

Design and Implementation of Low Cost ECG Monitoring System Using Smart Devices (Mobile or Laptop)

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Abstract- Now a days Heart disease has become a dangerous problem for human health. This Cardiovascular(Heart) disease causes the death of human. The most challenging job is identification of Cardiovascular disease in early stages of patients. This research work approaches to develop an ECG monitoring system at very low cost for the patients who can identify and detect the probability of heart diseases instantly at home also. The ECG signal is transmitted via Bluetooth module with support of software simulation where extraction and detection algorithm is setup for cardiovascular Heart disease. This network can be connected with the doctors and hospitals to get the treatment immediately. This proposed system is to contribute to bring under control heart diseases and also act as an expected results in health care service to patients in remote area.

Keywords- Arduino, Bluetooth, Cardiac Patient, ECG Sensors, Laptop, Smart phone, Zigbee,.

I. INTRODUCTION

ELECTROCARDIOGRAM (ECG) is the recording of the electrical activity of heart so that heart disease can be identified. Electrocardiography (ECG) is the extraction of electrical activity of the heart captured over time by an external electrode attached to the skin. Each of the cell membranes that form the outer covering of the heart cell have an associated charge which is depolarized during every heart beat and the normal range of the signal is 0.05-100Hz . Its amplitude ranges from 10 μ V to 5mV, whose approx value is 1mV. Cardiovascular disease (CVD) is defined as a group of disorders of the heart and blood vessels. CVD has become a cause of death in the world. Our goal is to develop a low cost ECG monitoring system, which is realtime, affordable, portable and user-friendly. In this research paper a prototype ECG monitoring system is developed which is low cost, portable, battery powered, and it includes wireless facility for safety concern and reducing noise interference.

1.1 Requirement of Such System:

a). To reduce the complexity of wired system in ECG Machines. This proposed work provides wireless monitoring of the heart disease.

b). Patient come hospital from long distance residence to check the ECG for identification of heart disease. In this proposed system it is able to monitor the ECG waveforms via smart devices any time from home and can send it to doctor

1.2 Way to Cut Down Cost of ECG Monitoring Devices

Current ECG Machines are bulky and connected with lots of wires, mobile phone-based ECG monitoring devices offer the paramount feature of instant warning about the heart condition of the patient.

One way to cut down the cost of ECG Monitoring devices is to implement these around Android Mobiles and laptops running under Android operating system and equipped with wireless Bluetooth technology.

This paper presents the design and evaluation of an ECG monitoring system deploying an Android mobile phone and using wireless technology (Bluetooth). In the system, we have developed an android application to visualize the ECG signal. This proposed idea consist with three electrodes, by which ECG signals can be taken from either limb leads (Lead I, II and III), and augmented limb leads (aVR, aVL, and aVF). This proposed system consumes low power and performs the ECG Monitoring for a long time.

II. SYSTEM ARCHITECTURE AND METHODOLOGY

2.1 The proposed ECG monitoring system consists with three distinct subsystems:

Subsystem1 : Amplification of the analog ECG signal.

Subsystem2 :Converting Analog signal to Digital Signal.

Subsystem3 : Cell phone and the PC itself.

As Shown in fig. 1 Firstly process the analog ECG signal, prepare it for conversion to the digital signal. It is necessary, for today's mobile phones do not include a means to directly interface to analog signals from the external world. For achieving this purpose we have used AD8232 single lead heart rate monitor. The second subsystem consists of a microcontroller, a Bluetooth module and a Zigbee Module. This unit samples the ECG signal, serializes the samples and

transmits them via the Bluetooth module to the Android cell phone and via Zigbee module to the PC application. After this ECG graphs can be identified on both the smart devices. The third one is the smart phone and the PC itself. Proposed application has been program written, the ECG samples and suitably charts the ECG signal on the screen for analysis.

2.2 ECG Sampling and Transmission via Bluetooth and Zigbee

ATMega-8 is an 8-bit Microcontroller which samples the ECG signal at 150 Hz, using an embedded 10-bit ADC. The control program sends the incoming raw samples to an embedded USART serial port and the program reduces every 10-bit sample into a correspondent 8-bit sample, before transmission, simply by discarding the two less significant bits. The USART serializes the samples at 9600 bits per seconds by using the following settings: 8-bit data length, no parity, and one stop bit. After receiving the bits streaming from the USART, the Bluetooth module (Linvor JY-MCU) sends them into the air, which can be received by a nearby Bluetooth-equipped smart phone. Bluetooth is used for short distance data transmission (Upto 10m). For PC application Zigbee is used to transmit data wirelessly. Zigbee can transmit data upto 100 meters. The XBee module uses Zigbee protocol for communication and hence they are used in microcontroller base boards (Arduino). We have used only two Xbee modules to transmit and receive the data but it is controlled by using the Arduino board. Since the communication of These modules happening using serial communication protocol with the interfacing devices they can be connected to a microcontroller using a minimum of four pins, Power supply, and Ground, UART Data Out, and UART Data In pins. The Xbee modules have several digital and analog I/O pins are available in The Xbee modules apart from these pins. The control program written for the microcontroller just implements the commands supplied by the datasheet for the Bluetooth module (EGBT046S AT Command Set) and Xbee module to establish communication with the mobile phone and

PC. Fig. 3 shows. ECG Graph monitored on Android Application via Bluetooth.

2.3 Smart Phone and PC:

Smart Phone with Bluetooth served as the target phone during implementation of this project. Android application has been developed by using Android Studio using java Programming Language and PC Application provides the Graphical User Interface over USB Connection.

III. RESULTS

- 1) We have monitored the ECG waves on android mobile as shown in Fig.3 and below is the ECG waveforms extracted on ECG Monitoring application.
- 2) Fig.4 shows the resulted graph extracted on PC Application via Zigbee of ECG Waveforms.
- 3) With the help of these waveforms we will calculate R-R interval of the ECG waves.

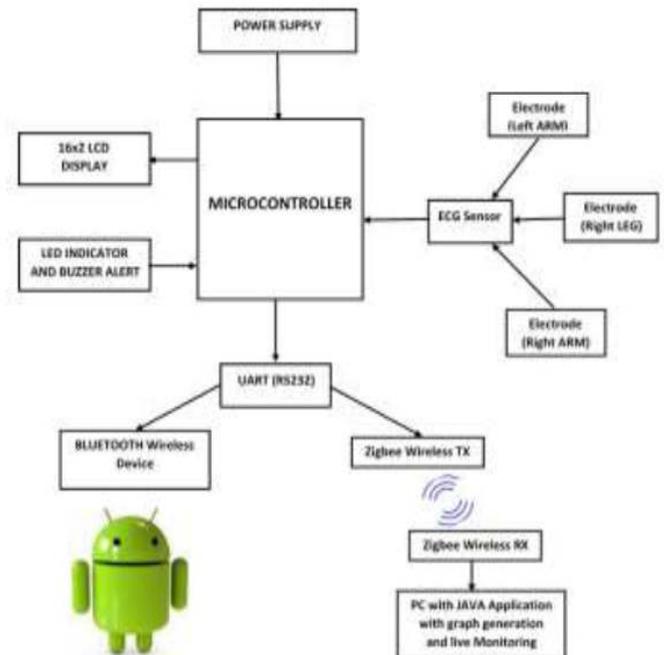


Fig. 1 ECG monitoring system based on Smart Devices



Fig. 2 Mobile phone based ECG monitoring prototype connected to a user

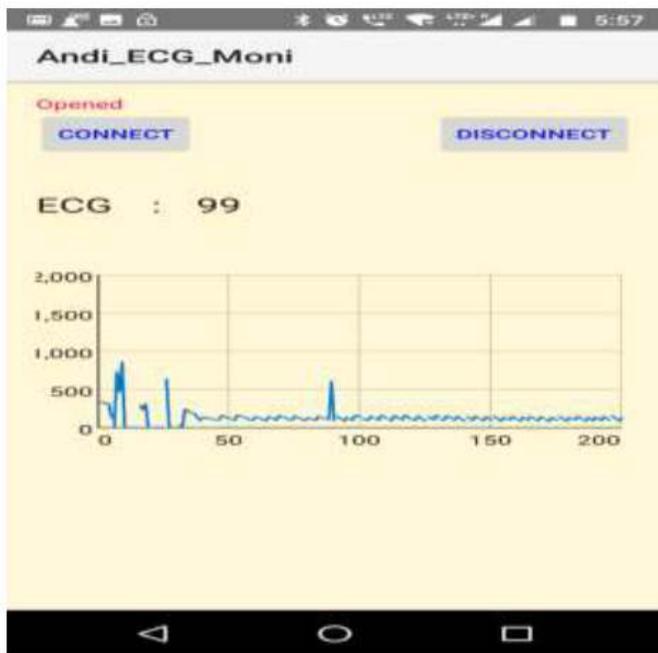


Fig. 3. ECG Graph Monitored on Android Mobile via Bluetooth

IV. EXTRACTION ALGORITHM OF ECG SIGNAL VIA BLUETOOTH

Here Software programming is used in java language which takes input values of ECG signal via Bluetooth port from the hardware part of the module(ATMega-8).Interfacing is done between hardware and software .R-R interval of ECG Signal is measured when ECG sensor sense the signal and it is

forwarded to the ATmega-8.To display it on the Mobile Software program comes into picture.

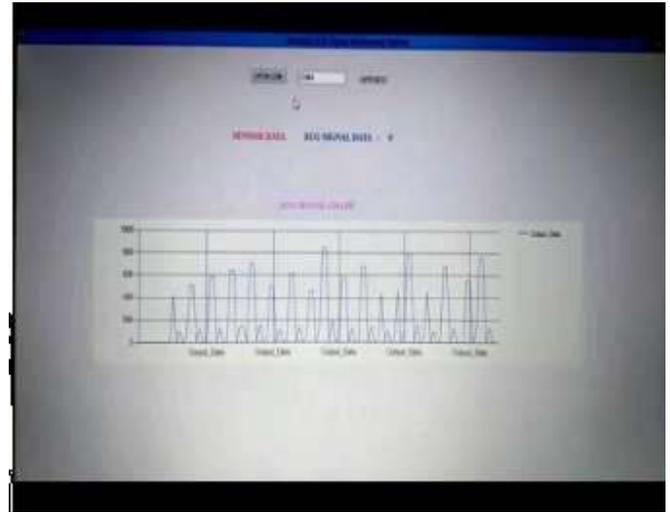


Fig.4 ECG Graph Monitored on PC Application via Zigbee

V. CONCLUSION

As we know the current ECG Monitoring systems are wired structure as well as very bulky in structure, in this research paper we have proposed a low cost ECG Monitoring system using smart devices(Android Mobile /Laptop).

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