

CONTROL HOME APPLIANCES VIA INTERNET (CoHAVI) – HARDWARE
DEVELOPMENT

SOO KUAN CHEONG

This report is submitted in partial fulfillment of the requirements for the award of
Bachelor of Electronic Engineering (Computer Engineering)
With Honours

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

April 2009



UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN
KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : Control Home Appliances Via Internet System (CoHAVI)
Sesi Pengajian : 2008/2009

SayaSOO KUAN CHEONG.....
 (HURUF BESAR)

mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan () :

SULIT*

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

TERHAD*

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

TIDAK TERHAD

Disahkan oleh:

 (TANDATANGAN PENULIS)

 (COP DAN TANDATANGAN PENYELIA)

Alamat Tetap: NO 21, JALAN MEGAH 8,
 TAMAN MEGAH SG. JELOK,
 43000 KAJANG, SELANGOR.

Tarikh: 30 APRIL 2009

Tarikh:

“I hereby declare that this report is the result of my own work except for quotes as cited in the references.”

Signature :
Author : SOO KUAN CHEONG
Date : 30 APRIL 2009

“I hereby declare that I have read this report and in my opinion this report is sufficient in terms of the scope and quality for the award of Bachelor of Electronic Engineering and Computer Engineering With Honours.”

Signature :

Supervisor's Name : EN. ABD. SHUKUR B. JA'AFAR

Date : 30 APRIL 2009

To my beloved mom and dad

ACKNOWLEDGEMENT

First and foremost, I'm very grateful to all those who contributed time, concern and efforts to teach in order to provide and to pass on knowledge. At the same time, I would like to special thanks to my supervisor; En. Abd Shukur Bin Ja'afar for his comments, critiques, and suggestion were taken seriously to make me understand the world of engineering. Their supports have led me to practice and learn more and more from them in order to be an engineer in the future.

And finally, I also appreciate the flagging support of my friends who had providing lots of constructive criticism and the way of an engineer should be. It would not have been possible to complete a report of this magnitude without the support from them.

ABSTRACT

All of us enjoy the benefits of modern technology. Whether it is microwaves or washing machines, the latest inventions and equipment make our everyday lives easier. But now, with innovative computer software and technological know-how, house designers have taken simple conveniences into new frontiers, creating a fresh model for the future: the smart home. This project is to develop a stand-alone Control Home Appliances via Internet (CoHAVI) hardware circuit to control home appliances through internet. The hardware part contains of two main circuits: transmitter and receiver circuits. For transmitter circuit, the PIC receives serial data from the personal PC via RS232 and transmits it using RF transmitter after encoding the data. For receiver circuit, the receiver receives and decodes the encoded data. PIC activates and deactivates the relay and controls the home appliances. This system is using internet as interface to control the home appliances such as lamp, rice cooker and others. The results of this project will create new alternatives to put into practice of smart home system.

ABSTRAK

Semua individu menikmati kemudahan teknologi moden, perkara yang sama juga boleh diaplikasikan dalam rumah. Penciptaan dan penggunaan peralatan moden memudahkan hidup kita samada dari segi penggunaan gelombang mikro atau mesin basuh. Dengan adanya inovatif perisian komputer dan ilmu teknologi pada masa kini, pereka bentuk rumah hanya perlu mengambil langkah mudah untuk mengeksploitasi dan mencipta modal baru untuk masa hadapan: Sistem Rumah Pintar. Projek ini dilaksanakan untuk mereka dan membina '*stand-alone Control Home Appliances via Internet (CoHAVI)*' sistem untuk mengawal perkakasan rumah melalui internet. Litar ini terdiri daripada litar '*transmitter*' dan litar '*receiver*'. Mikro pengawal 'PIC' berfungsi untuk menghantar data dan isyarat ke komputer peribadi melalui 'serial port' RS232. Isyarat ini akan dihubungkan ke litar penerima '*receiver*'. Seterusnya isyarat ini akan dihantar ke litar pengawal untuk mengawal peralatan rumah. Sistem ini menggunakan internet sebagai perantara untuk mengawal perkakasan rumah seperti lampu, periuk nasi elektronik dan sebagainya. Hasil daripada projek ini akan mencipta alternatif baru untuk dipraktikkan pada Sistem Rumah Pintar.

TABLE OF CONTENTS

CHAPTER	CONTENT	PAGE
	PROJECT TITLE	i
	REPORT STATUS APPROVAL	ii
	DECLARATIONS	iii
	SUPERVISOR’S APPROVAL	iv
	DEDICATION	v
	ACKNOWLEDGEMENT	vi
	ABSTRACT	vii
	ABSTRAK	viii
	TABLE OF CONTENTS	ix
	LIST OF TABLES	xiii
	LIST OF FIGURES	xiv
	LIST OF ABBREVIATIONS	xvi
	LIST OF APPENDIX	xvii
I	INTRODUCTION	
	1.1 Overview	1
	1.2 Objective	2
	1.3 Problem Statement	3
	1.4 Scope	3
	1.5 Project Methodology	4
	1.6 Report Structure	5

II LITERATURE REVIEW

2.1	Background of Study	6
2.2	Peripheral Interface Controller (PIC)	6
2.2.1	Microcontroller-PIC 16F84A	7
2.3	Radio Frequency	9
2.3.1	Special Properties of RF Electric Signals	10
2.3.2	Transmitter and Receiver	11
2.3.2.1	RF_TX and RF_RX 315 Module	12
2.3.2.2	Specifications of RF Transmitter Module	12
2.3.2.3	Antenna	13
2.3.2.4	RF_TX and RF_RX 315 Product Layout	13
2.4	RS232	14
2.4.1	Introduction to RS232 Serial Port	14
2.4.2	Serial Pinout (D25 and D9 Connectors)	16
2.4.3	Null Modem	16
2.4.4	Data Transmission	17
2.5	MAX232	19
2.6	Encoder and Decoder	20
2.6.1	PT2262 Encoder	20
2.6.2	PT2272 Decoder	22
2.6.3	Encoder and Decoder Application	24
2.7	Relay	24
2.7.1	Relay Application	26
2.8	Visual Basic	26
2.9	PIC C Compiler	28
2.10	PICBasic Pro	29
2.11	Case Study	31
2.11.1	Smart Home	31
2.11.2	Home Appliances Control System (HACS)	32

III PROJECT METHODOLOGY

3.1	Overview	33
3.2	Literature Review	34
	3.2.1 Computer-Instrument Control and Interface	34
	3.2.2 Radio Frequency Transceiver	35
3.3	Research and Analysis	36
3.4	Ideation	36
3.5	Hardware Development	37
3.6	Software Development	41
	3.6.1 Testing and Analysis	43
3.7	Source Code Design	43
	3.7.1 PICBASIC PRO Source Code for Serial Data via RS232	43
	3.7.2 CCS Source Code for Receiver Circuit to Enable Relay	44
3.8	Journals and Books	45

IV RESULTS AND DISCUSSION

4.1	Result	46
	4.1.1 Transmitter Circuit	46
	4.1.2 Receiver Circuit	48
	4.1.3 Relay Circuit	49
4.2	Discussion	51

V CONCLUSION

5.1	Conclusion	52
5.2	Future Work	53

REFERENCES	54
APPENDICES	55

LIST OF TABLE

NO	TITLE	PAGE
2.1	Key Features of PIC16F84A	8
2.2	Technical specification of RF Transmitter Module	12
2.3	RF Module Label Description	14
2.4	RS232 Abbreviation and Function	15
2.5	D Type 9 Pin and D Type 25 Pin Connectors	16
2.6	RS232 Connector and Function	17
2.7	MAX232 to RS232 DB9 Connection as a DCE	20
2.8	Pin Description for PT2262 Encoder	21
2.9	Pin Description for PT2272 Decoder	23

LIST OF FIGURE

NO	TITLE	PAGE
1.1	A General Flowchart of the Project	4
2.1	PIC16F84A Outline	7
2.2	PIC16F84A Chips Layouts in DIP Package	8
2.3	PIC16F84A Block Diagram	9
2.4	Basic Building Blocks of Transmitter and Receiver	11
2.5(a)	Transmitter 315 Module Product Layout	13
2.5(b)	Receiver 315 Module Product Layout	13
2.6	Simple null modem without handshaking	16
2.7	Serial Interfaces	18
2.8	Start Bit and Stop Bit of Asynchronous Data	18
2.9	Diagram of MAX 232	19
2.10	PT2262 Encoder Pin Configuration	21
2.11	PT2272 Decoder Pin Configuration	22
2.12	AC coil Relay	25
2.13	Smart Home System	31
2.14	HACS System	32
3.1	General Block Diagram of Project	33
3.2	Flowchart of the Hardware Development	37
3.3	The Transmitter Circuit Diagram	38
3.4	The Receiver Circuit Diagram	39
3.5	The Transmitter Circuit	40
3.6	The Receiver Circuit	40
3.7	Exterior Outlook	41
3.8	Proteus circuit simulation	42

3.9	Flowchart of the Software Development	42
4.1	Serial Data via RS232	47
4.2	Data Transmit via RF Transmitter	47
4.3	Data Receive via RF Receiver	48
4.4	PIC React to the Data Received	48
4.5	Full View of the CoHaVI System	49
4.6	Relay Circuit	49
4.7	Manual Switch Attached on the Relay Circuit	50
4.8	Electric Appliances React to the PIC	50

LIST OF ABBREVIATIONS

CoHAVI	-	Control Home Appliances via Internet System
SFR	-	Special Function Register
PIC	-	Peripheral Interface Controller
RAM	-	Random Access Memory
ROM	-	Read Only Memory
GUI	-	Graphic User Interface
EEPROM	-	Electrically Erasable Programmable Read-Only Memory
TD	-	Transmit Data
RD	-	Receive Data
CTS	-	Clear to Send
DCD	-	Data Carrier Detect
DSR	-	Data Set Ready
DTR	-	Data Terminal Ready
RTS	-	Request To Send
DTE	-	Data Terminal Equipment
DCE	-	Data Circuit-terminating Equipment
LED	-	Light Emitter Diode
UTeM	-	Universiti Teknikal Malaysia Melaka
RF	-	Radio Frequency
VT	-	Valid Transmission
TE	-	Transmission Enabled

LIST OF APPENDIX

NO	TITLE	PAGE
A1	PICBASIC PRO Source Code for Serial Data via RS232	54
A2	CCS Source Code for Receiver Circuit to Enable Relay	55
B1	PIC16F84A Datasheet	58
B2	PT2262 Encoder Datasheet	64
B3	PT2272 Decoder Datasheet	67
B4	RF-TX-315 Transmitter Module	74
B5	RF-RX-315 Receiver Module	77
C	TECHNICAL PAPER	81

CHAPTER 1

INTRODUCTION

All of us enjoy the benefits of modern technology. Whether it is microwaves or washing machines, the latest inventions and equipment make our everyday lives easier. But now, with innovative computer software and technological know-how, house designers have taken simple conveniences into new frontiers, creating a fresh model for the future: the smart home.

1.1 OVERVIEW

There's so much hype about 'smart homes' but what exactly do these terms mean? Generally speaking, home automation refers to anything that gives users to control over the various technologies or sub-systems found at home. For instances: security, lighting, heating, ventilation and air conditioning. It's just a regular house, except every piece of electrical equipment is hooked up to a computer system. With this technology, users no longer need to depend on switches or other forms of manual activation. Instead, every light bulb, every TV, and even the thermostat are controlled remotely from a computer database.

To fulfill this technology, Control Home Appliances via Internet (CoHAVI) been developed to control home appliances through internet. The purpose of using

internet as the medium or the controller is because the internet provides even more incredible access to information and services.

1.2 OBJECTIVES

The objective of this project is to develop a stand-alone Control Home Appliances via Internet (CoHAVI) system to control home appliances through internet. The objectives can be summarized as below:-

- a) To develop a system that can control the home appliances via internet.
- b) To construct a transmitter that will receiver signal from RS232 and transmit it to the receiver part of home appliances.
- c) To construct a receiver (RF) that will control the appliances using relay.

1.3 PROBLEM STATEMENT

The resistance in this project is the wide selection of RF transceiver and PIC. The key considerations that impact transceiver and PIC selection are: communications standard, hardware platform, communications modes, power management, application interface. A reliable and maintenance-free system is hard to implement with a limited budget. Full supports and faith of the users are needed towards the system in order to maximize its usage. Beside that, the invention of smart home is not fully acceptable by the public for the time being due to the misunderstanding of the smart home concepts.

1.4 SCOPES

This project is subjected to several scope and limitations that are narrowed down to the study are:-

- a) Research study on the on the Programmable Intelligence Computer, PIC16F84A microcontroller and the control system of the circuit

- b) To acquire the function of RF Transmitter and receiver module of 315MHz with frequency from 350 - 433.92MHz within range of 100m.
- c) Research study on application of RF transceiver as medium of transmitting data.
- d) To construct and develop the model of the circuit designed (hardware)
- e) Research study of the communication of max232 communicates with serial port (RS 232).
- f) Research study of a simple electromagnetic relay and the relay application consideration of different relays.

1.5 PROJECT METHODOLOGY

- a) Project Planning
- b) Literature Review
- c) Software Design and Circuit Construction
- d) PIC Interfacing to the Data Transfer from RS232
- e) RF Transmission with Encoder and Decoder
- f) Relay Circuit Design and Construction
- g) Performance Analysis

Figure 1.1 shows the project methodology of Control Home Appliances via Internet system.

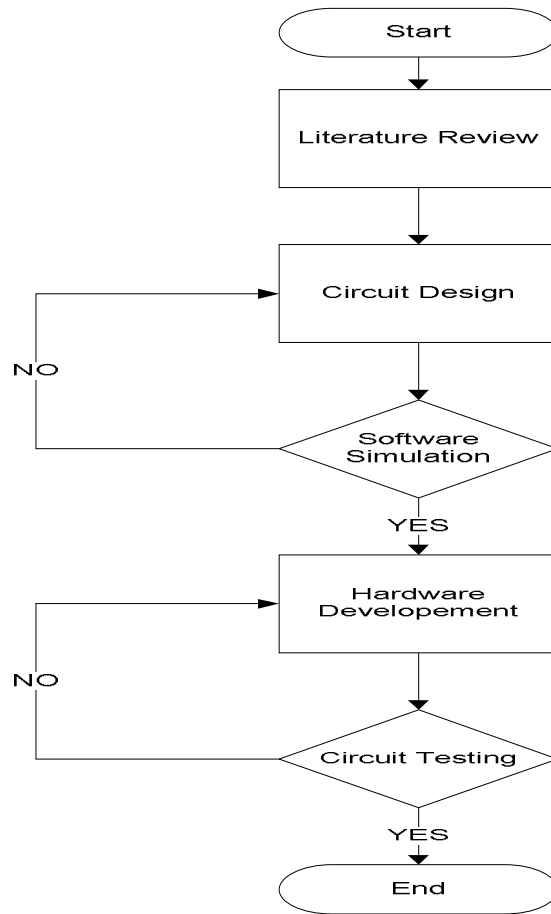


Figure 1.1 General Flowchart of the Project

1.6 REPORT STRUCTURE

Chapter one briefly introduces the overall of the project titled Control Home Appliances via Internet (CoHAVI) to control home appliances through internet. The introduction consists of overview, objective, problem statement, scope of work, methodology and structure report.

Meanwhile, chapter two discuss about the background of study related to CoHAVI system. Literature review will produce overall structure of the CoHAVI system which shows the relation between project research and theoretical concept.

Chapter three will explain about the project methodology. Project methodology give details about the method used to solve problem to complete the project. The methods used such as collecting data method, process and analysis data method, modeling and etc.

Chapter four consists of result and discussion of the project, finding and analysis throughout the research and project development. It inevitably shows how precise the hypothesis could be to realization.

Lastly, Chapter five is the project conclusion. This chapter rounds up the attained achievement of the whole project and reserves suggestions for possible future researches.

CHAPTER II

LITERATURE REVIEW

2.1 BACKGROUND OF STUDY

2.2 PERIPHERAL INTERFACE CONTROLLER (PIC)

PIC is a family of Harvard architecture microcontrollers made by Microchip Technology. The name PIC initially referred to "Programmable Interface Controller", but shortly thereafter was renamed "Programmable Intelligent Computer". It is an IC developed to control peripheral devices, to ease the load from the main CPU. The PIC, akin to the CPU, has calculation functions and memory, and is controlled by the software. It has separate code and data spaces in accordance to Harvard architecture.

Listed below are the characteristics of a general PIC architecture.

- a) A small number of fixed length instructions
- b) Most instructions are single cycle execution (4 clock cycles), with single delay cycles upon branches and skips
- c) A single accumulator (W), the use of which (as source operand) is implied (ie. is not encoded in the opcode)
- d) All RAM locations function as registers as both source and/or destination of math and other functions. a hardware stack for storing return addresses
- e) A fairly small amount of addressable data space (typically 256 bytes), extended through banking

- f) Data space mapped CPU, port, and peripheral registers
- g) The program counter is also mapped into the data space and writable (this is used to synthesize indirect jumps)

2.2.1 MICROCONTROLLER PIC16F84A

PIC16F84A belongs to a class of 8-bit microcontrollers of RISC architecture. Its general structure is shown on the following map representing basic blocks in Figure 2.1. Program memory (FLASH) is for storing a written program. Since memory made in FLASH technology can be programmed and cleared more than once, it makes this microcontroller suitable for device development. EEPROM - data memory that needs to be saved when there is no supply. It is usually used for storing important data that must not be lost if power supply suddenly stops. For instance, one such data is an assigned temperature in temperature regulators. If during a loss of power supply this data was lost, adjustment has to be made once again upon return of supply.

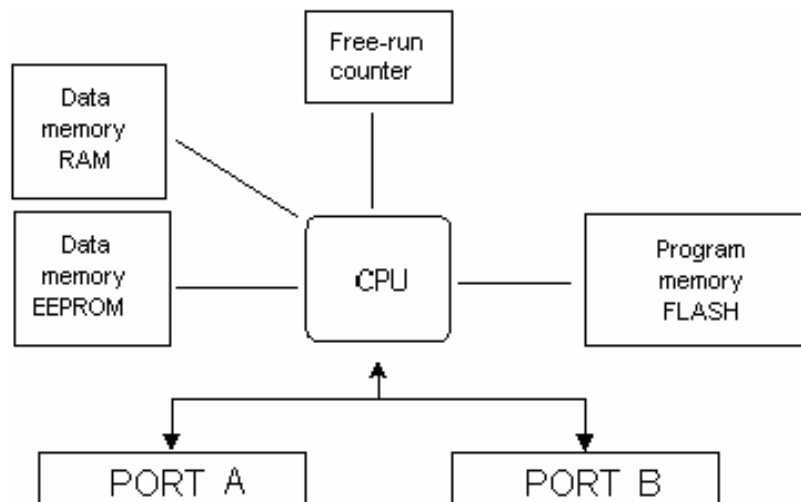


Figure 2.1 PIC16F84A Outline