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Research Paper

Smartphone Based Cardiac Chekup

Engineering

KEYWORDS : ECG, AD8232, Correlation, Interpretation Coefficient.

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ABSTRACT

Today, if we look towards our modern life there is no time for man to manage his/ her health. As per WHO survey there are tremendous amount of increments in heart decease. And there is a need of quick and simple cardiac checking device with cheap cost. Also, almost everyone today uses the smartphone. Therefore, in this paper we propose, design and implementation of an easy to use real time ECG monitoring system using android Smartphone. If proper medical care can be given to the patients at the right time their lives can be saved, for that we need a system that regularly checks ones' ECG signal easily. This system can be used by patient for self-diagnosis, and remote-diagnosis for chronic heart disease patients before sudden outbreaks. This system will check the ECG signal from the body and if any deviation is found will generate a proper message on the screen. This system is mainly useful for patient living alone and has disability. The System will measure the ECG (EKG) signal using three lead electrocardiography and transmit these signals to Smartphone via Bluetooth for processing and generating proper message on the screen.

INTRODUCTION

The motivation for this project came from the health condition of human life in the presence day. As if we look towards our modern life there is no time for man to manage his/ her health. As per WHO survey there are tremendous amount of increments in heart decease. So we need a cardiac checking device which is easy to use and with cheap cost.

Today to keep heart healthy is very difficult task because of the degraded quality of food like fast food, pollution, race for to survive a life etc. Our aim for this project is to understand the heart condition of a human in his busy life.

Our project will serve the following purpose:

With minimum cost anybody can analyze his / her heart quickly.

Make a decision on the basis of obtained heart wave weather approach or not to a doctor.

We have taken an online survey; for that we have asked nearly 6 questions in that survey form. The results are as follows:

1. On an average 2 people from each family go for regular check-ups and 15 min average time lapse between their home and hospital/ check-up center.

2. 80% People think it will be helpful to perform heart tests at home and also it will be convenient by using an android app.

3. 92% People think their family members will be comfortable with such a device to measure heart health.

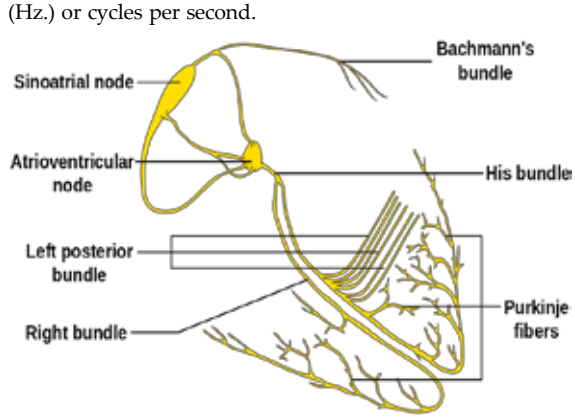
4. For smartphone there are 75% of response and 87% for Bluetooth use.

5. So in last we summarized that the need of such device is very useful and can be used at home.

Now, there are many existing smartphone based systems which can be used for quick heart checkup, but either they are not cheap or they just check for the heart rate only and nothing else.

ECG Generation

Actually the generated heart waves are nothing but the electrical flow within a heart. During each heartbeat, a healthy heart will have an orderly progression of depolarization that starts with pacemaker cells in the Sino atrial node, spreads out through the atrium, passes through the atrioventricular node down into the bundle of His and into the Purkinje fibers spreading down and to the left throughout the ventricles. This orderly pattern of depolarization gives rise to the characteristic ECG tracing. An ECG is generated by a nerve impulse stimulus to a heart [6]. The current is diffused around the surface of the body surface. The current at the body surface will build on the voltage drop, which is a couple of μV to mV with an impulse variation. Electrocardiogram (ECG or EKG) is a diagnostic tool that measures and records the electrical activity of the heart in exquisite detail. Interpretation of these details allows diagnosis of a wide range of heart conditions. These conditions can vary from minor to life threatening [1], [2]. Usually, this is very small amplitude of impulse, which requires a couple of thousand times of amplification. The electrical activity of the heart is generally sensed by monitoring electrodes placed on the skin surface. The electrical signal is very small (normally 0.0001 to 0.003 volt). These signals are within the frequency range of 0.05 to 100 Hertz (Hz.) or cycles per second.



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Literature Review
Currently, for Cardiac check mostly the standard Electrocardiograms are used by the medical professionals.

These devices usually operate with up to 12 leads connected to the patient's skin in a prescribed pattern.

In addition to hospital based systems, there are also long-term home monitoring systems such as Holter monitors. These systems record 3 to 12 electrodes worth of data onto the device, and are then brought in by the patient for analysis. These monitors are intended to be used over longer periods or to test for off-site conditions such as daily routine or specific triggers [7].

Other device in market is Zenicor-ECG[8], 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.

There are very few wireless based systems present for cardiac check. The LifeSync 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.2) 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 [9].

Also, there are very few mobile based cardiac check systems.

Most of them just displays the ECG signal but can't store the data, and also they can't interpret the ECG. Some of them do interpret, but those interpretations are mostly based on the heart rate [10].

SYSTEM REQUIREMENT AND SPECIFICATION
Hardware Requirement :
1) ECG Electrode: In the heart muscle cell, electric activation takes place by means of the same mechanism as in the nerve cell - that is, from the inflow of sodium ions across the cell membrane. The amplitude of the action potential is also similar, being about 100 mV for both nerve and muscle. We will be using 3 ECG sensor electrodes to measure the ECG signal. A bio potential electrode is a transducer that senses ion distribution on the surface of tissue, and converts the ion current to electron current. An electrolyte solution/jelly is placed on the side of the electrode that comes into contact with tissue; the other side of the electrode consists of conductive metal attached to a lead wire connected to the instrument. A chemical reaction occurs at the interface between the electrolyte and the electrode.

2) AD8232: The AD8232 kit Single Lead Heart Rate Monitor is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram and output as an analog reading. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op amp to help obtain a clear signal from the PR and QT Intervals easily. . It is designed to extract, amplify, and filter small bio potential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement.

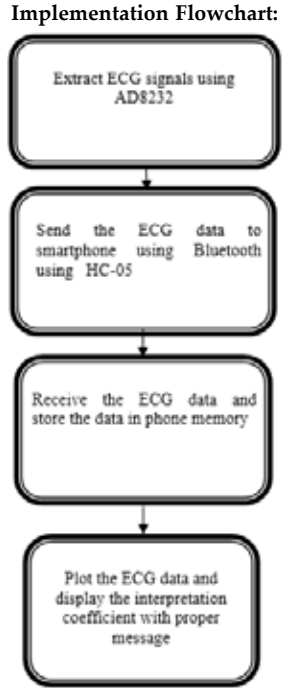
3) Arduino Uno: The purpose of the microcontroller is to acquire analogue signals ranging from 0 to 3.3V and sending them by standard serial protocol to a Bluetooth module.

4) Bluetooth Module: Bluetooth is a short-range communications system intended for cable replacement between electronic devices in a low cost, low power, robust way. A Bluetooth system consists of a RF transceiver, baseband, and protocol stack offering services to connect and exchange data between devices.

Software Requirement:
The mobile platform that we will be using is Android which was developed by Open Handset Alliance led by Google. We used Eclipse IDE for the developing environment.

SYSTEM ARCHITECTURE AND IMPLEMENTATION
System architecture is divided in two parts Firmware design and android system app.

Implementation Flowchart:



Firmware Design:
It consists of the ECG electrodes, amplifier, microcontroller and the Bluetooth module. ECG electrode will capture the electrical signal and send them to operational amplifier. The output generated by the amplifier is analog form and need to be converted in digital form. The microcontroller (PIC18) will process the output from operational amplifier and perform the following task:

- Sample analogue values from ECG and convert then to digital.
- Serial port configuration.
- Controlled sample rate.
- Sending data via serial UART to Bluetooth Module.

The Bluetooth module will only act as connecting media

between phone and the hardware. The Bluetooth module will be controlled by the microcontroller. When the system is turn on microcontroller will initialized the serial port and set the baud rate for communication.

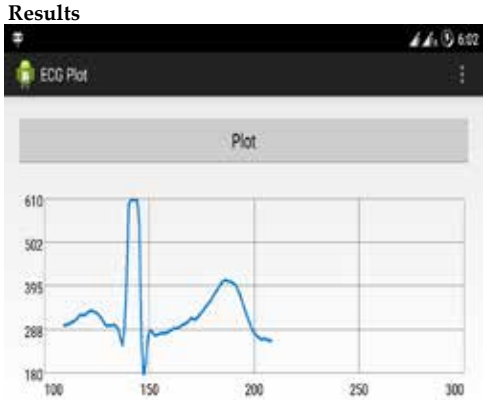
Android System App:
This consists of application developed on android operating system [4] from Google. This will act as GUI of system and user can easily interact with the system. Data from the ECG sensing hardware can be shown in graphics with Smartphone applications. The ECG App frameworks based on the Android OS (Operating System).The main functions of android app system are as follows:

1) Initiate communication with the ECG system: This module is involved with setting up communication with the ECG device using the Android Bluetooth API. Indentify system for mutual recognition between the devices and network pairing by handshaking between the transmitter and receiver. Sending acknowledgement to the hardware and receiving the ECG packet. It also performs controlling the mode of operation of the firmware.
2) Read and display output from the ECG system: Smart phone reads the output received from Bluetooth module and displays it on screen. The ECG packet will be decoded and plotted using java layout.
3) Analyze the ECG wave: We will analyze the ECG wave by comparing the incoming ECG wave with a reference ECG wave using cross correlation method [3]. The interpretation coefficient, whose value lies between 0 and 1, is calculated using this method which is used as a measure to interpret the ECG as normal or abnormal.
4) Generating a message: A message is displayed on the screen which tells the value of the interpretation coefficient and tells whether ECG is normal or abnormal.

Algorithm
1) First we calculate the cross correlation function between the incoming ECG data and the reference data. Let the incoming ECG signal be x (n) and the reference signal be y (n). We obtain a new vector (array) as a result of the cross correlation operation between x (n) and y (n). Let this new vector be z (n).
2) Now we select the maximum value from z (n). Let this value be 'rxy'.
3) Now we calculate the autocorrelation function of the reference signal x (n), and select the maximum value from the resultant vector. Let that value be 'rxx'.
4) Now we divide rxy by rxx resulting in a value ranging from 0 to 1. Let this value be 'r'.

This 'r' is our interpretation coefficient.

Results



CONCLUSIONS
In this paper, we proposed system which will monitor the ECG of subject based on the Android OS platform. This system can monitor and diagnose patient's heart conditions in real time with an ECG sensor. This system will analyze the ECG wave and generates the proper message. Also the saved ECG data can be shown later on to the doctor. In future the analysis can be made more accurate and then can be used in critical situations to alert the other people and the doctors by sending them alert message. Another feature that can be added is storing the ECG data on the cloud storage and making it secure using login ID and password.

REFERENCES
1. S. Correia, J. Miranda, L. Silva, and A. Barreto, "Labview and Matlab for ECG Acquisition, Filtering and Processing," *3rd International Conference on Integrity, Reliability and Failure, Porto/Portugal*, pp.
2. 20-24, 2009.
3. K. M. F. Haque, H. Ali1, M. A. Kiber, and Md. T. Hasan, "Detection of Small Variations of ECG Features Using Wavelet," ISSN 1819-6608, *ARPN Journal of Engineering and Applied Sciences*, vol. 4, no. 6, pp 27-30, 2009.
4. Alias Bin Ramli and Putri Aidawati Ahmad "Correlation Analysis for Abnormal ECG Signal Features Extraction", 4th National Conference on Telecommunication Technology Proceedings, Shah Alam, Malaysia, IEEE Proceedings, pp. 232-237, 2003.
5. Android Developers (2013, Apr 2). "Android APIs" [Website]. http://developer.android.com/reference/packages.html
6. Sheng Hu, Zhenzhou Shao, Jindong Tan (2011), "A Real-time Cardiac Arrhythmia Classification System with Wearable Electrocardiogram", IEEE computer society, 112.
7. Electrocardiography. Wikipedia, the Free Encyclopedia. 17 Dec. 2009. 02 Jan. 2010. http://en.wikipedia.org/wiki/Electrocardiography.
8. Wikipedia Contributors. (2013, Mar 26). "Holter Monitor," *Wikipedia, the Free Encyclopedi* [Website]. http://en.wikipedia.org/wiki/Holter_monitor
9. "OMRON HCG-801" http://www.omronhealthcare.com/products/portable -ecg-monitor/
10. "LifeSync Wireless EKG System." http://www.lifesynccorp.com/products/wirelesssystem.html
11. Alauddin Al-Omary, Wael El-Medany, and Riyad Al-Hakim, "Heart Disease Monitoring System Using Web and Smartphone", IJAREEIE, Vol. 3, Issue 4, April 2014.