

BAB 6

KESIMPULAN DAN SARAN

6.1. Kesimpulan

Berdasarkan hasil dan pembahasan yang telah dijelaskan pada Bab 5, kesimpulan yang dapat diambil dari penelitian Tugas Akhir ini adalah:

1. Mikrokontroler ATMegal6 digunakan sebagai unit kendali, sedangkan komputer digunakan untuk memberikan *input* berupa nilai *set point* dan untuk menampilkan sinyal masukan serta keluaran motor DC yang dilengkapi dengan grafik.
2. *Set point* nilai PWM pada motor DC memiliki batas *minimal* yaitu dengan nilai PWM 155. Apabila *set point* di bawah nilai PWM 155, maka motor DC tidak akan berputar.
3. Hasil pengujian kecepatan motor DC tanpa pembebanan membuktikan bahwa dengan kendali PID didapatkan *settling time* yang cepat dan kendali PID mampu meminimalkan kesalahan sistem.
4. Hasil pengujian kecepatan motor DC dengan pembebanan membuktikan bahwa kendali PID mampu mempertahankan kecepatan akibat pembebanan sehingga kecepatan motor DC dapat kembali sesuai dengan *set point* yang diberikan.

6.2. Saran

Berdasarkan hasil penelitan yang telah dilakukan, ada beberapa saran yang dapat diberikan untuk lebih

menyempurnakan hasil penelitian ini atau untuk dikembangkan lebih lanjut, yaitu:

1. Sensor putaran sebaiknya menggunakan sensor *optocoupler* dengan kepekaan yang lebih baik agar pembacaan masukan lebih akurat.
2. Sebaiknya kendali PID yang meliputi konstanta *proposional*, konstanta *integral*, dan konstanta *derivative* diinputkan melalui komputer agar lebih mudah dan *flexible* dalam pemrograman.
3. Sebaiknya pembebanan yang dilakukan menggunakan suatu skala atau mengaplikasikan langsung pada suatu sistem.

DAFTAR PUSTAKA

- Alldatasheet, 2012, Alldatasheet Website, <<http://www.alldatasheet.com>> diakses 17 Januari 2012.
- Andrianto, H., 2008, *Pemrograman Mikrokontroler AVR ATMEGA16 Menggunakan Bahasa C (CodeVision AVR)*, Informatika, Bandung.
- Atmel, 2011, Atmel Website, <www.atmel.com/images/doc2466.pdf>, diakses 27 November 2011.
- Bejo, A., 2008, *C & AVR Rahasia Kemudahan Bahasa C dalam Mikrokontroler ATmega8535*, Graha Ilmu, Yogyakarta.
- Berahim, H., 1991, *Pengantar Teknik Tenaga Listrik*, Andi, Yogyakarta.
- Circuitstoday, 2008, Circuitstoday Website, <<http://www.circuitstoday.com/12v-5v-combo-power-supply>>, diakses 20 Oktober 2011.
- Deccanrobots, 2011, Deccanrobots Website, <<http://embeddedmarket.com/storerresources/NN-61/user%20manual.pdf>>, diakses 27 Oktober 2011.
- Delta-electronic, 2010, Delta-electronic Website, <<http://www.delta-electronic.com/Design/Data%20Sheet/kits/st-16/manual.pdf>> diakses 20 Oktober 2011.
- Groover, M.P., 2001, *Otomasi, Sistem Produksi, dan Computer-Integrated Manufacturing* (terjemahan

Arthaya, B.), ed. 2, Guna Widya Kertajaya 178, Surabaya.

Hastra, M.R., 2010, *Robot Penjejak Garis dengan Kendali PID*, Skripsi Program Studi Teknik Industri, Fakultas Teknologi Industri, Universitas Atma Jaya Yogyakarta, Yogyakarta.

Innovativeelectronics, 2011, Innovativeelectronics Website, <http://innovativeelectronics.com/innovative_electronics/download_files/artikel/AN13.pdf> diakses 27 Oktober 2011.

Nugraha, B.A., 2007, *Mikrokontroler AT89C51 sebagai Pengendali Gerak Model Robot Lengan Tiga Sumbu*, Skripsi Program Studi Teknik Industri, Fakultas Teknologi Industri, Universitas Atma Jaya Yogyakarta, Yogyakarta.

Ogata, K., 1991, *Teknik Kontrol Automatik -terjemahan: Ir. Edi Laksono*, Erlangga, Jakarta.

Pitowarno, E., 2006, *Robotika Desain, Kontrol, dan Kecerdasan Buatan*, Andi, Yogyakarta.

Prasetia, R., 2006, *Teori & Praktek Interfacing Port Paralel & Port Serial Komputer dengan Visual Basic 6.0*, Andi, Yogyakarta.

Solarbotics, 2008, Solarbotics Website, <http://content.solarbotics.com/products/datasheet/s/solarbotics_l298_compact_motor_driver_kit.pdf> diakses 7 Desember 2011.

Susilo, D., 2010, *48 Jam Kupas Tuntas Mikrokontroler MCS51 & AVR*, Andi, Yogyakarta.

Wijanarko, A.P., 2009, *Simulasi Speedometer dan Odometer Digital Berbasis Mikrokontroler ATmega8535*, Skripsi Program Studi Teknik Elektro, Fakultas Teknik, Universitas Negeri Yogyakarta, Yogyakarta.

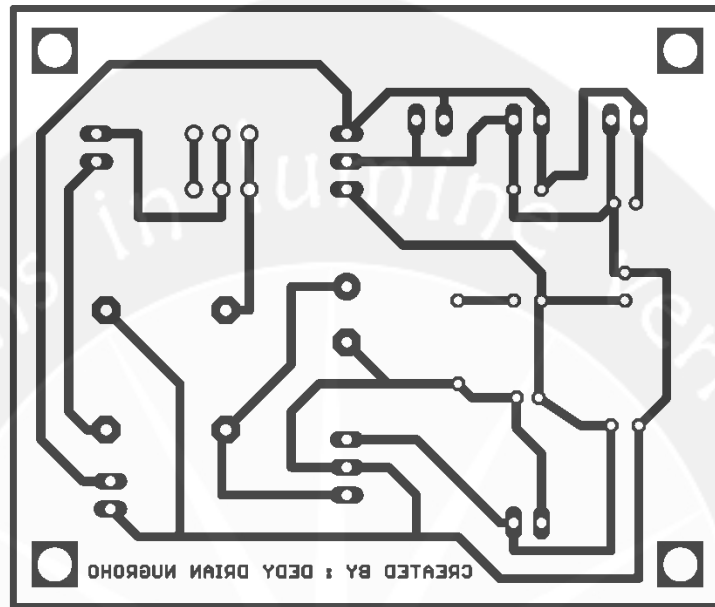
Wikipedia, 2012, Wikipedia Website, <http://en.wikipedia.org/wiki/PID_controller> diakses 25 April 2012.



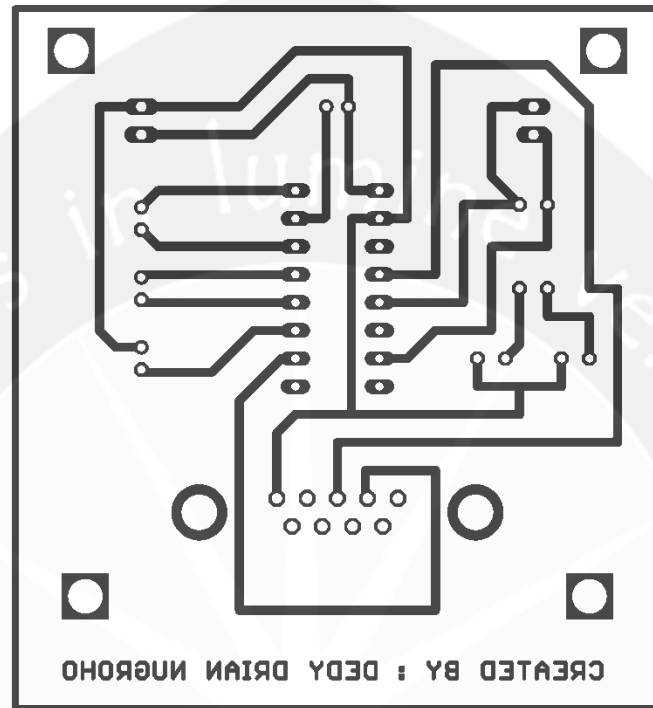
Lampiran 1 : Data Kecepatan Motor DC

Kecepatan Motor DC	Set Point										
	155	165	175	185	195	205	215	225	235	245	255
1	411	540	736	859	949	1069	1134	1172	1205	1210	1221
2	398	572	717	872	979	1074	1142	1175	1205	1210	1221
3	384	534	714	842	968	1088	1142	1170	1200	1208	1246
4	379	570	747	859	970	1077	1148	1183	1202	1208	1250
5	417	550	720	834	981	1060	1170	1175	1200	1210	1246
6	403	559	720	853	965	1060	1164	1183	1200	1210	1257
7	400	548	730	853	954	1069	1134	1183	1202	1213	1260
8	390	531	728	856	960	1080	1142	1170	1200	1213	1260
9	406	553	720	831	957	1071	1142	1172	1200	1213	1262
10	368	534	695	834	968	1069	1137	1175	1202	1210	1246
11	395	561	706	859	965	1080	1153	1172	1202	1205	1246
12	381	559	739	861	976	1063	1159	1172	1205	1205	1249
13	381	567	698	820	976	1074	1131	1172	1205	1208	1249
14	403	567	698	870	970	1058	1153	1159	1208	1210	1262
15	390	559	698	859	965	1071	1145	1170	1208	1210	1262
16	384	564	692	842	962	1074	1140	1167	1208	1213	1250
17	392	545	692	864	984	1074	1156	1167	1205	1213	1260
18	381	548	711	859	965	1077	1142	1172	1205	1216	1260
19	381	512	690	883	968	1055	1145	1167	1200	1216	1250
20	392	567	730	859	962	1069	1140	1172	1200	1208	1221
21	400	540	692	850	940	1080	1142	1167	1200	1210	1221
22	384	545	733	864	951	1058	1150	1178	1205	1208	1246
23	387	540	695	837	976	1074	1153	1172	1202	1216	1246
24	370	540	690	840	940	1055	1140	1178	1202	1216	1250
25	400	540	714	845	973	1055	1142	1178	1202	1216	1257
26	368	526	706	856	954	1069	1159	1175	1200	1210	1262
27	387	550	714	864	968	1066	1148	1175	1205	1216	1260
28	376	548	695	850	973	1082	1159	1161	1202	1213	1260
29	376	559	698	856	965	1060	1156	1175	1202	1213	1257
30	357	570	717	870	965	1063	1129	1172	1205	1216	1260
Rata-rata	388	550	711	853	965	1069	1147	1173	1203	1211	1250

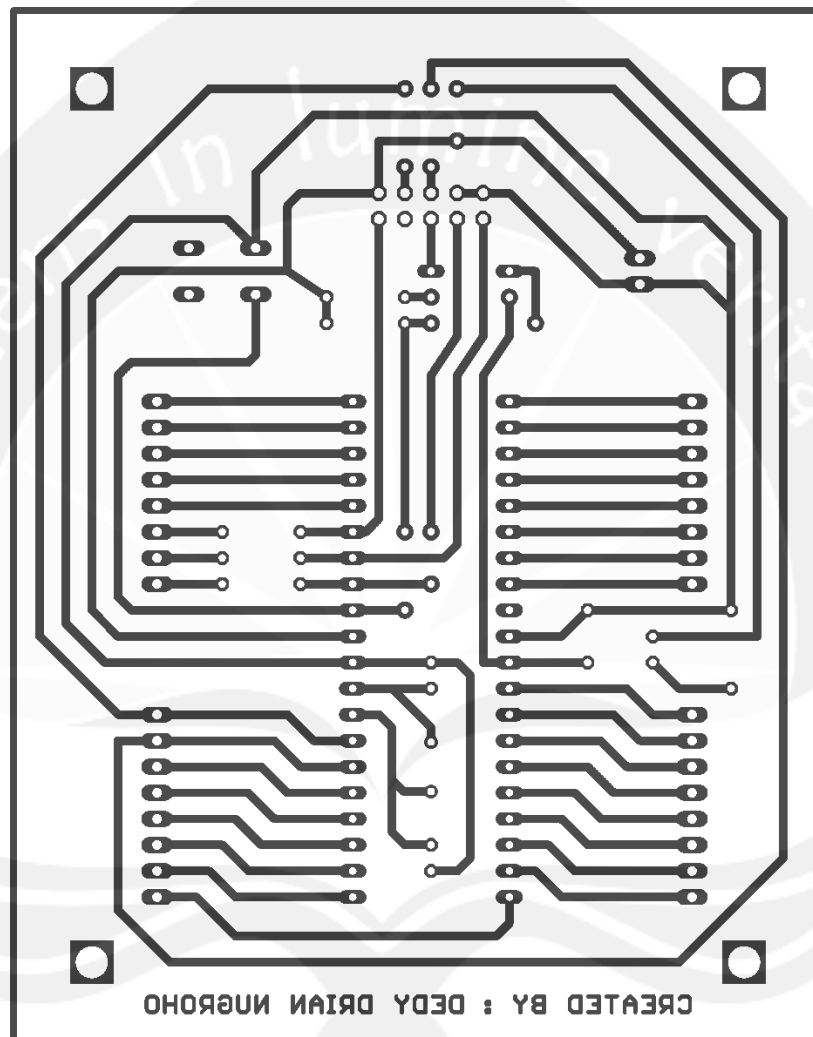
Lampiran 2 : PCB *Layout* Rangkaian Catu Daya



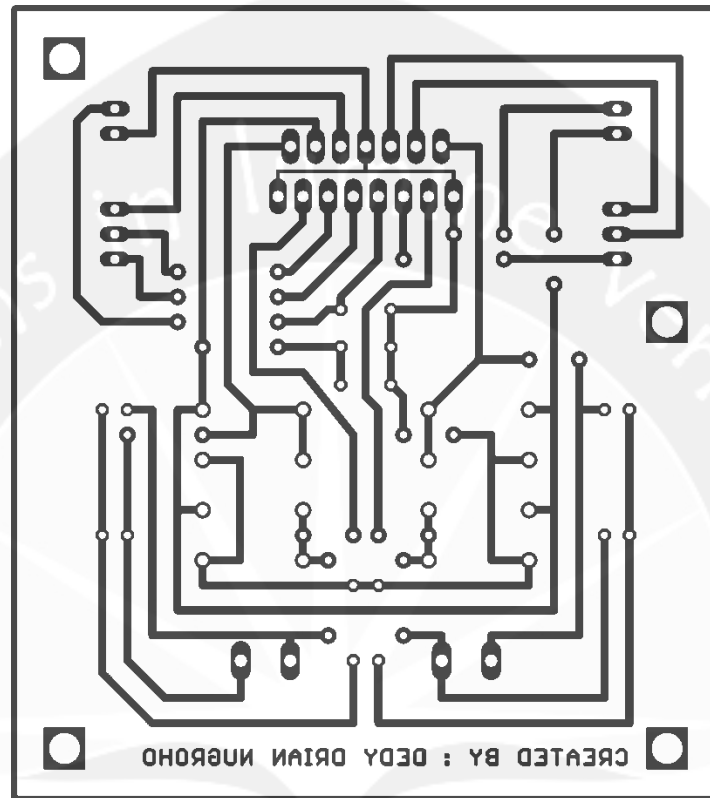
Lampiran 3 : PCB *Layout* Rangkaian Komunikasi Serial



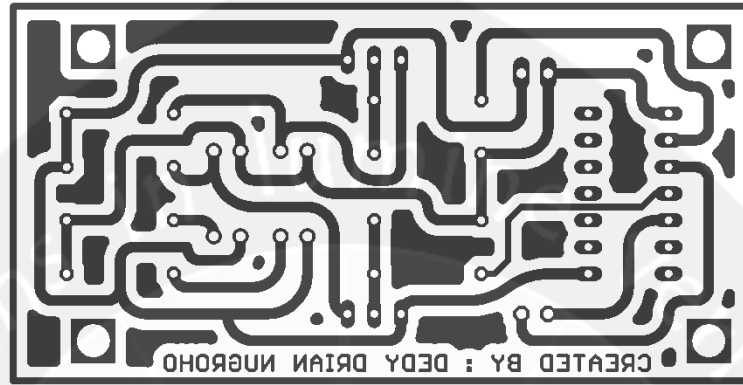
Lampiran 4 : PCB *Layout* Sistem *Minimum* Mikrokontroler
ATMega16



Lampiran 5 : PCB *Layout* Rangkaian *Driver* Motor L298



Lampiran 6 : PCB *Layout* Rangkaian *Optocoupler*



Lampiran 7 : Program C Mikrokontroler ATmega16

```
/******  
This program was produced by the  
CodeWizardAVR V2.03.9 Standard  
Automatic Program Generator  
© Copyright 1998-2008 Pavel Haiduc, HP InfoTech s.r.l.  
http://www.hpinfotech.com
```

```
Project : SISTEM KENDALI KECEPATAN MOTOR DC DENGAN PID  
Version :  
Date    : 7/20/2012  
Author  : LAB.SKI  
Company : UNIVERSITAS ATMA JAYA YOGYAKARTA  
Comments:
```

```
Chip type           : ATmega16  
Program type        : Application  
AVR Core Clock frequency: 11.059200 MHz  
Memory model        : Small  
External RAM size    : 0  
Data Stack size     : 256
```

```
*****/
```

```
char putar;  
char tes;  
float Kp=0.4, Ki=0.09, Kd=0.1, error_lama=0,  
error_baru=0, sum_error=0, selisih_error, outP, outI,  
outD, outPID, Tc=1;  
int SP, kec, SP_baru, SPVar, kecepatan, PV, pulsa=0;
```

```

#include <mega16.h>
#include <delay.h>

// External Interrupt 0 service routine
interrupt [EXT_INT0] void ext_int0_isr(void)
{
    // Place your code here
    pulsa++;
}

// External Interrupt 1 service routine
interrupt [EXT_INT1] void ext_int1_isr(void)
{
    // Place your code here
}

// Standard Input/Output functions
#include <stdio.h>
#include <stdlib.h>

// Timer 1 overflow interrupt service routine
interrupt [TIM1_OVF] void timer1_ovf_isr(void)
{
    // Reinitialize Timer 1 value
    TCNT1H=0xD5D0 >> 8;
    TCNT1L=0xD5D0 & 0xff;
    // Place your code here
    kecepatan=((float)pulsa*60/22);
    pulsa=0;
}

```

```

// Declare your global variables here

void main(void)
{
// Declare your local variables here

// Input/Output Ports initialization
// Port A initialization
// Func7=In Func6=In Func5=In Func4=In Func3=In
Func2=In Func1=In Func0=In
// State7=T State6=T State5=T State4=T State3=T
State2=T State1=T State0=T
PORTA=0x00;
DDRA=0x00;

// Port B initialization
// Func7=Out Func6=Out Func5=Out Func4=Out Func3=Out
Func2=Out Func1=Out Func0=Out
// State7=0 State6=0 State5=0 State4=0 State3=0
State2=0 State1=0 State0=0
PORTB=0x00;
DDRB=0xFF;

// Port C initialization
// Func7=In Func6=In Func5=In Func4=In Func3=In
Func2=In Func1=In Func0=In
// State7=T State6=T State5=T State4=T State3=T
State2=T State1=T State0=T
PORTC=0x00;
DDRC=0x00;

```

```

// Port D initialization
// Func7=In Func6=In Func5=In Func4=In Func3=In
Func2=In Func1=In Func0=In
// State7=T State6=T State5=T State4=T State3=T
State2=T State1=T State0=T
PORTD=0x00;
DDRD=0x00;

// Timer/Counter 0 initialization
// Clock source: System Clock
// Clock value: 11059.200 kHz
// Mode: Fast PWM top=FFh
// OC0 output: Non-Inverted PWM
TCCR0=0x69;
TCNT0=0x00;
OCR0=0x00;

// Timer/Counter 1 initialization
// Clock source: System Clock
// Clock value: 10.800 kHz
// Mode: Normal top=FFFFh
// OC1A output: Discon.
// OC1B output: Discon.
// Noise Canceler: Off
// Input Capture on Falling Edge
// Timer 1 Overflow Interrupt: On
// Input Capture Interrupt: Off
// Compare A Match Interrupt: Off
// Compare B Match Interrupt: Off
TCCR1A=0x00;
TCCR1B=0x05;

```



TCNT1H=0xD5;
TCNT1L=0xD0;
ICR1H=0x00;
ICR1L=0x00;
OCR1AH=0x00;
OCR1AL=0x00;
OCR1BH=0x00;
OCR1BL=0x00;

// Timer/Counter 2 initialization
// Clock source: System Clock
// Clock value: Timer 2 Stopped
// Mode: Normal top=FFh
// OC2 output: Disconnected
ASSR=0x00;
TCCR2=0x00;
TCNT2=0x00;
OCR2=0x00;

// External Interrupt(s) initialization
// INT0: On
// INT0 Mode: Falling Edge
// INT1: On
// INT1 Mode: Falling Edge
// INT2: Off
GICR|=0xC0;
MCUCR=0x0A;
MCUCSR=0x00;
GIFR=0xC0;

```

// Timer(s)/Counter(s) Interrupt(s) initialization
TIMSK=0x04;

// USART initialization
// Communication Parameters: 8 Data, 1 Stop, No Parity
// USART Receiver: On
// USART Transmitter: On
// USART Mode: Asynchronous
// USART Baud Rate: 9600
UCSRA=0x00;
UCSRB=0x18;
UCSRC=0x86;
UBRRH=0x00;
UBRRL=0x47;

// Analog Comparator initialization
// Analog Comparator: Off
// Analog Comparator Input Capture by Timer/Counter 1:
Off
ACSR=0x80;
SFIOR=0x00;

tes=getchar();
if(!(UCSRA & 0x80))
{
    if (tes=='0')
    {
        printf("RESPON OK");
    }
}

```

```

// Global enable interrupts
#asm("sei")

while (1)
{
    SP=getchar();
    SPVar=getchar();
    putar=getchar();

    if(!(UCSRA & 0x80))
    {
        if (putar=='1') //arah CW
        {
            PORTB.1=0;
            PORTB.2=1;
        }
        else if (putar=='2') //arah CCW
        {
            PORTB.1=1;
            PORTB.2=0;
        }

        OCR0=SPVar;
    }

    printf("%i", kecepatan);

    kec=((float) (kecepatan/1250)*255);

    PV=((float) kecepatan/kec*SP);
}

```

```

error_lama=error_baru;
error_baru=((float)SP-PV);
sum_error+=error_baru;
selisih_error=error_baru-error_lama;

//kendali proposional
outP=Kp*error_baru;
//kendali integral
outI=Ki*sum_error*Tc;
//kendali derivatif
outD=(Kd*selisih_error)/Tc;

//kontrol PID
outPID=outP+outI+outD;

SP_baru=((float)outPID+SP);

if (SP_baru>255)
{
SP_baru=255;
}
else if (SP_baru<0)
{
SP_baru=0;
}

SPVar=SP_baru;
printf("%i",SPVar);

};
}

```

Lampiran 8 : Program *Interface* pada Komputer

```
Dim dataku(200) As Double
Dim X As Control
Dim z As Control
Dim con As New Connection
Dim indek, error_lama, error_baru As Integer

Private Sub cmdConnect_Click()
Dim port As Integer
On Error GoTo errcode
Select Case Combol.ListIndex
Case -1
    port = 1
Case 0
    port = 1
Case 1
    port = 2
Case 2
    port = 3
Case 3
    port = 4
Case 4
    port = 5
Case 5
    port = 6
Case 6
    port = 7
Case 7
    port = 8
```

Case 8

port = 9

Case 9

port = 10

End Select

If cmdConnect.Caption = "&Connect" Then

'Proses Connect

If MSComm1.PortOpen = False Then

MSComm1.CommPort = port

MSComm1.RThreshold = 1

MSComm1.InputLen = 0

MSComm1.Settings =

Combo2.List(Combo2.ListIndex) & ",N,8,1"

MSComm1.PortOpen = True

cmdKirim.Enabled = True

cmdgrafik.Enabled = True

lblrpm.Caption = "0"

Timer1.Enabled = True

cmdConnect.Caption = "&Disconnect"

Tim_label.Enabled = False

Tim_grafik.Enabled = False

txt3.SetFocus

optkiri.Enabled = False

optkanan.Enabled = False

End If

Else

'Proses Disconnect

Timer1.Enabled = False

optkiri.Enabled = True

optkanan.Enabled = True

```

lblkecepatan.Caption = "0"
lblSP.Caption = "0"
lbltes.Caption = ""
lblrpm.Caption = "0"
MSComm1.Output = Chr(Val(lblSP.Caption))
MSComm1_OnComm
MSComm1.Output = Chr(Val(lblkecepatan.Caption))
MSComm1_OnComm
MSComm1.Output = Chr(Val(lblSPVar.Caption))
MSComm1_OnComm
MSComm1.Output = Chr(Val(lblkecepatan.Caption))
MSComm1_OnComm
If MSComm1.PortOpen = True Then
    MSComm1.PortOpen = False
End If
cmdConnect.Enabled = True
cmdConnect.Caption = "&Connect"
cmdKirim.Enabled = False
cmdTes.Visible = True
cmdgrafik.Enabled = False
End If
Exit Sub

'Jika Terjadi Error
errcode:
If Err.Number = 8002 Then
    MsgBox "Port Salah !", vbOKOnly, "Peringatan"
    cmdConnect.Caption = "&Connect"
    Comb1.SetFocus
End If
End Sub

```

```
Private Sub cmdExit_Click()
```

```
End
```

```
End Sub
```

```
Private Sub cmdexitgrafik_Click()
```

```
Call GrafikNonAktif
```

```
Me.Top = (Screen.Height - Me.Height) / 2
```

```
Me.Left = (Screen.Width - Me.Width) / 2
```

```
End Sub
```

```
Private Sub cmdgrafik_Click()
```

```
Call GrafikAktif
```

```
Me.Top = (Screen.Height - Me.Height) / 2
```

```
Me.Left = (Screen.Width - Me.Width) / 2
```

```
End Sub
```

```
Private Sub cmdKirim_Click()
```

```
If Trim(txt2.Text) = "" Then
```

```
    MsgBox "Set Point tidak boleh kosong..!!",
```

```
    vbCritical
```

```
Else
```

```
    lblSP.Caption = Trim(txt2.Text)
```

```
    lblSPVar.Caption = Trim(txt2.Text)
```

```
    Timer1.Interval = 1000
```

```
    Tim_grafik.Interval = 1000
```

```
End If
```

```
End Sub
```

```
Private Sub cmdok_Click()
```

```
If Val(txtkecepatan.Text) > 100 Then txtkecepatan.Text
```

```
= "100"
```

```
If Val(txtkecepatan.Text) < 0 Then txtkecepatan.Text =  
"0"
```

```
End Sub
```

```
Private Sub cmdsimpan_Click()
```

```
'Untuk Menyimpan Grafik ke File .jpg
```

```
cdlg.Filter = "Gambar JPEG | *.jpg"
```

```
cdlg.ShowSave
```

```
namafile = cdlg.FileName
```

```
If Trim(namafile) <> "" Then
```

```
    SavePicture pic_grafik.Image, namafile
```

```
End If
```

```
End Sub
```

```
Private Sub cmdstop_Click()
```

```
If cmdstop.Caption = "&Start" Then
```

```
    cmdsimpan.Enabled = False
```

```
    cmdstop.Caption = "&Stop"
```

```
    Tim_grafik.Enabled = True
```

```
    Tim_label.Enabled = True
```

```
Else
```

```
    Tim_grafik.Enabled = False
```

```
    Tim_label.Enabled = False
```

```
    cmdsimpan.Enabled = True
```

```
    cmdstop.Caption = "&Start"
```

```
End If
```

```
End Sub
```

```
Private Sub cmdTes_Click()
```

```
txt1.Enabled = True
```

```

txt3.Enabled = False
MSComm1.Output = "0"
cmdTes.Enabled = False
cmdTes.Visible = False
End Sub

Private Sub Command1_Click()
'Untuk Mencetak Hasil Data Sample
con.Execute ("DELETE FROM temp")
For i = 1 To lvdata.ListItems.Count
    sql = "INSERT INTO temp VALUES('" &
        Trim(lvdata.ListItems(i).Text) & _
        "',''" & Trim(lvdata.ListItems(i).SubItems(1)) &
        "',''" & Trim(lvdata.ListItems(i).SubItems(2)) &
        "')"
    Set rs = con.Execute(sql)
Next i

CR1.ReportFileName = App.Path & "\RptSampling.rpt"
CR1.RetrieveDataFiles
CR1.Destination = crptToWindow
CR1.WindowTitle = "Daftar Sampling"
CR1.WindowState = crptMaximized
CR1.Action = 1
End Sub

Private Sub Form_Load()
indek = 0
Me.Top = (Screen.Height - Me.Height) / 2
Me.Left = (Screen.Width - Me.Width) / 2

```

```
With Combo1
    .AddItem "COM1"
    .AddItem "COM2"
    .AddItem "COM3"
    .AddItem "COM4"
    .AddItem "COM5"
    .AddItem "COM6"
    .AddItem "COM7"
    .AddItem "COM8"
    .AddItem "COM9"
    .AddItem "COM10"
```

```
End With
```

```
With Combo2
    .AddItem "2400"
    .AddItem "4800"
    .AddItem "9600"
    .AddItem "19200"
    .AddItem "38400"
    .AddItem "56600"
```

```
End With
```

```
Combo2.ListIndex = 2
Timer1.Interval = 0
cmdConnect.Enabled = True
cmdKirim.Enabled = False
cmdTes.Enabled = False
Call GrafikNonAktif
lbltes.Caption = ""
lblrpm.Caption = "0"
Call buatgaris
```

```

lvdata.BorderStyle = ccNone
lvdata.FullRowSelect = True
lvdata.GridLines = True
lvdata.LabelEdit = lvwManual
lvdata.View = lvwReport
lvdata.ColumnHeaders.Add 1, , "Setpoin", 600
lvdata.ColumnHeaders.Add 2, , "Detik ke", 1200
lvdata.ColumnHeaders.Add 3, , "RPM", 3000

Tim_grafik.Enabled = False
Tim_label.Enabled = False
optkiri.Value = True
cmdTes.Enabled = True
End Sub

Private Sub MSComm1_OnComm()
'Prosedur Untuk Menerima Masukan dari Hardware
Dim buffer As String
Dim temp As String

buffer = MSComm1.Input
If buffer <> "" Then
    If txt1.Enabled = False Then
        txt3.SelStart = Len(txt3.Text)
        txt3.SelText = buffer
        lblrpm.Caption = txt3.Text
    Else
        txt1.SelStart = Len(txt1.Text)
        txt1.SelText = buffer
        lbltes.Caption = txt1.Text
    End If
End If

```

```
End If
End Sub
```

```
Private Sub Tim_grafik_Timer()
    If lblrpm.Caption = "" Then
        lblrpm.Caption = "0"
    End If
    If lblrpm.Caption = "0" Then
        dataku(0) = 0
    Else
        'Menentukan Nilai yang akan ditampilkan pada
        Grafik
        '-----
        dataku(0) = CInt(Mid(lblrpm.Caption, 1,
        Len(lblrpm.Caption) - 3))
        '-----
    End If
    Call gambarGrafik
End Sub
```

```
Private Sub Tim_label_Timer()
    'Untuk Menentukan Nilai Timer (Keterangan pada Sumbu x)
    With FrmKendali
        !Lbl1.Caption = CInt(!Lbl1.Caption) + 1
        !Lbl2.Caption = CInt(!Lbl2.Caption) + 1
        !Lbl3.Caption = CInt(!Lbl3.Caption) + 1
        !Lbl4.Caption = CInt(!Lbl4.Caption) + 1
        !Lbl5.Caption = CInt(!Lbl5.Caption) + 1
        !Lbl6.Caption = CInt(!Lbl6.Caption) + 1
        !Lbl7.Caption = CInt(!Lbl7.Caption) + 1
        !Lbl8.Caption = CInt(!Lbl8.Caption) + 1
    End With
End Sub
```

```

!Lbl19.Caption = CInt(!Lbl19.Caption) + 1
!Lbl10.Caption = CInt(!Lbl10.Caption) + 1
!Lbl11.Caption = CInt(!Lbl11.Caption) + 1
!Lbl12.Caption = CInt(!Lbl12.Caption) + 1
!Lbl13.Caption = CInt(!Lbl13.Caption) + 1
!Lbl14.Caption = CInt(!Lbl14.Caption) + 1
!Lbl15.Caption = CInt(!Lbl15.Caption) + 1
End With

For i = UBound(dataku) To 1 Step -1
    dataku(i) = dataku(i - 1)
Next i
If lblrpm.Caption = "" Then
    lblrpm.Caption = "0"
End If
If lblrpm.Caption = "0" Then
    dataku(0) = 0
Else
    dataku(0) = CInt(Mid(lblrpm.Caption, 1,
        Len(lblrpm.Caption) - 3))
End If

Call gambarGrafik
End Sub

Private Sub Timer1_Timer()
    txt3.Text = ""
    txt1.Enabled = False
    txt3.Enabled = True

```

```

'Untuk mengirimkan ke motor DC
'-----
MSComm1.Output = Chr(Val(lblSP.Caption))
MSComm1_OnComm

MSComm1.Output = Chr(Val(lblSPVar.Caption))
MSComm1_OnComm

If optkanan.Value = True Then
    MSComm1.Output = "2"
    MSComm1_OnComm
Else
    MSComm1.Output = "1"
    MSComm1_OnComm
End If
'-----

indek = indek + 1

'Untuk Pengiriman Umpan Balik Nilai PWM
'-----

If indek > 3 Then
    lblSPVar.Caption = CInt(Right(lblrpm.Caption, 3))
End If

If Len(lblrpm.Caption) > 2 Then
    Lblrpmasli.Caption = Mid(lblrpm.Caption, 1,
        Len(lblrpm.Caption) - 3)
End If
End Sub

```

'=====PROSEDUR=====

```
Private Sub GrafikAktif()  
FrameLuar.Height = 8730  
FrameLuar.Width = 10110  
cmdExit.Top = 8730  
FrameGrafik.Visible = True  
Me.Height = 9795  
Me.Width = 10620  
cmdgrafik.Enabled = False  
cmdsimpan.Enabled = False  
cmdstop.Enabled = True  
cmdstop.Caption = "&Stop"  
Tim_grafik.Enabled = True  
Tim_label.Enabled = True  
End Sub  
  
Private Sub GrafikNonAktif()  
FrameLuar.Height = 3080  
FrameLuar.Width = 5190  
cmdgrafik.Enabled = True  
cmdExit.Top = 3130  
FrameGrafik.Visible = False  
Tim_label.Enabled = False  
Me.Height = 4125  
Me.Width = 5610  
End Sub
```

```

Private Sub buatgaris()
Dim Y As Integer
Dim lastx As Single
Dim lasty As Single

For Y = 1 To 15
    Set X = FrmKendali.Controls.Add("VB.Line", "Line" &
        Y, pic_grafik)
    Set z = FrmKendali.Controls.Add("VB.label", "Lbl" &
        Y, Picture2)
    If Y = 1 Then
        X.X1 = pic_grafik.ScaleWidth / 15
        X.X2 = X.X1
        X.Y1 = 0
        X.Y2 = pic_grafik.ScaleHeight

        lastx = X.X1
        z.Left = lastx + pic_grafik.Left - 400
    Else
        X.X1 = lastx + (pic_grafik.ScaleWidth / 15)
        X.X2 = X.X1
        X.Y1 = 0
        X.Y2 = pic_grafik.ScaleHeight
        lastx = X.X1
        z.Left = lastx + pic_grafik.Left - 400
    End If

    z.Top = pic_grafik.Height - 50
    z.Caption = Y
    z.AutoSize = True
    z.BackStyle = 0

```

```

        z.ForeColor = vbBlue
        z.Visible = True
        X.BorderColor = vbBlue
        X.BorderStyle = 3
        X.Visible = True
    Next Y

    nilaiY = 0
    For Y = 16 To 25 - 1
        nilaiY = nilaiY + 200
        Set X = FrmKendali.Controls.Add("VB.Line", "Line" &
            Y, pic_grafik)
        Set z = FrmKendali.Controls.Add("VB.label", "L" &
            Y, Picture2)

        If Y = 16 Then
            X.Y1 = pic_grafik.ScaleHeight / 10
            X.Y2 = X.Y1

            X.X1 = 0
            X.X2 = pic_grafik.ScaleWidth

            lasty = X.Y1
            z.Top = lasty + pic_grafik.Top - 350 ' - 50

        Else
            X.Y1 = lasty + pic_grafik.ScaleHeight / 10
            X.Y2 = X.Y1

            X.X1 = 0
            X.X2 = pic_grafik.ScaleWidth
        End If
    Next Y

```

```

        lasty = X.Y1
        z.Top = lasty + pic_grafik.Top - 350 '- 50
    End If

    z.Left = 50
    z.Caption = 2000 - nilaiY '25 - Y
    z.AutoSize = True
    z.BackStyle = 0
    z.ForeColor = vbBlue
    z.Visible = True
    X.BorderColor = vbBlue
    X.BorderStyle = 3
    X.Visible = True
Next Y
End Sub

Private Sub gambarGrafik()
    lastx = pic_grafik.ScaleWidth

    pic_grafik.Cls
    pic_grafik.ForeColor = vbRed
    pic_grafik.AutoRedraw = True
    For i = 0 To UBound(dataku) - 1
        X1 = pic_grafik.ScaleHeight - (dataku(i) / 200 *
            pic_grafik.ScaleHeight / 10)
        Y1 = pic_grafik.ScaleHeight - (dataku(i + 1) / 200
            * pic_grafik.ScaleHeight / 10)

        pic_grafik.Line ((lastx), X1)-((lastx -
            (pic_grafik.ScaleWidth / 15)), Y1)
        lastx = lastx - (pic_grafik.ScaleWidth / 15)
    
```

```
If chkcetak.Value = 1 Then
    pic_grafik.CurrentY = pic_grafik.CurrentY - 200
    pic_grafik.Print Format(dataku(i + 1), "##.##")
End If
Next i
End Sub
```



Lampiran 9 : Foto *Prototype* Sistem Kendali PID untuk Kecepatan Motor DC Berbasis Mikrokontroler ATMega16

