Innovative Smart Lock System for Efficient Door Management

Project Members

Adel Aljaed	CoE	2036396
Aws Alsaedi	CoE	2035072
Ahmed Badahdh	CoE	2035096

Project Advisor:
DR. SAUD WASLY

Team 8

Outlines

01

Introduction

Introduction

- Smart locks offer convenience and better security. Our system replaces traditional keys using BLE and app control, ideal for homes and buildings.

02

Problem Statement

Problem Statement

Old locks can be duplicated or broken. Most smart locks are hard to manage or too expensive. We built a simpler, secure, and cost-effective solution.

03

Project Objectives

Higher-level objectives

Improve access security

Replace physical keys

Log every access

Provide app-based control

Lower-level objectives

Real-Time Access Logging

Biometric Authentication

BLE Communication Stability

Project Design Specification

Musts

MUSTS

Secure Authentication

Access Logging

BLE Communication

Wants

Wants

Biometric Unlocking

Cloud Backup

Multi-User Access Levels

Constraints

Constraints

1

Budget Limit

2

Mobile-Only Access

Standards

Standards

IEEE 802.15.1 (Bluetooth)

ISO/IEC 30107 (Biometric Security)

OWASP Mobile Security Standards

IEEE 16262-2018 (Embedded Systems Reliability)

Project deliverables

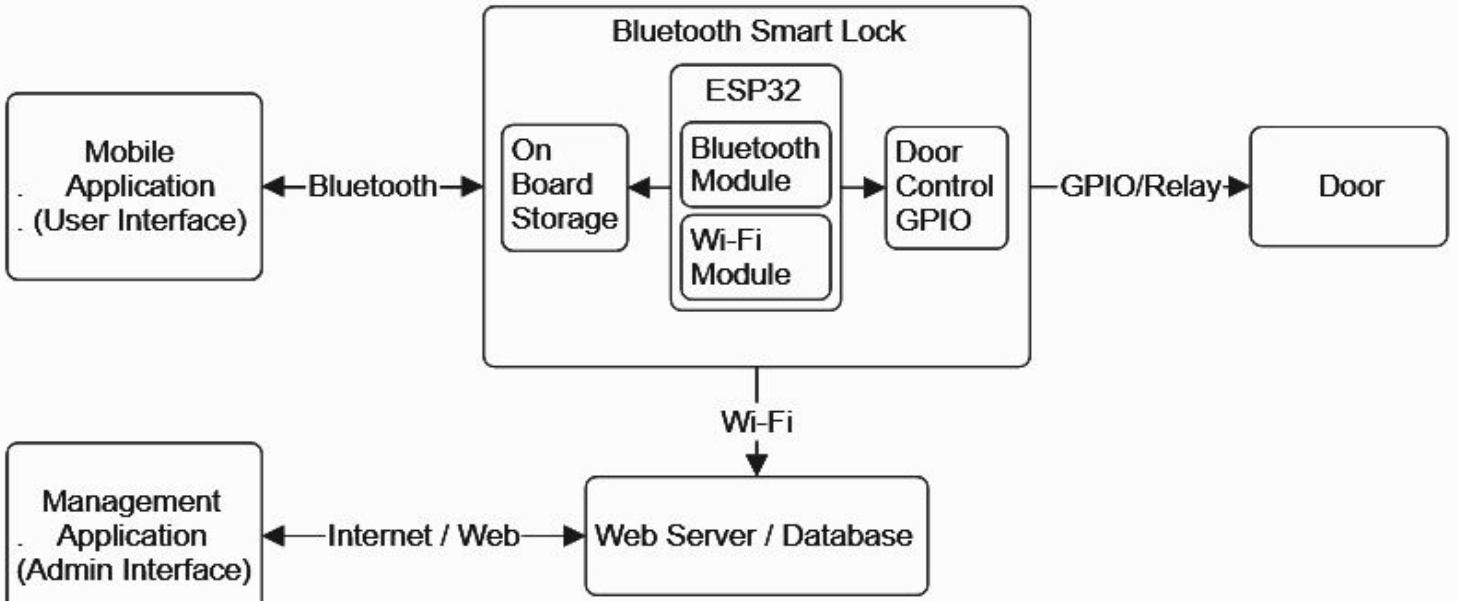
Project deliverables

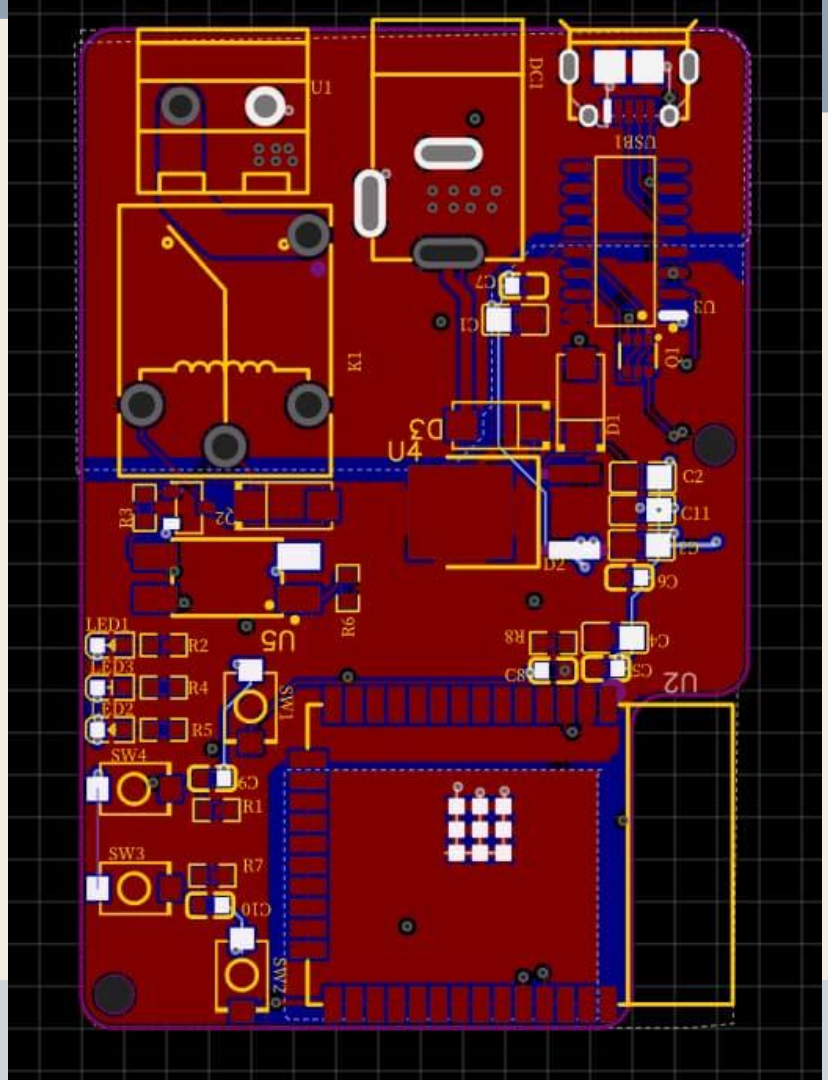
A complete smart lock system featuring BLE-based locking, mobile app control with biometric authentication, local and cloud access logging.The system also includes a backend API, user management features, and full functionality for reliability.

04

Baseline Design

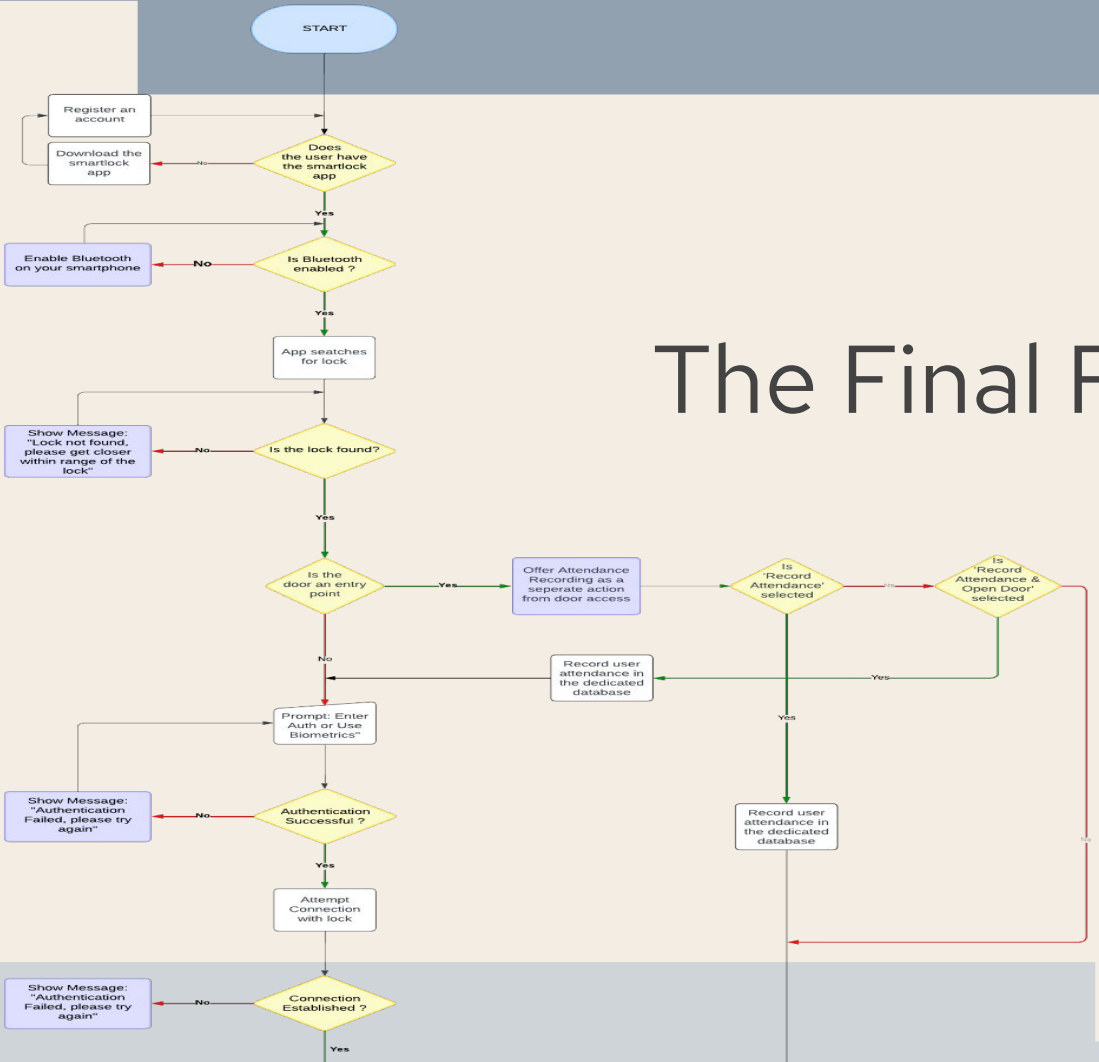
Baseline Design

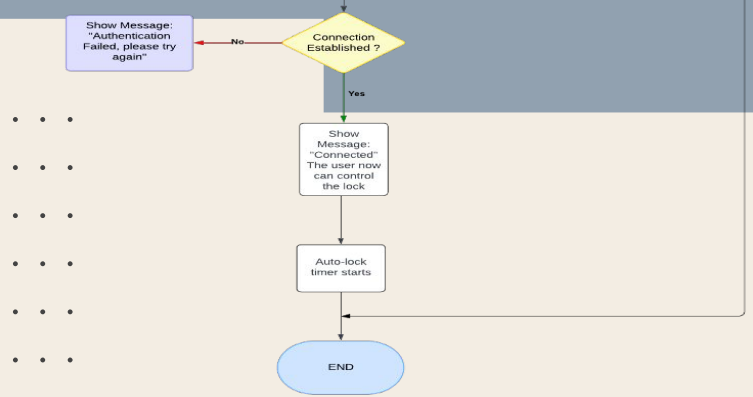




Circuit Diagram

The Final Flow Chart



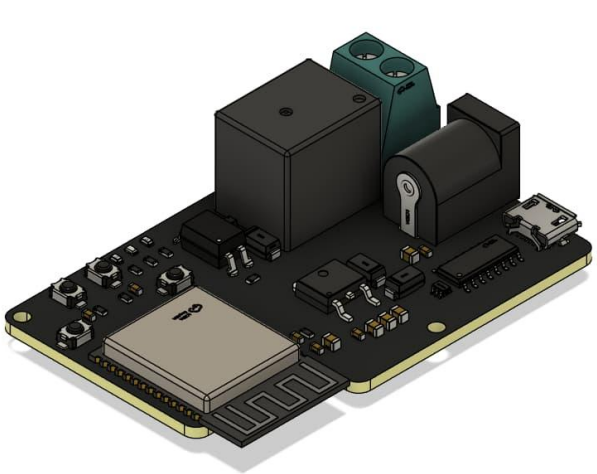


The Final Flow Chart

05
Implementation

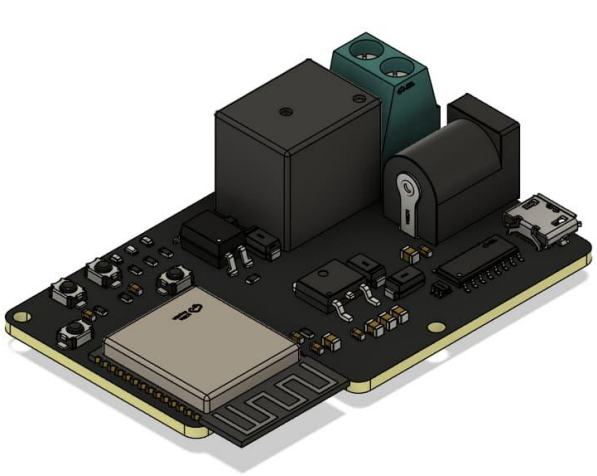
Hardware List

- ESP32 microcontroller
- Relay board
- Lock motor + power
- Custom PCB



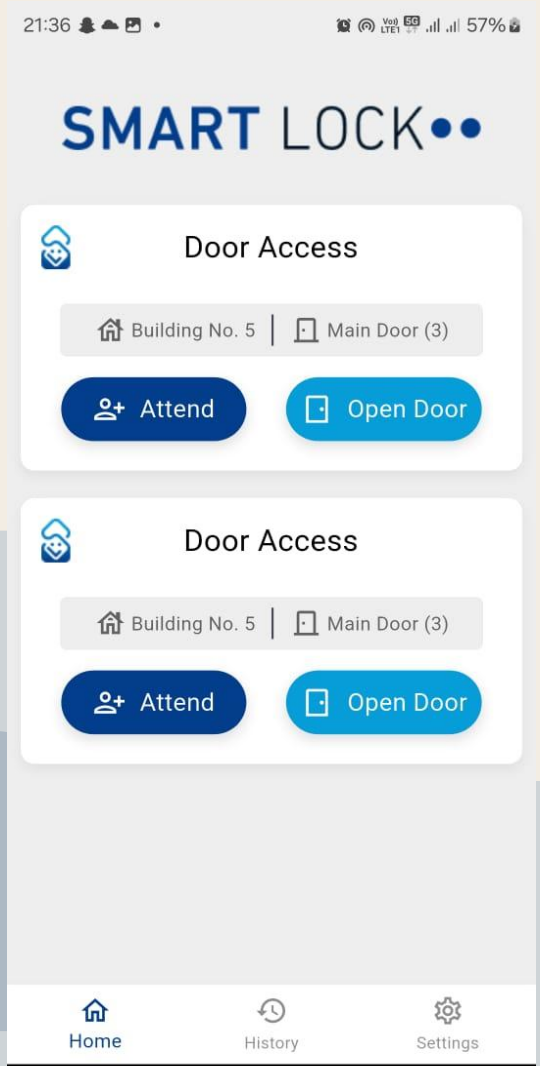
Firmware Job

- Connect via BLE
- Unlock door when approved



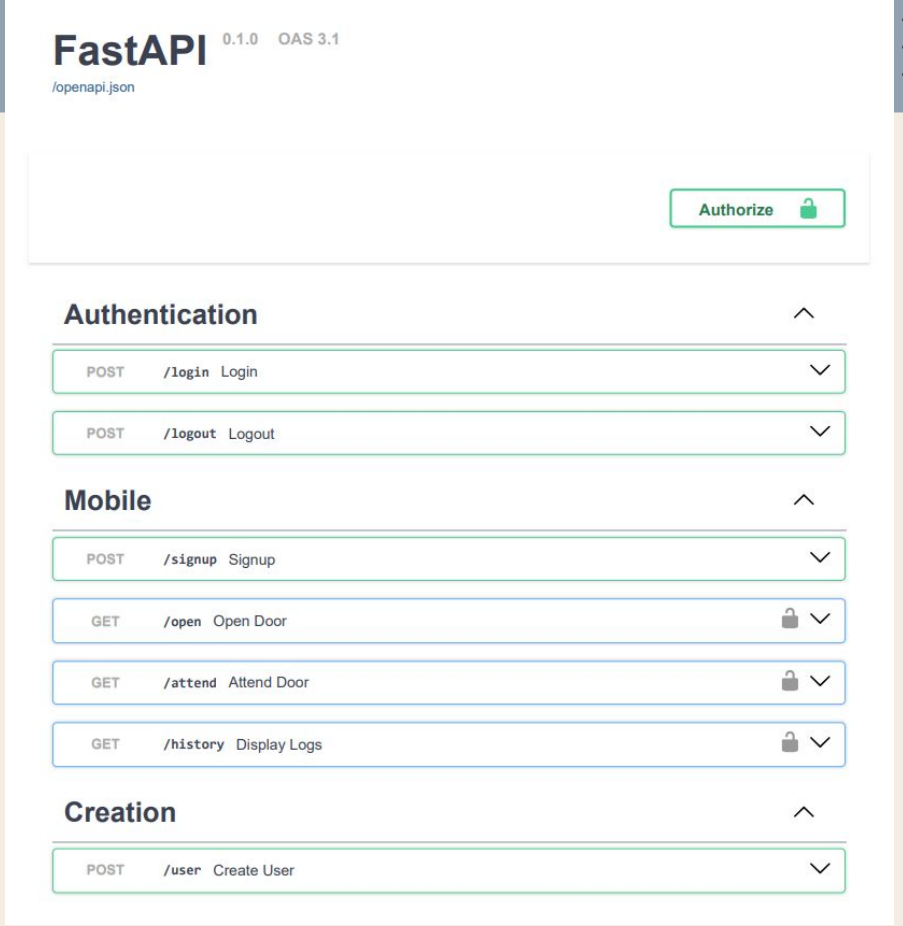
Mobile App UI

1. **Access controls**
2. **History logs**
3. **Notifications**
4. **User settings**



Backend Features

- Login / Sign up
- Unlock command
- Access history
- Built with FastAPI



Final Assembly

All parts installed inside a lock box.
Fully wired, tested, and functional.

Challenges We Fixed

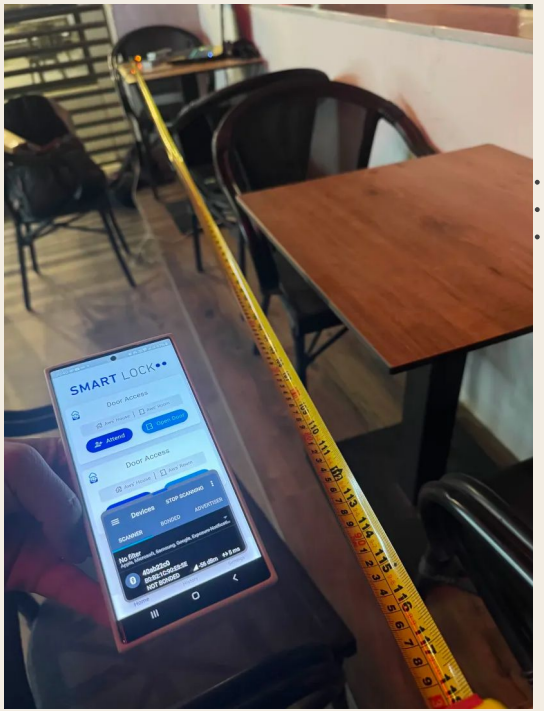
- BLE range: adjusted firmware
- Tight casing: redesigned layout

06 Validation Experiments

BLE Test Result

1

- We tested the system at 1m, 5m, and 10m distances.
- Results showed stable BLE signal with smooth unlocking.
- Stable connection up to 5m
- No drops, smooth control



Response Test Result 2

- 10 tests from app to unlock
- Avg time: 1.48 seconds

Response Time	*Visual Proof*
00:51s	
00:65s	
00:94s	
00:53s	
00:76s	
00:85s	
00:51s	
00:58s	
00:71s	
01:08s	

Notification Test Result

3

- Alerts appeared in ~2 seconds
- Instant feedback works

07

Evaluation and Impact of Solution

Evaluation of Solution: **System Success**

- BLE stayed stable at 1–8 meters
- Unlock time always under 2 seconds
- Notifications worked with less than 3 seconds
- Met all musts, wants, and constraints from our plan.

Our lock meets all design targets:

- Secure BLE
- Fast unlock
- Real-time tracking

Impact of Solution

1. **Global: Supports global smart living by offering a secure, scalable lock system. It's ready for homes and offices and aligns with sustainability goals.**

2. **Social: Gives users more control and safety, boosting trust and comfort at home or work.**

Impact of Solution

3. **Economic: Works with existing door setups, cutting down on setup and maintenance costs.**

4. **Environmental: Uses BLE tech to reduce energy waste and support eco-friendly smart systems.**

5. **Safety: Provides real-time alerts and tracks access to prevent unauthorized entry.**

08

Future Work

Future Work

1. **Add voice command**
2. **Admin web panel**
3. **Add a battery**

09

Conclusion

10

Prototype Demonstration

Any Question?