

**GSM CONTROL FOR HOME APPLIANCES**

**NURUL HANIS BINTI SHAHBUDIN**

**This report is submitted in partial fulfillment of the requirements for the award of  
Bachelor of Electronic Engineering (Industrial Electronics) With Honors**

**Faculty of Electronic and Computer Engineering  
Universiti Teknikal Malaysia Melaka**

**JUNE 2012**



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**  
**FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER**

**BORANG PENGESAHAN STATUS LAPORAN**  
**PROJEK SARJANA MUDA II**

**Tajuk Projek : GSM CONTROL FOR HOME APPLIANCES**

**Sesi Pengajian : 2011/2012**

Saya **NURUL HANIS BINTI SHAHBUDIN**

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 : NO.7, JLN BM5/13,  
 SEKSYEN 5, BDR BUKIT  
 MAHKOTA, BANGI, 43000  
 KAJANG, SELANGOR.

Tarikh: 14 JUNE 2012

Tarikh:

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

Signature : .....  
Author : NURUL HANIS BINTI SHAHBUDIN  
Date : 14 JUNE 2012

“I hereby declare that I have read this report and in my opinion this report is sufficient in terms scope and quality for the award of Bachelor of Electronic Engineering (Industrial Electronics) With Honors”

Signature : .....  
Name : NUR FATIHAH BINTI AZMI  
Date : .....

Special dedication to my beloved parents, Shahbudin Bin Ibrahim and Salmah Binti Kadir, my entire siblings, my friends Mohd Shazwan Bin Suhaimi, Aina Safia Binti Saluddin, Nur Nadiah Binti Mamat, all my dearest friends and my kind hearted supervisor Nur Fatimah Binti Azmi

## ACKNOWLEDGEMENTS

Special thanks to my supervisor, Mrs. Nur Fatimah Binti Azmi for her support, idea, knowledge and sharing her experience to fulfill the objective of this final year project. With her support I gain knowledge from this project. I have learned a lot of project management skill which include the time and cost effective to realize the project.

Also thanks to my friend for spending their time teaching me about the PIC controller connection and teaching me about PIC C Compiler, which seems to be very difficult for me to understand before. Million thanks to all my friends that giving me so much supports to obtain the output of this project.

Lastly, thank you to all of my family that has spending many time and money to give a never-ending support. Without them my life would be nothing.

## ABSTRACT

This project is designed to make home automation easy to control their home appliance when a user is not at home. The project is designed to allow effective use of a mobile phone to control appliances in the home. GSM technology is used in this project and the development of the control system will be carried out using SMS. This will communicate with another mobile phone, which in turn controls the devices attached to microcontroller modules. When the action has been carried out then a response is sent to the user. The project involves three main areas, research, development, programming, testing and the writing of the report.

## ABSTRAK

Projek ini dicipta untuk membuat automasi rumah yang memudahkan pengguna untuk mengawal peralatan di rumah apabila ketiadaan mereka di rumah. Projek ini direka untuk membolehkan penggunaan yang lebih efektif menggunakan telefon mudah alih untuk mengawal peralatan di rumah. Teknologi GSM digunakan dalam menjalankan projek ini dan pembangunan system kawalan akan dijalankan menggunakan SMS. Hal ini membolehkan komunikasi dengan telefon mudah alih yang lain, seterusnya mengawal peralatan elektronik yang disertakan dengan modul mikropengawal. Apabila tindakan telah dijalankan, maka jawapan dihantar kepada pengguna. Projek ini melibatkan tiga bidang utama iaitu penyelidikan, pembangunan, pengaturcaraan, pengujian dan penulisan laporan.



## CONTENTS

CHAPTER	TITLE	PAGES
	<b>PROJECT TITLE</b>	i
	<b>DECLARATION FORM</b>	ii
	<b>DECLARATION</b>	iii
	<b>SUPERVISOR DECLARATION</b>	iv
	<b>DEDICATION</b>	v
	<b>ACKNOWLEDGEMENT</b>	vi
	<b>ABSTRACT</b>	vii
	<b>ABSTRAK</b>	viii
	<b>CONTENTS</b>	ix
	<b>TABLE LIST</b>	xiii
	<b>FIGURE LIST</b>	xiv
	<b>ABBREVIATIONS LIST</b>	xvi
	<b>APPENDIX LIST</b>	xvii
<b>I</b>	<b>INTRODUCTION</b>	
	1.1 Introduction of the project	1
	1.2 Objective	2
	1.3 Scope of work	2
	1.4 Problem Statement	3
	1.5 Advantages of GSM	3

1.6	Peripheral Interface Controller advantages	3
1.7	Project Basic operation	4
1.8	The comparison between GSM control system and others smart home system	5
1.9	The comparison between GSM control system and without GSM control system	6

## **II LITERATURE REVIEW**

2.1	GSM Module	7
2.2	Introduction to PIC microcontroller	10
	2.2.1 Pin Description	12
	2.2.2 Memory	16
2.3	USB ICSP PIC Programmer (UIC00B)	17
2.4	Introduction to SK-40B	17
2.5	MPLAB IDE Compiler	18
	2.5.1 Implementing the Embedded System with MPLAB IDE	19
2.6	Global System for Mobile Communication	19
2.7	Transistor	20
	2.7.1 Category of transistor	21
	2.7.2 Bipolar Junction Transistor (BJT)	21
	2.7.3 Field Effects Transistor (FET)	22
	2.7.4 Transistor	23
2.8	MAX232 IC Chip	23
2.9	Relay	24
3.0	Voltage Regulator	24

**III PROJECT METHODOLOGY**

3.1	Project Methodology flowchart	27
3.2	Flowchart for Software Programming	29
3.3	MPLAB IDE Compiler Program	30

**IV CIRCUIT OPERATION**

4.1	General Description	31
4.2	Power Supply Circuit	33
4.3	PIC16F887 (Microcontroller)	22
4.4	MAX232 Circuit	35
4.5	Relay	36

**V RESULTS AND DISCUSSION**

5.1	Results	38
5.2	PIC programming Result	40
5.3	Hardware Result	42
5.4	Discussion	52
5.4.1	Hardware Development	52
5.4.2	Software Programming (PIC microcontroller)	52

<b>VI</b>	<b>CONCLUSSION AND RECOMMENDATION</b>	
6.1	Conclusion	54
6.2	Recommendation	55
	<b>REFERENCES</b>	56
	<b>APPENDIX A</b>	58
	<b>APPENDIX B</b>	59
	<b>APPENDIX C</b>	61
	<b>APPENDIX D</b>	63

**TABLE LIST**

<b>TABLE</b>	<b>TITLE</b>	<b>PAGES</b>
1.1	The comparison between GSM control system and others smart home system	5
1.2	The comparison between GSM control system and without GSM control system	6
2.1	Table lists of the AT commands	20
5.1	Hardware Results	39

## FIGURE LIST

FIGURE	TITLE	PAGES
2.1	TC35 external circuit	8
2.2	GSM module connected through a serial port with MCU	8
2.3	Circuit diagram of the GSM Module	9
2.4	PIC16F887	11
2.5	USB ICSP PIC Programmer (UIC00B)	17
2.6	SK-40B cytron	18
2.7	BJT and JFET symbols	21
2.8	Bipolar Junction Transistor	22
2.9	MAX 232 IC	23
2.10	Voltage Regulator	24
2.11	Circuit Diagram of Power Supply	25
3.1	Project Methodology Flowchart	27
3.2	Software Programming Flowchart	29
3.3	MPLAB IDE compiler program	30
4.1	Block diagram of the project	32
4.2	Power supply circuit	33
4.3	PIC16F887/884	37
4.4	MAX232 circuit	36
4.5	Relay for switching	37
5.1	PIC programming test with virtual schematics	40
5.2	Output from virtual terminal	40
5.3	System flowchart	42
5.4	The GSM control hardware	43

5.5	Lamp switch on activated	44
5.6	SMS received	44
5.7	Lamp switch off activated	45
5.8	SMS received	45
5.9	High speed of fan switch on activated	46
5.10	SMS received	46
5.11	High speed of fan switch off activated	47
5.12	SMS received	47
5.13	Medium speed of fan switch on activated	48
5.14	SMS received	48
5.15	Medium speed of fan switch off activated	49
5.16	SMS received	49
5.17	Lower speed of fan switch on activated	50
5.18	SMS received	50
5.19	Lower speed of fan switch off activated	51
5.20	SMS received	51
5.21	Software programming (PIC microcontroller)	53
A.1	PIC16F887 datasheet	58
B.1	PIC coding	59
C.1	Wavecom GSM modem kit	61
C.2	Modem RS232 port pin-out	62
C.3	Wavecom GSM technical specification	62
D.1	MAX232 pin connection	63
D.2	MAX232 board schematic	63
D.3	ULN2003 pin connection	64

## LIST OF ABBREVIATIONS

GSM	-	Global System for Mobile Communication
SMS	-	Short Messaging Service
PIC	-	Peripheral Interface Controller
RISC	-	Reduced Instruction Set Computing
SRAM	-	Static random-access memory
DC	-	Direct Current
AC	-	Alternate Current
LED	-	Light Emitting Diode
ADC	-	Analog Digital Converter
I/O	-	Input/ Output
RAM	-	Random Access Memory
EEPROM	-	Electrically Erasable Programmable Read-Only Memory
RXD	-	Received eXchange Data
TXD	-	Transmitted eXchange Data
PSM	-	Projek Sarjana Muda
V <sub>cc</sub>	-	Collector voltage
V <sub>GND</sub>	-	Ground Voltage
IC	-	Integrated Circuit



**APPENDIX LIST**

<b>APPENDIX</b>	<b>TITLE</b>	<b>PAGES</b>
A	PIC16F887 Datasheet	58
B	PIC coding	59
C	Wavecom GSM modem kit	61
D	MAX232 and ULN2003 circuit schematics	63

## **CHAPTER I**

### **INTRODUCTION**

This chapter will discuss a brief about the introduction of the project. Where, it state about the purpose of the project, objective, scope of work, problem statement and advantage acquire from the project.

#### **1.1 Introduction of the project**

The development of digital information has led the rapid change in human lifestyle. The use of electricity is very important as one of the main source of energy that is vital in today modern life. Some kinds of mechanism using available technology could be used to reduce wastage in electricity usage. Thus a prototype based on a microcontroller device using SMS is developed. It can automatically control any electrical equipment at home remotely using mobile phone. Hence the electrical energy saving in daily life can be made more efficient and effective. As the technology grows, SMS technology has been widely accepted as a part of medium of communication. The purpose of using SMS is to provide widest coverage at minimal cost. Therefore the use of SMS would facilitate in controlling the electrical device at home from long distance and low in maintenance and independent from any physical geographical boundary. At the present time, people use electrical energy as one of the main source of power of energy to operate any electrical device or appliance. Most of the people turn on the light for 24 hours per day when they are away from

home. Leaving the light turned on continuously, lead to energy waste. Thus this project is proposed to develop a system is to facilitate the home owner to optimize usage of electricity remotely using SMS. Thus this research is carried out to provide a mechanism through the development of a prototype to provide a service to the home owner to optimize the usage of electricity through remote control using SMS services.

## **1.2 Objective**

The objective of this project is:

- To build a GSM control for home appliances.
- To develop a system that allows for a user to remotely control and monitor multiple home appliances using a cellular phone.
- To implement a microcontroller-based control module that receives its instructions and command from a cellular phone over the GSM network.

## **1.3 Scope of work**

There are 4 steps to developed the project.

### **1.3.1 Research about the problem statement:**

- Find information from books, internet and supervisor point of view.
- Study about the PIC programming.
- Study about the global system for mobile communication(GSM).

### **1.3.2 Design and build the hardware part:**

- Simulate the GSM control circuit using the Proteus Isis software.
- Test the GSM control circuit on the breadboard.

### 1.3.3 Design software programming:

- Design PIC programming using PIC C compiler.
- Test run and troubleshoot the program.
- Request the components for this project.

### 1.3.4 Test run and troubleshoot:

- Link the hardware and the software.
- Tests run the project and troubleshoot if needed

## 1.4 Problem statement

Below show the problem possibilities occur without the GSM control System:

- The user cannot control their home appliances when they are not at home.
- Worried about the wastage of electricity when the home appliances are not switch off.

## 1.5 Advantages of GSM

GSM is more stable network with robust features. GSM also have a less signal deteriorations in the buildings and able to use repeaters. Talk time is generally higher in GSM phones due to the pulse nature of transmission. The availability of Subscriber Identity Modules allows users to switch networks and handsets at will. GSM covers virtually all parts of the world so international roaming is not a problem

## 1.6 Peripheral Interface Controller (PIC) advantages

- **Flexibility:** One single Peripheral Interface Controller (PIC) can be used many times.

- **Low Cost:** Prices of Peripheral Interface Controller vary from few hundreds to few thousand. User can use the microcontroller many times.
- **Testing:** A Peripheral Interface Controller program can be tested and evaluated in a lab. The program can be tested, validated and corrected.
- **Visual observation:** When running a PIC program a visual operation can be seen on the screen. Hence, troubleshooting a circuit is really quick, easy and simple.
- **Space Efficient:** Today's Peripheral Interface Controller memory is getting bigger and more complex. It is small design device which can operate as small computers.
- **Reliability:** The PIC controlled system often resides machines that are expected to run continuously for many years without any error and in some cases recover itself if an error occurs.
- **Performance:** Many of PIC based embedded system use a simple pipelined RISC processor for computation and most of them provide on-chip SRAM for data storage to improve the performance.
- **Power consumption:** A PIC controlled system operates with minimal power consumption without sacrificing performance. Power consumption can be reduced by independently and dynamically controlling multiple power platforms.
- **Memory:** Most of the PIC based systems are memory expendable and will help in easily adding more and more memory according to the usage and type of application.

### 1.7 Project Basic operation:

Normally, peoples always forget to turn off the switch before leave the house. Then the users must turn back home to turn off the switch manually. These scenarios are uncomfortable mostly for users who are busy with their works. Most of the people will turn on the light when they leave their house for a couple of days for a

safety reason, but this will waste the electricity. Therefore, this application will try to solve these problems. It will let the users to control switch at home through their mobile. Users can control their home appliance by using a mobile.

The project is aimed at developing and testing the use of mobile phones to remotely control an appliance control system. The microcontroller would then control a device based on the information given to it. The proposed solution will need to be easy to use, simple, secure, robust, and be useful on most mobile phones. To achieve this testing will need to be carried out to create a useful system.

### 1.8 The comparison between GSM control system and others smart home system.

Table 1.1: The comparison between GSM control system and others smart home system.

No.	Other available Smart Home System	GSM control system
1	Can be control by :- i. Mobile phone (GSM module) ii. Internet (Ethernet module)	Can be control by:- i. Mobile phone (GSM module)
2	Control ON/OFF only	Control speed of fan
3	i. Price: Too expensive to be built. ii. The circuit and the programming more complex. iii. For professional operation and suitable for industrial.	i. Price: Far cheaper than other technology. ii. The circuit and the programming are easier. iii. Friendly user and suitable for home user.

### 1.9 The comparison between GSM control system and without GSM control system.

Table 1.2: The comparison between GSM control system and without GSM control system.

No.	Without the System	With the System
1	Turn ON or OFF manually.	Remotely control by using mobile phone
2	Did not know home appliance status.	Did know home appliances status
3	Cannot control if not at home	Can control everywhere as long in coverage network

## **CHAPTER II**

### **LITERATURE REVIEW**

In this chapter, it will discuss about the literature review which it contains the information gathered to gain knowledge and ideas in completing the project. There are several sources that have been taken as a resource such as books, thesis, journal and website.

It was included the operation of the circuit, the hardware and software which is useful in the project.

#### **2.1 GSM Module**

GSM SMS Module makes TC35 as the core. GSM communication module is the key component to achieve data transmission of the system and which is the system's wireless interface part. The system mainly communicates through the GSM SMS. Based on journal [1] and [3], the project is mainly about a design of a GSM SMS (Short Message Service) remote appliance control system. This project used TC35 Series modules of Siemens which can work under the GSM900MHz and GSM1800MHz band [1], [3]. It is designed to provide users with a solution of convenient wireless voice and data connectivity that can be widely used in GSM-related platform, which allows users to build their own minimum cost wireless