



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DEVELOPMENT OF SMART HOME AUTOMATION SYSTEM  
USING WI-FI**

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

by

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## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

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## **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's of Electronics Engineering Technology (Telecommunication) with Honours. The members of the supervisor committee are as follow:

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**ENCIK MOHD FAIZAL BIN ZULKIFLI**

.....

**ENCIK AHMAD SAYUTHI BIN MOHAMMAD SHOKRI**

## ABSTRAK

Sistem automasi rumah pintar adalah idea wujud sejak awal abad ke-20 dan ia semakin popular sejak 5 tahun yang lalu. Sistem ini boleh digunakan untuk mengawal peralatan elektrik rumah dengan menghantar arahan tertentu kepada mikrokontroler. Sebelum ini, Bluetooth adalah medium yang paling popular yang digunakan untuk isyarat untuk mengalir dari pengguna ke mikropengawal. Bagaimanapun liputan Bluetooth adalah terhad; Sistem automasi rumah pintar menggunakan Wi-Fi semakin popular kerana liputannya lebih luas daripada Bluetooth. Projek ini dimulakan dengan matlamat untuk membangunkan sistem automasi rumah pintar menggunakan Wi-Fi. Untuk menjadikan sistem pintar, Perintang Bergantung Cahaya, LDR digunakan untuk mengesan keamatan cahaya dan mengawal teduh matahari di dalam rumah. Tambahan pula, Apl Android telah dibangunkan untuk tujuan mengawal peralatan elektrik. Ini menyediakan platform yang lebih baik bagi pengguna untuk mengawal peralatan rumah, hanya menyentuh butang untuk menghidupkan atau mematikan peranti. Sistem ini akan menjadi lebih mudah terutamanya untuk orang tua dan orang kurang upaya kerana peralatan rumah dapat dikendalikan melalui Smartphone pada tapak tangan, tidak perlu bergerak. Dalam projek ini, perkakasan yang akan digunakan ialah Arduino Uno, Light Resistor Resistance, pemandu motor L298N, motor geared arus terus dan relay. Selain itu, Arduino IDE digunakan untuk menulis program sistem manakala pencipta App MIT digunakan untuk membangunkan aplikasi Android. Sistem yang dibangunkan dapat mengendalikan cahaya mentol dan cahaya matahari oleh aplikasi Android, selain itu teduh matahari dapat berfungsi dalam mod otomatis dengan tingkat intensitas cahaya. Oleh itu, suis dinding konvensional boleh digantikan oleh sistem dan memudahkan pengguna terutamanya orang tua dan orang kurang upaya.

## **ABSTRACT**

Smart home automation system was an idea exists since early of 20 century and it is getting popular from 5 years ago. The system can used to control the home electrical appliances by sending certain command to the microcontroller. Previously, Bluetooth was the most popular medium that used for signals to flows from the user to the microcontroller. However coverage of Bluetooth was limited; the smart home automation system using Wi-Fi was getting popular as the coverage is wider than Bluetooth. This project is started with an objective of develop a smart home automation system using Wi-Fi. In order to make the system smart, Light Dependent Resistor, LDR was used in order to detect the light intensity and control the sun shade in a house. Moreover, an Android Apps was developed for the purpose of controlling the electrical appliances. This provides a better platform for the user to control the home appliances, just touch the button to turn on or turn off the device. This system will brings convenient especially for elderly and disabled because the home appliances can be control through Smartphone on palm, no moving is needed. In this project, the hardware that will be use are Arduino Uno, Light Dependent Resistor, L298N motor driver, DC geared motor and relay. Besides that, Arduino IDE was used to write the program of the system while MIT App inventor was used to develop the Android apps. The developed system is able to control light bulb and sun shade by the Android apps, besides that the sun shade can works in automatic mode with the light intensity level. Hence, conventional wall switches can be replaced by the system and bring convenient to the user especially elderly and disabled.

## **DEDICATIONS**

This thesis is dedicated to:

My beloved parents,

My supervisors,

My lecturers,

My family,

And all my friends,

Thank you for the guidance, encouragements and support.

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## LIST OF SYMBOL AND ABBREVIATIONS

WLAN	Wireless Local Area Networks
GHZ	Gigahertz
IEEE	Institute of Electrical and Electronics Engineer
MAC	Media Access Control
PHY	Physical Layer
RF	Radio Frequency
TDMA	Time Division Multiple Access
OFDMA	Orthogonal Frequency Division Multiple Access
DFS	Dynamic Frequency Selection
TPC	Transmit Power Control
AES	Advanced Encryption Standard
BSS	Basic Service Set
ESS	Extended Service Set
IOT	Internet of Things
GCM	Google Cloud Messaging
API	Application Programming Interface
GUI	Graphical User Interface
LDR	Light Dependent Resistor
SRAM	Static Random Access Memory
EEPROM	Electrical Erasable Programmable Read only Memory
GND	Ground
VCC	Voltage Collector Collector
DC	Direct Current
IDE	Integrated Development Environment
USB	Universal Serial Bus
PWM	Pulse Width Modulation

# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction

Smart home automation system using Wi-Fi is a system that allow user to control their electrical appliances at any where through electronic gadget. In this project, microcontroller is use to process the received instruction from user. In this chapter, the objective, scope of project and problem statement was stated clearly.

### 1.1 Background of Project

Smart home system is an idea that exists at early of 20th century. At that time, smart home began to increase in popularity because the price is affordable and this leads to appearance of gadgets on store shelves (Hendricks, 2014). In the early days until now, every human being hope to enhance their living style; there are no reason for them to feel satisfy with the technology that exists. Conventional wall switches often located at different parts of a house, the common method to turn on or off the electrical appliances is walk to the particular switch and turn it on and off, this became an obstacle for those who cannot move freely especially elderly. Besides that, human always forgot to turn off what they don't need when leaving their house and this leads to electricity waste. To overcome this problem, a smart home automation system using Wi-Fi is presented. This system allow user to switch on and off the electrical appliances at anytime, anywhere without walking to the switch. Besides that, user could know the status of the home appliances. If there are any home appliances is not switch off, user can switch it off even though they are far away from home.



## 1.2 Problem Statement

Global warming has been a concern for more than 10 years; everyone was looking for method to slow down the process. Carbon dioxide was the main factor that causes global warming. When generating electricity, Carbon Dioxide was emitted to the atmosphere. So it can be said that usage of electricity causes more Carbon Dioxide to be release to the atmosphere and this leads to global warming. According to the International Energy Agency (IEA), 19% of global electricity generation is taken for lighting. By reducing consumption of electricity will helps to slow down global warming. Switch to efficient lighting systems is one of the methods to reduce electricity consumptions while smart home is the another way.

Besides that, conventional wall switches are located in different parts of a house, thus manual operations like to switch on or off these switches to control various appliances are needed and this become an obstacle for those who cannot move freely especially elderly. Smart home automation system provided an easier platform to control various appliances.

## 1.3 Objective

The objectives of this project are stated below:

- a) To develop a smart home automation system using Wi-Fi.
- b) Sensor is used to detect light intensity in order to control sun shade.
- c) Create an Android application for control purpose

## **1.4 Scope of Work**

This project is aim to developed a smart home automation system using Wi-Fi. There are several steps will involve to achieve the aim. Firstly, the Arduino will receive instruction from user through Wi-Fi module. Besides that, LDR sensor that used to measure light intensity will keep on monitor the changes of light. Lastly, the receive instruction will be process by Arduino in order to give output such as switch on the electrical appliances or sun shade.

## **1.5 Thesis Outline**

This report consists of 3 chapters that describe the flow of this project. The first chapter consists of background, problem statement, objectives and the work scope of this project.

While the second chapter consists of the literature review in which this part is used to compare the ideas of other researcher and analysis will carry out in order to determine the possible hardware and software that will be use in this project

Next, third chapter is about the methodology which will explain the method that used to do the analysis of this research project.

Follow by the fourth chapter, it will reveal the result that obtained from the analysis and discussion will be made through the output that obtained from the project

Last chapter will cover the overall progress from the beginning until the end of this project.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.0 Introduction**

This chapter will discuss the concept and method that will be used in this project based on the information and the sources that obtained from books, journals and website. Wi-Fi is one of the wireless technologies that available on the market so the information of Wi-Fi technology will be further discussed. Besides that, previous related project and hardware used will be discussed as well.

#### **2.1 Wireless Technology**

According to (Rose Mary, 2010) wireless technology refers to the transmission of information through radio signal over a distance without the needs of wire. There are a few types of wireless technology such as satellite, WiMAX, Wi-Fi, Bluetooth and ZigBee. According to (WOOD, 2014) Wi-Fi was first released for consumers in 1997 after a committee called 802.11 was created. 802.11 refer to a set of standards that define communication for wireless local area networks (WLANs). Electromagnetic waves was the medium that used by Wi-Fi to communicate, the frequency used by Wi-Fi is 2.4 GHz and 5 GHz. Throughout the days, 2.4 GHz was used as it worked with most of the devices and require lower cost. In year 2003, the new 802.11g standard offer higher Wi-Fi transmission rate wider coverage by combining earlier Wi-Fi version together.

### **2.1.1 History of Wi-Fi**

Development of wireless LAN standards by the IEEE began in the late 1980s, following by the opening of the three industrial, scientific and medical (ISM) radio bands for unlicensed use by the Federal Communications Commission in 1985 then a major milestone was reached in 1997 with the approval and publication of 802.11 standards. This standard initially specified modest data rates of 1 or 2 Mbps that has been enhanced over the years. After that, many revisions was done by adding a suffix letter to the original 802.11 such as 802.11a,b,g and n. 802.11a and b extensions ratified in July 1999 where 802.11b standard offers data rates up to 11 Mbps which then become the first standard with product to market under Wi-Fi banner.

### **2.1.2 Wi-Fi**

Wi-Fi is a common wireless communication that used by many electronics device such as laptop and smart phones. The adoption of Wi-Fi in electronics devices provides user another platform to access the internet. Wi-Fi communication consumes low- power and it can support a higher speed compare to cellular data. There are different standard under Wi-Fi communication, 802.11 was the first WLAN standard created by the Institute of Electrical and Electronics Engineers (IEEE) which is actually a set of Media Access Control (MAC) and physical layer (PHY) specification that used in implementing Wireless Local Area Network (WLAN). Besides 802.11, there are 3 standards that often used in Wi-Fi among them are 802.11b, 802.11g, 802.11n and 802.11ac. The information is as shown below.

Standard	Key features
802.11a	High speed WLAN standard, supporting 54 Mbps data rate using OFDM modulation in the 5 GHz ISM band.
802.11b	The original Wi-Fi standard, providing 11 Mbps using DSSS and CCK on the 2.4 GHz ISM band.
802.11d	Enables MAC level configuration of allowed frequencies, power levels and signal bandwidth to comply with local RF regulations, thereby facilitating international roaming.
802.11e	Addresses quality of service (QoS) requirements for all 802.11 radio interfaces, providing TDMA to priorities and error-correction to enhance performance of delay sensitive applications.
802.11f	Defines recommended practices and an Inter-Access Point Protocol to enable access points to exchange the information required to support distribution system services. Ensures interoperability of access points from multiple vendors, for example to support roaming.
802.11g	Enhances data rate to 54 Mbps using OFDM modulation on the 2.4 GHz ISM band. Interoperable in the same network with 802.11b equipment.
802.11h	Spectrum management in the 5 GHz band, using dynamic frequency selection (DFS) and transmit power control (TPC) to meet European requirements to minimize interference with military radar and satellite communications.
802.11i	Addresses the security weaknesses in user authentication and encryption protocols. The standard employs advanced encryption standard (AES) and 802.1x authentication.
802.11j	Japanese regulatory extension to 802.11a adding RF channels between 4.9 and 5.0 GHz.
802.11k	Specifies network performance optimization through channel selection, roaming and TPC. Overall network throughput is maximized by efficiently loading all access points in a network, including those with weaker signal strength.
802.11n	Provides higher data rates of 150, 350 and up to 600 Mbps using MIMO radio technology, wider RF channels and protocol stack improvements, while maintaining backward compatibility with 802.11 a, b and g.
802.11p	Wireless access for the vehicular environment (WAVE), providing communication between vehicles or from a vehicle to a roadside access point using the licensed intelligent transportation systems (ITS) band at 5.9 GHz.
802.11r	Enables fast BSS to BSS (Basic Service Set) transitions for mobile devices, to support delay sensitive services such as VoIP on stations roaming between access points.

802.11s	Extending 802.11 MAC to support ESS (Extended Service Set) mesh networking. The 802.11s protocol will enable message delivery over self-configuring multi-hop mesh topologies.
802.11T	Recommended practices on measurement methods, performance metrics and test procedures to assess the performance of 802.11 equipment and networks. The capital T denotes a recommended practice rather than a technical standard.
802.11u	Amendments to both PHY and MAC layers to provide a generic and standardized approach to inter-working with non-802.11 networks, such as Bluetooth, ZigBee and WiMAX.
802.11v	Enhancements to increase throughput, reduce interference and improve reliability through network management.
802.11w	Increased network security by extending 802.11 protections to management as well as data frames.

Table 1: IEEE 802.11 standard and information

## **2.2 Previous Related Work**

### **2.2.1 "Real Time Smart Home Automation based on PIC Microcontroller, Bluetooth and Android Technology" by Er. Vikram Puri & Anand Nayyar**

This paper was written by Er. Vikram Puri and Anand Nayyar in March 2016. In this paper, smart home automation system is being proposed with the use of PIC 16F877A microcontroller. Besides that, this system also contains a HC-05 Bluetooth sensor to provide long range and energy efficient wireless communication. As a result, the system has fully operation to control various types of appliances such as TV, blubs, tube light, fans and air conditioner.

PIC 16F877A microcontroller is the heart in the proposed system which used to perform algorithm and gives output to the system. The microcontroller can be interface with a 5V input in order to process received signals. Besides that, The Bluetooth module (HC-05) interfaced with microcontroller provides the input signals to control the devices to ensure smooth connection; user should stay 10m within the Bluetooth sensor to ensure smooth operation. Furthermore, Android application is the platform that allow user to control the operation of smart home system. Figure 2.1 shows the "Smt Home Control" Android App.



Figure 2.1: Android App developed "Smt Home Control" (Nayyar, 2016)

In this project, OptoIsolator and TRIAC were used to control the output of appliances. OptoIsolator or known as optical coupler and optocoupler is a semiconductor device that transfers an electrical signal between circuits or element of a circuit by using a short optical transmission path while keeping them electrically isolated. It is an isolated TRIAC driver device that design for interfacing power TRIACS and electronic components to control the resistive and inductive loads for VAC operations. Besides that, TRIAC are also used in this project to receive trigger from opto-isolator in order to control the operation of electrical appliances.

Smart home system could provide user comfort as everything can be controlled without approach to the equipment physically. All command can be given via Smartphone or Tablet so user can feel relax and in full of comfort. Besides that, smart home automation technology helps to save energy and electricity bills because electrical appliances which are not in use can be turn off even though user is not in the house. However, architecture complexity becomes one of the reasons that blocking the implementation of smart home automation system. This technology still consider complex as there are lots of coding and equipment's integration such as central controller