

## LAMPIRAN

### Lampiran 1 Daftar program untuk tuning konstanta PID

```
#include <MsTimer2.h>

#define BUTTON 2
#define TRIGPIN 7
#define ECHOPIN 8
#define PWMPINR 10
#define PWMPINL 11

int toggle,PID;
unsigned long int timer;
float distance;

void timing(){
    if(toggle==1){timer++;}
    else{ }
}

void pwm (int x){
    if(x>255){
        analogWrite(PWMPINL,255);
        digitalWrite(PWMPINR,LOW);
    }
    else if(x>0){
        analogWrite(PWMPINL,x);
```



```

void setup() {
  pinMode(PWMPINL,OUTPUT);
  pinMode(PWMPINR,OUTPUT);
  pinMode(ECHOPIN,INPUT);
  pinMode(TRIGPIN,OUTPUT);
  pinMode(BUTTON,INPUT_PULLUP);

  Serial.begin(9600);
  Serial.println("CLEAR SHEET");
  Serial.println("LABEL,Time,Timer,Distance");

  MsTimer2::set(10, timing); // 500ms period
  MsTimer2::start();
}
void loop() {
  toggle=0;
  pwm(0);
  readDistance();
  Serial.println( (String) "DATA,TIME," + timer + "," + distance + "," );
  if(digitalRead(BUTTON)==LOW){
    while(1){
      toggle=1;
      readDistance();
      pwm(0);
      Serial.println( (String) "DATA,TIME," + timer + "," + distance + "," );

    }
  }
}

```

## Lampiran 2 Daftar program untuk kontrol PID

```
#define BUTTON 2
#define TRIGPIN 7
#define ECHOPIN 8
#define PWMPINR 10
#define PWMPINL 11

int distance,error,lastError,deltaError,PID;
float iDistance,kp=0.6,ki=0.12,kd=0.03,P,I,D;

void pwm (int x){
    if(x>255){
        analogWrite(PWMPINL,255);
        digitalWrite(PWMPINR,LOW);
    }
    else if(x>0){
        analogWrite(PWMPINL,x);
        digitalWrite(PWMPINR,LOW);
    }
    else if(x<-255){
        analogWrite(PWMPINR,255);
        digitalWrite(PWMPINL,LOW);
    }
    else if(x<0){
        analogWrite(PWMPINR,-(x));
        digitalWrite(PWMPINL,LOW);
    }
}
```

```

else{
    digitalWrite(PWMPINL,LOW);
    digitalWrite(PWMPINR,LOW);
}
}
void setDistance(int setpoint){
    error=setpoint-distance;
    iDistance+=error;
    deltaError=error-lastError;
    P=error*kp;
    I=iDistance*ki;
    D=deltaError*kd;
    PID=(int)(P+I+D);
    lastError=error;
    pwm(PID);
}
void readDistance(){
    digitalWrite(TRIGPIN, LOW);           // Set the trigger pin to low for 2uS
    delayMicroseconds(2);
    digitalWrite(TRIGPIN, HIGH);         // Send a 10uS high to trigger ranging
    delayMicroseconds(10);
    digitalWrite(TRIGPIN, LOW);         // Send pin low again
    long duration = pulseIn(ECHOPIN, HIGH); // Read in times pulse
    distance=(int)(83-(duration/5.8));
    if(distance<0){distance=0;}
    else{distance=distance;}
    delay(10);                           // Wait 10mS before next ranging
}
void sendToExcel(){

```

```

    Serial.println( (String) "DATA,TIME," + distance + "," + error + "," + lastError +
    "," + P + "," + I + "," + D + "," + PID + "," );
}
void setup() {
    // put your setup code here, to run once:
    pinMode(PWMPINL,OUTPUT);
    pinMode(PWMPINR,OUTPUT);
    pinMode(ECHOPIN,INPUT);
    pinMode(TRIGPIN,OUTPUT);
    pinMode(BUTTON,INPUT_PULLUP);
    Serial.begin(9600);
    Serial.println("CLEARSHEET");
    Serial.println("LABEL,Time,Distance,Error,lastError,P,I,D,PID");
}
void loop() {
    pwm(0);
    if(digitalRead(BUTTON)==LOW){
        while(1){
            setDistance(10); //set point is 10mm
            // setDistance(15); //set point is 15mm
            // setDistance(20); //set point is 20mm
            // setDistance(25); //set point is 25mm
            // setDistance(30); //set point is 30mm
            readDistance();
            sendToExcel();
        }
    }
}
}

```

### Lampiran 3 Daftar Program untuk pengujian tipe kontroler P untuk set point 15mm

```
#define BUTTON 2
#define TRIGPIN 7
#define ECHOPIN 8
#define PWMPINR 10
#define PWMPINL 11

int distance,error,lastError,deltaError,PID;
float iDistance,kp=0.5,kd=0,P,I,D;
char ki="infinity";
void pwm (int x){
    if(x>255){
        analogWrite(PWMPINL,255);
        digitalWrite(PWMPINR,LOW);
    }
    else if(x>0){
        analogWrite(PWMPINL,x);
        digitalWrite(PWMPINR,LOW);
    }
    else if(x<-255){
        analogWrite(PWMPINR,255);
        digitalWrite(PWMPINL,LOW);
    }
    else if(x<0){
        analogWrite(PWMPINR,-(x));
        digitalWrite(PWMPINL,LOW);
    }
}
```





```

}
void sendToExcel(){
    Serial.println( (String) "DATA,TIME," + distance + "," + error + "," + lastError +
    "," + P + "," + I + "," + D + "," + PID + "," );
}
void setup() {
    // put your setup code here, to run once:
    pinMode(PWMPINL,OUTPUT);
    pinMode(PWMPINR,OUTPUT);
    pinMode(ECHOPIN,INPUT);
    pinMode(TRIGPIN,OUTPUT);
    pinMode(BUTTON,INPUT_PULLUP);

    Serial.begin(9600);
    Serial.println("CLEARSHEET");
    Serial.println("LABEL,Time,Distance,Error,lastError,P,I,D,PID");

}
void loop() {
    pwm(0);
    if(digitalRead(BUTTON)==LOW){
        while(1){
            setDistance(15); //set point is 15mm
            readDistance();
            sendToExcel();
        }
    }
}
}

```

#### Lampiran 4 Daftar Program untuk pengujian tipe kontroler P untuk set point 30mm

```
#define BUTTON 2
#define TRIGPIN 7
#define ECHOPIN 8
#define PWMPINR 10
#define PWMPINL 11

int distance,error,lastError,deltaError,PID;
float iDistance,kp=0.5,kd=0,P,I,D;
char ki="infinity";
void pwm (int x){
    if(x>255){
        analogWrite(PWMPINL,255);
        digitalWrite(PWMPINR,LOW);
    }
    else if(x>0){
        analogWrite(PWMPINL,x);
        digitalWrite(PWMPINR,LOW);
    }
    else if(x<-255){
        analogWrite(PWMPINR,255);
        digitalWrite(PWMPINL,LOW);
    }
    else if(x<0){
        analogWrite(PWMPINR,-(x));
        digitalWrite(PWMPINL,LOW);
    }
}
```



```

}

void sendToExcel(){
    Serial.println( (String) "DATA,TIME," + distance + "," + error + "," + lastError
+ "," + P + "," + I + "," + D + "," + PID + "," );
}

void setup() {
    // put your setup code here, to run once:
    pinMode(PWMPINL,OUTPUT);
    pinMode(PWMPINR,OUTPUT);
    pinMode(ECHOPIN,INPUT);
    pinMode(TRIGPIN,OUTPUT);
    pinMode(BUTTON,INPUT_PULLUP);
    Serial.begin(9600);
    Serial.println("CLEAR SHEET");
    Serial.println("LABEL,Time,Distance,Error,lastError,P,I,D,PID");
}

void loop() {
    pwm(0);
    if(digitalRead(BUTTON)==LOW){
        while(1){
            setDistance(30); //set point is 30mm
            readDistance();
            sendToExcel();
        }
    }
}

```

## Lampiran 5 Daftar Program untuk pengujian tipe kontroler PI untuk set point 15mm

```
#define BUTTON 2
#define TRIGPIN 7
#define ECHOPIN 8
#define PWMPINR 10
#define PWMPINL 11

int distance,error,lastError,deltaError,PID;
float iDistance,kp=0.45,ki=20,kd=0,P,I,D;

void pwm (int x){
  if(x>255){
    analogWrite(PWMPINL,255);
    digitalWrite(PWMPINR,LOW);
  }
  else if(x>0){
    analogWrite(PWMPINL,x);
    digitalWrite(PWMPINR,LOW);
  }
  else if(x<-255){
    analogWrite(PWMPINR,255);
    digitalWrite(PWMPINL,LOW);
  }
  else if(x<0){
    analogWrite(PWMPINR,-(x));
    digitalWrite(PWMPINL,LOW);
  }
}
```



```
}
```

```
void sendToExcel(){
```

```
  Serial.println( (String) "DATA,TIME," + distance + "," + error + "," + lastError +  
  "," + P + "," + I + "," + D + "," + PID + " ");
```

```
}
```

```
void setup() {
```

```
  // put your setup code here, to run once:
```

```
  pinMode(PWMPINL,OUTPUT);
```

```
  pinMode(PWMPINR,OUTPUT);
```

```
  pinMode(ECHOPIN,INPUT);
```

```
  pinMode(TRIGPIN,OUTPUT);
```

```
  pinMode(BUTTON,INPUT_PULLUP);
```

```
  Serial.begin(9600);
```

```
  Serial.println("CLEARSHEET");
```

```
  Serial.println("LABEL,Time,Distance,Error,lastError,P,I,D,PID");
```

```
}
```

```
void loop() {
```

```
  pwm(0);
```

```
  if(digitalRead(BUTTON)==LOW){
```

```
    while(1){
```

```
      setDistance(15); //set point is 15mm
```

```
      readDistance();
```

```
      sendToExcel();
```

```
    }
```

```
  }
```

```
}
```

## Lampiran 6 Daftar Program untuk pengujian tipe kontroler PI untuk set point 30mm

```
#define BUTTON 2
#define TRIGPIN 7
#define ECHOPIN 8
#define PWMPINR 10
#define PWMPINL 11

int distance,error,lastError,deltaError,PID;
float iDistance,kp=0.45,ki=20,kd=0,P,I,D;

void pwm (int x){
  if(x>255){
    analogWrite(PWMPINL,255);
    digitalWrite(PWMPINR,LOW);
  }
  else if(x>0){
    analogWrite(PWMPINL,x);
    digitalWrite(PWMPINR,LOW);
  }
  else if(x<-255){
    analogWrite(PWMPINR,255);
    digitalWrite(PWMPINL,LOW);
  }
  else if(x<0){
    analogWrite(PWMPINR,-(x));
    digitalWrite(PWMPINL,LOW);
  }
}
```





```
}
```

```
void sendToExcel(){
```

```
  Serial.println( (String) "DATA,TIME," + distance + "," + error + "," + lastError +  
  "," + P + "," + I + "," + D + "," + PID + " ");
```

```
}
```

```
void setup() {
```

```
  // put your setup code here, to run once:
```

```
  pinMode(PWMPINL,OUTPUT);
```

```
  pinMode(PWMPINR,OUTPUT);
```

```
  pinMode(ECHOPIN,INPUT);
```

```
  pinMode(TRIGPIN,OUTPUT);
```

```
  pinMode(BUTTON,INPUT_PULLUP);
```

```
  Serial.begin(9600);
```

```
  Serial.println("CLEARSHEET");
```

```
  Serial.println("LABEL,Time,Distance,Error,lastError,P,I,D,PID");
```

```
}
```

```
void loop() {
```

```
  pwm(0);
```

```
  if(digitalRead(BUTTON)==LOW){
```

```
    while(1){
```

```
      setDistance(30); //set point is 30mm
```

```
      readDistance();
```

```
      sendToExcel();
```

```
    }
```

```
  }
```

```
}
```

## Lampiran 7 Daftar Program untuk pengujian tipe kontroler PID untuk set point 15mm

```
#define BUTTON 2
#define TRIGPIN 7
#define ECHOPIN 8
#define PWMPINR 10
#define PWMPINL 11

int distance,error,lastError,deltaError,PID;
float iDistance,kp=0.6,ki=0.12,kd=0.03,P,I,D;

void pwm (int x){
  if(x>255){
    analogWrite(PWMPINL,255);
    digitalWrite(PWMPINR,LOW);
  }
  else if(x>0){
    analogWrite(PWMPINL,x);
    digitalWrite(PWMPINR,LOW);
  }
  else if(x<-255){
    analogWrite(PWMPINR,255);
    digitalWrite(PWMPINL,LOW);
  }
  else if(x<0){
    analogWrite(PWMPINR,-(x));
    digitalWrite(PWMPINL,LOW);
  }
}
```



```
}
```

```
void sendToExcel(){
```

```
  Serial.println( (String) "DATA,TIME," + distance + "," + error + "," + lastError +  
  "," + P + "," + I + "," + D + "," + PID + " ");
```

```
}
```

```
void setup() {
```

```
  // put your setup code here, to run once:
```

```
  pinMode(PWMPINL,OUTPUT);
```

```
  pinMode(PWMPINR,OUTPUT);
```

```
  pinMode(ECHOPIN,INPUT);
```

```
  pinMode(TRIGPIN,OUTPUT);
```

```
  pinMode(BUTTON,INPUT_PULLUP);
```

```
  Serial.begin(9600);
```

```
  Serial.println("CLEARSHEET");
```

```
  Serial.println("LABEL,Time,Distance,Error,lastError,P,I,D,PID");
```

```
}
```

```
void loop() {
```

```
  pwm(0);
```

```
  if(digitalRead(BUTTON)==LOW){
```

```
    while(1){
```

```
      setDistance(15); //set point is 15mm
```

```
      readDistance();
```

```
      sendToExcel();
```

```
    }
```

```
  }
```

```
}
```

## Lampiran 8 Daftar Program untuk pengujian tipe kontroler PID untuk set point 30mm

```
#define BUTTON 2
#define TRIGPIN 7
#define ECHOPIN 8
#define PWMPINR 10
#define PWMPINL 11

int distance,error,lastError,deltaError,PID;
float iDistance,kp=0.6,ki=0.12,kd=0.03,P,I,D;

void pwm (int x){
  if(x>255){
    analogWrite(PWMPINL,255);
    digitalWrite(PWMPINR,LOW);
  }
  else if(x>0){
    analogWrite(PWMPINL,x);
    digitalWrite(PWMPINR,LOW);
  }
  else if(x<-255){
    analogWrite(PWMPINR,255);
    digitalWrite(PWMPINL,LOW);
  }
  else if(x<0){
    analogWrite(PWMPINR,-(x));
    digitalWrite(PWMPINL,LOW);
  }
}
```



```
}
```

```
void sendToExcel(){
```

```
  Serial.println( (String) "DATA,TIME," + distance + "," + error + "," + lastError +  
  "," + P + "," + I + "," + D + "," + PID + " ");
```

```
}
```

```
void setup() {
```

```
  // put your setup code here, to run once:
```

```
  pinMode(PWMPINL,OUTPUT);
```

```
  pinMode(PWMPINR,OUTPUT);
```

```
  pinMode(ECHOPIN,INPUT);
```

```
  pinMode(TRIGPIN,OUTPUT);
```

```
  pinMode(BUTTON,INPUT_PULLUP);
```

```
  Serial.begin(9600);
```

```
  Serial.println("CLEARSHEET");
```

```
  Serial.println("LABEL,Time,Distance,Error,lastError,P,I,D,PID");
```

```
}
```

```
void loop() {
```

```
  pwm(0);
```

```
  if(digitalRead(BUTTON)==LOW){
```

```
    while(1){
```

```
      setDistance(30); //set point is 30mm
```

```
      readDistance();
```

```
      sendToExcel();
```

```
    }
```

```
  }
```

```
}
```





## LEMBAR REVISI dan TUGAS UJIAN SARJANA

Berdasarkan Rapat Tim Penguji Ujian Sarjana

Hari : Jum'at  
Tanggal : 20 September 2019  
Tempat : R. Lab TE

Memutuskan bahwa mahasiswa :

Nama : Tsaabit Taqiyyuddin  
NIM : 30601401579  
Judul TA : Kontrol Posisi pada Sistem Pelayangan Magnetik menggunakan Kontrol PID

wajib melakukan perbaikan dan membuat tugas seperti tercantum dibawah ini:

NO	REVISI	BATAS REVISI
	<p>- Daftar pustaka cek yg ta penuh sm TA - tugas / am kya BTS 7960</p>	<p>Acc 9/10/19 Munaf</p>
NO	TUGAS	

Mengetahui,  
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Semarang, 20 September 2019  
Penguji, I

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## LEMBAR REVISI dan TUGAS UJIAN SARJANA

Berdasarkan Rapat Tim Penguji Ujian Sarjana

Hari : Jum'at  
Tanggal : 20 September 2019  
Tempat : R. Lab TE

Memutuskan bahwa mahasiswa :

Nama : Tsaabit Taqiyuddin  
NIM : 30601401579  
Judul TA : Kontrol Posisi pada Sistem Pelayanan Magnetik menggunakan Kontrol PID

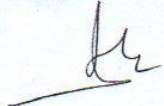
wajib melakukan perbaikan dan membuat tugas seperti tercantum dibawah ini:

NO	REVISI	BATAS REVISI
	<ul style="list-style-type: none"><li>Font abstrak → 10 ✓</li><li>Diagram sistem, cara kerja sistem, dan fungsi masing-masing komponen diperbaiki ✓</li><li>Flowchart sistem kontrol PID diperbaiki → tambahkan perhitungan PID detail di flowchart</li></ul>	<p>Act H 9/10/19</p>
NO	TUGAS	

Mengetahui,  
Ketua Tim Penguji

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## LEMBAR REVISI dan TUGAS UJIAN SARJANA

Berdasarkan Rapat Tim Penguji Ujian Sarjana

Hari : Jum'at  
Tanggal : 20 September 2019  
Tempat : R. Lab TE

Memutuskan bahwa mahasiswa :

Nama : Tsaabit Taqiyyuddin  
NIM : 30601401579  
Judul TA : Kontrol Posisi pada Sistem Pelayangan Magnetik menggunakan Kontrol PID

wajib melakukan perbaikan dan membuat tugas seperti tercantum dibawah ini:

NO	REVISI	BATAS REVISI
1	Adq bloc diagram sistem kontrol tertutup untuk sistem sesuai dengan rancangan sistem kelayangan magnetik	9/20/19 W. Jk

NO	TUGAS

Mengetahui,  
Ketua Tim Penguji

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