WIRELESS HOME SECURITY SYSTEM

NURUL HUSNA BINTI ABDUL KHALIL

This report is submitted in partial fulfillment of the requirement for the award of Bachelor of Electronic Engineering (Telecommunication) With Honours.

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

June 2013

© Universiti Teknikal Malaysia Melaka

UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : WIRELESS HOME SECURITY SYSTEM

Sesi Pengajian : | 1 | 2 | / | 1 | 3 |

Saya NURUL HUSNA BINTI ABDUL KHALIL
mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (√) :

☐	**SULIT***	*(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	**TERHAD****	**(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	**TIDAK TERHAD**	

Disahkan oleh:

(TANDATANGAN PENULIS)

(COP DAN TANDATANGAN PENYELIA)
FAKRULRADZI BIN IDRIS
Pensyarah
Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka (UTeM)
Karung Berkunci No 1752
Pejabat Pos Durian Tunggal
76109 Durian Tunggal, Melaka

Tarikh: 10/6/2013

Tarikh: 10/6/2013

© Universiti Teknikal Malaysia Melaka

"I hereby declared that this report entitle Wireless Home Security System is the result off my own work except for quotes as cited in the references"

Signature : .....

Author : Nurul Husna Binti Abdul Khalil

Date : 10 JUNE 2013

© Universiti Teknikal Malaysia Melaka

"I hereby declare that I have read this report and in my opinion this report is sufficient in terms of the scope and quality for the award of Bachelor of Electronic Engineering (Telecommunication) With Honours."

Signature : .....

Supervisor's Name : Engr Fakrulradzi Bin Idris

Date : 10 JUNE 2013

© Universiti Teknikal Malaysia Melaka

Specially dedicated to my late father, my late mother and my lover who encouraged guided and inspired me throughout my journey of education.

© Universiti Teknikal Malaysia Melaka

ACKNOWLEDGEMENT

Praise to Allah, with His blessing, I manage to complete this thesis successfully. Firstly, I would like to express my appreciation to my supervisor, Engr. Fakrulradzi Bin Idris for the guidance, enthusiasm and motivation given throughout the progress of this project. Without his continued support and interest, this project would not be accomplished as presented here. My sincere appreciation also goes to my family who has been so tolerant and supportive in all these years either morally or financially. I would like to thank all my friends who have directly or indirectly give me a hand and do me a favors at various occasions to complete my project as part of the Bachelor program in Universiti Teknikal Malaysia Melaka (UTeM).

© Universiti Teknikal Malaysia Melaka

ABSTRACT

House break-ins and robbery cases happen every day. The situation turns worse due to the inflation and global economy downturn recently. Home security is getting concern from all range of people. A Wireless technology has already becoming important application nowadays. Wireless are exploited all the range of technology whereby its can be enhance the old technology. It also gives the ease of control to the users to control the system at the certain range. Nowadays, almost all the electronic device is equipped with wireless technology. This project is mainly concern about Wireless Home Security System which is inexpensive, user-friendly, small in size, easy to install and it portable. The whole project consists of one main circuit and one remote control and the Zigbee technology were used in the communication of both circuits to the remote control or vice versa.

© Universiti Teknikal Malaysia Melaka

ABSTRAK

Kes pecah masuk rumah dan rompakan berlaku setiap hari. Kejadian ini mrnjadi lebih buruk ketika inflasi dan kemeresetan ekonomi dunia kebelakangan ini. Oleh hal yg demikian, keselamtan rumah mula dititikberatkan oleh kebanyakan orang. Teknologi tanpa wayar mula menjadi kepentingan di masa kini. Teknologi tanpa wayar juga sudah mula mengekplotasi teknologi yang dahulu kala yg menggunakan wayar. Tambahan pula, teknologi tanpa wayar memberikan kemudahan kawalan kepada pengguna. Pada zaman sekarang, kebanyakan aplikasi sudah mula menggunakan teknologi tanpa wayar. Projek ni berkaitan system pengawasan rumah yang mampu milik, mesra pelanggan, bersaiz kecil, mudah diletakkan di mana sahaja. Keseluruhan projek ini mengandungi satu litar utama dan satu alat kawalan jauh. Kedua-duanya mengguna Zigbee untuk menghubungkan satu sama lain.

© Universiti Teknikal Malaysia Melaka

TABLE OF CONTENT

CHAPTER	TITLE		PAGE
	DECLARATION		**ii**
	DEDICATION		**iii**
	ACKNOWLEDGEMENT		**iv**
	ABSTRACT		**v**
	ABSTRAK		**vi**
	TABLE OF CONTENTS		**vii**
	LIST OF TABLES		**xi**
	LIST OF FIGURES		**xii**
	LIST OF APPENDICES		**xiv**
I	**INTRODUCTION**		
	1.1	Chapter Overview	1
	1.2	Background	1
	1.3	Problem Statement	3
	1.4	Objectives	3
	1.5	Scope of Work	4
	1.6	Thesis Organization	4
II	**LITERATURE REVIEW**		**6**
	2.1	Chapter Overview	6

© Universiti Teknikal Malaysia Melaka

2.2	Wireless Home Security System available In market		6
2.3	The Comparison and Analysis of The Wireless Network		11
	2.3.1.1	Radio Frequency	11
	2.3.1.2	Bluetooth	12
	2.3.1.3	Infrared	12
	2.3.1.4	Zigbee	12
	2.3.2	Hardware Devices/ Components	13
	2.3.2.1	Zigbee Technology	13
	2.3.2.1.1	Zigbee Module	16
	2.3.2.1.2	Magnetic Sensor	17
	2.3.2.1.3	Vibration Sensor	18
	2.3.2.1.4	PIR Motion Sensor	19
	2.3.2.1.5	Buzzer	20
	2.3.2.1.6	LCD module	20
2.4	PIC-Microcontroller – PIC16F877A		21
	2.4.1	PIC 16F877A block diagram	24
2.5	Overview of Zigbee Technology		25
	2.5.1	Xbee/Xbee-PRO OEM RF modules	26
	2.5.2	Advantages of Xbee	28
	2.5.3	The pin signal	28
	2.5.4	About Zigbee Standard	29
	2.5.5	Mechanical Drawing	30
	2.5.6	Mounting Consideration	31
2.6	Similar research done another student		31
III	**METHODOLOGY**		
3.1	Chapter Overview		32
3.2	Flowchart		33
	3.2.1	The work flow for the whole project	34

© Universiti Teknikal Malaysia Melaka

	3.3	Project Overview	35
	3.4	Hardware Development	
	3.4.1	Transmitter Circuit	36
	3.4.2	Receiver Circuit	38
	3.5	Wireless Module	38
	3.5.1	Serial Communication	39
	3.5.2	UART data flow	39
	3.5.3	Transparent operation	41
	3.5.4	Flow Control	41
	3.6	SKXbee	43
	3.6.1	SKXbee Specification	45
	3.7	Interface PIC16F877A with XBee	45
	3.8	General Process in Fabricating	46
	3.8.1	Layout printing	46
	3.8.2	UV exposure	47
	3.8.3	Developing the image	47
	3.8.4	Spray washing	48
	3.8.5	Etching	48
	3.8.6	Resist stripping	49
	3.8.7	Scrub Cleansing	50
	3.8.8	Cutting and drilling	50
	3.8.9	Soldering Process	50
	3.9	Software Development	51
	3.9.1	Overview	51
	3.9.1.1	Proteus Professional 7.6	51
	3.9.1.2	XCTU software	52
	3.9.1.3	PIC C Compiler	58
IV	**PROJECT OVERVIEW**		**60**
	4.1	Chapter Overview	60
	4.2	Circuit Design	60

© Universiti Teknikal Malaysia Melaka

		4.2.1 Transmitter Circuit	61
		4.2.2 Receiver Circuit	63
	4.3	Practical prototype demonstration	66
	4.4	Analysis of overall project	68
V	**FUTURE WORK AND CONCLUSION**		**70**
	5.1	Limitation	70
	5.2	Suggestions for Future Work	70
		5.2.1 Increase Number of Zones	70
	5.3	Discussion	71
	5.4	Conclusion	72
	REFERENCES		**73**
	APPENDIX A		**75**
	APPENDIX B		**77**
	APPENDIX C		**78**

© Universiti Teknikal Malaysia Melaka

LIST OF TABLES

NO	TITLE	PAGE
2.1	Comparison of The Wireless Network	13
2.2	Specification of Zigbee Module	17
2.3	Magnetic Sensor Specification	17
2.4	PIC Comparison	22
2.5	Xbee series 1 specification	27
2.6	DC Characteristic of the Xbee	32
2.7	ADC Characteristics (operating)	32
2.8	ADC timing/performance characteristics	33
2.9	Related research topics	36
3.1	Xbee features	39
3.2	Functional of SKXbee	43
3.3	SKXbee specifications	45

© Universiti Teknikal Malaysia Melaka

LIST OF FIGURE

NO.	TITLE	PAGE
2.1	Watchdog plus Control Panel	7
2.2	REX plus Electronic	7
2.3	Wireless door and window sensor	8
2.4	Wireless P.I.R Motion Sensor with Pet Immune	8
2.5	Monitor Smoke Detector	9
2.6	External Siren	9
2.7	Keychain Remote	10
2.8	Topology of Zigbee Network	15
2.9	Zigbee	16
2.10	Magnetic Sensor	18
2.11	Vibration Sensor	18
2.12	PIR Motion Detector	19
2.13	Buzzer	20
2.14	LCD (16x2) character	21
2.15	Schematic PIC 16F628 pin	23
2.16	PIC 16F877A microcontroller	23
2.17	PIC 16F877A internal architecture	24
2.18	The Zigbee layered model	25
2.19	Xbee RF module pin numbers	28
2.20	Network Layer that involved in the Zigbee module	30
2.21	Mechanical drawings of the Xbee/Xbee-Pro	30
2.22	Xbee Module Mounting to an RS-232 Interface Board	31
3.1	Flowchart	33
3.2	Basic Block Diagram	36
3.3	Transmitter Block Diagram	37

© Universiti Teknikal Malaysia Melaka

3.4	IC LM7805	37
3.5	Receiver Block Diagram	38
3.6	System data flow diagram in a UART-interfaced Environment	40
3.7	UART data packet 0x1F	40
3.8	Internal data flow diagram	42
3.9	SKXbee board layout	43
3.10	Example of connection PIC16F877A microcontroller	44
3.11	Ultra-Violet Ray exposed	47
3.12	Developer	47
3.13	Etching equipment	48
3.14	Cutting the PCB board	50
3.15	Drilling Process	50
3.16	Soldering Process	51
3.17	ISIS professional window	52
3.18	X-CTU window	53
3.19	Test/Query of X-CTU window	54
3.20	X-CTU software in windows environment	55
3.21	X-CTU window when the two of Zigbee Connected each other	57
3.22	PIC C Compiler window	59
4.1	Schematic Diagram of Transmitter Circuit	61
4.2	PCB layout design of transmitter circuit	62
4.3	Circuit design on transparency paper	62
4.4	Schematic diagram for receiver circuit	63
4.5	PCB layout design of receiver circuit	64
4.6	Circuit design on transparency paper	65
4.7	Practical prototype demonstration.	66
4.8	Demonstration of Main Circuit	67
4.9	Demonstration of Remote Control	67
4.10	When the system in the standby mode	68

© Universiti Teknikal Malaysia Melaka

4.11	LCD display when it detect the magnetic sensor	68
4.12	LCD display when it detects the Motion Sensor	69
4.13	LCD display when it detect the Vibration sensor	69

© Universiti Teknikal Malaysia Melaka

CHAPTER 1

INTRODUCTION

1.1 Chapter Overview

In this chapter will be discussed on the reason why the Wireless Home Security System is carried out. While you're reading this chapter, you will find out the strength, features and also find out the trend of home security systems in the market and the suitability and the contribution of this system to its targeted market.

1.2 Background

Everybody has their own space to live, it must be comfortable and it called home. Home should be can be the safety place but how much can you guarantee that your own house is safe? Nowadays, house break-ins and robbery happens every day and all this happens because to achieve of higher standard living. The most common threat to home resident is burglary. Millions of Ringgit are lost in each day. By definition, the crime of burglary is breaking and entering a residence for the intention of committing a crime or while lawfully within, commit a crime and to thereafter break out, usually crime that occurs when homeowners are not at home. To

© Universiti Teknikal Malaysia Melaka

avoid this thing happening, all houses should have the Security System. Security is the most important in day-to-day life for almost all the sectors of the world. A special security is most essential for houses [1]

In the developed countries like the United State and European country, home security system has been in use for so long but in our country, our Malaysian, didn't realize about the importance of this system since the price is too expensive and only a few of Malaysian can afford it. As a result of this situation, a home security system which is an allowable Malaysia requirement has to be produced. Home security system is necessary in order to enhance the occupants, convenient and safe environment from any in the invasion. Today, there are many types of home security system are being produced in the market. There are in range of rm350- RM5000 and their prices depend on how the systems operate.

All the home security systems are designed to achieve the same purpose – to thwart a break-in attempt. The most basic of all of the types of the home security system is the simple electrical circuit built into an entry way alarm. Some home security systems are wired to all potential entries into the home, including doors and windows. But now the technologies are implementing the new device and the wireless form of the home security were developed. The reasons are wireless can save cost of wiring, easy to install, occupy lesser space, easy maintenance and more reliable.

Wireless communications have many types of devices, its include Infrared (IR), Bluetooth, Radio frequency (RF) and the latest technologies is using Zigbee. ZigBee technology offers a multi-hop communication capability for data transfer. Multi-hop communication will provide an unlimited range of communication for the system as long as there are intermediate nodes that will pass the data from one node to another until it reaches the destination. [2]

In the market now, the wireless home security basically offered system consists of intrusion detectors, a control panel, and a triggered-on siren. After all the years, the

© Universiti Teknikal Malaysia Melaka

wireless home securities are more advanced. They have the intrusion detectors or more commonly known as intrusion sensors; include magnetic switch, passive infrared sensor, and vibration sensor. The threatening may be a human intrusion, metal detection, fire hazardous problems, door tampering problems, gas leakage problem. [1] It's also having an automatic system to call or send a message to the police station and the house owner.

1.3 Problem Statement

There are a lot of wireless home securities offered in the market. Some of them were designed for very high security level protection and long term protection using GSM system, but this kind of system really suite the Malaysians? It will need more cost and they have to pay monthly service and it needs a big amount of money where, the Malaysian majority came from an average.

Some of them also offered the basic security system and its normally offers some simple features like trigger alarm and remote control only and it has a low level of security system. Therefore, in this project, a wireless home security system is designed in such a way which suits a double-storey terrace house in Malaysia. In addition, the system gives enough security protection and is low-cost, user-friendly and lasting.

1.4 Objectives

i. To design cost effective, user- friendly, small in size, easy to install.
ii. To implement the wireless technology in this project.
iii. To evaluate a home security system that can give two ways communication between system and user.

© Universiti Teknikal Malaysia Melaka

1.5 Scope of Work

One of the main work scopes is to understand the Zigbee module in how the Zigbee can be operating in this project. In order to understand these things, literature review must be done by referring paperwork that is related to this project and a lot of books regarding of this module. The second work scope is to design a transmitter and receiver pair which can cater important security features of a wireless home security system. The Zigbee technology is implemented as the communication met between this circuit and remote controls. The project will be divided into two parts. In the hardware part, components PIC-microcontroller and Zigbee module will be used in the circuit design and remote board. In the software part, C language is used in programming the PIC-microcontroller to enable it to perform tasks. Software MicroC is used as the compiler. At the end of the project, the system that we design should be portable, easy to operate and lastly the PCB board and one remote control will be produced.

1.6 Thesis Organization

This thesis is divided into five chapters. The contents of each chapter were summarized as below.

Chapter 1 as an introduction about the current technology of wireless security system and this chapter consists the overview of the objective and scope of the project. It also summarizes the content of this thesis.

Chapter 2 is about the literature review that covers the related theory and previous work regarding this project. There are included about the Zigbee Module, PIC Microcontroller, and PIR motion sensor.

Chapter 3 is a methodology for this project. It consists of information about the scope of work that we had done to accomplish this project.

© Universiti Teknikal Malaysia Melaka

Chapter 4 consists of result and analysis. It's more focused on hardware and software development.

Chapter 5 is about the future work and conclusion of this project.

© Universiti Teknikal Malaysia Melaka

CHAPTER 2

LITERATURE REVIEW

2.1 Chapter Overview

This chapter explains the literature review and the theoretical part relate to this project. This will help further understanding of this project and will enhance the knowledge to contribute towards the completion of this project. Most of these theories are based on previous works that has been done by researchers. Their previous work is one of the factors to contribute ideas in designing this project. At the beginning of the project, the features of this Wireless Home Security System are available in the market are being analyzed. Afterwards, studies have been done in identifying the features needed to be incorporated into my project. From time to time, theories and related knowledge have been acquired and implemented in achieving the objectives of this project.

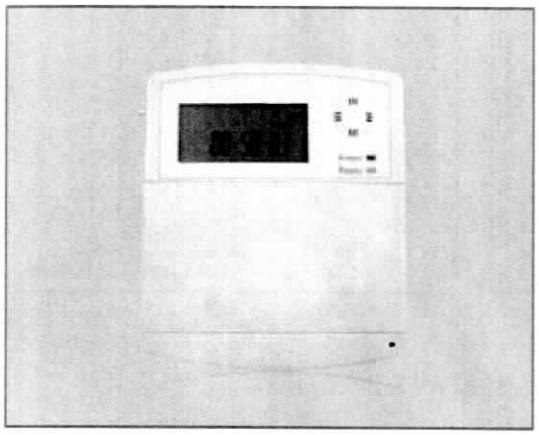
2.2 Wireless Home Security System available in market

A survey has been done on wireless home security system products that are available in the market. All their features and specification are deeply analyzed so that, I

© Universiti Teknikal Malaysia Melaka

it can implement in my project. There are a few of product currently available in the market

Product Name: The Watchdog plus Control Panel



- Easy wireless install
- Talking commands for easy operation
- Password protection
- Digital display with Night-Vision for night viewing

Figure 2.1: Watchdog plus keypad

Product Name: REX plus Electronic

- Maintenance free
- Reliable 24 hour protection
- Volume control
- Perfect for all public and private buildings

Figure 2.2: REX Plus Electronic

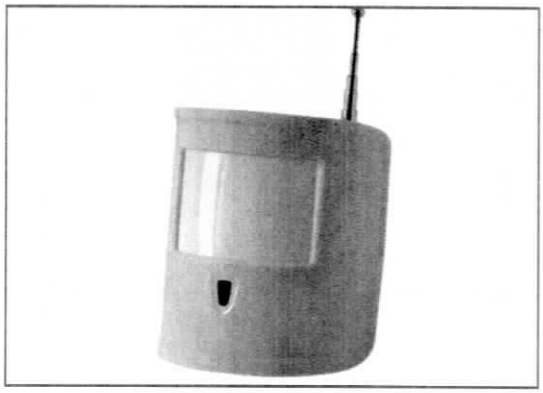
© Universiti Teknikal Malaysia Melaka

Product Name: Wireless Door and Window Sensor

- Wireless will transmit up to 100m max depending on condition. (30-50m)
- On activation upper LED will illuminate
- On low battery lower LED will illuminate
- Indoor use only

Figure 2.3: Wireless door and window sensor

Product Name: Wireless P.I.R Motion Sensor with Pet Immune



- Can be use with DCOM alarm system or operate other panel with 433mhz
- When human pass by, the sensor will trigger
- Battery operated and wireless

Figure 2.4: Wireless P.I.R Motion Sensor

© Universiti Teknikal Malaysia Melaka