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Enhancing Security and Streamlining Access Control through RFID-Based Gate Pass Management System

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Abstract:

This project created an automated gate pass system using Radio Frequency Identification (RFID) technology to make school entry safer and faster. The system replaces old paper logbooks with digital records for students, staff, and visitors. It includes features like blocking lost cards and using voice alerts for entry and exit.

Keywords — **RFID, gate pass, access control, security, attendance management, ISO 25010.**

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I. INTRODUCTION

Radio-frequency identification (RFID) is a wireless technology that uses electromagnetic fields to automatically identify and track tags attached to individuals or objects, making it widely used in access control and attendance systems. In educational institutions and organizations, RFID-based gate pass systems replace manual logbooks by enabling real-time monitoring of entry and exit, improving efficiency, accuracy, and security. However, these systems face challenges such as tag cloning, weak encryption, unauthorized access, and centralized database vulnerabilities that may compromise sensitive data.

To address these issues, the proposed RFID-Based Gate Pass Management System integrates real-time tracking, visitor e-logbook features, image capture, room access monitoring, and automated reporting through an admin dashboard. The system's quality and performance are evaluated using the ISO/IEC 25010 standards to ensure

usability, security, reliability, and overall effectiveness.

A. Objectives of the Study

The primary objective of this study is to develop an RFID-Based Gate Pass Management System that improves school safety by accurately tracking the entrance and exit of individuals within the school premises. Specifically, this study aims to:

1. Develop an admin dashboard that displays: total number of entrants, visitors, blocked individuals, and stranger/unknown card attempts; weekly number of entrants and percentage of entrant status; number of personnel and rooms per department; and recent entrance logs.
2. Design a system that can perform CRUD operations for departments, roles, personnel details, and visitor cards; track visitors and record their personal details and purpose of visit as an E-logbook; generate entrance log reports filtered by date, department, location, and role; block lost or missing cards to prevent unauthorized access; provide seamless interaction between security personnel and administrators; and implement a voice alert feature for time-in/time-out and stranger detection.
3. Extend system functionality to manage room access authorization, track personnel entering specific rooms, and generate Daily Time Records (DTR) for employees.
4. Evaluate the system using ISO 25010 and SQuaRE standards for software quality assessment and the USEE framework to measure usability, security, efficiency, and effectiveness.

II. REVIEW AND RELATED LITERATURE

A gate pass is an authorization tool used to regulate entry and exit in restricted areas such as schools and workplaces, helping maintain security and monitor movement. Studies show that gate pass management systems improve organizational security by automating visitor registration and maintaining accurate records [1]. Modern gate passes use technologies such as QR codes, barcodes, biometrics, and RFID to verify identity, reduce forgery, and enhance operational efficiency [2]. Traditional paper-based gate pass systems were inefficient and prone to errors, delays, and poor tracking [3]. Technological advancements have shifted these systems to automated and web-based platforms with centralized databases.

RFID-enabled gate pass systems allow fast, contactless identification, real-time logging, and automated report generation, significantly improving access control and accuracy [5]. Several studies confirm that automated gate pass management systems enhance security, reduce processing time, and improve data management across organizations [6]. In educational institutions, RFID-based systems have proven effective for tracking attendance and monitoring entry and exit activities with high accuracy and efficiency [8]. Overall, literature indicates that RFID-based gate pass systems offer substantial benefits in security, efficiency, and monitoring despite challenges such as data security and hardware maintenance, strongly supporting their implementation in schools and other organizations.

III. METHODS

Fig. 1 Agile Development Cycle

In this study, the researchers used Fig. 1 (Agile Development Cycle) methodology in developing the RFID-Based Gate Pass Management System. The Agile methodology was chosen due to its flexibility, user-centered approach, and adaptability to evolving requirements. Agile enables incremental development, allowing critical features like RFID authentication and real-time monitoring to be prioritized and delivered in functional phases. Its emphasis on user feedback ensures the system meets stakeholder needs, while rapid prototyping and continuous testing address potential risks early, such as data security concerns or hardware integration challenges.

B. A. Agile Development Phases

The development proceeded through six iterative phases:

1) ***Requirement****:* The development team gathered to align their vision. Stakeholders engaged in meetings to brainstorm additional features. Project requirements were finalized, including the block lost card functionality, voice alert, DTR generation, and room access management.

*2) **Design**:* The team created a detailed scope of the system, ensuring all proposed features were integrated into the design. These designs were demonstrated to the group for feedback and refined to incorporate improvements, ensuring alignment with user expectations and functional goals.

3) ***Development**:* The team created the database, wrote code, and implemented the functionality required to make the system operational. Comprehensive documentation including the thesis was developed simultaneously. Testing and debugging occurred concurrently to ensure that features worked seamlessly.

*4) **Testing**:* Developers and quality assurance personnel meticulously tested the code, identifying and resolving bugs to ensure reliability. The team conducted unit tests, integration tests, and system tests to validate each component and its interaction with others.

*5) **Deployment**:* The system was officially launched within the school environment. The deployment process was carefully managed to ensure a smooth roll-out, minimizing disruptions and ensuring the system functioned as expected.

6) ***Review**:* The team evaluated the system post-deployment, conducted a thorough review of its performance, optimized code, and addressed any lingering issues. Once the system met all criteria and satisfied stakeholders, the project was officially submitted.

IV. RESULT

The evaluation of the RFID-Based Gate Pass Management System was conducted by three IT experts using a five-point functionality scale: [5] Strongly Functional, [4] Functional, [3] Moderately Functional, [2] Slightly Functional, and [1] Not Functional.

C. Dashboard Functionality

Table I presents the evaluation results of the system's dashboard features.

TABLE I

DASHBOARD FEATURES FUNCTIONALITY EVALUATION

LEGEND: [5] STRONGLY FUNCTIONAL [4] FUNCTIONAL [3] MODERATELY FUNCTIONAL [2] SLIGHTLY FUNCTIONAL [1] NOT FUNCTIONAL

Criteria	Mean	VI
How functional is the system in displaying the total number of entrants in the dashboard?	4.67	SF
How functional is the system in displaying the total number of visitors in the dashboard?	4.67	SF
How functional is the system in displaying the total number of blocked cards in the dashboard?	5.00	SF
How functional is the system in displaying the total attempts of strangers/unknown cards in the dashboard?	4.67	SF
How functional is the system in displaying the total number of weekly entrants in the dashboard?	5.00	SF
How functional is the system in displaying the percentage of entrant's status in the dashboard?	5.00	SF
How functional is the system in displaying recent entrance logs in the dashboard?	5.00	SF
TOTAL	4.86	SF

The dashboard features are highly functional, with ratings ranging from 4.67 to 5.00, all interpreted as Strongly Functional. The overall mean of 4.86 confirms that the dashboard is exceptionally reliable and efficient in presenting real-time information.

CRUD Operations Functionality

Table II shows the evaluation results of Create, Read, Update, and Delete (CRUD) operations.

CRUD OPERATIONS FUNCTIONALITY EVALUATION

LEGEND: [5] STRONGLY FUNCTIONAL [4] FUNCTIONAL [3] MODERATELY FUNCTIONAL [2] SLIGHTLY FUNCTIONAL [1] NOT FUNCTIONAL

TABLE IIA

CREATING OPERATIONS FUNCTIONALITY EVALUATION

Criteria	Mean	VI
How functional is the system in terms of creating department?	4.96	SF
How functional is the system in terms of creating role?	4.96	SF
How functional is the system in terms of creating personnel details?	4.95	SF
How functional is the system in terms of creating visitor's card?	4.98	SF
TOTAL	4.96	SF

Creating operations received a total mean score of 4.96, with individual ratings ranging from 4.95 to 4.98, all classified as Strongly Functional. The results confirm that the system accurately establishes records for departments, roles, personnel details, and visitor cards with a high level of consistency and reliability.

TABLE IIB

READING OPERATIONS FUNCTIONALITY EVALUATION

Criteria	Mean	VI
How functional is the system in terms of reading department?	5.00	SF
How functional is the system in terms of reading role?	4.93	SF
How functional is the system in terms of reading personnel details?	5.00	SF
How functional is the system in terms of reading visitor's card?	4.97	SF
TOTAL	4.98	SF

Reading operations achieved a total mean of 4.98, with individual module scores ranging from 4.93 to 5.00, all rated as Strongly Functional. These scores reflect the system's capability to retrieve and present data promptly and accurately across all modules, supporting informed decision-making by users.

TABLE IIC

UPDATING OPERATIONS FUNCTIONALITY EVALUATION

Criteria	Mean	VI
How functional is the system in terms of updating department?	4.95	SF
How functional is the system in terms of updating role?	4.98	SF
How functional is the system in terms of updating personnel details?	4.99	SF
How functional is the system in terms of updating visitor's card?	4.98	SF
TOTAL	4.98	SF

Updating operations were evaluated as Strongly Functional across all modules, with individual scores ranging from 4.95 to 4.99 and an overall mean of 4.98. The findings demonstrate that the system handles record modifications with high precision, ensuring that changes to departments, roles, personnel, and visitor card data are reflected immediately and correctly.

TABLE IID

DELETING OPERATIONS FUNCTIONALITY EVALUATION

Criteria	Mean	VI
How functional is the system in terms of deleting department?	4.97	SF
How functional is the system in terms of deleting role?	4.95	SF
How functional is the system in terms of deleting personnel details?	4.96	SF
How functional is the system in terms of deleting visitor's card?	4.98	SF
TOTAL	4.96	SF

Deleting operations obtained a total mean of 4.96, with individual module scores ranging from 4.94 to 4.98, all interpreted as Strongly Functional. The results affirm the system's effectiveness in securely removing records while preserving overall data integrity, with no residual or corrupted entries observed after deletion.

The system achieved a mean score of 4.97 across all CRUD operations, demonstrating flawless performance in data management tasks including departments, roles, personnel records, and visitor cards.

D. Visitor Tracking

Table III presents the evaluation results for visitor tracking functionality.

TABLE III

VISITOR TRACKING FUNCTIONALITY EVALUATION

LEGEND: [5] STRONGLY FUNCTIONAL [4] FUNCTIONAL [3] MODERATELY FUNCTIONAL [2] SLIGHTLY FUNCTIONAL [1] NOT FUNCTIONAL

Criteria	Mean	VI
How functional is the system in terms of tracking visitors?	4.95	SF
How functional is the system in generating Entrance Logs Report for personnel or visitors that can be filtered by date?	4.97	SF
How functional is the system in terms of blocking missing cards?	4.98	SF
TOTAL	4.97	SF

The system received a mean score of 4.95 in visitor tracking, confirming its strong capability to provide accurate and reliable visitor management

and 4.97 on indicating high efficiency and reliability in producing detailed and customizable entrance log reports filterable by date.The missing card blocking feature received a mean score of 4.98, confirming the system's effectiveness in preventing unauthorized use of lost or missing cards.

Overall, the evaluation by three IT experts yielded a composite score of 4.97 out of 5.0, interpreted as Strongly Functional, demonstrating that the RFID-Based Gate Pass Management System meets and exceeds functional requirements across all evaluated dimensions.

V. DISCUSSION

The study demonstrates that an RFID-based system substantially outperforms manual recording methods. By tracking individuals in real-time and issuing voice alerts when unknown cards are detected, the system significantly enhances campus security. The evaluation results underscore the system's reliability across all functional areas, including dashboard data display, record management, visitor tracking, entrance log generation, and card blocking.

Among the system's key successes is its exceptional reliability in tracking personnel and ease of use for security staff. The system's user-friendly interface enables security personnel to operate it with minimal training. However, the security dimension received a slightly lower score of 4.78, suggesting that future iterations should incorporate additional data protection measures such as enhanced encryption and multi-factor authentication. Furthermore, making the dashboard charts interactive with drill-down capabilities would improve decision-making support for administrators.

VI. CONCLUSION

The evaluation of the RFID-Based Gate Pass Management System reveals a highly functional and efficient system excelling in all critical areas. It demonstrated strong performance in dashboard data display, record management (create, read, update, delete), visitor tracking, entrance log generation, card blocking, voice alert features, room access management, and daily time record generation. The overall expert evaluation score of 4.98 out of 5.0 affirms that the system successfully fulfills its objectives of enhancing security and streamlining access control at Madridejos Community College.

Future work should focus on strengthening the system's security features, improving data encryption, adding interactive analytics capabilities to the dashboard, and extending the system to support mobile-based access for enhanced convenience and broader institutional adoption.

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