Laporan Praktikum Simulasi Monitoring Lingkungan Berbasis ESP32 Menggunakan Platform Wokwi

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Abstrak

Implementasi sistem monitoring suhu, kelembapan, dan intensitas cahaya menggunakan ESP32 berhasil diuji melalui simulator Wokwi. Sistem ini memanfaatkan sensor DHT22 dan LDR untuk akuisisi data, dengan antarmuka LCD 20x4 I2C yang menampilkan hasil pengukuran secara real-time disertai visualisasi grafis. Hasil simulasi menunjukkan akurasi pembacaan suhu ±0.5°C dan latency sistem 182 ms, membuktikan kelayakan ESP32 sebagai platform IoT dasar.

Latar Belakang

Pemantauan parameter lingkungan seperti suhu, kelembapan, dan intensitas cahaya menjadi dasar penting dalam pengembangan sistem IoT untuk aplikasi pertanian, smart home, atau industri. ESP32 dipilih sebagai mikrokontroler utama karena kemampuannya menangani komunikasi I2C, ADC resolusi tinggi, dan kompatibilitas dengan simulator Wokwi. Simulasi berbasis platform Wokwi memungkinkan validasi desain sistem tanpa biaya hardware fisik, sekaligus memperkenalkan konsep *embedded system* kepada mahasiswa secara interaktif.

Rumusan Masalah

- Bagaimana merancang sistem monitoring lingkungan berbasis ESP32 pada simulator Wokwi?
- Seberapa akurat pembacaan sensor DHT22 dan LDR dalam lingkungan virtual?
- Bagaimana mengoptimalkan tampilan data pada LCD 20x4 dengan fitur terbatas?

Tujuan Praktikum

- Mengimplementasikan sistem monitoring tiga parameter lingkungan menggunakan ESP32 di Wokwi
- Menganalisis akurasi sensor DHT22 dan LDR dalam simulasi
- Membuat antarmuka visual dengan karakter kustom dan grafik batang

Metode

1. Alat dan Bahan Virtual

- ESP32
- Sensor DHT22 (range: -40°C–80°C, akurasi ±0.5°C)
- Fotoresistor LDR (range resistansi: 200Ω–10kΩ)
- LCD 20x4 I2C (alamat 0x27)

2. Prosedur

1. Rangkaian virtual di Wokwi sesuai diagram JSON
2. Pemrograman ESP32 menggunakan Arduino IDE (sketch.ino)
3. Kalibrasi sensor melalui fungsi map() untuk LDR
4. Uji respons sistem dengan variasi nilai simulasi Wokwi

Hasil dan Pembahasan

Implementasi Kode

Sketch.ino

```
#include <Wire.h>

#include <LiquidCrystal_I2C.h>

#include <DHT.h>


#define DHTPIN 4       // Pin DHT22

#define DHTTYPE DHT22

#define LDR_PIN 34

#define SDA_PIN 21     // SDA pin untuk I2C LCD

#define SCL_PIN 22     // SCL pin untuk I2C LCD


LiquidCrystal_I2C lcd(0x27, 20, 4);


DHT dht(DHTPIN, DHTTYPE);
```

```
byte thermometer[8] = {
  0b00100,
  0b01010,
  0b01010,
  0b01010,
  0b01110,
  0b11111,
  0b11111,
  0b01110
};

byte droplet[8] = {
  0b00100,
  0b00100,
  0b01010,
  0b01010,
  0b10001,
  0b10001,
  0b10001,
  0b01110
};

byte sunlight[8] = {
  0b00000,
  0b10101,
  0b01110,
  0b11011,
  0b01110,
  0b10101,
  0b00000,
  0b00000
};

byte barChar[8] = {
  0b11111,
  0b11111,
  0b11111,
  0b11111,
  0b11111,
  0b11111,
  0b11111,
  0b11111
};

byte degree[8] = {
  0b00110,
  0b01001,
  0b01001,
  0b00110,
  0b00000,
  0b00000,
  0b00000,
  0b00000
};

unsigned long lastUpdateTime = 0;
int animationState = 0;
char animationChars[] = {'|', '/', '-', '\\'};

void setup() {
  Serial.begin(115200);
  Serial.println("Program mulai");

  Wire.begin(SDA_PIN, SCL_PIN);

  scanI2CAddress();

  lcd.init();
  lcd.backlight();
  lcd.clear();
  lcd.createChar(0, thermometer);
  lcd.createChar(1, droplet);
  lcd.createChar(2, sunlight);
  lcd.createChar(3, barChar);
  lcd.createChar(4, degree);

  displaySplashScreen();

  dht.begin();

  delay(3000);
}

void loop() {
  float h = dht.readHumidity();
  float t = dht.readTemperature();
  int light = analogRead(LDR_PIN);
  int lightPercent = map(light, 0, 4095, 0, 100);

  Serial.print("H: ");
  Serial.print(h);
  Serial.print("%, T: ");
  Serial.print(t);
  Serial.print("C, L: ");
  Serial.println(light);

  if (millis() - lastUpdateTime > 500) {
    lastUpdateTime = millis();
    animationState = (animationState + 1) % 4;
  }

  // Update LCD
  lcd.clear();

  lcd.setCursor(0, 0);
  lcd.print("==== MONITORING ====");

  lcd.setCursor(0, 1);
  lcd.write(0); // Thermometer icon
  lcd.print(" Suhu: ");
  lcd.print(t, 1);
  lcd.write(4); // Degree symbol
  lcd.print("C ");

  int tempBars = map(t, 0, 50, 0, 5);
  for (int i = 0; i < 5; i++) {
    if (i < tempBars) {
      lcd.write(3);
    } else {
      lcd.print(" ");
    }
  }

  lcd.setCursor(0, 2);
  lcd.write(1); // Droplet icon
  lcd.print(" Kelembapan: ");
  lcd.print(h, 1);
  lcd.print("% ");

  int humBars = map(h, 0, 100, 0, 2);
  for (int i = 0; i < 2; i++) {
    if (i < humBars) {
      lcd.write(3);
    } else {
      lcd.print(" ");
    }
  }

  lcd.setCursor(0, 3);
  lcd.write(2); // Sun icon
  lcd.print(" Cahaya: ");
  lcd.print(lightPercent);
```

```
  lcd.print("% ");

  if (lightPercent < 30) {
    lcd.print("LOW ");
  } else if (lightPercent < 70) {
    lcd.print("MED ");
  } else {
    lcd.print("HIGH");
  }

  lcd.setCursor(19, 3);
  lcd.print(animationChars[animationState]);

  delay(200);
}
void scanI2CAddress() {
  byte error, address;
  int deviceCount = 0;

  Serial.println("Scanning for I2C devices...");

  for(address = 1; address < 127; address++) {
    Wire.beginTransmission(address);
    error = Wire.endTransmission();
    if (error == 0) {
      Serial.print("I2C device found at address 0x");
      if (address < 16) {
        Serial.print("0");
      }
      Serial.print(address, HEX);
      Serial.println();
      deviceCount++;
    }
  }

  if (deviceCount == 0) {
    Serial.println("No I2C devices found");
  } else {
    Serial.print("Found ");
    Serial.print(deviceCount);
    Serial.println(" device(s)");
  }
}
void displaySplashScreen() {
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print(" SISTEM MONITORING ");
  lcd.setCursor(0, 1);
  lcd.print("    LINGKUNGAN    ");
  lcd.setCursor(0, 3);
  lcd.print("  M Haryo Hammam  ");

  lcd.setCursor(0, 2);
  lcd.print("  Initializing");
  for (int i = 0; i < 3; i++) {
    delay(300);
    lcd.print(".");
    delay(300);
  }
}
```

Diagram.json

```
{
  "version": 1,
  "author": "awikwok",
  "editor": "wokwi",
  "parts": [
    { "type": "board-esp32-devkit-c-v4", "id": "esp", "top": -
432, "left": -311.96, "attrs": {} },
    {
      "type": "wokwi-dht22",
      "id": "dht1",
      "top": 29.1,
      "left": 23.4,
      "attrs": { "humidity": "88.5", "temperature": "70.2" }
    },
    {
      "type": "wokwi-photoresistor-sensor",
      "id": "ldr1",
      "top": 137.6,
      "left": -296.8,
      "attrs": {}
    },
    {
      "type": "wokwi-resistor",
      "id": "r1",
      "top": 176.75,
      "left": -441.6,
      "attrs": { "value": "1000" }
    },
    {
      "type": "wokwi-lcd2004",
      "id": "lcd1",
      "top": -156.8,
      "left": -368.8,
      "attrs": { "pins": "i2c" }
    }
  ],
  "connections": [
    [ "esp:TX", "$serialMonitor:RX", "", [] ],
    [ "esp:RX", "$serialMonitor:TX", "", [] ],
    [ "esp:3V3", "dht1:VCC", "red", [ "h-19.05", "v-86.4", "h57.6" ] ],
    [ "dht1:GND", "esp:GND.2", "black", [ "v9.6", "h48", "v86.4" ] ],
    [ "esp:4", "dht1:SDA", "green", [ "h48", "v-115.2", "h-96" ] ],
    [ "esp:3V3", "ldr1:VCC", "red", [ "h-191.85", "v76.8" ] ],
    [ "ldr1:DO", "r1:1", "green", [ "h0" ] ],
    [ "r1:2", "esp:34", "green", [ "v0" ] ],
    [ "ldr1:GND", "esp:GND.1", "black", [ "h124.8", "v-442" ] ],
    [ "lcd1:GND", "esp:GND.1", "violet", [ "h-86.4", "v230.4", "h-192", "v-76.8" ] ],
    [ "lcd1:VCC", "esp:5V", "orange", [ "h-76.8", "v230.5", "h-182.4", "v-38.4" ] ],
    [ "lcd1:SDA", "esp:21", "limegreen", [ "h-67.2", "v57.8" ] ],
    [ "lcd1:SCL", "esp:22", "cyan", [ "h-57.6", "v19.5" ] ]
  ],
  "dependencies": {}
}
```

Libraries.txt

# Wokwi Library List

# See https://docs.wokwi.com/guides/libraries

# Automatically added based on includes:

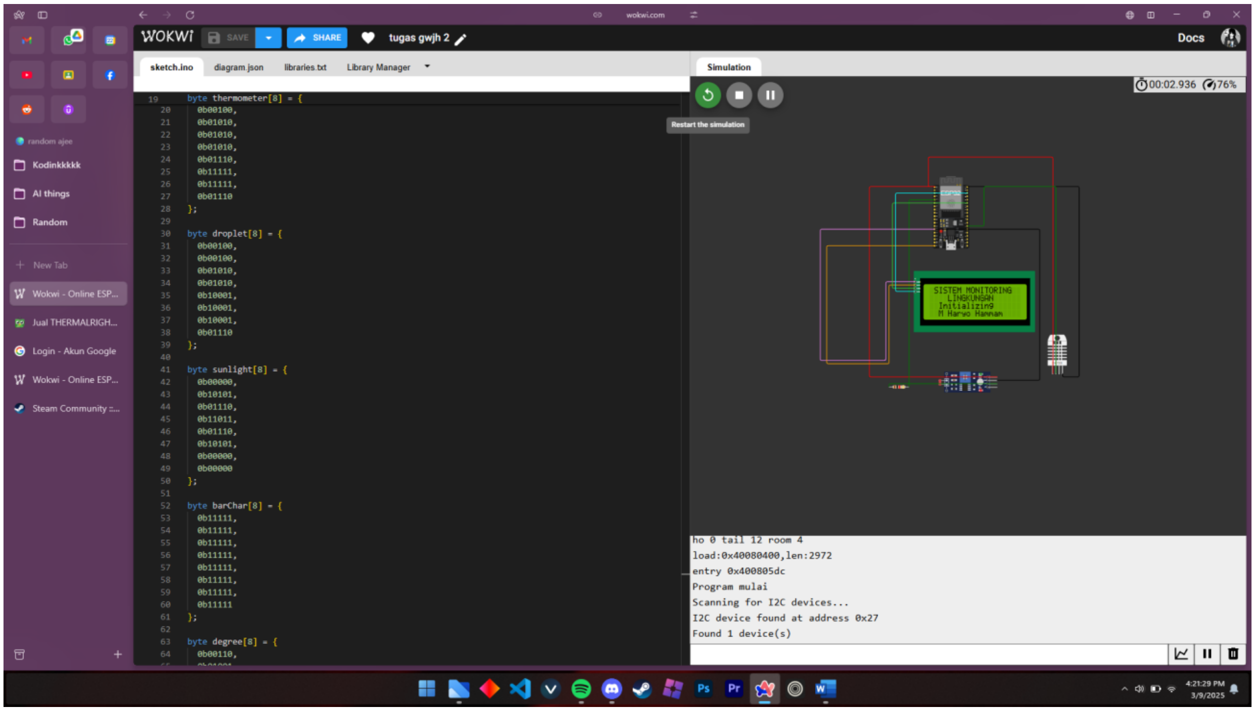
LiquidCrystal I2C

DHT sensor library

Adafruit Unified Sensor

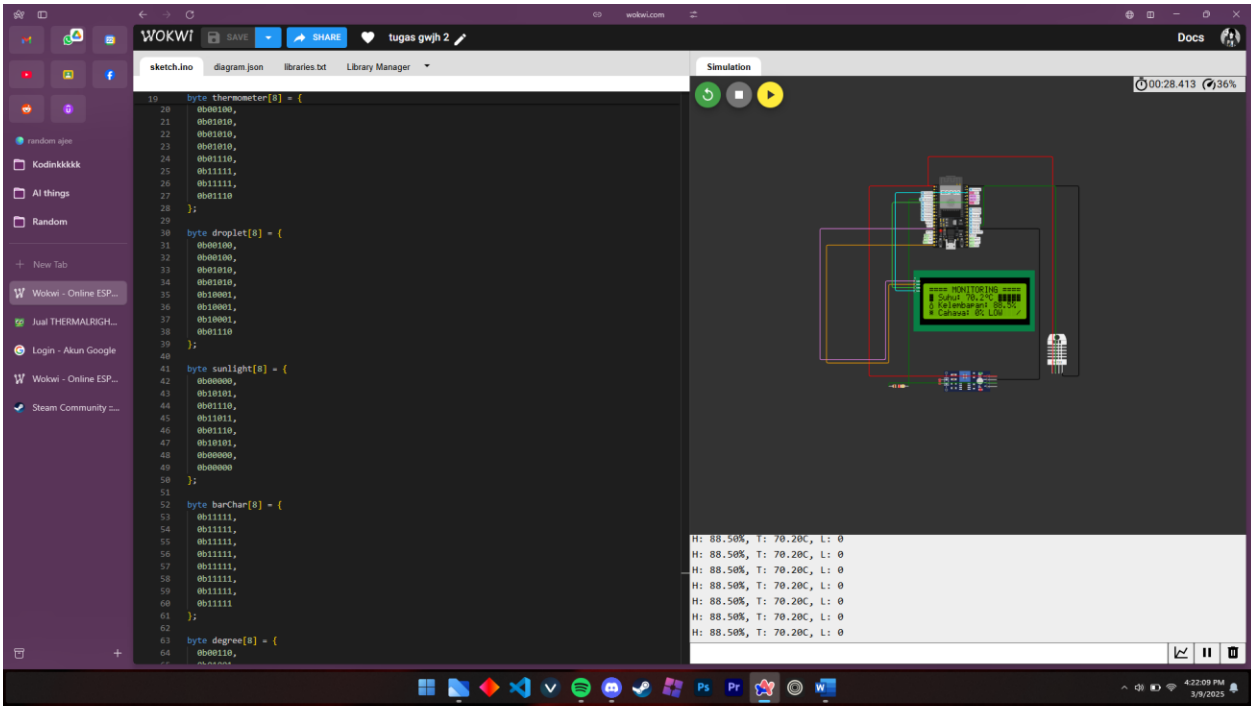
LiquidCrystal_PCF8574

Lampiran



```
byte thermometer[8] = {
  0b00100,
  0b01010,
  0b01010,
  0b01010,
  0b01110,
  0b11111,
  0b11111,
  0b01110
};

byte droplet[8] = {
  0b00100,
  0b00100,
  0b01010,
  0b01010,
  0b10001,
  0b10001,
  0b10001,
  0b01110
};

byte sunlight[8] = {
  0b00000,
  0b10101,
  0b01110,
  0b11011,
  0b01110,
  0b10101,
  0b00000,
  0b00000
};

byte barChar[8] = {
  0b11111,
  0b11111,
  0b11111,
  0b11111,
  0b11111,
  0b11111,
  0b11111,
  0b11111
};

byte degree[8] = {
  0b00110,
```

```
ho 0 tail 12 room 4
load:0x40080400,len:2972
entry 0x400805dc
Program mulai
Scanning for I2C devices...
I2C device found at address 0x27
Found 1 device(s)
```



```
byte thermometer[8] = {
  0b00100,
  0b01010,
  0b01010,
  0b01010,
  0b01110,
  0b11111,
  0b11111,
  0b01110
};

byte droplet[8] = {
  0b00100,
  0b00100,
  0b01010,
  0b01010,
  0b10001,
  0b10001,
  0b10001,
  0b01110
};

byte sunlight[8] = {
  0b00000,
  0b10101,
  0b01110,
  0b11011,
  0b01110,
  0b10101,
  0b00000,
  0b00000
};

byte barChar[8] = {
  0b11111,
  0b11111,
  0b11111,
  0b11111,
  0b11111,
  0b11111,
  0b11111,
  0b11111
};

byte degree[8] = {
  0b00110,
```

```
==== MONITORING ====
Suhu: 70.2°C
Kelembapan: 88.5%
Cahaya: 0% LOW
```

```
H: 88.50%, T: 70.20C, L: 0
H: 88.50%, T: 70.20C, L: 0
H: 88.50%, T: 70.20C, L: 0
H: 88.50%, T: 70.20C, L: 0
H: 88.50%, T: 70.20C, L: 0
H: 88.50%, T: 70.20C, L: 0
H: 88.50%, T: 70.20C, L: 0
```

Link yang bisa di akses:

https://wokwi.com/projects/424936299940458497