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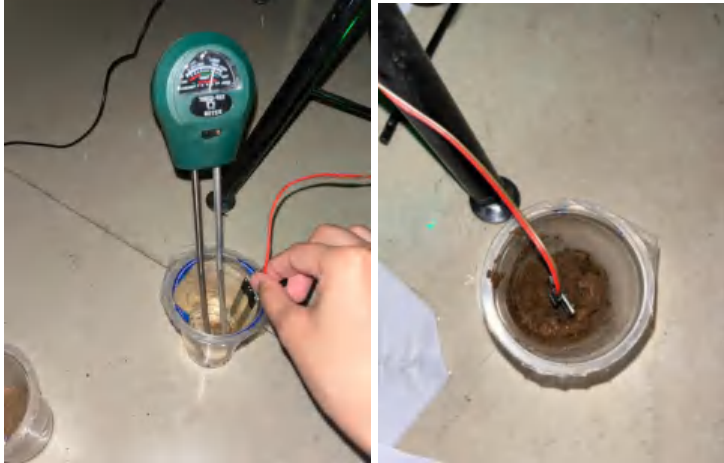
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LAMPIRAN

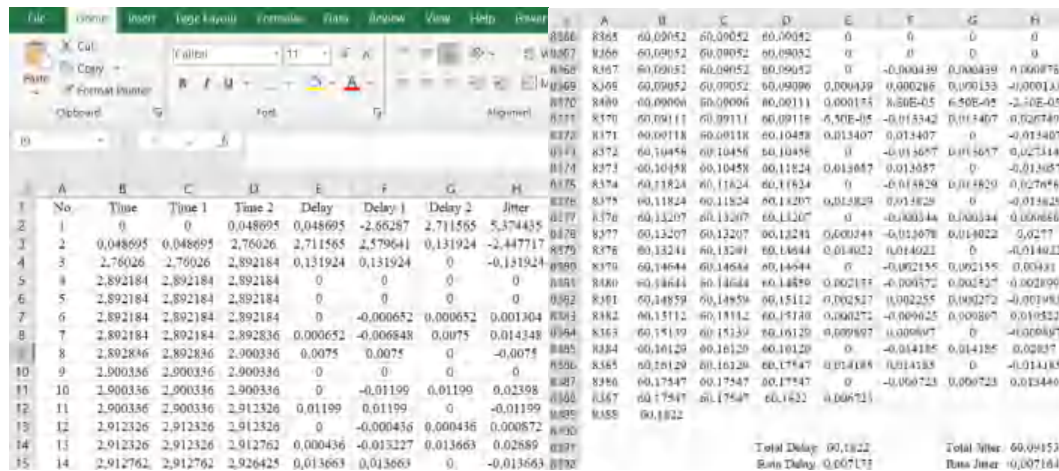
Lampiran 1 Dokumentasi kalibrasi Sensor *Soil Moisture* dan *Soil Meter*



Lampiran 2 Dokumentasi kalibrasi sensor DHT22 dan HTC-2

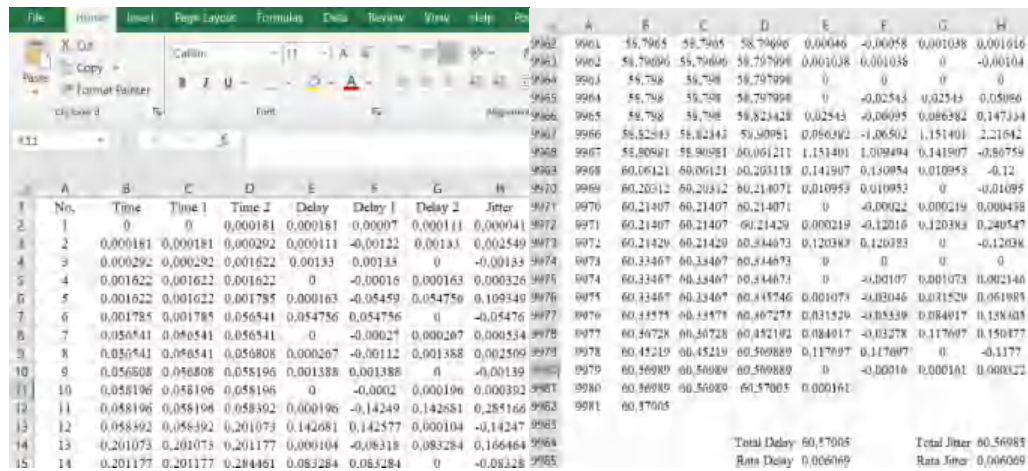


Lampiran 3 Perhitungan delay dan jitter pengujian pertama pada Excel



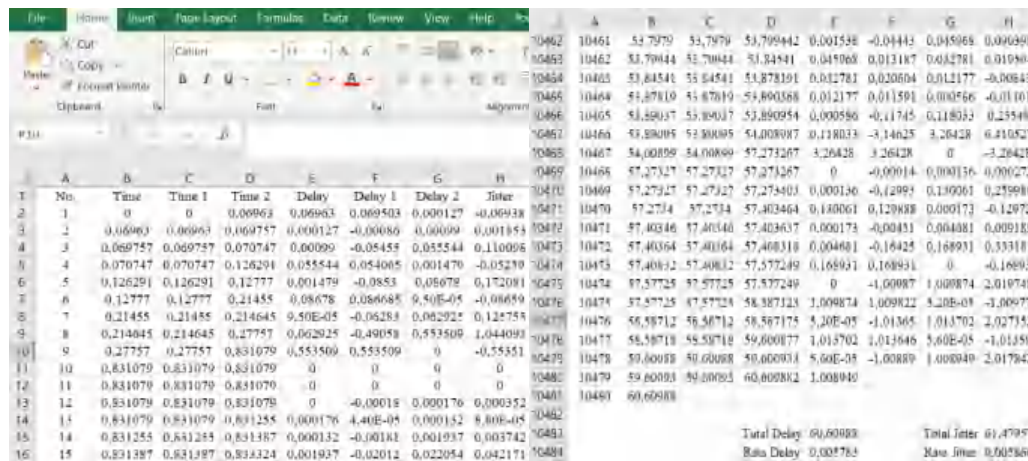
No	Time	Time 1	Time 2	Delay	Delay 1	Delay 2	Jitter
1	0	0	0.048695	0.048695	-2.65257	2.711565	5.374435
2	0.048695	0.048695	2.76026	2.711565	2.579641	0.131924	-2.447717
3	2.76026	2.76026	2.892184	0.131924	0.131924	0	-0.131924
4	2.892184	2.892184	2.892184	0	0	0	0
5	2.892184	2.892184	2.892184	0	0	0	0
6	2.892184	2.892184	2.892184	0	-0.000652	0.000652	0.001304
7	2.892184	2.892184	2.892836	0.000652	-0.006948	0.0075	0.014348
8	2.892836	2.892836	2.900336	0.0075	0.0075	0	-0.0075
9	2.900336	2.900336	2.900336	0	0	0	0
10	2.900336	2.900336	2.900336	0	-0.01199	0.01199	0.02398
11	2.900336	2.900336	2.912326	0.01199	0.01199	0	-0.01199
12	2.912326	2.912326	2.912326	0	-0.000436	0.000436	0.000872
13	2.912326	2.912326	2.912326	0.000436	-0.013227	0.013663	0.02689
14	2.912326	2.912326	2.926425	0.013663	0.013663	0	-0.013663
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Lampiran 6 Perhitungan delay dan jitter pada pengujian keempat pada Excel



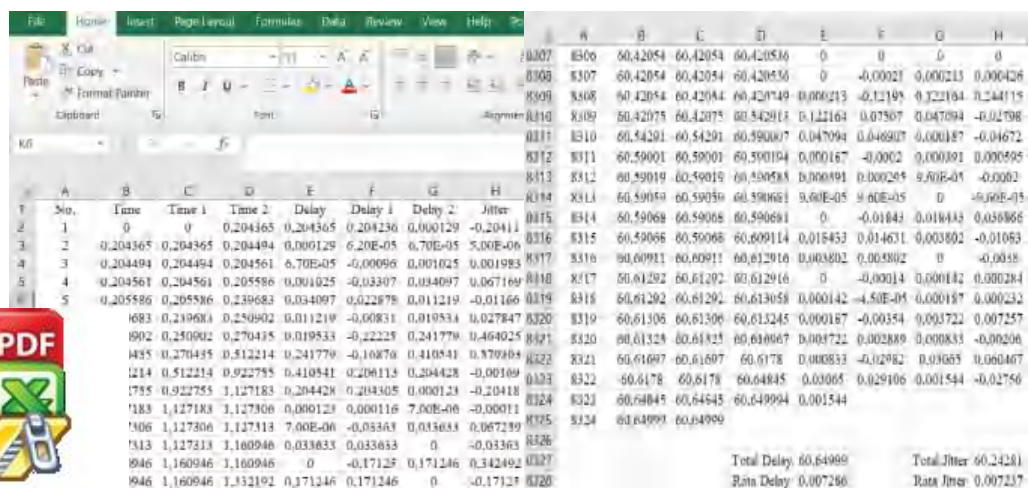
No.	Time	Time 1	Time 2	Delay	Delay 1	Delay 2	Jitter
1	0	0	0	0	0	0	0
2	0.000181	0.000181	0.000292	0.000111	-0.00122	0.00133	0.002549
3	0.000292	0.000292	0.001622	0.00133	0.00133	0	-0.00133
4	0.001622	0.001622	0.001622	0	-0.00016	0.000163	0.000326
5	0.001622	0.001622	0.001785	0.000163	-0.05459	0.054756	0.109349
6	0.001785	0.001785	0.056541	0.054756	0.054756	0	-0.05476
7	0.056541	0.056541	0.056541	0	-0.00027	0.000267	0.000534
8	0.056541	0.056541	0.056808	0.000267	-0.00112	0.001388	0.002509
9	0.056808	0.056808	0.058196	0.001388	0.001388	0	-0.00139
10	0.058196	0.058196	0.058196	0	-0.0002	0.000196	0.000332
11	0.058196	0.058196	0.058392	0.000196	-0.14249	0.142681	0.285166
12	0.058392	0.058392	0.201073	0.142681	0.142577	0.000104	-0.14247
13	0.201073	0.201073	0.201177	0.000104	-0.08318	0.083284	0.166464
14	0.201177	0.201177	0.284461	0.083284	0.083284	0	-0.08328
Total Delay	60.57005						
Rate Delay	0.006069						
Total Jitter	60.56983						
Rate Jitter	0.006069						

Lampiran 7 Perhitungan delay dan jitter pada pengujian kelima pada Excel



No.	Time	Time 1	Time 2	Delay	Delay 1	Delay 2	Jitter
1	0	0	0	0	0	0	0
2	0.00963	0.00963	0.009757	0.000127	-0.00086	0.00099	0.001853
3	0.009757	0.009757	0.070747	0.06099	-0.05455	0.055544	0.110096
4	0.070747	0.070747	0.126291	0.055544	0.054065	0.001470	-0.05239
5	0.126291	0.126291	0.12777	0.001479	-0.0853	0.08678	0.172091
6	0.12777	0.12777	0.21455	0.08678	0.086685	9.50E-05	-0.08669
7	0.21455	0.21455	0.214645	9.50E-05	-0.06288	0.062925	0.124753
8	0.214645	0.214645	0.27757	0.062925	-0.49059	0.553509	1.044099
9	0.27757	0.27757	0.831079	0.553509	0.553509	0	-0.55351
10	0.831079	0.831079	0.831079	0	0	0	0
11	0.831079	0.831079	0.831079	0	0	0	0
12	0.831079	0.831079	0.831079	0	-0.00018	0.000176	0.000352
13	0.831079	0.831079	0.831255	0.000176	4.40E-05	0.000152	8.80E-05
14	0.831255	0.831255	0.831387	0.000132	-0.00181	0.001937	0.003742
15	0.831387	0.831387	0.833324	0.001937	-0.02012	0.022054	0.042171
Total Delay	60.60988						
Rate Delay	0.004783						
Total Jitter	61.47957						
Rate Jitter	0.004783						

Lampiran 8 Perhitungan delay dan jitter pengujian keenam pada Excel



No.	Time	Time 1	Time 2	Delay	Delay 1	Delay 2	Jitter
1	0	0	0	0	0	0	0
2	0.204365	0.204365	0.204365	0	0.204236	0.000129	-0.20411
3	0.204365	0.204365	0.204494	0.000129	6.20E-05	0.70E-05	5.00E-06
4	0.204494	0.204494	0.204561	6.70E-05	-0.00096	0.001025	0.001993
5	0.204561	0.204561	0.205586	0.001025	-0.03307	0.034697	0.067169
6	0.205586	0.205586	0.239683	0.034697	0.022878	0.011219	-0.01166
7	0.239683	0.239683	0.250902	0.011219	-0.00833	0.019534	0.027847
8	0.250902	0.250902	0.270435	0.019533	-0.22225	0.241779	0.464025
9	0.270435	0.270435	0.312214	0.241779	-0.10878	0.410843	0.879094
10	0.312214	0.312214	0.322755	0.410843	0.208113	0.204428	-0.00109
11	0.322755	0.322755	0.322755	0.204428	0.204305	0.000123	-0.20418
12	0.322755	0.322755	0.322755	0.000123	0.000116	7.00E-06	-0.00011
13	0.322755	0.322755	0.322755	0.000116	-0.03363	0.033633	0.067239
14	0.322755	0.322755	0.322755	0.033633	0.033633	0	-0.03363
15	0.322755	0.322755	0.322755	0	-0.17125	0.171246	0.342492
Total Delay	60.64999						
Rate Delay	0.007286						
Total Jitter	60.24281						
Rate Jitter	0.007287						



Lampiran 9 Perhitungan delay dan jitter pengujian ketujuh pada Excel

A	B	C	D	E	F	G	H
No	Time	Time 1	Time 2	Delay	Delay 1	Delay 2	Jitter
1	0	0	0,059915	0,059915	-0,13226	0,192178	0,324441
2	0,059915	0,059915	0,252093	0,192178	0,153142	0,039036	-0,11411
3	0,252093	0,252093	0,291129	0,039036	0,038935	0,000101	-0,03383
4	0,291129	0,291129	0,29112	0,000101	-0,00009	0,000794	0,001487
5	0,29112	0,29112	0,292024	0,000794	-0,04128	0,042072	0,08335
6	0,292024	0,292024	0,334098	0,042072	0,008599	0,033475	0,034874
7	0,334098	0,334098	0,367569	0,033475	0,014226	0,019245	0,005017
8	0,367569	0,367569	0,366814	0,019245	-0,23244	0,251686	0,484127
9	0,366814	0,366814	0,6385	0,251686	0,248959	0,002727	-0,24623
10	0,6385	0,6385	0,641227	0,002727	-0,02082	0,029548	0,056369
11	0,641227	0,641227	0,670775	0,029548	0,029459	8,90E-05	-0,02937
12	0,670775	0,670775	0,670864	8,90E-05	-0,03443	0,034517	0,068945
13	0,670864	0,670864	0,705381	0,034517	-1,01096	1,045478	2,056439
14	0,705381	0,705381	1,750859	1,045478	1,045478	0	-1,04548
Total Delay	60,15208						
Rate Delay	0,006564						
Total Jitter	60,32626						
Rate Jitter	0,006193						

Lampiran 10 Program pengirim pada Arduino IDE

```
#include <SPI.h>
#include <LoRa.h>
#include <DHT.h>

#define relay1Pin 4 // Heater
#define relay2Pin 5 // Fan
#define ss 2
#define rst 13
#define dio0 14
#define en 32
#define dhtPin 15
#define kadarAirPin A0

DHT dht(dhtPin, DHT22);
int counter = 0;

void setup() {
  pinMode(relay1Pin, OUTPUT);
  pinMode(relay2Pin, OUTPUT);
  pinMode(en, OUTPUT);
  digitalWrite(en, LOW);

  Serial.begin(115200);
  (!Serial);

  1.println("LoRa Sender");
```



```

LoRa.setPins(ss, rst, dio0);

while (!LoRa.begin(915E6)) {
    Serial.println("LoRa Initializing...");
    delay(500);
}

LoRa.setSyncWord(0xF3);
Serial.println("LoRa Initializing OK!");
dht.begin();
}

void loop() {
    Serial.print("Sending packet: ");
    Serial.println(counter);

    float suhu = dht.readTemperature();
    float kelembapan = dht.readHumidity();

    int sensorValue = analogRead(kadarAirPin);
    int kadarAir = map(sensorValue, 4092, 0, 0, 100);

    Serial.print("suhu: ");
    Serial.print(suhu);
    Serial.print("°C, kelembapan: ");
    Serial.print(kelembapan);
    Serial.print("%, kadarAir: ");
    Serial.println(kadarAir);

    String sensorData = String(suhu, 1) + "," + String(kelembapan)
+ "," + kadarAir;

    LoRa.beginPacket();
    LoRa.print(sensorData);
    LoRa.endPacket();

    counter++;
    delay(2000); // Send data every 2 seconds

    // Control Relay 1 based on conditions
    if (suhu < 40 || kelembapan > 70 || kadarAir > 14) {
        digitalWrite(relay1Pin, LOW); // Relay 1 ON
    } else {
        digitalWrite(relay1Pin, HIGH); // Relay 1 OFF
    }
}

```



```
// Control Relay 2 based on conditions
if (suhu > 60) {
    digitalWrite(relay2Pin, LOW); // Relay 2 ON
} else {
    digitalWrite(relay2Pin, HIGH); // Relay 2 OFF
}
}
```

Lampiran 11 Program penerima pada Arduino IDE

```
#include <SPI.h>
#include <LoRa.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <WiFi.h>
#include <HttpClient.h>

const char* ssid = "sals";
const char* password = "salsabilaa21";
const String host = "api.thingspeak.com";
const String apiKey = "11SVWWFIILAIZAYN"; // Ganti dengan API
Key ThingSpeak Anda

LiquidCrystal_I2C lcd(0x27, 20, 4); // Alamat I2C dan ukuran LCD
16x2

void setup() {
    // Connect to Wi-Fi
    WiFi.begin(ssid, password);
    while (WiFi.status() != WL_CONNECTED) {
        delay(1000);
        Serial.println("Connecting to WiFi...");
    }
    Serial.println("Connected to WiFi");

    // Initialize the LoRa Enable pin
    pinMode(32, OUTPUT);
    // LoRa chip is Active Low
    digitalWrite(32, LOW);
}
```



```
nititalize Serial Monitor
al.begin(115200);
e (!Serial);
```

```

// Setup LoRa transceiver module
LoRa.setPins(2, 13, 14); // Ganti pin sesuai dengan konfigurasi
ESP32
while (!LoRa.begin(915E6)) {
    Serial.println("LoRa Initializing...");
    delay(500);
}

// Change sync word to match the sender
LoRa.setSyncWord(0xF3);
Serial.println("LoRa Initializing OK!");

// Initialize LCD
lcd.init();
lcd.backlight();
lcd.setCursor(0, 0);
lcd.print("LoRa Receiver");
}

void loop() {
    int packetSize = LoRa.parsePacket();

    if (packetSize) {
        while (LoRa.available()) {
            String receivedData = LoRa.readString();
            Serial.print("Data diterima: ");
            Serial.println(receivedData);

            // Split the received data into temperature, humidity, and
            // soil moisture
            float suhu, kelembapan;
            int kadarAir;
            if (sscanf(receivedData.c_str(), "%f,%f,%d", &suhu,
                &kelembapan, &kadarAir) == 3) {
                // Display data on the LCD
                lcd.clear();
                lcd.setCursor(0, 0);
                lcd.print("suhu: ");
                lcd.print(suhu);
                lcd.print("C");
                lcd.setCursor(0, 1);
                lcd.print("kelembapan: ");
                lcd.print(kelembapan);
                lcd.print("%");
            }
        }
    }
}

```



```

        delay(2000); // Display temperature and humidity for 2
seconds

        lcd.clear();
        lcd.setCursor(0, 0);
        lcd.print("kadarAir: ");
        lcd.print(kadarAir);
        lcd.print("%");
        lcd.setCursor(0, 1);
        lcd.print("");

        // Send data to ThingSpeak
        sendToThingSpeak(suhu, kelembapan, kadarAir);
    }
}
}
}

void sendToThingSpeak(float suhu, float kelembapan, int kadarAir)
{
    HTTPClient http;

    String data = "field1=" + String(suhu, 1) + "&field2=" +
String(kelembapan) + "&field3=" + String(kadarAir);
    String url = "http://" + host + "/update";

    http.begin(url);
    http.addHeader("Content-Type", "application/x-www-form-
urlencoded");
    http.addHeader("X-THINGSPEAKAPIKEY", apiKey);

    int httpResponseCode = http.POST(data);
    if (httpResponseCode > 0) {
        Serial.print("HTTP Response code: ");
        Serial.println(httpResponseCode);
    } else {
        Serial.println("Error sending data to ThingSpeak");
    }

    http.end();
}

```

