LAMPIRAN A

SOURCE CODE ARDUINO

```
#include <OneWire.h>
#include <DallasTemperature.h>

#include <LiquidCrystal_I2C.h>

#include <DS3231.h>

#include <SPI.h>
#include <SD.h>

#define Sampling_Time 5
#define Num_Samples 600
#define Peak_Threshold_Factor 85
#define Minimum_Range 500
#define Minimum_Peak_Separation 75  // 75*5=375 ms
#define DC_Added 10;
#define Moving_Average_Num 5

#define ONE_WIRE_BUS A2

OneWire oneWire(ONE_WIRE_BUS);

DallasTemperature sensors(&oneWire);

LiquidCrystal_I2C lcd(0x3F, 20, 4);

int ADC_Samples[Num_Samples], Index1, Index2, Index3, Peak1, Peak2, Peak3;
long Pulse_Rate, Temp1=1L, Pulse_Time1, Pulse_Time2;
int Peak_Magnitude, Peak_Threshold, Minima, Range;

DS3231  rtc(SDA, SCL);
File myFile;
int pinCS = 53; // Pin 10 on Arduino Uno

const byte tombolkirim=8;
int statustombol=0;

char valsuhu[10];
char valdetak[10];
```

```
char valsuhu[10];
char valdetak[10];

unsigned long waktusebelum=0;
unsigned long interval = 120000;
unsigned long waktu = millis();

float suhu;

void setup(void)
{
  Serial.begin(9600);
  Serial1.begin(9600);
  pinMode(pinCS, OUTPUT);
  pinMode(tombolkirim, INPUT_PULLUP);

  if (SD.begin())
  {
    Serial.println("SD card is ready to use.");
  }
  else
  {
    Serial.println("SD card initialization failed");
    return;
  }

  rtc.begin();
  // start serial port
  lcd.begin();

  lcd.setCursor(3,0);
  lcd.print("Selamat Datang ");
  delay (1000);

  lcd.setCursor(2,1);
  lcd.print("Alat Tugas Akhir");
  delay (1000);

  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Sistem Monitoring");
  delay (2000);

  lcd.setCursor(0,1);
  lcd.print("Denyut Jantung dan");
  delay (1500);


  lcd.setCursor(0,2);
  lcd.print("Suhu Tubuh Berbasis");
  delay (1300);
```

```
  lcd.setCursor(0,3);
  lcd.print("Arduino & SMSGateway");
  delay (1100);

 for (int i=0; i<5; i++){
 lcd.noBacklight();
  delay(300);
  lcd.backlight();
  delay(100);}

 lcd.clear();



// Start up the library
  sensors.begin();

}

/*
 * Main function, get and show the temperature
 */

void Read_ADC_Samples()
 {
   for (int i = 0; i < Num_Samples; i++)
   {
      ADC_Samples[i] = analogRead(A0);
      delay(Sampling_Time);
   }
 }
 void Remove_DC()
 {
   Find_Minima(0);
   for (int i = 0; i < Num_Samples; i++){
     ADC_Samples[i] = ADC_Samples[i] - Minima;
   }
   Minima = 0;
 }

void Find_Minima(int Num)
{
  Minima = 1024;
  for (int m = Num; m < Num_Samples-Num; m++)
  {
    if(Minima > ADC_Samples[m])
    {
    Minima = ADC_Samples[m];
    }
  }
}
```

```
void Scale_Data()
{
Find_Peak(0);
Range = Peak_Magnitude - Minima;
  for (int i = 0; i < Num_Samples; i++)
  {
     ADC_Samples[i] = map(ADC_Samples[i], 0, Range, 1, 1023);
  }
  Find_Peak(0);
  Find_Minima(0);
} // Scale_Data

void Find_Peak(int Num)
{
  Peak_Magnitude = 0;
  for (int m = Num; m < Num_Samples-Num; m++)
  {
    if(Peak_Magnitude < ADC_Samples[m])
    {
      Peak_Magnitude = ADC_Samples[m];
    }
  }
} // Find_Peak

void Filter_Data()
{
  int Num_Points = 2*Moving_Average_Num+1;
  for (int i = Moving_Average_Num; i < Num_Samples-Moving_Average_Num; i++)
  {
    int Sum_Points = 0;
    for(int k =0; k < Num_Points; k++)
    {
      Sum_Points = Sum_Points + ADC_Samples[i-Moving_Average_Num+k];
    }
    ADC_Samples[i] = Sum_Points/Num_Points;
  }
}  // Filter_Date


void Compute_Pulse_Rate()
{
  // Detect Peak magnitude and minima
  Find_Peak(Moving_Average_Num);
  Find_Minima(Moving_Average_Num);
  Range = Peak_Magnitude - Minima;
  Peak_Threshold = Peak_Magnitude*Peak_Threshold_Factor;
  Peak_Threshold = Peak_Threshold/100;
   // Now detect three peaks
```

```
Peak1 = 0;
Peak2 = 0;
Peak3 = 0;
Index1 = 0;
Index2 = 0;
Index3 = 0;
// Find first peak
for (int j = Moving_Average_Num; j < Num_Samples-Moving_Average_Num; j++){
    if(ADC_Samples[j] >= ADC_Samples[j-1] && ADC_Samples[j] > ADC_Samples[j+1] &&
       ADC_Samples[j] > Peak_Threshold && Peak1 == 0){
      Peak1 = ADC_Samples[j];
      Index1 = j;
    }

    // Search for second peak which is at least 10 sample time far
    if(Peak1 > 0 && j > (Index1+Minimum_Peak_Separation) && Peak2 == 0)
    {
      if(ADC_Samples[j] >= ADC_Samples[j-1] && ADC_Samples[j] > ADC_Samples[j+1] &&
      ADC_Samples[j] > Peak_Threshold)
      {
        Peak2 = ADC_Samples[j];
        Index2 = j;
      }
    } // Peak1 > 0

    // Search for the third peak which is at least 10 sample time far
    if(Peak2 > 0 && j > (Index2+Minimum_Peak_Separation) && Peak3 == 0)
    {
      if(ADC_Samples[j] >= ADC_Samples[j-1] && ADC_Samples[j] > ADC_Samples[j+1] &&
      ADC_Samples[j] > Peak_Threshold)
      {
     if(ADC_Samples[j] >= ADC_Samples[j-1] && ADC_Samples[j] > ADC_Samples[j+1] &&
     ADC_Samples[j] > Peak_Threshold)
      {
        Peak2 = ADC_Samples[j];
        Index2 = j;
      }
    } // Peak1 > 0

    // Search for the third peak which is at least 10 sample time far
    if(Peak2 > 0 && j > (Index2+Minimum_Peak_Separation) && Peak3 == 0)
    {
      if(ADC_Samples[j] >= ADC_Samples[j-1] && ADC_Samples[j] > ADC_Samples[j+1] &&
      ADC_Samples[j] > Peak_Threshold)
      {
        Peak3 = ADC_Samples[j];
        Index3 = j;
      }
    } // Peak2 > 0
  }
  Pulse_Time1 = (Index2-Index1)*Sampling_Time; // In milliseconds
  Pulse_Time2 = (Index3-Index2)*Sampling_Time;
  if(Pulse_Time1 > 0 && Pulse_Time1 > 0)
  {
    Pulse_Rate = 2*60000/(Pulse_Time1+Pulse_Time2); // In BPM
  }
```

```
  Serial.print("Pulse Rate (BPM) = ");
  Serial.println(Pulse_Rate);
}  // Compute_Pulse_Rate

void loop(void)
{
  waktu = millis();
  //if (digitalRead(tombolkirim)==LOW)
  if (waktu-waktusebelum>=interval)
  {
    statustombol=1;
    waktusebelum=waktu;
  }
  while (statustombol==1)
  {
   lcd.clear();
   lcd.setCursor(0,0);
  //lcd.print("Hari/Tgl: RTC Module");
  lcd.print("Sedang Mengirim Data");
  lcd.setCursor(0,1);
  lcd.print("      Via SMS      ");
  delay(1000);
 //Serial.println("Set format SMS ke ASCII");
  //kirim 1
  Serial1.write("AT+CMGF=1\r\n");
  delay(1000);

  //Serial.println("SIM800L Set SMS ke Nomor Tujuan");
  Serial1.write("AT+CMGS=\"082114151994\"\r\n");
  delay(1000);
  Serial1.write("Data Pengukuran Denyut Jantung dan Suhu Tubuh Manusia\n");
  Serial1.write("Tanggal/Waktu: ");
  Serial1.write(rtc.getDateStr());
  Serial1.write(" / ");
  Serial1.write(rtc.getTimeStr());
  Serial1.write("\n");
  Serial1.write("Denyut Jantung: ");
  sprintf(valdetak,"%d",(int)Pulse_Rate);
  Serial1.write(valdetak);
  Serial1.write(" BPM\n");
  Serial1.write("Suhu Tubuh: ");
  suhu = sensors.getTempCByIndex(0);
  sprintf(valsuhu,"%d.%02d", (int)suhu, (int)(suhu*100)%100);
  Serial1.write(valsuhu);
  Serial1.write("C");
  Serial1.write("\n");
  Serial1.write("Kondisi: ");
```

```
if (Pulse_Rate>=70&&Pulse_Rate<=91){Serial1.write("Normal ");}
else if (Pulse_Rate>=92&&Pulse_Rate<=120){Serial1.write("Tinggi ");}
else if (Pulse_Rate>=40&&Pulse_Rate<=69){Serial1.write("Rendah ");}
else Serial1.write("        ");
delay(1000);

//Serial.println("Mengirim Char Ctrl+Z / ESC untuk keluar dari menu SMS");
Serial1.write((char)26);
delay(1000);

//Serial.println("SMS Selesai Dikirim!");
lcd.clear();
lcd.setCursor(0,0);
lcd.print("Data Sudah Terkirim ");
lcd.setCursor(0,1);
lcd.print("       Via SMS      ");
delay(2000);
lcd.clear();
statustombol=0;
}
while (statustombol==0)
{
waktu = millis();
//if (digitalRead(tombolkirim)==LOW){statustombol=1;}
if (waktu-waktusebelum>=interval){statustombol=1;waktusebelum=waktu;}

Read_ADC_Samples();
Remove_DC();
Scale_Data();
if (Range > Minimum_Range)
{
  Filter_Data();
  Compute_Pulse_Rate();
  //Serial.println("Pulse rate computed ");
}
int sensorValue = analogRead(A0);
// call sensors.requestTemperatures() to issue a global temperature
sensors.requestTemperatures(); // Send the command to get temperatures
lcd.setCursor(0,0);
//lcd.print("Hari/Tgl: RTC Module");
lcd.print(rtc.getDOWStr(FORMAT_LONG));
lcd.setCursor(8,0);
lcd.print(rtc.getDateStr());
```

```
  if (Pulse_Rate<=0||Pulse_Rate>250){Pulse_Rate=0;}
  lcd.setCursor(0,1);
  lcd.print("D. Jantung: ");
  lcd.print(Pulse_Rate);
  lcd.print(" BPM  ");

  lcd.setCursor(0,2);
  lcd.print("Suhu Tubuh: ");
  lcd.print(sensors.getTempCByIndex(0));
  lcd.print((char)223);
  lcd.print("C");

  lcd.setCursor(0,3);
  lcd.print("Kondisi: ");
  if (Pulse_Rate>=70&&Pulse_Rate<=91){lcd.print("Normal ");}
  else if (Pulse_Rate>=92&&Pulse_Rate<=120){lcd.print("Tinggi ");}
  else if (Pulse_Rate>=40&&Pulse_Rate<=69){lcd.print("Rendah ");}
  else lcd.print("        ");

  myFile = SD.open("data.txt", FILE_WRITE);
  if (myFile) {
    myFile.print(rtc.getDateStr());
    myFile.print(",");
    myFile.print(rtc.getTimeStr());
    myFile.print(",");
    myFile.print(int(Pulse_Rate));
    myFile.print(",");
    if (Pulse_Rate>=70&&Pulse_Rate<=91){myFile.print("Normal");}
    if (Pulse_Rate>=92&&Pulse_Rate<=150){myFile.print("Tinggi");}
    if (Pulse_Rate>=40&&Pulse_Rate<=69){myFile.print("Rendah");}
    myFile.print(",");
    //Peak_Magnitude - Minima
    myFile.println(sensors.getTempCByIndex(0));
    myFile.close(); // close the file
  }
  }
}
```

LAMPIRAN B

TABEL DATA PENGUKURAN

Tabel B.1 Hasil pengukuran Radial dan Densuh

No	Nama	Umur (Th)	Kategori (Umur)	Hasil Pengukuran				Selisih nilai pengukuran kondisi santai (%)	Selisih nilai pengukuran kondisi aktifitas/olahraga (%)
				Denyut Nadi (BPM)					
				Radial		Densuh			
				Santai	Aktivitas/Olahraga	Santai	Aktivitas/Olahraga		
1	Ibra	7	Anak-anak	96	112	109	118	13,54	5,357
2	Ayu	7	Anak-anak	102	108	105	112	2,941	3,703
3	Rian	9	Anak-anak	98	110	99	112	1,02	1,818
4	Agus	10	Anak-anak	98	114	102	117	4,081	2,631
5	Ica	10	Anak-anak	100	102	103	104	3	1,96
6	Candra	13	Remaja	88	98	87	96	1,136	2,04
7	Angga	14	Remaja	78	102	76	102	2,564	0
8	Bayu	14	Remaja	86	102	80	108	6,976	5,882
9	Sinta	14	Remaja	86	96	79	100	8,139	4,166
10	Teguh	16	Remaja	84	102	89	112	5,952	9,803
11	Yeni	21	Dewasa	82	94	92	116	12,19	23,4
12	Emi	22	Dewasa	74	96	83	109	12,16	13,54
13	Wandre	26	Dewasa	78	92	82	99	5,128	7,608
14	Zenko	26	Dewasa	78	86	85	97	8,974	12,79
15	Anas	27	Dewasa	76	90	88	98	15,78	8,888
16	Ibu. Harti	46	Lansia	74	92	89	101	20,27	9,782
17	Bpk. Sutisno	48	Lansia	78	94	90	92	15,38	2,127
18	Bpk. Sholeh	52	Lansia	76	96	85	97	11,84	1,041
19	Ibu. Warti	53	Lansia	84	90	81	94	3,571	4,444
20	Bpk. Sudarwoko	55	Lansia	74	92	87	98	17,56	6,521
Rata-rata								8,6101	6,37505

Tabel B.2 Hasil pengukuran Cortoid dan Densuh

No	Nama	Umur (Th)	Kategori (Umur)	Hasil Pengukuran Denyut Nadi (BPM)				Selisih nilai pengukuran kondisi santai (%)	Selisih nilai pengukuran kondisi aktifitas/olahraga (%)
				Cortoid		Densuh			
				Santai	Aktivitas/Olahraga	Santai	Aktivitas/Olahraga		
1	Ibra	7	Anak-anak	92	116	109	118	18,47	1,724
2	Ayu	7	Anak-anak	96	110	105	112	9,375	1,818
3	Rian	9	Anak-anak	96	105	99	112	3,125	6,666
4	Agus	10	Anak-anak	94	104	102	117	8,51	12,5
5	Ica	10	Anak-anak	96	116	103	104	7,291	10,34
6	Candra	13	Remaja	86	94	87	96	1,162	2,127
7	Angga	14	Remaja	82	116	76	102	7,317	12,06
8	Bayu	14	Remaja	84	114	80	108	4,761	5,263
9	Sinta	14	Remaja	82	94	79	100	3,658	6,38
10	Teguh	16	Remaja	82	108	89	112	8,536	3,703
11	Yeni	21	Dewasa	78	88	92	116	17,94	31,81
12	Emi	22	Dewasa	76	82	83	109	9,21	32,92
13	Wandre	26	Dewasa	82	90	82	99	0	10
14	Zenko	26	Dewasa	88	94	85	97	3,409	3,191
15	Anas	27	Dewasa	82	94	88	98	7,317	4,255
16	Ibu. Harti	46	Lansia	82	90	89	101	8,536	12,22
17	Bpk. Sutisno	48	Lansia	80	92	90	92	12,5	0
18	Bpk. Sholeh	52	Lansia	84	92	85	97	1,19	5,434
19	Ibu. Warti	53	Lansia	82	94	81	94	1,219	0
20	Bpk. Sudarwoko	55	Lansia	80	88	87	98	8,75	11,36
Rata-rata								7,1138	8,68855

Tabel B.3 Hasil pengukuran termometer air raksa dan Densuh

No	Nama	Umur (Th)	Kategori (Umur)	Hasil Pengukuran				Selisih nilai pengukuran kondisi santai (%)	Selisih nilai pengukuran kondisi aktifitas/olahraga (%)
				Suhu Tubuh (°C)					
				Termometer Air Raksa		Densuh			
				Santai	Aktivitas/Olahraga	Santai	Aktivitas/Olahraga		
1	Ibra	7	Anak-anak	36,2	36,4	36,4	37,3	0,552	2,472
2	Ayu	7	Anak-anak	36,3	36,7	36,3	37,1	0	1,089
3	Rian	9	Anak-anak	36,4	36,8	36,5	36,9	0,276	0,271
4	Agus	10	Anak-anak	36,1	36,6	36,4	37	0,831	1,092
5	Ica	10	Anak-anak	36,2	36,6	36,3	37	0,276	1,092
6	Candra	13	Remaja	36,4	36,7	36,6	37,1	0,549	1,089
7	Angga	14	Remaja	36,2	36,9	36,5	37,4	0,828	1,355
8	Bayu	14	Remaja	36,3	36,8	36,4	37,2	0,275	1,086
9	Sinta	14	Remaja	36,1	36,5	36,1	36,7	0	0,547
10	Teguh	16	Remaja	36	37	36,4	37,3	1,111	3,611
11	Yeni	21	Dewasa	36,5	36,9	36,1	37	1,095	1,369
12	Emi	22	Dewasa	36,3	36,9	36,2	37,1	0,275	1,089
13	Wandre	26	Dewasa	36,5	36,6	36,3	37,1	0,547	1,643
14	Zenko	26	Dewasa	36,4	36,5	36	37,2	1,098	2,197
15	Anas	27	Dewasa	36,5	36,8	36	37	1,369	1,369
16	Ibu. Harti	46	Lansia	35,7	36,1	35,9	36,4	0,56	0,831
17	Bpk. Sutisno	48	Lansia	35,9	36,3	36,1	36,1	0,557	0,55
18	Bpk. Sholeh	52	Lansia	36,1	36,6	36	36,3	0,277	0,554
19	Ibu. Warti	53	Lansia	35,9	36,5	35,9	36,2	0	0,835
20	Bpk. Sudarwoko	55	Lansia	36	36,4	35,8	36,3	0,555	0,833
Rata-rata								0,55155	1,2487

Tabel B.4 Hasil pengukuran termometer digital dan Densuh

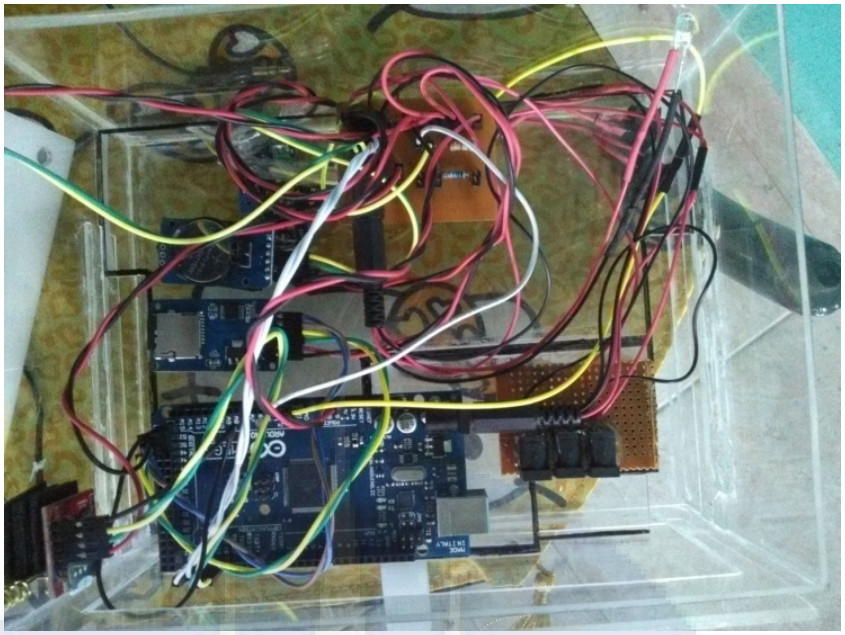
No	Nama	Umur (Th)	Kategori (Umur)	Hasil Pengukuran				Selisih nilai pengukuran kondisi santai (%)	Selisih nilai pengukuran kondisi aktifitas/olahraga (%)
				Suhu Tubuh (°C)					
				Termometer Digital		Densuh			
				Santai	Aktivitas/Olahraga	Santai	Aktivitas/Olahraga		
1	Ibra	7	Anak-anak	36,2	37	36,4	37,3	0,552	0,81
2	Ayu	7	Anak-anak	36,3	36,9	36,3	37,1	0	0,542
3	Rian	9	Anak-anak	36,4	36,9	36,5	36,9	0,274	0
4	Agus	10	Anak-anak	36	36,6	36,4	37	1,111	1,092
5	Ica	10	Anak-anak	36,3	37,2	36,3	37	0	0,537
6	Candra	13	Remaja	36,3	37,2	36,6	37,1	0,826	0,268
7	Angga	14	Remaja	36,2	37	36,5	37,4	0,828	1,081
8	Bayu	14	Remaja	36,1	37,3	36,4	37,2	0,831	0,268
9	Sinta	14	Remaja	36,2	36,8	36,1	36,7	0,276	0,271
10	Teguh	16	Remaja	36,3	37,5	36,4	37,3	0,275	0,533
11	Yeni	21	Dewasa	36,2	37	36,1	37	0,276	0
12	Emi	22	Dewasa	36,3	37,1	36,2	37,1	0,275	0
13	Wandre	26	Dewasa	36,5	37,3	36,3	37,1	0,547	2,203
14	Zenko	26	Dewasa	36,3	37	36	37,2	0,826	0,54
15	Anas	27	Dewasa	36,4	37,2	36	37	1,098	0,537
16	Ibu. Harti	46	Lansia	35,5	36,2	35,9	36,4	1,126	0,552
17	Bpk. Sutisno	48	Lansia	35,9	36,1	36,1	36,1	0,557	0
18	Bpk. Sholeh	52	Lansia	35,8	36,2	36	36,3	0,558	0,276
19	Ibu. Warti	53	Lansia	35,2	36,6	35,9	36,2	1,988	1,092
20	Bpk. Sudarwoko	55	Lansia	35,7	36,3	35,8	36,3	0,28	0
Rata-rata								0,6252	0,5301

LAMPIRAN C

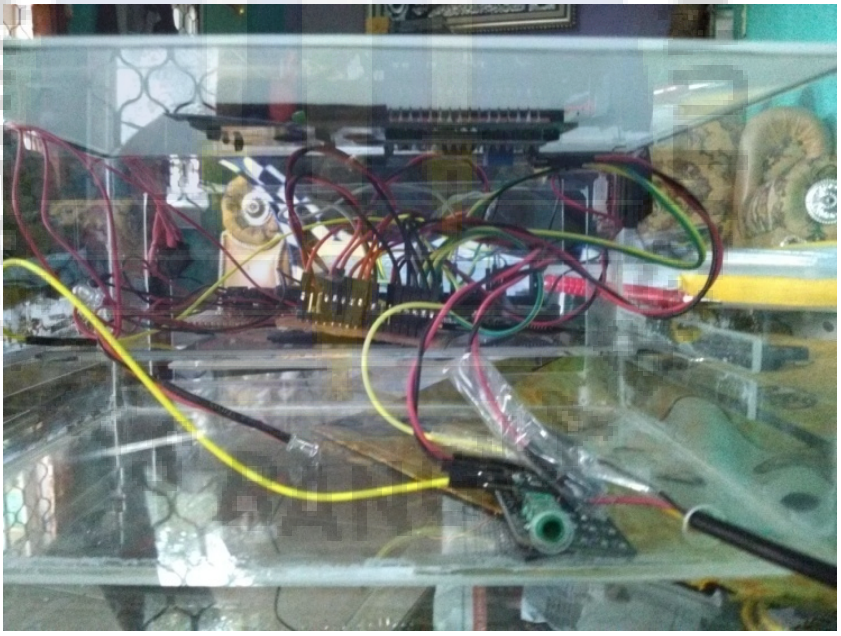
GAMBAR ALAT PENELITIAN

Gambar C.1 Tampak keseluruhan alat penelitian

Gambar C.2 Tampak atas dari alat penelitian



Gambar C.3 Tampak atas bagian dalam



Gambar C.4 Tampak bawah bagian sensor