LAMPIRAN

1. **Hasil Pengujian BPM**

   a. **Analisa Perhitungan pada 60 Bpm**

      1) **Nilai Rata-rata**

      Rata-rata $(\overline{X}) = \frac{Xn}{n}$

      $= \frac{60+61+61+59+61+61+61+61+61+61+61+60+60+61+61+61+61+60+61+61}{20}$

      = 60.7

      2) **Nilai Koreksi**

      Koreksi $= \bar{X}$ - X_S

      = 60.7 – 60

      = 0.7

      3) **Nilai Standar Deviasi**

      Standar deviasi $= \sqrt{\frac{\sum(X_{i-\overline{X)}}}{n-1}}$

      $= \sqrt{\sum \frac{\begin{matrix}(60-60)^2+(60-61)^2+(60-61)^2+(60-59)^2+(60-61)^2+\\(60-61)^2+(60-61)^2+(60+61)^2+(60+61)^2+(60-61)^2+\\(60-61)^2+(60-60)^2+(60+60)^2+(60-61)^2+(60-61)^2+\\(60-61)^2+(60-61)^2+(60-60)^2+(60-61)^2+(60-61)^2\end{matrix}}{20-1}}$

      = 0.57

      4) **Nilai Ketidakpastian Tipe a**

      Ketidakpastian $= \frac{standar\ deviasi}{\sqrt{20}}$

      $= \frac{0.57}{\sqrt{20}}$

      = 0.18

   b. **Analisa Perhitungan pada 80 BPM**

      1) **Nilai Rata-rata**

      Rata-rata $(\overline{X}) = \frac{Xn}{n}$

      $= \frac{80+79+80+79+80+80+81+79+80+80+80+80+80+80+79+81+80+80+80}{20}$

      = 79,9

      2) **Nilai Koreksi**

      Koreksi $= \bar{X}$ - X_S

      = 79,9 – 80

      = - 0.1

3) Nilai Standar Deviasi

Standar deviasi $= \sqrt{\frac{\sum(X_{i-\overline{X)}}}{n-1}}$

$$= \sqrt{\sum \frac{\begin{matrix}(80-80)^2+(80-79)^2+(80-80)^2+(80-79)^2+(80-80)^2+\\(80-80)^2+(80-81)^2+(80+79)^2+(80+88)^2+(80-80)^2+\\(80-81)^2+(80-80)^2+(80+80)^2+(80-80)^2+(80-80)^2+\\(80-79)^2+(80-81)^2+(80-80)^2+(80-80)^2+(80-80)^2\end{matrix}}{20-1}}$$

$= 0.55$

4) Nilai Ketidakpastian Tipe a

Ketidakpastian $= \frac{standar\ deviasi}{\sqrt{20}}$

$= \frac{0.55}{\sqrt{20}}$

$= 0.17$

c. Analisa Perhitungan pada 100 Bpm

1) Nilai Rata-rata

Rata-rata $(\overline{X}) = \frac{Xn}{n}$

$$= \frac{\begin{matrix}101+101+101+101+100+100+101+100+100+101\\101+101+101+101+100+100+100+101+100+100\end{matrix}}{20}$$

$= 100,6$

2) Nilai Koreksi

Koreksi $= \bar{X} - X_S$

$= 100,6 - 100$

$= 0.6$

3) Nilai Standar Deviasi

Standar deviasi$= \sqrt{\frac{\sum(X_{i-\overline{X)}}}{n-1}}$

$$= \sqrt{\sum \frac{\begin{matrix}(100-101)^2+(100-101)^2+(100-101)^2+(100-101)^2+(100-100)^2+\\(100-100)^2+(100-101)^2+(100+100)^2+(100+100)^2+(100-101)^2+\\(100-101)^2+(100-101)^2+(100+101)^2+(100-101)^2+(100-100)^2+\\(100-100)^2+(100-100)^2+(100-101)^2+(100-100)^2+(100-100)^2\end{matrix}}{20-1}}$$

$= 0.51$

4) Nilai Ketidakpastian Tipe a

Ketidakpastian $= \frac{standar\ deviasi}{\sqrt{20}}$

$= \frac{0.51}{\sqrt{20}}$

$= 0.16$

d. Analisa Perhitungan pada 120 Bpm

1) Nilai Rata-rata

Rata-rata $(\overline{X}) = \frac{Xn}{n}$

$= \frac{123+123+124+123+124+123+124+123+123+123}{\frac{122+122+123+123+124+124+123+123+123+123}{20}}$

$= 123{,}2$

2) Nilai Koreksi

Koreksi $= \bar{X}$ - X_S

$= 123{,}2 - 120$

$= 3{,}2$

3) Nilai Standar Deviasi

Standar deviasi $= \sqrt{\frac{\sum(X_{i-\overline{X)}}}{n-1}}$

$$= \sqrt{\sum \frac{\begin{matrix}(\mathbf{120-123})^2+(\mathbf{120-123})^2+(\mathbf{120-124})^2+(\mathbf{120-123})^2+(\mathbf{120-124})^2+\\(\mathbf{120-123})^2+(\mathbf{120-124})^2+(\mathbf{120+123})^2+(\mathbf{120+123})^2+(\mathbf{120-123})^2+\\(\mathbf{120-122})^2+(\mathbf{120-122})^2+(\mathbf{120+123})^2+(\mathbf{120-123})^2+(\mathbf{120-124})^2+\\(\mathbf{120-124})^2+(\mathbf{120-123})^2+(\mathbf{120-123})^2+(\mathbf{120-123})^2+(\mathbf{120-123})^2\end{matrix}}{\mathbf{20-1}}}$$

$= 0.59$

4) Nilai Ketidakpastian Tipe a

Ketidakpastian $= \frac{standar\ deviasi}{\sqrt{20}}$

$= \frac{0.59}{\sqrt{20}}$

$= 0.19$

e. Analisa Perhitungan pada 140 Bpm

1) Nilai Rata-rata

Rata-rata $(\overline{X}) = \frac{Xn}{n}$

$= \frac{139+139+140+139+139+140+140+141+139+139}{\frac{140+140+140+140+140+139+139+139+140+140}{20}}$

$= 139{,}6$

2) Nilai Koreksi

Koreksi $= \bar{X} - X_S$

$= 139,6 - 140$

$= - 0,4$

3) Nilai Standar Deviasi

Standar deviasi $= \sqrt{\frac{\sum(X_{i-\overline{X)}}}{n-1}}$

$$= \sqrt{\sum \frac{\begin{matrix}(\mathbf{140-139})^2+(\mathbf{140-139})^2+(\mathbf{140-140})^2+(\mathbf{140-139})^2+(\mathbf{140-139})^2+ \\ (\mathbf{140-140})^2+(\mathbf{140-140})^2+(\mathbf{140+141})^2+(\mathbf{140+139})^2+(\mathbf{140-139})^2+ \\ (\mathbf{140-140})^2+(\mathbf{140-140})^2+(\mathbf{140+140})^2+(\mathbf{140-140})^2+(\mathbf{140-140})^2+ \\ (\mathbf{140-139})^2+(\mathbf{140-139})^2+(\mathbf{140-139})^2+(\mathbf{140-140})^2+(\mathbf{140-140})^2\end{matrix}}{\mathbf{20-1}}}$$

$= 0,60$

4) Nilai Ketidakpastian Tipe a

Ketidakpastian $= \frac{standar\ deviasi}{\sqrt{20}}$

$= \frac{0.60}{\sqrt{20}}$

$= 0.19$

f. Analisa Perhitungan pada 160 Bpm

1) Nilai Rata-rata

Rata-rata $(\overline{X}) = \frac{Xn}{n}$

$$= \frac{\begin{matrix}159+159+159+159+160+600+160+159+159+159 \\ 160+160+159+159+160+159+159+160+160+160\end{matrix}}{20}$$

$= 159,5$

2) Nilai Koreksi

Koreksi $= \bar{X} - X_S$

$= 159,5 - 160$

$= - 0,5$

3) Nilai Standar Deviasi

Standar deviasi $= \sqrt{\frac{\sum(X_{i-\overline{X)}}}{n-1}}$

$$= \sqrt{\sum \frac{\begin{matrix}(160-159)^2+(160-159)^2+(160-159)^2+(160-159)^2+(160-160)^2+\\(160-160)^2+(160-160)^2+(160+159)^2+(160+159)^2+(160-159)^2+\\(160-160)^2+(160-160)^2+(160+159)^2+(160-159)^2+(160-160)^2+\\(160-159)^2+(160-159)^2+(160-160)^2+(160-160)^2+(160-160)^2\end{matrix}}{20-1}}$$

= 0,60

4) Nilai Ketidakpastian Tipe a

Ketidakpastian $= \frac{standar\ deviasi}{\sqrt{20}}$

$= \frac{0.51}{\sqrt{20}}$

= 0.16

g. Analisa Perhitungan pada 180 Bpm

1) Nilai Rata-rata

Rata-rata $(\overline{X}) = \frac{Xn}{n}$

$= \frac{179+179+179+180+180+179+179+180+180+180}{179+180+179+180+179+179+180+180+179+180}$

= 179,5

2) Nilai Koreksi

Koreksi $= \bar{X} - X_S$

= 179,5 – 180

= - 0,5

3) Nilai Standar Deviasi

Standar deviasi $= \sqrt{\frac{\sum(X_{i-\overline{X)}}}{n-1}}$

$$= \sqrt{\sum \frac{\begin{matrix}(180-179)^2+(180-179)^2+(180-179)^2+(180-180)^2+(180-180)^2+\\(180-179)^2+(180-179)^2+(180+180)^2+(180+180)^2+(180-180)^2+\\(180-179)^2+(180-180)^2+(180+179)^2+(180-180)^2+(180-179)^2+\\(180-179)^2+(180-180)^2+(180-180)^2+(180-179)^2+(180-180)^2\end{matrix}}{20-1}}$$

= 0,51

4) Nilai Ketidakpastian Tipe a

Ketidakpastian $= \frac{standar\ deviasi}{\sqrt{20}}$

$= \frac{0.51}{\sqrt{20}}$

$= 0.16$

2. Hasil Pengujian Temperatur

a. Analisis Perhitungan Temperatur 29 Derajat Celcius

1) Nilai Rata-rata

Rata-rata $(\overline{X}) = \frac{Xn}{n}$

$= \frac{29,14+29,14+29,04+24,6+29,22}{5}$

$= 29,23$

2) Nilai Koreksi

Koreksi $= \bar{X} - X_S$

$= 29,23 - 29$

$= 0,23$

3) Nilai Standar Deviasi

Standar deviasi $= \sqrt{\frac{\sum(X_{i-\overline{X)}}}{n-1}}$

$= \sqrt{\sum \frac{(29-29,14)^2+(29-29,14)^2+(29-29,04)^2+(29-29,6)^2+(29-29,22)^2}{5-1}}$

$= 0.22$

4) Nilai Ketidakpastian Tipe a

Ketidakpastian $= \frac{standar\ deviasi}{\sqrt{5}}$

$= \frac{0.22}{\sqrt{5}}$

$=0.10$

b. Analisis perhitungan temperature 31 derajat

1) Nilai Rata-rata

Rata-rata $(\overline{X}) = \frac{Xn}{n}$

$= \frac{31,18+31,19+31,09+31,18+31,18}{5}$

$= 31,16$

2) Nilai Koreksi

Koreksi $= \bar{X} - X_S$

$= 31{,}16 - 31$

$= 0{,}16$

3) Nilai Standar Deviasi

Standar deviasi $= \sqrt{\frac{\sum(X_{i-\overline{X)}}}{n-1}}$

$$= \sqrt{\sum \frac{(31-31{,}18)^2+(31-31{,}19)^2+(31-31{,}09)^2+(31-31{,}18)^2+(31-31{,}18)^2}{5-1}}$$

$= 0{,}04$

4) Nilai Ketidakpastian Tipe a

Ketidakpastian $= \frac{standar\ deviasi}{\sqrt{5}}$

$= \frac{0{,}04}{\sqrt{5}}$

$= 0.02$

3. Hasil Pengujian Respirasi

a. Analisis Perhitungan Respirasi Pada 15

1) Nilai Rata-rata

Rata-rata $(\overline{X}) = \frac{Xn}{n}$

$$= \frac{15+15+15+15+15+15+15+12+12+15+15+15+15+15+15+15+15+15+15+15}{20}$$

$= 14{,}7$

2) Nilai koreksi

Koreksi $= \bar{X} - X_S$

$= 14{,}7 - 15$

$= -0.3$

3) Nilai Standar Deviasi

Standar deviasi $= \sqrt{\frac{\sum(X_{i-\overline{X)}}}{n-1}}$

$$= \sqrt{\sum \frac{\begin{matrix}(15-15)^2+(15-15)^2+(15-15)^2+(15-15)^2+(15-15)^2+\\(15-15)^2+(15-15)^2+(15+12)^2+(15+12)^2+(15-15)^2+\\(15-15)^2+(15-15)^2+(15+15)^2+(15-15)^2+(15-15)^2+\\(15-16)^2+(15-15)^2+(15-15)^2+(15-15)^2+(15-15)^2\end{matrix}}{20-1}}$$

$= 0.92$

4) Nilai Ketidakpastian Tipe a

Ketidakpastian $= \frac{standar\ deviasi}{\sqrt{20}}$

$= \frac{0.92}{\sqrt{20}}$

$=0.21$

b. Analisis Perhitungan Respirasi Pada 18

1) Nilai Rata-rata

Rata-rata $(\overline{X}) = \frac{Xn}{n}$

$$= \frac{\begin{matrix}18+18+18+18+18+18+18+18+15+18+\\18+18+18+18+18+18+18+18+18+18\end{matrix}}{20}$$

$= 17,9$

2) Nilai Koreksi

Koreksi $= \bar{X} - X_S$

$= 17,9 - 18$

$= -0.1$

3) Nilai Standar Deviasi

Standar deviasi $= \sqrt{\frac{\sum(X_{i-\overline{X)}}}{n-1}}$

$$= \sqrt{\sum \frac{\begin{matrix}(18-18)^2+(18-18)^2+(18-18)^2+(18-18)^2+(18-18)^2+\\(18-18)^2+(18-18)^2+(18+18)^2+(18+15)^2+(18-18)^2+\\(18-18)^2+(18-18)^2+(18+18)^2+(18-18)^2+(18-18)^2+\\(18-18)^2+(18-18)^2+(18-18)^2+(18-18)^2+(18-18)^2\end{matrix}}{20-1}}$$

$= 0.67$

4) Nilai Ketidakpastian Tipe a

Ketidakpastian $= \frac{standar\ deviasi}{\sqrt{20}}$

$= \frac{0.67}{\sqrt{20}}$

$= 0.15$

c. Analisis Perhitungan Respirasi Pada 21

1) Nilai Rata-rata

Rata-rata $(\overline{X}) = \frac{Xn}{n}$

$= \frac{21+21+21+21+21+24+24+21+21+21+21+21+21+21+21+21+21+21+21+21}{20}$

$= 21,3$

2) Nilai Koreksi

Koreksi $= \bar{X} - X_S$

$= 21,3 - 21$

$= 0.3$

3) Nilai Standar Deviasi

Standar deviasi $= \sqrt{\frac{\sum(X_{i-\overline{X})}}{n-1}}$

$$= \sqrt{\sum \frac{\begin{matrix}(\mathbf{21-21})^2+(\mathbf{21-21})^2+(\mathbf{21-21})^2+(\mathbf{21-21})^2+(\mathbf{21-21})^2+\\(\mathbf{21-24})^2+(\mathbf{21-24})^2+(\mathbf{21+21})^2+(\mathbf{21+21})^2+(\mathbf{21-21})^2+\\(\mathbf{21-21})^2+(\mathbf{21-21})^2+(\mathbf{21+21})^2+(\mathbf{21-21})^2+(\mathbf{21-21})^2+\\(\mathbf{21-21})^2+(\mathbf{21-21})^2+(\mathbf{21-21})^2+(\mathbf{21-21})^2+(\mathbf{21-21})^2\end{matrix}}{\mathbf{20-1}}}$$

$= 0.92$

4) Nilai Ketidakpastian Tipe a

Ketidakpastian $= \frac{standar\ deviasi}{\sqrt{20}}$

$= \frac{0.92}{\sqrt{20}}$

$= 0.21$

d. Analisis Perhitungan Respirasi Pada 24

1) Nilai Rata-rata

Rata-rata $(\overline{X}) = \frac{Xn}{n}$

$= \frac{24+24+24+24+24+21+21+24+24+24+22+21+24+24+24+24+24+24+24+24}{20}$

$= 23,6$

2) Nilai Koreksi

Koreksi $= \bar{X} - X_S$

$= 23,6 - 24$

$= -0.4$

3) Nilai Standar Deviasi

Standar deviasi $= \sqrt{\frac{\sum(X_{i-\overline{X)}}}{n-1}}$

$$= \sqrt{\sum \frac{\begin{matrix}(24-24)^2+(24-24)^2+(24-24)^2+(24-24)^2+(24-24)^2+\\(24-21)^2+(24-21)^2+(24+24)^2+(24+24)^2+(24-24)^2+\\(24-24)^2+(24-21)^2+(24+24)^2+(24-24)^2+(24-24)^2+\\(24-24)^2+(24-24)^2+(24-24)^2+(24-24)^2+(24-24)^2\end{matrix}}{20-1}}$$

$= 1,10$

4) Nilai Ketidakpastian Tipe a

Ketidakpastian $= \frac{standar\ deviasi}{\sqrt{20}}$

$= \frac{1,10}{\sqrt{20}}$

$= 0.25$

4. PROGRAM ALAT

```
#include <Time.h>
#include <TimeLib.h>

#define USE_ARDUINO_INTERRUPTS true
#include <PulseSensorPlayground.h>

const int PulseWire = 1;
const int LED13 = 13;
int Threshold = 500;

PulseSensorPlayground pulseSensor;
#define sensorlm35  A0
#define sensorresp  2
#include <LiquidCrystal.h>
LiquidCrystal lcd(8, 7, 6, 5, 1, 0);
int counter,counterresp;
float volt,suhu;
int tanda,timeout;
void setup() {

 //Serial.begin(9600);
 lcd.begin(16, 4);
 pulseSensor.analogInput(PulseWire);
 pulseSensor.blinkOnPulse(LED13);
```

```
  pulseSensor.setThreshold(Threshold);

   if (pulseSensor.begin()) {
    Serial.println("We created a pulseSensor Object !");
  }
}




void celcius()
{

  int dataadc2 ;
  long sum = 0;
  int i;

  for (i = 0; i < 100; i++)
  {
    sum += analogRead(sensorlm35);
  }


  dataadc2  = analogRead(sensorlm35); //sum / 100;
  volt = (dataadc2 * (5.0 / 1023.0)-0.04);
  suhu = volt * 100;
```

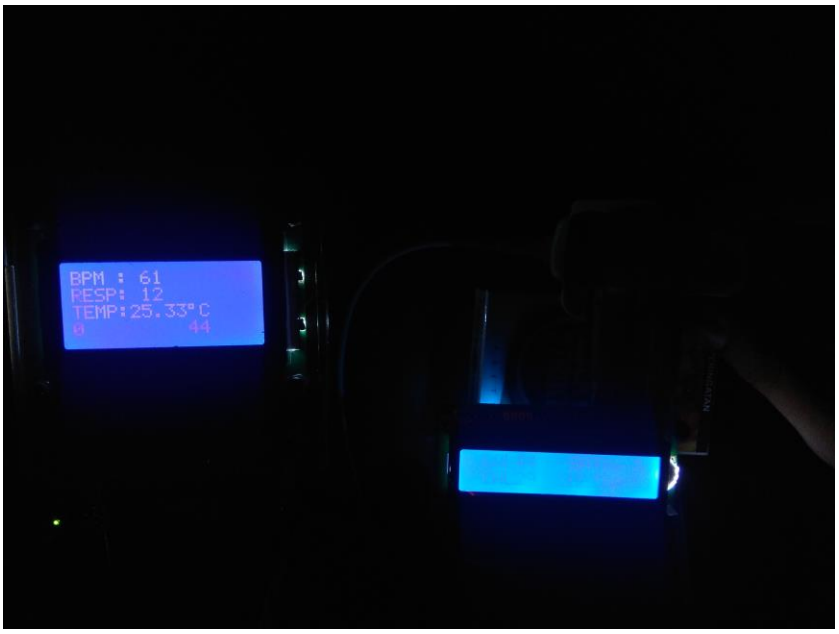
```
   lcd.setCursor(0,2);
   lcd.print("TEMP:");
   lcd.print(suhu);
   lcd.print((char)223);     // degree symbol
   lcd.print("C");
}
void resp(){
 if(digitalRead(sensorresp)==LOW&& tanda==1)
 {
  //digitalWrite(buzz,HIGH);
   counter++;
   tanda=0;
   timeout=0;
 }
 if( digitalRead(sensorresp)==HIGH)
 {
  //digitalWrite(buzz,LOW);
   timeout++;
 }
 if(timeout>15){tanda=1;}
 if(timeout<15){tanda=0;}
 if(second()==20||second()==40||second()==0)
 {
 celcius();
 counterresp=counter*3;
```

```
  lcd.setCursor(0,1);
  lcd.print("RESP: ");
  lcd.print(counterresp);
  delay(1000);
  counter=0;
   }
}
void loop() {

 int myBPM = pulseSensor.getBeatsPerMinute();

if (pulseSensor.sawStartOfBeat()) {
// Serial.println("♥  A HeartBeat Happened ! ");
 //Serial.print("BPM: ");
 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("BPM : ");
 lcd.print(myBPM);

 lcd.setCursor(0,1);
 lcd.print("RESP: ");
 lcd.print(counterresp);

 lcd.setCursor(0,2);
 lcd.print("TEMP:");
```

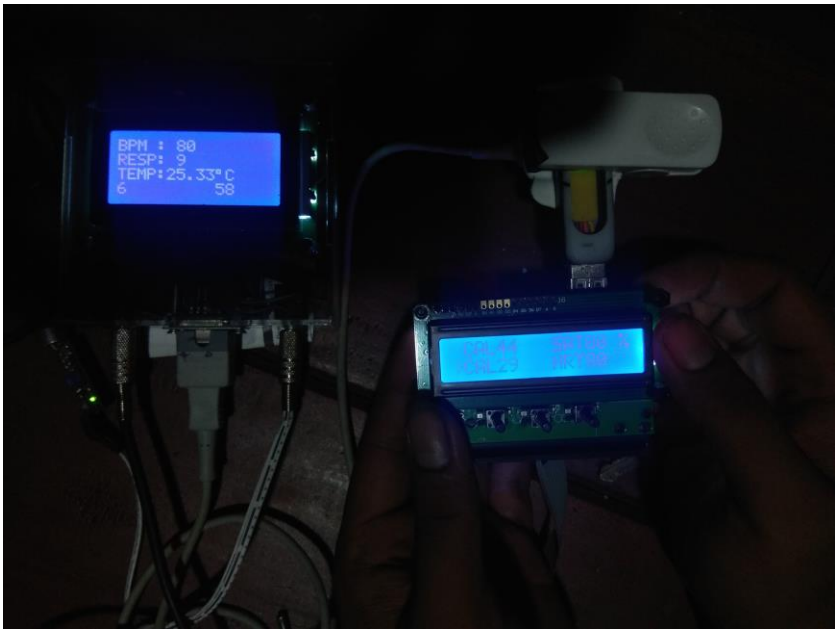
```
 lcd.print(suhu);
 lcd.print((char)223);     // degree symbol
 lcd.print("C");



}
 delay(10);

 resp();
 lcd.setCursor(0,3);
 lcd.print(counter);

 lcd.setCursor(10,3);
 lcd.print(second());



}
```

5. GAMBAR PENGAMBILAN DATA BPM

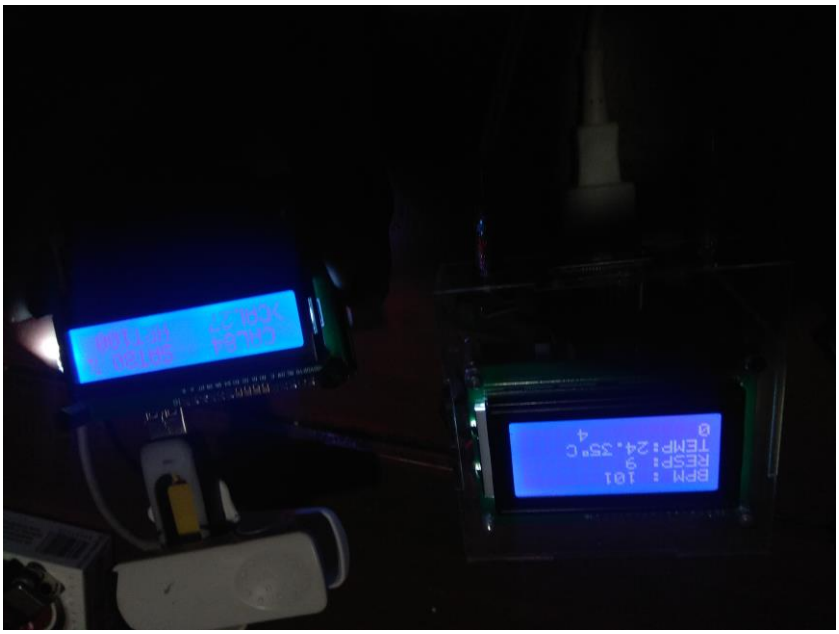
a. Pengambilan Data 60 BPM



b. Pengambilan Data 80 BPM



c. Pengambilan Data 100 BPM



d. Pengambilan Data 120 BPM

e. Pengambilan Data 140 BPM

f. Pengambilan Data 160 BPM

g. Pengambilan Data 180 BPM

6. GAMBAR PENGAMBILAN DATA SUHU

a. Pengambilan Data Suhu 29°C

b. Pengambilan Data Suhu 31°C

REFERENSI