19Z604 - EMBEDDED SYSTEMS LABORATORY

DOOR UNLOCKING USING RFID AND SIMPLE HOME AUTOMATION

Elavendhan K P - 21z306
Saam Dennis S -21z340
Suriya E - 21z361
Vaishnev A P - 21z367
Vijay K S - 21z369
Amritharaj B - 21Iz02

BACHELOR OF ENGINEERING

Branch: COMPUTER SCIENCE AND ENGINEERING
of Anna University

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
PSG COLLEGE OF TECHNOLOGY
(Autonomous Institution)
COIMBATORE – 641 004

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1. Problem Statement

In modern living environments, security, convenience, and comfort are paramount concerns for residents. However, existing door entry systems often face several challenges that hinder their effectiveness. These challenges include the risk of unauthorized access attempts, false alarms triggered by motion sensors, compatibility issues with RFID cards, and inadequate environmental comfort control. Additionally, there's a lack of clear user feedback in many systems, leading to user confusion and frustration.

Hence, there's a pressing need to develop an advanced door entry system that addresses these challenges comprehensively. This system should prioritize security by effectively preventing unauthorized access attempts while also ensuring convenience for authorized users. It should incorporate technologies such as RFID for access control, motion sensors to detect approaching individuals, and environmental sensors to maintain optimal comfort levels. Additionally, providing clear visual feedback to users during interaction with the system is crucial for enhancing user experience and reducing ambiguity.

Therefore, the problem statement revolves around designing and implementing a robust door entry system that overcomes these challenges to provide residents with a seamless, secure, and comfortable living experience.

2. Components Used

- DHT11 Sensor
- PIR Motion Sensor
- Voltage Regulator
- Axial Fan
- RFID Module(sensor)
- Jumper Wires
- ESP32
- Arduino Nano
- Breadboard
- OLED 128x64 Display
- Electric Door Lock

3. Sensors Used in Our Project

- DHT11 Temperature and Humidity Sensor
- PIR Motion Sensor
- RFID Module

4. Circuit Diagram

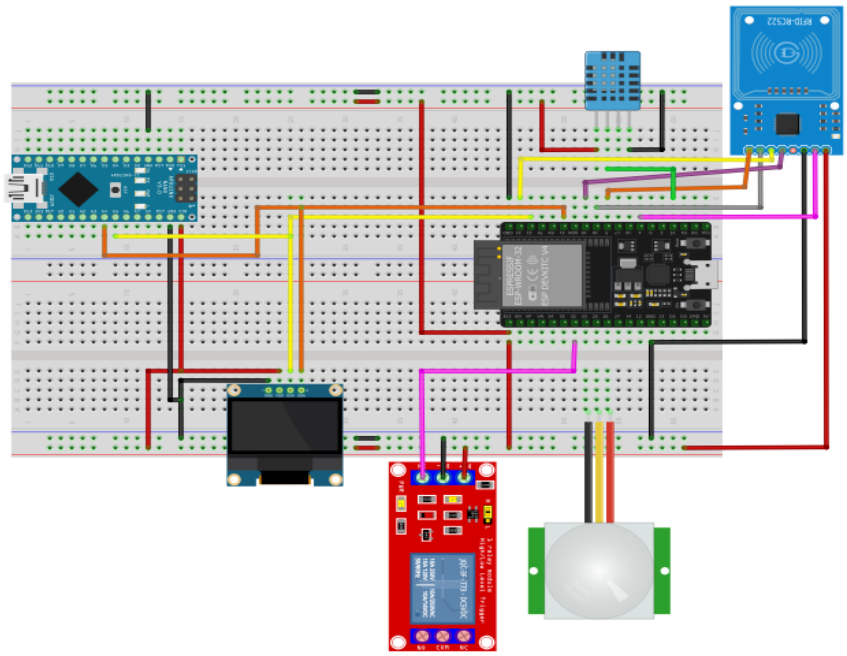

Fig 1Circuit Diagram

5. Code

```
#include <SPI.h>
#include <MFRC522.h>
#include <WiFi.h>
#include <WebServer.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
#include <DHT.h>

#define SS_PIN 5 // ESP32 pin GPIO5
#define RST_PIN 4 // ESP32 pin GPIO4
#define RELAY_PIN 32 // ESP32 pin GPIO32 controls the solenoid lock via the relay
#define PIR_PIN 14 // ESP32 pin GPIO14 for PIR sensor
#define DHT_PIN 15 // ESP32 pin GPIO15 for DHT11 sensor
#define OLED_SDA 21 // Define the OLED SDA pin
#define OLED_SCL 22 // Define the OLED SCL pin
#define SCREEN_WIDTH 128 // OLED display width, in pixels
#define SCREEN_HEIGHT 32 // OLED display height, in pixels
```

```
MFRC522 rfid(SS_PIN, RST_PIN);
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT,
&Wire, -1);
DHT dht(DHT_PIN, DHT11);
WebServer server(80);

const char *ssid = "ESP32-DoorLock";
const char *password = "123456789";
byte authorizedUID[4] = {0xF3, 0x07, 0x96, 0xF4};
bool accessGranted = false;
bool doorClosed = false;
unsigned long unlockTime = 0;
float temperature = 0.0;
float humidity = 0.0;

void readDHTSensor() {
  temperature = dht.readTemperature();
  humidity = dht.readHumidity();
}

void setup() {
  Serial.begin(115200);
  SPI.begin();
  rfid.PCD_Init();
  pinMode(RELAY_PIN, OUTPUT);
  digitalWrite(RELAY_PIN, LOW);
  pinMode(PIR_PIN, INPUT);
  pinMode(33, OUTPUT);
  Wire.begin(OLED_SDA, OLED_SCL);

  if (!display.begin(SSD1306_SWITCHCAPVCC, 0x3C)) {
    Serial.println(F("SSD1306 allocation failed"));
    for (;;) {}
  }

  dht.begin();

  display.clearDisplay();
  display.setTextSize(1);
  display.setTextColor(SSD1306_WHITE);
  display.setCursor(0, 0);
  display.println("Please tap your card to unlock the door");
```

```
  display.display();

  Serial.println("Starting SoftAP");
  WiFi.softAP(ssid, password);
  delay(100);
  IPAddress IP = WiFi.softAPIP();
  Serial.print("AP IP address: ");
  Serial.println(IP);

  server.on("/", HTTP_GET, []() {
    readDHTSensor();

    String response = "<!DOCTYPE html><html><head><title>Door
Lock</title>";
    // HTML styling and script omitted for brevity
    server.send(200, "text/html", response);
  });

  // Additional server routes and handlers omitted for brevity

  server.begin();
}

void loop() {
  server.handleClient();

  // RFID card detection and authentication
  if (rfid.PICC_IsNewCardPresent()) {
    if (rfid.PICC_ReadCardSerial()) {
      if (compareUID()) {
        accessGranted = true;
        unlockTime = millis();
        digitalWrite(RELAY_PIN, LOW);
        displayMessage("Access Granted");
      } else {
        accessGranted = false;
        displayMessage("Access Denied");
      }
      rfid.PICC_HaltA();
      rfid.PCD_StopCrypto1();
    }
  }
```

```
  // PIR motion detection
  if (accessGranted && digitalRead(PIR_PIN) == HIGH) {
    digitalWrite(33, LOW); // Turn on the light
    Serial.println("Motion detected");
  } else {
    digitalWrite(33, HIGH); // Turn off the light
  }

  // Reset access status after a certain time
  if (accessGranted && (millis() - unlockTime >= 8000)) {
    accessGranted = false;
    digitalWrite(RELAY_PIN, HIGH);
    displayMessage("Please tap your card to unlock the door");
  }

  // Display message when the door is closed
  if (doorClosed && !accessGranted) {
    displayMessage("Please tap your card");
    doorClosed = false;
  }
}

bool compareUID() {
  for (int i = 0; i < 4; i++) {
    if (rfid.uid.uidByte[i] != authorizedUID[i]) {
      return false;
    }
  }
  return true;
}

void displayMessage(String message) {
  display.clearDisplay();
  display.setCursor(0, 0);
  display.println(message);
  display.display();
}
```

6. Photos and ScreenShot of Project

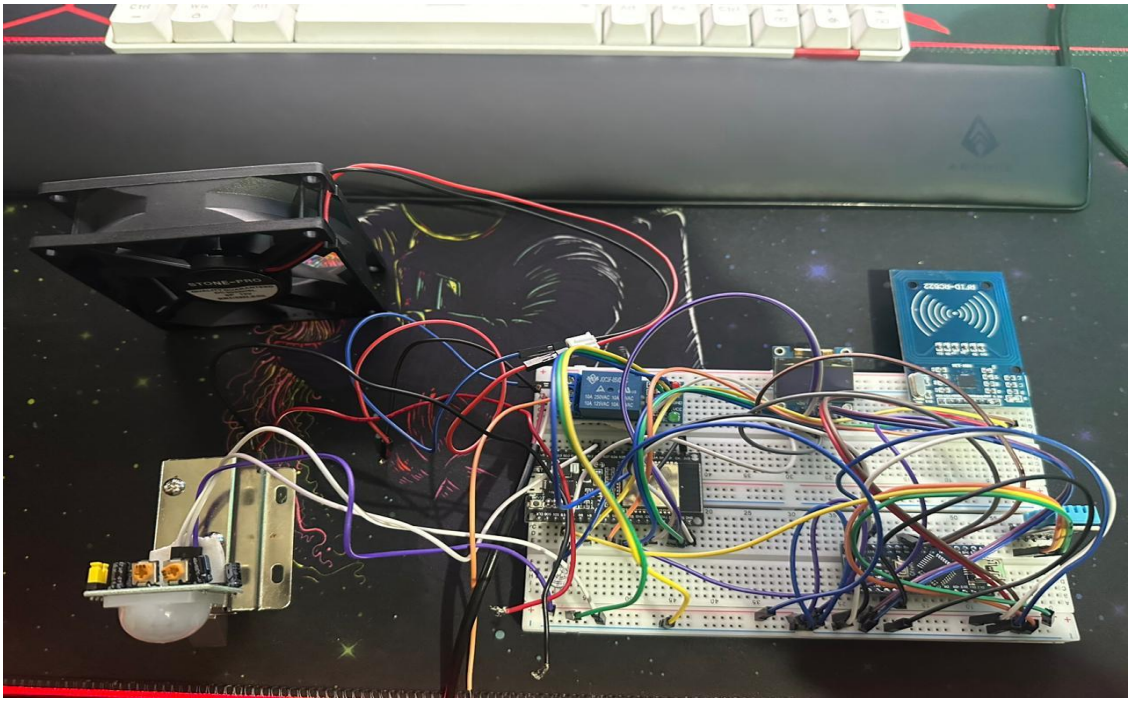

Fig 2 Overall project Hardware Interface

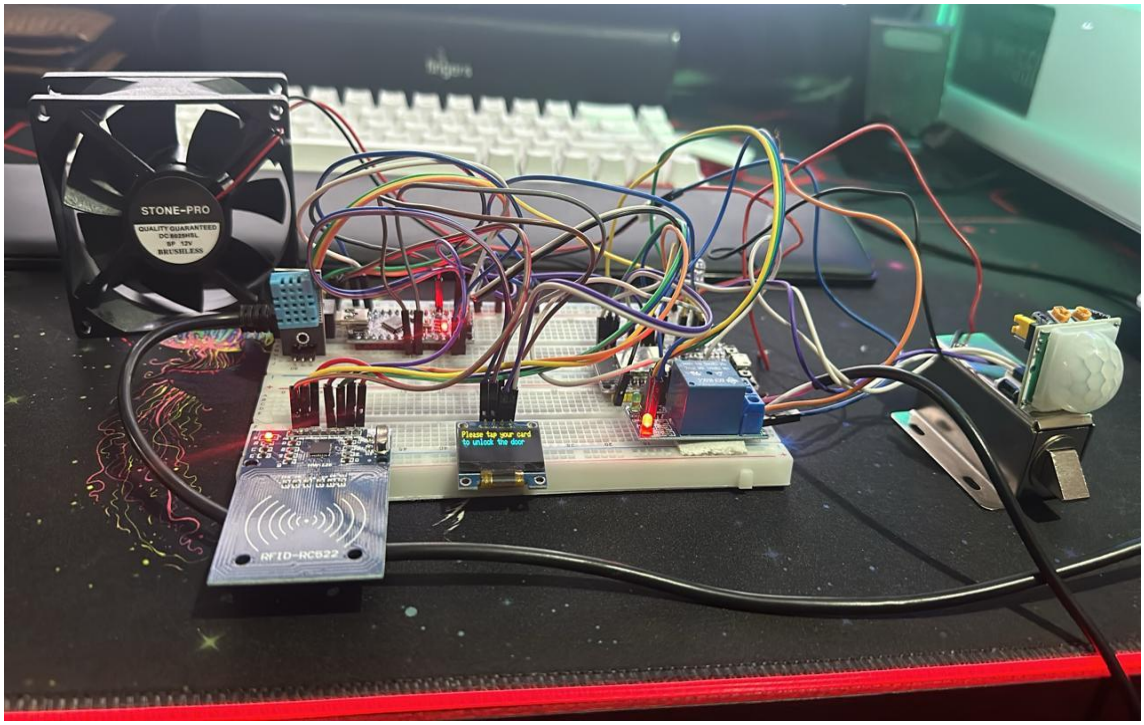

Fig 3 Project setup

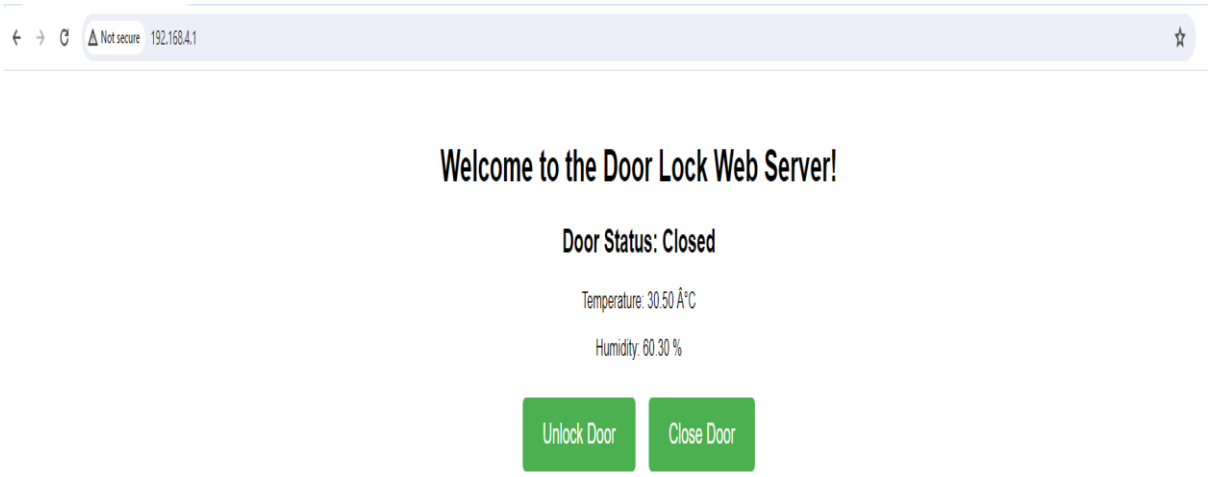

Fig 4 Website showing locked door status ,temperature and humidity

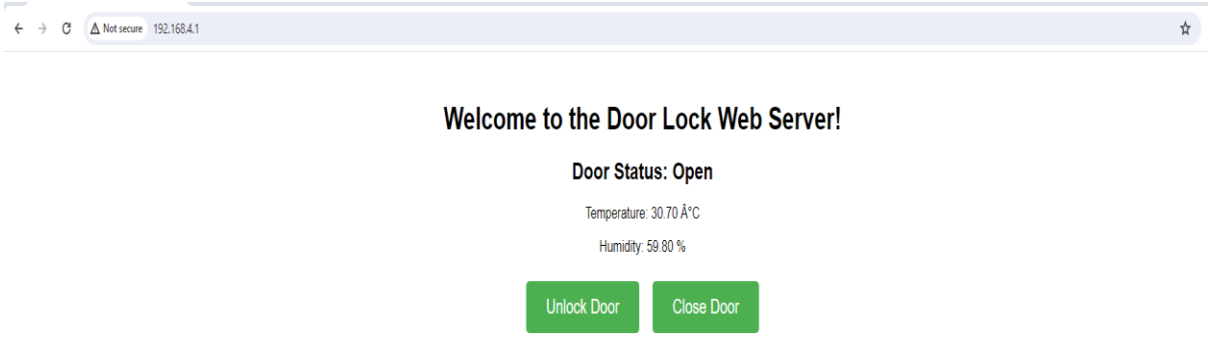

Fig 5 Website showing open door status ,temperature and humidity

Conclusion

In conclusion, the project successfully integrates RFID-based access control with a web server interface on the ESP32 platform, along with the incorporation of environmental sensors for monitoring temperature and humidity levels. The system effectively manages access to the door, granting or denying entry based on the authentication of RFID cards. Additionally, it provides real-time feedback to users through an OLED display and allows remote monitoring and control via a web interface. The inclusion of PIR motion detection enhances security by activating lights when motion is detected near the door. Overall, this project demonstrates a robust and versatile solution for door access control and environmental monitoring in various settings.