



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

HOME SECURITY SYSTEM USING ZIGBEE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology Electronic (Telecommunication) (Hons.)

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology, item as a partial fulfillment of the requirements for the Bachelor of Engineering Technology Electronic Telecommunication With Honors.

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ABSTRACT

This paper explains on how to develop an efficient home security system using Zigbee. The security system is widely used in home, institution or organization or public utility places such as railway station, factory and educational sector to secure the important equipment or the safety of the place itself. However, some security systems were expensive, inappropriate and messy. So, this home security system will be created with a combination CuteDuino using Zigbee, which is wireless systems in the data transmission process. Zigbee model will be used in combination of CuteDuino and Zigbee as a head of the system. This paper used as a source and reference for the construction of low-cost but effective products. Other than that, as a role to achieve the objective which is able to design a home security system using Zigbee properly and to analyze the system design performance in term of detectable range and delay. Zigbee has been used in this project as a technology to send data from the transmitter to the receiver wirelessly. CuteDuino used to store and execute code as an assignment to Zigbee. In this project, 3 Zigbee is used, two Zigbee as a transmitter and a receiver. Receiver coupled to the Arduino UNO and connected by wire to a computer to show the output using Graphical Use Interface (GUI). The magnetic door sensor and motion sensor is used as the end device to detect the intruder. If the intruder bypass the motion sensor or open the door that has been attached with magnetic door sensor, the data will send to the transmitter and then transmit the data to the receiver wirelessly. After that, the data will be analyzed and trigger the buzzer. The Graphical Use Interface is used to appear the message “Motion detected”, “Door is Open” or both. This message will be displayed at the Personal Computer accordance with the buzzer alarm.

ABSTRAK

Papan kenyataan yang berasaskan Zigbee ini menerangkan cara untuk membangunkan system keselamatan rumah yang cekap menggunakan Zigbee modul. Papan kenyataan digunakan secara meluas di mana-mana institusi / organisasi atau tempat kemudahan awam seperti stesen kereta api, stesen bas, tempat pengiklanan awam, dan sektor pendidikan. Dalam projek ini, Zigbee modul akan digunakan dengan gabungan bersama CUTE DUINO dan Zigbee sebagai pengawal utama sistem. Kertas kerja ini memainkan peranan penting dalam membangunkan produk yang berkos rendah tetapi cekap. Selain daripada itu, sebagai peranan untuk mencapai objektif yang mampu untuk mereka bentuk sistem keselamatan rumah dengan menggunakan ZigBee dengan betul dan untuk menganalisa prestasi reka bentuk sistem dari segi jarak dan masa. Zigbee telah digunakan dalam projek sebagai satu teknologi untuk menghantar data dari transmitter kepada penerima secara tanpa wayar. CuteDuino digunakan untuk menyimpan dan melaksanakan kod sebagai satu tugas kepada Zigbee. Dalam projek ini juga 3 Zigbee digunakan, dua Zigbee sebagai transmitter dan satu Zigbee sebagai penerima. Penerima digabungkan kepada Arduino UNO dan disambung secara wayar kepada komputer untuk mengeluarkan keputusan menggunakan GUI.

DEDICATION

This thesis is dedicated to my parents and my supervisor who have supported me all the way since the beginning of my studies. Also, this thesis is dedicated to my friend who has been a great source of motivation and inspiration. Finally, this thesis is dedicated to all those who believe in the richness of learning.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

WPAN	-	Wireless Personal Area Networking
IrDA	-	The Infrared Data Association
LAN	-	Local Area Network
ISM	-	Industrial Scientific and Medical
MAC	-	Media Access Control
PHY	-	Physical
CSMA- CA	-	Carrier Sense Multiple Access with Collision Avoidance
AES	-	Advanced Encryption Standard
FIFO	-	First In And First Out
CCA	-	Clear Channel Assessment
ED	-	Energy Detection
PIB	-	Pan Information Base
GTS	-	Guaranteed Time Slot
IETF	-	The Internet Engineering Task Force
AODV	-	Ad hoc On Demand Distance Vector
FFD	-	The Full Function Device
RFD	-	The Reduced Function Device
τ	-	Torque

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter discusses the background, problem statement, objective, scope and the main technology that is used during the development of the project. All this main part and combine with some component was used to create a home security system. The main technology that will be highlighted is Zigbee.

1.2 Background

ZigBee is an established set of specifications for wireless personal area networking (WPAN). So, we can call wireless personal area networking as Zigbee. It provides for the devices that use low data rates, consume very low power and characterized by long battery life. ZigBee makes possible completed networked homes where all devices are able to communicate and be controlled by a single unit. The ZigBee Alliance, the standards body which defines ZigBee, also publishes application profiles that allow multiple OEM vendors to create interoperable products. The current list of application profiles, either published or in the works is:

- I. Home Automation(Home Security)
- II. ZigBee Smart Energy
- III. Telecommunication Applications

The relationship between IEEE 802.15.4 and ZigBee is similar to that between IEEE 802.11 and the Wi-Fi Alliance. For non-commercial purposes, the ZigBee specification is available free to the general public. An entry level membership in the ZigBee Alliance, called Adopter, costs US\$ 3500 annually and provides access to the as-yet unpublished specifications and permission to create products for market using the specifications. ZigBee is one of the global standards of communication protocol formulated by the relevant task force under the IEEE 802.15 working group. The fourth in the series, WPAN Low Rate/ZigBee is the newest and provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life. Other standards like Bluetooth and IrDA address high data rate applications such as voice, video and LAN communications.

ZigBee devices are actively limited to a through rate of 250Kbps, compared to Bluetooth's much larger pipeline of 1Mbps, operating on the 2.4 GHz ISM band, which is available throughout most of the world. In the consumer market ZigBee is being explored for everything from linking low-power household devices such as smoke alarms to a central housing control unit, to centralized light controls.

The specified maximum range of operation for ZigBee devices is 250 feet (76m), substantially further than that used by Bluetooth capable devices, although security concerns raised over "sniping" Bluetooth devices remotely, may prove to hold true for ZigBee devices as well. Due to its low power output, ZigBee devices can sustain themselves on a small battery for many months, or even years, making them ideal for install-and-forget purposes, such as most small household systems. Predictions of ZigBee installation for the future, most based on the explosive use of ZigBee in automated household tasks in China, look to a near future when upwards of sixty ZigBee devices may be found in an average American home, all communicating with one another freely and regulating common tasks seamlessly.

The ZigBee Alliance has been set up as “an association of companies working together to enable reliable, cost-effective, low-power, wirelessly networked, monitoring and control products based on an open global standard”. Once a manufacturer enrolls in this Alliance for a fee, he can have access to the standard and implement it in his products in the form of ZigBee chipsets that would be built into the end devices. Philips, Motorola, Intel, HP are all members of the Alliance. The goal is “to provide the consumer with ultimate flexibility, mobility, and ease of use by building wireless intelligence and capabilities into every day devices. ZigBee technology will be embedded in a wide range of products and applications across consumer, commercial, industrial and government markets worldwide. For the first time, companies will have a standards based wireless platform optimized for the unique needs of remote monitoring and control applications, including simplicity, reliability, lowcost and low-power”.

The target networks encompass a wide range of devices with low data rates in the Industrial Scientific and Medical (ISM) radio bands, with building-automation controls like intruder/fire alarms, thermostats and remote (wireless) switches, video/audio remote controls likely to be the most popular applications. So far sensor and control devices have been marketed as proprietary items for want of a standard. With the acceptance and implementation of ZigBee, interoperability will be enabled in multi-purpose, self-organizing mesh networks.

1.3 Problem Statement

A security system is needed to secure our property neither house nor car or the other else that is high value property. As the market for security systems expanded, the technology and resulting features available in home security systems has also skyrocketed. There are so many security system technology that have been creates but some of it is expensive or maybe complex, not compatible and not portable. If the technology too complex, probably it will influence the appearance – big and heavy weight. There are many security system that use high technology and it is simple, it use a sticky sensor to every metal such windows. The sensor transfers

electromagnetic wave along the metal, if an intruder touches the metal by hand or by metal the alarm will be triggered and alarm the house owner. But its same goes to the people inside the house, if the insider touches the metal the alarm also triggered and make a noise.

Other than that, the maintenance also expensive due to the high quality component is used. But, for me the quality can be maintained for a long period even though we use low quality component. Usually, electronics device or component has to make a maintainance twice a month for good result. But usually, people will not concern anymore about it after setup the device. So the electronic device will not be long lasting.

While use Zigbee, user still have to make maintenance, but if it disfunction we just need to change the component with cheap price. So, I choose Zigbee technology as home security systems because it is cheaper than the other technology.

1.4 Objectives

The objectives of this project are:

1. To design a home security system using Zigbee.
2. To analyze the system design in term of detectable range and delay.

1.5 Scope

We can use Zigbee for many purposes that relate to security control. In industries, there are many harmful situations can be happen.

The project work scope are:

1. MC 38 Wired Door Window Sensor Magnetic is used as door sensor and Passive Infrared (PIR) motion sensor. It is connected to Arduino UNO which is directly connected to CuteDuino.
2. The data will be transmitted by Zigbee to trigger the alarm to avoid any adverse condition occur.
3. Another component that uses this system are a pair of Zigbee modules, Arduino UNO, Zigbee Shield, CuteDuino, Arduino compatible wireless Zigbee shield and Mini/Micro USB-B cable.
4. This project also uses X-CTU, Arduino IDE and Processor IDE for the software part.

1.6 Project Significant

Home Security System using Zigbee is designed to secure residents in the house while all the resident is napping or sleeping. Apart from that, this project can also be used in the buildings and factories to prevent intruders or strangers entered without permission. With specifications Zigbee that save energy, this project would last up to one year duration. Apart from that, with only a few Zigbee technologies is able to control the entire home or can become even home automation system apart from the home security system. In addition, even Zigbee is little bit costing it has many but the technology used is great. With that specification, it can be considered cheap and affordable.

1.7 Conclusion

This research will be used to create the new home security system using wireless systems. This makes the space more organized and neatly applied. By simply using a wireless system, it will send data to the receiver when the system is disturbed or triggered. This system is very useful for users who want high technology but neat. Other than that, this project will be created with low cost, glad created and used, and portable to carry everywhere for connection elsewhere.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter explains the overview of Zigbee technology, CuteDuino, various types of switching component and the component involved in the implementation of the Home Security System. The Zigbee technology represents the main technology that is used for transmitting(tx) and receiving(rx) data through wireless. The sensor device is discussed to select of the suitable component to use and it is accurate in board developing. As long as Zigbee is made to suit with any sensor device, so all sensors are suitable.

2.2 Overview of Zigbee technology

Zigbee is a based wireless technology designed to address the unique needs of low-cost, low power usage and simple but efficient. Zigbee is using 802.15.4 standard, which specifies the physical layer and media access control (MAC) for low rate wireless personal area network. The implication of low power usage and low output power, Zigbee can sustain it self for a month or even years, make it ideal to install and forget purpose [1].

Zigbee has three typical traffic types. IEEE 802.15.4 can accommodate all those types.

- I. Data is periodically activated. The system that uses Zigbee dictates the rate, trigger the sensor to activate, check for data and deactivates it back.
- II. Data intermittently transfer and then enable optimum saving on energy. The device needs to connect to the network only when communication is necessitated.
- III. Data is also repetitive and the rate is fixed a prior. Depending on allotted time slots, devices operate for fixed durations.

Zigbee has two modes to enable the to and fro data traffic, which is beacon and non-beacon. Beacon is used when the main system runs on batteries and offers maximum power savings. In beacon mode, the system refers to the coordinator's beacon that gets transmitted at periodically, locks and looks for messages addressed to it. After the message is transmitted, the coordinator dictates a schedule for the next beacon so that the device goes to sleep mode.

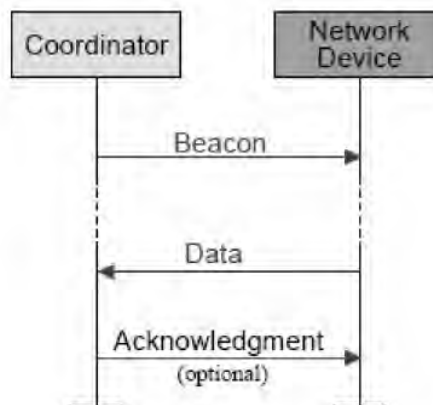


Figure 2.0: Beacon Network Communication

The non-beacon mode will be included in a system where devices are in sleep mode continuously such as smoke detectors and burglar alarms. The devices active and confirm its presence in the network at random time.