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Heart Pulse Rate Detection and Alerting Using Arduino with GSM Module

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Abstract. Respiratory problems are known to be one of the fatal conditions leading to human death. Regular health check-ups can help in early detection of various diseases. Coronary syndromes have claimed many lives, and during the current coronavirus period, doctors may not be able to physically meet and treat patients unless the situation is critical. To address this issue, we have developed an Internet of Things (IoT) system to assist individuals and provide immediate treatment. Our system utilizes a pulse sensor that calculates the person's heartbeat when a finger is placed on it. It consists of two main components: hardware for heartbeat calculation and continuous monitoring of the collected heartbeat data. The pulse sensor is connected to an Arduino UNO, which allows us to monitor the heartbeat and transmit the data to the internet using a GSM module. The collected data is sent to an SMS service via a SIM card and Arduino, enabling continuous monitoring of the heartbeat for any abnormalities. The user can set a threshold limit, and if the patient's heartbeat exceeds this limit, an SMS is sent to the doctor or client, providing them with the patient's current heartbeat information. This automated system allows for remote monitoring of a patient's heartbeat and provides an immediate response based on the heartbeat data.

1. INTRODUCTION

The COVID-19 pandemic has presented numerous challenges for everyone, particularly patients, with one of the most affected groups being those who require regular monitoring of their heart rate by doctors. The outbreak has led to a breakdown in communication between these patients and their healthcare providers or caregivers. The situation has been exacerbated by the global implementation of lockdown measures, which has further complicated matters for these patients. The human heart is a vital organ responsible for maintaining the proper functioning of the body's systems. It ensures the circulation of blood to various organs such as the lungs and kidneys. A normal heart rate typically falls within the range of 60 to 100 beats per minute. When a person's heart rate exceeds 100 beats per minute, it is referred to as tachycardia. It is important to note that an elevated heart rate can lead to a decrease in the heart's efficiency and may eventually contribute to cardiovascular ailments, including heart attacks. Therefore, frequent monitoring of the heart's condition is crucial in order to mitigate the risk of cardiac diseases.

FIGURE 1. Heart pulse rate detection and alerting using Arduino with GSM module

This research paper discusses the utilization of GSM technology for heart rate monitoring. It focuses on monitoring patients with heart disease at regular intervals. A pulse oximeter, which serves as the heart rate sensor, is connected to a GSM modem to transmit the heart rate readings to the user interface. The sensor detects the blood circulation rate with each heartbeat, allowing for the calculation of the heart rate per minute. This calculated value is compared to a predetermined threshold, and an alert message is sent to the relevant individual. This device can be used to measure and monitor heart rates across different age groups, from children to the elderly. Cardiovascular disease is a leading cause of death globally, accounting for over 15 million fatalities. Additionally, millions of individuals are left disabled by heart-related conditions. The elderly population is particularly vulnerable to heart problems, often living alone without constant monitoring. In this proposed device, patient heart rates and temperatures are measured using analog sensors, which are then converted into digital data through an analog-to-digital converter (ADC) for wireless transmission via SMS messages using a GSM modem. The microcontroller device is employed for temporary data storage prior to transmission. For patients already diagnosed with critical heart conditions, continuous monitoring of their heart rate is crucial. This project focuses on designing a heartbeat monitor that can continuously track the patient's heart rate condition. The microcontroller processes the signal to determine the heart rate per minute, and an SMS alert is sent to medical professionals, the patient's family members, or relatives, providing information on the patient's condition and any abnormalities detected. This enables doctors to continuously monitor and diagnose the patient, allowing for early precautions and prompt attention from family members.

2. LITERATURE SURVEY

Mr. Kuo-Kai Shyu has suggested the utilization of Ultra-wideband (UWB) radio detection and ranging, which is extensively employed in various sensing signal applications. It is commonly used in wireless networking and consumes low power while allowing for a larger bandwidth. UWB remote sensing can also assist in identifying respiratory and cardiac issues. (IEEE 2018). Naoki Hagiyama has presented a paper on monitoring signals by utilizing the aortic blood vessels to extract organic signals from arterial waves. The sensor is placed near the heart valve to detect any blockages or other issues in the human body. Another method discussed is catheter insertion, which aids in identifying health disorders over a period of time. (IEEE 2018). Renevey has proposed a wearable watch system for evaluating the respiratory and cardiac systems during nighttime. Sleep monitoring is employed to observe sleep patterns throughout the day, and this paper focuses on noting respiratory and cardiac problems. The wearable watch serves as an emergency monitor for measuring patients' health, particularly during the night. (IEEE 2018). Mark Gardner and Sharmil Randhawa have introduced a model called "A changed Mask for Continuous Viscous Observation throughout Positive Airway Pressure Therapy." The paper describes the use of a pressure mask with an ECG device for enhanced application. Measurement of signals is done using an oximeter to determine blood oxygen levels. Viscous observation refers to the fluid resistance flow in the blood. Positive airway pressure therapy is beneficial for treating various disorders in the human body. (2018). Raja Lavanya and M. Nivetha have proposed a system called "Smart Chair - A Telemedicine Based Health Monitoring System using a pulse sensor." This project incorporates a smart chair for monitoring, with telemonitoring and additional features. It is particularly useful for addressing emergency health issues and ensuring comfortable monitoring of aged patients. The system can be connected through GSM, Bluetooth, Wi-Fi, and other network connections. (IEEE 2018).

3. PROPOSED METHOD

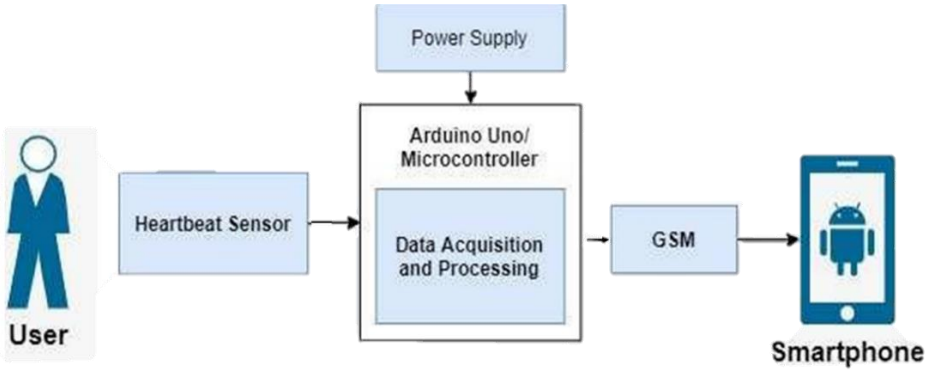

FIGURE 2. block diagram of heart pulse rate detection and alerting using Arduino with GSM module

Whenever the 12v, 1Amp power supply is applied to Arduino based on the voltage regulator it takes the power required (5v). Now the pulse sensor which consists of 3 pins (signal, Vcc, ground), APDS 9008 light photo sensor and reverse mount led, which are connected to the analogy pin (A0) of the Arduino Uno gets active by connecting 3.3v or 5v pin of Arduino. Now it starts emitting the IR rays which has 550nm wavelength by APDS 9008 light photo sensor. When a finger is pressed against the sensor, the APDS 9008 light photo sensor emits rays that are reflected back by the oxygenated haemoglobin in arterial blood. This haemoglobin has the ability to absorb green light. The level of absorption depends on the richness of the blood's redness, which is determined by the amount of haemoglobin present. As the heart beats, blood is circulated through the finger, resulting in fluctuations in the amount of light reflected. This reflected light is captured by the reverse mount LED, causing changes in the waveform. As we all known the normal human heart pulse rate is 60 – 100 beats per minute. In our project we have set a threshold value of 550 i.e. when it comes to Arduino it sense the value and multiplies it with 5 because of internally we used MCP6001 Op-Amp to avoid noise and to get a good effective output by this the heart rate is multiplied by 5. So by this in Arduino the approximate normal human heart rate is 500 – 545 we choose it as threshold value. Whenever the heart pulse rate of user will more than the threshold value, the Arduino compare the values, usually the values will stored in the form of ASCII values. Now due the heart pulse rate is more than the threshold value the GSM module which is connected as per the configuration shown above in table, we are using GSM module 900a in the name it given it has a frequency of 900/1800mhz. It can operate in the baud rate of 1200 – 11520.

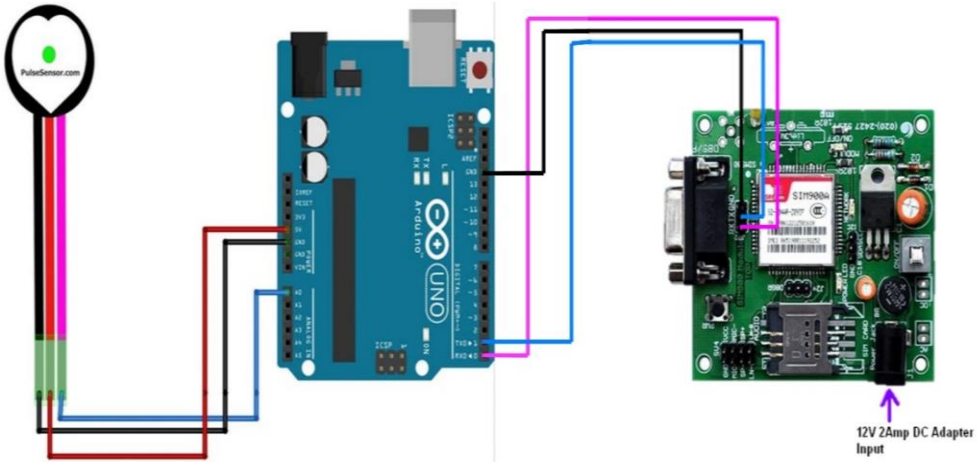

FIGURE 3. Circuit Diagram

4. RESULT

Normal Heart Rate: Instead of going to analyses result directly, now we take a normal heart rate graph as a reference. Based on the reference we will analyses the result, as we know the normal heart pulse rate is 60 – 100 beats per minute but when we use a pulse sensor to detect the heart rate due the existence of internal amplifier and rc circuit to avoid noise by that the result will be multiplied by 5. So, by this the threshold value of the heart rate is 550 based on the pulse sensor.

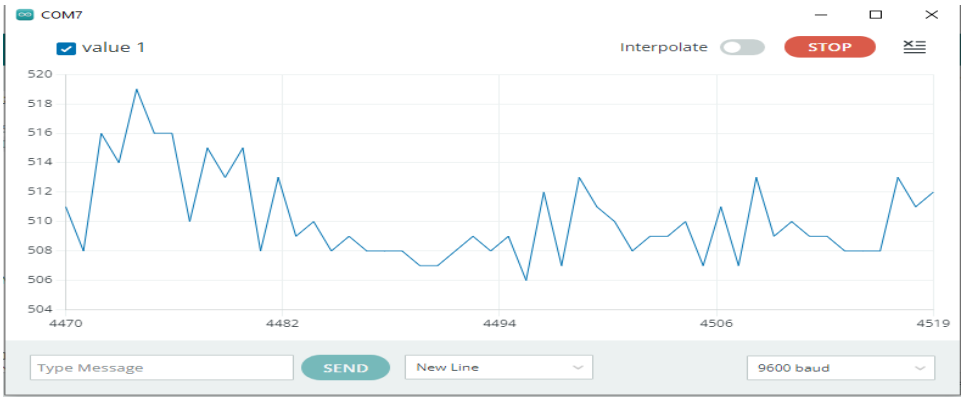

FIGURE 4. Serial plotter of normal heart pulse rate

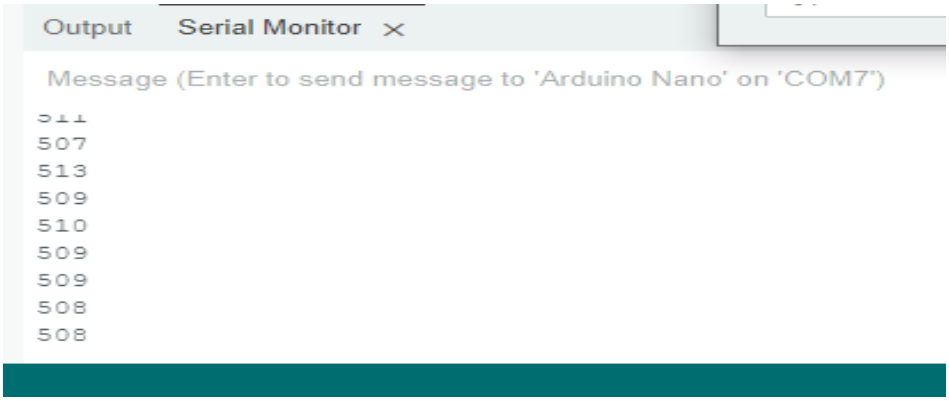

FIGURE 5. Serial monitor of normal heart pulse rate

In this case -1 the pulse is within the threshold value, so we consider that this heart rate is normal and no command will be passed to GSM module to get active and no message alerts.

Random Person: When a person's heart beats, it propels blood throughout their body, which is then forced into the capillary tissues. As a result, the volume of these tissues expands. However, during the interval between two consecutive heartbeats, the volume within the capillary tissues decreases. This fluctuation in volume between heartbeats has an impact on the amount of light that can pass through these tissues. By utilizing an Arduino Uno, it becomes possible to measure this variation in transmitted light.

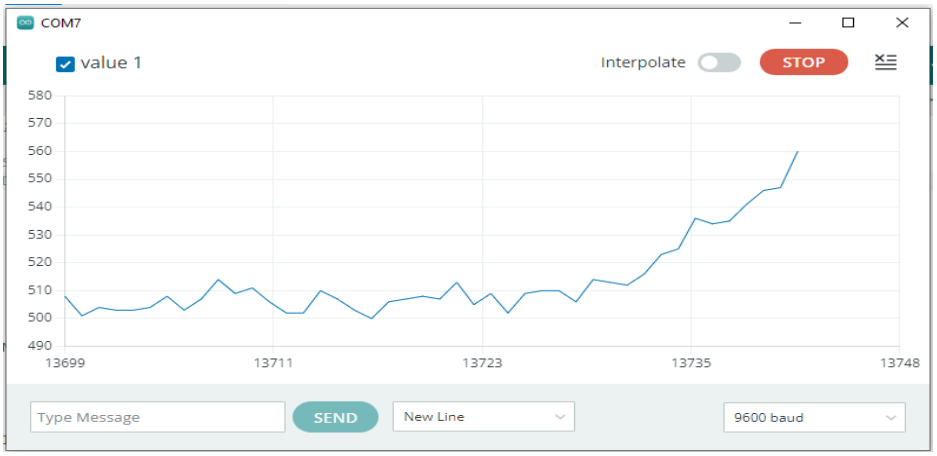

FIGURE 6. Serial plotter of random heart pulse rate

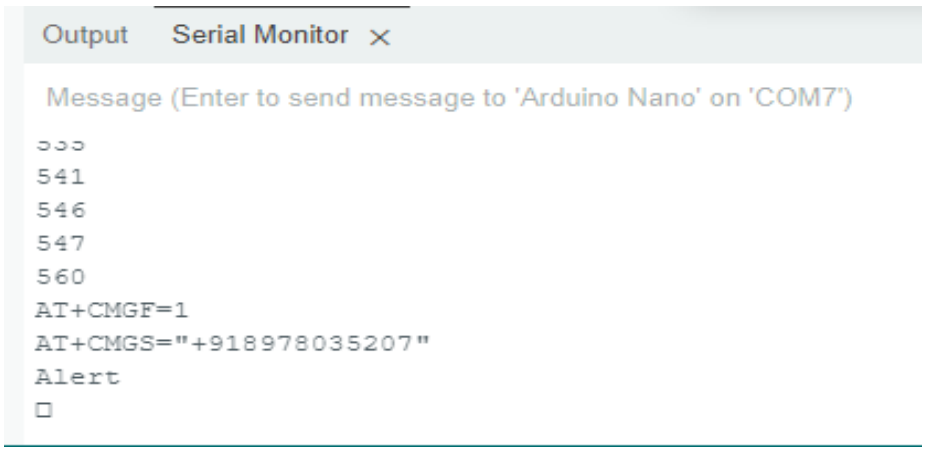

FIGURE 7. Serial monitor of random heart pulse rate

In case - 3 by observing the serial plotter, we can get a clean view that the pulse crosses the threshold value then automatically Arduino uno sent an active pulse command to the GSM module to get the module active then it will

send a SMS to the registered mobile number which is present in code and you can also analyse the heart rate by observing the serial monitor. Now you can see the SMS which is sent by the GSM module to mobile at below

FIGURE 8. Alerting via SMS to mobile

FIGURE 9. Prototype Model

5. CONCLUSION

The Covid-19 pandemic has posed numerous challenges for everyone, particularly patients. Those requiring regular monitoring of their heart rate have been significantly affected by this outbreak. A communication gap has emerged between these patients and their doctors or caregivers. The global implementation of lockdown measures has exacerbated the situation for these patients. In response to this issue, our idea has emerged to assist individuals whose heart rate needs frequent monitoring. Drawing upon our understanding of GSM technology and its applications in the medical field, we extensively researched relevant scientific papers pertaining to our problem statement. The primary objective of our project is to establish a communication bridge between patients and their caregivers or doctors. To accomplish this, we utilized reliable components such as the Arduino Uno, serving as the system's core, a heart rate sensor to detect the patient's heart rate, and a GSM module to establish a mobile connection for transmitting data. Whenever an abnormality is detected in the patient's heart rate, the system sends the data to the designated doctor. We are confident that the implementation of this project will prove beneficial to society.

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