

Arduino-Based Embedded-Software for Offline and Web-Based Attendance System

Alimi Olasunkanmi Maruf^{1*}, Afariogun AbdulKabir Eniola², Saheed Yakubu Kayode³

Abstract

Embedded software originally controlled hardware but algorithm and software developed determine mode of control and action expected of the hardware. Arduino hardware microcontroller board called Arduino UNO is one of the best electronics boards with coding these days while many attendance systems developed today are mostly one-way. Many developing and underdeveloped countries cannot guaranty 24/7 electricity and strong network connection or data for fully online attendance system. Based on this assertion, enhanced system was developed using Arduino UNO R3, RFID Reader, and Ethernet Shield for web-based or online version while Data Logger was used for Local or manual version and RFID cards for individual's identity. Optimized one was designed, developed and software was embedded using Arduino codes to control the machine. The machine was able to store student attendance on SD-card for manual while it was able to store in database online for web-based type. These two types give opportunity to individual assessor or lecturer to store on SD card and have access with ease while web-based gives room for online access while on transit.

Keywords: Algorithm, Arduino, Data logger, Embedded-software, Ethernet shield.

INTRODUCTION

Presently most organizations and institutions have embraced e-attendance system in place of manual where staff or student may be called or sign attendance or write their names which gives room for impersonation by colleagues. Due to this inaccuracy, correct and actual number of staff or students that came to the office or attended a lecture cannot be ascertained. It can be manageable for small organization or class but for large class or staff, it is nearly impossible to use manual and have correct attendance results. Many have been looking for a way to solve problem of attendance submission by the lecturers or staff impersonation but still unsatisfactory due to the human attitudes and stubbornness of people to follow simple rules. Technology is a way out for many problems in this world. Despite Nigerian Universities Commission (NUC) rule of 75% attendance before student should be allowed to sit for any examination and many other universities across the world, people still circumvent while staff may not come to the office for days or week(s) and still collect his/her salary at the end of the month.

*Author for Correspondence

Alimi Olasunkanmi Maruf

¹Associate Professor, Department of Computer Science, Al-Hikmah University, Ilorin, Nigeria

²Ex-Student, Department of Computer Science, Al-Hikmah University, Ilorin, Nigeria.

³Assistant Professor, Department of Computer Science, American University of Nigeria, Yola, Nigeria

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Many people have developed many systems such as the use of fingerprint, iris, face, Bluetooth, etc. which used to waste time, RFID for just one side but not for both online and offline, and many others with many variant. These limitations put in mind, lead to this research to try and make things better for organizations, lecturers or any assessor at any level.

JUSTIFICATION/OBJECTIVES

Non availability and stability of electricity and network failure are endemic in many nations today, while most of the machines for attendance are either for offline or online only rather than one machine doing both at the same time. The objective of the Arduino Based Attendance System is to help organizations, students and lecturers with problems of calling attendance or manual signing which is time consuming, allow impersonation, and inaccuracy to be easier without hitches. This new system will make things easier with or without light and increase accuracy, minimize impersonation and timeliness in attendance with raising student consciousness to come to the class by the time they are aware of non-availability of shortcut for attendance system anymore.

Many schools have been on a manual attendance system right from inception and haven't been giving any good impact on the performance of the student academically, because student attendance helps a lot in making student perform better in any examination. Some of the students that don't attend classes get assisted by his or her friends in taking attendance due to lack of verification when taking the attendance. Organizations also needs enhanced one that allows both offline and online system.

The proposed system would both upgrade the office and school attendance system and as well add impact on the academic performance of the student as it wouldn't give room for impersonation, because it requires fast verifications of attendant when taking the attendance and this will urge the student to come to class, sign in, take lecture and sign out at the end of each lecture.

RELATED WORKS

Attendance system development researches are recently much which include web-based, mobile based and other computerized students' attendance system that utilizes hardware technology such as fingerprint machine, iris-based, face recognition, RFID (Radio Frequency Identification) Bluetooth and NFC (Near Field Communication) [1–4].

Universal Communication Design

Another contribution was the development of Web application attendance management system that can store and update student attendance, generate report using SMS software technology and finally send the messages to the parents of the students [5]. This reduces paper wastage, but the system is not cost effective as SMS to parents will cost the institution a lot of money.

In addition, another researcher used QR code technology to register student along with web service for student attendance management system. Students are to use QR code scanner and the student information delivered to the server and the server will have to make call to the API [6]. In this system, time efficiency is lacking as it takes time for the QR code scanner to detect the QR code generally, also, if it's not properly placed in the scanner box, it requires more time to place the QR code to the scanner box successfully.

Fingerprint based Attendance system with GSM was introduced as another technique where Fingerprint acquisition module is used for capturing the fingerprint and pre-treatment. The GSM modem is then used to send the attendance of the students to their parents in the form of SMS [7]. This system isn't cost effective because it will require continuous financing in sending SMS to each student parents.

Attendance management system using biometrics was also developed in which the system takes attendance electronically with the help of a finger print device and the records of the attendance are stored in a database [8]. Attendance is then marked after but the system failed to address network failure and may force them to return to manual system of marking the student attendance. Use of RFID and web system for Student Attendance is more preferable as it improves the current manual system of processing student attendance system. Most of the institutions of higher learning especially university promote a semi- automated approach in capturing the student attendance [9–12]. This does not take network failure into consideration.

Most institutions uses 75% attendance as part of the conditions for examinations, or sometimes as part of continuous assessment, then full automation with calculation of attendance percentage is necessary. Network failure or fluctuation of electricity in most developing countries makes this system introduce a low cost automated approach in taking the staff, student and lecturer's attendance. Individual will flash their identification card encrypted with RFID to the RFID reader with auto recording of attendance if there is network or manual when there is network failure since the machine battery charges when there is light.

METHODOLOGY

The new system was developed using Arduino UNO R3, RFID Reader, Ethernet Shield for Online (Database version) or Data Logger for Local (SD card version) and RFID cards for individual's Identity.

Algorithms

Since we have two versions, one for local and the other for online, the algorithm will be divided into two in which the first will be for local access while the second one will be for online access.

i. Offline version

- Start
- Initialise the machine
- Is SD card inserted
- If no display No card inserted and close
- Else
- create new .xlsx file in the SD Card
- Lecturer swipe first after inserting SD card
- create new file in the SD Card
- Accept both lecturer and student cards and store automatically
- End of lecture?
- No, continue accepting student cards
- If Yes, remove SD Card
- Stop

Note: The system will read the first line as Lecturer's attendance and recognize others as students until the lecturer remove the SD card. The file can be accessed by the lecturer in Excel document (.xlsx) format and can be uploaded online manually when needed subsequently.

Offline Configuration

Lecturer will insert the SD card and touch menu of the machine, then enter the course code and swipe his card which was originally having lecturer status. If any other person not a lecturer did the same, it will not accept it as lecturer's card. The system will automatically accept and save others as students in the SD card until the lecturer removes the SD card.

ii. Online version

- Start
- Initialize the machine
- Is it connected to server?
- No, Display no connection
- retry five (5) times, then stop
- else, start accepting Lecturer's card
- If not lecturer's card, display file not found
- Else
- Create new .xlsx file in the lecturer's profile and register the lecturer in the file
- Start accepting student's card

- Is the lecturer's card signed out?
- No, continue accepting student cards
- Yes, lecture close
- Stop

Note: The software will read status from the card and accept the lecturer's card first with the course code because a lecturer may be taking many courses. The files created in the lecturer's profile online would be in Excel document (.xlsx) format which can be easily downloaded and access when needed for evaluation and easy sharing to respective individuals (like parents) through mails and other means.

Online Configuration

Just like offline except that there is no need for SD Card. Lecturer will have to touch the menu of the machine, then enter the course code and swipe his card which was originally having lecturer status. The system will automatically accept others as students and stored the attendance on the server until the lecturer removes the SD card.

Flow Charts for Online and Offline

Flowchart for Online (Web-based) System

The flowchart in Figure1 shows the online aspect where the system will try to connect to the server with opportunity to connect many times in case of failure or weak network connections.

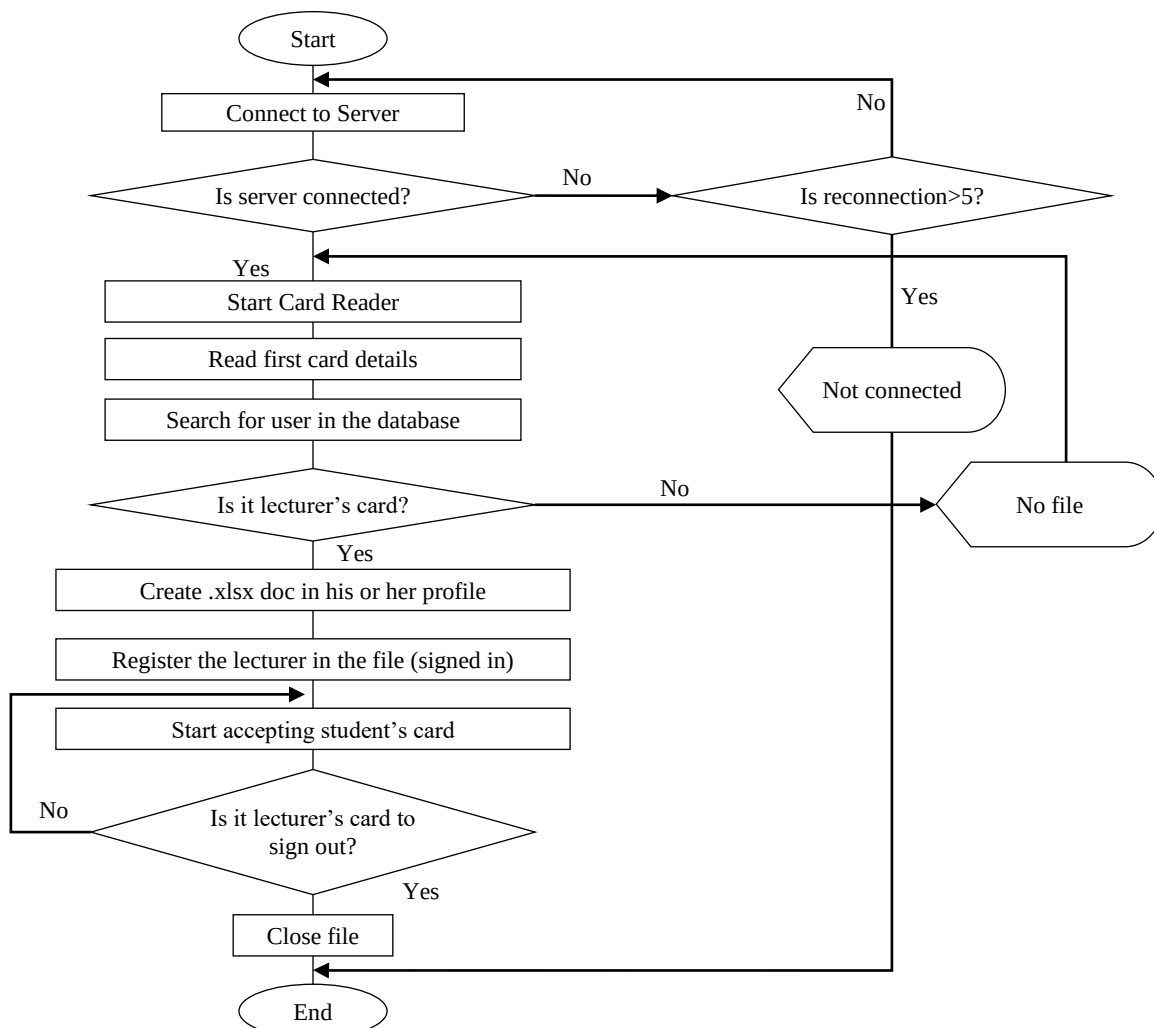


Figure 1. Online (Web-based) System Flowchart.

This gives room for the system to check for connections up to five times in case of network failure to start saving attendance to the server.

Flowchart for Offline

The offline system as in Figure 2 shows the flow in which SD card can be used in case of network failure or unavailability of electricity at the time of need in order not to affect the assessor or the class.

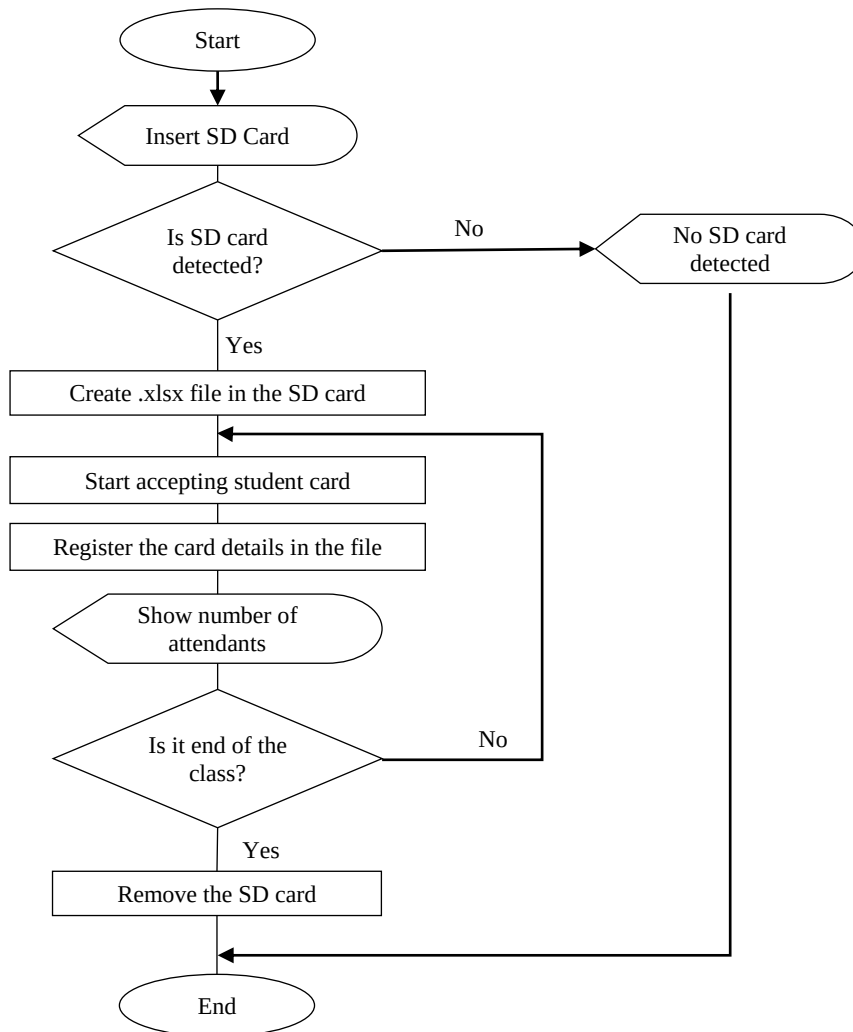


Figure 2. Offline System Flowchart.

The advantage of this is that it gives room for cases where there is no network and electricity problem where light may be fluctuating or having total downtime from the server or network.

Block Diagram

Online (Web-based) Block Diagram

Apart from the embedded code in the machine, Figure 3 shows that, there is another code using PHP for the sever side of the system. This will be communicating between the Arduino code and the server for online attendance system.

Offline Block Diagram

Figure 4 depict that, this didn't need network since it will be saving the attendance in the SD card in Excel format automatically and can be accessed or uploaded to the online one after the lecture or Used without uploading as it may be necessary.

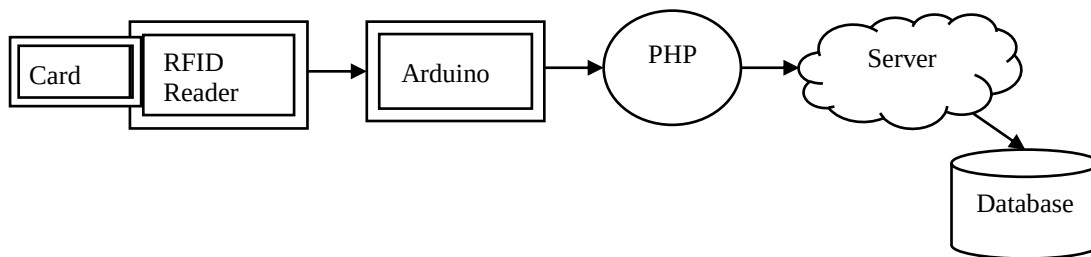


Figure 3. Block diagram for Online Attendance System.



Figure 4. Block Diagram for Local Offline Attendance System.

Coding

Arduino Software (IDE) 1.0 was used to code the system and burn or embedded on the system ROM. The online version requires the use of internet and Database where all attendance will be stored for easy access, each lecturer and student will require RFID card as an Identity card for taking the attendance. Each lecturer will have their login detail to access the files after the lecture.

Each class or individual lecturer will have the system at the main entrance of the door, once the lecturer swipes in their card, the system will automatically create a file for the lecturer and takes the lecturer's attendance then student can begin to swipe their card when entering the class. After the end of class, the student will swipe their card to log out and after all the students have logged out, the lecturer will then swipe his or her card to log out and the system will automatically save and close the file for that lecture.

In the local version, it requires only a SD card for each lecturer and RFID cards for both lecturers and student. In this case, once the lecturer enters the class, he or she will insert the SD card to the system and turn on the system, automatically a file will be created in the SD card, then the lecturer will swipe his or her card for attendance and student will do the same at the point of entry. Then after the end of class the lecturer will remove the SD card and leave.

Hardware Used

Arduino UNO R3

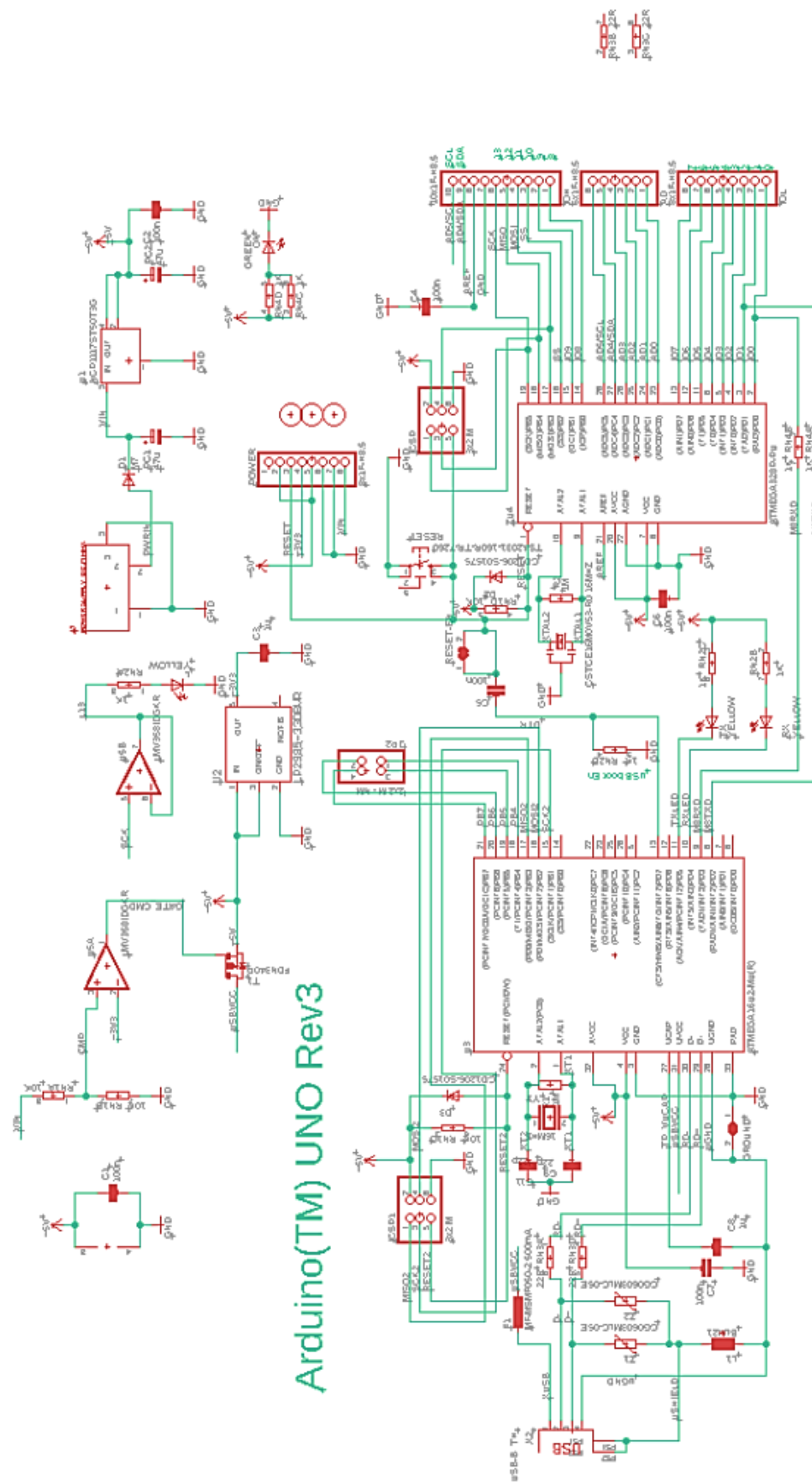
Arduino UNO R3 as in Figures 5–7 is the brainbox used in controlling the whole system, it's where the writing code is been embedded to and it controls the other hardware connected to it. It is cheaper, faster, robust, easier to learn and reprogrammable. It is based on the ATmega28p (datasheet).



Figure 5. Arduino UNO R3 [13].



Figure 6. Arduino UNO R3 Top view [13].



Arduino Data Logger Shield

Arduino data logger stamps the time when the RFID reader reads a card and then sends it to the micro controller to input in the time stamp along with the details of the card.

Jumper Wires

Figure 8 called jumper wires are the long flexible conductor wires used in connecting two or more hardware components together.

LCD (Liquid Crystal Display)

LCD (Liquid Crystal Display) screen is a 16x2 electronic display module used in displaying the current activity of the system. LCDs are easily programmable, economical, have no limitation of displaying special and even custom characters [15].

Arduino Ethernet Shield

The Arduino Ethernet Shield as in Figure 9 is based on the Wiznet W5100 ethernet chip (datasheet) that allows the Arduino board to connect to the internet with the use of RJ45 (Local area network) LAN cable.



Figure 8. Jumper wires [14].



Figure 9. Ethernet shield [16].

MFRC522 RFID

MFRC522 based RFID Reader Module is what is used to read each RFID card that comes closer to it. It reads any RFID card while the micro controller saves the details of card that is pre-registered in the database (Figure 10).

DESIGN, DEVELOPMENT AND IMPLEMENTATION

The goal of this research is to develop a hybrid attendance system with a low cost RFID based system that is capable of taking Lecturer and students Lecture attendance or offices either online or offline since electricity and network failure cannot be guaranteed 24/7 in some nations. The steps necessary for implementation include:

- i. Examine and design Arduino hardware and other electronic components interfaces.
- ii. Get all necessary components.
- iii. Design a low-cost RFID based attendance system.
- iv. Couple the components following the designed system
- v. Develop algorithms and Software to control the system.
- vi. Embed the software for control of the hardware for online and offline system.
- vii. Finally implement the system.

The components that are to be connected as listed above are as in the Figure 11.

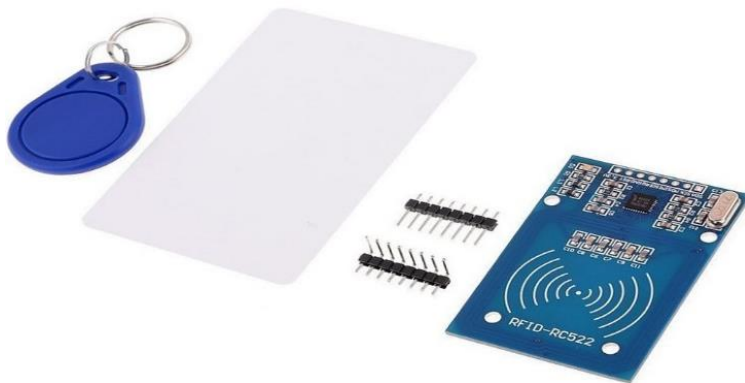


Figure 10. RFID Reader and Cards [17].

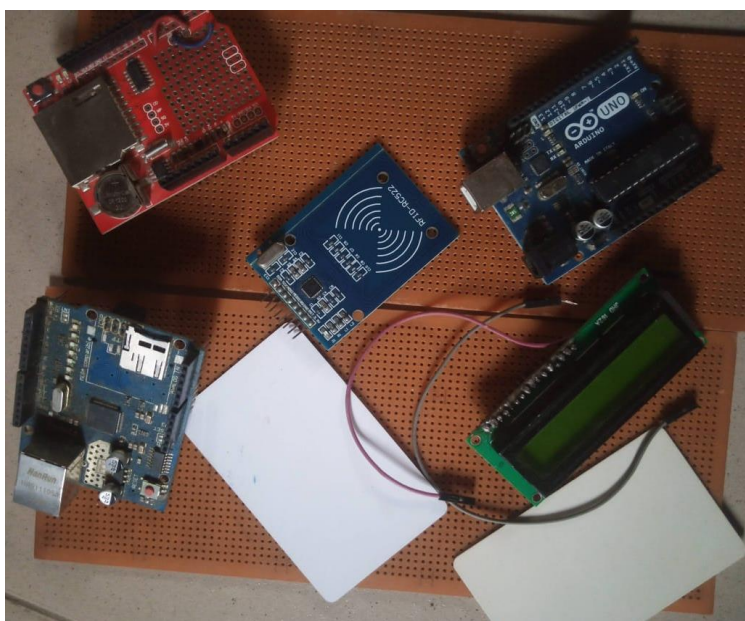


Figure 11. Connection of the Components.

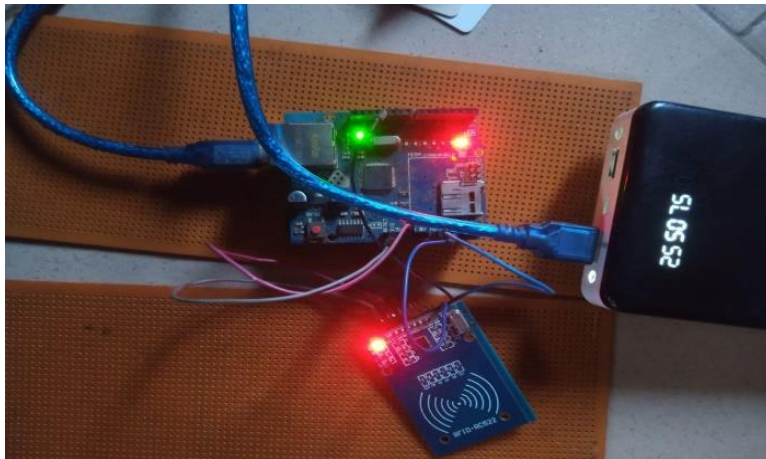


Figure 12. Components and their Connections.

Figure 12 shows the connections and when connected to a power source.

RESULTS AND DISCUSSION

Four RFID cards were used with each card unique ID on the first column to test the system and output in CSV under excel format as in the Table 1.

Table 1. System Result Output.

UID	Date	Day	Time
231 240 210 44	2019/3/14	Thursday	12:03:07
121 35 228 86	2019/3/14	Thursday	12:03:15
214 176 176 247	2019/3/14	Thursday	12:03:19
217 11 192 99	2019/3/14	Thursday	12:03:23
121 35 228 86	2019/3/14	Thursday	12:03:37

Each UID in Table 1 shows the date, day and time the user logged in and it has shown that many people can log in within one minute and it reduces the time it takes many people to be able to log in without wasting time.

It was found that hybrid attendance with combination of offline and online systems will help nations with problem of electricity and network failures. Institutions especially will be able to solve problems of impersonation, absence and improve students' performance. Ministries and other organizations will witness have decline in absenteeism or total halt of staff to abscond from the office. In addition, using Arduino hardware and software with RFID, the system is cheaper, easier and manageable. The code developed works perfectly and affordable with timeliness for both online and offline versions. Within one minute many students can be captured by the system and stored immediately compared to fingerprint, iris, face and other types of attendance systems.

CONCLUSION

It is our hope that this research will be of immense benefit to any institution in many ways by improving the students' performance due to auto-attendance system and the public in general as it may bring attitudinal change in student and lecturer and boost seriousness in both. The online one can be used to send the student performance in school to the parents as well if necessary.

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