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Web-Based Temperature, Oxygen Saturation, and Heart Rate Monitoring System

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Abstract

Heart rate and oxygen saturation is a tool designed to measure heart rate, oxygen level, and body temperature without any contact with the human body. It is mainly used to assess primary health conditions. Symptoms resulting from a heartbeat are abnormal conditions of tachycardia and bradycardia. Symptoms caused by oxygen levels are ARI and asthma, an irregular breathing condition. Symptoms of an abnormal heart rate and oxygen saturation may indicate disease. Therefore, we created a web-based heart rate and oxygen saturation monitoring system for this study. IoT (Internet of Things) is used to manufacture this tool. This tool is programmed with sensors such as the AMG8833 sensor, the MAX30102 sensor, and the ESP32 microcontroller as a data processor, and the data is sent via a Wi-Fi connection to be read from the sensor. Wirelessly to your website in real-time. The website displays sensor data sent wirelessly from the microcontroller and then stored in a web server database. This data collection or monitoring system makes it easier for us, especially medical personnel, to check the health and analyze the results of data stored in our web server database.

Keywords: Website, IOT, AMG8833, MAX30102, ESP32

1. Introduction

The human body has several important functions. In other words, it is very important for the human body. Vital signs are blood pressure, body temperature, oxygen saturation, pulse, and respiratory rate which have physiological values. These vital signs can be used as indicators of whether a person is healthy or sick[1]. One of the vital signs is heart rate. Heart rate is the heart rate per unit time, expressed in minutes or beats per minute (bpm). Heart rate is a health parameter related to human cardiovascular health. Heart rate per minute can reflect a person's physiological status, including: B[2]. Activity, stress, drowsiness. Healthy, exercising adults usually have a heart rate or pulse rate of around 60 to 100 beats per minute. A very slow



heartbeat is called bradycardia, and a very fast heart rate is called tachycardia. Normal heart disease can be divided into four sections based on the age of the person[3]. The four sections are shown in Table 1.

Table 1. Classification of Heart Rate by Age

Age (Years)	Bradycardia (bpm)	Normal (bpm)	Takikardia (bpm)
<1	<100	100-160	>160
1-10	<70	70-120	>120
11-17	<60	60-100	>100
>17	<60	60-100	>100

Sensors that I use include temperature sensors, heart rate, and body oxygen levels[4]. The main parameters must be checked every hour and the data results obtained through sensors, stored in a database that can access through the website. Health monitoring is needed to allow the medical team to analyze and determine further action based on the results of this monitoring.

Body temperature and heart rate are vital signs of clinical symptoms that are usually checked in the hospital. In some hospitals, this process still uses a manual system to control body temperature and heart rate, requiring nurses to go to the patient's room to record and manage the patient's heart rate and temperature[5]. Wireless monitoring technology can be performed remotely, simplifying the process of monitoring heart rate and temperature[6].

After the researcher evaluates several studies, there are several things related to the research conducted by the researcher. The first research paper that the researchers found was by Rizal Maulana (2018), entitled "Heart Rate Monitoring System Using Node MCU and MQTT." The purpose of this study was to monitor heart rate. This heart rate monitoring system measures your heart rate by reading the rate sensor value[7]. After reading the sensor value, nodemcu processes it to get BPM (beats per minute). After receiving the BPM value, the system checks whether sending SMS is at risk of tachycardia if it exceeds 100 and if sending SMS is at risk of bradycardia if it is less than 60[8]. To do. The system uses MQTT to send BPM data to the Thingspeak channel. The system is always ready to receive a heart rate request SMS, which response to an SMS with a BPM value[9].

The results of the functionality test state that the system is booming, and the test results of heart rate readings show an error rate of 2.6%. This test can send heart rate data to the Thingspeak channel, SMS notifications, and reply to SMS with the latest heart rate readings[10].

The second research that the researcher found was a study by Edita Rosana Widasari (2017) entitled "Implementing a Wireless Heart Rate System and Monitoring Human Body Temperature." The purpose of this study was to provide information in the form of a graph of heart rate per minute, patient temperature, indicators of the patient's heart rate status, and changes in heart rate. This system uses a pulse sensor to detect heart rate, LM35 to detect body temperature, Arduino Nano to process data, and NRF24L01 as a wireless data transmission medium. This system detects heart rate and body temperature in real-time[11]. The processed data is displayed in the application. The information provided by the app includes heart rate per minute, body temperature, and an indicator of the patient's heart rate and body temperature. In addition, the app can save your heart rate and body temperature at any time[12].

From the test results, the success rate of detecting the system's heart rate is 97.17%. This system has a 99.28% success rate in detecting body temperature. As for data transmission, the system can transmit data smoothly at a distance of up to 15 meters with obstacles. When saving to the database, the system can save the heart rate and temperature data as expected[13].

2. Research Method

This research method makes hardware and software[14]. The hardware circuits are the 2004 i2c LCD interface circuit, the 30102 maximum sensor interface circuit, the FireBeetle ESP32 circuit and the amg8833 circuit. For software created using the website. The system block diagram is shown in Figure 1. The following system block diagram[15].

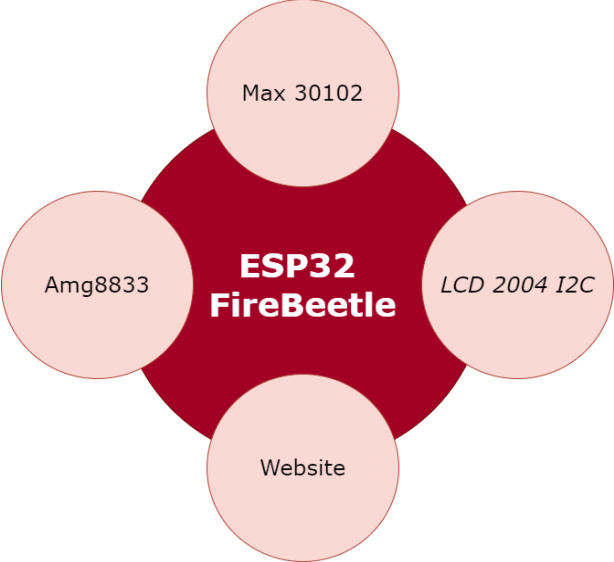


Table1. System Block Diagram

The results of the monitoring carried out by the website are heart rate and oxygen saturation readings from the max30102 sensor readings and body temperature readings from the Amg8833 sensor readings read by the ESP32 FireBeetle microcontroller. ESP32 FireBeetle sends read data to your website so you can monitor your website live anytime, anywhere[16].

Sensor readings use I2C communication, namely communication between two ICs using the SDA (serial data) and SCL (serial clock) pins. The voltage used by this sensor is 5 volts. The SDA pin of the sensor is connected to pin D4 of the ESP32 FireBeetle microcontroller, and the SCL pin of the sensor is connected to D2. The current use of SCL is to control the transmission of sensor data from the sensor via SDA to the microcontroller. The function of this sensor consists of two LEDs, namely a red LED and an IR (infrared) photodetector. Photodetectors located on either side of the probe scatter light through body tissues to the photodetector. Infrared light is absorbed by hemoglobin, which has a high oxygen content, and hemoglobin, which does not contain oxygen, absorbs red light. Read some relative absorbance per second. The measurement results are directly processed by the microcontroller. Average measurement results for 3 seconds[17]. The following is the program code used by the ESP32 FireBeetle microcontroller to read the heart rate and oxygen saturation values:

```
#include <MAX30100_PulseOximeter.h>
#define REPORTING_PERIOD_MS 1000
Pulse Oximeter pox;
uint32_t tsLastReport = 0;

void onBeatDetected() {
  Serial.println('Beat!'); }

void setup() {
  Serial.begin(115200);
  Serial.print('Initializing pulse oximeter..');
  if (!pox.begin()) {
    Serial.println('FAILED');
    for(;;); }
  else {
    Serial.println('SUCCESS'); }
  pox.setIRLedCurrent(MAX30100_LED_CURR_7_6MA);

  pox.setOnBeatDetectedCallback(onBeatDetected); }

void loop() {
  pox.update();
  if (millis() - tsLastReport > REPORTING_PERIOD_MS)
  {
    Serial.print('Heart rate: ');
    Serial.print(pox.getHeartRate());
    Serial.print('bpm / SpO2: ');
    Serial.print(pox.getSpO2());
    Serial.println('%');
    Serial.print('Time: ');
    //time = millis;
    Serial.println('time');
    delay(3000);
    tsLastReport = millis(); } }
```

3. Research Results and Discussion

Heart rate measurements were carried out on 3 respondents by comparing measurements with patient monitors[18]. Table 2 shows the comparison results of the measured values. The heart rate measurement table is as follows.

Table 2. Heart Rate Measurement

NO	Name	LCD (bpm)	Website (bpm)	Patient Monitor (bpm)	Difference in Readings %
1	Ayu	75	75	76	0,8%
		75	75	77	

		75	75	74	
2	Dimas	73	73	72	0,8%
		68	73	65	
		68	68	69	
3	Rey	85	85	85	0,3%
		88	88	86	
		89	91	90	

In comparing heart rate samples between the study instrument readings and patient monitors, the most significant percentage difference is 0.8%, and the smallest percentage is 0.3%, where the most significant percentage error is in samples 1 and 2 with an average heart rate of 75 bpm and 68.9 bpm[19]. Where changes in the heart rate of the human body can be affected by pulse rate, sending heart rate data to the website requires an exact time so bad conditions do not occur.

Oxygen saturation output (SPO2) measurements are performed the same way as heart rate measurements by comparing readings from the device to a patient monitor. The size is the same as the heart rate measurement to see the respondent. Table 3 shows the comparison results of the measured values—oxygen measurement table[20].

Table 2. Oxygen Saturation Measurement

NO	Name	LCD (bpm)	Website (bpm)	Patient Monitor (bpm)	Difference in Readings %
1	Ayu	97	97	98	1%
		97	97	98	
		97	97	98	
2	Dimas	97	97	97	0,6%
		97	97	97	
		97	97	98	
3	Rey	98	97	97	0%
		97	97	97	
		97	97	97	

In comparing the results of the measurement of oxygen saturation of the sample between the readings of the research instrument and the patient monitor, the most significant percentage difference is 1%[21]. The smallest percentage is 0%, where the most significant percentage error is in sample 1, with an average oxygen saturation reading of 97%[22]. Where changes in oxygen saturation in the human body can be influenced by pulse rate, body oxygen saturation conditions that can change at any time, and sending oxygen saturation data to website applications that require exact time so bad conditions do not occur. Occur.

4. Conclusion

This paper presents a web-based heart rate, oxygen saturation, and temperature monitoring system using the Internet of Things (IoT). This tool supports the AMG8833 sensor, MAX30102 sensor, and ESP32 microcontroller. ESP32 acts as a data processor and Wi-Fi connection. The sensors' data is transmitted wirelessly to the website in real-time[23]. This website displays sensor data sent wirelessly from the microcontroller and stored in a database on a web server. This data acquisition or monitoring system makes it easy for us, mainly medical staff, to check your health and analyze the results of the data stored in our web server database[24].

In the future, we plan to implement a web-based heart rate, oxygen saturation, and temperature monitoring system for comprehensive health care performance analysis. We also plan to expand this tool in areas such as Office[25].

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