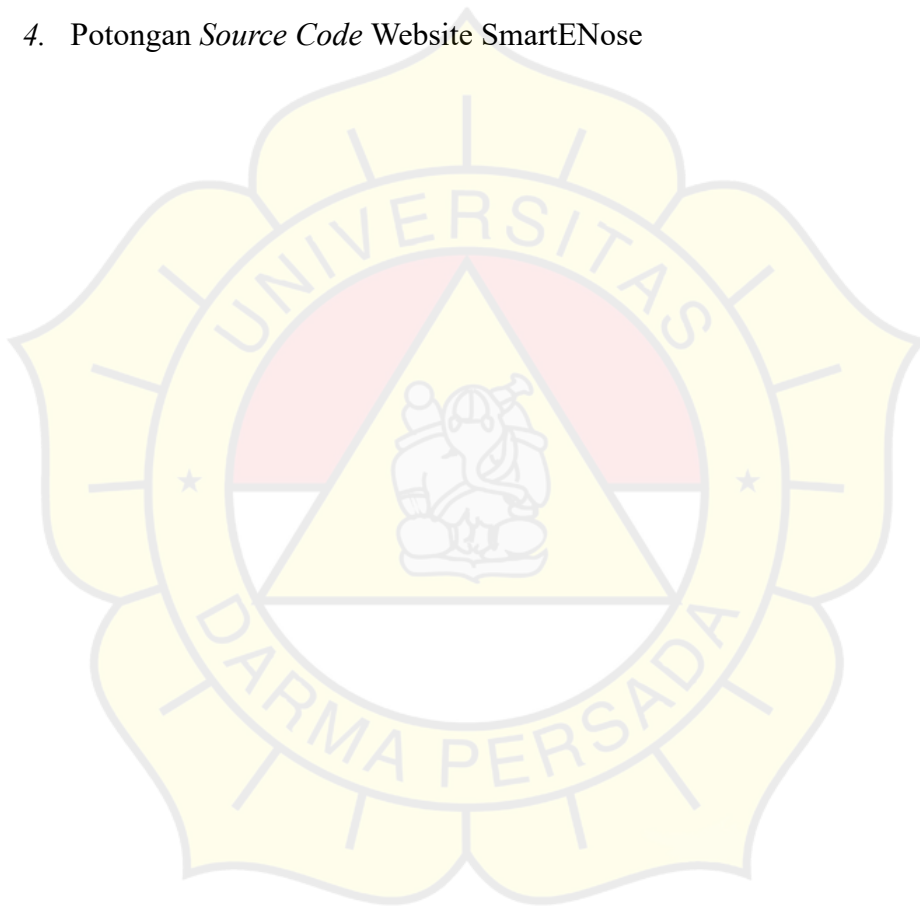


## LAMPIRAN

1. Surat Keterangan Bebas Plagiat
2. Hasil Laporan Cek Plagiat
3. *Source Code* Arduino
4. Potongan *Source Code* Website SmartENose





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AMONIA, METANA DAN KARBON MONOKSIDA

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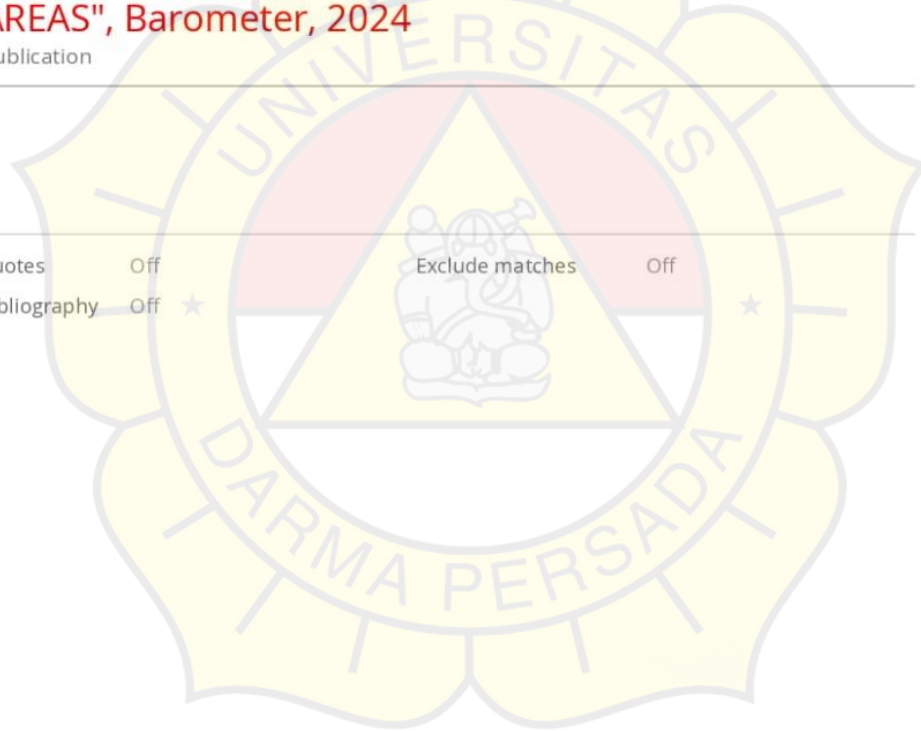
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## Lampiran Source Code Arduino

```
// === SMART MONITORING KANDANG SAPI BERBASIS IoT ===
// Konfigurasi Pin dan Variabel untuk ESP32

#include <WiFi.h>
#include <BlynkSimpleEsp32.h>
#include <Wire.h>
#include <HTTPClient.h>
#include <LiquidCrystal_I2C.h>

// Informasi koneksi
#define BLYNK_TEMPLATE_ID "TMPL6a2XksT_h"
#define BLYNK_AUTH_TOKEN "4eAFpGY7Z9ow_wbKHYq_sDumYE1bG_tp"
char ssid[] = "Infinix GT 10 Pro";
char pass[] = "psrams18";
char auth[] = BLYNK_AUTH_TOKEN;

// Inisialisasi LCD I2C
LiquidCrystal_I2C lcd(0x27, 20, 4);

// Pin Sensor dan Aktuator
#define MQ135_PIN 34
#define MQ4_PIN 35
#define MQ7_PIN 32
#define MQ135_D0 15
#define MQ4_D0 16
#define MQ7_D0 17
#define BUZZER_PIN 25
#define LED_BIRU 33
#define LED_HIJAU 26
#define LED_KUNING 27

// Logika simulasi heater MQ7
#define MQ7_HEATER_PIN 13
unsigned long heaterStartTime = 0;
const int HEATER_HIGH_TIME = 9000;
const int HEATER_LOW_TIME = 60000;
bool isHeaterHigh = true;
float last_ppm_co = 0.0;

// Pin virtual Blynk
#define VPIN_PPM_AMONIA V0
#define VPIN_STATUS_AMONIA V1
#define VPIN_PPM_METANA V2
#define VPIN_STATUS_METANA V3
#define VPIN_PPM_CO V4
#define VPIN_STATUS_CO V5

// Parameter kalibrasi sensor MQ
float R0_MQ135 = 10.0;
float a_MQ135 = 116.6020682;
float b_MQ135 = -2.769034857;
```

```

float R0_MQ4 = 10.0;
float a_MQ4 = 1012.7;
float b_MQ4 = -2.786;

float R0_MQ7 = 6.0;
float a_MQ7 = 11.23;
float b_MQ7 = -2.789;

// Variabel status gas
String status_amonia = "Aman";
String status_metana = "Aman";
String status_co = "Aman";

// Fungsi untuk fuzzyfikasi triangular
float triangularMF(float x, float a, float b, float c) {
    if (x <= a || x >= c) return 0;
    else if (a < x && x <= b) return (x - a) / (b - a);
    else if (b < x && x < c) return (c - x) / (c - b);
    else return 1;
}

// Fungsi kombinasi fuzzy Sugeno untuk tingkat bahaya gabungan
float fuzzySugenoCombined(float nh3, float ch4, float co, int
d0_nh3, int d0_ch4, int d0_co) {
    float muNH3_Aman = triangularMF(nh3, 0, 0, 10);
    float muNH3_Waspada = triangularMF(nh3, 10, 17.5, 25);
    float muNH3_Bahaya = triangularMF(nh3, 25, 50, 1000000000);

    float muCH4_Aman = triangularMF(ch4, 0, 0, 5000);
    float muCH4_Waspada = triangularMF(ch4, 5000, 7500, 10000);
    float muCH4_Bahaya = triangularMF(ch4, 10000, 15000,
1000000000);

    float muCO_Aman = triangularMF(co, 0, 0, 30);
    float muCO_Waspada = triangularMF(co, 30, 40, 50);
    float muCO_Bahaya = triangularMF(co, 50, 80, 1000000000);

    if (d0_nh3 == HIGH) muNH3_Bahaya = 1.0;
    if (d0_ch4 == HIGH) muCH4_Bahaya = 1.0;
    if (d0_co == HIGH) muCO_Bahaya = 1.0;

    if (d0_nh3 == HIGH) { muNH3_Aman = 0.0; muNH3_Waspada = 0.0; }
    if (d0_ch4 == HIGH) { muCH4_Aman = 0.0; muCH4_Waspada = 0.0; }
    if (d0_co == HIGH) { muCO_Aman = 0.0; muCO_Waspada = 0.0; }

    float muNH3_NonBahaya = max(muNH3_Aman, muNH3_Waspada);
    float muCH4_NonBahaya = max(muCH4_Aman, muCH4_Waspada);
    float muCO_NonBahaya = max(muCO_Aman, muCO_Waspada);

    float w[8], z[8];
    int i = 0;

    // Rule Base
    w[i] = min({muNH3_NonBahaya, muCH4_NonBahaya,
muCO_NonBahaya});
    z[i++] = 0.0;

```

```

w[i] = min({muNH3_NonBahaya, muCH4_NonBahaya, muCO_Bahaya});
z[i++] = 3.0;
w[i] = min({muNH3_NonBahaya, muCH4_Bahaya, muCO_NonBahaya});
z[i++] = 1.0;
w[i] = min({muNH3_NonBahaya, muCH4_Bahaya, muCO_Bahaya});
z[i++] = 4.0;
w[i] = min({muNH3_Bahaya, muCH4_NonBahaya, muCO_NonBahaya});
z[i++] = 2.0;
w[i] = min({muNH3_Bahaya, muCH4_NonBahaya, muCO_Bahaya});
z[i++] = 5.0;
w[i] = min({muNH3_Bahaya, muCH4_Bahaya, muCO_NonBahaya});
z[i++] = 3.0;
w[i] = min({muNH3_Bahaya, muCH4_Bahaya, muCO_Bahaya});
z[i++] = 6.0;

// Defuzzifikasi Sugeno
float sumW = 0, sumWZ = 0;
for (int j = 0; j < 8; j++) {
    sumW += w[j];
    sumWZ += w[j] * z[j];
}
return (sumW == 0) ? 0 : sumWZ / sumW;
}

// Fungsi pembacaan sensor
float readSensorPPM(int pin, float R0, float a, float b, String
sensorName) {
    int adcValue = analogRead(pin);
    float voltage = adcValue * (3.3 / 4095.0);
    float RL = 10.0;
    float Rs = ((3.3 - voltage) / voltage) * RL;
    float ratio = Rs / R0;
    float ppm = a * pow(ratio, b);
    if (isnan(ppm) || ppm < 0) ppm = 0;
    return ppm;
}

float readSensorPPM_MQ7(int pin, float R0, float a, float b) {
    int adcValue = analogRead(pin);
    float voltage = adcValue * (3.3 / 4095.0);
    float RL = 10.0;
    float Rs = ((3.3 - voltage) / voltage) * RL;
    if (Rs <= 0) Rs = 0.01;
    float ratio = Rs / R0;
    float ppm = a * pow(ratio, b);
    if (isnan(ppm) || ppm < 0) ppm = 0;
    return ppm;
}

// Fungsi Fuzzy Sugeno untuk tiap gas (individual)
String fuzzySugenoAmonia(float ppm, int d0) {
    String newStatus;
    if (d0 == HIGH) {
        newStatus = "Bahaya";
    } else {
        float muAman = triangularMF(ppm, 0, 0, 10);

```

```

float muWaspada = triangularMF(ppm, 10, 17.5, 25);
float muBahaya = triangularMF(ppm, 25, 50, 1000000000);
float zFinal = ((muAman * 0.0) + (muWaspada * 0.5) +
(muBahaya * 1.0)) / (muAman + muWaspada + muBahaya);
if (zFinal <= 0.3) newStatus = "Aman";
else if (zFinal <= 0.7) newStatus = "Waspada";
else newStatus = "Bahaya";
}
if (newStatus == "Bahaya") digitalWrite(LED_HIJAU, HIGH);
else digitalWrite(LED_HIJAU, LOW);
status_amonia = newStatus;
return newStatus;
}

String fuzzySugenoMetana(float ppm, int d0) {
String newStatus;
if (d0 == HIGH) {
newStatus = "Bahaya";
} else {
float muAman = triangularMF(ppm, 0, 0, 5000);
float muWaspada = triangularMF(ppm, 5000, 7500, 10000);
float muBahaya = triangularMF(ppm, 10000, 15000,
1000000000);
float zFinal = ((muAman * 0.0) + (muWaspada * 0.5) +
(muBahaya * 1.0)) / (muAman + muWaspada + muBahaya);
if (zFinal <= 0.3) newStatus = "Aman";
else if (zFinal <= 0.7) newStatus = "Waspada";
else newStatus = "Bahaya";
}
if (newStatus == "Bahaya") digitalWrite(LED_KUNING, HIGH);
else digitalWrite(LED_KUNING, LOW);
status_metana = newStatus;
return newStatus;
}

String fuzzySugenoCO(float ppm, int d0) {
String newStatus;
if (d0 == HIGH) {
newStatus = "Bahaya";
} else {
float muAman = triangularMF(ppm, 0, 0, 30);
float muWaspada = triangularMF(ppm, 30, 40, 50);
float muBahaya = triangularMF(ppm, 50, 80, 1000000000);
float zFinal = ((muAman * 0.0) + (muWaspada * 0.5) +
(muBahaya * 1.0)) / (muAman + muWaspada + muBahaya);
if (zFinal <= 0.3) newStatus = "Aman";
else if (zFinal <= 0.7) newStatus = "Waspada";
else newStatus = "Bahaya";
}
if (newStatus == "Bahaya") digitalWrite(LED_BIRU, HIGH);
else digitalWrite(LED_BIRU, LOW);
status_co = newStatus;
return newStatus;
}

// Fungsi Aktuator & LCD

```

```

void activateBuzzerOnce() {
    tone(BUZZER_PIN, 1000);
    delay(300);
    noTone(BUZZER_PIN);
}

void lcdStartupSequence() {
    lcd.clear(); lcd.setCursor(1, 1); lcd.print("--Selamat Datang--"); delay(3000);
    lcd.clear(); lcd.setCursor(4, 1); lcd.print("--LCD Aktif--"); delay(3000);
    lcd.clear(); lcd.setCursor(1, 1); lcd.print("Menghubungkan ke");
    lcd.setCursor(4, 2); lcd.print("Aplikasi"); delay(3000);
    lcd.clear(); lcd.setCursor(6, 1); lcd.print("Memulai");
    lcd.setCursor(4, 2); lcd.print("Monitoring"); delay(2000);
    lcd.clear();
}

// Fungsi untuk mengirim data ke web server
void sendDataToWeb(float amonia, float metana, float co, int d0_amonia, int d0_metana, int d0_co) {
    if (WiFi.status() == WL_CONNECTED) {
        HTTPClient http;

        http.begin("http://smartenose.my.id/api/post_sensor_data.php");
        http.addHeader("Content-Type", "application/x-www-form-urlencoded");
        String httpRequestData = "amonia=" + String(amonia) + "&metana=" + String(metana) + "&co=" + String(co) + "&d0_amonia=" + String(d0_amonia) + "&d0_metana=" + String(d0_metana) + "&d0_co=" + String(d0_co);
        http.POST(httpRequestData);
        http.end();
    }
}

// Fungsi utama SETUP
void setup() {
    Serial.begin(115200);

    pinMode(BUZZER_PIN, OUTPUT);
    pinMode(LED_BIRU, OUTPUT);
    pinMode(LED_HIJAU, OUTPUT);
    pinMode(LED_KUNING, OUTPUT);
    pinMode(MQ7_HEATER_PIN, OUTPUT);
    pinMode(MQ135_D0, INPUT);
    pinMode(MQ4_D0, INPUT);
    pinMode(MQ7_D0, INPUT);

    digitalWrite(BUZZER_PIN, LOW);
    digitalWrite(LED_BIRU, LOW);
    digitalWrite(LED_HIJAU, LOW);
    digitalWrite(LED_KUNING, LOW);
    digitalWrite(MQ7_HEATER_PIN, HIGH);
}

```

```

lcd.init();
lcd.backlight();
lcdStartupSequence();

WiFi.begin(ssid, pass);
while (WiFi.status() != WL_CONNECTED) {
    delay(500); Serial.print(".");
}
Serial.println("\nWiFi Connected");
Blynk.config(auth);
Blynk.connect();
heaterStartTime = millis();
}

// Fungsi utama LOOP
void loop() {
    Blynk.run();

    // Logika siklus pemanasan MQ7 (simulasi)
    if (isHeaterHigh && millis() - heaterStartTime >=
HEATER_HIGH_TIME) {
        digitalWrite(MQ7_HEATER_PIN, LOW);
        isHeaterHigh = false;
        heaterStartTime = millis();
    } else if (!isHeaterHigh && millis() - heaterStartTime >=
HEATER_LOW_TIME) {
        digitalWrite(MQ7_HEATER_PIN, HIGH);
        isHeaterHigh = true;
        heaterStartTime = millis();
    }

    // Pembacaan sensor
    float ppm_amonia = readSensorPPM(MQ135_PIN, R0_MQ135, a_MQ135,
b_MQ135, "MQ135");
    float ppm_metana = readSensorPPM(MQ4_PIN, R0_MQ4, a_MQ4,
b_MQ4, "MQ4");
    if (!isHeaterHigh) {
        last_ppm_co = readSensorPPM_MQ7(MQ7_PIN, R0_MQ7, a_MQ7,
b_MQ7);
    }
    float ppm_co = last_ppm_co;

    // Pembacaan D0
    int d0_amonia = digitalRead(MQ135_D0);
    int d0_metana = digitalRead(MQ4_D0);
    int d0_co = digitalRead(MQ7_D0);

    // Penentuan status gas
    status_amonia = fuzzySugenoAmonia(ppm_amonia, d0_amonia);
    status_metana = fuzzySugenoMetana(ppm_metana, d0_metana);
    status_co = fuzzySugenoCO(ppm_co, d0_co);

    // Perhitungan level bahaya gabungan
    float bahayaLevelFloat = fuzzySugenoCombined(ppm_amonia,
ppm_metana, ppm_co, d0_amonia, d0_metana, d0_co);
    int bahayaLevel = (int)round(bahayaLevelFloat);
}

```

```

// Kontrol buzzer jika ada bahaya
if (status_amonia == "Bahaya" || status_metana == "Bahaya" ||
status_co == "Bahaya") {
    activateBuzzerOnce();
} else {
    noTone(BUZZER_PIN);
}

// Kirim data ke Blynk dan tampilkan di LCD
Blynk.virtualWrite(VPIN_PPM_AMONIA, ppm_amonia);
Blynk.virtualWrite(VPIN_STATUS_AMONIA, status_amonia);
Blynk.virtualWrite(VPIN_PPM_METANA, ppm_metana);
Blynk.virtualWrite(VPIN_STATUS_METANA, status_metana);
Blynk.virtualWrite(VPIN_PPM_CO, ppm_co);
Blynk.virtualWrite(VPIN_STATUS_CO, status_co);

lcd.clear();
lcd.setCursor(5, 0); lcd.print("Monitoring:");
lcd.setCursor(0, 1); lcd.print("NH3 : " + status_amonia);
lcd.setCursor(13, 1); lcd.print("|");
lcd.setCursor(0, 2); lcd.print("CH4 : " + status_metana);
lcd.setCursor(13, 2); lcd.print("|");
lcd.setCursor(0, 3); lcd.print("CO : " + status_co);
lcd.setCursor(13, 3); lcd.print("|");
lcd.setCursor(14, 1); lcd.print("Bahaya");
lcd.setCursor(14, 2); lcd.print("Level:");
lcd.setCursor(14, 3); lcd.print(bahayaLevel);

sendDataToWeb(ppm_amonia, ppm_metana, ppm_co, d0_amonia,
d0_metana, d0_co);

delay(1000);
}

```

## Lampiran Source Code Website SmartEnose

### 1. Program Kodingan Website SmartENose: post\_sensor\_data.php

```
<?php
require '../config.php';

// Terima data POST
$amonia = isset($_POST['amonia']) ? floatval($_POST['amonia']) : 0;
$metana = isset($_POST['metana']) ? floatval($_POST['metana']) : 0;
$co      = isset($_POST['co']) ? floatval($_POST['co']) : 0;

$d0_amonia = isset($_POST['d0_amonia']) ?
intval($_POST['d0_amonia']) : 0;
$d0_metana = isset($_POST['d0_metana']) ?
intval($_POST['d0_metana']) : 0;
$d0_co     = isset($_POST['d0_co']) ? intval($_POST['d0_co']) : 0;

// Simpan ke DB
$sql = "INSERT INTO sensor_data (amonia, metana, co, d0_amonia,
d0_metana, d0_co) VALUES (?, ?, ?, ?, ?, ?)";
$stmt = $config->prepare($sql);
$stmt->execute([$amonia, $metana, $co, $d0_amonia, $d0_metana,
$d0_co]);

echo "Data received and stored.";
```

### 2. Program Kodingan Website SmartENose: get\_sensor\_data.php

```
<?php
require '../config.php';

// Mengatur header untuk respons JSON
header('Content-Type: application/json');
header('Cache-Control: no-cache, must-revalidate');

// Mengambil data sensor terbaru dari database
$query = $config->query("SELECT * FROM sensor_data ORDER BY
waktu DESC LIMIT 1");
$data_sensor = $query->fetch();

$amonia_value = 0.0;
$metana_value = 0.0;
$co_value     = 0.0;
$d0_amonia   = 0;
$d0_metana   = 0;
$d0_co       = 0;
$waktu       = date("d M Y, H:i:s");

// Memproses data jika ditemukan
if ($data_sensor) {
```

```

    $amonia_value = floatval($data_sensor['amonia']);
    $metana_value = floatval($data_sensor['metana']);
    $co_value = floatval($data_sensor['co']);
    $d0_amonia = intval($data_sensor['d0_amonia']);
    $d0_metana = intval($data_sensor['d0_metana']);
    $d0_co = intval($data_sensor['d0_co']);
    $waktu = date('d M Y, H:i:s',
strtotime($data_sensor['waktu']));
}

/**
 * Fungsi untuk fuzzyfikasi triangular.
 */
function triangularMF($x, $a, $b, $c) {
    if ($x <= $a || $x >= $c) return 0.0;
    else if ($x == $b) return 1.0;
    else if ($x > $a && $x < $b) return ($x - $a) / ($b - $a);
    else return ($c - $x) / ($c - $b);
}

/**
 * Fungsi Fuzzy Sugeno untuk status Amonia (NH3).
 */
function fuzzySugenoAmonia($ppm, $d0) {
    $muAman = triangularMF($ppm, 0, 0, 10);
    $muWaspada = triangularMF($ppm, 10, 17.5, 25);
    $muBahaya = triangularMF($ppm, 25, 50, 1000000000);

    if ($d0 == 1) {
        $muBahaya = 1.0;
        $muAman = 0.0;
    }

    $sum_w = $muAman + $muWaspada + $muBahaya;
    $sum_wz = ($muAman * 0.0) + ($muWaspada * 0.5) + ($muBahaya
* 1.0);
    $zFinal = ($sum_w == 0) ? 0.0 : $sum_wz / $sum_w;

    if ($zFinal <= 0.3) return "Aman";
    elseif ($zFinal <= 0.7) return "Waspada";
    else return "Bahaya";
}

/**
 * Fungsi Fuzzy Sugeno untuk status Metana (CH4).
 */
function fuzzySugenoMetana($ppm, $d0) {
    $muAman = triangularMF($ppm, 0, 0, 5000);
    $muWaspada = triangularMF($ppm, 5000, 7500, 10000);
    $muBahaya = triangularMF($ppm, 10000, 15000, 1000000000);

    if ($d0 == 1) {
        $muBahaya = 1.0;
        $muAman = 0.0;
    }
}

```

```

    $sum_w = $muAman + $muWaspada + $muBahaya;
    $sum_wz = ($muAman * 0.0) + ($muWaspada * 0.5) + ($muBahaya
* 1.0);
    $zFinal = ($sum_w == 0) ? 0.0 : $sum_wz / $sum_w;

    if ($zFinal <= 0.3) return "Aman";
    elseif ($zFinal <= 0.7) return "Waspada";
    else return "Bahaya";
}

/**
 * Fungsi Fuzzy Sugeno untuk status Karbon Monoksida (CO).
 */
function fuzzySugenoCO($ppm, $d0) {
    $muAman = triangularMF($ppm, 0, 0, 30);
    $muWaspada = triangularMF($ppm, 30, 40, 50);
    $muBahaya = triangularMF($ppm, 50, 80, 1000000000);

    if ($d0 == 1) {
        $muBahaya = 1.0;
        $muAman = 0.0;
    }

    $sum_w = $muAman + $muWaspada + $muBahaya;
    $sum_wz = ($muAman * 0.0) + ($muWaspada * 0.5) + ($muBahaya
* 1.0);
    $zFinal = ($sum_w == 0) ? 0.0 : $sum_wz / $sum_w;

    if ($zFinal <= 0.3) return "Aman";
    elseif ($zFinal <= 0.7) return "Waspada";
    else return "Bahaya";
}

// Mengemas data untuk respons JSON
$response = [
    'amonia' => $amonia_value,
    'metana' => $metana_value,
    'co' => $co_value,
    'amonia_status' => fuzzySugenoAmonia($amonia_value,
$d0_amonia),
    'metana_status' => fuzzySugenoMetana($metana_value,
$d0_metana),
    'co_status' => fuzzySugenoCO($co_value, $d0_co),
    'waktu' => $waktu
];

// Mengirimkan respons JSON
echo json_encode($response);
?>

```

### 3. Program Kodingan Website SmartENose: home.php

```

<?php
session_start();

```

```

// Memasukkan file konfigurasi database
require 'config.php';

// Cek apakah pengguna sudah login sebagai admin, jika tidak,
arahkan ke halaman login
if (!isset($_SESSION['admin'])) {
    header("Location: login.php");
    exit();
}

// Mengambil data sensor terbaru dari database
$query = $config->query("SELECT * FROM sensor_data ORDER BY
waktu DESC LIMIT 1");
$data_sensor = $query->fetch();

$amonia_value = $data_sensor['amonia'];
$metana_value = $data_sensor['metana'];
$co_value = $data_sensor['co'];

$d0_amonia = $data_sensor['d0_amonia'];
$d0_metana = $data_sensor['d0_metana'];
$d0_co = $data_sensor['d0_co'];

$waktu = date("d M Y, H:i:s", strtotime($data_sensor['waktu']));

/**
 * Fungsi untuk fuzzyfikasi triangular.
 */
function triangularMF($x, $a, $b, $c) {
    if ($x <= $a || $x >= $c) return 0.0;
    else if ($x == $b) return 1.0;
    else if ($x > $a && $x < $b) return ($x - $a) / ($b - $a);
    else return ($c - $x) / ($c - $b);
}

/**
 * Fungsi Fuzzy Sugeno untuk status Amonia (NH3).
 */
function fuzzySugenoAmonia($ppm, $d0) {
    $muAman = triangularMF($ppm, 0, 0, 10);
    $muWaspada = triangularMF($ppm, 10, 17.5, 25);
    $muBahaya = triangularMF($ppm, 25, 50, 1000000000);

    if ($d0 == 1) {
        $muBahaya = 1.0;
        $muAman = 0.0;
    }

    $w1 = $muAman;
    $z1 = 0.0;
    $w2 = $muWaspada;
    $z2 = 0.5;
    $w3 = $muBahaya;
    $z3 = 1.0;

    $sum_w = $w1 + $w2 + $w3;

```

```

    $sum_wz = ($w1 * $z1) + ($w2 * $z2) + ($w3 * $z3);

    $zFinal = ($sum_w == 0) ? 0.0 : $sum_wz / $sum_w;

    if ($zFinal <= 0.3) return "Aman";
    elseif ($zFinal <= 0.7) return "Waspada";
    else return "Bahaya";
}

/**
 * Fungsi Fuzzy Sugeno untuk status Metana (CH4).
 */
function fuzzySugenoMetana($ppm, $d0) {
    $muAman = triangularMF($ppm, 0, 0, 5000);
    $muWaspada = triangularMF($ppm, 5000, 7500, 10000);
    $muBahaya = triangularMF($ppm, 10000, 15000, 1000000000);

    if ($d0 == 1) {
        $muBahaya = 1.0;
        $muAman = 0.0;
    }

    $w1 = $muAman;
    $z1 = 0.0;
    $w2 = $muWaspada;
    $z2 = 0.5;
    $w3 = $muBahaya;
    $z3 = 1.0;

    $sum_w = $w1 + $w2 + $w3;
    $sum_wz = ($w1 * $z1) + ($w2 * $z2) + ($w3 * $z3);
    $zFinal = ($sum_w == 0) ? 0.0 : $sum_wz / $sum_w;

    if ($zFinal <= 0.3) return "Aman";
    elseif ($zFinal <= 0.7) return "Waspada";
    else return "Bahaya";
}

/**
 * Fungsi Fuzzy Sugeno untuk status Karbon Monoksida (CO).
 */
function fuzzySugenoCO($ppm, $d0) {
    $muAman = triangularMF($ppm, 0, 0, 30);
    $muWaspada = triangularMF($ppm, 30, 40, 50);
    $muBahaya = triangularMF($ppm, 50, 80, 1000000000);

    if ($d0 == 1) {
        $muBahaya = 1.0;
        $muAman = 0.0;
    }

    $w1 = $muAman;
    $z1 = 0.0;
    $w2 = $muWaspada;
    $z2 = 0.5;
    $w3 = $muBahaya;
}

```

```

    $z3 = 1.0;

    $sum_w = $w1 + $w2 + $w3;
    $sum_wz = ($w1 * $z1) + ($w2 * $z2) + ($w3 * $z3);
    $zFinal = ($sum_w == 0) ? 0.0 : $sum_wz / $sum_w;

    if ($zFinal <= 0.3) return "Aman";
    elseif ($zFinal <= 0.7) return "Waspada";
    else return "Bahaya";
}

$status_amonia = fuzzySugenoAmonia($amonia_value, $d0_amonia);
$status_metana = fuzzySugenoMetana($metana_value, $d0_metana);
$status_co = fuzzySugenoCO($co_value, $d0_co);

/**
 * Fungsi untuk menentukan kelas CSS Bootstrap.
 */
function labelClass($status) {
    if ($status == "Aman") return "label label-success";
    elseif ($status == "Waspada") return "label label-warning";
    else return "label label-danger";
}
?>
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="utf-8">
    <title>Dashboard SmartENose</title>
    <link rel="stylesheet" href="assets/css/bootstrap.css">
    <link rel="stylesheet" href="assets/font-awesome/css/font-
awesome.css">
    <style>
        .panel-heading {
            font-weight: bold;
        }
    </style>
</head>
<body>
    <section id="main-content">
        <section class="wrapper">
            <h2><i class="fa fa-tachometer"></i> Dashboard
SmartENose</h2>
            <hr>
            <div class="row">
                <div class="col-md-4">
                    <div class="panel panel-primary">
                        <div class="panel-heading bg-primary
text-white">
                            <h4><i class="fa fa-cloud"></i>
Kadar Amonia (NH3)</h4>
                        </div>
                        <div class="panel-body text-center">
                            <h1 id="amonia_value"></h1>
                            <h4>Status: <span
id="amonia_status"></span></h4>

```

```

        </div>
        <div class="panel-footer text-
center">Terakhir diperbarui: <?= $waktu ?></div>
        </div>
    </div>
    <div class="col-md-4">
        <div class="panel panel-danger">
            <div class="panel-heading bg-danger
text-white">
                <h4><i class="fa fa-fire"></i> Kadar
Metana (CH4)</h4>
            </div>
            <div class="panel-body text-center">
                <h1 id="metana_value"></h1>
                <h4>Status: <span
id="metana_status"></span></h4>
            </div>
            <div class="panel-footer text-
center">Terakhir diperbarui: <?= $waktu ?></div>
        </div>
    </div>
    <div class="col-md-4">
        <div class="panel panel-warning">
            <div class="panel-heading bg-warning
text-dark">
                <h4><i class="fa fa-cloud"></i>
Kadar Karbon Monoksida (CO)</h4>
            </div>
            <div class="panel-body text-center">
                <h1 id="co_value"></h1>
                <h4>Status: <span
id="co_status"></span></h4>
            </div>
            <div class="panel-footer text-
center">Terakhir diperbarui: <?= $waktu ?></div>
        </div>
    </div>
</div>
<div class="row">
    <div class="col-md-12">
        <div class="panel panel-default">
            <div class="panel-heading">
                <h4><i class="fa fa-table"></i>
Tabel Ambang Batas Gas</h4>
            </div>
            <div class="panel-body text-center">
                <table class="table table-bordered
table-hover">
                    <thead style="background-color:
#f2f2f2;">
                        <tr>
                            <th>Jenis Gas</th>
                            <th>Aman</th>

```

```

        <th>Waspada</th>
        <th>Bahaya</th>
    </tr>
</thead>
<tbody>
<tr>
        <td>Amonia (NH3)</td>
        <td>< 10 ppm</td>
        <td>10 - 25 ppm</td>
        <td>> 25 ppm</td>
    </tr>
<tr>
        <td>Metana (CH4)</td>
        <td>< 5000 ppm</td>
        <td>5000 - 10000
ppm</td>
        <td>> 10000 ppm</td>
    </tr>
<tr>
        <td>Karbon Monoksida
(CO)</td>
        <td>≤ 30 ppm</td>
        <td>31 - 50 ppm</td>
        <td>> 50 ppm</td>
    </tr>
</tbody>
</table>
</div>
</div>
</div>
</div>
<div class="row">
    <div class="col-md-12">
        <div class="panel panel-default">
            <div class="panel-heading">
                <h4><i class="fa fa-exclamation-
triangle"></i> Tabel 3.6 Kombinasi Tingkat Bahaya Level Gas</h4>
            </div>
            <div class="panel-body text-center">
                <table class="table table-bordered
table-hover">
                    <thead style="background-color:
#f2f2f2;">
                        <tr>
                            <th>Status Amonia</th>
                            <th>Status Metana</th>
                            <th>Status Karbon
Monoksida</th>
                            <th>Level Bahaya</th>
                        </tr>
                    </thead>
                    <tbody>
                        <tr>
                            <td>Aman</td>
                            <td>Aman</td>

```

```

        <td>Aman</td>
        <td>0</td>
    </tr>
    <tr>
        <td>Aman</td>
        <td>Aman</td>
        <td>Bahaya</td>
        <td>3</td>
    </tr>
    <tr>
        <td>Aman</td>
        <td>Bahaya</td>
        <td>Aman</td>
        <td>1</td>
    </tr>
    <tr>
        <td>Aman</td>
        <td>Bahaya</td>
        <td>Bahaya</td>
        <td>4</td>
    </tr>
    <tr>
        <td>Bahaya</td>
        <td>Aman</td>
        <td>Aman</td>
        <td>2</td>
    </tr>
    <tr>
        <td>Bahaya</td>
        <td>Aman</td>
        <td>Bahaya</td>
        <td>5</td>
    </tr>
    <tr>
        <td>Bahaya</td>
        <td>Bahaya</td>
        <td>Aman</td>
        <td>3</td>
    </tr>
    <tr>
        <td>Bahaya</td>
        <td>Bahaya</td>
        <td>Bahaya</td>
        <td>6</td>
    </tr>
</tbody>
</table>
</div>
</div>
</div>
</div>
</section>
</section>
<script src="assets/js/jquery.js"></script>
<script>
    function updateSensorData() {

```

```

$.ajax({
    url: 'api/get_sensor_data.php',
    method: 'GET',
    dataType: 'json',
    success: function(data) {

$('#amonia_value').text(data.amonia.toFixed(2) + ' ppm');

$('#metana_value').text(data.metana.toFixed(2) + ' ppm');
        $('#co_value').text(data.co.toFixed(2) + '
ppm');

        $('#amonia_status').html("<span class='label
" + getLabelClass(data.amonia_status) + "'>" +
data.amonia_status + "</span>");
        $('#metana_status').html("<span class='label
" + getLabelClass(data.metana_status) + "'>" +
data.metana_status + "</span>");
        $('#co_status').html("<span class='label " +
getLabelClass(data.co_status) + "'>" + data.co_status +
"</span>");

        $('#panel-footer').text('Terakhir
diperbarui: ' + data.waktu);
    }
});
}

function getLabelClass(status) {
    if (status === "Aman") return "label-success";
    if (status === "Waspada") return "label-warning";
    return "label-danger";
}

setInterval(updateSensorData, 2000);
updateSensorData();
</script>
</body>
</html>

```