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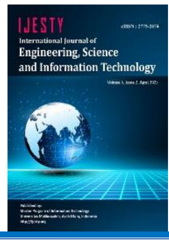

Design of Attendance System for Informatics Engineering Lecturers Using RFID Sensors Based on IoT and Telegram Applications

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Abstract

The attendance system is an essential element in the academic environment to ensure lecturer attendance in the lecture process. However, the manual attendance method still has various weaknesses, such as the potential for data manipulation and inefficiency in recording attendance. To overcome these problems, this research designs and implements an Internet of Things (IoT)-based lecturer attendance system using Radio Frequency Identification (RFID) sensors integrated with the Telegram application. The research method includes hardware design with ESP32 microcontroller, ESP32-CAM, RFID sensor, and HC-SR04 ultrasonic sensor. This system works by detecting lecturer attendance through RFID cards confirmed by ESP32, taking pictures with ESP32-CAM, and sending automatic notifications via the Telegram bot. Lecturer attendance data is then stored in a web-based database to facilitate the monitoring and evaluation. The test results show that the developed system can detect and record lecturer attendance accurately, with the response speed of the RFID sensor in reading cards ranging from 1-5 cm. The ultrasonic sensor also successfully detects objects accurately within a predetermined distance range. Lecturer attendance notifications sent via Telegram allow administrators to conduct real-time monitoring. With this IoT-based attendance system, the attendance recording process becomes more efficient and transparent and can reduce the risk of data manipulation. Further development can be done by adding data encryption and biometric authentication features to improve system security.

Keywords: *IoT, Attendance, RFID, Ultrasonic Sensor, Telegram.*

1. Introduction

In the world of lectures, attendance is a familiar activity, as well as making reports and collecting data on student and lecturer attendance. Recording the attendance of students and lecturers is very important to create discipline during the teaching and learning process. Attendance is divided into two systems, namely manual and digital. The manual system is usually done in an attendance record book with names and blank columns that students and lecturers will fill in with their signatures. With the application of the manual system, there are many opportunities for students to manipulate attendance data by leaving a signature with their friends so that it is likely that the student skips class during lecture activities. RFID attendance information technology that uses a digital system can now overcome these shortcomings. The RFID system consists of readers and tags and has been developed as a machine to find out when students and lecturers are absent from class. One of the benefits of this RFID system is that it can make students more disciplined to stay in class. In addition, this system makes it easier for lecturers to monitor student attendance in real-time without recording manually. Attendance recapitulation, report generation, and data analysis for discipline evaluation become easier by integrating data collected through RFID technology into the academic information system. As a result, using RFID technology improves administrative efficiency and helps create a more professional and organized learning environment.

Attendance in this study will be focused on lecturer attendance during teaching. As it is related to the team member's salary calculation report, attendance is also important because attendance issues can become a problem if there are incorrect records or incomplete attendance reports. Teaching employees, especially lecturers, need attendance to ensure that the workload mentioned in the Director General of Higher Education Letter No. 3298/D/T/99 dated December 29, 1999, has been met. As stipulated in Article 52 of Law No. 14 of 2005, proof of attendance can also be used to compensate lecturers. It is appropriate for the attendance system to be improved by using the Internet of Things (IoT). The use of Internet of Things (IoT) technology can provide convenience and regularity for its users. IoT enables automatic control of electronic devices and monitoring of home conditions, such as temperature, humidity, and motion detection, which contribute to improved home security [1]. However, IoT devices are also vital because they are often connected to vulnerable networks, leading to extensive vulnerabilities and security issues if not adequately protected. IoT security involves practices to keep IoT systems secure, safeguard against threats and breaches, and identify and address risks. It also ensures IoT solutions' availability, confidentiality, and integrity [2].

This research aims to apply the rule-based method to the IoT-based lecturer attendance system. Starting with the design of tools such as esp32, esp32 Cam, RFID (RADIO FREQUENCY IDENTIFICATION), ultrasonic sensor (hc sr04), relay, door lock, and buzzer. Then, the sensor system design will be integrated with the telegram bot. Once thriving, users can give commands to the telegram bot to activate the sensors that have been designed. This command can be done by the lecturer standing at the door and then attaching the ID card to the RFID sensor. The sensor will read whether the ID card attached is by the database. If appropriate, then esp 32 will notify the Telegram that the lecturer concerned is present at the scheduled class. Then, when the lecturer stands in front of the door at a distance of 1 meter, the ESP 32 camera will take a picture of the lecturer and store it in the database.

This IoT-based lecturer attendance system is expected to overcome lecturer indiscipline. This system is intended to make the lecturer attendance process easier and more efficient. Effectively, all attendance data is recorded and can be accessed in real time, thus reducing the possibility of data manipulation. In addition, attendance reports can be sent directly to management, making it easier to monitor lecturer discipline regularly. With this technology, attendance records are expected to be more accurate, lecturers will be more responsible for their teaching schedules, and attendance management in various organizations will be cost-effective and reliable [3].

2. Literature Review

2.1. Previous Research

Based on research conducted by Ikhwan Mardin et al. in Developing a Faculty Attendance System Based on Radio Frequency Identification (RFID) that can be integrated with a web platform and Telegram bot for notifications. This system aims to facilitate touchless attendance recording that enables parents and school administrators to perform accurate monitoring and reporting. This research emphasizes the importance of reliable attendance tracking in educational institutions and presents contemporary methods to address current challenges[4].

The application for a faculty attendance system based on radio frequency identification (RFID) has also been carried out by Hendra & Nuryani. The researcher designed a home security system based on Telegram with Esp32-Cam. The system can detect motion from up to 6 meters using a PIR sensor. When motion is detected, the system can send an image to the Telegram app without replaying the recording. Additionally, this system allows residents to monitor their homes when they are away through the Telegram app. The study found that this security system enhances home surveillance and reduces the likelihood of theft[5].

Following the research topic, Christian has conducted similar research regarding developing an RFID-based attendance system with an average reading speed of 0.4 seconds per tag and an accuracy of 35% from 200 tests. Despite obstacles and signal interference, the system could still read some tags. The research results indicate that the RFID system can track presence, but it notes that the system has issues with accuracy and how the antennas must be positioned appropriately [6].

Similar research has also been conducted by Islami et al., who developed an RFID-based attendance system to automate the attendance process, improve efficiency, and reduce human errors associated with manual attendance methods. The system operates well and demonstrates its effectiveness in capturing attendance data, with recommendations for future improvements, such as adding notification features and ensuring system maintenance for greater scalability[7].

Research conducted by Johan aims to show that the automated system has helped implement health protocols by reducing crowding during faculty attendance and avoiding the use of shared pens, which pose a risk of COVID-19 transmission. This system allows faculty members to record attendance by scanning RFID-based identity cards, thereby reducing physical contact and the risk of virus transmission. Further research is needed to develop the RFID-based system[8].

Research by Fardela et al. shows that the digital attendance system using RFID sensors and MySQL database at STT Payakumbuh can simplify the attendance process. This system is more automated and efficient than the currently used manual attendance system. Additionally, this research emphasizes that skilled personnel are required to operate the system properly [9].

These studies emphasize the effectiveness of RFID and IoT in access control applications, demonstrating their potential to enhance security and operational convenience. Building on this foundation, the current research integrates an automatic faculty attendance system based on RFID with a web platform and Telegram notifications to meet the need for fast and accurate attendance recording.

2.2. Internet of Things (IoT)

The Internet of Things (IoT) is a framework in which everything has a representation and presence on the Internet. IoT aims to offer new applications and services that bridge the physical and virtual worlds, where Machine-to-Machine (M2M) communication represents the fundamental communication that enables interaction between Things and applications in the cloud. This is defined by the IEEE Communications Magazine [10]. The use of Internet of Things (IoT) technology with RFID sensors, ultrasonic sensors and ESP32 CAM, controlled by an ESP32 microcontroller that can be viewed or monitored remotely by the user using a laptop or smartphone. The Internet of Things (IoT) also helps improve efficiency, convenience, and accuracy by automatically connecting devices to exchange data. IoT also helps to collect real-time data, save resources, and enable faster and more accurate decision-making. IoT can be applied in various sectors, such as smart home, hobby, agriculture, and industry [11].

2.3. Radio Frequency Identification (RFID)

RFID is the process of identification using radio frequency waves. RFID uses radio frequencies to read information from a device called an RFID tag card [12]. RFID combines advantages not available in other identification technologies, making it flexible, easy to use and ideal for automated operations. RFID technology operates in various frequency bands, including the low-frequency (LF) band, high-frequency (HF) band and ultra-high frequency (UHF) band, which cover different frequency ranges[13]. RFID is available in either read-only or read/write devices. It does not require direct contact or a light path to operate and enables high levels of data integration.

2.4. Ultrasonic Sensor (HC SR04)

Ultrasonic sensors convert physical quantities (sound) into electrical quantities and vice versa. The HC-SR04 ultrasonic sensor emits ultrasonic waves with a frequency of 40,000 Hz that propagate through the air. If objects or obstacles are within the broadcast range, the ultrasonic waves will be reflected to the module. This sensor consists of four (4) connected pins, namely ground (GND), power (VCC), trigger (TRIG), and echo (ECHO) pins. A high voltage of 5v from the controller is connected to the TRIG pin to generate high-frequency waves over a period that help determine the distance between the sensor and the objectThis sensor consists of four (4) connected pins, namely ground (GND), power (VCC), trigger (TRIG), and echo (ECHO) pins. A high voltage of 5v from the controller is connected to the TRIG pin to generate high-frequency waves over a period that helps determine the distance between the sensor and the object[14].HC-SR04 is a plug-and-play ultrasonic sensor that functions as a transmitter, receiver, and ultrasonic control device. The HC-SR04 sensor can be tested for sensitivity by comparing a standard distance value and the distance calculated from the sensor output[15].

2.5. Nodemcu (ESP32)

The ESP32 is a chip with 2.4 GHz WiFi and Bluetooth, designed with 40 technology for optimal durability and radio performance. It demonstrates ruggedness, versatility and reliability in various applications and performance scenarios. The ESP32 is a microcontroller module with dual-mode WiFi and Bluetooth capabilities that facilitates users' development of various IoT (Internet of Things) application systems and projects. It is the successor of the ESP8266 microcontroller introduced by Espressif Systems. The ESP32 has many additional features and benefits compared to the previous generation of microcontrollers[16]. The good thing about the ESP32, like the ESP8266, is the integrated RF components such as Power Amplifier, Low-Noise Receive Amplifier, Antenna Switch, and Filter. This makes designing hardware on the ESP32 easier as it requires very few external components. This microcontroller already provides WiFi and Bluetooth modules on its chip, supporting the creation of Internet of Things application methods[17].

2.6. ESP32 CAM

ESP32-CAM is a Camera Version Module with good quality, including an OV2640 camera. Equipped with WiFi + Bluetooth connection, which is low consumption and MicroSD slot. So that users can create systems that conceptualize the Internet of Things, such as online CCTV that can be programmed using the Arduino IDE [18]. ESP 32 CAM is a microcontroller-based system and controller equipped with a camera, so it is very efficient when making designs, especially as a monitoring security system. The ESP32-CAM is a highly versatile module that offers excellent potential for Internet of Things (IoT) applications, particularly monitoring and security. The ability to connect via WiFi and Bluetooth and the feature of a Micro SD slot for storage allow users to build flexible, interconnected systems. The OV2640 camera, which provides decent image quality, is ideal for projects such as online CCTV systems that can be programmed and managed through the Arduino IDE.

Additionally, its low power consumption is a significant advantage, ensuring it operates efficiently compared to similar modules. The module has a built-in ESP32 S WiFi processor, two high-performance 32-bit LX6 CPUs, and a 7-stage pipeline architecture[19]. This is especially beneficial in environments that require continuous monitoring without draining power. The ease of integrating sensors and connectivity options makes the ESP32-CAM a perfect choice for innovative smart security solutions, home automation, and various IoT applications that focus on keeping costs low while ensuring ease of use and management.

2.7. Buzzer

A buzzer is an electronic component that converts electrical energy into sound. It works similarly to a speaker, where a coil is attached to a diaphragm. When an electric current flows through the coil, a magnetic field is formed that causes the coil to move back and forth according to the change in direction of the electric current. This movement vibrates the diaphragm, producing sound waves in the air. With this working principle, the buzzer can produce sound according to the frequency of electrical vibrations. Buzzers generally indicate that a work procedure has been completed or an error has occurred in a device (alarm) [20].

3. Research Methods

3.1. Research Design

This research uses a prototyping approach to develop and test an automated lecturer attendance system using RFID and IoT technologies. The system design includes hardware and software components developed and refined iteratively based on performance testing. This prototype aims to ensure that the system meets the needs of lecturer attendance by integrating RFID technology, nodemcu as a microcontroller, and a web-based interface with real-time notifications via Telegram bot. This study adopts a prototyping methodology to design and evaluate an automated lecturer attendance system utilizing RFID and IoT technologies. The system's design incorporates hardware and software components, which are iteratively developed and improved through performance testing. The prototype's goal is to ensure that the system effectively addresses the needs of lecturer attendance, integrating RFID technology, nodemcu as the microcontroller, and a web-based interface that provides real-time notifications through a Telegram bot.

3.2. System Architecture

The system architecture is designed to connect the RFID-based lecturer attendance system with a centralized server via nodemcu, enabling data processing, verification, and control operations. This architecture consists of several components:

1. RFID sensor: Serves as the primary verification device, reading ID cards to control access for absenteeism.
2. Ultrasonic Sensor: Measures the preset distance at the nearest and farthest bushel from the sensor.
3. ESP32 CAM: Takes a picture of the object in front of the sensor previously triggered by the ultrasonic sensor at a predetermined distance.
4. Telegram Bot and Web Interface: Provides real-time notifications and enables remote monitoring and management of access logs.

3.3. System Development

The system development process consists of five main steps:

1. Literature Review: A comprehensive review of previous studies and related technologies was conducted to identify best practices and relevant methodologies.
2. System Design: This step involves creating a flowchart to illustrate the operational flow of the system and specifying hardware and software components, such as the Arduino IDE for nodemcu programming.
3. System Construction: All components, including nodemcu, RFID reader, Ultrasonic sensor, ESP32 Cam, web and Telegram bot, are assembled and integrated. nodemcu is programmed to manage the lecturer attendance system by connecting it with sensors and communicating with the server for data processing.
4. Testing and Calibration: The prototype was tested by verifying RFID tag accuracy and Ultrasonic sensor response to ensure consistent functionality. Adjustments were made to optimize sensor accuracy and response time.
5. System Evaluation: The system was evaluated based on its ability to accurately verify ID cards, send real-time notifications, and respond to object detection in front of the sensor.

3.4. System Diagram

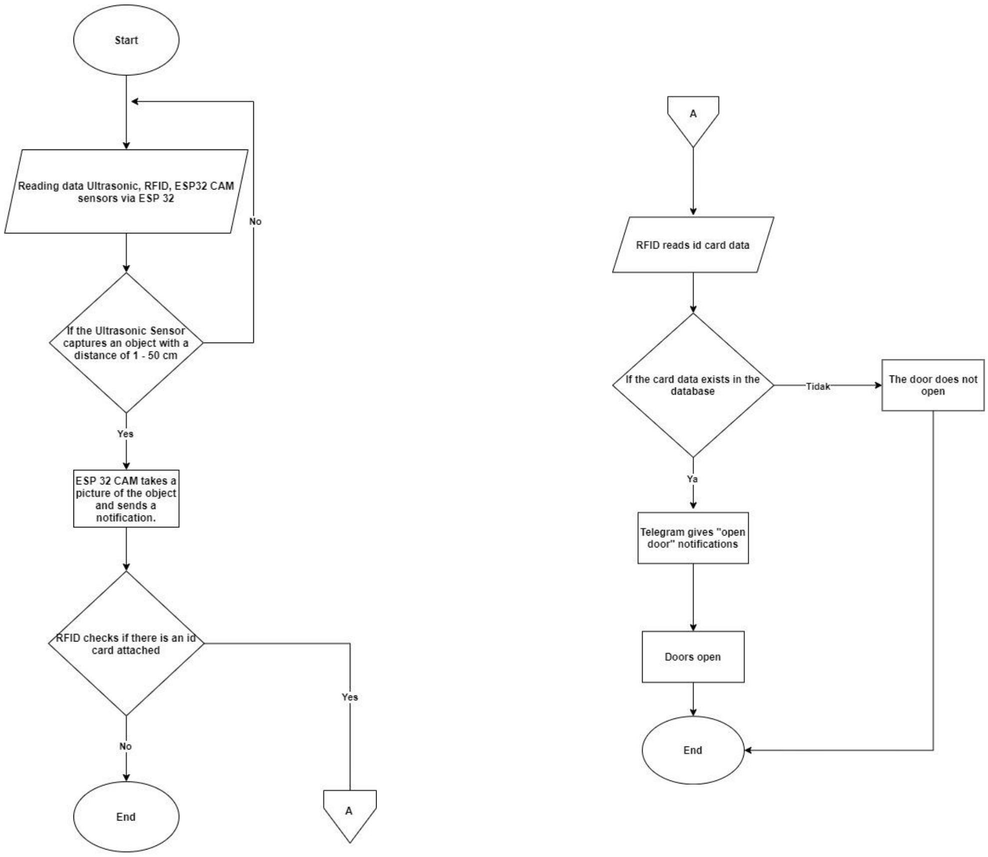


Fig 1. System Diagram

The system begins by using the ESP32 to read data from three key sensors: an ultrasonic sensor, an RFID sensor, and the ESP32-CAM. The ultrasonic sensor detects objects within a range of 1 to 50 cm. If an object is detected, the ESP32-CAM captures an image of it. If no object is detected within that range, the ultrasonic sensor continuously checks for any objects. Once the object detection process is completed, the system moves on to the next step. The RFID sensor then scans for any attached ID cards. If an ID card is present, the RFID sensor checks its data against a predefined database. If the ID matches one from the database, the system sends a notification through Telegram with the message "door open," and the door is unlocked. However, if the ID card is not recognized, the door remains closed, and no notification is sent. This system ensures security and automation, streamlining the access process based on object and ID detection.

4. Results and Discussion

4.1. System Implementation Result

The implementation results of this automatic access control system include integrating various hardware and software components that work together to manage access and provide real-time notifications to the administrator automatically. The main components consist of a nodemcu microcontroller, an RFID sensor to read identity cards, an Ultrasonic sensor to measure object distance, an ESP32 Cam, a Localhost server to manage data and Telegram as notification. Nodemcu is a central controller connected to a WiFi network and a Localhost server. The Ultrasonic sensor measures the object's distance with a predetermined distance in front of the sensor. In addition, a Telegram bot is integrated into the system to send real-time notifications to the administrator whenever access is attempted. This implementation successfully created a lecturer attendance system capable of automatically verifying identities and monitoring and recording access activities remotely.

4.2. System Testing Result

Testing the sensor is an essential step in prototyping this lecturer attendance system. The RFID sensor will be evaluated for its accuracy in reading the card. If the card read by the RFID sensor is registered, the relay will open the doorlock on the door. In addition, the ultrasonic sensor will measure the object's distance with the lowest range of 1 cm and the furthest range of 50 cm. During the RFID testing, experiments were conducted with three valid and registered cards and one invalid and unregistered card.

Table 1. RFID Sensor Response Testing

ID	Card Status	RFID and Motor Servo respons
460607A486780	Registered	Reads the registered card and opens the gate
584A23AAC910	Registered	Reads the registered card and opens the gate
53493AFC	Registered	Reads the registered card and opens the gate
331DD9FD	Unregistered	The unregistered card cannot open the gate

In testing the RFID sensor, it is concluded that the relay will open the doorlock selenoid on the room door if the card read by the sensor is valid and registered. If the card is invalid and not registered, the relay will not open the doorlock selenoid on the door. In this test, the RFID sensor can read cards at 1-5 cm from the sensor.

This prototype uses the HC SR04 type Ultrasonic sensor to test the Ultrasonic sensor. This ultrasonic sensor can detect objects with the lowest distance of 1 cm and the farthest distance of 50 cm from the sensor.

Table 2. Ultrasonic Sensor Distance Testing

Jarak	Durasi	Status
1 cm	2 second	The sensor can read
30 cm	5 second	The sensor can read
50 cm	5 second	The sensor can read
51 cm	-	The sensor is unable to read.
60 cm	-	The sensor is unable to read.

The table above shows the test results of the ultrasonic sensor's ability to read objects at various distances. The test results show that the sensor can read well at a distance of 1 cm, taking about 2 seconds. The same happens between 30 and 50 cm, where the sensor can still read for 5 seconds. However, when the distance was increased to 51 cm and 60 cm, the sensor could not detect the object. This can be seen from the absence of the recorded reading duration. Based on these results, it can be concluded that the sensor's ability to read objects decreases as the distance increases until, at some point, the sensor can no longer detect.

Table 2. Result Testing

Valid Card	Invalid Card
	

The table above describes two conditions. For the first column, there is an image of an open door if the ID card attached is registered with the appropriate ultrasonic sensor distance measurement, the ESP32 Cam will take pictures, and the Nodemcu microcontroller will send data to the Web database. Conversely, in the column with the image, the door will remain closed if the ID card is not registered in the web database and no data is transmitted from Nodemcu to the web database.

4.3. System Development Process

Prototyping involves several key components designed to be integrated to produce a functional automatic doorstop prototype. The ESP32 microcontroller is the main component due to its reliable capability, especially in supporting WiFi connectivity. The ESP32 CAM captures images of objects before the door to enhance security. This camera is activated by a proximity sensor, which will detect the presence of objects in the door area automatically. In addition, the system is also equipped with an RFID sensor in charge of reading ID cards as an authentication method. Relays control the doorstop opening and closing mechanism, ensuring movement is only performed if authorization is successful. These components are connected to a single system that supports remote operation via an internet connection. Users will also receive real-time notifications via the Telegram bot, which makes the system practical and provides additional security.

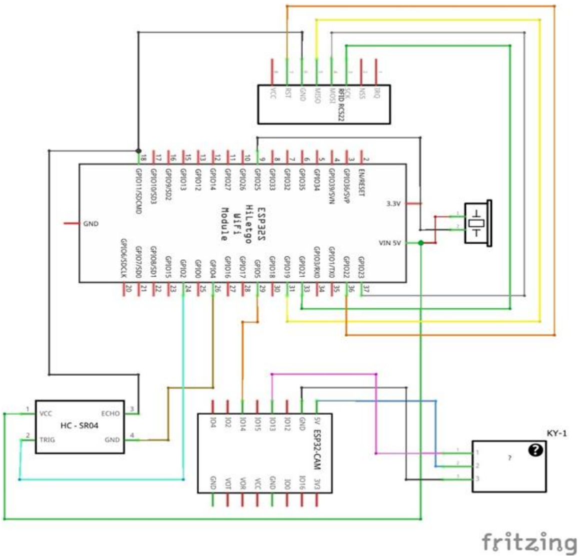


Fig 2. Circuit Schematic

Below is the assembly of its components:

a. ESP32 – RFID RC522 :
   Pin D21 pada ESP32 terhubung ke pin SCK pada Modul RFID.
   Pin D23 pada ESP32 terhubung ke pin MOSI pada Modul RFID.
   Pin D19 pada ESP32 terhubung ke pin MISO pada Modul RFID.
   Pin D22 pada ESP32 terhubung ke pin RST pada Modul RFID.
   Pin GND pada Breadboard terhubung ke pin GND pada Modul RFID.
   Pin 3,3V pada ESP32 terhubung ke pin 3,3V pada Modul RFID.

b. ESP32 – Ultrasonic Sensor (HC-SR04)
   Pin D2 pada Esp32 terhubung ke pin Trig pada Ultrasonic Sensor.
   Pin D4 pada Esp32 terhubung ke pin Echo pada Ultrasonic Sensor.
   Pin 5V pada Breadboard terhubung ke pin VCC pada Ultrasonic Sensor.
   Pin GND pada Breadboard terhubung ke pin GND pada Ultrasonic Sensor.

c. ESP32 – ESP32 CAM

Pin D5 pada ESP32 terhubung ke pin D14 pada ESP32 CAM.

d. ESP32 CAM – Relay Module
Pin D13 pada ESP32 CAM terhubung ke pin IN pada Relay Module.
Pin GND pada ESP32 CAM terhubung ke pin GND pada Relay Module.
Pin 5V pada ESP32 CAM terhubung ke pin VCC pada Relay Module.

e. ESP32 – Buzzer
Pin D25 pada ESP32 terhubung ke pin positive (+) pada Buzzer.
Pin GND pada ESP32 terhubung ke pin negative (-) pada Buzzer.

After creating the prototype, the next step is to develop the web-based information system. The website interface includes:

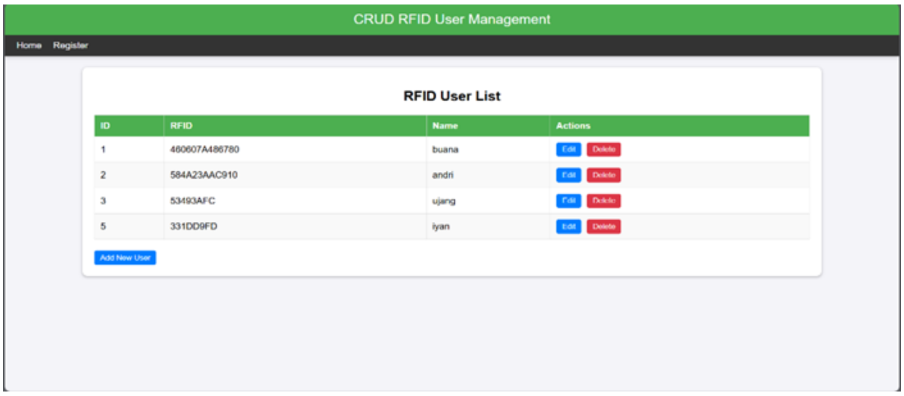


Fig 3. Dashboard

The dashboard view has four tables. Starting with the User ID table where this is the sequence number of the registered user, then the unique number of each RFID ID, user name, and action. In the action column, there are edit and delete buttons. Finally, at the bottom of the column, an Add new user button functions to add a new user.

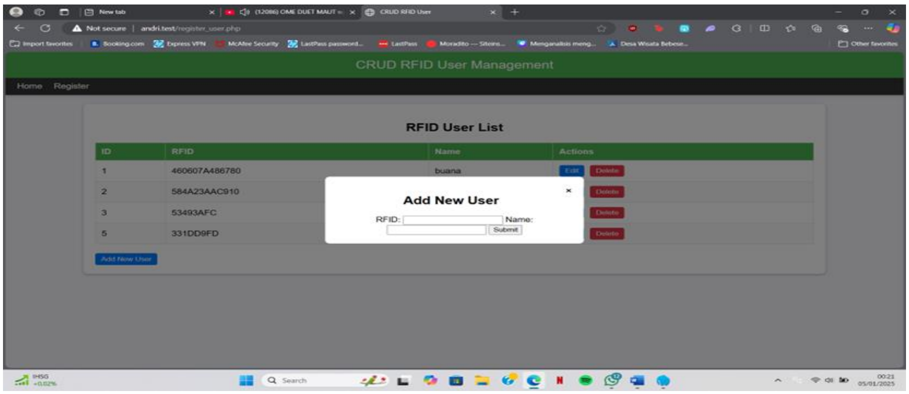


Fig 4. Registration

The image above displays a pop-up when the admin clicks the add new user button. The admin can fill in the RFID number previously known on the serial monitor when the admin taps the ID card on the RFID sensor. Then, the admin can fill in the name of the ID card user.

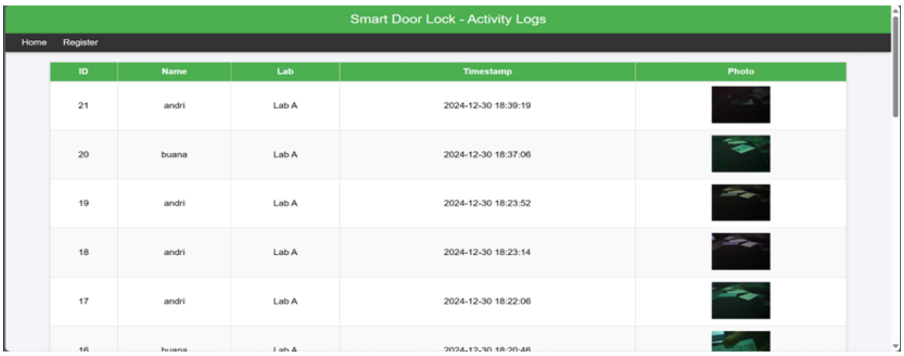


Fig 5. Data

The image above shows the "Smart Door Lock - Activity Log" system interface, which monitors and records user activity on the smart lock system. There is a table containing the activity log that consists of several columns of information, such as ID, which is a unique number for each activity; Name, which records the name of the user interacting with the system; Lab, which indicates the location or room where the activity took place (in this case, "Lab A"); Timestamp, which records the specific time of the activity in date and hour format; and Photo, which displays the photo or image captured by the ESP32 CAM camera.

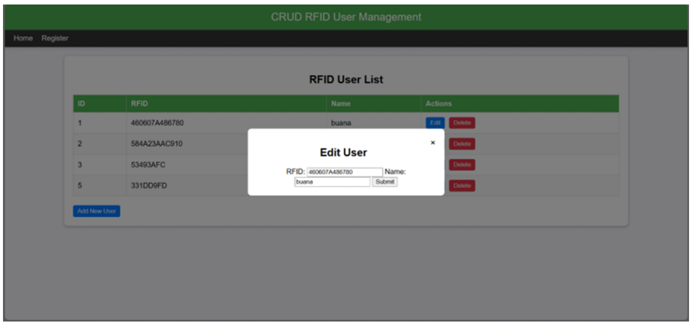
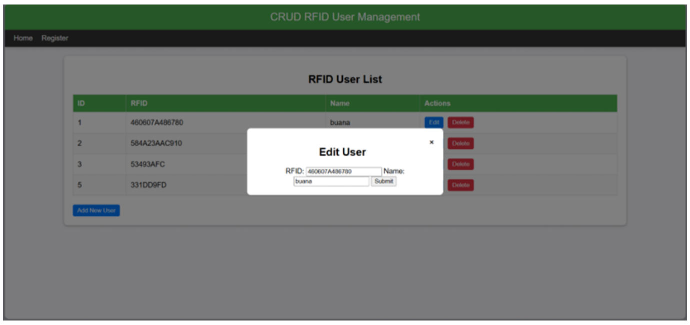


Fig 6. Edit

The figure shows the system interface "RFID CRUD User Management," specifically the Edit User feature that appears in the form of a pop-up after the user presses the "Edit" button on one of the data rows in the table "RFID User List." The table contains information about RFID users, with columns ID (unique number), RFID (RFID device identification number), Name (user name), and Actions (buttons to perform actions such as editing or deleting user data). If the "Edit" button is pressed, a pop-up with the title "Edit User" will appear. In the pop-up, users can view and edit user-related information, such as the RFID number that is already locked (cannot be changed) and the Name field that can be updated. After making changes, users can click the "Submit" button to save the updated data. This display is designed to facilitate the management of RFID user data quickly and efficiently without having to leave the main page. When the "Submit" button on the "Edit User" pop-up is pressed, the system will process and save the data changes into the database. If the process is successful, the "RFID User List" table on the main page will be updated to show the latest data.

Fig 7. Delete



The figure shows the system interface "CRUD RFID User Management," specifically the Delete User feature that appears in the form of a pop-up when the user presses the "Delete" button on one of the data rows in the table "RFID User List." The table contains information about RFID users, such as ID (unique number), RFID (RFID device identification number), Name (user name), and Actions (options to edit or delete data). When the "Delete" button is pressed, the system displays a confirmation pop-up titled "Delete User." The pop-up contains the message, "Are you sure you want to delete this user?" which asks the user to confirm the decision to delete the data. This pop-up provides two buttons: Yes to confirm data deletion and No to cancel the action. This feature is designed to avoid accidental deletion of data, providing an additional layer of security in managing RFID user data.

4.4. System Testing Mechanism

In the system testing mechanism, cards that have not been registered will be registered first by the administrator by tapping the card on the RFID sensor, and the Ultrasonic sensor will measure the distance of the object in front of the sensor.

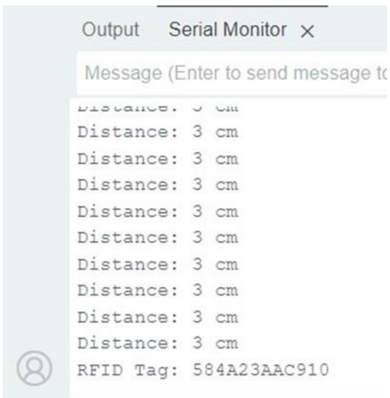
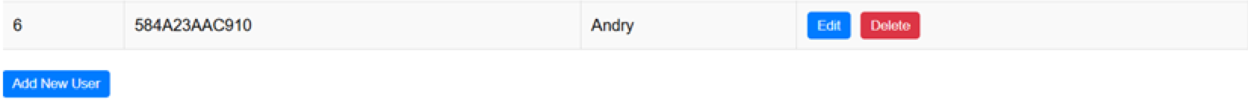


Fig 8. Serial Monitor

After the card is tapped, the unique number of the ID card will appear on the serial monitor, which will later be used for registration in the web database.

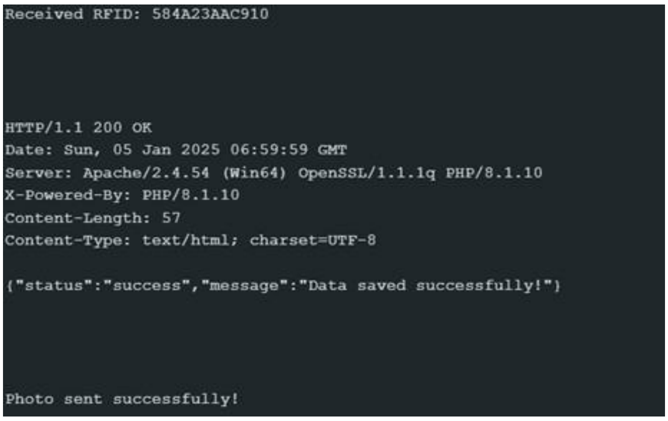


6	584A23AAC910	Andry	Edit Delete

Add New User

Fig 9. Registered User Card ID number

After the ID card number and user name are registered, the user can perform the same steps: tap the ID card again on the RFID sensor to authenticate. At this stage, I will provide two conditions for the cards that have been registered and those that have not been registered.



```
Received RFID: 584A23AAC910



HTTP/1.1 200 OK
Date: Sun, 05 Jan 2025 06:59:59 GMT
Server: Apache/2.4.54 (Win64) OpenSSL/1.1.1q PHP/8.1.10
X-Powered-By: PHP/8.1.10
Content-Length: 57
Content-Type: text/html; charset=UTF-8

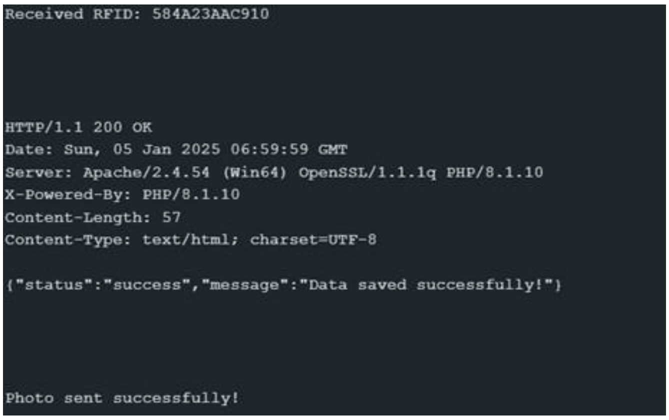
{"status":"success","message":"Data saved successfully!"}



Photo sent successfully!
```

Fig 10. Id Card Valid

In a valid card condition, the data read by the ESP32 microcontroller through the RFID sensor and Ultrasonic sensor will be sent to the ESP32 CAM. Then, ESP32 CAM will validate the web database to see whether the card is registered. If the card number is registered in the web database, then ESP32 CAM will send data in status, message, and photo to the web database. The validation process takes 10 seconds. After the validation process is complete, the ESP32 CAM gives the relay the command to open the Selenoid Door Lock so that the door can open.



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Received RFID: 584A23AAC910



HTTP/1.1 200 OK
Date: Sun, 05 Jan 2025 06:59:59 GMT
Server: Apache/2.4.54 (Win64) OpenSSL/1.1.1q PHP/8.1.10
X-Powered-By: PHP/8.1.10
Content-Length: 57
Content-Type: text/html; charset=UTF-8

{"status":"success","message":"Data saved successfully!"}



Photo sent successfully!
```

Fig 11. Id Card Invalid

In the condition of an invalid card, the data read by the ESP32 microcontroller through the RFID sensor and Ultrasonic sensor will be sent to the ESP32 CAM. Then ESP32 CAM will validate the web database whether the card is registered or not, if the card number is not registered in the web database then ESP32 CAM will not send data in the form of status, messages and photos to the web database. And the door will remain locked.

The last stage is after the web database receives user data sent by ESP32 CAM. Then, the ESP32 CAM will send the data to the Telegram Bot.

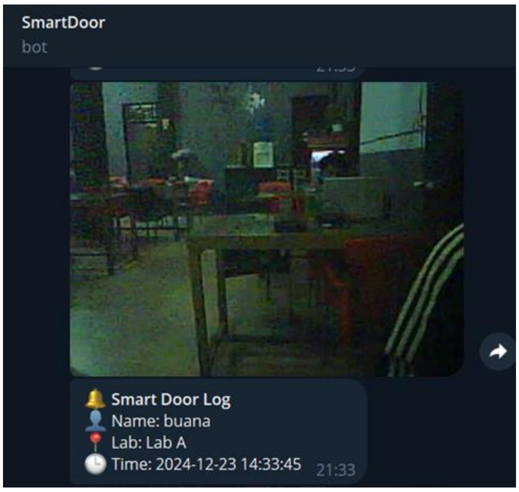

Fig 12. Telegram Notification

The picture above is a notification display from a Telegram bot named SmartDoor in the form of user log data sent by a web database designed to provide logs of lecturer attendance activities. This notification consists of two main elements, namely photos and information text. The photo displayed is taken by the ESP32-CAM camera to record the situation or activity at the door when the log is generated. This photo provides visual context to the admin as to what is happening at any given time. In addition, informational text accompanies the image to provide additional details, such as the name of the detected user (Name: Buana), the location of the activity (Lab: Lab A), and the time of the event (Time: 2024-12-23 14:33:45). This text is neatly organized with supporting icons for easy reading and identification of information. With this feature, admins can monitor lecturer attendance activities in real time via Telegram, increasing the overall security and transparency of the system.

4.5. System Evaluation

This prototype lecturer attendance system using IoT-based RFID sensors provides good results in recording lecturer attendance activities by utilizing RFID technology to detect ID cards owned by lecturers. The recorded attendance data is automatically sent to the server via an internet connection and can be accessed in real time through a web database. The system also has a Telegram bot notification feature that allows the administration to monitor lecturer attendance efficiently and accurately. With IoT-based integration, this system can increase transparency and reduce potential errors that often occur in manual attendance methods. If the system is applied to each study room in the Informatics Engineering study program, monitoring lecturer attendance can be done centrally and more systematically. Each lecturer only needs to tap their ID card on the RFID device in each study room, so the attendance recording time becomes faster and more efficient. In addition, the data stored in the web database can be used for further analysis, such as lecturer attendance patterns, tardiness, or teaching schedules. Implementing this system can also provide additional benefits, such as integration with academic systems for synchronization of lecture schedules or automatic management of attendance reports. Thus, the Informatics Engineering study program can improve administrative efficiency and ensure the accuracy of lecturer attendance data, ultimately improving the quality of education management.

5. Conclusion

Based on the research results on the IoT-based lecturer attendance system that utilizes RFID sensors and Telegram applications, several important points can be concluded that the RFID and IoT-based lecturer attendance system integrated with the Telegram application has been successfully implemented. This system utilizes RFID sensors to read lecturer ID cards, ESP32-CAM to take pictures, and Telegram applications to provide real-time notifications. Then, integrating devices such as RFID sensors, ESP32-CAM, and ultrasonic sensors with the IoT system ensures that attendance data is only recorded and sent to the database when the ID card read is valid. This improves the accuracy and security of lecturer attendance data.

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