APPENDIX

FORMULIR SCAN ANTI PLAGIARISME 3,03

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berupa(**TESIS, TUGAS AKHIR, PROPOSAL, SKRIPSI,SUMMARY, LAPORAN KERJA PRAKTEK**)

dengan judul : Analyzing Of Human Heart Rate In Three Activities : Sitting, Running And Exercising Using Arduino Lilypad

Semarang, 25 Januari 2019

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ABSTRACT

Everyone does activities in their daily lives, both walking, exercising or working. This project will analyze the condition of the human body when doing activities and not doing activities based on heart rate data and human body temperature.

This project uses a Pulse sensor and IR Thermometer sensor and ESP8266 Wifi module to detect the heart rate and body temperature that are paired in the glove and the data will then be sent to the MySQL database. Heart rate is tested in three activity categories. Each category has two types of heart rate data which are heart rate data that has been averaged and heart rate data that has not been average.

The result of this project is analyzing the comparison of people who are doing ordinary activities by looking at the heart rate data and body temperature data based on graphs that have been created from the MySQL database.

Keyword: heart rate, body temperature, Pulse sensor, IR Thermometer sensor, MySQL database

PREFACE

This project is titled "Analyzing Heart Rate And Measuring Body Temperature Using Arduino Lilypad". This project is to determine a person's heart rate and body temperature while doing activities. This project consists of 6 chapters.

Chapter I discusses about background, scopes and objectives from this research project.

Chapter II contains the study of literature from national and international. there are 5 journals that are used as references in this project. This journal makes it easy to work on this project.

Chapter III discusses about research methodology. There are 6 steps used in this project. Every step has a detailed explanation.

Chapter IV discusses about analysis and design. There are 3 tables for analyze, the sensor installation scheme and 2 flowcharts on this chapter.

Chapter V explains the implementation of the main program code and the results of analysis of the data obtained

Chapter VI as the final chapter discusses conclusion and suggestion for the future research.

CHAPTER 1
INTRODUCTION

1.1 Background

The health of the human body is very important. humans need to exercise so that their bodies are healthy. When someone is exercising, it will certainly cause the heart rate and temperature of the human body to increase at a certain stage. When someone is doing heavily exercise, it can increase the heart rate in a dangerous level. This project is used for monitoring and recording the heart rate and body temperature.

This project consists of the Arduino Lilypad, Pulse sensor, IR Thermometer sensor, and ESP8266 Wifi module. The sensor data read by Lilypad will be sent to MySQL server through Wifi. The process begins with the installation of Arduino Lilypad as a microcontroller along with a Pulse sensor, an ESP8266 Wifi module, and an IR Thermometer sensor. All module include the Arduino Lilypad are sewed at a glove. The Pulse sensor and IR Thermometer sensor detect the heart rate and temperature of the human body. Then through ESP8266, heart rate data and temperature data are sent to MySQL database in the server.

The result of this project is to analyze the condition of someone who is exercising so that he/she can be monitored if he/she practices too much. With the background of heartbeat-and-temperature charts, this program will display graphics simultaneously in real time.

1.2 Scope

Some of the points that must be used in this project are:

1. How is the comparison between the results of accuracy of heart rate data when exercising with normal standard data on exercise?
2. Does the IR Thermometer sensor detect body temperature normally just like an ordinary mercury thermometer?
3. Can data collection in a certain period detect and identify someone's activity?

1.3 Objective

The purpose of this project is to be able to identify the heart rate and temperature of the human body based on data recorded from sensors.

CHAPTER 2

LITERATURE STUDY

This Project uses references from several journals:

I Nengah Sandi (2016) did a research entitled "PENGARUH LATIHAN FISIK TERHADAP FREKUENSI DENYUT NADI" discusses about physical exercise affects the increase on heart rate. this is caused by the increased need for blood that carries oxygen to body tissues, transporting carbondioxide. Increasing exercise intensity, heart rate increases, when the intensity of the exercise decreases, the pulse rate decreases. This change is regulated by the nervous system and hormonal system. This is the acute effect of exercise. If physical exercise is carried out regularly and continuously over the long term, there will be a decrease in resting pulse. This is a chronic effect of exercise.

Nengah Sandi, *et al* (2016) di a research entitled "RELATIVE HUMIDITY of 40% INHIBITING THE INCREASE of PULSE RATE, BODY TEMPERATURE, AND BLOOD LACTIC ACID DURING EXERCISE" discusses about excessive sweating of the body is a reaction to decrease the heat caused by prolonged exercise at high relative humidity (RH). This situation may cause an increase in pulse rate (PR), body temperature (BT), and blood lactic acid training (BLT).

Dani Sasmoko, and Yanuar Arief Wicaksono (2017) did a research entitled "IMPLEMENTASI PENERAPAN INTERNET of THINGS (IoT) PADA MONITORING INFUS MENGGUNAKAN ESP8266 DAN WEB UNTUK BERBAGI DATA" discusses about ESP8266 is a WiFi module that already has SOC (System on Chip), so it can program directly into ESP8266 without requiring additional microcontrollers. The important thing from ESP8266 Wifi module is runs at 3.3V.

Dharmendra Singh Rajput, and Rakesh Gour (2016) did a research entitled "AN IOT FRAMEWORK FOR HEALTHCARE MONITORING SYSTEMS" discusses about Pulse sensors is a plug and play heart rate sensor designed for Arduino. Heart rate data can be useful for studying your activity with your heart rate. The Pulse Sensor can solve that problem. Pulse Sensor sips power with just 4mA current draw at 5V so it's great for mobile applications. Simply clip the Pulse Sensor to your earlobe or fingertip and plug it into your 3 or 5 Volt Arduino and you're ready to read heart rate.

Hasmah Mansor, *et al* (2015) did a research entitled "PORTABLE HEART RATE MEASUREMENT FOR REMOTE HEALTH MONITORING SYSTEM" discusses about Pulse sensor responds to relative changes in light intensity. If the amount of light incident on the sensor remains constant, the signal value will remain. If more light detected, the signal will goes up and when less light detected, the signal goes down. In other words, the pulse sensor measures subtle changes in light from expansion of the capillary blood vessels to sense the heartbeat.

CHAPTER 3
RESEARCH METHODOLOGY

There are six steps in this project : Testing sensors, Set up and attach the Arduino Lilypad to the glove, Preparing software and program, Sending data to MySQL server from sensors, Collecting data, Analyzing data.

3.1 Testing sensors

The sensor tested for this project are : Pulse sensor, IR Thermometer sensor, ESP8266 Wifi module. All the sensors tested with Arduino Lilypad.

3.2 Set up and attach the Arduino Lilypad to the glove

To simplify the use of sensors when used, it can be done by sewing Arduino Lilypad into gloves using thread, so the sensors don't fall when used.

3.3 Preparing software and program

This project used Arduino IDE software to load program in Arduino Lilypad. By using PHP programming to display data obtained from sensors.

3.4 Sending data to MySQL server from sensors

To send data from Pulse sensor and IR Thermometer sensor using ESP8266 Wifi module then data send to MySQL server used php code.

3.5 Collecting data

By the glove that has been installed with sensors worn on someone within an hour, to find out the heart rate and temperature data of the person's body that will be sent to MySQL.

3.6 Analyzing data

Data which inside MySQL is converted into a graph with php code used for analyze.

CHAPTER 4

ANALYSIS AND DESIGN

4.1 Analysis

This project is to analyze a person's heart rate and body temperature while doing activities. Activity categories are divided into 3 types : No Activity, Low Activities Level, and Heavy Activities Level. From these 3 categories of activities, to see the difference in heart rate data when people do activities.

Through Pulse sensor to determine how big a person's heart rate is. The IR Thermometer sensor is to determine the condition of a person's body temperature in degrees Celsius. A person's heart rate and body temperature data will be recorded by a Pulse sensor and IR Thermometer sensor that have been installed in the glove someone is wearing.

Here are some steps that must be done in this project to obtain data, this project requires an Arduino Lilypad that is installed in a glove. Pulse sensor, IR Thermometer sensor and ESP8266 Wifi module are installed with Arduino Lilypad. This Arduino Lilypad functions as a microcontroller to run a heart rate sensor, IR Thermometer sensor, and ESP8266 Wifi module. Arduino Lilypad needs a battery as a power source for power.

The analysis was carried out by comparing the heart rate data from 3 categories of activities carried out by a person over a period of 1 hour. With graphic for each category of activities makes it easy to analyze the person's heart rate.

Table 1: Heart Rate Data

No Activity	Low Activities Level	Heavy Activities Level

80 BPM	118 BPM	127 BPM
85 BPM	116 BPM	129 BPM
84 BPM	115 BPM	133 BPM
79 BPM	102 BPM	132 BPM
79 BPM	102 BPM	130 BPM
80 BPM	106 BPM	131 BPM
82 BPM	113 BPM	133 BPM
80 BPM	109 BPM	128 BPM
80 BPM	102 BPM	124 BPM
80 BPM	102 BPM	126 BPM

Table 4.1 above is the ten sample data of a person's heart rate from MySQL database. When the Pulse sensor gets a BPM value, it will send directly into the MySQL database. In this table divided into 3 columns, to distinguish changes that occur in a person's heart rate against the activities being carried out.

Table 2: Heart Rate Data with Averaging of ten BPM Values

No Activity	Low Activities Level	Heavy Activities Level
81 BPM	109 BPM	125 BPM
81 BPM	109 BPM	126 BPM
80 BPM	109 BPM	127 BPM
80 BPM	110 BPM	128 BPM
81 BPM	108 BPM	130 BPM
81 BPM	108 BPM	130 BPM
80 BPM	107 BPM	128 BPM
81 BPM	109 BPM	127 BPM
80 BPM	108 BPM	127 BPM
80 BPM	108 BPM	125 BPM

Table 4.2 above is ten samples of a person's heart rate data after averaging from a MySQL database. Pulse Sensor will loop ten times to get ten BPM values, then calculate the total ten BPM values and divide by ten as the average BPM value. After getting the average BPM value, the data will be sent into the MySQL database. This table is still divided into 3 columns, to distinguish the changes that occur in a person's heartbeat against the activities carried out.

Table 3: Body Temperature Data

No Activity	Low Activities Level	Heavy Activities Level
36 °c	36 °c	36 °c
36 °c	36 °c	36 °c
36 °c	36 °c	36 °c
36 °c	36 °c	36 °c
36 °c	36 °c	36 °c
36 °c	36 °c	36 °c
36 °c	36 °c	36 °c
36 °c	36 °c	36 °c
36 °c	36 °c	36 °c
36 °c	36 °c	36 °c

Table 4.3 above is ten samples of body temperature data from the MySQL database. The output temperature value from the IR Thermometer sensor is an integer number. The body temperature data in this table is stagnant, which is 36 degrees Celsius.

4.2 Design

In this subchapter explains using images about the design of sensors placement and the flowchart of a running process. This is a series of sensors and Arduino used in this project:

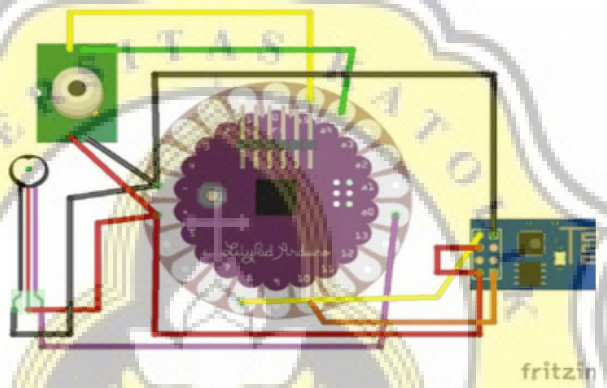

Illustration 1: Arduino Lilypad and Sensors Scheme

From Illustration 4.1 above, this project uses Arduino Lilypad, Pulse sensor, IR Thermometer sensor, and ESP8266 Wifi module. Arduino Lilypad is useful as a microcontroller for all sensors installed and provides a voltage (+) (-) for the sensor. Pulse sensor function to detect a person's heart rate. Pulse sensor requires a voltage of 5V. IR Thermometer sensor function to measure a person's body temperature. IR Thermometer sensor requires a voltage of 5V. And ESP8266 Wifi module function to connect Arduino Lilypad to WIFI network and make TCP/IP connections. ESP8266 Wifi module requires a voltage of 3.3V. Using the Lipo RC JJRC H36 battery with 3.7V to turn on the Arduino Lilypad and provide voltage to all sensors.

Here is the flowchart of the running process to get heart rate data and body temperature data :

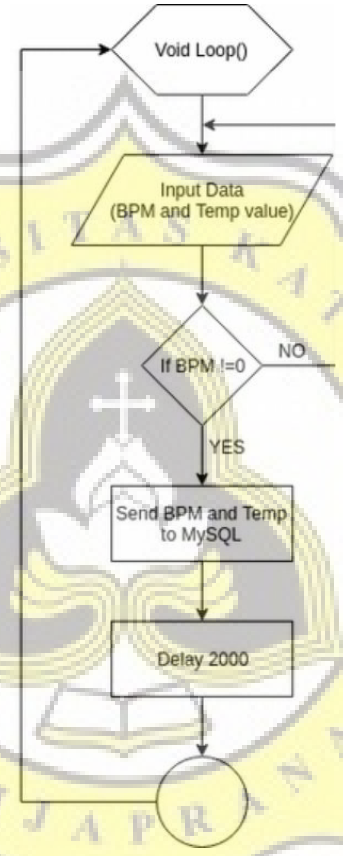

Illustration 2: Flowchart of Running Process

Flowchart on the Illustration 4.2 explains the data extract process from Pulse sensor and IR Thermometer sensor into MySQL database. First is reading data from the Pulse sensor and IR Thermometer sensor as input data, then get the BPM and Temperature value. When successfully obtaining a BPM and Temperature value, it will be sent to the MySQL database and interval for 2 seconds to return to the beginning again.

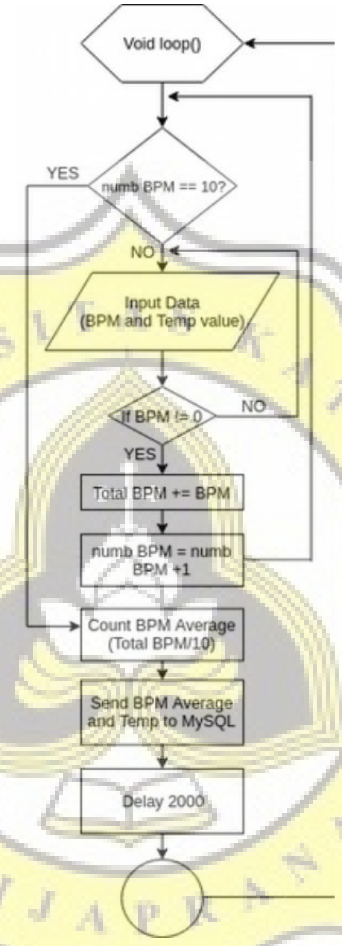

Illustration 3: Flowchart of Running Process with Averaging

From Illustration 4.3, first is reading data from the Pulse sensor and IR Thermometer sensor as input data, then get the BPM and Temperature value. When successfully obtaining a BPM and Temperature value, the BPM value will be looped and added continuously with a new BPM value of 10 times. After getting a total of 10 BPM values, then it will be divided by 10 to get an average

value of one BPM. Then it will be sent to the MySQL database and interval for 2 seconds to return to the beginning again.

CHAPTER 5
IMPLEMENTATION AND TESTING

5.1 Implementation

Pulse sensor, IR Thermometer sensor and ESP8266 Wifi module are installed on Arduino Lilypad. These are some parts of the code for reading BPM

```
pulseSensor.begin();
pulseSensor.analogInput(PulseWire);
myBPM = pulseSensor.getBeatsPerMinute();
 if (pulseSensor.sawStartOfBeat())
 {
    Serial.print("\tBPM = ");
    Serial.println(myBPM);
 }
 else
  {
      myBPM = 0;
  }
```

The code function above is used for Pulse sensor. Pulse sensor will detect person's heart rate. The output of pulse sensor is integer value of heart rate that converted into BPM (Beat per Minute).

```
pulseSensor.begin();
pulseSensor.analogInput(PulseWire);
for(int a=0; a<10; a++)
{
   myBPM += pulseSensor.getBeatsPerMinute();
   Serial.print("myBPM  :");
   Serial.println(myBPM);
}
myBPM = myBPM/10;
if (pulseSensor.sawStartOfBeat())
{
   Serial.print("\tBPM = ");
   Serial.println(myBPM);
}
else
{
   myBPM = 0;
}
```

The code function above is used for Pulse sensors by adding the average calculation. The BPM value will be looped and added continuously 10 times and then the final total is divided by 10 to get an average value of one BPM.

```
mlx.begin();
temp = mlx.readObjectTempC();
Serial.print("\tBody Temperature = ");
Serial.print(temp);
Serial.println("°C");
```

The function above is the code used on the IR Thermometer sensor. The output of the IR Thermometer sensor is a value of body temperature detection from infrared converted to degrees Celsius.

```
36.   String cmd = "AT+CIPSTART=\"TCP\",\"";
37.   cmd += ipAddress;//"192.168.43.88";
38.   cmd += "\",80";
39.   wifi.println(cmd);
40.   if(wifi.find(wifierr))
41.   {
42.     Serial.println("AT+CIPSTART error");
43.     return;
44.   }
45.   if(SendmyBPM!=0)
46.   {
47.             String          getStr          =          "GET
  http://"+ipAddress+"/Harapan2/conf.php?pulseSensor=";
48.    getStr += SendmyBPM;
49.    getStr += "&tempSensor=";
50.    getStr += temp;
51.    cmd = "AT+CIPSEND=";
52.    cmd += String(getStr.length());
53.    wifi.println(cmd);
54.    Serial.println("AT+CIPSEND=");
55.    Serial.println(getStr);
56.    wifi.print(getStr);
57.    delay(2000);
58.    }
```

The code above is for sending data from Arduino to MySQL database. It needs to be connected to the IP that is on the server, the server used in this project is localhost. Data sent will be received by PHP using GET Method and then entered into the MySQL database.

5.2 Testing

Before testing, Arduino Lilypad and all sensors must be installed and sewn in gloves. After that the testing tool was ready to be used by someone to record heart rate and body temperature data.

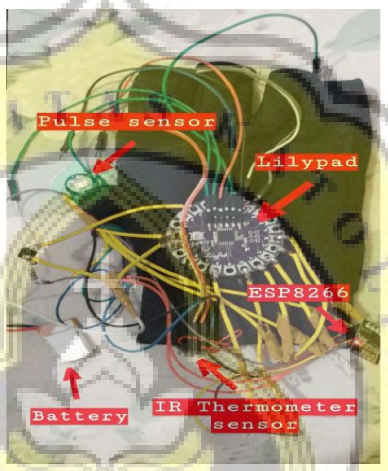

Illustration 4: Glove that have Arduino Lilypad and sensors

The set up on Illustration 5.1 shows Pulse sensor, IR Thermometer sensor, ESP8266 Wifi module, battery and Arduino Lilypad which installed and sewed on glove. Arduino Lilypad. Arduino Lilypad is very light, so it can be installed in the middle of the glove, and does not interfere when someone is doing activities. The Pulse sensor is also mounted on the index finger on the glove. IR Thermometer is installed at the bottom near the skin so that it can detect body temperature. Here uses a Lipo RC JJRC H36 with 3.7V as a voltage source for Arduino Lilypad and all the sensors.

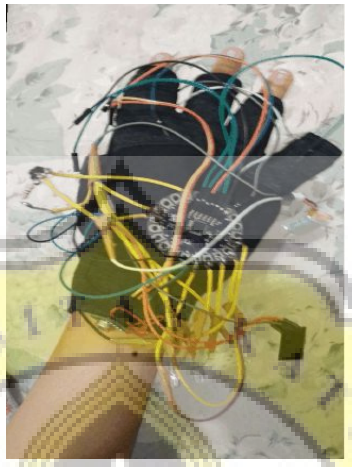

Illustration 5: Glove have worn by someone

Illustration 5.2 glove already applied on someone. Pulse sensor and IR thermometer sensor will record data from that person. Data collection is divided into 3 categories: First, record data when not doing activities, the second is recording data during low activities and the third is recording data when doing heavy activities.

The examples of low activities data taken from jogging activities within an hour. The examples of heavy activities data taken from sprint activities until get 1000 data, takes half an hour.

All recorded heart rate and body temperature data will be saved into MySQL database. From the MySQL database, there are a total of 4.464 data from all 3 activity categories. For the no activity category there were a total of 1.792 data. For the low activities category there were a total of 1.783 data. For the heavy activities category there were a total of 889 data.

This is the graphs of the results of recording data stored in the MySQL database.

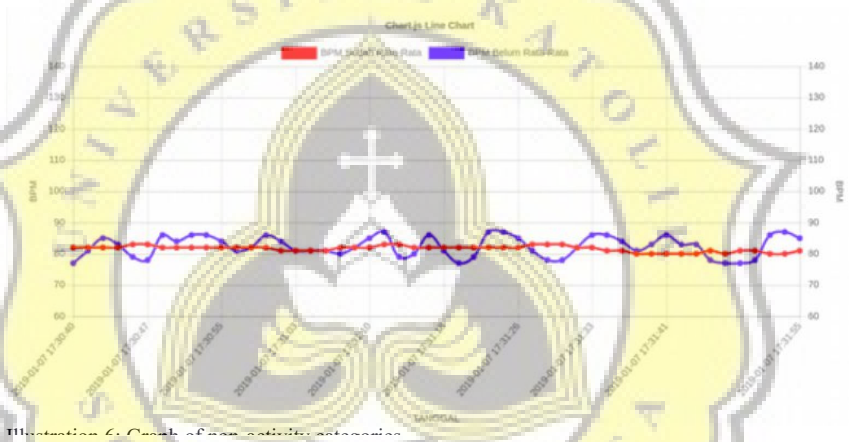

Illustration 6: Graph of non-activity categories

Illustration 5.3 is a graph of first categories. There are 2 different lines, red line for averaged BPM data and the blue line for BPM data that has not been averaged. Recorded time data for red and blue lines is different because the blue line is old data and the red line is new data. This happens because this project uses the same database table to record two BPM data (BPM with average and BPM without average) in this category. The red line is more stable than the blue line, so this project uses the red line to be analyzed. When people are not doing activities, based on data from this project shows the average BPM is around 80-83.

Illustration 5.4 is a graph of second categories. There are 2 different lines, red line for averaged BPM data and the blue line for BPM data that has not been averaged. Recorded time data for red and blue lines is different because the blue

line is old data and the red line is new data. This happens because this project uses the same database table to record two BPM data (BPM with average and BPM without average) in this category. The red line is more stable than the blue line, so this project uses the red line to be analyzed. When people doing low activities like jogging, based on data from this project shows the average BPM is around 108-109.

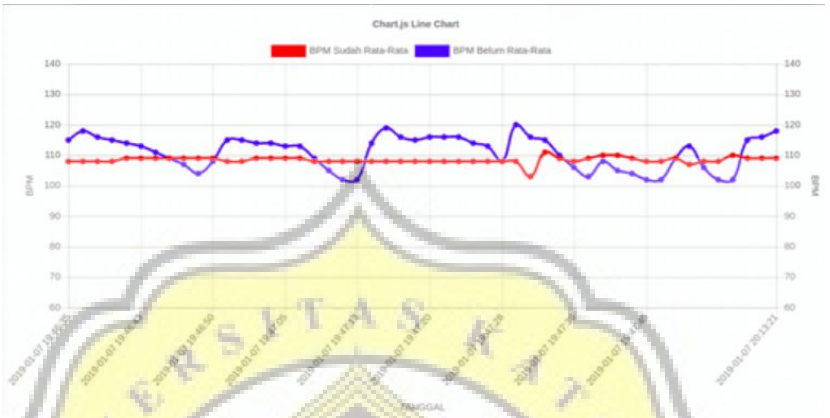

Illustration 7: Graph of low activity categories

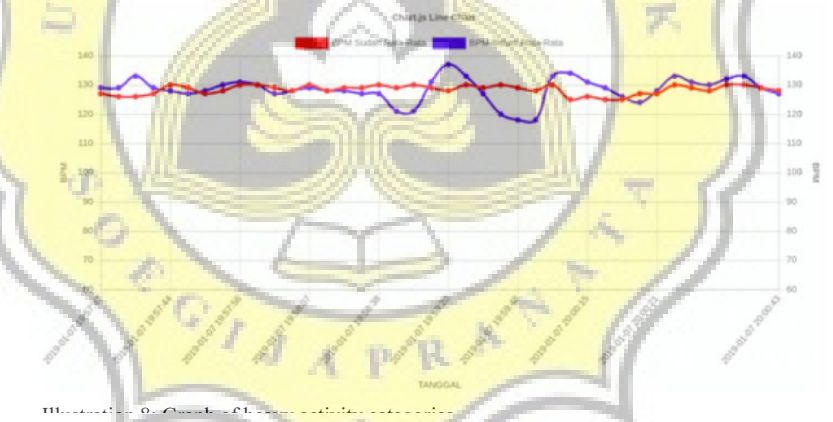

Illustration 8: Graph of heavy activity categories

Illustration 5.5 is a graph of third categories. There are 2 different lines, red line for averaged BPM data and the blue line for BPM data that has not been averaged. Recorded time data for red and blue lines is different because the blue line is old data and the red line is new data. This happens because this project uses the same database table to record two BPM data (BPM with average and BPM without average) in this category. The red line is more stable than the blue line, so this project uses the red line to be analyzed. When people doing heavy activities

like sprinting, based on data from this project shows the average BPM is around 127-130.

CHAPTER 6
CONCLUSION

From the project result, the conclusions to answer the problem are:

1. The comparison of heart rate data from this project with standard heart rate data is the same, normal heart rate is 60-100 BPM. When doing activities, whether light or heavy activities, the heart rate will be above 100 BPM and for a maximum heart rate it depends on age, calculated from the formula 220 BPM – age.

2. IR Thermometer sensor can detect body temperature normally such as mercury thermometers and the value of the data generated is very accurate.

3. Through heart rate data recorded in a certain period can identify a person's activity by analyzing the person's heart rate graph.

Suggestions for the future of this project is using the AMX3d Lilypad Conductive Thread instead of the cable on the Arduino Lilypad to make the glove more comfortable when used.