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# A Review on Existing Smart Door Lock Systems

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**Abstract**— Nowadays, safety is one of the most critical factors in life. Lock control remains an unsatisfactory experience for many people. Despite the fact that keyed locks have been used since the beginning of history, there is a high risk that keys will get lost or in the wrong hands. Therefore, many individuals prefer smart door locks for improving the security of their homes or workplaces over traditional keyed locks. As long as people want security, convenience and control, they will seek solutions beyond conventional approaches, whether physically present or not. The result has been that human has devised a variety of security systems utilizing a variety of technology. These technologies include fingerprint recognition, Radio-Frequency Identification (RFID), Internet of Things (IoT), Global System for Mobile communications (GSM) technology, facial recognition, and Arduino microcontrollers. A review of a few of the more recently developed smart locks that are effective security systems can be found here. Security plays a vital role in almost every aspect of our society, which is why I believe this study is so important.

**Keywords**— Door lock, Smart door lock System, Security, RFID, GSM, Arduino microcontroller, Fingerprint recognition, Facial recognition, Internet of Things, Knock-pattern, Colour Image Edge Detection

## I. INTRODUCTION

Technology has made it easier for humans to live comfortably in the modern world due to a growing number of facilities. As a result of the introduction of a number of technologies, people are now able to accomplish many things more easily in their day-to-day lives. However, it can lead to security concerns as well. Therefore, we must ensure the security of our lives and our personal belongings. It is imperative that researchers continue to pay more attention to gadgets and locks in order to safeguard our lives and properties are protected in the long run.

The problem with conventionally installed door locks is that almost anyone can break them and gain access to the home. With only a metal lock that can be disfigured or melted cannot neglect security issues. People are vulnerable to security threats due to the ease with which conventional door locks can be broken. Crime rates have increased in many countries that use mechanical locks due to the ease

with which they can be broken. It is not even possible to identify who has illegally entered a house or apartment where mechanical locks are used. Thus, overcoming these obstacles is a very challenging task.

People generally use CCTV to secure their homes. Any suspicious incident can be investigated using the images stored in the database. This type of approach is passive, but an active approach is needed here. When a security threat occurs, this type of approach allows immediate action to be taken. It is clear from this that most security systems currently available in homes and businesses are inadequately suited to protect the occupants of these buildings. By applying new technology-based control systems and other methods that allow for efficient access control, these security breaches can be addressed.

A new technological system, such that if any one step fails during the process, an immediate warning alarm is received by the administrator would be a solution for this. The smart door lock system concept comes at this time. It is a keyless technology that allows people to unlock doors without using a physical key. In order to increase reliability, smart door locks are crucial.

Some mechanical locks can be upgraded physically when smart locks are installed on them. There are also smart locks that have cameras that offer an image of those entering the door and can be utilized as a face detection feature and, in addition, to serve as a handy record of who has accessed the door. Whenever a person enters the doorway, the pi camera takes a picture, and a face detection process is performed. If it matches with the database images, the door is unlocked; otherwise, a message with the body image will be sent via GSM and Local Area Network (LAN).

Password protected door lock systems use a secure password to unlock a locked door, and an individual is allowed to access the secured area when the code or password is entered appropriately. But sometimes, passwords and codes are extremely vulnerable and can be easily stolen or lost. A poor password can result in security breaches and hackers can attack even the strongest password. The process of resetting a password can be time-consuming and cause an employee to lose productivity. Biometrics can be used to solve this problem. It involves recognizing or confirming individuals based on physiological or

behavioural attributes, such as iris, fingerprints, facial pattern, Deoxyribonucleic acid (DNA), speech pattern, etc.

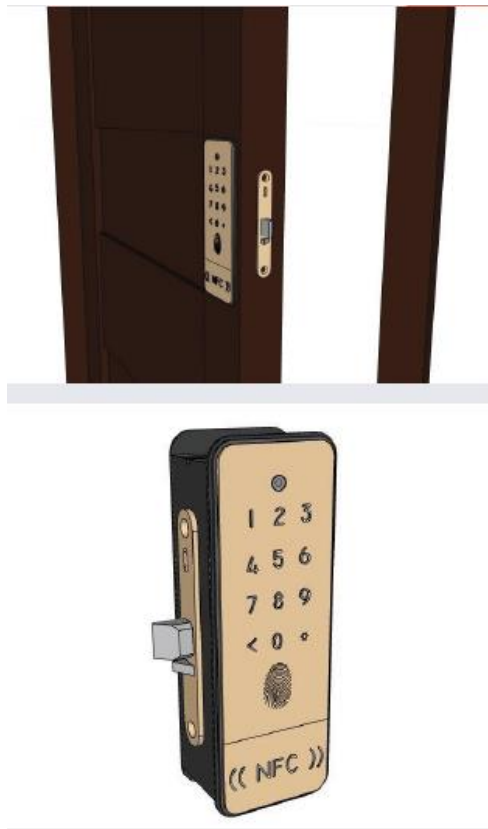


Figure 1. Fingerprint Recognition Door Lock System

Most people prefer smart door locks over traditional keyed locks to improve the security of their homes or workplaces. Some of the side benefits that come here are ease of opening the door lock without using keys, avoiding inconvenience caused by losing keys, no problem even in case of forgetting to carry keys.

The purpose of the study was to look at the characteristics and drawbacks of the existing door lock systems that are utilized for security related objectives.

The remaining section of this paper is as follows. The literature review includes the related systems of smart door locks that have been done so far in the security domain. The discussion section includes an idea about the experience level of using these systems. Moreover, the discussion includes the technologies and features used in existing systems. Finally, the paper includes a conclusion and further work.

## II. LITERATURE REVIEW

Among the existing smart door lock systems, designed using different technologies, a few selected systems are discussed below, along with their features. As soon as a person is detected, the door would open, and they would be welcomed.

### A. Smart IoT-based Facial Recognition Door Lock System

A smart IoT-based facial recognition system is a proactive approach that can take immediate action upon a security threat. The system recognizes the face of that person nearby the door and compares it with the faces uploaded to the database. A message and email with an intruder image will be sent to the owner in the event that an unknown person enters the building. This system uses Raspberry Pi, a Pi camera that is installed near the door to recognize an intruder's face, Direct Current (DC) motors connected through relays to open the door, Light-Emitting Diodes (LED) to indicate whether the door is open, and a GSM module is used to send texts to the registered mobile number.

### B. Microcontroller-based Password Enabled Door Lock System

Microcontroller-based Password Enabled Door Lock System is an electronic security system that can detect an intruder and report it to the security personnel. The construction of an electronic digital lock using a microcontroller based on security information using a four-digit pass key. This operation involves opening the door, closing the door, changing the password, and alerting when entering the wrong password. The research objectives are achieved by using a micro-controller that interfaces the ATMEGA328P microprocessor with all the other components in the circuit. In the end, the circuit has activated by the relay and triggers the alarm. The password-protected lock system is designed previously using a microcontroller known as an 8051, accompanied by a 4\*3 keypad for entering the password. A comparison is made between the entered password and the predefined password. If the password is correct, the door will be unlocked by rotating the door motor and the status of the door will be displayed on Liquid Crystal Display (LCD). On the other hand, when the password is incorrect, the door remains locked and a message appears on the LCD that reads "Password incorrect". The information will be stored in the database.

However, when the correct password is received, the DC motor performs the action of unlocking the door as per the instructions of the controller. The door lock system is secured with the user's password. A door lock can only be opened if the correct password is entered. However, the option to change the password appears to be more secure since only authorized persons have access to it.

### C. Knock-pattern using Arduino and GSM Communication

This technique uses a 'Secret Knocking Pattern,' which is only known by the owner of the safe, luggage, or other object or item on which the device is installed. It is necessary to apply the knocking pattern only at a specific spot known only by the owner in order to open the lock. Changing the secret pattern is only possible after unlocking

the secret knock. Duplication cannot be done using this method because there is no key to copy.

#### D. Fingerprint Door Locking System

Fingerprints are widely considered as a unique identification of a person and the fastest and easiest method of biometric identification. Due to the fact that they are so unique and don't change for one in a lifetime, they are so secure and reliable to use. As long as the minutiae matching technique is used appropriately, fingerprint recognition can be cheap, reliable, and accurate. A minutiae matching approach is used in this thesis work for fingerprint matching. The main difference between this algorithm and other conventional minutiae matching algorithms is the fact that it takes account of region and line structures between minutiae pairs. More structural information about the fingerprint should be accounted for to increase the certainty of matching minutiae. Most of the region analysis is pre-processed, so the algorithm does not become slower as a result.

#### E. RFID-Based Digital Door Locking System

As part of the RFID-Based Digital Door Locking System process, an image of the user is also captured. This image is scanned and compared against the database for matching. Depending on the card Unified Information Devices (UID) and capture image match, access is granted or denied, alerting the system for security purposes. This system is a significant entrance monitoring controller and exit monitoring controller, which can be installed at entrances and exits. This system can be used in hostels for security purposes. With a controller process and real time images and controller processes, this technology can improve response time.



Figure 2. RFID-Based Digital Door Lock System

#### F. The Five-Button Door Lock System

These locks are called simplex locks. Combination numbers in simplex locks are related to Stirling numbers of the

second kind and Mahler's algorithm for writing polynomials. Has the result that the number of combinations using all the buttons equals the number of combinations using fewer than all the buttons. It is common for schools, hospitals, and office buildings to have programmable door locks like the one in the figure that provides selective security and entry to a variety of rooms and spaces.



Figure 3. The Five-Button Door Lock System

#### G. Colour Image Edge Detection

In this method, the amount of information required to complete facial recognition on a user is reduced by reducing the amount of data that needs to be stored every time. Using this technique, it is possible to create a CV on both greyscales or coloured images differently to provide sharp edges to the person, thus using less data traffic to transfer information between the accessor and the primary user, who will receive all notifications and images related to each activity. The process of entering details of a new user, while the primary user is located at a remote location, is faster, more accurate (because the image reconstruction and edging are performed by the primary user), and more feasible. Despite the fact that this system is more data friendly, the accuracy of edge defining may not be a proper condition for verification because people with similar face cuts have similar edges.

### III. DISCUSSION

The smart door lock system is an automatic security door lock system which is used an advance techniques and tools such as fingerprint recognition, facial recognition, Arduino microcontrollers, Internet of Things, RFID, GSM, knock patterns, etc.

Smart system control for automatic door lock systems is done through various methods like Bluetooth, Internet etc. Many laptops, tablets and mobile phones have built-in

adapters that reduce the cost of the system, but control it within the Bluetooth range.

There are smart door lock systems that let you know when doors open and close, and some systems allow you to set individual passcodes for different people so you know who is entering. The lock can also be combined with a smart doorbell camera, allowing you to see exactly who's at your door with just a click of the button.

When a security password is used for security door lock systems, the person is only allowed to access the security area if the password is correct. But passwords and codes can be easily stolen or lost. Biometrics can be suggested as an ideal solution to this. It seems that there are not only advantages but also disadvantages to using passwords.

Using fingerprint recognition technology for security doors is a very accurate solution, but in a pandemic situation like COVID 19, this is not a very good method. Compared to this, facial recognition can be considered as a good method.

The five-button door lock is a traditional method that can be seen from the early years and can be installed at an affordable cost. There are also door lock systems that improve this technology with more number of buttons.

Finally, the overall advantages of smart door locks are high security, simplicity and ease to access, convenience, time-saving, and no problems such as losing keys.

#### IV. CONCLUSION

It is not a new concept for science society to use a smart door lock, as it has existed for decades. With technological advancements, the field of home security automation is growing rapidly.

When security is considered in the modern social system, it is more desirable if it can be enhanced and stabilized with technology. Smart door lock technology contributes greatly to satisfying one of society's needs which is security.

It must be admitted that the projects and research shown here have been a great help in advancing this smart door lock technology. It is important to ensure security through various technical strategies such as fingerprint recognition, facial recognition, knocking patterns etc., and to be able to handle keys through remote access.

Although hacking and disruptions that may occur in the event of a power outage can be seen here, it should be believed that the remedies for that will come soon. An example would be the use of a battery pack for a power outage problem.

Therefore, smart door lock technology needs to be further developed for the future world and needs to be created to suit various fields to satisfy customer needs.

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#### ABBREVIATIONS AND SPECIFIC SYMBOLS

- RFID - Radio-frequency Identification
- GSM -Global System for Mobile Communications
- LAN - Local Area Network
- DNA - Deoxyribonucleic acid
- IoT - Internet of Things
- DC – Direct Current
- LED - Light-Emitting Diode
- LCD - Liquid Crystal Display
- UID - Unified Information Devices

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