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IoT Based Heart Rate Detector Design

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ABSTRACT
Heart rate is a very vital part of the human body, if the heart rate exceeds the maximum limit it will be very dangerous for the body. So we need a heart rate recording device that can store heart rate recording data so that it makes it easier to control health. This study aims to test the heart rate recording system with a comparison of a factory-made device, namely an oximeter. Making measuring instruments consists of making hardware and making software. In making hardware, several components are used, namely pulse sensors, NodeMCU, Oled and the device for making software is the Arduino IDE. Testing of the heart rate detection device is carried out by placing a pulse sensor at the tip of the finger to measure the heart rate of respondents of different ages. The test results show that the measuring tools that have been made show that manual calculations and using tools have fairly good accuracy. The results of the data obtained from the test were 60% (3 out of 5 people) who had the same heart rate using either a device or an oximeter. The average accuracy value of the heart rate recording system when compared to an oximeter is relatively small, namely 1-2 bpm.

***Keyword** : Blynk, Heart rate, IoT, Pulse Sensor, Oxymeter*

INTRODUCTION

Every human activity will not always be easy if it is not balanced with health support, because health is the main factor so that humans can carry out normal activities, and one of the most important things to maintain our health is to take care of our heart so that it stays healthy and is not burdened with other activities. can make the heart weak, because it is the heart that functions to pump blood flow throughout the body to keep it flowing. Therefore, it is necessary for us to maintain heart health so that it remains balanced in carrying out its function of pumping blood throughout the body, because it could be our daily activities that force the body to be active causing the heart's performance to be disrupted. In terms of maintaining heart health it is actually very easy, but sometimes because we are busy with activities we often neglect to always check our heart health (Patombongi et al., 2018).

A person's pulse is known by feeling the wrist using three fingers (index, middle and ring) pressed together to feel the pulse and then counted for one minute (Prijosaksono & Kurniali, 2005). So we need a heart rate recording device that can store heart rate recording data so that it makes it easier to control health. One of the heart rate sensors that is easy to get is the Pulse Sensor which can be used to detect heart rate. This sensor will replace the role of manual reading of the heart rate by placing your finger on the pulse sensor and then calculating the reading time using a microcontroller.

Heart rate data will then be recorded and stored on the SD Card module which will then be monitored using the Blynk application (Hermansyah et al., 2022). Phone-based control and display is done through the blynk app connected to setup via wifi. Blynk is downloadable software that provides an easy-to-use platform for the user to control the device and receive output. Authentication of using blynk is done through a code that was sent to their email at configuration time. This code can then be shared with other users to authorize access (Hermansyah et al., 2022).

METHOD

This method is used to understand the basic theory related to research. so that it is expected to be able to provide an overview in the design of the system design. Prototyping is a software development method, in the form of a physical working model of the system and serves as an initial version of the system. With this method a prototype system will be produced as an intermediary for developers and users so that they can interact in the process of information system development activities. In order for the prototyping process to work well, it is necessary to define the rules at an early stage, that is, the developer and the user must have one understanding that the prototype is built to define the initial requirements. The flowchart above explains how the heart rate detector works in an easy and structured way. Starting from how do the sensors work until the flow of the system will arrive at displaying the results of the sensors used. By looking at the flowchart, you can see how this IoT-based heart rate detection system works.

- System Chart

The heart rate detection system consists of several components, namely the pulse sensor, sd-card module, OLED, buzzer. The relationship of some of these components can be described in a block diagram as follows

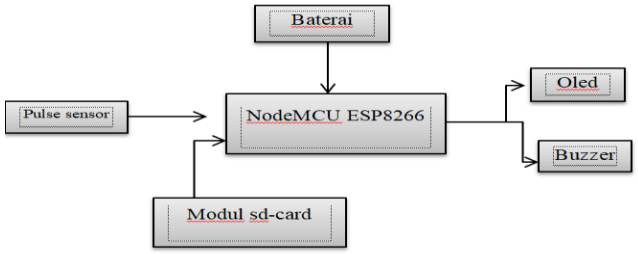

Figure 1 System Chart

- Pulse Sensor
  Detecting the pulse on the index finger by combining the pulse data from the sensor with the program on the microcontroller, you can get the bpm value. The heart rate itself is the heart rate per unit of time which is usually expressed in beats per minute (bpm).Node MCUESP8266
  Sebagai sumber daya dari semua komponen.
- Modul Sd-Card.
  Read and write data and store it on sd card memory with NodeMCU.
- Oled
  Means of information between the pulse sensor and arduino
- Buzzer
  The sound signature generated from each detected heartbeat

- Tool Design
  - Pulse Sensor Design
    The Max30100 sensor is a sensor that can be connected to NodeMCU, the pulse sensor pin (-) is connected to the black GND pin, the (+) pin of the pulse sensor is connected to the red 3v3 pin, the SCL pin is connected to the yellow Nodemcu D1 pin, and Nodemcu D2 pin is connected to green SDA.

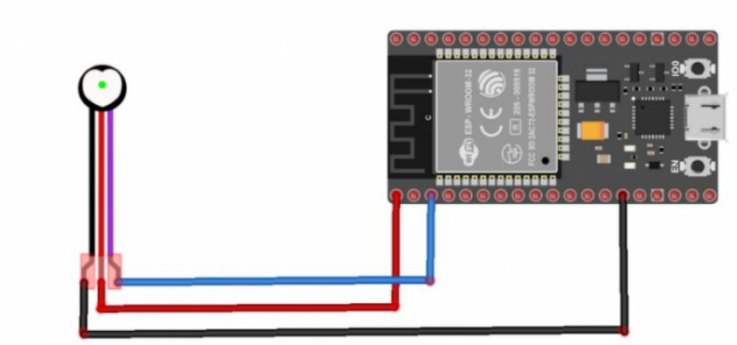

Figure 2 Pulse Sensor Design

- Oled Design
  Oled serves as a means of information between the pulse sensor and NodeMCU, on pin D1 connect it to SCL in orange, for pin D2 on the SDA pin it is yellow, pin 3v3 on VCC is red and for GND on GND is black.

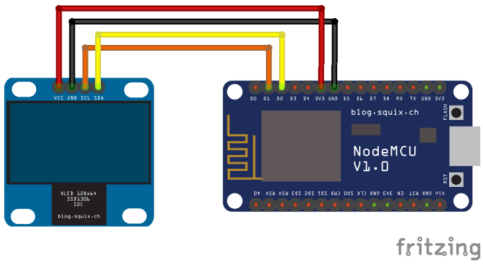

Figure 3 Oled Design

- Modul Sd-Card Design
  Read and write data and store it on sd card memory with NodeMCU. The NodeMCU GND pin on GND is black, the 3v3v pin on 3v3 is red, the CS pin on pin D8 is blue, the MOSI pin on pin D7 is brown, the SCK pin on D5 is gray, the MISO pin on D6 is orange.

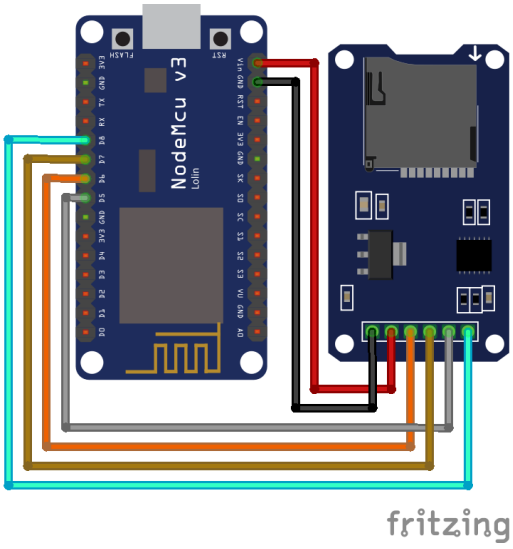

Figure 4 Moduls Sd - Card Design

- Overall Design
  The design of this tool will explain the assembly of the tools/hardware required by the system, both in terms of the whole and per part that support the running of the system.

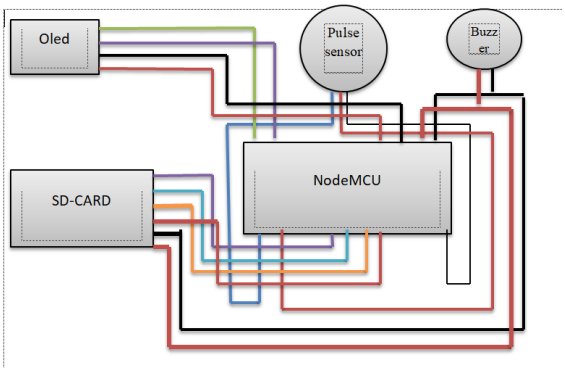

Figure 5 Overall of Design

Table 1 Overall Circuit Pin Path

NodeMCU	Oled	Pulse sensor	Sd-card
D5			SCK
D6			MISO
D7			MOSI
D8			CS
GND			GND
3v			Positif(+)
A0		S	
3v		Positif(+)	
GND		Negatif(-)	
D1	SCL		
D2	SDA		
GND	GND		
3V	VCC		
3v			
GND			

Table 2 Heart Rate by Age

Age	Minimum (BPM)	Maximum (BPM)	Average (BPM)
Newborn	100	180	140
1 moon – 1 year old	80	160	120
1 year old – 3 years old	80	130	105
3 years old – 6 years old	80	120	100

Age	Minimum (BPM)	Maximum (BPM)	Average (BPM)
6 years old – 12 years old	65	100	83
12 years old – 18 years old	60	90	85
19 years old – 69 years old	60	100	80
>70 years old	60	100	80

From the table above, it can be seen that newborn babies have a higher BPM or heart rate than when they are 1 month old or have reached 1 year or more. At the age of 3 years old-6 years old, a child's heart rate is at least at 80, and when entering adolescence to adulthood, a person's heart rate is at 65-60 and when someone has entered old age, a person's heart rate will decrease due to by the condition of the body that is getting weaker and when the elderly a person's heart rate is around 60 Bpm.

RESULT AND DISCUSSION

This stage is carried out in each series to find out that the tool is running as expected, which is then followed by testing the tool as a whole which will be presented as a whole which will later be displayed in the form of a table or figure which then ends with evaluating the test results to get the success rate of the tool already made.

Result

Figure 6 The end result of project

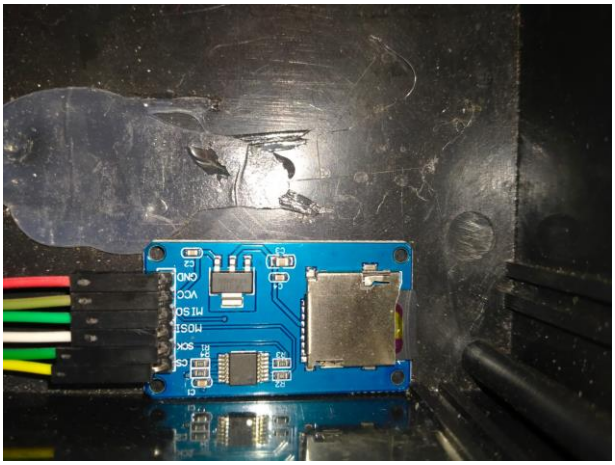

Figure 7 The end result of project

The display results of the design of the heart rate recording system device, where in Figure 6 it can be seen above that there is a heart rate sensor, then a micro USB port as a power supply connector. Whereas in Figure 7 it can be seen that there is a series of components of the heart rate recording system starting from the ESP 8266, the SD-card module which is integrated with one another. The material of the heart rate recording system tool box is made of black plastic which has a length of 10 cm, a width of 7 cm and a height of 4 cm.

With regard to IoT, the heart rate recording system is where the blynk application functions as a datalog server and the ESP8266 microcontroller functions as a publisher. There is wifi which serves as a connecting device from the smartphone to the internet network. smartphone is used as a device for monitoring data that has been processed via ESP8266 and sent via the blynk application.

Discussion

The test procedure is carried out by attaching a heart rate recording system to the index finger, while the oximeter is placed on the middle finger of the same hand. This test uses 5 people as a sample where everyone will do activities such as when relaxing, eating and after sports. The heart rate calculation is carried out for 1 minute because the unit used is Bite Per Minute (BPM).

This test is carried out when the body is in a relaxed state, not doing any activity. This test was carried out for 15 minutes. The process of this test is to prepare a heart rate recording system device, then attach the index finger to the heart pulse sensor contained in the tool that has been prepared and the middle finger is attached to the oximeter, after that the results of measuring the heart rate can be monitored on the blynk application and stored on the sd-card module.

Table 3 relaxed test

NO	Sample	Age(years old)	Weight (kg)	Height(Cm)	Puls Heart Rate(BMP)	Oxymeter (BPM)
1	A	21	53	158	62	63
2	B	20	58	156	74	73
3	C	21	56	157	61	62
4	D	20	43	143	65	65
5	E	21	51	158	71	71

Table 4 testing after eating

NO	Sampel	Usia (years old)	WEIGHT (kg)	Height (Cm)	Puls Heart Rate(BMP)	Oxymeter (BPM)
1	A	21	53	158	94	93
2	B	20	58	156	91	90
3	C	21	56	157	94	92
4	D	20	43	143	88	89
5	E	21	51	158	87	87

Table 5 testing after exercise

NO	Sampel	Usia (years old)	WEIGHT (kg)	Height(Cm)	Puls Heart Rate(BMP)	Oxymeter (BPM)
1	A	21	53	158	114	115
2	B	20	58	156	121	120
3	C	21	56	157	121	119
4	D	20	43	143	107	107
5	E	21	51	158	109	109

The results of testing the heart rate recording system show that the system can measure the heart rate of the five samples with the resulting heart rate range of at least 61 bpm and a maximum of 121 bpm. The following results show that the system created has been able to measure according to the specifications for the heart rate measurement limit, namely from 50 bpm to 200 bpm. From the test results it is also seen that the system created has a relatively small average measurement accuracy value of 1-2

bpm when compared to an oximeter, this is shown from various tests such as in relaxed conditions which have a percentage of 40% (2 out of 5 people) the same measurement both using the tool made and using an oximeter. As for testing the condition when eating, the percentage is 20% (1 out of 5 people) and for testing after exercise, it is 60% (3 out of 5 people).

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