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LAMPIRAN A-FUZZY RULE PROGRAM

```
// ----- LDR -----
#define LDR_1_PIN A0
int Kecerahan_1;
#define LDR_2_PIN A1
int Kecerahan_2;
#define LDR_3_PIN A2
int Kecerahan_3;
#define LDR_4_PIN A3
int Kecerahan_4;
// ----- SERVO -----
#include <Servo.h>
Servo Servo_Atas;
Servo Servo_Bawah;
const int Servo_Atas_PIN = 9;
const int Servo_Bawah_PIN = 10;
int Pos_Servo_Atas;
int Pos_Servo_Bawah;
int K_SA_int;
int K_SB_int;
//----- LCD -----
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
byte Simbol_derajat = B11011111;
LiquidCrystal_I2C lcd(0x27, 16, 2);
//----- RTC DS3231 -----
#include <Wire.h>
#include <SPI.h>
#include "RTClib.h"
RTC_DS3231 RTC;
char daysOfTheWeek[7][12] = {"Sunday", "Monday", "Tuesday",
"Wednesday", " Thursday", "Friday", "Saturday"};
char Nama[30];
char Time_Now[300];
//----- SD CARD -----
#include <SPI.h>
#include <SD.h>
File myFile;
```



```

//Mega:
//MOSI - pin 51,
//MISO - pin 50,
//CLK - pin 52,
//CS - pin 53
const int chipSelect = 53;
unsigned long ulang_baca;
int delay_simpan_data = 1000;

//----- VARIABEL TAMBAHAN
String ServoAtasBawah;
String BacaDataFile;
int Panjang ;
String NamaFile_Buat;
String NamaFile_Buka;
String String_K_SA, String_K_SB;

// ----- MILLIS SENSING -----
unsigned long millis_sm;
unsigned long previousMillis_sm;
const long interval_sm = 1000;
//----- FUZZY -----
#include <Fuzzy.h>
Fuzzy *fuzzy = new Fuzzy();

//-----FUZZY INPUT-----
// FuzzyInput 1
FuzzySet *Gelap_1 = new FuzzySet(0, 0, 30, 50);
FuzzySet *Terang_1 = new FuzzySet(40, 60, 100, 100);
// FuzzyInput 2
FuzzySet *Gelap_2 = new FuzzySet(0, 0, 30, 50);
FuzzySet *Terang_2 = new FuzzySet(40, 60, 100, 100);
// FuzzyInput 3
FuzzySet *Gelap_3 = new FuzzySet(0, 0, 30, 50);
FuzzySet *Terang_3 = new FuzzySet(40, 60, 100, 100);
// FuzzyInput 4
FuzzySet *Gelap_4 = new FuzzySet(0, 0, 30, 50);
FuzzySet *Terang_4 = new FuzzySet(40, 60, 100, 100);
//-----FUZZY OUTPUT-----

```



```

// FuzzyOutput 1
FuzzySet *Diam_Atas = new FuzzySet(0, 0, 0, 0);
FuzzySet *Bergerak_25_Atas = new FuzzySet(15, 25, 25, 35);
FuzzySet *Bergerak_50_Atas = new FuzzySet(40, 50, 50, 60);

// FuzzyOutput 2
FuzzySet *Diam_Bawah = new FuzzySet(0, 0, 0, 0);
FuzzySet *Bergerak_45_Bawah = new FuzzySet(20, 45, 45, 70);
FuzzySet *Bergerak_90_Bawah = new FuzzySet(65, 90, 90, 115);
FuzzySet *Bergerak_135_Bawah = new FuzzySet(110, 135, 135, 160);
FuzzySet *Bergerak_180_Bawah = new FuzzySet(180, 180, 180, 180);

//----- TAB LAIN -----
#include "FuzzySet.h"
#include "FuzzyRule.h"
#include "BuatFile.h"
#include "BukaFile.h"
#include "TampilanLCD.h"

void setup() {
  Serial.begin(115200);
  //----- RULES FUZZY
  fuzzySet ();
  fuzzyRule ();

  // ----- RTC
  RTC.begin();
  //---Aktifkan Program untuk Kalibrasi Mengikuti Waktu di Laptop/PC
  //RTC.adjust(DateTime(F(__DATE__), F(__TIME__)));

  //---Aktifkan Program Untuk Kalibrasi Sesuai Waktu yang Diinginkan
  //RTC.adjust(DateTime(2022,7,20,10,0,0)); //(Tahun, Bulan, Tanggal,
  Jam, Menit, Detik)

  // ----- SDCARD
  pinMode(SS, OUTPUT);
  SD.begin(chipSelect);
  if (!SD.begin(chipSelect)) {
    Serial.println("Memory Tidak Terdeteksi");
  }
}

```



```

}

//----- SERVO
Servo_Atas.attach(Servo_Atas_PIN);
Servo_Bawah.attach(Servo_Bawah_PIN);

//----- LCD
lcd.begin();
lcd.backlight();

delay(1000);
}

void loop() {
    DateTime now = RTC.now();
    Kecerahan_1 = (((analogRead(LDR_1_PIN) / 1023.00) * 100));
    Kecerahan_2 = (((analogRead(LDR_2_PIN) / 1023.00) * 100));
    Kecerahan_3 = (((analogRead(LDR_3_PIN) / 1023.00) * 100));
    Kecerahan_4 = (((analogRead(LDR_4_PIN) / 1023.00) * 100));

    // ----- FUZZY
    fuzzy->setInput(1, Kecerahan_1);
    fuzzy->setInput(2, Kecerahan_2);
    fuzzy->setInput(3, Kecerahan_3);
    fuzzy->setInput(4, Kecerahan_4);
    Pos_Servo_Atas = fuzzy->defuzzify(1);
    Pos_Servo_Bawah = fuzzy->defuzzify(2);

    if (now.hour() >= 8 && now.hour() < 18) { //Dari Jam 8 Sampai 16

        // ----- BUKA FILE UNTUK MANGAMBIL DATA KEMARIN
        if (Kecerahan_1 < 30 && Kecerahan_2 < 30 && Kecerahan_3 < 30
        && Kecerahan_4 < 30) { //JIKA MENDUNG
            Buka_File_Data_Kemarin();

            // ----- EKSEKUSI SERVO KEMARIN
            Servo_Atas.write(K_SA_int);
            Servo_Bawah.write(K_SB_int);
        }
    }
}

```

```

else { //JIKA TIDAK MENDUNG
  // ----- EKSEKUSI SERVO HARI INI
  Servo_Atas.write(Pos_Servo_Atas);
  Servo_Bawah.write(Pos_Servo_Bawah);
}
// ----- BUAT FILE SESUAI JAM DAN MENYIMPAN DATA
Buat_File();
}

// ----- TAMPILKAN DI LCD
Tampilan_LCD();

// ----- SERIAL MONITOR
millis_sm = millis();
if (millis_sm - previousMillis_sm >= interval_sm) {
  previousMillis_sm = millis_sm;
  sprintf( Time_Now, " %02hhu.%02hhu.%02hhu
%02hhu:%02hhu:%02hhu", now.day(), now.month(), now.year(),
now.hour(), now.minute(), now.second() );
//https://forum.arduino.cc/t/converting-rtc-to-string/251388/9
  Serial.println("");
  Serial.print(daysOfTheWeek[now.dayOfTheWeek()]);
  Serial.println(Time_Now);
  Serial.print("Kecerahan 1 : ");
  Serial.println(Kecerahan_1);
  Serial.print("Kecerahan 2 : ");
  Serial.println(Kecerahan_2);
  Serial.print("Kecerahan 3 : ");
  Serial.println(Kecerahan_3);
  Serial.print("Kecerahan 4 : ");
  Serial.println(Kecerahan_4);
  Serial.print("Servo Atas : ");
  Serial.println(Pos_Servo_Atas);
  Serial.print("Servo Bawah : ");
  Serial.println(Pos_Servo_Bawah);
}

```



```

    if (Kecerahan_1 < 30 && Kecerahan_2 < 30 && Kecerahan_3 < 30
    && Kecerahan_4 < 30) {
        Serial.print("\nKeadaan Mendung ---> Mengambil Data
Kemarin\n");
        Serial.print("\tFile yg dibuka : ");
        Serial.print>NamaFile_Buka);
        Serial.print(" ---> ");
        Serial.println(BacaDataFile);
        Serial.print("\tServo Atas Kemarin: "); Serial.println(K_SA_int);
        Serial.print("\tServo Bawah Kemarin: "); Serial.println(K_SB_int);
        Serial.println("\n-----");
    }
    else {
        if (now.second() != 01) {
            Serial.println("\n-----");
        }
    }
}
}
}
}

```


LAMPIRAN B-PROGRAM MEMBUAT FILE

```
void Buat_File () {
//=====SIMPAN DATA SD CARD PER SEKIAN WAKTU =====
  unsigned long currentMillis = millis();
  DateTime now = RTC.now();
  sprintf( Nama, "%02hhu%02hhu", now.hour(), now.minute() );
  String ServoAtasBawah = String(Pos_Servo_Atas) + ";" +
String(Pos_Servo_Bawah) ;

  if (now.second() == 01) {
    if (currentMillis - ulang_baca >= delay_simpan_data) {
      NamaFile_Buat = (String>Nama);
      SD.remove>NamaFile_Buat + ".txt");
      myFile = SD.open>NamaFile_Buat + ".txt", FILE_WRITE);
      (! myFile) ? Serial.println("\n\tError Buat File") :
Serial.println("\n\tBerhasil Buat File");

      Serial.print("\tFile yg dibuat: ");
      Serial.print>NamaFile_Buat);
      Serial.print(" ----> ");
      Serial.println>ServoAtasBawah);
      myFile.print>ServoAtasBawah);
      Serial.println("\n-----");

      myFile.close();
      ulang_baca = currentMillis;
    }
  }
}
```


LAMPIRAN C-PROGRAM MEMBUKA FILE KEMARIN

```
void Buka_File_Data_Kemarin () {
    DateTime now = RTC.now();
    sprintf( Nama, "%02hhu%02hhu", now.hour(), now.minute() );
   >NamaFile_Buka = (String>Nama);

    if (now.second() == 00) {
        File myFile = SD.open>NamaFile_Buka + ".txt");
       >BacaDataFile = myFile.readString();

        Index = BacaDataFile.lastIndexOf(';');
       >Panjang = BacaDataFile.length();

        String_K_SA = BacaDataFile.substring(0, Index);
       >K_SA_int = String_K_SA.toInt();

        String_K_SB = BacaDataFile.substring(Index + 1, Panjang);
       >K_SB_int = String_K_SB.toInt();

        //https://dronebotworkshop.com/sd-card-arduino/
        myFile.close();
    }
}
```


LAMPIRAN D-FUZZY RULE 16 SET

```
void fuzzyRule () {
//-----1
FuzzyRuleAntecedent *GL_1_GL_2_1 = new FuzzyRuleAntecedent();
GL_1_GL_2_1 ->joinWithAND(Gelap_1, Gelap_2);
FuzzyRuleAntecedent *GL_3_GL_4_1 = new FuzzyRuleAntecedent();
GL_3_GL_4_1 ->joinWithAND(Gelap_3, Gelap_4);
FuzzyRuleAntecedent *GL_1_GL_2_1_GL_3_GL_4_1 = new
FuzzyRuleAntecedent();
GL_1_GL_2_1_GL_3_GL_4_1 ->joinWithAND(GL_1_GL_2_1,
GL_3_GL_4_1);

FuzzyRuleConsequent *Ber_25_A_D_B_1 = new
FuzzyRuleConsequent();
Ber_25_A_D_B_1->addOutput(Bergerak_25_Atas);
Ber_25_A_D_B_1->addOutput(Diam_Bawah);
FuzzyRule *fuzzyRule1 = new FuzzyRule(1,
GL_1_GL_2_1_GL_3_GL_4_1, Ber_25_A_D_B_1);
fuzzy->addFuzzyRule(fuzzyRule1);

//-----2
FuzzyRuleAntecedent *GL_1_GL_2_2 = new FuzzyRuleAntecedent();
GL_1_GL_2_2 ->joinWithAND(Gelap_1, Gelap_2);
FuzzyRuleAntecedent *GL_3_TR_4_2 = new FuzzyRuleAntecedent();
GL_3_TR_4_2 ->joinWithAND(Gelap_3, Terang_4);
FuzzyRuleAntecedent *GL_1_GL_2_2_GL_3_TR_4_2 = new
FuzzyRuleAntecedent();
GL_1_GL_2_2_GL_3_TR_4_2 ->joinWithAND(GL_1_GL_2_2,
GL_3_TR_4_2);

FuzzyRuleConsequent *Ber_50_A_Ber_45_B_2 = new
FuzzyRuleConsequent();
Ber_50_A_Ber_45_B_2->addOutput(Bergerak_50_Atas);
Ber_50_A_Ber_45_B_2->addOutput(Bergerak_45_Bawah);
FuzzyRule *fuzzyRule2 = new FuzzyRule(2,
GL_1_GL_2_2_GL_3_TR_4_2, Ber_50_A_Ber_45_B_2);
fuzzy->addFuzzyRule(fuzzyRule2);
```

```

//-----3
FuzzyRuleAntecedent *GL_1_GL_2_3 = new FuzzyRuleAntecedent();
GL_1_GL_2_3 ->joinWithAND(Gelap_1, Gelap_2);
FuzzyRuleAntecedent *TR_3_GL_4_3 = new FuzzyRuleAntecedent();
TR_3_GL_4_3 ->joinWithAND(Terang_3, Gelap_4);
FuzzyRuleAntecedent *GL_1_GL_2_3_TR_3_GL_4_3 = new
FuzzyRuleAntecedent();
GL_1_GL_2_3_TR_3_GL_4_3 ->joinWithAND(GL_1_GL_2_3,
TR_3_GL_4_3);

FuzzyRuleConsequent *D_A_Ber_135_B_3 = new
FuzzyRuleConsequent();
D_A_Ber_135_B_3->addOutput(Diam_Atas);
D_A_Ber_135_B_3->addOutput(Bergerak_135_Bawah);
FuzzyRule *fuzzyRule3 = new FuzzyRule(3,
GL_1_GL_2_3_TR_3_GL_4_3, D_A_Ber_135_B_3);
fuzzy->addFuzzyRule(fuzzyRule3);

//-----4
FuzzyRuleAntecedent *GL_1_GL_2_4 = new FuzzyRuleAntecedent();
GL_1_GL_2_4 ->joinWithAND(Gelap_1, Gelap_2);
FuzzyRuleAntecedent *TR_3_TR_4_4 = new FuzzyRuleAntecedent();
TR_3_TR_4_4 ->joinWithAND(Terang_3, Terang_4);
FuzzyRuleAntecedent *GL_1_GL_2_4_TR_3_TR_4_4 = new
FuzzyRuleAntecedent();
GL_1_GL_2_4_TR_3_TR_4_4 ->joinWithAND(GL_1_GL_2_4,
TR_3_TR_4_4);

FuzzyRuleConsequent *Ber_50_A_D_B_4 = new
FuzzyRuleConsequent();
Ber_50_A_D_B_4->addOutput(Bergerak_50_Atas);
Ber_50_A_D_B_4->addOutput(Diam_Bawah);
FuzzyRule *fuzzyRule4 = new FuzzyRule(4,
GL_1_GL_2_4_TR_3_TR_4_4, Ber_50_A_D_B_4);
fuzzy->addFuzzyRule(fuzzyRule4);

//-----5
FuzzyRuleAntecedent *GL_1_TR_2_5 = new FuzzyRuleAntecedent();

```

```

GL_1_TR_2_5 ->joinWithAND(Gelap_1, Terang_2);
FuzzyRuleAntecedent *GL_3_GL_4_5 = new FuzzyRuleAntecedent();
GL_3_GL_4_5 ->joinWithAND(Gelap_3, Gelap_4);
FuzzyRuleAntecedent *GL_1_TR_2_5_GL_3_GL_4_5 = new
FuzzyRuleAntecedent();
GL_1_TR_2_5_GL_3_GL_4_5 ->joinWithAND(GL_1_TR_2_5,
GL_3_GL_4_5);

```

```

FuzzyRuleConsequent *Ber_50_A_Ber_135_B_5 = new
FuzzyRuleConsequent();
Ber_50_A_Ber_135_B_5->addOutput(Bergerak_50_Atas);
Ber_50_A_Ber_135_B_5->addOutput(Bergerak_135_Bawah);
FuzzyRule *fuzzyRule5 = new FuzzyRule(5,
GL_1_TR_2_5_GL_3_GL_4_5, Ber_50_A_Ber_135_B_5);
fuzzy->addFuzzyRule(fuzzyRule5);

```

//-----6

```

FuzzyRuleAntecedent *GL_1_TR_2_6 = new FuzzyRuleAntecedent();
GL_1_TR_2_6 ->joinWithAND(Gelap_1, Terang_2);
FuzzyRuleAntecedent *GL_3_TR_4_6 = new FuzzyRuleAntecedent();
GL_3_TR_4_6 ->joinWithAND(Gelap_3, Terang_4);
FuzzyRuleAntecedent *GL_1_TR_2_6_GL_3_TR_4_6 = new
FuzzyRuleAntecedent();
GL_1_TR_2_6_GL_3_TR_4_6 ->joinWithAND(GL_1_TR_2_6,
GL_3_TR_4_6);

```

```

FuzzyRuleConsequent *Ber_50_A_Ber_90_B_6 = new
FuzzyRuleConsequent();
Ber_50_A_Ber_90_B_6->addOutput(Bergerak_50_Atas);
Ber_50_A_Ber_90_B_6->addOutput(Bergerak_90_Bawah);
FuzzyRule *fuzzyRule6 = new FuzzyRule(6,
GL_1_TR_2_6_GL_3_TR_4_6, Ber_50_A_Ber_90_B_6);
fuzzy->addFuzzyRule(fuzzyRule6);

```

//-----7

```

FuzzyRuleAntecedent *GL_1_TR_2_7 = new FuzzyRuleAntecedent();
GL_1_TR_2_7 ->joinWithAND(Gelap_1, Terang_2);

```



```

FuzzyRuleAntecedent *TR_3_GL_4_7 = new FuzzyRuleAntecedent();
TR_3_GL_4_7 ->joinWithAND(Terang_3, Gelap_4);
FuzzyRuleAntecedent *GL_1_TR_2_7_TR_3_GL_4_7 = new
FuzzyRuleAntecedent();
GL_1_TR_2_7_TR_3_GL_4_7 ->joinWithAND(GL_1_TR_2_7,
TR_3_GL_4_7);

```

```

FuzzyRuleConsequent *Ber_25_A_Ber_135_B_7 = new
FuzzyRuleConsequent();
Ber_25_A_Ber_135_B_7->addOutput(Bergerak_25_Atas);
Ber_25_A_Ber_135_B_7->addOutput(Bergerak_135_Bawah);
FuzzyRule *fuzzyRule7 = new FuzzyRule(7,
GL_1_TR_2_7_TR_3_GL_4_7, Ber_25_A_Ber_135_B_7);
fuzzy->addFuzzyRule(fuzzyRule7);

```

```
//-----8
```

```

FuzzyRuleAntecedent *GL_1_TR_2_8 = new FuzzyRuleAntecedent();
GL_1_TR_2_8 ->joinWithAND(Gelap_1, Terang_2);
FuzzyRuleAntecedent *TR_3_TR_4_8 = new FuzzyRuleAntecedent();
TR_3_TR_4_8 ->joinWithAND(Terang_3, Terang_4);
FuzzyRuleAntecedent *GL_1_TR_2_8_TR_3_TR_4_8 = new
FuzzyRuleAntecedent();
GL_1_TR_2_8_TR_3_TR_4_8 ->joinWithAND(GL_1_TR_2_8,
TR_3_TR_4_8);

```

```

FuzzyRuleConsequent *Ber_50_A_Ber_45_B_8 = new
FuzzyRuleConsequent();
Ber_50_A_Ber_45_B_8->addOutput(Bergerak_50_Atas);
Ber_50_A_Ber_45_B_8->addOutput(Bergerak_45_Bawah);
FuzzyRule *fuzzyRule8 = new FuzzyRule(8,
GL_1_TR_2_8_TR_3_TR_4_8, Ber_50_A_Ber_45_B_8);
fuzzy->addFuzzyRule(fuzzyRule8);

```

```
//-----9
```

```

FuzzyRuleAntecedent *TR_1_GL_2_9 = new FuzzyRuleAntecedent();
TR_1_GL_2_9 ->joinWithAND(Terang_1, Gelap_2);
FuzzyRuleAntecedent *GL_3_GL_4_9 = new FuzzyRuleAntecedent();
GL_3_GL_4_9 ->joinWithAND(Gelap_3, Gelap_4);

```



```

FuzzyRuleAntecedent *TR_1_GL_2_9_GL_3_GL_4_9 = new
FuzzyRuleAntecedent();
  TR_1_GL_2_9_GL_3_GL_4_9 ->joinWithAND(TR_1_GL_2_9,
GL_3_GL_4_9);

  FuzzyRuleConsequent *D_A_Ber_45_B_9 = new
FuzzyRuleConsequent();
  D_A_Ber_45_B_9->addOutput(Diam_Atas);
  D_A_Ber_45_B_9->addOutput(Bergerak_45_Bawah);
  FuzzyRule *fuzzyRule9 = new FuzzyRule(9,
TR_1_GL_2_9_GL_3_GL_4_9, D_A_Ber_45_B_9);
  fuzzy->addFuzzyRule(fuzzyRule9);

//-----10
  FuzzyRuleAntecedent *TR_1_GL_2_10 = new
FuzzyRuleAntecedent();
  TR_1_GL_2_10 ->joinWithAND(Terang_1, Gelap_2);
  FuzzyRuleAntecedent *GL_3_TR_4_10 = new
FuzzyRuleAntecedent();
  GL_3_TR_4_10 ->joinWithAND(Gelap_3, Terang_4);
  FuzzyRuleAntecedent *TR_1_GL_2_10_GL_3_TR_4_10 = new
FuzzyRuleAntecedent();
  TR_1_GL_2_10_GL_3_TR_4_10 ->joinWithAND(TR_1_GL_2_10,
GL_3_TR_4_10);

  FuzzyRuleConsequent *Ber_25_A_Ber_45_B_10 = new
FuzzyRuleConsequent();
  Ber_25_A_Ber_45_B_10->addOutput(Bergerak_25_Atas);
  Ber_25_A_Ber_45_B_10->addOutput(Bergerak_45_Bawah);
  FuzzyRule *fuzzyRule10 = new FuzzyRule(10,
TR_1_GL_2_10_GL_3_TR_4_10, Ber_25_A_Ber_45_B_10);
  fuzzy->addFuzzyRule(fuzzyRule10);

//-----11
  FuzzyRuleAntecedent *TR_1_GL_2_11 = new
FuzzyRuleAntecedent();
  TR_1_GL_2_11 ->joinWithAND(Terang_1, Gelap_2);
  FuzzyRuleAntecedent *TR_3_GL_4_11 = new
FuzzyRuleAntecedent();

```



```

TR_3_GL_4_11 ->joinWithAND(Terang_3, Gelap_4);
FuzzyRuleAntecedent *TR_1_GL_2_11_TR_3_GL_4_11 = new
FuzzyRuleAntecedent();
TR_1_GL_2_11_TR_3_GL_4_11 ->joinWithAND(TR_1_GL_2_11,
TR_3_GL_4_11);

```

```

FuzzyRuleConsequent *D_A_Ber_90_B_11 = new
FuzzyRuleConsequent();
D_A_Ber_90_B_11->addOutput(Diam_Atas);
D_A_Ber_90_B_11->addOutput(Bergerak_90_Bawah);
FuzzyRule *fuzzyRule11 = new FuzzyRule(11,
TR_1_GL_2_11_TR_3_GL_4_11, D_A_Ber_90_B_11);
fuzzy->addFuzzyRule(fuzzyRule11);

```

```

//-----12
FuzzyRuleAntecedent *TR_1_GL_2_12 = new
FuzzyRuleAntecedent();
TR_1_GL_2_12 ->joinWithAND(Terang_1, Gelap_2);
FuzzyRuleAntecedent *TR_3_TR_4_12 = new
FuzzyRuleAntecedent();
TR_3_TR_4_12 ->joinWithAND(Terang_3, Terang_4);
FuzzyRuleAntecedent *TR_1_GL_2_12_TR_3_TR_4_12 = new
FuzzyRuleAntecedent();
TR_1_GL_2_12_TR_3_TR_4_12 ->joinWithAND(TR_1_GL_2_12,
TR_3_TR_4_12);

```

```

FuzzyRuleConsequent *D_A_Ber_135_B_12 = new
FuzzyRuleConsequent();
D_A_Ber_135_B_12->addOutput(Diam_Atas);
D_A_Ber_135_B_12->addOutput(Bergerak_135_Bawah);
FuzzyRule *fuzzyRule12 = new FuzzyRule(12,
TR_1_GL_2_12_TR_3_TR_4_12, D_A_Ber_135_B_12);
fuzzy->addFuzzyRule(fuzzyRule12);

```

```

//-----13
FuzzyRuleAntecedent *TR_1_TR_2_13 = new
FuzzyRuleAntecedent();
TR_1_TR_2_13 ->joinWithAND(Terang_1, Terang_2);

```

```

FuzzyRuleAntecedent *GL_3_GL_4_13 = new
FuzzyRuleAntecedent();
GL_3_GL_4_13 ->joinWithAND(Gelap_3, Gelap_4);
FuzzyRuleAntecedent *TR_1_TR_2_13_GL_3_GL_4_13 = new
FuzzyRuleAntecedent();
TR_1_TR_2_13_GL_3_GL_4_13 ->joinWithAND(TR_1_TR_2_13,
GL_3_GL_4_13);

```

```

FuzzyRuleConsequent *D_A_Ber_180_B_13 = new
FuzzyRuleConsequent();
D_A_Ber_180_B_13->addOutput(Diam_Atas);
D_A_Ber_180_B_13->addOutput(Bergerak_180_Bawah);
FuzzyRule *fuzzyRule13 = new FuzzyRule(13,
TR_1_TR_2_13_GL_3_GL_4_13, D_A_Ber_180_B_13);
fuzzy->addFuzzyRule(fuzzyRule13);

```

```
//-----14
```

```

FuzzyRuleAntecedent *TR_1_TR_2_14 = new
FuzzyRuleAntecedent();
TR_1_TR_2_14 ->joinWithAND(Terang_1, Terang_2);
FuzzyRuleAntecedent *GL_3_TR_4_14 = new
FuzzyRuleAntecedent();
GL_3_TR_4_14 ->joinWithAND(Gelap_3, Terang_4);
FuzzyRuleAntecedent *TR_1_TR_2_14_GL_3_TR_4_14 = new
FuzzyRuleAntecedent();
TR_1_TR_2_14_GL_3_TR_4_14 ->joinWithAND(TR_1_TR_2_14,
GL_3_TR_4_14);

```

```

FuzzyRuleConsequent *Ber_50_A_Ber_135_B_14 = new
FuzzyRuleConsequent();
Ber_50_A_Ber_135_B_14->addOutput(Bergerak_50_Atas);
Ber_50_A_Ber_135_B_14->addOutput(Bergerak_135_Bawah);
FuzzyRule *fuzzyRule14 = new FuzzyRule(14,
TR_1_TR_2_14_GL_3_TR_4_14, Ber_50_A_Ber_135_B_14);
fuzzy->addFuzzyRule(fuzzyRule14);

```

```
//-----15
```

```

FuzzyRuleAntecedent *TR_1_TR_2_15 = new
FuzzyRuleAntecedent();

```

```

TR_1_TR_2_15 ->joinWithAND(Terang_1, Terang_2);
FuzzyRuleAntecedent *TR_3_GL_4_15 = new
FuzzyRuleAntecedent();
TR_3_GL_4_15 ->joinWithAND(Terang_3, Gelap_4);
FuzzyRuleAntecedent *TR_1_TR_2_15_TR_3_GL_4_15 = new
FuzzyRuleAntecedent();
TR_1_TR_2_15_TR_3_GL_4_15 ->joinWithAND(TR_1_TR_2_15,
TR_3_GL_4_15);

FuzzyRuleConsequent *D_A_Ber_45_B_15 = new
FuzzyRuleConsequent();
D_A_Ber_45_B_15->addOutput(Diam_Atas);
D_A_Ber_45_B_15->addOutput(Bergerak_45_Bawah);
FuzzyRule *fuzzyRule15 = new FuzzyRule(15,
TR_1_TR_2_15_TR_3_GL_4_15, D_A_Ber_45_B_15);
fuzzy->addFuzzyRule(fuzzyRule15);

//-----16
FuzzyRuleAntecedent *TR_1_TR_2_16 = new
FuzzyRuleAntecedent();
TR_1_TR_2_16 ->joinWithAND(Terang_1, Terang_2);
FuzzyRuleAntecedent *TR_3_TR_4_16 = new
FuzzyRuleAntecedent();
TR_3_TR_4_16 ->joinWithAND(Terang_3, Terang_4);
FuzzyRuleAntecedent *TR_1_TR_2_16_TR_3_TR_4_16 = new
FuzzyRuleAntecedent();
TR_1_TR_2_16_TR_3_TR_4_16 ->joinWithAND(TR_1_TR_2_16,
TR_3_TR_4_16);

FuzzyRuleConsequent *Ber_25_A_D_B_16 = new
FuzzyRuleConsequent();
Ber_25_A_D_B_16->addOutput(Bergerak_25_Atas);
Ber_25_A_D_B_16->addOutput(Diam_Bawah);
FuzzyRule *fuzzyRule16 = new FuzzyRule(16,
TR_1_TR_2_16_TR_3_TR_4_16, Ber_25_A_D_B_16);
fuzzy->addFuzzyRule(fuzzyRule16);
}

```

LAMPIRAN E-PRGRAM FUZZY INPUT DAN OUTPUT

```
void fuzzySet () {
    FuzzyInput *LDR_1_IN = new FuzzyInput(1);
    LDR_1_IN->addFuzzySet(Gelap_1);
    LDR_1_IN->addFuzzySet(Terang_1);
    fuzzy->addFuzzyInput(LDR_1_IN);

    FuzzyInput * LDR_2_IN = new FuzzyInput(2);
    LDR_2_IN->addFuzzySet(Gelap_2);
    LDR_2_IN->addFuzzySet(Terang_2);
    fuzzy->addFuzzyInput( LDR_2_IN);

    FuzzyInput *LDR_3_IN = new FuzzyInput(3);
    LDR_3_IN->addFuzzySet(Gelap_3);
    LDR_3_IN->addFuzzySet(Terang_3);
    fuzzy->addFuzzyInput(LDR_3_IN);

    FuzzyInput *LDR_4_IN = new FuzzyInput(4);
    LDR_4_IN->addFuzzySet(Gelap_4);
    LDR_4_IN->addFuzzySet(Terang_4);
    fuzzy->addFuzzyInput(LDR_4_IN);

    FuzzyOutput *Servo_Atas_OUT = new FuzzyOutput(1);
    Servo_Atas_OUT->addFuzzySet(Diam_Atas);
    Servo_Atas_OUT->addFuzzySet(Bergerak_25_Atas);
    Servo_Atas_OUT->addFuzzySet(Bergerak_50_Atas);
    fuzzy->addFuzzyOutput(Servo_Atas_OUT);

    FuzzyOutput *Servo_Bawah_OUT = new FuzzyOutput(2);
    Servo_Bawah_OUT->addFuzzySet(Diam_Bawah);
    Servo_Bawah_OUT->addFuzzySet(Bergerak_45_Bawah);
    Servo_Bawah_OUT->addFuzzySet(Bergerak_90_Bawah);
    Servo_Bawah_OUT->addFuzzySet(Bergerak_135_Bawah);
    Servo_Bawah_OUT->addFuzzySet(Bergerak_180_Bawah);
    fuzzy->addFuzzyOutput(Servo_Bawah_OUT);
}
```


LAMPIRAN F-PROGRAM RTC DAN SD CARD

```
void sdcard () {
//===== SIMPAN DATA SD CARD PER SEKIAN WAKTU =====
  unsigned long currentMillis = millis();
  DateTime now = RTC.now();

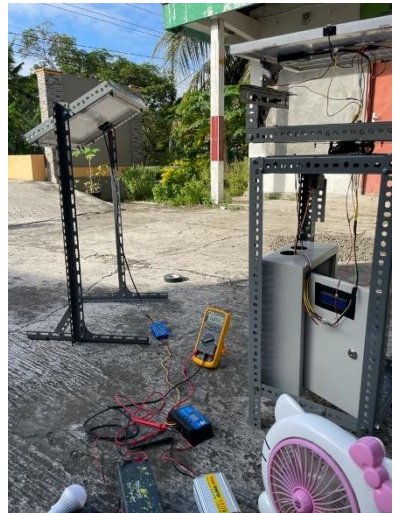
  // if (currentMillis - ulang_baca > delay_simpan_data) {
  myFile = SD.open("Cost.txt", FILE_WRITE);
  // if (myFile) {
  //   // Serial.println("SD card OK");
  //   // Hari
  //   myFile.print(daysOfTheWeek[now.dayOfTheWeek()]);
  //   myFile.print(",");
  //
  //   // tanggal bulan tahun
  //   myFile.print(now.day(), DEC);
  //   myFile.print(".");
  //   myFile.print(now.month(), DEC);
  //   myFile.print(".");
  //   myFile.print(now.year(), DEC);
  //
  //   //PEMISAH
  //   myFile.print(";");
  //
  //   // Jam Menit Detik
  //   if (now.hour() < 10) {
  //     myFile.print("0");
  //   }
  //   myFile.print(now.hour(), DEC);
  //   myFile.print(":");
  //   if (now.minute() < 10) {
  //     myFile.print("0");
  //   }
  //   myFile.print(now.minute(), DEC);
  //   myFile.print(":");
  //   if (now.second() < 10) {
  //     myFile.print("0");
  //   }
  // }
```

```
// myFile.print(now.second(), DEC);
//
// //PEMISAH
// myFile.print(";");
//
// myFile.print(energy, 3); // 5 ANGKA DI BELAKANG KOMA
//
// //PEMISAH
// myFile.print(";");
//
// myFile.println(cost, 3); // 3 ANGKA DI BELAKANG KOMA
// myFile.close();
// }
// ulang_baca = currentMillis;
// }
}
```

LAMPIRAN G- PROGRAM TAMPILAN LCD

```
void Tampilan_LCD() {  
  //-----LCD  
  lcd.setCursor(0, 0);  
  lcd.print(Kecerahan_1);  
  lcd.print("% ");  
  lcd.setCursor(6, 0);  
  lcd.print(Kecerahan_2);  
  lcd.print("% ");  
  lcd.setCursor(0, 1);  
  lcd.print(Kecerahan_3);  
  lcd.print("% ");  
  lcd.setCursor(6, 1);  
  lcd.print(Kecerahan_4);  
  lcd.print("% ");  
  
  lcd.setCursor(12, 0);  
  lcd.print(Pos_Servo_Atas);  
  lcd.write(Simbol_derajat);  
  lcd.setCursor(12, 1);  
  lcd.print(Pos_Servo_Bawah);  
  lcd.write(Simbol_derajat);  
}
```


LAMPIRAN H- DOKUMENTASI PEMBUATAN ALAT



BIODATA PENULIS



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pribadi yang ulet. Nanti orang lain gatal-
gatal.

Riwayat Pendidikan

SD : SD Negeri Kalisabuk 03
SMP : SMP Negeri 2 Kesugihan
SMA : SMA Negeri 1 Sampang
Politeknik / Univ : Politeknik Negeri Cilacap
Pengalaman Magang : CV. Radesma Technologies Semarang