Prof. Krashna Rathi, 2026, 14:3
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology
An Open Access Journal

Rfid Based Passport Authentication System

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Abstract- The objective of this project is to develop an RFID-based passport authentication system using ESP32 technology to improve security and automate identity verification. The system uses RFID tags/cards as digital passports and verifies them through an RFID reader module (RC522). The ESP32 microcontroller acts as the main controller and processes the RFID data. If the scanned RFID card matches the stored authorized UID, access is granted; otherwise, access is denied. The system displays authentication status on an LCD display and indicates the result using LEDs and a buzzer. This system reduces manual verification, increases security, and provides a fast and reliable authentication mechanism.

Keywords: RFID Technology, Passport Authentication System, ESP32 Microcontroller, RFID Reader RC522, Access Control System, Identity Verification, Security Automation, Digital Passport, Embedded Systems, Smart Authentication.

I. INTRODUCTION

In today's world, secure identification and authentication systems are essential in airports, border checkpoints, government offices, and high-security areas. Traditional passport verification systems involve manual checking of documents, which is time-consuming and vulnerable to human errors and fraudulent activities. The RFID-Based Passport Authentication System using ESP32 provides a smart and automated solution for identity verification. In this system, each passport is represented using an RFID tag or RFID card containing a unique identification number (UID). The RC522 RFID reader scans the RFID card and sends the UID information to the ESP32 microcontroller.

The ESP32 compares the scanned UID with the authorized database. If the UID matches the stored records, authentication is successful, a green LED glows, and the LCD display shows "Authentication Successful." If the UID does not match, authentication fails, the red LED glows, and a buzzer sounds for one second to indicate unauthorized access. The ESP32 also transmits authentication information wirelessly to a laptop or cloud server through Wi-Fi or Bluetooth technology. This system improves security, reduces manual work, and provides fast real-time verification.

II. LITERATURE SURVEY

RFID technology has become widely used in modern authentication and security systems due to its speed, reliability, and contactless operation.

Kumar, S., Sharma, A., and Gupta, P. (2019) proposed a biometric authentication system for secure access control environments. Their system improved security and reduced impersonation risks by using automated authentication techniques.

Lee, J., Park, M., and Kim, H. (2020) developed an RFID and biometric-based authentication model for access control applications. Their work demonstrated that automated authentication systems are more efficient and secure compared to traditional manual verification methods.

Santos, A. P., Costa, F. R. G., and Oliveira, D. A. (2021) implemented a secure authentication framework using IoT-based technologies and wireless communication systems. Their research highlighted

the importance of real-time monitoring and cloud integration for modern authentication systems.

Based on these studies, the proposed RFID-Based Passport Authentication System using ESP32 provides a low-cost, wireless, and secure authentication mechanism suitable for passport verification and identity management applications.

III. DESIGN GOALS

The main objective of the proposed system is to create a secure and wireless passport authentication system using RFID technology and ESP32.
The design goals are:

- To automate passport authentication using RFID technology.
- To reduce manual verification and human errors.
- To provide real-time authentication results.
- To enable wireless communication using Wi-Fi/Bluetooth.
- To display authentication status on an LCD display.
- To improve security using authorized UID matching.
- To provide visual and audio indication for authentication results.
- To make the system portable using a power bank supply.

Traditional passport verification systems are slow and require manual inspection. Such systems are vulnerable to fake identities, unauthorized access, and operational delays. The proposed RFID-based authentication system solves these problems by using digital authentication and wireless communication.

The proposed RFID-Based Passport Authentication System using ESP32 is designed to provide a smart, secure, and wireless

authentication mechanism for identity verification applications. The system aims to eliminate the limitations of traditional passport verification methods by automating the authentication process using RFID technology. By integrating ESP32 with Wi-Fi and Bluetooth communication, the system enables real-time monitoring and wireless transmission of authentication data to laptops or cloud servers. The design also focuses on portability and low power consumption by supporting power bank operation, making the system suitable for practical deployment in airports, security checkpoints, educational institutions, and restricted access areas. The use of LCD display, LEDs, and buzzer provides immediate visual and audio feedback, improving user interaction and operational efficiency.

IV. SYSTEM

The proposed system consists of an ESP32 microcontroller, RC522 RFID reader module, LCD display, LEDs, buzzer, and power supply.

The RC522 RFID reader scans the RFID card and sends the UID data to the ESP32 through SPI communication. The ESP32 processes the UID and compares it with the stored authorized UID.
If the scanned UID matches the stored UID:

- Green LED glows
- LCD displays "Authentication Successful"
- Access is granted

If the scanned UID does not match:

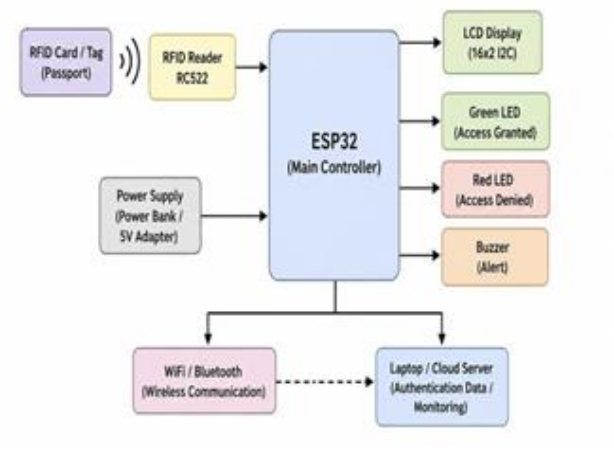
- Red LED glows
- LCD displays "Authentication Unsuccessful"
- Buzzer sounds for one second
- Access is denied

The ESP32 transmits authentication data wirelessly to a laptop or cloud server using Wi-Fi or Bluetooth communication. The system can be powered through USB, adapter, or power bank, making it fully portable and wireless.

The LCD display continuously shows system status and authentication results. This system provides a secure, fast, and reliable solution for passport authentication applications.

The proposed RFID-Based Passport Authentication System consists of an ESP32 microcontroller, RC522 RFID reader module, LCD display, LEDs, buzzer, and wireless communication system. The RC522 module scans the RFID card or tag and sends the UID data to the ESP32 through SPI communication. The ESP32 compares the scanned UID with the stored authorized UID database. If the UID matches, the system grants access by glowing the green LED and displaying "Authentication Successful" on the LCD screen. If the UID does not match, the red LED glows, the buzzer sounds for one second, and the LCD displays "Authentication Unsuccessful." The ESP32 also transmits authentication data wirelessly to a laptop or cloud server using W-iFi or Bluetooth for real-time monitoring. The entire system can be powered using a USB adapter or power bank, making it portable, efficient, and suitable for secure authentication applications.

V. BLOCK DIAGRAM



The block diagram of the RFID-Based Passport Authentication System illustrates the overall working and interaction between different hardware components. The system consists of an RFID card or tag, RC522 RFID reader, ESP32 microcontroller, LCD display, LEDs, buzzer, wireless communication module, laptop/cloud server, and power supply. The RFID card acts as a digital passport containing a unique identification number (UID). When the card is brought near the RC522 RFID reader, the reader scans the UID and sends the data to the ESP32 microcontroller through SPI communication. The ESP32 acts as the main controller of the system and processes the received UID by comparing it with the stored authorized database. If the UID matches, the ESP32 activates the green LED and displays "Authentication Successful" on the LCD display. If the UID does not match, the red LED glows, the buzzer sounds as an alert, and the LCD shows "Authentication Unsuccessful." The ESP32 also uses built-in Wi-Fi and Bluetooth features to transmit authentication data wirelessly to a laptop or cloud server for monitoring and data storage purposes. The entire system is powered using a 5V adapter or power bank, making the setup portable and suitable for wireless operation.

VI. ACKNOWLEDGMENT

We would like to express our sincere gratitude to everyone who supported and guided us throughout the development of the project titled "RFID-Based Passport Authentication System using ESP32." This project provided us with an excellent opportunity to gain practical knowledge in the fields of embedded systems, wireless communication, RFID technology, and IoT-based security applications.

We are highly thankful to our project guide and faculty members for their valuable guidance, continuous encouragement, and technical support during every stage of the project. Their suggestions and motivation helped us improve the quality and implementation of the system. We also extend our gratitude to our institution and department for providing the necessary laboratory facilities, internet resources, and technical environment required for successful project completion. The support provided by our friends and classmates through discussions and idea sharing was also very helpful during troubleshooting and testing. Special thanks to the developers and open-source communities of Arduino IDE, ESP32, and RFID libraries, whose documentation and resources helped us understand the concepts and complete the programming part effectively. Finally, we would like to thank our family members for their constant motivation, patience, and moral support throughout the project work. Their encouragement inspired us to complete the project successfully.

We would also like to acknowledge the contribution of various online platforms, research papers, tutorials, and technical forums that helped us understand the practical implementation of RFID communication, ESP32 programming, wireless data transmission, and LCD interfacing. These resources played an important role in enhancing our technical knowledge and problem-solving abilities during the development and testing phases of the project. The experience gained while working on this project has improved our understanding of real-time embedded systems and motivated us to explore more advanced IoT and security-based applications in the future.

VII. CONCLUSION

he RFID-Based Passport Authentication System using ESP32 successfully demonstrates a secure, reliable, and wireless method for identity verification and access control. The system utilizes RFID technology to automate the authentication process, thereby reducing manual verification efforts and minimizing the possibility of unauthorized access or human errors. By integrating the RC522 RFID reader with the ESP32 microcontroller, the system is capable of identifying authorized RFID cards and providing immediate authentication results through the LCD display, LEDs, and buzzer indications.

The built-in WiFi and Bluetooth capabilities of the ESP32 further enhance the system by enabling wireless communication and real-time monitoring on a laptop or cloud platform. The use of a portable power supply such as a power bank makes the system compact, flexible, and suitable for practical deployment in security-sensitive environments like airports, offices, institutions, and restricted access areas.

Overall, the proposed system offers a cost-effective and efficient solution for smart authentication applications while also providing opportunities for future enhancements such as biometric integration, cloud storage, and IoT-based security monitoring systems.

VIII. REFERENCE

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