DIGITAL ATTENDANCE MANAGEMENT
WITH QUICK RESPONSE CODE INTEGRATION

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Abstract

This study focuses on the development and implementation of a Digital Attendance Management System with Quick Response Code Integration, aiming to improve attendance monitoring in educational settings. Specifically, the study aimed to achieve several objectives: firstly, to create a user-friendly interface for attendance monitoring, facilitating ease of use for both students and faculty. Secondly, the integration of QR code technology was intended to streamline attendance tracking processes, allowing for efficient and accurate recording of attendance data. Additionally, the study aimed to enhance data integrity and security through encryption integration and the implementation of authentication protocols, ensuring the confidentiality and integrity of attendance records. Moreover, the establishment of robust attendance tracking mechanisms, including the development of algorithms for real-time recording and secure storage solutions, aimed to improve the accuracy and reliability of attendance data management. Finally, the study evaluated the effectiveness and efficiency of the developed system using ISO 25010 criteria, assessing various quality characteristics such as functional suitability, performance efficiency, usability, reliability, security, maintainability, and portability. Through these efforts, the study sought to contribute to the advancement of attendance management practices in educational institutions.

The implementation of a Digital Attendance Management System with Quick Response Code Integration represents a significant step towards modernizing attendance tracking processes in educational institutions. By incorporating QR code technology, the system provides a more efficient and convenient method for recording attendance, reducing the administrative burden on faculty and improving accuracy. Moreover, the emphasis on data integrity and security through encryption integration and authentication protocols ensures that attendance records remain confidential and tamper-proof, addressing concerns regarding data privacy and reliability. The robust attendance tracking mechanisms established in this study, including real-time recording algorithms and secure storage solutions, contribute to more accurate and reliable attendance data management, enabling educational institutions to make informed decisions based on attendance trends and patterns. Overall, this study underscores the importance of leveraging technology to enhance attendance management practices, ultimately promoting efficiency, transparency, and accountability in educational settings.

Introduction

In today's global educational landscape, the imperative for educational institutions to adopt a more efficient and secure method of monitoring learner attendance is paramount. Monitoring and managing learners' attendance using Quick Response (QR) code technology has emerged as a crucial solution across international settings, encompassing schools, colleges, and training centers. A robust Digital Attendance Management System integrated with QR Code technology is indispensable for ensuring accountability, improving operational efficiency, and enriching the overall learning experience. This system harnesses technology to streamline attendance tracking processes, providing real-time data insights into learner engagement. It ensures that the individual logging attendance is indeed the registered student, thereby thwarting potential manipulation or loss of manual attendance records. Such measures bolster security and mitigate proxy attendance issues.

Regular attendance has consistently been linked to academic achievement, and this correlation is evident from the early stages of a student's educational journey. Moreover, punctuality and attendance are universally recognized as fundamental attributes for learners and employees alike. Fostering a culture of consistent attendance and punctuality not only boosts learner morale but also positively impacts academic performance. Students who attend school regularly tend to exhibit better study habits, encounter fewer discipline issues, and achieve higher levels of success compared to their peers with irregular attendance patterns.

Chronic absenteeism poses multifaceted challenges and demands a collaborative approach from various stakeholders, including parents, teachers, administrators, and policymakers. By delving into the root causes and consequences of absenteeism, a deeper understanding of the significance of school attendance emerges. Research underscores that school attendance serves as a robust predictor of student outcomes, with irregular attendance often signaling a higher likelihood of dropping out before graduation. Furthermore, chronic absenteeism can impede social and emotional development, hindering the acquisition of crucial school readiness skills and exacerbating disparities in academic performance.

Efforts to address chronic absenteeism necessitate innovative solutions. Implementing a Digital Attendance Management System with QR Code Integration represents a proactive step towards automating attendance tracking processes, thereby ensuring accuracy and efficiency for both learners and staff. By offering real-time access to attendance information, this system empowers educators and administrators to make informed decisions and interventions promptly. QR code technology simplifies attendance tracking, providing a convenient, tamper-proof method that reduces administrative burdens associated with manual recording.

In conclusion, the adoption of a Digital Attendance Management System with QR Code Integration marks a paradigm shift in attendance tracking methodologies. By leveraging technology to automate processes, educational institutions can enhance student involvement, academic achievement, and overall school success. This system represents a versatile solution that not only addresses the challenges of traditional attendance tracking but also aligns with the evolving needs of modern educational environments.

Specific Objectives

Specifically, this study aimed to:

1. Develop and implement a comprehensive Digital Attendance Management System with Quick Response Code Integration by:
   1.1. Creating a user-friendly interface for attendance monitoring.
   1.2. Integrating QR code technology for efficient attendance tracking.
   1.3. Implementing user authentication mechanisms to ensure data security.

2. Enhance data integrity and security through encryption integration by:
   2.1. Implementing encryption algorithms to safeguard attendance data.
   2.2. Integrating authentication protocols for secure access to attendance records.

3. Establish robust attendance tracking mechanisms by:
   3.1. Developing algorithms for accurate and real-time attendance recording.
   3.2. Implementing storage solutions for secure and organized attendance data management.

4. Evaluate the effectiveness and efficiency of the Digital Attendance Management System using ISO 25010 criteria in terms of:
   4.1. Functional Suitability
   4.2. Performance Efficiency
   4.3. Compatibility
   4.4. Usability
   4.5. Reliability
   4.6. Security
   4.7. Maintainability
   4.8. Portability

Scope and Delimitation

The Digital Attendance Management with QR Code Integration System was used for checking attendance in classrooms and institutional events at Aemilianum Colleges Inc. for both students, focusing on the development and implementation of the QR-based attendance monitoring system. This included testing and refining the system in a real educational setting and involving training for educators and learners on how to use the system effectively. In today's dynamic educational landscape, efficiently tracking and managing Digital Attendance was a critical aspect of ensuring educational success and security. To meet this need, we introduced our innovative Digital Attendance Management with QR Code Integration, enhanced with the power of QR code technology.

The system provided user interfaces for learners, educators, and administrators to generate reports and perform data analysis. Each learner was assigned a unique QR code that linked to their attendance record. They used their smartphones or ID cards to scan QR codes during check-in and check-out. Educators maintained a database storing attendance records, making them accessible for analysis and reporting. The system raised the bar for both teachers and students in terms of accountability. The knowledge that their attendance was being tracked motivated students to routinely attend classes, and educators could monitor their own attendance.

The study focused solely on a technological solution designed to streamline and enhance

the process of digital attendance, utilizing QR codes as integration to automate digital attendance tracking and providing more efficient and accurate methods for learners, educators, and administrators at Aemilianum College Inc. After development, it was evaluated by 10 IT professionals and 10 faculty members of Aemilianum College Inc.

Significance of the Study

This study view as the following:

Organizations of Institutional Activities. They will have more efficient and streamlined method for tracking attendance, reducing administrative workload.

Students. They will experience a faster and more convenient way to record their attendance, eliminating the need to for manual sign-ins and paper-based methods.

Deans/Principal. They can use the system to verify attendance records for compliance and accountability.

Employees. Similar to students, employees will benefit from a simplified attendance recording process, particularly for professional development or training sessions.

Administrative Staff. Those responsible for managing digital attendance records will save time and reduce the likelihood of errors associated with manual record-keeping.

IT Professionals. Those involved in system implementation and maintenance can gain valuable experience in integrating technology.

Institution. The school or institution will benefit from improved data accuracy, reduced administrative overhead, and the potential for data analysis and reporting to improve future events.

Security Personnel. If applicable, security personnel can use the system to monitor and control access to the event, enhancing security measures.

Government Authorities. The system can help educational institutions meet regulatory requirements.

Researcher. They can use the system's data for educational research and analysis.

Hardware Requirements

All the resources gathered and included were carefully selected to ensure they were appropriate for achieving the set objectives of the proposed system. These resources proved to be invaluable assets to the system, serving as the precise mediums to be utilized by the end-users and facilitating seamless collaboration between various components. Identification of hardware requirements played a crucial role in the system's development, as the hardware needed to align seamlessly with the specific requirements of the system type.

To gain deeper insights into the hardware requirements and their compatibility with the proposed system, the researcher meticulously compiled a comprehensive list, as illustrated in Tables 3.1 and 3.2. These tables served as valuable references, providing detailed information on each hardware component's specifications and its alignment with the system's functionalities. Through this detailed analysis, the researcher ensured that every hardware component selected was not only compatible but also optimized for seamless integration with the proposed system.

Table 3.1 - Server Hardware Requirements

Required Hardware	Hardware Specifications
Processor	Intel® Core™ i3
Hard disk drive	1 TB
Memory	16.0 GB DDR3
Devices	Mouse, Keyboard, 11b/g Wireless Stick
Intel band width	433+ 10 Mbps Wireless Router
Free Disk Space	300 GB

Table 3.1 presents the system hardware requirements necessary for deploying the system on a server. The system demanded a stable bandwidth and high server specifications to fulfill the system's expectations and maximize its potential. Additionally, a large hard disk capacity was necessary to store uploaded files from the internet and log files. With the appropriate hardware configuration, the system could efficiently handle the required processes. It was crucial for the hardware to align with the expected output of the system and the software utilized by the developer.

Table 3.2 - Client Hardware Requirements

Required Hardware	Hardware Specifications
Processor	Intel® Core™ i3
Hard disk drive	1 TB
Memory	8.00 GB
Internet band width	30 Mbps
Devices	Keyboard, Mouse, QR code scanner

Table 3.2 displays the hardware requirements necessary for client computers. These computers encompassed the units utilized by office staff and students' personal computers. Any computer with an internet connection could access and utilize the system provided it met the hardware requirements. While higher specifications outlined in Table 3.1 could augment the system's capability, client computers did not necessitate high specifications since only a portion of the system would run on them. Nevertheless, employing higher specifications could enhance the system's performance.

Table 3.3 - Software Requirements

Particulars	Recommendation Specification
Operating system	Windows 7 or up
Database	Firebase Built -in Database
Web Server	Firebase
Server-side-Scripting	PHP, React
Client-side Scripting	Bootstrap, JavaScript, JQuery

Table 3.3 presents the crucial software requirements essential for achieving the full functionality of the proposed system. These requirements were meticulously identified by the researcher to ensure optimal performance and compatibility with the intended functionalities of the system. The tables below illustrate the comprehensive list of software requirements compiled during the research process. Each software requirement was carefully assessed and selected based on its capability to support the system's operations and meet the desired objectives.

Table 3.4 - Client Software Requirements

Particulars	Recommended Specification
Operating System	Windows 7,8.1 or 10
Web Browser	Mozilla Firefox or Google Chrome
Report Viewer	ADOBE Acrobat

Table 3.4 presents the client software requirements essential for the smooth functioning of the system. The system is designated as cross-platform, meaning it is compatible with multiple operating systems and devices. It can be accessed and utilized on devices running Microsoft Windows 10 or 11 operating systems, as well as Android operating systems equipped with a web browser. This versatility ensures that users can conveniently interact with the system regardless of their preferred operating system or device, enhancing accessibility and usability.

Phase 1: Project Planning

The planning phase of a project was a crucial step that set the foundation for the work that would be done in subsequent phases. During this phase, the project's goals and objectives were defined, the resources needed to complete the project were determined, and a plan for achieving the goals within the allotted time and budget was created. To begin the planning phase, the scope of the project was defined, including the tasks to be completed, the deliverables, and any potential risks or challenges. A detailed project plan was then created, including a timeline with specific tasks and milestones, a budget, and a list of resources. The project team was also assembled, and roles and responsibilities were assigned. It was important to be thorough and comprehensive in the planning phase to increase the chances of success for the project.

Phase 2: Project Requirements

The requirements phase of the project was focused on gathering and documenting the specific requirements for the project. This included identifying the needs and expectations of the stakeholders, as well as any constraints or limitations that had to be considered. The requirements phase began by identifying the stakeholders for the project and gathering information from them to understand their needs and expectations. This information was then documented in a clear and concise manner, such as through a requirements document or user stories. The requirements phase was crucial in ensuring that the project was aligned with the needs and expectations of the stakeholders and that any potential challenges or limitations were identified.

Identified Problems and Proposed Solutions

Based on the conducted interviews and observations, the researcher identified the following findings of the difficulties encountered in calling the name of students through manual attendance. The table below shows the recognized problems with the manual attendance in the College. It was supported with the description to have the capacity to identify the required data for the proposed project entitled Digital Attendance Management with QR Code Integration. To address these issues, many organizations opted for automated attendance systems like biometric scanners, QR codes, RFID tags, or software-based solutions. These systems could significantly reduce errors, save time, enhance security, and provide more accurate and accessible attendance data. If you were facing challenges with a manual system, considering a shift towards automation might have alleviated these issues.

Problem Description: Time-Consuming - Manually taking attendance was often time-consuming, especially in larger groups. It took a significant portion of a person's time, especially if done daily. Solution: Automation - Considered transitioning to automated attendance systems. Biometric scanners, QR Code, RFID tags, or software-based solutions could significantly reduce the time spent on manual data entry. By implementing these strategies, the time spent on manual attendance was reduced, allowing for more productivity and accuracy in recording attendance data.

Problem Description: Human Error - Manual attendance was susceptible to human errors such as typos, incorrect entries, or misplaced records, leading to inaccurate data. Solution: Training and Clear Instructions - Thorough training was provided to staff responsible for taking attendance. Clear and standardized instructions were given to reduce the chances of errors due to misunderstanding or confusion. Human errors in manual

attendance systems were significantly reduced, ensuring more accurate and reliable records.

Problem: Difficulty in Tracking - It was challenging to keep track of attendance records over time, especially if there was a need to refer back to them for any reason. Solution: Digital Documentation - Considered digitizing manual records. Scanning paper documents and storing them digitally made searching and tracking attendance history much easier. Backup and Security Measures - Implemented backup systems and security measures for stored records to prevent loss or unauthorized access. By implementing these strategies, tracking attendance in a manual system became more systematic, organized, and accessible, reducing the difficulty associated with keeping track of attendance records over time.

Problem: Security Concerns - Paper-based attendance sheets or manual systems might have posed security risks as they could have been lost, damaged, or accessed by unauthorized individuals. Solution: Access Control: Restricted access to attendance records. Limited the number of people who could handle, view, or modify these records. Used passwords or physical locks for storage. Secure Storage: Stored physical attendance records in locked cabinets or rooms to prevent unauthorized access. For digital records, used secure servers or encrypted databases. With these security measures, the risks associated with handling attendance records in a manual system could have been significantly reduced, and sensitive information could have been protected from unauthorized access or breaches.

Problem: Lack of Real-Time Data - With manual systems, it was difficult to have real-time insights into attendance trends or discrepancies. Solution: Digital Tools for Quick Compilation, If using paper-based systems,

considered tools that enabled quick compilation or digitization of attendance data. For instance, scanned documents for digital storage. Utilized mobile apps for attendance tracking that allowed instant data entry and updates, enabling real-time access to attendance information. Implemented systems that generated alerts for discrepancies or missed entries, allowing for immediate action. By incorporating these strategies, the gap between attendance recording and data availability could have been reduced, making information more

current and accessible in the manual attendance system.

The researcher proposed the system "Digital Attendance Management with QR Code Integration" to resolve the current problem encountered by the researcher. The proposed system provided an efficient and convenient digital attendance management through the user interface. All data were kept in the database wherein only the admin could see for security purposes; however, users could view data only of their respective concerns

. **Phase 3: Project Design**

The 3rd phase covered the research design. It referred to the totality of the researcher's strategy that had been used to integrate the different components of the study aligned in a logical way, and this was to ensure that it effectively addressed the research problem. Project design included the blueprint for the collection and analysis of the data. In this phase, the researcher designed the proposed system that satisfied the requirements

identified in the analysis phase, and the system architecture was also established. System architecture defined the components and interfaces together with the functionalities. Details on the used computer programming languages and environments, diagrams, application architecture, platforms, data structures, algorithms, and interfaces were also established.

Fishbone Diagram

The Fishbone Diagram was a process of identifying and grouping the causes which generated a quality problem; it was also known as an Ishikawa diagram. It was a cause-and-effect diagram that helped managers trace

down the reasons for gaps, imperfections, variations, failures, and defects. Thus, the fishbone diagram had also been used to group by categories the causes of other types of problems which an organization focused on.
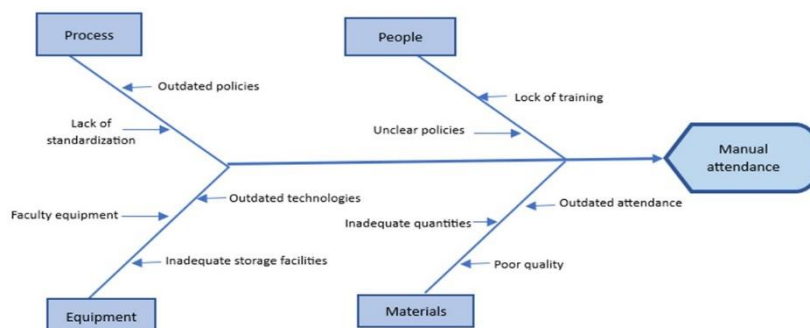

Figure 4.1 Fishbone Diagram

Figure 4.1 showed the fishbone diagram, the problems encountered in the conduct of learning resources management system were present in the diagram. The causes were grouped into the following categories: The people (students), Material (manual attendance), Process (process of evaluation) and Equipment. Fishbone diagram helped the researcher identify the cause and effects that may happen in the implementation of Digital Attendance Management with QR Code Integration System.

Context Diagram

Context diagram also known as a level of data flow diagram was used to define and clarify the software's boundaries. This was to establish the boundaries and context of the system to be developed, as well as the details of what is inside and outside of the system and how the system interacts with the external factors. The entire software system was presented as a single process, this was also known as a high-level overview of what the system accomplished. The context diagram represented the system as a single high-level process, as well as the system's relationships with other external entities such as the system, organizational groups, and external data storage.
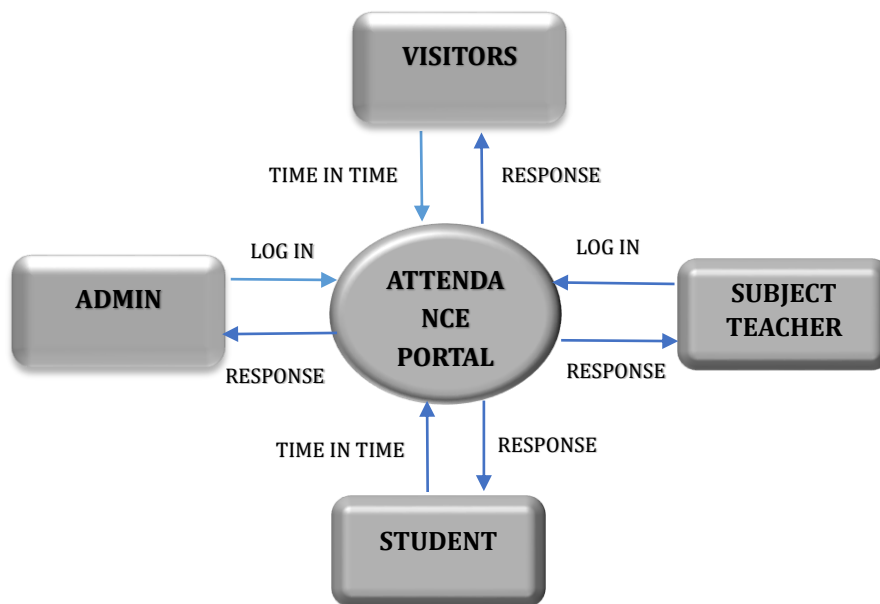
Figure 4.2 Context Diagram

Figure 4.2 showed the process and people involved in the proposed Digital Attendance Management with QR Code Integration System. Presented in the diagram were the exchange of information and activities between the systems and its users. It also showed how the user of the developed system interacted with the system itself.
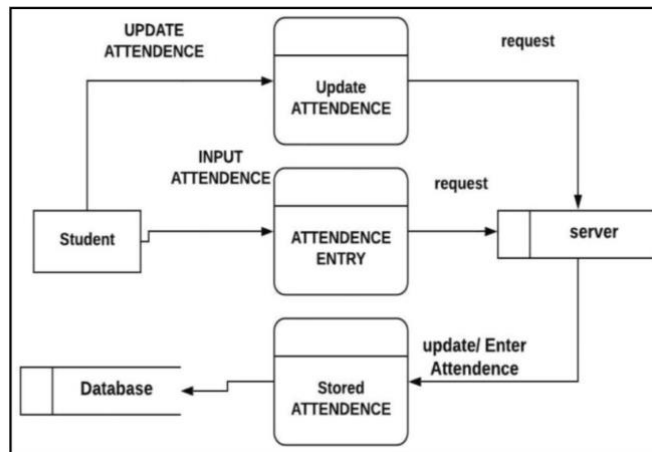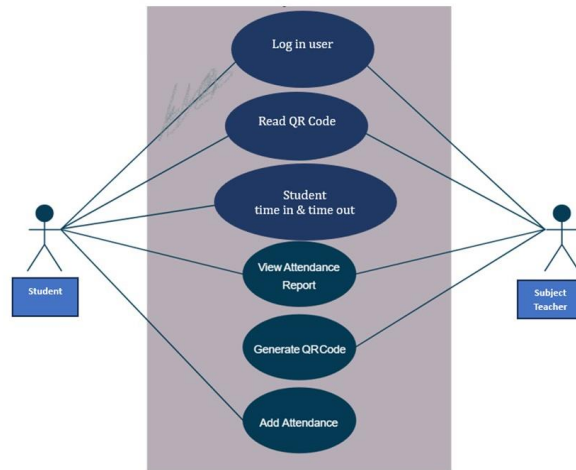
Figure 4.3 Data Flow Diagram level 0

The context level data flow diagram (DFD) describes the whole system. It shows the all-user module who operate the system. The student attendance management system data flow diagram shows there are three users to run the system Admin, Staff and Student. Data Flow Diagram arranges the flow of data and or information for any process in the system. It shows logical model that demonstrates the processes that are expected from the system. It presents the input, output, and the processes together with the database storage of each data.

Level 0 diagrams showed the details of the system operations that are expected to happen. It was shown in figure 4.4 in which it was divided into modules(process). The Level 0 data Flow Diagram of the system represented the detailed format of the context diagram wherein actual processes of the system were shown such as: create account, add resources, manage resources details, and generate report. Included in each process are the input and output data. The diagram above showed the broad overview of the system and

let the succeeding level to work down to a hierarchy of detailed diagrams, the detailed process of each module. The following diagram showed the level 1 of the data flow diagram, each module (process) is exploded to represent the specific processes within the module. This provided details on the specific process in the system.

The context level data flow diagram (DFD) described the entire system, illustrating all user modules that operated the system. The student attendance management system data flow diagram depicted three users responsible for running the system: Admin, Staff, and Student. The DFD arranged the flow of data and information for each process in the system, presenting a logical model demonstrating the expected processes. It showcased the input, output, and processes, along with database storage for each data.

Level 0 diagrams detailed the expected system operations, depicted in Figure 4.4, where they were divided into modules (processes). The Level 0 Data Flow Diagram of the system represented the detailed format of the context diagram, displaying actual system processes such as creating an account, adding resources, managing resource details, and generating reports. Each process included input and output data. The diagram provided a broad overview of the system, enabling subsequent levels to work down to a hierarchy of detailed diagrams, showcasing the specific processes within each module. The following diagram depicted Level 1 of the data flow diagram, where each module (process) was exploded to represent specific processes within the module, offering details on the system's specific processes.

Table 4.11

Overall Summary of the System Evaluation

Characteristics	IT Experts (10)	Faculty (10)	Mean	Interpretation
System Functionality Suitability	3.5	3.6	3.6	Presence of the Expectation
System Performance Efficiency	3.5	3.6	3.6	Presence of the Expectation
System Compatibility	3.5	3.7	3.6	Presence of the Expectation
System Usability	4	3.9	4	More than what is expected
System Reliability	3.8	3.85	3.83	Presence of the Expectation
System Security	4.72	4.78	4.75	More than what is expected
System Maintainability	4	4	4	More than what is expected
System Portability	4	4.6	4.3	More than what is expected
Weighted Mean	**3.88**	**4.0**	**4.0**	**More than what is expected**

Table 4.11 provides an overall summary of the evaluation of the system across various characteristics as assessed by IT experts and faculty members. The characteristics evaluated include system functionality suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. According to the table, both IT experts and faculty members rated the system consistently high across most characteristics, with ratings ranging from 3.5 to 4.78. The weighted mean across all characteristics is 4.0, indicating a strong consensus between IT experts and faculty members that the system's overall performance exceeds expectations. Specifically, the system's usability, security, maintainability, and portability are rated more than what is expected, while other characteristics such as functionality suitability, performance efficiency, compatibility, and reliability meet the expected standards. Overall, the system is perceived to be more than what is expected, as indicated by the weighted mean of 4.0.

Summary

Specifically, this study aimed to develop and implement a comprehensive Digital Attendance Management System with QR Code Integration by: creating a user-friendly interface for attendance monitoring; integrating QR code technology for efficient attendance tracking; and implementing user authentication mechanisms to ensure data security.

Enhance data integrity and security through encryption integration by implementing encryption algorithms to safeguard attendance data and integrating authentication protocols for secure access to attendance records.

Establish robust attendance tracking mechanisms by: Developing algorithms for accurate and real-time attendance recording; and Implementing storage solutions for secure and organized attendance data management.

Evaluate the effectiveness and efficiency of the Digital Attendance Management System using ISO 25010 criteria in terms of: Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, Portability.

Findings

During the development and after testing and evaluation of the developed system the following findings have been established:

1. The comprehensive Digital Attendance Management System with QR Code Integration was successfully developed and implemented, featuring a user-friendly interface for attendance monitoring, efficient QR code technology integration for tracking, and robust user authentication mechanisms to uphold data security.

2. Findings indicate that data integrity and security were significantly enhanced through the integration of encryption algorithms to safeguard attendance data and the implementation of authentication protocols for secure access to attendance records.

3. Highlighting the successful establishment of robust attendance tracking mechanisms, this was accomplished through the development of algorithms for accurate and real-time attendance recording, and the implementation of secure and organized storage

solutions for managing attendance data effectively.

4. Following a thorough system evaluation, the researcher concludes that the system meets the ISO 25010 level of acceptability, encompassing functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. The evaluation, conducted by 10 end users from Aemilianum College Inc. and 10 IT experts, yielded an overall mean rating of 4.0, signaling a performance exceeding expectations.

Conclusions

Based on the findings of this study the following conclusions are formulated:

1. The successful development and implementation of the comprehensive Digital Attendance Management System with QR Code Integration, characterized by its user-friendly interface, efficient QR code technology integration, and robust user authentication mechanisms, mark a significant advancement in attendance management and data security measures.

2. The integration of encryption algorithms and authentication protocols has notably enhanced data integrity and security in attendance management systems.

3. The successful establishment of robust attendance tracking mechanisms,

4. including accurate real-time recording algorithms and secure storage solutions, underscores the effectiveness of the system in managing attendance data efficiently.

4. The researcher's comprehensive evaluation confirms that the system meets ISO 25010 standards, surpassing expectation.

demonstrating exceptional performance across functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability, with an overall mean rating of 4.0, indicating a performance

Recommendations

The conclusion drawn from the findings were the following:

1. Continuously monitor user feedback and conduct regular usability tests to ensure the Digital Attendance Management System remains intuitive and user-friendly.

2. Implement regular security audits and updates to stay ahead of emerging threats and maintain the integrity of attendance data.

3. Provide ongoing training and support for users to maximize utilization of the attendance tracking system's features and functionalities.

4. Consider soliciting feedback from a wider range of stakeholders and conducting periodic evaluations to ensure the system maintains its high level of performance and meets evolving user needs.

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