# IOT BASED
# AUTOMATION SYSTEM FOR SMART HOME

TEE KOK KIAN

Bachelor of Engineering Technology
(Electrical) With Honors

UNIVERSITI MALAYSIA PAHANG

## SUPERVISOR'S DECLARATION

We hereby declare that we have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Engineering Technology in Electrical with Honors.

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at University Malaysia Pahang or any other institutions.

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## ABSTRACT

Due to communications technology advancement, home automation system has grown in popularity. Smart Home (SH) is one of the Internet of Things (IoT) applications that allow the users to control and real time monitor the home appliances through internet connection. Most existing systems are not affordable for most users due to high cost and difficult in maintenance. In addition, the existing systems are either locally or remotely controlled. Last but not the least is the lack of user-friendly interface. To overcome these limitations, this project proposes a cost effective and hybrid (local and remote) IoT-based home automation system which monitors and controls home appliances easily and efficiently via a user-friendly interface using smartphones and/or laptops. The project aims at enhancing the design and fabrication of an existing SH prototype to utilizing the IoT technology. The proposed system will integrate both technologies; Wi-Fi for local control and the IoT for enabling remote control and monitoring via an IoT platform and check ubiquitously if something is happening. This allows the system support the independence of both mobile provider and user location. NodeMCU act as a microcontroller and WIFI as a communication protocol. The messages sent from the WI-FI connected microcontroller managed system can be received by the users on smartphone or computer from any distance by making sure that the electronic devices are connected to the internet. The software used to program the NodeMCU is the Arduino software (IDE). This software helps to write and upload the program into the chip in the microcontroller. The system then can merged to the switches and sensor of home appliances to prove efficient control. Several sensors will be attached to under controlled household appliances and placed throughout the home to track activities and events, and then send the sensed data wirelessly to a gateway. The system will be integrated with alert devices to detect any threats for safety and security purposes. The proposed system will be an enabler for easier, safer, and more comfortable life especially for elderly and disabled people.

# ABSTRACK

Oleh kerana kemajuan teknologi komunikasi, sistem automasi rumah telah berkembang dengan popularity. Smart Home (SH) adalah salah satu aplikasi Internet Things (IoT) yang membolehkan pengguna mengawal dan memantau masa nyata peralatan rumah melalui sambungan internet. Kebanyakan sistem yang sedia ada tidak mampu dimiliki oleh kebanyakan pengguna kerana kos yang tinggi dan kesulitan dalam penyelenggaraan. Di samping itu, sistem yang sedia ada sama ada secara tempatan atau dikawal dari jauh. Yang terakhir tetapi tidak sedikit adalah kekurangan antara muka mesra pengguna. Untuk mengatasi batasan ini, projek ini mencadangkan sistem automasi rumah berasaskan IoT yang berkesan dan hibrid (tempatan dan terpencil) yang memantau dan mengawal peralatan rumah dengan mudah dan cekap melalui antara muka yang mesra pengguna menggunakan telefon pintar dan atau komputer riba. Projek ini bertujuan untuk meningkatkan reka bentuk dan fabrikasi prototaip SH yang sedia ada untuk menggunakan teknologi IoT. Sistem yang dicadangkan akan mengintegrasikan kedua-dua teknologi; Wi-Fi untuk kawalan tempatan dan IoT untuk membolehkan kawalan jauh dan pemantauan melalui platform IoT dan semak di mana-mana jika berlaku. Ini membolehkan sistem menyokong kebebasan penyedia mudah alih dan lokasi pengguna. NodeMCU bertindak sebagai mikrokontroler dan WIFI sebagai protokol komunikasi. Mesej-mesej yang dihantar dari sistem pengurusan mikrokontroler yang disambungkan WI-FI boleh diterima oleh pengguna pada telefon pintar atau komputer dari jarak jauh dengan memastikan peranti elektronik disambungkan ke internet. Perisian yang digunakan untuk program NodeMCU ialah perisian Arduino (IDE). Perisian ini membantu untuk menulis dan memuat naik program ke dalam cip dalam mikrokontroler. Sistem itu kemudiannya boleh digabungkan ke suis dan sensor peralatan rumah untuk membuktikan kawalan yang cekap. Beberapa sensor akan dilampirkan di bawah peralatan rumah terkawal dan ditempatkan di seluruh rumah untuk menjejaki aktiviti dan peristiwa, dan kemudian menghantar data yang dirasakan tanpa wayar ke pintu masuk. Sistem ini akan disepadukan dengan peranti amaran untuk mengesan sebarang ancaman untuk tujuan keselamatan dan keselamatan. Sistem yang dicadangkan akan menjadi penyumbang untuk kehidupan yang lebih mudah, selamat, dan lebih selesa terutama untuk warga tua dan orang kurang upaya.

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| | |
|---|---|
| MQTT | Message Queuing Telemetry Transport |
| IoT | Internet of Things |
| NODEMCU | Node-Microcontroller Unit |
| IDE | Integrated Development Environment |
| M2M | Machine-to-machine |
| GSM | Global System for Mobile Communications |
| LCD | Liquid-crystal Display |

# CHAPTER 1

# INTRODUCTION

## 1.1 Project Background

In this modern world, technology has become a vital part of our daily life. Home automation, home environment automation, intelligent house, smart home, and control, systems integration, home network, home area network, management of home from any locations or domestics all refer to one thing which is a system uses various technologies to equip home parts for easy monitoring and remote control and enabling them for influential harmonic interaction among them such that the everyday house works and activities that he or she is engaged with (Alkar & Buhur, 2005). The system allows interaction with the inhibitors in order to provide convenience, comfort, safe living and energy efficiency at all the times. After many years, Smart Home (SH) has only become practical since the early 20th Century following the widespread introduction of electricity into the home, and the rapid advancement of information technology (Humphries, Rasmussen, Voita, & Pritchett, 1997). During 1960s, American hobbyists built up the first “wired homes”. However, there were limited by the technology of the times. The term "smart house" was first coined by the American Association of House builders in 1984. With the invention of the microcontroller, the cost of electronic control dropped rapidly and during the 1990s home automation rose to prominence. Despite interest in home automation, by the end of the 1990s there was not a widespread uptake - with such systems still considered the domain of hobbyists or the rich.

Majority of the homes already have some of the "smartness" because countless devices already have built-in sensors or electronic appliance controllers. Devices of smart home system are linked with each other and reachable through one main point,

which are tablet, smartphone or laptop. Light, thermostat, televisions, door locks, home monitors and cameras and the other home appliances such as the washing machine, refrigerator and television can be monitored via a smart home system. The smart home system is installed on internet-access devices (Woodford, 2018). Smart home appliances appear with self-learning expert by which the users can study the homeowner's schedules and timetables and arrange as needed. Smart homes enabled the lighting control and allow the users to reduce the electric consumption and thus it saves energy-consumption cost. Another example is home automation systems will notify homeowners if any motion is detected at home while they are not around, and some of the appliances can even report to fire station if in case of fire situations. These are actually the example of Internet of Things (IoT) technology. The Internet of Things (IoT) is an approach that takes all t hings a step forward by introducing a main control.

The most leading form of smart home system is there are gadgets used by the homeowners and it can be controlled by them. It is a constant system at which it controls the home in all aspects such as switches appliances on and off. The gadgets which had been commonly used are android. Android is a well-known brand. The prove is it had been used over 328 million shipped worldwide, the system has a great monopolized the smartphone industries. According to Strategy Analytics, android managed to hold a record of 88% of the worldwide market in 2016, meanwhile for Apple's IOS devices, the share dropped to 12.1% from 13.6% the previous year (Bhattacharya, 2016). There are some of the source system for the smart home which are Linux and Kernel. Linux is the well-known and the common used as an open source operating system. It is software that is crucial for all of the software on a computer, receiving requests from the programs and communicates the requests to the computer's hardware. Kernel is a great piece of the system that monitors the CPU hardware, allocates memory, accesses data and runs the applications. It is the first program will on the computer screen when the it starts up (Halvens, 2018).

## 1.2 Problem Statement

Nowadays, there is a lot of the home automation systems exists in the market. This home automation system can be categorized into two main categories which is local control and remotely controlled systems. The different between local control and remotely control systems is the way for operation (Demiris et al., 2004). Basically, the

remotely control can use internet connection by using their electronic devices for long distance while the local control using in-home controller with a stationary or wireless communication technology to connect to the central hub or gateway. There are several issues that increase the difficulty for designing home automation systems.

Most of the existing home automation systems had limitation with the range of the connectivity. The existing prototype has limitation in its connectivity, sensor, and automation of windows and door (Möller et al., 2004). This limitation brings the smart home not user-friendly and this project will overcome this limitation by using NodeMCU. Besides, some existing smart home provides insufficient features and functionality because the original installer may not have adequate knowledge of how to install and commission the system. Furthermore, there is less of prototype in existing project such as door and window. The automatic door and window will apply in this project to ensure the systems more smart. In addition, the existing smart home is lacking in security element such as gas leakage alertness. This safety element is important in any smart home to avoid any incident.

In summary, the home automation system should provide a user-friendly interface to allow setting up, monitoring and controlling home appliances more efficiently. To overcome these design issues and minimize the shortcomings of home automation systems, this project will integrate locally and remotely controlled home automation systems. This project also adds some safety and security element by connecting sensor to home appliances. In this project, the low cost NodeMCU and mobile apps will use that related to the Internet of Things (IoT). The IoT allows individuals to control their appliance and devices over the Internet connection.

## 1.3 Objectives

The main objective of this project is to develop a cost effective and IoT-enabled system for Smart Home to monitor home and control its appliances easily and efficiently. To achieve the aim of the project, several objectives are needed:

- To fabricate a Smart Home prototype that facilitates the monitoring and control of home appliances over an IoT platform and support home safety by utilizing NodeMCU as a gateway to connect the system to the Internet.

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