DEVELOPMENT OF RFID AND MOBILE PHONE-BASED SMART ELECTRICITY CONTROL SYSTEM FOR COMPUTER LABORATORIES AT CAINTA CATHOLIC COLLEGE

A Thesis

Presented to the Faculty of Cainta Catholic College

Cainta, Rizal

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science in Computer Science

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This study, Development of an RFID and Mobile Phone-Based Smart Electricity Control System for Computer Labs, is dedicated to those who have been our pillars of strength and inspiration.

To our parents, whose unwavering support and sacrifices have fueled our determination. Their love and guidance have been the foundation of our perseverance.

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ABSTRACT

Title : Development of RFID and Mobile Phone-Based Smart Electricity Control System for Computer Laboratories at Cainta Catholic College

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Course : Bachelor of Science in Computer Science

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This study presents the prototype development of an RFID and mobile phone-based smart electricity control system for computer labs at Cainta Catholic College. The increasing demand for energy efficiency in educational institutions necessitates innovative solutions to minimize unnecessary power consumption while ensuring operational convenience. Traditional electricity management systems rely on manual switching, which is often prone to inefficiency and human error.

The proposed system integrates Radio Frequency Identification (RFID) technology and mobile-based control to automate and optimize electricity usage in computer laboratories. Authorized users can activate and deactivate power supply

through RFID authentication, ensuring that only registered personnel and students can access the system. Additionally, a mobile application provides remote monitoring and control, allowing administrators to manage electricity usage efficiently. The system is designed to enhance security, reduce energy wastage, and promote a sustainable approach to power management in educational settings.

The prototype was tested in a simulated environment to evaluate its effectiveness in controlling power consumption. Results showed significant improvements in energy efficiency, access control, and operational convenience compared to conventional systems. The study concludes that implementing RFID and mobile technology for smart electricity control can contribute to sustainable energy management in academic institutions.

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Chapter 1

THE RESEARCH PROBLEM AND ITS BACKGROUND

This chapter presents the introduction, background of the study, statement of the problem, significance of the study, and scope and delimitations.

Introduction

Cainta Catholic College (CCC), established in 1931, is a respected school in Cainta, Rizal, known for combining academic excellence with Catholic values to support students' intellectual, spiritual, and social growth.

Our concept suggests installing a Smart Electricity Control System in computer laboratories to encourage sustainability and conscientious energy usage. To provide simple and effective power management, the Development of RFID And Mobile Phone-Based Smart Electricity Control System for Computer Laboratories will make use of RFID technology and a smartphone app. Authorized worker, including instructors, may manage the power to computers, lights, and air conditioners by scanning their RFID cards or by using the app, making sure that electricity is only used when needed.

By reducing energy waste and operating expenses, this approach hopes to improve the sustainability and environmental friendliness of the surrounding area. By encouraging prudent resource use and building a more thoughtful, energy-efficient structure, it supports the larger objectives of environmental stewardship.

Background of the Study

The researchers propose this study at the Cainta Catholic College computer laboratories to help save energy, manage security, and to facilitate the opening and closing of the breaker. In the computer laboratories, there are many electronic devices and appliances like computers, air conditioners, and lights. Sometimes, students or teachers forget to turn off the circuit breaker, which stops the electricity from flowing to these devices. In the computer laboratories, there have been several instances where unauthorized persons or students used the computers and air conditioners without the permission of administrators or advisers.

The use of RFID technology can significantly enhance both energy management and security. By implementing an RFID-based system similar to those used in modern hotels and offices can be equipped with smart electrical control systems. These systems would allow authorized faculty, staff, or students to activate lighting, air conditioning, and other electrical devices upon entering a room. This will help the computer laboratories reduce energy consumption and contribute to the school's sustainability goals.

In addition to energy savings, this RFID-based system would improve security by ensuring that only authorized individuals can access computer laboratories. It offers a modern, user-friendly solution to eliminate the need for manual operation of circuit breakers or switches, reducing both energy wastage and the complexity of managing electrical systems.

By developing and deploying this RFID-based electrical management system at the computer laboratories, the institution can modernize its infrastructure, align with the latest technological trends, enhance operational efficiency, and promote sustainability within the campus environment.

Statement of the Problem

This study aimed to develop of RFID and Mobile Phone-Based Smart Electricity Control System for Computer Laboratories at Cainta Catholic College. The study addressed the following questions:

1. What is the profile of the respondents in terms of department level?
2. What is the performance level of the RFID and Mobile Phone-Based Smart Electricity Control System in terms of:
   - 2.1 Reliability;
   - 2.2 User interface;
   - 2.3 Accuracy;
   - 2.4 Functionality;
   - 2.5 User-Friendliness?
3. What is the level of acceptability of the RFID and Mobile Phone-Based Smart Electricity Control System in terms of:
   - 3.1 Reliability;
   - 3.2 User interface;

3.3 Accuracy;

3.4 Functionality;

3.5 User-Friendliness?

4. Is there any significant difference between level of performance and acceptability of the RFID and Mobile Phone-Based Smart Electricity Control System?

Hypothesis

H_0 = Null Hypothesis

There is no significant relationship between the level of performance and the level of acceptability of the RFID and Mobile Phone-Based Smart Electricity Control System.

Significance of the Study

The researchers are confident that the following will benefit from this Development of RFID and Mobile Phone-Based Smart Electricity Control System for Computer Laboratories at Cainta Catholic College.

Faculty. The automated system ensures that electrical devices are properly managed and controlled, minimizing the risk of electrical wastage or malfunction.

Students. While students do not control the system directly, they benefit from consistent access to lab resources without needing a teacher present to operate equipment. This flexibility enhances their learning experience, enabling efficient use of laboratory time and resources.

Cainta Catholic College. The researchers believe that implementing this smart electricity control system will enhance the school's energy management and security, contributing to a more efficient and safer environment for students and staff.

School Administrators. The school administrators will benefit from streamlined access to the smart electricity control system through both RFID technology and mobile phone application, enabling efficient monitoring and management of- electrical usage in the computer laboratories from anywhere.

Future Researchers. The study will help and provide guidelines to those who want to make a study about this kind of system. They can obtain necessary information and reporting in a presentable manner.

Scope and Delimitations

SCOPE

The study aimed to develop an RFID and Mobile Phone-Based Smart Electricity Control System for the computer laboratories at Cainta Catholic College.

- The authorized RFID cards will be used to control the activation of the room’s electricity, including lights and air conditioning, allowing for automated power management.
- There are 9 computer laboratories where this system is planned to be implemented.
- The system has a restricting access to authorized personnel only.
- The system has time in and time out application.

- The system has email notification when time in and time out.
- The mobile app has login and logout features.
- The mobile app notifies users with a pop-up if the electricity is still on.

DELIMITATIONS

The system has boundaries and specific areas where it cannot operate or perform beyond its intended scope. These limitations help define the focus and constraints of the study.

- The system cannot measure the energy consumption of individual equipment in the computer laboratories.
- The system only sends in emails not on SMS.

Chapter 2

REVIEW OF RELATED LITERATURE AND STUDIES

This chapter presents the gathered literature and studies that were obtained from local and foreign sources.

Studies and Literatures

Palencia et al. (2015) designed a system that reduces energy consumption and increases security within educational institutions through time-controlled access systems. In their system, an Arduino Mega ADK 2560 microcontroller with an integrated RFID module controlled the access and regulated the usage of energy, since the devices were on only when the room was occupied. The system would also display real-time status about the access and also record all the activities by the user.

Matillano and Canda (2022) studied automation of tasks and energy conservation by using RFID technology in a faculty room in the university setup in Davao City, Philippines. Their research work established a system that managed attendance monitoring and door access control, lighting, and air conditioning. Their system captured attendance and achieved a significant amount of energy-saving reduction with an achieved payback period of five months and 20.45% return on investment.

Flores et.al (2023) stated that a high percentage of the budget of a higher educational institution in the Philippines goes to electricity, partly due to the lavish spending by students for non-educational purposes. They developed a device

using RFID technology as a power-saving tool that allows only authorized personnel, such as instructors, to access and turn on the power in classrooms. The study found that implementing this RFID-based power switch reduced power wastage by 7.81%. Feedback from 207 participants indicated agreement with the project, highlighting its effectiveness in conserving energy in educational settings.

Fontanilla et. al. (2023) RFID technology and real-time clocks were explored in connection with the control of power distribution in schools to avoid wasting energy. Their experimentation in this case relied on Arduino, ESP8266 NODEMCU, and ACS-712 Current Sensor to monitor and adjust the air-conditioning consumption based on schedule. Thus, the system was proven efficient in reducing power use significantly.

Lopez et. al (2017) conducted an energy audit on an educational building in the Philippines with a purpose of improving energy efficiency without losing functionality. Their research was able to find that the largest consumer of energy was air-conditioning, then equipment, and then lighting. In the study, the importance of an energy audit was emphasized. Among the recommendations is to use energy-efficient air-conditioning systems, lighting, and minimum energy performance standards (MEPS). Moreover, they emphasized effective scheduling for the optimization of energy usage.

Okafor et al. (2017) conducted a study on the use of RFID-based systems in energy management, focusing on the ways in which they could monitor and control the intake of electricity by their association of RFID with different appliances. The above study demonstrated how an implementation of RFID

technology can significantly minimize energy intake that is not necessary to consume unnecessarily in places as equipment tends to be left on during non-use.

Soumil Nitin Shah (2019) developed an IoT-based Smart Attendance System (SAS) that used RFID to automate student attendance tracking. Their system dealt with the inefficiencies of traditional methods of attendance, such as roll calls or signing sheets, through RFID technology integrated with the IoT to streamline the process and increase accuracy and efficiency

Das et al. (2017) had created a low-cost, as well as energy-efficient home security system that would grant control over appliances at remote through usage of technologies such as RFID, GSM, as well as IR sensors. Their system gave security to the home by alerting the homeowner of unauthorized access while at the same time allowing remote management of appliances to save energy.

Hasan et. al (2020) conducted a study on IoT-based smart electricity monitoring systems, emphasizing their role in enhancing energy efficiency across various environments, including educational institutions. The research demonstrated that monitoring and controlling electrical devices based on real-time usage data could reduce energy consumption significantly.

Brown et. al (2022) further explored the application of automated control systems in school environments. They found that incorporating such systems helped institutions reduce operational costs by automatically managing lights, air conditioners, and other electronic devices based on occupancy.

Literatures

Amendola et al. (2014) study on RFID technology for IoT-based personal healthcare settings offers critical insights into the use of RFID for automated device control and real-time resource management. Although the application focused on healthcare, it set a foundational framework showing RFID's adaptability to other environments requiring precision control, like educational institutions.

Booc et al. (2020) discussed home automation by using IoT-driven applications. Their system controlled the home appliances from any location with the help of mobile applications, and therefore, demonstrated how the daily chores would be made simpler with the help of the IoT and Node MCU.

Mir et al. (2021) gave insight about large-scale energy management and its study on the "Smart Grid," an innovation seeking to optimize the use of energy and cut it down in places of more demand. Their research goes about how automation will work on the increasing energy demands in buildings and other kinds of constructions.

Patil et. al (2021) stated that their study proposes a hybrid automation system for controlling energy consumption in a laboratory setting using Internet of Things (IoT) technology. The system allows users to control electrical appliances manually through an Android application or automatically using Passive Infrared (PIR) sensors. The system was deployed in a laboratory, where it controlled appliances like fans and tube lights, and resulted in a 24% reduction in the

electrical bill. The system aims to reduce energy wastage by offering both manual and automatic control of appliances, ensuring more efficient energy use.

Simbulan et.al (2023) stated that their system features power consumption monitoring, control, and protection of electrical appliances through RFID technology. The system allows user identification via an RFID card, which helps in tracking and distributing electricity consumption among users in an apartment or dormitory. The system also includes automatic shutdown for standby appliances, overvoltage, undervoltage, and overloading protection. The system used PZEM-004T for measuring voltage and current with high accuracy (95.15% to 99.94% for current and 99.30% to 99.90% for voltage). This power management system allows for more efficient use of energy, promotes fair distribution of electricity bills, and provides a comprehensive solution for monitoring and protecting appliances.

Galvez et. al (2023) stated that their study developed an RFID-based power control system with classroom scheduling to reduce energy consumption. The system is a centralized setup that enables automatic power control for classrooms based on occupancy, where faculty can activate power by tapping their RFID/ID. The system is designed to turn off automatically after each scheduled class, helping to prevent unnecessary electricity usage when classrooms are unoccupied. This approach addresses the issue of high electricity bills in schools by reducing energy waste and improving resource efficiency through automation and scheduling.

Ibarra et, al (2023) stated that their system monitors energy consumption using RFID technology integrated with a Wi-Fi-based convenience outlet. The

prototype utilizes a microcontroller, power analyzer, RFID, and relays to track the actual usage of electrical appliances by different users. The energy consumption data is logged and displayed in a Graphical User Interface (GUI), providing real-time monitoring and projected costs for each user. The use of RFID identifies the user accessing the outlet, enabling accurate tracking of energy usage, which helps in fair electricity bill distribution. The system demonstrated reliable performance in monitoring electricity usage based on statistical analysis.

Galera et. al (2017) stated that a real-time energy monitoring system is essential for helping consumers identify opportunities to adjust their energy usage and conserve electricity effectively. They developed a system using a microcontroller (DFRduino Uno) to collect energy data, which is then stored in a cloud-based database and displayed on a mobile web application. The system provides real-time feedback, helping users understand their energy consumption patterns. Their testing showed a 94% accuracy in measuring energy usage, and user feedback indicated its usefulness for monitoring and improving energy efficiency.

Velasco (2023) stated that a system using RFID-based attendance authentication was developed to secure computer laboratories while providing smart, automated attendance monitoring. The study was conducted at Isabela State University, focusing on monitoring entry logs and calculating attendance metrics such as tardiness and absences for both students and teachers. The web-based system records attendance and entry logs through an RFID reader, with data stored in a local MySQL database. The system also integrates hardware

components like an Arduino Uno and solenoid locks, allowing it to control access and enhance the security of the laboratory rooms.

Nepa et. al (2022) stated that their study developed an Android-based mobile application to control and monitor the power usage of air conditioning (AC) units in a laboratory setting. The system used NodeMCU ESP8266 for network connectivity and Arduino Uno to read data from voltage and current sensors. The mobile application allowed users to switch the AC units ON/OFF and provided accurate power consumption monitoring, achieving 91.09% accuracy in power calculation. The system aimed to replace conventional remote controllers with a mobile app, enhancing the management of energy consumption in the laboratory.

Synthesis and Relevance of the Study

Okafor et al. (2017) and Hasan et al. (2020) both focus on the use of RFID and IoT technologies to improve energy management. Okafor et al. (2017) explore how RFID can be integrated with appliances to minimize unnecessary energy consumption, while Hasan et al. (2020) expand this concept by focusing on real-time monitoring and control of electrical devices to reduce energy use across various environments, including educational institutions. Both studies demonstrate the potential of these technologies to reduce energy consumption, but Hasan et al. (2020) emphasize real-time data, while Okafor et al. (2017) focus on the prevention of energy wastage by managing the appliances' power intake.

Soumil Nitin Shah (2019) developed an IoT-based Smart Attendance System (SAS) using RFID for automating student attendance, improving accuracy

and efficiency. Although not directly related to energy management, this study shares the same principle of automating systems with RFID and IoT. Shah's study emphasizes operational efficiency, similar to the efficiency improvements seen in Okafor et al. (2017) and Hasan et al. (2020) studies, albeit in a different domain (attendance vs. energy management).

Das et al. (2017) also combine RFID with other technologies like GSM and IR sensors to create a low-cost, energy-efficient home security system. This system controls appliances remotely and contributes to energy savings. The integration of multiple technologies for both security and energy efficiency in Das et al. (2017) contrasts with the more focused applications in the studies by Okafor et al. (2017) and Hasan et al. (2020), which concentrate solely on energy management.

Brown et al. (2022) further explored the use of automated control systems in schools, specifically focusing on lights, air conditioners, and other electronics. This aligns closely with the findings of Hasan et al. (2020), as both studies demonstrate how automation based on occupancy can reduce energy costs in educational environments. However, Brown et al. (2022) focus more on the operational cost reduction in schools, while Hasan et al. (2020) concentrate on real-time monitoring and management.

All studies explore the integration of RFID and IoT technologies to improve system efficiency. Energy management and efficiency are common themes in Okafor et al. (2017), Hasan et al. (2020), and Brown et al. (2022), with a particular focus on reducing unnecessary energy consumption or operational costs.

Automation and real-time control of devices (whether for energy management or other purposes like attendance) are core elements in all the studies.

Okafor et al. (2017) and Hasan et al. (2020) focus on energy management, while Soumil Nitin Shah (2019) and Das et al. (2017) explore efficiency improvements in different domains (attendance tracking and home security, respectively). Das et al. (2017) combine RFID with other technologies like GSM and IR sensors, unlike Okafor et al. (2017) and Hasan et al. (2020), which primarily rely on RFID and IoT for energy management. Brown et al. (2022) focus on operational cost reduction in schools through automation, while Hasan et al. (2020) are more focused on enhancing energy efficiency via real-time monitoring and data-driven control of devices.

Palencia et al. (2015), Matillano and Canda (2022), Flores et al. (2023), Fontanilla et al. (2023), and Lopez et al. (2017) all explore energy management within educational institutions, particularly through the integration of RFID technology and automated systems. Palencia et al. (2015) and Matillano and Canda (2022) emphasize energy conservation by controlling access to spaces and regulating the use of energy-consuming devices like air conditioning, lighting, and other equipment. Both studies rely on RFID to ensure that devices only operate when rooms are occupied, preventing unnecessary energy consumption.

Flores et al. (2023) and Fontanilla et al. (2023) also utilize RFID technology for power regulation. Flores et al. (2023) focus on a smart classroom system that reduces electricity costs by ensuring only authorized users can activate power usage, targeting high-energy consumption in classrooms. Fontanilla et al. (2023),

on the other hand, integrate RFID with real-time clocks and other sensors to monitor and adjust energy consumption, particularly focusing on air conditioning systems based on schedules. Both studies seek to reduce power wastage, but Fontanilla et al. (2023) incorporate more sensor technology and real-time adjustments, while Flores et al. (2023) focus on controlling power access through RFID.

Lopez et al. (2017) provide a broader perspective on energy efficiency in educational buildings, focusing on an energy audit to identify the largest energy consumers and suggest energy-efficient solutions. Their recommendations for improving energy efficiency align with the approaches in the other studies, such as promoting energy-efficient air conditioning and lighting systems. However, Lopez et al. (2017) do not directly use RFID technology or automated systems but focus more on optimizing energy usage through effective scheduling and energy-efficient technologies. All studies aim to reduce energy consumption and improve energy efficiency in educational institutions. RFID technology is commonly used across the studies for controlling access and regulating energy use. Several studies focus on reducing energy wastage, especially from devices like air conditioning and lighting.

Palencia et al. (2015), Matillano and Canda (2022), and Flores et al. (2023) focus on integrating RFID systems with energy management, while Lopez et al. (2017) conduct an energy audit without incorporating RFID technology. Fontanilla et al. (2023) incorporate additional technologies like real-time clocks and current sensors to monitor and adjust energy use, particularly for air conditioning, while

the other studies rely primarily on RFID for access control and energy regulation. Matillano and Canda (2022) and Palencia et al. (2015) emphasize the use of RFID for access control to energy-consuming rooms, whereas Flores et al. (2023) and Fontanilla et al. (2023) focus more on controlling energy usage directly through RFID-based systems and sensors.

Amendola et al. (2014) provided insights into the use of RFID technology for IoT-based personal healthcare settings, focusing on automated device control and real-time resource management. While their study was healthcare-specific, it demonstrated the adaptability of RFID technology to other environments that require precise control, such as educational institutions. This adaptability is also seen in Simbulan et al. (2023), who applied RFID technology for power consumption monitoring and control, but in a more direct context related to electrical appliances. Both studies highlight the use of RFID for efficient resource management, though Amendola et al. (2014) focused on healthcare and Simbulan et al. (2023) on energy management in shared living spaces like apartments or dormitories.

Booc et al. (2020) explored IoT-driven applications for home automation, particularly focusing on mobile app control of home appliances. Similar to Amendola et al. (2014) and Simbulan et al. (2023), Booc et al. demonstrated the potential of IoT for simplifying resource management, although their focus was on general home appliances, rather than specifically on energy management or healthcare. Their use of mobile applications for controlling appliances aligns with the mobile-based control aspect seen in Patil et al. (2021), who also used Android

applications to manually control appliances and reduce energy wastage in a laboratory setting. Both studies demonstrate the power of mobile applications for remote appliance management, although Patil et al. (2021) integrated sensors for automatic control, which adds an additional layer of automation for energy efficiency.

Mir et al. (2021) explored large-scale energy management through the "Smart Grid," a concept designed to optimize energy usage across large systems, similar to the focus of Patil et al. (2021) on reducing energy consumption in laboratory environments. However, Mir et al. (2021) looked at optimizing energy across entire buildings or even cities, making their study more applicable to large-scale energy management compared to the more localized, small-scale implementations discussed by Patil et al. (2021) and Simbulan et al. (2023).

All studies utilize IoT or RFID technology to manage or control resources, whether for energy consumption, appliances, or healthcare devices. They emphasize automation and control through mobile applications or RFID systems to improve efficiency, reduce energy consumption, and simplify resource management.

Amendola et al. (2014) focused on healthcare and Booc et al. (2020) on home automation, both Simbulan et al. (2023) and Patil et al. (2021) focused on energy management in more structured settings like apartments and laboratories. Additionally, Mir et al. (2021) explored large-scale energy management through the "Smart Grid," which is distinct from the small-scale, localized focus of the other studies. The integration of Passive Infrared (PIR) sensors in Patil et al. (2021) for

automatic control of appliances further distinguishes their approach from the other studies, which mainly focus on either manual or RFID-based control.

The studies conducted by Ibarra et al. (2023), Galera et al. (2017), Velasco (2023), Nepa et al. (2022), and Galvez et al. (2023) share a common focus on monitoring and managing energy consumption in various contexts, particularly in educational and laboratory environments. All these studies utilize RFID technology, microcontrollers, or mobile applications to enhance the efficiency of power usage and improve control mechanisms.

Ibarra et al. (2023) developed a system combining RFID and Wi-Fi-based convenience outlets, which tracks energy consumption by users and provides real-time monitoring through a Graphical User Interface (GUI). This ensures accurate tracking and fair distribution of electricity bills. Galera et al. (2017) created a real-time energy monitoring system using a microcontroller to collect and store energy data in a cloud-based database. The system aims to help consumers adjust their energy usage, providing feedback with high accuracy (94%). Nepa et al. (2022) implemented a mobile application for controlling air conditioning units in laboratories, emphasizing mobile-based energy management with significant accuracy in power control.

Galvez et al. (2023) introduced an RFID-based power control system with classroom scheduling, allowing faculty members to activate and deactivate power through RFID scanning. This system automatically turns off the power after scheduled class periods, reducing electricity usage and addressing energy wastage in educational settings.

Velasco (2023) utilized RFID technology for attendance authentication and security in computer laboratories. While its main application differs from energy monitoring, it shares the use of RFID for access control and local data storage. Ibarra et al. (2023) focus on real-time energy monitoring with RFID technology for access control, but Ibarra et al. (2023) emphasizes precise tracking and GUI-based feedback. Galera et al. (2017) utilizes cloud-based storage for real-time energy data, contrasting with Nepa et al. (2022) and Galvez et al. (2023), which emphasize localized control using mobile apps and RFID for power management.

Velasco (2023) focuses more on security and attendance monitoring in computer laboratories, differing from the primary energy conservation goals of the other studies. Nepa et al. (2022) uniquely focuses on air conditioning management using an Android mobile app for laboratory settings, which contrasts with the more general power control systems of other studies, such as those by Ibarra et al. (2023) and Galvez et al. (2023). Galvez et al. (2023) introduces a classroom scheduling feature in their RFID-based power control system, enabling automatic shutoff of power after scheduled class times. This scheduling aspect differentiates it from other studies that focus more on real-time user access and control without automated scheduling.

Theoretical Framework

The Technology Acceptance Model (TAM), developed by Davis (1989) and expanded by Davis & Venkatesh (1996), is frequently used to study the acceptance of new electronic technologies or services. TAM is a significant adaptation of Ajzen and Fishbein's Theory of Reasoned Action (TRA). It is one of the most widely

applied models for understanding how users accept and utilize innovative technologies. Research has shown a connection between users' beliefs about a technology's usefulness and their attitude and intention to use it. Among the model's variables, perceived usefulness has the strongest correlation with actual usage. As a result, the researchers chose to incorporate Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) into the new research model. The degree to which a user thinks that utilizing a certain technology would enhance their ability to accomplish their work is known as perceived usefulness, or PU. The degree to which a user feels that utilizing a specific technology will be effortless is known as perceived ease of use, or PEOU.

Conceptual Framework

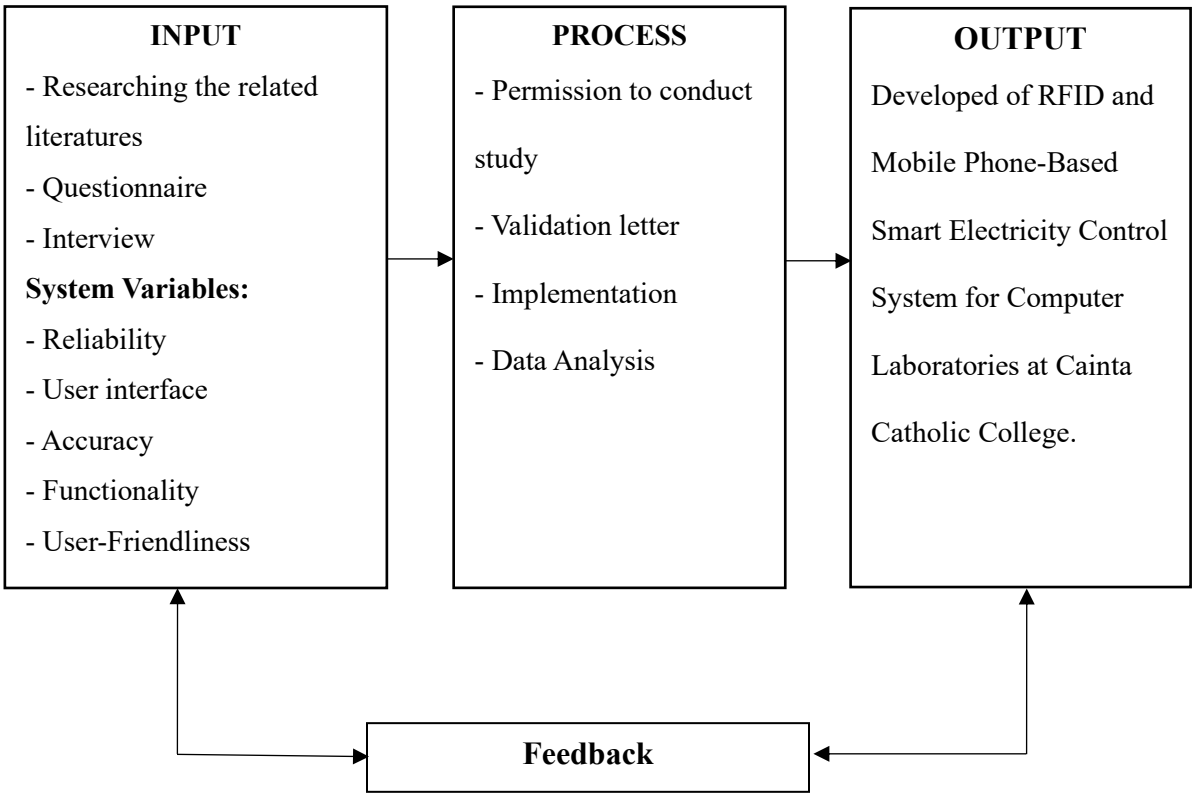


Figure 1 Research Paradigm on the Development of RFID and Mobile Phone-Based Smart Electricity Control System for Computers Laboratories at Cainta Catholic College

Figure 1 presents the demonstration of the research using a framework that represents all the input, process, and output.

The **input** includes system variables such as accuracy, functionality, reliability, user-interface, and user-friendliness. These variables will guide the development and evaluation of the system.

The **process** consists of several stages, including brainstorming, researching and reviewing related literature, designing an evaluation survey questionnaire, and proposing a title. These processes ensure a thorough exploration of the relevant concepts and a structured approach to system development.

The **output** is the final product—an RFID and Mobile Phone-Based Smart Electricity Control System for Computers at Cainta Catholic College's laboratories. This system aims to enhance efficiency in managing electricity usage for computers within the school's laboratories.

The **feedback** indicates how the system meets the desired goals of improved accuracy, functionality, and user-friendliness. The feedback loop provides valuable insights to optimize the system further, ensuring that it meets the needs of both the users and the institution.

Definition of Terms

Automation. According to Digittrix automation refers to the use of technology to perform work without the aid of people but while improving efficiency and consistency in operations.

Based on Kanade, automation is the use of machines or technology to perform tasks without much human intervention. Automation allows lab equipment automatically to turn on and off based on the presence of the user as sensed by an RFID, thereby not having to manually manage the consumption of energy and thus enhancing sustainability.

IoT (Internet of Things). According to Amazon Web Services the term IoT, or Internet of Things, refers to the collective network of connected devices and the technology that facilitates communication between devices and the cloud, as well as between the devices themselves

Based on Oracle the Internet of Things (IoT) describes the network of physical objects “things” that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.

RFID Technology. According to Allah et al. (2018) the RFID technology is employed for monitoring and controlling electricity access in computer laboratories. An RFID tag is allocated to authorized users, and the system detects presence and activates or deactivates the electrical devices accordingly.

Based on Britannica RFID is a wireless communication technology that uses electromagnetic fields for the automatic identification and tracking of tags attached to objects.

Smart Electricity Control System. According to Xu et al. (2020) a smart energy management system has an essential role in optimal control and management of smart energy systems. A smart energy management system integrates the energy generation systems, end users, distribution and storage systems and provides smart communication and optimal control strategies to create highly automated, responsive and flexible energy systems.

This system shall integrate RFID and IoT. It will automatically turn computers, lights, and AC units on and off since power shall only be needed in the lab when working.

Smart Grid. According to International Energy Agency, a Smart Grid refers to an advanced electricity network that uses digital technology to monitor and manage the flow of electricity from all generation sources to meet the varying electricity demands of end-users.

Based on Cecati et al. (2014) Smart Grid is a concept for transforming the electrical power grid by using advanced automatic control and communications techniques and other forms of information technology. It integrates innovative tools and technologies from generation, transmission and distribution all the way to consumer appliances and equipment.

Streamline. According to Webflow streamline refers to the process of simplifying or optimizing a system or procedure by removing unnecessary steps or making it more efficient. It often involves improving workflows, reducing complexity, and enhancing overall productivity.

Based on NASA a streamline is a path traced out by a massless particle as it moves with the flow. It is easiest to visualize a streamline if we move along with the body (as opposed to moving with the flow).

System Reliability. According to Law Insider means the probability that a system, including all hardware, firmware, and software, will satisfactorily perform the task for which it was designed or intended, for a specified time and in a specified environment

Reliability will be a measure of how consistently the RFID-based control system operates without failures or errors in the management and conservation of energy in computer laboratories.

User Interface. According Tranquillo et al. (2022) user interfaces are defined by the FDA as “all points of interaction between the user and the device, including all elements of the device with which the user interacts (i.e., those parts of the device that users see, hear, touch).”

The user interface includes both the RFID system and the mobile application. The method of accessing, monitoring, and controlling lab energy utilization by Cainta Catholic College users is now possible through these interfaces.

Chapter 3

RESEARCH METHODOLOGY

This chapter presents the research method used as well as the instrument, data gathering techniques and procedures, the statistical treatment of data, software development methodology, and the technologies used in making this study

Research Design

The research study employed a developmental method of research. Developmental research, as opposed to simple instructional development, has been defined as "the systematic study of designing, developing and evaluating instructional programs, processes and products that must meet the criteria of internal consistency and effectiveness" (Seels & Richey, 1994). This approach is particularly useful for creating and refining a system to meet specific needs. In this case, the focus was on designing, developing, and testing the RFID and mobile phone-based smart electricity control system to ensure its functionality and effectiveness in the computer laboratories of Cainta Catholic College.

Settings of the Study

The researchers conducted the study at Cainta Catholic College located in A. Bonifacio Avenue, Cainta Rizal. The study is focused on the 9 computer laboratories.

Subject of the Study

This study aimed to gather information and insights from the teachers who use the computer laboratory regarding the development of an RFID and mobile phone-based smart electricity control system for the computer laboratories at Cainta Catholic College.

Sampling

This study utilized a purposive sampling method to select the respondents from the faculty members of Cainta Catholic College during the school year 2024-2025. Purposive sampling is a technique where participants are chosen based on specific characteristics required for the study (Nikolopoulou, 2023). In this case, the respondents were selected based on their involvement in the management and use of the computer laboratories. Faculty members who are directly responsible for the supervision or operation of these laboratories were chosen, as they can provide the most relevant insights regarding the development and effectiveness of the RFID and mobile phone-based smart electricity control system.

Research Instrument

The instrument data was gathered through published documents and online resources. The information shown here was compiled and used by the researchers as a guide.

Interview Method. It is a conversation in which facts or statements are obtained from another person, such as one conducted by an interviewer. The researchers used it to acquire some information.

Questionnaire Method. The study used a structured questionnaire to assess the prototype's reliability, user interface, accuracy, functionality, and user-friendliness, with statements rated on a Likert scale (Strongly Agree, Agree, Disagree). Reliability measures the system's consistency, user interface evaluates design and interaction ease, accuracy assesses output precision, functionality checks task performance, and user-friendliness determines system intuitiveness. Respondents' feedback will identify improvements and evaluate overall effectiveness.

Data Gathering Procedure

To gather data needed in the study the researchers do the following:

1. **Permit to Conduct the Study**

   A formal letter of request was sent to the principals and dean of each department detailing the purpose and significance of the research. Upon approval, the researchers proceeded to the pre-testing questionnaire.

2. **Pre-Testing the Questionnaire**

   The researchers developed and draft of survey questionnaires that was checked by the adviser. Feedback from the draft questionnaires was used to refine the questions for clarity, ease of understanding, and relevance.

3. **Content Validation**

The final version experts questionnaire was underwent content validation by the experts. They evaluated whether the items in the questionnaire are acceptable to cover the key concepts of the study. Based on the feedback, the questionnaire was revised to ensure that it is valid, reliable, and appropriate for data collection.

4. **Conducting the Survey**

After finalizing the questionnaire, the researchers conducted the survey by distributing the questionnaires to the target participants. Participants were be briefed on the purpose of the study and their voluntary participation. Informed consent was obtained prior to the commencement of the survey. The distribution method was through printed questionnaires

5. **Gathering the Survey Questionnaire**

After have completing the survey, the researchers collected the questionnaires. The researchers ensured that all questionnaires are accounted for before proceeding to data analysis.

Data Analysis

After collecting the data, it was analyzed and interpreted using appropriate statistical tools for quantitative data.

The Likert Scale survey question type was used to readily measure respondent's opinions.

Scale	Verbal Description
4	Strongly Agree
3	Agree
2	Disagree
1	Strongly Disagree

Table 1 Likert Scale Format

Scale	Verbal Description
3.26 – 4.0	Very High Performance
2.51 – 3.25	High Performance
1.76 – 2.50	Low Performance
1.0 – 1.75	Very Low Performance

Scale	Verbal Description
3.26 – 4.0	Highly Acceptable
2.51 – 3.25	Moderately Acceptable
1.76 – 2.50	Acceptable
1.0 – 1.75	Not Acceptable

Demographics of the Respondents

To analyze the demographic data of the respondents, frequency counts and percentages was calculated. This allow the researchers to describe the distribution of respondents by department and other demographic factors.

Frequency and Percentage Distribution. To determine the percentage of the respondent's profile, the researchers used the following formula.

$$\% = \frac{f}{\mathrm{N}}\ x\ 100$$

Where:

% = Percent

f = Frequency

N = Total number of respondents

Performance and Acceptability Levels

Mean and Standard Deviation. The mean was calculated for each of the subcategories (Reliability, User Interface, Accuracy, Functionality, and User-Friendliness) for both performance and acceptability. The mean gives an average score of the ratings, while the standard deviation measures. This provides an overall understanding of the respondents' perception of the RFID and mobile phone-based smart electricity control system's performance and acceptability in each of these areas.

Significant Difference Between Performance and Acceptability

Paired Sample t-test. To determine if there is a significant difference between the performance and acceptability levels, a paired sample t-test was conducted. This test was compared the means of the performance and acceptability ratings for

each criterion (Reliability, User Interface, Accuracy, Functionality, User-Friendliness). The paired t-test is appropriate because the same group of respondents will be evaluating both the performance and acceptability of the system, and it helped determine the significant difference between the two.

Software Methodology

The System Devolopment Life Cycle (SDLC) is a framework used in software engineering to describe the phrases and processes involved in building and maintaining information systems. It encompasses a series of structured steps that guide the development of softwware or information systems from initiation through to deployment and maintenance.

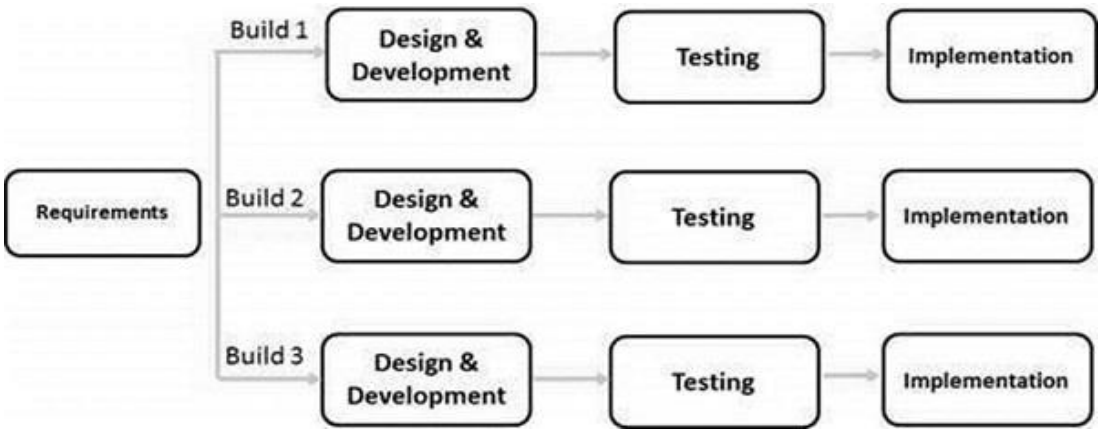


Figure 2 Iterative model

Requirements. The RFID and Mobile Phone-Based Smart Electricity Control System must perform specific tasks such as calculations, data processing, and control operations to meet the needs and expectations of end-users. The system's core functions include RFID-based user identification, smart electricity control, and mobile phone integration. These requirements form the foundation for developing the system.

First Build. Prototype Using Two ESP32 Modules

Design and Development. In this stage, the initial flowchart and planning were completed to outline the system's structure. The code was implemented, enabling basic functionality. Two ESP32 modules were used to support the RFID reader and ensure stable communication.

Testing. The RFID reader was tested by scanning an ID card, successfully toggling the relay on and off. The initial prototype performed well, demonstrating its basic functionality.

Implementation. Testing the RFID prototype provided insights into areas where functionality and accuracy could be improved. The initial build helped identify the potential for optimization in future iterations.

Second Build. Prototype with Unsecured Power Supply

Design and Development. In this stage, additional components were introduced, including a power supply, LED lights, and DC fan, to showcase the system's electricity control features.

Testing. The new components were tested and found to be working correctly. The light bulb and DC fan responded properly when triggered by the RFID scanner.

Implementation. The added components were successfully integrated into the prototype, enhancing its capabilities. However, the use of an unsecured power supply highlighted the need for improvements in safety and stability.

Third Build: Optimized Prototype Using One ESP32, Secured Power Supply, Android App, and Admin Panel Design and Development. The system was optimized by keeping a single ESP32 module, simplifying the design. A more secure power supply was implemented to address safety concerns. An SQL database was added for user data management. All components were fixed inside an enclosure, and consistent scanning of multiple IDs was ensured. Mobile phone integration was enhanced, enabling remote access to the electricity control features. The light bulb was replaced with LED lights, and an email notification system was added. An Android app was developed to allow switching without requiring an RFID card. An admin panel was created to add and monitor teachers for accessing the system.

Testing: Final testing was conducted to ensure that all system requirements were met. The RFID scanner, SQL integration, Android app, and mobile phone control were thoroughly tested for functionality and reliability.

Implementation: The RFID objectives were successfully met, and the system, including mobile phone control, the Android app, and the admin panel, was fully developed and tested. The final version of the RFID and Mobile Phone-Based Smart Electricity Control System was completed and prepared for deployment.

CONTEXT DIAGRAM

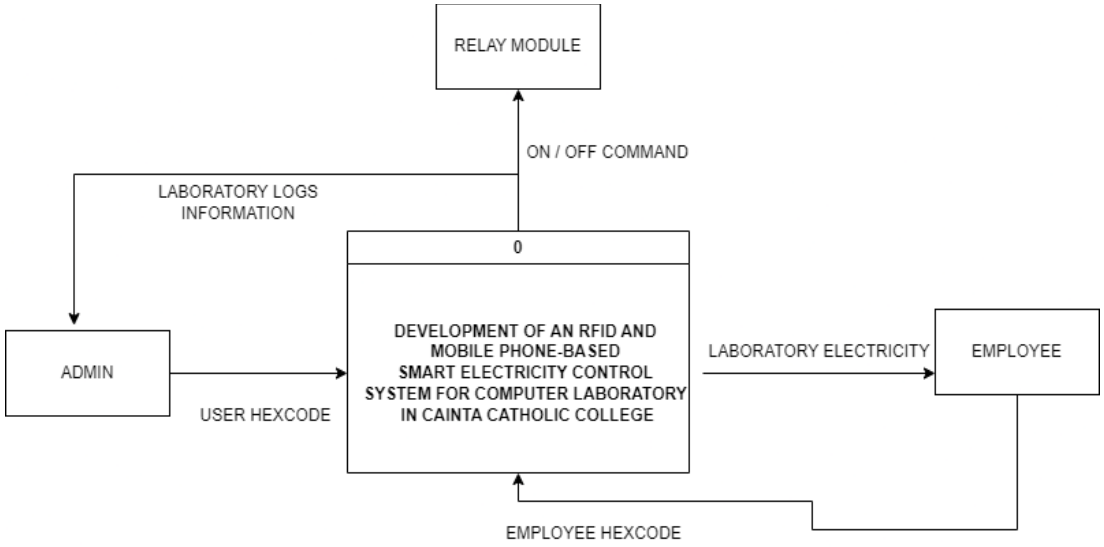


Figure 3 Context Diagram of the Program

In Figure 3 it illustrates an RFID and mobile phone-based smart electricity control system for a computer laboratory at Cainta Catholic College, where employees use RFID hex codes to control laboratory electricity via a relay module. The system logs user activity sends data to the admin, and processes on/off commands to manage power usage efficiently.

DFD

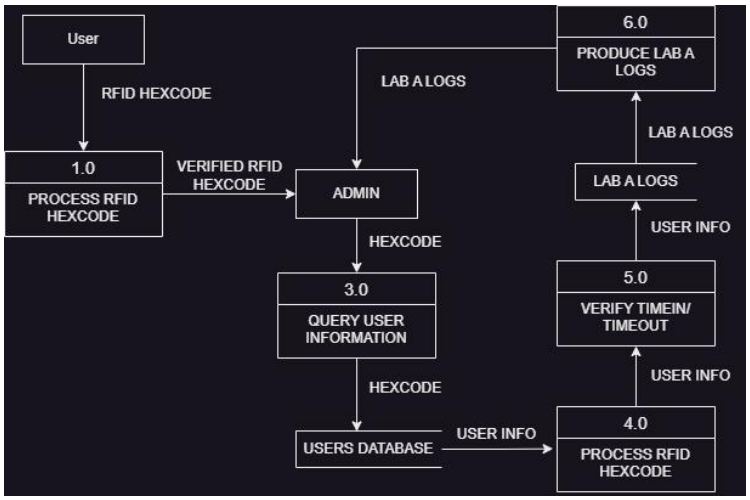


Figure 4 Data Flow Diagram of the Program

Figure 4 from the previous page shows the RFID-based user verification and logging system where a user's RFID hex code is processed and verified before being sent to the admin for authentication. The system queries user information from a database, verifies time-in/time-out logs, and generates reports for Lab A, ensuring accurate monitoring of laboratory access.

FLOWCHART

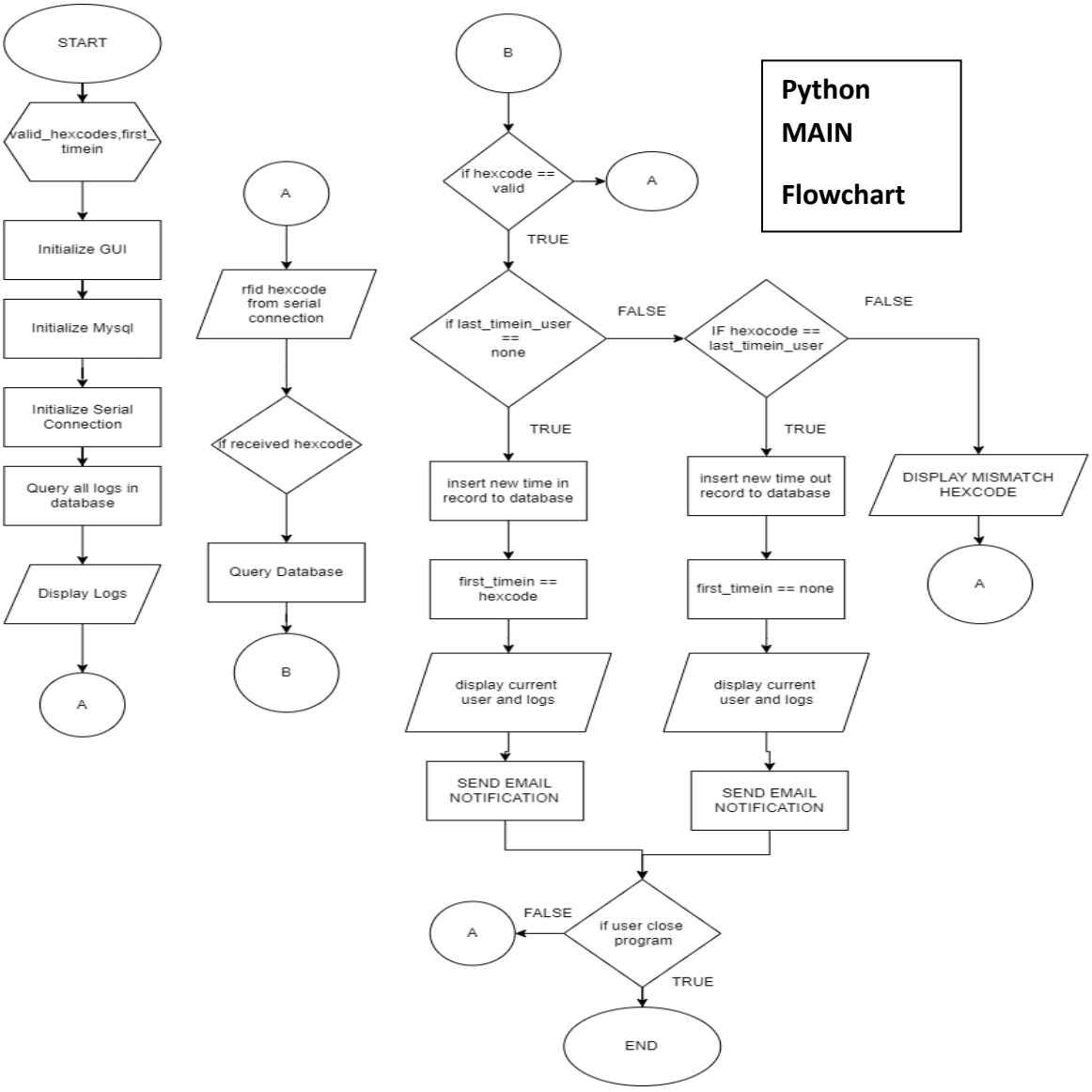


Figure 5 Python Flowchart of the Program

Figure 5 in page 36 flowchart represents an **RFID-based attendance logging system** that initializes a GUI, MySQL database, and serial connection to read RFID hexcodes, validate users, and store time-in/time-out records. It also queries logs, displays user data, sends email notifications upon log entry, and ends when the user closes the program.

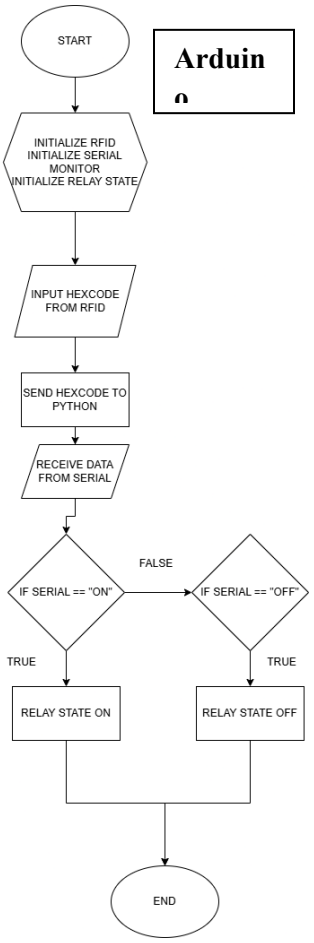


Figure 6 Arduino Flowchart of the Program

In Figure 6 the flowchart depicts an RFID-based relay control system using ESP32, where an RFID tag is scanned, and the data is sent to Python for validation. Python processes the data and sends back a serial message to the ESP32 to toggle the relay switch ON or OFF accordingly.

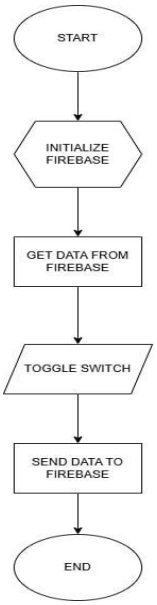


Figure 7 Java Flowchart of the Program

In Figure 7 it illustrates a process where Firebase is initialized, data is retrieved, a switch is toggled, and the updated data is sent back to Firebase. This sequence ensures real-time synchronization between the application and Firebase, allowing dynamic state changes.

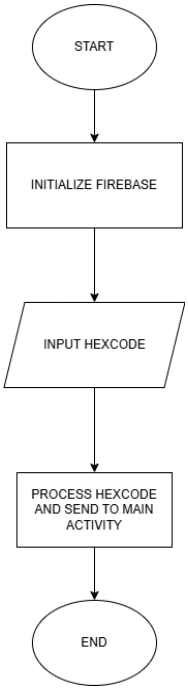


Figure 8 Login Flowchart of the Program

Figure 8 on page 38 represents the process where Firebase is initialized, a hex code is inputted, and then processed before being sent to the main activity. It visually outlines the sequential steps from the start to the end of the operation.

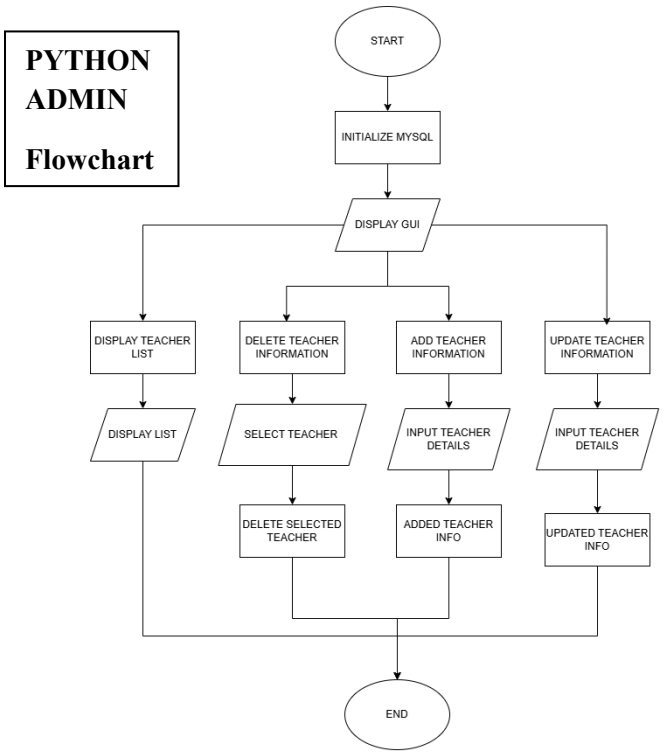


Figure 9 Admin Panel Flowchart of the Program

In Figure 9.0 the flowchart represents the admin panel of a MySQL-based teacher management system, allowing administrators to display, add, update, or delete teacher information through a graphical user interface (GUI). Each operation follows a structured process, ensuring efficient management of teacher records before the system concludes.

ERD

Figure 10 Entity Relationship Diagram of the Program

In Figure 10 it shows the entity-relationship diagram illustrates a one-to-many relationship between the users and labA_logs tables, where each user can have multiple log entries. The labA_logs table records the user's name, time-in, and time-out, while referencing the users table through a foreign key (FK) relationship.

Development Tools and Technologies

Below the software prerequisites needed to carry out the proposed study:

Programming languages

Python. A high-level, interpreted programming language known for its simplicity and readability. It is widely used in web development, data science, automation, AI, and IoT projects.

Java. A versatile, object-oriented programming language commonly used for building enterprise applications, mobile apps (Android), and web-based systems. It runs on the Java Virtual Machine (JVM), making it platform independent.

C++/Arduino. C++ is a powerful, high-performance programming language often used in system programming, game development, and embedded systems. Arduino, based on C++, is used for programming microcontrollers in hardware projects, such as IoT and automation.

Database Server

MySQL Workbench. A graphical tool for MySQL database design, administration, and development. It allows users to create, manage, and visualize databases easily.

Firebase. A cloud-based platform by Google that provides real-time database services, authentication, cloud storage, and hosting solutions for web and mobile applications.

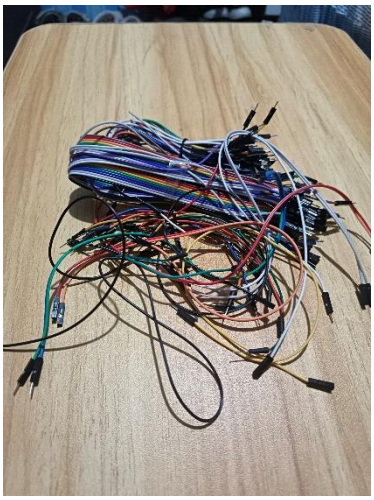
Text Editor

Visual Studio. A powerful integrated development environment (IDE) by Microsoft, used for software development in various languages like C++, C#, and Python, with extensive debugging and code management features.

Android Studio. The official IDE for Android app development, providing tools for coding, testing, and deploying applications using Java, Kotlin, and Flutter.

Hardware Requirements

To further associate and distinguish the tools used, the proponents decided to use a tabular chart as shown below

Hard Ware Type	Classification	Specification
Jumper Wire 	A **jumper wire** is a short wire used to connect two points in a circuit. It's useful for temporary connections or bypassing parts in a circuit. Jumper wires are often used in electronics for testing, troubleshooting, and prototyping. They usually have connectors on both ends, such as DuPont connectors, alligator clips, or bare wire, making them flexible for various uses. Jumper wires are especially handy on breadboards, where components can be connected and tested before being permanently soldered.	**Length:** Typically ranges from 10 cm to 30 cm, though other lengths are available. **Connector Types:** Male-to-Male (M-M): Both ends have male connectors. Male-to-Female (M-F): One end has a male connector, and the other a female. Female-to-Female (F-F): Both ends have female connectors. **Wire Gauge:** Usually 22 AWG, suitable for breadboards and most prototyping needs. **Insulation Material:** PVC or silicone, providing flexibility and durability. **Voltage Rating:** Often supports up to 300V (varies with specific wire type). **Current Rating:** Typically supports up to 1A to 2A.

Hard Ware type	Classifications	Specifications
Button 	A **buzzer** is a device that creates a buzzing sound, commonly used to signal or alert people.	**Type**: Common types include push-button (momentary), toggle, and switch. **Size**: Varies in diameter, typically ranging from 6 mm to 12 mm for standard push-buttons. **Material**: Usually made of plastic or metal, with conductive contacts inside. **Operating Mode**: Normally open (NO) or normally closed (NC) circuits. **Voltage and Current Rating**: Often rated for low-voltage circuits (e.g., 5V or 12V) and low current (around 1A). **Mounting**: Can be through-hole, surface-mount, or panel-mounted.

Hard Ware Type	Classifications	Specifications
Relay Switch 	**Relay switches** can be classified in several ways, including by type, function, and design. By type, there are electromechanical relays, which use a physical switch controlled by an electromagnet to open or close a circuit, and solid-state relays, which use electronic components like transistors to control the switch without moving parts. By function, relays can be SPST (Single-Pole Single-Throw), a basic switch that opens or closes one circuit, SPDT (Single-Pole Double-Throw), which allows switching between two circuits, and DPDT (Double-Pole Double-Throw), which controls two	**Type**: **Electromechanical Relay:** Uses a mechanical switch controlled by an electromagnet. **Solid-State Relay:** Uses electronic components, with no moving parts. **Contact Configuration:** **SPST (Single-Pole Single-Throw):** Controls one circuit. **SPDT (Single-Pole Double-Throw):** Switches between two circuits. **DPDT (Double-Pole Double-Throw):** Controls two circuits with two switching options. **Coil Voltage:**

	circuits simultaneously with two options for each. By design, relays are classified as Normally Open (NO), where the switch remains open until triggered and then closes the circuit, or Normally Closed (NC), where the switch stays closed until triggered and then opens the circuit. These classifications help in selecting the right relay switch for different electrical needs.	Typically ranges from 5V to 24V DC or 120V to 240V AC, depending on the application. **Current Rating:** Common relay switches can handle 10A to 30A of current, depending on the model and application. **Switching Type:** Normally Open (NO): Switch is open when not activated. Normally Closed (NC): Switch is closed when not activated. **Response Time:** Typically, 5 to 15 milliseconds for most electromechanical relays, and even faster for solid-state relays.

Hard Ware Type	**Classifications**	**Specifications**
ESP 32 	The **ESP32** is an affordable, low-power microcontroller with built-in Wi-Fi and Bluetooth. Created by Espressif Systems, it's commonly used in IoT (Internet of Things) projects, smart devices, and embedded systems because of its flexibility, processing power, and wireless connectivity.	**Processor**: Dual-core 32-bit LX6 CPU, up to 240 MHz. **Memory**: 520 KB SRAM, plus external flash and PSRAM options. **Connectivity**: Built-in **Wi-Fi** (2.4 GHz) and **Bluetooth** (BLE and Classic). **GPIO (General Purpose I/O)**: 34 programmable GPIO pins for various input/output functions. **Power**: Low power consumption, suitable for battery-powered applications. **Operating Voltage**: 3.3V for core operations. **Peripherals**:

		Supports **SPI**, **I2C**, **UART**, **ADC**, **DAC**, and **PWM** for communication and control.

Hard Ware Type	**Classifications**	**Specifications**
I2C LCD 	An **I2C LCD** is a liquid crystal display that communicates with a microcontroller or other devices using the I2C (Inter-Integrated Circuit) protocol. This protocol allows multiple devices to communicate over just two wires: one for data (SDA) and one for the clock (SCL). This setup makes I2C LCDs simpler and more efficient compared to traditional parallel connections.	**Communication Protocol**: **I2C (Inter-Integrated Circuit)**, uses two wires (SDA for data and SCL for clock). **Display Type**: **LCD** (Liquid Crystal Display), typically with 16x2 or 20x4 character formats. **Voltage**: Operates at **5V** or **3.3V**, depending on the model. **Pin Connections**: **VCC** (power), **GND** (ground), **SDA** (data), and **SCL** (clock). **Backlight**: Often includes an adjustable backlight for visibility in different lighting.

Hard Ware Type	Classifications	Specifications
RFID Reader 	An RFID (Radio Frequency Identification) reader is a device that uses radio waves to read and capture data from an RFID tag. The RFID tag has a microchip with data and an antenna that transmits this data to the reader when it's within range.	**Communication**: Uses **radio waves** to communicate with RFID tags. **Frequency**: Operates at **low frequency (LF)**, **high frequency (HF)**, or **ultra-high frequency (UHF)**, depending on the type of RFID system. **Range**: Typical reading range is **a few centimeters to several meters**, depending on the frequency and reader type. **Power Supply**: Typically operates on **5V** or **3.3V**. **Compatibility**: Works with RFID tags that match the reader's frequency.

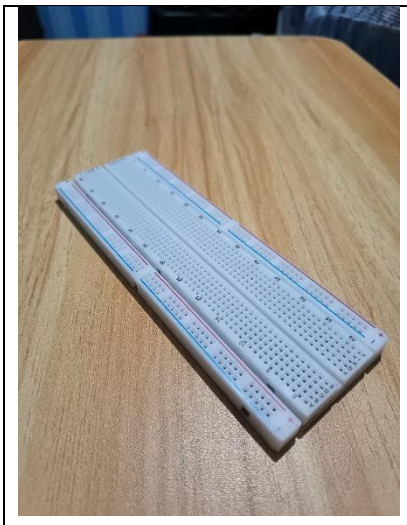
Hard Ware Type	Classifications	Specifications
DC Fan 	DC fan control with Arduino can be set up in a few different ways. First, you can choose either on/off control (where the fan turns on at a certain temperature) or speed control (where the fan gets faster as it gets hotter). The temperature sensor can give readings as numbers (analog) or as digital values. Power for the fan can come directly from the Arduino for small fans or from a separate power source for bigger	- Arduino (Uno or similar) - DC Fan (e.g., 12V) Transistor or MOSFET (for fan control) Temperature Sensor (e.g., LM35) Diode (for protection) - Power Supply (for fan if required) Features: **Temperature-Based Control:** Fan turns on and adjusts speed automatically based on temperature.

	fans. You can see the temperature and fan speed on the computer or on a small screen. Lastly, the fan can be set to automatic (adjusting on its own) or manual (using a knob or button to control it). These choices make it easy to build a fan system that suits different needs.	**PWM Speed Control:** Arduino uses PWM (Pulse Width Modulation) to control fan speed smoothly. Serial Monitor Output (Optional): Displays temperature and fan speed for easy monitoring.

Hard Ware Type	**Classifications**	**Specifications**
ESP 32 Adapter 	An **ESP32 adapter** is a small board that helps connect the ESP32 microcontroller to other devices or power sources. It often includes features like a voltage regulator to safely convert power to the 3.3V needed by the ESP32, USB ports for easy programming, and pins or headers for connecting sensors or other components. ESP32 adapters make it easier to power, program, and integrate the ESP32 into various projects, especially for Internet of Things (IoT) applications.	**Power Input**: Supports **5V USB** input, with a voltage regulator to supply **3.3V** to the ESP32. **Connectivity**: **USB Port** for programming and power, usually **Micro-USB** or **USB-C**. **GPIO Access**: Pin headers to access the ESP32's **GPIO pins** for connecting sensors and components. **Compatibility**: Compatible with most ESP32 development boards, including ESP32-WROOM and ESP32-WROVER. **Additional Features**: May include **reset** and **boot buttons** to help with programming, and **LED indicators** for power and connectivity.

Hard Ware Type	Classifications	Specifications
LED Lights  White Strip + USB Port	By LED Type Likely SMD (Surface Mounted Device) LEDs, common in flexible strips, providing efficient and bright light. Single Color (White): Emits a consistent white light, ideal for general or accent lighting. USB-Powered: Designed to draw power from a USB port, making it versatile and portable for use with power banks, computers, or USB adapters. Flexible Strip: Easily bendable for various applications and installations. Appears to be Non-Waterproof, suitable for indoor use only.	**Voltage:** Commonly available in 5V, 12V, and 24V options. **Power Consumption:** Measured in watts per meter, typically 4.8W/m, 7.2W/m, or higher. **LED Density:** Number of LEDs per meter, e.g., 30, 60, or 120 LEDs/m. **Lifespan:** Approximately 25,000 to 50,000 hours. Brightness: Measured in lumens per meter, varies by LED type and density. **Color Temperature:** For white strips, ranges from warm white (2700K) to daylight (6500K). Control Options: Manual or via mobile app, remote control, or smart home systems. **Connectivity:** Compatible with controllers for dimming and color changing, including Wi-Fi or Bluetooth integration.

Hard Ware Type	Classifications	Specifications
Bread Board	**Breadboards** can be classified by size, power rails, and adhesive backing. In size, there are full-size (for complex circuits), half-size (for general use), and mini (for simple circuits). Some breadboards have power rails on the sides for easy	**Size**: Available in full-size, half-size, and mini. **Number of Tie Points**: Typically ranges from 170 (mini) to 830+ (full-size). **Power Rails**: Some breadboards have side rails for easy power and ground connections.

	power connections, while others don't and are used for basic setups. Breadboards may also have adhesive backing to stick to surfaces or no adhesive for flexible use. These features help users pick the right breadboard for their projects.	**Connection Rows**: Typically organized in rows and columns with metal strips inside to connect components. **Compatibility**: Works with standard components like resistors, capacitors, LEDs, and jumper wires. **Material**: Usually made of ABS plastic with metal contacts inside. **Reusability**: No soldering allowing easy removal and reuse of components. **Adhesive Backing:** Some models come with adhesive backing for secure attachment to surfaces, while others do not, making them more portable. **Voltage and Current Limits:** Typically rated to handle low-voltage circuits (up to about 5V) and low current (under 1A), suitable for prototyping.

Chapter 4

PRESENTATION ANALYSIS AND INTERPRETATION OF DATA

This chapter contains the data from the study presented analyzed and interpreted. To test the hypothesis and provide answers to the research questions the collected data need to be analyzed to properly finish this study. Information is interpreted as was previously indicated in the chapter before, using a table and a descriptive format.

Table 2

Frequency and Percentage Distribution of Profile of the Respondents in Terms of Department Level

Department	Frequency	Percentage
Elementary	4	28.57
Highschool	4	28.27
College	6	42.86
Total	14	100

Table 2 indicates the frequency and percentage distribution of the respondents profile in terms of department level. The table shows the department breakdown for the respondents, with 4 from Elementary (20%), 4 from Highschool (20%), and 6 from College (60%). This gives a total of 14 participants.

Table 3

Computed Mean on the Level of Performance of the Proposed System in terms of Reliability

Statement	Mean	Verbal Interpretation
1.The system maintains consistent performance during use.	3.71	Very High Performance
2.The system reliably connects with RFID and mobile devices.	3.86	Very High Performance
3.The system operates consistently without technical issues.	3.57	Very High Performance
4.The system executes commands accurately and consistently.	3.64	Very High Performance
5.The system consistently operates without unexpected downtime or malfunctions.	3.57	Very High Performance
OVERALL MEAN	3.67	Very High Performance

LEGEND: 4.00 – 3.26 (Very High Performance), 3.25 – 2.51 (High Performance), 1.76 – 2.50 (Low Performance), 1.75 – 1.00 (Very Low Performance)

Table 3 presents data showing that the highest-rated aspect of the system's reliability is its consistent connection with RFID and mobile devices, achieving a mean score of 3.86. This indicates that the system maintains stable and dependable communication with its components. With an overall mean of 3.67, which falls under the Very High Performance category, the table highlights that the system operates reliably, executes commands consistently, and minimizes unexpected downtimes or malfunctions.

Hasan et al. (2020) emphasized that IoT systems need stable connections and consistent performance for reliable energy management. Similarly, Brown et

al. (2022) found that automated systems in schools must stay reliable in different conditions.

Table 4

Computed Mean on the Level of Performance of the Proposed System in terms of User Interface

Statement	Mean	Verbal Interpretation
1.The interface responds to user input promptly without delays.	3.86	Very High Performance
2.The system's interface design is visually appealing.	3.86	Very High Performance
3.The system handles user input without freezing or lagging.	3.5	Very High Performance
4.The system provides clear and effective visual indicators for the status of actions.	3.79	Very High Performance
5.The user interface supports interaction effectively without causing errors or confusion.	3.71	Very High Performance
OVERALL MEAN	3.74	Very High Performance

LEGEND: 4.00 – 3.26 (Very High Performance), 3.25 – 2.51 (High Performance), 1.76 – 2.50 (Low Performance), 1.75 – 1.00 (Very Low Performance)

Table 4 shows that the highest-rated aspects of the system's user interface are responsiveness to user input and visual appeal, both achieving a mean score of 3.86. This indicates that users experience minimal delays and find the design aesthetically pleasing. With an overall mean of 3.74, which falls under the Very High Performance category, the table highlights that the system provides an efficient, visually appealing, and user-friendly interface.

Smith et al. (2021) stated that a good user interface improves experience and efficiency, making smart technologies easier to adopt. Similarly, Jones and Kim (2020) stressed that clear and responsive designs are key to user satisfaction in RFID systems.

Table 5

Computed Mean on the Level of Performance of the Proposed System in terms of Accuracy

Statement	Mean	Verbal Interpretation
1.The system accurately recognizes and responds to RFID scans.	3.79	Very High Performance
2.The system precisely identifies specific user inputs.	3.86	Very High Performance
3.The system accurately processes commands from the mobile application.	3.93	Very High Performance
4.The system effectively differentiates between authorized and unauthorized users.	3.86	Very High Performance
5.The system reliably reads RFID tags from varying distances.	3.64	Very High Performance
OVERALL MEAN	3.81	Very High Performance

LEGEND: 4.00 – 3.26 (Very High Performance), 3.25 – 2.51 (High Performance), 1.76 – 2.50 (Low Performance), 1.75 – 1.00 (Very Low Performance)

As shown in Table 6 the highest-rated aspect of the system's accuracy is its precise processing of commands from the mobile application, achieving a mean score of 3.93. This indicates that the system consistently interprets and executes user commands with high reliability. With an overall mean of 3.81, which falls under the Very High Performance category, the table highlights that the system

accurately recognizes RFID scans, differentiates users effectively, and maintains reliable performance in processing inputs.

According to Simbulan et al. (2023) demonstrated that RFID-based systems with high accuracy in user identification and energy monitoring are essential for efficient energy management. Similarly, Nepa et al. (2022) found that monitoring and controlling power use accurately helps reduce energy waste.

Table 6

Computed Mean on the Level of Performance of the Proposed System in terms of Functionality

Statement	Mean	Verbal Interpretation
1.The integration between RFID and mobile control functions is smooth.	3.86	Very High Performance
2.The system performs well without noticeable lag or delay when executing commands from RFID or the mobile application.	3.79	Very High Performance
3.The system effectively supports operation by one person at a time using either RFID or mobile phone commands.	3.86	Very High Performance
4. The system executes commands quickly when RFID tags are scanned.	3.86	Very High Performance
5.The system quickly executes commands when RFID tags are scanned	3.79	Very High Performance
OVERALL MEAN	3.83	Very High Performance

LEGEND: 4.00 – 3.26 (Very High Performance), 3.25 – 2.51 (High Performance), 1.76 – 2.50 (Low Performance), 1.75 – 1.00 (Very Low Performance)

Table 6 presents that the highest-rated aspects of the system's functionality are smooth integration between RFID and mobile control, effective single-user

operation, and quick command execution, each achieving a mean score of 3.86. This indicates that the system ensures seamless interaction between RFID and mobile functions while maintaining efficiency. With an overall mean of 3.83, which falls under the Very High Performance category, the table highlights that the system is highly functional and operates efficiently without noticeable delays.

Palencia et al. (2015) found that combining RFID with microcontrollers like Arduino allows efficient access control and energy management. Similarly, Matillano and Canda (2022) showed that RFID systems effectively automate tasks like attendance and appliance control to save energy.

Table 7

Computed Mean on the Level of Performance of the Proposed System in terms of User Friendliness

Statement	Mean	Verbal Interpretation
1.The system is easy for new users to learn and operate.	3.79	Very High Performance
2.The overall user experience of the system is satisfactory.	3.79	Very High Performance
3.The system responds well to user inputs.	3.86	Very High Performance
4.The system is accessible and easy to use for non-technical users.	3.79	Very High Performance
5.The system provides clear feedback when an action is performed.	3.71	Very High Performance
OVERALL MEAN	3.79	Very High Performance

LEGEND: 4.00 – 3.26 (Very High Performance), 3.25 – 2.51 (High Performance), 1.76 – 2.50 (Low Performance), 1.75 – 1.00 (Very Low Performance)

Table 7 presents that the highest-rated aspect of the system's user-friendliness is its responsiveness to user inputs, achieving a mean score of 3.86.

This indicates that users find the system highly interactive and efficient in processing commands. With an overall mean of 3.79, which falls under the Very High Performance category, the table highlights that the system is easy to learn, accessible to non-technical users, and provides a satisfying user experience.

Galera et al. (2017) emphasized the importance of user-friendly interfaces in energy monitoring systems, noting that intuitive designs and real-time feedback significantly enhance user satisfaction. Similarly, Velasco (2023) emphasized that users are more likely to adopt RFID systems that are easy to use and have clear instructions.

Table 8

Computed Mean on the Level of Acceptability of the Proposed System in terms of Reliability

Statement	Mean	Verbal Interpretation
1.The system is dependable for regular use.	3.71	Highly Acceptable
2.The system maintains consistent performance over time.	3.64	Highly Acceptable
3.The system operates smoothly under varying conditions (e.g., power outages).	3.64	Highly Acceptable
4.The system can operate reliably even under heavy usage.	3.64	Highly Acceptable
5.The system is dependable in maintaining functionality without frequent interruptions.	3.57	Highly Acceptable
OVERALL MEAN	3.64	Highly Acceptable

LEGEND: 4.00 – 3.26 (Highly Acceptable), 3.25 – 2.51 (Moderately Acceptable), 1.76 – 2.50 (Acceptable), 1.75 – 1.00 (Not Acceptable)

Table 8 presents that the highest-rated aspect of the system's reliability acceptability is its dependability for regular use, achieving a mean score of 3.71. This indicates that users trust the system to function consistently in daily operations. With an overall mean of 3.64, categorized as Highly Acceptable, the table highlights that the system maintains stable performance, operates smoothly under varying conditions, and remains reliable even under heavy usage.

Hasan et al. (2020) emphasized that reliable IoT-based systems are essential for long-term user satisfaction and adoption. Similarly, Brown et al. (2022) found that reliable automated systems help lower costs and build user trust, supporting the high reliability ratings in Table 8.

Table 9

Computed Mean on the Level of Acceptability of the Proposed System in terms of User Interface

Statement	Mean	Verbal Interpretation
1.The interface design is user-friendly and simple to understand.	3.86	Highly Acceptable
2.Users feel comfortable while interacting with the system.	3.93	Highly Acceptable
3.The buttons, icons, and labels are easy to understand and use.	3.79	Highly Acceptable
4.I can easily locate and use the system's features.	3.79	Highly Acceptable
5.The system provides clear and understandable feedback when an action is performed.	3.86	Highly Acceptable
OVERALL MEAN	3.84	Highly Acceptable

LEGEND: 4.00 – 3.26 (Highly Acceptable), 3.25 – 2.51 (Moderately Acceptable), 1.76 – 2.50 (Acceptable), 1.75 – 1.00 (Not Acceptable)

In Table 9, the highest-rated aspect of the system's user interface acceptability is user comfort during interaction, achieving a mean score of 3.93. This indicates that users find the system intuitive and enjoyable to use. With an overall mean of 3.84, categorized as Highly Acceptable, the table highlights that the system is user-friendly, easy to navigate, and provides clear feedback, ensuring a smooth user experience.

Smith et al. (2021) stated that user comfort and intuitive design are key to the acceptance of smart systems. Similarly, Jones and Kim (2020) found that attractive and responsive interfaces greatly improve user satisfaction, supporting the high acceptance ratings in Table 9.

Table 10

Computed Mean on the Level of Acceptability of the Proposed System in terms of Accuracy

Statement	Mean	Verbal Interpretation
1.The system is precise in identifying authorized users.	3.79	Highly Acceptable
2.The processes within the system are easy to understand and use.	3.79	Highly Acceptable
3. The system reliably executes commands without errors.	3.71	Highly Acceptable
4. The system effectively differentiates between valid and invalid entries.	3.79	Highly Acceptable
5. The system accurately registers input from mobile devices and RFID cards.	3.79	Highly Acceptable
OVERALL MEAN	3.77	Highly Acceptable

LEGEND: 4.00 – 3.26 (Highly Acceptable), 3.25 – 2.51 (Moderately Acceptable), 1.76 – 2.50 (Acceptable), 1.75 – 1.00 (Not Acceptable)

Table 10 shows that the system's accuracy in identifying users, distinguishing entries, and registering inputs scored 3.79, indicating high reliability. With an overall mean of 3.77, the system is deemed Highly Acceptable, ensuring accurate performance and a smooth user experience.

Simbulan et al. (2023) highlighted that accurate user identification and energy monitoring are essential for the acceptance of RFID systems. Similarly, Nepa et al. (2022) found that precise power monitoring improves user trust and satisfaction, supporting the high accuracy ratings in Table 10.

Table 11

Computed Mean on the Level of Acceptability of the Proposed System in terms of Functionality

Statement	Mean	Verbal Interpretation
1.The system meets all the operational needs expected from an electricity control system.	3.86	Highly Acceptable
2. There is no lag or delay in executing commands from either the RFID or the mobile application.	3.64	Highly Acceptable
3.The system's functions are straightforward to understand.	3.71	Highly Acceptable
4.The system is easy for new users to learn and operate.	3.79	Highly Acceptable
5.All essential features of the system are available and work correctly.	3.71	Highly Acceptable
OVERALL MEAN	3.74	Highly Acceptable

LEGEND: 4.00 – 3.26 (Highly Acceptable), 3.25 – 2.51 (Moderately Acceptable), 1.76 – 2.50 (Acceptable), 1.75 – 1.00 (Not Acceptable)

Table 11 shows that the system's highest-rated functionality is its ability to meet all operational needs as an electricity control system, with a mean score of 3.86. With an overall mean of 3.74, categorized as Highly Acceptable, the system is functional, easy to use, and operates efficiently without major delays.

According to Flores et al. (2023) demonstrated that RFID-based systems designed for energy conservation are highly effective in meeting operational needs, particularly in educational settings. Similarly, Fontanilla et al. (2023) found that systems integrating RFID and real-time clocks significantly improve energy efficiency, which aligns with the high functionality acceptability ratings in Table 11.

Table 12

Computed Mean on the Level of Acceptability of the Proposed System in terms of User Friendliness

Statement	Mean	Verbal Interpretation
1.The system's interface is easy to navigate, even for users with limited technical knowledge.	3.86	Highly Acceptable
2.The system is easy to use without needing detailed instructions or assistance.	3.86	Highly Acceptable
3.System instructions are clear and easy to follow.	3.86	Highly Acceptable
4.The system's design makes it easy to perform tasks without unnecessary complexity.	3.86	Highly Acceptable
5.The system's interface adapts well to different screen sizes or devices.	3.79	Highly Acceptable
OVERALL MEAN	3.84	Highly Acceptable

LEGEND: 4.00 – 3.26 (Highly Acceptable), 3.25 – 2.51 (Moderately Acceptable), 1.76 – 2.50 (Acceptable), 1.75 – 1.00 (Not Acceptable)

Table 12 illustrates that the system's user-friendliness is highly acceptable, with ease of navigation, independent usability, clear instructions, and straightforward task execution receiving the highest ratings, each with a mean score of 3.86. This signifies that users perceive the system as intuitive and effortless to operate. With an overall mean of 3.84, categorized as Highly Acceptable, the findings confirm that the system is exceptionally user-friendly, accessible even to users with minimal technical expertise, and designed for seamless interaction.

Galvez et al. (2023) emphasized that user-friendly systems with clear instructions and easy navigation are more likely to be adopted by users. Similarly, Ibarra et al. (2023) highlighted the importance of designing systems that are accessible to non-technical users, which aligns with the high user-friendliness acceptability ratings in Table 12.

Table 13

Significant Difference Between The Level of Performance and Acceptability of the RFID and Mobile Phone-Based Smart Electricity Control System

Variable	T-Value	P-Value	Decision	Remarks
User- interface	-1.528	0.151	Accept Ho	Not Significant
Functionality	1.312	0.212	Accept Ho	Not Significant
User Friendly	-0.672	0.513	Accept Ho	Not Significant
Accuracy	0.898	0.385	Accept Ho	Not Significant
Reliability	0.434	0.671	Accept Ho	Not Significant

According to the results presented in Table 13, there is no statistically significant difference between the “Level of Performance” and “Level of

Acceptability” of the RFID and mobile phone-based smart electricity control system across all evaluated variables. The p-values for user interface (0.151), functionality (0.212), user-friendliness (0.513), accuracy (0.385), and reliability (0.671) are all greater than the 0.05 significance level. As a result, the null hypothesis (Ho) is accepted for all variables, indicating that the differences observed between performance and acceptability are not statistically significant. This suggests that users perceive the system's performance and acceptability similarly across all measured aspects.

Chapter 5

SUMMARY, CONCLUSION AND RECOMMENDATION

Based on the data analyzed in the preceding chapter, this chapter gives a summary of the findings, conclusions, and suggestions. This page also includes a conclusion and a research idea, as well as research limits and recommendations for future researchers.

Summary of Findings

This chapter presents the summarized findings of the study based on the analysis and interpretation of collected data. The results indicate the overall performance and acceptability of the proposed system across various evaluation criteria.

1. **Demographic Profile of the Respondents at Cainta Catholic College in terms of:**

    1.1 **Department.** The study included 14 respondents, with 4 from Elementary (28.57%), 4 from High School (28.57%), and 6 from College (42.86%).

2. **Level Of Performance of the Proposed Systems in terms of**:

    2.1 Reliability. With a mean score of 3.67 under Very High Performance, the system maintained consistent functionality with minimal technical issues. Users found its stable connections and dependable operation suitable for daily use.

2.2 User Interface. The system received an overall mean score of 3.74, categorized as Very High Performance, indicating that users found the interface responsive and visually appealing. Its well-structured layout and intuitive design contributed to a seamless user experience.

2.3 Accuracy. The system demonstrated precise RFID recognition, accurately distinguishing between authorized and unauthorized users, achieving a mean score of 3.81. This accuracy ensured that commands were reliably executed, preventing errors and unauthorized access.

2.4 Functionality. The integration between RFID and mobile control was smooth, achieving an overall mean score of 3.83 under Very High Performance. Users noted that commands were executed efficiently without noticeable delays, enhancing operational effectiveness.

2.5 User-Friendliness. With an overall mean of 3.79, the system was rated as Very High Performance, proving to be easy to learn and navigate even for non-technical users. The intuitive controls and minimal learning curve contributed to an overall satisfying user experience.

3. **Level of Acceptability of the Proposed System in terms of:**

3.1 Reliability. The system demonstrated stable performance under various conditions, earning an overall mean score of 3.64 under Highly Acceptable. Users found it dependable for daily operations, with smooth functionality even under heavy usage.

3.2 User Interface. The system's intuitive design and ease of interaction resulted in an overall mean score of 3.84. Users appreciated its well-organized layout, which facilitated effortless navigation and usability.

3.3 Accuracy. Achieving a mean score of 3.77, the system consistently identified users correctly and executed commands without errors. This level of precision reinforced its reliability and security in real-world applications.

3.4 Functionality. The system met all operational requirements as an electricity control solution, earning a Highly Acceptable rating with a mean score of 3.74. Its seamless execution of tasks and effective integration ensured a smooth and efficient user experience.

3.5 User-Friendliness. With an overall mean of 3.84, the system was rated as highly acceptable in terms of user-friendliness and ease of navigation. The straightforward controls and well-designed interface allowed users to operate the system with minimal effort.

4. **Significant Difference Between The Level of Performance and Acceptability**

The findings indicate that there is no statistically significant difference between the Level of Performance and Level of Acceptability of the RFID and Mobile Phone-Based Smart Electricity Control System across all evaluated variables. The p-values for User Interface (0.151), Functionality (0.212), User-Friendliness (0.513), Accuracy (0.385), and Reliability (0.671) are all greater than the 0.05 significance level. Since all p-values exceed this threshold, the results

suggest that the system's performance and acceptability are closely aligned, demonstrating its effectiveness and user satisfaction.

Conclusion

Based on the findings of this study, the RFID and Mobile Phone-Based Smart Electricity Control System for Computer Laboratories at0000000000 Cainta Catholic College has demonstrated a high level of performance and acceptability among users. The system effectively integrates RFID technology and mobile control, providing an efficient, user-friendly, and reliable solution for managing electricity usage in computer laboratories.

The system received high ratings across all evaluation criteria, including User Interface, Functionality, User-Friendliness, Accuracy, and Reliability. The statistical analysis confirmed that there is no significant difference between performance and acceptability, further validating the effectiveness and practicality of the system.

The results indicate that the system is capable of meeting the needs of faculty members, students, school administrators, and the institution as a whole. By automating electricity management, the system enhances operational efficiency, reduces energy waste, and contributes to a more secure and sustainable learning environment.

Recommendations

For the faculty, the system should be officially implemented in the computer laboratories to ensure proper management and control of electrical devices.

Faculty members should be trained in using the system to minimize electrical wastage and prevent malfunctions. With proper knowledge of the system, faculty members can maximize its potential in ensuring energy efficiency and operational convenience.

For the students, while they do not directly control the system, they should be informed of its benefits in ensuring consistent access to lab resources. Future developments could consider student feedback to further enhance the system's usability and effectiveness. Their awareness and understanding of the system will help them appreciate its role in improving their learning environment.

For Cainta Catholic College, the institution should adopt the system to improve energy management and security within the school premises. Expansion of the system to other school areas such as classrooms and offices should be explored for better sustainability. Implementing this system can contribute to cost savings and a more responsible approach to energy consumption.

For school administrators, they should utilize the RFID and mobile phone application for streamlined monitoring and management of electrical usage. Regular assessments should be conducted to ensure continuous improvement and efficiency of the system. Administrators can benefit from the convenience of remote access, enabling better oversight and control over electricity usage.

For future researchers, this study can serve as a reference for developing similar systems or improving upon the existing model. Enhancements such as AI-driven analytics, integration with renewable energy sources, and real-time

electricity consumption measurement could significantly improve its functionality. Future research may also explore the integration of a cloud server to enable seamless communication between the RFID system and mobile devices, utilizing platforms like Raspberry Pi for efficient data processing and remote monitoring. Additionally, incorporating a sound alarm notification system can remind teachers to turn off the electricity when leaving the room, promoting energy conservation. Further studies can address potential limitations and explore new technological advancements to optimize the system's effectiveness. By adopting these recommendations, the institution can maximize the potential benefits of the RFID and Mobile Phone-Based Smart Electricity Control System and contribute to a more technologically advanced and energy-efficient learning environment.

REFERENCES

Aljarrah, E., Elrehail, H., & Aababneh, B. (2016). E-voting in Jordan: Assessing readiness and developing a system. *Computers in Human Behavior*, *63*, 860–867. https://doi.org/10.1016/j.chb.2016.05.076

Amendola, S., De Vito, L., & Rizzi, A. (2014). RFID technology for IoT-based personal healthcare in smart spaces. *International Journal of Advanced Computer Science and Applications,* *5*(3), 1-6. https://doi.org/10.14569/IJACSA.2014.050301

Binondo, Y. C., Magbanua, M. E., Rago, G., Sanjuan, A. N., Teoxon, J. V., (2022). PROTOTYPE: RFID DOOR SECURITY SYSTEM, Cainta Catholic College, Cainta, Rizal

Booc, R. P., Laderas, M. A., & Rivas, J. S. (2020). IoT based: Mobile controlled appliances with online monitoring system. *ISJ Theoretical & Applied Science, 8*(88), 58-64. https://www.academia.edu/download/84067886/08-88-15.pdf

Cecati, Carlo & Mokryani, Geev & Piccolo, Antonio & Siano, Pierluigi. (2010). An overview on the Smart Grid concept. IECON Proceedings (Industrial Electronics Conference). 3322 - 3327. 10.1109/IECON.2010.5675310.

Das, S., Nag, S., Pyne, S. and Roy, D.S.S.,(2017). Low cost energy efficient remotely controlled smart home security system. *Advances in Industrial Engineering and Management*, *6*(1), pp.53-56. https://aiem.com.my/archives/2017/1/53-56.pdf

Davis, F. D., & Venkatesh, V. (1996). A critical assessment of potential measurement biases in the technology acceptance model: three experiments. *International Journal of Human-Computer Studies*, *45*(1), 19–45. https://doi.org/10.1006/ijhc.1996.0040

E. Matillano and R. I. Canda, "Design and Development with Analysis of Energy Efficient University Faculty Room based on IoT," 2022 IEEE 2nd International Conference on Electronic Technology, Communication and Information (ICETCI), Changchun, China, 2022, pp. 194-199 https://ieeexplore.ieee.org/abstract/document/9832362/authors#authors

Flores, J. P., Laxa, R. J. S., Jocson, J. C., & de Lara, R. J. L. (2023). Design of Smart Classroom System Using RFID Technology: Energy Saving Tool. International Journal of Progressive Research in Science and Engineering, 4(4), 83–89. Retrieved from https://journal.ijprse.com/index.php/ijprse/article/view/820

Fontanilla, R. C., Querol, J. V., & Tejada, M. A. (2023). *“EXTENDING THE CAPACITY OF AN RFID TECHNOLOGY AND REAL TIME CLOCK IN CONTROLLING THE POWER DISTRIBUTION OF”* ResearchGate. https://doi.org/10.17605/OSF.IO/CHBXD

Galera, Kristine Mae & Llantos, Orven. (2017). Mobile Web Energy Monitoring System Using DFRduino Uno. Procedia Computer Science. 124. 706-713. DOI:10.1016/j.procs.2017.12.208

Galvez, F. P. ., Fernandez, D. ., Mancio, J. V. ., Sestina, S. ., & Buscagan, N. . (2020). Development of Classroom Automated Power Control by Using Arduino and RFID with Classroom Scheduling System. *Ascendens Asia Singapore – Bestlink College of the Philippines Journal of Multidisciplinary Research*, *2*(1). Retrieved from https://ojs.aaresearchindex.com/index.php/aasgbcpjmra/article/view/1404

G. F. P. Palencia, H. L. G. Bernadez, L. P. Q. Enriquez, M. P. D. D. Negru and A. S. Banacia, "Time-controlled access with power management using RFID acquisition and power control distribution," 2015 International Conference on Humanoid, Nanotechnology, Information Technology,Communication and Control, Environment and Management (HNICEM), Cebu, Philippines, 2015, pp. 1-7 https://ieeexplore.ieee.org/abstract/document/7393214/metrics#metrics

Hasan, Mohammad Kamrul, Ahmed, Musse Mohamud, Pandey, Bishwajeet, Gohel, Hardik, Islam, Shayla, Khalid, Izzul Fitrie, Internet of Things-Based Smart Electricity Monitoring and Control System Using Usage Data, Wireless Communications and Mobile Computing, 2021, 6544649, 16 pages, 2021. https://doi.org/10.1155/2021/6544649

J. B. Ibarra et al., "Development of WiFi-Based Convenience Outlet with Graphical User Interface for Monitoring Power Consumption of RFID-Based Appliances," 2019 IEEE 11th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management (HNICEM), Laoag, Philippines, 2019, pp. 1-5, doi: 10.1109/HNICEM48295.2019.9073394.

Kanade, V. (2024, March 13). What is automation? Definition, types, benefits, and importance | Spiceworks. Spiceworks Inc. https://www.spiceworks.com/tech/artificial-intelligence/articles/what-is-automation/#:~:text=Automation%20is%20the%20use%20of,February%2026%2C%202024

Ltd, D. I. P., & Ltd, D. I. P. (2024, October 4). How does automation in IT help businesses and individuals? Digittrix Infotech. https://digittrix.com/blogs/how-does-automation-in-it-help-businesses-and-individuals

Nepa, Kimberly & Angelia, Randy. (2021). Android-Based Mobile Application for Managing the Laboratory Air Conditioning Units. 194-199. https://doi.org/10.1109/CGIP62525.2024.00012

Nikolopoulou, K. (2023, June 22). What Is Purposive Sampling? | Definition & Examples. Scribbr. Retrieved October 15, https://www.scribbr.com/methodology/purposive-sampling/

N. S. Lopez, J. Gonzaga and L. A. G. Lim, "Energy audit and analysis of the electricity consumption of an educational building in the Philippines for smart consumption," 2017IEEE 9th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM), Manila, Philippines, 2017, pp. 1-4, https://ieeexplore.ieee.org/abstract/document/8269505

Okafor K. C., Ononiwu G. C., Precious U., and Godis A. C., (2017). “Development of Arduino based IoT metering system for on-demand energy monitoring, International Journal of Mechatronics, Electrical and Computer Technology”, 7, 3208–3224. https://onlinelibrary.wiley.com/doi/full/10.1155/2021/6544649

O. A. Allah, S. Abdalla, M. Mekki and A. Awadallah, "RFID based Access Control and Registration System," *2018 International Conference on Computer, Control, Electrical, and Electronics Engineering (ICCCEEE)*, Khartoum, Sudan, 2018, pp. 1-4, doi:10.1109/ICCCEEE.2018.8515794.

Olipas, C. N. (2023). “A Sentiment Analysis Approach on the Acceptance of Radio Frequency Identification Technology-Based Solutions among Schools in Nueva Ecija, Philippines.” Altezoro, s. r. o. & Dialog. https://www.ceeol.com/search/article-detail?id=1173859

Oracle, *Accelerate Your Operations with IOT*. (n.d.). https://www.oracle.com/ph/internet-of-things/#:~:text=What%20is%20IoT%3F,and%20systems%20over%20the%20internet.

Patil, Manoj A. & Parane, Khyamling & Poojara, Shivananda & Patil, Ashwini. (2021). Internet-of-things and mobile application based hybrid model for controlling energy system. International Journal of Information Technology. DOI:10.1007/s41870-021-00667-1

Raikar, S. P. (2023, September 13). *Radio-frequency identification (RFID) | Technology, History, & Applications*. Encyclopedia Britannica. https://www.britannica.com/technology/RFID

Seels, B.B. and Richey, R.C. (1994) Instructional technology: The definition and domains of the field. AECT, Washington DC. https://www.scirp.org/reference/referencespapers?referenceid=1062503

R. J. M. Simbulan, I. C. U. Navalta and C. F. Ostia, "Development of a Smart Convenience Outlet with Radio Frequency Identification (RFID) Reader and Android Application for Power Monitoring, Control, and Protection of Electrical Home Appliances," 2023 IEEE 14th Control and System Graduate Research Colloquium (ICSGRC), Shah Alam, Malaysia, 2023, pp. 33-38, doi: 10.1109/ICSGRC57744.2023.10215394.

S. N. Shah and A. Abuzneid, "IoT Based Smart Attendance System (SAS) Using RFID," *2019 IEEE Long Island Systems, Applications and Technology Conference (LISAT), Farmingdale, NY, USA, 2019, pp. 1-6,* doi:10.1109/LISAT.2019.8817339

Smart grids - IEA. (n.d.). IEA. https://www.iea.org/energy-system/electricity/smart-grids

System Reliability Definition | Law Insider. (n.d.). Law Insider. https://www.lawinsider.com/dictionary/system-reliability#:~:text=System%20Reliability%20means%20the%20probability, Sample%201

Tranquillo, J., Goldberg, J., & Allen, R. (2022). Detailed design. In Elsevier eBooks (pp. 235–285). https://doi.org/10.1016/b978-0-12-816444-0.00008-0

Team, W. (2024, October 2). *The ultimate step-by-step guide to streamlining your business processes*. Webflow. https://webflow.com/blog/streamlining-processes

Upadhye, V. K., & Turkane, S. M. (2017). Remote Control of Home Appliances with Smart Energy Efficient Model Using Android Application Based on Raspberry Pi Embedded Linux Board. *International Research Journal of Engineering and Technology (IRJET)*, *4*(6), 1640-1646.

U. Mir, U. Abbasi, T. Mir, S. Kanwal and S. Alamri, "Energy Management in Smart Buildings and Homes: Current Approaches, a Hypothetical Solution, and Open Issues and Challenges," in IEEE Access, vol. 9, pp. 94132-94148, 2021, doi:10.1109/ACCESS.2021.3092304.

Velasco, Rose Mary. (2023). IoT Security Solutions for Students' Laboratory with RFID-based Attendance Authentication. Volume 5. pp. 23-32, ISSN 2686. DOI: https://doi.org/10.32664/ijitgeb.v5i1.106

What is IoT? - Internet of Things Explained - AWS. (n.d.). Amazon Web Services, Inc.https://aws.amazon.com/whatis/iot/#:~:text=The%20term%20IoT%2C%20or%20Internet,as%20between%20the%20devices%20themselves.

Xu, Y., Yan, C., Liu, H., Wang, J., Yang, Z., & Jiang, Y. (2020). Smart energy systems: A critical review on design and operation optimization. Sustainable Cities and Society, 62, 102369. https://doi.org/10.1016/j.scs.2020.102369

APPENDICES

APPENDIX A

SURVEY QUESTIONNAIRE

"DEVELOPMENT OF RFID AND MOBILE PHONE-BASED SMART ELECTRICITY CONTROL SYSTEM FOR COMPUTER LABORATORIES AT CAINTA CATHOLIC COLLEGE"

1. Demographic of the respondents
   1.1 Which department are you affiliated with?
   ( ) College Department
   ( ) High School Department
   ( ) Grade School Department
   Other (please specify): _____

Likert Scale	Range	Verbal Interpretation
4	3.25 – 4.0	Strongly Agree
3	2.50 – 3.24	Agree
2	1.75 – 2.49	Disagree
1	1.0 – 1.74	Strongly Disagree

Level Of Performance

2.Rating: 4 - Strongly Agree, 3 – Agree, 2 – Disagree ,1 – Strongly Disagree

User Interface	(4) SA	(3) A	(2) D	(1) SD
1.The interface responds to user input promptly without delays.				
2.The system's interface design is visually appealing.				
3.The system handles user input without freezing or lagging.				
4.The system provides clear and effective visual indicators for the status of actions				
5.The user interface supports interaction effectively without causing errors or confusion.				
Functionality				
1.The integration between RFID and mobile control functions is smooth				
2.The system performs well without noticeable lag or delay when executing commands from RFID or the mobile application.				

3.The system effectively supports operation by one person at a time using either RFID or mobile phone commands.				
4. The system executes commands quickly when RFID tags are scanned.				
5.The system quickly executes commands when RFID tags are scanned				
User Friendliness				
1.The system is easy for new users to learn and operate.				
2.The overall user experience of the system is satisfactory.				
3.The system responds well to user inputs.				
4.The system is accessible and easy to use for non-technical users.				
5.The system provides clear feedback when an action is performed.				
Accuracy				
1.The system accurately recognizes and responds to RFID scans.				
2.The system precisely identifies specific user inputs.				
3.The system accurately processes commands from the mobile application.				
4.The system effectively differentiates between authorized and unauthorized users.				
5.The system reliably reads RFID tags from varying distances.				
Reliability				
1.The system maintains consistent performance during use.				
2.The system reliably connects with RFID and mobile devices.				

3.The system operates consistently without technical issues.				
4.The system executes commands accurately and consistently.				
5.The system consistently operates without unexpected downtime or malfunctions.				

Level of Acceptability

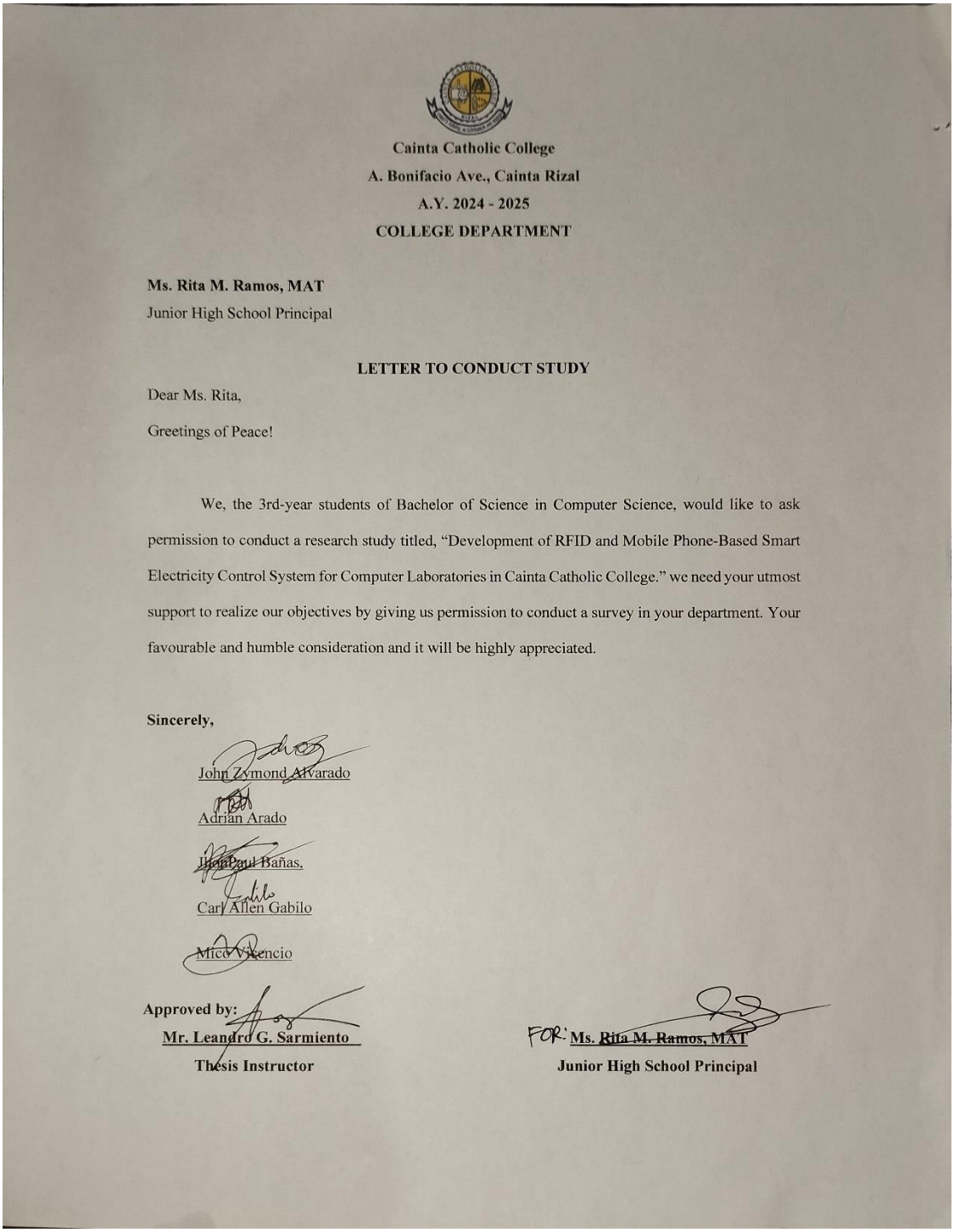
3. Rating: 4 - Strongly Agree, 3 – Agree, 2 – Disagree ,1 – Strongly Disagree

User Interface	(4) SA	(3) A	(2) D	(1) SD
1.The interface design is user-friendly and simple to understand.				
2.Users feel comfortable while interacting with the system.				
3.The buttons, icons, and labels are easy to understand and use.				
4.I can easily locate and use the system's features.				
5.The system provides clear and understandable feedback when an action is performed.				
Functionality				
1.The system meets all the operational needs expected from an electricity control system.				
2. There is no lag or delay in executing commands from either the RFID or the mobile application.				
3.The system's functions are straightforward to understand.				
4.The system is easy for new users to learn and operate.				
5.All essential features of the system are available and work correctly.				
User Friendliness				
1.The system’s interface is easy to navigate, even for users with limited technical knowledge.				

2.The system is easy to use without needing detailed instructions or assistance.				
3.System instructions are clear and easy to follow.				
4.The system’s design makes it easy to perform tasks without unnecessary complexity.				
5.The system's interface adapts well to different screen sizes or devices.				
Accuracy				
1.The system is precise in identifying authorized users				
2.The processes within the system are easy to understand and use.				
3. The system reliably executes commands without errors.				
4. The system effectively differentiates between valid and invalid entries.				
5. The system accurately registers input from mobile devices and RFID cards.				
Reliability				
1.The system is dependable for regular use.				
2.The system maintains consistent performance over time.				
3.The system operates smoothly under varying conditions (e.g., power outages).				
4.The system can operate reliably even under heavy usage.				
5.The system is dependable in maintaining functionality without frequent interruptions.				

APPENDIX B

REQUEST LETTER



Cainta Catholic College
A. Bonifacio Ave., Cainta Rizal
A.Y. 2024 - 2025
COLLEGE DEPARTMENT

Ms. Rita M. Ramos, MAT
Junior High School Principal

LETTER TO CONDUCT STUDY

Dear Ms. Rita,

Greetings of Peace!

We, the 3rd-year students of Bachelor of Science in Computer Science, would like to ask permission to conduct a research study titled, "Development of RFID and Mobile Phone-Based Smart Electricity Control System for Computer Laboratories in Cainta Catholic College." we need your utmost support to realize our objectives by giving us permission to conduct a survey in your department. Your favourable and humble consideration and it will be highly appreciated.

Sincerely,

John Zymond Alvarado
Adrian Arado
JhanPaul Bañas
Carl Allen Gabilo
Mico Vicencio

Approved by:

Mr. Leandro G. Sarmiento
Thesis Instructor

FOR: **Ms. Rita M. Ramos, MAT**
Junior High School Principal

Cainta Catholic College
A. Bonifacio Ave., Cainta Rizal
A.Y. 2024 - 2025
COLLEGE DEPARTMENT

Mr. Joriel P. Catura, MAT
Senior High School Principal

LETTER TO CONDUCT STUDY

Dear Mr. Catura,

Greetings of Peace!

We, the 3rd-year students of Bachelor of Science in Computer Science, would like to ask permission to conduct a research study titled, "Development of RFID and Mobile Phone-Based Smart Electricity Control System for Computer Laboratories in Cainta Catholic College." we need your utmost support to realize our objectives by giving us permission to conduct a survey in your department. Your favourable and humble consideration and it will be highly appreciated.

Sincerely,

John Zymond Alvarado
Adrian Arado
JhonPaul Bañas,
Carl Allen Gabilo
Mico Vicencio

Approved by:

Mr. Leandro G. Sarmiento
Thesis Instructor

Mr. Joriel P. Catura, MAT
Senior High School Principal

> To be answered (survey) by the SHS computer teacher.

12/4/2024

Cainta Catholic College
A. Bonifacio Ave., Cainta Rizal
A.Y. 2024 - 2025
COLLEGE DEPARTMENT

Dr. Lerma S. Fernandez
College Dean

LETTER TO CONDUCT STUDY

Dear Dr. Fernandez,

Greetings of Peace!

We, the 3rd-year students of Bachelor of Science in Computer Science, would like to ask permission to conduct a research study titled, "Development of RFID and Mobile Phone-Based Smart Electricity Control System for Computer Laboratories in Cainta Catholic College." we need your utmost support to realize our objectives by giving us permission to conduct a survey in your department. Your favourable and humble consideration and it will be highly appreciated.

Sincerely,

John Zymond Alvarado
Adrian Arado
JhonPaul Bañas,
Carl Allen Gabilo
Mico Vicencio

Approved by:

Mr. Leandro G. Sarmiento
Thesis Instructor

Dr. Lerma S. Fernandez
College Dean

Cainta Catholic College
A. Bonifacio Ave., Cainta Rizal
A.Y. 2024 - 2025
COLLEGE DEPARTMENT

Mrs. Jennifer A. Yadao, MAED
Grade School Principal

LETTER TO CONDUCT STUDY

Dear Mrs. Yadao,

Greetings of Peace!

We, the 3rd-year students of Bachelor of Science in Computer Science, would like to ask permission to conduct a research study titled, "Development of RFID and Mobile Phone-Based Smart Electricity Control System for Computer Laboratories in Cainta Catholic College." we need your utmost support to realize our objectives by giving us permission to conduct a survey in your department. Your favourable and humble consideration and it will be highly appreciated.

Sincerely,

John Zymond Alvarado
Adrian Arado
JhonPaul Bañas,
Carl Allen Gabilo
Mico Vicencio

Approved by:

Mr. Leandro G. Sarmiento
Thesis Instructor

Mrs. Jennifer A. Yadao, MAED
Grade School Principal

APPENDIX C

CONTENT VALIDATION

CERTIFICATION OF CONTENT VALIDATION

This is to certify that the questionnaire checklist used by the researchers to conduct the study entitled "Development of RFID and Mobile Phone-Based Smart Electricity Control System for Computer Laboratories in Cainta Catholic College" has been content validated by the following experts/teachers.

Experts	Position	Signature
Mr. Julius Salonga	BSCS Instructor	
Mr. Jethro D, Gamad	BSCS Instructor	
Mr. Rosel D.M Bianan	BSCS Instructor	
Mrs. Jennifer A. Yadao	Grade School Principal	

APPENDIX D

ADVISER CERTIFICATION

CAINTA CATHOLIC COLLEGE
Cainta, Rizal

APPOINTMENT OF THE THESIS ADVISER

November 24, 2024

Dr. Jose Procalla Jr.

Dear Mr./Ms./Mrs./Dr. Jose Procalla Jr.

This is to appoint you as thesis adviser to guide Vicencio, Mico Basas Jhon paul, on their thesis entitled "Development of RFID and Mobile Phone - Based Smart Electricity control System for Computer Laboratories in Cainta Catholic College. Kindly meet with the students regularly to evaluate the progress of their work and to guide them on their research project and research presentation.

The adviser shall be responsible for:

1. advising the students in their research project
2. guiding and monitoring the students' research project
3. endorsing their research project for final oral defense

Dr. Lerma S. Fernandez
College Dean

Conforme:

Dr. Jose Procalla Jr.

APPENDIX E

LANGUAGE EDITOR'S CERTIFICATION

Cainta Catholic College
A. Bonifacio Ave., Cainta Rizal
A.Y. 2024 - 2025
COLLEGE DEPARTMENT

Dr. Maricar C. Manuel, LPT, PhD
RDO Head

LETTER TO CHECK GRAMMAR OF THE QUESTIONNAIRE

Dear Dr. Maricar,

Greetings of Peace!

We are 3rd-year Bachelor of Science in Computer Science students, currently undertaking the research study entitled "Development of RFID and Mobile Phone-Based Smart Electricity Control System for Computer Laboratories in Cainta Catholic College"

We kindly ask for your expertise in reviewing the grammar of our questionnaires for research. Your support in facilitating this study is highly appreciated. We are looking forward to your positive response. Thank you!

Sincerely,

John Zymond Alvarado

Adrian Arado

JhonPaul Bañas,

Carl Allen Gabilo

Mico Vicencio

Approved by:

Mr. Leandro G. Sarmiento
Thesis Instructor

Dr. Maricar C. Manuel, LPT, PhD
RDO Head

APPENDIX F

ENDORSEMENT LETTER

CAINTA CATHOLIC COLLEGE
Cainta, Rizal

RESEARCH, PLANNING AND DEVELOPMENT OFFICE

ENDORSEMENT LETTER FOR FINAL ORAL DEFENSE

March 21, 2025

Dr. Lerma S. Fernandez
College Dean

Dear Madam:

I am submitting herewith the paper of the following students: (Bachelor of Science in Computer Science)

RESEARCHERS	THESIS TITLE	DATE AND TIME OF FINAL DEFENSE
Arado, Adrian Nemuel Alvarado, John Zymond Bañas, Jhon Paul Gabilo, Carl Allen Mico Vicencio	DEVELOPMENT OF RFID AND MOBILE PHONE-BASED SMART ELECTRICITY CONTROL SYSTEM FOR COMPUTER LABORATORIES At CAINTA CATHOLIC COLLEGE	March 21, 2025 8 AM

I have examined the entire paper as regards its format and content, and I hereby recommend it for final oral defense.

Thank you.
Very truly yours,

Dr. Jose Procalla Jr.
Adviser

Approved by:

Dr. Lerma S. Fernandez
College Dean

APPENDIX G

SOURCE CODE

main.py

```
import serial
import re
import mysql.connector
from datetime import datetime
import tkinter as tk
from tkinter import ttk
from PIL import Image, ImageTk
import threading
import time
import firebase_admin
from firebase_admin import credentials, db

import calendar
from emailSender import EmailHandler

class RFIDLogSystem:
    def __init__(self):
        # MySQL connection setup
        self.db = mysql.connector.connect(
            host="localhost",
            user="root",
            password="micopogi",
            database="RFID_System"
        )

        self.cursor = self.db.cursor()
        self.first_timein = None
        self.firebase_json_path = "firebase.json"  # Path to your Firebase credentials file
        self.firebase_db_url = "https://thesis-86ff4-default-rtdb.firebaseio.com/"
        self.status_ref_path = "/status/electricity"  # Firebase reference path for status
```

```
        # Set up the serial connection
        self.esp_ref_path = "/status/esp32"  # New Firebase reference path for logs

        # Firebase setup

        self.firebase_cred = credentials.Certificate(self.firebase_json_path)
        firebase_admin.initialize_app(self.firebase_cred, {'databaseURL':
self.firebase_db_url})
        self.status_ref = db.reference(self.status_ref_path)
        self.esp32_ref = db.reference(self.esp_ref_path)  # Add another reference here
        self.last_status = None

        self.esp32 = serial.Serial("COM3", baudrate=115200, timeout=1)

        # Regular expression patterns
        self.hex_pattern = re.compile(r"Received Hex Code: ([0-9a-fA-F]+)")

        # Initialize the main window
        self.root = tk.Tk()
        self.root.title("RFID Log System")
        self.root.geometry("1500x800")
        self.root.configure(bg="#f0f0f0")
        self.root.state('zoomed')
        self.root.protocol("WM_DELETE_WINDOW", self.on_close)

        # Configure grid layout with weight distribution for full space utilization
        self.root.grid_rowconfigure(0, weight=0)
        self.root.grid_rowconfigure(1, weight=1)
        self.root.grid_columnconfigure(0, weight=1)
        self.root.grid_columnconfigure(1, weight=2)
        self.root.grid_columnconfigure(2, weight=1)

        # Load and display the logo in the top-left corner
        self.load_logo()
```

```
        # Add label for "SMART ELECTRICITY CONTROL SYSTEM" next to the seal
        self.system_label = tk.Label(self.root, text="SMART ELECTRICITY CONTROL SYSTEM - Lab A", font=('Arial', 22, 'bold'), bg="#d9eaf5", bd=2, relief="solid", anchor="w")
        self.system_label.grid(row=0, column=1, columnspan=2, padx=(10, 5), pady=10, sticky="w")

        # Time label to display the current time and date next to the system label
        self.time_label = tk.Label(self.root, font=('Arial', 20, 'bold'), bg="#d9eaf5", bd=2, relief="solid", anchor="e")
        self.time_label.grid(row=0, column=2, padx=(0, 10), pady=10, sticky="e")
        self.update_time_label()

        # Profile Section (Left side)
        self.profile_frame = tk.Frame(self.root, width=250, height=300, bg="#cfe2f3", bd=2, relief="solid")
        self.profile_frame.grid(row=1, column=0, padx=10, pady=10)

        # Frame for the current user's information
        self.profile_info_frame = tk.Frame(self.profile_frame, width=250, bg="#cfe2f3")
        self.profile_info_frame.pack(pady=10)

        # Label to display current user
        self.current_user_label = tk.Label(self.profile_info_frame, text="Current User", font=('Arial', 25,), bg="#cfe2f3")
        self.current_user_label.grid(row=0, column=0, padx=10)

        # Placeholder for profile picture
        self.load_profile_picture()

        # Labels for displaying the current user's profile (name and department)
        self.profile_name_label = tk.Label(self.profile_info_frame, text="Name: ", font=('Arial', 20), bg="#cfe2f3", width=20, anchor="w")
```

```
        self.profile_name_label.grid(row=2, column=0, padx=10)
        self.profile_dept_label = tk.Label(self.profile_info_frame, text="Department: ",
font=('Arial', 20), bg="#cfe2f3", width=20, anchor="w")
        self.profile_dept_label.grid(row=3, column=0, padx=10)

        # Logs Section (Center and Right side)
        self.logs_frame = tk.Frame(self.root, width=706, height=120, bg="red", bd=2,
relief="solid")
        self.logs_frame.grid(row=1, column=1, columnspan=2, padx=10, pady=10,
sticky="nsew")

        # Treeview style customization
        self.style = ttk.Style()
        self.style.configure("Treeview", font=('Arial', 17), padding=(5, 5), rowheight=55)
        self.style.configure("Treeview.Heading", font=('Arial', 20, 'bold'))

        # Treeview to display logs (Time In and Time Out)
        self.tree = ttk.Treeview(self.logs_frame, columns=("Name", "Department", "Time
In", "Time Out"), show="headings", height=10, style="Treeview")
        self.tree.heading("Name", text="Name", anchor="center")
        self.tree.heading("Department", text="Department", anchor="center")
        self.tree.heading("Time In", text="Time In", anchor="center")
        self.tree.heading("Time Out", text="Time Out", anchor="center")

        # Configure columns
        self.tree.column("Name", width=250, anchor="center")
        self.tree.column("Department", width=250, anchor="center")
        self.tree.column("Time In", width=250, anchor="center")
        self.tree.column("Time Out", width=250, anchor="center")

        self.tree.pack(fill="both", expand=True)

        # Start serial communication in a separate thread
        self.serial_thread = threading.Thread(target=self.read_serial_data, daemon=True)
```

```
        self.serial_thread.start()
        self.update_logs()
        self.monitor_thread = threading.Thread(target=self.monitor_and_control)
        self.monitor_thread.daemon = True  # Ensures the thread will exit when the main
program ends
        self.monitor_thread.start()
        self.set_online()

    def set_status(self, status):
        """Sets the status in the Firebase Realtime Database."""
        if self.esp32_ref:
            self.esp32_ref.set(status)
            print(f"Status set to '{status}'")
        else:
            print("Database reference is not initialized.")

    def set_online(self):
        """Sets status to 'on'."""
        self.set_status("ONLINE")

    def set_offline(self):
        """Sets status to 'offline'."""
        self.set_status("offline")

    def on_close(self):
        """Handle the window close event."""
        print("Closing the app...")
        self.set_offline()
        self.root.destroy()

    def load_logo(self):
        # Load and resize the logo image
        image = Image.open("logo.png")
        image = image.resize((200, 150), Image.LANCZOS)
```

```
        self.logo_image = ImageTk.PhotoImage(image)

        # Display logo on the top-left corner
        logo_label = tk.Label(self.root, image=self.logo_image, bg="#f0f0f0")
        logo_label.grid(row=0, column=0, padx=10, pady=10, sticky="nsew")

    def load_profile_picture(self):
        # Load a placeholder profile picture
        placeholder_image = Image.open("placeholder.png")  # Replace "placeholder.png"
with the path to your placeholder image
        placeholder_image = placeholder_image.resize((300, 260), Image.LANCZOS)
        self.profile_picture = ImageTk.PhotoImage(placeholder_image)

        # Profile picture label below "Current User"
        self.profile_picture_label = tk.Label(self.profile_info_frame,
image=self.profile_picture, bg="#cfe2f3")
        self.profile_picture_label.grid(row=1, column=0, pady=(10, 10))

    def update_time_label(self):
        current_time = time.strftime("%H:%M:%S")
        current_date = time.strftime("%A, %B %d, %Y")
        self.time_label.config(text=f"{current_date}\n{current_time}")
        self.root.after(1000, self.update_time_label)

    def update_logs(self):
        """Fetch and display the latest 11 logs in the TreeView with privacy-masked
names."""
        # Query to fetch logs
        self.cursor.execute("""
            SELECT l.name, l.timein, l.timeout, u.department
            FROM LabA_logs l
            JOIN users u ON l.name = u.name
            ORDER BY l.timein DESC
            LIMIT 11
```

```
        """)
        logs = self.cursor.fetchall()

        # Clear previous logs before inserting the updated logs
        for row in self.tree.get_children():
            self.tree.delete(row)

        # Insert each log entry into the TreeView and apply zebra striping
        for i, row in enumerate(logs):
            if len(row) == 4:  # Ensure there are exactly 4 elements in the row
                masked_name = self.mask_name(row[0])  # Mask the name for privacy
                tag = "even" if i % 2 == 0 else "odd"  # Apply 'even' or 'odd' tag for zebra
striping
                self.tree.insert('', 'end', values=(masked_name, row[3], row[1], row[2]),
tags=(tag,))  # Insert name, department, timein, timeout into the tree

        # Configure zebra striping
        self.tree.tag_configure("even", background="#f0f0f0")  # Light color for even rows
        self.tree.tag_configure("odd", background="#ffffff")

    def generate_message(self, name, do):
        now = datetime.now()

    # Get the full weekday name (e.g., Monday, Tuesday)
        day_of_week = now.strftime("%A")

    # Get the month in words (e.g., July)
        month_name = calendar.month_name[now.month]

    # Get the day, year, and time (formatted as 12-hour with AM/PM)
        day = now.day
        year = now.year
        time = now.strftime("%I:%M %p")  # Time in 12-hour format with AM/PM
```

```
    # Create the personalized message based on whether it's timein or timeout
        if do == "timein":
            message = f"Good day {name}, You entered the laboratory on {day_of_week}, {month_name} {day}, {year} at {time}"
        elif do == "timeout":
            message = f"Good day {name}, You left the laboratory on {day_of_week}, {month_name} {day}, {year} at {time}"
        else:
             message = f"Good day {name}, This Email is to remind you to turn off the electricity on {day_of_week}, {month_name} {day}, {year} at {time}"
        return message

    def add_log_entry(self, name):
        """Add a time-in or time-out entry to the log."""
        # Get current time
        current_time = datetime.now().strftime("%Y-%m-%d %H:%M:%S")

        # Mask the name for privacy
        masked_name = self.mask_name(name)

        # Check if the user has a time-in record that is not closed (no timeout)
        self.cursor.execute("SELECT id FROM LabA_logs WHERE name = %s AND timeout IS NULL", (name,))
        record = self.cursor.fetchone()

        # Check if there's an existing time-in
        if record:
            # User is already timed in, so record the timeout
            self.esp32.write(('off' + '\n').encode())
            self.cursor.execute("UPDATE LabA_logs SET timeout = %s WHERE id = %s", (current_time, record[0]))
            print(f"Timeout recorded for {name}")
            self.profile_dept_label.config(text="Department: None")  # Clear the current user after timeout
```

```
            self.profile_name_label.config(text="Name: None")  # Clear the current user after timeout
            # Reset `first_timein` to allow new time-ins after timeout
            self.cursor.execute("SELECT email FROM users WHERE name = %s", (name,))
            email = self.cursor.fetchone()
            message = self.generate_message(name,"timeout")
            email_handler = EmailHandler(email, message)
            email_handler.send()
            self.first_timein = None

        else:
            # Only log new time-in if `first_timein` is None
            if self.first_timein is None:
                self.esp32.write(('on' + '\n').encode())
                # Insert Time-in entry if no previous open record exists
                self.cursor.execute("INSERT INTO LabA_logs (name, timein) VALUES (%s, %s)", (name, current_time))
                print(f"Timein recorded for {name}")
                # Update labels with the new user's information
                self.cursor.execute("SELECT department FROM users WHERE name = %s", (name,))
                department = self.cursor.fetchone()[0]
                self.cursor.execute("SELECT email FROM users WHERE name = %s", (name,))
                email = self.cursor.fetchone()
                message = self.generate_message(name,"timein")
                email_handler = EmailHandler(email, message)
                email_handler.send()
                self.profile_name_label.config(text=f"Name: {masked_name}")  # Use masked name
                self.profile_dept_label.config(text=f"Department: {department}")
                # Set `first_timein` to this user's name to prevent another time-in
                self.first_timein = name
```

```
        # Commit the transaction
        self.db.commit()

        # Refresh the TreeView to show all logs
        self.update_logs()

    def mask_name(self, name):
        """Masks a name by showing the first two characters and the last letter, replacing the middle part with asterisks."""
        name_parts = name.split(" ")  # Split the name by spaces (for first and last name)

        masked_name_parts = []
        for part in name_parts:
            if len(part) > 2:  # Mask only if the part has more than 2 characters
                # Mask the middle characters, keeping the first 2 and last character intact
                middle_length = len(part) - 3  # Subtract 2 for the first and last character
                masked_name = part[:2] + '•' * middle_length + part[-1]
                masked_name_parts.append(masked_name)
            else:
                # Keep short names (like "Jo") as they are
                masked_name_parts.append(part)

        return " ".join(masked_name_parts)

    def read_serial_data(self):
        while True:
            line = self.esp32.readline().decode("utf-8").strip()
            match = self.hex_pattern.search(line)
            if match:
                hex_code = match.group(1)  # Extract the hex code
                print(f"Hex Code Received: {hex_code}")

                # Check if the hex code matches a user and retrieve name and department
```

```
            self.cursor.execute("SELECT name FROM users WHERE hexcode = %s",
(hex_code,))
            user = self.cursor.fetchone()

            if user:
                name = user[0]
                print(f"User Found: {name}")
                self.add_log_entry(name)
            else:
                print("Hex code not found in the database.")

    def monitor_and_control(self):
        """Combined function to monitor Firebase and send commands to ESP32."""
        while True:
            try:
                # Fetch the current status from Firebase
                current_status = self.status_ref.get()

                # Check if the status has changed
                if current_status != self.last_status:
                    if current_status == "on":
                        self.esp32.write(('on' + '\n').encode())
                        print(f"Sent to ESP32: on")
                    elif current_status == "off":
                        self.esp32.write(('off' + '\n').encode())
                        print(f"Sent to ESP32: off")

                    # Update the last status
                    self.last_status = current_status
                time.sleep(1)  # Delay before checking again
            except Exception as e:
                print(f"Error in monitor_and_control: {e}")
                time.sleep(1)  # Retry delay in case of error
```

```
    def run(self):
        # Run the Tkinter event loop
        self.root.mainloop()


# Run the application
if __name__ == "__main__":
    system = RFIDLogSystem()
    system.run()
```

emailsender.py

```
# email_service.py

import requests

class EmailService:
    def __init__(self, service_id, template_id, user_id):
        self.service_id = service_id
        self.template_id = template_id
        self.user_id = user_id
        self.url = "https://api.emailjs.com/api/v1.0/email/send"

    def send_email(self, recipient_email, message):
        # Define the payload with dynamic email and template parameters
        payload = {
            "service_id": self.service_id,
            "template_id": self.template_id,
            "user_id": self.user_id,
            "template_params": {
                "to_name": "Recipient",  # You can modify this dynamically if needed
                "from_name": "RFID System",  # The sender's name
                "message": message,  # The message content
                "to_email": recipient_email,  # Dynamically set the recipient's email address
```

```
            "reply_to": "micovicencio55@gmail.com"  # The reply-to email address
        }
    }

    # Send the email request
    response = requests.post(self.url, json=payload)

    # Check if the request was successful
    if response.status_code == 200:
        print("Email sent successfully!")
    else:
        print(f"Failed to send email. Status code: {response.status_code}, Response:
{response.text}")

class EmailHandler:
    def __init__(self, email, message):
        self.email = email
        self.message = message
        self.email_service = EmailService(service_id='service_9zbj8qj',
template_id='template_94nqmxf', user_id='Dj3EBJY39okL6yTPP')

    def send(self):
        # Use the EmailService to send the email
        self.email_service.send_email(self.email, self.message)
```

admin.py

```
import tkinter as tk
import mysql.connector
from PIL import Image, ImageTk
from tkinter import ttk
from tkinter import messagebox
```

```
class AdminPanel():
    def __init__(self):
        self.db = mysql.connector.connect(
            host="localhost",
            user="root",
            password="micopogi",
            database="RFID_System"
        )
        self.cursor = self.db.cursor()
        self.root = tk.Tk()
        self.root.geometry("800x400")
        self.root.title("Admin Panel")

        # Load and resize the logo image
        image = Image.open("seal.png")
        image = image.resize((770, 150), Image.LANCZOS)
        self.logo_image = ImageTk.PhotoImage(image)

        # Display logo on the top-left corner
        logo_label = tk.Label(self.root, image=self.logo_image, bg="#f0f0f0")
        logo_label.grid(row=0, column=0, padx=10, pady=10, sticky="nsew")

        button_frames = tk.Frame(self.root)
        button_frames.grid(row=1,column=0,padx=10,pady=10)

        create_button = tk.Button(button_frames,text="Add
Teacher",font=("Arial",15),width=20,height=2,command=self.create_window)
        create_button.grid(row=0,column=0,padx=10,pady=10)

        view_teachers = tk.Button(button_frames,text="View
Teachers",font=("Arial",15),width=20,height=2,command=self.show_teachers)
        view_teachers.grid(row=0,column=1,padx=10,pady=10)
```

```
        update_teacher = tk.Button(button_frames,text="Update
Teacher",font=("Arial",15),width=20,height=2,command=self.update_teacher)
        update_teacher.grid(row=1,column=0,padx=10,pady=10)

        delete_teacher = tk.Button(button_frames,text="Delete
Teacher",font=("Arial",15),width=20,height=2,command=self.delete_teacher)
        delete_teacher.grid(row=1,column=1,padx=10,pady=10)

    def run(self):
        self.root.mainloop()

    def create_window(self):
        self.create = tk.Toplevel()
        self.create.geometry("400x350")
        self.create.title("Creating Teacher")

        title = tk.Label(self.create,text="Enter Details",font=("Arial",15))
        title.grid(row=0,column=1,padx=10,pady=10,sticky="nsew")

        name_label = tk.Label(self.create,text="Name:",font=("Arial",15))
        self.name_entry = tk.Entry(self.create,font=("Arial",15))
        name_label.grid(row=1,column=0,padx=10,pady=10)
        self.name_entry.grid(row=1,column=1,padx=10,pady=10)



        department_label = tk.Label(self.create,text="Department:",font=("Arial",15))
        department_label.grid(row=2,column=0,padx=10,pady=10)
        options  = ["Elementary", "Senior High", "Junior High", "College"]
        self.department_choices =
ttk.Combobox(self.create,values=options,state="readonly",font=("Arial",14))
        self.department_choices.set("Select Department")
        self.department_choices.grid(row=2,column=1,padx=10,pady=10)

        email_label = tk.Label(self.create,text="Email:",font=("Arial",15))
```

```
        self.email_entry = tk.Entry(self.create,font=("Arial",15))
        email_label.grid(row=3,column=0,padx=10,pady=10)
        self.email_entry.grid(row=3,column=1,padx=10,pady=10)

        hexcode_label = tk.Label(self.create,text="Hexcode:",font=("Arial",15))
        self.hexcode_entry = tk.Entry(self.create,font=("Arial",15))
        hexcode_label.grid(row=4,column=0,padx=10,pady=10)
        self.hexcode_entry.grid(row=4,column=1,padx=10,pady=10)

        submit =
tk.Button(self.create,text="Submit",font=("Arial",15),command=self.create_teacher)
        submit.grid(row=5,column=1,padx=10,pady=10)

    def create_teacher(self):
        name = self.name_entry.get()
        department = self.department_choices.get()
        email = self.email_entry.get()
        hexcode = self.hexcode_entry.get()

        name_query = "SELECT name FROM users"
        self.cursor.execute(name_query)
        result = self.cursor.fetchall()

        teacher_exist = False
        for row in result:
            if row[0] == name:
                teacher_exist = True
                break
        if teacher_exist:
            messagebox.showerror("Error", "Teacher already exists in the database.")
        else:
            sql_query = "INSERT INTO users (name, department, hexcode, email) VALUES
(%s, %s, %s, %s)"
            data = (name, department, hexcode, email)
```

```
            try:
                self.cursor.execute(sql_query, data)
                self.db.commit()
                messagebox.showinfo("Done","Adding Teacher Succesfully")
                self.create.destroy()
            except mysql.connector.Error as err:
                print(f"Error: {err}")

    def show_teachers(self):
        """
        Display a window showing a list of teachers in a treeview
        with a zebra-stripe design and department information.
        """
        self.showPanel = tk.Toplevel()
        self.showPanel.geometry("400x400")
        self.showPanel.title("List of Teachers")

        # Title
        title = tk.Label(self.showPanel, text="Teachers for Lab A", font=("Arial", 15))
        title.pack(padx=10, pady=10)

        # Treeview setup
        columns = ("Name", "Department")
        tree = ttk.Treeview(self.showPanel, columns=columns, show="headings",
height=15)
        tree.pack(fill=tk.BOTH, expand=True, padx=10, pady=10)

        # Define column headers
        tree.heading("Name", text="Name")
        tree.heading("Department", text="Department")
        tree.column("Name", width=150, anchor="w")
        tree.column("Department", width=150, anchor="w")

        # Zebra style (alternating row colors)
```

```
    style = ttk.Style()
    style.configure("Treeview", font=("Arial", 12), rowheight=25)
    style.map("Treeview", background=[("selected", "lightblue")])
    style.configure("Treeview.Heading", font=("Arial", 12, "bold"))
    tree.tag_configure("odd", background="lightgray")
    tree.tag_configure("even", background="white")

    # Query to fetch teacher names and departments
    name_query = "SELECT name, department FROM users"
    self.cursor.execute(name_query)
    result = self.cursor.fetchall()

    # Insert data into treeview with zebra striping
    for i, row in enumerate(result):
        tag = "even" if i % 2 == 0 else "odd"
        tree.insert("", "end", values=row, tags=(tag,))



def on_combobox_select(self,event):
    name = self.update_nameU.get()

    query = "SELECT * FROM users WHERE name = %s"
    self.cursor.execute(query,(name,))
    result = self.cursor.fetchone()
    print(result)
    if result:
        # Update the Tkinter variables with the fetched values
        self.depPlace.set(result[2])
        self.hexPlace.set(result[3])
        self.emailPlace.set(result[4])

def update_teacher(self):
    self.update_window = tk.Toplevel()
    self.update_window.geometry("480x320")
```

```
        self.update_window.title("Updating Information")

        name_query = "SELECT name FROM users"
        self.cursor.execute(name_query)
        result = self.cursor.fetchall()
        options = [row[0]for row in result]

        # Initialize Tkinter variables
        self.depPlace = tk.StringVar()
        self.hexPlace = tk.StringVar()
        self.emailPlace = tk.StringVar()

        title = tk.Label(self.update_window,text="Update Information",font=("Arial",15))
        title.grid(row=0,column=1,padx=10,pady=10)

        name = tk.Label(self.update_window,text="Select Teacher",font=("Arial",15))
        name.grid(row=1,column=0,padx=10,pady=10)
        self.update_nameU = ttk.Combobox(self.update_window,values=options,
state="readonly", font=("Arial",15))
        self.update_nameU.grid(row=1,column=1,padx=10,pady=10)
        self.update_nameU.bind("<<ComboboxSelected>>", self.on_combobox_select)

        department_label =
tk.Label(self.update_window,text="Department:",font=("Arial",15))
        department_label.grid(row=2,column=0,padx=10,pady=10)
        options  = ["Elementary", "Senior High", "Junior High", "College"]
        self.department_choicesU =
ttk.Combobox(self.update_window,values=options,textvariable=self.depPlace,state="rea
donly",font=("Arial",14))
        self.department_choicesU.set("Select Department")
        self.department_choicesU.grid(row=2,column=1,padx=10,pady=10)


        email_label = tk.Label(self.update_window,text="Email:",font=("Arial",15))
```

```
        self.email_entryU =
tk.Entry(self.update_window,textvariable=self.emailPlace,font=("Arial",15))
        email_label.grid(row=3,column=0,padx=10,pady=10)
        self.email_entryU.grid(row=3,column=1,padx=10,pady=10)

        hexcode_label = tk.Label(self.update_window,text="Hexcode:",font=("Arial",15))
        self.hexcode_entryU =
tk.Entry(self.update_window,textvariable=self.hexPlace,font=("Arial",15))
        hexcode_label.grid(row=4,column=0,padx=10,pady=10)
        self.hexcode_entryU.grid(row=4,column=1,padx=10,pady=10)

        submit =
tk.Button(self.update_window,text="Submit",font=("Arial",15),command=self.update_info
rmation)
        submit.grid(row=5,column=1,padx=10,pady=10)

    def update_information(self):
        name = self.update_nameU.get()
        department = self.department_choicesU.get()
        email = self.email_entryU.get()
        hexcode = self.hexcode_entryU.get()

        query = "UPDATE users SET department = %s, email = %s, hexcode = %s
WHERE name = %s"
        data = (department,email,hexcode,name)

        try:
            self.cursor.execute(query,data)
            self.db.commit()
            print("Commit successful")
            messagebox.showinfo("Notice","Updatin Details Successfuly!")
            self.update_window.destroy()
        except mysql.connector.Error as err:
            messagebox.showerror("Error",f"{err}")
```

```
    def delete_teacher(self):
        self.delete_window = tk.Toplevel()
        self.delete_window.geometry("480x220")
        self.delete_window.title("Deleting Teacher")

        name_query = "SELECT name FROM users"
        self.cursor.execute(name_query)
        result = self.cursor.fetchall()
        options = [row[0]for row in result]

        title = tk.Label(self.delete_window, text="Select Teacher",font=("Arial",15))
        title.pack(padx=10,pady=10)

        self.del_name = ttk.Combobox(self.delete_window,values=options,font=("Arial",15))
        self.del_name.pack(padx=10,pady=10)

        submit = tk.Button(self.delete_window,text="Delete", font=("Arial",15),
command=self.delete_record)
        submit.pack(padx=10,pady=10)

    def delete_record(self):
        name = self.del_name.get()
        query = "DELETE FROM users WHERE name = %s"

        try:
            self.cursor.execute(query,(name,))
            self.db.commit()
            self.delete_window.destroy()
            messagebox.showinfo("Notice","Deleting Teacher Sucessfully!")
        except mysql.connector.Error as err:
            messagebox.showerror("Error",f"{err}")
```

```
adminPanel = AdminPanel()
adminPanel.run()
activity_main.xml
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:background="@drawable/bg"
    android:orientation="vertical"
    android:padding="16dp">

    <!-- Seal Image -->

    <!-- Centered Content -->

    <ImageView
        android:id="@+id/sealImageView"
        android:layout_width="wrap_content"
        android:layout_height="124dp"
        android:layout_gravity="center_horizontal"
        android:contentDescription="Seal Image"
        android:src="@drawable/seal" />

    <LinearLayout
        android:layout_width="379dp"
        android:layout_height="518dp"
        android:layout_weight="1"
        android:gravity="center"
        android:orientation="vertical">

        <!-- Title -->
        <TextView
            android:id="@+id/titleTextView"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
```

```
    android:layout_marginBottom="8dp"
    android:text="Admin Application"
    android:textColor="#000000"
    android:textSize="24sp"
    android:textStyle="bold" />

<!-- Subtitle -->
<TextView
    android:id="@+id/subtitleTextView"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_marginBottom="32dp"
    android:text="Mobile Switch for Laboratory A"
    android:textColor="#000000"
    android:textSize="18sp" />

<!-- ESP32 Status -->
<TextView
    android:id="@+id/esp32StatusTextView"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_marginBottom="16dp"
    android:text="ESP32 Status: OFFLINE"
    android:textColor="#000000"
    android:textSize="20sp" />

<!-- Electricity Status -->
<TextView
    android:id="@+id/electricityStatusTextView"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_marginBottom="16dp"
    android:text="Electricity Status: OFF"
    android:textColor="#000000"
```

```
            android:textSize="20sp" />

        <!-- Electricity Switch -->
        <Switch
            android:id="@+id/electricitySwitch"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:layout_marginTop="16dp"
            android:scaleX="1.5"
            android:scaleY="1.5"
            android:text="Toggle Electricity"
            android:textColor="#000000" />
    </LinearLayout>

</LinearLayout>
```

MainActivity.java

```
package com.example.thesis;

import androidx.annotation.NonNull;
import androidx.appcompat.app.AppCompatActivity;

import android.os.Bundle;
import android.widget.Switch;
import android.widget.TextView;
import android.widget.Toast;

import com.google.firebase.database.DataSnapshot;
import com.google.firebase.database.DatabaseError;
import com.google.firebase.database.DatabaseReference;
import com.google.firebase.database.FirebaseDatabase;
import com.google.firebase.database.ValueEventListener;

import java.util.HashMap;
```

```
import java.util.Map;

public class MainActivity extends AppCompatActivity {

    private DatabaseReference databaseReference;
    private Switch electricitySwitch;
    private TextView electricityStatusTextView, esp32StatusTextView;
    private boolean isElectricityOn = false;
    private boolean isEsp32Online = false;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);

        // Initialize Firebase Database reference
        databaseReference = FirebaseDatabase.getInstance().getReference("status");

        // Initialize UI components
        electricitySwitch = findViewById(R.id.electricitySwitch);
        electricityStatusTextView = findViewById(R.id.electricityStatusTextView);
        esp32StatusTextView = findViewById(R.id.esp32StatusTextView);

        // Read the current statuses from Firebase
        databaseReference.addValueEventListener(new ValueEventListener() {
            @Override
            public void onDataChange(@NonNull DataSnapshot snapshot) {
                if (snapshot.exists()) {
                    // Read electricity status
                    String electricityStatus = snapshot.child("electricity").getValue(String.class);
                    if (electricityStatus != null) {
                        isElectricityOn = electricityStatus.equals("on");
                        electricityStatusTextView.setText("Electricity: " +
electricityStatus.toUpperCase());
```

```
                electricitySwitch.setChecked(isElectricityOn);
            }

            // Read ESP32 status and update UI
            String esp32Status = snapshot.child("esp32").getValue(String.class);
            if (esp32Status != null) {
                isEsp32Online = esp32Status.equals("ONLINE");
                esp32StatusTextView.setText("ESP32: " + esp32Status.toUpperCase());

                // Disable the switch if ESP32 is offline
                electricitySwitch.setEnabled(isEsp32Online);
                if (!isEsp32Online) {
                    Toast.makeText(MainActivity.this, "ESP32 is Offline. Cannot toggle
electricity.", Toast.LENGTH_SHORT).show();
                }
            }
        }
    }

    @Override
    public void onCancelled(@NonNull DatabaseError error) {
        Toast.makeText(MainActivity.this, "Failed to read database",
Toast.LENGTH_SHORT).show();
    }
});

// Toggle electricity status on switch change
electricitySwitch.setOnCheckedChangeListener((buttonView, isChecked) -> {
    if (isEsp32Online) {
        String newElectricityStatus = isChecked ? "on" : "off";
        Map<String, Object> updates = new HashMap<>();
        updates.put("electricity", newElectricityStatus);

        databaseReference.updateChildren(updates).addOnCompleteListener(task ->
```

```
{
                if (task.isSuccessful()) {
                    Toast.makeText(MainActivity.this, "Electricity changed to " +
newElectricityStatus.toUpperCase(), Toast.LENGTH_SHORT).show();
                } else {
                    Toast.makeText(MainActivity.this, "Failed to update electricity status",
Toast.LENGTH_SHORT).show();
                }
            });
        } else {
            Toast.makeText(MainActivity.this, "Cannot change electricity status, ESP32 is
offline.", Toast.LENGTH_SHORT).show();
        }
    });
  }
}
```

final_arduino.ino

```
#include <SPI.h>
#include <MFRC522.h>

// RFID setup
#define RST_PIN 22    // Reset pin
#define SS_PIN 21     // Slave select pin (SDA)
MFRC522 mfrc522(SS_PIN, RST_PIN);  // Create MFRC522 instance


// Relay and Buzzer configuration
const int relayPin = 13;   // Relay GPIO pin
const int buzzerPin = 17;  // Buzzer GPIO pin
bool relayState = false;   // Current state of the relay

void setup() {
```

```
  Serial.begin(115200);

  // Initialize relay and buzzer pins
  pinMode(relayPin, OUTPUT);
  digitalWrite(relayPin, HIGH);  // Start with relay OFF
  pinMode(buzzerPin, OUTPUT);
  digitalWrite(buzzerPin, LOW);  // Start with buzzer OFF

  // Initialize RFID module
  SPI.begin();
  mfrc522.PCD_Init();

  Serial.println("RFID and Serial Relay Control System Initialized");
}

void loop() {
  // Check for new RFID cards
  if (mfrc522.PICC_IsNewCardPresent() && mfrc522.PICC_ReadCardSerial()) {
    String hexCode = "";
    for (byte i = 0; i < mfrc522.uid.size; i++) {
      hexCode += String(mfrc522.uid.uidByte[i], HEX);
    }

    Serial.print("Received Hex Code: ");
    Serial.println(hexCode);

    // Activate buzzer for feedback
    digitalWrite(buzzerPin, HIGH);
    delay(100);
    digitalWrite(buzzerPin, LOW);
    delay(3000); // Small delay for stability
  }

  // Check for serial commands
```

```
  if (Serial.available()) {
    String command = Serial.readStringUntil('\n'); // Read the command from the serial

    // Control the relay based on the received command
    if (command == "on") {
      relayState = true;
      digitalWrite(relayPin, LOW); // Turn relay ON (Active LOW)

      Serial.println("Relay is ON (via Serial)");

    }
    else if (command == "off") {
      relayState = false;
      digitalWrite(relayPin, HIGH); // Turn relay OFF (Active LOW)
      Serial.println("Relay is OFF (via Serial)");
    } else {
      Serial.println("Unknown command. Use 'on' or 'off'.");
    }
  }
  delay(1000); // Small delay for stability
}
```

```
package com.example.thesis;

import androidx.annotation.NonNull;
import androidx.appcompat.app.AppCompatActivity;
import androidx.core.app.ActivityCompat;
import androidx.core.app.NotificationCompat;
import androidx.core.app.NotificationManagerCompat;
import androidx.core.content.ContextCompat;

import android.app.NotificationChannel;
import android.app.NotificationManager;
import android.content.Intent;
```

```
import android.content.pm.PackageManager;
import android.os.Build;
import android.os.Bundle;
import android.os.Handler;
import android.widget.Switch;
import android.widget.TextView;
import android.widget.Toast;

import com.google.firebase.database.DataSnapshot;
import com.google.firebase.database.DatabaseError;
import com.google.firebase.database.DatabaseReference;
import com.google.firebase.database.FirebaseDatabase;
import com.google.firebase.database.ValueEventListener;

import java.util.HashMap;
import java.util.Map;

public class MainActivity extends AppCompatActivity {

    private DatabaseReference databaseReference;
    private Switch electricitySwitch;
    private TextView electricityStatusTextView, esp32StatusTextView;
    private boolean isElectricityOn = false;
    private boolean isEsp32Online = false;
    private String receivedHexCode = ""; // Store received hex
    private static final String POST_NOTIFICATIONS =
"android.permission.POST_NOTIFICATIONS";
    private Handler notificationHandler = new Handler();
    private Runnable notificationRunnable;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
```

```
        if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.TIRAMISU) { // Android
13+
            if (ContextCompat.checkSelfPermission(this, POST_NOTIFICATIONS)
                    != PackageManager.PERMISSION_GRANTED) {
                ActivityCompat.requestPermissions(this,
                        new String[]{POST_NOTIFICATIONS}, 101);
            }
        }

        // Get hex code from intent
        Intent intent = getIntent();
        if (intent.hasExtra("HEX_CODE")) {
            receivedHexCode = intent.getStringExtra("HEX_CODE");
            Toast.makeText(this, "Hex Code: " + receivedHexCode,
Toast.LENGTH_LONG).show();
        }

        // Initialize Firebase Database reference
        databaseReference = FirebaseDatabase.getInstance().getReference("status");

        // Initialize UI components
        electricitySwitch = findViewById(R.id.electricitySwitch);
        electricityStatusTextView = findViewById(R.id.electricityStatusTextView);
        esp32StatusTextView = findViewById(R.id.esp32StatusTextView);

        // Read the current statuses from Firebase
        databaseReference.addValueEventListener(new ValueEventListener() {
            @Override
            public void onDataChange(@NonNull DataSnapshot snapshot) {
                if (snapshot.exists()) {
                    // Read electricity status
                    String electricityStatus = snapshot.child("electricity").getValue(String.class);
                    if (electricityStatus != null) {
```

```
                isElectricityOn = electricityStatus.equals("on");
                electricityStatusTextView.setText("Electricity: " +
electricityStatus.toUpperCase());
                electricitySwitch.setChecked(isElectricityOn);

                if (isElectricityOn) {
                    startNotificationLoop();
                } else {
                    stopNotificationLoop();
                }
            }

            // Read ESP32 status and update UI
            String esp32Status = snapshot.child("esp32").getValue(String.class);
            if (esp32Status != null) {
                isEsp32Online = esp32Status.equals("ONLINE");
                esp32StatusTextView.setText("ESP32: " + esp32Status.toUpperCase());

                // Disable the switch if ESP32 is offline
                electricitySwitch.setEnabled(isEsp32Online);
                if (!isEsp32Online) {
                    Toast.makeText(MainActivity.this, "ESP32 is Offline. Cannot toggle
electricity.", Toast.LENGTH_SHORT).show();
                }
            }
        }
    }

    @Override
    public void onCancelled(@NonNull DatabaseError error) {
        Toast.makeText(MainActivity.this, "Failed to read database",
Toast.LENGTH_SHORT).show();
    }
});
```

```
        // Toggle electricity status on switch change
        electricitySwitch.setOnCheckedChangeListener((buttonView, isChecked) -> {
            if (isEsp32Online) {
                String newElectricityStatus = isChecked ? "on" : "off";

                Map<String, Object> updates = new HashMap<>();
                updates.put("electricity", newElectricityStatus);
                updates.put("hexcode", receivedHexCode); // Update hex code

                databaseReference.updateChildren(updates).addOnCompleteListener(task ->
{
                    if (task.isSuccessful()) {
                        Toast.makeText(MainActivity.this, "Electricity changed to " +
newElectricityStatus.toUpperCase(), Toast.LENGTH_SHORT).show();
                    } else {
                        Toast.makeText(MainActivity.this, "Failed to update electricity status",
Toast.LENGTH_SHORT).show();
                    }
                });
            } else {
                Toast.makeText(MainActivity.this, "Cannot change electricity status, ESP32 is
offline.", Toast.LENGTH_SHORT).show();
            }
        });
    }

    private void createNotificationChannel() {
        if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.O) {
            String channelId = "my_channel_id";  // Change this to your ID
            CharSequence name = "My Channel";
            String description = "Channel for app notifications";
            int importance = NotificationManager.IMPORTANCE_HIGH;
            NotificationChannel channel = new NotificationChannel(channelId, name,
```

```
importance);
            channel.setDescription(description);

            NotificationManager notificationManager =
getSystemService(NotificationManager.class);
            if (notificationManager != null) {
                notificationManager.createNotificationChannel(channel);
            }
        }
    }

    private void showNotification() {
        String channelId = "my_channel_id";  // Same as the one used in
createNotificationChannel()

        NotificationCompat.Builder builder = new NotificationCompat.Builder(this,
channelId)
                .setSmallIcon(R.drawable.ic_launcher_foreground)
                .setContentTitle("Electricity Alert")
                .setContentText("The electricity in the computer laboratory is still on!")
                .setPriority(NotificationCompat.PRIORITY_HIGH)
                .setAutoCancel(true);

        NotificationManagerCompat notificationManager =
NotificationManagerCompat.from(this);
        if (ActivityCompat.checkSelfPermission(this,
android.Manifest.permission.POST_NOTIFICATIONS) !=
PackageManager.PERMISSION_GRANTED) {
            return;
        }
        notificationManager.notify(1, builder.build());
    }

    private void startNotificationLoop() {
```

```
        stopNotificationLoop();
        notificationRunnable = new Runnable() {
            @Override
            public void run() {
                showNotification();
                notificationHandler.postDelayed(this, 3000); // Repeat every 30 seconds
            }
        };
        notificationHandler.post(notificationRunnable);
    }

    private void stopNotificationLoop() {
        if (notificationRunnable != null) {
            notificationHandler.removeCallbacks(notificationRunnable);
        }
    }
}
package com.example.thesis;

import android.content.Intent;
import android.os.Bundle;
import android.view.View;
import android.widget.Button;
import android.widget.EditText;
import android.widget.Toast;

import androidx.appcompat.app.AppCompatActivity;

public class LoginActivity extends AppCompatActivity {

    private EditText hexCodeEditText;
    private Button loginButton;

    @Override
```

```
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.login);

        // Initialize UI elements
        hexCodeEditText = findViewById(R.id.hexCodeEditText);
        loginButton = findViewById(R.id.loginButton);

        // Set click listener for login button
        loginButton.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View v) {
                String hexCode = hexCodeEditText.getText().toString().trim();

                if (!hexCode.isEmpty()) {
                    // Send hex code to MainActivity
                    Intent intent = new Intent(LoginActivity.this, MainActivity.class);
                    intent.putExtra("HEX_CODE", hexCode);
                    startActivity(intent);
                    finish(); // Close login activity
                } else {
                    Toast.makeText(LoginActivity.this, "Please enter a Hex Code",
Toast.LENGTH_SHORT).show();
                }
            }
        });
    }
}
```

APPENDIX H

CURRICULUM VITAE

ALVARADO, JOHN ZYMOND

0929-967-7176 zymondjalvarado@gmail.com

60 General Ricarte St Brgy San juan

EDUCATION

Francisco P Felix
Memorial National High School
2017 - 2020

STI College Ortigas Cainta
2020 - 2022

SKILLS

- Time Management
- Active Listener
- Computer Skills
- Mobile Enthusiast

LANGUAGE

- Tagalog
- English

PROFILE

I am looking for a job that will enhance my skills, and allow me to challenge myself. I'm looking for a steady career with a proper guidance that will lead me to a success future and expertise in return.

Personal Information

Birthplace	: Marikina City, Rizal
Birth Date	: May 26, 2004
Age	: 20
Gender	: Male
Civil Status	:Single
Citizenship	: Filipino
Height	: 168cm
Weight	: 70kg
Religion	: Catholic
Name of Guardian	: Olive D. Alvarado
Occupation	: Housewife
Language/Dialect	: Tagalog, English

WORK EXPERIENCE

I am a beginner in the field of computer science with no prior work experience. However, I am eager to learn and enhance my skills in programming, troubleshooting, and software development. My willingness to embrace new challenges allows me to adapt quickly and grow in a professional setting. I am highly motivated to gain hands-on experience, which will help me develop practical knowledge and improve my technical abilities for future opportunities in the industry.

NEMUEL ADRIAN ARADO

COLLEGE STUDENT

CONTACT

+639910765470

Aradonemueladrian@gmail.com

#007 Mercury Street Pinalad Road, Centennial 2, Nagpayong Pinagbuhatan, Pasig City

Github.com/Adrlann (Adrian Arado)

PROFILE

I am a dedicated computer science enthusiast who enjoys solving complex problems and developing practical solutions. I am responsible, well-organized, and eager to contribute to a team while making a positive impact.

SKILLS

- Video Editing
- Photoshop
- Multitasking
- Time Management
- Adaptability

HOBBIES

- Gaming
- Painting /Drawing
- Basketball
- Reading Novels/Manga

EDUCATION

2010-2016 Nagpayong Elementary School

2016-2020 Nagpayong High School

2020-2022 Rizal High School(Senior High)

2025 (Present) Cainta Catholic Collage

BAÑAS, JHON PAUL B.

PROFILE

As a dedicated computer science enthusiast, I thrive on solving complex problems and creating innovative solutions. Known for my responsibility and organizational skills, I am eager to contribute to a dynamic team and make a meaningful impact.

CONTACT ME

09674535985

jhonpaulbanas1@gmail.com

143 Pag -asa st.
Caniogan Pasig City

EDUCATION

ARELLANO UNIVERSITY
Grade 11 - Grade 12
2018-2020

CAINTA CATHOLIC COLLEGE
3rd year Bachelor of Science in Computer Science

LANGUAGE

Filipino

English

SKILLS

Multitasking and time management

Active listening and empathy

Communication skills

Computer skills

WORK EXPERIENCE

DISCORD MODERATOR (2020-2021)
I ensured rule adherence, mediated conflicts, maintained a safe environment, coordinated with fellow moderators for events, and provided technical support to community members.

CARL ALLEN GABILO

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

CONTACT

Blk 28 Lot 18 Timothy St.
Exodus Floodway, Taytay Rizal
09603834868
allenpogi818@gmail.com
github.com/AllenCarl1804

OBJECTIVES

To learn and improve continuously, adapting to new challenges and enhancing my skills over time. I aim to contribute effectively to my field while growing both professionally and personally

SKILLS

- Communicating
- Listener
- Multi-tasking
- Responsible
- Observant
- Basic knowledge in coding
- Adaptability

EDUCATION

College: Cainta Catholic College

High School: Cainta Catholic College

Elementary: Exodus Elementary School

PERSONAL INFORMATION

Date of Birth: June 18 2004

Age: 20

Height: 5'11

Gender: Male

Religion: Catholic

Citizenship: Filipino

Civil Status: Single

MICO VICENCIO

MY CONTACT

Phone
+63 9998090144

Email
micovicencio55@gmail.com

Address
Sitio Bukal 2, Barangay Dolores, Taytay Rizal

EXPERTISE

- Programming
- Problem Solving
- Marketing

REFERENCES

Github Account

https://github.com/MicoVicencio

ABOUT MYSELF

My name is Mico Dilag Vicencio. I am 20 years old and from Taytay Rizal. I am currently in my third year of college at Cainta Catholic College. I am a hardworking person and smart student who has a GPA of 1.1 every year. I am a kind and trustworthy person. I have a lot of knowledge of computers because I am taking a computer science course.

EXPERIENCE

Freelance - Programmer | 2023 - Present

Programmer

I freelance by working on programming tasks, including developing systems, prototypes, and software for educational institutions, with students being my primary clients.

Freelance - Vendor | 2021 - 2024

Game Resources Provider

I do freelancing as a game resource provider. I give services to my clients, especially in foreign countries, to improve their game accounts and ensure their happiness when playing the game with the help of my service.

EDUCATION

2022 - Present

College - Cainta Catholic College

2019-2021

SHS - Golden Faith Academy

2015 - 2019

JHS - CAYSMNHS

2009 - 2015

ELEMENTARY - DOLORES ELEMENTARY SCHOOL

APPENDIX I

GANTT CHART