Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2023, 10(5):172-180**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Development of a Radio Frequency Identification Attendance System

Usman, M.,[1*] Obomeghie, M.A. [1], Ezolome, S.[1], Abu, K.[1] and Usman, A.O.[1]

[1]Department of Electrical/Electronic, Auchi Polytechnic, Auchi, Nigeria
Corresponding author: mrsusmanmaro@gmail.com

Abstract Attendance systems are used to track student involvement in lectures and other academic activities, which are important in educational institutions. The manual procedures for taking attendance take a lot of time and are vulnerable to student imitation. The goal of this project, dubbed "RFID Attendance System," is to develop and build an automated attendance system that includes a fingerprint detector. This system includes a fingerprint sensor, tags, an RFID reader, a microcontroller, and an RTC module. The RTC module keeps track of the precise moment a student entered and exited, while the RFID reader reads RFID cards and transmits the information to the microcontroller unit for processing. The system's results are astounding because the card reader was able to read the data on the card that was placed next to it in just 5 to 20 seconds.

Keywords RTC module, RFID reader, Educational institution, Academic activities

1. Introduction

Attendance systems are used to track student involvement in lectures and other academic activities, which are important in educational institutions (Akinkuade *et al.*, 2022) With regular attendance, the instructor or lecturer can get to know each student better, identify their strengths and weaknesses, and understand and handle their differences. This fosters a seamless teacher-student interaction (Lasisi *et al*., 2021). In most educational institutions in Nigeria, roll calling, a traditional method of manually taking attendance using paper and a pen is usually used (Akinkuade *et al.*, 2022). Historically, in order to encourage student participation, lecturers would manually record attendance on a piece of paper, conduct a roll call, or occasionally administer a surprise quiz. But these approaches have drawbacks as well, such being time-consuming, prone to mistakes, easily lost, impersonating, demanding, and stressful because valuable lecture time that should be used for lectures is instead used to track student attendance and, occasionally, grade papers (Awofolaju, 2019; Nkalo *et al.*, 2019).

The traditionally manual attendance procedure can now be automated due to the development of technology in the 21st century, which can be used in practically every aspect of human life to facilitate and simplify processes. Radio Frequency Identification (RFID) is a new technology that can identify objects automatically. Currently, a number of industries, including transportation, agriculture, and manufacturing, are using RFID technologies to an increasing extent (Akinkuade *et al.*, 2022; Zaman *et al.*, 2017). In order to identify and track an object, radio waves are used by radio-frequency identification (RFID) technology to transmit data from an electronic tag, also known as an RFID tag or label, affixed to the object (Chiagozie and Nwaji, 2012). It is a sophisticated technology that uses electromagnetic or electrostatic coupling in the radio frequency part of the electromagnetic spectrum to specifically identify an object, an animal, or a human.

Automated attendance systems have been established using a variety of methods in the past, including magnetic stripe, barcode, and biometric techniques (Chiagozie and Nwaji, 2012). Because it is a more straightforward and

efficient means of identifying than the others, RFID is the approach that is employed the most frequently nowadays. This project's work is therefore focused on designing and building an automatic attendance system that uses RFID technology and a fingerprint detector.

2. Materials and Methods

The RFID student attendance system's component parts were carefully chosen and skilfully put together in order to fulfil the intended function. Figure 1 displays a block diagram of the system. It consists of a number of blocks. The hardware and software stages are the two main stages that make up the system model.

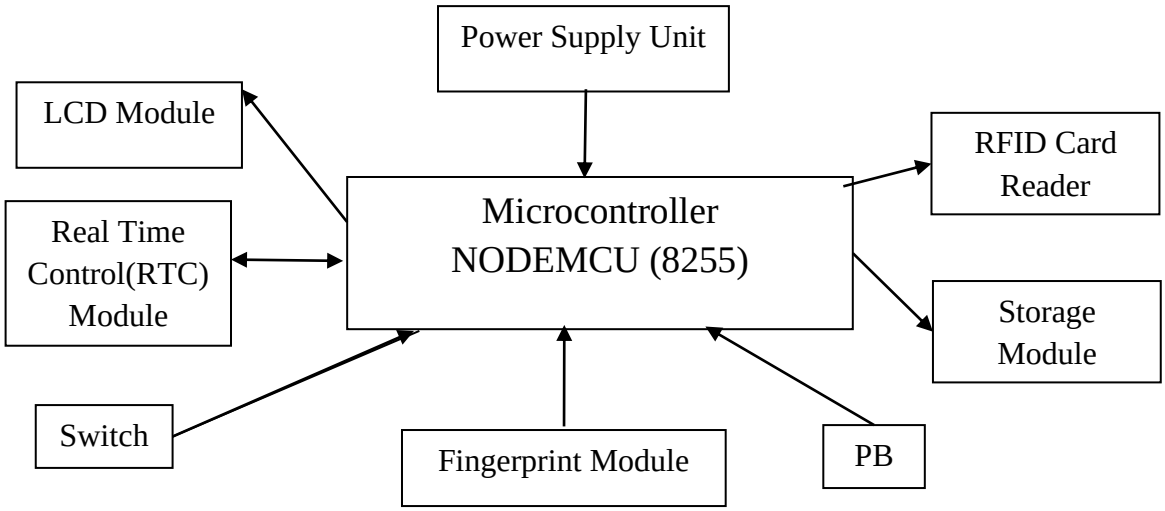

Fig. 1 Block Diagram of the RFID student Attendance System

2.1 Hardware Stage

The RFID reader, RTC module, LCD module, NODEMCU (8255), and fingerprint sensor are all components of the hardware stage.

2.1.1 Power Supply Unit

This is the component that gives the system its power. It is an adaptor that provides 5V DC SMPS stepped down from the AC main supply of 220V-240VAC. LEDs are used to show when the system is ON as shown Figure 2.

Figure 2: A 5V adapter

2.1.2 NodeMCU (8266)

The system's key component is **NodeMCU (8266)**. All other modules are connected to the minicomputer via communication, ensuring the proper operation of the system. It keeps the system's operating software design program. The specifications and features of NodeMCU (8266) are shown as follows:
Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
Operating Voltage: 3.3V
Input Voltage: 7-12V
Digital I/O Pins (DIO): 16
Analog Input Pins (ADC): 1
UARTs: 1
SPIs: 1
I2Cs: 1
Flash Memory: 4 MB
SRAM: 64 KB
Clock Speed: 80 MHz
USB-TTL based on CP2102 is included onboard, Enabling Plug n Play
PCB Antenna
Small Sized module to fit smartly inside your IoT projects.

2.1.3 LCD Module

There are 16 pins on a 16 x 2 LCD module, however not all of them were utilized for this project. The LCD was powered by the first two pins. Along with the read, write, and register pins, we also used the contrast pin to change the LCD's colour. A distinctive digital display is made possible by a number of additional pins working in concert. The pinout of the 16 x 2 LCD display is shown below. The LCD was connected to the microcontroller and programmed to show the time and a welcome message during initialization before asking for card swipes as shown in Figure 3.

2.1.4 RFID Reader Module

The MFRC522 RFID reader is in charge of reading RFID cards and transmitting the data to the microcontroller device. The SPI protocol is used for communication with the MCU. Before attaching any other component, the MFRC522 RFID Reader was installed and its various pins attached to the NODEMCU 8266. After that, a card was used to test the reader to make sure it was fully working. The reader has the following features:

- MFRC522 Chip based board
- Operating frequency: 13.56MHz
- Supply Voltage: 3.3v
- Current: 13-26mA
- Read Range: Approx 3cm
- Serial Peripheral Interface
- Max Data Transfer Rate: 10Mps
- Dimension: 60mm x 39mm

Interfacing RFID Reader with the Microcontroller is shown in Figure 4.

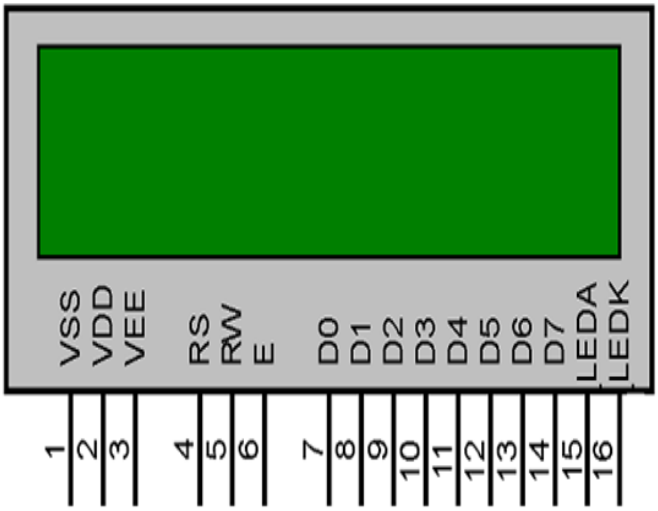

Figure 3: Pinout of 16 x 2 LCD Module

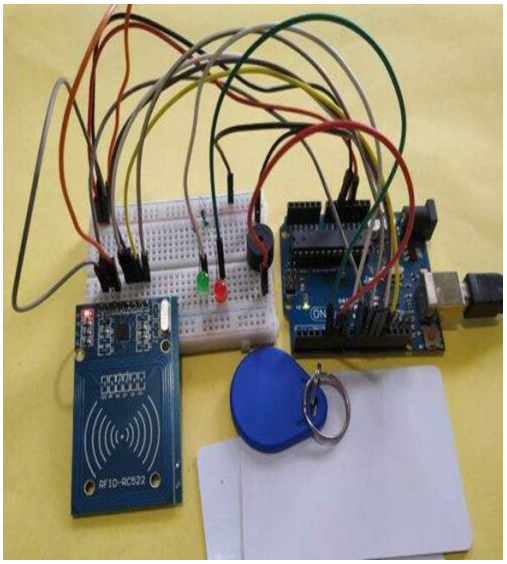

Figure 4: Interfacing RFID Reader with the Microcontroller

2.1.5 Finger Sensor

For reading and taking daily attendance, a finger sensor that also functions in tandem with a card reader is used. To make the connections in the circuit less complicated, I^2C was employed.

2.1.6 RTC Module

The RTC module maintains the system's timekeeping capabilities. It assists the MCU in tracking the precise time when registered users entered and exited. It communicates using the I^2C protocol. To assist the system in tracking the time function, the DS 3231 provides various pins for communication with the microcontroller. It was connected to NODEMCU 8266 as displayed in Figures 5 and 6.

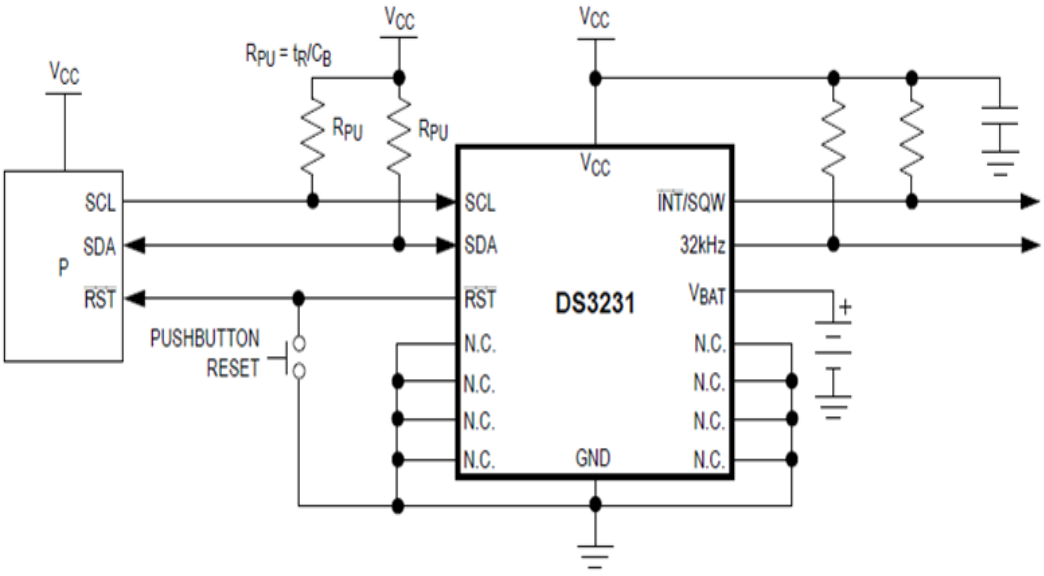

Figure 5: Interfacing the RTC with the Microcontroller

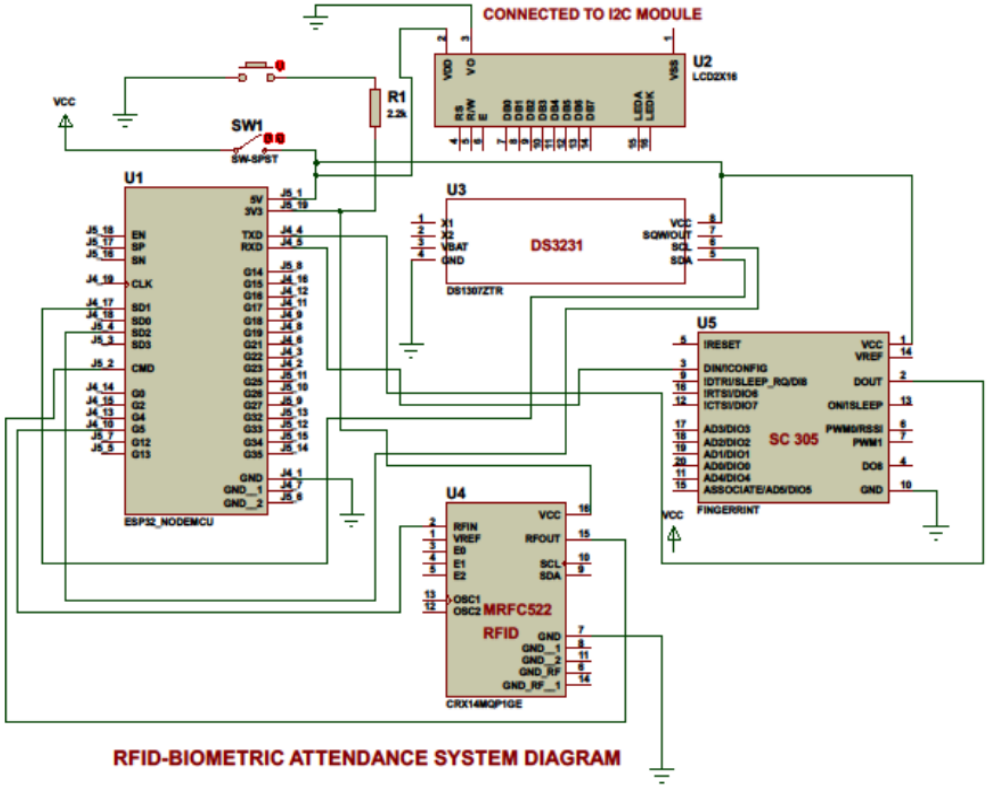

Figure 6: Diagram showing the connections of each component of the system

2.2 Software Stage

Proteus was used to code the entire system from scratch. The Proteus's serial monitor was regularly used to monitor the system's behaviour at any given time. Some of the libraries used for the project are already included by default in the Proteus, like the LCD library, while others, like the RC522 RFID library, were added as custom libraries. The following libraries were utilized for this project:

- LiquidCrystal.h library for the LCD.
- SPI.h library for Serial Communication.
- RFID.h library for the RC522 RFID reader.
- RFID.h library for the RC522 RFID reader.
- SD.h library for the SD card.

A C++ and C language compiler called Code Blocks was used to create the majority of the functions utilized in the source code before being converted to Proteus. This is due to the syntax of the Proteus language being quite similar to that of C++, despite some changes. For instance, when using the keyword "string" in Proteus code, which is acceptable in C++, a fault results. For the purposes of this experiment, the system had a single user and was set up to run for 20 lecture days. By changing its code, it is easily reprogrammable for more teaching days. Reprogramming the system will allow for the registration of more students. Figure 7a and b show the construction diagrams while the flowchart of the attendance system is shown in Figure 8.

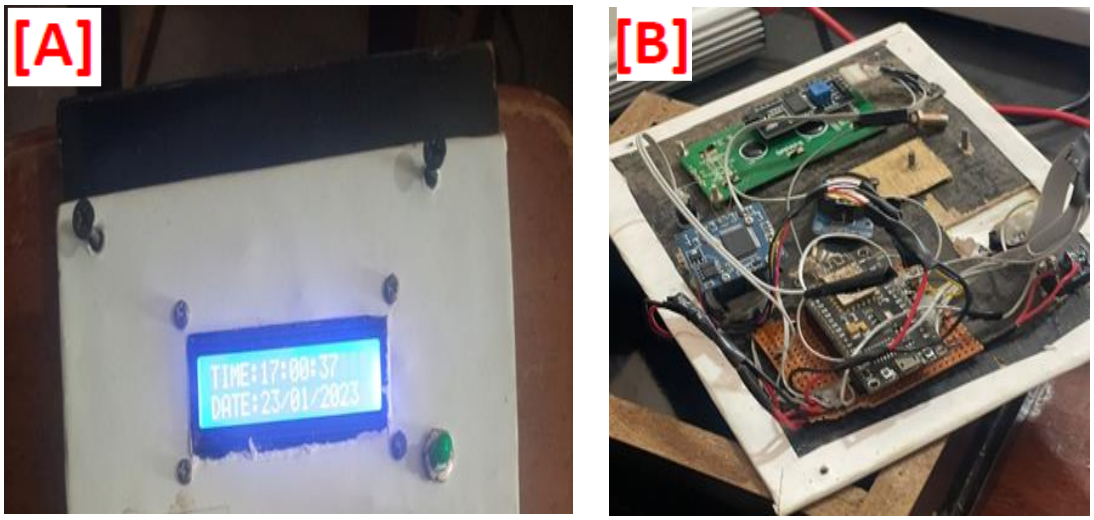

Figure 7: Construction diagrams

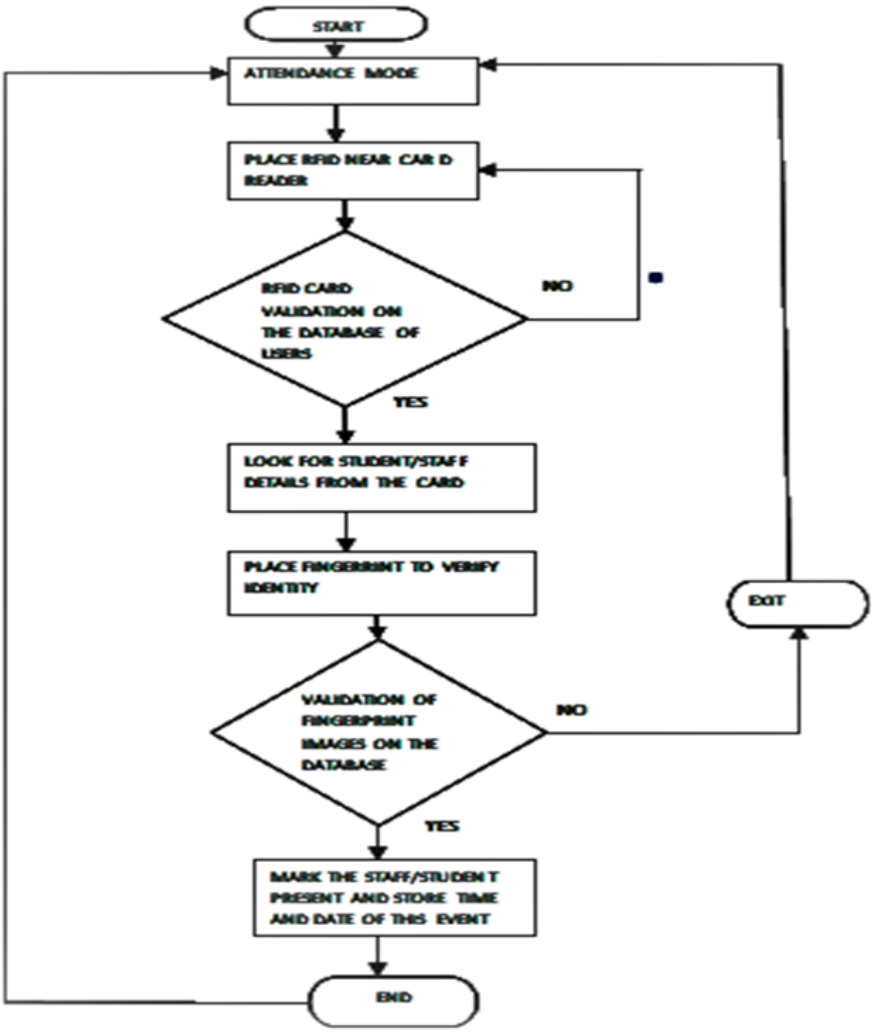

Figure 8: Flowchart of the attendance system

3. Results and Discussion

3.1 Testing

3.1.1 Enrollment Mode Testing

The following steps were taken to enroll the users in the system:

i. The administrator entered the enrollment field to check for and enroll a user (a student). The admin only needs to check in by merely placing their registered finger on the fingerprint scanner.

ii. The next step was to activate the enrollment mode of a user's RFID card. The microcontroller has all the cards' unique ID codes to verify a particular card. The system then displays the fingerprint ID number on the card and knows the fingerprint slot number.

iii. The program prompts the user to insert a fingerprint. The system would then take the fingerprint images, or pictures of the finger put on the scanner.

iv. The system prompts a second time for the user's fingerprint to confirm whether it matches. If the fingerprint scans or pictures match, the system will store the image on the array.

3.1.2 Attendance Mode Testing

i. The first mode is attendance, and it can be used without administrative approval. Following are the testing procedures:

ii. When the user (student) inserts his or her card into the system, the RFID reader scans the code and looks up the student's number;

iii. The system then instructs the user to place his or her finger on it to confirm if it is indeed him or her; and

iv. After confirmation, the system marks the particular user present and stores it on the array created for attendance.

3.1.3 Compilation Mode Testing

This mode aids in gathering every user in attendance. The attendance cannot be changed once the compilation mode has been engaged. The procedures are as follows:

i. The system administrator is required to verify before compiling the attendance. When the administrator places his or her fingerprint on the scanner, the system does the verification and automatically generates the attendance.

ii. The generated attendance is then stored on an SD card or sent to the admin's email address for backup. The storage is in TXT file format. The auto-generated attendance shows the ID number, date, and time, along with status.

Various users tried the system. One of the students was not enrolled, whereas the majority of users had already been added by the admin through the enrolment process. Figures 9a and b and Figure 10 a-b display the outcomes after analysing a sample of students for signing in and out.

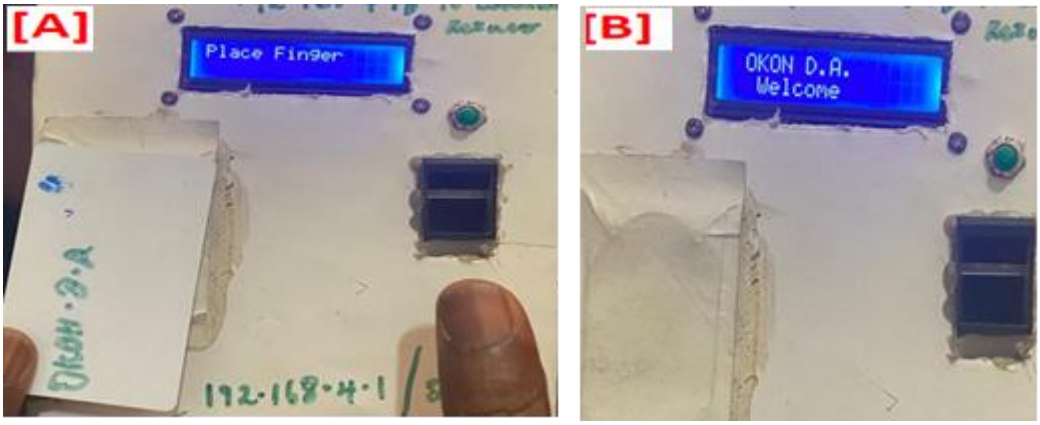

Figure 9: Screenshot of RFID attendance in operation (student signing in)

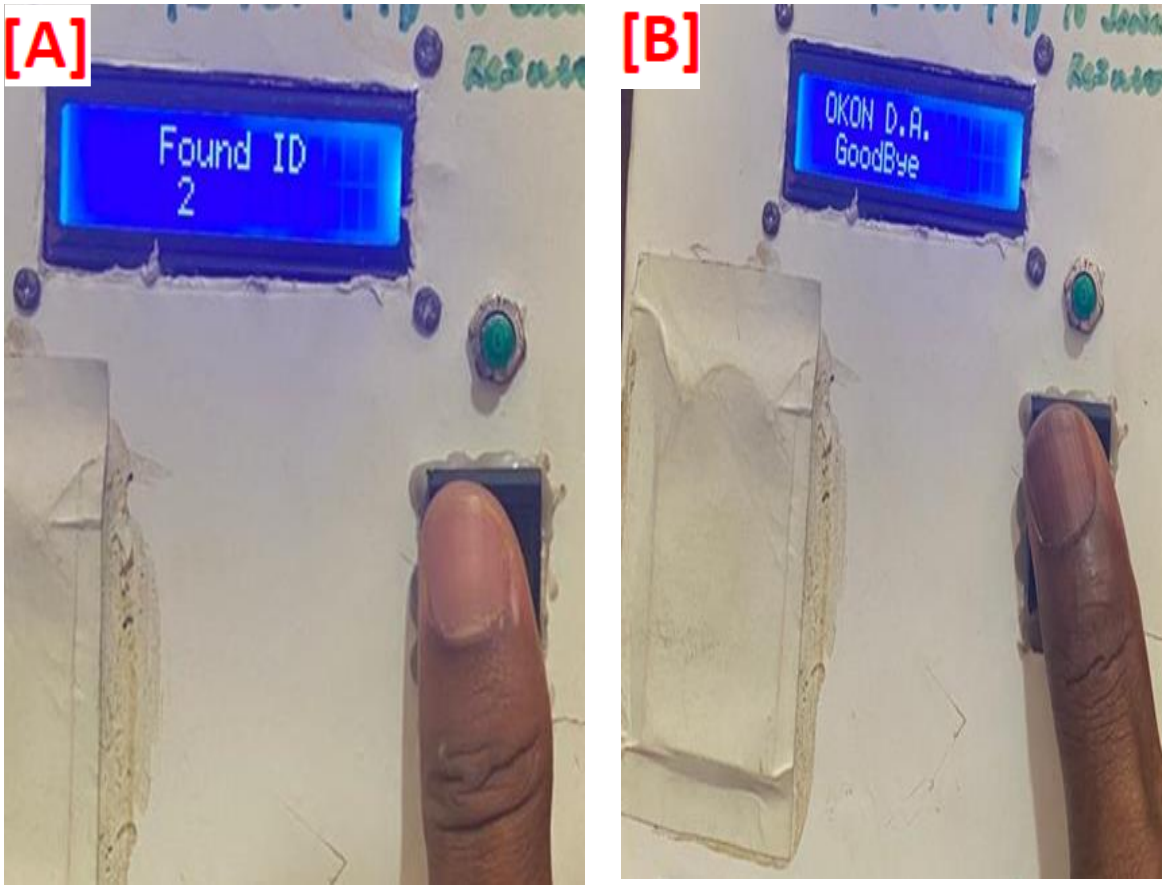

Figure 10: Screenshot of RFID attendance in operation (student signing out)

The project's outcomes demonstrate that the system can efficiently track student attendance. When entering the classroom and the exam room, students would need to make sure their cards were with them. We cannot enter or exit the classroom without this card. There will be a significant decrease in dishonest behaviours like impersonations that harm students' performance. It takes the card reader 5 to 20 seconds to read the information from a card that is placed close to it. Due to the fact that no two fingerprints are the same, adding fingerprint biometrics makes impersonation impossible.

4. Conclusion

The project's goal and objective, the design and implementation of an RFID-based automatic attendance system, were both accomplished. When compared to the manual methodology, this system offers a more efficient and practical way to take attendance. The system was programmed for twenty lecture days and tested with one user tag. By changing its code, it is easily reprogrammable for extra teaching days. By reprogramming the system, more students can be added to the registration list.

In this project, we have taken advantage of the flexibility of RFID to implement a practical and automatic student course attendance recording system. This system enables students to easily fill out their attendance by simply swiping or moving their ID cards over the RFID readers, which are placed at the entrance of lecture halls. This technology is expected to change the way that student lecture attendance is tracked in the classroom and offer a more modern, precise, and manageable method of recording student attendance at our polytechnic and throughout Nigeria.

Recommendations

Each effective advancement in engineering design has its limitations. As a data gathering technique with precise and fast data entry, this passive RFID-based lecture attendance monitoring system has some limitations. The system is only capable of supporting a small number of users because it lacks a true database. Therefore, the drawback of this design should be addressed going forward by taking the following key suggestion into account:

- By incorporating a face/biometric recognition application, that would serve to further increase the security of the system against impersonation by erring students; and
- Incorporating of an online MySQL database so that it can be used for institutions or organizations with a large number of students or employees.

References

[1]. Akinkuade, S., Olatunbosun, L., & Fawale, O. (2022). Automatic Attendance System Based on Radio Frequency Identification and A Microcontroller. *Journal for Pure and Applied Sciences (JPAS)*, *1*(1).

[2]. Awofolaju, T. T., Orolugbagbe, D. O., Oladoye, S. O., & Obiyemi, O. O. (2019). Design And Construction of a Stand-Alone Attendance System. In *1st International Conference on Engineering And Environmental Sciences* (P. 1095).

[3]. Chiagozie, O. G., & Nwaji, O. G. (2012). Radio frequency identification (RFID) based attendance system with automatic door unit. *Academic Research International*, *2*(2), 168.

[4]. Lasisi, H. O., Ajibade, B. R., Ajayi, O. C., Obiyemi, O. O., Thakur, S. C., & Adetiba, E. (2021, October). Implementation of cloud-based biometric attendance system for educators in a developing country. In *Journal of Physics: Conference Series* (Vol. 2034, No. 1, p. 012018). IOP Publishing.

[5]. Nkalo, U. K., Agwu, E. O., & Stanley, E. C. (2019). Radio frequency identification (RFID) based attendance system with short message service (SMS) backup. *IOSR Journal of Computer Engineering (IOSR-JCE)*, *21*(2), 1-8.

[6]. Zaman, H. U., Hossain, J. S., Anika, T. T., & Choudhury, D. (2017, July). RFID based attendance system. In *2017 8th International Conference on Computing, Communication and Networking Technologies (ICCCNT)* (pp. 1-5). IEEE.