CITE_STEMA SA ATENDANSIYA: MODERNIZING CITE-STUDENTS ATTENDANCE SYSTEM WITH RFID TECHNOLOGY

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ABSTRACT

In an era of technological advancements, the traditional practice of recording attendance through pen and paper in educational institutions is giving way to innovative solutions. This project focused on developing and implementing a Radio-Frequency Identification (RFID) based attendance system in the College of Information Technology and Engineering, Notre Dame of Midsayap College, to address the challenges associated with the manual attendance process in school or departmental activities. The conventional pen-and-paper method has faced human error, time-consuming record-keeping, and limited accessibility. These limitations prompted the department to develop an RFID-based system to improve efficiency and enhance data accessibility. The RFID-based attendance system has the potential to revolutionize education and bring attendance management into line with modern digital technologies.

KEYWORDS

RFID technology; technological advancement; attendance system; attendance management; digital technologies

1. INTRODUCTION

Technology has emerged as a transformative force in the contemporary education landscape, revolutionizing various aspects of academic administration. Among these innovations, the attendance management system stands out as an area where technology promises to offer significant advantages. While a longstanding practice, the conventional pen-and-paper method has begun to reveal its limitations in an increasingly digital world. The emergence of Radio-Frequency Identification (RFID) technology presents an opportunity for educational institutions to modernize their attendance tracking processes. RFID technology uses wireless communication to identify and track objects, typically via RFID tags or cards emitting radio signals containing unique identification codes. With RFID technology, institutions can streamline attendance procedures, ensuring efficiency, accuracy, and data-driven insights [1, 2, 3].

The attendance process in the school or departmental activities of the College of Information Technology and Engineering relies on the traditional pen-and-paper method, which, while simple, has become increasingly outdated. The manual system presented several issues that impede its effectiveness. Notably, it is prone to human error, such as illegible entries and misplaced records, leading to inaccuracies in attendance data. Moreover, it is time-consuming, consuming a significant portion of time and diminishing the overall efficiency of the attendance process. Managing large quantities of paper records also poses organizational challenges and increases the risk of losing critical attendance data. Additionally, accessibility to attendance records is limited,

restricting students and faculty members from easily and promptly accessing their attendance information [1, 2, 3, 4].

Before developing the RFID-based attendance system, the department conducted a comprehensive survey to ascertain the need for such a transformative approach. The survey revealed a pressing demand for an attendance system that transcends the limitations of the traditional method. It became evident that inefficiencies, inaccuracies, and accessibility issues associated with manual attendance management impeded the attendance process.

In response to the shortcomings of the pen-and-paper attendance process, the department boarded a project to develop an RFID-based attendance system. Several key objectives guide this project: firstly, enhancing efficiency by significantly reducing the time required for attendance tracking. Secondly, errors can be reduced by eliminating manual data entry and ensuring data accuracy. Thirdly, data accessibility should be improved, real-time attendance data access should be provided to students and faculty members, and transparency and engagement should be fostered. Lastly, the project aims for cost-efficiency by optimizing resource utilization and reducing paper consumption. As technology continues to reshape the educational landscape, this project underlines the department's commitment to a more efficient, transparent, and data-driven approach to attendance management, ultimately benefiting all stakeholders in the educational process [1, 2, 3, 4].

1.1. Theoretical Framework

In this project, the proponents draw upon Technology Adoption Theories, specifically the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). TAM [5] underscores the significance of perceived usefulness, which the proponents evaluated by assessing the system's benefits to students and faculty members. Additionally, ease of use is critical, emphasizing the importance of user-friendly interfaces and intuitive interactions.

The Unified Theory of Acceptance and Use of Technology (UTAUT) [6] further enhances the understanding by introducing concepts like performance expectancy, effort expectancy, social influence, and facilitating conditions. These concepts help to gauge user expectations, the ease of technology adoption, the influence of peers, and the supporting infrastructure. By applying these theories, the proponents gain a comprehensive view of the factors influencing adopting the RFID-based attendance system. This understanding guides the strategies for successful implementation within the department, ensuring that students and faculty find the system user-friendly and valuable in enhancing their educational experience.

1.2. Conceptual Framework

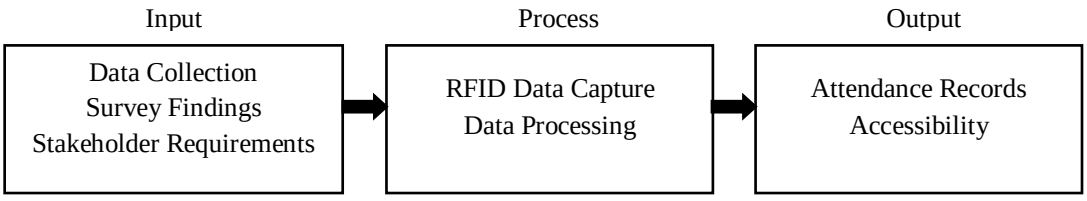

Figure 1. The Conceptual Framework of the Project

The proponents developed a conceptual framework based on the Input-Process-Output (IPO) model to illustrate the implementation of the RFID-based attendance system (Figure 1). The “Input” phase includes data collection via RFID technology, insights from pre-implementation

surveys, and stakeholder requirements. The “Process” stage involves RFID data capture, real-time processing, and storage in a database for attendance records. The “Output” phase generates precise, real-time attendance records accessible to stakeholders via the application, enhancing transparency and engagement. The IPO model guides the project's development and evaluation to ensure alignment with goals and expected benefits.

2. RELATED WORKS

2.1. Technology Adoption Theories

Technology Adoption Theories provide a comprehensive framework for understanding the dynamics that influence the acceptance and utilization of new technologies. The Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) stand out among the widely acknowledged theories.

As a foundational model, TAM elucidates how users embrace and integrate new technology into their routines. It posits that a user's intention to adopt a technology is shaped by two pivotal factors: perceived usefulness and perceived ease of use. The former denotes the user's belief in the technology's ability to enhance performance, while the latter signifies the user's perception of the technology's ease of operation [6].

UTAUT builds upon TAM by incorporating additional elements that contribute to technology acceptance. These elements include performance expectancy, effort expectancy, social influence, and facilitating conditions. Performance expectancy gauges how a user perceives a technology's impact on job performance, while effort expectancy assesses the perceived ease of use. Social influence measures the user's perception of the technology's endorsement by significant others, and facilitating conditions evaluate the user's belief in adequate infrastructure and support for technology use [6] [7].

TAM and UTAUT have found extensive applications in diverse contexts, from education to healthcare and e-commerce. These theories serve as theoretical cornerstones for understanding the factors that influence the acceptance and integration of new technologies in various domains [6] [8] [9].

Connecting these theoretical frameworks to the implementation of attendance systems, it becomes evident that the successful adoption of technology is contingent upon user perceptions of its usefulness, ease of use, and the broader social and organizational context. As this paper focuses on developing and implementing an RFID-based attendance system, these theories provide a theoretical lens to assess and interpret user acceptance and adoption. By considering factors such as perceived usefulness and ease of use in the context of attendance tracking, the paper aims to ensure the seamless integration of the technological solution within the College of Information Technology and Engineering at Notre Dame of Midsayap College.

2.2. RFID Technology

Radio-frequency identification (RFID) technology has diverse applications within the education sector, showcasing its versatility and efficiency. In school libraries, RFID facilitates the streamlined management of resources, enabling the efficient borrowing of books, DVDs, and other media. Within research facilities, RFID plays a crucial role in identifying and tracking experimental samples in laboratories, contributing to the precision of scientific endeavors.

Moreover, universities leverage RFID to validate qualifications conferred by post-secondary institutions, ensuring the authenticity of academic credentials [10].

A significant application of RFID in education involves attendance tracking for students, teachers, and non-teaching staff. This utilization enhances the accuracy of attendance records and streamlines the monitoring process, fostering a more efficient administrative environment [11]. Furthermore, RFID technology extends its impact on campus security by introducing smart ID cards embedded with RFID and tamper-resistant laminates. These cards serve a dual purpose, facilitating administrative tasks like registration, book purchases, and meal programs while concurrently bolstering campus security [12].

The overarching importance of RFID technology in education lies in its capacity to enhance resource management and operational efficiency. Through precise attendance tracking, schools can ensure regular student class attendance and teacher presence, positively influencing the overall quality of education [10]. Additionally, the implementation of RFID technology aids in cost reduction by automating administrative tasks, exemplified by the efficient management of library books. This automation not only saves time but also allocates resources to other critical areas, contributing to the holistic improvement of the educational institution [11].

Connecting these broader applications to this paper, which involves implementing an RFID-based attendance system, underscores the relevance and alignment of the technological intervention with the broader landscape of RFID technology in education. By adopting RFID for attendance tracking, the paper contributes to the overarching goals of enhancing administrative efficiency and ensuring the regular presence of students and teachers, thereby positively impacting the educational experience within the College of Information Technology and Engineering.

3. METHODS

This paper utilized a quantitative design approach to systematically investigate the implementation and effectiveness of the RFID-based attendance system in the College of Information Technology and Engineering at Notre Dame of Midsayap College during the academic year 2023-2024. The quantitative approach allowed for the collection of structured numerical data, offering statistical insights into participants' perceptions of the system. The College of Information Technology and Engineering was chosen for its relevance to the objectives and the specific context of technology adoption within an academic environment.

Before initiating the project, an initial survey was conducted to assess the manual attendance system. This step aimed to identify inefficiencies and limitations, serving as a crucial diagnostic tool to inform the development of the RFID-based attendance system. The survey was foundational in guiding the project by pinpointing specific issues that needed improvement in the manual attendance process.

A purposive sampling technique was employed to select the participants. This ensured that the data collected accurately represented the experiences and perceptions of students and CITE-LSG and CITE organization officers directly involved in the system's adoption.

Data collection was carried out through a structured survey questionnaire. The questionnaire included items related to participants' perceptions of the system's usefulness, ease of use, and overall satisfaction. Responses were collected on a Likert scale to facilitate quantitative analysis. The data collection process involved the distribution of survey questionnaires to targeted participants. Before administering the survey, participants were briefed on the objectives and

assured of the confidentiality of their responses. Completed surveys were then collected, ensuring a comprehensive dataset for analysis.

The quantitative data obtained from the surveys were subjected to statistical analysis using relevant software. Descriptive statistics, including the mean, were computed to summarize and describe participants' responses.

4. SYSTEM OPERATION AND TESTING

RFID tag usage patterns suggest potential applications for tracking student attendance through computer programs. Each RFID tag is linked to a student's database record, ensuring records are logged when students attend Departmental Activities via the CITE Faculty Office window. Entries include timestamps from each student's card, which are cross-verified using their photo and other personal data in case of disputes. Automated attendance score calculations can then utilize this data, following the operational mode outlined in Figure 2.

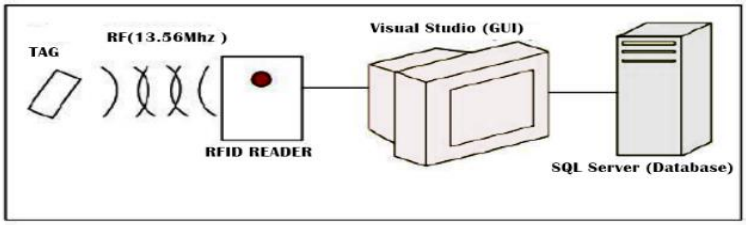

Figure 2. Illustration of the RFID system operational principle

When the tag travels through an RF field (in this case, 13.56 MHz), it becomes active, produced by the reader box's internal antenna. The software verifies the validity of the tag. If the officer in charge clicks "Yes," the legitimate tag will proceed to the database software, where the student's attendance will be registered. If the tag is invalid, the application notifies the administrator or responsible officer that it has not been registered with a student and that they must register the tag.

This RFID attendance design application uses a passive tag; thus, in every class, students must bring their tags close to the reader (approximately 10 cm) due to implementation flexibility and cost considerations. The reader reads the tag in this process, and the application program logs the student's arrival time for each departmental or school function. On the LCD screen of the monitor where the system was installed within the CITE Faculty Office, the relevant short message service is displayed together with arrival time data. Officers and faculty members can obtain information about any student with the help of the system's personal information queries. This will increase the overall cost of the system [13].

The CITE teachers and local student officers can calculate the overall amount of fines students have paid by adding up all of the payables for the penalties after the semester. Based on the predetermined metrics, the application outputs the following: the student's name, control number, tag ID number, department, course, activity (ongoing), total fines, and attendance status. According to the RFID system application control program's Graphical User Interfaces (GUIs), a privileged user can remove students from their particular tag and reassign it to other students, if necessary, as shown in Figure 3.

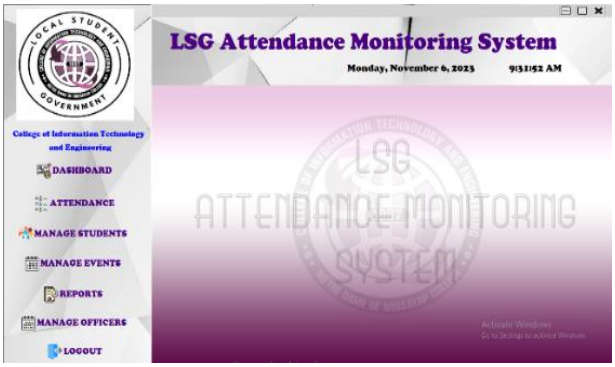

Figure 3. Attendance Monitoring System Dashboard Interface

The College of Information Technology and Engineering Department's Main Page is displayed in the figure when the application is double-clicked on the desktop after it has been installed or after the system is loaded. When the administrator or LSG officer logs into the system to accept RFID tags of student attendance for the specified event, they will initially see this screen.

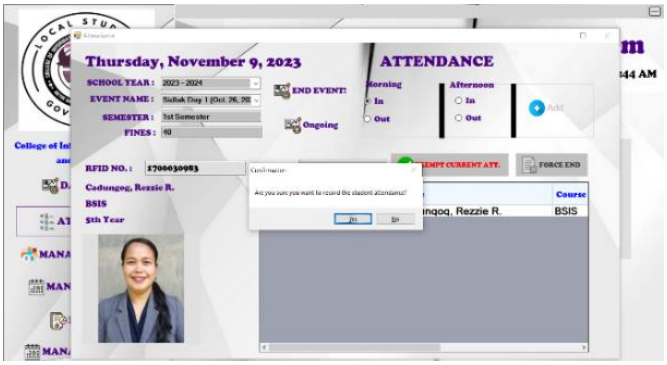

Figure 4. Interface of the Attendance Monitoring System for Student RFID Tagging During Event Check-in/Check-out

When students scan their assigned RFID, the system asks the administrator (or officer-in-charge) whether to approve or refuse the tag's entrance. The figure depicts the page on both screens. The officer or admin will manually enter every student's attendance by clicking the Yes or No option.

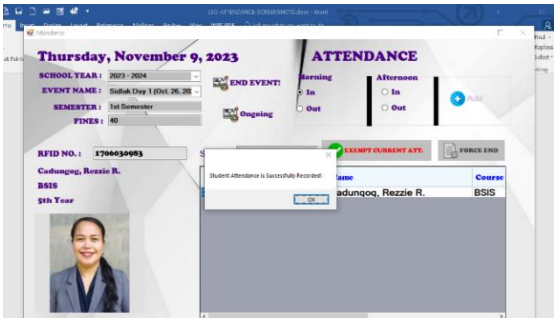

Figure 5. Interface of the Attendance Monitoring System after an LSG Officer Presses OK to Record the Student's RFID Tag

When the student has finished swiping the RFID on the RFID Reader, the admin/officer clicks the YES option on the selection, as shown in the figure, which displays the message prompt. The

image only serves as evidence that the student will depart the property at the designated time after the officer has properly recognized their attendance sticker

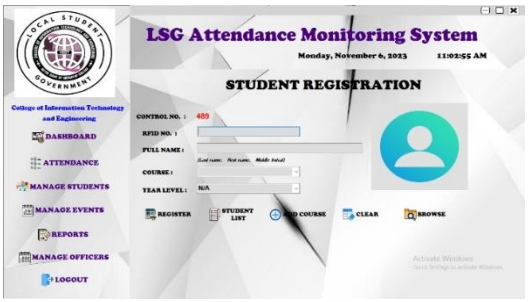

Figure 6. Registration Interface for New RFID Card Holders in the Attendance Monitoring System

The interface under the Manage Student page is depicted in the picture. This is where the administrator or officer will enter the personal data about the student that the system requires, along with the control number of the card and its matching RFID number. The administrator or officer must enter the student's control number, RFID number, full name, course enrolment, year level, and current term, along with the matching 2 x 2 photo, as shown in the example in Figure 7.

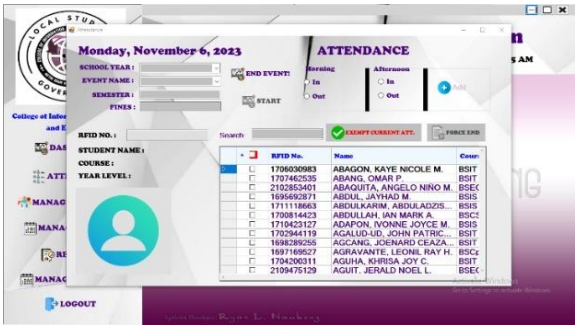

Figure 7. Student List

The figure shows the attendance summary during the event day in the real-time record. The admin/officer can easily track student attendance in the entire department.

Figure 8. Event/Activity Registration Page for the School

The website to register an upcoming event that the CITE Department will celebrate and the number of days it will take place are depicted in the image. Every day, the administrator or officer will also enter the total penalties for each in and out.

Figure 9. Report Options Interface

This image depicts the "Report Page," where the administrator or officer will produce a report with event details, a student list report, an individual student attendance report, or both.

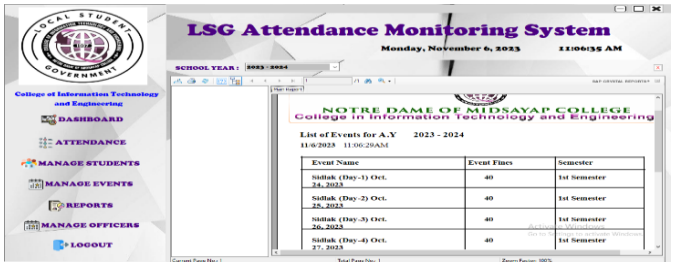

Figure 10. Event Lists Report Page of the System

The Event List Report's interface material is displayed in the figure beneath the "Report" Section Page. The page will include the event's specifics along with the associated penalty.

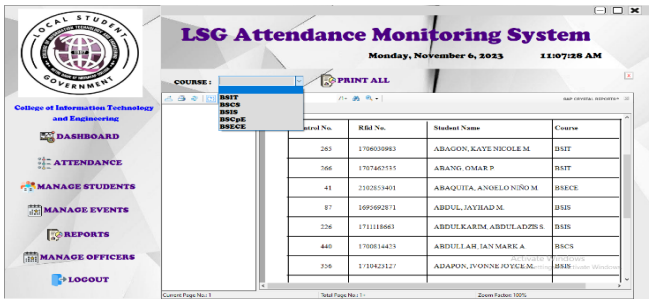

Figure 11. Student Lists Report Page of the System

The picture shows the facts that the user can view while clicking or creating a report summary from the "Student List Report" page, which is located on the Report main page.

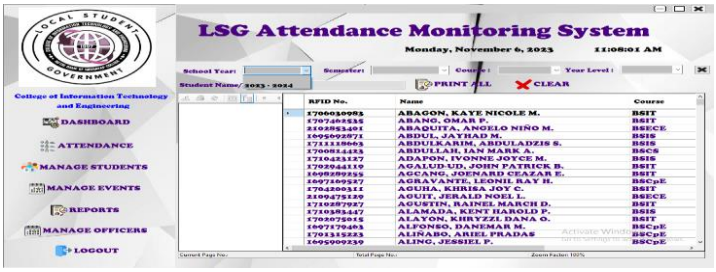

Figure 12. Student Report Page under the System's Dashboard

When the administrator or officer clicks the "Student Report" tab to create a report of all the students who have already tagged in their attendance for the day, the information content is displayed in the figure.

Figure 13. Manage Officers Page for Account Registration

The data that an administrator or officer can view on the system dashboard when they click on the "Manage Officers" page is depicted in the figure. This page allows you to register an administrator or officer account so they may log in to the system.

Figure 14. Logout Dashboard with Yes/No Prompt

The figure displays the administrator's or officer's logout page for the attendance monitoring that the LSG adviser assigned. The administrator or officer must log out of the account so the next officer can access the system and manage the student's attendance.

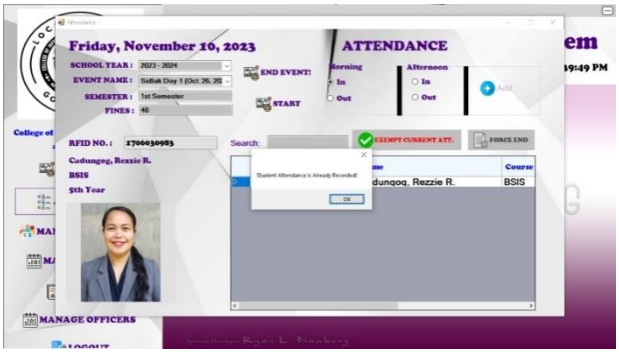

Figure 15. Notification for Multiple RFID Tagging Attempts

The screen where the student receives the notification "Student Attendance is Already Recorded" after repeatedly swiping their RFID card is depicted in the figure. This indicates that the system has already logged the student's initial swipe, and subsequent swipes are no longer permitted.

5. RESULTS AND DISCUSSIONS

The proponents conducted pre-assessment and post-assessment surveys of the 60 CITE students to assess the manual and the computerized attendance system, respectively. Also, 20 CITE Local Student Government and CITE Organizations officers were surveyed for the system's functionality, security, and graphical user interface.

Table 1. Pre-Assessment Survey Results (Manual Attendance System)

Aspects	**Rating**					**Mean**
1. Attendance Process	**1 Strongly Disagree**	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**	
• The attendance process is efficient.	0	40	5	15	0	2.58
• The accuracy of manual attendance records is reliable.	0	42	10	8	0	2.43
• The current attendance process is time-effective.	0	45	5	10	0	2.42
• Attendance tracking methods are user-friendly.	0	40	7	13	0	2.55
					Total Mean:	**2.50**
2. Challenges with the Process						
• The current attendance process is prone to errors.	0	10	10	40	0	3.50
• The current attendance process is time-consuming.	0	9	8	43	0	3.57
					Total Mean:	**3.53**
3. Perception of a Computerized Attendance System						
• Implementing a computerized attendance system would improve efficiency.	0	0	5	55	0	3.92
• A computerized attendance system would enhance the accuracy of attendance records.	0	0	10	50	0	3.83
					Total Mean:	**3.88**

Table 1 presents findings from a pre-assessment survey on the manual attendance process, divided into three sections: "Attendance Process," "Challenges with the Process," and "Perception of Computerized Attendance System." Ratings range from 1 (Strongly Disagree) to 5 (Strongly Agree). The mean rating for the "Attendance Process" section is 2.50, indicating disagreement on its efficiency, accuracy, time effectiveness, and user-friendliness. In the "Challenges with the Process," the mean rating is 3.53, indicating agreement on its time-consuming nature and error-proneness. For "Perception of a Computerized Attendance System," the mean rating is 3.88, indicating agreement on its potential to enhance efficiency and accuracy. Overall, the survey suggests dissatisfaction with the current process but optimism about the benefits of a computerized system.

Table 2. Post-Assessment Survey Results (Computerized Attendance System)

Aspects	**Rating**					**Mean**
1. Attendance Process	**1 Strongly Disagree**	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**	
• The attendance process is efficient.	0	0	10	30	20	4.17
• The accuracy of manual attendance records is reliable.	0	0	7	25	28	4.35
• The current attendance process is time-effective.	0	0	5	20	35	4.50
• Attendance tracking methods are user-friendly.	0	0	3	22	35	4.53
					Total Mean:	**4.39**
2. Challenges with the Process						
• The current attendance process is prone to errors.	20	33	7	0	0	1.78
• The current attendance process is time-consuming.	25	30	5	0	0	1.67
					Total Mean:	**1.73**
3. Perception of a Computerized Attendance System						
• Implementing a computerized attendance system would improve efficiency.	0	0	5	5	50	4.75
• A computerized attendance system would enhance the accuracy of attendance records.	0	0	3	5	52	4.82
					Total Mean:	**4.78**

Table 2 summarizes the results of the post-assessment survey on the computerized attendance process, categorizing responses into three sections: "Attendance Process," "Challenges with the Process," and "Perception of Computerized Attendance System." Ratings range from 1 (Strongly Disagree) to 5 (Strongly Agree). The mean rating for the "Attendance Process" section is 4.39, indicating strong agreement on its efficiency, accuracy, time-effectiveness, and user-friendliness. The "Challenges with the Process" section has a mean rating of 1.73, indicating strong disagreement regarding error-proneness and time consumption. For "Perception of a Computerized Attendance System," the mean rating is 4.78, reflecting strong agreement on the system's potential to enhance efficiency and accuracy. The survey underscores satisfaction with the computerized attendance process and confidence in its benefits.

Table 3. Survey Results for the System's Functionality, Security, and Graphical User Interface

Aspects	Rating					Mean
1. Functionality	**1 Strongly Disagree**	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**	
• The system accurately records attendance without false positives or false negatives.	0	0	0	5	15	4.75
• The system efficiently handles a varying number of users and effectively manages high traffic during peak times.	0	0	3	4	13	4.50
• The system registers attendance promptly, and performance is maintained during periods of high user activity.	0	0	0	5	15	4.75
• The system effectively handles errors or exceptions, providing clear error messages and recovering gracefully from unexpected situations.	0	0	0	5	15	4.75
					Total Mean:	**4.69**
2. Security						
• The RFID authentication process is secure, preventing unauthorized access or cloning of RFID cards.	0	0	0	3	17	4.85
• The system implements effective access control measures, including role-based access, to secure administrative functions.	0	0	0	2	18	4.90
• The physical infrastructure, including the RFID reader, is secure, preventing tampering or unauthorized access to the hardware.	0	0	0	2	18	4.90
					Total Mean	**4.88**
3. Graphical User Interface						
• The screen designs in the system are visually appealing and contribute to a positive user experience.	0	0	5	13	2	3.85
• The choice of fonts in the interface enhances readability and is appropriate for conveying information effectively.	0	0	5	15	0	3.75
• The color scheme used in the GUI is visually pleasing and contributes to a cohesive and user-friendly interface.	0	0	10	7	3	3.65

• Icons used throughout the system are clear and easily understandable, aiding in quick recognition of functions and features.	0	0	10	10	0	3.50
• The interface maintains consistency in design elements across different screens, providing a unified and seamless user experience.	0	0	10	10	0	3.50
• Navigating through the system is intuitive, with clear menu structures and easy access to essential features.	0	0	5	15	0	3.75
• Error indicators are clear and provide users with actionable information to resolve issues when they occur.	0	0	5	15	0	3.75
					Total Mean:	**3.68**
					Grand Mean:	**4.42**

Table 3 details survey findings on the system's functionality, security, and graphical user interface, divided into three sections: "Functionality," "Security," and "Graphical User Interface." Ratings range from 1 (Strongly Disagree) to 5 (Strongly Agree), with mean ratings provided for each section. Surveyed were 20 CITE-LSG and CITE-Organization officers, key users of the system.

In the "Functionality" section, the mean rating is 4.69, indicating strong agreement that the system accurately records attendance, handles varying user loads efficiently, manages peak traffic effectively, registers attendance promptly, and manages errors well.
For "Security," the mean rating is 4.88, reflecting strong agreement on the system's secure RFID authentication, effective access control measures, and physically secure infrastructure.

In the "Graphical User Interface" section, the mean rating is 3.75, indicating general agreement on visually appealing screen designs, readable fonts, pleasing color schemes, clear icons, consistent design elements, and intuitive navigation.

Overall, respondents were satisfied with the system's functionality and security, and found the graphical user interface to be visually appealing and user-friendly.

6. CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the survey results confirm the success of the RFID-based attendance system implemented at the College of Information Technology and Engineering, Notre Dame of Midsayap College. The system has proven highly effective, particularly in simplifying attendance tracking during significant school events such as intramurals and departmental meetings. Positive feedback highlights its capability to overcome challenges associated with the previous manual attendance process. Users expressed satisfaction with its user-friendly interface, marking a successful transition from traditional methods to advanced RFID technology. Additionally, the favorable reception of the graphical user interface (GUI) underscores its importance in technology adoption within academic settings.

This implementation not only signifies improved attendance management but also demonstrates technology's adaptability in enhancing administrative efficiency. The enthusiastic response from students and faculty reflects a willingness to adopt technological solutions that improve accuracy and efficiency in academic operations.

Based on these positive outcomes, several recommendations are proposed to enhance the RFID-based attendance system further:

1. Online Integration: Integrate the attendance system online to enable remote access and real-time data management. This enhancement will allow students and faculty to conveniently access attendance information from anywhere, improving overall system accessibility.
2. GUI Improvement: Continuously improve the GUI to enhance visual appeal, user experience, and interface aesthetics. Regular updates will sustain user satisfaction and engagement with the system.
3. QR Code Integration: Consider integrating QR code technology into the attendance system to provide an alternative, efficient method for attendance tracking. QR codes offer a seamless way for users to register attendance using mobile devices, aligning with current technological trends and user convenience.

These recommendations aim to elevate the RFID-based attendance system into a more versatile, user-friendly, and technologically advanced platform. By embracing online integration, refining the GUI, and exploring QR code utilization, the system can evolve to meet the dynamic needs of the academic environment and continue making a positive impact on attendance management.

DOCUMENTATION

The images below were taken during the system deployment during the *Sidlak 2023 Intramurals*.

ACKNOWLEDGEMENT

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