Heart Rate and Activity Monitoring

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Abstract—Continuous monitoring of the heart for various metrics is very important, this has led to at home and remote monitoring of events such as heart attacks or any other issues concerning the heart and reporting to the doctor and family members in case of emergency. This paper contains an intelligent pulse sensor and temperature sensor integrated with the arduino chip and GSM (Global System for Mobile communication) modem. The sensor measures the heart rate and room temperature and based on the readings, plots the ECG (Electrocardiogram) and displays the heart rate and room temperature. A special feature of detecting the mood of the person by using the heart rate is also deployed here. This is done by calculating the CPR (Cardiopulmonary Resuscitation) value using the heart rate. In case of any sudden variations in the heart rate, a message is sent to the doctor and family members using GSM modem for the immediate rescue of the person concerned.

Keywords—Arduino, CPR (Cardiopulmonary Resuscitation), GSM (Global System for Mobile Communication), pulse sensor, temperature sensor.

I. INTRODUCTION

With the cost of healthcare rising, there is a necessity for effective methods of reducing the hospital expenses. Home based monitoring technologies allow for real time health monitoring and facilitates observation of important cardiopulmonary and activities in patients and also detect the mood of the patient.

The reduction in size of the components and reduced cost of maintenance has allowed such technologies to become increasingly popular.

Furthermore, the use of wireless communication using phones has made remote monitoring a great success. The monitoring of heart rate and ECG can provide important information about patients with any heart diseases such as congestive heart failure. Detection of such events at an early stage can save the life of the person. Monitoring the room temperature is also important as the heart rate varies according to the room temperature. The monitoring of room temperature and calculating the heart rate based on it provides accurate result. Based on the result obtained, if there are any fluctuations in heart rate, a message would be immediately sent to the doctor and family members using the GSM modem technology. The activity of the patient is also monitored and based on the CPR value; the patient’s mood is detected as to whether he is excited or depressed. This helps the doctor and family members predict about what kind of incident the patient is thinking and what caused the heart attack for the patient.

II. METHODOLOGY

A. Arduino, GSM and sensors.

Arduino is a simple microcontroller board and an open source development environment that helps
users build digital devices and interactive objects. It is used as the basic component to connect the pulse sensor and temperature sensor. An arduino IDE is available to program the arduino chip. The pulse and temperature sensors contain three pins; a ground pin, a pin to connect to 5V voltage on arduino board and a pin to connect to the output pin of the arduino as shown in Fig. 1. To detect the room temperature, LM-35 temperature sensor has been used. The pulse sensor used here emits infrared waves into the finger placed on it and detects the flow of blood in the vessels and gets the pulse rate in the body of the person. The pulse sensor and temperature sensor are connected to the arduino and readings are obtained from the output pins of the arduino board. The arduino is connected to the laptop via an USB cable provided with the arduino board. The laptop has arduino drivers installed along with the arduino IDE software which helps in processing the output obtained. The GSM modem is also connected to the arduino board via the RX and TX ports on it (Fig. 1). The GSM modem accepts a SIM card and operates over a subscription to a mobile operator just like a mobile phone. This is used to send SMS to the doctor and family members of the patient in case of emergency like a heart attack. The GSM modem is so controlled by programming the arduino using the arduino IDE software.

A. Processing the readings.

The pulse rate is obtained by placing the finger of the patient on the pulse sensor. The output of the sensors is obtained from the output pins of the arduino and is processed using the arduino IDE software. Inter Beat Interval (IBI) is calculated by monitoring until the last beat to avoid noise [1]. Dichrotic noise is avoided by waiting 3/5 of the last IBI and the running total of the last 10 IBI values is calculated and its average is used to find the heart rate in Beats Per Minute (BPM) [1].

The pulse rate depends on the room temperature also. The pulse rate is higher at a temperature than it would be at that same temperature and pulse rate is lower at a temperature than it would actually be at that lower temperature.

The CPR value is calculated to predict the emotional state of the patient. If the CPR value is greater than 3, it means that the patient is excited and if CPR is less than -3, it means that the patient is depressed [3].

If the pulse rate exceeds a threshold value, the first aid instructions are displayed on the screen so that any of the family members can help the patient and a message is sent to the doctor and family members so that they come to the rescue of the patient.

The results calculated in arduino IDE is passed to the Processing IDE to display. The arduino and processing IDEs interact with each other through serial communication. The data is passed to processing IDE. The various BPM values obtained are used to plot the ECG [4] and heart rate in BPM is also displayed at that instance of time. Along with ECG, graph of IBI values and room temperature are also displayed on the screen.

III. RESULTS

A. Heart Rate and ECG.

The heart rate along with the ECG is plotted using the processing IDE [4] as shown in Fig. 2.
Emoticons are used to display the emotional status of the patient [3].

![Fig. 2. ECG.](image)

**B. Message sent using GSM.**

A message is sent to the doctor and family members using the GSM modem. The message is sent using SMS. GSM works just like a mobile phone and makes use of the mobile operator. The message sent to the doctor and family members can be customized as required.

IV. CONCLUSIONS

This study has demonstrated the use of arduino and sensors to help patients monitor themselves without going to the hospital and remote monitoring of the patient by the doctor. This reduces the cost of readmission to hospital [2]. The measurements are of comparable accuracy to those made by larger medical devices.

The use of this technology helps to take immediate actions in case of emergency and enhances the response rate of the medical support to the patient.

V. FUTURE WORK

As the technology is changing faster, the newer technology can be made use of. By integrating GPS (Global Positioning System), the latitude and longitude of the patient can be obtained and can be sent to the ambulance so that patient can be taken to the hospital in the ambulance in case of serious situations.

Furthermore, calling doctor automatically and telling the status of the patient can also be implemented using the GSM modem itself. When the heart rate exceeds a certain limit, automatically the concerning doctor is called to inform.

Using an alarm with the system, incase when the doctor, nurse or any family member is not nearby and the patient’s heart rate rises or drops badly and needs urgent help but no one is nearby, this alarm will help in such situations. Due to the alarm sound, someone would come to the rescue of the patient.

Lastly, an LCD display could be used to display the ECG signal as well as the heart rate. Along with it, a monitor to display the emotions can be designed.

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REFERENCES


