RFID-based Attendance Monitoring System with SMS Notification and Data Analytics

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Student attendance plays a vital role in monitoring learners' engagement with their course of study. It serves as proof of a student's presence in class and participation in school activities. Traditionally, attendance has been recorded using a paper-based system before students enter the campus. However, this method presents several limitations, such as the difficulty of processing and analyzing attendance data since records are not uploaded into a centralized system (Aldabagh, 2025; Ali et al., 2018; Acasamoso et al., 2021). Currently, most of the schools, colleges and universities in the Philippines still rely on this manual paper-based approach (Grefaldo et al., 2025; Santos et al., 2021; Acasamoso et al., 2021), which highlights the need for a more efficient and accurate solution.

To address this, this study proposed the development of a Radio Frequency Identification (RFID) based attendance monitoring system with SMS notification and data analytics. This system will automatically record students' time-in and time-out upon entering and leaving the campus. Additionally, SMS notifications will be sent to parents once their child taps

the RFID card at the school gate, ensuring transparency and real-time communication. The use of RFID cards allows for quick, accurate, and efficient identification of multiple students, thereby streamlining the attendance process.

According to Aldabagh (2025), the student attendance management system with SMS notification eliminates the traditional pen-and-paper process and promotes online attendance recording with just a click. Teachers can easily track and manage attendance information using both mobile and desktop devices. By scanning a digital RFID card, a student's attendance is automatically recorded in the system, reducing teachers' workload and saving valuable instructional time. Similarly, Khan et al. (2020) emphasized that conventional attendance systems requiring students to manually sign attendance sheets are inefficient. RFID-based systems address this limitation by automating the process. Furthermore, Puckdeevongs et al. (2020) developed a web-based application for daily student attendance within universities, demonstrating that such systems can generate reports, evaluate attendance eligibility, and significantly reduce the use of human and material resources. By integrating RFID technology with SMS notifications and data analytics, the project aims to modernize attendance monitoring, reduce manual workload, and enhance communication between the school and parents.

The main objective of this study is to develop the RFID-based Attendance Monitoring System with SMS Notification and Data Analytics for the Senior High School and College students of a private college in the Philippines, to efficiently monitor their time-in and time-out on campus.

Theoretical Framework

Web-Based and Electronic Solutions on Student Attendance

Monitoring student attendance is essential in academic institutions as it verifies student presence and engagement. However, traditional methods such as manual signing or paper-based systems are often inefficient, time-consuming, and prone to errors. These systems also hinder data processing and analysis, delaying administrative tasks and reducing monitoring effectiveness. Hence, adopting automated attendance systems is crucial to improve accuracy, efficiency, and reliability.

Several studies emphasize the benefits of modern, web-based, and electronic attendance systems (Ali et al., 2022; Rahaman et al., 2025; Nguyen-Tat et al., 2024). Jacksi et al. (2018) proposed a web-based application for daily student attendance at the university level, which could generate reports and evaluate student eligibility based on attendance records. This system not only improved monitoring but also conserved human and material resources. In a similar context, Gillespie (2020) explained that electronic gadgets provide students with greater access to information, more opportunities for collaboration, and enhanced communication, all of which contribute to independent learning and improved educational outcomes. By extension, these technological innovations can also be applied to attendance monitoring, making the process faster and more reliable. These systems allow teachers to monitor attendance through mobile and desktop devices, thereby minimizing workload and saving valuable classroom time. With just a scan of a digital or RFID card, attendance data is captured instantly, ensuring that teachers can focus on instruction rather than administrative tasks.

Integration of RFID Technology in Attendance Systems

RFID has become one of the most effective tools in modern attendance systems. Su et al. (2023) describe RFID as a technology that uses radio waves to automatically recognize people or objects. By embedding a serial number and related details in a microchip attached to an antenna, RFID readers can efficiently identify individuals and log their entry or exit. This integration simplifies data recording and enhances system reliability.

According to Farag (2023), implementing RFID-based systems can significantly improve the monitoring of students' attendance, benefiting both administrators and lecturers. By replacing manual signing with RFID scanning, schools reduce errors and increase efficiency. Likewise, Ukoima et al. (2019) developed a student monitoring system that used low-frequency RFID in combination with SMS to track students. The study confirmed the accuracy of the system in monitoring entry and exit times and suggested that future research explore the use of high-frequency RFID readers for even greater convenience, allowing students to simply wear or carry RFID-enabled cards.

RFID with SMS Notification for Enhanced Monitoring

The combination of RFID technology with Short Messaging Service (SMS) notification adds a valuable communication layer between schools and parents. Anitha et al. (2023) emphasized that when students use their RFID card to enter the school premises, the system verifies the card against the school database. At the same time, SMS alerts are sent to parents informing them of their child's arrival and departure. This ensures real-time parental awareness, even if they are not physically present at school.

A similar approach was explored in the study of Rahman et al. (2019) where RFID cards were utilized to track entry and exit. Text

messages were automatically sent to both administrators and parents, specifying the time students entered and exited the school campus. This enhanced transparency reassures parents of their children's safety while providing school administrators with accurate attendance data.

In addition, Farag (2023) highlighted that RFID and SMS-based systems could also extend functionality beyond simple attendance monitoring. Their system was able to track not only time-in and time-out but also account balances and class schedules, offering a multi-functional tool for school administration. This demonstrates the adaptability of RFID-SMS systems to serve broader institutional needs.

Research Framework

Data

The data in this study were gathered from 150 respondents selected using Slovin's formula and a random sampling method for questionnaire distribution. The respondents were Senior High School students in Sariaya, Quezon. The number of respondents and their percentage distribution by age are as follows: one hundred thirty-eight (138) respondents belonged to the age bracket of 17–25 years and above, representing 75% of the total respondents; eleven (11) respondents belonged to the age bracket of 26–30 years and above, accounting for 20% of the total respondents; and one (1) respondent was in the age bracket of 34 years old, representing 5% of the total respondents.

The questionnaire is based on ISO 2510, which contains functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. The study used the four-point Likert scale that contains these categories: strongly agree, agree, disagree,

and strongly disagree. Each scale has a mean range assigned to determine the evaluation result.

Experimental Design

The developed system intended to transform the existing paper-based attendance method into an RFID-based attendance monitoring system. This involved coding the system components, integrating RFID functionality, and preparing the platform for subsequent testing and evaluation.

Figure 1

Experimental design of the study

Figure 1 presents the experimental design of the study. The design begins when a student arrives at the school gate. Each student uses an RFID

card, which is tapped against the RFID reader installed at the entrance. Once tapped, the student's information is validated by the system and automatically displayed on the monitor. At the same time, an SMS notification is sent to the parent or guardian, informing them that their child has arrived safely at the school premises.

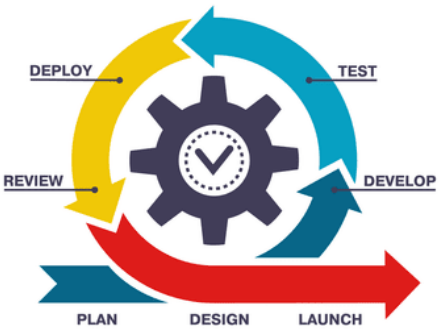
At the end of classes, the same process is repeated. Students tap their RFID card before leaving the campus. The system validates the card, records the time-out information, and sends a second SMS notification to the parent or guardian indicating that the student has left the school grounds. This design ensures accurate monitoring of student attendance while providing parents with real-time updates of their child's whereabouts.

System Development Approach

Figure 2 illustrates the System Development Life Cycle (SDLC) Agile Model, which follows a sequential yet iterative process. In this model, development is not viewed as a one-time sequence but as a circular process that includes planning, system design, system development, system testing, system deployment, review, and launch. This cycle ensures that the system is continuously improved based on feedback and testing results.

Figure 2

Agile model



The development of the system followed the Agile-inspired SDLC methodology, which consists of the following phases:

Planning. Developing a project plan was the initial and essential phase. The researchers collected information on how to create an attendance system suitable for the school, conducted requirement analysis, and defined system specifications.

Designing. In the design phase, the researchers used the data and insights gathered during planning to create system designs, interfaces, and functions tailored to the target users—the students and administrators.

Developing. During this phase, the system was coded using the selected programming languages and applications. Both the back-end functionality and the visual interface of the system were created to ensure usability and efficiency.

Testing. Once the system was fully developed, it underwent testing to verify that all code worked correctly. This included testing individual modules as well as the integrated system.

Deployment. The system was then deployed in the school environment. This phase allowed students to enter and leave the campus efficiently without the need for manual paper-based attendance, streamlining the process.

Review. The review phase involved evaluating the system's performance to ensure that all modules operated as intended and that the system met the defined objectives.

Launch. After successful review and verification, the system was officially launched and made operational for everyday use in the school.

Testing. In the testing phase, the researchers conducted systematic evaluations of each module. Two primary types of testing were applied:

Test Cases – Specific scenarios were prepared to evaluate whether each function of the system performed as expected.

Test Approach – Methods and procedures were defined to systematically verify the system's operations, including time-in/time-out recording, RFID validation, SMS notifications, and data storage.

Procedures of Different Phases

The following procedures describe how the system operates during different phases of student entry and exit:

Tapping the RFID card upon entering the school campus. Before entering the school gate at Tierra Monde, students must tap their RFID cards on the reader. This action serves as their official time-in record.

Displaying student information. Once validated by the system, the student's basic information, along with their picture, is displayed on the monitor. After this confirmation, the student can proceed to their classroom.

Sending SMS notification to parents. After validation, the system sends an SMS notification to the parent or guardian, confirming that the student has entered the school premises.

Tapping the RFID card upon leaving the campus. At dismissal, the student taps the RFID card again at the school gate. This records the student's time-out and ensures that the system logs the exact time the student leaves.

Sending second SMS notification to parents. Once the time-out is validated, the system generates a second SMS notification to inform parents that their child has left the campus safely.

This cycle ensures that both school administrators and parents have accurate, real-time attendance records of the students.

Technical Framework

Materials

The development of the system required the use of specific software and hardware to ensure functionality, efficiency, and ease of integration.

Software

The following tools and languages were utilized in coding and developing the system:

Table 1

Software specifications and software platform

System Type	Web-Based
Operating System	Windows
System Model	Asus X454L
Language	JAVASCRIPT, PHP
Text Editor	Visual Studio Code
Designing	HTML, CSS
Web server and Database	XAMPP

JavaScript. JavaScript is a dynamic programming language commonly used in web development. It allows the creation of interactive features, controls multimedia, updates web content dynamically, and supports the development of web-based applications and games.

Visual Studio Code. Visual Studio Code (VS Code) is a free, open-source code editor developed by Microsoft. It is lightweight yet powerful, supporting multiple platforms including Windows, Linux, and macOS. With its rich features, extensions, and debugging capabilities, VS Code has become one of the most widely used development environments.

HTML (HyperText Markup Language). HTML is the standard markup language used to structure content on the web. It defines the layout of web pages, including text, images, tables, and multimedia elements. In

this system, HTML was used to design and structure the user interface.

CSS (Cascading Style Sheets). CSS is a styling language used to control the visual presentation of web pages written in HTML or XML. It is responsible for the design, layout, fonts, colors, and responsiveness of the web interface, enhancing the user experience.

XAMPP. XAMPP is an open-source cross-platform web server solution that includes Apache, MySQL, PHP, and Perl. It is primarily used for local web application testing. Developers use XAMPP to simulate a server environment on their personal computers, enabling them to run and test their code before deployment.

PHP (Hypertext Preprocessor). PHP is a widely used server-side scripting language designed for web development. It is primarily employed for creating dynamic web pages and applications. In this study, PHP handled system logic, database interaction, and back-end processes.

Hardware

The system required the following hardware specifications for the development of this project as itemized in Table 2.

Table 2

Hardware specifications

Laptop	**Specs**
Processor	Intel Core i3-5010U (3M Cache, 210GHz)
RAM	4GB DRAM DDR3
Hard Disk Space	1TB 5400RPM
Edition	Windows 10
RFID	Specs
RFID Card	125 khz
RFID Reader	125 khz

The system required the following hardware components.

Figure 3

RFID card

The RFID card uses radio frequency to identify, track, and store information such as serial numbers. It serves as a primary component of the system, with RFID tags functioning as intelligent labels that store details about students when entering and leaving the school premises.

Figure 4

RFID reader

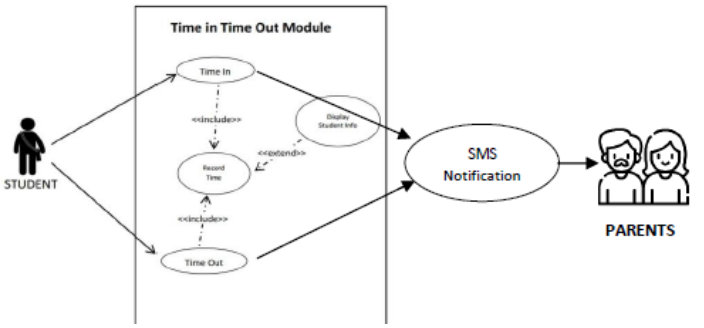
The RFID reader is a device that validates the RFID card when it is tapped. This device must be connected to a monitor, laptop, or PC via a USB port to function properly.

Modeling

Figure 5 shows the use case diagram of the system. The system records the time-in and time-out of each student and displays the student's picture on the monitor.

Figure 5

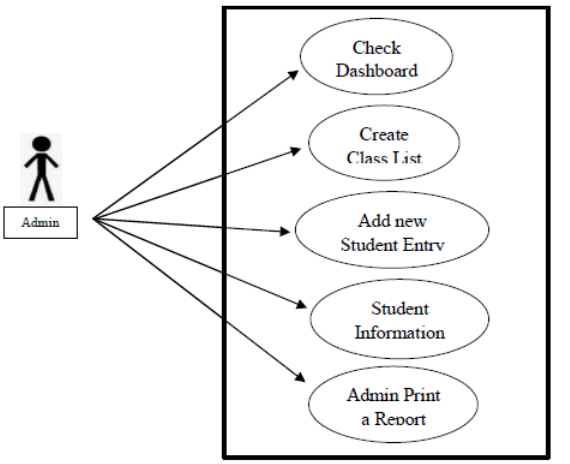
Use case diagram time-in, time-out module



When a student taps their RFID card, the time-in is automatically recorded in the database, and an SMS notification is sent to the parents. Similarly, upon tapping the card when leaving, the time-out is recorded, and a second SMS notification is sent. The student's time-in and time-out records can be accessed through the system's attendance form.

Figure 6

Use case diagram for admin



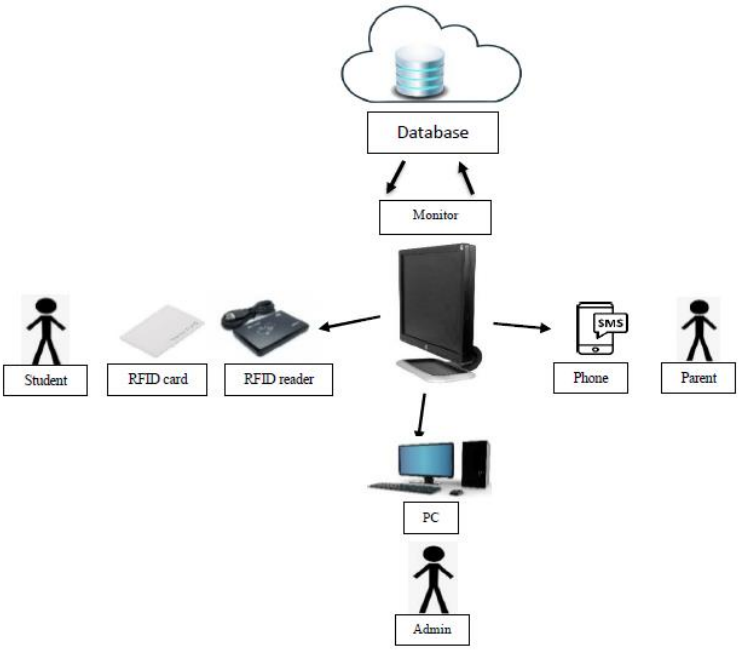
The system administrator can use the dashboard to monitor student attendance and manage class lists for each course. The administrator is also responsible for adding new students by registering their RFID cards, collecting their personal information, and generating printable reports containing attendance records and other relevant student data.

System Architecture

Figure 7 shows the system architecture, which illustrates the overall framework of the proposed system, including its major components and how they interact with one another. It provides a visual representation of the flow of processes, data, and communication between hardware, software, and users, ensuring a clear understanding of how the system operates as a whole.

Figure 7

System architecture

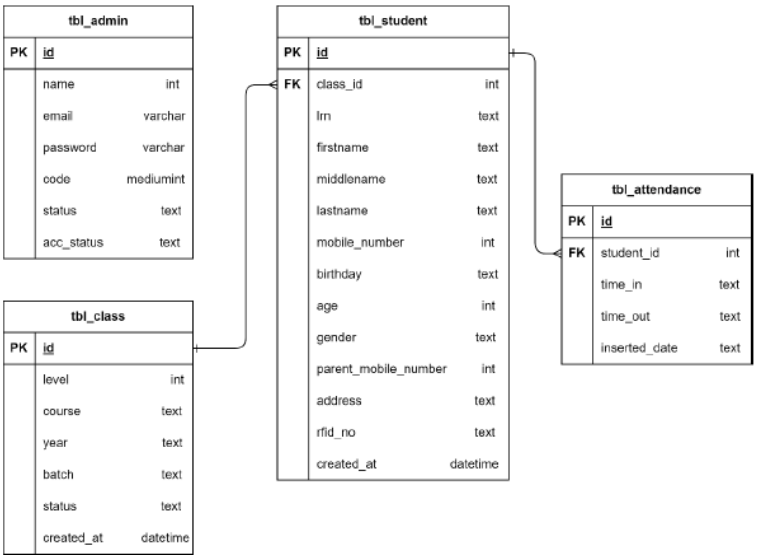


Database Schema

Figure 8 presents the database schema, which outlines the structure of the database, including the tables, fields, and relationships among them. It provides a clear visualization of how data is organized, stored, and connected within the system to support efficient data management and retrieval.

Figure 8

Database schema



System Design

The system was developed using the following programming languages and applications: Visual Studio Code, XAMPP, phpMyAdmin, HTML, CSS, and PHP. The system is web-based and consists of several key modules, including:

Login Page – Allows the administrator to securely access the system.

Dashboard – Displays real-time information on the number of students entering the school campus.

RFID Scanner Form – Automatically shows the student information when the student taps their RFID card.

Student List Module – Displays all registered students, allows management of student information, and provides the option to generate printable reports.

Figure 9

Login form

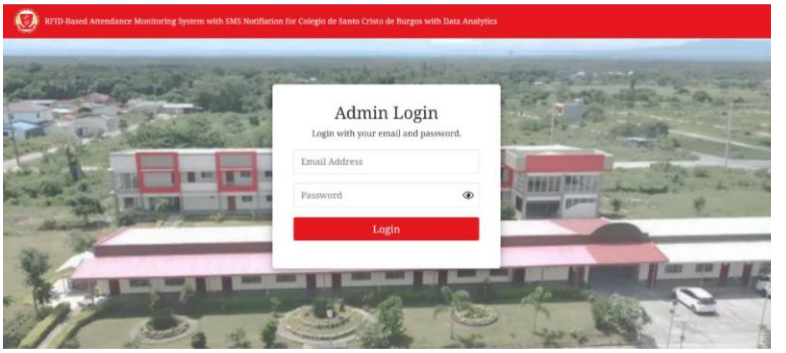


Figure 9 shows the login form, where users can access the site by entering their Gmail account and password. The login process is initiated after plugging in the RFID reader, ensuring secure and authenticated access to the system.

Figure 10

Creating class in class list

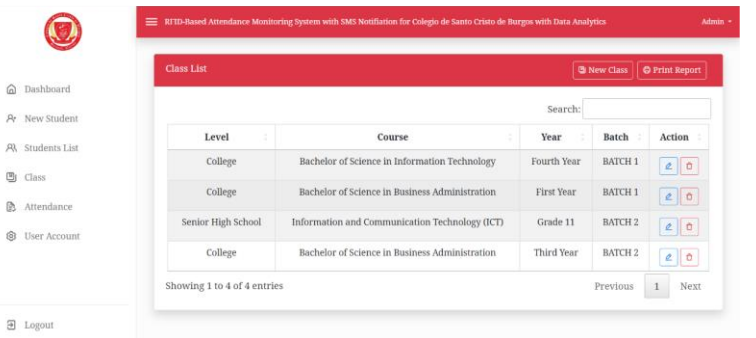


Figure 10 shows the process of creating a class in the Class List. In this part of the system, the admin can add and manage Class Lists for both Senior High School and college students, ensuring proper organization of student records within the database.

Figure 11

Adding new student

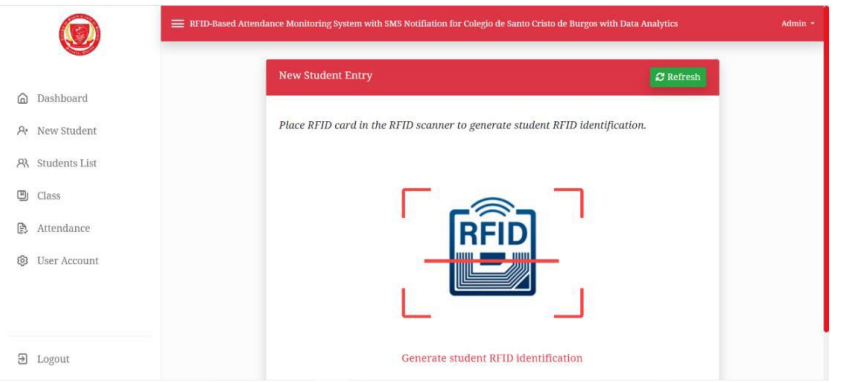


Figure 11 shows the 'Add New Student' feature in the New Student Entry module. This is a vital part of the system, as it uses the student's RFID card and the RFID reader to register new students and automatically generate their unique RFID number.

Figure 12

Managing student list

Figure 12 shows the 'Manage or Update Student List' feature. After completing the student information, the newly added student is automatically included in the system's Student List, where records can be managed and updated as needed.

Figure 13

Attendance time-in and time-out

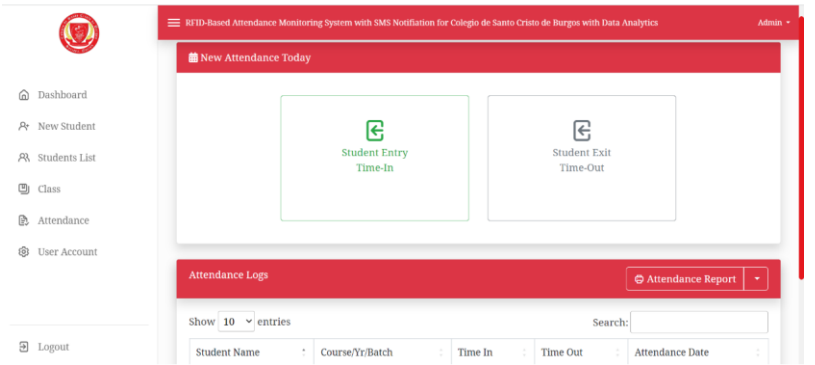


Figure 13 shows the 'Start Attendance Time-in and Time-out' feature. In this process, students tap their RFID cards when entering and leaving the school gate, allowing the system to automatically record their attendance.

Figure 14

Tap card

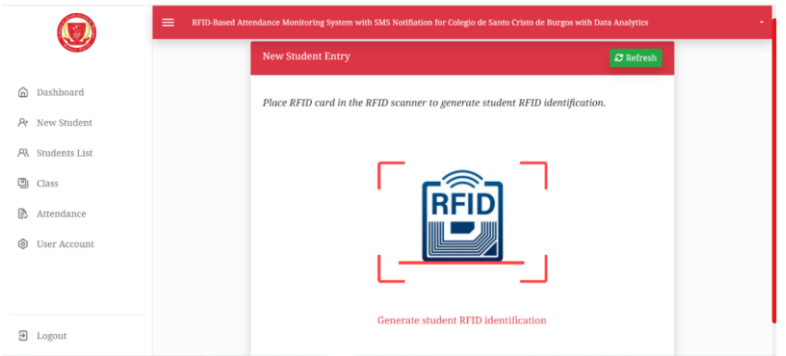


Figure 14 shows the 'Tap RFID Card' process, where students tap their RFID card or ID on the reader to authenticate their identity and record their attendance.

Figure 15

Attendance monitoring dashboard

Figure 15 shows the 'Check and Monitor Student Attendance' feature in the dashboard. After logging into the site, users are directed to the student dashboard, where attendance records can be viewed and monitored in real time.

Figure 16

Print report

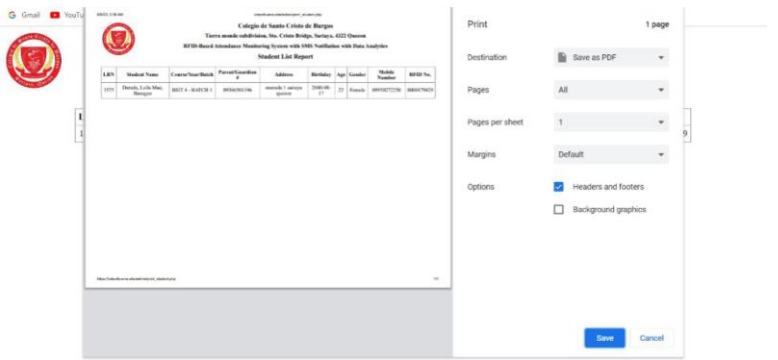


Figure 16 shows the 'Print Report' feature, which allows the generation and printing of attendance reports for students who have attended on the school campus.

Figure 17

Scanning RFID Card

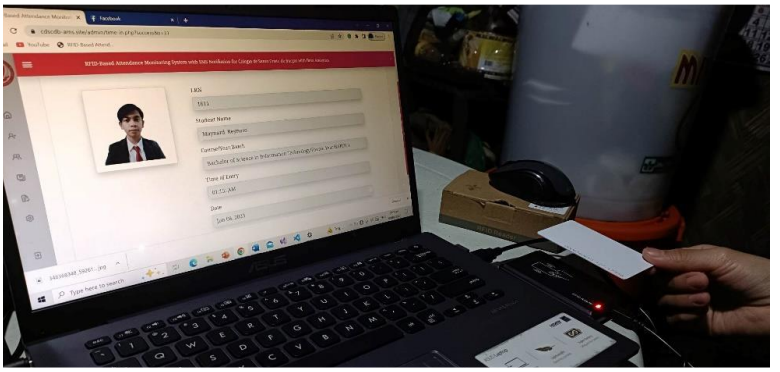


Figure 17 shows the system user scanning their RFID card upon entering the campus, which records their time-in. The same process applies when leaving, recording the time-out automatically.

Figure 18

SMS Notification

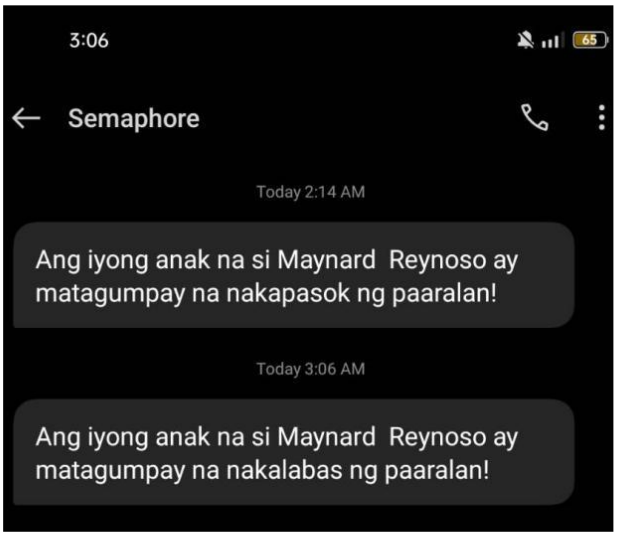


Figure 18 shows the SMS notification feature, where parents receive alerts indicating that their child has entered or left the campus, providing real-time updates on student attendance.

Test Approach

Both students and the system administrator can use the RFID-based Attendance Monitoring System according to their respective roles and expected outputs.

For deployment, the researchers employed a parallel approach to ensure the system functions correctly. This involved monitoring the devices, validating the data in the database, and verifying system performance in a real-world environment. The system was installed on the school premises, and user training was provided to ensure students and administrators could effectively operate the system.

Maintenance of the system includes remedial care such as revisions, updates, and fixing issues identified either by users or through reports generated by the system. Additionally, quarterly maintenance is performed to evaluate system efficiency during operation. Regular database backups are conducted to prevent data loss and ensure system reliability.

System Evaluation

This section presents the survey results based on responses from 150 respondents. The questionnaire was designed according to ISO/IEC 25010 standards, covering the following software quality aspects: functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. A four-point Likert scale was used, with the following response categories: Strongly Agree, Agree, Disagree, and Strongly Disagree. The results indicate that the system was

generally well-received by respondents.

Table 3

Weighted mean distribution of the criteria for the developed system

Criteria	Weighted Mean	Remarks
Functional Suitability	3.7	Agree (A)
Performance Efficiency	3.7	Agree (A)
Compatibility	6.7	Strongly Agree (SA)
Usability	3.66	Strongly Agree (SA)
Reliability	3.65	Agree (A)
Security	3.7	Agree (A)
Maintainability	3.71	Strongly Agree (SA)
Portability	3.69	Strongly Agree (SA)
Average	**3.69**	**Strongly Agree (SA)**

Overall, the average weighted mean of 3.69 (Strongly Agree) indicates that respondents perceive the system as highly effective, reliable, user-friendly, and secure. The evaluation demonstrates that the system successfully meets its intended objectives of improving student attendance monitoring and facilitating communication with parents.

Functional Suitability: The system is highly functional and meets the intended objectives of monitoring student attendance. Respondents agreed that it performs effectively and is easy to use. The weighted mean is 3.7 (Agree).

Performance Efficiency: Respondents found the system efficient and responsive, facilitating smooth operation. The weighted mean is 3.7 (Agree), indicating satisfaction with the system's performance.

Compatibility: The system integrates well with existing devices and software, allowing seamless operation. Respondents strongly agreed that it functions correctly across platforms, with a weighted mean of 3.66

(Strongly Agree).

Usability: The system is user-friendly and easy to manage. Respondents were satisfied with its ease of use, with a weighted mean of 3.65 (Strongly Agree).

Reliability: The system consistently performs as expected without errors or failures. Respondents agreed that it is reliable, with a weighted mean of 3.7 (Agree).

Security: The system effectively safeguards student information and prevents unauthorized access. Respondents agreed that the system is secure, with a weighted mean of 3.7 (Agree).

Maintainability: The system is easy to maintain, update, and analyze, ensuring continued effective use. Respondents strongly agreed, with a weighted mean of 3.71 (Strongly Agree).

Portability: The system can be adapted to different environments and is easy to deploy. Respondents strongly agreed with its portability, with a weighted mean of 3.69 (Strongly Agree).

Conclusion

The RFID-based Attendance Monitoring System with SMS Notification and Data Analytics is effective, reliable, and user-friendly. The system successfully records students' time-in and time-out attendance while allowing administrators to create new classes, update class lists, and register new students using RFID cards. It efficiently stores students' information along with their parents' or guardians' contact details, enabling real-time SMS notifications for monitoring purposes. The system also generates accurate and comprehensive reports per class and attendance summaries through data analytics. Students can easily scan their RFID cards upon

entering and leaving the campus, streamlining the attendance process, while parents receive timely notifications of their child's attendance. Overall, the system meets its intended objectives by improving student attendance monitoring, enhancing communication with parents, and providing a reliable and technologically feasible solution for the school.

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