



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DEVELOPMENT OF HOME APPLIANCES CONTROLLER  
VIA PHONE SYSTEM**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia  
Melaka (UTeM) for the Bachelor Degree of Engineering Technology  
(Industrial Electronics) (Hons.)

**AMANINA ZAHIDAH BINTI ANUAR**

**B071310756**

**941011-14-5470**

**FACULTY OF ENGINEERING TECHNOLOGY**

**2016**

## **ABSTRAK**

Pada zaman kini, kebanyakan manusia akan pergi ke tempat kerja mereka seawal yang mungkin bagi mengelakkan kesesakan lalu lintas terutamanya di bandar besar. Mereka cenderung untuk terlupa memeriksa sama ada mereka telah mematikan peralatan rumah seperti kipas dan lampu. Situasi ini akan membawa kepada pembaziran elektrik akibat kecuaiian manusia. Sistem Global untuk Komunikasi Mudah Alih (GSM) telah terbukti menjadi alat komunikasi yang berkesan dan cekap melalui jarak yang jauh dengan menggunakan satelit telekomunikasi. Objektif utama peralatan rumah pengawal melalui sistem telefon ini adalah untuk membangunkan satu sistem di mana pengguna dapat mengawal perkakas rumah dengan menggunakan telefon selular melalui modul GSM dan melaksanakan modul kawalan berasaskan Arduino yang menerima arahan daripada telefon selular melalui rangkaian GSM. Projek ini akan dapat mengawal perkakas rumah, menghidupkan atau mematikan dengan menghantar mesej melalui telefon bimbit. Projek ini terdiri daripada dua bahagian penting iaitu pembangunan perkakasan dan pembangunan perisian. Pembangunan perkakasan ini direka dengan menggunakan perisian Fritzing versi 0.9.3b. Ia merangkumi hubungan antara modul GSM, pengawal antara muka Arduino dan litar utama. Sementara itu, perisian ini direka dengan menggunakan perisian Arduino IDE VERSI 1.6.5-r5

## **ABSTRACT**

Nowadays, people mostly will go to their work place as early as possible to avoid traffic jammed especially at the main city. They tend to forget to check whether they had turn off their home appliances such as lamp and fan. This situation can led to the electricity wastage due to the human negligence. Global System for Mobile Communication (GSM) has been proven to be an effective and efficient communication device over a long distance using the telecommunication satellite. The main objective of home appliances controller via phone system is to develop a system where user able to control household appliances by using cellular phone through GSM module and to implement a Arduino microcontroller-based control module that receives instruction from cellular phone over GSM network. This project will able to control household appliances ON and OFF by sending messages through. This project mainly consist of two important parts which are hardware development and software development. The hardware is designed by using Fritzing version 0.9.3b. It covers the connection between GSM module, Arduino microcontroller and the main circuit circuit. Meanwhile, the software is designed by using Arduino IDE 1.6.5-r5 software.

## **DEDICATION**

Dedicated, in thankful appreciation for support, encouragement and understandings  
to my beloved mother and father, brother and sister,  
and as well as my supportive friends

## **ACKNOWLEDGEMENT**

Alhamdulillah grateful to Allah, I have done my thesis and submitted it on time given. A lot of challenge I have to face in order to finish this thesis as well as the final year project. However, I feel grateful because I learn a lot and get a new experiences that I think very valuable in my life.

I would like to wish a million thank you to my supervisor, Engr. Mohd Syahrin Amri bin Mohd Noh because guide me very well, giving and sharing opinion and also willingness to help me in completing my final year project

My sincere appreciation also goes to my family especially my father Anuar bin Yaacob and my beloved mother Zakiah binti Musa who has been so tolerant and supportive in every aspect. Thanks for their continuous encouragement, love and emotional supports that they had given to me all this while.

I also would like to thank to all my friends who had given me helps technically and mentally throughout my journey in completing this project. I thank you from the bottom of my heart.

## TABLE OF CONTENT

Abstrak	i
Abstract	ii
Dedication	iii
Acknowledgement	iv
Table of Content	vi
List of Tables	vii
List of Figures	viii
List Abbreviations, Symbols and Nomenclatures	ix
<b>CHAPTER 1: INTRODUCTION</b>	<b>1</b>
1.0 Introduction	1
1.1 Introduction to Project	1
1.2 Background of the Project	2
1.3 Problem Statement	3
1.4 Objective of the Project	3
1.5 Scope of the Project	4
1.6 Report Outline	4
<b>CHAPTER 2: LITERATURE REVIEW</b>	<b>6</b>
2.0 Chapter Overview	6
2.1 Type of Remote Monitoring	7
2.2 Previous Project Analysis	8

2.2.1	Internet based monitoring	8
2.2.2	Remote monitoring using Wireless Sensor Networks, Bluetooth, Wi-Fi, ZigBee Technologies	9
2.2.3	GSM-SMS based monitoring	10
2.2.4	Findings from Previous Project	11
2.3	Software and Hardware Review	12
2.3.1	Hardware Review	12
2.3.1.1	Types of Microcontroller	12
2.3.1.2	Arduino	12
2.3.1.2.1	Arduino UNO	13
2.3.1.3	Cellular Phone	15
2.3.2	Software Review	16
2.3.2.1	Arduino IDE	16
2.3.2.2	Summary of GSM Technology	18
2.3.2.3	Advantages of GSM	18
2.3.2.4	GSM Modem	19
	<b>CHAPTER 3: METHODOLOGY</b>	<b>20</b>
3.0	Project Planning	20
3.1	System Design	23
3.2	Flowchart of Circuit Operation	25
3.3	Software Development	27
	<b>CHAPTER 4: RESULT AND DISCUSSION</b>	<b>30</b>
4.0	Introduction	30

4.1	Hardware Development	30
	4.1.1 Overall Result	31
	4.1.2 Hardware Result	32
4.2	Software Development	33
4.3	Analysis Process	36
4.4	Troubleshooting Process	37

**CHAPTER 5: CONCLUSION AND RECOMMENDATION** **38**

5.1	Conclusion	38
5.2	Recommendation	39

**REFERENCES** **40**

**APPENDICES**

A	Source Code Arduino
B	Gantt Chart



## LIST OF TABLES

2.0	Research about internet based monitoring	8
2.1	Research about remote monitoring	9
2.2	Research about GSM-SMS based monitoring	10
2.3	Comparison between GSM control system and other monitor control system	11
2.4	Research about GSM-SMS based monitoring	11
2.5	Arduino UNO Characteristics	14
3.1	List of Messages	28
4.1	Example of Messages	32
4.2	Average Time Taken to Transmit SMS	36

## LIST OF FIGURES

2.1	Type of Arduino	13
2.2	Arduino UNO R3	14
2.3	Screenshot of the Arduino IDE	16
2.4	Screenshot of the two main function	17
3.1	General flowchart of the project	21
3.2	System block diagram	24
3.3	Diagram of project flowchart	25
3.4	Diagram of software development	27
4.1	Figure of Circuit Activated	31
4.2	Code description for LCD Programming Library	33
4.3	Code description for Serial Communication	33
4.4	Code description for receiving Serial Data	34
4.5	Code description for data been stored in a string	34
4.6	Code description to perform relative operation	35

## **LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE**

GSM	-	Global System for Mobile Communication
SMS	-	Short Message Service
LCD	-	Liquid Crystal Display
I/O	-	Input/Output
IDE	-	Integrated Development Environment
AT	-	Attention
TDMA	-	Time Division Multiple Access
ISDN	-	Integrated Services Digital Network
USB	-	Universal Serial Bus
PC	-	Personal Computer
LED	-	Light Emitting Diode
SIM	-	Subscriber Identity Module
ATA	-	Advanced Technology Attachment
RFID	-	Radio Frequency Identification

# **CHAPTER 1**

## **INTRODUCTION**

### **1.0 Introduction**

This chapter will briefly explain each of the background of the project, objective, statement of problem and project scope in detail. Lastly, the report outline of this thesis will be explained in details.

### **1.1 Introduction to Project**

The Global System for Mobile Communications (GSM) based Control System is a new type of applications in Mobile Communications technology. By using Global System for Mobile Communications technology, a system that has been recommended will act as an embedded system that can observe and control appliances or any other devices locally using built-in input and output peripherals (Baig, Beg, & Khan, 2012).

In this project, the proposed system will allows the user to control their home appliances such as fan and lamp through mobile phone by sending commands in the form of Short Message Service (SMS). The main concept of this project is the system will receive the SMS that been sent and process it further as been required to perform several operations (Baig et al., 2012). The type of the operation to be performed depends on the status of the Short Message Service (SMS) sent. Short Message Service or also known as SMS is a service that available on most digital mobile phones that permit the sending of short message, also known as text messaging service.

## 1.2 Background of the project

In this new era of technology, communication had been reformulate (Ahmed & Ladhake, 2011). Most of the people nowadays have an access to mobile. In any given moment, any particular individual able to be contacted with only using the mobile phone. However, the user would not glad if the application of mobile phone been restricted with only by sending SMS or starting a conversations. A new innovations or fresh ideas need to be generated from it for the application can boost to its maximum proficiencies. Technologies that been cultivate in recent years such as Infra-red and Bluetooth has already exposed a fact that developments are in fact is possible and these developments have improved human's life.

At the present time, mobile phone can also been used to send text messages apart from supporting voice calls. This text messages are included multimedia message that may contain either a pictures, graphics or animations. Sending written text messages is very popular among mobile phone users. This type of messages are also known as instant messaging, allows quick transmission of short message that permit an individual to share their ideas, opinions and other relevant information.

In this project, the concept that will be applied to the system is by receiving messages that will act as a commands to control different appliances that had been connected with the Global System for Mobile Communications technology. With this, the user will able to control the home appliances by sending command to switch on or switch off the home appliances.

### **1.3 Problem Statement**

Nowadays, most of the people will leave for work early in the morning and get back only in the evening or worst, at night due to journey to the other cities for their workplace. When they are away, they tend to forget whether their home appliances been turned off or turn on. Hence, case like wastage of electricity often happen. The best resolution is to improve a home appliances control system by using a wireless in order to keep control of their appliances status when they are not at home. Based on the events above, the project that been developed able to make simplify the user works. It is significant because the system also can be a great assistance for disabled and elderly through the awareness of a fully automated home. Therefore, this projects will develop the home appliances that can control lamp and fan, either been turned on or off in the house.

### **1.4 Objective of the Project**

Based on the above problem statement, the main objective is to create and improve a home appliance control where the user can control their home appliances by using cellular phone through SMS. The system that been develop can only control two types of home appliances which are lamp and fan only. Another objective of this project is to avoid wastage due to the human negligence.

## **1.5 Scope of Project**

The scope of this projects are divided into two part, the hardware development and software development. In order to build the hardware part, the design circuit for the overall systems will cover the GSM and Arduino UNO as a central microcontroller. The circuit design will then connect to computer interface and mobile phone device. The home appliances that will be covered in this project are only fan and lamp.

The software part for this project will be using the open-source Arduino Software (IDE) to make it easy to write the code and upload it to the board.

## **1.6 Report Outline**

This thesis is divided into five chapter. Chapter 1 consists of introduction of project that covers the project background, objective, scope of this project, the problem that occurs before this project been implement and expected outcome for the project. Chapter 2 is about review based on previous research that have been done by researcher regarding system for remote monitoring and control. This chapter also will provide an assessment on the research of the components and software that are used in this project. In chapter 3, it discuss the methodology and approach that will be used in order to develop this project. The chapter 4 are discusses about the result and discussion and the last chapter, Chapter 5 will summarizes this project, discusses the limitations of this project and suggests possible future works.

The following are the main chapters and its descriptions:

Chapter 1: Research about the background and scope of the project.

The first chapter is about project introduction, the main objective of this project to develop where it is a system that user able to control household appliances by using cellular phone through GSM module and the scope of this project only cover two types of home appliances, fan and lamp.

Chapter 2: Literature review about related project for home security system.

This chapter explained on the previous past project that related with Global System for Mobile Communications control system. Advantages and disadvantages of the previous project are stated so that this project can improve the disadvantages of the previous project. This chapter also review in detail about the parts in the circuit.

Chapter 3: Description about the project methodology flowchart, software methodology flowchart and circuit.

This chapter explained in detail about the project methodology that been used in the project as well as the design of circuit diagram, software development and also the flowchart circuit operation

Chapter 4: Software and hardware implementation and results.

In this chapter, it will focuses more on hardware development, programming on microcontroller for Global System for Mobile Communication (GSM) modem to send SMS. This chapter also will review the results that able to obtain from hardware and how AT command is constructed



## Chapter 5: Conclusion and future recommendation for the project

The last chapter will review the overall project whether the implemented solution is meet the objective of the project. Discussion on problems that encountered, conclusion and recommendation for this project also will be discuss in this chapter.

The project is divided into several chapter to ensure the project work in systematic so that the project will be able to implement smoothly.

# **CHAPTER 2**

## **LITERATURE REVIEW**

### **2.0 Chapter Overview**

This chapter been carried out with objective to increase required knowledge and skills in order for this project to be completed. The main references for this project are from the previous project and thesis that is related to this project. The sources are also able to be obtained from books, journals and articles from internet. Therefore, this chapter deliberates the projects and theses that related to this project. This chapter also deliberates a correlated studies that been conducted. Hence, by doing analysis from the project that been done by other researchers, there is a chances to know what characteristics are lacking in their project in order to develop a successful project.

### **2.1 Type of remote monitoring**

There are many systems for remote monitoring and control design as commercial products or experimental research platforms (Ahmed & Ladhake 2011). Most of the research that had been carried out belongs to one of the following categories:

- Internet based Monitoring using Servers and GPRS modems
- Monitoring using Wireless Sensor Networks, Bluetooth, Wi-Fi, ZigBee Technologies
- GSM-SMS protocols using GSM module individually or in combination with Internet Technologies

## 2.2 Previous Project Analysis

### 2.2.1 Internet based monitoring

One of the common approaches in remote monitoring is internet monitor. Many researches have worked in field of internet based remote monitoring. Table 2.0 is a summary researches that have been done about internet based monitoring.

Table 2.0: Research about internet based monitoring

Researcher	Project Description	Advantage	Disadvantage
Alkar and Buhur,2005	<ul style="list-style-type: none"><li>Implement Internet based wireless flexible solution where home appliances are connected to slave node. The slave node communicate with master node through RF and master node has serial RS232 link with PC server. The nodes are based on PIC16877<math>\mu</math>c</li></ul>	Efficient	Costly and complicated
Yuksekkaya et al, 2006	<ul style="list-style-type: none"><li>Developed wireless home automation system by merging communication technologies of GSM, Internet and speech recognition. GSM and Internet methods were used for remote access of devices of house whereas speech recognition was designed for users inside the house</li></ul>	Easy to use because use speech recognition	Expensive to build

## 2.2.2 Remote monitoring using Wireless Sensor Networks (WSN), Bluetooth, Wi-Fi, ZigBee Technologies

Wireless technologies such as RF, Wi-Fi, Bluetooth and ZigBee have been developed as remote monitoring systems due to its flexibility, low operating cost, etc. (Alkar & Buhur 2005). Table 2.1 is a summary researches that have been done about remote monitoring.

Table 2.1: Research about remote monitoring

Researcher	Project Description	Advantage	Disadvantage
Kanma et al., 2003	<ul style="list-style-type: none"> <li>Proposed a home appliance control system over Bluetooth with a cellular phone, which enables remote-control, fault-diagnosis and software update for home appliances through Java applications on a cellular phone</li> </ul>	Low operating charges	Complicated to implement
Wijetungey et al., 2008	<ul style="list-style-type: none"> <li>Designed a general purpose controlling module designed with the capability of controlling and sensing up to five devices simultaneously. The communication between the controlling module and the remote server is done using the Bluetooth technology</li> </ul>	Easy to build	Limited only to five devices

### 2.2.3 GSM-SMS based monitoring

With the wide spread use of cellular networks, this approach is also popular when small amount of data is to be transferred through the networks.

Table 2.2: Research about GSM-SMS based monitoring

Researcher	Project Description	Advantage	Disadvantage
Alheraish ,2004	<ul style="list-style-type: none"> <li>Implemented home security system by means of GSM cellular communication network using microcontroller 89X52 and Sony Ericsson GM-47 GSM module. This system enables far end user through SMS facility to monitor the state of home door, provide password facility for key based door lock and control home lighting system</li> </ul>	Provide security as well as control home appliances	If the SIM gets lost, user will lose all the data
Van Der Werf et al., 2005	<ul style="list-style-type: none"> <li>Proposed a mobile-based home automation system that consists of a mobile phone with Java capabilities, a cellular modem and a home server. The home appliances are controlled by the home server which operates according to the user commands received from the mobile phone via the cellular modem</li> </ul>	Easy to build	If the SIM gets lost, user will lose all the data

## 2.2.4 Findings from Previous Project

From the previous project, there are several findings that able to extract. Table 2.3 and Table 2.4 are a summary about the comparison between control system using GSM and without GSM control system.

Table 2.3: Comparison between GSM control system and other monitor control system

<b>Other monitor and control system</b>	<b>GSM control system</b>
Can be control by : i. Mobile phone (GSM module) ii. Internet	Can be controlled by : i. Mobile phone (GSM module)
For professional operation and suitable for industrial	Friendly user and suitable for home user
The circuit and the programming more complex	The circuit and the programming are easier
The price are too expensive in order to build	Far cheaper than other technology

Table 2.4: Research about GSM-SMS based monitoring

<b>Without the GSM control system</b>	<b>With the GSM control system</b>
Turn ON or OFF manually	Remotely control by using mobile phone
Did not know home appliances status	Able to know about home appliances status
Cannot control if not at home	Can control everywhere as long in coverage network

## **2.3 Software and Hardware Review**

### **2.3.1 Hardware Review**

#### **2.3.1.1 Types of Microcontroller**

There are various type of microcontroller that available in today's market such as Arduino, Raspberry Pi and 8051. This part will discuss about the microcontroller that been selected in the project. Arduino microcontroller been chosen in this project due to the special characteristic and its advantages compared to the other microcontroller.

#### **2.3.1.2 Arduino**

Arduino is an open-source electronics type of microcontroller development that based on its flexible, easy-to-use hardware and software. This is one of the special characteristics of Arduino, able to provide an easy way to develop a project instantly. By using Arduino, the user can simply load necessary code and it can read sensors or perform some actions based on the input that come from buttons or motor. Arduino boards were built around the AVR microcontroller that act as the base. Arduino software are been provided with software libraries that been written and this are available for free. Arduino was created at Ivera Interaction Design Institute and it's aimed for student without education in electronics and programming (Smith, Alan G., 2011). There are many types of Arduino that available in the market such as Arduino UNO, Arduino Pro, Arduino Mini and Arduino Mega. This various type of Arduino can be differentiate based on its own characteristics.



Figure 2.1: Types of Arduino

### 2.3.1.2.1 Arduino UNO

Arduino Uno or also known as Genuino Uno is a family type of microcontroller board that based on the ATmega 328P. This type of Arduino consists of characteristics such as 14 digital input/output pins and 6 of it can be used as PWM outputs, 6 analog inputs, a 16MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything that needed in order to support the microcontroller.

This type of Arduino can simply being used as it only need to connect to a computer with a USB cable or give a power AC-to-DC adapter or by using a battery. This simple step able to start the microcontroller. In Italian language, “Uno” means one and this term was chosen to mark the release of Arduino Software (IDE) (Smith, Alan G.,2011)