

# ECG Monitoring on Android Smart Phone

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## Abstract

The Cardiovascular Disease (CVD) is the leading cause of death in the world. Due to the changing life style heart attack rate is increasing day by day. In India, current heart attack rate is about 25%. The main cause of heart attack is a lack of medical care at the right time. To avoid this there is a need of regular checkup of health. In some cases it might be required to monitor ECG frequently. But it is not possible due to the high cost of healthcare equipment as well as time consuming process. This is the limitations of existing system. So, there is a need of low cost, portable, low power and time saving ECG monitoring device. With the use of this portable device patient can monitor there ECG anytime, anywhere and send the report of ECG to the doctor and can effectively communicate with the doctor. In case of any abnormality doctor may call the patient. This paper presents the development of Low cost, low power, portable and time saving ECG monitoring device.

## Keywords

ECG electrode, AD8232, Arduino, Android App

## I. Introduction

The design of portable systems for remote monitoring of patients specifically those who are suffering from cardiac diseases are becoming one of the most important fields in telemedicine. A long-term continuous ECG monitoring has been very significant in many situations such as caring for elderly people, especially those with cardiovascular diseases, and for athletes or fitness enthusiasts. Also, in recent years mankind has witnessed a revolution in the smart phone industry and emerging growth in the usage of mobile applications that range from entertainment and educational apps to simple games, health care apps and more. 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's 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. Several groups have developed applications to monitor the ECG in mobile devices, where the samples have been obtained from standard data bases, or they have development the ECG module. Other works have proposed techniques for signal processing via software to reduce noise or classify heart pathologies. Some groups have presented a wearable health monitoring system and its applications for long term monitoring. Some have developed application for PDAs and PCs for visualization of ECG. 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. 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. One of the invariable risks associated with space missions are the threats posed by the very harsh spatial environments to the physical and mental health of the astronauts. Being exposed to these types of environment for

long periods of time has adverse impact on cardiac, muscular, and neurological functions on astronauts (example of reduced gravity, high temperatures, planet dust particles, solar rays, etc). Fortunately, the continuous monitoring of physiological parameters such as electrocardiography, oxygen saturation in hemoglobin and variability of cardiac frequency may provide crucial information for a rapid diagnosis of medical conditions in astronauts; preventing the growth of any health condition to proportions susceptible to cause mission failure or even death of a crew member.

In this paper, we present a low cost, small, low power consumption portable system with wireless transmission for real time ECG acquisition, processing, storing and visualization in a mobile phone. In this work, we describe the implementation of an Android Application that can receive ECG raw signal from acquisition module with wireless transmission capabilities (Bluetooth), process it, extract and display it for real time ECG visualization in mobile device. Also we have implemented the Android Application that can send the text file of processed ECG signal data to the remote server with wireless transmission (File Transfer Protocol). So, server can send it to desired person like doctor or physician for medical decisions.

## II. Problem Statement

Using current electrocardiograms in hospitals can be a time-consuming and unsanitary task. 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 deprived 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.

## III. Project Objective

Project objective is to develop a Portable ECG monitor that will continuously monitor the ECG. It will notify the user. This project will allow a patient to move freely and at the same time can be monitored continuously.

## IV. System Development

### A. Block Diagram

Layout of the proposed system is as shown in Fig. 1. The system consists of three modules: the patients ECG acquisition device, cloud server, and the control unit in the mobile phone. ECG device is real time continuously attended ambulatory cardiac monitoring system. Ambulatory cardiac monitoring refers to ECG monitoring

services provided while the patient is at home or performing daily activities, including sleep. The patient will be wearing a wearable electrode continuously and his ECG will be recorded continuously on real time basis. This data is then sent to the mobile device of the patient, where it is processed, filtered, and plotted in the form of actual ECG waveform. This ECG signal is then sent to the server and

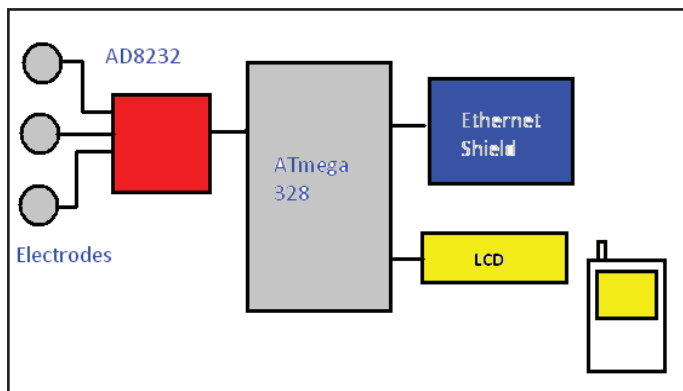


Fig. 1: System Block Diagram

Sends this information to the concerned physician along with the patients basic information, so that the physician can see the ECG of patient directly on his mobile phone. Thus, this system has immediate, 24 hour access to a physician to review transmitted data and make clinical decisions regarding the patient. The physician can assist the patient in case of an emergency. We are using three lead electrodes, the combinations are given as follows:

- Lead I: RA (Right Arm).
- Lead II: LA (Left Arm).
- Lead III: RL (Right Leg).

It is made up of AgCl.(Silver chloride).

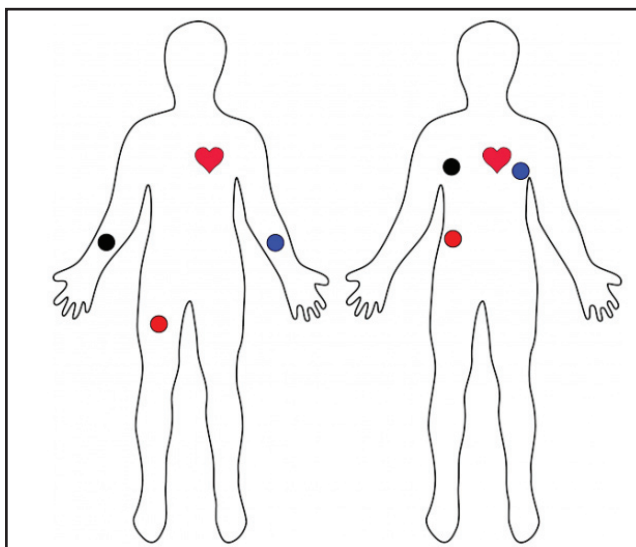


Fig. 2: Position of Electrode on Body

## V. Methodology

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

### A. At the sender (ECG monitor):

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.

### B. At the Receiver (Android Phone)

The ECG waves will be sent to THINGSPEAK application from where the doctor can access the channel and can check the waveforms for further diagnosis.

## VI. 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. In this work, an android application was proposed which can continuously receive ECG signals from acquisition device wirelessly, detect QRS complex, compute heart rate and plot the real time ECG signal on mobile phone for displaying. Also, it can send this information to concerned physician via server for medical decision. Experiments show that the proposed system is unobtrusive and can be comfortably used by the user during daily activities.

## VII. Future Scope

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. The paper sets a foundation for future developments that can improve proposed application for wireless health solutions. Some of the features that can be included are detection of irregularities in the rhythms of the heart, monitoring and analysing ECG signals at home and simultaneous automatic alert to the doctor of any emergencies. It is also important to include more options like zooming functionality, which will improve the usability of the app.

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