Oximeter and BPM on Smartwatch Device Using Mit-App Android with Abnormality Alarm

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Monitoring is an activity that is carried out continuously. Healthy condition is a parameter that is needed in life, one of the important parameters is the measurement of oxygen saturation in the blood and heart rate. The purpose of this research is to develop a Smartwatch SpO2 device and BPM sensor that is connected to WIFI using the Android Platform instead of using an LCD for parameter reading. This module design method uses the MAX30100 sensor to display the SpO2 and BPM values displayed on the OLED. Data processing is carried out using ATMEGA 328P programming and then displayed in the Android-based Mit-app application. The results show the average error for the SPO2 value is 0.868% and the standard deviation is 0.170%, while the BPM value has an average error of 0.57% and a standard deviation of 0.05%. From the results of the comparison data analysis, the largest error was 1.03% and the smallest was 0.62% for SpO2 ml/hour with an accuracy of 0.05 (0.57%) with a precision value of 0.08 at the selection speed of 50 ml/hour. From the results above, it can be concluded that the data can be displayed on OLED using the Mit-app Android application with an error rate accuracy of 0.57%. From the results of this research design, it is hoped that it can facilitate the diagnosis of the condition of patients and health nurses.

Keywords: Oximeter, Heartbeat rate, At Mega328P, Smartwatch Android

I. INTRODUCTION

Heart monitoring is very important because the body needs blood flow to all our organs.[1] Heart rate greatly affects a person’s health condition. The pacemaker rate is influenced by age and the human condition itself, the condition of children and adults has different heart rates, as well as sick people and healthy people by feeling the pulse, it can be seen a person’s heart rate. Practitioners doctors or nurses usually use this method to determine the pulse. The calculation process is carried out within 15 seconds, the result is multiplied by 4 to get the result of the number of heart beats in 1 minute. This activity requires high concentration and requires equipment and time as a basis for calculation, so a nurse or doctor cannot do other work all the time.

Along with the development of technology and information, monitoring heart rate can be done using direct or indirect techniques. [2] This is done directly by placing sensors on the heart itself, while indirectly by utilizing the flow of blood vessels, namely by tapping sensors on the blood flow. [1][3]

Based on WHO data, people who have never done physical exercise will have an increase in all causes of death by 20% - 30%, [4][3] Physical exercise will cause several changes in the body, such as oxygen levels in the blood, under normal conditions there is storage of oxygen reserves in the blood when doing these physical exercises the body requires large amounts of oxygen to meet the needs for energy. [4] Oxygen will be taken up by the blood through the lungs and binds to hemoglobin. If the oxygen level in the blood decreases past normal limits, it will be very dangerous for health because it can cause fainting and even death.

The level of oxygen in the blood bound to hemoglobin is called oxygen saturation (SpO2). [5] Normal values for oxygen saturation levels range from 95 percent to 100 percent. Measurement of oxygen saturation can be done by several techniques. One of them is by using oximetry. Pulse oximetry is

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Abstract

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Keywords:
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a non-invasive continuous monitoring method of hemoglobin oxygen saturation (SpO2). Physical activity is any body movement that comes from skeletal muscles that require energy expenditure. The importance of hemoglobin function in the human body and the importance of a person doing regular physical activity are two interrelated things. The relationship between physical activity that a person does to hemoglobin levels in a study that when someone does physical activity, such as exercising, there is a high increase in metabolic activity, the acid produced (hydrogen ions, lactic acid) is also increasing, resulting in a decrease in pH. [5][6] A low pH reduces the attraction between oxygen and hemoglobin. This causes the hemoglobin to release more oxygen thereby increasing oxygen delivery to the muscles.

In this study the author tries to find a solution to the problem, namely when someone does an activity not knowing whether the condition is normal or not, the author designs a spo2 and bpm detection tool that can be seen directly by the user, and monitored remotely and there is an sms reminder to the user. the family when the user is in an abnormal condition.

Along with the development of technology, several equipments have been developed, a.l. Portable BPM conducted by Yessy Mega Jayanti, (2013), for monitoring BPM not yet equipped with a remote monitor, and RTC patient data every hour and Lokeswara Darmalaksana, (2017), developed a Portable BPM design with a finger sensor equipped with RTC and storage SD card which aims to detect bpm by displaying data on seven segments. Furthermore, it was developed by Riszay Cahyaning Maulina by displaying Heart Rate with Graphic LCD equipped with SD Card Storage and RTC "aims to display BPM with Graphic display equipped with SD Card storage. Furthermore, researcher Fachrul rozie from Electrical Engineering, Tanjungpura University, (2016), by designing an android-based pulse monitoring tool but limited to displaying one parameter and another researcher Guruh Hariyanto, Airlangga University also designed a digital oximeter based on the Atmega16 microcontroller to determine Spo2 levels but it is still limited on one parameter and not portable.

From several literature studies, research on heart rate monitoring is still limited to designing tools using one parameter, therefore it is necessary to develop a monitoring equipment that can be used to monitor several sensor parameters related to vital signs (biomedical) that can detect a person's health, therefore need to design the design for some sensor parameters. The design of the smartwatch model is the application of an application using a very simple arduino 328P [7][8] The purpose of this research is to develop a BPM and SPO2 sensor Smartwatch with an android display [9] the purpose of monitoring the condition of heart rate and Spo2 levels using a remote system based on Android users, which is equipped with SMS in the form of reminder notifications to patients equipped with Bluetooth so that doctors and paramedics will quickly take action if the patient is in an urgent situation.

II. MATERIALS AND METHODS
A. Research Design
This study uses a Pulse Oximeter with the brand Puremed oxy-77 for data collection. Data is taken 5 times on 5 respondents.

1) Material and Methode
This study uses the Max30100 sensor as a Spo2 and BPM interceptor and RTC as a time display. [9] The display on this tool uses OLED as well as the Mitapp application as an application for android [10].

2) Experiment
At this stage, after the design is finished, testing the results of the Max30100 sensor readings. The reading results are compared by a comparison in order to determine the measurement results.
B. Diagram Block

In the block diagram below, the Max30100 sensor is used for Spo2 and BPM intercepts, RTC provides the date and time, then the data is processed using Atmega 328P which will later be displayed on the OLED and Bluetooth devices to send data to Android.

![System Design Block Diagram](image)

1. Max30100
   Max30100 functions as a Spo2 and BPM interceptor [11][12]
2. RTC
   RTC is used to display the time and clock which will later be displayed on the display
3. OLED
   OLED as a display that will display the results of the Max30100 and RTC sensors
5. Arduino ATmega 328P
   Arduino ATmega 328 as a microcontroller
6. HC-05
   HC-05 is Bluetooth which will later send data to android

![HC-05 Module](image)

In fig. 2. HC-05 is a module device for sending data wireless to android applications with a frequency of 2.4 GHz

C. Diagram Flow

![Flow Transmitter](image)

In Fig. 3. The flowchart at start, the OLED will initialize and at that time the Max30100 sensor will start tapping and the RTC is already running. Then the results will be displayed on the OLED screen and the data results will be sent via the Bluetooth HC-05 module to android

![Flow Receiver](image)

In Fig. 4. It is depicted when Bluetooth on Android has been turned on and then enters the telephone number then the data
will be sent via Bluetooth and will be displayed by Android, if the conditions tapped by the sensor show abnormal conditions, the Android will send an SMS to the number that has been written. When Bluetooth is on, Android will enter the telephone number, then the data will be sent via Bluetooth and will be displayed on Android. If the conditions tapped by the sensor show abnormal conditions, Android will send an SMS to the number that has been written.

C. Circuit Analog

An important part of this research is the analog circuit shown in fig. 5 (minimum circuit system). This circuit is used to process all circuits and then digital processing will be carried out using a microcontroller.

1) Circuit Minimum System

A minimum circuit system as shown in Fig. 4 consists of an infrared photodiode sensor, ATMega 328P as a microcontroller, OLED as a display to show results.

2) Circuit Max30100

The circuit used to connect the max30100 sensor with the minimum system circuit.

3) Circuit RTC DS3231

The circuit used to connect the rtc ds3231 with the minimum system circuit.

III. RESULTS

In this study, the Design of Smartwatch Spo2 and Bpm with Android Display has been compared using pulse oximetry puremed oxyx-77 to test performance. The results showed that the tool, Spo2 and Bpm Smartwatch Design with Android Display was feasible because the measurement results were still within tolerance limits.
1) Module Design, Spo2 and Bpm Sensor Smartwatch With Android Display

Module Design, Smartwatch Device sensor Spo2 dan Bpm.[13] The Android display is shown in Figure 9 while in Figure 8 an equation is made with the original tool to ensure the accuracy of the module. The digital part consists of the ATmega328 microcontroller which is the controller and controller of the system. There are Max30100 and RTC sensors. RTC is useful for displaying the date and time which will later be displayed on the OLED layer. There is an OLED as a display and HC-05 to send data to android then on android the data is captured and displayed on the android layer then the data is processed if the Spo2 and Bpm are less than the settings it will send a message.

![Design Modul](image)

Fig. 10. Design Modul

2) Listing Program Arduino

At the first time we turn on the tool, the OLED display will appear Name and title

Listing Program 1. Program Arduino

```
1. LOOP:
2. display.begin(SSD1306_SWITCHCAPVCC, OLED_ADDR);
3. display.clearDisplay();
4. display.display();
5. display.fillRect(0, 0, 128, 64, BLACK);
6. display.setTextSize(1);
7. display.setTextColor(WHITE);
8. display.setCursor(1, 8);
9. display.print("ERYANDA BIMA MAHENDRA");
10. display.setTextColor(WHITE);
11. display.setCursor(25, 18);
12. display.print("P27838016017");
13. display.display();
14. delay(1000);
15. display.clearDisplay();
16. display.begin(SSD1306_SWITCHCAPVCC, OLED_ADDR);
17. display.clearDisplay();
18. display.display();
19. display.fillRect(0, 0, 128, 64, BLACK);
20. display.setTextSize(1);
21. display.setTextColor(WHITE);
22. display.setCursor(1, 8);
23. display.print("PERANCANGAN SMARTWATCH SPO2 DAN BPM TAMPIL ANDROID");
24. display.setTextColor(WHITE);
25. display.setCursor(10, 35);
26. display.print("I");
27. display.display();
28. delay(1000);
29. display.clearDisplay();
30. Serial.begin(9600);
31. ENDLOOP
```

Program data reading sensor Max30100.

```
1. LOOP:
2. Serial.print("Initializing pulse oximeter..");
3. if (!pox.begin()) {
4. Serial.println("FAILED");
5. for(;;);
6. } else {
7. Serial.println("SUCCESS");
8. }
9. ENDLOOP
```

Program RTC reading and display data on OLED

```
1. LOOP:
2. display.setTextSize(1);
3. display.setCursor(0, 17);
```

Program homepage: http://jeeemi.org/index.php/jeeemi
Email: editorial.jeeemi@gmail.com
Program for sending data via HC-05 to android

The program is used to connect the module with android

Program to send the number to be ordered

Program to send the number to be ordered
The program is used to set Spo2, when at a certain BPM it will send a message.

In testing and measuring the adc red and ir data through the serial plotter and serial monitor on the arduino, there are graphs in Figures 10 and 11.

![Graph 1](image1.png)

**Fig. 10. Plotter When Sensor Open**

Fig. 10 shows the difference between the Red and IR adc data at the open sensor position.

![Graph 2](image2.png)

**Fig. 11. Plotter When Sensor close**

Fig. 11 shows the difference between the IR and Red adc data in the closed sensor position.

5) Results Measurement and Testing Error and Testing on Respondents

| Responden | Error% |
|-----------|--------|
| Subject 1 | 0.83   | 0.47   |
| Subject 2 | 0.83   | 0.56   |
| Subject 3 | 0.62   | 0.27   |
| Subject 4 | 1.03   | 0.45   |
| Subject 5 | 1.03   | 1.07   |
| Mean      | 0.868  | 0.564  |
| SD        | 0.1709 | 0.3018 |
IV. DISCUSSION

To find out the precision level of the tool, we have to compare this tool with a more accurate and calibrated comparator, so here the researcher uses pulse oximetry puremed oxxy-77 to find out how much accuracy and precision the tool is made.

The results obtained on the average SPO2 comparison tool are 0.868 standard deviations of 0.170 with the largest error range 1.03% and the smallest 0.62% while the average BPM comparison is 0.564, the standard deviation is 0.30 with the largest error range 1.07 and the smallest 0.27%. And each sensor has an accuracy of 0.05 (0.57%) and a precision value of 0.08 at the selection speed of 50 ml/hour

V. CONCLUSION

The results of this study indicate that the Spo2 and BPM Smartwatch Design tool with an Android display can display measurement values and accuracy of 0.05% respectively and 0.08 precision so that this module tool is still feasible to use and in the future this research is expected to help patient care and health nurse in monitoring the patient's condition. Furthermore, from this research, it can be developed more applicable and innovative in the case of technology-based health services.

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