DESIGN AND IMPLEMENTATION OF SMART HOME CONTROL SYSTEM BASED ON INTERNET OF THINGS

Liu Wen Yee

Bachelor of Engineering (Hons)

Electrical and Electronics Engineering

2019

UNIVERSITI MALAYSIA SARAWAK

Grade: A-

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DESIGN AND IMPLEMENTATION OF SMART HOME CONTROL SYSTEM BASED ON INTERNET OF THINGS

LIU WEN YEE

A final year project report submitted in partial fulfilment of
the requirement for the degree of
Bachelor of Engineering (Hons) Electrical and Electronics Engineering

Faculty of Engineering
Universiti Malaysia Sarawak

2019

To my beloved family and friends.

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First and foremost, I would like to express my deepest gratitude to my supervisor, Dr. Yonis M. Yonis Buswig for offering this project title (Design and Implementation of Smart Home Control System Based on Internet of Things) to me. When carrying out my project, Dr Yonis is a great source of support and guidance where he taught me on how to handle a project effectively and how to deal with problems. This project could not be completed without his supervision and inspirations.

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ABSTRACT

This project describes on the design and implementation of smart home control system which can helps to save energy and reduce power wastage. This control system is based on four different sensors which including the motion sensor, smoke sensor, ultrasonic sensor, and temperature and humidity sensor. Arduino MEGA2560 board acts as the main control unit and ESP8266 Wi-Fi module as a communication protocol. The users can control the home systems easily by using the sensors, such as controlling the lights, door and window. These systems are easily controlled and can be monitored via user-friendly interface for smartphones. IoT based home automation system is applicable in this project, whereby the home automation systems can be monitored through mobile phones with Internet connections. Besides, an addition feature that enhances the protection of house is added to the system. Mobile applications such as ThingView and Virtuino are installed in the mobile phones to allow the users to monitor the home appliances as well as the security and safety of the house. An alerting message is sent to the smartphone when fire accident or burglar incident happens. This message alerts the users and thus prevent the house from danger. The main advantage of this smart home control system is that it is a sensible, secure and easily configurable system that provides the users with a smart and neat home automation. Thus, all the objectives are achieved.

ABSTRAK

Projek ini menerangkan reka bentuk dan pelaksanaan sistem kawalan rumah pintar yang dapat membantu untuk menjimatkan tenaga dan mengurangkan pembaziran kuasa elektrik. Sistem kawalan adalah berdasarkan kepada empat sensor yang berbeza, iaitu sensor gerakan, sensor asap, sensor ultrasonik, dan juga suhu dan kelembapan sensor. Papan *Arduino MEGA2560* bertindak sebagai unit kawalan utama dan modul *ESP8266 Wi-Fi* sebagai protokol komunikasi. Para pengguna boleh mengawal sistem rumah dengan mudah dengan menggunakan sensor, seperti mengawal lampu, pintu dan tingkap. Sistem ini mudah dikawal dan boleh dipantau melalui aplikasi dalam telefon pintar. Sistem automasi rumah berasaskan teknologi *IoT* dibentuk dalam projek ini, di mana sistem automasi rumah boleh dipantau melalui telefon mudah alih dengan sambungan *Internet*. Selain itu, ciri-ciri tambahan yang meningkatkan perlindungan rumah ditambah ke dalam system ini. Aplikasi mudah alih seperti *ThingView* dan *Virtuino* dipasang dalam telefon mudah alih untuk membolehkan pengguna memantau peralatan rumah serta keselamatan rumah. Mesej amaran dihantar kepada telefon pintar apabila kemalangan kebakaran atau kejadian pencurian berlaku. Mesej ini mengawasi pengguna dan mengelakkan rumah daripada bahaya. Kelebihan utama sistem kawalan rumah pintar ini adalah ia adalah satu sistem yang waras, selamat dan mudah dikonfigurasikan yang memberikan pengguna dengan automasi rumah pintar dan kemas. Oleh itu, semua objektif telah dicapai.

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LIST OF SYMBOLS

A	-	Amperes
B	-	Bytes
cm	-	Centimeter
Hz	-	Hertz
kg	-	Kilograms
ktoe	-	Kilotonne of Oil Equivalent
kWh	-	Kilowatts Hour
ppm	-	Parts Per Million
R	-	Resistance
R_o	-	Resistance at 100ppm in clean air
R_s	-	Resistance of sensor
s	-	Seconds
V	-	Volts
W	-	Watts
Ω	-	Ohms
°	-	Degree
°C	-	Degree Celsius
%	-	Percent
+ve	-	Positive
-ve	-	Negative

LIST OF ABBREVIATIONS

A_o	-	Analog Signal
AC	-	Alternating Current
AT	-	Attention
CAD	-	Computer-Aided Design
CH_4	-	Methane
CH_PD	-	Chip Power-Down
CFL	-	Compact Fluorescent Lamp
CO	-	Carbon Monoxide
COM	-	Common
DC	-	Direct Current
D_o	-	Digital Output
D0	-	Data Pin 0
D1	-	Data Pin 1
D2	-	Data Pin 2
D3	-	Data Pin 3
D4	-	Data Pin 4
D5	-	Data Pin 5
D6	-	Data Pin 6
D7	-	Data Pin 7
E	-	Enable
GND	-	Ground
GPIO	-	General Purpose Input/Output
H_2	-	Hydrogen
HTTP	-	HyperText Transfer Protocol
I/O	-	Input / Output
IC	-	Integrated Circuit
ICSP	-	In-Circuit Serial Programming
IDE	-	Integrated Development Environment
IN	-	Input Signal

IoT	-	Internet of Things
IR	-	Infra-Red
LabVIEW	-	Laboratory Virtual Instrument Engineering Workbench
LCD	-	Liquid Crystal Display
LDR	-	Light Dependent Resistor
LED	-	Light Emitted Diode
LED+	-	LED Anode (Source +5V)
LED-	-	LED Cathode (Ground)
LPG	-	Liquefied Petroleum Gas
MATLAB	-	Matrix Laboratory
MEIH	-	Malaysia Energy Information Hub
MQTT	-	Message Queuing Telemetry Transport
NC	-	Normally Closed
NO	-	Normally Open
Node MCU	-	Node Micro-Controller Unit
NTC	-	Negative Temperature Coefficient
PIR	-	Passive Infra-Red
PWM	-	Pulse Width Modulation
RH	-	Relative Humidity
RPM	-	Revolutions Per Minute
RS	-	Register Select
RST	-	Reset
RXD	-	Receive Data
R/W	-	Read/Write
SPDT	-	Single Pole Double Throw
SPP	-	Single Payback Period
SRAM	-	Static Random-Access Memory
Trig Pin	-	Trigger Pin
TXD	-	Transmit Data
USART	-	Universal Synchronous/ Asynchronous Receiver/ Transmitter
USB	-	Universal Serial Bus

V_{cc}	-	Voltage Common Collector
V_E	-	Contrast Control
V_{ss}	-	Negative Supply (Ground)
Wi-Fi	-	Wireless Fidelity

CHAPTER I

INTRODUCTION

1.1 Project Background

In recent years, Malaysia's power electricity consumption is increasing annually. Based on the statistics as shown in Figure 1.1 from Suruhanjaya Tenaga, Malaysia Energy Information Hub (MEIH) [1], the total electricity consumption increased significantly from the year 2014 to 2016. From the statistics, home power consumption contributes to part of the energy consumption. There are few factors causing the high consumption of power electricity in residential. One of the main factors is the lighting systems. This is due to manual switching and human carelessness whereby people forget to switch off the lights when they are away from home. Thus, resulting in the total electricity consumption increases and yet a lot of energy is being wasted.