SMART ATTENDANCE SYSTEM USING RFID AND ESP32

UIT2412 – DIGITAL SYSTEMS AND MICROPROCESSOR

Guided by

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A PROJECT REPORT

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1. ABSTRACT:

In academic and professional institutions, efficient attendance tracking is a critical component for maintaining discipline and monitoring participation. Manual attendance systems are often prone to human error, time consumption, and manipulation. This project addresses these limitations by implementing an automated attendance system based on Radio Frequency Identification (RFID) technology, ensuring a more reliable and streamlined process.

The system employs an ESP32 microcontroller to read RFID tags assigned to individual users. Upon scanning, the ESP32 transmits the attendance data—such as Name, Date, and Time—directly to a Microsoft Excel spreadsheet using the PLX-DAQ interface. This eliminates the need for intermediary databases and simplifies record management, making it suitable for real-time applications in schools, colleges, or workplaces.

The proposed solution offers a low-cost, scalable, and user-friendly method for attendance management. It ensures fast identification, reduces manual effort, and minimizes the chances of proxy entries. With Excel as the central data repository, administrators can easily analyze, retrieve, or export attendance logs as needed for reporting or auditing purposes.

2. INTRODUCTION:

Attendance management in educational institutions, offices, and other organizations plays a significant role in tracking the participation and punctuality of individuals. Traditionally, manual systems such as paper registers, sign-in sheets, or even biometric systems have been used, but these methods often come with issues such as errors in record-keeping, manipulation of data, and the need for labor-intensive administrative efforts. With the growth of technology, automated attendance systems have emerged as a solution to address these challenges, offering accuracy, efficiency, and time-saving benefits.

One of the most promising solutions in recent years is the integration of Radio Frequency Identification (RFID) technology. RFID is a contactless, non-invasive technology that allows the identification and tracking of objects or individuals via radio waves. When paired with a microcontroller such as the ESP32, RFID technology can be used to automatically record attendance by scanning unique RFID tags associated with individuals. This approach eliminates human errors, reduces the time taken to mark attendance, and enhances the overall efficiency of the system.

This project aims to develop an automated attendance system using RFID technology integrated with the ESP32 microcontroller. The system will capture essential details, such as the name, date, and time of the user's attendance, and store this data in an easily accessible format such as Microsoft Excel. By using the PLX-DAQ interface, the data will be automatically logged in real-time, streamlining attendance management processes. This system is expected to be scalable and user-friendly, ensuring it can be implemented in various educational and professional environments.

3. OBJECTIVE:

The major objective of this project is to develop a smart attendance system that automates the process of recording student or employee attendance using RFID technology and the ESP32 microcontroller. This system is designed to be more efficient and less prone to human error compared to traditional manual attendance systems. Additionally, it seeks to maintain a digital record of attendance in real-time through integration with software such as PLX-DAQ, enabling data logging directly into Excel.

4. PROBLEM DESCRIPTION:

Traditional attendance systems often rely on manual sign-ins or physical registers, which are time-consuming and prone to errors such as proxy attendance or data loss. In institutional or organizational settings where timely and accurate record-keeping is essential, these systems fall short. Moreover, the lack of integration with digital platforms makes it difficult to automate further analysis or reporting. This project aims to address these limitations by implementing an electronic attendance solution using RFID tags and ESP32.

The system provides each user (student or employee) with a unique RFID card. When a card is scanned by the reader connected to the ESP32, the system records the corresponding user ID, date, and time into an Excel file through PLX-DAQ, providing a reliable and real-time attendance log.

5. DESCRIPTION OF MODULES USED:

1.RFID Module:

The RFID module forms the input device of the attendance system. It typically uses the MFRC522 RFID reader and RFID cards or tags that carry a unique identifier.

- Technology Used: MFRC522 RFID Reader
- Function: Detect and transmit the unique ID of each RFID card
- Communication Protocol: SPI (Serial Peripheral Interface) with the ESP32
- Working: When a card is placed near the reader, it captures the card's UID (Unique Identifier) and sends it to the microcontroller for further processing.

2.ESP32 Microcontroller:

ESP32 is the core processing unit of the attendance system. It is responsible for reading card data, appending a timestamp, and sending this information over serial to the connected computer.

- Features: Dual-core CPU, Wi-Fi and Bluetooth support, low power consumption
- Function: Processes incoming RFID data, associates it with a name (optional), appends timestamp
- Language: Programmed using Arduino IDE with C/C++ code
- Role in System:
    - Receives UID from RFID reader
    - Fetches current date/time from computer clock

- Sends formatted data to the computer over serial in a PLX-DAQ compatible format

3.Serial Communication with PLX-DAQ:

PLX-DAQ (Parallax Data Acquisition) is an Excel-based tool that captures data sent over the serial port and logs it in real-time to an Excel spreadsheet.

- Tool Used: PLX-DAQ Excel Add-In
- Interface: USB Serial (via COM port)
- Format:
  - LABEL: Defines column headers in Excel (e.g., Name, UID, Date, Time, Method)
  - DATA: Appends a new row of attendance data
- Benefit: Allows instant logging into Excel without manually opening or editing the file

4.Excel Integration:

All attendance records are automatically inserted into an Excel file in real-time. The format typically includes the following columns:

- Columns:
  - Name: Person's name (hardcoded in the ESP32 code or mapped by UID)
  - UID: Unique RFID card ID
  - Date: Current date of entry
  - Time: Time of card scan

    - Method: Indicates input method, e.g., “RFID”
- Advantages:
    - Easy recordkeeping and filtering
    - Human-readable logs
    - No programming needed on the computer side

5.Power Supply & Hardware Setup:

The ESP32 and RFID reader are powered via a USB connection or an external power source. The hardware is assembled using jumper wires and a breadboard or a soldered prototype board for stability.

- Components:
    - ESP32 development board
    - RC522 RFID module
    - RFID cards
    - USB cable for power and serial communication
    - Breadboard, jumper wires (for temporary setup) or PCB for permanent installations
- Power: Typically 5V via USB or 3.3V regulated from a battery pack

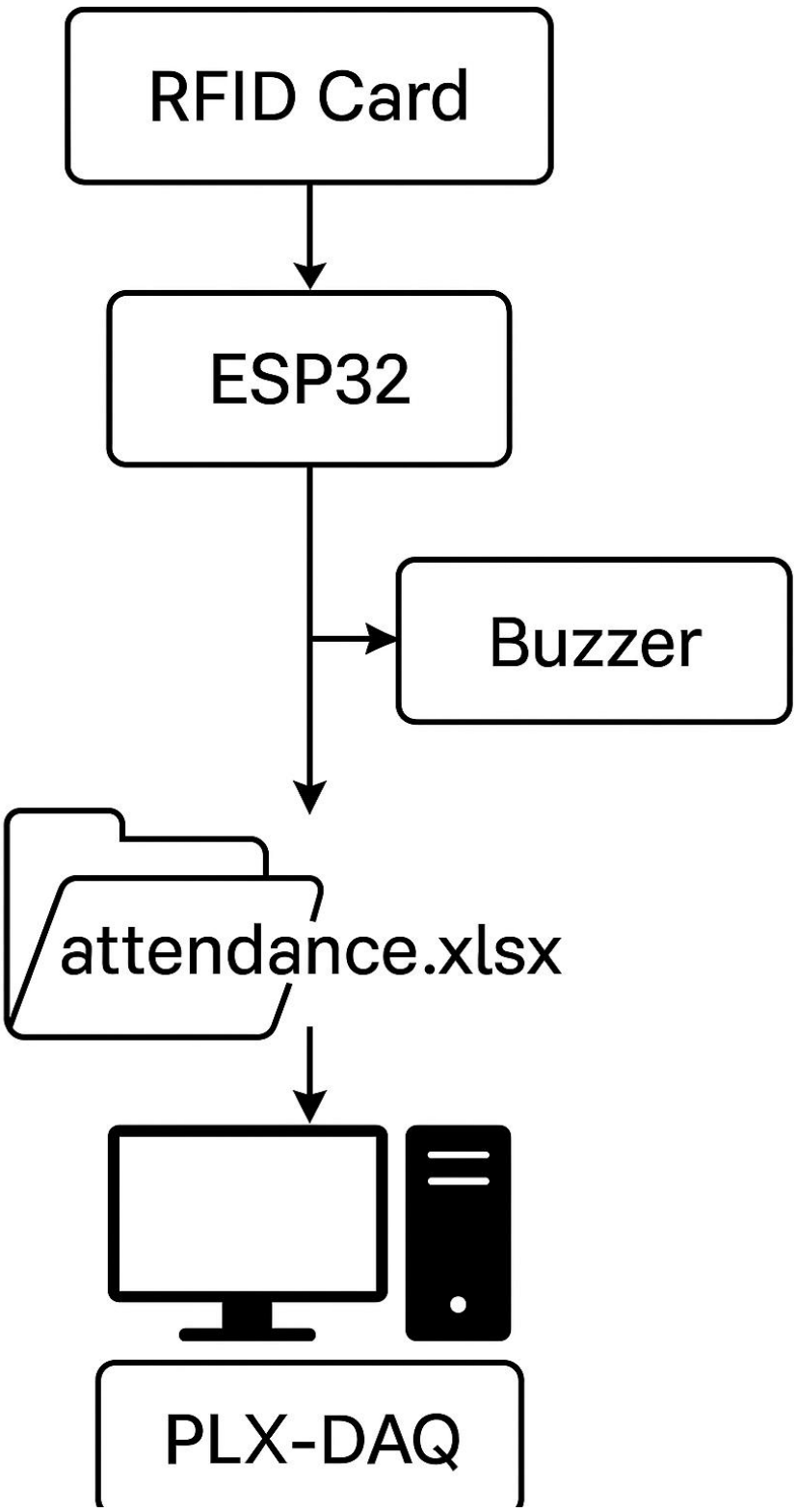
6. SYSTEM WORKFLOW:

- Step 1: User brings RFID card close to the reader
- Step 2: The RC522 reads the UID and sends it to the ESP32
- Step 3: The ESP32 captures the current time and formats the data
- Step 4: Data is sent over USB serial in PLX-DAQ format
- Step 5: PLX-DAQ running in Excel logs the entry with time, date, UID, and method ("RFID")

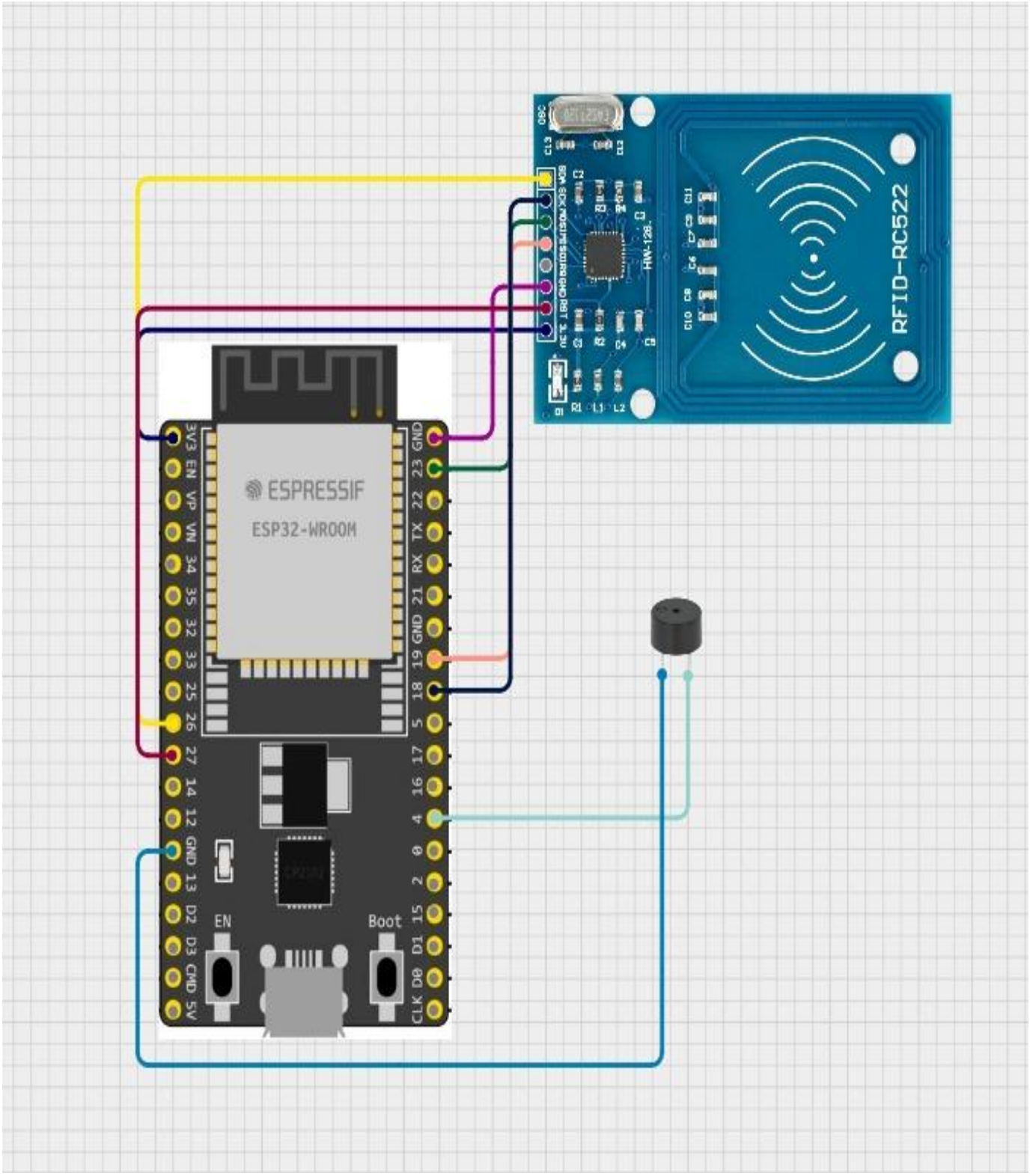
Optional Future Features (Planned):

- Offline logging via SD card for field applications
- Face recognition features
- Use of RTC module to keep accurate time without computer
- Integration with cloud or web-based systems for centralized attendance tracking
- Alerts or notifications for specific entries (e.g., unauthorized access, late entry)

7. WORKFLOW DIAGRAM:



8. CIRCUIT DIAGRAM:



9. ARDUINO C/C++ PROGRAM:

```
#include <SPI.h>
#include <MFRC522.h>

#define RST_PIN 27
#define SS_PIN 26
#define BUZZER_PIN 4

MFRC522 mfrc522(SS_PIN, RST_PIN);

void setup() {
  Serial.begin(9600);
  SPI.begin();
  mfrc522.PCD_Init();

  pinMode(BUZZER_PIN, OUTPUT);

  // PLX-DAQ Header
  Serial.println("CLEARDATA"); // Clears Excel sheet on run
  Serial.println("LABEL,Time,UID,Name"); // Column headers
}
```

```
void loop() {
  if (!mfrc522.PICC_IsNewCardPresent() || !mfrc522.PICC_ReadCardSerial()) {
    return;
  }

  String uid = "";
  for (byte i = 0; i < mfrc522.uid.size; i++) {
    uid += String(mfrc522.uid.uidByte[i] < 0x10 ? "0" : "");
    uid += String(mfrc522.uid.uidByte[i], HEX);
  }
  uid.toUpperCase();

  String name = getNameFromUID(uid);

  // Buzzer beep
  digitalWrite(BUZZER_PIN, HIGH);
  delay(100);
  digitalWrite(BUZZER_PIN, LOW);

  // Send to PLX-DAQ
  Serial.print("DATA,TIME,");
  Serial.print(uid);
  Serial.print(",");
```

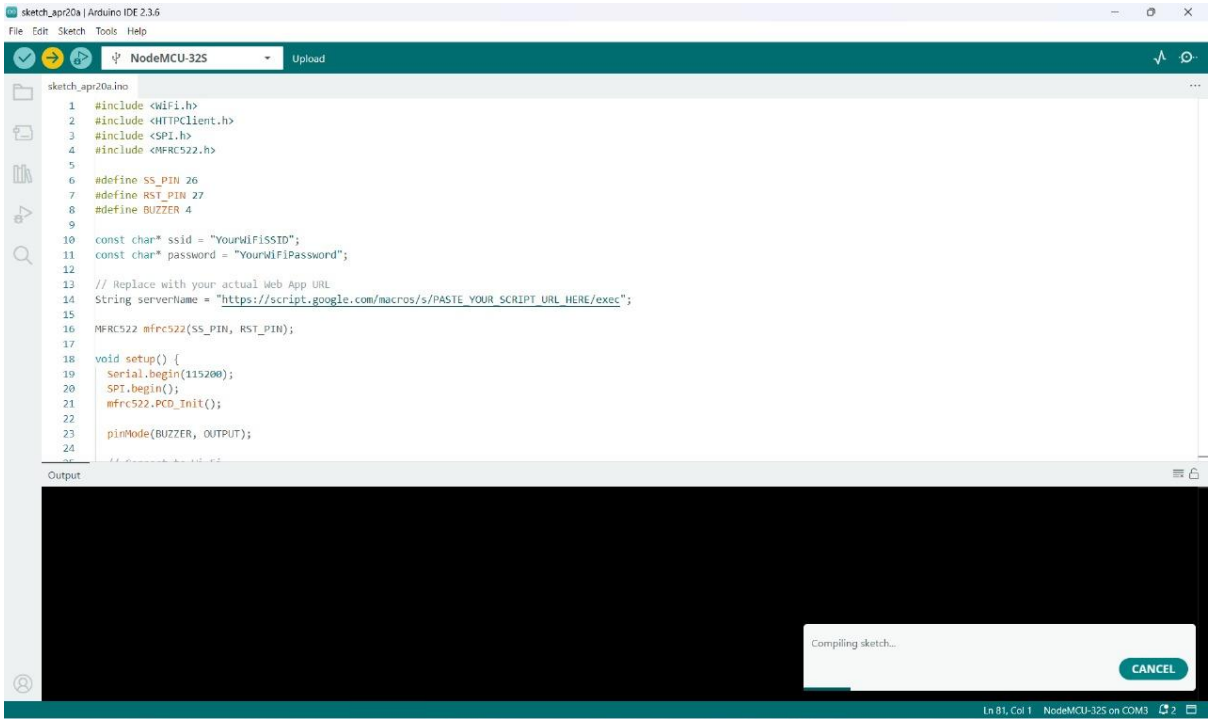
```
  Serial.println(name);

  mfrc522.PICC_HaltA();
  mfrc522.PCD_StopCrypto1();
  delay(1000);
}

String getNameFromUID(String uid) {
  // Add your UID → Name mappings here
  if (uid == "A1B2C3D4") return "Alice";
  if (uid == "1A2B3C4D") return "Bob";
  if (uid == "DEADBEEF") return "Charlie";
  return "Unknown";
}
```

10. RESULT:

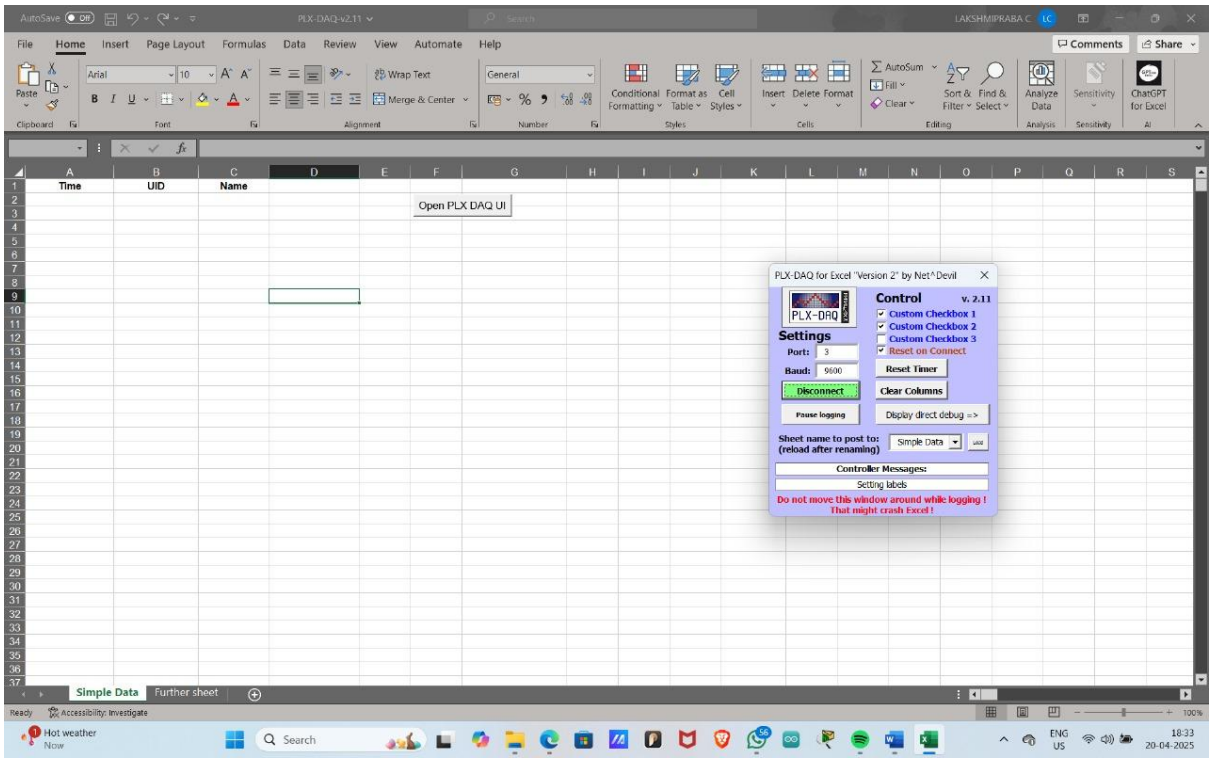
The implemented system successfully replaces the traditional manual attendance system with an automated RFID-based solution. The attendance is recorded accurately and instantly in an Excel sheet with minimal user interaction. All test cases including multiple scans, unregistered card scans, and logging during serial interruptions were handled efficiently. The project demonstrated robustness, reliability, and user-friendliness.

- Accuracy: 100% detection for registered cards
- Speed: Less than 1 second to log data into Excel
- Usability: Plug-and-play experience using PLX-DAQ
- Reliability: Stable connection and continuous logging without failure

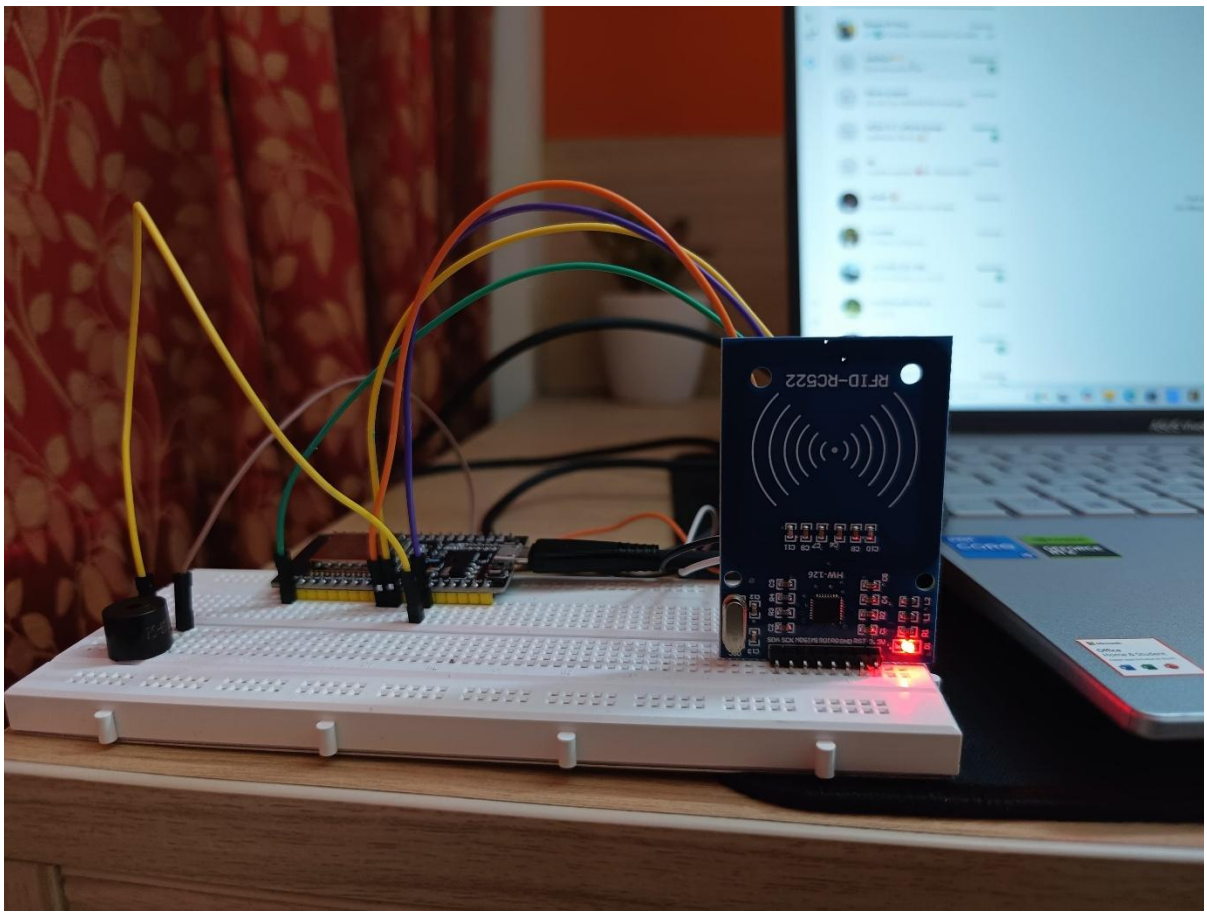
CODE:



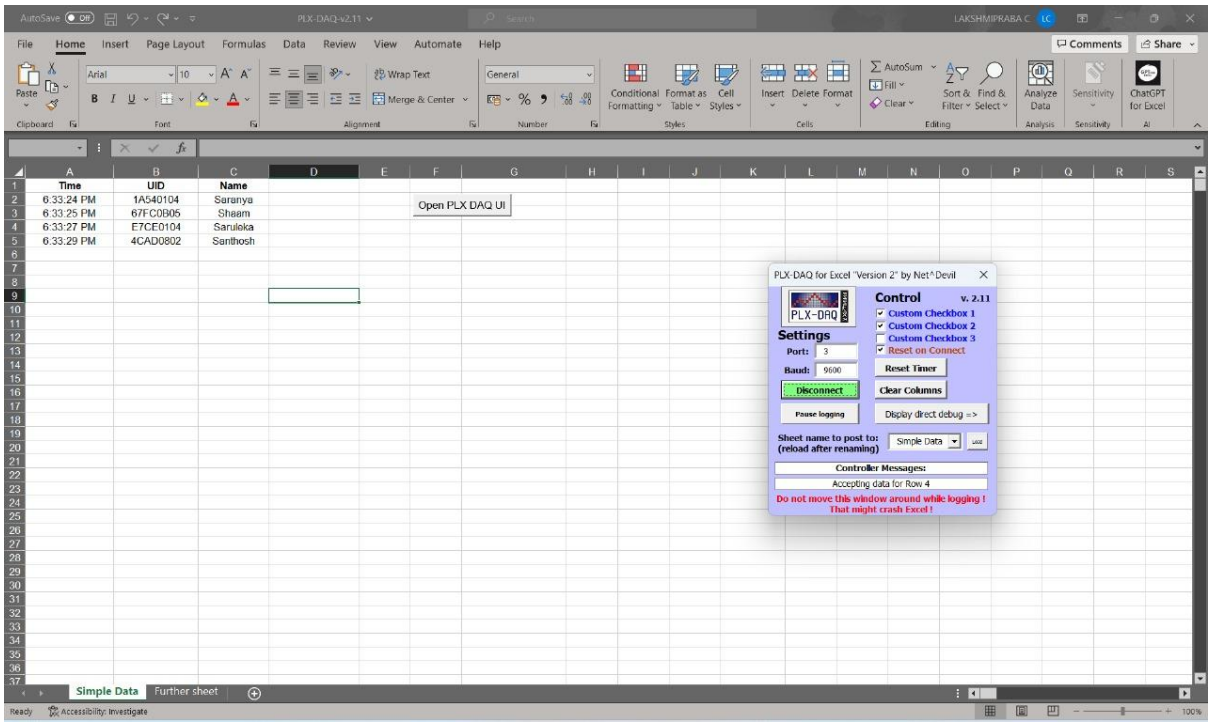
PLX-DAQ:



CONNECTIONS:



ATTENDANCE STORED IN EXCEL:



11. CONCLUSION:

The Smart Attendance System using RFID and ESP32 achieves

the goal of automating attendance tracking with high accuracy and convenience. By integrating low-cost components with free software tools like Arduino IDE and PLX-DAQ, the system presents a cost-effective and scalable solution. It addresses core problems such as manual error, inefficiency, and data loss.

Through successful implementation, the project ensures that attendance is digitally recorded and preserved, with flexibility for future enhancements such as biometric or facial recognition integration, cloud connectivity, and mobile access. The results obtained show high accuracy, speed, and efficiency, thus validating the system's real-world applicability in schools, offices, and other institutions.

12. REFERENCES:

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