

**SMART DOOR LOCK SYSTEM WITH FINGERPRINT BY USING
RASPBERRY PI**



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN

JUDUL: SMART DOOR LOCK SYSTEM WITH FINGERPRINT BY USING RASPBERRY PI

SESI PENGAJIAN: [2021/ 2022]


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SMART DOOR LOCK SYSTEM WITH FINGERPRINT BY USING RASPBERRY PI

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This report is submitted in partial fulfilment of the requirements for the
Bachelor of Computer Science (Computer Network) with Honours.

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

DECLARATION

I hereby declare that this project report entitled

SMART DOOR LOCK SYSTEM WITH FINGERPRINT BY USING RASPBERRY PI

Is written by me and is my own effort and that no part has been plagiarized without citations.



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DEDICATION

Especially committed Towards my supportive and lovely friends and siblings, whom always encouraged, lead the way, motivated myself on my educational journeys. Many thanks because encouragement from beginning of the start and completion of my project, to my supportive lecturer



ACKNOWLEDGEMENTS

Alhamdulillah, with His Heart great blessing, I able to complete this project report to fulfil the requirement of Projek Sarjana Muda 2 (BITU 3983). I want to thank all of those people who help me during the project conducted. First at all, I want to give a special thank and a greet appreciation to my supervisor, Ts. Dr. Norharyati Binti Harum who give full support throughout the project.

Thank you because give me advices and guide me during this project report conducted. I appreciate the patient and guidance.

Besides, I would like to express my deepest thanks and gratitude to my beloved parents, Salim bin Wahid and Norlida Hj. Mohd Zain because of their unconditional trust, timely encouragement, endless patience and emotional support in the most positive way during my challenging period. In addition, thanks to all my family members, Nur Syuhaibah binti Salim, Nur Syazatul Syima and the others members because they always give a greet companion and celebrated each other accomplishment.

I also want to thank my entire coursemate who is willing to help me during the project. Thanks for sharing knowledge, especially to Muhammad Adib bin Said and my special best friend, Nur Amirah binti Shahadan, who always entertained, supported, encouraged, company and sharing idea together.

Finally, I would like to express my gratitude to everyone who supported me throughout the project. I am very thankful for their aspiring guidance, invaluable constructive criticism and friendly advice during the project. I am sincerely grateful to them for sharing their time, truthful and illuminating views of issues related to the project.

ABSTRACT

This report is about developing some additional smart door lock system by using fingerprint that is built-in Raspberry Pi 4 Model B and the Node-RED application. This project aims to use biometric identification, the fingerprint sensor, to authenticate the smart door lock system. The biometric identification project focuses on using fingerprint recognition and how the system will be implemented. If implemented in this project, this system would give the authorised user access to the smart door. The scanner that will be used in this project is the R307 fingerprint scanner. This project also uses the Telegram application to send a smart notification and act as a backup if any miscommunication occurs from fingerprint to smart door. The user enables to send a Telegram command to control the smart door, such as unlock and lock. Furthermore, the smart door lock system enables users to gain the log and tracking module where there are databases about the user and the door activity will be display by using Node-RED dashboard application.



ABSTRAK

Laporan ini adalah mengenai penambahbaikan sistem kunci pintu pintar dengan menggunakan cap jari yang terdapat dalam Raspberry Pi 4 Model B dan aplikasi Node-RED. Projek ini bertujuan menggunakan pengenalan biometrik, sensor cap jari, untuk mengesahkan sistem kunci pintu pintar. Projek pengenalan biometrik memberi tumpuan kepada penggunaan pengecaman cap jari dan bagaimana sistem akan dilaksanakan. Sekiranya dilaksanakan dalam projek ini, sistem ini akan memberi akses kepada pengguna yang dibenarkan ke pintu pintar. Pengimbas yang akan digunakan dalam projek ini adalah pengimbas cap jari model R307. Projek ini juga menggunakan aplikasi Telegram untuk mengirim pemberitahuan pintar dan bertindak sebagai sandaran sekiranya terdapat salah komunikasi dari cap jari ke pintu pintar. Pengguna membolehkan untuk menghantar arahan Telegram untuk mengawal pintu pintar, seperti buka kunci dan kunci pintu. Selanjutnya, sistem kunci pintu pintar membolehkan pengguna memperoleh modul log dan penjejakan di mana terdapat pangkalan data mengenai pengguna dan aktiviti pintu akan dipaparkan melalui aplikasi Node-RED.

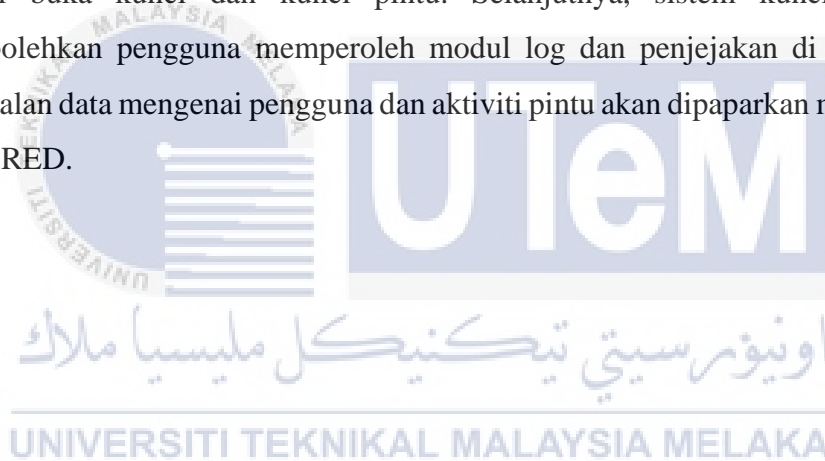


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CHAPTER 1

INTRODUCTION

1.1 Introduction

The Smart Door Lock system with fingerprint uses a biometric identification that is an automated identification that will support human biological characteristics for the authentication function. Nowadays, using a physical key or card reader locks is the way everyone is familiar with it. Furthermore, although the way is a common way that people currently applied, it has many flaws. For example, careless users need to carry many keys, lose their key, and forget to bring the key, misplaced or lost. The project aims to secure access control that can replace the physical key or the card reader lock. We proposed a solution by using a fingerprint sensor to unlock the door.

Therefore, few features will be added to the project to overcome the problem: log and tracking module and smart notification. Furthermore, this project will be using the Node-RED application to provide details about the door activity, such as the time and date the user enters and left the door, the number of user access, and who accesses the door. The smart notification features are a technique designed to make real-time for the user. These features will send notifications through the Telegram application if any unauthorized users try to access the smart door. Therefore, the user can take immediate action and is more secure. It will heighten security and will eliminate the need to carry physical keys and card readers every time.

1.2 Problem statement

Table 1.1: Problem Statement

PS	Problem Statement
PS ₁	The duration to open the door take longer time by using physical keys and user's careless action such as lost the keys and forgot to bring keys

1.3 Project Question

Table 1.2: Project Question

PS	PQ	Project Question
PS ₁	PQ ₁	What are the current technology of smart door?
	PQ ₂	How to develop the fingerprint sensor for smart door that enable the user to control the door?
	PQ ₃	How to validate the functionality of prototype?

1.4 Project Objective

Table 1.3: Project Objective

PS	PQ	PO	Project Objective
PS ₁	PQ ₁	PO ₁	To identify the current technology in smart door which are using biometric sensor
	PQ ₂	PO ₂	To develop the fingerprint sensor for smart door that enable the user to control the door
	PQ ₃	PO ₃	To validate the functionality testing of the prototype

1.5 Project Scope

The smart door lock system using fingerprints can be applied anywhere and anytime. It can be applied in many doors that need to be remotely controlled, such as home, door office, and industrial door. The smart door lock system will provide faster accessing the door for the user within a few seconds. Furthermore, it will provide a complete and user-friendly application to understand and access all the data easily. The system includes the fingerprint sensor, smart notification via Telegram application, remotely access the door via Telegram command and data storage with details via Node-RED.

1.6 Project Contribution

Table 1.4: Project Contribution

PS	PQ	PO	PC	Project Contribution
PS ₁	PQ ₁	PO ₁	PC ₁	Help the user to increase the security by using smart door and propose a faster processing time to open the door with accurate details of the door activity
	PQ ₂	PO ₂		
	PQ ₃	PO ₃		

1.7 Conclusion

This chapter explains the purposes of the project for the user by outline the main point such as problem statement, objective, scope, and project question. The project's aim is to higher the security of the door to the user. It also will be applied a smart notification and logs and tracking module. This project is really convenient as it can make life easier and faster, including for older adults.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Internet of things, known as IoT, is an emerging technology that can change world technology, primarily industrial operations. The IoT enables us to control, configured, and operate our devices remotely. The IoT has had a tremendous impact on the home automation development field. The smart door lock system is essential for a house to maintain more robust security. The implementation has been made to an integrated door automation system with smart devices technology that will make people's lives easier and increase the quality of life. There are many issues regarding the previous manual door that the user forgets to bring their key, lost the key, and duplicated many keys for each member, but still keeping in mind the key of security level.

Chapter 2 is a study about literature review. This topic will enhance previous work regarding the smart door lock system or door automation. Therefore, we will analyze the previous work problem, including the solution, which will be tabulated. Ten previous work has discovered to analyzed from the table, and proposed solutions have been made to overcome the problem. The last subtopic of this chapter is the conclusion of the overall chapter.

2.2 Supporting Technologies

The supporting technologies that related to the project key is the Internet of Things(IoT), smart home and the recognition device.

2.2.1 Internet of Things (IoT)

The IoT, Internet Of Things, is an emerging technology that can change world technology, primarily industrial operations. The IoT enables us to control, configured, and operate our devices remotely. The IoT has a tremendous impact on the home automation development field. The smart door lock system is essential for a house to maintain more robust security. The implementation has been made to an integrated

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There are a few components in IoT that represent the integration of the system work, which is the sensors, connectivity, data processing, and a user interface:

1. The sensor or device that collects data from the surrounding environment includes the time we insert fingerprint, temperature, and many more.
2. The connectivity is when the data is collected and sent to the cloud infrastructure using various mediums such as Wi-Fi, Bluetooth, cellular, and many more.
3. Data processing occurs when the data is collected and gets to the cloud, where the software will be processing each information it obtains.
4. The user interface is where the end-user obtains their information through many platforms such as email, notification, website, and many more. A user will have the interface to check any data or update their system proactively.

2.2.2 Smart Home

The smart home is a term given to an essential home filled with communication technology, enabling remote-controlled devices in the house. The home appliance that is primarily can be controlled include the appliance such as the fridge, garage, home security system and environmental such as the lighting and air conditioning.

The smart home can be feature either in a wireless or hardwired system or both. The wireless system is much convenient as it is more cost-friendly than the hardwired system. A hardwired system is more reliable as it is more challenging to be a hack, but it is much more expensive as the user needs to install a luxury hardwired smart system.

There is a lot of advantage installing the smart home technology as it provides the homeowner with convenience. The homeowner can control their appliance using only one device, such as a phone or tablet. Besides, the user is also enabled to get a notification and any updates issues about their home. For example, the homeowner can obtain notification when someone is trying to access their house when they are not at home.

2.2.3 Biometric identification

The biometric is a unique characteristic of a person or personal characteristics that can be used to validate the person's identity. The biometric identification cannot be transferred or copy from one user to another easily. The biometric characteristic is common, including the use of fingerprints, face recognition and the voice recognition.

There are many benefits of using biometric as it, unlike the passcards, key or password that can be transferred to each other easily. Biometric identification is very secure and less susceptible to fraud as it is only concerned with individual identification. Furthermore, biometrics cannot be removed easily using physical characteristics such as fingerprint, hands, and eyes. Besides, it is really a beneficial technology as the user does not need to memories anything such as the password and carry anything such as the key or cards. Hence, it provides higher security for the user.

There are several examples of biometric authentication that are using in today's technology. Firstly, the fingerprint biometric will compare the user's fingerprint to a stored fingerprint template in order to validate the user's identity. The fingerprint biometric has many benefits. It will be much harder to be duplicate, convenient, and easy for the user, cannot be guessed, forgotten, or misplaced, and is considered one of the most secured authentication methods. Besides, facial recognition has very instantly become a mainstream component in our daily life today, such as unlocking our mobile devices. Facial recognition has increased security in society, preventing any crime and reducing human interaction. Face recognition works by using a computer algorithm to pick out the specific detail of a person's face, such as the gap between eyes or the pattern of the user's chin. It will be converted into a mathematical representation and compare the data on other faces that are collected in the database.

2.2.4 Minutiae Algorithm

A fingerprint is a unique identity for each individual as it has a pattern of ridges and valleys. The uniqueness of each person's fingerprint is defined by the local ridge aspect of the fingerprint. There are two prominent local ridges which are ridge ending and ridge bifurcation. Both of the ridges are called minutiae. The ridge ending is defined as the point where the ridge ends abruptly, while the ridge bifurcation is the point where a ridge forks or diverse into branches of ridges.

The fingerprint matching algorithm is using phase correlation based on the minutiae points. It is a popular choice to undergoes image registration because of its robust performance and simplicity. The theorem use in phase correlation is the Fourier shift theorem. The phase cannot have used the two align point directly as it needs to be converted the minutiae sets into 2D image space that called as Minutiae Direction Map (MDM). These alignments will parameters will be determined by differentiating the two-phase correlation of MDM. Figure below shows the algorithm that are used to differentiate the two images:

$$M^M(m, n) = \begin{cases} \cos \alpha_i + j \sin \alpha_i & m = x_i, n = y_i, \\ 0 & \text{otherwise} \end{cases}$$

Figure 2.1: Minutiae algorithm

The phase correlation will experience two stages which are the alignment stage and matching stage. The alignment stage will occur transformation, including the rotation and translation between two minutiae sets. Both of them will be calculated, and then the input minutia set is aligned to models of similarity measurement. Both of the similarities between the aligned input minutiae set and template will be calculated in the next stage, which is the matching stage.

In the matching stage, the minutiae set will be aligned to a new set regarding the parameter of transformation. It will compare both of the sets to see the comparison and the percentage of matching. If the distance of both minutiae sets is less than the threshold, the two images might be from the same finger. Else it comes from a different finger.

2.3 Related Work/Previous Work

2.3.1 Door-Automation System Using Bluetooth-Based Android for Mobile Phone

From the journal by *Kamelia L, et al. (2014)*, the smart door automation system uses a Bluetooth-based Android Smartphone and uses Arduino platforms that are more easy and efficient as it is a free open source software. The Bluetooth will act as a command agent, Arduino will microcontroller as a control center or data processing center, and solenoid act as door lock output. The device provides a safe and effective solution for controlling home automation. Rather than using a key, it uses a command delivered by Bluetooth on a Smartphone and other mobile devices. The uses of Bluetooth on Android smartphones are to provide better security than conventional keys.

It will be controlling and conducted by sending a command via Bluetooth to the Arduino circuit that will connect the Android smartphone and the solenoid. The diagram represent the block diagram of the door automation system by using android. The block diagram in Figure 1 shows that the android system's input uses Arduino software while the output solenoid is connected to the Arduino microcontroller circuit.

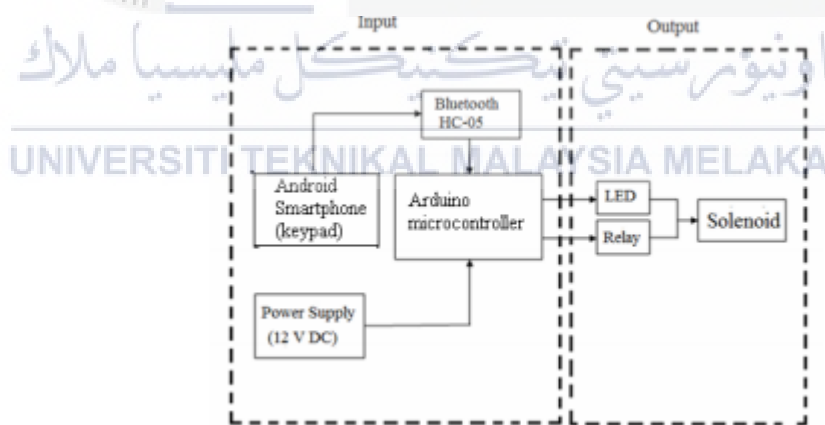


Figure 2.2: Block diagram of smart door (Kamelia L, et.al 2014)

2.3.2 Smart Door Using Bluetooth Technology and Camera Verification

The journal from *Pandurang et al. (2016)* states that the system is designed with a user motion-captured from the camera, and the user will be detected, and then he will be given a key to lock and unlock. It purposes to secure the door that can replace a good amount of human working force and humans are more prone to making errors.