

## ANALYSIS OF IOT BASED MONITORING DEVICE FOR ARRHYTHMIA

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### ABSTRACT

Medical devices have been improved with rapid growth of technologies. Arrhythmias are defined as abnormal heart rhythm experience by millions of people. Arrhythmias are caused by an abnormality in that electrical conduction system and can make the heart beat too slowly, too quickly, or in an irregular way. Electrocardiogram (ECG) is one of the best ways to obtain the heart condition information. An ECG can provide and analyse data such as heart beats, heart rhythm and type of heart disease. Lack of awareness among the public on heart rhythm disease which is one of the main causes of sudden death or weaken a heart condition. In addition, the patients need to spend few hours in order to check the heart condition frequently. This paperwork describes on the Android mobile application receiving the data from heart rate sensor in form of electrical signal via Bluetooth module and Wi-Fi. The electrical signal received will be converted into heart rate by NodeMCU. Finally, the types of Arrhythmia will be identified based on heart rate calculated. Moreover, the heart rhythm, heart rate and types of Arrhythmia will be displayed on Android Application. The device with ability of monitoring heart patients and alert the caregiver via Email with GPS location information. The android application is providing the data to the user and caregiver so that the caregiver able to monitor the patient from long and short distance. The device has been tested to get the accurate results and it is compared with standard results of heart rhythm. In addition, this device will help the society to taking a good care of their body system especially heart in good condition. Lastly, device may use as educational purpose to learn on how the heart is functioning with several types of arrhythmia that may happened to human heart. Indirectly, it creates awareness to all stage of ages.

**Keywords:** Electrocardiogram (ECG), heart rhythm, Arrhythmia, Heart rate sensor, IoT.

### 1. INTRODUCTION

Arrhythmias are defined as abnormal heart rhythm experienced by millions of people. Our heart has an electrical conduction system that makes the heart pump blood around the body. An abnormality in that electrical conduction system and can make the heartbeat too slowly, too quickly, or in an irregular way [1].

According to European heart disease and heart failure Congress millions of people across the world are affected by cardiac disorders. Some are categorized as minor others critical [3]. As per World Health Organization (W.H.O.) research, more than 17.5 million people have CVDs, an estimated 31% of all deaths worldwide and 80% of all CVD deaths are due to heart attacks and strokes. In addition, according to the market study, the expectation of Cardiovascular disease in 2019 may grow from \$13.7 billion to 18.2 billion [4]. Arrhythmia disease can be prevented by monitoring in the early stage with the symptoms. Creating awareness to the public about the heart rhythm disease can save a person from death due to irregularities of heart rhythm.

ECG devices are the vital medical equipment used by medical experts to detect arrhythmia [9]. Heart condition is categorized as one of the important parameters to be monitored for normal human and especially heart disease patients. Continuous monitoring while doing daily life activity and condition of heart for bedridden patients can be observed to determine the condition of the heart.

In this paper, a device with alerting and monitoring function are developed to help the arrhythmias patients. The device functioning as real-time ECG signal processing system based on the Android platform and Heart Rate sensor. It can be used to monitor the working status of the heart rate and heart rhythm classification. The Android application will acquire the ECG data continuously and analyses it within the mobile phone itself in real-time. The system is able to store the diagnostic information of heart rate via Blynk application that can be downloaded from the android play store. Moreover, this device system able to detect danger signal and immediately the guardian will get the alert via Email. Lastly, the patients and guardians can use their smartphone as mini patient monitor to view the heart rhythm in real-time.

## **2. METHODOLOGY**

### **2.1 Hardware**

#### **2.1.1 Heart rate sensor (AD8232)**

The AD8232 is a chip mainly used to measure the electrical activity of the heart. This electrical activity is normally displayed as an ECG or Electrocardiogram waveform [6].

This sensor is used in this project to capture the heart rhythm of the heart and convert it into a heart rate. The sensor converts the analogue data into digital by using 5V as the input voltage. The data will be processed by the Node MCU in order to get the expected output.

#### **2.1.2 Electrodes**

Simple three electrode monitoring using two electrodes at a time for lively monitoring and one as a ground electrode. But the electrodes can be used in special configurations to get lead I, II or III, one at a time. The signal acquisition is bipolar, between the chosen two electrodes for the given lead. Three electrode system was once quite frequent with telemetry video display units [7].

In this project, 3 lead ECG electrode was used to capture the data from the heart of the patient. Einthoven triangle concept is applied to place the electrode on the patient.

#### **2.1.3 Node MCU V3**

The Node MCU (Node Micro Controller Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266.

Node MCU has been used in order to process data captured from the sensor. This microcontroller is integrated with the WIFI shield which helps as a medium to transfer data and location information to the guardian during an emergency.

#### **2.1.4 Bluetooth module**

The Bluetooth HC-05 module is integrated with this device to transmit the data in a short distance to send the ECG wave with less interruption of other signals. Bluetooth is proven as a good transmitting data medium. There are numerous numbers of devices that's has been used Bluetooth as transmitting medium of health data.

HC-05 had been used in order to transfer the data to the mobile application. To make it easy to transfer heart rhythm (ECG signal), Bluetooth is one of the good ways to send the data in real-time with least of noise and inference.

### **2.2 Software**

Mobile gadgets like smartphones and tablets computer systems consistently develop in processing energy and come to be a fundamental part of each day life, even in improving countries. Recently, such mobile units are additionally used for biomedical signal processing and ECG analysis. The drastic adjustments in technology, the inventors are motivated to strengthen the gadgets with the collaboration of smartphone application both Android or IOS application.

#### **2.2.1 Arduino IDE**

The open-source Arduino Software (IDE) makes it handy to write code and add it to the board. Normally this software is runs on Windows, Mac OS X, and Linux. The surroundings are written in Java and based totally on Processing and another open-source software. Arduino IDE has been used to write the coding and bring together earlier than importing to the Node MCU barring any error [9].

#### **2.2.2 Blynk**

Blynk was designed for the Internet of Things. It has multiple functions such as can control the hardware, able to displayed sensor data, ability to store data and visualize it. Blynk using Wi-Fi as a medium of transferring data from users to the guidance. An easy application where all the users can install and use it regularly. Moreover, the guidance also may help the user during an emergency by connecting to this application.

#### **2.2.3 Bluetooth Electronic**

Control your electronic project with an Android device. This app communicates using Bluetooth to an HC-06 or HC-05 Bluetooth module in the project. It can also be used with Raspberry Pi. It is one of the android applications. This application used mainly to view the heart rhythm of the heart patient. It helps the user to reduce the weight of the device by add on screen in this device to view the signal. This makes easy for the user and guidance to view the heart rhythm of the patient just connected via Bluetooth.

### 2.3 Functional system

Mobile gadgets like smartphones and tablets computer systems consistently develop in processing energy and come to be a fundamental part of each day life, even in improving countries. Recently, such mobile units are additionally used for biomedical signal processing and ECG analysis. The drastic adjustments in technology, the inventors are motivated to strengthen the gadgets with the collaboration of smartphone application both Android or IOS application.

Figure 1: Block diagram of device.

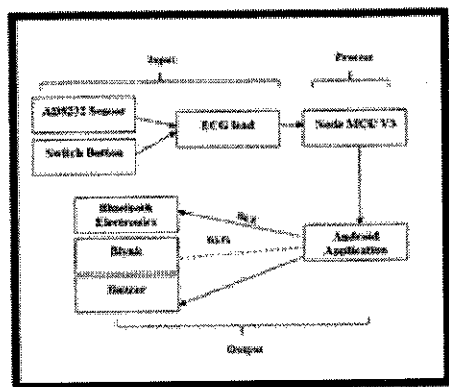
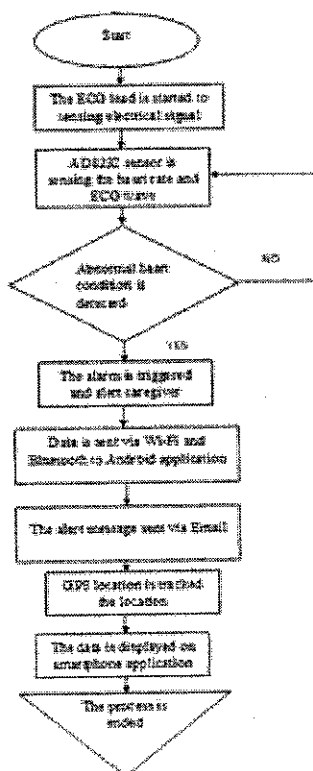


Figure 1 describes the block diagram of the device process. As the main input the heart rate sensor working to capture the electrical signal via ECG lead. The electrical signal will be transferred to the microcontroller from ECG lead which attached to the user body using Einthoven Triangle concept. The ECG lead is connected to the heart rate sensor. The data will be processed by microcontroller and send the output from the device. As an additional function, the manual switch button added to this device in order to help the user during an emergency. It produces an alarm once the button was pressed. It creates alert to the short as well as long distance caregiver.

### 2.3 Functional system

Figure 2: Flowchart of product functioning



The flowchart in figure 2 describes the device functioning in detecting the abnormal heart condition. Additional safety features were added in this device and it also included on how it will be working. This device is using 2 different medium which is WIFI and Bluetooth. WIFI medium mainly functions to send alert to the long-distance caregiver and stored the heart rate data up to months in Blynk application. Next, the Bluetooth medium mainly functions to transfer heart rhythm from the device to the Bluetooth Electronic application. Followed by, the heart rate will be calculated based on the heart rhythm received and the status of the heart will be detected based on the heart rate calculated. This 3 information will be displayed on the smartphone by using Bluetooth Electronic application. There is buzzer which acts as safety features. It will be triggered during an emergency to alert the surroundings.

### 3. RESULTS AND DISCUSSIONS

In this part, it mainly discussed the analysis of results with 3 different methods. At first (Fig.3), technical test or calibration was done using ECG simulator. This testing was done to calibrate and identify the output from the device is accurate. All the medical are need to undergo a calibration process to ensure the output from the devices are reliable and detect the health condition of the user correctly.

Secondly, several subjects were chosen to test by using the patient monitor and this device. Each of the results received from the patient monitor and device of each subject was compared (Fig.4). This testing performed to verify the results received from the device and patient monitor is similar. It also ensured the data from the device can be used by the professionals to get some basic information on the patient's health condition. This device has the ability to produce similar output compare with real equipment.

Additionally, the testing continued with testing the stability of the heart rate received from a device for 1 minute (Fig.5). This testing mainly focusing on the stability of sensor producing output. 3 subjects were chosen to proceed with this testing. Stability tested was performed and the data was presented in the graph below. It shows the sensor able to produce data with good stability for 1 minute for 3 different subjects.

Figure 3: Calibration of device with ECG simulator

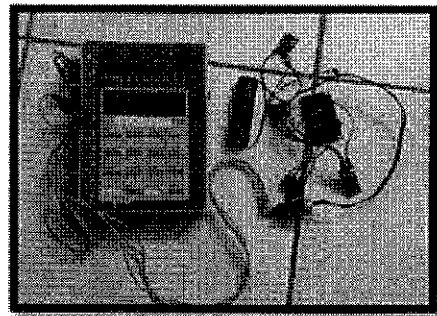
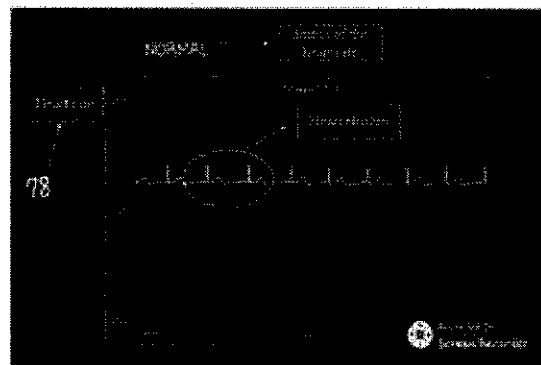
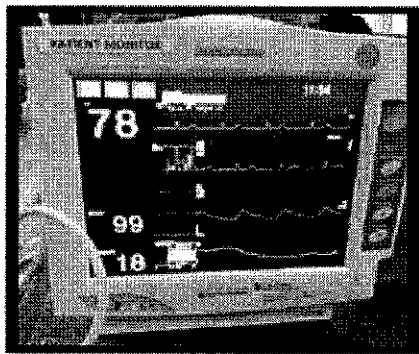
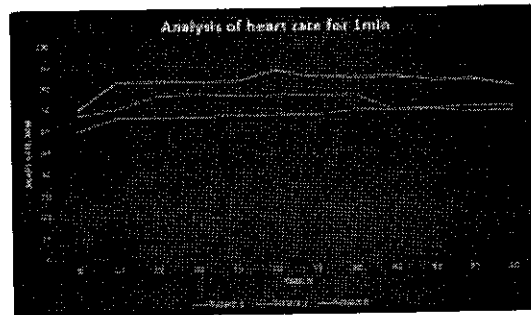


Figure 4: Comparing the results with patient monitor



**Figure 5: Testing of stability of heart rate with different subject**



#### 4. CONCLUSIONS

The heart has been proven an important internal part of the body. It needs excellent care in order to live a healthy life. Recently, many inventors have invented a device to diagnose and monitor the body system by applying the latest technology. This device will help the society to take good care of their body system especially heart in good condition. Moreover, the application with the latest technology with an easy method of using has been applied in this device. The device may use as an educational purpose to learn on how the heart is functioning with several types of arrhythmia that may happen to a human heart. Indirectly, it creates awareness for all stages of ages to take care of the heart at an early stage. It can reduce the number of heart disease death by using this device anywhere in this world as a precautioning device.

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