

**SMART TILT GARAGE MONITORING WITH NODE-RED**

Group 3

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**PROJECT INFORMATION**

Project Title : Smart Tilt Garage Monitoring With Node-RED

Code Language : C++

Batch Code : 3ISA2

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Name of Faculty : Listyo Edi Prabowo, S.T., M.T.

Names of Developer :

1. Alfonda Dimas Cahaya
2. Ferdi Alwan Muhammad

**CERTIFICATE OF ORIGINALITY**

This is to certify that the project report titled "Smart Garage" is an original work completed by Alfonda Dimas Cahaya, and Ferdi Alwan Muhammad. This project has been submitted in partial fulfillment of their course requirement at the National Institute of Information Technology (NIIT).

The project report has been prepared under our guidance and supervision, and it is ensured that the work presented in this report is the result of the individual efforts of the aforementioned students. The contents of this report have not been submitted to any other institution or organization for the award of any degree, diploma, or other similar recognition.

Author acknowledge that the ideas, designs, and implementations presented in this project report are the intellectual properties of the students mentioned above. Any use or reproduction of this work must give proper credit to the original authors.

Author hereby endorse the authenticity and originality of the work presented in this project report and confirm that it meets the academic standards and requirements set forth by the National Institute of Information Technology (NIIT).



Coordinator :

Listyo Edi Prabowo, S.T., M.T.

**ACKNOWLEDGEMENT**

Author would like to acknowledge the completion of the insightful paper entitled "Smart Tilt Garage Monitoring With Node-RED." This paper comprehensively discusses the integration of Internet of Things (IoT) technology enhancing their efficiency, security, and convenience for users.

The contents of this paper provide a detailed overview of the current state of Tilt Garage systems and the potential benefits of incorporating IoT technology. The authors have meticulously examined the various aspects of IoT, such as remote access, real-time monitoring, and seamless integration with other smart home devices. Furthermore, the paper explores the challenges and limitations associated with the implementation of IoT in tilt garage, offering valuable insights for future research and development in this area.

Overall, the paper serves as a significant contribution to the growing body of knowledge on IoT applications in the context of residential security and smart living. It is evident that the “Smart Tilt Garage Monitoring With Node-RED.” has the potential to revolutionize the way author secure and manage our homes, paving the way for a safer and more connected living environment.

Depok, 25 December 2023

Authors

**SYSTEM ANALYSIS**

In today's modern era, a smart garage project utilizing ESP32 technology combined with RFID, ultrasonic, and IR sensors offers an innovative solution to enhance security and convenience in managing vehicular access within a garage. This project stands out by integrating multiple sensors to ensure safe and efficient access.

This project is particularly relevant for garage owners seeking stricter control over vehicular access. With the combination of RFID and ultrasonic sensors, owners can ensure that only authorized vehicles gain entry or exit. Additionally, the ability to monitor the garage's status in real-time via a website adds an extra layer of convenience and security, enabling swift actions when necessary.

Components Used:

* RFID RC522: Used to recognize and validate RFID tags on vehicles. When a tag is detected, the ESP32 grants access for entry or exit.
* Ultrasonic HC-SR04: Positioned at the garage exit, ensuring the door only opens when a vehicle is moving outward. This sensor effectively detects nearby objects, ensuring safety around the garage.
* IR Sensor: Functions to ensure that a vehicle has completely entered or exited the garage before the door closes.
* Servo: Controls the garage door's movement, allowing it to open and close automatically based on ESP32 instructions.
* ESP32: The primary microcontroller that integrates all components, controlling the system's logic based on sensor inputs.
* Breadboard: A temporary platform for arranging and connecting components, facilitating the prototyping process.
* Jumping Wire (Male to Male & Male to Female): Jumper cables used to connect the ESP32 to other components, simplifying component integration without soldering.

**SYSTEM ANALYSIS**

Programming Language and Others:

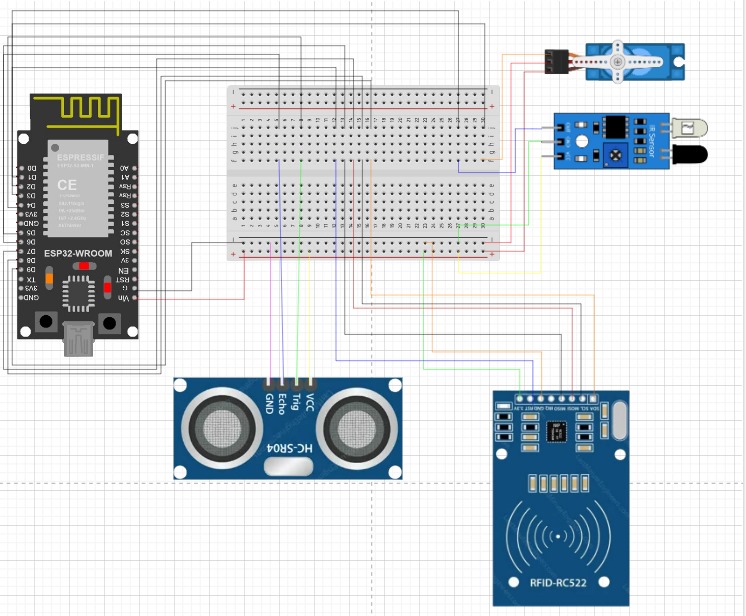
C++ Programming Language: Utilized to write code for the ESP32, ensuring efficiency and optimal performance. C++ was chosen due to its capability in managing microcontroller resources and its compatibility with various IoT applications.

This Project is integrated with node-red as the monitoring of Smart Tilt Garage that can be accessed from remote or website. And the communication between ESP32 and Node-red is by MQTT protocol.

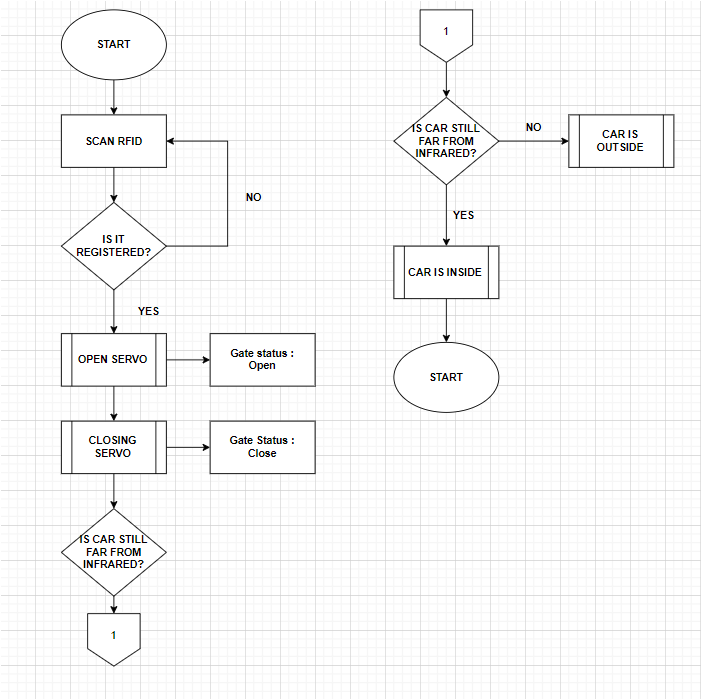
Every data that was send to node-red from esp32. Will be saved into its database that has been created in mySQL for the databases.

Overall, this smart garage project offers sophisticated technological integration to enhance security and convenience in managing vehicular access within the garage, leveraging the strengths of each component utilized.

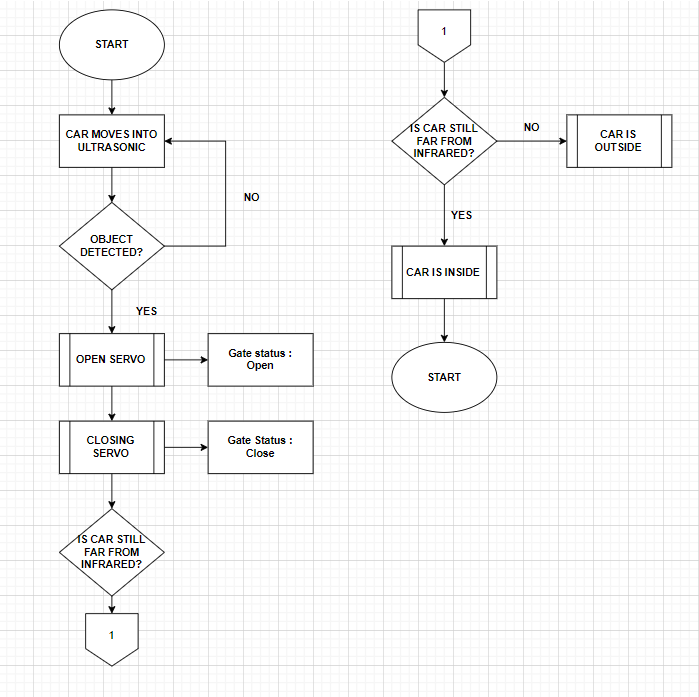
**DIAGRAM**



**FLOWCHART**



**FLOWCHART**



**HARDWARE**

1. ESP32



1. Breadboard



1. RFID RC522



1. Ultrasonic HC-SR04



1. Servo motor



**HARDWARE**

1. IR Sensor



1. RFID Card



1. Jumping wires Male to male and Female to male



1. USB Cable



**CODE PROGRAM**

#define DISTANCE\_THRESHOLD 5

#define RFID\_SS\_PIN 21

#define RFID\_RST\_PIN 22

#define INTERVAL 1000

Servo myservo; // servo object

unsigned long lastDetectionTime = 0;

MFRC522 mfrc522(RFID\_SS\_PIN, RFID\_RST\_PIN);

const int MAX\_CARDS = 6;

String registeredCards[MAX\_CARDS] = {

  "371165245",

  "514093134661620",

  "45483138249110128",

};

bool CarisInside = false;

const char \*ssid = "wifi.id";

const char \*password = "cienumpangwifi";

const char \*mqtt\_server = "test.mosquitto.org";

const char\* mqtt\_topic1 = "/Node-RED-Co";

const char\* mqtt\_topic2 = "/Node-RED-Ci";

const char\* mqtt\_topic3 = "/Node-RED-Do";

const char\* mqtt\_topic4 = "/Node-RED-Dc";

const char\* mqtt\_topic5 = "/Node-RED-User";

WiFiClient espClient;

PubSubClient client(espClient);

long lastMsg = 0;

char msg[50];

int value = 0;

**CODE PROGRAM**

void setup()

{

    Serial.begin(115200);

    pinMode(TRIGGER\_PIN, OUTPUT);

    pinMode(ECHO\_PIN, INPUT);

    pinMode(IR\_SENSOR\_PIN, INPUT);

    myservo.attach(SERVO\_PIN);

    SPI.begin();

    mfrc522.PCD\_Init();

    setup\_wifi();

    client.setServer(mqtt\_server, 1883);

    client.setCallback(callback);

}

void setup\_wifi()

{

    delay(10);

    Serial.println();

    Serial.print("Connecting to ");

    Serial.println(ssid);

    WiFi.begin(ssid, password);

    while (WiFi.status() != WL\_CONNECTED)

    {

        delay(500);

        Serial.print(".");

    }

    Serial.println("");

    Serial.println("WiFi connected");

    Serial.println("IP address: ");

    Serial.println(WiFi.localIP());

}

**CODE PROGRAM**

void callback(char \*topic, byte \*payload, unsigned int length)

{

    String string;

    Serial.print("Message arrived [");

    Serial.print(topic);

    Serial.print("] ");

    for (int i = 0; i < length; i++)

    {

        string += ((char)payload[i]);

    }

    Serial.print(string);

    if (String(topic) == "/ThinkIOT/Servo-nodered")

    {

        Serial.print(" ");

        int status = string.toInt();

        int pos = map(status, 1, 100, 0, 180);

        Serial.println(pos);

        myservo.write(pos);

        delay(15);

    }

}

void reconnect()

{

    while (!client.connected())

    {

        Serial.print("Attempting MQTT connection...");

        if (client.connect("ESPClient"))

        {

            Serial.println("connected");

            client.subscribe("/ThinkIOT/Servo-nodered");

        }

        else

        {

            Serial.print("failed, rc=");

            Serial.print(client.state());

            Serial.println(" try again in 5 seconds");

            delay(5000);

        }

    }

**CODE PROGRAM**

void loop() {

  if (!client.connected()) {

    reconnect();

  }

  client.loop();

  handleRFID();

  ultrasonicCondition();

  infrared();

  delay(100);

}

void handleRFID() {

  if (mfrc522.PICC\_IsNewCardPresent() && mfrc522.PICC\_ReadCardSerial()) {

    //Serial.println("Kartu RFID terdeteksi!");

    String cardSerial = getCardSerial();

    //Serial.println("Serial Number Kartu: " + cardSerial);

    if (isCardRegistered(cardSerial)) {

      //Serial.println("Kartu terdaftar. Membuka servo...");

        openServo();

        delay(2000);

        client.publish(mqtt\_topic5, cardSerial.c\_str());

        delay(3000);

        closeServo();

    } else {

      Serial.println("Kartu tidak terdaftar.");

    }

  }

}

String getCardSerial() {

  String cardSerial = "";

  for (byte i = 0; i < mfrc522.uid.size; i++) {

    cardSerial += String(mfrc522.uid.uidByte[i]);

  }

  return cardSerial;

}

**CODE PROGRAM**

bool isCardRegistered(String cardSerial) {

  for (int i = 0; i < MAX\_CARDS; i++) {

    if (registeredCards[i] == cardSerial) {

      return true;

    }

  }

  return false;

}

bool ultrasonicCondition()

{

    long duration, distance;

    digitalWrite(TRIGGER\_PIN, LOW);

    delayMicroseconds(2);

    digitalWrite(TRIGGER\_PIN, HIGH);

    delayMicroseconds(10);

    digitalWrite(TRIGGER\_PIN, LOW);

    duration = pulseIn(ECHO\_PIN, HIGH);

    distance = duration \* 0.034 / 2;

    if (distance < DISTANCE\_THRESHOLD)

    {

        openServo();

        delay(5000);

        closeServo();

        return true;

    }

    return false;

}

bool cardetected() {

  return digitalRead(IR\_SENSOR\_PIN) == HIGH;

}

**CODE PROGRAM**

void infrared()

{

    if (cardetected())

    {

        if (!CarisInside)

        {

            Serial.println("Car is Outside");

            client.publish(mqtt\_topic1, "Car is Outside");

            CarisInside = true;

        }

    }

    else

    {

        if (CarisInside)

        {

            Serial.println("Car is Inside");

            client.publish(mqtt\_topic2, "Car Is inside");

            CarisInside = false;

        }

    }

    delay(INTERVAL);

}

void openServo()

{

  myservo.write(120);

  Serial.println("Door is Open");

  client.publish(mqtt\_topic3, "Door is Open");

}

void closeServo()

{

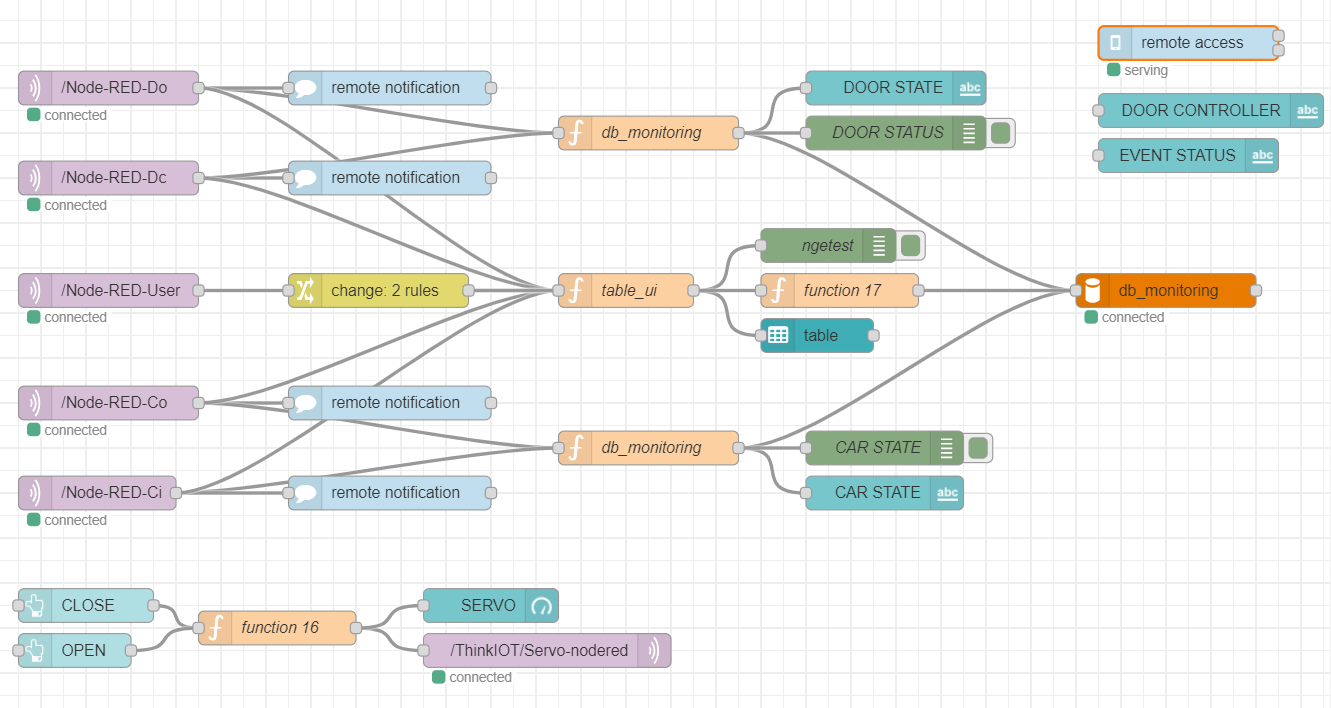
  myservo.write(0);

  Serial.println("Door is Close");

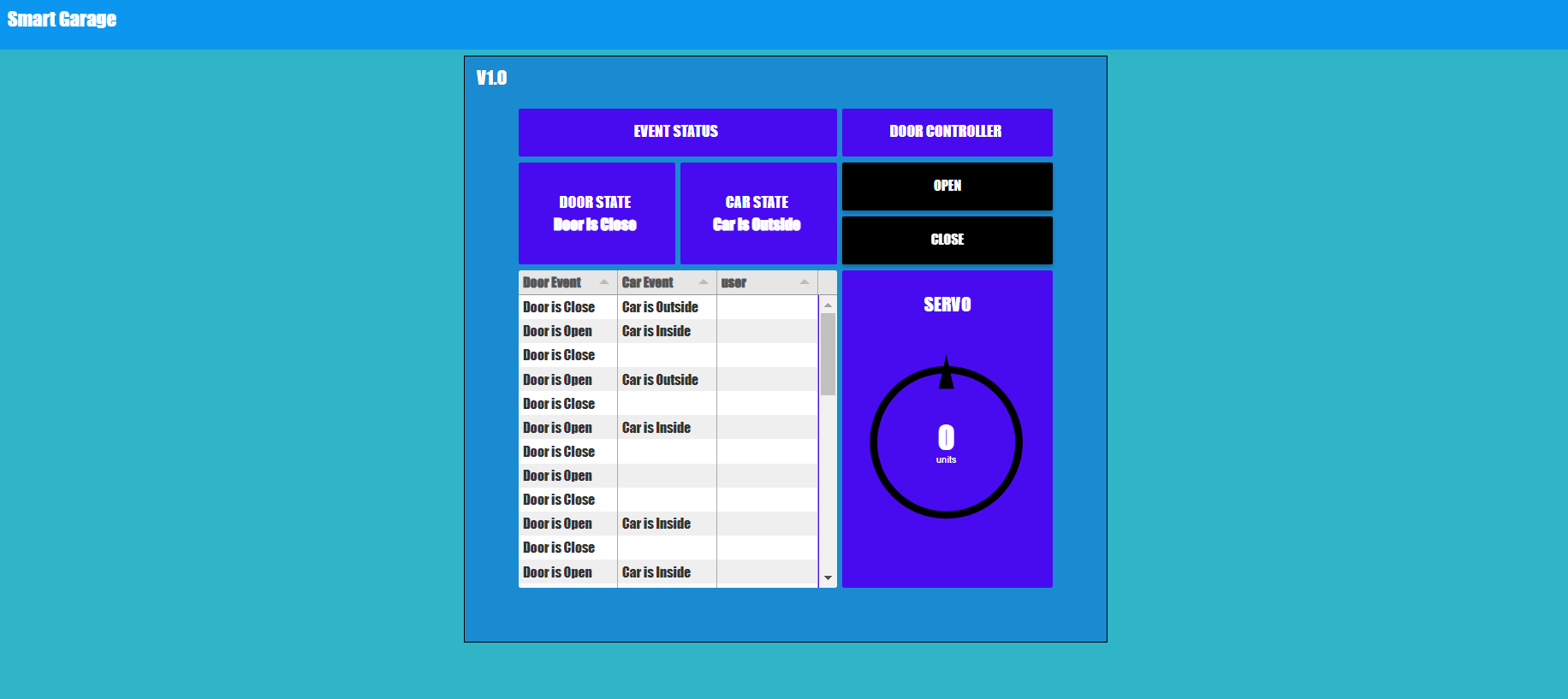
  client.publish(mqtt\_topic4, "Door is Close");

}

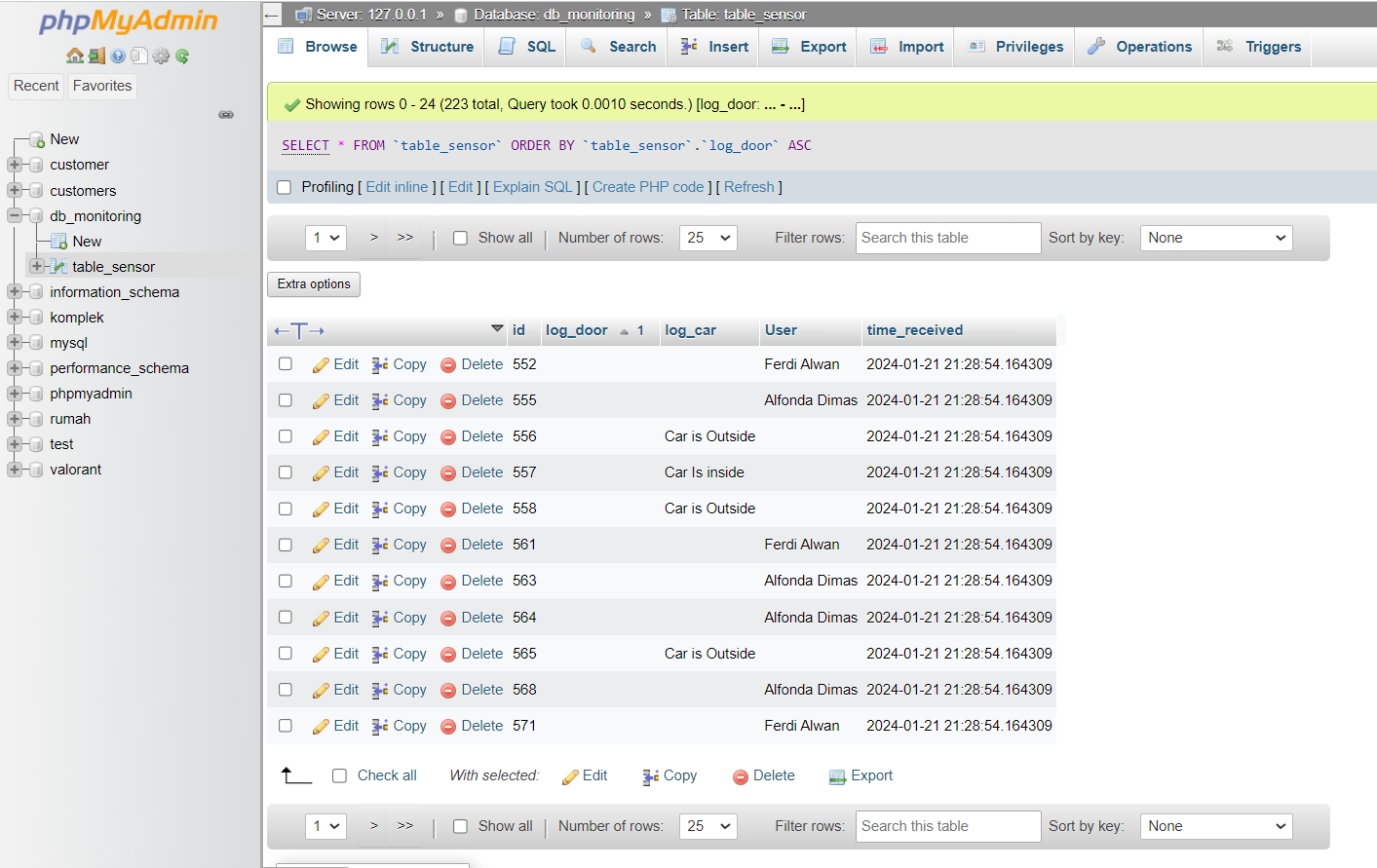
**NODE-RED FLOW**



**UI DASHBOARD**



**DATABASE**



**ADVANTAGES**

1. Enhanced Security: With the combination of RFID, ultrasonic sensors, and an IR sensor, the garage ensures multiple layers of security to prevent unauthorized access.
2. Automated Operation: The system's automation allows for seamless entry and exit, reducing the need for manual interventions.
3. Real-time Monitoring: Users have the ability to monitor the garage's status in real-time through the provided website, adding convenience.
4. Flexibility: By using an ESP32, the system can easily be integrated with other IoT devices or expanded upon in the future.
5. Remote Control: The ability to control the servo from the HTML page provides users with the flexibility to manage the garage's access remotely.
6. User-friendly Interface: The web-based control panel offers an intuitive interface for users to interact with the system.
7. Customization: Given the modular nature of the project, users can customize and add features based on specific requirements or preferences.

**DISADVANTAGES**

1. Dependence on Internet: The system's reliance on a web interface means it might be affected if there's an internet outage or connectivity issues.
2. Potential Vulnerabilities: Web-based control might be susceptible to hacking attempts if not adequately secured.
3. Complexity: For users unfamiliar with IoT or web interfaces, the setup and maintenance of the system might be challenging.
4. Cost: Implementing multiple sensors, an ESP32, and a servo might lead to higher initial costs compared to traditional garage security systems.
5. Maintenance: IoT devices, like the ESP32 and sensors, might require regular updates or troubleshooting, adding to maintenance efforts.
6. Limited Physical Security: While the system provides electronic security, the physical integrity of the garage door and surrounding structures also plays a crucial role.
7. Power Dependency: The system's operation is dependent on continuous power, and any power interruptions could disrupt its functionality.

**CONCLUSION**

The "Smart Garage" project, built upon the foundation of ESP32 technology and an array of sensors, represents a commendable stride towards modernizing garage security and convenience. By integrating advanced IoT capabilities like RFID recognition, ultrasonic detection, and real-time web-based monitoring, the project exemplifies the potential of smart technologies in refining everyday residential functionalities.

From a security standpoint, the project offers robust features, ensuring that vehicular access is both restricted and monitored. The layered approach to security through multiple sensors enhances the reliability of the system, while the real-time monitoring capability offers homeowners unprecedented oversight over their garage's status.

However, like all technological advancements, the project is not without its challenges. Concerns about internet dependence, potential vulnerabilities, and the initial investment required might deter some users. Additionally, while the electronic aspects of security are well-addressed, the broader physical security considerations of the garage infrastructure remain pivotal.

In essence, the "Smart Garage" project is a testament to the evolving landscape of smart home technologies. While it presents a compelling solution for those seeking advanced garage management, potential adopters should weigh the benefits against the associated challenges to determine its suitability for their specific needs and circumstances.