

# Dual Authentication Door Lock System Using ESP32

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**Abstract-** This paper presents a dual authentication door lock system based on the ESP32 microcontroller aimed at enhancing security in modern access control applications. The system employs two levels of authentication, such as RFID, password, or biometric verification, to ensure that only authorized users can gain access. By integrating Internet of Things (IoT) technology, the system supports remote monitoring, real-time alerts, and data logging for improved user control and convenience. The ESP32 platform is utilized for its low power consumption, built-in Wi-Fi and Bluetooth capabilities, and efficient processing performance. The proposed system offers a reliable, cost-effective, and scalable solution suitable for smart homes and industrial security applications.

**Keywords:** Authentication, Access Control, Embedded Systems, ESP32, Internet of Things (IoT), Security System, Smart Door Lock

## I. INTRODUCTION

A dual authentication door lock system using the ESP32 represents a modern approach to enhancing security in residential. Traditional lock-and-key mechanisms are increasingly vulnerable to unauthorized access, duplication, and physical tampering. To address these challenges, smart security systems incorporating multiple layers of authentication have gained significant attention. The ESP32 microcontroller, with its integrated Wi-Fi and Bluetooth capabilities, provides an efficient and cost-effective platform for implementing such advanced access control systems. By combining two independent verification methods—such as RFID, biometric fingerprint scanning, or password-based authentication—the system ensures improved reliability and stronger protection against unauthorized entry.

This research focuses on the design and implementation of a dual authentication mechanism that requires two distinct credentials before granting access. The integration of Internet of Things (IoT) technology enables features such as remote monitoring, real-time alerts, and data logging, thereby enhancing system functionality and user convenience. The ESP32's low power consumption and high processing capability make it suitable for continuous embedded applications. The proposed system not only

strengthens security but also demonstrates scalability for future smart home and industrial automation solutions.

## II. LITERATURE SURVEY

Recent studies in smart security systems highlight the growing adoption of microcontroller-based access control mechanisms to improve safety and reliability. Traditional systems relying on single authentication methods, such as passwords or RFID, have been found vulnerable to security breaches and unauthorized access. Researchers have explored various solutions using embedded platforms like the ESP32 and Arduino, integrating technologies such as biometric fingerprint recognition, keypad entry, and RFID modules. These systems demonstrate improved security by validating user identity through digital means, while also offering flexibility and ease of implementation in both residential and commercial settings.

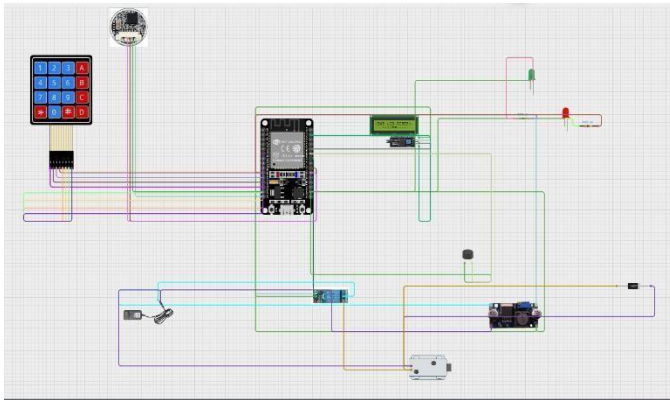
Furthermore, with the advancement of Internet of Things (IoT) technology, many proposed systems incorporate remote monitoring and control features using mobile applications and cloud connectivity. Studies show that dual or multi-factor authentication significantly enhances system security by requiring multiple credentials, thereby reducing the risk of intrusion. The ESP32 has gained popularity in such applications due to its built-in Wi-Fi and Bluetooth capabilities, low power consumption, and high processing efficiency. Overall, existing literature emphasizes the importance of combining multiple authentication techniques with IoT-based monitoring to develop robust, scalable, and user-friendly smart security solutions.

## III. METHODOLOGY

The proposed dual authentication door lock system is implemented using the ESP32 microcontroller to provide a secure and reliable access control mechanism. The system uses two authentication methods: a keypad for password entry and a fingerprint sensor for biometric verification. When a user attempts to unlock the door, the system first prompts for a password through the keypad. If the entered password matches the stored credentials, the system proceeds to the second level of authentication, where the user must verify their identity using the fingerprint sensor. Access is granted only when both

authentication steps are successfully completed. The system is built using hardware components including the ESP32 microcontroller, keypad, fingerprint sensor, relay module, buzzer, and LCD display. The ESP32 acts as the central controller, managing all input and output operations. The LCD display is used to provide instructions and display system status messages such as “Enter Password” or “Place Finger.” The buzzer gives audio feedback for correct or incorrect attempts, while the relay module controls the electronic door lock mechanism. All components are interfaced with the ESP32 and programmed using Arduino IDE. The working process begins with system initialization, after which the ESP32 continuously monitors user input. If an incorrect password or fingerprint is detected, access is denied and the buzzer alerts the user. If both authentication steps are verified successfully, the ESP32 activates the relay to unlock the door for a few seconds, after which it automatically locks again. This methodology ensures enhanced security, reduces unauthorized access, and provides a user-friendly and efficient smart locking system, with scope for future improvements such as IoT-based monitoring.

#### IV. CIRCUIT DIAGRAM



The proposed dual authentication door lock system requires several hardware components for proper implementation. The main component is the ESP32 microcontroller, which acts as the central processing unit and controls all system operations. A keypad is used for password entry, while a fingerprint sensor provides biometric authentication, ensuring enhanced security through dual verification. Additional components include an LCD display, relay module, buzzer, and LED indicators. The LCD display is used to show system messages such as prompts and access status. The relay module controls the door locking mechanism by acting as a switch. The buzzer and LEDs provide audio and visual indications for successful or failed authentication attempts. Other supporting components include connecting wires, a regulated power supply, and basic electronic elements

required for circuit connections. All components are interconnected with the ESP32 to form a complete and efficient security system.

#### V. COMPONENTS REQUIRED

This circuit represents a **Smart Door Lock System** using an ESP32 microcontroller with two layers of security: a fingerprint sensor and a 4\*4 matrix keypad. It also features a power management system to drive the high-current solenoid lock. Here are the detailed breakdown of the components and their roles in your system:

##### 1. Core Control & Input Components

- **ESP32 Microcontroller:** The brain of the operation. It handles the logic for both authentication methods, manages the I2C communication for the LCD, and triggers the relay for the door.
- **Fingerprint Sensor:** Used for biometric authentication. It communicates with the ESP32 via serial (TX/RX) pins to verify stored prints.
- **4\*4 Matrix Keypad:** Used for password-based entry. It is connected to 8 GPIO pins on the ESP32 to scan for button presses.
- **16x2 I2C LCD Display:** Provides user feedback (e.g., "Enter Pin," "Access Granted"). Using the I2C module saves pins by only using two data wires (SDA/SCL).

##### 2. Power Management & Output

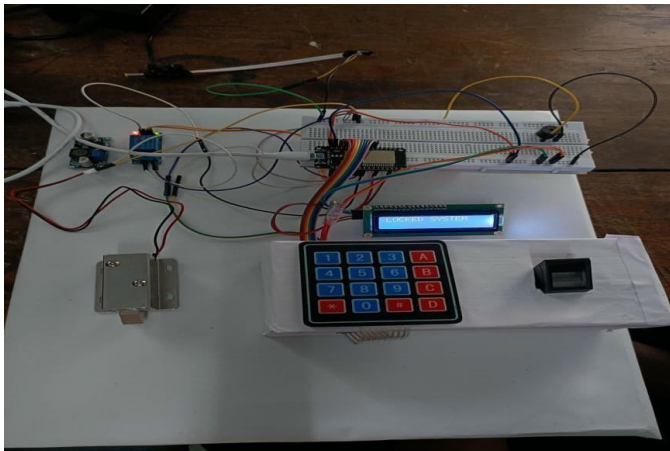
- **Solenoid Door Lock:** The physical locking mechanism. These typically require 12V to retract the pin and unlock the door.
- **Relay Module:** Acts as a high-voltage switch. The ESP32 cannot power a 12V solenoid directly, so it sends a low-power signal to the relay, which then "closes" the circuit to power the lock.
- **Buck Converter / Voltage Regulator:** Since your power adapter (bottom left) likely provides 12V, this module steps that voltage down to 5V or 3.3V to safely power the ESP32 and sensors without frying them.
- **Buzzer & LEDs:**
  - **Buzzer:** Provides audible alerts for successful or failed attempts.
  - **Green LED:** Signals "Access Granted." ○ **Red LED:** Signals "Access Denied" or "System Error."

##### 3. How the System Operates

Based on your wiring, the logic flow works like this:

1. **Standby:** The LCD displays a prompt. The Solenoid is in the "Locked" position (Relay is open).
2. **Authentication:** The user scans a finger **OR** enters a PIN on the keypad.
3. **Verification:**
  - **If Successful:** The ESP32 triggers the **Relay**, the **Green LED** lights up, and the **Solenoid** retracts to unlock the door.
  - **If Failed:** The **Red LED** flashes, the **Buzzer** sounds, and the door remains locked.
4. **Reset:** After a set time (e.g., 7 seconds), the ESP32 deactivates the relay, and the solenoid springs back to the locked position.

## VI. RESULT



The figure shows the hardware implementation of the dual authentication door lock system using the ESP32 microcontroller. The system consists of a keypad for password entry, a fingerprint sensor for biometric verification, an LCD display for user messages, and a relay module connected to an electronic door lock. All components are connected on a breadboard using jumper wires to form a complete system.

The ESP32 controls all operations by processing inputs from the keypad and fingerprint sensor. If both authentication steps are successful, the relay is activated to unlock the door; otherwise, access is denied. The LCD displays system status, making the system user-friendly and efficient

## VII. CONCLUSION

The dual authentication door lock system using the ESP32 microcontroller provides a secure and reliable solution for modern access control by combining password-based and biometric verification. The integration of components such as a keypad, fingerprint sensor, LCD display, and relay module ensures efficient operation and user-friendly interaction. This system significantly reduces the chances of unauthorized access compared to traditional locking mechanisms. The developed prototype demonstrates effective performance, low **cost**, and scalability, making it suitable for residential and commercial security applications, with potential for future enhancements using IoT technologies.

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