



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Smart Door Lock System

¹Dr. Adarsh TK, ²Jayanth Basavaraj Kittada, ³Sunil M ⁴Brunda V, ⁵Lavanya G

¹HOD, ²Student, ³Student, ⁴Student, ⁵Student ¹Information Science & Engineering,

¹T John Institute of Technology, Bangaluru, India

Abstract: RFID, Radio Frequency Identification is an inexpensive technology, that can be implemented for several applications such as security, asset tracking, people tracking, inventory detection, and access control applications. The main objective of this paper is to design and implement digital security synthetics that can deploy in a secured zone where only an authentic person can be entered. We implemented a security system containing a door-locking system using a passive type of RFID that can activate, authenticate, and validate the user and unlock the door in real time for secure access. The advantage of using passive RFID is that it functions without a battery and passive tags are lighter and less expensive than tags. A centralized system manages the controlling, transaction, and, operation tasks. The door locking system functions in real-time as the door opens quickly when the user put their tag in contact with reader. The system also creates a log containing check- in and check-out of each user along with basic information of user.

INTRODUCTION

RFID, Radio Frequency Identification is a fundamental and inexpensive technology that enables wireless data transmission. This technology has not been very often used in industry due to a lack of standardization among the manufacturing companies earlier. RFID technologies are efficient and secure compare to other networks. With RFID, wireless automatic identification takes a very specific form: the object, location, or individual is marked with a unique identifier code contained with an RFID tag, which is in some way attached to or embedded in the target. RFID is not a single product but a comprehensive system, a typical RFID system includes three basic elements: RFID tag (transponder), reader (transceiver). The software is used for management, controlling, transaction, operation, and maintaining the record of the various users using RFID smart card. A digital door-locking system is also implemented and governed by an RFID reader which authenticates and validates the user and opens the door automatically. It also keeps a record of the check-in and check-out of the user. It's very important to authenticate the user before entering a secure space and RFID provides this solution. The system enables users to check in and check out under fast, secure, and convenient conditions. The system includes a door locking system which opens when the user puts their tag in contact with the reader and the user information matches with the information already stored in a database. The RFID controls the opening and closing of the door. In this study, we utilize RFID technology to provide the solution for secure access to a space while keeping a record of the user. We used a passive type of RFID here. The passive types of RFID are battery-less, and they obtain the power to operate from the reader. The major advantages of passive RFID are it's cost-effective and small in the size. Due to the above advantages, it is widely used by inventory tracking technology. Current antenna technology makes it possible to be smaller in size. In an RFID door lock access control system, the user's credential (usually a key card or fob with an RFID chip) contains unique identifying information called a tag. When the user comes within proximity of a reader, the reader's signal locates the information stored on the user's RFID tag and sends it through antennas and transceivers to authorize the tag in the access control system. Once read, the system will either accept or deny the request to unlock the door. Data from an RFID- enabled.

RESEARCH METHODOLOGY

Smart Door Lock System: The system is designed to operate with a Six-digit password, which can be easily changed by the user for added security. Upon entering the correct code, the Arduino activates a servo motor to unlock the door. Additionally, the project incorporates an LED indicator and a buzzer to provide feedback for successful or failed access attempts. RFID cards are used for smart access.

System Architecture

1. User Action (Presentation Layer):

- User interacts with the system via the mobile app, web dashboard, or physical interface to request access (e.g., lock/unlock).

2. Request Processing (Application Layer):

- The system validates credentials and processes the access request.
- Business logic determines if the user has permission to unlock the door.

3. Database Interaction (Database Layer):

- Access logs are updated to record the request details.
- User credentials and permissions are fetched from the database.

4. Response (Application → Presentation Layer):

- The smart lock hardware responds by locking/unlocking the door.
- Notifications are sent to users about the access status (success, failure, or alerts).

Key Features

1. Enhanced Security

- o The system incorporates multi-factor authentication (PIN, RFID), ensuring only authorized users can gain access.
- o Real-time alerts for unauthorized access attempts and tampering provide proactive security monitoring.

2. User Management and Role-Based Access

- o Administrators can assign role-based permissions (e.g., owners, staff, or guests) to manage access rights efficiently.
- o Temporary or time-bound access codes enhance convenience without compromising security.

Software Components

Arduino Mega is a microcontroller board based on the ATmega2560 chip. It is part of the Arduino family of development boards and is designed for projects that require more input/output pins, more memory, and more complex processing capabilities than its smaller counterpart, the Arduino Uno. It is particularly suitable for large projects, such as those involving multiple sensors, actuators, or complex systems like smart door lock systems, robotics, and home automation.

Literature Survey

The rapid advancement of technology has revolutionized how security systems, such as smart door locks, are developed and implemented, making digital solutions a key component in modern residential, commercial, and industrial spaces. The implementation of Smart Door Lock Systems has gained significant attention over the past decade due to the demand for improved accessibility, efficient resource management, and enhanced user experience. This literature survey aims to examine existing studies, technologies, and frameworks surrounding the development, design, and impact of smart door lock systems.

Evolution of Door Lock Systems

Historically, traditional door lock systems relied on mechanical locks and physical keys for access control. With the advent of electronics in the late 20th century, door locks began incorporating electronic mechanisms, such as keypad access, which offered improved convenience and security. Early systems primarily featured

standalone access controls but were limited in their ability to provide remote management or real-time monitoring. The first-generation smart locks introduced in the 2000s combined electronic and digital components, offering features such as PIN-based entry, RFID cards, and simple authentication mechanisms. However, these systems were standalone and lacked integration with IoT (Internet of Things) frameworks.

Key Features and Technologies of Smart Door Lock Systems

Access Control Mechanisms

A central feature of smart door lock systems is their ability to provide secure and convenient access control. These systems employ multiple authentication methods, including:

- **PIN Codes:** Password-based access through keypads or mobile applications.
- **Biometric Authentication:** Fingerprint, face recognition, and voice recognition technologies are increasingly being implemented for higher security (Smith & Wong, 2018).
- **Mobile App Integration:** Remote access and monitoring via smartphones using Bluetooth, Wi-Fi, or NFC technologies (Lee & Park, 2019).
- **RFID and NFC Tags:** Contactless cards and tags that allow secure entry without physical keys. The integration of multi-factor authentication has significantly improved system reliability by requiring users to provide two or more credentials for access (e.g., a PIN code plus a fingerprint scan).

Challenges

Despite the numerous advancements in smart door lock systems, challenges remain:

- **Power Limitations:** Battery-powered systems require efficient energy management to ensure reliability without frequent maintenance.
- **Cybersecurity Risks:** As IoT adoption increases, smart locks remain vulnerable to sophisticated hacking techniques.
- **Cost and Adoption:** High initial costs and user hesitancy to adopt new technologies can slow down the widespread implementation of smart locks.
- **Standardization:** A lack of universal protocols for IoT devices and access control systems creates interoperability issues (Ahmed et al., 2020).

Future Trends

1. **Artificial Intelligence (AI) and Machine Learning:** AI-powered smart locks can analyze user behavior to predict access patterns and improve security by detecting anomalies.
2. **Biometric Advancements:** Facial recognition and voice authentication systems are expected to become more precise and widely adopted.
3. **Blockchain Technology:** Blockchain can enhance security by providing immutable logs of access events and enabling secure decentralized authentication.
4. **Integration with 5G Networks:** Faster communication enabled by 5G will improve real-time monitoring and reduce latency in smart lock operations.
5. **Smart Cities and IoT Ecosystems:** Smart door locks will play a critical role in integrated smart city infrastructures, where homes, offices, and public buildings are interconnected.

Authentication and Authorization

• Description: Users log in with secure credentials, and access permissions are based on roles (e.g., Admin, User, Guest).

• Steps:

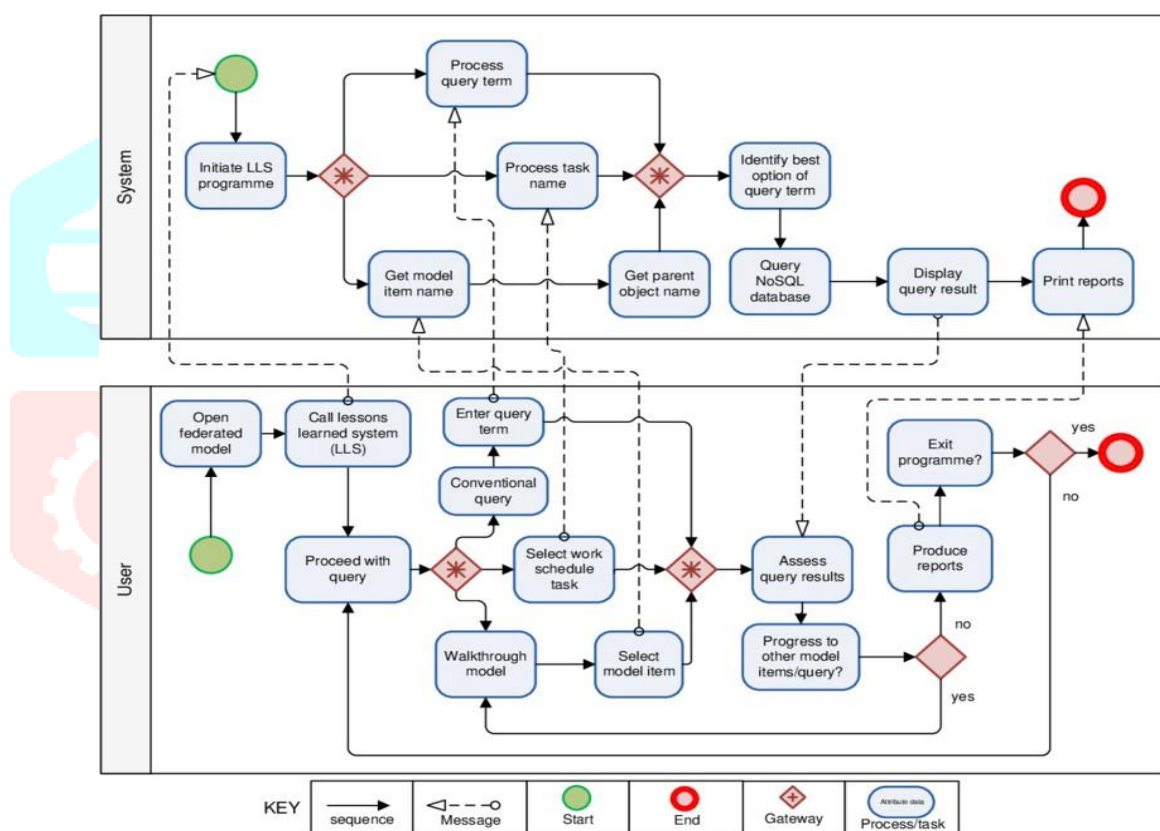
1. User enters credentials (PIN, RFID).
2. The system verifies credentials against the database.
3. Role-based access control is applied:

Admin: Full access to manage the system (add/remove users, view logs, etc.).

User (Homeowner/Family): Access to lock/unlock the door and monitor door status.

Guest: Temporary access with restricted permissions.

1. Failed attempts are logged, and after multiple failures, a **lockout** or notification alert is triggered.



1. Door Access Control (Locking and Unlocking)

Description: Users can lock or unlock the door based on their access permissions.

• Steps:

User sends a request to lock/unlock the door using one of the authentication methods (PIN, mobile app, fingerprint, etc.).

• The system validates the access request.

• The Door Lock Mechanism activates (physical lock opens or closes).

CONCLUSION

The Smart Door Lock System represents an innovative approach to security, integrating advanced technology to enhance both convenience and safety. Much like the E-Library and Bookstore Management System, it bridges traditional methods with modern advancements, providing seamless, efficient, and secure access control solutions. The system operates through key technologies such as Internet of Things (IoT), RFID, which allows users to unlock doors via smartphones, key fobs, or even facial recognition. This eliminates the need for traditional physical keys, offering a more efficient, secure, and user-friendly experience. The system can be managed remotely, enabling users to lock and unlock doors from anywhere in the world, which is a significant advantage for both residential and commercial properties.

REFERENCE

Books and Journals:

- Hawkins, B. (2019). Digital Libraries and Accessibility. MIT Press.
- Robinson, L., & Howe, E. (2020). Evolving Digital Bookstores: Trends and Innovations. Oxford University Press.

Online Articles:

- Chen, J. (2021). The Rise of Second-Hand Book Marketplaces: Sustainability in the Digital Age. Sustainability Journal.

: • Jones, T. (2018). User Management and Digital Library Systems.

In Proceedings of the Digital Library Conference.

Online Platforms:

- Google, Meta AI, and ChatGPT. (n.d.) Applications for smart door locking systems.

