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Heart Rate Monitoring System Using Wrist Pulses Through Arduino and Processing Software

Ritesh Pandey, Shreshth Khare, Priyanshu Rai and Ritu Gupta

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Ritesh Pandey
Galgotias University
(Under the Uttar Pradesh Private Universities Act No. 12 of 2019)
Greater Noida, India
Email: ritesh.20scse1010664@galgotiasuniversity.edu.in

Shreshth Khare
Galgotias University
(Under the Uttar Pradesh Private Universites Act No. 12 of 2019)
Greater Noida,India
Email: shreshth.20scse1010304@galgotiasuniversity.edu.in

Priyanshu Rai
Galgotias University
(Under the Uttar Pradesh Private Universites Act No. 12 of 2019)
Greater Noida,India
Email: priyanshu.20scse1010511@galgotiasuniversity.edu.in

Under the guidance of

Mrs. Ritu Gupta
Assistant Professor
(Galgotias University)
Greater Noida, India
Email: ritu.gupta@galgotiasuniversity.edu.in

Abstract *- This research paper presents the design and implementation of an internet of things-based (IoT) smart framework for human heartbeat rate monitoring and control system. A comprehensive study of various techniques and technologies that are used in controlling the heartbeat rate is explored. The proposed system was designed and implemented on a breadboard with the various system components that are assembled, connected and tasted. Experimental results obtained from the implemented prototype were found to be accurate, as the system was able to sense and read the heartbeat rate of its user and transmit the sensed data through the internet. The system components were soldered on a breadboard, and cased inside a plastic container with the heart pulse sensor stretched, so as to be clipped on the fingertip of the system's user. Experimental results demonstrate that the resting heartbeat rate of children below the age of 17 is between 65 to 115 beats per minute (bpm) and the resting heartbeat rate of an adult between the ages of 17 to 60 is 60 to 100 bpm. In addition, the resting heartbeat rate of old people who are 60 years old and above, their heartbeat rate is between 65 to 120 bpm. These findings are in agreement with the state-of-the-art in the medical field. Furthermore, this research paper presents an approach that is flexible, reliable, and confidential for heartbeat rate monitoring and control system using sensor network and IoT technology which can be deployed to the medical field to assist the medical practitioners in doing their work easily.*

Keywords: sensor network; internet of things (IoT); heart pulse sensor; heartbeat rate; monitoring and control; smart framework; beats per minute (bpm).

1. INTRODUCTION

Due to the advancement in Technology in the field of Medical Science it has become much easier to determine different parameters of a patient through electronic machine-like Heart rate, temperature etc. One such electronic device is Heart rate monitoring System. In this project we will measure different parameters of a patient and display them on LCD. These parameters can be shown on global as well as local server. The component required are Arduino Uno, lcd, analog heart beat sensor and a WIFI module. Heart rate is simply measured by placing the thumb over pulse sensor for few seconds till the analog value is received by Arduino. Heart rate is then taken for 5 seconds to calculate heart rate per second. Then this value is multiplied by 60 to get heart rate in bpm (beats per minute). This method although simple, is not accurate and can give errors when the rate is high. Recently, public health has received a lot of attention due to the rapid growth of population and the high cost of medical care. It is an obvious fact that organized health care the monitoring system can detect, monitor, and control abnormal health conditions in real time, and provide a diagnosis based on patient data taken. An important method of diagnosing heart-related diseases is the use of an ECG to monitor the signal. However, ECG devices rely on a mobile application for data collection and visualization. The Internet of Things (IoT) plays an important role in our daily lives. It provided the means where many of the devices and equipment used today can be rented and remotely controlled externally human intervention. regularly measured to ensure health and wellness

2. LITERATURE SURVEY

Different researchers used different methods and technologies to carry out the process of heart rate monitoring. Some of the important research works are reviewed in this paper.

In this research paper heart-rate signals were collected from finger or ears using IR TX-RX (Infrared Transmitter and Receiver pair) module which was amplified in order to convert them to an observable scale. A low pass filter was used to filter inherent noise. These signals were counted by a microcontroller module (ATmega8L) and displayed on the LCD. Microcontroller is programmed with an algorithm to run the proposed heart rate counting system. The results obtained using this process when compared to those obtained from the manual test involving counting of heart rate was found satisfactory. The proposed system is applicable for family, hospital, community medical treatment, sports healthcare and other medical purposes. Also, fit for the adults and the pediatrics. However, this method in the developed system needs further investigation and need more functionality, which may be useful to consider advance in future research.

This paper includes working on a wirelessly display of Heart beat and temperature based on a microcontroller ATmega328 (Arduino Uno). Most monitoring systems that are used in today's world works in offline mode but our system has been designed in such a way that a patient can be monitored remotely in real time. This system consists of sensors which measures heartbeat and body temperature of a patient which is controlled by the microcontroller. Both the parameters are displayed in LCD monitor. The transmitted data is wireless and is send through microcontroller. Heartbeat is counted through pulse sensor in Beats per Minute while the temperature sensor measures the temperature and both the data are sent to the microcontroller for transmission to receiving end. Finally, the data are displayed at the receiving end. This system could be made available at a reasonable cost with great effect and accuracy.

This research paper shows GSM enabled real time heart rate monitoring system. GSM system is used for communicating the abnormalities in heat rate values. Unusual change in the values of any of these parameters from their set point values will be immediately sensed and local help is sought from the nearby people. If any help is not available, this system sends SMS directly to home, doctor or care taker's mobile phone. Heart rate is the

number of heat-beats per unit of time, simply expressed as beats per minute (bpm). An attempt is made to design and develop a system that uses a simulator circuit to diagnose abnormalities in the heart rate which includes Tachycardia and Bradycardia conditions. It is a two-directional communication system in which the care taker or Doctor, can also send SMS to know the present parameter status of the person or patient.

In this research paper implementation of heartbeat monitoring and heart attack detection system using Internet of things is shown. These days we saw an increased number of heart diseases & heart attacks. The sensor is interfaced to a microcontroller that allows checking heart rate readings and transmitting them over internet. The user may set the levels of heart beat limit. After setting these limits, the system starts monitoring and as soon as patient heart beat goes above a certain limit, the system sends an alert to the controller which then transmits this over the internet and alerts the doctors as well as concerned users. Also, the system alerts for lower heartbeats. Whenever the user logs on for monitoring, the system also displays the live heart rate of the patient. Thus, concerned patients may monitor heart rate as well get an alert of heart attack to the patient immediately from anywhere and the person can be saved on time.

In this research paper, the design and development of a microcontroller-based heartbeat and body temperature monitor using fingertip and temperature sensor is shown. The device involves use of optical technology to detect the flow of blood through the finger and offers the advantage of portability over conventional recording systems. Wireless body area network based remote patient monitoring systems have been presented with numerous problems including efficient data extraction and dynamic tuning of data to preserve the quality of data transmission. Evaluation of the device on real signals shows accuracy in heartbeat measurement, even under intense physical activity. This paper presents these challenges as well as solution to these problems by proposing an architecture which allows a network to be formed between the patient and doctor in order to enable remote monitoring of patient by analyzing the data of patient. The device consists of sensors which are used to measure heartbeat as well as body temperature of a patient and it is controlled by a central unit. The readings from these sensors are further processed and sent via GSM module to a remote location where it is displayed on cell phone. The optical heartbeat sensor counts the heartbeat per minute and temperature sensor measures the temperature from the body and both the measured data are sent to a receiving end utilizing wireless technology where the data is displayed in a cell phone for further processing and patient care. This device is shown superior in comparison to traditional systems.

In this research paper, it is shown that the heart rate can be measured by monitoring one's pulse using specialized medical devices such as an electrocardiograph (ECG), portable wrist strap watch, or any other commercial heart rate monitors. Despite of its accuracy, somehow it is costly, involve many clinical settings and patient must be attended by medical experts for continuous monitoring. For a patient whom already diagnosed with fatal heart disease, their heart rate condition has to be monitored continuously. This paper proposed an alert system that able to monitor the heart beat rate condition of patient. The heart beat rate is detected using photo plethysmograph (PPG) technique. This signal is processed using PIC16F87 microcontroller to determine the heart beat rate per minute. Then, it sends SMS alert to the mobile phone of medical experts or patient's family members, or their relatives via SMS. This will also alert the family members to quickly attend the patients.

3. HEART RATE MONITORING SYSTEM IMPLEMENTATION

Hardware Architecture

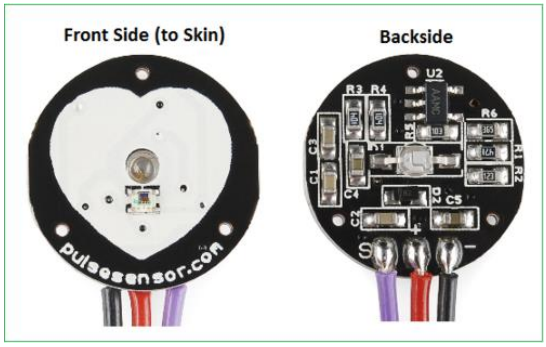
Components:

A. OLED 128*32:

These displays are small, only about 1" diagonal, but very readable due to the high contrast of an OLED display. This display is made of 128x32 individual white OLED pixels, each one is turned on or off by the controller chip. Because the display makes its own light, no backlight is required.

B. Pulse Sensor

Pulse sensor has three pin and connection of it with Arduino is very easy. Connection is made through 5V supply provided by Arduino, the ground pin of the pulse sensor is connected to the ground of the Arduino and the signal pin to the A0 of Arduino.



C. ArduinoUno,

Connect pin 1 (VEE) of the LCD to the ground.

Connect pin 2 (VCC) to the 5V.

Connection of pin 3 (V0) is made with middle pin of the 10K potentiometer and then other two ends of the potentiometer to the VCC and the GND. The potentiometer is used to control the contrast of the LCD. Potentiometer of values other than 10K will also work.

Pin 4 (RS) is connected to the pin 12 of the Arduino.

Pin 5 (Read/Write) is connected to the ground of Arduino.

Connection of pin 6 (E)is made to the pin 11 of the Arduino. The RS and E pin are used to send data and characters and act as control pins.

The following four pins are data pins which are used to communicate with the Arduino.

Pin 11 (D4) is connected to pin 5 of Arduino.

Pin 12 (D5) is connected to pin 4 of Arduino.

Pin 13 (D6) is connected to pin 3 of Arduino.

Pin 14 (D7) is connected to pin 2 of Arduino.

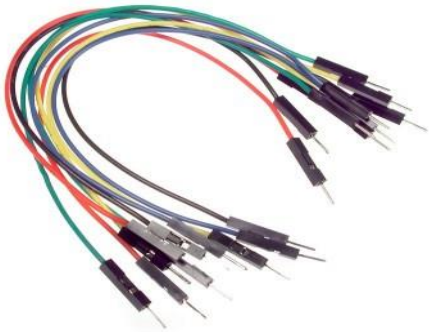
Connection of pin 15 is made to the VCC through the 220- ohm resistor. The resistor will be used to set the back-light brightness. Larger values will make the back light much darker.

Pin 16 is connected to the Ground

A complete circuit of heart beat monitoring system is shown below fig 4

D. Connecting Wires

Jumper wires are used for making connections between items on your breadboard and your Arduino's header pins. We can use them to wire up all your circuits and Buy jumper wires from Amazon, Spark Fun, Adafruit, or Newark.



Software Architecture

Components:

A. Proteus Software

Proteus is used to simulate, design and drawing of electronic circuits. It was invented by the Lab centre electronic. By using proteus you can make two-dimensional circuits designs as well. With the use of this engineering software, you can construct and

simulate different electrical and electronic circuits on your personal computers or laptops.

There are numerous benefits to simulate circuits on proteus before make them practically.

Language Used: C

C is a powerful general-purpose programming language. It can be used to develop software like operating systems, databases, compilers, and so on. C programming is an excellent language to learn to program for beginners.

4. RESULTS & DISCUSSION

First, we need to attach the Pulse Sensor to any organ of body where it can detect the pulse easily like finger, ears etc. Then the Pulse Sensor will measure the change in volume of blood, which occurs when every time heart pumps blood in the body. This change in volume of blood causes a change in the light intensity through that organ. The Arduino will then convert this change into the heart beat per minute (BPM). The LED connected at pin 13 will also blink according to the Heart Beat.

The ESP8266 will then communicate with the Arduino and will send the data to Thing speak site which can be made by creating account on it. The ESP8266 will connect the network to router that will provide in the code and will send the data of the sensor online. This data on the Thing speak will be shown in a Graph form showing the past readings too and can be accessed from anywhere over internet. The LCD connected will also show the heartbeat in BPM.

Technological innovations reach deeply into our daily lives and an emerging trend supports the use of commercial smart wearable devices to manage health. In the era of remote, decentralized and increasingly personalized patient care, catalysed by the COVID-19 pandemic, the cardiovascular community must familiarize itself with the wearable technologies on the market and their wide range of clinical applications. In this Review, we highlight the basic engineering principles of common wearable sensors and where they can be error-prone. We also examine the role of these devices in the remote screening and diagnosis of common cardiovascular diseases, such as arrhythmias, and in the management of patients with established cardiovascular conditions, for example, heart failure. To date, challenges such as device accuracy, clinical validity, a lack of standardized regulatory policies and concerns for patient privacy are still hindering the widespread adoption of smart wearable technologies in clinical practice. We present several recommendations to navigate these challenges and propose a simple and practical 'ABCD' guide for clinicians, personalized to their specific practice needs, to accelerate the integration of these devices into the clinical workflow for optimal patient care.

Key points

• Smart wearables generate a plethora of data through various sensors and software algorithms and understanding their basic engineering principles and limitations can be helpful for clinicians and scientists.

• Evidence supports the use of wearable devices in cardiovascular risk assessment and cardiovascular disease prevention, diagnosis and management, but large, well-designed trials are needed to establish their advantages.

• Several challenges still hinder the widespread adoption of wearables in clinical practice, including a concern for device accuracy, patient privacy and cost, and how to separate actionable data from noise.

• Overcoming these challenges requires that various stakeholders come together to develop comprehensive evaluation frameworks, pragmatic regulatory policies, clinical trials and medical education curricula.

5. CONCLUSION

• In our heart rate monitoring system through IOT, data related to patient's heart rate is collected via finger print sensor through Arduino board. This data is transferred on both Global as well as local server. A local server is created by html page and global server is connected via Think Speak software. Think speak provides a good platform for storing and analyzing data through Wi-Fi module. Since a normal heart beat of a person is 72 approx. if it is less than 60 then it will show Bradycardia and if it is greater than 90 then it will show Tachycardia. it was found that the resting heartbeat rate of children below the age of 17 is between 65 to 115 bpm and the resting heartbeat rate of an adult between the ages of 17 to 60 is 60 to 100 bpm. In addition, the resting heartbeat rate of old people who are 60 years old and above, their heartbeat rate is between 65 to 120 bpm. These findings are in agreement with the state-of-the-art in the medical field. Furthermore, this research paper presents an approach that is flexible, reliable, and confidential for a heartbeat rate monitoring and control system using sensor network and IoT technology. The implemented device prototype can be deployed to the medical field to assist the medical practitioners to efficiently and reliably do their work without difficulties. Biomedical engineering (BME) combines the design and problem-solving skill of engineering with medical and biological sciences to improve patient's health care and the quality of life of individuals. Cardiovascular disease is one of the major causes of untimely deaths in world, heart beat readings are by far the only viable diagnostic tool that could promote early detection of cardiac events[13].By using this we can measure one's heart rate through fingertip. This paper focuses on the heart rate monitoring and

alert which is able to monitor the heart beat rate condition of patient. The system determines the heart beat rate per minute and then sends short message service (SMS) alert to the mobile phone. It is portable and cost effective. It is a very efficient system and very easy to handle and thus provides great flexibility and serves as a great improvement over other conventional monitoring and alert systems.

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