SMART LOCKING SYSTEM

## Shuchita Singh\*1, Vandana Gupta\*2 , Ms. Shagufta Siddiqui\*

\*UG Student of Department of Bachelor of Computer Application, Shri Ramswaroop Memorial College of Management, Lucknow, Uttar Pradesh, India.

\*2 Assistant Professor, Department of Bachelor of Computer Application, Shri Ramswaroop Memorial College of Management Lucknow, Uttar Pradesh, India.

# ABSTRACT

The research describes that now on days, technology is growing rapidly, and with it, security systems have gained a lot of importance in residential, commercial, and industrial areas. The older styles of locks, which are used very frequently, do not take into consideration the need for higher security, greater convenience, and ease of use. This research describes how the Smart Locking System has been developed and implemented. It makes use of the latest technologies like IoT (Internet of Things) to provide a simple, efficient, and secure way of locking and unlocking doors. The users of this system are able to control and monitor the locks from any remote location which allows them to provide access or revoke it as per their need. Additionally, they've designed a smart lock that is economical, energy-efficient, and thus more widely usable. The addition of various forms of authentication helps reinforce restriction against unwanted access. CADR (Keypad and RFID card) authentication are integrated to increase protection measures. Also, this research talks about the privacy and confidentiality issues regarding data and connectivity that arise during the development, along with other problems, and how they can be solved. In general, the Smart Locking System has an exceptional approach to revolutionizing external security methods while adapting to the needs of the people.

**KEYWORD-** Smart Locking System, IoT Security, Keypad and RFID authentication

# INTRODUCTION

Security has always been one of the issues that matter to people today and as technology continues to advance we need to have better and more reliable locks. Old-school lock designs are very hard to copy or break into nowadays, so we need to look for new solutions to the security problem. As part of this project we’re going to show how to construct a Smart Locking System which blends hardware and software making the system more powerful and more interactive for its users. Using a keypad, screen, RFID card, buzzer (solenoid lock), jumper wires and many other components, we have created a flexible lock for mobile and computer use that allows easy unlocking and unlocking from anywhere in the world. People can unlock or lock the door by typing code on the keypad or scanning a valid RFID card with it. The buzzer makes a noise telling you if you got in or not, and a solenoid lock locks the door and opens it when the user press a button. The system is run on Python code, enabling users to log in to a software program and check whether the door is locked or unlocked from anywhere

## Background of locking system and importance of authentication of system

Locks have been used to keep people and things out of accessible areas for centuries. Modern mechanical locks have been the most used form of unlocking in many households. But as technology advanced, so too have the methods that people have used to get around these locking mechanisms. Other than physical access control, mechanical locks are relatively vulnerable to hacking to prevent people from gaining entry. Lock picking can be a common reason why people can easily break into houses through doors with mechanical locks. In addition, the hassle of handling physical keys (the risk of losing them or duplicating them without the owner’s permission) has created a need for more complex and intelligent lock solutions. In response to all of these drawbacks, smart locking systems have emerged as a modern security solution, implementing electronic components, wireless communication, and software interfaces.

Smart locking systems normally combine access validation technologies such as RFID, keypad access, biometric verification, and mobile or cloud based monitoring and control. They are advantageous for not only better security, but also greater flexibility since smart locks enable remote control, real-time monitoring, and audit trails of access events. The main advantage of smart locking systems is their multi-level security, ease of use, and dynamic management of access without the requirement for the traditional key. Smart locking devices can be installed in environments such as homes, office buildings, hospitals, as well as research laboratories, and unauthorized access can lead to serious damage. By combining hardware (such as RFID readers, display units, buzzers, and solenoid locks) with a programming language (such as Python), smart locks make the separation between physical and digital security possible in a simple and straightforward manner.

## Purpose of the research and objectives of Smart Locking System:

1. **Research and development of multi-authentication smart locking system**: that can integrate keypad password authentication and RFID card verification to enhance security and reliability of access control to move away from traditional mechanical locks, introduce a locking system that will be harder to break in and thus easier for users to use and with this offer a modern and secure method of controlling door access.
2. **Development of a Python based user interface:** for remote monitoring and control of locks. To let users log in, see real-time status of lock (lock/unlock), and to perform locking or unlocking operations over the network. This will enable users to control access from places outside the physical confines of the door in terms of flexibility, convenience, and system performance.
3. **Implement real-time feedback mechanisms (via a display and buzzer):** delivering real-time notifications to users about the access status, successful or unsuccessful authentication attempts, and system errors, which improves the overall user experience and security awareness and ensures that users are always aware .

# METHODOLOGY

## Overall description of Smart Locking System

Smart Locking System is an access control system that was developed to provide security, convenience and real-time management of security access points. Instead of using traditional locking methods, smart locks use a combination of hardware components and software to develop a multi-layered security environment. Keypad – The keyboard has user input password input, RFID card reader (for identity verification), display, buzzer for audio notification, solenoid lock (for physical lock and unlock) and jumper wires for circuit integration. With these peripheral hardware modules, the system will be controlled by hardware and function in every way.

## Data collection methods and analysis techniques

1. **Data Collection:** More precisely, performance measurements of the system were accomplished Data Performance Measurement of the system and user feedback is collected Log Performance Measurement Log entries were performed to record important aspects of the processing of the authentication (tries, accuracy, unlock/unlock time) User feedback Based on surveys usability as well as response time of the system and how the users were satisfied is measured via surveys.
2. **Analysis Technique:** The quantitative approach was used to analyze data on response time and error rate. System performance was quantified based on statistical measures. User feedback was analyzed qualitatively to extract patterns and possible improvements regarding the user experience and security.

# FUNCTIONS AND FEATURES

1. **Multi-Authentication Methods**: Various forms of access are supported, password on the keypad, scanning an RFID tag and you can add these to your network and We have a few different types of keypad-controlled locks in the Adafruit shop. This adds a further level of security.
2. **Real-Time Monitoring and Control:** Real-time data of lock status (locked/unlocked) can be monitored by user through a Python based interface of the lock from anywhere using internet. The doors or locks can also be controlled remotely by users with the devices, offering more flexibility and convenience.
3. **Instant Feedback and Notifications:** Upon authentication, the system provides an immediate response via buzzer and display screen to show whether access was granted or denied improving user experience and security awareness.
4. **User activity logging:** In addition to the logs, the system logs all access attempts (including successful and unsuccessful authentication events) making it much easier to keep track of security related activities.

# RESULTS AND ANALYSIS

## User feedback and satisfaction rating

**Quality Assurance:** For the sake of ensuring quality performance, the Smart Locking System is thoroughly tested in different situations, such as multiple authentication methods, environmental conditions, and user interactions. The response time, reliability, and error rates of the system are constantly tracked and optimized. Any detected problems or bugs are resolved through frequent software updates and hardware modifications, making the system reliable and efficient in the long run.

**User Engagement:** User feedback is proactively collected via surveys, interviews, and user testing to determine levels of satisfaction, pinpoint pain areas, and understand user experience. The feedback loop helps to make constant improvements to the user interface as well as system features. Users are able to rate features such as ease of use, response time, and security, and their input is considered for subsequent updates, which encourages high levels of engagement and trust in the system.

## Pre vs Post Smart Locking System Performance

### Pre Smart locking System Performance:

Prior to the Smart Locking System introduction, security measures and access control within residential and commercial settings were mainly dependent on traditional mechanical locks and key-based systems. The conventional method had the following limitation:

1. **Manual Security Management**: Physical keys were needed for traditional locks, and these were prone to loss, duplication, or theft, making security vulnerable. Users were required to lock or unlock doors manually, resulting in delays and possible lapses in security.
2. **Limited Access Control and Monitoring**: Security systems did not have remote monitoring, so users could not check if doors were locked or unlocked when not present at their locations. It was also impossible to monitor who went in or out of a secured location unless recorded manually, which could be subject to human error.
3. **Inefficient User Management**: Access control to rooms or buildings entailed having a physical record of keys, which would result in unauthorized access in the event that keys were lost or transferred from one person to another. Access had to be controlled in certain instances by meeting physically to deliver a key, which resulted in delays and compromise on security.

### Post-Smart Locking System Performance

With the integration of the Smart Locking System, significant improvements have been made to security, efficiency, and user experience. The system has modernized access control with advanced technologies, even though it does not involve AI. Major changes include:

1. **Automated Access Control**: The Smart Locking System electronically locks and unlocks using keypad codes or RFID cards, without the use of physical keys. It minimizes human error, provides better security, and enables easy management of access.
2. **Improved User Management**: The system provides multi-user access via a combination of single-password and RFID cards. The logs are automatically kept, and they offer comprehensive records of attempted entries. The system can easily identify unauthorized access attempts, and the users can easily withdraw access when necessary.
3. **Instant Feedback and Alerts**: The system gives immediate feedback through a buzzer and display screen, warning users the moment a door is left open or if an unauthorized attempt has been made. The feature heightens security awareness and allows for instant corrective measures.

# FUTURE SCOPE

The Smart Locking System has already transformed the management of access control and security, but there are still considerable opportunities for further development and integration of new technologies. Some of the main areas for future development are:

1. **Integration with Mobile Applications and IoT:** In the future, the Smart Locking System may be more integrated with mobile apps and Internet of Things (IoT), so users can control and administer access using their smartphones or other connected devices. This would grant even greater flexibility, as users can lock/unlock doors remotely, get push notifications, and track activity in real-time through one mobile platform.
2. **Biometric Authentication:** As the biometric technology continues to evolve, incorporating fingerprint scanning, facial recognition, or voice recognition capabilities into the smart locking system could also increase the security. This would offer a strongly secured, personalized method of authentication that can substitute or complement the current password and RFID card-based access.
3. **AI and Machine Learning for Anomaly Detection:** Although the current infrastructure does not involve AI, any future designs can incorporate machine learning algorithms for sensing abnormal patterns of access, signaling potential areas of security threat, and generating autonomous responses for deviations. This will enhance the response capability of the system against evolving threats as well as improve overall security stance.
4. **Cloud-based Access Control and Analytics:** Subsequent versions of the system may incorporate cloud- based management systems, enabling remote control and monitoring of multiple locks in different locations. Cloud-based analytics may further offer detailed reporting, usage patterns, and predictive maintenance, all of which assist in optimizing system performance and enhancing security**.**
5. **Integration with smart home system:** The system may be scaled up to interface with other intelligent home appliances seamlessly, like intelligent lighting, surveillance cameras, and alarms. With the establishment of an integrated setting, the Smart Locking System may have a pivotal role to play in heightening the degree of overall home automation and security

# CONCLUSION

The creation of the Smart Locking System is a milestone innovation in contemporary security systems through integrating hardware devices such as keypads, RFID readers, solenoid locks, buzzers, and displays with a Python-based interface to facilitate real-time control and monitoring. The system effectively overcomes the weaknesses of conventional locking devices by providing increased security, improved user management, and greater convenience without using artificial intelligence. By means of automated access control, real-time feedback, and effective logging of user activity, the Smart Locking System offers a practical and user-friendly replacement for traditional locks. The project illustrates how combining simple electronics with software interfaces can produce a powerful and usable solution to everyday security requirements. In the future, the system has high potential for further development, such as integration with mobile devices, biometric verification, and cloud-based management, making it remain flexible to meet the changing needs of users and technology directions.

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