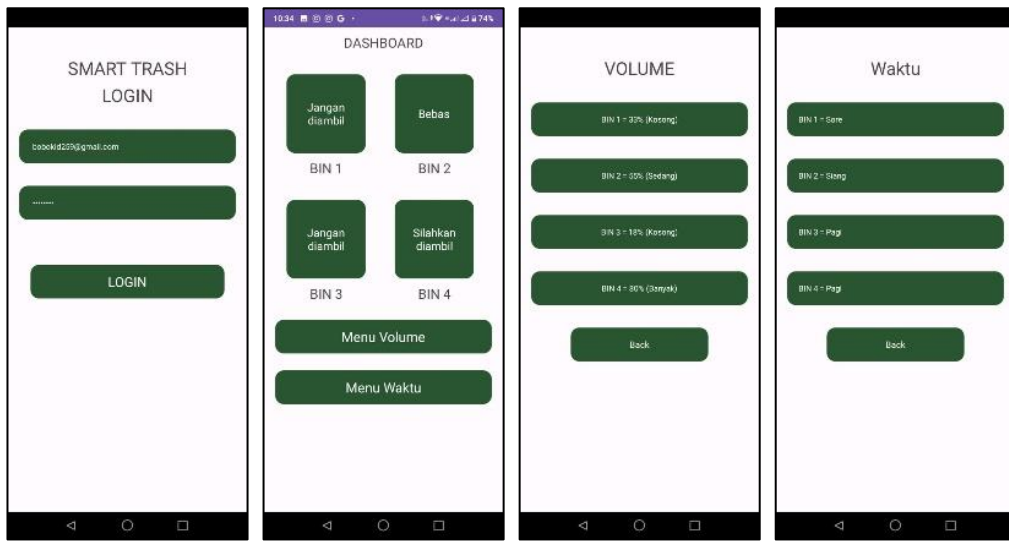


# LAMPIRAN

## Lampiran 1. Dokumentasi Penelitian





The screenshot shows the Firebase Realtime Database console for the project 'SKRIPSI SEPTIYAN'. The 'Data' tab is selected, showing a tree view of the database structure. The data is as follows:

```
https://skripsi-septiyan-default-rtdb.asia-southeast1.firebaseio.com/  
├── BIN_1  
│   ├── Volume: 33  
│   └── Waktu: 17  
├── BIN_2  
│   ├── Volume: 65  
│   └── Waktu: 13  
├── BIN_3  
└── BIN_4
```

Database location: Singapore (asia-southeast1)

The screenshot shows the Firebase Realtime Database console for the project 'SKRIPSI SEPTIYAN'. The 'Data' tab is selected, showing a tree view of the database structure. The data is as follows:

```
https://skripsi-septiyan-default-rtdb.asia-southeast1.firebaseio.com/  
├── BIN_1  
├── BIN_2  
├── BIN_3  
│   ├── Volume: 18  
│   └── Waktu: 6  
└── BIN_4  
    ├── Volume: 80  
    └── Waktu: 6
```

Database location: Singapore (asia-southeast1)

## Lampiran 2. Coding Sistem

```
#include <Arduino.h>
#if defined(ESP32)
#include <WiFi.h>
#elif defined(ESP8266)
#include <ESP8266WiFi.h>
#endif
#include <Firebase_ESP_Client.h>
#include "addons/TokenHelper.h"
#include "addons/RTDBHelper.h"
#define WIFI_SSID "Septiyan"
#define WIFI_PASSWORD "12345678"
#define API_KEY "AIzaSyDCvzRxGVT10ed0pBtBpWcPa70t0hnpX-E"
#define DATABASE_URL "https://skripsi-septiyan-default-rtdb.asia-southeast1.firebaseio.com/"

FirebaseData fbdo;
FirebaseAuth auth;
FirebaseConfig config;
bool signupOK = false;

#include <Wire.h>
#include "RTClib.h"

RTC_DS3231 RTC;
char days[7][12] = { "Mgg", "Sen", "Sel", "Rab", "Kam", "Jum", "Sab"
};

#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 20, 4);

#define trigPin1 D7
#define echoPin1 D8

#define trigPin2 D5
#define echoPin2 D6

#define trigPin3 D3
#define echoPin3 D4

#define trigPin4 1
#define echoPin4 3

int volumeTong1, volumeTong2, volumeTong3, volumeTong4;
String statusVolume1, statusVolume2, statusVolume3, statusVolume4;
int waktuTong1, waktuTong2, waktuTong3, waktuTong4;
String statusWaktu1, statusWaktu2, statusWaktu3, statusWaktu4;
String kriteriaTong1, kriteriaTong2, kriteriaTong3, kriteriaTong4;

bool lockTime1 = 0;
bool lockTime2 = 0;
bool lockTime3 = 0;
bool lockTime4 = 0;
```

```

unsigned long previousMillis = 0;
const long interval = 5000;
int currentDisplay = 0;

void setup() {
  Serial.begin(9600);
  lcd.init();
  lcd.init();
  lcd.backlight();

  pinMode(trigPin1, OUTPUT);
  pinMode(echoPin1, INPUT);
  pinMode(trigPin2, OUTPUT);
  pinMode(echoPin2, INPUT);
  pinMode(trigPin3, OUTPUT);
  pinMode(echoPin3, INPUT);
  pinMode(trigPin4, OUTPUT);
  pinMode(echoPin4, INPUT);

  lcd.setCursor(4, 0);
  lcd.print("SMART TRASH");
  lcd.setCursor(3, 1);
  lcd.print("DWI SEPTIYAN N");
  lcd.setCursor(4, 2);
  lcd.print("18552011058");
  lcd.setCursor(2, 3);
  lcd.print("FMIK UNUGHA 2023");

  if (!RTC.begin()) {
    Serial.println("Couldn't find RTC");
    while (1);
  }

  if (RTC.lostPower()) {
    Serial.println("RTC lost power, let's set the time!");
    RTC.adjust(DateTime(F(__DATE__), F(__TIME__)));
  }

  WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
  Serial.print("Connecting to Wi-Fi");
  while (WiFi.status() != WL_CONNECTED) {
    Serial.print(".");
    delay(300);
  }
  Serial.println();
  Serial.print("Connected with IP: ");
  Serial.println(WiFi.localIP());
  Serial.println();

  config.api_key = API_KEY;
  config.database_url = DATABASE_URL;

  if (Firebase.signUp(&config, &auth, "", "")) {
    Serial.println("ok");
    signupOK = true;
  } else {
    Serial.printf("%s\n", config.signer.signupError.message.c_str());
  }
}

```

```

}
config.token_status_callback = tokenStatusCallback;

Firebase.begin(&config, &auth);
Firebase.reconnectWiFi(true);

delay(1000);
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("Starting");
for (int i = 0; i < 7; i++) {
    int kolom = 8 + i;
    lcd.setCursor(kolom, 0);
    lcd.print(".");
    delay(500);
}
lcd.clear();
}

void loop() {
    displayLCD();
    sendFirebase();
}

void variabelVolume() {
    DateTime now = RTC.now();
    volumeTong1 = hitungPresentase(trigPin1, echoPin1);
    volumeTong2 = hitungPresentase(trigPin2, echoPin2);
    volumeTong3 = hitungPresentase(trigPin3, echoPin3);
    volumeTong4 = hitungPresentase(trigPin4, echoPin4);

    if (volumeTong1 < 35.0) {
        statusVolume1 = "KOSONG";
    } else if (volumeTong1 > 35.0 && volumeTong1 < 65.0) {
        statusVolume1 = "SEDANG";
    } else if (volumeTong1 > 65.0) {
        statusVolume1 = "PENUH";
    } else if (volumeTong1 > 15.0 && lockTime1 == 0) {
        lockTime1 == 1;
    }
}

if (volumeTong2 < 35.0) {
    statusVolume2 = "KOSONG";
} else if (volumeTong2 > 35.0 && volumeTong2 < 65.0) {
    statusVolume2 = "SEDANG";
} else if (volumeTong2 > 65.0) {
    statusVolume2 = "PENUH";
} else if (volumeTong2 > 15.0 && lockTime2 == 0) {
    lockTime2 == 1;
}

if (volumeTong3 < 35.0) {
    statusVolume3 = "KOSONG";
} else if (volumeTong3 > 35.0 && volumeTong3 < 65.0) {
    statusVolume3 = "SEDANG";
} else if (volumeTong3 > 65.0) {
}

```

```

    statusVolume3 = "PENUH";
} else if (volumeTong3 > 15.0 && lockTime3 == 0) {
    lockTime3 == 1;
}

if (volumeTong4 < 35.0) {
    statusVolume4 = "KOSONG";
} else if (volumeTong4 > 35.0 && volumeTong4 < 65.0) {
    statusVolume4 = "SEDANG";
} else if (volumeTong4 > 65.0) {
    statusVolume4 = "PENUH";
} else if (volumeTong4 > 15.0 && lockTime4 == 0) {
    lockTime4 == 1;
}

Serial.println("Persentase ketinggian tong sampah 1: " +
String(volumeTong1) + " %");
Serial.println("Status volume 1: " + String(statusVolume1));

Serial.println("Persentase ketinggian tong sampah 2: " +
String(volumeTong2) + " %");
Serial.println("Status volume 2: " + String(statusVolume2));

Serial.println("Persentase ketinggian tong sampah 3: " +
String(volumeTong3) + " %");
Serial.println("Status volume 3: " + String(statusVolume3));

Serial.println("Persentase ketinggian tong sampah 4: " +
String(volumeTong4) + " %");
Serial.println("Status volume 4: " + String(statusVolume4));
delay(1000);
}

float getDistance(int trigPin, int echoPin) {
    digitalWrite(trigPin, LOW);
    delayMicroseconds(2);

    digitalWrite(trigPin, HIGH);
    delayMicroseconds(10);
    digitalWrite(trigPin, LOW);

    float duration = pulseIn(echoPin, HIGH);
    float distance = duration * 0.0344 / 2;

    return distance;
}

float hitungPresentase(int trigPin, int echoPin) {
    float distance = getDistance(trigPin, echoPin);
    float percentage = ((25.0 - distance) / 25.0) * 100.0;

    if (percentage > 100) {
        percentage = 100;
    } else if (percentage < 0) {
        percentage = 0;
    }
}

```

```

    return percentage;
}

void variabelWaktu() {
    DateTime now = RTC.now();

    if (volumeTong1 < 10 && lockTime1 == 1) {
        waktuTong1 = now.hour();
        lockTime1 = 0;
    }
    if (volumeTong2 < 10 && lockTime2 == 1) {
        waktuTong2 = now.hour();
        lockTime2 = 0;
    }
    if (volumeTong3 < 10 && lockTime3 == 1) {
        waktuTong3 = now.hour();
        lockTime3 = 0;
    }
    if (volumeTong4 < 10.0 && lockTime4 == 1) {
        waktuTong4 = now.hour();
        lockTime4 = 0;
    }

    if (waktuTong1 < 8) {
        statusWaktu1 = "PAGI";
    } else if (waktuTong1 > 9 && waktuTong1 < 15) {
        statusWaktu1 = "SIANG";
    } else if (waktuTong1 > 16) {
        statusWaktu1 = "SORE";
    }

    if (waktuTong2 < 8) {
        statusWaktu2 = "PAGI";
    } else if (waktuTong2 > 9 && waktuTong2 < 15) {
        statusWaktu2 = "SIANG";
    } else if (waktuTong2 > 16) {
        statusWaktu2 = "SORE";
    }

    if (waktuTong3 < 8) {
        statusWaktu3 = "PAGI";
    } else if (waktuTong3 > 9 && waktuTong3 < 15) {
        statusWaktu3 = "SIANG";
    } else if (waktuTong3 > 16) {
        statusWaktu3 = "SORE";
    }

    if (waktuTong4 < 8) {
        statusWaktu4 = "PAGI";
    } else if (waktuTong4 > 9 && waktuTong4 < 15) {
        statusWaktu4 = "SIANG";
    } else if (waktuTong4 > 16) {
        statusWaktu4 = "SORE";
    }

    Serial.println("Waktu pengambilan tong sampah 1: " +
String(waktuTong1));
}

```

```

    Serial.println("Status waktu 1: " + String(statusWaktu1));

    Serial.println("Waktu pengambilan tong sampah 2: " +
String(waktuTong2));
    Serial.println("Status waktu 2: " + String(statusWaktu2));

    Serial.println("Waktu pengambilan tong sampah 3: " +
String(waktuTong3));
    Serial.println("Status waktu 3: " + String(statusWaktu3));

    Serial.println("Waktu pengambilan tong sampah 4: " +
String(waktuTong4));
    Serial.println("Status waktu 4: " + String(statusWaktu4));
    delay(1000);
}

void fuzzyLogic1() {
    DateTime now = RTC.now();
    if (statusVolume1 == "KOSONG" && statusWaktu1 == "PAGI") {
        kriteriaTong1 = "JANGAN AMBIL";
    } else if (statusVolume1 == "KOSONG" && statusWaktu1 == "SIANG") {
        kriteriaTong1 = "JANGAN AMBIL";
    } else if (statusVolume1 == "KOSONG" && statusWaktu1 == "SORE") {
        kriteriaTong1 = "JANGAN AMBIL";
    }

    else if (statusVolume1 == "SEDANG" && statusWaktu1 == "PAGI") {
        kriteriaTong1 = "SILAHKAN AMBIL";
    } else if (statusVolume1 == "SEDANG" && statusWaktu1 == "SIANG") {
        kriteriaTong1 = "SILAHKAN AMBIL";
    } else if (statusVolume1 == "SEDANG" && statusWaktu1 == "SORE") {
        kriteriaTong1 = "JANGAN AMBIL";
    }

    else if (statusVolume1 == "PENUH" && statusWaktu1 == "PAGI") {
        kriteriaTong1 = "SILAHKAN AMBIL";
    } else if (statusVolume1 == "PENUH" && statusWaktu1 == "SIANG") {
        kriteriaTong1 = "SILAHKAN AMBIL";
    } else if (statusVolume1 == "PENUH" && statusWaktu1 == "SORE") {
        kriteriaTong1 = "BEBAS";
    }

    Serial.println("Kriteria tong sampah 1: " + String(kriteriaTong1));
}

void fuzzyLogic2() {
    DateTime now = RTC.now();
    if (statusVolume2 == "KOSONG" && statusWaktu2 == "PAGI") {
        kriteriaTong2 = "JANGAN AMBIL";
    } else if (statusVolume2 == "KOSONG" && statusWaktu2 == "SIANG") {
        kriteriaTong2 = "JANGAN AMBIL";
    } else if (statusVolume2 == "KOSONG" && statusWaktu2 == "SORE") {
        kriteriaTong2 = "JANGAN AMBIL";
    }

    else if (statusVolume2 == "SEDANG" && statusWaktu2 == "PAGI") {
        kriteriaTong2 = "SILAHKAN AMBIL";
    }
}

```



```

    } else if (statusVolume2 == "SEDANG" && statusWaktu2 == "SIANG") {
        kriteriaTong2 = "SILAHKAN AMBIL";
    } else if (statusVolume2 == "SEDANG" && statusWaktu2 == "SORE") {
        kriteriaTong2 = "JANGAN AMBIL";
    }

    else if (statusVolume2 == "PENUH" && statusWaktu2 == "PAGI") {
        kriteriaTong2 = "SILAHKAN AMBIL";
    } else if (statusVolume2 == "PENUH" && statusWaktu2 == "SIANG") {
        kriteriaTong2 = "SILAHKAN AMBIL";
    } else if (statusVolume2 == "PENUH" && statusWaktu2 == "SORE") {
        kriteriaTong2 = "BEBAS";
    }
}

Serial.println("Kriteria tong sampah 2: " + String(kriteriaTong2));
}

void fuzzyLogic3() {
    DateTime now = RTC.now();
    if (statusVolume3 == "KOSONG" && statusWaktu3 == "PAGI") {
        kriteriaTong3 = "JANGAN AMBIL";
    } else if (statusVolume3 == "KOSONG" && statusWaktu3 == "SIANG") {
        kriteriaTong3 = "JANGAN AMBIL";
    } else if (statusVolume3 == "KOSONG" && statusWaktu3 == "SORE") {
        kriteriaTong3 = "JANGAN AMBIL";
    }

    else if (statusVolume3 == "SEDANG" && statusWaktu3 == "PAGI") {
        kriteriaTong3 = "SILAHKAN AMBIL";
    } else if (statusVolume3 == "SEDANG" && statusWaktu3 == "SIANG") {
        kriteriaTong3 = "SILAHKAN AMBIL";
    } else if (statusVolume3 == "SEDANG" && statusWaktu3 == "SORE") {
        kriteriaTong3 = "JANGAN AMBIL";
    }

    else if (statusVolume3 == "PENUH" && statusWaktu3 == "PAGI") {
        kriteriaTong3 = "SILAHKAN AMBIL";
    } else if (statusVolume3 == "PENUH" && statusWaktu3 == "SIANG") {
        kriteriaTong3 = "SILAHKAN AMBIL";
    } else if (statusVolume3 == "PENUH" && statusWaktu3 == "SORE") {
        kriteriaTong3 = "BEBAS";
    }
}

Serial.println("Kriteria tong sampah 3: " + String(kriteriaTong3));
}

void fuzzyLogic4() {
    DateTime now = RTC.now();
    if (statusVolume4 == "KOSONG" && statusWaktu4 == "PAGI") {
        kriteriaTong4 = "JANGAN AMBIL";
    } else if (statusVolume4 == "KOSONG" && statusWaktu4 == "SIANG") {
        kriteriaTong4 = "JANGAN AMBIL";
    } else if (statusVolume4 == "KOSONG" && statusWaktu4 == "SORE") {
        kriteriaTong4 = "JANGAN AMBIL";
    }

    else if (statusVolume4 == "SEDANG" && statusWaktu4 == "PAGI") {

```

```

    kriteriaTong4 = "SILAHKAN AMBIL";
} else if (statusVolume4 == "SEDANG" && statusWaktu4 == "SIANG") {
    kriteriaTong4 = "SILAHKAN AMBIL";
} else if (statusVolume3 == "SEDANG" && statusWaktu4 == "SORE") {
    kriteriaTong4 = "JANGAN AMBIL";
}

else if (statusVolume4 == "PENUH" && statusWaktu4 == "PAGI") {
    kriteriaTong4 = "SILAHKAN AMBIL";
} else if (statusVolume4 == "PENUH" && statusWaktu4 == "SIANG") {
    kriteriaTong4 = "SILAHKAN AMBIL";
} else if (statusVolume4 == "PENUH" && statusWaktu4 == "SORE") {
    kriteriaTong4 = "BEBAS";
}

Serial.println("Kriteria tong sampah 4: " + String(kriteriaTong4));
}

void getFuzzy() {
    DateTime now = RTC.now();
    variabelVolume();
    variabelWaktu();
    fuzzyLogic1();
    fuzzyLogic2();
    fuzzyLogic3();
    fuzzyLogic4();
}

void displayLCD() {
    DateTime now = RTC.now();
    unsigned long currentMillis = millis();
    if (currentMillis - previousMillis >= interval) {
        previousMillis = currentMillis;
        currentDisplay = currentDisplay + 1;
    }

    if (currentDisplay == 0) {
        lcd.clear();
        display0();
        getFuzzy();
    }
    if (currentDisplay == 1) {
        lcd.clear();
        display1();
        getFuzzy();
    }

    if (currentDisplay == 2) {
        lcd.clear();
        display2();
        getFuzzy();
    }

    if (currentDisplay == 3) {
        lcd.clear();
        display3();
        getFuzzy();
    }
}

```

```

    }

    if (currentDisplay == 4) {
        lcd.clear();
        display4();
        getFuzzy();
    }

    if (currentDisplay > 3) {
        currentDisplay = 0;
    }
}

void display0() {
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("B_1: " + String(kriteriaTong1));
    lcd.setCursor(0, 1);
    lcd.print("B_2: " + String(kriteriaTong2));
    lcd.setCursor(0, 2);
    lcd.print("B_3: " + String(kriteriaTong3));
    lcd.setCursor(0, 3);
    lcd.print("B_4: " + String(kriteriaTong4));
}

void display1() {
    DateTime now = RTC.now();
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("BIN: 1");
    lcd.setCursor(0, 1);
    lcd.print("VOL: " + String(volumeTong1) + " % " +
String(statusVolume1));
    lcd.setCursor(0, 2);
    lcd.print("WKT: " + String(waktuTong1) + " " +
String(statusWaktu1));
    lcd.setCursor(0, 3);
    lcd.print("KET: " + String(kriteriaTong1));
}

// Fungsi untuk menampilkan display 2
void display2() {
    DateTime now = RTC.now();
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("BIN: 2");
    lcd.setCursor(0, 1);
    lcd.print("VOL: " + String(volumeTong2) + " % " +
String(statusVolume2));
    lcd.setCursor(0, 2);
    lcd.print("WKT: " + String(waktuTong2) + " " +
String(statusWaktu2));
    lcd.setCursor(0, 3);
    lcd.print("KET: " + String(kriteriaTong2));
}

// Fungsi untuk menampilkan display 3

```

```

void display3() {
    DateTime now = RTC.now();
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("BIN: 3");
    lcd.setCursor(0, 1);
    lcd.print("VOL: " + String(volumeTong3) + " % " +
String(statusVolume3));
    lcd.setCursor(0, 2);
    lcd.print("WKT: " + String(waktuTong3) + " " +
String(statusWaktu3));
    lcd.setCursor(0, 3);
    lcd.print("KET: " + String(kriteriaTong3));
}

// Fungsi untuk menampilkan display 4
void display4() {
    DateTime now = RTC.now();
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("BIN: 4");
    lcd.setCursor(0, 1);
    lcd.print("VOL: " + String(volumeTong4) + " % " +
String(statusVolume4));
    lcd.setCursor(0, 2);
    lcd.print("WKT: " + String(waktuTong4) + " " +
String(statusWaktu4));
    lcd.setCursor(0, 3);
    lcd.print("KET: " + String(kriteriaTong4));
}

void sendFirebase() {
    DateTime now = RTC.now();
    if (Firebase.ready() && signupOK) {
        //-----BIN 1-----
        -----
        if (Firebase.RTDB.setFloat(&fbdo, "BIN_1/Volume", volumeTong1)) {
            Serial.println("Data Terkirim BIN 1: ");
            Serial.println("Volume: " + String(volumeTong1) + " %" +
String(statusVolume1));
        } else {
            Serial.println("FAILED");
            Serial.println("REASON: " + fbdo.errorReason());
        }

        if (Firebase.RTDB.setFloat(&fbdo, "BIN_1/Waktu", waktuTong1)) {
            Serial.println("Waktu: " + String(waktuTong1) +
String(statusWaktu1));
            Serial.println("Output: " + String(kriteriaTong1));
            Serial.println(" ");
        } else {
            Serial.println("FAILED");
            Serial.println("REASON: " + fbdo.errorReason());
        }
    }
}
//PENGIRIMAN DATA BIN 2 KE FIREBASE
if (Firebase.ready() && signupOK) {

```

```

//-----BIN 2-----
if (Firebase.RTDB.setFloat(&fbdo, "BIN_2/Volume", volumeTong2)) {
    Serial.println("Data Terkirim BIN 2: ");
    Serial.println("Volume: " + String(volumeTong2) + " %" +
String(statusVolume2));
} else {
    Serial.println("FAILED");
    Serial.println("REASON: " + fbdo.errorReason());
}

if (Firebase.RTDB.setFloat(&fbdo, "BIN_2/Waktu", waktuTong2)) {
    Serial.println("Waktu: " + String(waktuTong2) +
String(statusWaktu2));
    Serial.println("Output: " + String(kriteriaTong2));
    Serial.println(" ");
} else {
    Serial.println("FAILED");
    Serial.println("REASON: " + fbdo.errorReason());
}
}
//PENGIRIMAN DATA BIN 3 KE FIREBASE
if (Firebase.ready() && signupOK) {
//-----BIN 3-----
if (Firebase.RTDB.setFloat(&fbdo, "BIN_3/Volume", volumeTong3)) {
    Serial.println("Data Terkirim BIN 3: ");
    Serial.println("Volume: " + String(volumeTong3) + " %" +
String(statusVolume3));
} else {
    Serial.println("FAILED");
    Serial.println("REASON: " + fbdo.errorReason());
}

if (Firebase.RTDB.setFloat(&fbdo, "BIN_3/Waktu", waktuTong3)) {
    Serial.println("Waktu: " + String(waktuTong3) +
String(statusWaktu3));
    Serial.println("Output: " + String(kriteriaTong3));
    Serial.println(" ");
} else {
    Serial.println("FAILED");
    Serial.println("REASON: " + fbdo.errorReason());
}
}
//PENGIRIMAN DATA BIN 4 KE FIREBASE
if (Firebase.ready() && signupOK) {
//-----BIN 4-----
if (Firebase.RTDB.setFloat(&fbdo, "BIN_4/Volume", volumeTong4)) {
    Serial.println("Data Terkirim BIN 4: ");
    Serial.println("Volume: " + String(volumeTong4) + " %" +
String(statusVolume4));
} else {
    Serial.println("FAILED");
    Serial.println("REASON: " + fbdo.errorReason());
}
}

```

```
    if (Firebase.RTDB.setFloat(&fbdo, "BIN_4/Waktu", waktuTong4)) {
        Serial.println("Waktu: " + String(waktuTong4) +
String(statusWaktu4));
        Serial.println("Output: " + String(kriteriaTong4));
        Serial.println(" ");
    } else {
        Serial.println("FAILED");
        Serial.println("REASON: " + fbdo.errorReason());
    }
}
}
```