

# **GSM CAR SECURITY SYSTEM**

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## **ABSTRACT**

The development of GSM Car Security System is a solution to all vehicle owners to increase the security of their vehicle from car theft. This project can alert the owner by sending SMS messages after detecting an intruder. The owner also can monitor their car status by sending SMS messages. This project consists of two parts which are hardware design and software development. For hardware design, the system is controlled by a microcontroller PIC 18F4550. The detector of limit switch is used as the input of PIC. Global System for Mobile Communication (GSM) is preferred in the wireless communication because due to its effectiveness and the use of Short Message Services (SMS). SMS was used because the increasing use of mobile phone. For Software development, CCS Compiler for PIC is use to program the system that enables the function of detecting, identifying, sending SMS and indication for every possible action.

## ABSTRAK

Pembangunan Sistem Keselamatan Kereta berdasarkan *GSM* adalah penyelesaian kepada semua pemilik kenderaan untuk meningkatkan keselamatan kenderaan mereka dari kecurian kereta. Projek ini boleh memberi amaran kepada pemilik dengan menghantar Sistem Pesanan Ringkas (*SMS*) selepas mengesan penceroboh. Pemilik juga boleh memantau status kereta mereka dengan menghantar *SMS*. Projek ini terdiri daripada dua bahagian iaitu reka bentuk perkakasan dan pembangunan perisian. Untuk bahagian reka bentuk perkakasan, sistem dikawal oleh mikropengawal PIC18F4550. Suis pegasan digunakan sebagai input PIC. *Global System for Mobile (GSM)* yang dipilih dalam komunikasi tanpa wayar kerana disebabkan keberkesanan dan penggunaan *SMS*. *SMS* digunakan kerana peningkatan penggunaan telefon bimbit. Untuk pembangunan perisian, MikroC untuk PIC digunakan untuk memprogram sistem yang membolehkan fungsi mengesan, mengenal pasti, menghantar *SMS* dan petunjuk bagi setiap tindakan yang mungkin.

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Introduction

In recent years, Malaysia faces the uprising of crime rate. The biggest crimes which are hard to eliminate is car theft. According to the statistic provide by the General Insurance Association of Malaysia (PIAM), the total numbers for the car theft that have been reported from the year 2000 to year 2010 is 80,577 [1].

Nowadays, car are produce with security such as steering lock or pedal lock that use to prevent the car from being invaded and stolen but how far is the efficiency of using that kind of security? Car thief can easily disarm the security within minutes. Usually when the owner will realize his car has been breach, the car probably has already got away or expensive items inside car have been stolen which increasing their burden and risk. That is when the idea of car security that utilizes GSM system is conducted to enhanced car security system in Malaysia.

Wireless and remote vehicles are an important technology with many advantages. Firstly, owner can monitor their status of car wherever there are without the necessity to go to check their vehicles by their self from time to time. Secondly,



the system can monitor the car and inform owner when there is breach hence provide real-time monitor for owners.

The wireless technology is now widely being used in communication area to facilitate information transfer and exchange in wireless sensor network. One of its usages is in promoting remote monitoring car for owners. However, some of underserved areas in the world do not have the communications infrastructure to be able to benefit from remote car monitoring systems.

GSM Car Security System is a wireless based security monitoring system. The aim of the project is to build and develop a system that has an additional feature of the present security system which is based on GSM. This system is equipped with limit switch as an input. PIC18F4550 is embedded to control the system operation. In addition, DC motor is used as an output to control the lock of car door. The GSM based technology is used in order to transmit and receive information wirelessly between car and owner.

The system are becoming more significant to developed is when the owner is far away from the car to hear the alarm of the car. The SMS from the in-car phone will give immediate alert to the owner to take an instant action or to notify the local authorities or car immobilizer service to immobilize the car. The present car security system is not sufficient to prevent auto theft even though the car is equipped with one of the most expensive system.

Sometimes the alarm does not even attract the attention of most of the public. With the installation of the new feature of this alarm, the owner will be notified immediately so the owner will take preventive measure to check his car or save the precious time by informing the authorities.

## **1.2 Project Statement**

This report describes an effort to produce GSM Car Security System. In current issues in Malaysia, car theft often occurs to vehicles that has no or minimum security that can lose a lot of property. By using GSM car security system, an early warning of breach can be faster transceiver to owner.

## **1.3 Objective**

The objective of making GSM Car Security System is to design and build a system that has an additional feature of the present security system which is based on GSM. GSM car security system is one tool that can help owner by provide a solution to avoid car theft in lower cost.

## **1.4 Scope of Project**

In order to achieve the objectives of the project, the scopes of project are summarized as follow:

1. Doing literature review about the hardware and software used in developing car security.
2. Develop Microcontroller that can lock/unlock the car door and operate the alarm systems which connect at several sensors.
3. Develop GSM modem that can communicate both ways.

4. Program AT command onto PIC 18F4550 microcontroller to sent information for GSM modem to send SMS to owner's phone.

## **1.5 Overview of Project**

This project is concerned with the designing and developing of GSM car security system which can be used for the commercial project at vehicles. An advantage of this project is it can reduce car theft and give early warning to owner when their vehicle is breach. Combination of GSM communication and interfacing with microcontroller develop using CCS compiler.

Once the vehicles are being breach, the information will be transmitted wirelessly to the owner of the vehicle. The microcontroller will be used to interface with the GSM modem in the event of data transmission. The PIC 18f4550 also will automatically active the GSM modem when the vehicles car door is not close properly and transmitted to inform the owner through GSM modem. The owner also can communicate with the GSM modem through owner phone.

## **1.6 Thesis Outline**

This thesis is structured in seven main chapters. The contents of each chapter are summarized as below:

Chapter 1 consist of the introduction, project statement, objectives, the scope of project, overview of the project and summary of the content of thesis.

Chapter 2 describes the literature review on Short Message Services (SMS), Global System for Mobile communication (GSM), Mobile Station (MS), AT command, PIC18F4550, Serial Communication and some literature reviews of related works.

Chapter 3 is the system architecture of project. It explains the operation of this project. Block diagram for each module are discussed in this chapter.

Chapter 4 present the hardware design which discusses the detail of hardware design of each module. The connections of hardware are shown in the circuit schematic diagram.

Chapter 5 indicates the software development for each module. The flow chart diagrams are shown in this chapter for the simple explanation.

Chapter 6 present the testing and evaluating results of each module which the entire integrated modules operation is also discussed in this chapter.

Chapter 7 concludes the outcome of this project and also include the recommendations on this project for future works to upgrade the system performance.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter elaborates the recent research on the technology and emphasizes the use of GSM modem in various applications. Explanation will be focused on the related car security system. Research and findings have been conducted in order to design and develop GSM Car Security System that will suit the aims and objectives in this project. All the related research papers and journals will be discussed here.

#### **2.2 Short Message Services (SMS)**

According to Ericsson, “Short Message Service: available on digital networks allowing messages of up to 160 characters to be sent and received via the network operator's message centre to your mobile phone” [2]

This can be simplified that SMS is a transmission of short messages by cellular phone, fax machine or IP address in two communications. The messages must not exceed 160 alphanumeric characters and contain no image or graphics. SMS messages are supported by GSM, TDMA and CDMA based cellular phone networks currently in use [3]. There are 10 million subscribers of mobile phones in the world and 97% users know how to use SMS [4].

### **2.3 Global System for Mobile Communication (GSM)**

GSM was introduced in the late 1980s where it was defined as the European standards for a new mobile communications system. GSM is also known for the existing of 2G and 2.5G digital cellular systems. Standard digital GSM based cellular phone services of the 2G era offer voice and low data rates. GSM networks are circuit switched and use a combination of the TDMA (Time Division Multiple Access) and FDMA (Frequency Division Multiple Access) standard to enable multiple subscriber bandwidth access at data transfer rates up to 14.4kbps [5].

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate [6].

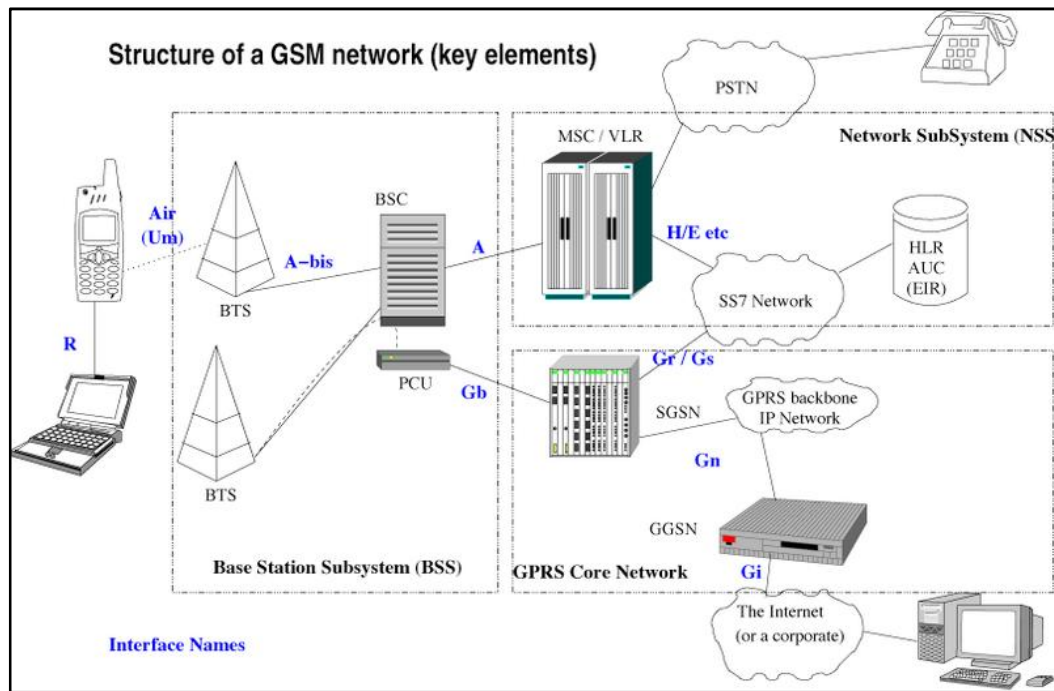


Figure 2.1: Structure of GSM network

## 2.4 Mobile Station (MS)

Mobile Station shortly is the combination of Mobile Equipment (ME) and Subscriber Identity Module (SIM). Together they provide various kinds of GSM services such as bearer services, tele-services and supplementary services. Each Mobile Equipment has its own unique identification which is known as International Mobile Equipment Identity (IMEI) while SIM has its own identification that is International Mobile Subscriber Identity (IMSI) [7].

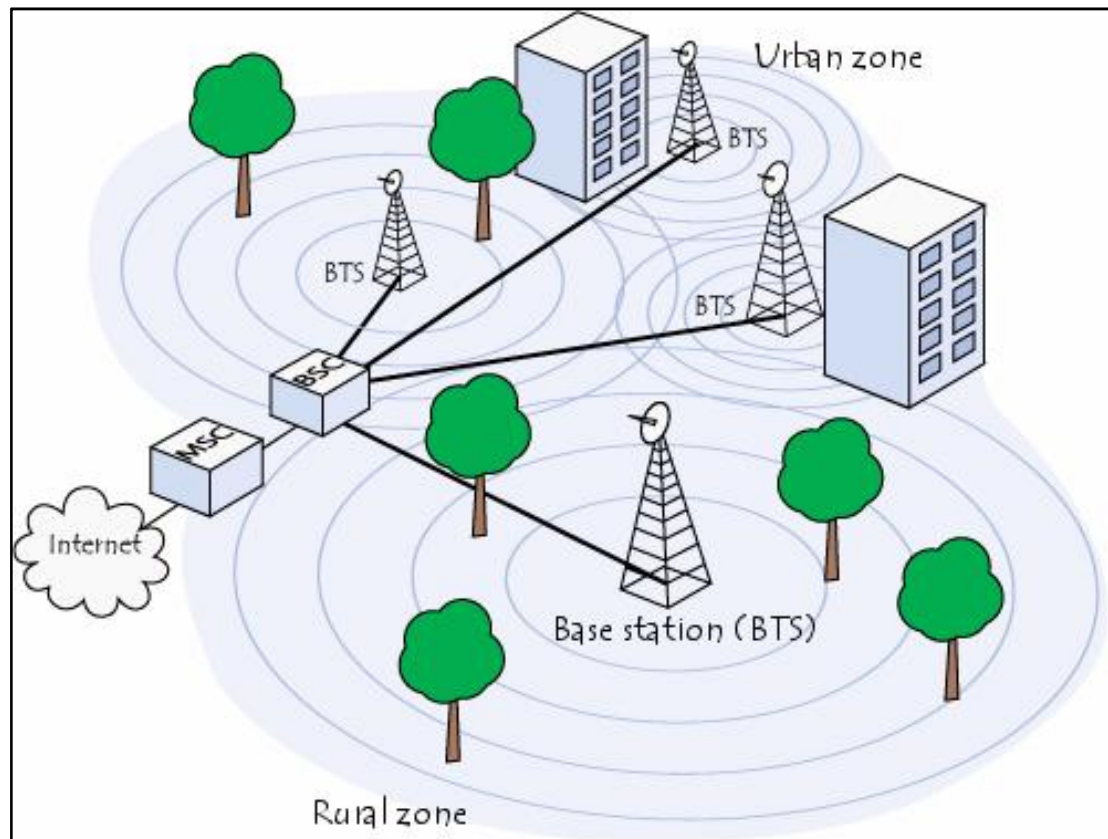


Figure 2.2: Communication between Mobile Station and Base Station

## 2.5 AT Command

Based on [8], AT commands are a set of commands that has been standardized to communicate with terminal equipments such as modem, mobile phone as well as control them. Most GSM modems support AT commands. The command set is quite elaborate. However, only a small part of it is related to SMS operations. The most frequently used commands are:

AT+CMGS: To send a short message

AT+CMGR: To read a short message from the GSM modem

AT+CMGL: To list SMS short messages stored in the GSM modem

AT+CMGD: To delete a short message from the GSM modem

AT+CNMI : Remind mode Setup when receive a new SMS



As the low-level function interface to the GSM modem, these commands play a fundamental role in the software developing of the gateway program.

## **2.6 Microcontroller PIC 18F4550**

PIC was acronym for 'Peripheral Interface Controller' also known as a microcontroller. It typically includes:

- CPU (Central Processing Unit)
- RAM (Random Access Memory)
- EPROM/PROM/ROM(Erasable Programmable Read Only Memory)
- I/O(Input/output)-serial and parallel
- Timers
- Interrupt controller

By only including the features specific to the task (control), cost is relatively low. A typical microcontroller has bit manipulation instructions, easy and direct access to I/O (input/output), and quick and efficient interrupt processing. Microcontrollers are "one-chip solution" which drastically reduces parts count and design costs [9].

### **2.6.1 Special Features of Microcontroller**

The PIC 18F4550 microcontroller is chosen since its easiness to use, high speed and its low cost compare to other microcontroller. It also low power, high speed FLASH/EEPROM using CMOS technology. It also has 100,000 write or erase

cycle enhanced FLASH program memory and has 1,000,000 write or erase cycle data EEPROM memory typical. The PIC 18F4550 have features as below [10]:

- C Compiler Optimized Architecture with optional extended instruction set.
- Wide Operating Voltage Range (2.0V to 5.5V)
- Extended Watchdog Timer (WDT)
- Programmable Code Protection
- Flash/Data EEPROM retention more than 40 years
- Priority levels for interrupts
- Single-Supply 5V In-Circuit Serial
- Self-Programmable under Software Control

Table below shows the similarities and differences between PIC 18F4550 and PIC 16F877A [11].

TABLE 2.1: Comparison between PIC 18F4550 and PIC 16F877A

Key Features	PIC 18F4550	PIC 16F877A
Pins	40 DIP	40 DIP
I/O Ports	A,B,C,D,E	A,B,C,D
Operating Frequency	DC-48Mhz	DC- 20Mhz
Reset (and Delays)	POR, BOR, RESET Instruction, Stack Full, (PWRT, OST), MCLR, WDT	POR, BOR (PWRT,OST)
Flash Program Memory	32K	8K
Data memory (bytes)	2048	368
EEPROM Data Memory(bytes)	256	256
Interrupts	20	15
Timers	4	3
Capture/Compare/PWM modules	1	2

Serial Communications	MSSP, Enhanced USART	MSSP, USART
10-bit Analog to Digital Module	13 input channels	8 input channels
Analog Comparators	2	2
Instruction Set	75	35

## 2.7 Serial Communication

Serial port is used in order to transmit and receive data because it allows user to change the baud rate, data bit, size and parity bits. This serial port communication such as RS232 at GSM modem is needed to communicate with microcontroller. In addition, PIC18F4550 is used as microcontroller which is built-in USART support (RS232). Furthermore, the PIC18F series has a large number of I/O ports which easier for debugging and other applications [12].

## 2.8 Related Works

Group of lecturer [13] has created a design that controls other electrical equipments by using SMS as the ways to switch on or off the devices. This circuit can control the devices by sending the specific SMS through mobile phone. The circuit is very simple where it uses relay as switch and AT commands as modem command that can understand the data send from PIC microcontroller. This design modified the mobile phone to work as a transmitter part that can send SMS when the switch is triggered. Ericsson T10 mobile phone is used in this circuit where terminal of communication at mobile phone operates at 5V control by AT9052313.

Noraishah bt. Mohd Tahir [14] has designed a security system used for motorcycle. The system used the limit switch as the sensor of the system to trigger the circuit. The limit switch is placed at double stand of the motorcycle where it functions as sensor to indicate any movement at motorcycle while the system in on mode. When intruders wants to move the motorcycle, it's automatically trigger the microcontroller circuit to send the notification SMS to the owners to follow up actions.

From this two related works, it is stated that both of this related works are using GSM modem or modified hand phone to send SMS to owner to inform when there is intruder which is similar to the objective of this project. Both work also use AT command to interface with microcontroller. The differences are that both work using difference microcontroller and different application.

## **2.9 Summary**

The main components of the project are described in this chapter. The first function in the system is that it can detect unknown person when the user activated this system. PIC microcontroller will read the data when the limit switch is activated. Then the GSM modem gets data from PIC Microcontroller to send SMS to owner hand phone.

To communicate between GSM modem and hand phone, AT command is apply to this project. It is because, the GSM modem just can only understand AT command declaration. From this, it can communicate with hand phone, computer and PIC microcontroller.

To accomplish this project, the whole component must work effectively. The GSM modem acts as medium to receive the instructions from microcontroller. C programming is used for PIC board application to develop program.

## CHAPTER 3

### ARCHITECTURE OF GSM CAR SECURITY SYSTEM

#### 3.1 Introduction

This chapter elaborates on the system architecture of GSM Car Security System. Figure 3.1 shows the block diagram of GSM Car Security System where the microcontroller is used to interface with the GSM modem by using serial communication (RS232) in the event of data transmission. The microcontroller will automatically activate the GSM modem when the cars doors are in unusual conditions such as lock/unlock without the present of car owner or the door is not close properly. It will send message to the car owner/authorities. The message contains the detail of status of the car. The car owner/authorities can send or reply message to microcontroller through the GSM modem.

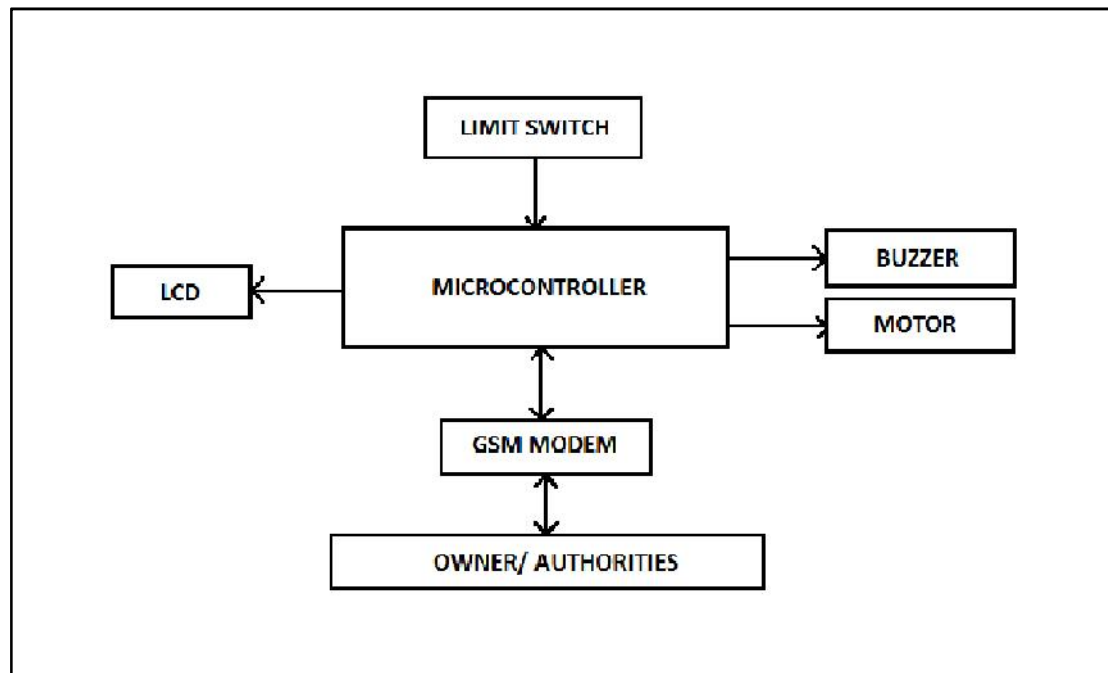


Figure 3.1: Block diagram of GSM car security system

### 3.2 Flowchart Methodology

Figure 3.2 below show the flowchart of methodology to conduct the project. First to start off are by reviewing several related literatures base on journals, relevant papers and publications. After that, type of components that will be use in the project such as PIC microcontroller, GSM and other components are listed and selected.

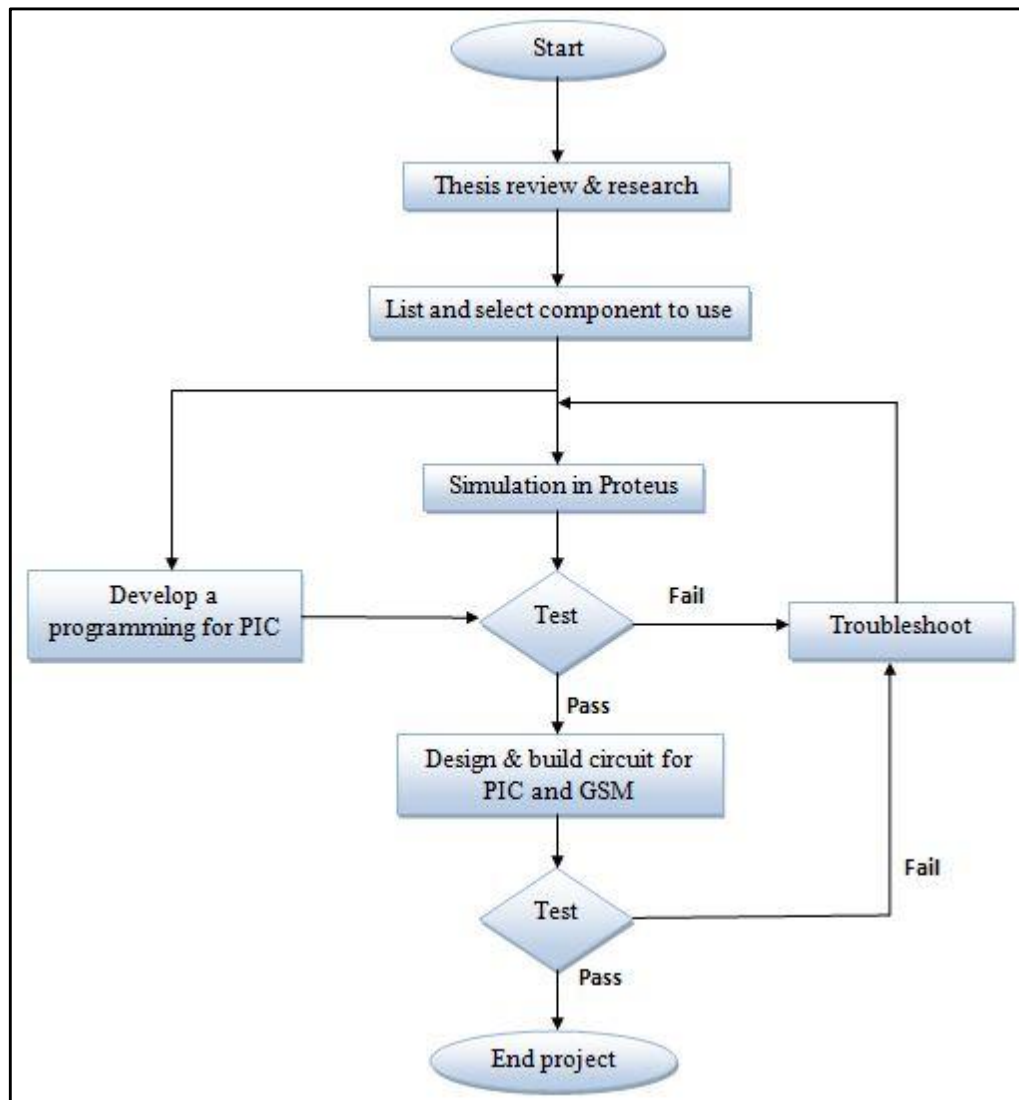


Figure 3.2: Flowchart methodology of project

This project is then proceeding to next part that is to design the hardware circuit. The system design and application was done in Proteus 7.8 Professional software. The simulation hardware is then run by using the simple programming from CCS Compiler. When the simulation run in the suppose way, then the hardware simulation design is success. In the meantime, the programming for the project is been constructs. If the test failed, the circuit and program will be troubleshoot to identify the problem. After both hardware simulation and programming succeed, then starts to build the prototype of the project. The last stage is to test the project with hardware and software developed.

### **3.3 System Architecture**

The GSM car security system consists of following hardware module:

- Microcontroller module
- LCD module
- Buzzer module
- Motor module
- Limit switch module
- GSM modem module

#### **3.3.1 Microcontroller System Board Module**

Microcontroller is a brain of the system which is to control all the operations of system. Microcontroller 18F series is been implement in this project due to its high performance. Microcontroller is designed into two packages that are Dial-In-Line Package (DIP) and Plastic Lead Chip Carrier (PLCC). There are various form PIC version available with different size and features. However, PIC 18F4550 is chosen in this project.