to manually interpret the ECG[6].

Other device in market is Zenicor-ECG [7], here the patient have to take reading at regular intervals and the doctor have to manually detect the variation in heart rhythm. The readings are user initiated and the data will be send to a database. The doctor has to manually check the database and then only the problem can be diagnosed. If the more number of patients are using Zenicor-ECG it will take a lot of time for the doctor to check the report and the checking interval will increase as the number of patient's increases.

The OMRON HCG-801[8] can record and store electrocardiogram (ECG) measurements of your heart rhythm. Each ECG reading records an approximately 30-second measurement and these ECG readings can help your doctor monitor your condition. The monitor is supplied with an SD memory card that can store up to 300 measurements, including the ECG data along with the date and time of measurement. The main disadvantage of this is it doesn't have leads that attach to the body the device has to be kept in a particular angle in order to get correct measurement otherwise the data acquired will be not accurate and will lead to wrong diagnosis. And also it doesn't have wireless capabilities so the patient has to physically carry the device to the doctor in order to diagnose the problem.

The Ambulatory Data Acquisition System (ADAS) is composed of the recorder base (Fig.1) and the signal input module. The recorder base acquires signals from twelve sensors through the signal input module. This can measure ECG, body position, limb position, heart rate, blood pressure, skin temperature, respiration and skin conductance level. After the sensors pick physiological signals, they are processed, displayed, saved and transmitted to a HRF portable computer (PC), which allow the users to setup the recorder base and view the signals [9].

The mobile device is previously programmed to complete the connection to Bluetooth module by using the information about MAC address. Once the application ”Receptor SenalesBiomdicas” connects the transmitter, data reading process starts. In the application the user can select the type of signal to visualize (Fig 2.).

The Life Sync Wireless ECG System is an innovative method for monitoring a patients ECG without the attachment of any data cable between the electrodes and the monitor. This device (Fig.1) is composed of a patient transceiver, which acquires the bio potential via leads attached to 3 or 12 electrodes placed on the subject’s skin. This unit is usually worn on the arm. Once, the signals are acquired, they are amplified and wirelessly transmitted using a Bluetooth module embedded in this first unit to a secondary unit, the monitor transceiver. The monitor transceiver is connected via input cables to a conventional monitor which then processes the signal as usual: numerical display of heart rate, graphical display of waveform, etc. [10].

The two units together make up for a small very low weight system (i.e. patient transceiver has dimensions of 8 x 12.5 x 3 cm and weight of 240 g) that allows its users more freedom of movement without jeopardizing continuity of ECG monitoring. It also, eliminates the need for detaching and reattaching lead wires when a patient needs to be transported [11]. The absence of heavy obstructing cables also reduces the amount of noise that interferes with the signal displayed on the monitor as a waveform. The main disadvantage of this is its just act as a wireless sensor and nothing else. It can’t display the ECG nor it cananalyse it. It still needs a general and heavy ECG monitor which weighs more than a kilo.

III. System Design

Proposed solution

The proposed prototype is a portable ECG monitor based on android. A patient will wear the mobile ECG monitor that gathers heart rhythm data and transmits it wirelessly to an android phone for storing and analysis. The android phone will be running detection algorithms to automatically detect abnormal variations in heart rhythm. Since the android is based on Linux it will be easy to port it to other Linux based platforms like PC or PDA etc.

The detection of abnormal heart rhythm will be performed by the android phone which can be achieved by introducing a new detection algorithm using the possibilities of image processing. If any abnormal event occurs it will send an SMS to the ambulance which will be containing the patient’s location (GPS data) which will help the ambulance to reach faster. And a copy of the ECG will be send to the physician through GPRS so that he can make necessary arrangements. The overview of the proposed system is shown in Fig.4.

Advantages

- Automatic detection of heart attack
- Alert the user and tells him how to perform first aid
- Alert the ambulance service along with the location
- Alert the physician so he can prepare for the treatment

Disadvantages

- Unavailability of networks leads to failure in alerting ambulance and doctor
- Using Bluetooth power consumption will be more

IV. Methodologies

Proposed system overview is shown in Figure 4. A circuit will be worn by the user which will be connected to the android phone using Bluetooth connection. Android phone will process the signals. Detailed description of the sender and receiver is specified below.

At the sender (ECG monitor)

Figure 5 shows the function of sender that is the circuit worn by the patient. Sensor leads will detect the weak electric signal generated by the beating of the heart. The weak electric signal will be amplified by amplifiers. Then the resulting amplified signal will be send to the receiver.

At the receiver (Android phone)

Receiver function is shown in figure 6. The receiver receives the data send by the circuit and it will display the ECG in its screen.

At the same time the application will calculate the values and it will compare it with the threshold. If the calculated value crosses the threshold value then three alarms are raised.

First alarm is for the user which will inform the user that he is going into a cardiac arrest and it also includes instructions for first aid.

Second alarm is for the ambulance driver in the form of an SMS. This SMS includes the location of the user so that he can be taken to the hospital with less time.

The third alarm is for the doctor in the Form of an E-MAIL which contains the ECG signal. The doctor can make the necessary arrangements before the patient is brought to the hospital hence saving the time and will increase the chance of patients survival.

Modules

The major components of the system are the software at the receiver part (Android phone) and the hardware circuitry at the sender part. The software part consist of the algorithm to detect heart attack, warning alarm, sending report to email and location to mobile.

Figures

The hardware at the sender consists of the sensors, Bluetooth module, noise reduction circuit, battery etc.

V. Conclusion

An effective heart attack detection system is proposed in this project. It helps to reduce deaths caused by heart attacks since the main cause of heart attack deaths are due to delay in proper treatment. This can be avoided since the system will notify the doctor with ECG report and his present location.

Since the android is based on Linux it will be easy to port it to other Linux based platforms like PC or PDA etc.

VI. Future Work

This idea can be further modified to add biometric authentication using ECG. The problem of remembering password can be avoided.

The circuit can be modified in such a way that it can be implanted on the body.

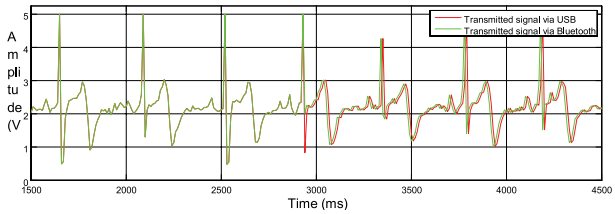
The algorithm can be expanded to detect additional heart ailments.

Fig.1 The base recorder of ADAS

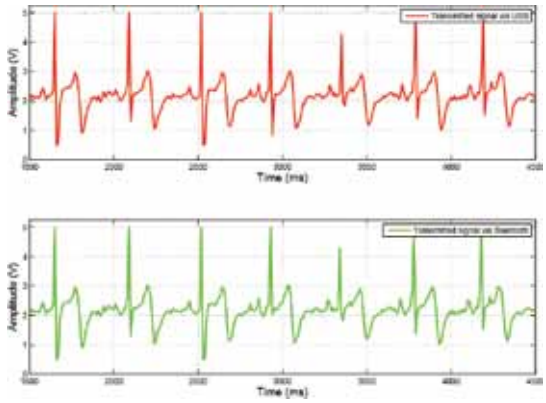
(a) (b) (c)

Fig. 2.Bluetooth linking. (a) Searching. (b) Localizing. (c) Connection.

Fig. 3.Visualizing Menu.



Transmission Delay between Bluetooth and USB Wired Signals.



Signals obtained by Bluetooth and Signal Wired Cable.

Fig 4. Proposed system overview

Fig. 5 Sender (ECG monitor) Architecture

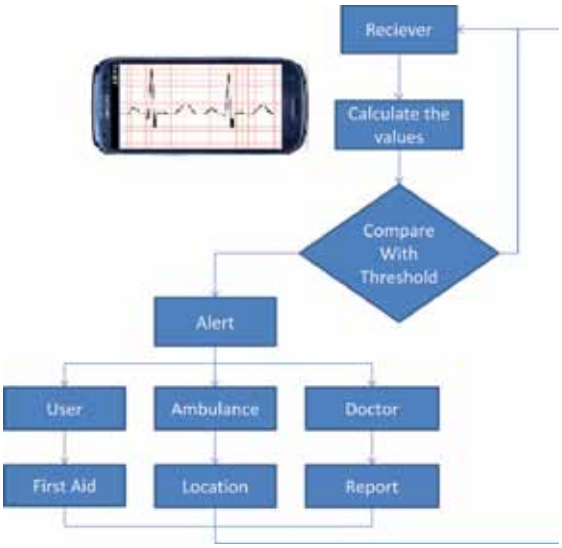


Fig. 6 Receiver (Android phone) Architecture

References

[1] J.R.C. Chien and C.-C. Tai, "A new wireless-type physiological signal measuring system using a pda and the bluetooth technology," *Biomedical Engineering Applications, Basis and Communications*, vol. 17, no. 5, pp. 229–235, October 2005.

[2] O. Krejcar, D. Janckulik, L. Motalova, and K. Musil, "Real time processing of ecg signal on mobile embedded monitoring stations," *Second International Conference on Computer Engineering and Applications*, 2010.

[3] Y. M. Lee and M. Voghavvemi, "Remot heart rate monitoring system based on phonocardiography," *Student Conference on Research and Development Proceedings, Shah Alam, Malasya*, 2002.

[4] S. Khoor, J. Nieberl, K. Fugedi, and E. Kail, "Telemedicine ecg telemetry with bluetooth technology," *Computers in Cardiology*, 2001.

[5] D. R. Zhang, C. J. Deepu, X. Y. Xu, and Y. Lian, "A wireless ecg plaster for real-time cardiac health monitoring in body sensor network," *Biomedical Circuits and Systems Conference (BioCAS), IEEE*, 2001.

[6] Z. Whittaker, "Nielsen: Smartphone owners surpass 50 percent mark," Available on http://www.zdnet.com/blog/btl/nielsen-smartphone-ownerssurpass-50-percent-mark/76347, May 2012.

[7] D. Melanson, "comscore report finds 42 percent of us mobile users have smartphones, android at nearly 50 percent," Available on http://www.engadget.com/2012/02/23/comscore-report-finds-42percent-of-us-mobile-users-have-smartph/, February 2012.

[8] T. K. Kho, R. Besar, Y. S. Tan, K. H. Tee, and K. C. Ong, "Bluetooth enabled ecg monitoring system," *Faculty of Engineering and Technology, Multimedia University (Melaka Campus), Jalan Ayer Keroh Lama, 75450 Melaka, Malasya*, 2005.