

Designing Of Web-Based Attendance and Class Scheduling System using RFID and Raspberry PI

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Abstract

Cloud services have emerged as a promising solution to facilitate a wide array of heterogeneous activities, delivering highly efficient services in various domains. This study focuses on the design and implementation of a Web-Based Attendance and Class Scheduling System for Columban College, Inc. (CCI) located in Olongapo City, Philippines. The system integrates Radio-Frequency Identification (RFID) technology and Raspberry Pi to streamline attendance tracking and class scheduling processes. The proposed system aims to enhance the efficiency and accuracy of attendance monitoring while simplifying the class scheduling procedure for both students and faculty members. RFID technology is employed to facilitate quick and convenient attendance recording, eliminating manual methods, and reducing errors. Additionally, the Raspberry Pi serves as the central processing unit for data management and web-based access. The study presents a detailed analysis of system design, development, and implementation, highlighting the technical aspects of integrating RFID and Raspberry Pi into a web-based platform. The benefits of this system include real-time attendance updates, automated scheduling, and improved data management, contributing to enhanced productivity and transparency within CCI. By leveraging cloud services, this innovative system provides a scalable and efficient solution to address the unique challenges faced by educational institutions in managing attendance and class scheduling. The study underscores the potential of cloud-based technologies in revolutionizing administrative processes and improving overall educational experiences in institutions like Columban College, Inc. This project makes use of the following applications and technologies: RFID Reader, Raspberry Pi 4 Model B, Database Server, Bootstrap, PHP, and CSS.

Keywords

Attendance Monitoring, RFID reader, Raspberry Pi, RFID tags, Web-based, Reports.

INTRODUCTION

Radio Frequency Identification (RFID) is a mechanism for automatically capturing or storing data from RFID tags without the need for physical touch. RFID tags, middleware, RFID readers, and backend databases are all components of the RFID system[1]. By their unique identifying sequence, RFID tags are universally identifiable following the headers of the EPC Global Tag Data Standard. An RFID reader can manually activate a tag, or it can actively transmit an RF signal to the reader. When these tags are nearby, the RFID reader antenna analyses the information stored inside them. The operating frequency of the leader dictates its range. The reader's working frequency ranges from 125 kHz to 2.4GHz.[2]

The development of wireless technology has been a major factor in the popularity of RFID technology. An essential prerequisite for RFID's full potential was wireless technology.[3] Over the previous two decades, this technology has experienced rapid expansion. Data integrity and excellent system efficiency are key requirements in modern enterprises. Uses for this technology include tracking vehicles and cargo, courier services, package processing, schools, and higher education[4].

[5]Attendance is primarily used to maintain a record of students in schools and colleges, acting as a basic requirement of discipline and providing quality education within the organization. The traditional method used to track attendance is to call each student's name or roll number and display attendance or absence accordingly. The existing RFID system

also has various vulnerabilities. Except for discrepancies and time consumption, a lot of paperwork is required which can lead to personal errors in tracking attendance. All these various problems need to be resolved. As technology evolves, a variety of new methods are evolving.[6]

Columban College, Inc. is a Christ-centered Catholic educational institution owned by the Diocese of Iba Educational Foundation Inc. Diocese of Iba, guided by the school motto: "We are Christ's and not our own" and has been providing services since 1961. The institution is dedicated to serving the educational needs of Olongapo City, Zambales, and its neighboring provinces. The institution made a great promotional impact due to the achievements and accomplishments contributed by several factors such as board passers-by, awards in sports, and academic competitions in international, national, and regional competitions. With the management's commitment to providing quality education and faculty services to its students, continuous improvements were made to promote the institution such as upgrades in its physical facilities and resources, updated curriculum, providing faculty development programs, and integrating computerized systems.

In the current process, the guard will approach the students for them to sign in the logbook and show their school ID to monitor the student's attendance. If the student has lost the ID, he/she will go to the adviser. Then, the adviser will report it to the year-level coordinator to give the admission slip. The adviser will contact the parent about the lost ID. The purpose of the admission slip is for latecomers, absenteeism, and distribution of modules.

Colleges and Universities that are still utilizing the methods of manually recording attendance raise the possibility that the attendance data produced is invalid and easily manipulated. Academic institutions confront two significant issues: time-consuming manual attendance and electrical power consumption[7].

The main concept of this proposed system is to maintain a record of student attendance. All students are selected from a specific official tag. This RFID tag can be used to record attendance by swiping in front of an RFID reader.

In the proposed system, the students will tap their RFID card into the RFID reader. They will wait for the system to show in the display their face and time before entering their class. A message will be sent to the parent/guardian informing them of the time in and time out of their child. The same procedure will be implemented upon exit from the school premises. If the student has no RFID card, he/she will go to the adviser. Then, the adviser will report it to the parent/guardian and ICT coordinator to process the request form for a new RFID card with a processing fee. The process of requesting a new RFID card includes registration in the system the basic information such as name, age, birthday, name of parent/ guardian, and year and section. The basic information will be stored in the database. After the process has been done the adviser will give the new RFID to the student.

In case the student loses the RFID card, the principal will have a record of it requesting the parent to provide an affidavit of loss and a processing fee so the ICT coordinator can process a new RFID card for the student.

If the student forgets the RFID card, the parent/guardian will receive a message from the adviser to go to the office asking them to sign in the admission form logbook. The adviser will receive an admission slip from the office to be given to the student.

Each student is required to carry a Student ID Card (RFID Card) when entering the School or Classroom. The backend data is managed by customized software. This project will initially be designed to oversee the attendance of students in the school but to support tracking the attendance requirements of given organizations. The attendance tracking system allows students to embark on learning as soon as possible without wasting time on the manual process of confirming attendance.

In terms of system implementation and delivery, it should be capable of assisting in the methodological management of its student attendance. The system must have a web-based portal with student/faculty information, as well as the capacity to aid advisers and principals in modifying data, updating databases, and notifying administrators, when necessary, as well as a user-friendly interface[8].

OBJECTIVES OF THE STUDY

The study aimed to design a web-based attendance monitoring system. Specifically, it sought to design for the following:

1. Web-Based Attendance and Class Scheduling System using RFID and Raspberry Pi 4;
2. Web-based system interface to display reports regarding attendance of students, class scheduling system; and
3. SMS-based notification feature of Web-based attendance and class scheduling system.

LITERATURE REVIEW

Triyono, (2020) RFID technology is now advancing at a rapid pace in its use. One use in the realm of education is its usage in the presence of an information system. Attendance systems can be beneficial in terms of lowering administrative complexity and cost rather than enhancing educational efficiency [9]. By utilizing this RFID, academics will be able to assist in recapitulating attendance and disciplining students in terms of on-time arrival, thus strengthening the purposes of education [10]. It may also be used to optimize the utilization of classrooms such that no two rooms are occupied at the same time.

[11] To assess students' engagement, attendance in teaching and learning activities must be recorded. The amount of educational institutions that still manually record attendance raises the possibility that the attendance data supplied is incorrect and readily manipulated.

Previous research [12] Oghuvbu, (2017) found a link between student attendance and overall academic achievement. As a result, absence can harm the institution's reputation while also resulting in poor learning on the side of the student.

Regardless, web-based applications have proliferated in education and other industries due to their mobility, adaptability, and flexibility. They are currently one of the preferred solutions for easing the process of maintaining data and records [10].

The remaining web-based attendance tracking systems with integrated RFID technology, on the other hand, lack wireless capabilities. This implies that desktop PCs or laptops must be situated near the RFID scanners. These systems frequently make use of a Raspberry Pi microcontroller to link to a real-time database environment [10].

[13] The Raspberry Pi is a dynamic microcontroller that can do everything a computer can. Regardless of how modest the system's scope is, it saves time by executing an automated and more exact procedure of collecting attendance. It does not complicate an organization's duty, but rather simplifies it and uses fewer resources because not all students must be present in a room to take attendance[14].

This integration will enable schools and institutions to employ an automated technique to take precise attendance of students in each of their classes. The project will be built around a Raspberry Pi 4 with an RFID card and reader connected[15]. The RFID device performs the same function as a barcode technology or a magnetic strip on the back of a credit or debit card or ATM card; much like a barcode or magnetic strip, the RFID device must be scanned to obtain

information. Each student must have their student ID card (RFID card) with them[16].

METHODOLOGY

The waterfall approach was applied in this study since it is particularly suited for both development and design, as well as being quite straightforward. The output of one step is the input for the following phase in this paradigm. Only once the preceding phase is completed does the following phase begin to be developed.

These information services are shown in Figure 1 shows that there are six (6) steps involved in performing research, including:

Requirement Analysis

Is the process of gathering diverse preliminary information (data) linked to the research project from the field or the library to examine the topic more systematically and deeply as a prologue to carrying out the steps or subsequent research processes. The System Design process can begin only when the requirement has been frozen. The SRS document created in this situation is a result of the Requirement phase and acts as an input for the System Design.

System Design

The approach used in this design is an experimental design approach since the item to be examined requires depth. Software architecture and design documentation are developed to serve as input for the following phase, i.e., Coding and implementation

Implementation

This is accomplished by referring to the prior design. This stage is carried out by acquiring existing hardware and software devices. This is the point when both hardware and software are customized. Customization, on the other hand, entails configuring and developing essential software applications. The coding process is complete, and the resulting software is utilized as input for the testing phase.

Testing

The model created in the design phase may be tested by analyzing the integration of all the subsystems involved, i.e. repeating the previous stage only if the objective is not met by the following process. The generated code is rigorously tested to identify software flaws. Defects are reported in a defect tracking tool and retested once they have been corrected. Until the program is ready for use, bug recording, retesting, and regression testing are carried out.

Deployment

During the deployment phase, the produced code is pushed into production once the client has granted his or her approval.

Maintenance

Everything that is done, whether successful or unsuccessful, must be noted in the report. As a result, steps

that must be completed in both the development and assessment phases can be taken. Furthermore, other parties may find this report valuable as a reference. Any problems that arise in the production environment are fixed by the developers.

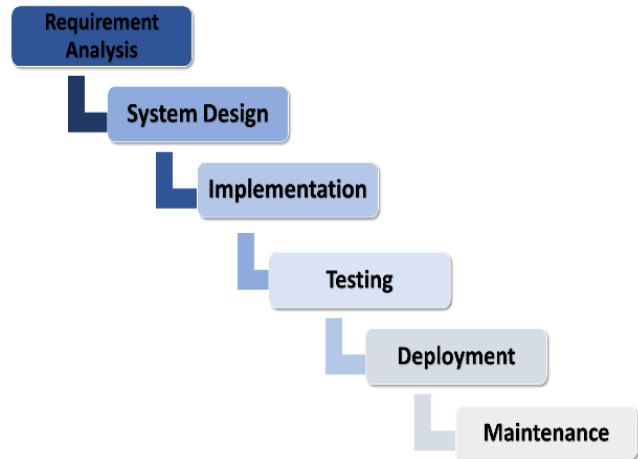


Figure 1. Research Methodology

IMPLEMENTATION ACTIVITIES

Business Process Model and Notation

The Web-based Attendance and Class Scheduling System using RFID and Raspberry Pi of Columban College, Inc., Figure 2 illustrates the entire system procedure.

In the proposed system, the students will tap their RFID card into the RFID reader. They will wait for the system to show in the display their face and time before entering their class. A message will be sent to the parent/guardian informing them of the time in and time out of their child. The same procedure will be implemented upon exit from the school premises. If the student has no RFID card, he/she will go to the adviser. Then, the adviser will report it to the parent/guardian and ICT coordinator to process the request form for a new RFID card with a processing fee. The process of requesting a new RFID card includes registration in the system the basic information such as name, age, birthday, name of parent/ guardian, and year and section. The basic information will be stored in the database. After the process has been done the adviser will give the new RFID to the student.

In case the student has lost the RFID card, the principal will have a record of it requesting the parent to provide an affidavit of loss and a processing fee so the ICT coordinator can process a new RFID card for the student.

If the student forgets the RFID card, the parent/guardian will receive a message from the adviser to go to the office asking them to sign in the admission form logbook. The adviser will receive an admission slip from the office to be given to the student.

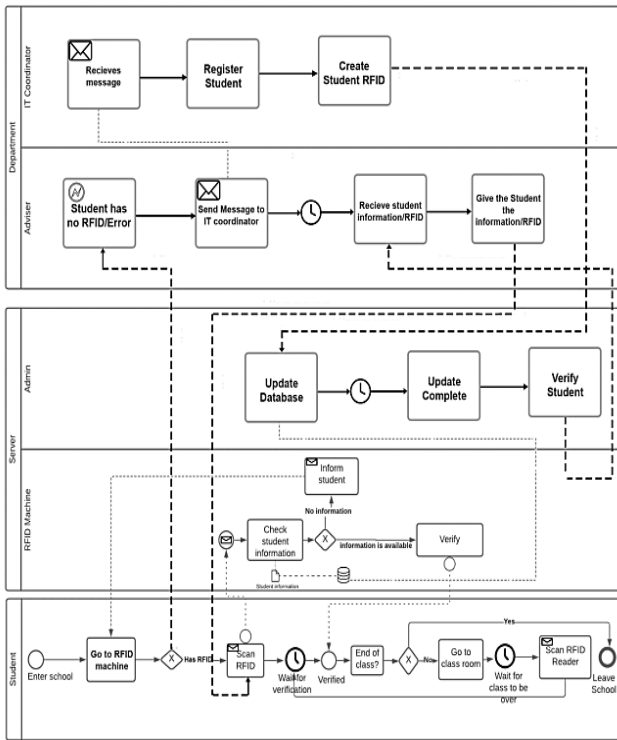


Figure 2. Proposed Business Process Model and Notation

Web-based Attendance and Class Scheduling System using RFID and Raspberry Pi.

System Architecture Diagram

The design of system architecture is crucial in the creation of tools and in affecting the results gained. Web-based Attendance Recording System Using RFID and Raspberry Pi would record students' presence by tapping an RFID card into an RFID reader and then sending it to the Raspberry Pi, which serves as the server and can be accessed through the web.



Figure 3. System Architecture Diagram

Use Case Diagram

In the use case diagram in the figure below, the Web-based Attendance and Class Scheduling System must be enabled first by the principal, advisers, and administration, and then by students using an RFID card that is brought closer to the RFID reader. This system also has a data review tool to make it easier to get information about student attendance. The Web-based Attendance and Class Scheduling System's use case diagram is shown below.

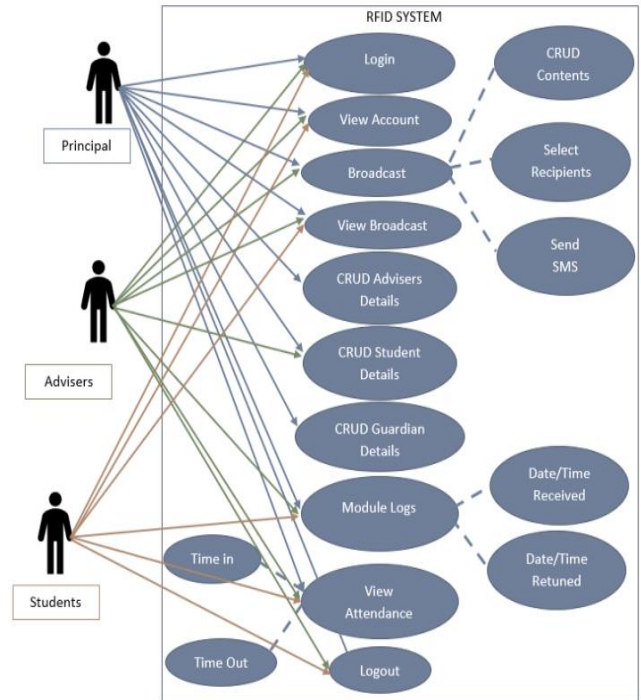


Figure 4. Use Case Diagram

Principal, Adviser, and Students

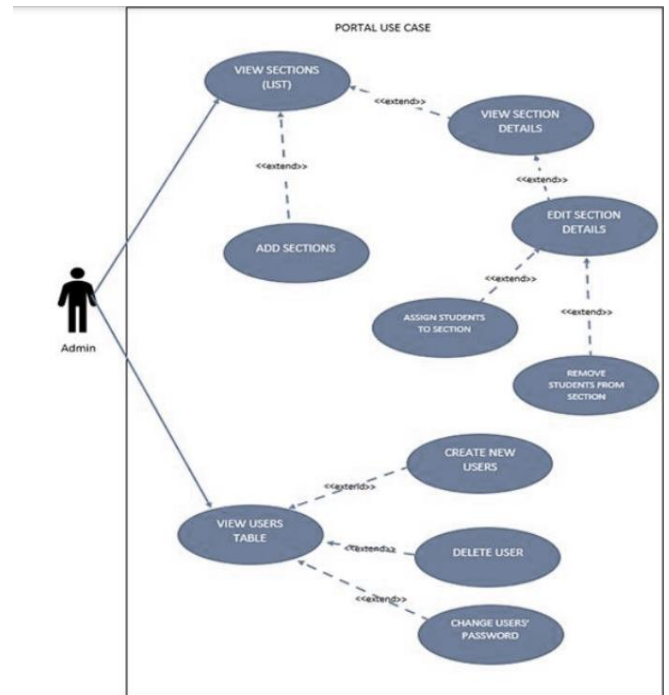


Figure 5. Use Case Diagram

Admin

Functional Requirements

Functional requirements describe what a system or software application is supposed to do. In this case, we'll discuss the functional requirements for an educational system that includes components like an RFID reader, mobile application, adviser, administrator, parent/guardian, and principal.

These functional requirements provide a framework for the development of an educational system that incorporates RFID technology, mobile applications, and user roles like advisers, administrators, parents/guardians, and principals, ensuring efficient communication, attendance tracking, and data management.

Table 1. Functional Requirements

ACTORS	REQUIREMENT	DESCRIPTION
RFID Reader	Record Attendance	RFID reader will be recording the attendance by detecting the Tags attached to student's uniform.
Mobile Application	Record Attendance Send Attendance information	Mobile application acts as a backup for recording attendance It will also be used to send attendance information to parents or Guardians
Adviser	Login View View Attendance Student, Register Student	Class teacher will login into the system and upon successful, he/she will be able to view attendance information, edit student details and register new students.
Administrator	Login View Attendance Edit Student Register Student Delete Student	The administrator will login into the system, view attendance, class scheduling, edit students' information, Register Students and Delete Students.
Parent/Guardian	Receive Attendance information	Parents or Guardians will be receiving attendance information for their kids in case of truancy.
Principal	<ul style="list-style-type: none"> View student Register student View attendance Login 	The principal monitors the registered students and their attendance. He / She is also responsible for registering or deleting student.

RESULT AND DISCUSSION

The proposed system achieves three objectives: the first is to design a Web-Based Attendance and Class Scheduling System using RFID and Raspberry Pi 4; the second is to design a Web-based system interface to display reports regarding attendance of students, class scheduling system; and the third is designed SMS-based notification feature of Web-based attendance and class scheduling system. The common approach for collecting student absenteeism reports is to use paper and write on the advertising wall. As a result, the paperwork technique consumes labor needs, replicates efforts, and imposes time-consuming and inefficient procedures.

The results of each step of design adopting the waterfall model methodology are described in the next section.

RFID Tag and Reader

[17]RFID tags are card-shaped devices that hold data that may be used to identify items. RFID tags only include one-of-a-kind ID tags that can be recognized from one another. RFID tags are either active or passive. Active tags are powered by a battery, reducing the amount of power required by the RFID reader and allowing the tags to broadcast information over a wider distance. Passive tags, on the other hand, derive their power source from the RFID reader's field.

RFID readers are RFID tag scanners that interact wirelessly with tag cards. RFID readers are divided into two categories: passive and active. Active RFID tags only send radio signals to passive RFID readers, whereas passive RFID readers send an interrogator signal to the tag and wait for an

authentication response. Before changing to a DC signal and becoming a passive tag resource, this interrogator signal also induces the tag. Figure 6 shows the RFID Reader.



Figure 6. RFID Tag and Reader

Raspberry Pi

The Raspberry Pi 4 Model B is the most recent addition to the popular Raspberry Pi computer series. When compared to the previous-generation Raspberry Pi 3 Model B+, it delivers significant improvements in CPU speed, multimedia performance, memory, and connection while maintaining backward compatibility and consuming comparable power [18]. The desktop performance of the Raspberry Pi 4 Model B is equivalent to that of entry-level x86 PC systems. A fast 64-bit quad-core processor, dual-display compatibility at up to 4K resolutions through two micro-HDMI ports, hardware video decoding at up to 4Kp60 rates, 4GB of RAM, and dual-band 2. 4/5. Bluetooth 5.0, Gigabit Ethernet wireless LAN, and USB 3.0 are all supported. In addition to PoE support (via a separate PoE HAT add-on). The dual-band wireless LAN and Photos modules have modular compliance certification, allowing the board to be included in final products with much-reduced compliance testing, reducing both cost and time to market. The temperature outside should be between 0 and 50 degrees Celsius. The Raspberry Pi board is seen in Figure 7.



Figure 7. Board of Raspberry Pi

Design Web-Based Attendance and Class Scheduling System using RFID and Raspberry Pi 4. The design of the web-based interface display is the design of the display used to make a display on the student.

1. Log in home page
2. Dashboard page
3. Broadcasts page

4. Student's page
5. Sections page
6. Lecture schedule form

Web-based system interface to display reports regarding attendance of students, and class scheduling system.

The starting page display is a demonstration of the Web-based system interface for showing reports on student attendance and the class scheduling system, which is a web portal available only to the administration, principal, and instructors shown in Figure 8.

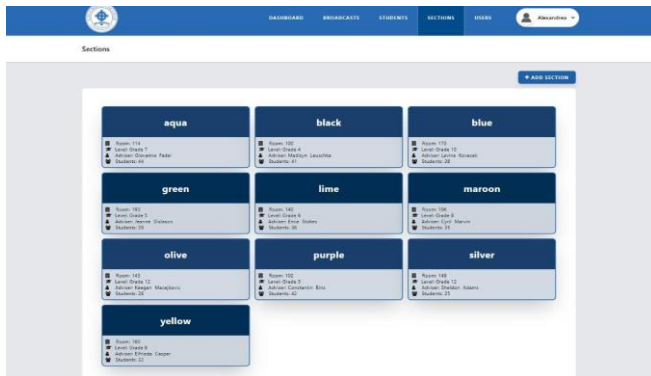


Figure 8. Sections Page (Class Scheduling)

On this page, the user can see the list of all class section schedules. Accessible to all users except the students.

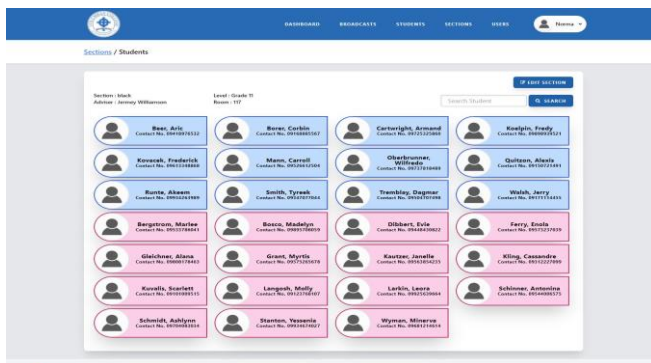


Figure 9. Sections Page

Sections of Students Here, the user can see the list of all students who belong to a specific class section.

USER INTERFACE DESIGN

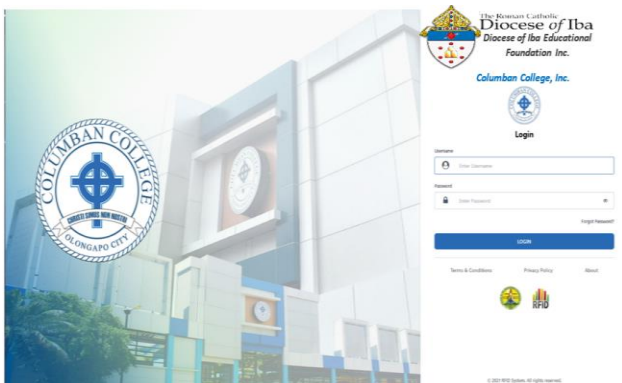


Figure 10. Log-in Home Page

represents the Login home page wherein the Administrator will enter his/her credentials to log in to the database. If the user/administrator enters an invalid ID/password, the system will notify the user of the invalid credentials and will deny access

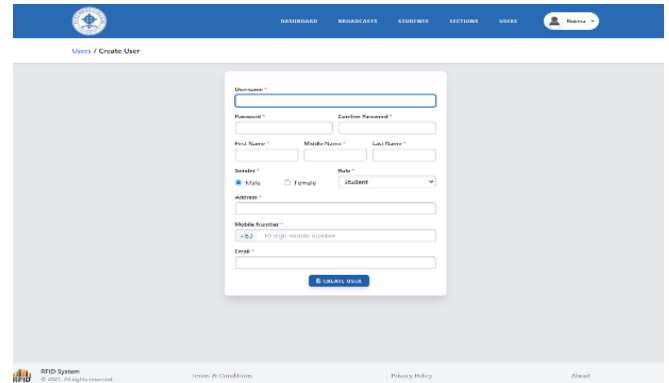


Figure 11. Create User

Indicates that the administrator may add specific students to the database in case there are new admissions. The screen above shows the Student Information page, where the administrator can create a new record by entering the enrollment number, student name, and student branch. Many other functions can also be performed on student records, such as adding records, deleting existing items, and resetting previous student items.

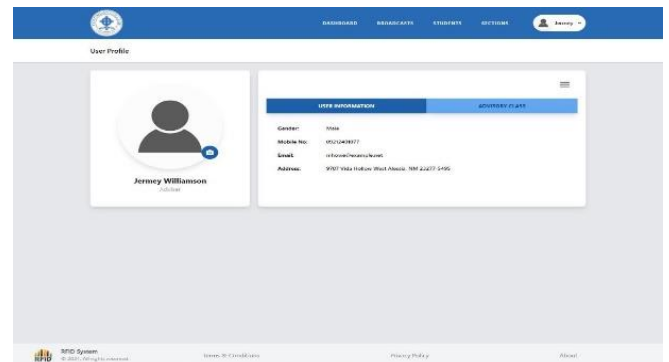


Figure 12. User Profile

On this page, the user can manage their account. They can update their contact information, change their password, and change their profile image.

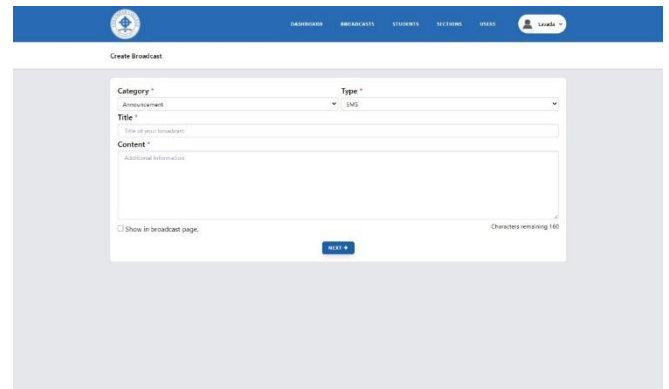


Figure 13. Dashboard Web Display

On this page, the user will see all the events /activities of the school that were displayed on the dashboard.

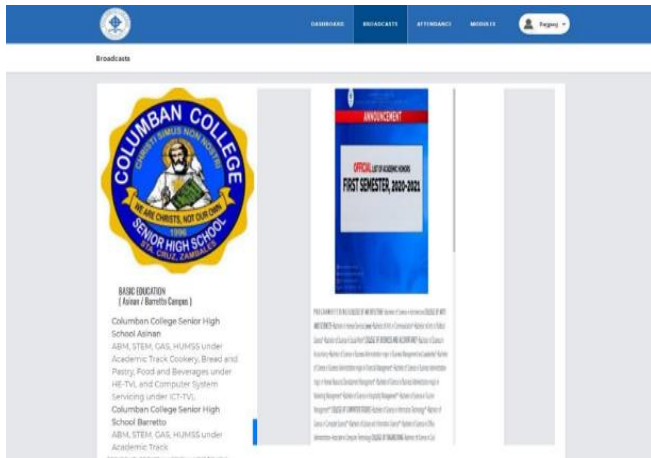


Figure 14. Broadcasts Page (List View)

On this page, the user will see all the broadcasts that were sent if he/she is included on the recipient's list of the broadcast.

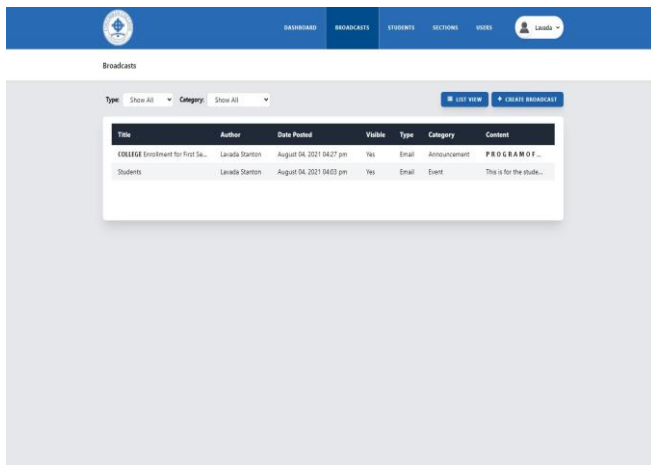


Figure 15. Broadcasts Page (Table View)

Only the administrator can access this page. All broadcasts sent will be included in this table.

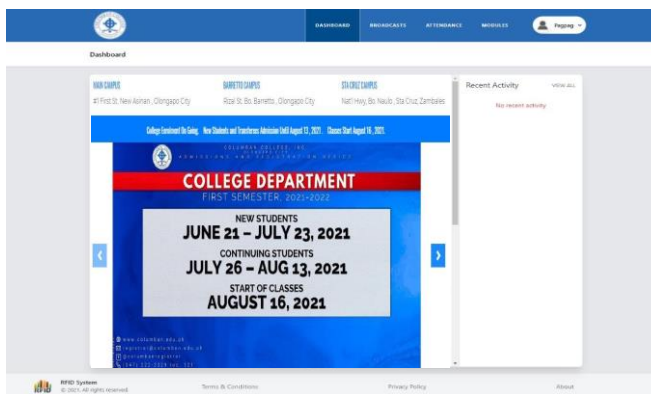


Figure 16. Create Broadcast Page

This page is accessible to all users except the students. The user can create a broadcast message that he can send to specific recipients.

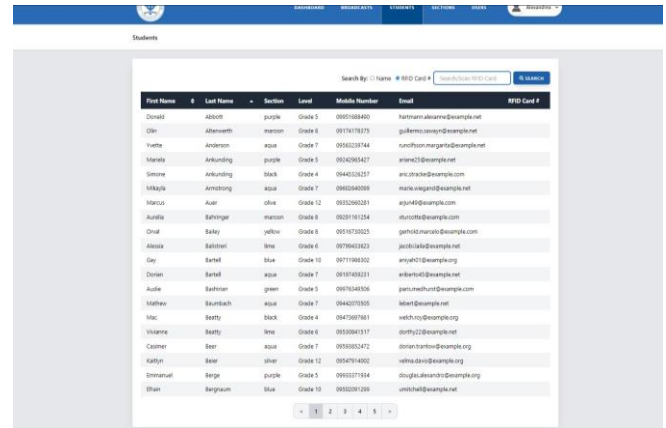


Figure 17. Users Page

On this page, you can see the first check-in log and the last check-out log of the day. The purpose of this is to see whether the student has entered the school or not. (Attendance purposes).

CONCLUSIONS

The waterfall model technique was used to design the Web-Based Attendance and Class Scheduling System Using RFID and Raspberry Pi. Aside from its wireless capability, which is not included in previous systems, the system offers other notable features such as SMS notification, report management, and announcement management. This might aid not just in tracking student attendance and class schedules but also in the generation of reports. As a result, this method would most likely benefit academic institutions that need to track students' attendance daily.

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