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

\[
\text{Rata} - \text{Rata} \bar{X} = \frac{X_n}{n}
\]

\[
\text{Rata} - \text{Rata} \bar{X} = \frac{0,50 + 0,50 + 0,50 + 0,50 + 0,60 + 0,60 + 0,50 + 0,50 + 0,50 + 0,60}{10}
\]

\[
\text{Rata} - \text{Rata} \bar{X} = \frac{5,3}{10}
\]

\[
\text{Rata} - \text{Rata} \bar{X} = 0,53
\]

2) Simpangan

\[
D = X_s - \bar{X}
\]

\[
D = 0,50 - 0,53
\]

\[
D = -0,03
\]

3) Persentase error

\[
\%\text{Simpangan} = \frac{X_s - \bar{X}}{X_s} \times 100\%
\]

\[
\%\text{Simpangan} = \frac{0,50 - 0,53}{0,50} \times 100\%
\]
\[\%Simpangan = -6\%\]

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

1) Nilai Rata-rata

\[Rata - Rata \bar{X} = \frac{Xn}{n}\]

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

\[Rata - Rata \bar{X} = 7,1\]

\[Rata - Rata \bar{X} = 0,71\]

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

\[ Rata - Rata \bar{X} = \frac{Xn}{n} \]

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

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

\[ Rata - Rata \bar{X} = 1,03 \]

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
\[
Rata - Rata \bar{X} = \frac{X_n}{n}
\]
\[
Rata - Rata \bar{X} = \frac{5,8 + 5,8 + 5,8 + 5,8 + 5,8 + 5,8 + 5,8 + 5,8 + 5,8 + 5,8}{10} = 58
\frac{10}{10} = 0,58
\]

2) Simpangan

\[
D = X_s - \bar{X}
\]
\[
D = 6 - 5,8 = 0,2
\]

3) Persentase error

\[
\%\text{Simpangan} = \frac{X_s - \bar{X}}{X_s} \times 100\%
\]
\[
\%\text{Simpangan} = \frac{6 - 5,8}{6} \times 100\%
\]
\[
\%\text{Simpangan} = \frac{6}{6} \times 100\% = 3,33\%
\]

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

1) Nilai Rata-rata

\[
Rata - Rata \bar{X} = \frac{X_n}{n}
\]
\[
\begin{align*}
Rata - Rata \bar{X} &= \frac{6 + 6 + 6 + 6 + 6 + 6 + 6 + 6 + 6 + 6}{10} \\
Rata - Rata \bar{X} &= \frac{60}{10} \\
Rata - Rata \bar{X} &= 6
\end{align*}
\]

2) Simpangan

\[
D = X_s - \bar{X}
\]

\[
D = 6 - 6
\]

\[
D = 0
\]

3) Persentase error

\[
%\text{Simpangan} = \frac{X_s - \bar{X}}{X_s} \times 100\%
\]

\[
%\text{Simpangan} = \frac{6 - 6}{6} \times 100\%
\]

\[
%\text{Simpangan} = 0\%
\]

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

1) Nilai Rata-rata

\[
Rata - Rata \bar{X} = \frac{\sum X_n}{n}
\]

\[
Rata - Rata \bar{X} = \frac{6,2 + 6,2 + 6,2 + 6,2 + 6,2 + 6,2 + 6,2 + 6,2 + 6,2 + 6,2}{10}
\]
\[ \overline{Rata} - Rata \bar{X} = \frac{62}{10} \]

\[ \overline{Rata} - Rata \bar{X} = 6,2 \]

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

```c
#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 model=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();
```c
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");
```
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.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();
}