

Smart Door Lock using RFID with Access Logging

An ESP32-based RFID door lock that authenticates tags, actuates a solenoid strike, and keeps a time-stamped access log on SD card.

1. Introduction / Background

RFID access control is standard in offices, hostels and laboratories, yet students rarely see the sensing, decision and actuation chain behind the reader on the wall.

This project builds that chain as a working prototype: a 13.56 MHz RC522 reader, an ESP32 controller, a solenoid door strike, and a DS3231 real-time clock with microSD logging.

2. Problem Statement

Conventional locks give no record of who entered and when; lost keys force lock replacement. Commercial access systems hide their internals, leaving students with no hands-on understanding of UID authentication, whitelist management, timestamped logging, or safe inductive-load driving.

3. Objectives

- Authenticate 13.56 MHz RFID tags against an on-device whitelist and actuate a solenoid strike on match.
- Log every granted/denied attempt with UID and date-time to microSD for later review.
- Provide master-tag enrollment/deletion without re-flashing, plus tamper alarm and LCD status.

4. Proposed Methodology

The RC522 returns each tag's UID over SPI; the ESP32 compares it with the whitelist in flash and timestamps the event with the DS3231. On a match, a relay pulses the 12 V solenoid strike for a configurable interval; on mismatch, a buzzer and red LED signal denial. A tamper micro-switch on the enclosure drives a continuous alarm until a reset key sequence is entered.

5. System Architecture / Working

- Sensing: RC522 (SPI) reads tag UID at 3–5 cm; DS3231 (I2C) provides date-time.
- Decision: ESP32 whitelist match; master-tag mode for enroll/delete.
- Actuation: relay + flyback diode pulses solenoid strike; re-locks automatically.
- Logging: CSV lines (UID, granted/denied, timestamp) to microSD; recent events scroll on 16x2 LCD.

6. Hardware / Software Requirements

- ESP32 dev board, RC522 reader + tags, 12 V solenoid strike, 5 V relay module with flyback diode, DS3231 RTC, microSD module, 16x2 LCD, tamper micro-switch, buzzer.
- Arduino IDE (C/C++); 12 V DC solenoid supply, 5 V DC logic supply.

7. Expected Outcomes

- A working RFID door lock prototype that grants/denies access and keeps a readable event log.
- Demonstrated enroll/delete workflow and tamper alarm.
- A complete report, PPT and viva Q&A; covering RFID fundamentals and UID security limits.

8. Applications

- Hostel/lab room access demonstration.
- Teaching RFID interfacing, RTC logging and relay driving.
- Base platform for extended access-control projects.

9. Future Scope

- Cloud-synced access log over Wi-Fi.
- Keypad PIN as second factor.
- Anti-passback and time-restricted access rules.

10. Conclusion

The project delivers the complete access-control loop — sense, decide, actuate, log — in one honest prototype, with UID-cloning limits stated openly rather than hidden.