IOT Based Heart Defect Monitoring System

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Abstract -
This paper describes the design of a simple Electrocardiogram (ECG) monitoring system using AD8232 and Arduino Microcontroller. The system gets the pulse input using Ag/Cl 3-lead electrodes placed on the arms and right leg of the patient under inspection. The model comprehends ECG module(AD8232) which is used for signal conditioning of the input pulse from the patient's body and viewed on Serial Monitor Window as the ECG waveform. Thus conditioned signal is also processed by the microcontroller Arduino Uno to control and transmit the function of ECG wave to monitor and Displaying the condition of the ECG wave in LCD display and IOT, whether it is a normal ECG or Abnormal.

Keywords: Electrocardiogram (ECG), Electrodes, LCD display, Arduino, IOT, Patient etc.

1. INTRODUCTION

At the present time, people suffering from heart diseases are increasing at an alarming rate. The ECG is one of the medical kits that can measure the heartbeat per unit time, convert it into a signal and display the data on a display device. An ECG is a recording of the electrical activity on the body surface generated by the heart muscles. ECG information is collected by electrodes placed at selected locations on the patient's body. It is the best way to monitor and diagnose abnormal rhythms of the heart muscles, mainly abnormal rhythms caused by damage to the conductive tissue that carries electrical signals. It is possible to be in cardiac arrest with a normal ECG signal (a condition known as pulseless electrical activity).

Electrocardiogram (ECG) is one of the frequently used and accurate methods for monitoring the electrical activity of the heart. ECG is an high-priced equipment and its use for the measurement of the heart rate only below an economic level. Low-cost devices are available in the form of wrist watches for the instantaneous measurement of the heart rate. Such devices can give accurate data but they are expensive. Most hospitals and diagnostic centers in India use incorporated devices designed to measure the heart rate, temperature, and blood pressure of the patient. Although such devices are valuable, their cost is usually uneconomical. This paper depicts the design of an ECG monitoring system which monitors ECG subject by Ag / Cl sticking electrode on the arms and then showing the ECG on monitor window and Liquid Crystal Display[1].

2. SYSTEM ARCHTECTURE

Figure.1 represents the block diagram of the proposed system. It consists of the Electrodes which are placed on the Left Arm, Right Arm and Right leg of the patient's body. The input is taken from the human body and then it is transmitted to ECG module (AD8232). The ECG module processes the data and it produces the continuous analog values according to the input given by the electrodes to the Arduino microcontroller. The Bluetooth module is connected to

the Arduino microcontroller for transmission purpose. On the other side, we have Android Application on our mobile for the reception of ECG signa.

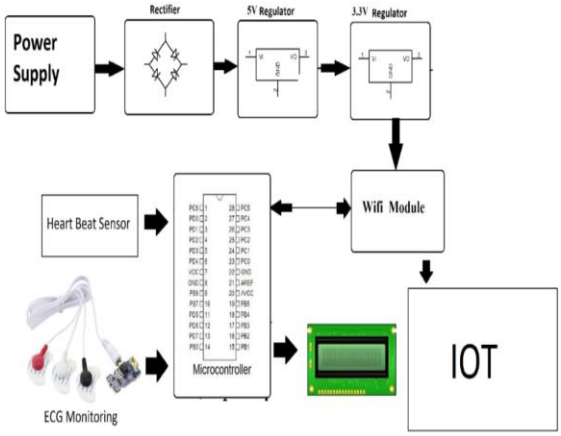

Figure.1 Pictorial representation of the System

A. Electrode:

3-lead Ag/Cl Electrodes transform bio-medical signals into electrical voltage. The voltage lies in between 1 mV ~ 5 mV. The pair of sensors are placed on the right arm (RA), left arm (LA) and right leg (RL) of the patient (see Figure 2). [4]

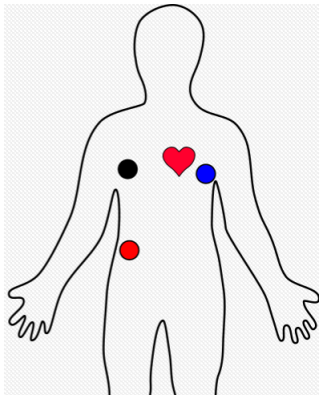

Figure.2 Placement of the Electrodes

B. ECG Module (AD8232):

The AD8232 is an integrated signal conditioning block for ECG and other bio-metric measurement applications. It is designed to pull out, amplify, and filterless energy bio-potential signals in the presence of noisy conditions, such as those created by movement or remote electrodeposition. This design allows for an ultralow power analog-to-digital converter (ADC) or an embedded microcontroller to obtain the output signal. The AD8232 can execute a two-pole high-pass filter for eliminating motion artificial facts and the electrode half-cell potential. This filter is tightly coupled with the instrumentation amplifier design to allow both large gain and high-pass filtering in a first stage, thereby saving money and space.

Figure.3 AD8232 ECG Module

C. Arduino Microcontroller Uno:

The Arduino Uno is an 8-bit microcontroller board based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz crystal oscillator, a power jack, an ICSP header a USB connection and a reset button. It has everything required to hold up the Arduino; Basically, connect it to a Laptop with the help of USB cable or power it with an adapter or battery to get initiated. The Uno differs from all previous boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

Figure.4 Arduino Uno Microcontroller

D. LCD Display:

Liquid Crystal Display (LCD) is an electronic display device and it has the wide range of applications in real time. A 16x2 LCD is the very basic component and is very commonly used in various devices, equipment and circuits. These

modules are chosen over 7 segments and other multi-segment light emitting diodes. The reasons being: LCDs are cost-effective; easily programmable; have no drawback of displaying special & even custom characters, animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in the 5x7 pixel matrix.

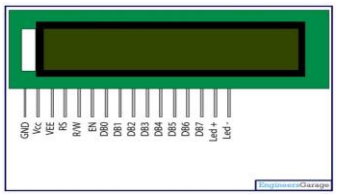

Figure.5 LCD Display

3. DESIGN OF THE SYSTEM

Here we have described briefly the hardware are an implementation of the system. The hardware part depicts briefly about the ECG monitoring circuit system parts such as Ag/Cl electrodes and ECG module. Figure.6 depicts the circuit diagram of the interfacing between ECG module and Arduino Uno [2].

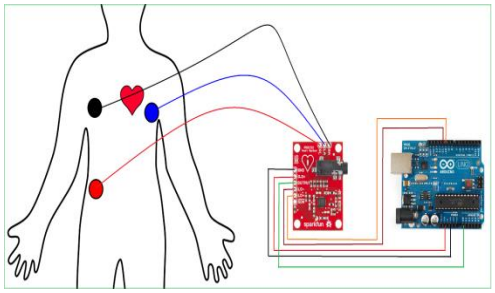

Figure.6 Interfacing of AD8232 and Arduino Uno[5]

Here, The ECG module is getting three inputs from the human body using 3-lead electrodes. The ECG module(AD8232) has Instrumentation Amplifier and High pass filter for the working purpose. After, processing the inputs, It produces the single output. This output is given to the Arduino Uno Microcontroller with the help of the Analog pins.

Figure.7 depicts the circuit diagram of interfacing between Arduino and LCD display module.

Here, Arduino Uno was interfaced with Liquid Crystal Display. Using 4 data lines. The displayed data were transmitted to the LCD. We can increase and decrease the brightness using the Potentiometer which is interfaced with the LCD.

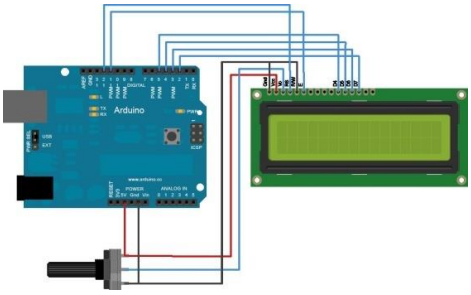

Figure.7 Interfacing of Arduino Uno and LCD Display

4. THE SOFTWARE SYSTEM

A. Arduino Software

The Arduino provides the Arduino Integrated Development Environment (IDE), which is a platform Independent Application written in Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, syntax highlighting automatic indenting, brace matching and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also has a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. The ECG wave is displayed on the Serial Monitor.

B. Flowchart of the program

The program is written in assembly C language. Figure 7 depicts a flow chart to ECG measurement.

The flow starts from getting inputs from the ECG module. After, getting the input, The microcontroller checks whether all three inputs are given properly. If anyone of the inputs is not detected well, The system will send the signal to the LCD. After getting the signal the LCD will display “The ECG is Abnormal” or else It simply displays “The ECG is normal”.

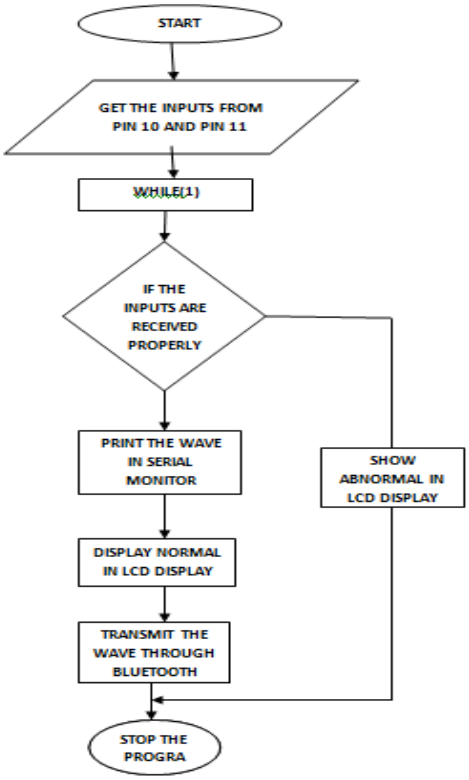

Figure.8. Flowchart of system

5. WORKING OF THE SYSTEM

The system gets the input bio-metric signals from the human body using 3-lead electrodes. After processing all the three inputs, the ECG module produces the single analog output. It was given to the Arduino Microcontroller. Arduino is the responsible for the remaining operations. It checks whether all the three inputs are received properly. If there is any problem while getting the input it sends the signal to LCD then the LCD shows "It is Abnormal" or else it shows "Normal". This is the working of the system.

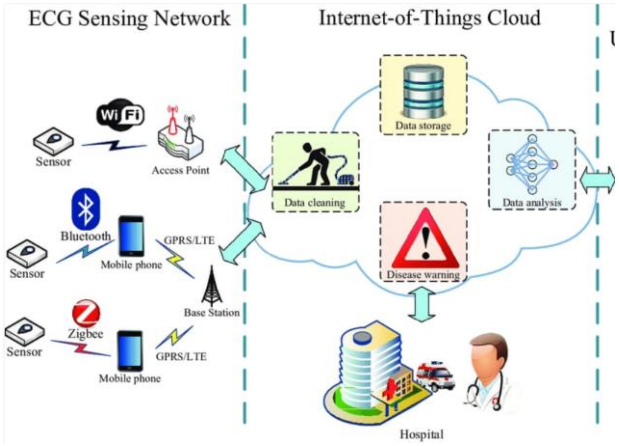

Figure.9. ECG Network system

6. RESULT AND DISCUSSION

We could get the display of ECG waveform on Monitor Window and the condition of the ECG wave is displayed in the LCD module whether it is a normal ECG or Abnormal through electronic hardware implementation of this project successfully. This can be seen in Figure.9, which shows an ECG signal acquired by the electrode on a Serial Plotter [4].

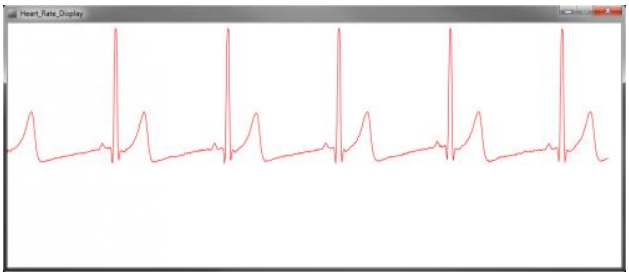

Figure.9. Output derived from system

Figure.9. Project Model

7. CONCLUSION

This project mainly concentrated on energy efficient and cost-effective. This system can be easily understood by the patient. When compared to the high-cost monitoring systems, It is more efficient. We also provide our experience with the technical aspects of sensor creation, as well as our experience with experimental and practical measurements with the ECG sensor, in this project. Despite the fact that a wearable ECG body sensor contains less information than a typical 12-lead ECG, it can provide a variety of closer glances at heart activity.

Furthermore, if at least three ECG sensors are put in appropriate areas on the body, measurements from several ECG sensors taken at the same time can provide redundancy and even synthesis of the standard ECG. When the heart rate per BPM (Beats per minute) is >40 and 60, the low pulse rate is indicated. Low heart rate can lead to medical issues, indicating that the patient requires medical assistance to maintain a normal heart rate. The typical pulse rate varies from >60 to 100, indicating that the patient's pulse rate is within the normal range with no complications. The high heartbeat is between>100 and<150 which indicates the patient has a high pulse range that could result in heart-related diseases. With actual heartbeat rates, the experimental results showed an acceptable range. Finally, for the end-user, this handheld system has shown to be a valuable heart rate counting and heart attack detection system.

8. FUTURE SCOPE

This system is for the Real-time Monitoring purpose. We can enhance this system by transmitting the ECG wave using IoT to Doctors or Analysts. We can build an Android Application for monitoring with more proficient.

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