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Research Paper

DESIGN OF ELECTRO CARDIO GRAM BASED ON MOBILE SYSTEM

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In the increasing busy world people hardly have time to concentrate on their health and there is ever increasing needs for devices that can help people monitor their health without having to waste a whole day to visit a hospital. A similar need exists for a device that can take the ECG of an individual at home or any place out of a hospital .This project involves the development of one such device that can record the ECG of a person very easily without requiring much time. In an increasingly busy world people hardly have the time to concentrate on their health and there is ever increasing needs for devices that can help people monitor their health without having to waste a whole day to visit a hospital. A similar need exists for a device that can take the ECG of an individual at home or any place out of a hospital. This project involves the development of one such device that can record the ECG of a person very easily without requiring a hospital setup or a doctor's presence. This device can be used to record ECG even in emergency situations when a doctor cannot be reached. Also this device can be very useful because the ECG can be recorded whenever the patient feels that there is a problem, thereby making the recording even more useful. The idea behind the project is to make it a very low cost device so that all the common people can use it. Hence in the project an android based device will be used to do a significant part of the project which record the ECG signal. Android based device like a smart phone can be used for this purpose. Once such an ECG signal is recorded in the android device it can be sent as a MMS or even as an email attachment to a doctor or a hospital for analysis of the ECG signal. On the doctors side the Doctor can use a PC or a Laptop to see the recorded ECG signal and for seeing the signal a lab view based virtual instrument can be used by the doctor. Hence this project can eliminate the hassle of making an appointment with a doctor, visiting a hospital and missing a day just for the ECG analysis. Also since the ECG can be taken at the exact time when the patient is experiencing some problems, this will make the signal more accurate and useful for detection of any serious problems

Keywords: Electrocardiography, android, MMS, EMAIL

INTRODUCTION

ECG is a continuous record of voltage changes as a result of physiological changes occurring in the heart muscles. It usually recorded from the

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skin using electrodes that are connected to a galvanometer (surface ECG). It can also be recorded by positioning electrodes in the oesophagus in the chambers of heart or directly from myocardium (transesophagial ECG). Surface ECG is the simplest and least expensive technology for diagnosis of cardiac diseases [1]. One of the important considerations in the ECG acquisition is the bandwidth requirement. For a clinical 12 lead ECG, the band width is 0.05-100Hz however for intensive care patients and for ambulatory recordings the bandwidth is 0.5-50Hz only. This is because for ICU patients the more important is the rhythmic disturbances. Various ECG systems have been developed. They can be classified into following categories, namely conventional 12 -lead ECG systems, body surface mapping systems (BSM), vector cardio graphic (VCG) systems, and Ambulatory ECG monitoring [2]. Conventional 12-lead ECG systems use 10 electrodes on the patient's body to form 12 leads. In clinics it is this 12 lead ECG system which \is used and cardiologists are well trained to read these ECGs. Because of this reason a huge number of ECG systems are using 10 electrodes and placement configuration which are further discussed in this paper. Electrocardiographic body surface mapping (BSM) is a technique that uses a number of leads (generally 80 or more) to detect electrical activity of the heart. BSM systems generally consists of an 80-lead (made from 32 to 212 electrodes) disposable electrode array in the form of a sleeveless garment (vest), that includes a conducting gel. This gel is applied to the subject s chest and back. This system displays clinical information in three forms; a 3-D torso image, an 80-lead single beat view, and the 12-lead ECG. The torso images are said to allow the specialist to rapidly scan the heart for significant abnormalities. However, the complexity of the placement of these electrodes on the human body in BSM systems hinders their wide employment in the clinical environment. In VCG systems body surface potentials are obtained that are used to generate a three dimensional vector model of the cardiac excitation. Based on a hypothesis that the electrical activity of the heart can be represented by a stationary dipole, the potentials recorded at the three leads are proportional to one rectangular component of the assumed heart dipole vector [3].

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.

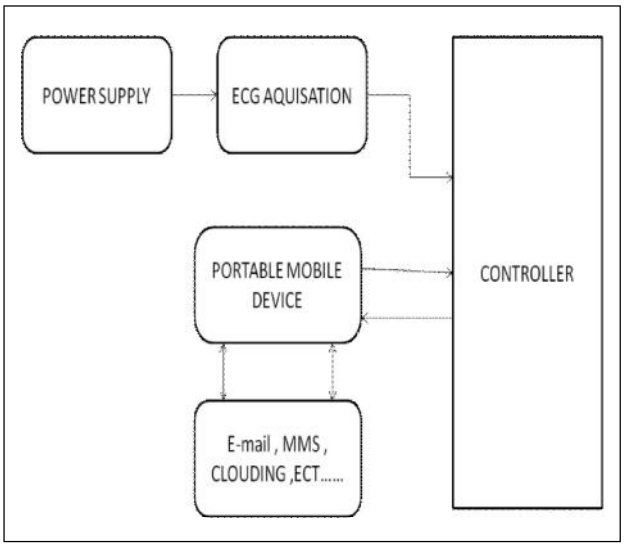
LITERATURE SURVEY

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 patients 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

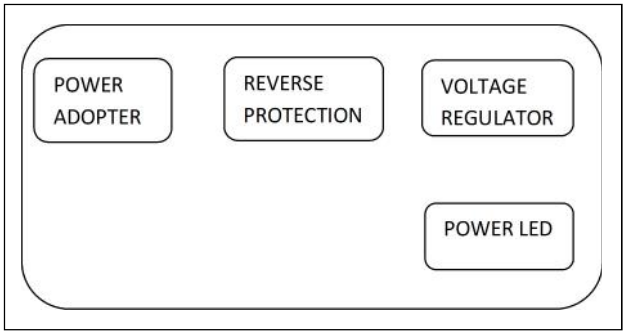
BLOCK DIAGRAM

The block diagram consist of the four segments

1. Power supply.
2. ECG Acquisition.
3. Controller.
4. Mobile platform.



1. Power Supply



2. ECG Aquisation

Heart Beat Sensor

Heart beat sensor is designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heart beat. This digital output can be connected to microcontroller directly to measure the Beats Per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse. The data which we get is in analog form

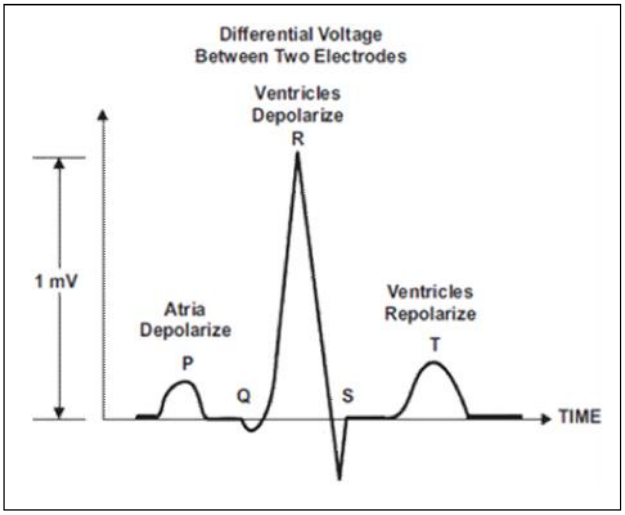
Heart Beat Measurement

Pulse Measurement

Your pulse is the rate at which your heart beats. Your pulse is usually called your heart rate, which is the number of times your heart beats each

minute (BPM). However, the rhythm and strength of the heartbeat can also be noted, as well as whether the blood vessel feels hard or soft. Changes in your heart rate or rhythm, a weak pulse, or a hard blood vessel may be caused by heart disease or another problem .As your heart pumps blood through your body, you can feel a pulsing in some of the blood vessels close to the skin's surface, such as your wrist, neck, or upper arm. Counting your pulse rate is a simple way to find out how fast your heart is beating .Your doctor will usually check your pulse during a physical examination or in an emergency, but you can easily learn to check your own pulse. You can check your pulse the first thing in the morning, just after you wake up but before you get out of bed. This is called a resting pulse. Some people like to check their pulse before and after they exercise .You check your pulse rate by counting the beats in a set period of time (at least 15 to 20 seconds) and multiplying that number to get the number of beats per minute. Your pulse changes from minute to minute. It will be faster when you exercise, have a fever, or are under stress. It will be slower when you are resting. The pulse rates can also be measured at any point on the body where an artery's pulsation is transmitted to the surface - often as it is compressed against an underlying structure like bone - by pressuring it with the index and middle finger. The thumb should not be used for measuring another person's heart rate, as its strong pulse may interfere with discriminating the site of pulsation. Some commonly palpated sites include:

1. The ventral aspect of the wrist on the side of the thumb (radial artery)
2. The ulnar artery
3. The neck (carotid artery),
4. Behind the knee (popliteal artery)
5. Over the abdomen (abdominal aorta)
6. The chest (aorta), which can be felt with one's hand or fingers. However, it is possible to auscultator the heart using a stethoscope.
7. The lateral edge of the mandible

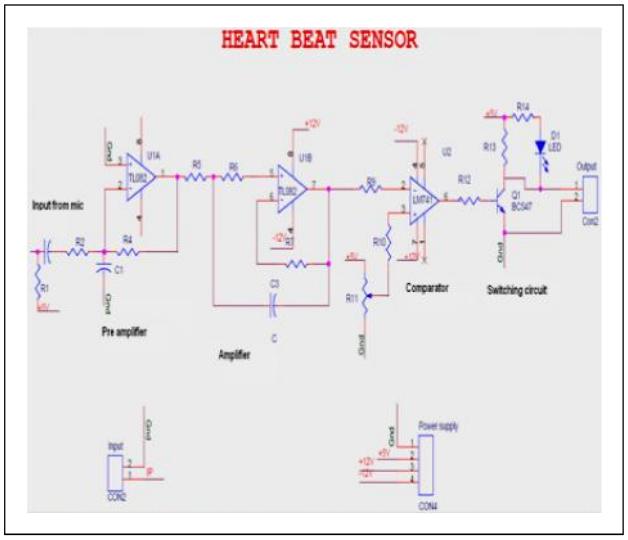


A more precise method of determining pulse involves the use of an electrocardiograph, or ECG (also abbreviated EKG). Continuous electrocardiograph monitoring of the heart is routinely done in many clinical settings, especially in critical care medicine. Commercial heart rate monitors are also available, consisting of a chest strap with electrodes. The signal is transmitted to a wrist receiver for display. Heart rate monitors allow accurate measurements to be taken continuously and can be used during exercise when manual measurement would be difficult or impossible (such as when the hands are being used).Here we have designed the circuit which is able to pick up the heart beat and give the pulsated signals in output. We can use that pulsated output to the microcontrollers.

CIRCUIT DIAGRAM

The circuit diagram consist of the four

segments.The signal which can be obtained from the sensor can be amplified to certain voltage level. After that the signal can be given to the operational amplifier. Then the signal form the sensor can be given to the comparator, the comparator compare the signal to the reference signal. Then the signal is given to the switching circuit. The switching circuit switches when the corresponding signal is given appropriate output is seen.



The circuit diagram consist of the four segments

i. pre-amplifier,

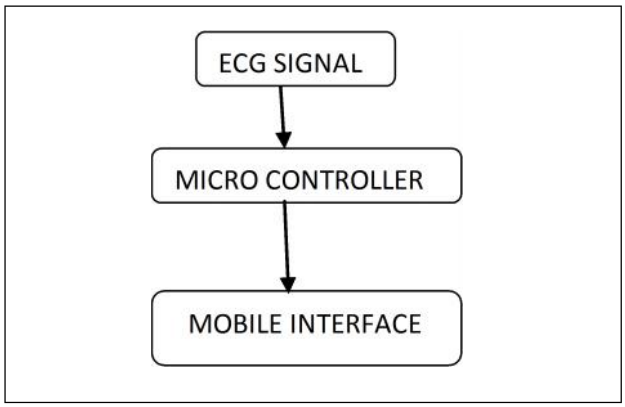
ii. operational amplifier,

iii. comparator,

ECG SIGNAL

Mobile Interface With Controller

There are large number of recognition algorithms used in ECG-analysers and, in many cases, the principles of operation vary. We have implemented the Pan-Tompkins real time QRS detection algorithm. As shown in this algorithm uses filtering, differentiation, signal squaring and time averaging to detect the complex. After



R peak detection in QRS complexes the heart rate is computed in terms of BPM (beats per minute) from no of R peaks detected per minute.

Analog Front End

This section discusses the design of analog front end whose function is to pick analog ECG signals and transmit them to microcontroller after some basic filtering. This is the most critical portion of ECG measurement since the detection and filtering of raw ECG signal completely depends upon the components used and design so as to reduce the noise associated with ECG signal. The front end is divided into 4 stages each with a specific function to reduce the noises mentioned above. The gain of the stages must be so that the noise offered by amplifiers is minimum. Noise figure of cascaded amplifier referred to input is given as

Hardware Required

1. ARM LPC11U67 / PIC 18LF45K22
2. ECG Electrodes
3. PC / Laptop
4. Android based Device
5. Signal conditioning circuit.

Features

1. Most effective portable ECG device.
2. Bluetooth connectivity.
3. Faster interfacing of device with smart phone.
4. Very handy on android platform.
5. Faster access from mobile to mail or remote device.

Result

The proposed application for mobile android mobiles the screen shots of user interface for application installed on mobile phone. We tested our system by placing the electrodes to a subjects chest and mobile phone in his hand. The subject was allowed to move freely with the acquisition device and the processing mobile phone kept together within the radio range. Fig. 5 shows the mobile user interface receiving ECG data samples from the acquisition device. shows the mobile phone display of a trace of ECG signal for 5.6 seconds that was sampled at 500 Hz. It also shows the QRS complex detected and heart rate .here the proposed system was very easy and can be portable

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