International Journal of Synergy in Engineering and Technology
IJSET
Journal homepage: https://tatiuc.edu.my/ijset/index.php/ijset/ e-ISSN: 2735-0622

Integrated RFID Solution for Students Entry and Exit Monitoring System

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KEYWORDS

Attendance monitoring system
RFID

ABSTRACT

Integrated RFID Solution for Student Entry and Exit Monitoring aims to enhance security and streamline monitoring processes at University College TATI. The initiative addresses growing security concerns and the limitations of manual gatekeeping methods by utilizing RFID technology to automate student movement tracking. This ensures accurate record-keeping and minimizes risks associated with human error. The system integrates hardware such as the Raspberry Pi 3 Model B microcontroller, RFID RC-522 reader, and Tower Pro MG90 servo motor, with software tools like PHP, XAMPP, and MySQL for database management. Adopting the ADDIE model comprising Analysis, Design, Development, Implementation, and Evaluation phases to ensure a systematic and reliable development process. By leveraging existing research and implementing practical solutions, the project highlights RFID technology's advantages in delivering a cost-effective, efficient, and secure tracking method. The design incorporates detailed process diagrams, user interface wireframes, and a flowchart demonstrating the workflow from RFID card scanning to gate operation. Deploying this system at UCTATI will bolster campus security, alleviate administrative burdens, and provide real-time data to support better decision-making and campus management.

Received 05 December 2024; Revised 09 February 2025; Accepted 30 March 2025; Published 01 April 2025

1.0 INTRODUCTION

In recent years, security concerns within educational institutions have escalated, prompting a need for efficient and reliable tracking systems for students' movements on campus. Traditional manual methods, such as sign-in sheets and physical gate checks, are increasingly inadequate in addressing modern security challenges, and they contribute to administrative inefficiencies. An Integrated RFID Solution for Student Entry and Exit Monitoring offers a promising technological solution to this problem, utilizing Radio Frequency Identification (RFID) technology to automate the process of tracking students' entry and exit in real time [1].

RFID technology, widely recognized for its accuracy, speed, and low-cost implementation, has been successfully employed in various sectors, including logistics and asset tracking [2]. In the context of academic institutions, RFID can significantly enhance campus security by ensuring that student movements are recorded automatically and accurately, reducing human error and improving operational efficiency [1].

This project proposes an integrated RFID-based system for monitoring students' entry and exit at University College TATI (UCTATI). The system is designed to reduce the administrative burden of manual attendance and increase security by providing real-time data on student movements. The system is composed of RFID tags, scanners, a microcontroller, and a database management system, allowing seamless communication between hardware and software components. The implementation of this system will not only streamline the monitoring process but also improve safety and provide a more efficient way to manage campus access.

By automating attendance logging and movement tracking, this RFID solution eliminates the need for physical gatekeepers and minimizes security risks associated with manual entry processes. Moreover, the system offers cost-effective, scalable, and time-efficient solutions for university campuses, paving the way for the development of smarter, more secure educational environments.

The lack of automated and reliable tracking systems leaves gaps in security protocols and impedes the ability of institutions to efficiently manage student access and attendance. Thus, there is a pressing need for an integrated system that can provide accurate, real-time data on student movements while reducing the administrative burden and enhancing security measures. [1]

This project aims to address these issues by introducing an Integrated RFID Solution for Student Entry and Exit Monitoring. Using RFID technology, the system will automate the entry and exit process, ensuring accurate tracking, minimizing human error, and improving the overall security and efficiency of campus management. By leveraging RFID, this solution will provide a cost-effective, scalable, and real-time system capable of supporting modern educational institutions security needs [2].

2.0 LITERATURE REVIEW

2.1 Previous work

This chapter explores existing research on RFID-based entry and exit tracking systems, with a particular focus on their application for student monitoring. It examines how RFID technology can enhance security frameworks, especially in managing access through gates, and reviews various studies to better understand the current landscape. The primary aim of this literature review is to inform the development of an RFID-based system for student entry and exit tracking, ensuring secure access by validating and authorizing students through automated gate control mechanisms. By analysing relevant studies, this review lays the groundwork for the successful implementation of such a system, addressing both security and efficiency concerns.

Smart healthcare offers fast and personalized medical services, bypassing lengthy registration processes [3]. It can cut costs, save staff time, and enhance the overall patient experience. The systematic healthcare approach can address resource disparities, promote medical reform, and encourage preventive measures, ultimately reducing societal medical expenses. However, challenges exist in securing the card system and storing patient data. Overcoming these challenges requires collaboration among patients, doctors, hospitals, and technology companies for future research and solutions.

The automated Hospital administration system includes RFID tags, readers, a local server, and a user-friendly interface. Passive RFID tags are used for patient identification and medicine authentication, while active RFID tags are more common for tracking. Active Readers are placed in each hospital department and region. The RFID reader collects data from the tag, sends it to the application, which filters, analyses, and records the data in the back-end database. The system is set to use both wired and wireless networks for data transmission between readers. Patients receive an RFID card for medical data monitoring and appointment scheduling.

The Arduino Uno is a microcontroller board based on the ATmega328P processor. It features 14 digital input/output pins (six of which are PWM outputs), six analogue inputs, a reset button, a USB connection, a power connector, an ICSP header, and six analogue outputs. This open-source and programmable board is low-cost, versatile, and easy to use in various electrical applications. It can interface with other Arduino boards, Arduino shields, and Raspberry Pi boards to control relays, LEDs, servos, and motors as outputs.

The microcontroller-based data acquisition system enables real-time monitoring of the RFID security system deployed in various locations [4]. The goal is to ensure absolute security in restricted areas, such

as industries, schools, offices, and more, allowing access only to authorized individuals. This solution addresses the issue of insecurity in both the Northern and Southern parts of Nigeria, aiming to reduce insecurities in the local community and the country.

A security system using RFID technology and smart card recognition operates in three phases: registration, recognition, and accessing. During registration, two smart cards provide information, including a unique ID, to the RFID tag. In the recognition phase, a 16F877A microcontroller reads the card's details and compares them with programmed characteristics on the card reader. If there's a match, access is granted; otherwise, an unauthorized card message is displayed. In the final stage, the 16F877A microcontroller commands the door mechanism. Notably, this system uses the 16F877A microcontroller instead of the Arduino or ARM11 processors.

The system successfully identifies students allowed to have meals at the campus dining room using RFID cards [5]. When a student taps their card on the reader, the application reads the unique number, compares it with the database, and displays the student's name, photo, and status. The software also tracks students who've used their card, preventing them from taking more than one plate during a meal. The database records are integrated into the university's online system, accessible to authorized parties on campus.

The proposed RFID-based authentication system is developed in collaboration with various university departments. Four actors have distinct responsibilities to ensure the system's integration across different departments at UNAI. The registrar office inputs student data into the database, takes photos, prints student cards, registers RFID serial numbers, and distributes cards to students. The student finance officer determines whether a student is registered for meals in the dining room. The dining room department supplies the necessary computer, RFID reader, and personnel to operate the system. The Information Technology (IT) department is tasked with providing the required applications for all departments and connecting computers and RFID readers to the system.

A secure door control system is essential for homes, offices, colleges, and campuses, ensuring human safety [6]. This system can even be accessed remotely by authorized users via a smartphone app using the internet through Wi-Fi or 3G/4G networks. Beneficiaries of this project include students, faculty, staff, and the public using the buildings. If someone knows the RFID card and password, the password can be changed. Further developments may include controlling automatic sliding door systems. Future work will explore creating a voice command application and implementing image recognition using face or hand gestures.

Table 1: Previous study

Author/Year	Title	Method/Technique	Result
Bakir et.al (2023)	RFID-Based Smart Health Card for Managing Patients Medical Records	RFID-based	Efficient and time-saving, improved medical record management and reduce healthcare operational expenses
Ibrahim et.al (2023)	Development Of Door Security System Using Radio Frequency Identification (RFID) Module with Smart Card Recognition Structure	RFID-based	Tool for real-time monitoring of the RFID security system at any location deployed.
Pakpahan et.al (2019)	Design and Implementation of RFID Card Based Authentication Software in Universitas Advent Indonesia's Dining Room	RFID-based	Quick and contactless authentication of a person owning an RFID tag and do not require a line of sight between the tag and the reader
Myint (2020)	Secure Door Control System using RFID Card	RFID-based	The attendance status of each student will be

Kingdavid (2021)	Automated Gate System Using RFID Technology	RFID-based	Provides an automatic identification and authentication Improved Security, limit unwanted visitors

3.0 METHODOLOGY

ADDIE is an acronym for the five stages of a development process: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model relies on each stage being done in the given order but with a focus on reflection and iteration. The model gives a streamlined, focused approach that provides feedback for continuous improvement. The analysis phase is a crucial stage that involves a comprehensive examination and understanding of the project's requirements, objectives, and constraints. To record and monitor UC TATI student's entry and exit of campus area is the objective of this system. This system will work for 24 hours at the main gate of UC TATI. Conduct a thorough analysis of the external threat and ensure the well-being of its UC TATI students. Research and analyze previous work by similar projects or application. Gather information on the existing infrastructure, available resources, and budget constraints to inform the design and development process. Identify the specific needs and requirements of the UCTATI students regarding a Student In/Out Tracking System Based on RFID.

In the design phase, develop a comprehensive design plan for this study using the information gathered during the analysis phase as Figure 2. The user needs to tap the RFID card at RFID reader to enter or exit the gate. Determine the necessary components, such as Raspberry Pi, RFID Reader, RFID card, Tower Pro micro, and Power Supply. Planning the design flow of the system, that is how the system works or connects to each other to gate the input and the output. Figure 1 shows the general diagram of the system.

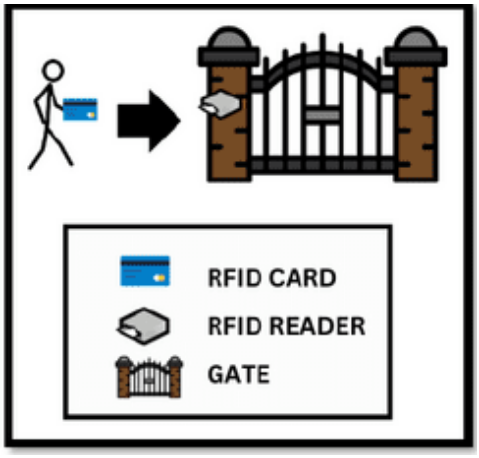

Figure 1: Project diagram

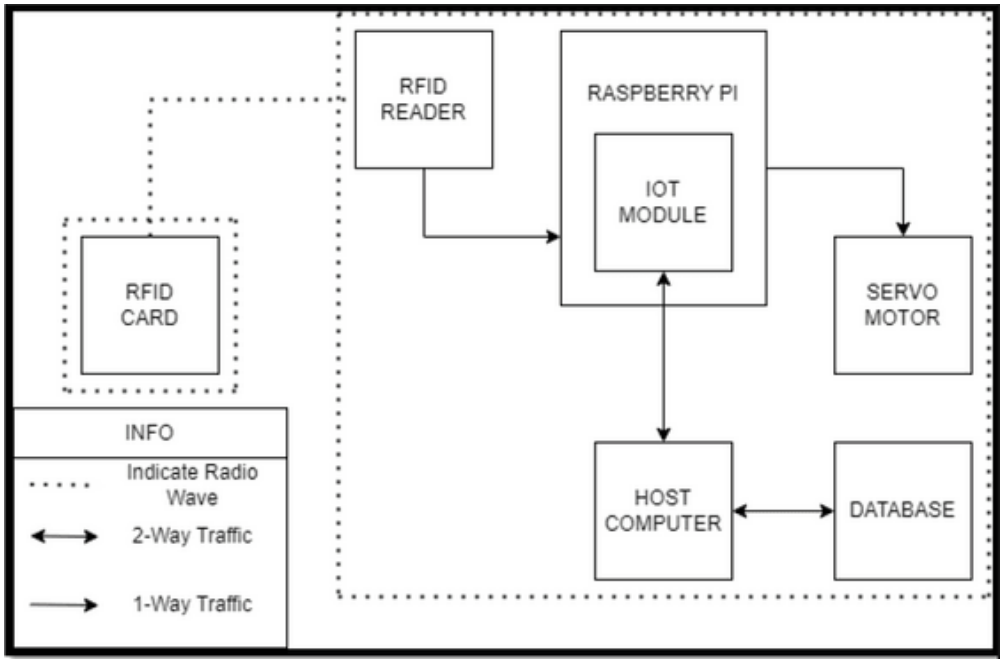

Figure 2: Block diagram of the system

To ensure a reliable infrastructure to support the system with UC TATI staff in the development phase. Involves deploying servers, configuring data storage solutions, and establishing network connectivity to support the smooth operation of the system. Ensures the required capacity and reliability standards to handle the system in UC TATI. The confirmation of the completed infrastructure setup provides the green light for the subsequent implementation of the system.

Implement phase focus on implementing and setting up the design plan by assembling the required hardware components and configuring the software components. Configure the RFID reader to record in/out students in UC TATI. Monitor entry and exit of students in UC TATI using data collected from this system. Test the system extensively to verify its effectiveness in student this research with real-time scenario. Verify the system's accuracy and responsiveness based on simulation. This phase is critical for fine-tuning the system's performance and identifying any potential technical issues that need resolution before the final deployment.

In the evaluation phase, the project team assesses the performance and effectiveness of the implementation in this study. Data on the system's response during actual time is collected to validate its reliability in real-world conditions. Identifies for improvement, such as enhancing sensor sensitivity or optimizing the information delivery mechanism. The evaluation report includes findings and recommendations to guide future enhancements and ensure the system's continuous effectiveness in the record and monitoring of UC TATI's students' entry and exit attendance.

3.1 Project Diagram

The flowchart of any program is a clear depiction of the system. Overall, the gate collecting system is shown in this picture. RFID readers will scan the ID number from the RFID card and based on that number, consult the host computer database for confirmation If the user is registered, the gate will not open, and the buzzer will sound as figures shown below.

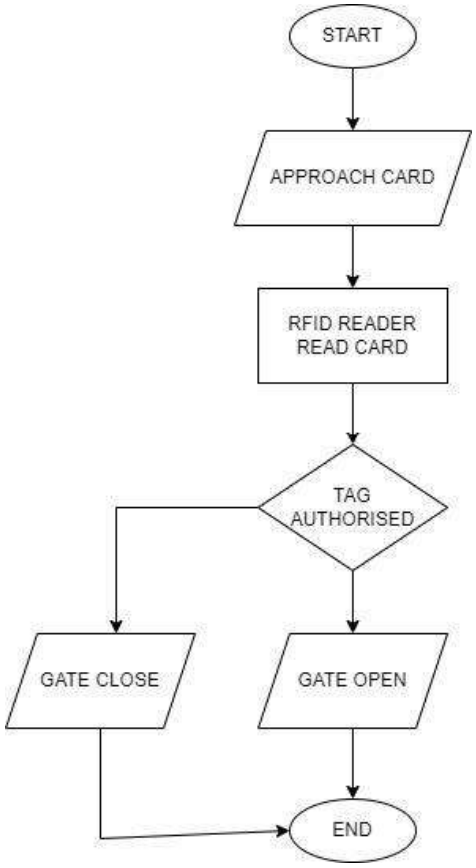

Figure 3: Flowchart

Figure 4 shows the entity relationship diagram (ERD) of any program is a clear depiction of the system. Overall, the gate collecting system is shown in this picture. RFID reader will scan the ID number from the RFID card and based on that number, consult the host computer database for confirmation If the user is registered, the gate will not open, and the buzzer will sound.

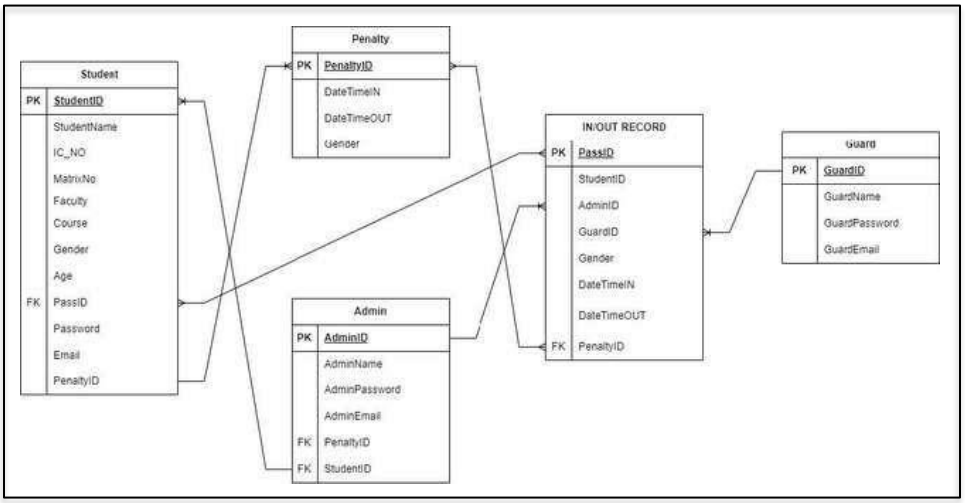

Figure 4: ERD of flow database

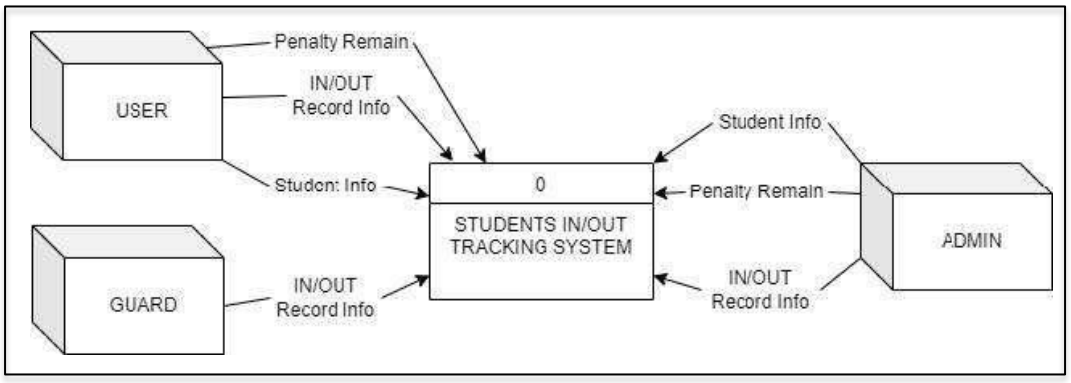

Figure 5: Context diagram

3.2 Project Implementation

Integrated RFID Solution for Student Entry and Exit Monitoring System used MySQL to store its database. MySQL is a relational database, organizes data in tables composed of rows and columns and allows users to define, manipulate, control, and query data using Structured Query Language (SQL). Despite its powerful features, MySQL is easy to set up and use. To install MySQL, the XAMPP server must be installed on the laptop first. There are two ways to create a database in MySQL: by executing SQL commands and simple SQL queries, or by using forward engineering in MySQL Workbench. All the code for the system is written using Visual Studio Code, a web development tool that allows users to create and edit web pages. The system's functions and interfaces will be developed using PHP, JavaScript, CSS, and HTML. HTML (Hyper Text Markup Language) is used to create detailed instructions for the style, type, format, structure, and makeup of a web page. It structures the page into elements such as paragraphs, sections, headings, and navigation bars. CSS (Cascading Style Sheets) is a design language that makes the web page look nice and presentable, improving its appearance. JavaScript and PHP are the programming languages used in the system. They handle actions, conditions, calculations, network requests, concurrent tasks, and many other types of instructions, enabling the webpage to "think and act." While HTML structures the content and CSS designs it, JavaScript and PHP bring interactivity and functionality to the web page.

The Raspberry Pi 3 Model B serves as the central hub for processing data and controlling hardware in this system. The RFID reader scans RFID tags to identify users, while the MG90S servo motor controls the physical locking mechanism. The Raspberry Pi processes RFID data, validates users, logs activity, and controls the servo motor to manage access, creating an efficient and automated tracking system. Figure 6 shows the setup of the project.

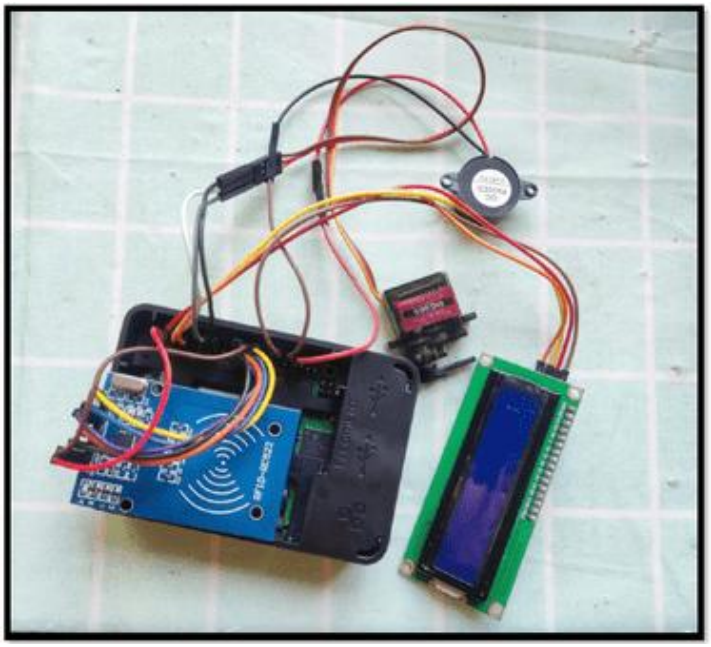

Figure 6: connection between Raspberry Pi, RFID, and MG90S Servo Motor

Figure 7 shows the login interface for 3 types of users, the admin UC TATI staff, security guard or students. Users need to enter their registered email address and password to login into the system based on RFID. Admin and security guard already have their own registered email address and password. If the students do not have a registered account yet, the user can click on register now in blue word colour. Figure 8 shows the record that is collected from the system based on RFID for every user. There is a back button, that can back to main interface and logout button, that can log out the account. The total penalty that collected of the system is based on each student as figure 9. The date can be filtered in the section. There is a back button, that can back to main interface and logout button, that can log out the account.

Figure 7: Login interface

Figure 8: Entry and exit records

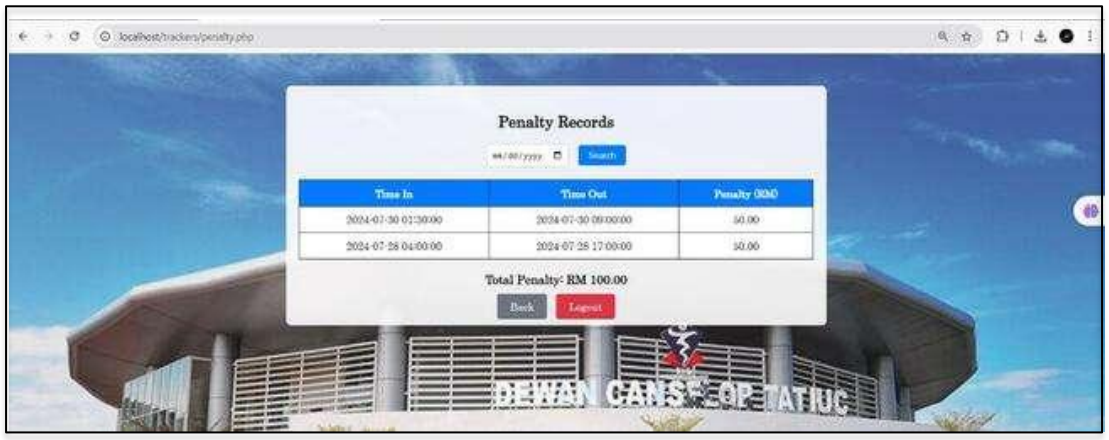

Figure 9: Total of penalty

The list of students that submit personal information is shown as figure 10. Admin needs to check the information and act so that the personal information needs to be approved or rejected. Admin needs to insert RFID tag for every user that he approved. Besides, if admin wants to reject the user registration, local hosts ask admin to certainty to reject the registration. There is a back button, that can back to main interface and logout button, that can log out the account.

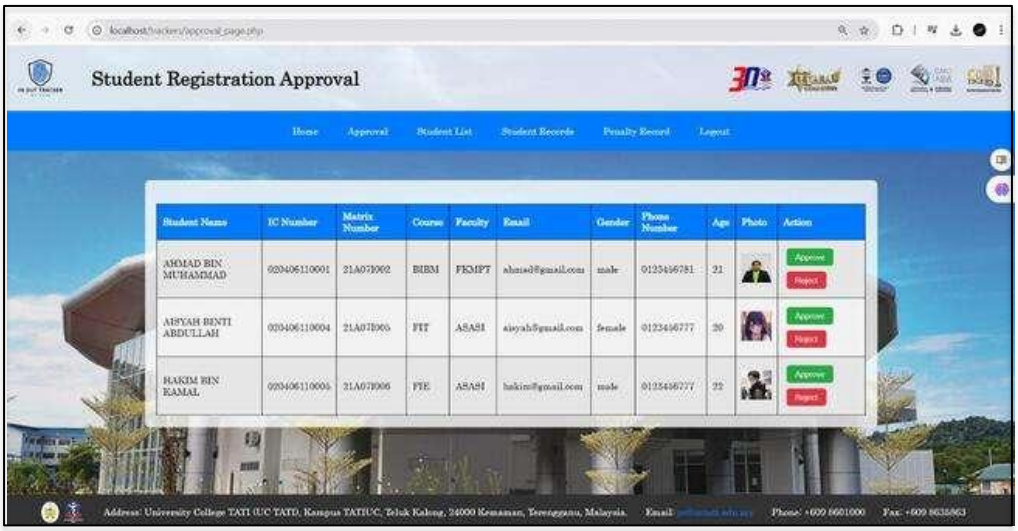

Figure 10: Approval page

4.0 RESULTS AND DISCUSSION

Based on the objectives and scope defined in the first chapter of this project, the web-based design system has been successfully developed for the final year project this semester. The primary goal of this study is to monitor students' entry and exit movements using RFID technology. The second objective is to record students' movements at UC TATI, ensuring all data is accurately stored in a database. The third objective is to enable real-time monitoring of students' entry and exit activities.

Upon implementation, this system will replace and enhance the existing security measures at the UC TATI gate. Security guards will be reassigned to optimize campus safety by conducting patrols, particularly during nighttime hours. This system minimizes the time needed for validation sessions with guards, as users can simply tap their RFID cards on a reader to have their data automatically recorded in the database. Users will be able to review entry and exit records and any penalties for rule violations.

Security guards will monitor users' movements in and out of UC TATI, while administrators will manage and oversee all user activities and personal information. The system ensures that all individuals comply with required inspections and procedures, thereby enhancing the overall security and efficiency of UC TATI's operations.

5.0 CONCLUSIONS

The RFID-based Student In/Out Tracking System at UC TATI effectively addresses the need for enhanced security and efficient monitoring of student movements. The system has successfully demonstrated its capability to provide real-time tracking, accurate data logging, and user-friendly access control, significantly improving campus safety and operational efficiency.

The systematic approach using the ADDIE model encompassing Analysis, Design, Development, Implementation, and Evaluation ensured that the project was methodically planned and executed. The integration of hardware components such as Raspberry Pi and RFID readers, along with software tools like PHP, XAMPP, and MySQL, contributed to a robust and reliable system.

Overall, this project highlights the importance of adopting modern technology to address security challenges in educational institutions. The recommendations for future improvements provide a pathway for the continuous enhancement of the system, ensuring it remains effective and scalable to meet future demands.

Author Contribution

S. Norwahidayah: Conceptualization, supervision, methodology, writing and editing. A. Luqman Bin Abdul Latif: Investigation, conceptualization, development, methodology, writing. Mohd Shah Shafie: supervision, methodology, writing, editing.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This research fully acknowledged University College TATI (UC TATI) for funding for final year projects.

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