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JOURNAL OF TECH-E

| 2581-1916 (ONLINE) | 2598-7585 (PRINTED) |

Article

Design and Implementation of an RFID-Based Automatic Doorstop System with Website and Telegram Bot Integration

Zainul Anwar Adi Putra[1], *Rizal Tjut Adek*[2], *Hafizh Al Kautsar Aidilof*[3]
[1, 2, 3] *Malikussaleh University, Department of Informatics, Aceh, Indonesia*

SUBMISSION TRACK

Recieved: 11, 28, 2024
Final Revision: 01, 12, 2025
Available Online: 02, 03, 2025

KEYWORD

Telegram Bot, Internet of Things, Automatic Control, RFID, Website

CORRESPONDENCE

E-mail:
zainul.200170190@mhs.unimal.ac.id
rizal@unimal.ac.id
hafizh@unimal.ac.id

A B S T R A C T

This research develops a prototype of an automatic doorstop control system based on Radio Frequency Identification (RFID) and the Internet of Things (IoT) integrated with a website-based information system and Telegram bot. This system is specifically designed to improve efficiency and security in access management at Malikussaleh University, by overcoming the vulnerabilities and limitations of traditional manual access control systems that are prone to security risks. The system uses RFID sensors to read user identity cards as access verification, while infrared (IR) sensors detect objects near the door to ensure security during automatic door operation. The system has an easy-to-use web interface for efficient management of data and activity records. In addition, real-time notifications are sent via Telegram bot to provide administrators with detailed information on access attempts. Tests show that the RFID sensor is capable of accurately reading ID cards at distances of up to 2 cm, while the IR sensor detects objects near the door quickly and precisely. The servo motors used had an average response time of 2 seconds to open and close the door. With a 98% accuracy rate on the RFID sensor, this system provides a reliable solution for automatic access control needs. With the advantages of high accuracy, fast response, and ease of integration, this prototype is expected to be implemented in various educational institutions and other public facilities.

DOI: 10.31253/te.v8i2.3447

I. INTRODUCTION

Various IoT solutions have been prototyped and deployed, including applications for smart buildings, smart homes, smart vehicles, smart farming, and smart industries[1]. Manual access control systems are still commonly used on many campuses in Indonesia, where entry is usually supervised by security guards or regulated through gates that remain open during operational hours. This system makes campus facilities vulnerable to security risks, as unauthorized people can easily enter the campus area, leading to potential problems such as theft, vandalism, and other criminal activities that jeopardize the security and order of the campus environment. For example, in September 2023, two men successfully stole five motorcycles in the Surabaya campus area by wearing alma mater jackets to disguise themselves as students. This case shows how the manual control system allows strangers to easily enter the campus environment without being detected [2]. Radio Frequency Identification (RFID) technology provides a solution for access control systems that is both rapid and accurate, enabling the identification of individuals without the need for direct contact. RFID technology has been successfully implemented in various sectors, including airports, residential complexes, and office buildings, as it offers enhanced security and streamlined access management. The key advantage of RFID is its ability to store and process data, allowing for identification and verification to occur quickly and securely [3]. The convergence of RFID technology with Internet of Things (IoT) technology has further expanded its application, enabling devices to connect online for remote management and monitoring capabilities. IoT-connected RFID systems can communicate with centralized servers to update and manage access data in real-time, providing administrators with up-to-date information on access points [4]. IoT is a system that can integrate various smart devices into a network, allowing them to communicate with each other as well as interact with their surrounding environment [5]. These systems can also integrate with web platforms and communication applications, such as Telegram, to provide notifications and streamline user access remotely management and real-time notifications, and evaluating the system's accuracy in identifying valid ID cards for authorized access. It is anticipated that this prototype will provide an effective and efficient solution for campus access management and serve as an inspiration for similar security system implementations.

II. LITERATURES REVIEW

Research on access control systems utilizing RFID and IoT technologies has been conducted extensively to enhance security and operational efficiency. Sari, I. P., Hazidar, A. H., Basri, M., Ramadhani, F., and Manurung, A. A. in 2023, titled “Penerapan Palang Pintu Otomatis Jarak Jauh Berbasis RFID di Perumahan,” developed an RFID-based automatic gate control system specifically for residential areas. This system enabled vehicle access via RFID scanning and monitored activity through the Blynk application, proving effective in enhancing residential security [6].

Azmi, F. in 2022, in a study titled "Implementasi Sistem Parkir dengan RFID," explored the application of RFID in automated parking systems. This research demonstrated how RFID technology could facilitate ticketless parking management through real-time vehicle identification, although the study identified sensor responsiveness as an area for improvement [7].

Mufida, E., Anwar, R. S., and Gunawam, I. in 2020, titled "Rancangan Palang Pintu Otomatis Pada Apartemen Dengan Akses e-KTP Berbasis Arduino," designed an access control system for apartment complexes using e-KTP and Arduino microcontrollers. The system integrated RFID technology for entry verification, significantly enhancing security by logging vehicle data for monitoring purposes [8].

Wahyudi, A., Fajri Nur, F., and Syaiful in 2020, with the study "Pemanfaatan Radio Frequency Identification (RFID) Berbasis Internet of Things (IoT) untuk Perancangan Palang Pintu Otomatis di Universitas Nurul Jadid," developed an IoT-integrated RFID system for automatic gate control

DOI: 10.31253/te.v8i2.3447

on a university campus. Utilizing NodeMCU for data transmission, the system demonstrated high accuracy in verifying authorized access within a short range of 2-3 cm [9].

Ramadhan, M. R., Lesmana, R. K., Siregar, F. S., Ridho, R., and Isnan, M. H. I. in 2023, in a study titled "Rancangan Teknologi RFID Gerbang Parkir Pada UINSU Medan," implemented an RFID-based system for campus parking. The system streamlined parking access by reducing wait times and improving vehicle flow, illustrating the practicality of RFID for campus environments [10].

These studies underscore the effectiveness of RFID and IoT in access control applications, demonstrating their potential to improve security and operational convenience. Building on this foundation, the current research integrates an RFID-based automatic gate control system with a web platform and Telegram notifications, addressing specific security needs in a campus setting.

Internet Of Things

Computers that are connected through a network and communicate with each other with unlimited time and area are called the internet. The concept of internet of things (IoT) refers to a situation where physical objects are connected with software, sensors, and connectivity. An object in IoT is any device with embedded sensors capable of collecting data and transmitting it over a network without manual intervention. IoT is a system that can integrate various smart devices into a network, allowing them to communicate with each other and interact with the environment. Internet of things is a program where objects can transmit data over the network without the help of computers and humans. The internet of things can facilitate work in the operation and supervision of something physical. Therefore, this IoT concept is very functional to help activities in everyday life, ranging from individual use, offices, agriculture, livestock to government. Internet of things or IoT is very beneficial for society because this technology can facilitate human work. Even humans can now monitor and control machines and electronic equipment without having to do it manually. These electronic machines or equipment can function automatically when connected to the internet network [11].

Nodemcu

Nodemcu is a microcontroller module based on the ESP8266 chip, enabling wifi connectivity, making it ideal for Internet of Things (IoT) projects. Nodemcu supports programming through the Arduino IDE, which makes it flexible and easy to use for various applications. In this study, nodemcu connects the automatic gate control system to the network, allowing data from the RFID and IR sensors to be transmitted and processed in real time. With its wifi connectivity, nodemcu acts as the data processing hub, ensuring that all components operate synchronously within the system [12].

Radio Frequency Identification (RFID)

Radio Frequency Identification (RFID) is a technology that utilizes radio waves to identify objects without direct contact. RFID consists of three main components: a tag, a reader, and middleware. The RFID tag stores data that can be recognized by the reader when connected by a radio signal. In this study, RFID is used to identify student or faculty ID cards as access keys. When the ID card is brought near the reader, the system verifies the data, and if registered, the gate will open. The RFID RC522 was selected for its efficiency in detecting tags at close range, making it ideal for this physical access control system [7]. The benefit of using RFID is that data can be displayed quickly and precisely, simply by scanning the RIFD tag, eliminating the need for manual input, such as on a keyboard [13].

Infrared (IR) Sensor

Infrared sensors are input devices that have the ability to identify infrared light and can be used as a means of data communication between transmitters and receivers[14]. An infrared (IR) sensor is a device capable of detecting the presence of objects by emitting infrared signals. In this study, the IR sensor functions to detect objects near the gate, allowing the gate to automatically close after the object passes through. IR is advantageous in detecting objects at short distances without

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physical contact, making it an ideal solution for automated door control in a campus environment. Therefore, the IR sensor plays a crucial role in optimizing the security and efficiency of this access control system [15].

Liquid Crystal Display (LCD)

Liquid crystal molecules organize themselves to refract light when an electric charge is introduced, so characters can be created. A 16x2 LCD has a 16 column x 2 row structure that can display characters, numbers, and basic symbols. 16x2 LCDs are often used to display information on electronic devices[16]. In this study, the LCD is used to display information about access status, such as "Access Granted" or "Access Denied," once the ID card has been verified by the RFID. The 16x2 LCD is very effective in providing immediate information to users, which helps speed up the access control process by offering easy-to-understand visual feedback [17].

III. METHODS

Research Design

This study employs a prototyping approach to develop and test an automated gate control system using RFID and IoT technology. The system design includes hardware and software components, which are iteratively developed and refined based on performance testing. The aim of the prototype is to ensure that the system meets campus access control needs by integrating RFID technology, nodemcu as a microcontroller, and a web-based interface with real-time notifications through a Telegram bot.

System Architecture

The system architecture is designed to connect the RFID-based gate control system with a centralized server via nodemcu, allowing for data processing, verification, and control operations. The architecture is comprised of several components:

1. RFID Sensor: Functions as the primary verification device, reading ID cards to control gate access.
2. IR Sensor: Detects objects in front of the gate to ensure the gate closes automatically after the user passes.
3. LCD 16x2: Displays access information, such as "Access Granted" or "Access Denied," for immediate feedback to users.
4. Telegram Bot and Web Interface: Provides real-time notifications and allows for remote monitoring and management of access logs.

System Development

The system development process consists of five main steps:

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

System Diagram

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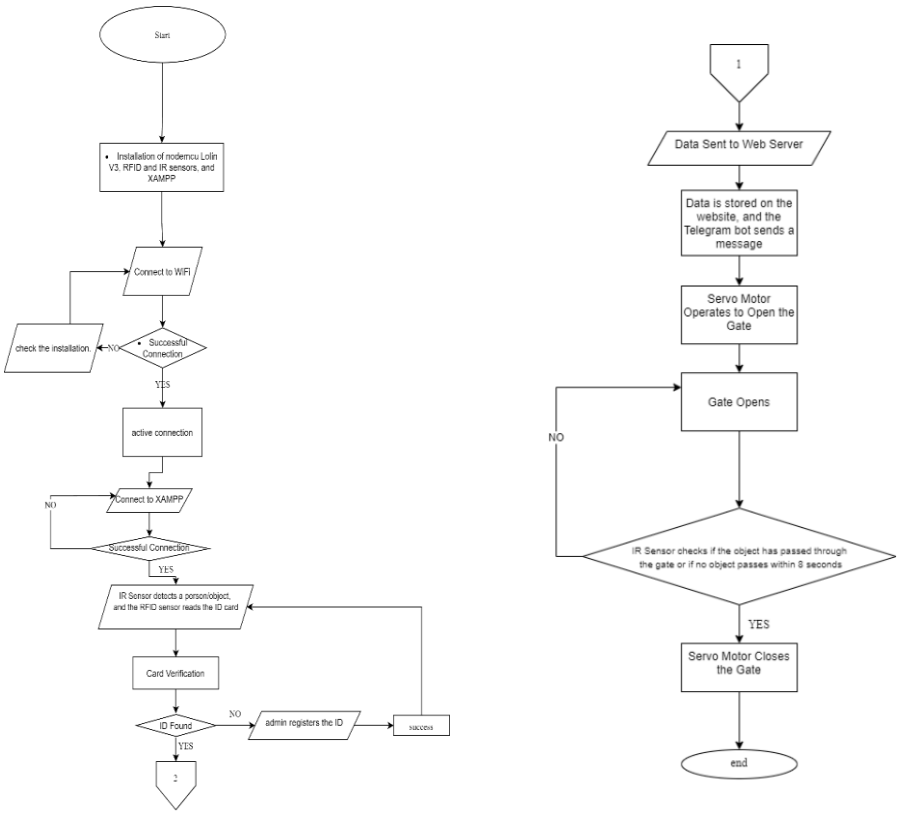

Figure 1. System Diagram

The flowchart illustrates the process of an automated access control system designed with RFID and IoT technologies. The process begins with the installation of the required components, including nodemcu lolin V3 (used as the microcontroller), RFID and IR sensors, and XAMPP (as a local server). Once the hardware is configured, the nodemcu attempts to connect to a WiFi network to enable data communication between the system and the server. If the connection fails, the system reverts to installation checks to ensure proper configuration. Upon a successful WiFi connection, the system proceeds with an active connection status.

Next, the nodemcu tries to connect to the XAMPP server, which will manage data storage and database operations. If the connection to XAMPP fails, the system will attempt reconnection until successful. With both WiFi and XAMPP connections established, the system is ready for detection activities.When the IR sensor detects the presence of an object or person near the gate, the RFID sensor reads the ID card to verify access. The system then checks the database for the ID card. If the ID is not found, an administrator registers the ID to allow future access. If the ID is valid and found in the database, the system proceeds with access approval.

Access data, including the detected ID information, is sent to the web server for logging. The data is stored on the website, and a notification is sent to the administrator via a Telegram bot, informing them of the access event. After verification, the servo motor is triggered to open the gate, allowing passage.Once the gate is open, the IR sensor monitors if the object has passed through. If no movement is detected within 8 seconds, the gate closes automatically. The servo motor then operates to close the gate, completing the access control process. This system ensures secure, automated access control with real-time monitoring and notification, offering an efficient solution for controlled environments.

IV. RESULT

System Impelentation Results

The implementation results of this automated access control system include the integration of various hardware and software components that work together to manage access automatically and

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provide real-time notifications to the administrator. The main components consist of the nodemcu microcontroller, an RFID sensor to read ID cards, an IR sensor to detect the presence of objects, an LCD 16x2 to display access status, and a XAMPP server to manage data. The nodemcu functions as the central controller connected to the WiFi network and the XAMPP server. The LCD 16x2 is used to display access status information, such as "Access Granted" or "Access Denied," providing immediate feedback to the user. Additionally, the Telegram bot is integrated into the system to send real-time notifications to the administrator every time access is attempted. This implementation successfully creates an access control system capable of automatically verifying identities, as well as monitoring and recording access activity remotely.

System Testing Results

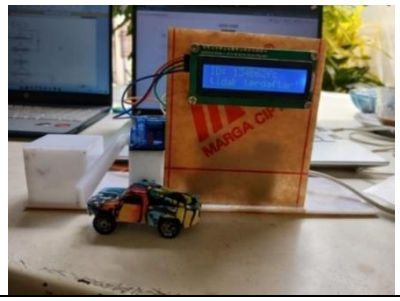
Testing the sensors is a crucial step in the prototyping of this gate control system. The RFID sensor will be evaluated for its accuracy in reading the cards; if the card read by the RFID sensor is registered, the servo motor will open the gate. Additionally, the infrared (IR) sensor will be assessed for its accuracy in detecting an object in front of the sensor. During RFID testing, experiments were conducted with 3 valid and registered cards and 2 invalid, unregistered cards.

Table 1. Testing Card

ID	Card Status	RFID and Motor Servo respons
53493afc	Registered	Reads the registered card and opens the gate
56743e3	Registered	Reads the registered card and opens the gate
9360b0fc	Registered	Reads the registered card and opens the gate
539e52ed	Unregistered	Unregistered card cannot open the gate
134b62fc	Unregistered	Unregistered card cannot open the gate

In the testing of the RFID sensor and servo motor response, it was concluded that the servo motor will open the gate if the card read by the sensor is valid and registered; if the card is invalid and unregistered, the servo motor will not open. In this test, the RFID sensor was able to read cards at a distance of 1-2 cm from the sensor.

Table 2. Results Testing

Valid Card	Unvalid Card
	

The RFID sensor used in this research is the RC522 type. If implementation with a longer reading range is desired, a UHF (Ultra High Frequency) type can be used, as it has a greater reading range compared to the RC522. Below is the distance range ratio between RC522 and UHF.

$$\text{distance ratio} = \frac{1000\text{cm UHF}}{3\text{cm RC522}} = 333\text{cm} \qquad (1)$$

From the above comparison of distance ratios, it can be concluded that:

1. 1cm on RC522 = 1 cm x 50 = 333 cm (3,33 meter) on the UHF
2. 2 cm on RC522 = 2 cm x 50 = 666 cm (6,66 meter) on the UHF
3. 3 cm on RC522 = 3 cm x 50 = 999 cm (9,99 meter) on the UHF

In this research, the RFID RC522 sensor effectively detects objects at a distance of 1 cm from the sensor, with a maximum detection range of 2 cm.

For IR sensor testing, this prototype uses the IR HW-201 sensor, which can detect objects within a range of 1-3 cm. However, if implemented in a full system, the Sharp GP2Y0A02YK0F sensor would be used, as it has a longer detection range compared to the HW-201. The Sharp GP2Y0A02YK0F sensor can detect objects within a range of 20-150 cm. Since the HW-201 sensor

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is used in this research, a distance range ratio will be created between the HW-201 and the Sharp GP2Y0A02YK0F.

$$\text{distance ratio} = \frac{150\text{cm GP2Y0A02YK0F}}{3\text{cm HW201}} = 50\text{cm} \qquad (2)$$

From the above comparison of distance ratios, it can be concluded that:

1. 1 cm on HW-201 is equivalent to 1 cm x 50 = 50 cm on the Sharp GP2Y0A02YK0F
2. 2 cm on HW-201 is equivalent to 2 cm x 50 = 100 cm on the Sharp GP2Y0A02YK0FF
3. 3 cm on HW-201 is equivalent to 3 cm x 50 = 150 cm on the Sharp GP2Y0A02YK0F

This ratio highlights the extended detection range provided by the Sharp GP2Y0A02YK0F compared to the HW-201 sensor.

The testing results show that the system performs adequately in terms of accuracy, responsiveness, and operational efficiency. Testing focused on three main components: the RFID reader and IR sensor.

1. RFID Reader Accuracy: This test was conducted with several ID cards registered and unregistered in the database. The results show that the RFID reader has an accuracy rate of 98%, with minimal delays when cards are scanned consecutively within a short period.
2. IR Sensor Responsiveness: The IR sensor was tested to detect objects near the gate. The sensor demonstrated a 100% detection rate and performed consistently

System Development Process

The system development process began with designing the system architecture and selecting appropriate hardware components. Once the architecture was established, the next step was to assemble the components, including the nodemcu as the main controller, RFID sensor for ID verification, IR sensor for object detection, LCD 16x2 for user feedback, and Telegram bot for notifications. The XAMPP software was used to manage the access database.The nodemcu was programmed using Arduino IDE to function as the main controller connected to the RFID and IR sensors, as well as the XAMPP server. The nodemcu was also configured to communicate with the Telegram bot over the internet to provide access notifications. Once all components were assembled, the system was tested to ensure that all functions operated as designed. Sensor testing is a crucial step in the development of this gate control system prototype. For the RFID sensor, accuracy is evaluated based on the successful reading of registered cards; if the RFID sensor reads a registered card, the servo motor will open the gate. The infrared (IR) sensor is assessed for its accuracy in detecting an object in front of it. In the RFID testing phase, experiments were conducted with three valid cards and two invalid and unregistered cards.

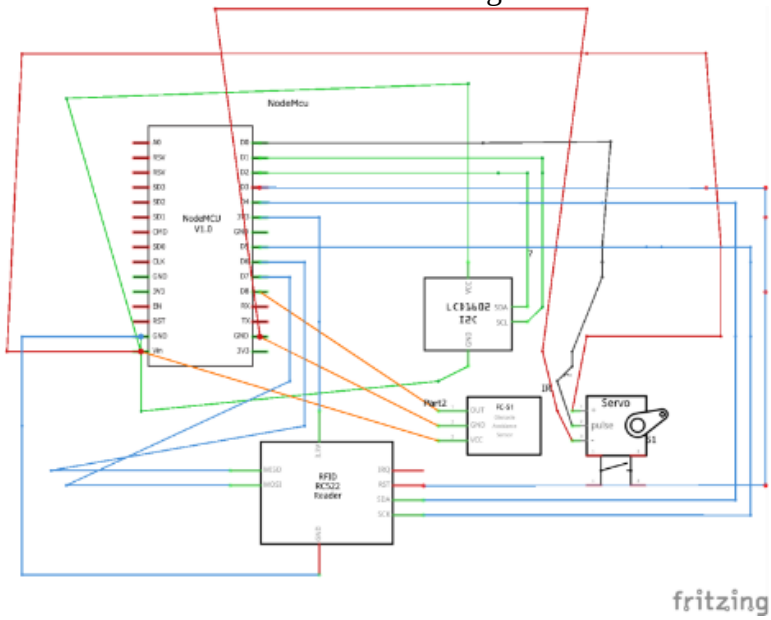

Figure 2. Circuit Schematic

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The developed prototype involves several components, such as a NodeMCU as the microcontroller, an RC522 RFID sensor for reading ID cards, an IR sensor for detecting objects, an SG90 servo motor for operating the gate, and a 16x2 LCD to display system-related information. All components are integrated and controlled via an internet connection, enabling remote control and monitoring through a website as well as real-time notifications via a Telegram bot. Below is the assembly of its components:

1. Nodmcu - RFID Module
   D3 (Nodemcu) is connected to RST (RFID Module)
   D4 (Nodemcu) is connected to SDA (RFID Module)
   D5 (Nodemcu) is connected to SCK (RFID Module)
   D6 (Nodemcu) is connected to MISO (RFID Module)
   D7 (Nodemcu) is connected to MOSI (RFID Module)
   GND (Nodemcu) is connected to GND (RFID Module)
   3V (Nodemcu) is connected to 3.3V (RFID Module)
2. Nodemcu - LCD (I2C)
   D2 (Nodemcu) is connected to SDA (LCD I2C)
   D1 (Nodemcu) is connected to SCL (LCD I2C)
   GND (Nodemcu) is connected to GND (LCD I2C)
   VUSB (Nodemcu) is connected to VCC (LCD I2C)
3. Nodemcu - IR Sensor
   D8 (Nodemcu) is connected to OUT (IR Sensor)
   GND (Nodemcu) is connected to GND (IR Sensor)
   VUSB (Nodemcu) is connected to VCC (IR Sensor)
4. NodeMCU - SG90 Servo Motor
   D0 (Nodemcu) is connected to kabel Yellow (data) wire on the Servo SG90
   GND (Nodemcu) is connected to kabel Brown (ground) wire on the Servo SG90
   VUSB (Nodemcu) is connected to kabel Red (power) wire on the Servo SG90

These connections integrate the components to work cohesively, with the NodeMCU acting as the central control unit.

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

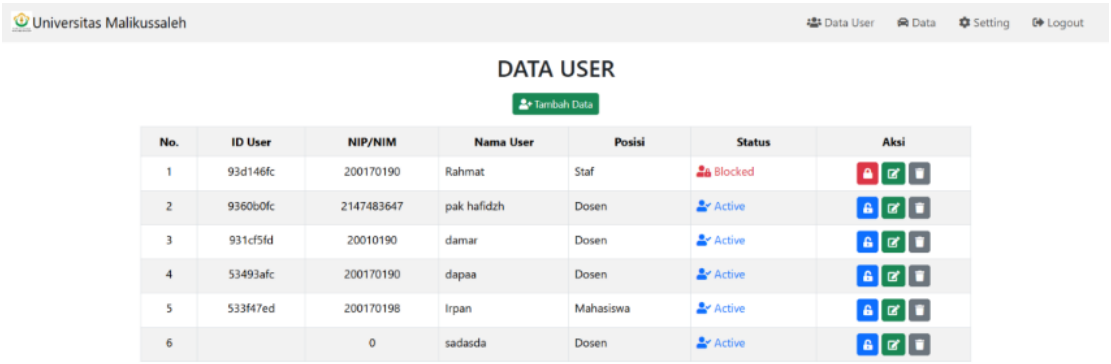

Figure 3. Dashboard

On the dashboard, there is a User ID table, where this ID represents the unique number from the RFID card. Each user also has an associated NIP/NIM, name, position, and status. The status field can be modified via the edit button under the actions column; if a user is blocked, they will be unable to open the gate with their card.The data page serves as a history page, containing records of who tapped their card. This page includes a table displaying user ID, name, entry time, exit time, and duration of the user's presence within the campus area. This page also offers a filter feature, allowing specific searches by date, month, or even year to identify users who tapped their card on specific occasions.

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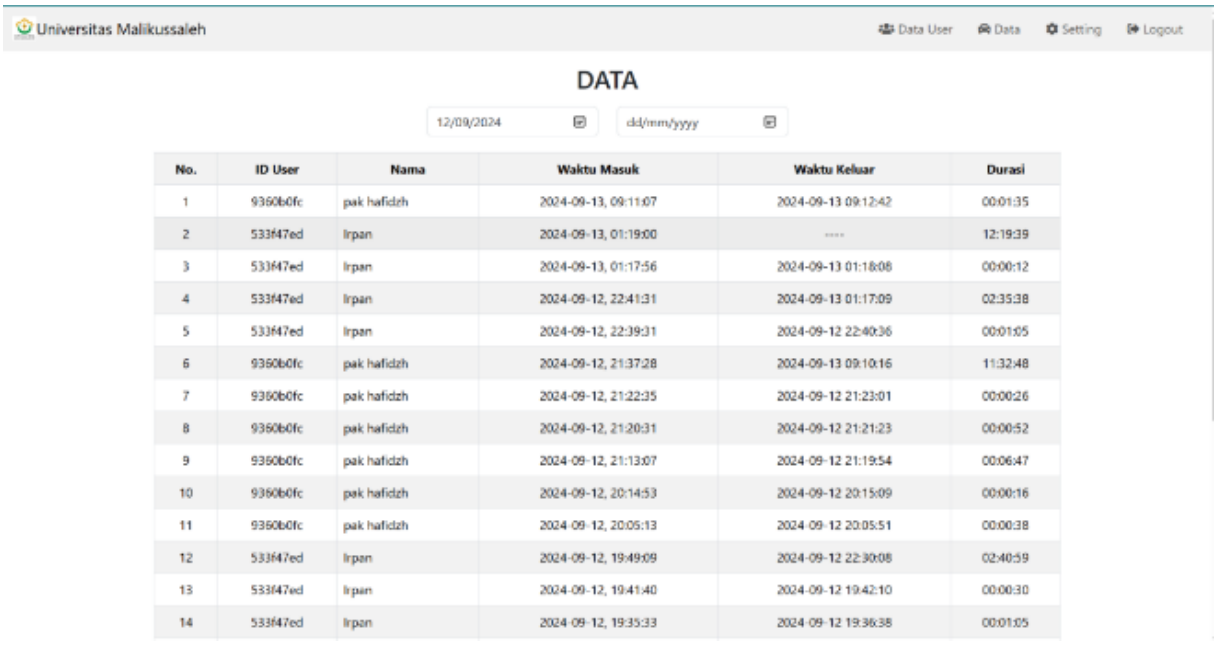

Figure 4. History

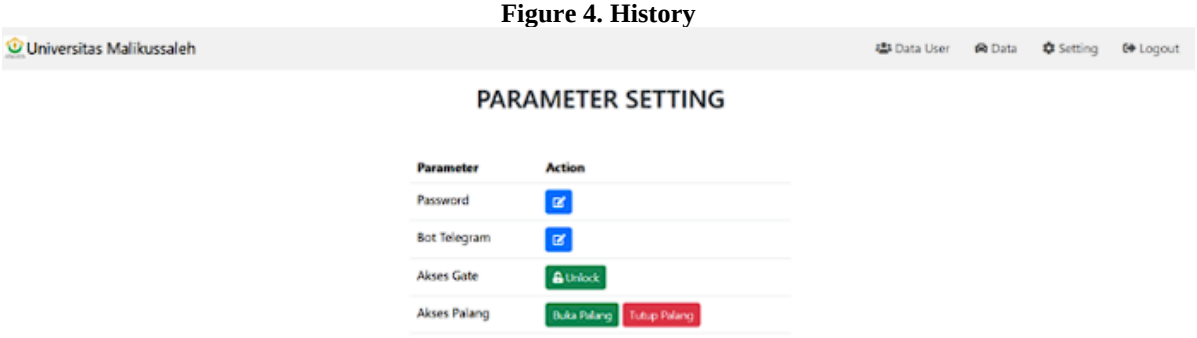

Figure 5. Settings

The image above shows the parameter settings, where four additional features are available:

1. Password: This feature allows the administrator to change the password for the admin page.
2. Telegram Bot: In this feature, the admin enters the token from the Telegram bot obtained by the admin.
3. Gate Access: This feature serves to lock and close the gate. Even if a registered card is tapped, if this feature is enabled, the gate will remain closed until the feature is deactivated (unlocked).
4. Open and Close Gate: This feature is used if a vehicle encounters an issue, such as a breakdown, in front of the gate after a user has already tapped a valid card. The admin can press a button to notify of the issue, allowing the gate to open temporarily until the problem is resolved.

System Testing Mechanism

In the testing mechanism, the sequence of testing steps is described. Unregistered cards will first be registered by the administrator by tapping the card on the RFID sensor.

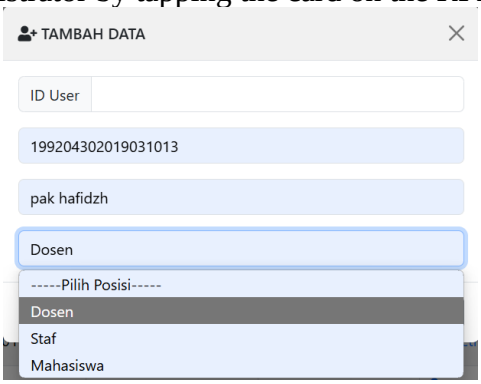

Figure 6. Add Users

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The user ID is obtained automatically when the card is read by the RFID sensor. The user ID field is populated automatically, the second row is filled with the NIP/NIM, the third row with the user's name, and the last row with the user's position (e.g., lecturer, student, or staff). Once the card is registered, the user can tap the card to access the gate. Registered cards will trigger the gate to open when read by the RFID sensor. A notification will then be sent via Telegram, detailing who tapped their card.

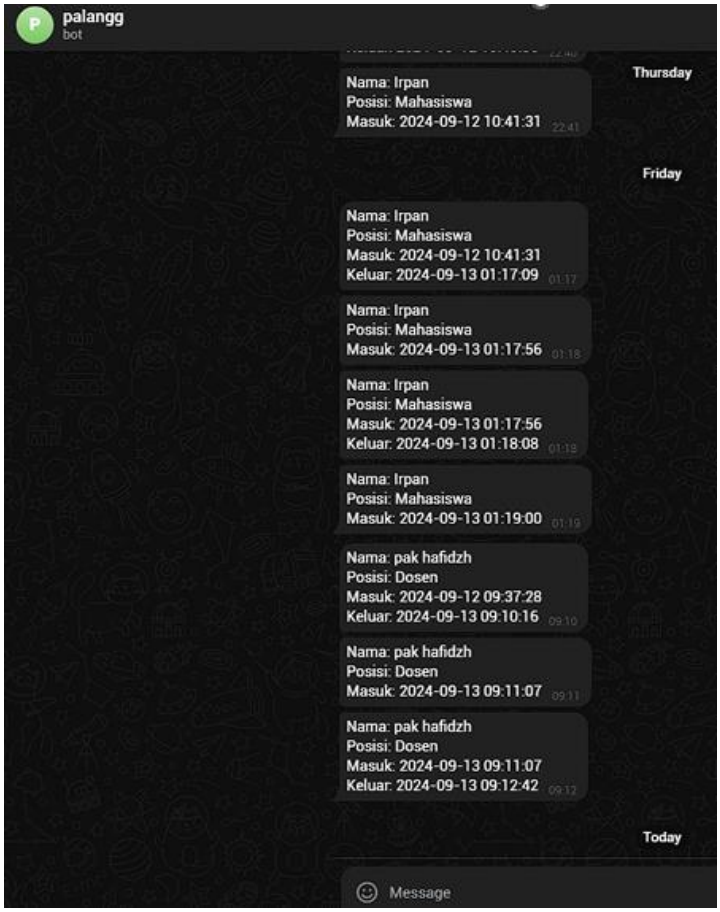

Figure 7. Telegram Notification

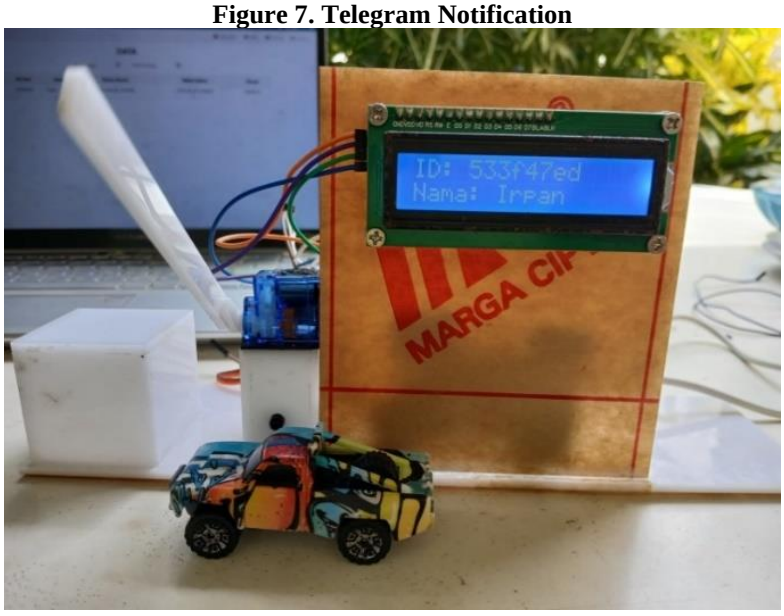

Figure 8. Gate Open

The object then passes the IR sensor; if the object has passed the IR sensor, the gate will close. If the object has not passed the sensor within 8 seconds, the gate will close to prevent unauthorized

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access by individuals who have not tapped their card. However, if a user encounters an issue with their vehicle after tapping their card, such as a breakdown, the administrator can press a button on the prototype. This action will send a message via the Telegram bot indicating that there is an issue near the gate.

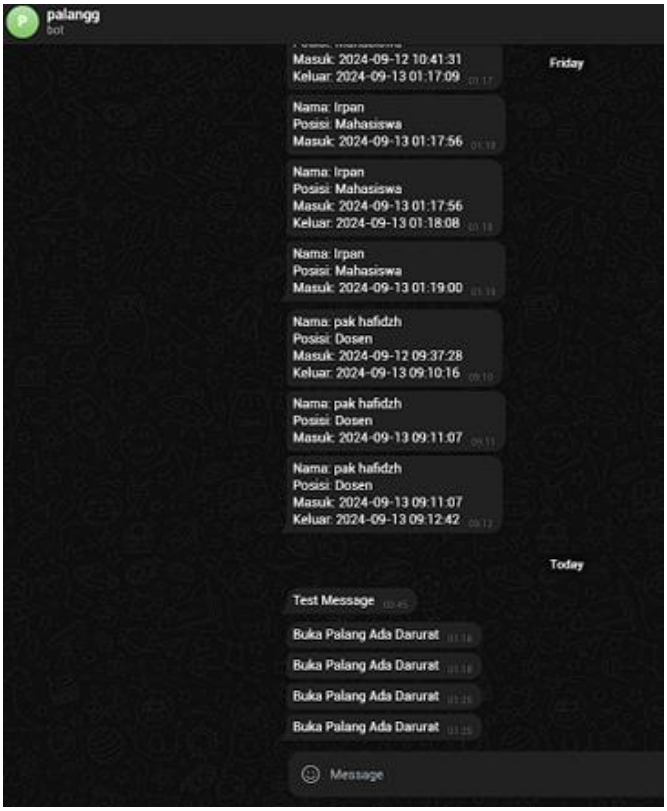

Figure 9. Emergency Button

When this message is received, the administrator responsible for managing the website information system can take action by opening the gate using the available feature in the parameter settings. Once the issue has been resolved, the administrator can close the gate using the website feature. After the gate is closed, it can be reopened only by tapping a registered user's card. If an unregistered user attempts to tap their card to open the gate, it will remain closed, as only registered cards allow access. Additionally, if a user who has been blocked by the administrator taps their card, the gate will not open, even though the card was previously registered.

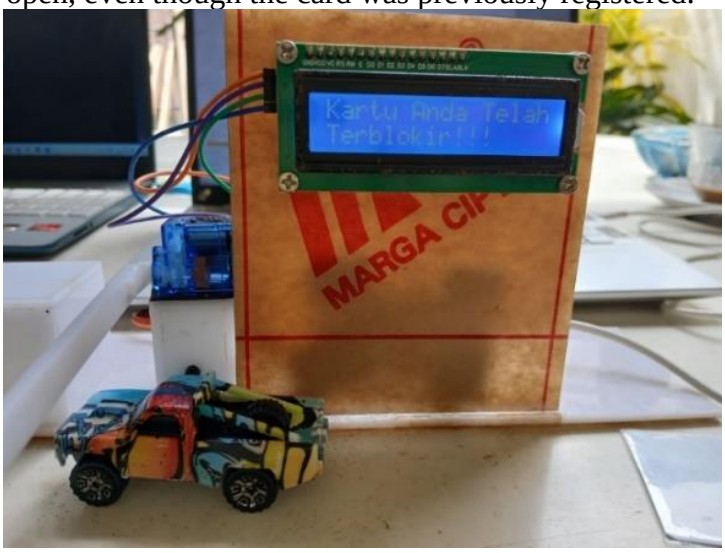

Figure 10. Blocked Card

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If the administrator wishes to lock the gate, they can use the gate access feature available on the website information system. Even if a card is already registered, it will not be able to open the gate if the gate access is locked.

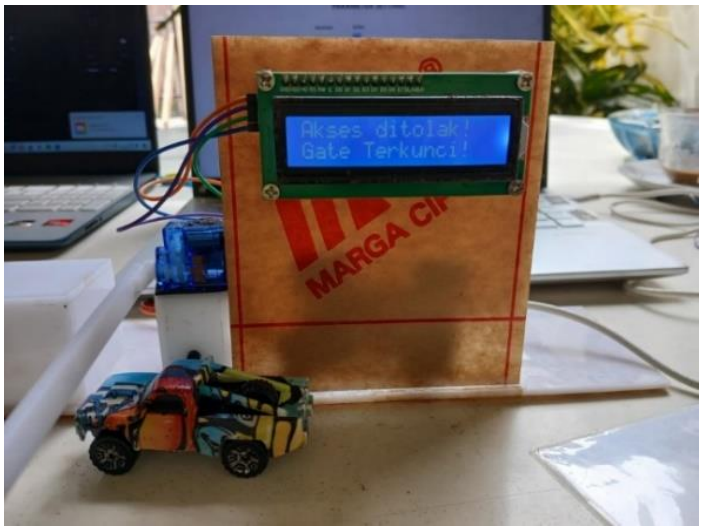

Figure 11. Gate Access

During testing, the card is read by the RFID sensor effectively when the distance between the card and RFID sensor is no more than 3 cm, with a read time of 5 seconds until the servo motor lifts the gate. The reliability of this system demonstrates that all sensors function well: the RFID sensor only recognizes valid, registered cards, while the IR sensor closes the gate if an object remains in front of the sensor for 8 seconds and closes the gate once the object has passed. On the website information system, all features operate optimally. The input feature successfully adds users, the edit feature allows for desired modifications to user information, the block feature effectively blocks specified users, the delete feature properly removes users, and the gate-closing feature on the website functions as intended. Finally, real-time notifications via the Telegram bot also work effectively. A similar study, "Rancangan Teknologi RFID Gerbang Parkir Pada UINSU Medan"[10] also used RFID to open automatic door bars, but with a focus on parking areas and did not integrate Internet of Things (IoT) technology or real-time notification systems. That study used ultrasonic sensors to close the bars after a vehicle passes, while this study uses infrared (IR) sensors to ensure safety during automatic door operation. The advantage of this research compared to previous research is the integration with IoT, which allows real-time monitoring through a web-based dashboard and instant notification to administrators through Telegram bots. These features provide a more comprehensive and modern solution for access control in campus environments, compared to automated parking systems that only use RFID and ultrasonic sensors. During implementation, obstacles were found such as limited RFID reading distance of 1-2 cm and IR detection that is only effective in the range of 1-3 cm. To overcome these obstacles, it is recommended to use a UHF RFID sensor to increase the range to 10 cm and an IR sensor with a wider range such as Sharp GP2Y0A02YK0F (20-150 cm).

V. DISCUSSION

In this study, the RFID and IoT-based automated gate control system integrated with a website information system and Telegram bot demonstrated satisfactory results. The system was successfully implemented with high accuracy in reading RFID cards and detecting objects through an infrared sensor. The RFID test showed that the system could accurately read valid cards within a 1-2 cm range from the RFID sensor, allowing only registered cards in the database to open the gate. This indicates that the system provides a higher level of security than the manual control systems still widely used on many campuses today.

DOI: 10.31253/te.v8i2.3447

The use of a Telegram bot for real-time notifications adds significant value to this system. Notifications sent via the Telegram bot allow administrators to immediately know who is accessing the gate, thus increasing campus security management efficiency. This feature also opens up possibilities for further development, such as remote control of the gate system through Telegram, allowing the administrator to enable or disable access during emergencies.

The IR sensor in this system performed well in detecting objects near the gate, though there are limitations in the detection range on this prototype, which is only 1-3 cm. For broader implementation, upgrading to a more advanced IR sensor, such as the Sharp GP2Y0A02YK0F with a detection range of up to 150 cm, could enhance system performance.

For future development, using UHF RFID technology could be considered to increase the flexibility and reading range of RFID cards. Unlike RC522 RFID, which has a short range (1-2 cm), UHF RFID can read cards at a much greater distance, up to several meters, allowing users to access the gate without having to bring the card very close to the reader. This improvement could enhance user convenience and speed up access, especially in high-traffic areas.

Overall, this system provides an efficient and secure solution for managing automated gate access in a campus environment. This research serves as a solid foundation for further development towards a modern and responsive smart campus security system. Future enhancements could focus on improving sensor responsiveness, expanding detection range, and using UHF RFID to optimize the access control process.

VI. CONCLUSION

This research successfully developed and implemented an RFID and IoT-based automatic gate control system integrated with a website information system and Telegram bot. The significant impacts of this research include increased campus security, reduced manual errors, and efficiency in access management. The use of RFID for identity card verification provides a high level of accuracy, while the IR sensor supports security by detecting the presence of objects in front of the gate.

Real-time notifications via Telegram bot add value to access management by allowing administrators to monitor each access attempt in real-time. The system also has potential for further development, such as integrating UHF RFID technology to increase the reading range and enable convenient access without direct contact with the reader. Overall, the system offers an efficient and secure solution for automated access management in a campus environment. Future enhancements can focus on extending the sensor range and optimizing the system to handle a larger user base. This system has great potential to be implemented in other campuses, especially in an effort to develop a smart and modern campus environment. The use of this technology can also be adopted by other public facilities such as housing and offices. With development opportunities that include the integration of additional IoT technologies, such as surveillance cameras or automated attendance monitoring systems, this research offers a comprehensive solution for IoT-based access control.

VII. ACKNOWLEDGEMENT

Thanks to the supervisor and parents and family who helped and supported the research process so that it could run better. And thanks to Malikussaleh University for providing facilities to support this research.

DOI: 10.31253/te.v8i2.3447

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DOI: 10.31253/te.v8i2.3447

BIOGRAPHY

Zainul Anwar Adi Putra, born in Padangsidimpuan, November 21, 2002, graduated from S1 Department of Informatics Engineering, Faculty of Engineering, Malikussaleh University.

Rizal, S.Si., M.IT, completed his undergraduate studies in Computational Mathematics at the Faculty of Mathematics and Natural Sciences, Universitas Syiah Kuala, in 2002. He pursued his master's degree in Information Technology at Universiti Kebangsaan Malaysia, graduating in 2005. Currently, he serves as a lecturer in the Informatics Engineering Department at Universitas Malikussaleh. His research interests include text mining, expert systems, and information retrieval.

Hafizh Al Kautsar Aidilof, S.T., M.Kom, completed his undergraduate education in Informatics Engineering at the Faculty of Engineering, Malikussaleh University in 2015. He continued his Masters in Informatics Engineering at the University of North Sumatra and graduated in 2018. Currently, he works as a lecturer at the Department of Informatics Engineering, Malikussaleh University. His research interests include data mining, machine learning, and digital image processing and pattern recognition.

DOI: 10.31253/te.v8i2.3447