



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**SECURITY HAZARDS ALERT AND PREVENTION SYSTEM IN
SPECIFIC AREA IN INDUSTRY BY USING GSM**

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

by

AHMAD SALWAN BIN YAHAYA

B071110135

920503025835

FACULTY OF ENGINEERING TECHNOLOGY

2015

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: Security Hazards Alert And Prevention System In Specific Area In Industry By Using GSM

SESI PENGAJIAN: 2014/15 Semester 1

Saya **AHMAD SALWAN BIN YAHAYA**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (✓)

- SULIT (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub 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)

(TANDATANGAN PENYELIA)

Alamat Tetap:

Cop Rasmi:

No 57, Kampung Gajah Mati

06700 Pendang

Kedah,

Tarikh: _____

Tarikh: _____

** Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declared this report entitled “Security Hazards Alert and Prevention System in Specific Area in Industry by Using GSM” is the result of my own research except as cited in the references.

Signature :
Author’s Name : AHMAD SALWAN BIN YAHAYA
Date :

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor's Degree in Electronics Engineering Technology (Industrial Electronics) with Honours. The member of the supervisory is as follow:

.....

(Project Supervisor)

ABSTRACT

This report is based on Global System for Mobile Communication (GSM) networks for the monitoring and preventing solution from hazard conditions of gas leakage, humidity and dangerous temperature in different site area for industries. This system provides ideal solution for monitoring critical plant on open place in industry which involves workers. The system is wireless and it use the Graphical User Interface (GUI) to update phone number therefore more adaptable and cost-effective. This system was used gas leakage sensor, temperature sensor and humidity sensor. The system can detect gas leakage and the reading of temperature and humidity at different area in industry. The GSM modem is use to send alert about the gas leakage, dangerous temperature and humidity through Short Message Service (SMS). Whenever the system detects the increase in the gas leakage, dangerous temperature and humidity in different site area, it immediately alerts by activating an alarm, light emergency and simultaneously sending message to the specified mobile phones. The exhaust fan is switched on only at the gas leakage and dangerous temperature site. The device ensures safety and prevents suffocation and explosion.

ABSTRAK

Laporan ini adalah berdasarkan Sistem Global untuk Komunikasi Mudah Alih (GSM) untuk memantau dan mencegah masalah yang melibatkan kebocoran gas, kelembapan dan suhu yang berbahaya di kawasan berasingan di dalam industri. Sistem ini memberi penyelesaian yang ideal untuk memantau keadaan kilang yang melibatkan penggunaan tenaga pekerja. Sistem ini adalah tanpa wayar dan menggunakan Antara Muka Grafik Pengguna (GUI) yang membolehkan pengguna menukar nombor telefon iaitu mudah digunakan dan melibatkan kos yang efektif. Sistem ini menggunakan pengesan kebocoran gas, pengesan suhu dan pengesan kelembapan. Sistem ini boleh mengesan kebocoran gas dan bacaan suhu dan bacaan kelembapan di kawasan berasingan di dalam industri. Modem GSM adalah digunakan untuk memberi amaran mengenai kebocoran gas, suhu berbahaya dan kelembapan berbahaya melalui Servis Pesanan Ringkas (SMS). Apabila sistem ini mengesan peningkatan dalam kepekatan kebocoran gas, suhu berbahaya dan kelembapan berbahaya di kawasan yang berbeza, ia segera memberi amaran dengan mengaktifkan penggera, isyarat lampu, dan pada masa yang sama menghantar mesej kepada telefon bimbit yang tertentu. Kipas ekzos akan dihidupkan dalam keadaan yang melibatkan kebocoran gas dan suhu berbahaya. Sistem ini dapat memastikan keselamatan dan mencegah sesak nafas akibat kebocoran gas dan letupan.

DEDICATION

I dedicate my thesis work to my family and my fellow friends. A special feeling of gratitude I would like to give to my loving parents, Encik Yahaya Bin Abd Hamid and Puan Mashitah Binti Haji Ghazali which give encouragement for me to complete this final year project degree report.

ACKNOWLEDGEMENT

First and foremost, I would like to take this opportunity to express my sincere acknowledgement to my supervisor Encik Ahmad Nizam Bin Mohd Jahari @ Mohd Johari from the Faculty of Engineering Technology, Universiti Teknikal Malaysia Melaka (UTeM) for his essential supervision, support and encouragement towards the completion of this project.

Special thanks to all my peers, my mother, beloved father and siblings for their moral support in completing this final year project degree report. Lastly, thank you to everyone who had been to the crucial parts of realization of this project.

TABLE OF CONTENT

Abstract	v
Abstrak	vi
Dedication	vii
Acknowledgement	viii
Table of Content	ix
List of Tables	viii
List of Figures	xii
List Abbreviations, Symbols and Nomenclatures	xiii

CHAPTER 1: INTRODUCTION **1**

1.1	Background	1
1.2	Problem Statement	2
1.3	Objective	3
1.4	Scope	3
1.5	Project Significant	4
1.6	Conclusion and Summary	4
1.7	Report Outline	5

CHAPTER 2: LITERATURE REVIEW **6**

2.1	Related work using GSM	6
2.2	Main Equipment used in this project	7
2.2.1	GSM technology	7
2.2.2	GSM architecture	8
2.2.3	GSM Modem: MOD 9001D RS232 GSM/GPRS Modem	9
2.2.4	Microcontroller	10
2.2.5	PIC Microcontroller: PIC16F877A	11
2.2.6	Liquid Crystal Display (LCD)	12
2.2.7	Gas Sensor	13
2.2.8	Temperature Sensor	14
2.2.9	Humidity Sensor	16

2.2.9.1	Recommended Relative Humidity (RH) in production and process environments	17
CHAPTER 3: MATERIALS AND METHODS/METHODOLOGY		20
3.1	Introduction	20
3.2	Project Planning	22
3.3	Software Development	26
3.3.1	Programming Tools: CCS C Compiler for PIC	26
3.3.2	Microsoft Visual Basic to Create Graphical User Interface (GUI)	26
3.3.3	Development of Detector Circuit	29
3.3.4	PIC Programmer	31
3.4	Hardware development	33
3.4.1	Exposing Process	34
3.4.2	Developing Process	35
3.4.3	Etching Process	35
3.4.4	Development of Voltage Regulator Circuit	38
CHAPTER 4: RESULT AND DISCUSSION		39
4.1	Project Result	39
4.1.1	The Operation of Hardware	39
4.2	Analysis of project	52
4.2.1	Analysis of MQ-5 gas sensor	52
4.2.2	Analysis of LM 35 temperature	53
4.3	Discussion	54
CHAPTER 5: CONCLUSION & FUTURE WORK		56
5.1	Conclusion	56
5.2	Project implication	57
5.3	Recommendation for future work improvements	57
REFERENCES		58

APPENDICES

- A Coding of project
- B Gantt chart of final year project activities in FYP 1 and FYP 2
- C Poster for presentation of project
- D Datasheet of microcontroller PIC16F877A

LIST OF TABLES

2.1	Function pin of LCD	13
2.2	Recommended Relative Humidity (RH) in some common production and process environments	18
3.1	Project activities for FYP 1 and FYP 2	23
3.2	Gantt chart of project activities for FYP 1	23
3.3	Gantt chart of project activities for FYP 2	24
4.1	Sensor reading and SMS send to user when sensor trigger at site 1	46
4.2	Sensor reading and SMS send to user when sensor trigger at site 2	46

LIST OF FIGURES

2.1	GSM architecture	9
2.2	MOD 9001D GSM/GPRS Modem	10
2.3	PIC16F877A by Microchip Technology	11
2.4	PIC16F877A Pin Diagram	12
2.5	Liquid Crystal Display (LCD)	12
2.6	MQ-5 gas sensor	14
2.7	LM 35 Temperature sensor	15
2.8	SN-HMD-MOD humidity sensor	17
3.1	Flowchart of procedure project in FYP 1	21
3.2	Flowchart of procedure project in FYP 2	22
3.3	Block diagram of project	25
3.4	CCS C Compiler for PIC	26
3.5	Design form in Microsoft Visual Basic	27
3.6	Coding in Microsoft Visual Basic	28
3.7	The Private Sub (start) and End Sub (end)	28
3.8	Form of Graphical User Interface (GUI)	29
3.9	Proteus Design Suit 8.0 software	30
3.10	Circuit constructed using ISIS Proteus Software	30
3.11	PCB Layout using ARES Proteus Software	31
3.12	USB ICSP PIC Programmer UIC00B	32
3.13	PICkit 2 Programmer	33
3.14	Ultra Violet Light Machine	34
3.15	Developing process	35
3.16	Machine for etching process	36
3.17	PCB board after etching process	37
3.18	Drilled process	37
3.19	The hardware circuit complete with component	38
3.20	Simulation of Voltage Regulator Circuit	38

4.1	Flowchart of project hardware operation	41
4.2	The prototype of the project from in front side	42
4.3	The prototype of the project from upper side	42
4.4	The Set-up of prototype with computer and GSM modem	43
4.5	The system is switched on supply voltage	44
4.6	USB to RS 232 serial port	45
4.7	Graphical User Interface (GUI)	46
4.8	The sensor MQ-5 detect LPG gas	47
4.9	The reading of gas sensor detect in site	48
4.10	SMS send to user	48
4.11	To give the heat for temperature sensor for LM 35	49
4.12	The construction of circuit in Proteus software	50
4.13	Virtual Serial Port Emulator software	50
4.14	Testing the output of hardware from circuit Proteus software	51
4.15	The typical sensitivity characteristics of the MQ-5 for several gases	52
4.16	The typical dependence of the MQ-5 on temperature and humidity	53

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

AUC	-	authentication center
A/D converter	-	analog to digital converter
BTS	-	base transceiver station
BSC	-	base station controller
FYP	-	final year project
GSM	-	global system for mobile communications
GUI	-	graphical user interface
HLR	-	home location register
ISDN	-	height
LPG	-	liquid petroleum gas
LED	-	light emitting diode
LCD	-	liquid crystal display
LM 35	-	temperature sensors
LNG	-	liquefied natural gas
MAX 232	-	dual driver or receiver
MQ-5	-	gas sensor
MSC	-	mobile services switching center
NPN	-	polarities of transistor
OMC	-	angular velocity
PIC 16F877A	-	microcontroller
PSTN	-	displacement
RAM	-	random access memory
ROM	-	read only memory
RTD	-	resistance temperature detectors
RH	-	relative humidity
SnO ₂	-	tin dioxide
SMS	-	short message service
SN-HMD-MOD	-	humidity sensor

CHAPTER 1

INTRODUCTION

This chapter covered project's background, objectives, problem statement, scope of the project and project result. Overview of methodology used was stated. The organization of this report also explained in this chapter.

1.1 Background

This project is microcontroller interface with Graphical User Interface (GUI). The controller system, Global System for Mobile Communications (GSM) modem and GUI is installed at maintenance room in industry which controlled by safety officer worker. The sensors used are temperature, humidity, and gas sensor. This project is to monitor the dangerous temperature, humidity, and gas in different area site which are site 1 and site 2. The GUI is creating to update the number of phone of receiver and it function to send the message in form of Short Message Service (SMS) to give information of dangerous temperature, humidity, and gas. The alert system which installed at each site 1 and site 2 are buzzer and light emergency. For the prevention system, each site 1 and site 2 are installed with exhaust fan which it trigger when detect the dangerous temperature and Liquid Petroleum Gas (LPG). In this project there are mainly three units, microcontroller unit, GSM modem and the GUI which controlled in computer. Microcontroller used to send the output of dangerous temperature, humidity, and gas using serial port RS 232. Then the information is reading in GUI and it sends the information by SMS on updated number using GSM modem. GSM modem can be configured by standard GSM AT command set for sending and receiving SMS and getting modem status. In the

system of microcontroller, the system also always shows the reading of temperature humidity and gas status on LCD.

Hardware requirements:

- (a) Gas sensor
- (b) Temperature sensor
- (c) Humidity sensor
- (d) Microcontroller
- (e) LCD display
- (f) GSM
- (g) MAX 232

1.2 Problem Statement

The problem to control dangerous temperature, humidity and gas leakage is very difficult among safety officer worker especially it involves to control in different site area. The system was proposed is an extended approach to automating a control system for prevention and give faster information through SMS. This system can minimize the energy of safety officer worker to monitor hazard especially which involved temperature, humidity and dangerous gas. This system will be a powerful and flexible tool that will offer this service at any time, and from anywhere with the constraints of the technologies being applied. The problem also comes when the safety officer worker is involved with different individual to control the safety in different site in one place. So, the system must very convenient and the GUI is suitable mechanism to exchange the phone number of different worker. This system is created which the user can exchange the phone number where the GSM modem only sends the information in form of SMS to the updated number phone only. The industry site is very wide, so it's very difficult for maintainer to manage site which are very expose to dangerous situation especially burn and explosion. The specific place in industry is needed to be monitoring its gas leakage, suitable humidity and temperature. There is a need for a system to detect and also prevent leakage of LPG gas, and dangerous temperature and humidity.

1.3 Objective

The objectives for this project are to:

- (a) design and develop system in monitoring hazards of dangerous temperature, humidity and gas in industry
- (b) maintain the safety in industry by create the new system which can be used in alert and prevent hazard
- (c) make system which produce faster information about hazard in industry

1.4 Scope

The system proposed consists of three major sensors namely gas leakage sensor MQ-5, temperature sensor LM 35 and humidity sensor SN-HMD-MOD. All the sensors give the output with PIC microcontroller send information through the serial port RS 232 to the GUI and to the GSM module act as a medium to send the SMS to user. This project uses Microchip's PIC 16F877A, which is an 8 bit microcontroller. The scope of the project is for industry critical plants which are involved many site. So, it's easy for maintainer or safety officer worker to monitor different site for example site 1 and site 2 by using GSM. The system detects the leakage of the LPG gas, dangerous temperature and humidity in different site area which are site 1 and site 2, it immediately alerts by activating an buzzer alarm, light emergency and simultaneously sending message to the specified mobile phones. The exhaust fan is switched on as prevent to exhaust gas leakage and to release excessive heat. The exhaust fan only trigger at the gas leakage site and dangerous temperature site. The additional function of this system is the user can change the phone number where the GSM modem function to send the information about hazard only for number that updated in application on the GUI.

1.5 Project Significant

The system can detect dangerous temperature and humidity and gas at specific area in industry which involve different site. The sensor has excellent sensitivity combined with a quick response time. The gas leakage, dangerous temperature and humidity detected are messaged to the authorized person like technician or safety officer worker using cellular network called GSM. Sending written text messages is very popular among mobile phone users. Instant messaging, as it is also known, allows quick transmission of short messages that allow an individual to share ideas, opinions and other relevant information. This system also use the GUI that function to exchange phone number of user and send the information to GSM modem that act to send message to user.

1.6 Conclusion and Summary

The industry site is very wide, so it's very difficult for maintainer to manage site which are very expose to dangerous situation especially burn and explosion. The specific place in industry is needed to be monitoring its gas leakage, suitable humidity and temperature. There is a need for a system to detect and also prevent leakage of LPG gas, and dangerous temperature and humidity. The paper proposes a wireless solution, based on GSM networks for the monitoring and preventing solution based on hazard conditions of gas leakage, humidity and dangerous temperature in specific area for industries. This system provides ideal solution for monitoring critical plant on open place in industry which involves workers.

1.7 Report Outline

In this report, there are five chapters which will briefly explain all the efforts and flows in completing this project.

Chapter 1 introduces the background knowledge of the project, explains work scope of the project, for instance, problem statements, objectives and the scope of the project has been briefly defined in this chapter.

Chapter 2 explains the basic knowledge of GSM technology and also reviews related information of hardware equipment used such as temperature sensor LM 35, humidity sensor SN-HMD-MOD, and gas sensor MQ-5. The information of microcontroller used also explained in this chapter. All information was got from reading books, journal article, conference proceedings, and other sources.

Chapter 3 states the methodology taken to complete this project successfully with a given period of time. In this chapter also will give a details work schedule in terms of Gantt chart for Final Year Project (FYP 1) and (FYP 2), project planning, block diagram of project and the brief descriptions for this project.

Chapter 4 implies the results obtained from the system testing and troubleshooting in order to achieve the overall objectives required to complete this project. After gone through all the process and successfully achieved all the objectives as stated in the earlier chapter, the overall project can be conclude as explains in chapter 5. Future recommendation for this project is included as well for future works and further improvement.

CHAPTER 2

LITERATURE REVIEW

This chapter explains the basic knowledge of GSM technology and also reviews the related information of hardware equipment used such as temperature sensor LM 35, humidity sensor SN-HMD-MOD, and gas sensor MQ-5. The information of microcontroller used also explained in this chapter. All information was got from reading books, journal article, conference proceedings, and other sources.

2.1 Related work using GSM

This section describes some earlier works related to the monitoring system using GSM network services.

The work presented by Islam *et al.* (2009), has developed a Prepaid Water Meter System for prepaid billing of water consumption through remote monitoring without any human intervention. This system promises may be fast and accurate billing of water as well as preventing any misuse of it. This project is can save energy and time of user to monitor the quantity of water used and it prepaid billing. In this Final Year Project (FYP), it was used the Global System for Mobile Communication (GSM) as a method to monitor hazard in industry with faster information.

However, according to Abd Wahab *et al.* (2011), developed a water meter reading using GSM network that appropriate for remote places to monitor the water meter reading before any billing process. This could reduce the use of human

resource for reading the meter and issuing a bill. There was also a work on monitoring of electrical meter reading using GSM network done. The system was capable of monitoring the meter reading and sent an SMS to the authorized center for billing purpose. This could reduce the number of estimated reading when the authorize person unable to reach the meter. The project before only monitor the output in one place but for this FYP project, it involve more than one place to monitor hazard at a time.

According to Landolsi *et al.* (2010), using wireless text messaging system to send early warning SMS messages to users advising them to proactively reduce their power consumption before system capacity is reached and systematic power shutdown takes place. This could increase cost-effective wireless distributed load shedding system for non-emergency scenarios. The project above has same application in this FYP project which it come with the prevention after the hazard was detected like when the system detect LPG gas, the exhaust fan will on automatically to exhaust the gas outside the industry building.

2.2 Main Equipment used in this project

This project consists of several main equipment which are GSM modem, microcontroller PIC16F877A, Liquid Crystal Display (LCD), gas sensor, temperature sensor, and humidity sensor.

2.2.1 GSM technology

GSM is a Global System for Mobile Communication. GSM is an international digital cellular telecommunication. According to Inderpreet Kaur (2010), the GSM standard was released by European Standard Telecommunication Standard (ETSI) back in 1989. The first commercial services were launched in 1991 and after its early introduction in Europe, the standard went global in 1992. Since then, GSM has become the most widely adopted and fastest-growing digital cellular standard, and it is positioned to become the world's dominant cellular standard.

Today's second generation GSM networks deliver high quality and secure mobile voice and data services such as SMS with full roaming capabilities across the world.

According to Jayanta Kumar Pany *et al.* (2011), GSM platform is a hugely successful technology and as unprecedented story of global achievement. In less than ten years since the first GSM network was commercially launched, it become, the world's leading and fastest growing mobile standard, spanning over 173 countries. Today, GSM technology is in use by more than one in ten of the world's population and growth continues to sour with the number of subscriber worldwide expected to surpass one billion by through end of 2003.

GSM platform is used for living, growing and evolving and already offers an expanded and feature-rich 'family' of voice and enabling services. The GSM network is a cellular telecommunication network with a versatile architecture complying with the ETSI GSM 900/GSM 1800 standard. Siemens' implementation is the digital cellular mobile communication system D900/1800/1900 that uses the very latest technology to meet every requirement of the standard.

2.2.2 GSM architecture

From the point of view of the consumers, the key advantage of GSM systems has been higher digital voice quality and low cost alternatives to making calls such as text messaging. The advantage for network operators has been the ability to deploy equipment from different vendors because the open standard allows easy interoperability. Like other cellular standards, GSM allows network operators to offer roaming services which mean subscribers can use their phones all over the world. Figure 2.1 show the GSM architecture.

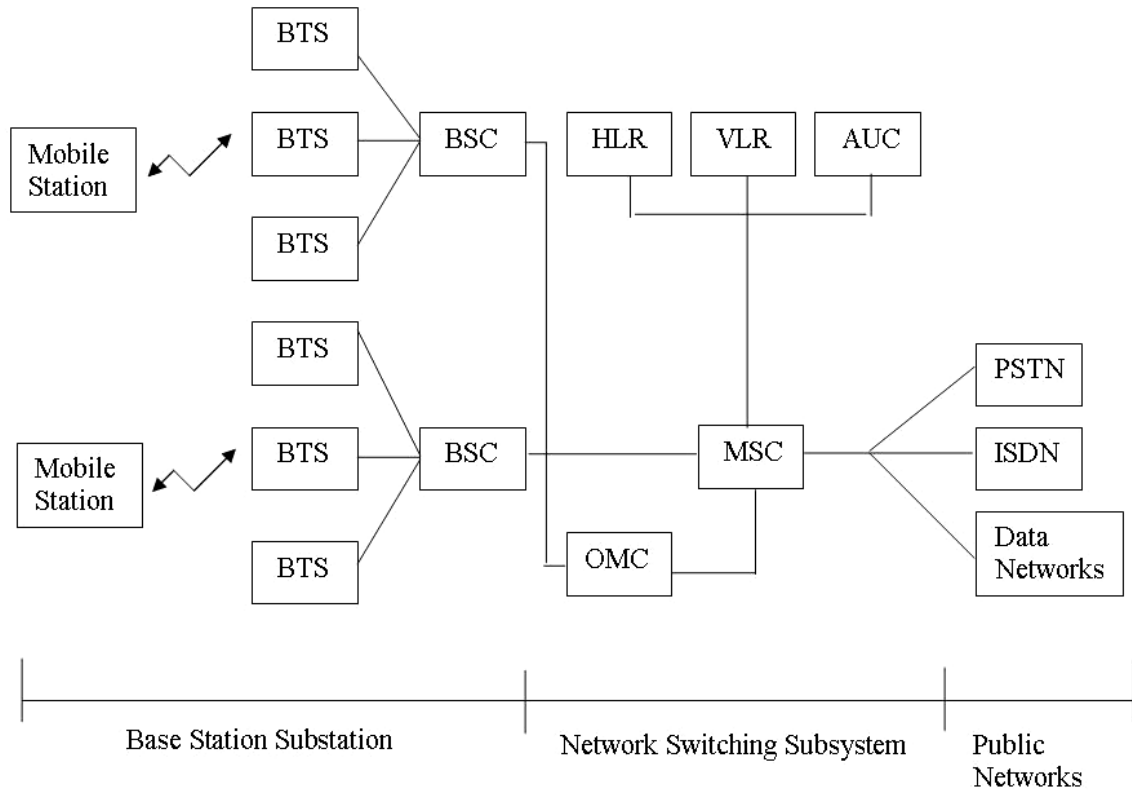


Figure 2.1: GSM architecture

2.2.3 GSM Modem: MOD 9001D RS232 GSM/GPRS Modem

GSM modem is a wireless modem that works with GSM wireless network, which used the radio waves interface to send and receive data. This GSM modem needed Subscriber Identity Module (SIM) card in order to function. Moreover, to control the function of GSM modem, AT command is used. Basically, AT commands is a standard command for GSM modem, which will allow it to perform various commands such as:

- (a) Read, write and delete SMS
- (b) Send SMS
- (c) Monitor the signal strength
- (d) Monitor the charging status and charge level of the battery
- (e) Check on the credit balance.