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Android-based Heart Rate and Blood Oxygen Level Monitoring System (Oximeter)

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ABSTRACT

The development of increasingly modern technology makes it possible to create a more advanced tool. The health sector as one of the important components of life also does not escape the support of technology. One of its implementations is an android-based heart rate and oxygen level monitoring system (oximeter). Heart rate monitoring can be done by everyone by utilizing existing technological developments. Measurements are made using only the fingers of the hand as input. The purpose of this study was to determine the design of a research tool for a heart rate monitoring system and blood oxygen levels (oximeter) based on android. This measuring instrument uses a Max30100 sensor which is attached to one person's fingertip to detect a heart rate signal, then the data generated by the sensor is received by Arduino, after that it is forwarded to Bluetooth and displayed on the Android application, then it will be processed into beats per minute (BPM) and blood oxygen levels (SPO2) so that you can find out the results of heart rate and oxygen levels displayed on Android. Based on the results obtained in heart rate monitoring, it can work well so that it can be seen the results of measurements using a device made with a person in normal conditions the heart rate beats between 60 to 75 beats per minute (BPM) and oxygen levels (SpO2) which can beat between 95 to 100, while using pulse oximetry results in normal body conditions the heart rate beats between 60 to 75 beats per minute (bpm) and oxygen levels (SpO2) which can be between 95 and 100 oxygen levels (SpO2).

1. Introduction

In today's medical equipment, it is required to use a problem-solving approach method in providing examinations to patients [1]. This examination is carried out by using a periodic examination process, to be able to implement the further examination process, it must have the knowledge and skills to formulate a diagnosis from the examination with tool technology that is currently developing rapidly in the market. The main assessment that can be done by knowing the condition of people is by checking the pulse. Basically, pulse examination uses a simple method, namely checking the pulse on the wrist, along with the development of technology measurements are carried out using tools, so that the pulse can be visually monitored by the help of technology [2].

Pulse is important for human health because pulse is a factor that can be used as an indicator to assess a person's condition [3]. A person's pulse is influenced by various factors including normal and abnormal conditions and physical activity that can be seen after the pulse examination. By observing and studying the results of the pulse examination, an overview of the design of the pulse

device can be analyzed [4]. In previous studies, the design of a pulse measuring instrument using a pulse sensor can measure heart rate by gluing the device to the fingertip where there are blood vessels flowing is a representation of the frequency of the heart rate itself with a note that the heart is not in a weak condition. Each heart rate changes the amount of infrared light detected by the photodiode sensor that uses a microcontroller to operate it. With the process of visually reading the signal, this change has an amplitude of light reflection that can be converted into a pulse called a pulse [5].

This signal will be processed directly by the microcontroller in a time span of 2 ms looping iteratively. After the process and signal calculation is completed, which is connected by the Bluetooth module to the gadget that is currently widely circulated in the market. The goal is to provide information to the user if they want to check their condition at that time. With today's technology, users can see their health condition through the pulse, so that their condition can be monitored from time to time. This pulse design is based on the Max30100 sensor which is detected at the fingertips using Arduino pro mini and displayed both on the gadget and on the monitor screen. So, it is hoped that its application can provide convenience in the medical world to send condition information to the examiner [6].

2. Research Methods

This study aims to create a tool that can help in checking heart rate and oxygen levels in the blood, the system using Arduino Pro mini and Max30100 sensor as a pulse detector and oxygen levels in a relaxed condition measuring heart rate and oxygen levels depicted via smartphone apps and Bluetooth delivery media Hc-05 [7].

2.1. System Design

The block diagram in this system has 3 main parts, namely, input, microcontroller, and output can be seen in Fig. 1. The input section of this system consists of a Max30100 heart rate circuit as a marker of the presence of a beat that is received and integrated by Infrared when the pulse rate is detected. Then the data enters the Arduino Pro Mini to be converted into digital data and processed so that it can display value information and then transferred by Bluetooth and then displayed the data input in the android monitor serial application / output [8].

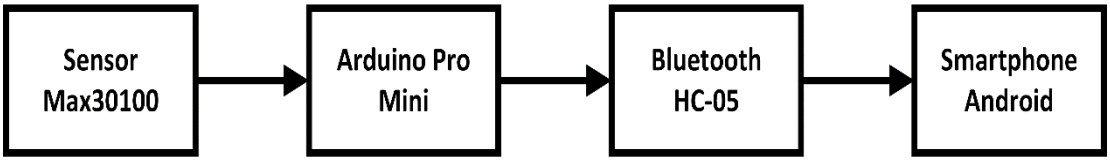

Fig. 1. Hardware block diagram

The Max30100 sensor as a pulse rate detector which later input data is sent to the Arduino as a program brain and processed. Then the data input is processed on Arduino which will later be processed as data input in the form of BPM (beats per minute) number values. And next the input data signal is sent via Bluetooth and which will be displayed on the android smartphone application [9].

2.2. Algorithm

After creating the finished hardware design, the next step is the software design (command program). Design the software using Arduino Pro Mini software. The thing that needs to create a program is to create a flowchart as a guide for writing programs. The flowchart can be seen in Figure 2.

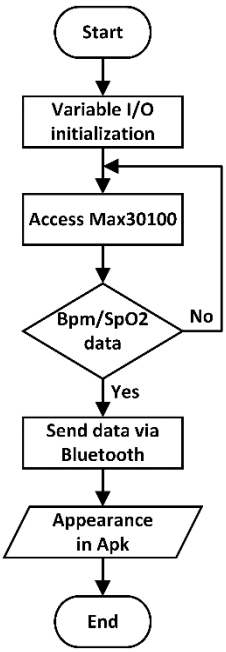

Fig. 2. Is a flowchart in general

2.3. Equation

The test result data is obtained from the calculation of the percentage of success to determine whether the tool made is appropriate or not with the purpose of manufacture. Percentage of the success of the heart rate monitoring system and oxygen levels in the blood designed in carrying out commands is calculated by the Equation (1) [10].

$$R = \frac{deAC_{red}/DC_{red}}{AC_{tred}/DC_{tred}} \quad (1)$$

3. Results And Discussion

3.1. Tool testing of a person

Table 1. Test results with created tools

NO	NAME		Experiment To										
			1	2	3	4	5	6	7	8	9	10	Average
1	Malik	Heartbeat	70	70	70	68	69	70	71	70	69	70	69.7
		Oxygen (SpO2)	98	98	98	99	98	98	99	98	98	98	98.2
2	Amry	Heartbeat	62	67	69	70	70	72	70	70	70	70	69
		Oxygen (SpO2)	97	98	98	99	98	98	98	98	98	99	98.1
3	Moon	Heartbeat	62	62	67	69	70	72	70	70	70	70	68.2
		Oxygen (SpO2)	99	97	98	98	98	99	98	98	98	99	98.2
4	Andi	Heartbeat	65	69	70	70	70	70	72	70	70	70	69.6
		Oxygen (SpO2)	99	99	99	98	98	98	99	98	98	98	98.4
5	Teguh	Heartbeat	50	62	69	70	70	72	70	70	70	70	67.3
		Oxygen (SpO2)	97	98	98	98	99	99	99	98	97	98	98.1
6	Krisna	Heartbeat	60	62	67	70	70	70	71	69	70	70	67.9
		Oxygen (SpO2)	96	96	98	98	99	99	99	99	99	99	98.2
7	Poo	Heartbeat	66	64	69	72	72	70	69	70	70	70	69.2
		Oxygen (SpO2)	98	98	98	98	99	99	99	98	98	98	98.3
8	Darso	Heartbeat	62	69	70	72	72	72	71	70	70	70	69.8
		Oxygen (SpO2)	98	98	99	99	99	99	99	98	98	98	98.5
9	Sandra	Heartbeat	65	67	69	74	72	71	70	70	70	70	69.8
		Oxygen (SpO2)	97	97	97	99	99	99	98	98	98	98	98
10	Irul h	Heartbeat	66	69	72	72	72	71	69	70	70	70	70.1
		Oxygen (SpO2)	97	98	99	99	99	99	98	98	98	98	98.3

The results of this experiment, the number of heart beats per minute of each person is calculated under normal circumstances ranging from 50 to 80 beats per minute (BPM) and oxygen levels (Spo2) 90-100. The difference in the number of pulse beats and oxygen levels can be seen in Fig. 3.

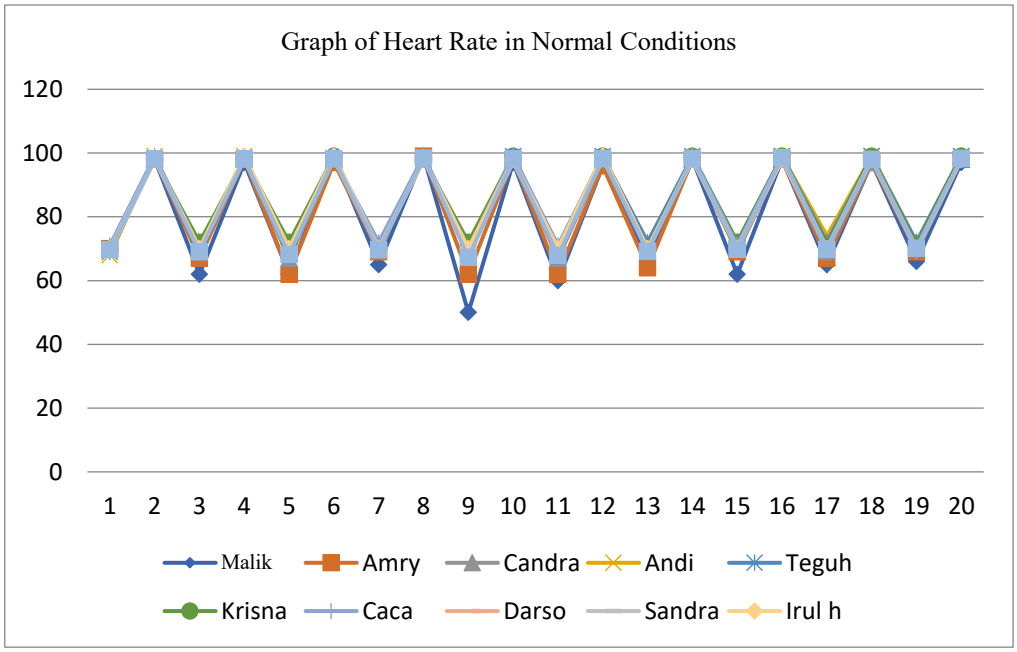

Fig. 3. Heart rate graph using the tool

Fig. 3 is a graph of the heart rate in normal people's conditions, showing that the patient's pulse, after monitoring with a device, beats between 50-80 bpm (beats per minute) and oxygen levels (Spo2) 90-100.

3.2. Testing Using Oximeter

Table 2. Comparison results using oximetry

NO	NAME		Experiment To										
			1	2	3	4	5	6	7	8	9	10	Average
1	Malik	Heartbeat	70	70	70	70	69	71	71	70	70	70	70.1
		Oxygen (SpO2)	98	98	98	99	98	98	99	98	98	98	98.2
2	Amry	Heartbeat	70	68	69	70	70	72	70	70	70	70	69.9
		Oxygen (SpO2)	98	98	98	99	98	98	98	98	98	99	98.2
3	Moon	Heartbeat	64	68	67	69	70	72	70	70	70	70	69
		Oxygen (SpO2)	99	98	98	98	98	99	98	98	98	99	98.3
4	Andi	Heartbeat	66	69	70	70	70	70	72	70	70	70	69.7
		Oxygen (SpO2)	99	99	99	98	98	98	99	98	98	98	98.4
5	Teguh	Heartbeat	60	62	69	70	70	72	70	70	70	70	68.3
		Oxygen (SpO2)	98	98	98	98	99	99	99	98	97	98	98.2
6	Krisna	Heartbeat	60	62	67	70	70	70	71	69	70	70	67.9
		Oxygen (SpO2)	96	96	98	98	99	99	99	99	99	99	98.2
7	Poo	Heartbeat	68	64	69	72	72	70	69	70	70	70	69.4
		Oxygen (SpO2)	98	98	98	98	99	99	99	98	98	98	98.3
8	Darso	Heartbeat	64	69	70	72	72	72	71	70	70	70	70
		Oxygen (SpO2)	99	98	99	99	99	99	99	98	98	98	98.6
9	Sandra	Heartbeat	68	67	69	74	72	71	70	70	70	70	70.1
		Oxygen (SpO2)	98	97	97	99	99	99	98	98	98	98	98.1
10	Irul h	Heartbeat	68	69	72	72	72	71	69	70	70	70	70.3
		Oxygen (SpO2)	98	98	99	99	99	99	98	98	98	98	98.4

The results of this experiment, the number of heart beats per minute of each person is calculated under normal circumstances ranging from 50 to 80 beats per minute (BPM) and oxygen levels (Spo2) 90-100. The difference in the number of pulse beats and oxygen levels can be seen in Fig. 4.

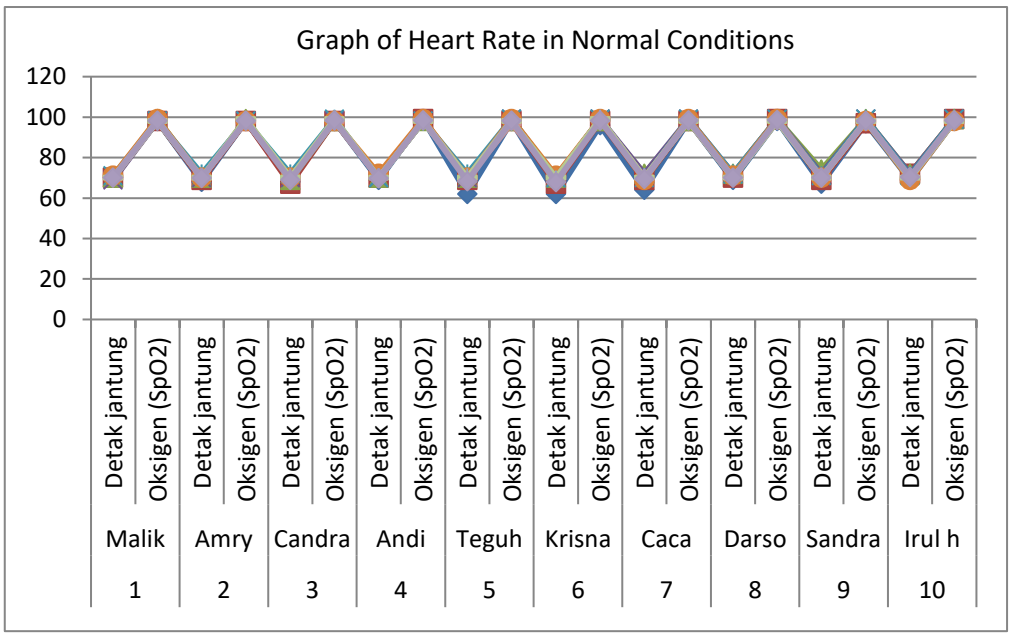

Fig. 4. Heart rate graph using oximeter

Fig 4. is a heart rate graph in normal people's condition, showing that the patient's pulse, after monitoring with an Oximeter, the pulse rate beats between 50-80 bpm (beats per minute) and oxygen levels (Spo2) 90-100.

4. Conclusion

The results obtained in the entire test, the pulse response detection system by utilizing a pulse oximeter and depicted via this app can monitor the pulse in a person very easily, then it can be analyzed and displayed on the monitor screen of an Android smartphone. So, with a tool like this it is in accordance with the purpose of the study. Based on the results of observations, comparison of data between several people, conclusions can be drawn. The pulse viewer occurs when the sensor is attached to the fingertip and when the LED on the Arduino flashes then also appears on the android monitor screen with the help of data transmission with Bluetooth media. Can create a system that detects heart rate and oxygen saturation automatically by using one sensor. An overview of the number of heart rates using the Max 30100 sensor for different people is produced, the number of normal heart beats ranges from 50 to 80 beats per minute (BPM) and oxygen levels range from 90-100 (SpO2).

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