



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

HOME APPLIANCES WEB SWITCH CONTROL WIRELESSLY USING SMARTPHONE

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

by

EU HUE LING

B071210247

921107-10-5328

FACULTY OF ENGINEERING TECHNOLOGY

2015

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Home Appliances Web Switch Control Wirelessly Using Smartphone**

SESI PENGAJIAN: **2015/16 Semester 1**

Saya **EU HUE LING**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. ****Sila tandakan (✓)**

SULIT

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

TERHAD

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)

TIDAK TERHAD

Disahkan oleh:

Alamat Tetap:

Cop Rasmi:

Tarikh: _____

Tarikh: _____

**** Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.**

DECLARATION

I hereby, declare that this thesis entitled “Home Appliances web switch using Arduino” is the result of my own research except as cited in references.

Signature :

Name :

Date :

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Engineering Technology (Type your department's name here) (Hons.). The member of the supervisory is as follow:

.....

(Project Supervisor)

ABSTRACT

Home appliance web switch is a design used to control the home appliances in a house by using Arduino Uno with a smartphone. The design and implementation of home appliances web switch is presented for the Bachelor Degree Final Year Project. This project is to introduce a low cost home appliances web switch by using Arduino. Arduino is a very famous electronic hardware in sensor or controlling so this project is using Arduino Uno. This project can be easily produced because it is based on web, which today has the largest internet base. The home appliances are controlling by the web browser in smartphone which the users can control them no matter where there are; as long as the smartphone is connected to the internet. This project is to improve the quality of life and also the technology used in a house.

ABSTRAK

Web suis peralatan rumah adalah reka bentuk yang digunakan untuk mengawal peralatan rumah dengan menggunakan Arduino Uno dan juga telefon bimbit. Reka bentuk dan penghasilan web suis peralatan rumah akan dibentangkan dalam Projek Tahun Akhir Sarjana Muda. Projek ini adalah untuk memperkenalkan web suis peralatan rumah yang berkos rendah dengan menggunakan Arduino Uno. Arduino adalah salah satu perkakasan elektronik yang sangat terkenal untuk sensor atau pengawalan, oleh itu projek ini menggunakan Arduino Uno. Projek ini berdasarkan web kerana pada masa kini internet mudah diasas. Peralatan rumah boleh dikawal dimana-mana sahaja oleh pengguna dengan menggunakan web suis dalam telefon bimbit; selagi telefon bimbit itu disambungkan dengan internet. Projek ini adalah dihasilkan untuk meningkatkan kualiti hidup dan juga teknologi yang digunakan dalam rumah.

DEDICATIONS

To my beloved parents,

Eu Wen Liang and Liew Chiew Ping

for raising me become who I am today.

ACKNOWLEDGEMENT

Firstly, I would like to express my deepest appreciation to all those who helped and encourage me to complete my project. I would like to take this opportunity to thanks my final year project's supervisor, Win Adiyansyah Indra and senior lecturer, Dr. Abdul Kadir who are from Electronics and Computer Engineering Technology Department in UTeM. Both of my lecturers guided me a lot in my project for two semesters session 2015/2016. Thanks to their contribution in stimulating suggestions, encouragement, support, patience and helped me to coordinate my project in hardware, software and report writing of my project. I have learnt a lot of knowledge and information from both of my lectures.

Furthermore, special thanks goes to my parents, family, aunty and others for their encouragement, opinions, motivation, fully support in my completion of project from beginning until the end. I would like to acknowledge with much appreciation to all of my friends and everyone that had been helping and supporting me during the progress of my final year project.

Last but not least, I would like to thanks to University Technology Malaysia Melaka (UTeM) for giving me this opportunity in completing my final year project.

TABLE OF CONTENTS

DECLARATION	i
APPROVAL	ii
ABSTRACT.....	iii
ABSTRAK.....	iv
DEDICATIONS.....	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS.....	vi
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF SYMBOLS AND ABBREVIATIONS.....	xii
CHAPTER 1: INTRODUCTION.....	1
1.1 Introduction	1
1.2 Background.....	1
1.3 Problem Statement.....	2
1.4 Objectives	2
1.5 Scope	3
1.6 Project Significance.....	3
1.7 Conclusion.....	4
CHAPTER 2: LITERATURE REVIEW.....	5

2.1 Home Automation or Smart Home.....	5
2.2 Electronic Hardware.....	8
2.2.1 Arduino and Arduino Uno.....	8
2.2.2 Arduino Ethernet.....	14
2.3 Arduino Ethernet Shield Web Server.....	16
2.4 Methods of Controlling Home Appliances.....	16
2.4.1 Home Appliances controlled by GSM.....	17
2.4.2 Home Appliances controlled by Remote Control.....	21
2.4.3 Home Appliances controlled by Bluetooth.....	22
2.4.4 Home Appliances controlled by ZigBee.....	22
2.4.5 Home Appliances controlled by Wi-Fi.....	24
2.4.6 Comparison between ZigBee with Other Wireless Technologies.....	24
CHAPTER 3: METHODOLOGY.....	27
3.1 Introduction.....	27
3.2 Gantt chart.....	28
3.3 Project Planning.....	30
3.3.1 Method and Process.....	31
CHAPTER 4: RESULTS AND DISCUSSION.....	32
4.1 Introduction.....	32
4.2 Schematic Diagram.....	32

4.3 Home Appliances Web Switch Hardware and Software Design	33
4.3.1 System Implementation	34
4.4 Result.....	37
4.4.1 LED.....	40
4.4.2 Fan	42
4.4.3 Door.....	43
4.4.4 Gate.....	44
4.5 Discussion.....	45
CHAPTER 5: CONCLUSION & FUTURE WORK.....	46
5.1 Introduction	46
5.2 Summary of Project.....	46
5.3 Achievement of Research Objectives.....	46
5.4 Suggestion for Future Work	47
APPENDIX A	49
APPENDIX B	57
REFERENCES.....	63

LIST OF TABLES

Table 2.2.3: Summary of Arduino Uno	12
Table 2.2.4: Comparison of Arduino Uno and Arduino Mega Capabilities	13
Table 2.4.4: Voice Command and its related SMS Command	20
Table 2.4.7: Differences between Remote Control and GSM based SMS Control	21
Table 2.4.9: Comparison between ZigBee with Other Wireless Technologies	25
Table 2.4.10: Comparison between different wireless technologies	26
Table 3.2.1: Project Plans for Bachelor Degree Project PSM 1	28
Table 3.2.2: Project Plans for Bachelor Degree Project PSM 2	29

LIST OF FIGURES

Figure 2.2.1.: Schematic Arduino Uno Front.....	11
Figure 2.2.2: Arduino Uno R3 Back.....	11
Figure 2.2.5: Arduino Ethernet Shield R3 Front.....	15
Figure 2.2.6: Arduino Ethernet Shield R3 Back.....	15
Figure 2.4.1: Various methods of controlling home appliances.....	17
Figure 2.4.2: System Architecture.....	18
Figure 2.4.3: System Architecture.....	18
Figure 2.4.5: System Overview.....	20
Figure 2.4.6: System Overview.....	21
Figure 2.4.8: Block diagram of Zigbee based home appliance controller.....	23
Figure 3.3.1: Project Planning Flowchart.....	30
Figure 4.2.1: Schematic diagram.....	32
Figure 4.3.1: Implementation of Circuit.....	33
Figure 4.3.2: Implementation of HTML language.....	34
Figure 4.3.3: IP address of Arduino.....	35
Figure 4.3.4: Typing of IP address in Arduino coding.....	35
Figure 4.3.5: TM setting web page.....	36
Figure 4.3.6: Port Forwarding.....	36
Figure 4.3.7: Windows Firewall with Advances Security.....	37
Figure 4.4.1: Error Image (Before).....	37
Figure 4.4.2: Successful In Loading Image (After).....	38
Figure 4.4.3: Error Page (Before).....	38
Figure 4.4.4: Successful in loading page (After).....	39

Figure 4.4.5: Completed House	39
Figure 4.4.6: Requested Character on Serial Monitor	40
Figure 4.4.7: “ON” conditions of LED	40
Figure 4.4.8: URL for “ON” state.....	41
Figure 4.4.9: URL for “OFF” state	41
Figure 4.4.10: “ON” conditions of fan.....	42
Figure 4.4.11: URL for “ON” state.....	42
Figure 4.4.12: URL for “OFF” state	42
Figure 4.4.13: “OPEN” conditions of door.....	43
Figure 4.4.14: URL for “OPEN” state	43
Figure 4.4.15: URL for “CLOSE” state.....	43
Figure 4.4.16: “OPEN” conditions of gate	44
Figure 4.4.17: URL for “OPEN” state	44
Figure 4.4.18: URL for “CLOSE” state.....	44

LIST OF SYMBOLS AND ABBREVIATIONS

AC	=	Alternate Current
AES	=	Advanced Encryption Standard
DC	=	Direct Current
EDGE	=	Enhances Data GSM Environment
EGPRS	=	Enhanced General Packet Radio Services
EEPROM	=	Electrically Erasable Programmable Read-Only Memory
ETSI	=	European Telecommunications Standard Institute
GND	=	Ground
GPRS	=	General Packet Radio Services
GSM	=	Global System for Mobile Communications
HTML	=	Hypertext Markup Language
HTTP	=	Hypertext Transfer Protocol
IC	=	Integrated Circuit
ICSP	=	In-Circuit Serial Programming
IEEE	=	Institute of Electrical and Electronics Engineers
I/O	=	Input/ Output
IP	=	Internet Protocol
IR	=	Infrared Radiation
LAN	=	Local Area Network
LED	=	Light-emitting diode
LDC	=	Liquid Crystal

LTE	=	Long Term Evolution
M2M	=	Machine to Machine
PC	=	Personal Computer
PDA	=	Personal Digital Assistant
PWM	=	Pulse Width Modulation
RFID	=	Radio-Frequency Identification
RX/ TX	=	Receive/ Transmit
SD card	=	Secure Digital Card
SMS	=	Short Message Service
SRAM	=	Static Random-Access Memory
TM	=	Telekom Malaysia
TM	=	Television
USB	=	Universal Serial Bus
WAN	=	Wide Area Network
WI-FI	=	Wireless Fidelity
WWW	=	World Wide Web
1G	=	First Generation
2G	=	Second Generation

CHAPTER 1

INTRODUCTION

1.1 Introduction

In this chapter, the topics covered are the background of the project title, problem statements faced, project's objectives, work scopes, project significant and lastly the conclusion of this project.

1.2 Background

“A home appliance web switch”, everyone is wondering how to control the home appliances easily using Internet. Home appliances web switch is a product that used to control the home appliances without the home owner's direct intervention. Home appliances are electrical or mechanical which has its own function. While for the web switch which is a switch used to control something by using the web server, it is assigned with multiple functionalities in respective buttons on a web page. Although it is not a new concept in today's world, it is used to provide convenience for user. Nowadays, most of the home owners are still controlling their home appliances manually or normal remote so this project is implemented to upgrade the technologies recently. Since the web-based interfaces is low in cost, so they can provide the infrastructure for the design of simple and more user-friendly interfaces for household appliances.

Besides that, a web page interface is much easier to modify as compared to a hardware interface. This project is not only inexpensive but also a flexible home control by using web browser with IP connectivity for accessing and controlling appliances wirelessly using web browser. It is designed to improve the technologies used in a house by using smartphone. The advantage of web switch is it can be

switched from any distance no matter where the house owner is, as long as it is connected to internet.

This project is using Arduino UNO Board with Arduino Ethernet Shield to give Internet connection so that the home appliances can be controlled by using the web page. The design of this project is which is stacking the shields on an Arduino and the simulation is done in the Arduino software to control the relay board. Through relay board this project can switch on and off the fan, light, gate and door of a house by using smartphone. The homeowners are able to control the home appliances with the help of smartphone that is connected to the Internet.

1.3 Problem Statement

Most of engineer today tried hard to make an improvement in switching on and off their home appliances. This project is needed to improve the technology used in a house and solve the problem encountered by the homeowners. The problems faced by the homeowners are sometimes they forget to turn off the lights and have to bring a lot of keys when they go out for a vacation. Besides that, when there is elderly and disable people staying in a double storey house, it is difficult for them to walk to upstairs to switch on and off any appliances. As a solution, a home appliances web switch using Arduino is designed in this project by using smartphone to control them. There is a lot of research needed to do to make a better performance in this project.

1.4 Objectives

The main objectives of this research are deeply concentrated on aspect as listed below:

- i. To design a web switch which controlled by using smartphone for convenience, reducing the wastage of electricity and making a better performance by using Arduino UNO.

- ii. To study the advantages of using Arduino in controlling the home appliances.
- iii. To implement communication between smartphone and home appliances.

1.5 Scope

Based on the problems above, there are some solutions to improve in switching on and off of home appliances. There are some scopes is limited on this projects based on the objectives. This project consists of hardware and software which the coding in the software will be load into the hardware. In this project, the software used is Arduino software and Microsoft Expression Web software while the hardware used are Arduino UNO, Ethernet shield, and sample house. Besides that, the home appliances are control wirelessly but the hardware are connected to a LAN cable so that the household can control the home appliances by using web browser via their smartphone. The internet connection is required for the connection in the hardware and also the smartphone itself. The home appliances that are being controlled in this project are fan, light, door and gate by clicking “ON” or “OFF” and “OPEN” or “CLOSE”.

1.6 Project Significance

The impact of this project is it will give convenience to the house owner so that they no need bring a lot of keys when go out for a vacation or when they forget to switch off the home appliances. They just need to use their smartphone to control the home appliances using fingertips. Besides that, the home appliance web switch can help to reduce the wastage of electricity on our earth. Lastly, this web switch also help to improve the technology used in a house.

1.7 Conclusion

In a nutshell, this project introduced the design and implementation of a low cost home appliances web switch by using Arduino. As we know Arduino is a very famous electronic hardware in sensor or controlling so this project is using Arduino. This project can be easily produced because it is based on web, which today has the largest internet base. By improving the technology used in a house and a smartphone with Internet connection, the home appliances can be easily controlled by homeowner.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, the characteristics and some information of the electronic hardware are also discussed in this chapter. The researches topics of project topic that had reviewed are home automation or smart home, electronic hardware, and methods of control home appliances.

2.2 Home Automation or Smart Home

Home automation can also be called as smart home. Home automation or smart home is a house which the house's electrical appliances are controlled automatically by multiple types of technology. Faisal Baig et al. (2012) defines that home automation is not a new concept in today's world, it is used to provide convenience for user to remotely control and monitor the appliances and it provides a better use of electricity. The efficient use of electricity makes the home automation to play an important role in daily life. As by the growth of PC (personal computers), internet, mobile phone and wireless technology makes it easy for a user to remotely access and controls the appliances. Faisal Baig et al. (2012) also mention that a lot of research has been done and many solutions have been proposed to remotely access the home appliances. Some of them used internet, wireless technology to communicate and control home appliances, others used Bluetooth and GSM technology for controlling the home appliances.

According to Piyare and Rajeev (2013), mention that home automation or smart homes can be described as introduction of technology within the home environment to provide convenience, comfort, security and energy efficiency to its

occupants. Adding intelligence to home environment can provide increased quality of life for the elderly and disabled people who might otherwise require caregivers or institutional care. In the research of Piyare and Rajeev (2013), there has been a significant increase in home automation in recent years due to higher affordability and advancement in Smart phones and tablets which allows vast connectivity. With the introduction of the Internet of things, the research and implementation of home automation are getting more popular. Much of the research attention has been given in academia. Various wireless technologies that can support some form of remote data transfer, sensing and control such as Bluetooth, Wi-Fi, RFID, and cellular networks have been utilized to embed various levels of intelligence in the home.

Mohamed Abd El-Latif Mowad et al. (2014) explain that smart home is an emerging concept that attracts the synergy of several areas of science and engineering. A lot of research has been going on for more than a decade now in order to increase the power efficiency at the consumer level of the power management systems. Smart Home is the term commonly used to define a residence that integrates technology and services through home networking to enhance power efficiency and improve the quality of living which is also discussed in this research. Smart house is not a new term for science society but is still far more away from people's vision and audition. This is because although recent various works has been done in designing the general overview of the possible remote access approaches for controlling devices or in cases simulating the smart house itself and designing the main server the design and implementation of an off-the-shelf smart house remote control application has been limited to simply the computer applications and just in cases mobile and web applications development.

Besides that, Mohamed Abd El-Latif Mowad et al. (2014) also mention that the "Smart house" technology is one realization of home automation ideals using a specific set of technologies. It's a house that has highly advanced automatic systems for lighting, temperature control, security, appliances, and many other functions. Coded signals are sent through the home's wiring to switches and outlets that are programmed to operate appliances and electronic devices in every part of the house. Smart home appears "intelligent" because its computer systems can monitor many aspects of daily living. Smart house can also provide a remote interface to home appliances or the automation system itself, via telephone line, wireless trans-mission

or the internet and android application, to provide control and monitoring via a smart phone or web browser (Mohamed Abd El-Latif Mowad et al, 2014). The growing numbers of elderly population and increasing life expectancy have brought enormous challenges to many aspects of human life, especially in health and healthcare. Home automation becomes more advantageous for safety, security. An embedded board physically connected all home automation devices and through integration with a personal computer (PC) based web server, provided remote access to the system.

Home automation is combination of computer or microcontroller and information technology to control the home appliance (Manish Kumar and Ramandeep singh, 2014). System can control through computer or other embedded system by using intelligence of system and automation. It is made for several reasons of energy efficiency, security and ease. In this era construction of industries and homes contains the wiring for telephones, TV outlets, electrical power, broadband wire, a doorbell and door lock. Special appliance is developed to automation in home automation. Many appliance are made to reduce the manual labor for example washing machine is were developed for reducing the manual labor for clothes cleaning and for bathing the water heaters also reduced the necessary labor.

Furthermore, Manish Kumar and Ramandeep singh (2014) conclude that the numbers of electrical devices are increasing day by day so interconnection of device and communication within device is very useful between appliance and communication between them is very likable feature. For example, an air conditioner will send a message on owner's phone when it require for cleaning, or an air cooler when it require its service. The embedded system is work as virtual intelligent system in which doors will become "Intelligent" and it will send signals to the microcontroller when someone entered. If alarm system is set and no one is in the home, the system either call or SMS to the owner or the saved neighbor's number or an emergency number (Manish Kumar and Ramandeep singh, 2014).

Rifat Shahriyar et al. (2008) defines that smart home is a home equipped with special facilities to enable occupants to control or program an array of automated home electronic devices. For example, a homeowner on vacation can arm a home security system, control temperature gauges, switch appliances on or off, control lighting, program a home theater or entertainment system, and perform many other

tasks. Smart home became smarter if the controlling can be done from any remote place.

As stated by Chesti Altaff Hussain et al. (2013), smart home is one of these types of system equipped with home appliances which we wish to control home appliances smartly from anywhere. Some products are commercially available which allow remote home appliance controlling through internet which is undoubtedly emerging. But it lacks the true sense of real mobility and security, making the remote home appliance controlling a limited term than it is supposed to be. In search of a true remote and adequately secure solution to be really effective and practicable, mobile telephony is better than any other solutions.

Home or office automation is the control of any or all electrical devices in our home or office, whether we are there or away which is explained by (Hari Charan Tadimeti and Manas Pulipati, 2013). Home or office automation is one of the most exciting developments in technology for the home that has come along in decades. There are hundreds of products available today that allow us control over the devices automatically, either by remote control or even by voice command.

As from all the researches above, the definition of smart home or home automation are the same. They can be concluded is which the home appliances are controlled automatically by using smart phone or any devices in a house. They provide convenience, comfort for house owner and also reduce wastage of electricity in a house.

2.3 Electronic Hardware

2.3.1 Arduino and Arduino Uno

Nowadays, Arduino is getting more famous because it can control a lot of things like robots, machines and even home appliances. There are many types of Arduino but the most famous is Arduino Uno. Gordon McComb (2013) identify that the Arduino hardware is complete circuit board, consisting of a microcontroller