Implementation of IoT on Heart Rate Monitoring System

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ABSTRACT
The increasing number of patients with heart disease and deaths from heart-related diseases has prompted various researchers to develop systems capable of diagnosing, monitoring, and ultimately preventing heart attacks. One of them is a heart rate monitor. Heart rate is an important health parameter and is related to the human cardiovascular system. Heart rate fluctuations can be detected through a pulse sensing mechanism placed at the fingertips. The signal captured by the sensor can be amplified and sent to the Arduino which is then processed through a serial port communication circuit. The process of developing this heart rate monitoring system uses several tools, namely a pulse sensor, Arduino as a processing unit, LCD OLED as a medium for displaying results, connections to display results on Android, and a database for data storage. The development steps taken are the development of block diagram designs and interfaces for applications on Android, system prototyping, and system testing. From the results of testing the system, by placing a finger on the pulse sensor, it is known that the heart monitoring device can work well. Heart rate results can appear on the LED screen in BPM units. Sensor measurement data can also be displayed properly on the android application. This heart rate monitoring can be seen in real-time through this android application.

Keywords: *IoT, Monitoring System, Heart*

1. INTRODUCTION

The heart is one of the most important organs in the human body, the heart functions to pump blood to and from the body [1]. Currently, diseases related to the heart are increasing, it is recorded that 35% or around 1.8 million people in Indonesia die from heart disease or heart attacks [2]. The heart works reflexively and heart rate can be used as a vital sign parameter, to determine the patient's physical condition [3].

In Indonesia, heart rate checks are carried out by medical personnel, generally using an electrocardiogram [4]. However, the use of the electrocardiogram tool used must be done repeatedly to get an accurate value [5]. This results in an increase in the time required for medical personnel to determine the results of the diagnosis [6][7]. Increased time in handling patients will increase the burden on doctors in conducting patient examinations [8], and the amount of costs that must be incurred by managers in completing expensive diagnostic equipment [9]. In general, pulse measurements [10] can be performed at nine points [11], namely the radial artery [12], brachial artery [13], common carotid artery [13], femoral artery, dorsalis pedis artery, popolite artery, temporal artery, apical artery, and posterior tibial artery [13]. A system that is affordable and able to monitor the heart at any time and from anywhere is one solution to this problem [14].

Modern technology-based heart monitoring system [15] is able to monitor the heart at any time and from anywhere remotely via the internet [16]. With this system, patients can send their heart monitoring results to doctors in real time [2]. This system was developed using a pulse sensor based on Arduino [17] Wemos D1 Mini which has a Wifi connection feature so that it can be applied as an IOT device [18] with real-time monitoring needs via Android devices [9].

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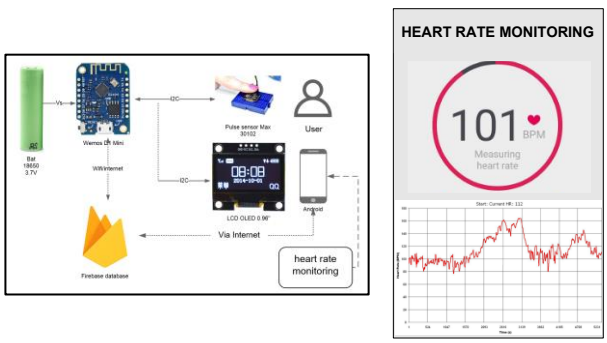
2. MATERIAL AND METHODS

2.1. Materials

The equipment used in making this IoT system include (1) the MAX30102 sensor module [19]. This sensor is able to detect heart rate as well as human body temperature [20]. This sensor has a red and infrared LED source equipped with a photodetector[2] that is located next to it and has low noise with light rejection around the sensor. (2) WeMos D1 Mini, is one of the Arduino-based WIFI modules [21], especially for projects related to the IoT concept [12]. WeMos has a chipset so that it is able to program via serial port or via OTA and transfer programs wirelessly [6]. (3) The 12C 0.96 inch display OLED (Organic Light Diode) module is used as a media for displaying the output of the measurement results. (4) RTC (Real Time Clock) is an electronic clock that is used as a real time marker.

2.2. System Design

The Heart Rate Detection Monitoring System Using Wemos D1 Mini Based on IoT is designed using a Wemos D1 R1 microcontroller as a data processor from the MAX30102 pulse sensor, RTC DS1307 and 0.96 inch OLED LCD. MAX30102 sensor data and OLED LCD are accessed via I2C communication connected via SDA and SCL ports. Heart rate data is sent to the firebase data node in realtime after connecting to the local WIFI network. Android and firebase devices are connected via the internet at the same url address Figure 1(a).



(a) (b)

FIGURE 1. (a) Heart rate monitoring system block diagram, (b) Android Interface

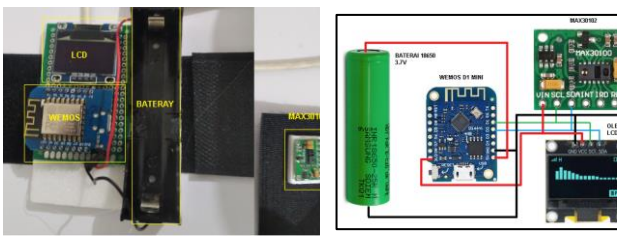
Max30102 sensor data, RTC time data and data updates on firebase are carried out at 1000ms intervals, so that the display on the LCD will be the same as the data on firebase. Every time there is a data change in the firebase, the android device will synchronize the data automatically so that the data displayed on the android device will be updated in real time.

The android interface used is in the form of a gauge library to display heart rate data in circular form and a library graph to display heart rate data in graphic form (Figure 1b). The data displayed is the updated data obtained from the Android database.

2.3. System Implementation

Implementation of a Heart Rate Detection Monitoring System Using Arduino Based Iot using the Wemos D1 Mini processing unit and the MAX20102 heart rate detection sensor which has heart rate detection and blood oxygen level detection features. Heartbeat Detection Monitoring System Using Arduino Based Iot can be explained as follows:

- Wemos D1 Mini, is a processing unit for processing MAX30102 sensor data, sending heart rate data and blood oxygen levels to the firebase database and displaying data to a 0.9" oled LCD screen.
- MAX30102 sensor, is a type of sensor that can detect the heart rate as well as the temperature of the human body, which is produced by Maxim Integrated. The MAX30102 sensor has a red and infrared LED source equipped with a photodetector that is located next to each other and has low noise with rejection of light around the sensor,
- OLED LCD, is one of the media that can be used as a display to display heart rate data. OLED LCD has a very sharp pixel contrast and does not require a backlight light so it is efficient in consuming energy.



(a) (b)

FIGURE 2. (a) Heart Rate Monitoring Prototype , (b) Wiring diagram of heart rate monitoring system

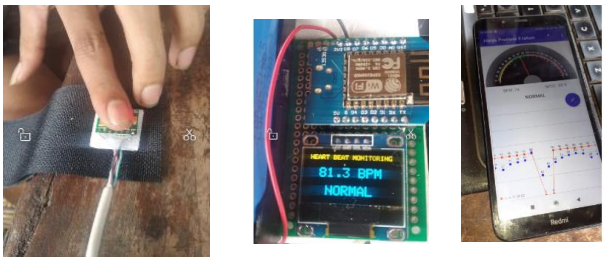
The wiring diagram for the system (Figure 2b) is explained as follows:

- The MAX30102 sensor is connected to the Wemos D1 Mini via the I2C line.
- The OLED LCD is connected to the Wemos D1 Mini via the I2C channel.
- The 18650 battery is connected to the Wemos D1 Mini pin VCC 5V and ground

3. RESULT AND DISCUSSION

Testing the system is done by placing the index finger on the MAX20102 heart rate sensor as shown in Figure 3a. With an interval of 1-2 seconds, the measurement results can be obtained and displayed on the OLED LCD. The measurement results are shown in BPM or beats per minute (Figure 3b). Android application testing is done by displaying the results of real-time heart rate measurements. The data change time interval used in the android application is 1 second.

From the results of prototyping and testing that have been carried out on Android devices and applications, the system created has advantages in the speed of changing the data displayed on the Android application. This is because the author uses a real-time database using firebase and can be synchronized quickly. However, the monitoring tool that has been developed has a drawback, namely the physical form that is less slender, resulting in a fairly difficult installation. Thus it is necessary to streamline the components with a smaller form and placement of components as tightly as possible.



(a) (b) (c)

FIGURE 3. (a) Tool testing process, (b) Heart rate display (BPM) on OLED LCD, (c) Heart rate monitoring on Android Application

CONCLUSIONS

The conclusions obtained based on the manufacture and testing of the Heart Rate Monitoring System that has been made can be explained as follows:

- The heart rate detection system can work well, as evidenced in testing the system can detect heart rate by placing the index finger on the sensor. The waiting time for processing heart rate data is about 1-2 seconds to get heart rate data and display the data on the LCD
- When the user places his index finger on the sensor, the wemos system will process the sensor data and display the sensor data on the LCD while sending heart rate data to Firebase. During the processing of the heart rate sensor data, if the system is working properly it will display the heart rate with a value range of 60-100 bpm for users under normal conditions.
- The heart rate monitoring system on the Android application shows the same heart rate value as the LCD display. This proves that the Android application based on the test results has worked well.

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