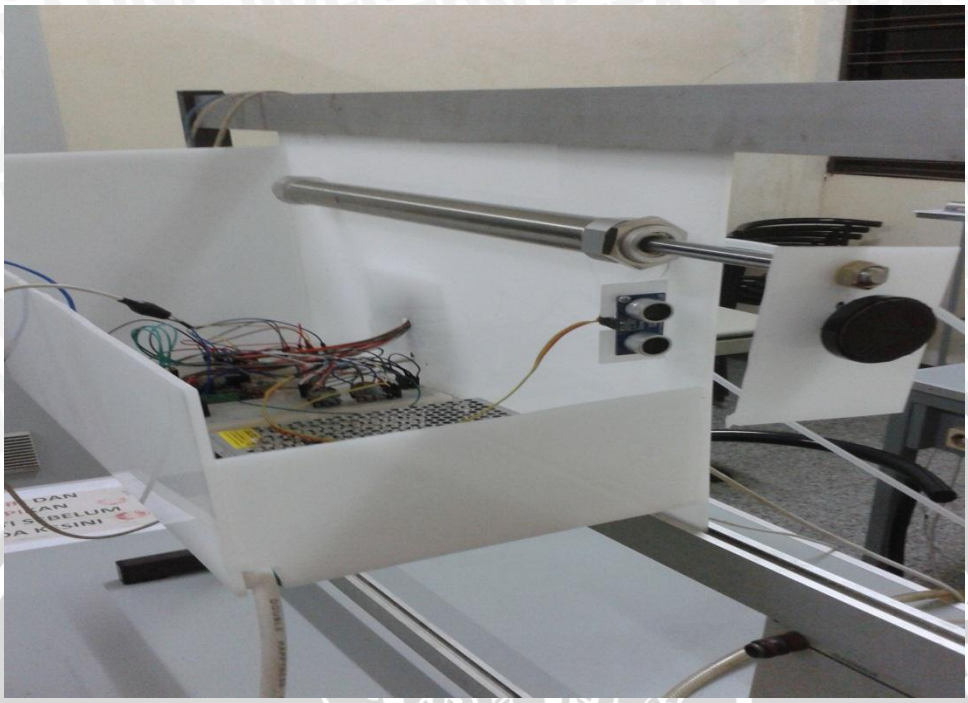
LAMPIRAN 1

Foto Alat



Gambar 1 Model *Stamping Rod*

Gambar 2 Sistem *Pneumatic*

LAMPIRAN 2

Listing Program

```
#include <LiquidCrystal.h> // header
#include "Wire.h" // header
#define PCF8591 (0x90 >> 1) // I2C bus address
const int pingPin = 7;
int error,delerror,sigmaerror,out,setpoin,lasterror;
unsigned char kp=2,ki=0.1,kd=0;
long duration, inches, cm;
long previousMillis = 0;
long currentMillis;
long interval = 1000;
int i=0; //penentuan tipe data integer untuk variabel waktu (i) dimulai dari 0.
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

void setup()
{
Wire.begin();
Serial.begin(9600);
lcd.begin(16, 2); // untuk memulai menampilkan kata “hello world”
  // Print a message to the LCD.
  lcd.print("hello, world!");

}

void loop()
{
   unsigned long currentMillis = millis();
```

```
  if(currentMillis - previousMillis >= interval) {
    // save the last time you blinked the LED
    i=i+1;
    previousMillis = currentMillis;
    //Serial.print(i);
    //Serial.println("     sekon");
  }

  setpoin=10;
//ambil data ping
  pinMode(pingPin, OUTPUT);
  digitalWrite(pingPin, LOW);
  delayMicroseconds(2);
  digitalWrite(pingPin, HIGH);
  delayMicroseconds(5);
  digitalWrite(pingPin, LOW);
  pinMode(pingPin, INPUT);
  duration = pulseIn(pingPin, HIGH);
  inches = microsecondsToInches(duration);
  cm = microsecondsToCentimeters(duration);
//selesai
Serial.print(cm);
//Serial.print("cm");
Serial.println();

error = setpoin-cm;
out = (95 + (kp*error + ki*sigmaerror + kd*delerror));
```

(*setting* PWM)

```
if(out>250)out=250;
else if(out<1)out=1;
//Serial.print(error);
//Serial.print("e");
//Serial.println();

delay(100);
Wire.beginTransmission(PCF8591); // wake up PCF8591
Wire.write(0x40); // control byte - turn on DAC (binary 1000000)
Wire.write(out); // value to send to DAC
Wire.endTransmission(); // end tranmission
delerror=error-lasterror;
sigmaerror+=error;
lasterror=error;

lcd.begin(16, 2); // untuk memulai menampilkan “error” dan “detik”
lcd.setCursor(0,0);
lcd.print("error=");
lcd.setCursor(7,0);
lcd.print(error);
lcd.setCursor(0,1);
lcd.print(currentMillis/1000);
lcd.setCursor(5,1);
lcd.print("detik");


}
```

```
long microsecondsToInches(long microseconds)
{
 // tiap 73.746 microseconds, pantulan suara mencapai jarak 2.54 cm atau 1 inchi.
 return microseconds / 74 / 2;
}

long microsecondsToCentimeters(long microseconds)
{
 // kecepatan suara 340 m/s atau 29 microseconds per centimeter
 return microseconds / 29 / 2;
}
```

LAMPIRAN 3

Komponen *Datasheet*