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Security system with Rhythm Touch and IoT Application

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronic Engineering Technology (Industrial Electronic) with Honours.

by

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DECLARATION

I hereby, declared this report entitled Security System with Rhythm Touch and IoT Application is the results of my own research except as cited in references.

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APPROVAL

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ABSTRAK

Keselamatan adalah sebahagian daripada aspek penting yang perlu diambil perhatian oleh komuniti. Terutamanya apabila ia melibatkan kehidupan dan harta benda, ramai orang menghadapi masalah keselamatan sistem kunci yang lemah. Sebagai contoh, masalah pencurian yang sering berlaku dalam beberapa tahun kebelakangan ini yang mungkin membawa kepada bahaya kehilangan harta-benda berharga. Tambahan pula, kunci loker telah menjadi beban bagi pengguna untuk membawa sekitar apabila dia mempunyai beberapa loker. Oleh kerana loker kunci mekanikal hanya boleh diakses oleh kunci, sangat menyusahkan apabila kunci hilang atau pemilik utama tidak ada di sekelilingnya. Berdasarkan masalah itu, satu kajian telah dijalankan. Tujuan projek ini adalah untuk membangunkan cara yang unik untuk membuka kunci kunci dengan menggunakan input berirama sebagai kod laluan. Mikrokontroler utama digunakan untuk mengesan dan mengesahkan irama input yang mempunyai kadar berbeza daripada sensor sentuh. Selepas mengenal pasti irama, ia akan membiarkan mekanisme penguncian aktif membuka kunci loker. Irama boleh ditetapkan oleh pengguna dengan hanya menekan butang set semula yang disediakan. Selain itu, sistem ini juga dilengkapi dengan aplikasi IoT yang membantu pengguna mengakses loker dari telefon pintar. Ia direka bentuk dengan antara muka pengguna interaktif untuk pengalaman pengguna yang lebih baik. Ia menyediakan pilihan buka kunci menengah yang akan sangat berguna apabila pengguna telah melupakan kata laluan atau apabila pengguna ingin membuka kunci sementara untuk rakan dari jauh.

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ABSTRACT

Security is part of important aspects that need to be concerned with the community. Especially when it involves lives and properties, many people encounter a problem of a weak security lock system which causes them to feel unsafe. As an example, a burglary problem which is often the case in recent years that may lead to a danger of losing valuable things. Otherwise, home safety lock system that is easy to be cracked by the theft or intruders where it can't guarantee the safety of a home. Furthermore, the locker's key has become a burden for the user to carry around when he has multiple of the locker. Since the mechanical key locker can only accessible by the key, it is very inconvenient when the key is lost or the key owner is not around. Based on the problem, a study is conducted. The purpose of this project is to develop a unique way to unlock the lock by using rhythmic input as a passcode. The main microcontroller is used to detect and verify the different pace of input rhythm that detected from the touch sensor. After identifying the rhythm, it will let the active the locking mechanism to unlock the locker. The rhythm can be set by the user by simply pressing the provided reset button. Besides that, the system also comes with IoT application that helps the user to access the locker from the smartphones. It is designed with interactive user interface for better user experience. It provides secondary unlock an option that will be very useful when the user has forgotten the password or when the user wants to unlock temporary for friends from far.

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DEDICATION

This thesis is dedicated to my beloved family, who support and encourage me all the time. It also dedicated to my supervisor who guide me by giving advice during this project. And finally, dedicated to all my friends who assists me when I need a hand.

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TABLE OF CONTENT

ABSTRAK i

ABSTRACT ii

DEDICATION iii

ACKNOWLEDGEMENT iv

TABLE OF CONTENTS v

LIST OF TABLES x

LIST OF FIGURE xi

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES xiv

CHAPTER 1: INTRODUCTION

1.0 Introduction 1

1.1 Overview 1

1.2 Problem Statement 2

1.3 Objectives 3

1.4 Project Scope 3

1.4.1 Design the rhythm recognition algorithm using the Arduino IDE 3

1.4.2 Design a locker with the implementation of the IoT application 4

1.4.3 Design a keyless locker that target consumer market 5

1.4.4 Fabricate the prototype of an electronic locker 5

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1.5 Project Outline 6

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction 8

2.1 History of project 8

2.2 Researches on the previous project that related to smart lock 9

2.2.1 Smart Door Lock System: Improving Home Security using Bluetooth Technology 9

2.2.2 A Locking System Using Bluetooth Technology & Camera Verification 11

2.2.3 Bank Locker Security System based on RFID and GSM Technology 13

2.2.4 Comparison between different types of electronic lock system 15

2.2.5 Design Secured Smart Door Lock Based on Jaro Winkler Algorithm 16

2.2.6 Raspberry Pi Based Smart Lock System 17

2.3 Research on the previous project that related to touch sensor 19

2.3.1 Touch Screens: Technology for Better Tomorrow 19

2.3.2 Capacitive Touch Communication: A Technique to Input Data through Devices' Touchscreen 23

2.4 Research on the previous project that related to Wi-Fi 24

2.4.1 Design of Smart Home System Based on Wi-Fi Smart Plug 24

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2.4.2 Wi-Fi Enabled Home Security Surveillance System using Raspberry Pi and IoT Module 26

2.4.3 A Smart Lock System using Wi-Fi Security 27

2.4.4 Comparison of connection to Wi-Fi router 28

CHAPTER 3: METHODOLOGY

3.0 Introduction 30

3.1 Project Planning 30

3.1.1 Gantt Chart 32

3.2 Project implementation 33

3.2.1 System Flowchart 33

3.2.2 Application Flowchart 35

3.2.3 System Block Diagram 36

3.3 Hardware Selection 37

3.3.1 Proximity sensor 38

3.3.2 Touch sensor 39

3.3.3 IoT module 40

3.3.4 Lock mechanism 41

3.3.5 Servo motor 42

3.3.6 Microcontroller 43

3.3.7 Microcontroller with Wi-Fi module 45

3.4 Software Selection 45

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3.4.1 Arduino Integrated Development Environment (IDE) 46

3.4.2 Proteus Professional 8 software 47

3.4.3 Android Studio 48

3.4.4 Firebase 49

CHAPTER 4: RESULTS & DISCUSSION

4.0 Introduction 51

4.1 Development Result 51

4.1.1 Schematic Diagram 51

4.1.2 PCB development 52

4.1.3 GUI development 54

4.2 Hardware Result 56

4.3 Software Result 58

4.4 Effects of gap distances between hands and the touch plate 63

4.5 Effects of touching conditions on capacitive sensor 65

4.6 Precision of rhythm verification system in different pace 67

4.7 Precision of rhythm verification system on different condition 69

4.8 Discussion 70

CHAPTER 5: CONCLUSION & FUTURE WORK

5.0 Introduction 74

5.1 Conclusion 74

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5.2 Future Development 75

REFERENCES **77**

APPENDICES **79**

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LIST OF TABLES

TABLE	TITLE	PAGE
Table 2.1	Comparison between types of electronic lock system	15
Table 2.2	Comparison of 4 type of touch sensor design	22
Table 2.3	Comparison of different wireless connectivity techniques	25
Table 2.4	Comparison between Wi-Fi connection and LAN cable	29
Table 4.1	Readings of the capacitive sensor based on the distance between finger and the capacitive touch sensor	63
Table 4.2	Readings of the capacitive sensor based on the distance between palm and the capacitive touch sensor	64
Table 4.3	Readings of the capacitive sensor based on each touching condition	66
Table 4.4	Delays of each successful rhythm input at different pace	68
Table 4.5	Delays of each rhythm input at different condition	69

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LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 2.1	The structure of the smart door lock using Bluetooth	10
Figure 2.2	The operation of lock\unlocking the smart door	11
Figure 2.3	The design of a looking system using Bluetooth technology and camera verification	13
Figure 2.4	The system architecture of Bank Locker Security System with RFID and GSM	14
Figure 2.5	First equation of Jaro Winkler Algorithm	17
Figure 2.6	Second equation of Jaro Winkler Algorithm	17
Figure 2.7	The system architecture of Raspberry Pi based locking system	18
Figure 2.8	Design of resistive touch sensor	20
Figure 2.9	Design of capacitive touch sensor	21
Figure 2.10	Design of AWS touch sensor	21
Figure 2.11	Design of infrared touch sensor	22
Figure 2.12	CMC touch sensor	24
Figure 2.13	The system architecture of smart locking system using WIFI	28
Figure 3.1	Flowchart of project planning	31
Figure 3.2	The Gantt chart that used to arrange project schedule	32

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Figure 3.3	Flowchart of system function	34
Figure 3.4	Flowchart of application start-up	36
Figure 3.5	Block diagram of the system	37
Figure 3.6	The reed sensor with screw	37
Figure 3.7	Aluminum foil that used to make capacitance touch sensor	40
Figure 3.8	ESP8266 Wi-Fi module	41
Figure 3.9	ELock627-6V solenoid lock in initial state	42
Figure 3.10	Servo motor SG-90 in initial state	43
Figure 3.11	Arduino UNO microcontroller with power cable	44
Figure 3.12	NodeMCU microcontroller	45
Figure 3.13	The interface of the Arduino IDE with serial monitor	46
Figure 3.14	The ISIS interface of Proteus	47
Figure 3.15	The ARES interface of Proteus	48
Figure 3.16	The user interface of the android studio	49
Figure 3.17	The interface of the Firebase Realtime Database	50
Figure 4.1	Schematic diagram of rhythm unlocking system	52
Figure 4.2	PCB layout design in PROTEUS	53
Figure 4.3	Backside of the completed PCB board	53
Figure 4.4	Front side of the completed PCB board	54
Figure 4.5	Development of GUI using Android Studio	55
Figure 4.6	Xml files of the application GUI	55

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Figure 4.7	Outer view of the final product	56
Figure 4.8	Inner view of the final product	56
Figure 4.9	Fully assembled circuit board	57
Figure 4.10	Wires are well organised	57
Figure 4.11	Main page of mobile application	58
Figure 4.12	Main page of mobile application with different status	59
Figure 4.13	Settings page of mobile application with different status	60
Figure 4.14	Password login page of mobile application with different status	60
Figure 4.15	Password reset page of mobile application with different status	61
Figure 4.16	Launching page of mobile application with different status	61
Figure 4.17	Notification of different condition	62
Figure 4.18	Realtime Database in Firebase	62
Figure 4.19	Comparison between hand and palm effects to the touch sensor	64
Figure 4.20	Comparison between different conditions to the touch sensor	66
Figure 4.21	Delays of each successful rhythm input at different pace	68
Figure 4.22	Delays of each rhythm input at different condition	70

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

ARES	-	Amateur Radio Emergency Service
B-ID	-	Bluetooth Identification
CMC	-	Carbon Micro Coil
CPU	-	Central Processing Unit
DC	-	Direct Current
EEPROM	-	Electrically Erasable Programmable Read-Only Memory
GPU	-	Graphics Processing Unit
GSM	-	Global System for Mobile
GUI	-	Graphical User Interface
HTTP	-	Hypertext Transfer Protocol
IDE	-	Integrated Development Environment
IoT	-	Internet of Things
IP	-	Internet Protocol
LCD	-	Liquid Crystal Display
LCR	-	Liquidity Coverage Ratio
PCB	-	Printed Circuit Board
PIN	-	Personal Identification Number
RFID	-	Radio Frequency Identification
SMS	-	Short Message Service
SOC	-	System On Chip
USB	-	Universal Serial Bus

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UTP	-	Unshielded Twisted Pair
Wi-Fi	-	Wireless Fidelity
WLAN	-	Wireless Local Area Network
UI	-	User Interface

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CHAPTER 1

INTRODUCTION

1.0 Introduction

In this chapter, it will briefly explain the project. It will cover the general overview of the project, objectives and the problem statement. This chapter will also include the scope of work that will state all the outcome of the project.

1.1 Overview

Nowadays, security is now an essential need of human. The word "security" is usually can be used in a different aspect of content and sense. It can be used in a system or services that involve private property that needed to be protected. In order to ensure the safety of their properties, locks have been invented in the Near East a long time ago. The earliest locks that need a key to unlock was created about 4000 years ago. These lockers will prevent people other than the owner to access their properties. As the people are having more personal and valuable items, the locks is becoming more important.

The advancement of technology has allowed engineers to create reliable keyless electronic locks. These keyless locking system has been replaced the traditional locker. They are less vulnerable to the burglary. Besides that, the traditional lockers will have the risk of losing the key. As the duplication of keys is easier this day, the security of the old kind of lock has been questioned, thus new technology is needed to develop to overcome these issues.

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Rhythm is systematic arrangement of sounds, principally according to duration. It can form many different unique patterns with combination of different delays duration between each beats. Thus this project will design another way of unlocking the locker by using the characteristic of rhythm. It will be using secret rhythm as passcode instead of a numeric passcode. This can greatly increase the security level because the rhythm password cannot see by others around the area. The rhythmic password will be able to detect by the touch capacitive sensor and sent to the 98microcontroller as input. Besides that, the capacitive sensor are easy to camouflage which made the unlocking process for people other than owner more difficult.

To further increase the security level of the system, the unlocking system has been integrated with IoT application using Wi-Fi connection. The system will be connected with the multiple user's smartphone through online cloud. The cloud enables real time sync between every devices that connected to it. With the help of proximity sensor that used to detect the status of the door, it will notify users the real time condition of the locker by sending the notification to the smartphone application whenever the door is opened or closed or even if it has been theft. In the meanwhile, the IoT also provides a secondary unlocking option for the system that can be used when the owner not around or when the owner forgets the password.

1.2 Problem Statement

In this modern era, there are many electronic lockers has been developed. There is some advance security locker with a high-security level that is used by the bank, but they are either very expensive or hard to learn. In addition, there has been a dramatic increase in the number of reported burglaries case in the past few years due to the

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similarity of lock system. This project is to give people another unique way to secure their properties. Besides that, peoples tend to be forgetful often having a hard time looking for their key. This has caused the property to not only lockout from the others but also the owner. Even the keyless electronic locker will have the same problem by forgetting their passcode to access the locker because of not having any other secondary unlocking option. So in order to get back the secured properties, the locker is needed to be destroyed or the owner will have to spend a lot of money to hire some professional to unlock the locker for them. Furthermore, it is natural for a people who leave the house or property unattended as people were busy with the basic routine of life daily. This is very inconvenient for the guest user if they want to access the locker with the absence of the owner. In this case, the owner can tell the guest user the passcode but this will cause the security of the locker vulnerable.

1.3 Objective

The objectives of this project to be achieved are as below:

1. To study the effectiveness of the developed capacitive touch sensor.
2. To develop a security lock that integrated with IoT application to control and supervise the status from anytime and anywhere
3. To analyze the precision of rhythm verification system.

1.4 Project scope

In this part describes the task that involves in this project. By explaining each the step of implementation that need to do the hardware part, software part until a test and analysis part of the project. The scope is to the guarantee that the project is heading in the right way to achieve the objectives of the project.

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1.4.1 Design the rhythm recognition algorithm using the Arduino IDE

The Arduino microcontroller will need the Arduino IDE to build the program by using C++ programming language. The program will allow the Arduino to control the input and output of all the others electronic equipment that connected to it. The main purpose is to of the program is to recognize the input rhythm for authentication. The program can adjust the sensitivity of the sensitivity of the touch detection. Since there too many uncertainties in a rhythm, it can be faster or slower pace, the program have the reject value that used to determine the true or false of the rhythm pattern were knock by the user. Furthermore, it also has included the maximum number of touches that user can record.

1.4.2 Design a locker with the implementation of the secured IoT application

The locker will connected to the cloud with the help of a Wi-Fi module to send and receive the signal from mobile devices at any time. The mobile application allow the system to notify the user the real time condition of the locker. It also provide secondary unlock option for the locker from the application. This will be useful when unlock the locker for the guest user when they are not around or if the owners forgets their secret rhythm. For security concern, the application is password protected with numeric password instead of rhythm in case the user have forget the rhythm. Furthermore, the password is sync between every devices that connected to it, the user are allowed to change the password anytime if they want to prevent others from access the

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application. Thus, even the others have that application installed, they cannot unlock the locker without knowing the password.

1.4.3 Design a keyless lock that targets consumer market

There are many types of keyless security lock available in the market but most of them are designed for commercial use. All the hardware that used in this lock system is selected carefully by judging from the cost and capabilities. It comes with all the basic function that a keyless lock will need with an additional of IoT system for more versatility. Since the system will be operated for 24 hours non-stop, the power consumption must as low as possible to prevent the high amount of electric bill. Besides that, the system application is designed such that it will be easy to use and learnt by non-professional. The mobile application will be designed to be easy to use and understand with attractive GUI and some customizable settings for personal preferences. It also enable multiple user to access the lock with the application which is very useful for a family.

1.4.4 Fabricate the prototype of the lock system in a locker

The purpose of this project is to create a lock that using a unique way to unlock it. The lock system is able to unlock by input correct touch rhythm or unlock through owner smartphone application via Wi-Fi. Since the main implemented technology is the unlocking system, it can be installed to any other application such as door and iron safe. As for this project, the prototype

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