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RADIO FREQUENCY IDENTIFICATION – BASED KIOSK SYSTEM FOR STUDENT EVALUATION

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Abstract

The Radio Frequency Identification (RFID) - Based Kiosk System for Student Evaluation was developed to enhance the efficiency and security of the student evaluation process. Utilizing the Rapid Application Development (RAD) Methodology, the system was designed with a comprehensive database, an intuitive data management module, RFID authentication, and an interactive evaluation sheet viewing interface. The system also includes a durable kiosk enclosure to ensure usability and protection of electronic components. To guarantee reliability and effectiveness, the system was evaluated based on the ISO/IEC 25010 standard, focusing on functional suitability, performance efficiency, usability, security, and maintainability.

The study's findings indicate that the system successfully stores and manages student evaluation data in a secure and organized manner. The data-management module enables authorized personnel to efficiently input and update evaluation sheets, while RFID authentication ensures secure and accurate student identification, preventing unauthorized access. The kiosk's evaluation sheet viewing interface effectively enhances accessibility for students, improving their overall experience. Additionally, the system meets industry standards, demonstrating its robustness in usability, security, and performance.

Based on these findings, the study concludes that the RFID-Based Kiosk System is a reliable and effective solution for managing student evaluations. Its secure database, user-friendly interface, and strong authentication mechanisms contribute to its efficiency and usability. The kiosk enclosure further supports its functionality by providing durability and protection for hardware components. Moreover, adherence to ISO/IEC 25010 ensures that the system aligns with global software quality standards, reinforcing its long-term sustainability and maintainability.

To further improve the system, it is recommended to regularly update and optimize the database for enhanced security and efficiency. Future upgrades should explore advanced RFID technology or additional authentication methods to strengthen data protection. User feedback should be continuously gathered to refine the evaluation sheet viewing interface, ensuring accessibility and usability. The kiosk design should also be periodically assessed for durability and aesthetic improvements. Additionally, implementing a robust backup and recovery plan is essential to safeguard data integrity and minimize disruptions. Future iterations of the system should maintain compliance with ISO/IEC 25010 standards to ensure continuous enhancement in functionality, security, and performance.

Keynotes: *Aemilianum College Inc., Academic Records, Radio Frequency, Identification-Based Kiosk System, RFID, Student Evaluation, Student Information Access*

Introduction

Education has always been a cornerstone of societal development, and in the modern era, technology has become an indispensable tool for enhancing its accessibility, efficiency, and effectiveness. Across the globe, educational institutions are increasingly embracing technological innovations to streamline administrative processes, improve data management, and provide students with seamless access to academic resources. Among these advancements, Radio Frequency Identification (RFID) technology has emerged as a transformative solution, addressing inefficiencies in traditional systems and aligning with the global push for digital transformation in education.

Organizations like the International Society for Technology in Education (ISTE) have underscored the importance of integrating technology into educational frameworks to foster innovation, improve efficiency, and safeguard data privacy. These efforts are guided by the principle that modern education should not only focus on knowledge acquisition but also on the development of systems that enable seamless learning experiences (Hummel, 2024). RFID technology exemplifies this shift, finding widespread applications in attendance tracking, library management, and examination monitoring in universities worldwide. By replacing manual processes with automated systems, institutions have reported significant improvements in operational efficiency and data accuracy. Studies have further shown that these systems contribute to a more student-centered learning environment by minimizing administrative delays and enabling faster access to critical academic information (Tech Journal, 2023). The proposed Radio Frequency Identification-Based Kiosk System for Student Evaluation (RBKSSE) builds on these successes, offering a secure and efficient platform for managing and accessing student academic records.

In the Philippines, the integration of technology into education is a national priority, as evidenced by policies and programs spearheaded by the Department of Education (DepEd) and the Commission on Higher Education (CHED). The Enhanced Basic Education Act of 2013, for instance, underscores the importance of utilizing technology to improve educational outcomes, promote inclusivity, and ensure equitable access to learning opportunities across the nation (RA 10533, 2013). Despite these efforts, many schools, particularly in rural areas, still rely on manual processes for administrative tasks. These outdated systems create significant challenges, including delays in accessing academic information, inaccuracies in data recording, and a heavy workload for administrative staff. Furthermore, manual record-keeping increases the risk of data breaches and compromises the efficiency of academic planning for students. These issues underscore the urgent need for automated solutions to modernize administrative processes and foster transparency in educational institutions.

In the province of Sorsogon, technological advancements have begun to permeate various sectors, including banking,

retail, and government services. Automated systems such as barcode scanners, queue management kiosks, and ATMs have demonstrated the benefits of automation in improving efficiency and user experience. These innovations have paved the way for similar advancements in educational administration, where the reliance on manual systems has led to inefficiencies. At Southern Luzon Technological College Foundation Pilar Inc., the process for evaluating student grades involves physically visiting the registrar's office to retrieve grades, a procedure that requires authorized personnel to record data on Student Evaluation Sheets. This process is not only time-consuming but also prone to errors and inconsistencies, resulting in frustration for both students and staff. Moreover, students often face delays in receiving their grades, which can hinder their ability to plan their academic progress effectively.

The introduction of the RBKSSE addresses these challenges by offering an automated, self-service kiosk system for student grade evaluation. By utilizing RFID technology, the system provides students with a secure, efficient, and user-friendly way to access their academic records independently. This innovation reduces the reliance on administrative staff, minimizes errors associated with manual data entry, and significantly enhances the speed and accuracy of grade dissemination. In addition to operational efficiency, the RBKSSE supports the development of critical life skills among students, such as accountability and self-management, by encouraging them to take ownership of their academic progress. This aligns with global trends in educational technology, which emphasize the role of digital tools in empowering students and fostering innovation.

The proposed system also supports the national goal of inclusivity in education. By simplifying access to academic records and ensuring that the system is accessible to all students, including those with disabilities, the RBKSSE contributes to the broader mission of creating an equitable educational environment. It reflects the principles of the Digital Rise Program, which aims to integrate advanced technological tools into Philippine schools to bridge the gap between urban and rural education (DepEd Initiatives, 2024). Moreover, the system's scalability and adaptability make it a viable model for other institutions in the region, potentially transforming the way academic records are managed nationwide.

Ultimately, the RBKSSE is not merely a technological solution but a critical step toward modernizing educational administration in the Philippines. By addressing the limitations of manual systems and providing a scalable, efficient alternative, the system sets a benchmark for other institutions in the region and beyond. It embodies the potential of technology to transform education, making it more accessible, transparent, and responsive to the needs of students in the 21st century. The adoption of such a system highlights the role of innovation in bridging gaps in the educational sector and ensuring that all students have the tools they need to achieve academic success.

Specific Objectives

Specifically, the study aimed to:

1. Develop a comprehensive database system to securely store and manage all necessary information related to student evaluation sheets including:
   a. Student data
   b. Evaluation criteria
2. Develop a data-management module for authorized personnel:
   a. Intuitive and secure data input

   b. Module that allows authorized personnel to efficiently manage and update evaluation sheets and related data
3. Integrate RFID authentication for enhanced security:
   a. Module to ensure secure and accurate student identification during the evaluation process preventing unauthorized access and maintaining data integrity
4. Design an evaluation sheet viewing interface:
   a. Module that allows students to easily access and view their evaluation forms
5. Construct a durable kiosk enclosure:
   a. A physical case for the kiosk that is both functional and aesthetically pleasing
   b. A case that protects the electronic components while maintaining ease of use
6. Construct a comprehensive system using the ISO/IEC 25010 standard, focusing on the following criteria:
   a. Functional Suitability
   b. Performance Efficiency
   c. Usability
   d. Security
   e. Maintainability

Scope and Delimitations

The System for Student Evaluation (RBKSSE) is specifically for Southern Luzon Technological College Foundation Pilar Inc. and encompassed several critical components as outlined in the specific objectives. The scope included the creation of a comprehensive database system that securely stored and managed student data and evaluation criteria. The system also featured a data-management module designed for authorized personnel, allowing for secure and efficient data input and updates. An integral part of the system was the RFID authentication module, which ensured secure and accurate student identification, thus maintaining data integrity and preventing unauthorized access. Additionally, the system included a user-friendly interface that enabled students to easily view their evaluation forms, and a durable kiosk enclosure that housed the system, designed for both functionality and protection of electronic components. The overall system was developed according to the ISO/IEC 25010 standard, ensuring it met criteria such as functional suitability, performance efficiency, usability, security, and maintainability. The evaluators of the developed system included ten (10) IT experts, three (3) academic staff responsible for managing and handling student records, and seven (7) students who used the kiosk to access their grades. Feedback from these evaluators was crucial in assessing the system's effectiveness, usability, and security.

The scope of this study is specifically delimited to the task of providing students with access to their grades through the system. The system was designed exclusively for use at Southern Luzon Technological College Foundation Pilar Inc. The student users were restricted to viewing their grades through pre-assigned navigation and authentication features, with RFID being the primary method of authentication, supported by pin code entry for added security. The system operated within a local area network, ensuring that it was not cloud-based, which was a deliberate choice to enhance security and maintain the confidentiality of student records.

Gap Bridged by the Study

Most systems had been set up to expand access to information, streamline processes, and enhance security in learning institutions by applying various technologies such as SMS-based delivery of information, web-based applications, RFID, and QR code systems. Still, no system, even as effective as it might have been in its field, offered a specific combination of access at location, high security, and user-friendliness concerning the availability of academic records, which the RBKSSE provided.

In terms of academic record management and access, the Registrar Information System via SMS by Zaragosa, the Academic Records Management Systems (ARMS) for Nigerian Universities by Udoh Okon, Umoren, and Philips, and the Web-Based Student Services Digital Records Management System for Veritas College by Adra, among others, focused on academic record management and accessibility. These systems enabled students to access their records remotely via SMS or online platforms. However, while RBKSSE leveraged RFID to ensure secure, on-campus access, these systems were not meant for real-time, online access by students for accessing academic records themselves. On-campus security for student access to academic records was achieved through the RBKSSE, which used RFID to require students to be on campus and authenticate securely.

Some attendance and tracking systems included the IoT-School Attendance System Using RFID by Mrabet and Moussa, the QR Code-based Attendance Management System by Gotis, and Digital Attendance Management with Fingerprint and RFID Integration by Achacon, Enriquez, Sebastian, and Ultado. The last two of these used RFID or QR to make tracking easier. Even though they aligned with the concerns of RBKSSE regarding data security and automation, their use was for attendance tracking and not for grade access. The RBKSSE focused specifically on enabling students to view their academic grades but did not track attendance or interaction, thereby filling a unique gap in the provision of secure, self-initiated access to academic records.

Other examples were kiosks, such as the Information Kiosk with Log Monitoring by Bulaclac, the self-service anamnesis kiosk for healthcare data collection by Pacheco and Goncalves, and the kiosk system for cashless payment by Monte, Rodrigues, and Salvaleon. Although these kiosks reduced interaction with personnel and increased service efficiency, they were used for purposes unrelated to access to academic information, such as healthcare anamnesis, environmental monitoring, or financial transactions. The gap that the RBKSSE filled was its specific development for educational applications, ensuring that students had easy and immediate access to their grades through a secure kiosk interface.

Further examples included grade and course management systems. The Kosovo Web-Based System for Grading and Course Management by Gashi, Agon, and Ajvazi, and the private school Grade Management System by Banag, were two such examples. These systems tended to encompass more functions, typically handling test management, teacher management, and event management, with access through a web interface. In contrast, the RBKSSE was a leaner, on-site solution for students, designed to ensure secure access to grades without extensive administrative features, bridging the gap between elaborate grade management systems and simple grade-viewing interfaces. In essence, since earlier systems had been robust and effective for remote access to academic records, attendance monitoring, general information dissemination, and multi-functional grades management, they failed to provide targeted, secure, local-grade-viewing experiences for students. The introduction of RBKSSE attempted to bridge

this gap; its kiosk-based, secure access to academic records at RFID-secured stations was designed to meet students' needs within a learning institution. This system ensured secure, on-site grade access while addressing the concern of overhead.

Requirements Planning

The requirements' planning phase was the initial phase where stakeholders, developers, and users collaborated to define the project's scope and objectives. This was where the researcher conceptualized the objectives and consulted the clients about their research plans.

It was in this phase where the researcher observed the existing evaluation process within the institution. The observation was critical in determining if the proposed system was indeed necessary, if the stakeholders would benefit from the system and the research, and which parts of the process could be turned into modules. The existing process began with college instructors submitting their grading sheets to the Registrar and College Dean. The Registrar then provided a soft copy of the Student Evaluation Sheet, in spreadsheet format, to the Curriculum Chair based on their assigned year level. The Curriculum Chair encoded the student grades from the grading sheets into the students' evaluation sheets within the spreadsheet provided by the Registrar. Afterward, students visited the registrar department, where authorized personnel manually wrote the grades on the students' copies of the Student Evaluation Sheet. This process concluded with students being able to view their academic ratings in their respective copies of the evaluation sheet, while the institution retained a matching digital copy in spreadsheet format, which could be printed upon request.

Once the researcher showed the existing process to the administrative supervisor and it was confirmed, the researcher drafted the proposed system, which was also presented to the administrative supervisor. In the proposed system, the process began with college instructors submitting their grading sheets to the Registrar and College Dean. The Registrar then forwarded the grading sheets to authorized personnel, who directly input the student grades into the system. Once completed, students could view their digital evaluations through a kiosk, and the institution maintained a secure digital database that could be printed upon request. This revised system streamlined the process by eliminating unnecessary manual steps, making it more efficient.

The system underwent further modifications to meet the demands of the research and its evaluators, but its core purpose remained intact. The proposed system's process became the foundational structure for RBKSSE. After confirming the system, the researcher listed the required components and determined an estimated budget through canvassing and research.

In the requirements process stage, the researcher began preparing the development environment. The development machine was set up with Apache NetBeans IDE 22 as the Integrated Development Environment (IDE) and XAMPP Control Panel v3.3.0 for database management. The necessary libraries were downloaded and installed into the prepared project file.

For the hardware requirements, the researcher ordered components that were either unavailable locally or significantly cheaper when purchased overseas. The acquired components included two RFID IC ID Card Readers (one as a backup), ten RFID IC Cards that were ID-sized and could also serve as student ID cards upon administrative

approval, a 14-inch portable monitor that required a DisplayPort-to-HDMI adapter due to the limited ports of the Dell minicomputer, and the Dell minicomputer itself, which came with the necessary adapters and was purchased locally.

To complete the design, the researcher studied various kiosks in Albay and Sorsogon to conceptualize the appearance and structure of the kiosk enclosure. This step ensured that the final system would be both functional and aesthetically aligned with the institution's needs.

User Design

The user design phase commenced once the requirements were fully established. During this phase, the researcher began developing initial models of the system interface, focusing on ensuring that the design would meet the users' needs and expectations. This phase involved an iterative process of creating, testing, and refining prototypes. Each iteration incorporated feedback and adjustments, gradually shaping the design into a more polished and user-centric version. It was a meticulous process aimed at balancing functionality and usability.

As part of the design process, the researcher finalized the modules outlined in the specific objectives. This included designing the overall flowchart, data flow diagram, use case diagram, entity-relationship diagram, and class diagram. These diagrams were essential for visualizing the system's structure, clarifying processes, and identifying any potential mishandling of data or tasks. By addressing these issues early in the design phase, the researcher ensured the system would operate efficiently and effectively.

The first model created was the system flowchart (Figure 4.1), which underwent several iterations throughout the development process. This flowchart played a critical role in illustrating the sequence of steps in the workflow, both for the kiosk system and the data management system. By mapping out these processes visually, the flowchart provided a clear and comprehensive representation of how the system would function, serving as a foundation for subsequent development stages.

Construction

The construction phase is the development phase and it began after the initial designs were validate. Here, the different system components were developed. The components mentioned were the RFID integration for student identification, paired with a pin code module for added security, the backend database, the user interface construction and frontend development, and the kiosk construction. As each of these modules were developed, they were immediately tested for functionality, usability, performance, security, and maintenance. Identified issues were resolved after rounds of research and trial and error.

The Kiosk System

The user interface and flow of the kiosk system is shown here. This consisted of the forms seen by the users of the system, with explanations of their functionalities as described in the system specifications. As an additional feature, the kiosk system returns to the kiosk login window (below) after 30 minutes of inactivity, or upon network disconnection.

Figure 4.5. Kiosk Login – Waiting for RFID detection

Figure 4.5 shows the default window of the kiosk system when there are no users. It showed the logo of the client school, the name of the system, and instructions on how to start using the kiosk. It featured an active listener that waits for someone to scan an RFID. Only recognized RFID can proceed to the next security measure.

Each scanned RFID is recorded in the kiosk logs, and each RFID is tagged if they are recognized or not. This is useful in monitoring if someone is trying to use the kiosk with an unrecognized RFID card, or if a lost or stolen RFID card was used after the loss.

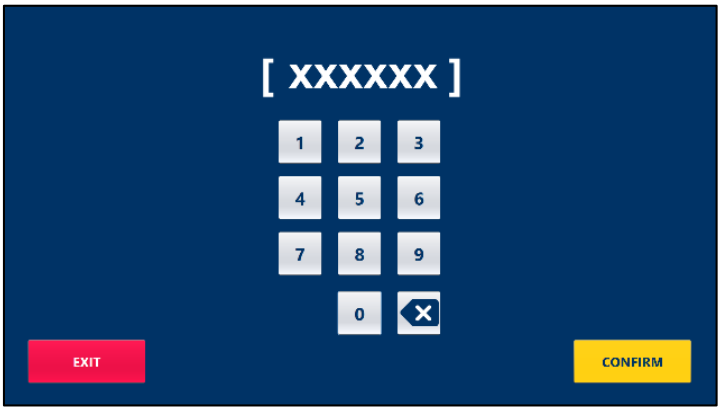

Figure 4.6. Pin code entry after RFID

Figure 4.5 allowed the user to type in their 6-digit pin code in order to successfully log in. Six digits were selected because it permutates to a 1/1000000 chance of getting the correct pin code in the event of the usage of a stolen RFID card.

The buttons EXIT and CONFIRM returned the user to the kiosk login window and sends the typed pin code for validating, consecutively. For ease of use, the CONFIRM button gets activated only when there are six (6) digits in the pin entry. The system returned the user to the kiosk login window after three (3) failed attempts.

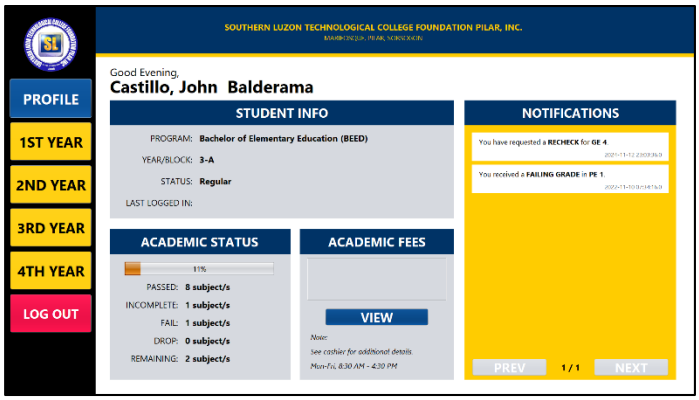

Figure 4.7. Student Profile (left) and when VIEW is clicked (right)

Figure 4.7 allowed the student to see their kiosk profile. It shows their basic student information, academic status, academic fees, and the notifications. The academic status showed the student's progress in their overall academic journey, represented by a progress bar. Below it is tallies on the status of the subjects that they have taken. For privacy concerns, the academic fees initially hide the student's balance and it can be viewed or hidden by clicking on the button VIEW/HIDE. The notifications show an overview of the latest updates regarding the grades of the students with focus on the subjects that are failed, incomplete, or if the student sent a "request to review records" on a specific subject, and also when the registrar "resolved and updated the records" on the subject.

This figure also showed the sidebar that lets the students easily navigate the kiosk for their grades. The blue buttons are the currently selected buttons, the yellow ones will bring the user to a different window or show different content, and the red one is for logging out, where, if the user confirms that they are indeed logging out, the kiosk will return to the kiosk login window (Figure 4.5).

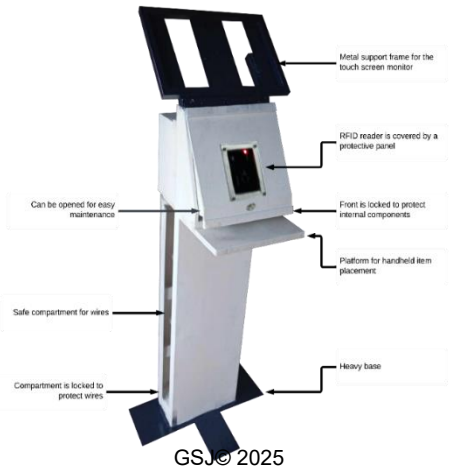

Figure 4.17. The Kiosk Enclosure

Figure 4.17 The Kiosk Enclosure had a height of 4 feet and the weight of 20 kilograms. It was made of plywood, aluminum, and metal plates. It has a small frame and a heavy base which prevents it from falling over. It houses a minicomputer inside its main compartment behind the RFID scanner. The touch screen monitor is framed by a metal support that is tilted at a fixed angle to support ergonomics and ease of use. The main compartment and the compartment for wires at the side both have locks for the safety of the components. Additionally, the design includes cable management systems to keep all wires organized and protected. The enclosure is also equipped with anti-theft mechanisms to prevent unauthorized access. Its sleek and modern design makes it an appealing addition to any public space

Cutover

In this final phase, the system was sent for a comprehensive evaluation and rigorous testing. This step was crucial to identify any problems, inconsistencies, and usability issues within the system. Based on the thorough evaluation results, necessary adjustments were made to ensure that the system adheres to stringent environmental standards and operational requirements. Both hardware and software aspects were meticulously refined to enhance performance, reliability, and user experience. Additionally, the feedback gathered during this phase played a pivotal role in shaping the system, ensuring it meets real-world demands and user expectations. The impact of these evaluations was profound, driving significant improvements and ensuring the system's readiness for deployment in diverse and challenging environments.

The Radio Frequency Identification Kiosk System for Student Evaluation was evaluated by 3 sets of evaluators: ten (10) IT experts, and for the client, three (3) administrative staff consisting of the registrar, cashier, and a dean, and seven (7) members of the student body.

Table 4.8. - Overall Evaluation of the System

Quality Characteristics		IT Experts	Administrative Staff	Students	Average	Interpretation
1.0	Functional suitability	4.4	4.9	5.0	4.8	Far exceeds expectations
2.0	Performance Efficiency	4.4	5.0	5.0	4.8	Far exceeds expectations
3.0	Usability	3.9	4.9	5.0	4.6	Far exceeds expectations
4.0	Security	3.7	5.0	5.0	4.6	Far exceeds expectations
5.0	Maintainability	4.0	4.9	5.0	4.6	Far exceeds expectations
Mean		**4.08**	**4.9**	**5.0**	**4.7**	Far exceeds expectations
Overall Mean		**4.7**				**Far exceeds expectations**

Table 4.8 presents the overall evaluation of the system based on five key quality characteristics, as rated by IT experts, administrative staff, and students. Each characteristic is evaluated on a scale where higher scores indicate a better assessment of the system's performance. The results reflect a high level of satisfaction from all user groups, demonstrating that the system meets and often exceeds expectations in multiple areas.

The first characteristic, Functional Suitability, received ratings of 4.4 from IT experts, 4.9 from administrative staff, and 5.0 from students, resulting in an average score of 4.8. This indicates that the system far exceeds expectations in terms of meeting functional requirements and user needs. Similarly, Performance Efficiency received ratings of 4.4, 5.0, and 5.0, with an overall average of 4.8, showing that the system operates efficiently, even under varying user demands.

Usability also garnered strong feedback, with scores of 3.9 from IT experts, 4.9 from administrative staff, and 5.0 from students, leading to an average of 4.6. This suggests that the system is user-friendly, with students and administrative staff particularly impressed by its ease of use. Security, another important aspect, was rated 3.7 by IT experts, 5.0 by administrative staff, and 5.0 by students, resulting in an average score of 4.6. This score reflects a high level of confidence in the system's security, particularly from the users who interact with it regularly.

The final quality characteristic, Maintainability, received scores of 4.0, 4.9, and 5.0, with an average of 4.6. This highlights the system's ease of maintenance and suggests that it is designed to be sustainable and adaptable over time.

The mean score for each group - IT experts (4.08), administrative staff (4.9), and students (5.0) - further emphasizes the system's overall success, with an overall mean score of 4.7. This result, categorized as "Far exceeds expectations," demonstrates that the system has been well-received across all user groups, offering high functional performance, efficiency, usability, security, and maintainability. The consistent positive ratings suggest that the system is robust and serves its purpose exceptionally well, meeting the needs of all stakeholders involved.

Findings

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

1. The development of a comprehensive database system successfully stores and manages student data and evaluation criteria, ensuring secure access and efficient organization for student evaluation sheets.
2. The data-management module enables authorized personnel to securely and intuitively input, manage, and update evaluation sheets and related data, enhancing efficiency and accessibility.
3. The integration of RFID authentication ensures secure and accurate student identification during the evaluation process, preventing unauthorized access and maintaining data integrity.
4. The evaluation sheet viewing interface effectively allows students to easily access and view their evaluation forms, enhancing user experience and accessibility.

5. The durable kiosk enclosure is designed to be both functional and aesthetically pleasing, offering protection for electronic components while ensuring ease of use.
6. The comprehensive system, constructed using the ISO/IEC 25010 standard, effectively meets criteria for functional suitability, performance efficiency, usability, security, and maintainability, ensuring a robust and reliable solution.

Conclusions

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

1. The comprehensive database system successfully stored and managed student evaluation data, ensuring secure access and efficient organization.
2. The data-management module enabled authorized personnel to securely and intuitively input, manage, and update evaluation sheets, enhancing efficiency and accessibility.
3. The integration of RFID authentication ensured secure and accurate student identification during the evaluation process, preventing unauthorized access and maintaining data integrity.
4. The evaluation sheet viewing interface effectively allowed students to easily access and view their evaluation forms, enhancing user experience and accessibility.
5. The durable kiosk enclosure was designed to be both functional and aesthetically pleasing, offering protection for electronic components while ensuring ease of use.
6. The comprehensive system, constructed using the ISO/IEC 25010 standard, met criteria for functional suitability, performance efficiency, usability, security, and maintainability, ensuring a robust and reliable solution.

Recommendations

Based on the conclusions drawn from this study, the following recommendations were formulated:

1. Regularly update and optimize the comprehensive database system to ensure continued secure access and efficient organization of student evaluation data.
2. Periodically assessed for improvements in user interface design and security features to further enhance usability and data handling.
3. Explore advanced RFID technology or additional authentication methods to further strengthen the security and accuracy of the student evaluation process.
4. Regular feedback from students should be collected to refine the evaluation sheet viewing interface, ensuring it continues to meet user needs and enhance accessibility.
5. The kiosk enclosure design should be periodically reviewed for potential upgrades in durability and aesthetics while maintaining ease of use and protection of electronic components.
6. Future development of the system should involve regular evaluations against ISO/IEC 25010 standards to ensure it continues to meet evolving needs for functional suitability, performance, and security.
7. implement a robust backup and recovery plan for the entire system to ensure data preservation and minimize potential disruptions in case of technical issues.

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