

**INVESTIGATION OF SECRET KNOCK ACCESS SYSTEM FOR  
IOT BASED SMART DOOR LOCK**

**TEY XUE QI**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**INVESTIGATION OF SECRET KNOCK ACCESS SYSTEM  
FOR IOT BASED SMART DOOR LOCK**

**TEY XUE QI**

**This report is submitted in partial fulfilment of the requirements  
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I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Bachelor of Electronic Engineering with Honours.

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Supervisor Name : Encik Mazran bin Esro

Date : .....

## **DEDICATION**

Dedicated with deepest love to my beloved parents who are always there for me, Tey Boon Siang and Kerk Poh Kiew. Special thanks to my siblings for their unlimited love. Not forgetting to show my appreciation to my friends for giving unconditionally support.

## **ABSTRACT**

The aim of this project is to build an Internet of Things (IoT) based smart door lock system to be used by a homestay operator in Malaysia. IoT based smart door lock system is designed to utilize a low-cost security system with special features to enable unique knocking pattern to unlock the door. The IoT based smart door lock allows the operator to enable the lock and unlock function via mobile phones over the internet. The system provided convenience to the homestay owner and guests whilst maintaining the security. The project consisted of sensor signal conditioning amplifier circuit design, controller system integration, microcontroller programming and IoT cloud platform configuration. A piezoelectric sensor is used to detect the vibration pattern from the door knock which signal output is usually very weak. Thus, an amplifier design is required to filter the signal before processed by microcontroller. This feature is very useful in case if there were issues with an internet connection or user do not have mobile phones with them. The system included other value-added feature which may increase the security of the door lock system in the future.

## ABSTRAK

*Matlamat projek ini adalah untuk membina sistem kunci pintu pintar berasaskan IoT yang akan digunakan oleh pengendali homestay di Malaysia. Sistem kunci pintu pintar berasaskan IoT direka bentuk untuk menggunakan sistem keselamatan kos rendah dengan ciri khas untuk membolehkan corak mengetuk unik untuk membuka kunci pintu. Kunci pintu pintar yang berasaskan IoT membolehkan pengendali untuk mengunci dan membuka kunci menggunakan telefon bimbit melalui internet. Sistem ini akan memberi kemudahan kepada pemilik dan tetamu homestay di samping mengekalkan ciri keselamatan. Projek ini terdiri daripada reka bentuk litar penguat isyarat penderia, integrasi sistem pengawal, pengaturcaraan pengawal mikro dan konfigurasi platform awan IoT. Sensor piezoelektrik digunakan untuk mengesan corak getaran dari pintu yang mengetuk output isyarat biasanya sangat lemah. Oleh itu, reka bentuk penguat diperlukan untuk menapis isyarat sebelum diproses oleh pengawal mikro. Ciri ini sangat berguna sekiranya terdapat masalah dengan sambungan internet atau pengguna tidak mempunyai telefon bimbit dengannya. Sistem ini turut mempunyai ciri nilai lain yang boleh meningkatkan keselamatan sistem kunci pintu pada masa hadapan.*



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## LIST OF SYMBOLS AND ABBREVIATIONS

ABS	:	Acrylonitrile Butadiene Styrene
ADC	:	Analog-to-Digital Converter
HTTP	:	Hypertext Transfer Protocol
HTTPS	:	HTTP over SSL
ID	:	IDentification
IDE	:	Integrated Development Environment
IFTTT	:	If This Then That
IoT	:	Internet of Things
MQTT	:	Message Queuing Telemetry Transport
PCB	:	Printed Circuit Board
P&G	:	Procter & Gamble
RFID	:	Radio Frequency ID
SSL	:	Secure Socket Layer
TCP IP	:	Transmission Control Protocol Information Processing
URL	:	Uniform Resource Locator
USB	:	Universal Serial Bus
Wi-Fi	:	Wireless Fidelity

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# CHAPTER 1

## INTRODUCTION

In this chapter is to explain a concisely regarding the project, wherever it covers the overall overview regarding the project, objectives, and the problem statements. Thus, this chapter also includes the scope of work and the thesis outlines of the report. For a clear understanding of this study, each of the parts is relevant to each other.

### **1.1 Background of Project**

The safety and security problems nowadays emerge as one of the vital forces inflicting alterations in the tourism industry in the era of the millennium. The most concern of these problems more specializes in crime rates, food safety and terrorism. Based on the 2017 Mid-Year Crime Index report compiled by Numbeo, Malaysia currently ranks number 2 with a crime index of 68.56 in Southeast Asia for highest crime rate [1]. It was even more concerning because 3 major cities in Malaysia had

crime indicated that currently rank top 15 in Southeast Asia, namely Kuala Lumpur, Petaling Jaya and Johor Bahru with the crime index of 68.56, 65.01 and 59.89 respectively. This was a serious matter because crime apparently has a negative impact on the economic growth of a country (Gaibulloev & Sandler, 2013) [2].

Thus, the homestay owner needs to predict how to secure their homestay or property from the burglary of crime. In this era, the smartphone becomes popular among people in different age groups, especially for adolescents and adults, as technology grows. However, smartphones nowadays not only use to communicate with each other, but it also can be used to monitor anything surrounding them by using wireless fidelity (Wi-Fi) connection. Thus, it is leading to IoT technology since it is a technology that aims to put the things around us on a network.

An IoT based smart door lock is an electronic and mechanical locking device. It can be unlocked wirelessly with authentication of sanctioned users [3]. In a smart homestay, the owner able to enter their homestay or provide others access without requiring a traditional key by the permit of a smart door locks. Instead, a smartphone or a key fob was used to wirelessly verify and mechanically unlock the door by the users. An IoT based smart door lock not only increase the security of homestay but also increase the convenience of homestay owner and customers. This is because people can get access to the internet from anywhere around the world.

This project, which is based on the IoT integration, allows the operator to enable the lock and unlock function via mobile phones over the internet. It does not limit to the same internet connection. The IoT based smart door lock system is designed to utilize a low-cost security system with special features to enable unique knocking pattern to unlock the door. This feature is very useful in case if there were issues with internet connection or user does not have mobile phones with them or the mobile

phones is out of battery. The vibration pattern from the door knock is detected by using a piezoelectric sensor.

## **1.2 Problem Statement**

Homestay is an inexpensive alternative accommodation, ideal for freelance leisure travelers of all ages, interns, students from gap years, students living abroad and anyone looking for a true and real travel experience. It gives them the opportunity to experience the local community and culture of the place they visit [4]. Homestay business is currently the booming and aggressive business trend in Malaysia.

However, there are many major issues facing by the homestay business owner. For instance, the increase in burglary which often can be heard on the news or television until cause great harm or death makes people become more feeling insecure. Secondly, homestay owners need to pass the key to guest if they check-in midnight and take the time to take back the key from the guest during check-out. Thirdly, homestay owner needs to spend the money to change the entire door lock unit if the guest does not return the key.

On the other hand, many homestay operators plan to renovate their traditional door lock into the smart door lock to increase the convenience and security of homestay. Meanwhile, there are several kinds of smart door lock in the current market. For example, one of them is non-mobile app based smart door lock such as face recognition smart door lock, fingerprint recognition smart door lock, iris recognition smart door lock and so on. Under this kind of smart door lock, it is unsuitable for homestay operator. This is because they still need to entertain the guests on the first day to teach them how to store their fingerprint, details of face and iris to let the system

recognize them. There is also a smart door lock based on the mobile app that connects Wi-Fi or Bluetooth. The disadvantages are the guests cannot unlock the door when their mobile phone is out of battery or the Wi-Fi in a bad condition.

To solve these problems, a project of IoT based smart door lock system with configurable secret knock pattern can be used by a homestay operator will be developed. This project will provide the homestay owners with a solution to prevent them from attending the guest who may arrive at odd times. At the same time, the system provides security and convenience. This project consists of secret knocking instead of just IoT is because if there were issues with an internet connection or guests don't have mobile phones with them, they still can go in the homestay by using secret knocking on the door. Thus, the success of this project may provide convenience to the homestay owner and guests whilst maintaining security.

### **1.3 Objectives**

The IoT based smart door lock system is one of the tools that can be used especially for homestay. This project aims to create an alternative method for the homestay operator who always needs to attend the guest that may arrive at odd time. Besides that, this project also helps for those who need to spend the money to change the whole unit of door lock if the guest does not return the key. This project has several objectives which are:

- i) To develop a low-cost security system which can detect specific knocking pattern in order to unlock the door.
- ii) To integrate an IoT based smart door lock system.
- iii) To analyse the functionality and reliability of the designed system.

#### **1.4 Scope of Project**

Homestay security is a critical concern for most homestay operator and tourists in daily life. Many security systems have been designed for door locking, but the scope of this project is on a new concept which is using knock to lock and unlock the door. This can eliminate the disadvantages of the existing traditional available door security system. This project will have software and hardware implementation.

For this project, the software of Multisim 14.0 will be used to simulate the circuit. This is to ensure that the circuit works. The Proteus 8 Professional used for the hardware to draw the device's circuit and then the device will be produced by referring to the circuit that the Proteus had drawn. The project consists of sensor signal conditioning amplifier circuit design, controller system integration, microcontroller programming and IoT cloud platform configuration. A piezoelectric sensor is proposed to detect the vibration pattern from the door knock which signal output is usually very weak. Thus, an amplifier design is required to filter the signal before processed by microcontroller. Lastly, both software and hardware will be combined, then the microcontroller can use to connect the mobile phone with the IoT smart door lock system.

#### **1.5 Thesis Outline**

This thesis is organized into five chapters to cover the research work that is related to “Investigation of Secret Knock Access System for IoT Based Smart Door Lock”. In this project, the content body is organized into five chapters that are an introduction, background studies, methodology, result and discussion, conclusion and future work.

The first chapter briefly describes the background and overview of the conducted work. Besides that, this chapter also covers the background, problem statement, objectives, the scope of the project and thesis outline of this report.

The second chapter covers important background studies related to the project. This chapter will do a comparison between this project and other researches. This may see the difference between this project and other researches.

The third chapter focused on methodology. A circuit will be designed based on the specification of the project. The circuit will be built on the breadboard with a piezoelectric sensor. The project consists of sensor signal conditioning amplifier circuit design, controller system integration, microcontroller programming and IoT cloud platform configuration. This chapter also includes the flow chart for the entire project process and block diagram for the developed system.

The fourth chapter is about result and discussion. The result is analysed and a full discussion is written based on the result. In this chapter, the system testing and validation will also be done and shown. Any related calculations and graphs are shown in this chapter.

The last chapter concludes all the parts that I had done. This part will also conclude the overall achievement of this project and compare it with the objectives that were written before to see whether they are achieved or not. Future work will also be discussed in this project so that improvement can be made to sustain a better quality of the project.