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A Device for Detecting Patient Heart Rate and Body Temperature based on ESP-32

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ABSTRACT

This article discusses the development of an Internet of Things (IoT) based patient health monitoring system using ESP32 as the main microcontroller and a web server to display data in real-time. This system is equipped with a MAX 30102 sensor, DS18b20 Sensor and DHT11 Sensor, designed to measure and monitor various patient health parameters, such as body temperature, heart rate, blood pressure, and blood oxygen levels (SpO2) through sensors connected to the ESP32. Data obtained from these sensors will be sent to the web to be processed and displayed in an easy-to-understand form. With this system, it is expected to facilitate monitoring of patient health conditions remotely, and increase the efficiency of medical monitoring.

Keywords: *health monitoring, IOT, sensor max 30102, sensor DHT 11, sensor DS18b20*

1. INTRODUCTION

In recent years, patient health monitoring has become a major concern in healthcare, especially with the increasing number of chronic diseases and the aging population. The limitations in direct health monitoring by medical personnel often result in delays in treating critical health conditions. Therefore, an Internet of Things (IoT) based health monitoring system offers an innovative solution by enabling real-time remote health monitoring. This system not only increases efficiency in health monitoring, but also provides convenience for patients to stay at home while still get the necessary medical attention (Kumar et al., 2020).

Several previous studies have shown the great potential of IoT technology in health monitoring. For example, research by Gupta and Sharma (2021) developed a health monitoring system that uses sensors to measure vital parameters such as heart rate and body temperature, and sends the data to a web-based platform. The results of the study showed that this system can provide accurate and real-time data to medical personnel, allowing for faster intervention. In addition, research by Patel et al. (2021) also developed a similar system using ESP32, which showed that this technology can be implemented at a relatively low cost and with high efficiency. These studies provide a strong foundation for the development of more sophisticated and integrated health monitoring systems.

This research aims to develop a patient health monitoring system based on ESP-32. This system will use several sensors, such as MAX3010 2 to measure heart rate and blood oxygen levels, and DS18B20 sensor to measure body temperature. Data obtained from the sensors will be sent to the web. By using ESP-32, this system can not only connect to the internet easily, but also has sufficient processing capacity to handle data from several sensors simultaneously. Thus, this system is expected to improve the quality of patient health monitoring and provide a faster response to changes in their health conditions.

2. RESEARCH METHODS

2.1 Research Stages

In this research, the author compiled the stages carried out to achieve the research objectives. The research stages arranged in the research can be seen in the form of a flow diagram in Figure 1.

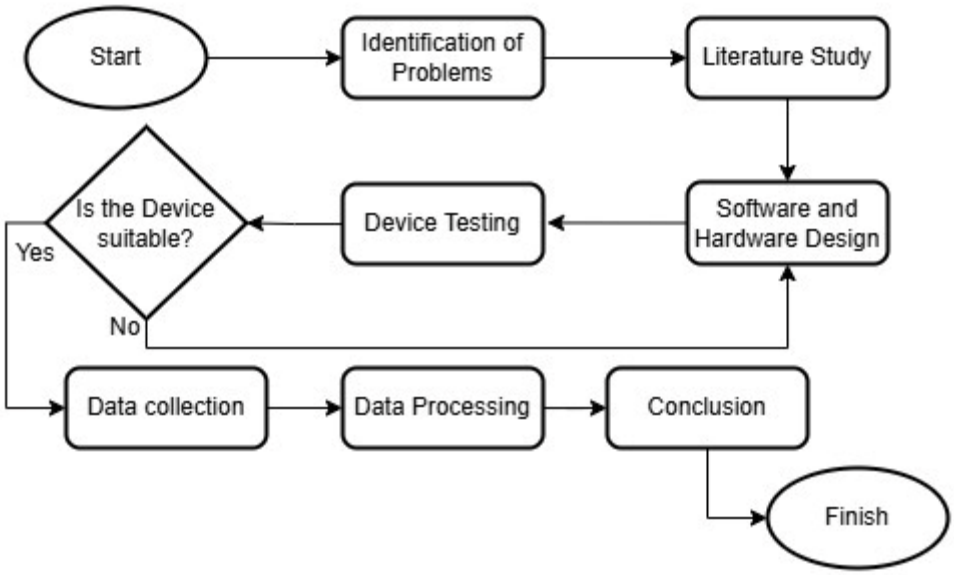

Figure 1. Research Stages

2.2 System Algorithm

The design of this IOT Health Monitoring system uses the ESP32 Devkit microcontroller for data processing. The Max30102 sensor as a sensor to detect heart rate, the DS18b20 sensor as a sensor to detect body temperature and the DHT 11 sensor to detect room temperature. Input data from the sensor will be entered and processed using a microcontroller which will then be displayed on the web server that has been created.

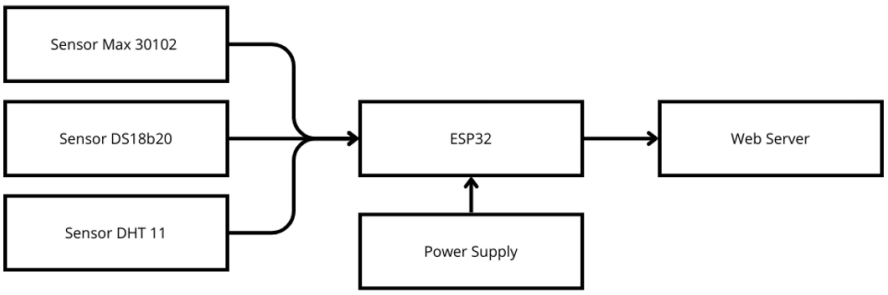

Figure 1. Block Diagram of Tool

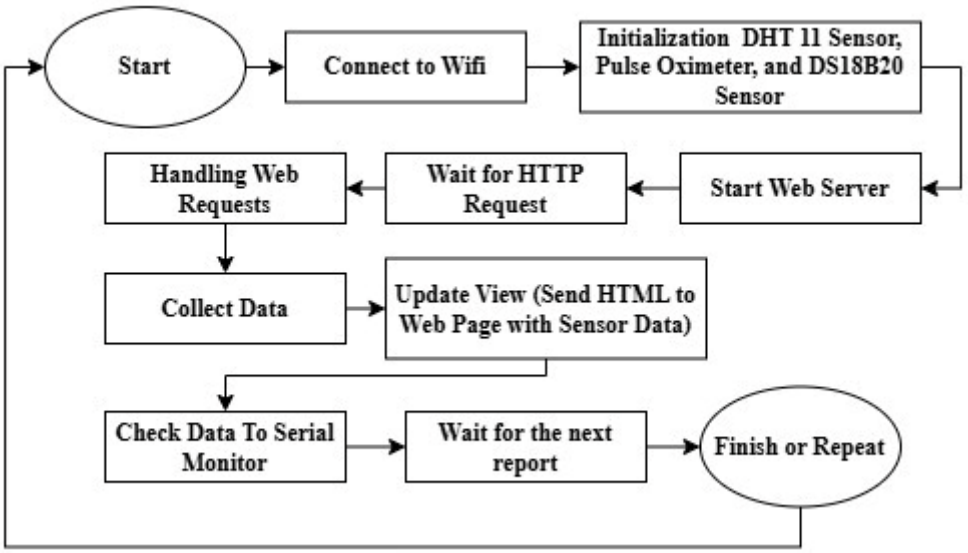

Figure 2. System Working Block Diagram

Block diagram of tool is shown in Figure 2 and the algorithm for how the system works can be seen in Figure 3.

2.3 Tool Design

The design of the tool for this IoT-based patient health monitoring system uses the ESP-32 module as the control center. This tool is equipped with various sensors, such as the MAX3010 2 heart rate sensor and the DS18B20 temperature sensor, which function to measure the patient's vital parameters in real time. Data collected by the sensors will be sent via a Wi-Fi connection to a web server. The design of this tool aims to ensure ease of use, measurement accuracy, and efficient accessibility of health data.

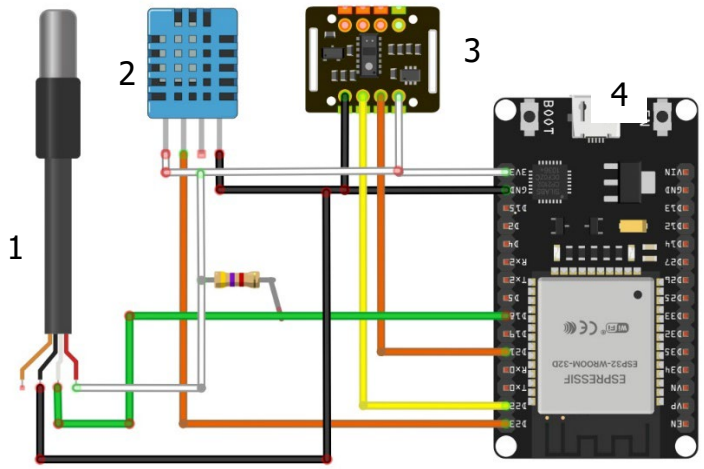

Figure 3. Hardware Design

Figure 4 shows hardware design where each number represents different component.

1. DS18B20 sensor
2. DHT11 sensor
3. Max30102 Sensor
4. ESP32 Devkit

3. RESULTS AND DISCUSSION

3.1 Design Results

In the design of the tool from the Health Monitoring system, it is equipped with several sensors as input for monitoring Health, the sensors used are MAX 30102 Sensor, DS18b20 Sensor, DHT11 Sensor. And in this system, it is already based on ESP32 for data processing and also to display the data results on the web server page that is created. The following is the design of the tool showing the components used can be seen in Figure 5.

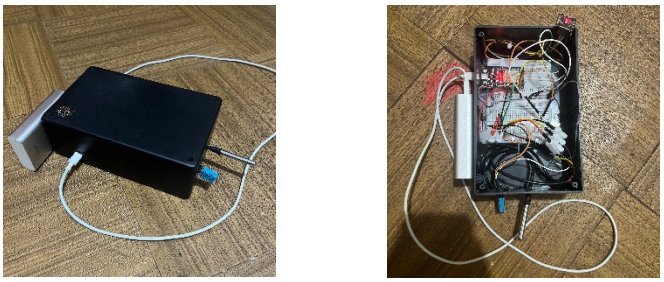

Figure 4. Results of tool design

3.2 How the Tool Works

The ESP32-based heart monitoring system using MAX30102, DHT11, and DS18B20 sensors is designed to monitor the user's health condition in real-time with data display via an IoT platform or web server. The MAX30102 sensor functions to measure heart rate and blood oxygen saturation (SpO2) using the Photoplethysmography (PPG), where photodiodes and infrared LEDs detect changes in blood flow. This sensor is connected to the ESP32 via the I2C

communication protocol. Furthermore, the DHT11 sensor is used to measure air temperature and ambient humidity, while the DS18B20 is used to measure body temperature digitally via One-Wire protocol.

Data from these three sensors are collected and processed by the ESP32, then sent to the IoT platform or web server using a Wi-Fi connection. With this feature, users can monitor measurement results in real-time via a web-based application or IoT dashboard that can be accessed using devices such as smartphones or computers. The data displayed includes heart rate per minute (bpm), SpO2 level, body temperature, and air temperature and humidity. The display on the web server can be seen in Figure 6 below.

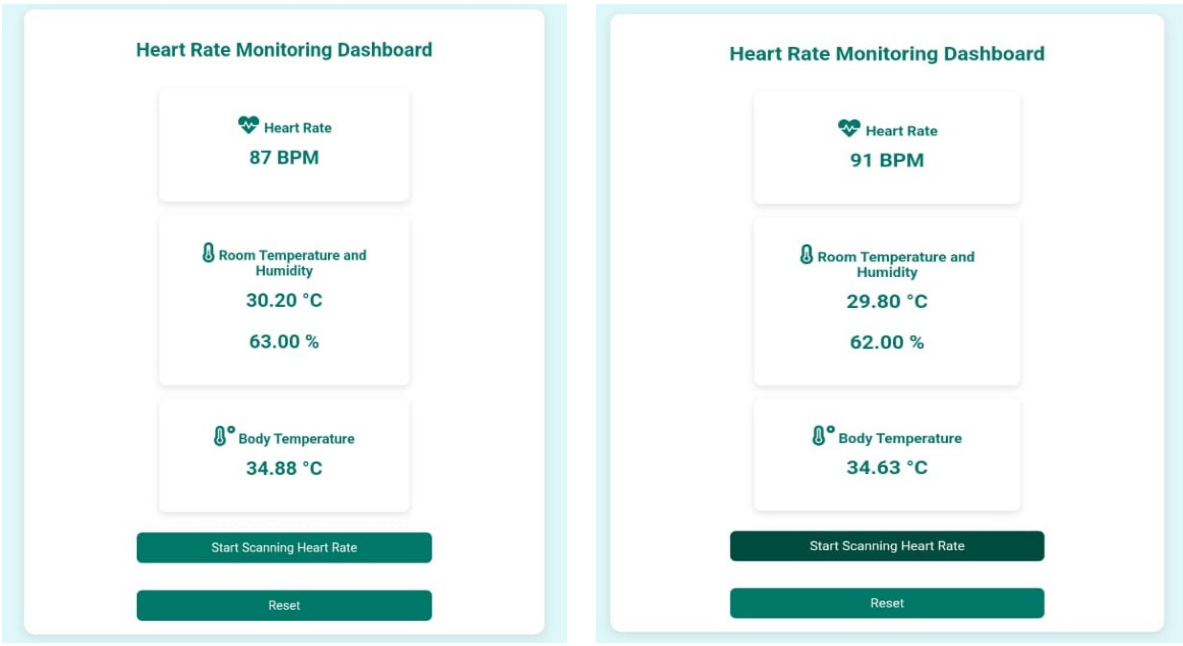

Figure 5. Web Server View

3. 3 Trial Results

After carrying out various component assembly processes, the next stage is testing the tool to find out whether the tool that has been assembled works properly design. The trial phase consists of two parts, namely overall circuit testing in Table 1 and sensor testing in Table 2.

Table 1. Overall System Experiment

Test	MAX30102 Sensor	DHT11 Sensor	DS18B20 Sensor
Person 1	66 BPM	30.80 C	35.19 C
Person 2	87 BPM	30.20 C	34.88 C
Person 3	91 BPM	29.80 C	34.63 C

The results of the testing can be seen in Table 1 and Table 2. Based on the table above, we can see the results of the experiments on each sensor on 3 different people. The explanation in the table above is as follows:

1. In the first experiment, the sensor read the heart rate at 66 BPM, with a body temperature of 35 C and a room temperature of 30 C.
2. In the second experiment, the sensor read the heart rate at 87 BPM, with a body temperature of 34 C and a room temperature of 30 C.
3. In the third experiment, the sensor read the heart rate at 91 BPM, with a body temperature of 34 C and a room temperature of 29 C.

From the above test carried out on 3 people in healthy condition and obtained data showing accuracy values according to the health standards of heart rate values, namely in healthy people 60 - 100 BPM and body temperature around 34 - 37 Celsius.

Table 2. Testing of each sensor

Component Name	Tests conducted	Test Results
Max Sensor 30102	Place your finger on the sensor for 10 seconds and release your finger from the sensor.	The results obtained show that the sensor can read the heart rate value properly when a finger is placed on the sensor and when the finger is released the sensor does not provide a value or 0 which indicates that no object is detected.
DS18B20 Sensor	Three tests were carried out, namely the first by holding the sensor, the second by placing it close to the fire, and the third by putting it in a glass filled with cold water.	The results obtained show that the sensor works well, namely by detecting normal conditions at body temperature when held directly, then when brought close to hot air, the sensor will read a high temperature value and also a low temperature value when the sensor is inserted into cold water.
DHT11 Sensor	Testing was carried out with the sensor placed in a room with normal weather.	The test results show that the sensor can read the temperature value in the room,

4. CONCLUSION

The IOT-based patient health monitoring system built using ESP 32 and a web server equipped with MAX 30102 sensor, DS18b20 sensor, DHT 11 sensor can show accurate test performance as evidenced by test data taken from 3 people in normal conditions showing heart rate values of 66, 87, 91 BPM and body temperature of approximately 35 C with a room temperature of approximately 30 C which indicates that the person is in normal condition with reference to the condition of normal people in general having a value of 60 - 100 BPM and body temperature of 35 - 37 C in healthy people.

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