IntelliRoom: Automated Seat Allocation, Smart Attendance, and Computer Access

Project Overview and Problem Statement

The **IntelliRoom: Automated Seat Allocation, Smart Attendance, and Computer Access** is designed to modernize how educational institutions manage student attendance and seating arrangements, and streamlining computer access, particularly in computer laboratories. In many schools, traditional methods such as using logbooks to track student attendance are still prevalent, making the process inefficient, time-consuming, and prone to errors. Manual attendance logging can result in inaccurate records due to human oversight, while tracking available seats and allocating them for students in labs is often done informally or without real-time monitoring.

This project aims to address these issues by leveraging RFID technology and microcontroller systems to automate attendance tracking, seat allocation, and computer access control. By using RFID cards, students can log their entry and exit from a room with a simple tap, which is then recorded automatically in Google Sheets. The system also dynamically assigns available seats upon entry and updates them as students leave, ensuring real-time monitoring of seat occupancy. In addition, it integrates with the lab's computer system, unlocking machines for student use when they enter and making them available again upon exit.

Problem Statement:

Many educational institutions in the Philippines continue to rely on outdated systems for managing student attendance and seating arrangements, especially in computer laboratories, which are labor-intensive and error-prone. These manual processes are inefficient and prone to inaccuracies, making it challenging for institutions to maintain reliable data. Additionally, there have been instances of losing or stealing devices such as peripherals within laboratories due to the lack of effective monitoring systems. The growing number of students and the push for technological integration in education further emphasize the need for smarter solutions that can efficiently handle these tasks, enhance security measures, reduce administrative burdens, and create a more seamless experience for both students and staff.

Key Features and Functionalities

- **RFID-based Student Identification**: Each student is issued an RFID card that they will tap when entering and exiting the room. The system logs their time in and out automatically in Google Sheets.
- **Automated Seat Assignment**: When a student enters the room, the system checks for available seats and assigns one to the student. The assigned seat number is displayed on

an LCD screen, ensuring students know where to sit. The system marks the seat as "occupied" and updates its availability in the seat management system.

- **Computer Access Automation**: To streamline the student experience, the system unlocks the student's assigned computer automatically when they enter the room. This eliminates the need for separate login credentials and ensures that only students who are logged in through the RFID system can access the machines.
- **Real-time Seat Monitoring**: The system tracks which seats are available and which are occupied in real-time, with the data continuously updated in Google Sheets. When a student leaves the classroom or lab, the system marks their seat as "available," allowing the next student to be assigned that spot.
- **Real-time Attendance using Google Sheets**: Once a student taps their RFID card upon entry or exit, the system immediately logs their attendance in Google Sheets, providing a real-time record of who is in the room at any given time. Enabling educators and administrators to monitor not only attendance but also how long students spend in the lab or classroom. This can be helpful for tracking usage patterns and resource allocation.

Technical Specifications

| Equipment Name	Description	Use in the System
RFID Reader (MFRC522)	Reads RFID cards used by students to check in and out of the room.	Identifies and records student entry/exit using unique RFID cards.
RFID Tags/Cards	Contains unique identifiers for each student.	Students tap these cards to mark attendance and reserve a seat.
NodeMCU (ESP32)	Microcontroller with Wi-Fi capability, connects the RFID system to the cloud for data logging.	Controls the RFID scanner and sends data to Google Sheets via Wi-Fi.
16x2 LCD Display	A simple display screen that shows information such as available seats and student seat assignments.	Provides real-time seat allocation and availability information.
Power Supply Unit	Provides power to all the hardware components such as the NodeMCU and RFID reader.	Ensures that the system operates smoothly by supplying adequate power to devices.
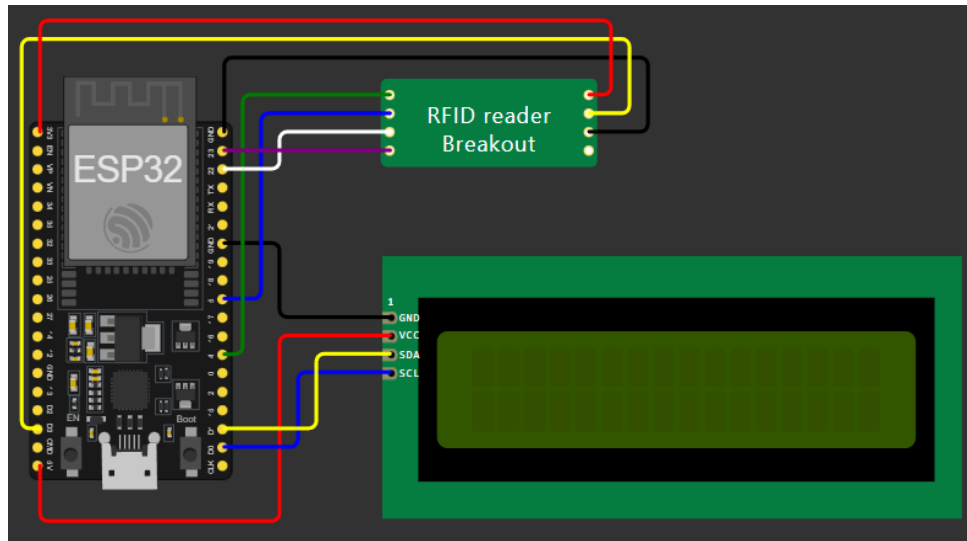
Fig 1.1 ESP32 connected to RC522 and LCD lcd 16x2 i2c (Seat Availability)

This circuit is designed to display seat availability outside a room, such as a computer laboratory, using an ESP microcontroller, an RC522 RFID reader, and a 16x2 I2C LCD. The RC522 RFID reader detects RFID cards, identifying users and triggering updates to the seat allocation system. The ESP32 microcontroller processes this data and communicates with a Google Sheets API via Wi-Fi to update seat availability. Each seat is tagged as either "occupied" or "available" in real-time. The 16x2 I2C LCD displays the available seat to be occupied by the RFID authorized holder, and number of available seats based on the data from the Google Sheet, allowing users to check seat occupancy before entering. This system ensures accurate seat monitoring for all students and personnel entering the premises.
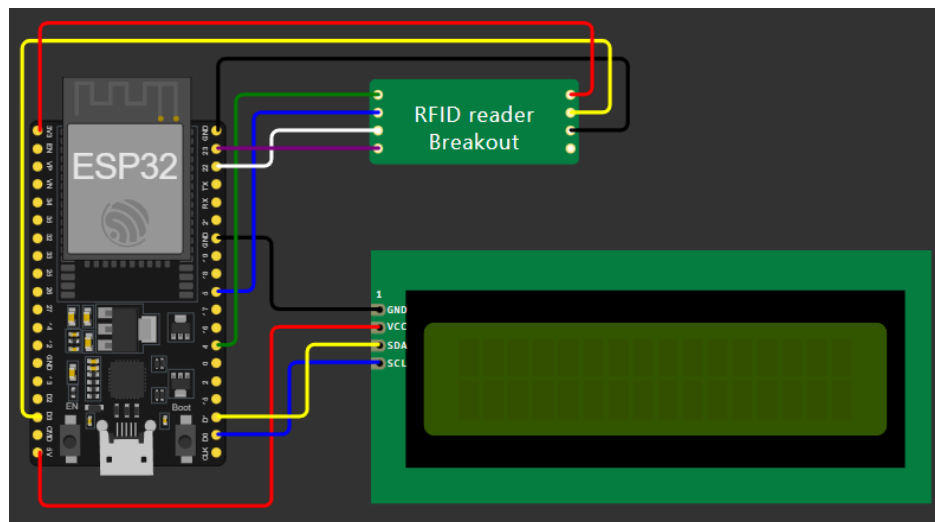

Fig 1.2 ESP32 connected to RC 522 and LCD lcd 16x2 i2c
(Student Attendance monitoring)

This circuit is designed for student attendance monitoring using an ESP microcontroller, an RC522 RFID reader, and a 16x2 I2C LCD. When a student taps their RFID card on the RC522 reader, the ESP32 reads the unique identifier encoded in the RFID. This identifier corresponds to the student's name and SR-code, which are displayed on the 16x2 LCD for confirmation. The ESP32 then updates the student's entry or exit time in a Google Sheet using its Wi-Fi capability, ensuring real-time attendance tracking. Unauthorized RFID holders are denied access, providing a secure system for monitoring and logging attendance.
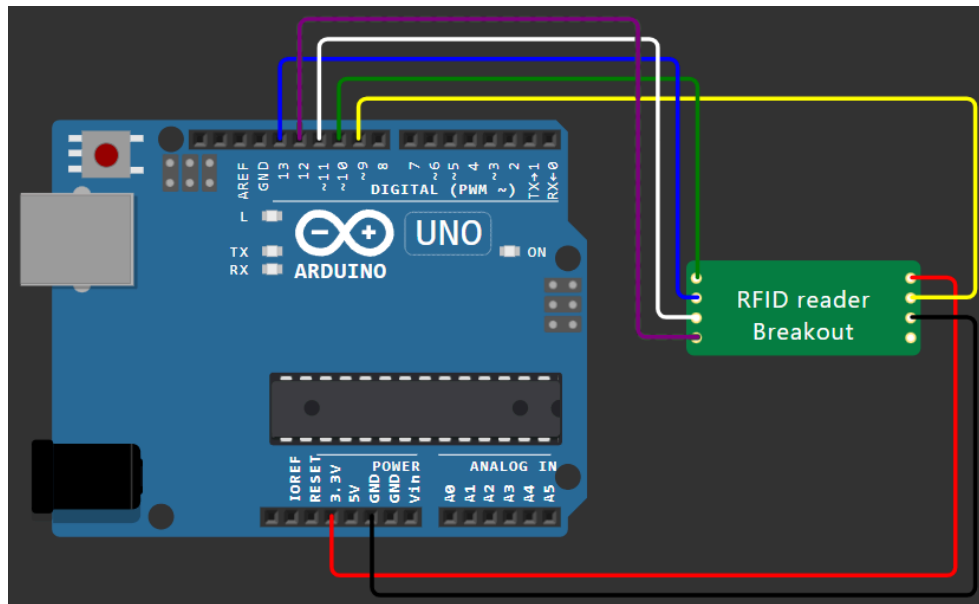

Fig 1.3 Arduino UNO connected to RC 522 (PC usage access)

This circuit uses an Arduino Uno and an RC522 RFID reader to control PC access in computer laboratories. The system ensures that only authorized users—those whose RFID cards are validated by the previous circuits (attendance and seat allocation)—can unlock and use a computer. When an RFID card is tapped on the RC522 reader, the Arduino Uno verifies the card's credentials against pre-registered IDs. If authorized, it sends a signal to unlock the corresponding PC assigned through the seat availability system. Unauthorized users are denied access, ensuring security and proper usage of the allocated computers. This ensures seamless integration with seat assignments for organized and controlled PC access.

Implementation Challenges

While the **IntelliRoom** offers numerous advantages, implementing such a system in the Education sector poses several challenges:

- **Technological Infrastructure**: Many schools, particularly public institutions, face challenges related to insufficient infrastructure, such as unreliable internet connections or lack of modern hardware. Since the system relies on stable Wi-Fi to connect the NodeMCU with Google Sheets for real-time data logging, these schools may encounter difficulties in fully utilizing the system's capabilities without upgrades to their network infrastructure.
- **Budget Constraints**: Implementing an RFID-based system involves upfront costs for purchasing equipment such as RFID readers, microcontrollers, LCD screens, and relay modules. Schools or institutions with limited funding may find it difficult to justify these expenses, especially when weighed against other pressing needs.
- **Faulty Equipment and Technical Problems**: The system's dependence on hardware components such as RFID readers, microcontrollers, and LCD screens introduces the potential for equipment malfunctions, which could interrupt its operations. Addressing these malfunctions promptly is critical, as delays in repairing or replacing faulty components can lead to system downtime and reduce overall reliability.
- **Data Security**: Storing student attendance and seat data in cloud-based platforms like Google Sheets requires careful attention to data privacy and security. Educational institutions must ensure compliance with data protection laws such as the Philippine Data Privacy Act. The system must incorporate safeguards to ensure the privacy of student information while also allowing for efficient monitoring and record-keeping.