LAMPIRAN

A. Hasil pengujian Modul dan Spirometer

1) Hasil pengujian dengan tabung kalibrasi Spirometer

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{3151 + 3130 + 3147 + 3139 + 3149 + 3148 + 3150 + 3147 + 3147 + 3148}{10}$$

$$\overline{X} = \frac{31356}{10} = 3135$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{3110 + 3110 + 3110 + 3110 + 3110 + 3110 + 3110 + 3110 + 3110 + 3110}{10}$$

$$\overline{X} = \frac{31100}{10} = 3110$$

Erorr (%):

$$\% = \frac{3110 - 3135}{3110} \text{ x } 100\% = -0,8 \%$$

Simpangan :

Simpangan $= 3110 – 3135 = -25,6$ mL

2) Hasil pengujian FVC dengan relawan Erina

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{2096 + 2089 + 2101 + 2200 + 2085 + 2097 + 2113 + 2054 + 2044 + 2080}{10}$$

$$\overline{X} = \frac{20959}{10} = 2095$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{2150 + 2090 + 2090 + 2230 + 2090 + 2220 + 2110 + 2210 + 2010 + 2010}{10}$$

$$\overline{X} = \frac{21210}{10} = 2121$$

Erorr (%):

$$\% = \frac{2121 - 2095}{2127} \times 100\% = 1,2\%$$

Simpangan :

Simpangan = 2121–2095 =25,1 mL

3) **Hasil pengujian FVC dengan relawan Intivada**

   Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{2413 + 2585 + 2591 + 2590 + 2912 + 2600 + 2575 + 2585 + 2495 + 2479}{10}$$

$$\overline{X} = \frac{25825}{10} = 2582$$

   Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{2610 + 2590 + 2590 + 2590 + 2900 + 2620 + 2600 + 2590 + 2480 + 2490}{10}$$

$$\overline{X} = \frac{26060}{10} = 2606$$

   Erorr (%):

$$\% = \frac{2606 - 2582}{2606} \times 100\% = 0,9 \%$$

   Simpangan :

   Simpangan = 2606–2585 =23,5 mL

4) **Hasil pengujian FVC dengan relawan Alfana**

   Nilai Rata-rata Pada Display Modul TA:

   $$\overline{X} = \frac{3104 + 3002 + 3401 + 2700 + 3010 + 2890 + 2985 + 3285 + 3281 + 3164}{10}$$

   $$\overline{X} = \frac{30822}{10} = 3082$$

   Nilai Rata-rata Pada Pembanding Modul (Spirometer):

   $$\overline{X} = \frac{2730 + 3010 + 3490 + 2990 + 3050 + 3100 + 3010 + 3290 + 3190 + 3010}{10}$$

   $$\overline{X} = \frac{30870}{10} = 3087$$

   Erorr (%):

   $$\% = \frac{3087 - 3082}{3087} \text{ x } 100\% = 0,1\ \%$$

   Simpangan :

   Simpangan $= 3087–3082 = 4,8$ mL

5) **Hasil pengujian FVC dengan relawan Anita**

   Nilai Rata-rata Pada Display Modul TA:

   $$\overline{X} = \frac{2144 + 2130 + 2304 + 2107 + 1982 + 2132 + 2564 + 2270 + 2311 + 2132}{10}$$

   $$\overline{X} = \frac{22076}{10} = 2207$$

   Nilai Rata-rata Pada Pembanding Modul (Spirometer):

   $$\overline{X} = \frac{2180 + 2140 + 2450 + 2310 + 2110 + 2230 + 2410 + 2110 + 2150 + 2240}{10}$$

   $$\overline{X} = \frac{22330}{10} = 2233$$

Erorr (%):

$$\% = \frac{2233 - 2207}{2233} \text{ x } 100\% = 1,1\,\%$$

Simpangan :

Simpangan = 2303–2207 = 25,4 mL

6) **Hasil pengujian FVC dengan relawan Rustami**

   Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{2540 + 2613 + 2790 + 2590 + 2871 + 3110 + 2975 + 2870 + 2695 + 3005}{10}$$

$$\overline{X} = \frac{28329}{10} = 2832$$

   Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{2660 + 2750 + 2780 + 2630 + 2990 + 3010 + 3010 + 2890 + 3110 + 3110}{10}$$

$$\overline{X} = \frac{28840}{10} = 2884$$

   Erorr (%):

$$\% = \frac{2884 - 2832}{2884} \text{ x } 100\% = 1,77\,\%$$

   Simpangan :

Simpangan = 2884–2832 = 51,1 mL

7) **Hasil pengujian FVC dengan relawan Daryo**

   Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{871 + 871 + 882 + 882 + 855 + 865 + 855 + 870 + 860 + 860}{10}$$

$$\overline{X} = \frac{8671}{10} = 867$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{870 + 870 + 890 + 850 + 850 + 860 + 860 + 850 + 870 + 860}{10}$$

$$\overline{X} = \frac{8630}{10} = 863$$

Erorr (%):

$$\% = \frac{863 - 867}{863} \times 100\% = 0{,}48\ \%$$

Simpangan :

Simpangan = 863–867 = 4,1 mL

8) Hasil pengujian FVC dengan relawan Cristian

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{876 + 876 + 876 + 877 + 877 + 877 + 880 + 860 + 870 + 860}{10}$$

$$\overline{X} = \frac{8729}{10} = 872$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{880 + 870 + 870 + 880 + 860 + 870 + 890 + 890 + 880 + 880}{10}$$

$$\overline{X} = \frac{8770}{10} = 877$$

Erorr (%):

$$\% = \frac{877 - 872}{877} \times 100\% = 0{,}47\ \%$$

Simpangan :

Simpangan = 877–872 = 4,1 mL

9) **Hasil pengujian FVC dengan relawan Afenda**

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{973 + 983 + 983 + 973 + 980 + 980 + 1010 + 1010 + 1005 + 998}{10}$$

$$\overline{X} = \frac{9895}{10} = 989$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{990 + 1010 + 990 + 980 + 980 + 990 + 1050 + 1010 + 1010 + 990}{10}$$

$$\overline{X} = \frac{10000}{10} = 1000$$

Erorr (%):

$$\% = \frac{1000 - 989}{1000} \text{ x } 100\% = 1,05 \text{ \%}$$

Simpangan :

Simpangan $= 1000 - 989 = 10,5 \text{ mL}$

10) **Hasil pengujian FVC dengan relawan Sridawati**

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{1087 + 1085 + 1011 + 1011 + 1011 + 1015 + 1015 + 1209 + 1210 + 1210}{10}$$

$$\overline{X} = \frac{10864}{10} = 1086$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{1080 + 1080 + 1010 + 1010 + 1020 + 1020 + 1020 + 1210 + 1230 + 1230}{10}$$

$$\overline{X} = \frac{10910}{10} = 1091$$

Erorr (%):

$$\% = \frac{1091 - 1086}{1091} \times 100\% = 0{,}42\ \%$$

Simpangan :

Simpangan = 1091–1086 = 4,6 mL

11) Hasil pengujian FVC dengan relawan Maman

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{1186 + 1186 + 1196 + 1196 + 1305 + 1305 + 1305 + 1170 + 1170 + 1170}{10}$$

$$\overline{X} = \frac{12189}{10} = 1218$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{1170 + 1270 + 1210 + 1150 + 1320 + 1310 + 1190 + 1200 + 1160 + 1170}{10}$$

$$\overline{X} = \frac{12150}{10} = 1215$$

Erorr (%):

$$\% = \frac{1215 - 1218}{1215} \times 100\% = 0{,}32\ \%$$

Simpangan :

Simpangan = 1215–1218 = 3,9 mL

12) Hasil pengujian FVC dengan relawan Aulia

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{2145 + 2120 + 2120 + 2120 + 2220 + 23226 + 2150 + 2150 + 2110 + 2110}{10}$$

$$\overline{X} = \frac{21571}{10} = 2157$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{2150 + 2110 + 2120 + 2150 + 2210 + 2290 + 2150 + 2150 + 2120 + 2150}{10}$$

$$\overline{X} = \frac{21600}{10} = 2160$$

Erorr (%):

$$\% = \frac{2160 - 2157}{2160} \text{ x } 100\% = 0,13 \%$$

Simpangan :

Simpangan = 2160–2157 = 2,9 mL

13) Hasil pengujian FVC dengan relawan Rina

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{2118 + 2190 + 2118 + 2190 + 2187 + 2118 + 2180 + 2296 + 2296 + 2118}{10}$$

$$\overline{X} = \frac{21811}{10} = 2181$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{2190 + 2140 + 2210 + 2180 + 2180 + 2110 + 2180 + 2310 + 2300 + 2190}{10}$$

$$\overline{X} = \frac{21990}{10} = 2199$$

Erorr (%):

$$\% = \frac{2199 - 2181}{2199} \text{ x } 100\% = 0,81 \%$$

Simpangan :

Simpangan = 2199–2181 = 17,9 mL

14) Hasil pengujian FVC dengan relawan Nurul

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{2326 + 2326 + 2290 + 2295 + 2328 + 2190 + 2190 + 2402 + 2402 + 2326}{10}$$

$$\overline{X} = \frac{23075}{10} = 2307$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{2330 + 2210 + 2290 + 2310 + 2190 + 2190 + 2120 + 2410 + 2410 + 2390}{10}$$

$$\overline{X} = \frac{22850}{10} = 2285$$

Erorr (%):

$$\% = \frac{2285 - 2307}{2285} \times 100\% = 0{,}98\ \%$$

Simpangan :

Simpangan = 2285–2307 = 22,5 mL

15) Hasil pengujian FVC dengan relawan Wagiran

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{3007 + 3005 + 3010 + 3010 + 3015 + 3010 + 3010 + 3026 + 3020 + 3020}{10}$$

$$\overline{X} = \frac{30133}{10} = 3013$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{3010 + 3020 + 3010 + 3020 + 3030 + 3050 + 3030 + 3020 + 3010 + 3010}{10}$$

$$\overline{X} = \frac{30210}{10} = 3021$$

Erorr (%):

$$\% = \frac{3021 - 3012}{3021} \times 100\% = 0,25\ \%$$

Simpangan :

Simpangan = 3021–3013 = 7,7 mL

16) Hasil pengujian FVC dengan relawan Ivan

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{3162 + 3162 + 3160 + 3160 + 3160 + 3095 + 3095 + 3095 + 3152 + 3152}{10}$$

$$\overline{X} = \frac{31393}{10} = 3139$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{3160 + 3150 + 3150 + 3160 + 3210 + 3090 + 3110 + 3120 + 3210 + 3230}{10}$$

$$\overline{X} = \frac{31590}{10} = 3159$$

Erorr (%):

$$\% = \frac{3159 - 3139}{3159} \times 100\% = 0,62\ \%$$

Simpangan :

Simpangan = 3159–3139 = 19,7 mL

17) Hasil pengujian FVC dengan relawan Ari

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{3307 + 3101 + 3101 + 3100 + 3305 + 3305 + 3305 + 3305 + 3258 + 3258}{10}$$

$$\overline{X} = \frac{32345}{10} = 3234$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{3250 + 3330 + 3110 + 3100 + 3250 + 3330 + 3330 + 3320 + 3320 + 3220}{10}$$

$$\overline{X} = \frac{32560}{10} = 3256$$

Erorr (%):

$$\% = \frac{3256 - 3234}{3256} \times 100\% = 0{,}66\ \%$$

Simpangan :

Simpangan = 3256–3234 = 21,5 mL

18) Hasil pengujian FVC dengan relawan Somo

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{1352 + 1352 + 1352 + 1289 + 1289 + 1194 + 1194 + 1289 + 1362 + 1362}{10}$$

$$\overline{X} = \frac{13035}{10} = 1303$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{1330 + 1320 + 1350 + 1280 + 1300 + 1210 + 1220 + 1210 + 1370 + 1360}{10}$$

$$\overline{X} = \frac{12950}{10} = 1295$$

Erorr (%):

$$\% = \frac{1295 - 1303}{1295} \times 100\% = 0{,}66\ \%$$

Simpangan :

Simpangan = 1295–1303 = 8,5 mL

19) Hasil pengujian FVC dengan relawan Agus

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{1864 + 1793 + 1793 + 1793 + 1865 + 1865 + 1520 + 1520 + 1520 + 1520}{10}$$

$$\overline{X} = \frac{17053}{10} = 1705$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{1870 + 1910 + 1880 + 1880 + 1880 + 1870 + 1320 + 1550 + 1530 + 1530}{10}$$

$$\overline{X} = \frac{17220}{10} = 1722$$

Erorr (%):

$$\% = \frac{1722 - 1705}{1722} \times 100\% = 0,97\ \%$$

Simpangan :

Simpangan = 1722–1705 = 16,7 mL

20) Hasil pengujian FVC dengan relawan Kuswanto

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{2630 + 2630 + 2630 + 2179 + 2225 + 2325 + 2325 + 2630 + 2630 + 2630}{10}$$

$$\overline{X} = \frac{24834}{10} = 2483$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{2660 + 2610 + 2610 + 2270 + 2300 + 2310 + 2310 + 2630 + 2630 + 2590}{10}$$

$$\overline{X} = \frac{24920}{10} = 2492$$

Erorr (%):

$$\% = \frac{2492 - 2483}{2492} \times 100\% = 0{,}35\ \%$$

Simpangan :

Simpangan = 2492–2483 = 8,6 mL

21) Hasil pengujian FVC dengan relawan Tulus

Nilai Rata-rata Pada Display Modul TA:

$$\overline{X} = \frac{2640 + 2583 + 2583 + 2583 + 2683 + 2683 + 2738 + 2738 + 2738 + 2738}{10}$$

$$\overline{X} = \frac{26707}{10} = 2670$$

Nilai Rata-rata Pada Pembanding Modul (Spirometer):

$$\overline{X} = \frac{2690 + 2610 + 2580 + 2580 + 2690 + 2720 + 2710 + 2810 + 2730 + 2690}{10}$$

$$\overline{X} = \frac{26810}{10} = 2681$$

Erorr (%):

$$\% = \frac{2681 - 2670}{2681} \times 100\% = 0{,}38\ \%$$

Simpangan :

Simpangan = 2681–2670 = 10,3 mL

B. Listing Program Pengukuran Kapasitas Vital Paksa (FVC)

```
#include <LiquidCrystal.h>
#include <EEPROM.h>


#define TB1 0
#define TB2 1
#define TB3 2
#define TB4 3
#define buzzer 14


 int addr = 5,no_urut=3,halaman,pengaturan,usia=20,bb=60,tb=160;
 int NOMOR,USIA,BB,TB;
 char no_pasien[5]={};
 int sampleNumber = 0;
 int sensorPin = A0;
 int sensorValue = 0;
 float averageInitialValue = 0;
 float diffPressure = 0;
 float volumetricFlow = 0;

const int rs = 17, en = 18, d4 = 19, d5 = 20, d6 = 21, d7 = 22;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);
float TC,VC,FVC,IC;
double volum=0;


float min_fvc=100,max_fvc=0,vol_fvc=0;
float baca_flow(){
   sensorValue =analogRead(sensorPin);
   sensorValue = sensorValue - (int)averageInitialValue;
   diffPressure = map(sensorValue, 0, 1023, 0, 4000);
   double dp_mb = diffPressure/100.0;
```

```
if (sensorValue >= 0)  {

    volumetricFlow = 0.1512*pow(dp_mb,3)-
3.3424*pow(dp_mb,2)+41.657*dp_mb;

    volumetricFlow = volumetricFlow * 0.01666667;

    }
  else if (sensorValue <= 0) {

    volumetricFlow = 0.1512*pow(dp_mb,3)-
3.3424*pow(dp_mb,2)+41.657*dp_mb;

    volumetricFlow = volumetricFlow * 0.01666667; // 1/60 (lpm to
lps)

    }
  if (volumetricFlow>-0.03 &&
volumetricFlow<0.03){volumetricFlow=0;}

  return  volumetricFlow;

  }
void setup() {
  Serial.begin(9600);
  pinMode(TB1,INPUT_PULLUP);
  pinMode(TB2,INPUT_PULLUP);
  pinMode(TB3,INPUT_PULLUP);
  pinMode(TB4,INPUT_PULLUP);
  pinMode(buzzer,OUTPUT);
  digitalWrite(23,HIGH);
  pinMode(sensorPin, INPUT);
  halaman=1;pengaturan=0;
  no_urut = EEPROM.read(addr);


  lcd.begin(20, 4);
 long int sum_val= 0;
   for (int i = 0; i < 100; i++) {
     sum_val= sum_val +  analogRead(sensorPin);

     }
   averageInitialValue =
(float)sum_val/100.0;//averageValue.mean();
```

```
    opening();
  }
bool jk=false;
void beep(){
  digitalWrite(buzzer,HIGH);delay(50);
  digitalWrite(buzzer,LOW);
  }

void opening(){
   lcd.clear();
   lcd.setCursor(0, 0);lcd.print("  ERINA DEWI AZARI  ");
   lcd.setCursor(0, 1);lcd.print("  NIM: 20153010057  ");
   lcd.setCursor(0, 2);lcd.print("    MERY TRESYA     ");
   lcd.setCursor(0, 3);lcd.print("  NIM: 20153010014  ");
   delay(3000);
   lcd.clear();
   lcd.setCursor(0, 0);lcd.print("   RANCANG BANGUN   ");
   lcd.setCursor(0, 1);lcd.print("   ALAT SPIROMETER  ");
   //lcd.setCursor(0, 2);lcd.print("SPIROMETER");
   delay(3000);
  }
void menu_input(){
   no_urut++;
   NOMOR = no_urut;
   EEPROM.write(addr, no_urut);

//============MENU=============
awal:lcd.clear();
  while(halaman==1){
   lcd.setCursor(0, 0);lcd.print("Nomor:");
   lcd.setCursor(0, 1);lcd.print("USIA :    Th");
   lcd.setCursor(14, 1);lcd.print("PRIA");
```

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

        lcd.setCursor(0, 3);lcd.print("TB    :     cm");

sprintf(no_pasien,"%04d",NOMOR);

   lcd.setCursor(6, 0);lcd.print(no_pasien);

   lcd.setCursor(6, 1);lcd.print(usia);

   lcd.setCursor(6, 2);lcd.print(bb);

   lcd.setCursor(6, 3);lcd.print(tb);

   pengaturan=0;beep();


   set_1:while
(digitalRead(TB3)==0||digitalRead(TB4)==0){}delay(500);

   while(pengaturan==0){

     if(digitalRead(TB1)==1&&digitalRead(TB2)==1&&digitalRead(TB3)
     ==1&&digitalRead(TB4)==1){

   lcd.setCursor(6, 1);lcd.print("    ");

   delay(100);}

   lcd.setCursor(6, 1);

   lcd.print(usia);

   delay(100);


   if(digitalRead(TB1)==0){beep();usia--
;lcd.setCursor(6,1);lcd.print(usia);}

if(digitalRead(TB2)==0){beep();usia++;lcd.setCursor(6,1);lcd.print
(usia);}

   if(digitalRead(TB3)==0){int no_rst=0;

      while(digitalRead(TB3)==0){

        no_rst++;delay(10);

        if (no_rst>300){beep();

          no_urut=1;

          NOMOR = no_urut;

          EEPROM.write(addr, no_urut);

          lcd.clear();
```

```
        lcd.setCursor(0,0);

        lcd.print("RESET NOMOR.....");

        delay(2000); beep();

        goto awal;}}}

  if(digitalRead(TB4)==0){beep();pengaturan=1;}

  }
  set_2: while
(digitalRead(TB3)==0||digitalRead(TB4)==0){}delay(500);

  while(pengaturan==1) {

    if(digitalRead(TB1)==1&&digitalRead(TB2)==1&&digitalRead(TB3)
    ==1&&digitalRead(TB4)==1){

  lcd.setCursor(14, 1);

  lcd.print("      ");

  delay(100);

  }

  lcd.setCursor(14, 1);

  if (jk==false){lcd.print("PRIA  "); }

  else if (jk==true){lcd.print("WANITA");}

  delay(100);


  if(digitalRead(TB1)==0){beep();delay(100);

  jk=false;lcd.setCursor(14, 1);lcd.print("PRIA  ");}

  if(digitalRead(TB2)==0){beep();delay(100);

  jk=true;lcd.setCursor(14, 1);lcd.print("WANITA");}

  if(digitalRead(TB3)==0){beep();pengaturan=0;goto set_1;}

  if(digitalRead(TB4)==0){beep();pengaturan=2;}

  }
  set_3:while
(digitalRead(TB3)==0||digitalRead(TB4)==0){}delay(500);

  while(pengaturan==2)

  {

  if(digitalRead(TB1)==1&&digitalRead(TB2)==1&&digitalRead(TB3)==
  1&&digitalRead(TB4)==1)
```

```
   {
   lcd.setCursor(6, 2);lcd.print("    ");
   delay(100);}

   lcd.setCursor(6, 2);
   lcd.print(bb);
   delay(100);


   if(digitalRead(TB1)==0){beep();
   delay(100);
   bb--;
   lcd.setCursor(6, 2);
   lcd.print(bb);
   }
   if(digitalRead(TB2)==0){beep();
   delay(100);
   bb++;lcd.setCursor(6, 2);
   lcd.print(bb);
   }
   if(digitalRead(TB3)==0){beep();pengaturan=1;goto set_2;}
   if(digitalRead(TB4)==0){beep();pengaturan=3;}
   }
   set_4:while
(digitalRead(TB3)==0||digitalRead(TB4)==0){}delay(500);
   while(pengaturan==3){
     if
(digitalRead(TB1)==1&&digitalRead(TB2)==1&&digitalRead(TB3)==1&&di
gitalRead(TB4)==1){
   lcd.setCursor(6, 3);lcd.print("    ");delay(100);}
   lcd.setCursor(6, 3);lcd.print(tb);delay(100);
   if(digitalRead(TB1)==0){beep();delay(100);tb--;lcd.setCursor(6,
3);lcd.print(tb);}
   if(digitalRead(TB2)==0){beep();delay(100);tb++;lcd.setCursor(6,
3);lcd.print(tb);}
```

```
   if(digitalRead(TB3)==0){beep();pengaturan=2;goto set_3;}

   if(digitalRead(TB4)==0){beep();pengaturan=0;goto ex;}

   }  }
  ex:
  beep();delay(1000);
  }
float flow;
void ukur_FVC(){ //hembus nafas kuat2, 4000mL
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("  Hembuskan Nafas   ");
  lcd.setCursor(0, 1);
  lcd.print("  Sekuat-kuatnya    ");
  delay(3000);
  volum=0;
  for (int ul=0; ul<100;ul++){
  flow=baca_flow();
  volum= volum + (flow/10);
  if (volum<min_fvc){min_fvc=volum;}
  if (volum>max_fvc){max_fvc=volum;}
  vol_fvc=max_fvc-min_fvc;

  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("   FVC Measure   ");
  lcd.setCursor(0, 1);
  lcd.print("Flow: ");
  lcd.print(abs(flow),1);lcd.print(" lps");
  if (flow<0.0){lcd.print(" EXH"); }
  else if (flow>0.0){lcd.print(" INH"); }
  delay(100);    }
  beep();
```

```
  vol_fvc=vol_fvc*1000;

  lcd.setCursor(0, 2);

  lcd.print("FVC : ");

  lcd.print(vol_fvc,0);lcd.print(" mL");


void hitung_hasil(){

  if (jk==false)

  FVC=vol_fvc;// 4000mL

  VC=vol_td+vol_irv+vol_erv;//FVC=TV+IRV+ERV , 4600mL

  IC=vol_td + vol_irv;//IC=TV+IRV , 3500mL

  TC=FVC+RV;//TC=FVC+RV, 5800mL

  }
void tampil_hasil(){

  lcd.clear();

  lcd.setCursor(11,1);lcd.print("FVC: ");lcd.print(FVC,0);

  lcd.setCursor(11,2);lcd.print("VC : ");lcd.print(VC,0);

  lcd.setCursor(11,3);lcd.print("TC : ");lcd.print(TC,0);

  delay(5000);

  }
void loop() {

  menu_input();

  ukur_FVC();

  hitung_hasil();

  tampil_hasil();

  while(digitalRead(TB4)==1){};

  beep();delay(500);

      }
```

1. Pengujian dengan tabung kalibrasi 3L

2. PENGUKURAN 1