Examination Room Guide Using Fingerprint, RFID, ESP32 Telegram Message Alert

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***Abstract*—Examination management in educational institutions often suffers from issues such as manual errors, impersonation, delays, and lack of transparency. Traditional methods of student verification and room allocation are inefficient and prone to security risks. This paper proposes an IoT-based smart examination room guidance system that integrates dual authentication using RFID and fingerprint biometrics with real-time communication through an ESP32 microcontroller. The system verifies student identity by combining RFID card scanning with fingerprint recognition to ensure secure and accurate authentication. Upon successful verification, examination room details are displayed on an LCD interface and simultaneously transmitted to the student via a Telegram message alert using a cloud-based API. The proposed system reduces manual intervention, minimizes impersonation, and enhances operational efficiency in examination processes. Experimental implementation demonstrates improved reliability, faster response time, and higher security compared to conventional methods. The system is cost-effective, scalable, and suitable for deployment in academic institutions aiming to achieve secure and automated examination management.**

***Index Terms*—IoT, ESP32, RFID, Fingerprint Authentication, Dual Authentication, Telegram Bot, Real Time Alert**

I. INTRODUCTION

Examinations play a critical role in evaluating the academic performance of students in educational institutions. However, managing examinations efficiently for a large number of students remains a challenging task due to issues such as manual errors, delays in room allocation, impersonation, and lack of transparency. Traditional examination management systems rely heavily on manual processes, including physical verification of student identity and printed seating arrangements, which are time-consuming and prone to inaccuracies. With the rapid advancement in Internet of Things (IoT) technology, there is a growing opportunity to automate and enhance the security of such systems. IoT-based solutions enable real-time data processing, communication, and monitoring, making them highly suitable for applications requiring accuracy and efficiency. In particular, the integration of identification technologies such as Radio Frequency Identification (RFID) and biometric fingerprint authentication has proven to be effective in This In improving security and reliability in various access control and attendance systems. Paper proposes a smart examination room guidance system based on an ESP32 microcontroller that combines RFID and fingerprint authentication to ensure secure and accurate student verification. The system uses a dual-authentication mechanism, where both RFID card and fingerprint data are validated against a stored database. Once the student is successfully authenticated, the system automatically displays the allocated examination room details on an LCD screen and sends real-time notifications to the student through a Telegram bot using Wi-Fi connectivity.

The proposed system aims to reduce manual intervention, eliminate impersonation, and improve overall transparency in examination management. By integrating IoT communication with biometric security, the system provides a reliable, cost-effective, and scalable solution suitable for modern educational institutions.

II. LITERATURE SURVEY

Recent Years, significant research has been carried out in the field of automated authentication systems using IoT, RFID, and biometric technologies. These systems aim to improve security, reduce manual intervention, and enhance operational efficiency in various applications such as attendance monitoring, access

control, and examination management.

RFID-based systems have been widely adopted in educational institutions for attendance tracking due to their simplicity and fast identification capability. A systematic review on IoT-based RFID attendance systems highlights that such systems eliminate manual errors, reduce time consumption, and provide reliable real-time data collection. However, RFID systems alone are vulnerable to misuse since RFID tags can be easily shared or duplicated to overcome these limitations, biometric authentication techniques such as fingerprint recognition have been introduced. Fingerprint-based systems provide high accuracy and uniqueness, making them suitable for secure identity verification. A study on IoT-based fingerprint authentication systems demonstrated that biometric verification significantly reduces impersonation and ensures reliable access control in sensitive environments such as examination halls. Recent research has focused on combining RFID and biometric authentication to enhance system security. An IoT-based attendance system integrating RFID and fingerprint sensors showed improved transparency, accuracy, and efficiency compared to traditional manual systems. Experimental results indicated a significant improvement in monitoring and reduction in data manipulation when both technologies were used together. Furthermore, dual authentication mechanisms have been widely studied to strengthen access control systems. Research on twofactor authentication using RFID and biometric sensors concludes that relying on a single authentication method introduces security risks, whereas combining multiple methods significantly increases the level of protection and reduces unauthorized access. Therefore, there is a need for a unified system that integrates dual authentication with real-time communication. The proposed system addresses this gap by combining RFID, fingerprint authentication, and IoT-based Telegram messaging using an ESP32 microcontroller to provide a secure, automated, and efficient examination room guidance solution.

Research Gap

Despite the rapid development of IoT-based authentication systems, several limitations still exist in current solutions. Most existing systems focus primarily on attendance monitoring or basic access control rather than examination management. RFID-based systems, although fast and cost- effective, are vulnerable to misuse due to card sharing or duplication. On the other hand, fingerprint based systems provide higher security but lack integration with real-time communication mechanisms. Some studies have explored dual-authentication techniques; however, they do not include instant notification or user guidance features. Additionally, many systems fail to utilize IoT capabilities for automated and transparent information delivery. There is also a lack of unified platforms that combine authentication, room allocation, and communication in a single system. Existing implementations often address either security or communication, but not both simultaneously. Moreover, scalability and cost-effectiveness remain concerns in large institutional deployments. Therefore, there is a need for an integrated, secure, and real-time examination management system. The proposed system addresses these gaps by combining RFID, fingerprint authentication, and Telegram- based IoT communication using ESP32.

Problem Statement

Traditional examination management systems rely on manual processes, leading to errors, delays, and risks of impersonation. Existing solutions lack integrated secure authentication and realtime communication. Therefore, there is a need for an automated IoT-based system that ensures secure student verification and provides instant examination room guidance.

Objectives

The objective of this work is to develop a secure and automated examination room guidance system using IoT technology with dual authentication through RFID and fingerprint verification. The system also aims to provide real- time examination details via Telegram alerts while reducing manual errors and transparency.

III. SYSTEM DESCRIPTION

The proposed system is an IoT-based examination room guidance solution designed to provide secure and real-time student authentication and information delivery. It uses an ESP32 microcontroller as the central processing unit, integrated with an RFID reader and a fingerprint sensor for dual authentication. When a student scans their RFID card and fingerprint, the system verifies the credentials against a stored

database. Upon successful authentication, the ESP32 retrieves the corresponding examination room details and displays them on a 16×2 LCD interface. Simultaneously, the system utilizes Wi-Fi connectivity to send real-time notifications to the student via a Telegram bot. The entire process ensures accurate identification, reduces manual intervention, and enhances transparency and efficiency in examination management.

IV. METHODOLOGY

The proposed system follows a systematic IoT-based approach to ensure secure and efficient examination room guidance. Initially, the ESP32 microcontroller is powered on and configured to establish a stable connection with the Wi- Fi network. All hardware components, including the RFID reader, fingerprint sensor, and LCD display, are initialized and tested for proper communication. Once the system setup is complete, it enters a standby mode, waiting for user interaction.

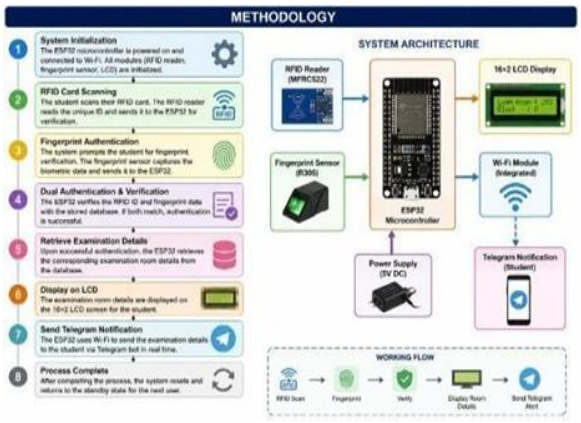
When a student approaches the system, they are required to scan their RFID card. The RFID reader captures the unique identification number and sends it to the ESP32 for preliminary verification. After successful RFID detection, the system prompts the user to provide fingerprint authentication. The fingerprint sensor captures the biometric data and compares it with the prestored templates in the database. The system ensures that both RFID and fingerprint data match to complete the dual authentication process.

If the authentication is successful, the ESP32 retrieves the corresponding examination room details from the database.

These details are immediately displayed on the 16×2 LCD screen to guide the student. At the same time, the ESP32 uses its Wi-Fi capability to send a real-time notification containing the examination details to the student via a Telegram bot. This ensures that the student receives accurate information through both local and remote interfaces.

In case of authentication failure, the system displays an appropriate error message and denies access, preventing unauthorized entry. After each operation, the system resets itself and returns to the standby state, ready to process the next student. This methodology ensures high security, reduces manual intervention, minimizes errors, and provides a fast and reliable solution for examination management.

Furthermore, the system incorporates a sequential processing mechanism to ensure proper synchronization between RFID and fingerprint inputs, avoiding conflicts during authentication. A timeout feature is implemented to handle cases where the user does not complete the authentication process within a specified time. The database used for storing student credentials and examination details is designed to ensure quick access and efficient retrieval of information. Error-handling mechanisms are also included to manage hardware failures, invalid inputs, or communication issues.



V. SYSTEM IMPLEMENTATION AND RESULT AND TESTING

The proposed system is implemented using an ESP32 microcontroller integrated with an RFID reader (MFRC522), fingerprint sensor (R307/AS608), and a 16×2 LCD display. All components are interfaced using appropriate communication protocols such as SPI for RFID, UART for the fingerprint sensor, and I2C for the LCD module. The system is programmed using the Arduino IDE with necessary libraries to ensure smooth communication between hardware modules. Wi-Fi connectivity is established to enable real-time communication with the Telegram Bot API for sending alerts.

During operation, the system captures RFID and fingerprint data from the user and processes it for authentication. Upon successful verification, the examination room details are retrieved and displayed on the LCD screen, while a notification is simultaneously sent to the student via Telegram. For

testing purposes, multiple scenarios were evaluated, including valid authentication, invalid inputs, and network failure conditions. The system demonstrated consistent performance with an average response time of 2– 3 seconds.

The testing results confirm that the system operates reliably under different conditions, providing accurate authentication and real-time communication. It effectively reduces manual errors and ensures secure access, making it suitable for practical deployment in educational institutions.

VI. APPLICATIONS

- Examination Centers for secure student verification and room guidance
- Educational Institutions for automated attendance and identity management
- Secure Access Control in laboratories, libraries, and restricted areas
- Event Management systems for participant verification and navigation
- Smart Campus systems for real-time monitoring and automation
- Corporate Offices for employee authentication and access control
- Government and Secure Facilities for authorized entry and tracking.
- Hostel and Residential Security systems for controlled entry and monitoring
- Library Management systems for user authentication and access tracking
- Parking Management systems for vehicle identification and entry control
- Healthcare Facilities for secure access to patient records and restricted areas
- Industrial Plants for worker authentication and safety compliance
- Airport and Railway Stations for passenger verification and guidance systems
- Smart Building Management systems for automated access and monitoring.

VII. CONCLUSION

The proposed IoT-based examination room guidance system provides an efficient and secure solution to the challenges faced in traditional examination management. By integrating RFID and fingerprint-based dual authentication with ESP32 and real-time Telegram alerts, the system ensures accurate student verification and eliminates the risk of impersonation. It significantly reduces manual intervention, minimizes errors, and improves transparency in the examination process. The implementation results demonstrate reliable performance with fast response time and high accuracy. Furthermore, the system is cost-effective, scalable, and easy to deploy in educational institutions. Overall, the proposed solution enhances the efficiency, security, and automation of examination management systems.

VIII. FUTURE SCOPE

Integration of face recognition for faster and contactless authentication

Development of a mobile application for easy access to examination details

Implementation of cloud-based storage for better scalability and data management

Use of Artificial Intelligence for data analysis and system optimization

Integration of GPS or indoor navigation for locating examination rooms easily

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