



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

THE SMART DOOR LOCK SYSTEM

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Computer Engineering Technology (Computer System) (Hons.)

by

MUHAMMAD RAZIF BIN MD DALLI

B071110353

880324045597

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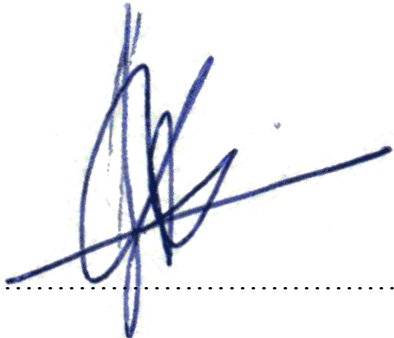
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DECLARATION

I hereby, declared this report entitled “The Smart Door Lock System” is the results of my own research except as cited in references.

Signature : 

Author's Name : MUHAMMAD RAZIF BIN MD DALI

Date : 14 January 2015

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Computer Engineering Technology (Computer System) (Hons.). The member of the supervisory is as follow:

.....
MRS. NORFADZLIA BINTI MOHD YUSOF
(Project Supervisor)

.....
MISS. ROSZIANA BINTI HASHIM
(Co-Supervisor)

ABSTRAK

Sistem Pengunci Pintu Pintar telah direka menggunakan mikrokomputer yang kecil dengan menggunakan keupayaan Raspberry Pi dan Aplikasi Android digunakan untuk mengawal Pengunci Pintu dari jarak jauh yang menghubungkan dengan komputer mikro yang kecil melalui Internet. Sistem Pengunci Pintu Pintar boleh mengawal dimana-mana sahaja dan ia kecil , mudah untuk dikawalan , tanpa wayar dan harga yang berpatutan. Pembangunan ini telah dilakukan dengan menggunakan Java Eclipse JUDO , Raspbian dan pengaturcaraan Python.

ABSTRACT

The Smart Door Lock System was designed utilizing small microcomputer, Raspberry Pi capabilities and An Android application that used to remotely control the Door Lock that connected to the small microcomputer via the Internet. This Door Lock System can be control anywhere and it's typically small, easy to control, wireless and affordable. Development was done using Java Eclipse JUDO, Raspbian and the python programming.

DEDICATION

I want to dedicate this to my parents who have supported me through all the journey and have been a great source of motivation and inspiration.

ACKNOWLEDGEMENT

Above and before all I thank ALLAH S.W.T, the creator and Sustainer of the Universe for giving me ability to completed my Final Year Project successfully.

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LIST OF ABBREVIATIONS

	Abbreviation
Raspberry Pi	Rasp
Secure Shell	SSH
Wireless Local Area Network	WLAN
Applications	Apps
Local Area Wireless Technology	Wi-Fi
General-purpose input/output	GPIO
Light-Emitting Diode	LED
Internet Protocol Address	I.P Address
Correlation System Analyzer	CSA
Open Graphics Library	OpenGL
Integrated Development Environment	IDE
System Development Kit	SDK
User Interface	UI

CHAPTER 1

INTRODUCTION

1.0 Background

Today, human have risen up their living standard due to the rapid economic expansion and the development of modern automation technology. The most automation technology that had become human interest is the door lock technologies which can help to enhance the quality of life. In order to implement these technologies, a project of The Smart Door Lock System is proposed with the benefits of convenient, comfortable, and high efficient life.

Despite, the new and exciting opportunities to increase the connectivity of devices within the home for the purpose of home automation remain largely unexploited. There were a huge number of projects that had proposed using different types of connectivity such as Bluetooth, ZigBee and GSM. However, the primary objectives of this project are expected to be enriched of the distance communication between mobile applications to the remote door lock. Therefore, this project used an internet connection to control the door lock with the ideal mobile devices in providing a user interface for a home automation system, due to their portability and their wide range of capabilities which it can be control the door lock in anywhere.

In this project prototype, a door lock system, which provides an alternative user friendly interface of an Android application, is presented. The system is built to serve multiple users, using high-end and emerging technologies in order to support the

communication between the main hardware components of the system. This system will use an authentication mechanism in Android application before it's connected to the Raspberry Pi before allows user to remotely control the door lock system.

Besides, this project is use Raspberry Pi (microcomputer) as brain of the hardware components. It will analysis and interpret signal in and out. Raspberry Pi will connect to the home router using Wi-Fi dongle and it will connect to the internet directly. This architecture reduces the amount of physical wiring required and hence the intrusiveness of the installation, through the use of wireless technology. This project will be design to be simple smart lock that fits directly on the back of our door.

Furthermore, controlling the door locking system might only available on the high-end system only and off course it is very expensive. In this project of the "Smart Door Lock System" offers the simplest yet cost efficient in build the door's lock by using the smart phone together with small Raspberry Pi microcomputer with an additional feature in this system which allowed user to give a grant access to his/her friends, family and guest through the app (Juing-Huei Su, Chyi-Shyong Lee, and Wei-Chen Wu, 2009).

This project will give a huge impact to the market because of the cheapest and effectiveness of door locking system that been offered.

1.1 Problem Statements

- a) The Door Locking System that exists in the market is very expensive.
- b) We have been carrying keys for a long time, and they are sharp pieces of metal in our pockets and it make us to feel uncomfortable when we carry it on.
- c) Door keys easily can get lost.
- d) Wasting time search for the right key.

1.2 Project Goal(s)

The goal of this project is to develop a system that can assist to lock and unlock the door by using the smartphones. By incorporating the use of a smartphone, the inconvenience of using a key was eliminated. With just a tap on the smartphone, the locking mechanism in the door can be activated or deactivated. In other hand, this project involved the development of an application on an Android platform which is used to remotely control the small microcomputer Raspberry Pi. An authentication is use in the system to help increasing the system security and allowed only the primitive user to get access toward the system.

1.3 Project Objective

The objectives of this project are:

- a) To develop an electronic based project that could act as a tool that able to assist users to unlock and lock their door.
- b) To build an Android application which use as phone based remote controller.
- c) To provides a secure apps by having an authentication mechanism.

1.4 Project Scope(s)

The scopes of this project are:

- a) Build a door lock system using Raspberry Pi (microcomputer).
- b) The system uses the internet as the network infrastructure.
- c) The system only can be applied on the single door only.

1.5 Project limitation(s)

- a) The system may become useless if both the smartphones and the Raspberry Pi microcomputer are disconnected from the internet.
- b) The system will not functional if there is no powers supply on the Microcomputer Raspberry Pi.
- c) The system only can operate on an Android mobile operating system.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

There are many definitions of home automation available in the literature. (Alexandru-Corneliu Olteanu, George-Daniel Oprina, Nicolae pu and Sven Zeisberg, 2013) Stated that a home automation system is a collection of interconnected devices for controlling various functions within a house and provides complex functionalities, such as energy management, consumption reports, setting up profiles and schedules, and remote control over several key devices. No matter what, home automation system help to increase life efficiency. One of the area people had put interest on the door lock system. There are huge numbers of projects of door lock system and home automation system that had proposed used with difference type of communication technologies between the phone based remote control and the hardware component such as Bluetooth, Zigbee, and Wi-Fi-internet. The differences these communication technologies will discuss in this chapter.

Besides, this chapter will discussed more on the hardware component that will be used and how it can be implemented in this project. Why these projects propose to use Raspberry Pi rather than having Arduino Uno as main processor component? The questions will be answer in this chapter.

In this chapter discussed about the communication technologies between mobile and system design and implementation, comparisons with existing research and diagram related to the door lock system.

2.1 Home Automation System

The most importance element in the home automation is the communication method used to communicate or to remotely control the main device in house. There a two method to approach this communication which is use wired or wireless. Although, the wired home network were famous at the early of developments of home automation system, nowadays wireless communication is replacing the wired system which are requires proper planning and constructions works for efficient and clean design. Therefore, this project proposes to use wireless connection to communicate but in the wireless there a few choices can be made such as Zigbee, Bluetooth and Wifi-Internet.

2.1.1 Home Automation System with Zigbee

One of the methods is using Zigbee communication. Zigbee , a newly developing protocols for wireless sensor networks based on the IEEE 802.15.4 specification, has become the most attraction technique in research and commercial domain because of open standard, low cost and low power characteristic (Devi, August 2012). Zigbee has its own benefit which it is suitable for system environments that demand on less power consumption and lower data-rates requirement.

Zigbee has been widely used in sensor network applications and recently, it is also been used in home automation systems (Devi, August 2012). Although the Zigbee based home automation system is in the early development phase and it only works on the limited distance, most of the project using Zigbee only focuses primarily on home automation within in the house only. This limited interaction capabilities should be neglected.

2.1.2 Home Automation System with Bluetooth

Bluetooth communication is much better than Zigbee in term of the communication distance with the range of 10 m (N. Sriskanthan, F. Tan and A. Karande, 2002). Using

a Bluetooth as based home automation system consisting of a primary controller and a number of Bluetooth sub-controller. In other word, each home device is physically connected to a local Bluetooth sub-controller. Bluetooth has a medium bandwidth, and it is used on the IEEE 802.15.1. Bluetooth technology has the disadvantage of incurring an access delay due to the sharing of a single Bluetooth module between numerous devices.

2.1.3 Home Automation System with Wi-Fi-internet

Wireless system like WLAN has become more and more common in home networking. The use of wireless technologies gives several advantages that could not be achieved by other communication. It reduced installation costs and it's come with the ideal of the integration of mobile devices such PDAs and smartphones with the automation system becomes possible everywhere and at any time.

This project proposed has to use smartphone which give a great flexibility by using Wi-Fi technology to interconnect its distributed modules to home automation server (Ahmed ElShafee, Karim Alla Hamed, August 2012). That will decrease the deployment cost and will insure to increase the ability of upgrading, and system reconfiguration. Using Wi-Fi internet use of secure wireless LAN connections between distributed hardware modules and server, and secure communication protocols between users and server. The Wi-Fi protocol use (IEEE 802.11a/b/g) which can communicate with other devices more longer distance compare to other technologies.

According to (Manasee Patil, S.R.N Reddy, July 2013), wireless communication technologies were expected to be widely employed in the near future in intelligent. It was evident that wireless communication technologies widely used in automation, aviation, construction and etc. the researchers encouraged people to build project using Wi-Fi because of its advantages.

Figure 2.1 show the priority standards of different wireless network with radar graph cited from research paper (Manasee Patil, S.R.N Reddy, July 2013).

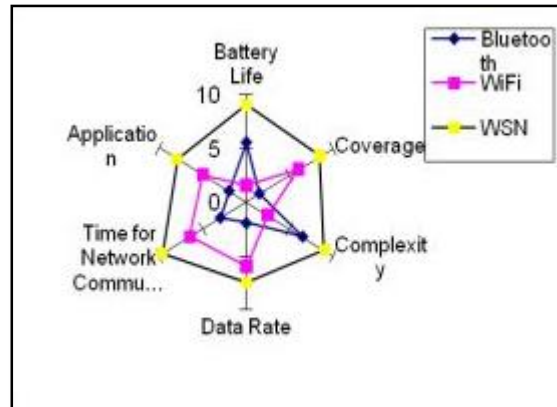


Figure 2.1 Priority of standards of different wireless networks with radar graph

In their paper (Bhavneet Sidhu, Hardeep Singh, and Amit Chhabra, 2010) told about the benefit of using WiFi-internet connection communication. The researchers mention about the emerging of data transmission system computing devices using radio waves which has change they came products using 802.11b and it could move data up to 11 Mbps then shortly after that 802.11g came out with maximum speeds of 54 Mbps and throughput of around 25 Mbps. This is the advantages for this project if use Wi-Fi internet as the communication technology to communicate the hardware and the mobile devices having high rate of data transmitting and reduce the complexity.

Table 2.1: Comparison of Wireless Communication Technologies

	ZigBee IEEE 802.15.4	WiFi IEEE 802.11a/b/g	Bluetooth IEEE 802.15.1
Bandwidth	250 Kbps	54 Mbps	1 Mbps
Range	10-100 meters	50-300 meters	10 meters
Topology	ad-hoc, star or mesh	point to access point	ad-hoc, small networks
Frequency	868 MHz (Europe) 900-928 MHz (NA) 2.4 GHz (world)	2.4 and 5 GHz	2.4 GHz
Coexistence	dynamic freq. selection	dynamic freq. selection	adaptive freq. hopping

Power	25mA TX, 27mA RX, standby 3uA	219mA TX, 217 mA RX, standby 20mA	57mA TX, 47mA RX, standby 0.2mA
Typical apps	industrial control sensor networks	Internet access	headsets, file transfer

This comparison takes into consideration key requirements in wireless communication between the mobile device and the hardware component, such as the high data transferring and the high frequency. Besides, using Wi-Fi-internet connection can reduce the complexity and expensive architecture; generally it can incorporate with the modern device for the purpose of network management and provision of remote access. Furthermore, having other communication required of high skill of installation and by using Wi-Fi-internet it can reduce the intrusive installation. We only need to configure the modern and a few basic installations which make this communication is much more easier compare to other. Zigbee is not suitable for home automation networks due to its low power consumption and expensive implementation costs. Bluetooth also does not fit as it was designed for a high data rate communication, and due to additional implementation expenses caused by the licensed frequency band in which it operates. it could be a feasible choice, but does not comply with a wide spread home automation network.

2.2 Raspberry Pi

Raspberry Pi is a minicomputer and the most inspiring minicomputer that available today and it was the first cheap single board computer that easy enough to use for the general purpose (Sean McManus and Mike Cook, June 2013). It comes with the Linux operating system and together with the Phyton programming language. Phyton is an interpreted language, which means that the code or script will execute it directly rather than compiling it into a machine code then only the machine can analyzed the output of the code. Not only that, Raspberry Pi comes with the GPIO pins which use for a general inputs/outputs port. It comes with 26 pins and each pin has its own functional. The beneficial of it had comes the idea to make the home automation system using Raspberry Pi.

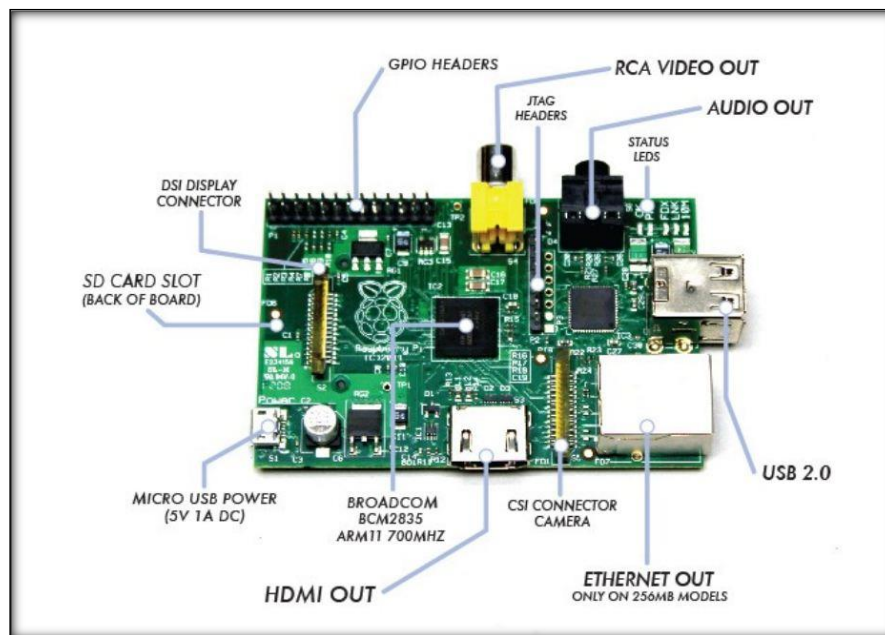


Figure 2.2 Show the picture of Raspberry Pi and its specifications