A Web-Based RFID System for Contactless Student Portal in City College of Angeles

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Abstract

This particular research focuses on the development and deployment of a Web-Based Radio Frequency Identification (RFID) System for contactless student attendance monitoring. This study aims to address the shortcomings of conventional attendance systems in educational institutions and transform the process of verifying students' presence. In this regard, this investigation highlights the importance, objectives, and area covered, as well as some restrictions of the system that will be developed using a descriptive research approach and prototyping method. Furthermore, not only does its innovative design provide a technologically advanced solution for tracking students' attendance, but it also aligns with current safety ideas by allowing a contactless experience. The post-implementation stage should have strong feedback loops that rely on user responses as well as data analysis to make iterative refinements and optimizations toward continuously improving system functionalities and user experiences. Thus, it will result in a simpler check on attendance, higher precision rates, and compliance with modern educational safety norms.

Keywords: student portal, Radio Frequency Identification (RFID), web-based, contactless student attendance, Arduino

INTRODUCTION

City College of Angeles is enhancing the student experience through technology integration in response to the changing landscape of educational services and the rising demand for efficiency. This study presents a Web-Based RFID System designed to revolutionize the student's portal with Radio-Frequency Identification (RFID) technique for a contactless, secure, and user-friendly platform. The use of manual attendance systems results in inefficiencies and inaccuracies (Hasanein D. Rjeib, 2018). According to this research, RFID technology can be integrated by providing students with RFID cards to minimize the labor-intensive nature of physical processes as they enter their classes or offices. This will go beyond time savings and improve the accuracy of attendance data.

The importance of efficient and effective attendance management is significant in the corporate world (Rashmi A., 2022). Universities face obstacles due to damage and loss of attendance forms, but RFID technology can help overcome these challenges. Additionally, the increasing popularity of RFID and other automated identification technologies has sparked extensive research, revealing certain limitations. It is a wireless technology where RFID tags or labels send data to an RFID reader using radio frequency waves, thereby facilitating identification. In preparation for this project, RFID tags will be integrated into students' ID cards, while their classrooms will have receivers set up for an easier roll-call process. Every ID card has its own Unique Identifier (UID), which is assigned by RFID cards. This means that even when someone enters class with his or her ID card, his or her presence is automatically noted down by the system.

Radio Frequency Identification (RFID) applications are gradually gaining prevalence in various fields such as industry, healthcare, and transportation (Abuzneid 2019). Manually collecting attendance during a class session consumes a significant amount of time and resources. When there are many students in a classroom, effectively managing attendance becomes difficult, making automatic attendance tracking necessary for school administration. According to this article (Aravindhan 2021), it is suggested that teachers should use RFID technology instead of manual methods to automatically record the attendance of their students. The process entails creating an RFID-based system for attendance monitoring, as

well as an information service system with programmable devices and web-based applications. The present study's experimental results demonstrate the practical and effective use of this system.

Radio-Frequency Identification (RFID) technology a Web-Based RFID System that uses is a game changer, and its adoption reflects the imperatives of this digital age for the City College of Angeles. Having educational systems that rely on manual attendance procedures presents constant challenges. This study argues for the use of Radio-Frequency Identification (RFID) technology in transforming students' experiences on the portal as other learning institutions grapple with such challenges. Efficiency, accuracy, and student experience are shown to be important in this new system. The study also outlines various problems that conventional attendance methods pose, as well as an all-inclusive look at what these processes should look like in the future.

Various industries employ Radio Frequency Identification (RFID) technology used in retail, smart cities, agriculture, and transportation. Moreover, educational institutions are adopting RFID as a method for tracking students' presence. It means joining RFID with Google Sheets and the Internet of Things (IoT) to create a real-time attendance system. It then looks at 21 major research on IoT-based attendance systems using RFID to analyze the developments in such systems (Kashif Ishaq, 2023). The manual process takes time, has proxy attendance challenges, and risks losing records which are difficulties rendered obsolete by automation through manual signature-based traditional attendance methods hence they can only persist online if done this way since it depends on one's signature. This eliminates all these earlier-mentioned problems by having an automated approach that records learners' by flashing their student cards equipped with RFID tags on a reader. As a result, it helps them to save more time while also ensuring accurate and reliable results are being reported concerning the issue of attendance management.

Different sectors have observed significant progress in the use of Radio Frequency Identification (RFID) systems, including education, manufacturing,

healthcare, and agriculture. As such, this technology uses passive or active tags plus appropriate readers to facilitate automated identification and tracking of items. The reasons for RFID technology's increasing acceptance in the past few years are inherent advantages. This paper discusses a proposal for an RFID-based student information system that enables students to easily obtain their details using RFID cards (Ismail Mohamed 2018). This study implements RFID a student information management system that facilitates the efficient sharing of key information on examinations and lecture timetables as well as venue details with students.

Enterprises and organizations are increasingly interested in a secure framework that is both hardy and quick-witted. When it comes to identifying different objects, one of the most reliable and instant methods is Radio Frequency Identification (RFID). The main advantage of RFID lies in its wireless-readability capacity as well as its ability to hold more data than barcodes and its greater robustness due to non-line-of-sight technology. In difficult environmental conditions such as these, it outperforms other reading technologies like barcodes or optical card readers by far. The article (Almansor Mohammed, 2021), proposes a secure system whose function is to provide information on student attendance; upon bringing the RFID card close to the RFID module, it reads the card data, compares it with programmed memory information, and then shows you name related to this card. Later this attendance data will be stored in a text file on the SD card which can be converted into an Excel sheet on the computer.

In higher learning institutions, physical education management relies heavily on attendance data. The wireless and passive Radio Frequency Identification (RFID) technology principles employed in this paper (Jiahuan Lin, 2022) were used to create a model for physical education attendance based on the use of Ultra High Frequency (UHF) passive RFID. In brief, the device contains three main parts: radio frequency transceiver, carrier leakage canceller, and digital baseband signal processing. Within the hierarchical structure of the model, the client initiates a Web request to the server and states what it wants from an RFID document that includes details such as

range, scale, and display attributes of a requested map. To achieve this effect, the Web server modifies its pre-defined map definition file by parsing this information.

Statement of the Problem

The study aims to address the following issues associated with the existing conventional student attendance system by implementing RFID Technology for a Contactless Student Portal:
1. The manual student attendance monitoring consumed a lot of time and effort.
2. The student attendance information is inconsistent and incorrect.
3. Progress is impeded by the absence of technologically advanced solutions for attendance tracking in educational institutions.
4. Some problems that may arise in manual attendance management include human errors in data recording and analysis.

Objectives of the Study

This section explains the main goals of the researchers to help the school through an innovative system.
1. To implement a student attendance monitoring system using Radio-Frequency Identification (RFID) technology that will provide efficient and reliable information.
2. To provide accurate information of the students' attendance, late and absences.
3. To develop an advanced solutions for attendance tracking in educational institutions using Web-Based RFID System that leverages RFID technology to overcome the limitations of traditional methods, providing an efficient and error-resistant solution for monitoring student attendance.
4. RFID technology could be employed as a way of minimizing mistakes made when recording and analyzing figures, making it more accurate than any other system used to track students' presence at schools in order to enhance efficiency and accuracy of the process that takes place in these settings for monitoring every individual's presence.

Scope of the Study

The primary focus of this study is to develop a Web-based RFID system that enables contactless entry for school attendance and other features within the student portal (grades, attendance, schedules, and certificate of registration). In this system, the data will be given to the instructor using the system as the student will use the RFID in entering the room to record the attendance. The system also provides information. In this system, each student has a unique ID for their data. The RFID system handles various aspects of student data, and certain information, such as schedules and specific course preferences, may still require manual input. Teachers can track the attendance of the students they are responsible for. This feature facilitates efficient monitoring and helps teachers stay informed about their students' attendance. Administrators can manage the database, ensuring its accuracy, addressing possible redundancies, and handling potential problems on the website. This oversight helps maintain the smooth functioning of the system and provides a reliable platform for both students and teachers.

Significance of the Study

This study aims to address the shortcomings of conventional attendance and provide a technologically advanced solution for tracking students' attendance. This is beneficial to the following:
1. To the Students – the system will help them taking their attendance with ease and allow them to view their grades and schedules.
2. To the Teachers – the system will help them to lessen the workload by supervising and monitoring the data such students' attendance and the like.
3. To the Administrators – The system will enable them to manage and oversee this database, ensuring accuracy, minimizing duplication in entries, and addressing any potential issues that may arise during its implementation. This is necessary for the effective operation of such a system because it provides a reliable environment on which both students and teachers can depend.
4. To the Researchers – the system will help them to learn more about developing it.
5. To the Future Researchers – this study will greatly help the future researchers to develop this study, the system will serve as a foundation in creating Implementing A Web-based RFID System for Contactless Student Portal.
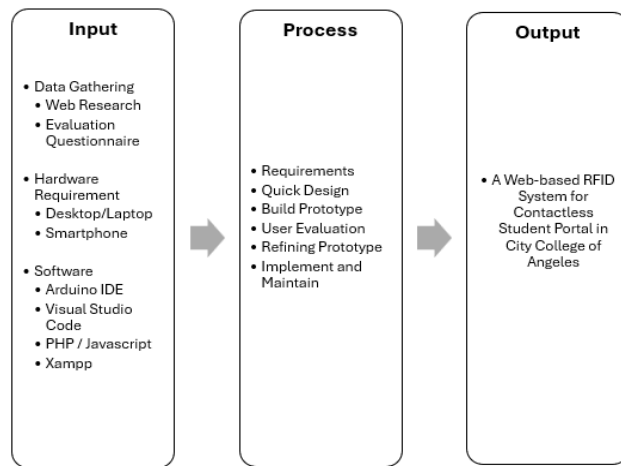
Conceptual Framework

Figure 1. IPO Model

Figure 1 illustrates the IPO model. The system's input incorporates RFID tags, RFID readers, and user interactions with the web-based application. The process encompasses RFID tag detection, data transmission, data processing, and attendance recording. The output is the student portal of City College of Angeles, which includes attendance reports.

METHODS

This section presents the methodology and procedures used by the researcher in conduct of the study.
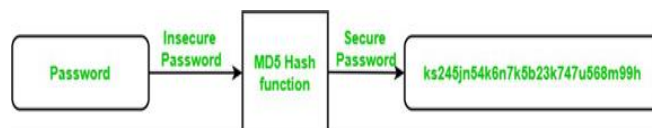
Algorithm

Figure 2. Message-Digest (MD5) Algorithm for Password

The algorithm that is used in Password is the message-digest algorithm (MD5) because it is more secure when it comes to generating a secured password. A process known as MD5 hash encryption generates an encrypted 128-bit hash value when the user enters their password. It also has a login process using MD5 hash verification for security purposes.

Research Design

This study employed descriptive research designs to observe a phenomenon and depict its characteristics. The researchers collected data using questionnaires to understand how certain conditions fit into these categories. The research design also encompasses the tools and techniques utilized to collect the data required for the initial system's development. It also contains computations or statistical procedures that assess the development's feasibility.

A descriptive research design was used for this study to achieve research objectives and address specific problems. It helped us to gather and analyze information systematically so that we could have a holistic understanding of what we were researching. In employing descriptive studies, we sought to capture a full picture of the present situation, recognize patterns, and make insights that can lead decision-makers toward appropriate actions based on facts.

Quantitative research is a systematic and structured approach to inquiry that relies on numerical data to gain insights into various phenomena. It involves collecting empirical data through methods such as surveys, experiments, and observations, focusing on quantifiable variables and statistical analysis. The primary goal of quantitative research is to provide a precise and objective understanding of a subject, allowing researchers to identify patterns, trends, and relationships within the data.

Participants

The study on web-based Radio Frequency Identification (RFID) system for contactless student portal in the City College of Angeles carried out with 50 participants who are directly involved in the college's educational ecosystem, which includes students and teachers. These individuals were chosen because they have first-hand experience or knowledge about RFID use and implementation.

This study used a purposive sampling technique to select its participants. This non-probability sampling method enables the deliberate selection of individuals with specific characteristics or experiences that align with the research objectives. In this case, we will deliberately pick out people who have used or managed a contactless student

portal before expressing their willingness to participate.

Researchers used purposive sampling to gain firsthand understanding and perspectives from individuals with specific knowledge or experiences. In this way, researchers can target participants who give useful insights, enhancing the richness and relevance of findings from investigations done based on interviews.

Procedures

To acquire data and knowledge about their potential users and stakeholders on the web-based RFID system for the contactless student portal in City College of Angeles, the researchers undertook various techniques. These involved data collection from students, teachers, and IT Experts as well as interactions with relevant stakeholders in the college.

1. Web Research

The main goal of this research is to develop a web-based RFID system for a contactless student portal. The study was conducted in order to identify any available gaps and discover new insights that may help improve the efficiency and effectiveness of student services. It followed a methodical and probing process of scientific inquiry which enabled it to gather information from many different sources such as academic literature, reports, and other relevant documents pertaining to this topic.

2. Evaluation Questionnaire

To gather valuable data from the potential users of the web-based RFID system, such as students, teachers, and IT experts, the researchers designed and conducted a questionnaire. The questionnaire included an ISO 25010 criteria comprising functionality, reliability, usability, efficiency, maintainability, and durability. The purpose of the questionnaire was to collect specific and relevant information regarding the needs, preferences, and expectations of the stakeholders. The primary objective of the questionnaire was to determine the feasibility and practicality of implementing the suggested web-based RFID system for the contactless student portal in City College of Angeles.

3. ISO 25010 Criteria

An evaluation system for product quality is built around the quality model. When assessing a software product's attributes, the quality model specifies which quality traits will be taken into account. A system's quality is determined by how well it serves the explicit and implicit needs of its many stakeholders and hence adds value. The requirements of those stakeholders (functionality, performance, security, maintainability, etc.) are precisely what the quality model, which divides product quality into characteristics and sub-characteristics, represents.

a. Functionality: It is necessary to appraise how well the functional requirements have been met by this kind of technology. This appraisal included checking if the system is able to precisely read and recorded RFID tags, provided instant student access, or helped track students' attendance.

b. Reliability: To evaluate how dependable it is, researchers looked at whether or not it can always perform its assigned tasks in different circumstances. In addition to that, we need to observe how stable it is, whether or not it has error handling mechanisms that are efficient, and also check data integrity so as to ascertain if student information got captured and saved accurately or not.

c. Usability: For usability testing, we will undertake a survey to determine how students interact with the web-based RFID system and their satisfaction with it. It also involves gathering opinions from faculty members, students, or staff in charge of administration through questionnaires or user evaluation sessions where they are asked about their views on some aspects of the program such as ease of navigation and overall use.

d. Efficiency: The efficiency aspect of the system measured based on resource utilization performance, response time and even energy consumption. It included assessing how fast a transaction is processed by the system; database scalability, and hardware resource optimization among other things.

e. Maintainability: Evaluate the maintainability of the system to appraise its ease of maintenance and future developments. Here, we looked at such aspects as modularity, documentation, and how easy is it to make

changes or updates because needs are changing.

f. Compatibility: The ability of the web-based RFID system to work with existing campus infrastructure and other applications examined so that it can coexist with other technologies without any conflicts.

g. Security: Enhancing security and safeguarding student data from any unauthorized access was among the most important things that need to be done during this process. This also included other measures like encrypting all transmitted information which in turn makes the RFID system harder for hackers or any other malicious people.

h. Portability: The adaptation of this technology into different settings or devices was important. Hence, it enabled students and staff to access this function seamlessly on various platforms while maintaining consistent performance and user experience across multiple platforms.

i. Durability: Assessing how long it lasts and how well it bounces back in time will enable me to know if the system is durable. Assessments included testing whether a system survived hardware or software breakdowns, come back from disruptions, and adjust itself to fit in the changing tech environment. Durability here guaranteed that web-based RFID keeps up its functions all through.

Data Analysis

Researchers utilized research data analysis as a method to distill data into a narrative and then interpret it to draw conclusions. It is logical that the data analysis process aids in breaking up enormous amounts of data into smaller pieces. After the data were gathered, data analysis and interpretation were done using frequency count distribution, percentage distribution, mean, and Likert Scale.

Frequency Distribution: Refers to the representation of individual values or categories as a percentage of the total. It involves expressing each specific value or category in relation to the whole dataset.

Percentage Distribution: It serves as a clear metric to demonstrate the relationship between two factors as a percentage of the overall frequency,

standardized to 100. This approach is particularly useful for illustrating survey results and other data frequencies. Tables, bar graphs, and pie charts are commonly used to display percentage frequency distributions.

Weighted Mean: It serves to sum up the total number of responses from respondents. This method creates an accurate representation of the input by taking into consideration each response's relative relevance. The calculation consists of multiply each numeric rating by its weight, adding these results, followed by dividing by the overall number of answers. This strategy guarantees that every participant's feedback is properly reflected in the final analysis.

Mean: $\bar{x} = \sum fx / N$

Where:

$$\sum = the\ sum\ of\ (summation\ of)$$

$\bar{x}$ = mean

f = weight given by respondent

N = total number of respondents

x = number of respondents

Likert Scale: is research tool used to measure respondents' attitudes, opinions, and perceptions. Participants rate their agreement with various statements on a numerical scale, allowing researchers to quantify and compare responses.

Table 1. Likert Scale

Numerical Rating	Description
5	Excellent
4	Very Good
3	Good
2	Fair
1	Poor

Table 1 above displays the range of scale values for questionnaires. It was based on how the participants perceived the application's purpose. In the surveys that participants had to fill out after using the application, numerical ratings were present. Different interpretations can be made of each numerical rating.

Likert Scale Interpretation of the Evaluation Result: The results from the testing and evaluation of the system were interpreted to achieve consistent ratings.

Table 2. Likert Scale Equivalent

Numerical Rating	Description
4.20 – 5.00	Excellent
3.40 – 4.19	Very Good
2.60 – 3.39	Good
1.80 – 2.59	Fair
1.00 – 1.79	Poor

Table 2 above displays the descriptive rating scale and precisely explains each numerical rating to ensure respondents' understanding.

RESULTS

This chapter discusses all parts of the results. It includes screenshots of system and application outputs and the different hardware equipment that the researchers use in the study. Also, the evaluation results from the I.T. Experts and non-I.T. experts.

Evaluation Results

In this evaluation results, table 5 and 6 discussed the result of the evaluations from the participants including the three I.T. Experts with the use of ISO-25010 as a survey tool in collecting data. The study had 50 Non – I.T. and Three I.T. Experts with a total of 53 respondents.

Table 3. Evaluation Results of IT Experts

Criteria	Mean	Descriptive Rating
Functional Suitability	3.88	Very Good
Performance Efficiency	4.44	Excellent
Compatibility	4.66	Excellent
Usability	3.94	Very Good
Reliability	4.08	Very Good
Security	4.26	Excellent
Maintainability	3.99	Very Good
Portability	3.99	Very Good
Overall Mean	**4.15**	**Very Good**

Table 3 presented the results of the evaluation completed by three I.T. specialists. The table displays the mean for each criterion, as well as its qualitative interpretation and ranking. The overall mean of the evaluation scores for software performance was 4.15, which corresponds to Very Good. This suggested that the system satisfies the user's needs, is dependable, simple to use, efficient with resources, and simple to maintain and manage.

The system's Functional Suitability received a score of 3.88, which is considered Very Good. This demonstrates that the system has accomplished its primary goal, which is further defined by its completeness, correctness, and appropriateness.

The Performance Efficiency received a score of 4.44, which is considered Excellent. This clearly demonstrates that the system has accomplished its primary goal, as evidenced by its operational behavior, resource efficiency, and capacity.

The Compatibility score was 4.66 out of 5, which is considered Excellent. This clearly demonstrates that the system has accomplished its primary goal, which is further defined by its appropriateness, learnability, operability, user error protection, user interface aesthetics, and accessibility.

The Usability was given a 3.94 rating, which is considered Very Good. This demonstrates that users and evaluators alike considered the system to be learnable and simple to use, independent of their prior experience with computers and systems in general. This also indicates that the system's graphical user interface is well-designed and appealing.

The Reliability performance was scored 4.08, which is a Very Good result. This demonstrates that the system has accomplished its primary goal, which is further defined by its maturity, availability, and fault tolerance.

The Security characteristics of software which includes confidentiality, integrity, accountability, and authenticity of the system. This attribute received a grade of 4.26, which is considered Excellent.

The Maintainability function received a score of 3.99, which is considered Very Good. Modularity, reusability, analyzability, modifiability, and testability are all indicators of system maintainability.

The Portability was the final characteristic to be assessed. It received a 3.99, which is a Very Good ranking in this category.

Table 4. Evaluation Results of Non-IT Experts

Criteria	Mean	Descriptive Rating
Functional Suitability	4.70	Excellent
Performance Efficiency	4.51	Excellent
Usability	4.54	Excellent
Reliability	4.51	Excellent
Maintainability	4.57	Excellent
Overall Mean	**4.56**	**Excellent**

Table 4 presented the results of the evaluation completed by three I.T. specialists. The table displays the mean for each criterion, as well as its qualitative interpretation and ranking. The overall mean of the evaluation scores for software performance was 4.15, which corresponds to Very Good. This suggested that the system satisfies the user's needs, is dependable, simple to use, efficient with resources, and simple to maintain and manage.

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Usability	4.54	Excellent
Reliability	4.51	Excellent
Maintainability	4.57	Excellent
Overall Mean	**4.56**	**Excellent**

Table 5 shows above, the result of the Non – I.T. The system was evaluated by experts, and 50 of the respondents were chosen to take part in the evaluation. The system received an overall mean of 4.56 from the known number of system evaluators, which corresponds to an Excellent grade. Only four characteristics were utilized because the other four were difficult for Non – I.T. Experts to judge.

The system's Functional Suitability received a score of 4.70, which is considered Excellent. This demonstrates that the system has accomplished its primary goal.

The Performance Efficiency received a score of 4.51, which is considered Excellent. This clearly demonstrates that the system has accomplished its primary goal.

The Usability was given a 4.54 rating, which is considered Excellent. This demonstrates that users and evaluators alike considered the system to be learnable and simple to use, independent of their prior experience with computers and systems in general. This also indicates that the system's graphical user interface is well-designed and appealing.

The system's Reliability performance was scored 4.51, which is an Excellent result. This demonstrates that the system has accomplished its primary goal.

The system's Maintainability was given a 4.57, which is an Excellent result. This demonstrated that the system has accomplished its primary goal.

DISCUSSION

The chapter discusses everything concerning the research; it includes summary of findings, conclusions and recommendations for improving quality as well as reliability or effectiveness of the whole system. The proposed Web-Based RFID System is a comprehensive way to enhance the student portal experience. Addressing challenges and incorporating recommendations can further strengthen the system's effectiveness.

Summary of Findings

The research on "A Web-Based RFID System for Contactless Student Portal in City College of Angeles" examined how the use of RFID can help improve the student attendance system that is already in place. The research aims to address the challenges posed by manual attendance taking methods in educational institutions, proposing an RFID web-based contactless student portal. The researchers highlighted and addressed issues with

the conventional methods of recording students' presence, which included time-consuming manual procedures and a lack of consistency or accuracy. The study targets to implement a Web-Based RFID System for a Contactless Student Portal. The system aims at ensuring efficiency, convenience and precision when it comes to monitoring attendance and controlling student portals. This study has been well-defined with focus on development of web-based RFID systems for contactless entry, class attendance tracking including other features such as the student portals. This involves having unique radio frequency identification (RFID) tags for each student which are integrated into a database resulting into a comprehensive solution. Limitations regarding internet dependency and range of RFID scanner have also been acknowledged. This implies that users must take these limitations into account to prevent any disruptions during their interactions with this type of system. This framework provided a clear understanding of the system flow from RFID tag detection to attendance recording. The integration of a web-based application and RFID technology was well-illustrated thereby outlining the input, process and output stages. The study emphasized on how students, teachers, researchers and future investigators would benefit from this system. Emphasis was placed on efficiency, accessibility and monitoring in order to improve the overall educational experience. Research design, system development methodology, participant selection through purposive sampling and data analysis using ISO 25010 Criteria were all systematically described. This is done by using Likert Rating Scale and ISO 25010 Criteria for analyzing data which provides a structured approach in assessing functionality, reliability, usability, efficiency and maintainability of a system whereas its user interface design, entity relationship diagramming (ERD), logical specifications (LS), computer specifications (CS) and software specifications (SS) were deliberated upon.

Conclusions

The main objective of this proposal was to present the development and implantation of a web-based RFID System for a contactless student portal that can help solve the problems with traditional attendance systems and improve the overall educational experience. The invention, which

effectively took over from the conventional way of keeping track of students' presence in class, will provide a stable, disturbance-free method to ensure accurate record keeping as well as enhance the teaching and learning process in general. The study also provided a deeper understanding of the proposed system by highlighting its importance and objectives, as well as its scope and limitations. The methodology encompassed descriptive research as well as a prototyping model, which ensured systematic steps towards system development. Further improvements and refinements will be guided by findings from participant feedback and data analysis on optimizing the system's functionality and user experience. This is because of its adaptability as well as responsiveness to technological advancements brought about by this web-based RFID solution thus making it dynamic too. Education institutions are increasingly being transformed through digital processes; hence, this RFID System proves to have emerged as an essential part of redefining students' attendance tracking in schools today. This can be considered as a modern security measure since no one can access it using physical means, while at the same time promising insights based on reliable data. The Web-Based RFID System for contactless student attendance was presently positioned on the cutting edge of technological innovation within education and ready to contribute enormously to the continuous development of educational systems worldwide.

Recommendations

In the improvement of systems, feedback from users should be made part of it, training programs for users be established, possibility of offline mode is considered, and longer-range RFID scanner technologies are explored by the use of hardened security features and working together with stakeholders. These recommendations will help develop the Web-Based RFID System into a platform that is beneficial to educational technology at City College of Angeles as it becomes strong and friendly to the user.

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