

Faculty of Information Technology

IN4300 - Embedded Systems

Smart Door Lock System with Fingerprint Authentication

Group No: 16

Group Members

204104H	Kularathna M.D.S.A.
204137K	Nethmini S.A.R.
204041K	Dilshan K.G.A.P.
204064H	Gunasiri G.C.S.
204244K	Jayasinghe N.D.

Supervised by: Mr. B.H. Sudantha

Faculty of Information Technology

University of Moratuwa

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Introduction

Security features have become necessary in today's home and corporate facilities. Standard lock-and-key systems are vulnerable to theft and unauthorized access through key duplication. Biometric authentication provides a trusted and tamper-proof solution to these problems.

We will explore Fingerprint Authentication based Smart Door Lock system using Arduino Uno along with R503 fingerprint sensor and solenoid Door Lock. It's safe and convenient as only the authorized personnel have the access to enter inside a secured premises. Additionally, it has built a mobile application for enabling registration for the users and viewing access logs for the app admins.

Components Used

- Arduino Uno – Microcontroller for processing authentication requests.
- R503 Fingerprint Sensor – Captures the fingerprints.
- Bluetooth Module (HC-06) – Enables communication with the mobile app.
- Solenoid Door Lock – Controlled by the Arduino via a relay module.
- Relay – Acts as a switch and enables 12V to the solenoid lock when needed.
- Power Supply – Provides a 12V DC current to the Solenoid lock.

Functionality

- Fingerprint Authentication: The R503 fingerprint sensor reads fingerprints.
- Access control: The Arduino Uno application processes authentication data and controls the electric door lock.
- Integration with Mobile App: The app provides a Bluetooth connection to the system which allows:
 - User registration
 - Access logs monitoring
- Admin Observation: The admin monitor access logs through the app.

The system uses a combination of biometric authentication, IoT connected technology for allowing access and a an access log for the purpose of building secure, easy to use and traceable environments.

Aim & Objectives

Aim:

The aim of this project is to design and develop a secure, efficient, and user-friendly Smart Door Lock System with fingerprint authentication. This system enhances access control through biometric verification and provides a seamless interface for user registration and access monitoring via a mobile application.

Objectives:

1. Implement a fingerprint-based authentication system using the R503 fingerprint sensor and Arduino Uno microcontroller.
2. Develop a secure and reliable mechanism to control a solenoid door lock based on successful fingerprint verification.
3. Integrate a Bluetooth communication module (HC-06) to enable data transfer between the hardware system and the mobile application.
4. Design and develop a mobile application for user registration, and access log monitoring.
5. Store user data, including fingerprint IDs and personal information, securely in a cloud-based MongoDB Atlas database.
6. Ensure real-time access control by activating the solenoid lock upon successful fingerprint authentication and providing alert mechanisms(buzzer) for unauthorized access attempts.
7. Maintain detailed access logs for security monitoring, including user details for each access attempt.

System Description

The smart door lock system works in the following manner:

- User registration: Users can be registered to the system using the mobile app by keeping the new user's fingerprint on the sensor and adding the name and email address. The fingerprint will be captured by the fingerprint sensor. The captured fingerprint ID along with the user details will be stored in the MongoDB database.
- Authentication Process:
 - User touches sensor with a finger
 - The data is processed by the sensor and matched.
 - Relay module activates on successful authentication and unlocks door.
- Mobile App Connectivity:
 - The hardware system will transfer fingerprint IDs via Bluetooth to the mobile app.
- Security Features:
 - If an unregistered attempt is made, the buzzer activates as an alert.
 - The system records logs when verified users keep their finger on the sensor.

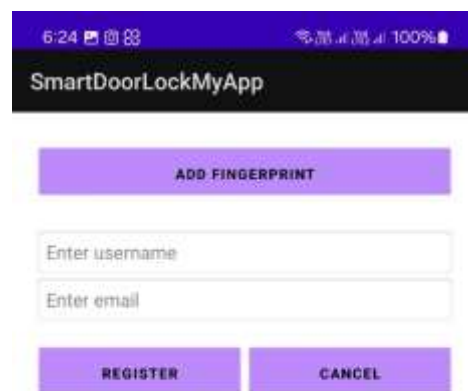
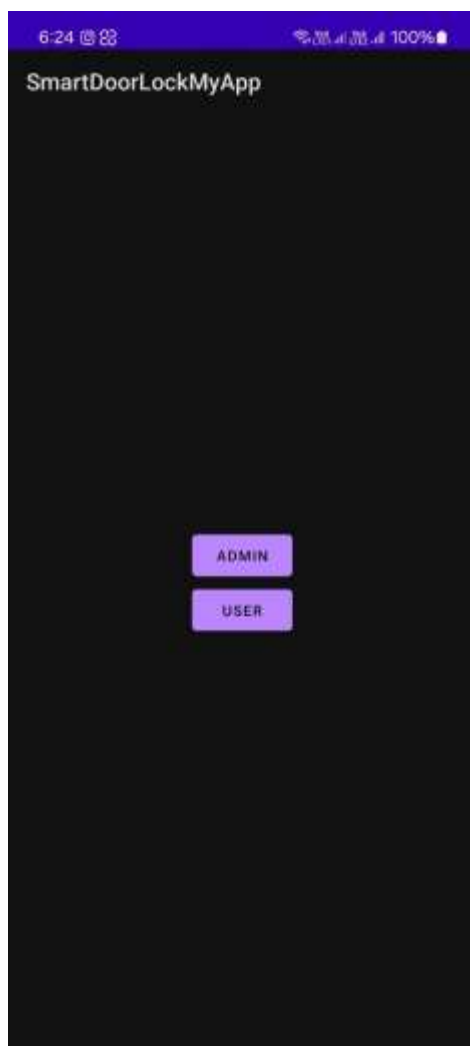
Testing and Implementations

Mobile App

The mobile app serves as the primary interface for user registration and viewing access logs in the smart door lock system.

Key Features:

- **User Registration:**
 - Users input their username, email and register their fingerprint, which will be captured by the fingerprint sensor.

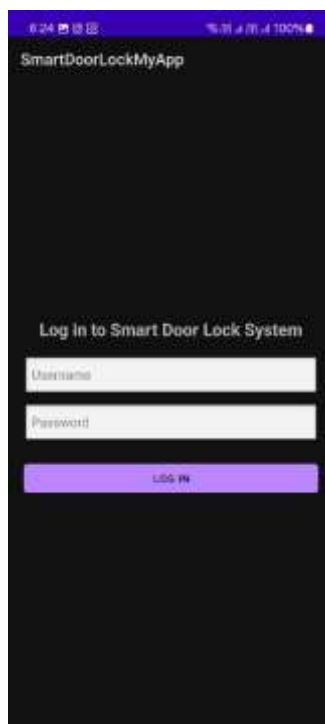


- **Authentication & Access Logs:**

- The app receives fingerprint IDs from the sensor via Bluetooth.



- The admin can log in to the app and view the access logs of successful attempts.



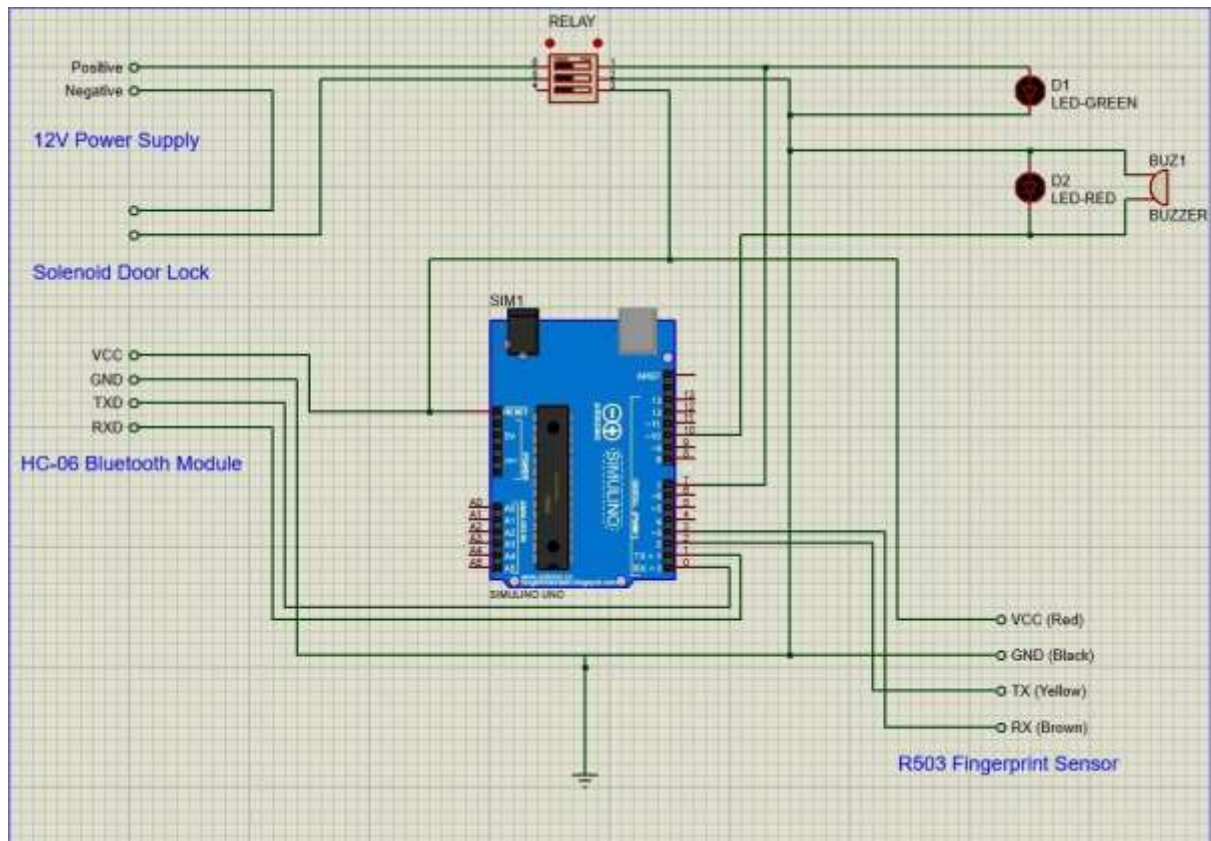
- **Security & Alerts:**

- It enables viewing successful access logs for security tracking.

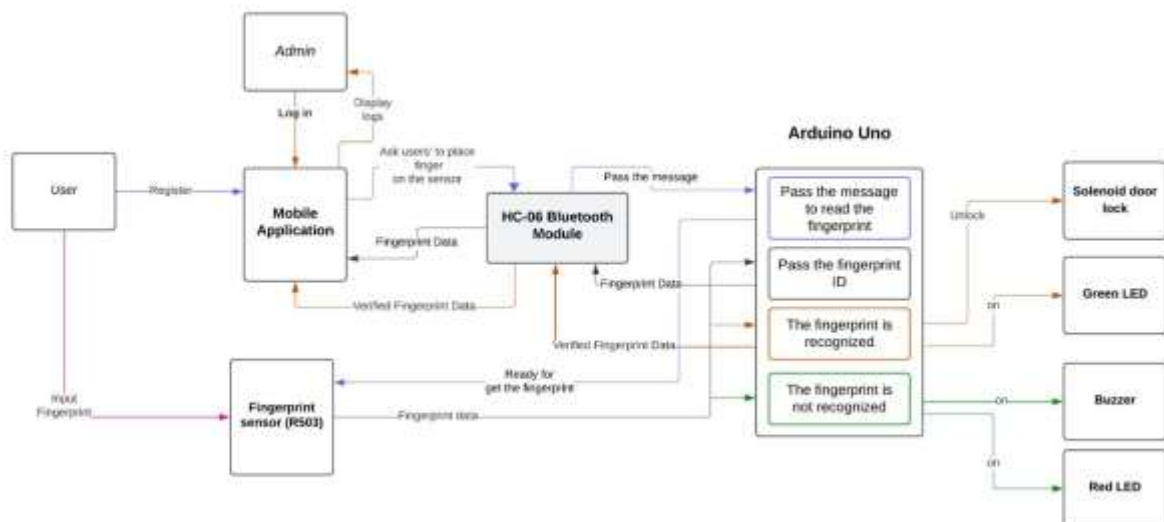


The mobile app enhances user experience by providing seamless registration, monitoring access, and ensuring security in the smart door lock system.

Circuit Diagram



Block Diagram



Cost & Expenditure

Component	Quantity	Unit Price(LKR)	Total Price (LKR)
R503 FingerPrint Sensor	1	4900	4900
Arduino UNO	1	2000	2000
Bluetooth Module(HC-06)	1	900	900
Solenoid Lock (MP001162)	1	1200	1200
Power Supply	1	1000	1000
Wires and Connectors	20	20	400
Breadboard	1	200	200
Total Cost			10400

Conclusion

The Smart Door Lock System is a secure and convenient solution for modern access control needs. With the use of biometric authentication and robust logging, it provides a tamper-proof and efficient security mechanism. Further development can continue to enhance its functionality, making it even more adaptable to smart home and industrial security applications.

References

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