Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 18698 - 18704
Received 25 April 2021; Accepted 08 May 2021.

A Home Kit for Heart Disease Prediction Basedon IOT during pandemic time

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ABSTRACT

Nowadays during pandemic time many people are mislaying their health due to heart disease and lack of medical observation to the patient at the correct stage. A low cost home kit can be handy for the patients. With the technology development, the paper focuses on a simple pulse monitoring and attack identification system using IoT. The pulse rate sensor will check heartbeat readings and transfer the same to the webserver. The user can set the high and low threshold points for heart rate. After setting threshold points, the system will monitor the patient's heartbeat. If the readings are not within the limits set, the system will alert the patient about the coming heart disease.The purpose of this arrangment is to teach the patients how to assemble and take readings if the hospital facility is not available near to the area.

Keywords
Monitoring, Threshold points, Limits

Introduction

These days many are losing their lives due to unusual heart attacks, and they occur due to non-uniform heart rate. If the heart disease is detected very late, we cannot save the life of that patient. In this paper, the design focuses on a system that helps to detect heart disease using IoT. For an average healthy adult, an ordinary heart rate is 60 to 100 beats per minute. Athlete's heartbeat generally ranges from 40 to 60 bpm(beats per minute) depending upon their fitness and obesity. If the patient's heart rate is constantly beyond the upper threshold, the person can get heart disease. If the blood pump rate is down or the amount of blood pumped is low, it causes chest pain[8]. Nowadays, due to advancements in technology, it is easily possible to check blood pressure at any place. IoT is the skill of network mechanism to intellect and gathers information from various places worldwide and then shares the information through the internet. Anywhere it can be managed for some tenacity. There are many deaths due to cardiovascular diseases. When predicting these critical conditions fails at first instance, it is too risky. Moreover, in remote locations and places like rural areas, many emergency ambulance services are complicated. So earlier predictions are suitable. The proposed system is more associated with connected smartphone applications and web server-based applications on smartphones, and a web page connecting with a sensible IoT device allows sharing of resources. Then upload the data into the webserver and predict the disease early, even before the attack—an IoT-based intelligent cyber-human system for heart abnormality prediction using unusual heart rates. A sensor connected to smartphones and a web application gets developed based on a heart disease monitoring system. The system is a highly efficient and low-power rated communication instrument to develop and implement the same. It helps us to develop a mobile system for remote monitoring and detecting health conditions[11].

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Literature Review

Heart rate measuring helps to find cardiovascular diseases in a person. It is preferable to monitor the heart rate for better health continuously. Generally, we use a stethoscope, digital pressure monitors for checking. In emergency cases, we use any of these methods to check and intimate the heart attack [1]. Lack of blood for heart muscle leads to a heart attack. The blood is carrying oxygen and essential nutrients to the heart. Due to many years of smoking, drinking, and cholesterol lead to blockage of blood [2]. If the blood flow stops for a more extended period to the heart, it leads to severe damage and may lead to fatality. 60-100 beats per minute (BPM) is the average heartbeat of adults [1]. Cardiac Arrhythmias is the case or condition where the people prone to get cardiac arrest may feel irregularities in the heartbeat, which is a sign of attack [2]. PVC is the most dangerous thing to happen. Extra beats disturb the regular heartbeat rhythm, and therefore missing heartbeats lead to heart strokes, dizziness.

A heartbeat has been monitored with a simple tool. A 5volt power supply is being utilized to make it user-friendly and portable [1]. Heart rate means the number of times or beats of the heart per minute, usually expressed n beats per minute(bpm). The heart's primary function is to carry blood with rich oxygen to the muscles and carry waste products from the tissues [2]. The heartbeat may vary from situation to situation based on the need for oxygen and excretion of carbon dioxide, which happens in a particular situation like sleep or exercise and differs between individuals based on age, fitness, and genetics. This paper gets used to giving patients proper health care [2]. Measurement could show the condition of the heart in any situation. The average heartbeat for a healthy adult is 60-70 bpm. It is a bit slower for an athlete as he/she needs to maintain a heartbeat [3]. The heartbeat of babies is very much higher than adults, 120 - 160, and for children is 115 - 140. Any change in the heart rate, which is lower than the standard rate, is called bradycardia. If it is higher, it is called tachycardia. Generally, the heart rate gets measured by placing a finger above the pulsing artery. Here add count pulse done in 30 seconds, and bpm multiplying it. However, there are some disadvantages in it, and it is low accurate when artery pulse is high. Electrocardiogram Machine usage is the most accurate method to find the heart rate but is expensive [4] since the Heart attack became the primary reason for causing unexpected deaths. There are not enough doctors to treat them in advance. So, this paper suggests a tool that collects different data for heart diseases as medical data. Data mining is used to treat different data sets and for large and massive data. The diagnosed result taken from all the combined techniques is accurate [5]. The heart's primary function is to carry blood with rich oxygen to the muscles and carry waste products from the tissues. The heartbeat may vary from situation to situation based on the need for oxygen and excretion of carbon dioxide, which happens in a particular situation like sleep or exercise and differs between individuals based on age, fitness, and genetics [6]. This paper aims to help patients proper health care. Measurement could show the condition of the heart in any situation. This paper also provides detecting heart attacks and intimate the occurrence of attacks to family or hospital through a wireless GSM module. Heartbeat signals get measured by using a pulse sensor [7].

Methodology

The proposed system helps to detect heart attacks using IoT. This method uses a heart rate sensor,

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an Arduino UNO board containing an ATmega328 controller, and a Wi-Fi module. After setting up the connections, the pulse sensor will sense the heartbeat rate, and the same gets displayed on LCD. The Wi-Fi module in ESP8266 will transmit the heart rate to the connected mobile or web application. The system user is allowed to set the threshold points to distinguish between healthy and unhealthy people. After setting these points, the system will monitor the heart rate of the patient[10]. An alert gets sent if the heart rate is not in the range set. So, this paper will help the individual to maintain his heart's health in good condition. Heart rate measuring helps to find cardiovascular diseases in a person[9]. Therefore, it is preferable to monitor the heart rate for better health continuously. Generally, a stethoscope, digital pressure monitors are used for checking the heart rate. In case of emergency, any of these methods need to check and intimate the heart attack.The blood is carrying oxygen and essential nutrients to the heart. However, due to many years of smoking, drinking, and cholesterol, it leads to blockage of blood. If the blood flow stops for a more extended period to the heart, it leads to severe damage and may lead to fatality. 60-100 beats per minute (BPM) is the average heartbeat of adults. Cardiac Arrhythmias is when the people prone to get cardiac arrest may feel irregularities in the heartbeat, which is a sign of attack. The heartbeat may vary from situation to situation based on the need for oxygen and excretion of carbon dioxide, which happens in a particular situation like sleep or exercise and differs between individuals based on age, fitness, and genetics. This paper focused on giving patients proper health care.The average heartbeat for a healthy adult is 60-70 bpm. It is a bit slower for an athlete as he/she needs to maintain a heartbeat. The heartbeat of babies is much higher than adults, 120 – 160, and 115 - 140. Any change in the heart rate, which is lower than the standard rate, is called bradycardia; conversely, if it is higher, it is called tachycardia. Generally, the heart rate is measured by placing the finger above the pulsing artery and counting the pulse in 30 seconds, and bpm can include by multiplying it. However, there are some disadvantages in it, and it is low accurate when artery pulse is high. The electrocardiogram is the most accurate method to find the heart rate but is expensive. The heart's primary function is to carry blood with rich oxygen to the muscles and carry waste products from the tissues. The heartbeat may vary from situation to situation based on the need for oxygen and excretion of carbon dioxide in a particular situation like sleep or exercise and differs between individuals based on age, fitness, and genetics. This paper realizes that the measurement could show the condition of the heart in any situation. This paper also detects heart attacks and intimate the occurrence of attacks to family or hospital through a wireless GSM module. Heartbeat signals took by using a pulse sensor[8], [9]. This device helps to send and record the user's heart rate values for every interval of time. From the recorded values, we can find the condition of the heart whether there is any abnormality. In figure Fig.1, the Arduino module contains a heart rate sensor that reads the heart rate values and sends them to Arduino using an amplifier to strengthen the signal for reducing the signal loss during transmission. In addition, the Arduino connects to ESP8266 which contains a Wi-Fi module. The Arduino is interfaced with ESP8266 using Logic Level Converter to convert the signal from Arduino to a signal that can transmit over Wi-Fi medium. The signal gets transferred to a mobile/web application contained PC/mobile to which the Wi-Fi module plugs to the hotspot.Then, in the mobile/web application, we log in with the Previously created credentials. Finally, we use the received signal to measure the condition of the heart. Those values have displayed the application and also displayed in the LCD, with the support of Arduino. The kit turns on the Wi-Fi module, and it gets connected to the mobile/PC's Hotspot. It shows in the display status of connected to the server. After the successful connection, it will show the readings such as heart rate, temperature, SPO2 percentage, and heart condition in

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the LCD. The values are sent to the cloud using MQTT protocol over Wi-Fi.

Implementation

The steps followed as shown in the block diagram of figure 1.

Step 1: Include the necessary library files and define the Digital PINs of the Arduino.
Step 2: Define the Minimum and Maximum threshold points for Heart Rate, SPO2, Temperature.
Step 3:Then, declare and define the functions for reading and writing registers, SPO2, and temperature sampling.
Step 4:Define the primary function and configure the LCD Display to show the required information such as Wi-Fi status, ESP status, MQTT status, and Server connection status.
Step 5:Now, read the signals receiving from the heart rate sensor, which contains BPM, SPO2, Temperature.
Step6:Define the levels for the condition of the heart as ABNORMAL, NORMAL, ERROR, LEVEL 1, LEVEL2.
Step 7: After that, set the conditions using BPM, SPO2, and temperature for identifying the levels set previously.
Step 8: Later, the heart rate sensor readings and the condition of the heart get displayed in the LCD Display.
Step 9: Then, the values are sent to the server using the MQTT protocol and accessed from the application.

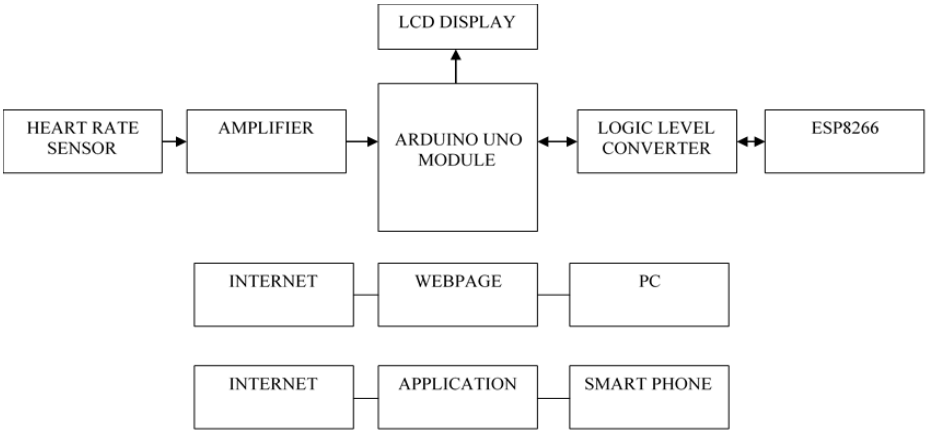

Figure 1. The Block representation of the System Arrangement

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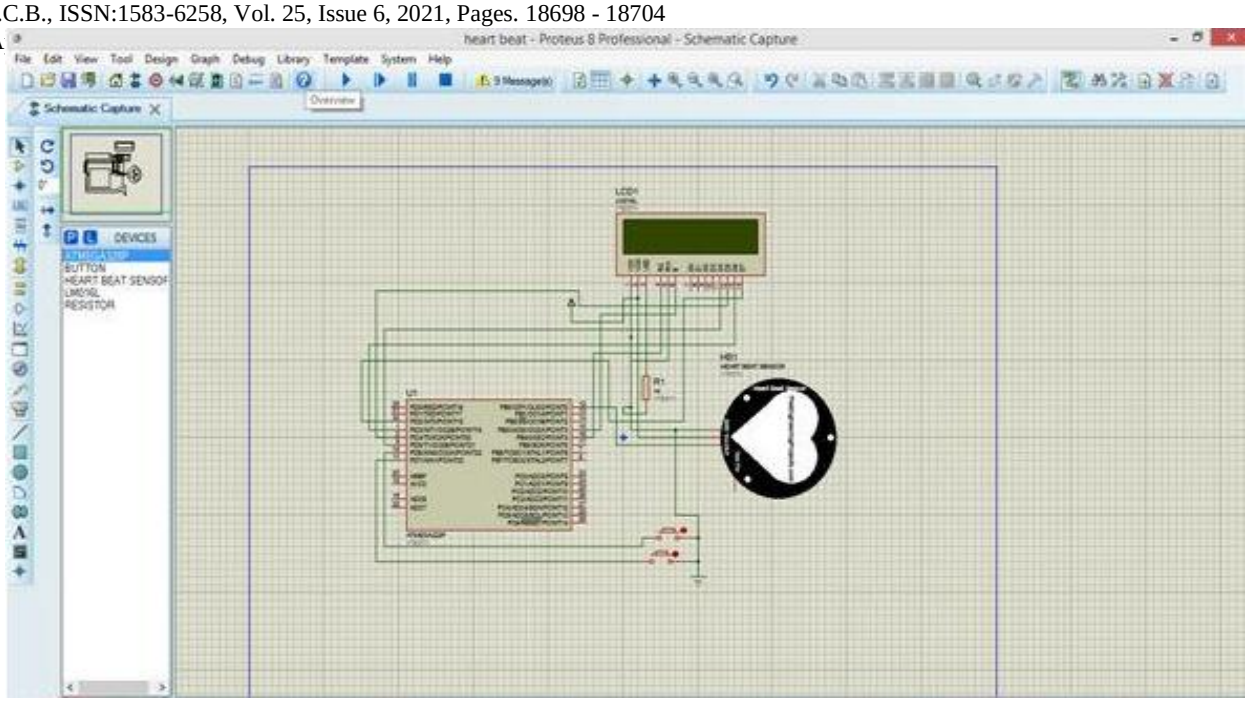

Figure 2. Schematic Arrangment of the System in proteus

In Fig. 2, the simulated circuit diagram and figure 3 shows that Arduino gets interfaced with many components like Pulse Sensor, Wi-Fi Module, LCD Display. For example, the seventh PIN of Arduino needs to engage to the Pulse Sensor at Node S. It measures the pulse rate and heart rate (BPM). Moreover, the third PIN interfaces with the supply of Pulse Sensor and VCC of LCD Display. Transmitter and Receiver PINs of the Arduino interact with the Receiver and Transmitter PINs of the Wi-Fi Module.It paves the way for the system to communicate with the database to fetch the results. Furthermore, the digital PINs (4, 5, 6, 7, 8, 9) of Arduino connects with the Data PINs (D3, D4, D5, D6, D7) of LCD Display. The Wi-Fi module adapts to configured with the user's mobile through the hotspot, which uses the mobile Internet connection to send the information to the cloud with registered mail, which gets accessed by an application in the user's mobile.

Result and Data Analysis

Table 1. Data Representation

S:No	BPM	SPO2	(%)	Temperature (ºC)Condition of Heart
1	63	99	34.93	NORMAL
2	102	98	35.62	LEVEL 2
3	45	95	38.15	ABNORMAL
4	68	98	36.56	NORMAL
5	55	96	34.31	LEVEL 1

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The above system was implemented based on IoT. The Fig. 3 consists of the different readings from the kit. Here the readings are noted for different conditions of the heart. When the heart rate is below 40 and the SPO2 percentage is irregular, the person's heart condition is abnormal. When no finger is recognized by the sensor, then it will show the status as ERROR. If the heart rate is in between 60 and 100 and SPO2 percentage is between 97 and 99, then the status is normal.

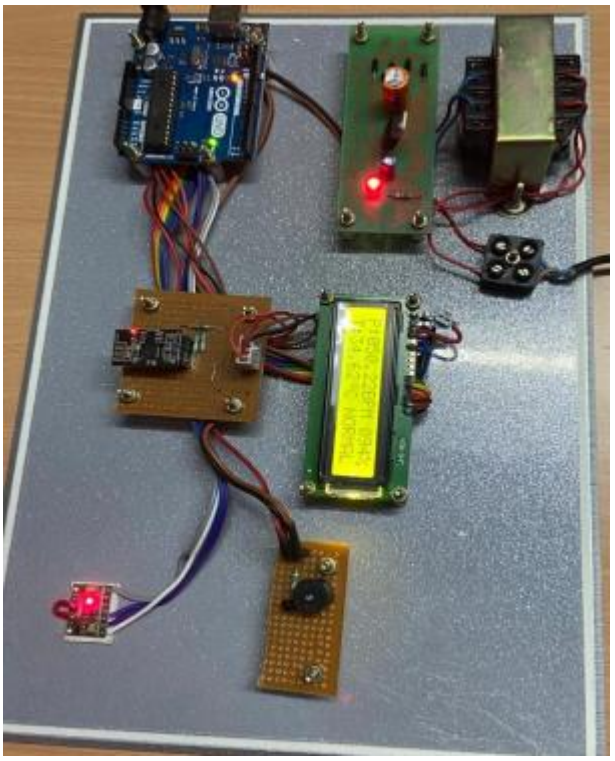

Figure 3. Hardware setup

Conclusion

The attempts here helps to improve the patient-doctor relationship through web applications. The approach helps to reduce the cost compared to instruments used before. Since the investment for instrument needed only once, this will reduce other immediate hospital charges. This system can also be capable of sending alerts through email.

Limitations and Future Studies

The Device is set up without any casing, and therefore Electromagnetic Interference and noise will be included when measuremnts are taken. A suitable packaging is planned to bring the casing free from Noise.With the help of deep learning algorithms , the future system can be more trained to predict pateient state suffering from heart disease.

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Acknowledgement

The Work is done at Linear Digital Integrated Circuits Laboratory of Kalasalingam Academy of Reserch and Education.

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