LAMPIRAN

A. Perhitungan Hasil Pengukuran

1. Hasil pengujian volume cairan infus pada 1 menit

a. Analisa Perhitungan pada pengaturan 0,50 ml/min

1) Nilai Rata-rata

$$Rata - Rata\ \bar{X} = \frac{Xn}{n}$$

$$Rata - Rata\ \bar{X} = \frac{0{,}50 + 0{,}50 + 0{,}50 + 0{,}50 + 0{,}60 + 0{,}60 + 0{,}50 + 0{,}50 + 0{,}50 + 0{,}60}{10}$$

$$Rata - Rata\ \bar{X} = \frac{5{,}3}{10}$$

$$Rata - Rata\ \bar{X} = 0{,}53$$

2) Simpangan

$$D = X_s - \bar{X}$$

$$D = 0{,}50 - 0{,}53$$

$$D = -0{,}03$$

3) Persentase error

$$\%Simpangan = \frac{X_s - \bar{X}}{X_s} \times 100\%$$

$$\%Simpangan = \frac{0{,}50 - 0{,}53}{0{,}50} \times 100\%$$

$$\%Simpangan = -6\%$$

b. Analisa Perhitungan pada pengaturan 0,75 ml/min

1) Nilai Rata-rata

$$Rata - Rata\ \bar{X} = \frac{Xn}{n}$$

$$Rata - Rata\ \bar{X} = \frac{0{,}80 + 0{,}70 + 0{,}70 + 0{,}70 + 0{,}70 + 0{,}70 + 0{,}70 + 0{,}70 + 0{,}70 + 0{,}70}{10}$$

$$Rata - Rata\ \bar{X} = \frac{7{,}1}{10}$$

$$Rata - Rata\ \bar{X} = 0{,}71$$

2) Simpangan

$$D = X_s - \bar{X}$$

$$D = 0{,}75 - 0{,}71$$

$$D = 0{,}04$$

3) Persentase error

$$\%Simpangan = \frac{X_s - \bar{X}}{X_s} \times 100\%$$

$$\%Simpangan = \frac{0{,}75 - 0{,}71}{0{,}75} \times 100\%$$

$$\%Simpangan = 5{,}33\%$$

c. Analisa Perhitungan pada pengaturan 1,00 ml/min

1) Nilai Rata-rata

$$Rata - Rata\ \bar{X} = \frac{Xn}{n}$$

$$Rata - Rata\ \bar{X} = \frac{1{,}00 + 1{,}00 + 1{,}00 + 1{,}00 + 1{,}00 + 1{,}00 + 1{,}00 + 1{,}10 + 1{,}10 + 1{,}10}{10}$$

$$Rata - Rata\ \bar{X} = \frac{10{,}3}{10}$$

$$Rata - Rata\ \bar{X} = 1{,}03$$

2) Simpangan

$$D = X_s - \bar{X}$$

$$D = 1{,}00 - 1{,}03$$

$$D = -0{,}03$$

3) Persentase error

$$\%Simpangan = \frac{X_s - \bar{X}}{X_s} \times 100\%$$

$$\%Simpangan = \frac{1{,}00 - 1{,}03}{1{,}00} \times 100\%$$

$$\%Simpangan = -3\%$$

2. Hasil pengujian volume pada variable maksimal volume 6 ml

a. Analisa data pengujian Kecepatan *Flow* pada variable 0,50 ml/min

1) Nilai Rata-rata

$$Rata - Rata\ \bar{X} = \frac{Xn}{n}$$

$$Rata - Rata\ \bar{X} = \frac{5{,}8 + 5{,}8 + 5{,}8 + 5{,}8 + 5{,}8 + 5{,}8 + 5{,}8 + 5{,}8 + 5{,}8 + 5{,}8}{10}$$

$$Rata - Rata\ \bar{X} = \frac{58}{10}$$

$$Rata - Rata\ \bar{X} = 0{,}58$$

2) Simpangan

$$D = X_s - \bar{X}$$

$$D = 6 - 5{,}8$$

$$D = 0{,}2$$

3) Persentase error

$$\%Simpangan = \frac{X_s - \bar{X}}{X_s} \times 100\%$$

$$\%Simpangan = \frac{6 - 5{,}8}{6} \times 100\%$$

$$\%Simpangan = 3{,}33\%$$

b. Analisa data pengujian Kecepatan *Flow* pada variable 0,50 ml/min

1) Nilai Rata-rata

$$Rata - Rata\ \bar{X} = \frac{Xn}{n}$$

$$Rata - Rata\ \bar{X} = \frac{6+6+6+6+6+6+6+6+6+6}{10}$$

$$Rata - Rata\ \bar{X} = \frac{60}{10}$$

$$Rata - Rata\ \bar{X} = 6$$

2) Simpangan

$$D = X_s - \bar{X}$$

$$D = 6 - 6$$

$$D = 0$$

3) Persentase error

$$\%Simpangan = \frac{X_s - \bar{X}}{X_s} \times 100\%$$

$$\%Simpangan = \frac{6-6}{6} \times 100\%$$

$$\%Simpangan = 0\%$$

c. Analisa data pengujian Kecepatan *Flow* pada variable 1,00 ml/min

1) Nilai Rata-rata

$$Rata - Rata\ \bar{X} = \frac{Xn}{n}$$

$$Rata - Rata\ \bar{X} = \frac{6{,}2+6{,}2+6{,}2+6{,}2+6{,}2+6{,}2+6{,}2+6{,}2+6{,}2+6{,}2}{10}$$

$$Rata - Rata\ \bar{X} = \frac{62}{10}$$

$$Rata - Rata\ \bar{X} = 6{,}2$$

2) Simpangan

$$D = X_s - \bar{X}$$

$$D = 6 - 6{,}2$$

$$D = -0{,}2$$

3) Persentase error

$$\%Simpangan = \frac{X_s - \bar{X}}{X_s} \times 100\%$$

$$\%Simpangan = \frac{6 - 6{,}2}{6} \times 100\%$$

$$\%Simpangan = -3{,}33\%$$

B. Litsing program alat

```
#include <LiquidCrystal_I2C.h>
#include <Wire.h>
#include <HX711.h>

LiquidCrystal_I2C lcd(0x27 ,16,2);
HX711 scale;

const int LOADCELL_DOUT_PIN = 12;
const int LOADCELL_SCK_PIN =11;
const int dirPin = 9;
const int stepPin = 10;
int buttonup, buttondown, buttonstart, buttonstop, buttonreset;
int bubble;
int volume=1;
int mod=0;
int mode1=0;
int mod2=0;
int flow=0;
float tetes=0;
float ml;
int kecmoto;
const int buzzer = 8;
int error=0;
const int PIN=13;
int data=0;
float calibration_factor = 7070;

void Button()
{
  buttonstart= digitalRead(0);
  buttonstop= digitalRead(1);
```

```
  buttonup= digitalRead(2);
  buttondown= digitalRead(3);
  buttonreset= digitalRead(4);
  bubble= digitalRead(6);
}

void habis()
{
  int a=digitalRead(PIN);
  if (a==HIGH)
  {
   data++;
   Serial.println(data);
   if (data==150)
   {
    mod=3;
    error=5;
   }
  }else{data=0;}
}

void moto()
{
  digitalWrite(stepPin,HIGH);
  delay(kecmoto);
  digitalWrite(stepPin,LOW);
  delay(kecmoto);
  if(buttonstop == LOW) {mod=3;error=1;delay(100);lcd.clear();}
  if(bubble == LOW) {mod=3;error=2;delay(100);lcd.clear();}
}
```

```
void occl()
{
  scale.set_scale(calibration_factor);
  float occ = scale.get_units();
  if (occ>8)
  {
    mod=3;error=3;delay(100);lcd.clear();
  }
}
void start()
{
  Button();
  //Pengaturan Mode
  if(buttonstart == LOW)
    {
      mod=mod+1;
      delay(200);
      data=0;
      scale.tare();
      lcd.clear();
      if (mod>2){mod=2;}
    }

   //Perintah Reset
   if(buttonreset == LOW) {TCNT1=0; mod=0; tetes=0; ml=0;
error=0; data=0; scale.tare(); noTone(buzzer); delay(300);
lcd.clear();}

   //Program Flow
   if (mod == 0)
   {
    if(buttonup == LOW)
    {flow=flow+1;if (flow>2){flow=0;}}
```

```
    if(buttondown == LOW)
    {flow=flow-1;if (flow<0){flow=2;}}

    lcd.setCursor(0,0);
    lcd.print("Kecepatan Flow");

    if (flow == 0)
    {lcd.setCursor(0,1);lcd.print("0.50");lcd.print("ml/min");
      kecmoto=38;}
    if (flow == 1)
    {lcd.setCursor(0,1);lcd.print("0.75");lcd.print("ml/min");
      kecmoto=25;}
    if (flow == 2)
    {lcd.setCursor(0,1);lcd.print("1.00");lcd.print("ml/min");
      kecmoto=11;}
    delay(200);
   }

  //Program Volume
  if (mod == 1)
  {
    if(buttonup == LOW)
    {
      lcd.clear();
      volume=volume+1;
      delay(200);
      if (volume>500){volume=1;}
     }

    if(buttondown == LOW)
    {
      lcd.clear();
```

```
      volume=volume-1;
    delay(200);
    if (volume<1){volume=500;}
  }
    lcd.setCursor(0,0);
    lcd.print("Set Volume");
    lcd.setCursor(0,1);
    lcd.print(volume);
    lcd.print("ml");
  }

//Program Mulai
if (mod==2)
{
  //TCNT1=tetes;
  error=0;
  tetesan();
  ml=TCNT1/19.3;
  if (ml>=volume){mod=3;error=4;lcd.clear();}
  moto();
  occl();
  noTone(buzzer);
 }

 //Program Error
  if (mod==3)
  {
    TCCR1B=0x00;
    tetes=TCNT1;
    if (error==1){lcd.setCursor(0,0); lcd.print("-STOP-");
    tone(buzzer,1000);}
    if (error==2){lcd.setCursor(0,0); lcd.print("ERROR");
    lcd.setCursor(0,1); lcd.print("    BUBBLE");
    tone(buzzer,1000);}
```

```
      if (error==3){lcd.setCursor(0,0); lcd.print("ERROR");
      lcd.setCursor(0,1); lcd.print("   OCCLUSION");
      tone(buzzer,1000);}

      if (error==4){lcd.setCursor(0,0); lcd.print(" PROSES
      SELESAI");tone(buzzer,1000);}

      if (error==5){lcd.print(""); lcd.setCursor(0,0);
      lcd.print("     ERROR"); lcd.setCursor(0,1); lcd.print("
      CAIRAN HABIS"); tone(buzzer,1000);}

    }

}


void tetesan()

{

  habis();

  TCCR1B=0x06;

  tetes=TCNT1;

  lcd.setCursor(1,0);

  lcd.print("-Cairan Keluar-");

  lcd.setCursor(0,1);

  lcd.print("Volume :");

  tetes=tetes/19.3;

  lcd.print(tetes);

  lcd.print("ml");

}

void setup()

{

  lcd.begin();

  Serial.begin(9600);


  pinMode(0,INPUT_PULLUP);

  pinMode(1,INPUT_PULLUP);

  pinMode(2,INPUT_PULLUP);

  pinMode(3,INPUT_PULLUP);

  pinMode(4,INPUT_PULLUP);

  pinMode(6,INPUT_PULLUP);
```

```
  pinMode(7,INPUT_PULLUP);
  pinMode(PIN, INPUT_PULLUP);
  pinMode(buzzer, OUTPUT);
  pinMode(stepPin,OUTPUT);
  pinMode(dirPin,OUTPUT);
  TCCR1B=0x00;
  TCNT1=0;
  //inisialisasi load cell
  scale.begin(LOADCELL_DOUT_PIN, LOADCELL_SCK_PIN);
  scale.set_scale();
  scale.tare(); // auto zero / mengenolkan pembacaan berat
  long zero_factor = scale.read_average();

  //Awalan
  lcd.setCursor(3,0);
  lcd.print("INFUS PUMP");
  delay(3000);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Alauddin M");
  lcd.setCursor(0,1);
  lcd.print("20163010052");
  delay(3000);
  lcd.clear();
}
void loop()
{
  digitalWrite(dirPin,HIGH);
  start ();
}
```