CERTIFICATION OF APPROVAL

**Effective Car Security System**

by

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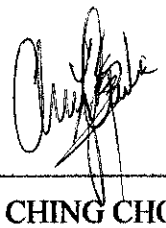
## CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



GOH CHING CHOK)

## ABSTRACT

The aim for this project is to design an effective and reliable car security system. Carjacking is not something strange and the amount of vehicles reported stolen has increased sharply over the years. The security system is designed specifically to cater for Proton cars, which are prone to carjacking, due to its popularity and quantity. This system targets the moderate earner as main customer and offers quite a reliable way to reduce parked cars from being stolen. The focus of this project is on improving the current security system available in Proton Car. The circuit design part focuses on the switching aspects, especially to activate the voice alarm system and to send short message service (SMS) to alert the car owner. Self diagnose system is included to identify the car problems if there is any fault detected. The features added although are based on Proton car module; however, the features can be added in other types of cars available in the market as well. The end result of this project is a working prototype of the security system, where a user will receive SMS whenever the car alarm system is being triggered. The overall system successfully reduces the chance of a false alarm situation to make the car security system more effective and reduces carelessness committed by owners in handling their cars.

## ACKNOWLEDGEMENT

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# CHAPTER 1

# INTRODUCTION

## 1.1 Background

There are news everyday reporting cars being stolen and some even cause trouble to the owner of the car. Therefore the purpose of this project is to make a car security system, which is effective enough to ensure that the parked cars are safe. Normally, the convention car security system consists of features to remotely lock and unlock a car, and also an alarm system, which is used to alert the user when somebody trying to break through the car door. Unfortunately, false alarm happens most of the time instead of real carjacking happens. Therefore, public just ignore the alarm thinking that the alarm is just another false alarm.

The best person to protect the car is the owner himself or herself. However, most of the time, the owners are not around and will not be able to realize that his car is under risk of being stolen away. A very effective way to alert the owner if the car is on the verge of being stolen away is to send a message to the owner, which can be received even if it is far away. One of the factors leading to cars are easily stolen away is carelessness. Owners of cars are careless most of the time concerning their cars. For some cases, the cars are stolen away because the car doors are not locked properly or alarm of the car is not functioning. The indicators for these faults of car are hardly noticed.

## 1.2 Problem Statement

Carjacking cases are becoming increasingly rampant. It has become so common that even the media journalist finds it unsensational to be reported. Car owners become more and more worry as they no longer feel safe to leave the car at any parking lots. Many car owners who has really worked hard to buy a new car, faces some kind of phobia, when comes to leaving the car unattended. According to the chairman of Persatuan Insurans Am Malaysia (PIAM), Anuar Mohd Hassan, vehicle theft is a problem that grows everyday [1]. The statistic by PIAM shows that 73 percent of vehicles were stolen everyday in year 2004. From the total amount of vehicles stolen, 27% of them are private cars. This results in insurance companies incurring great loss on vehicles theft claim. From the statistic provided by PIAM, the total numbers of private car stolen is 7263 in year 2004 [1].

According to a source from Paul Tan [2], on average, a carjacker needs only 3 minutes to steal away a car. Another half an hour is needed to sell off the parts or ship the parts out to other countries. In second hand dealership of cars in Batam, Indonesia, one can find Proton Perdana V6 or Proton Waja sold for only half the manufacture price. A local mechanic revealed that most of the cars were smuggles in from Malaysia and believed to be stolen. Effective methods must be implemented on cars to reduce, if not avoid, car theft cases. General car security systems available in Proton cars have limited features. The features, based on module analysis done, are such as:

- Car locking/ unlocking system
- Alarm system which sounds if triggered.
- Alarm triggered after doors are locked but are not closed properly

- Boot detection to trigger alarm if it is open without unlocking the car doors.

These features are passive and not power enough to actually reduce carjacking cases. The security system is only alarm based. If the owner is not around, the alarm will hardly play a role in preventing carjacking from happening. Powerful security system such as the G5 system in the US cost dearly and only affordable by high income earners 3]. This project will focus on making an effective car security system which can be ntegrated in local Proton cars built-in module. Besides, the cost is estimated to be affordable by moderate income car owners and of course the high income class car owners.

## 1.3 Objectives

The objectives of this project are to:

- Design a car security system with SMS capability
- Minimize "false alarm" situation
- Design a self-diagnose security system

When these objectives are met, a proton car built-in alarm module will be able to act better in protecting the car.

## 1.4 Scope of Project

This project is to design an effective car security system to reduce any carjacking cases, if not avoid. There is no perfect security system in the world as any powerful security systems can still be hacked and sabotaged by people. Therefore, this project on car security system focuses on a few effective to reduce the chances of getting the cars stolen. Besides, this security system is actually meant for moderate earners who cannot afford to have their cars stolen. Since the majority cars in Malaysia are Proton and Perodua (both Malaysian product), therefore this security system is designed to suit these local made cars and also easily integrated with the built-in alarm module.

For this car security system worked on, it has a few important areas, which require thorough research. The areas worked on for this project are:

- False Alarm Minimizer
- Short Message Service (SMS) system
- Self-diagnose system

This project involves circuitry using both analog and digital devices. False alarm minimizer implemented will make the alarm to continuously sound. For SMS system, only for prototyping purpose, the SMS system is done by using computer, sending SMS through a mobile phone, to another mobile phone. Self diagnose system is a system which will indicated the particular parts of the car which is having problem regarding security system. In short, this project is to implement new technology into car security system to make the system more effective and more robust.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Background Study on Car Theft in Malaysia

Due to drastic increase in vehicles stolen in Malaysia, car theft has become a major issue around the car owners throughout Malaysia. According to a report dated 25th September 2005, in a total of 35,888 vehicles were stolen in the first half of the year [2]. Vehicle theft has contributed a total of 45%, which is almost half of the countries overall crime index. Among the vehicles, there are 4,756 cases on cars. This has lead to loss of money over millions Ringgit Malaysia. From the statistic, it can be overviewed that car theft is very serious in Malaysia. The charts below shows the number of Malaysian made cars being stolen in only 6 months time for year 2003 and 2004.

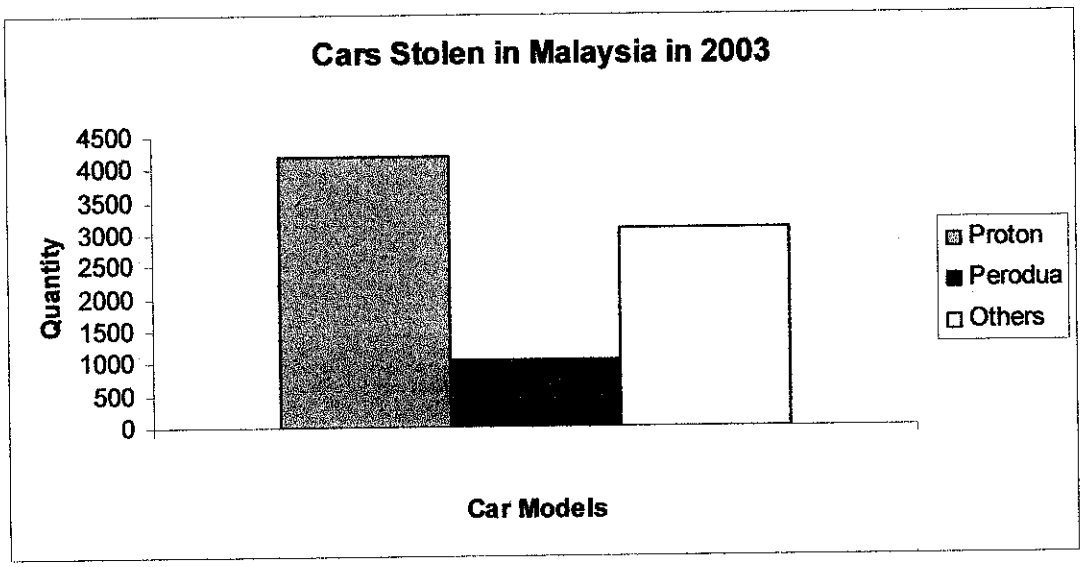



Figure 2.1: Cars stolen in Malaysia in half a year for year 2003

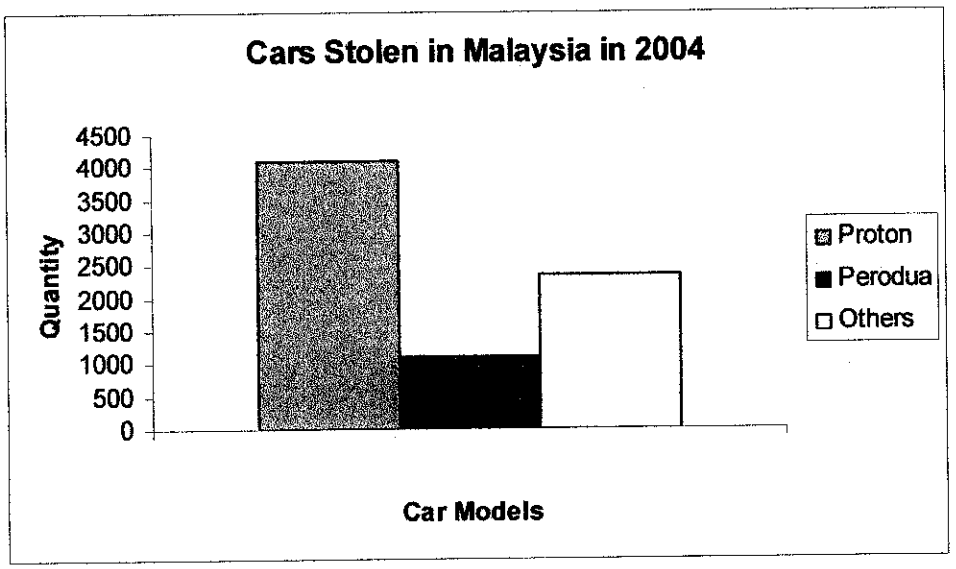



Figure 2.2: Cars Stolen in Malaysia in half a year for year 2004

Table 2.1: Number of Cars Stolen for Year 2003 and 2004

| | Number of Cars Stolen in Malaysia (year) | |
|---|---|---|
| **Car Models** | **2004** | **2003** |
| Proton | 4097 | 4197 |
| Perodua | 1091 | 1054 |
| Others | 2351 | 3081 |
| **Total** | **7539** | **7539** |

From the figures above, it can be seen that Proton cars are prone to car theft. The total number of proton cars stolen is more than half of the total cars stolen in both years [1]. Besides, according to the report by Netstar Advance System Sdn Bhd, for car models below RM70,000, Proton Waja, Proton Gen2, and Proton Satria GTi are among the popular cars get stolen away. For cars cost between RM70,000 to RM100,000, Proton Perdana V6 emerges as the popular car model for car thieves [4].

From the statistic obtained so far, it is clearly shown that Malaysia made cars are the popular cars to be stolen away. One of the reasons is the quantity of these cars on the road is much higher than the other imported cars. Proton cars are affordable by average earners and are less expensive than imported cars. Therefore, in term of price, more people in Malaysia will choose Proton cars. Apart from this, another reason will go down to the security system installed in Proton cars, which makes the Proton cars become prone to theft. This will be the focus of this topic chosen.

False alarm happens almost most of the time. According to a report by Aaron Friedman and Co [4], authorities in New York estimate that 95% to 99% of the alarms being activated are false alarm. Besides, Most of the cars got stolen away, equipped with alarm system. This is partly because of passers-by perception of false alarm occurs instead of real car theft. Based on the report over in the United States, in New York, 95% of people who heard of the siren of alarm, will take any action to help if there is really car theft occurring. From this figure, we can see that alarm system has become the 'kid who cried wolves', due to frequent false alarm. This can not be avoided as long as false alarm occurs most of the time.

## 2.2 Car Security System Evolution

Car security system became an issue ever since automobile had been owned by not only the rich but the average earner. There were more and more cars driven on the road. People start to have more information and knowledge about cars. More and more people getting skillful in picking locks and doors. Therefore, car theft cases started.

Manufacturers tried to popularize the automobile by providing security system to the car. The reason is to tell the public that by buying the cars manufactured by the particular company will be safe from being stolen. Soon, car security system becomes a

must for a car and also becomes a feature which customers will look at before determining the types of cars to be bought.

### 2.2.1 Simple Door Lock

The first security system is a door lock which the key is inserted to open to lock. This avoids any intruders from opening the car door and steals the car away. However, later on, thieves became skillful in door picking. Therefore, this system is not secure enough to protect the cars.

### 2.2.2 Early Stage Immobilizer System

The immobilizer system had been added after finding door can be picked. This immobilizer system is turned on when the owners activate a switch in a hidden place on the car body. After it is turned on, the immobilizer system will be cut out power distribution to either the engine or the ignition part [6]. This is to avoid the car being driven away if the thieves manage to break in to the car. For the owner to activate back the engine or ignition, the owner must first turn off the switch, which is hidden somewhere on the car. Supposedly, the owner will be the only one who knows the location of the switch. However, this system can be breached if someone observes the action of the car owner, whenever the owner leaves the car. After sometime, he will be able to notice the location of the switch. Besides, human factor will cause this system to fail. This human factor will be explained in later part.

### 2.2.3 Immobilizer + Siren + Timer System

After realizing that the immobilizer system alone is not enough, automobile manufacturers added the immobilizer system with the siren and timer system. Siren will be triggered once the car door is open without disabling the immobilizer system. This siren intends to scare away the potential thieves and also to alert the owner bout the car being carjacked. Timer system is added to trigger the siren when someone opens the car door but does not start the car engine within certain time. Somehow if the thief manages to locate the immobilizer switch, breaks into the car, but having problem trying to start the car, the siren will still sound to alert the owner of potential carjacking. These combine systems later on proved to be adequate as the thief can turn off the siren system once he manages to get into the car. Siren system normally can cause false alarm when the owner himself forgot to turn off certain switches. This false alarm makes the public believe there is no theft going on even when someone tries to steal a car. Immobilizer can be override as well, by using the master key which have access to all the cars made by the same company.

### 2.2.4 Wireless Car Lock

Key-hole car lock can be easily picked by using hard materials such as knives, ruler, and so on. Therefore, manufacturers come out with the wireless car lock idea where the car lock is switched on and off by using remote control. This wireless system reduces the chance of car door being picked. However, there is concern regarding this wireless remote control. The owner will have problem when the remote control runs out of battery, or the remote control becomes malfunction. The owner himself will not be able to get into the car. Therefore, the key-hole lock is still maintained but the wireless remote control becomes dominant in terms of accessing the car. If the door is locked using remote control, then the alarm will be triggered if someone attempted to open to

car door using key. This system is used in most Proton cars especially Wira, Iswara, Saga, and other economical cars. This system will be explained in detail in later section.

### 2.2.5 Sensors + Immobilizer + RF Lock

The more competition among automobile manufacturers, the better the security systems have evolved. Security systems nowadays includes sensors, immobilizer plus radio frequency (RF) based lock. Sensors are used to detect if there is any attempt to break in to the car by using some possible methods. For example, a sensor is put at the car door key hole to sense if any objects besides the key are put in, in attempt to pick the door. Besides, a sensor might be put in a place near the door to sense if someone manages to open the door, and thus the immobilizer system will be automatically activated.

### 2.2.6 Electronic Immobilizer

Immobilizer itself has evolved since last time. The immobilizer system used previously was mechanical immobilizer system which can be categorized into physical barriers. This immobilizer system includes gear and steering locks. Gear lock makes the intruder unable to use the gear while steering lock makes it unable to turn the steering. This may make the car seems protected, however, they are easily breached when the car is intruded by professional and skillful thieves.

Electronic immobilizer has been more effective in curbing car theft compared to those mechanical immobilizers. These systems comprise the electronic devices installed into a car that interfaces with the car engine management unit (ECU), fuel pump relays, and ignition or even starter motor units

### 2.2.7 Surveillance Camera and GPS Tracking

After wireless technology has developed a lot and widely used, surveillance camera is installed in a car to monitor the surrounding of the car. This is to see if there is anyone suspicious attempting to carjack the car. With this surveillance camera, owner of car will have more than to react if anyone found suspicious around the car. The owner can either get to the car immediately or maybe use some remote controls to lock the door and so on. This will somehow reduce the chances of the car being stolen away. Besides, if a notice is stick on the mirror saying the car is protected by this camera; potential thieves will have to think twice before trying to break into the car.

Another wireless technology can be applied in this security system is GPS tracking system. Global Positioning System (GPS) is normally a satellite based devices or for some, it uses Frequency Modulation (FM) wave to operate. This GPS tracking system can track down the location of the car if it is driven away. Based on the location shown on the device, owner can recover the car before being shipped out. However, this system is very expensive.

### 2.2.8 Latest Car Security System

Finally, the latest and considered as most powerful security systems available in the market are such as the G5, COBRA, VIPER, and others. G5 are the latest among the others and the features included are believed to be able to reduce, if not avoid carjacking cases. G5 is a system manufactured in early days and more features are added and improved. It has the anti-false alarm technology, anti-code grabbing encryption algorithm and also a Global Positioning System (GPS) built-in. These features are powerful enough to enable the owners of the cars to reclaim the car if the cars are stolen away [7].

Unfortunately these power security systems, including G5 are very expensive and mostly unaffordable by average earner. This actually drives the design of an effective yet inexpensive security system.

## 2.3 Security System Available in Proton Cars

Proton cars manufactured in Malaysia have only limited security system. Most of the Proton cars have only the door lock with both key based and remote control based, and alarm system. These features for security are not adequate to counter car theft cases. The door lock system is very normal where user can lock and unlock the car from a short distance.

The focus is on the alarm system, which is the only system acts as security. This alarm system is very simple in terms of circuitry and the way it works. It can be breached easily. The alarm module used in more economical Proton cars is Delloyd 1991, manufactured by Delloyd Company. The alarm can be activated by using a remote control. The module consists of a few input pins which will receive signal from doors, brakes, ignition key and so on to trigger the alarm. Besides, the module also provides output for locking of car doors. The lock and unlock pins of the main car door will send signal to the module and the signal will then turns on the relay to unlock and lock the other 3 doors. Figure 2 shows the inputs and outputs of the module:

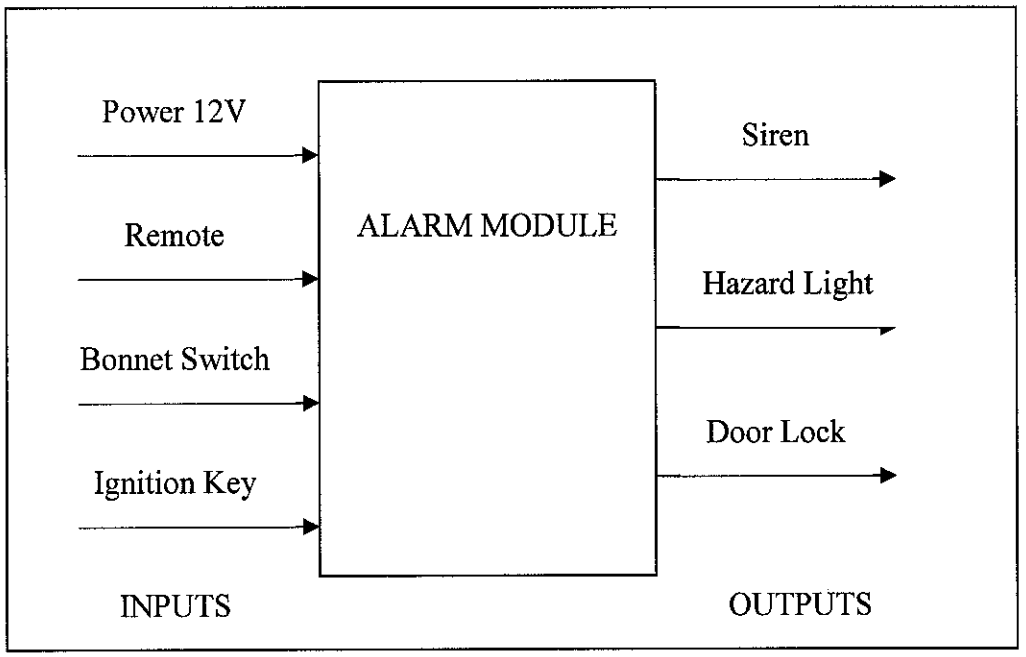



Figure 2.3: Inputs Outputs of Alarm Module

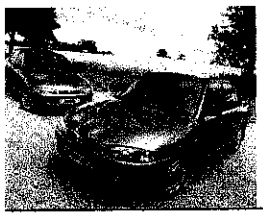
From the module, it is known that the function of the alarm system is limited. The alarm will sound when the door switches send signals to module indicating the doors are open, after the alarm is armed. The original Proton car alarm module does not have the auto lock system. Auto lock system is important for security as sometimes car owners might accidentally unlock the door lock without realizing this. The auto lock, which is part of the modified alarm module, will automatically lock the car doors after some short period of time.

Basically, when the door is locked by using the remote control, the alarm system is set to standby mode and ready to be triggered. If later on the car door is unlocked using the key, once the door is opened, the alarm is triggered. This feature is to notify public that someone tries to break into the car. However, a lot of times, there are false alarms which lead to public's ignorance of the alarm. For example, some people use the siren as car locater instead for security purpose. The alarm will not sound if the door is not

open. This is due to the system uses the light switch as trigger. The light switch is located at the bottom of the door. When it is released (manually or by open the car door) the light in the car will turn on. This alarm system is controlled by the same switch; meaning the door is opened when the alarm is in standby mode, the alarm will be triggered.

For each type of Proton cars in Malaysia, they have different types of security system. Economical cars such as Perodua Kancil, and Proton Saga, have less features in the security system built in. On the other hand, Luxury car like Proton Perdana (including V6), the security systems built in are more powerful. The following diagram shows the features available in each and every type of the Malaysia made cars.

As far as the car security system is concerned, **Captor Security and Tracking System** is available in the luxury cars. However, it can still be installed in the other Proton cars. This Captor system is quite powerful for owners to retrieve their stolen cars. However, powerful systems go with high cost. According to the website, Captor normal security system requires **RM1,950** if it is to be installed in Malaysia made Proton cars. Besides, there is annual fee of RM150 for all the possible services provided. For tracking system, Captor uses the GPS tracking system and this tracking system costs **RM4,000** [4]. From the cost, we can see that most of the car owners in Malaysia cannot afford to pay this huge amount of money for these powerful systems.



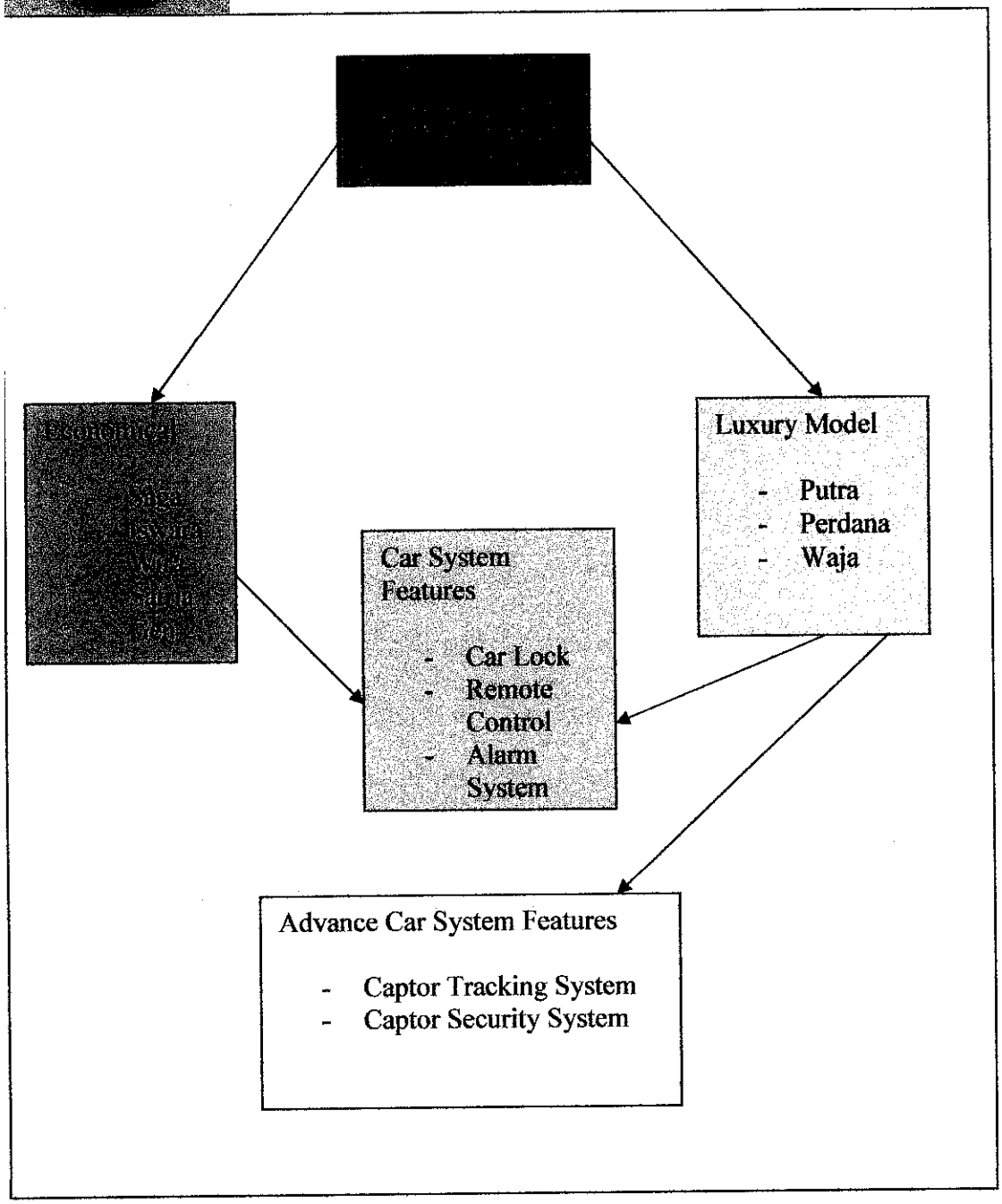



Figure 2.4: Proton cars and the Built-in Car Security System

## 2.4 Ways to Breach Proton Cars Security System and Factor of Car Theft

After analyzing the module of the alarm system in Proton car, a few easy methods can be figured out in order to breach the entire system. This analysis is to show how inadequate the security features provided by this system and to justify the reason why this project is worked on.
The methods will be explained in the following subsections.

### 2.4.1 Pick the Car Door

As we know, to open the car door, one can either unlock it using the remote control or by inserting the door key (Please refer to Appendix A1for example). Therefore, there is a weakness where a thief can use a knife, or some hard metal which have almost the same size as the key, and insert into the key hole. In this way the knife or metal will somehow act like a key. Besides, for a more professional way of picking the door, a thief can use a moderate size wires and unlock the door. These ways of picking door are very usual and a lot of people believed to have the skill.

### 2.4.2 Open the Door through the Side

The side of the car door has a layer of rubber which acts as protection from rain and for making contact between the door and the car body (Please refer to Appendix A2). A thief can remove or cut the rubber and thus a small opening will be available. Then by using some thin wires or other materials, the door can be unlocked by pulling up the door lock from inside. This somehow requires some time to unlock the door, thus it is not as popular as picking the door from key hole.

### 2.4.3 Disabling the Alarm System

Once a thief manage to unlock the car door, either by picking the lock or other methods, the moment he opens the door, the alarm will sound. To disable this alarm, a thief needs only less than 3 seconds to disable the alarm. As mention before the alarm in Proton cars are triggered by the light switch (Please refer to Appendix A3). Therefore, for a thief to disable the alarm, he just needs to press the light switch continuously or get something and press on the switch. This whole process needs only less than 3 seconds and 3 seconds is short enough to make the public unaware of the alarm or unable to realize which car's alarm is triggered. Then the entire car is no longer under protection and the thief will be able to steal it away.

For an alarm system which does not depend on the light switch, the alarm can also be disabled by picking the car ignition system (Appendix A4) and then pressing the reset button (Appendix A5). Reset button will reset the entire alarm system and the alarm will no longer activate. If a thief is able to pick the car door lock, he will be able to pick the car ignition system by using the same technique. Then he can reset the whole system and the car is no longer protected.

### 2.4.4 Human Factor

For a car owner who intends to install a powerful security system, there is one thing he or she should take into account – the Human Factor. Human Factor exists everywhere and can lead to carjacking cases. Car owner send a security system module bought to a workshop for installation; the owner will face a risk where the workshop mechanics might reveal the car number and all the relevant information to potential thieves. With this information, the thieves can easily access the car in the safest way and steal away

the cars. This human factor is hard to avoid unless the owner is skillful enough to install the module by himself.

### 2.4.5 Ways to Get the Breached Cars Away

After bypassing all the possible security system, the most important thing is to steal the cars away. The popular methods used to steal a car away according to security system vendor, Netstar, are:

- Hotwiring
- Tow-away

Hotwiring is a method to start a car's engine without using the ignition key. One way of doing this is to locate the ignition wires attached to the switch, and then tie or touch the exposed ends of both wires. Normally these wires can be located under the dashboard. This method basically power up the started motor which is connected to the engine. Another way is by using brute force to smash the key mechanism. By doing this, the rotation switch will be revealed and a screwdriver or similar tools can be used to turn the switch on. Hotwiring method is the most popular method being used by car thieves [8].

For tow-away, basically the cars are parked somewhere, and the cars are moved away by using tow trucks or some vehicles with lifts. This method is rarely used unless the cars are wanted by a big car theft syndicates.

### 2.4.6 Factors which Contribute to Car Theft

The factor, which contributes the most, leading to car theft cases is Human's carelessness. There is no perfect system in the world. The same applies to human brain system. Therefore, it is impossible for someone not to make mistake or being careless totally. It is understood that human can never be on guard of everything all the time.

However, carelessness is now a major concern for car owners since car theft cases increase drastically in recent years. How carelessness lead to car theft? For example, someone parked his car at the car park and he left the car to buy something. When he left the car, he did not check whether the car doors are closed tight, locked, and the security system is armed. Unfortunate for him, one of his car doors is not closed properly. Therefore, a thief nearby managed to notice this and quickly took his advantage to steal the car away.

In this case, who is to be blamed, the thief or the owner? Well it is obvious that the owner of the car is to be blamed, because of his carelessness in handling the car. If he would have closed the door tight and locked it, this car theft case could have been avoided. Apart from the car doors, human relies on the security system a lot to protect the car. However, most of the people have never checked whether the security system is still functioning well. A 'sick' security system is unable to help much in protecting the car. Besides, it is known that there are indicators to indicate whether security system is armed, and doors are closed properly. However, these indicators are shown as a logo or blinking LED light. In a bright day, human's eyes are not so sensitive to this type of indicator lights, especially the blinking LED light. Therefore, it is still possible for the owner will miss out the indicator in the cars.

## 2.5 Problem Caused by Alarm System

In most of the cars on the road in Malaysia, alarm systems are installed. The sound produced by these alarm systems, is quite annoying and irritating most of the time. Various types of alarm sound are available but most of these are siren type and loud sound. This kind of sound can actually cause problem to the owner and also to the people around.

False alarm can happen anytime anywhere. There is time when false alarm happens more than 5 times a day. In New York City, a survey was done on 811 people to see the reaction of the citizens with regard to the noise caused by the car alarm [5]. The result of the survey shows that 91% of the citizens feel that car alarm noise actually diminish their quality of life.

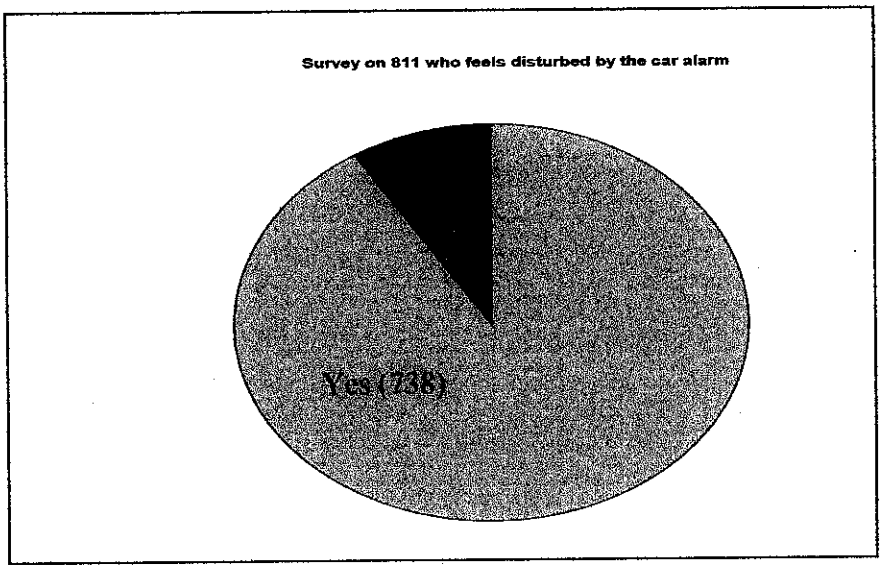



Figure 2.5: Survey on 811 people who feel disturbed by the car alarm

Car alarm system can cause problems such as:

- Health Problem
- Childhood Learning and Development Problem
- Relationship of Neighborhood

For health problem, noise produced by car alarm system, will cause sudden rise in stress hormones and this might lead to cardiovascular disease, gastrointestinal illnesses. Besides, stress can cause psychological problems, too. Nowadays, due to daily workload and also schooling, a lot of adults and children already suffer from stress. With additional stress coming from unnecessary noise from car alarm system, the problem will become worse. False alarm sometimes happens during night time when everybody is asleep. The entire neighborhood might be awaken by the alarm and their sleep is disturbed. Without proper rest and sleep, it will cause some other health problems which include weak immune system, high blood pressure etc.

Besides, a child's learning and development may be affected by this unwanted noise. According to a study by environmental psychologist, Gary Evans, from Cornell University [9], children affected by the traffic noise, which includes alarm noise, will become less motivated and they might develop sense of helplessness. This causes children unable to learn properly in a peaceful environment.

For relationship of neighborhood, it was known, since long time ago, relationship for people in city towards their neighbor is not very good. With this unnecessary alarm noise, the relationship can get even worse. Imagine a car's alarm keep on sounding for no reason, the neighbor of the owner will definitely feel disturbed. In fact this actually develops a sense of selfishness among the neighborhood. 'I care of my car; therefore I added alarm system to avoid it being stolen.' This sounds as if the owner of the car does not even care of the others in the neighborhood. Therefore, the relationship among the neighbors may get bad due to this alarm system.

## 2.6 Potential Benefits of this Project

This project basically targets average earners and enable these average earners to have a more effective yet not costly security system. This project, if analyzed in detail, does not only bring benefits to the buyer but also to other parties. The benefits are explained below:

### 2.6.1 Affordable by Average Earners

From the information obtained from the Internet, powerful security systems such as G5, COBRA are very costly. 1 system requires a few thousands US Dollar. Average earners are unable to afford this kind of security system. At the same time they can not afford to lose their car as well. This project focus on using moderate cost materials and with some modification, it will protect the car effectively. Although it will not secure the car perfectly, but at least reduce the chances of car being stolen.

### 2.6.2 Focus on Proton Cars helps to Market the Car

For this project, the Proton car module is studied in detail. The reason is to design an effective security system which can be easily installed and integrated with the built-in Proton alarm module. If this effective security system is accepted by Proton, the installation will be done during manufacturing process and thus avoids the problem of human factor. Before the car is registered, information leaked out will be irrelevant for the thieves. Besides, with better security system installed, this can bring up the reputation of local made cars and help to market the local cars among the Malaysian. As a result, Malaysia economy will grow.

# CHAPTER 3

# METHODOLOGY

## 3.1 Methodology

In order to complete this project, there are a lot of stages of work need to be carried out. These stages are necessary as the results obtained will be more accurate and more precise. Basically the project is divided into few stages which include:

- Researching
- Comparing and Analyzing
- Designing and Enhancement
- Testing and Troubleshooting
- Implementing
- Reporting

The process flow of the project can be summarized in the flow chart in Figure 3.1. In the figure, the stages of methodology listed above are shown in proper sequence which will lead to the success of the project.

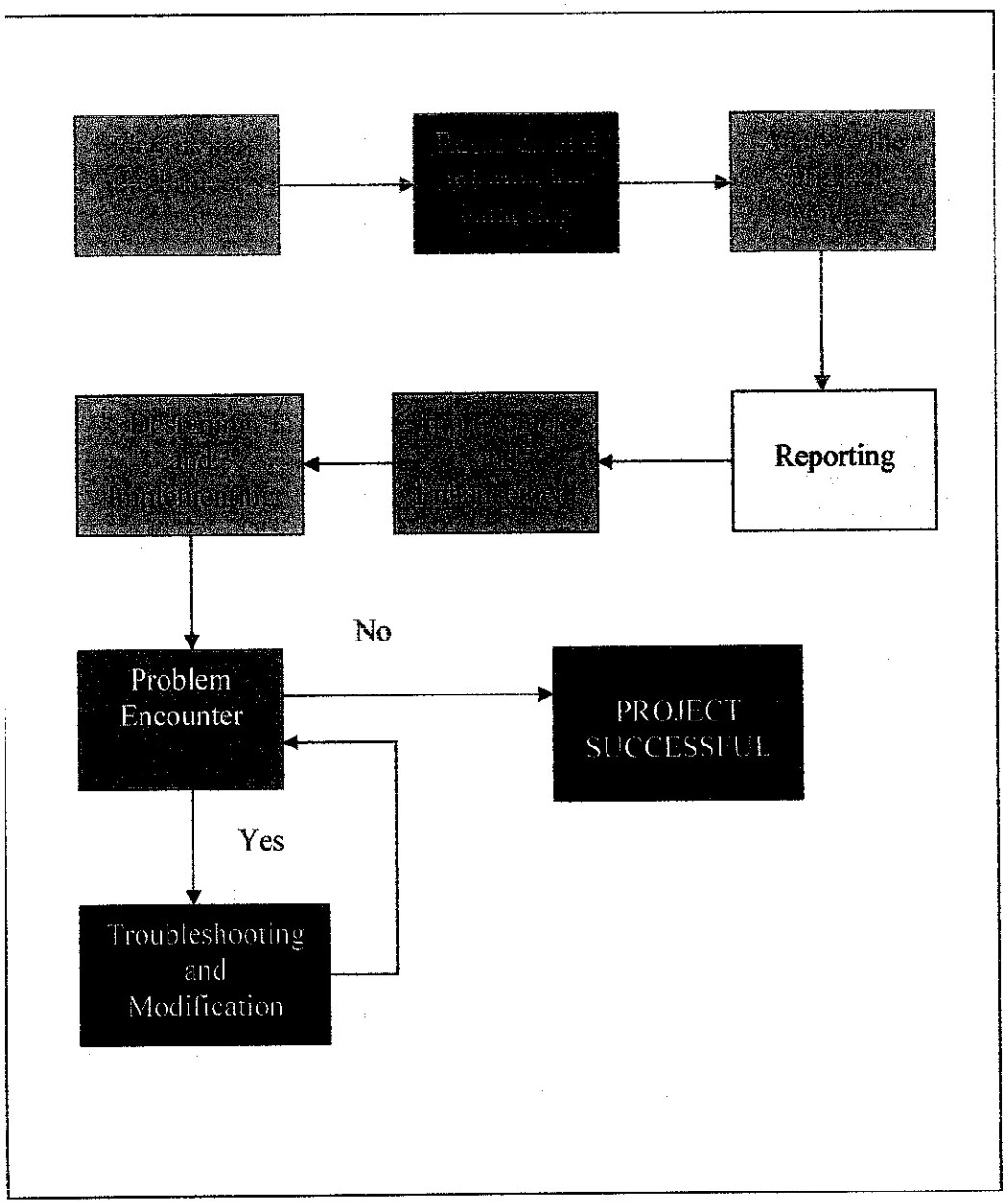



Figure 3.1: Flowchart of the Project

## 3.2 Stages of the Project

For the first half of the project, it is basically divided into 3 major parts. They are identifying the project and researching, analyzing the module, and reporting. These 3 stages are very important as they are interrelated.

### 3.2.1 Identifying Project and Researching

Identifying the project is an important stage and also a crucial area to be worked on. First the purposes of the project must be well clarified before any further work is carried out. This is to avoid any work done which is unrelated to the purpose of the project. Besides, with the purposes well identified, the design work will be easier to carry out.

The project is identified as a system enhancement project on the original built-in alarm system of Proton car of Malaysia. This project is necessary because the original alarm system provides inadequate security system to prevent the cars from being stolen away. The main purpose of this project is to design a better and more effective yet inexpensive security system for Proton car.

Researching is also a very important stage. Researching includes information gathering and analysis. The researches done for this project are mainly on

- Current car security system available in market
- The evolution of car security system
- Affordable cost for moderate earner
- Methods to breach the Proton car security system

- Possible improvements to be designed
- Technology to be used in the design

### 3.2.2 Analyzing Module

The alarm module of the Proton car has been bought to analyze the functions available and the way the module works. Without proper analysis of the module, it is very hard to know the weakness in the system. With proper analysis, the improvement design can only be proposed and further implemented. The module is made connection according to the usual way the factory install the module. The user manual which comes along the module does explain the basic method to connect the wires. Simulation is done to make sure the module will work as the alarm system in Proton cars. Then the functions of the module available will be explored one by one. Besides, the module's functions are compared to a better security system to find more space for improvement. The analysis of the module will be explained in detail in the Result section.

### 3.2.3 Design and Enhancement

The most important stage of all is the design part. This is where the knowledge learnt in university, will be applied. For the features to be added to the alarm module, the circuit must be designed and test. Circuitry knowledge is applied to design the circuit to make the module works as desired. For design stage, every single aspect is important such as the output current and output voltage, the power consumption, protection and etc. These aspects will determine whether the designed circuit will work as wanted. A slight miscalculation can cause the entire circuit to be malfunction, and for worse case, it might spoil the integrated circuit (IC) used. The circuit design is based on the information obtained from the respective datasheet of every component used. The

circuit will be simulated using the simulation software, PSPICE. This is to make sure that in theory the circuit designed is working fine. Next, it is constructed on the breadboard to check for practical result. Enhancement is done to simplify the circuitry and to make the circuit more robust. Simple circuit will have less uncertainty, as every component will have some tolerance. Robust circuit will make the circuit more stable and produce the desired result always.

### 3.2.4 **Testing and Troubleshooting**

For every circuit designed, there will always be problems. Therefore, the circuits must be tested properly. One of the most necessary skills to design circuit is the ability to troubleshoot the problem. After the circuits are tested, the results are recorded for further reference. Whenever a problem is encountered, the problem must be solved to obtain the desired result. One of the methods can be used is to check every single output of the components in the circuit. With this it is easier to identify the root cause of the problem.

### 3.2.5 **Implementing**

After the designs are verified to be working fine, the circuits are implemented on Printed Circuit Board (PCB). The schematics of all the components are converted into PCB layout before converting them into PCB. PCB is a better way to implement circuitry. Conversion of circuit is done by using Eagle software. Next, the circuits are installed to the original car alarm module. Finally, a report is produced to record all the results and schematics design for further reference.

### 3.2 Tools and Equipment

For this project, the following tools and equipment are necessary:

1) 12V 6A power supply or battery
2) Proton car compatible alarm module
3) Housing for module
4) Soldering Equipment
5) Mechanical tools
6) PIC burner

Besides the equipment listed above, electronics circuits are necessary as well (refer to Appendix D for Bill of Material (BOM)). Before a circuit is being implemented, the designed circuit is simulated before hand to predict the results. The circuits are then made into Printed Circuit Board (PCB). A PIC microcontroller is used in the project and the PIC needs to be programmed before it is able to carry out the order we program in. All these require software such as:

1) PSPICE (simulation software)
2) Eagle (PCB software)
3) PICC (PIC compiler software)
4) Warp13 and Maxloader (PIC burner software)

# CHAPTER 4

# RESULTS AND DISCUSSION

## 4.1 Analysis of the Car Alarm Module

The car alarm module used for analysis is obtained from a car accessories shop. This module is compatible with the Proton cars in Malaysia. However, it has slight improvement than the original Proton car alarm module built in.

### 4.1.1 Functions of the module

This car alarm module has only limited functions to be considered as security system. The main function is to sound the alarm whenever it is triggered. There are a few ways which will trigger the alarm. One of them is when the door is locked by using the remote but later on the door is being open manually through the key hole. Another method is when there is a loud sudden noise near the car. Thunder and firecrackers sound might trigger the alarm. Sudden shock occurs on the car will also trigger the alarm; however, this is subject to the car having the shock sensor installed. Unfortunately, all these possible alarm triggering factors can occur anytime, anywhere and thus causes confusion to the owner; whether the car is under the risk of being carjacked, or just a false alarm. False alarm happens more frequent and this gives a predetermined idea to car owners that false alarm happens when the alarm is triggered; in fact the car is on the verge of being stolen away.

Besides the alarm, the module also acts as the central locking of the car doors. It controls the locking and unlocking of the car doors through a few methods. When the

lock/unlock button on the remote control is pressed, the module will send signal to the motor of the car doors, to drive the motor turning the pistons up or down. Pistons going up equal to unlocking and conversely, they are to lock the door. Driving the 4 motors of the 4 car doors requires very high current, which is approximately 3A in average. This large current is only drained when the button is pressed. Apart from the button on the remote, the car doors can be lock or unlock manually, either by using the key or from inside the car.

For this improved version of car module, when the car is moving and the footbrake is stepped, the footbrake will send a signal to indicate the module to automatically lock the door. This function provides security to car owner as in when the car is not moving for example at a traffic light. Since the car doors are locked early on, thieves are unable to open the car door and snatch the handbags of the owners away. However, this function has nothing to do with car security system when the owner is away. The circuit of the module is complicated and involves a lot of ICs. Therefore, to show the module, the module is represented by the block diagram shown in Figure 4.1.

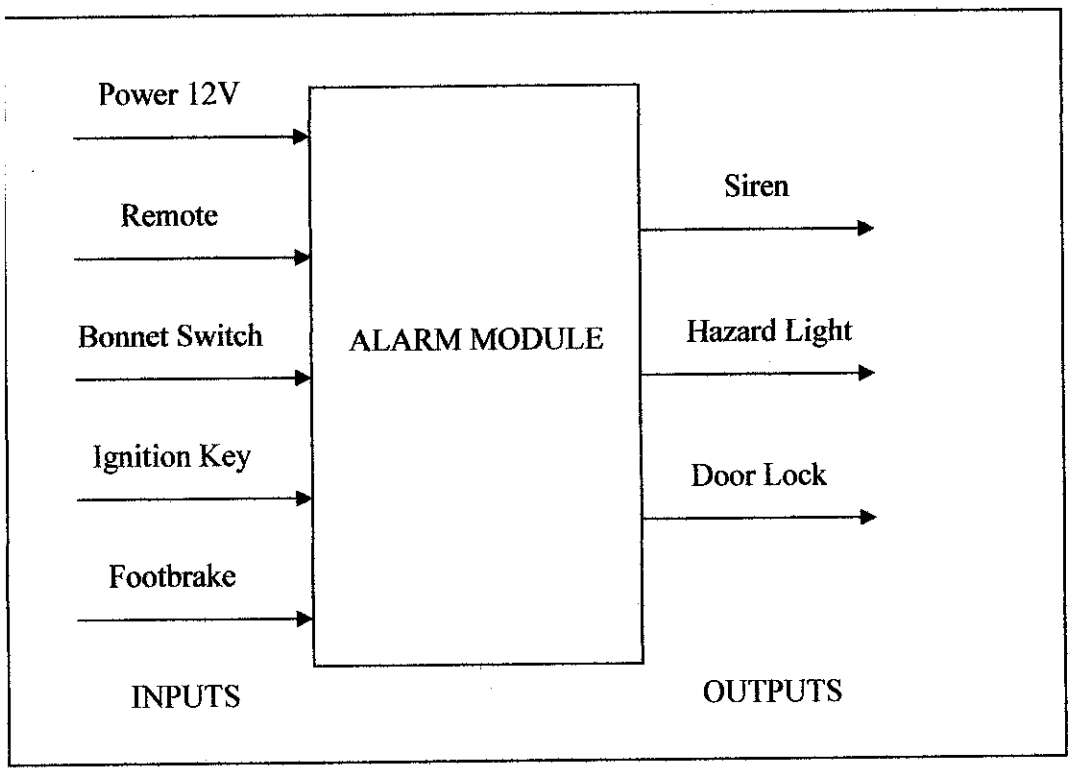



Figure 4.1: Block diagram of the Module Analyzed (Improved Version with footbrake control)

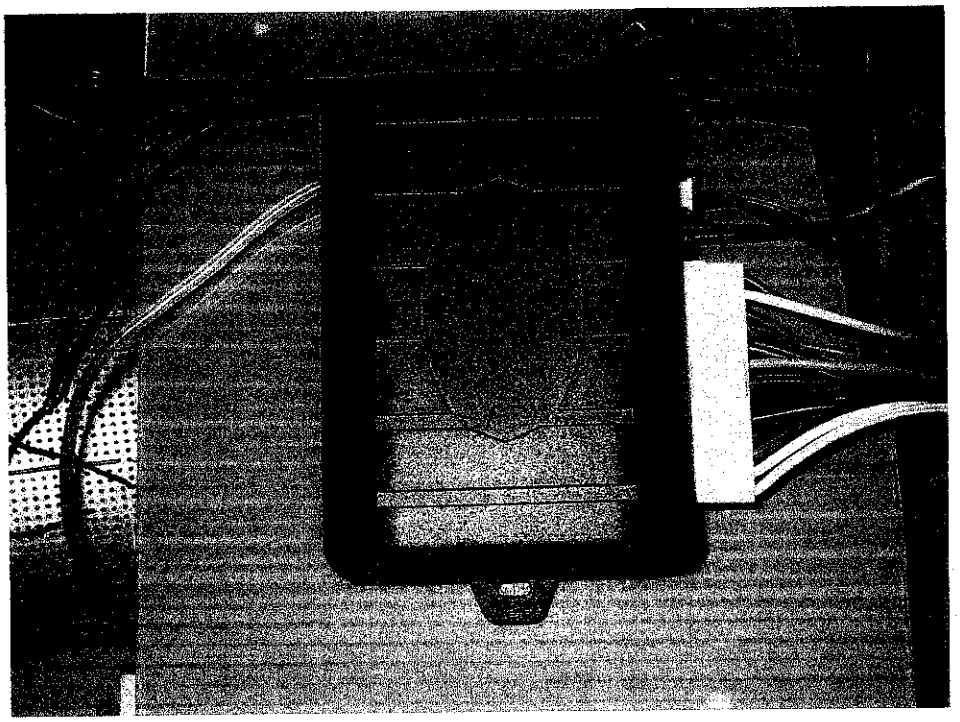


Figure 4.2: Picture of the Original Alarm Module

### 4.1.2 Electrical Specification of the Module

The module receives electrical signal from various sources and send out the corresponding output to other component of the security system. As an electrical and electronic engineering project, the electrical specification is very important. For this module, the electrical specification focuses on the voltage received by the module and the voltage sent out to the other components. Basically, the module works with a 12V DC car battery supply, which has maximum current of 55A. This high current is needed to drive the engine and the motor. For this project, 12V DC battery supply is needed but 6A current was sufficient to turn the 4 motors at the car doors. The actuators require higher current compared to normal electronic devices. The following table shows the electrical specification analyzed for this module.

Table 4.1: Electrical Specification for Car Security Module

| | Input to Module | Output from Module |
|---|---|---|
| | Voltage | Voltage |
| 12V Power Supply | 12V | |
| Foot Brake | 12V | |
| Bonnet Switch | 0V (Ground) | |
| Ignition Key | 12V | |
| Actuator (Door Lock) | | 12V (Not Activated) 3V - 4V (When Activated) |
| Siren | | 12V |
| Hazard Light | | 3V – 5V (Blinking) |

## 4.2 Enhancement and New Features

From the analysis in previous section (4.1), and also the literature review on ways to breach the current security system, it can be seen that the current security system is not enough to protect the car. In fact, the alarm system is ignored totally when a thief attempts to steal the car away. Frequent false alarm makes people having the perception of false alarm, whenever an alarm is triggered. This further reduces the effectiveness of alarm system. Besides, the noise made by alarm system does cause other unwanted side effects, such as psychological problems. Therefore, new features are needed to make the car security system more effective, and at the same time, reduces the chance of causing the other unwanted side effects. The new features to be added are divided into 3 parts:

- Self diagnose system
- False Alarm minimizer
- SMS system to indicate carjacking

The enhancements added will provide extra features to the existing alarm module. The figure in the next page summarizes the enhancements added and the main components used for the enhancement.

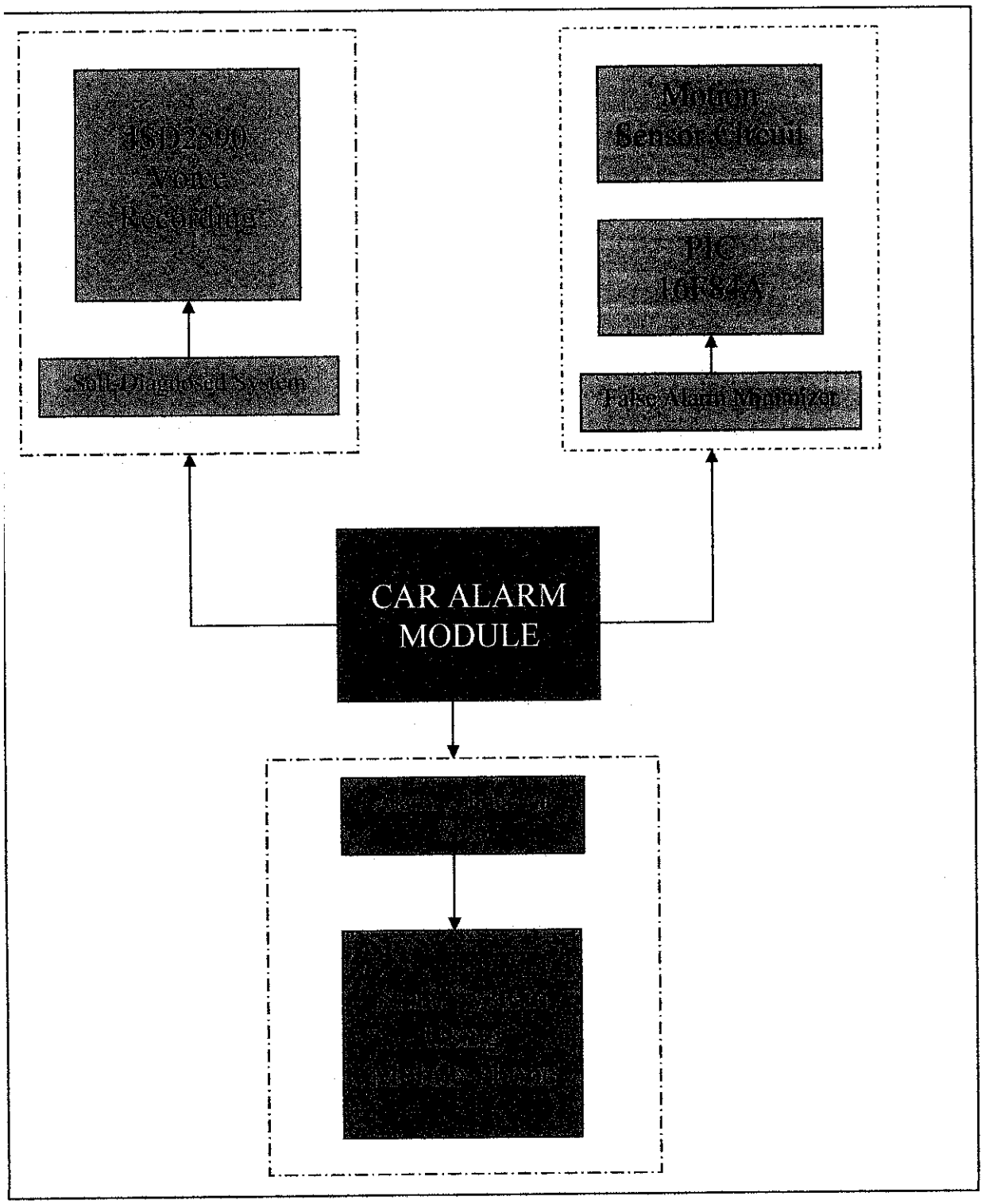



Figure 4.3: Block Diagram of Incorporating the New Features

### 4.2.1 Self Diagnose System

Self diagnose system is a system, made to tell the owner of the car, about the parts of the car is not in proper security condition. By adding this feature, owner of the car will be notified about the problem with the security of the car when leaving the car. For example, if the security system is malfunction, the owner will be notified by the system, indicating the security is malfunction. With this, proper action will be taken by the owner to repair the security system. Without this feature, the owner will not be aware that the security system is not functioning. By leaving the car unattended without the security system functioning, the car can be easily stolen away by thieves. Sensors are installed at every door as well in order to make sure all the doors are tightly closed. Having a small gap between the door and car body, is enough for thieves to crack it open with ease.

This system uses voice indication, where the voice is prerecorded. The reason for using voice instead of the light indicator (in use currently in a lot of cars' system), is that human tend to pay more attention to voice then having themselves to check the indicator. Normally light indicator is made of small LEDs and when activated, they will blink. However, these LEDs' effectiveness will highly reduce during daytime where the surrounding is bright. Owners of cars will normally miss out the indicator. Using voice system, the voice is not affected by surrounding brightness. Actually, it is highly immune to surrounding noise as well. This is because the moment the owner stops the engine; the system will be able to notify the owner if there is anything wrong with the security system. At that moment, the owner will still be in the car and the voice from the system can be clearly heard by the owner, even thought there are loud noise from outside the car.

Besides notifying the car owners about the car problems, the alarm system will be replaced by this voice alarm system. The reason to replace the normal alarm system

with this voice alarm system is to reduce the unwanted side effect, mostly psychological problem, not only to the car owners, also for the people around. The side effect was explained in the literature review section. Repeated tones can cause disturbance to the people around. However, if the voice alarm system is used instead, then this disturbance will be greatly reduced. To the people around, it is as if someone is talking, and keeps on repeating the same sentences only. Compared to repeated tones of noise, voice does not cause that much disturbance, and thus will reduce the chance of causing psychological problems and so on.

With this feature being installed in the car, small mistakes usually made by car owners, such as doors are not close tightly, will be notified to the car owners. Owner of cars will be able to take proper action to avoid their cars from getting stolen away easily. Therefore, this feature will increase the effectiveness of the security system.

#### 4.2.1.1 ISD2590 IC

To make this self-diagnose system, ISD2590 IC is used. ISD 2590 is a voice recording IC which enables voice to be recorded. The recorded voice data can be played back later on.

The voice data can be kept for a long time. The memory system for this IC is non volatile, which means without any power supply, the data kept will remain in the memory. Voice is recorded through input from a microphone. P/R pin is set to LOW for recording. Then the voice data from microphone is in analog form, which the voltage value is continuous, is processed by the IC. To store the data in memory, the voice data must be converted into digital binary number. This is done by the IC

internally, through analog to digital converter (ADC). After the conversion of data, it is stored in an internal EEPROM, where the address is set by the user.

To play back the message, P/R pin is set to HIGH to enable the playback function. Voice data is retrieved from the memory storage. The address pins are set by user to indicate the message to be played back. Once the voice data is confirmed, the data is passed through a digital to analog converter (DAC) to play back the original message.

#### 4.2.1.2 Using ISD2590 in the Self-diagnose System

The major components used with this IC are the microphone to collect input voice data, and the speaker to output the voice data recorded. The record and playback processes are controlled by the CE and P/R pin. PD pin is connected either to power source or ground to power up the IC. Both CE and PD pins are controlled by the PIC output pins. The M0 and M3 pins are also controlled by PIC for enabling the message cueing and looping mode respectively. The schematic for all the connections of this IC is shown in the following figure:

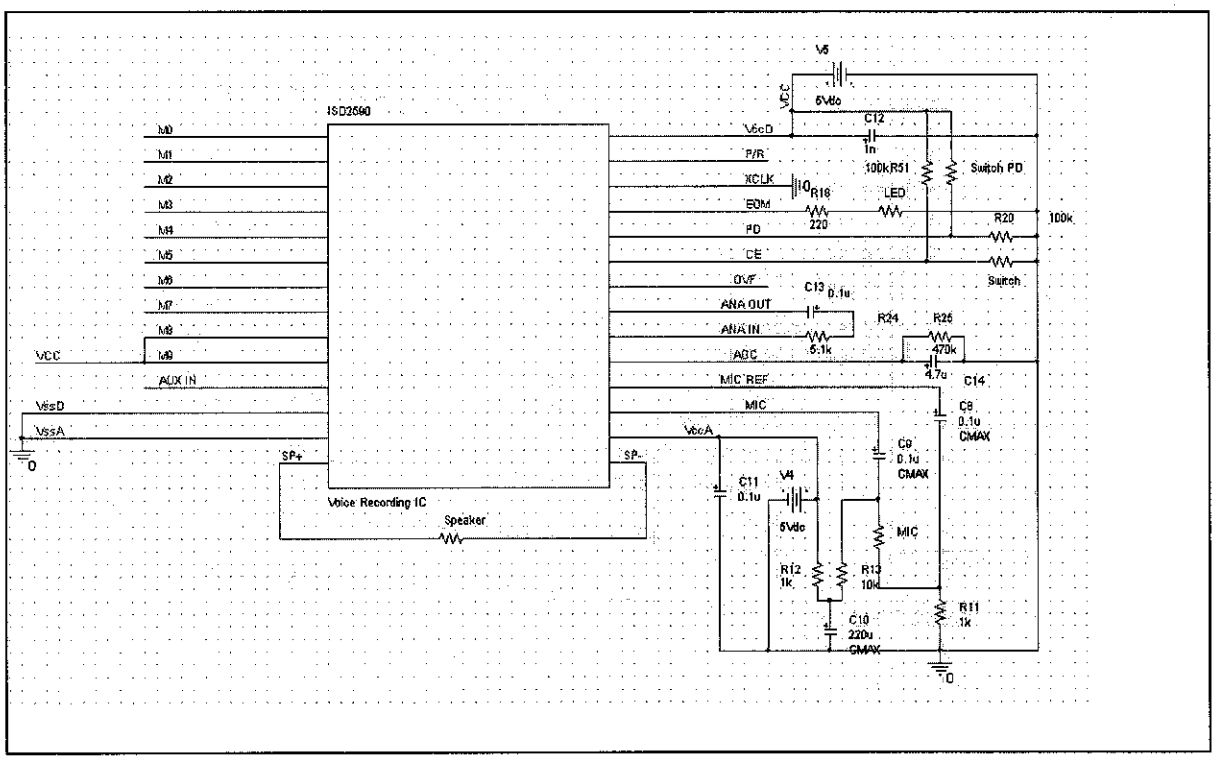



Figure 4.4: Schematic for ISD 2590

A few different indicator messages are prerecorded into the IC. For the system, the necessary function is the playback function only. Therefore, the P/R pin can be connected to $V_{CC}$. The messages which will be played back will depend on the mode chosen and the recorded messages. These different messages' functions are as table below:

Table 4.2 Voice Messages and Functions

| Address | Messages | Indication |
|---|---|---|
| FIRST MESSAGE | Warning! Intruder Detected | The car is on the risk of being stolen away |
| SECOND MESSAGE | Front right door is not tight | The front right door is not closed properly. |
| THIRD MESSAGE | Front left door is not tight | The front left door is not closed properly. |

| | | |
|---|---|---|
| FOURTH MESSAGE | Back right door is not tight | The back right door is not closed properly. |
| FIFTH MESSAGE | Back left door is not tight | The back left door is not closed properly. |
| SIXTH MESSAGE | Alarm System is not up | Alarm system is malfunction. |

For the 6 different messages, the first message is the message which requires continuous play back. For this, mode message looping is needed and it can be done by sending logic '1' to M3 pin from the PIC. With this mode, the first address message is continuously played back. For other messages, the messages are independent from each other. Instead of playing them in sequence, the messages are cued. PIC is responsible to send logic '1' to pin M0. To correctly select the messages, the CE pin input is important. The procedure is explained in the playback part.

ISD2590 is an IC where users do not record the message into known physical addresses. Instead, the messages are recorded in sequence. This means that each of the messages can be of different length. Push button mode is used for this project by using the M6 operation mode. For this mode, the M6 pin is connected to $V_{CC}$ together with pin A8 and A9. For recording messages, before a message is recorded, the PD pin must be connected to logic '0' (normally it is grounded) to power up the IC. The recording procedure is listed below:

1) IC is powered up by giving logic '0' to PD pin and P/R pin is in logic '0' to enable recording.
2) CE pin is given a Low pulse once to enable recording (EOM is High).
3) Start recording message by talking into the microphone.
4) CE is given a Low pulse again to indicate end of the particular message (EOM is Low).
5) CE is given a Low pulse again to record the next message in sequence (EOM High).

6) Procedure 4 and 5 is repeated until all the messages are recorded.
7) P/R pin is made High (logic '1') to change the IC to playback mode.

For play back part, the messages are played back in sequence unless either cueing mode or looping mode is selected. The procedures are listed below:

1) PD pin is made Low to power up the IC. P/R pin is made High for playback function.
2) For message looping, M3 is made High while for message cueing, M0 is made High.
3) CE is given a Low pulse once to start playback at the first message (EOM High). For message cueing, procedure 4 to 5 is carried out.
4) CE is given a Low pulse second time to skip the message and proceed to the second message.
5) CE is given a Low pulse every time a message is to be skipped and proceed to the next message. Other messages can be chosen by giving CE the correct amount of Low pulses.

Note: When a message is successfully played back, the EOM pin will go to Low.

6) PD pin is given a Low pulse to reset the message to the starting address.

The speaker which can be driven by the IC is 16 Ohm speaker. 16 Ohm speaker is more sensitive than 8 Ohm speaker used for this IC. The output voltage and current for the speaker pins are low and the voice signal will not be able to be picked up by the less sensitive 8 Ohm speaker. Therefore an amplifier is needed to amplify the signal of the voice data before the speaker. For the amplifier, an op-amp of LM386 is used. This op-amp is an amplifier designated for small AC signal. Besides, the output voltage of the speaker can be adjusted by changing the value of the resistor R10. The circuit for the amplifier is shown in the next figure.

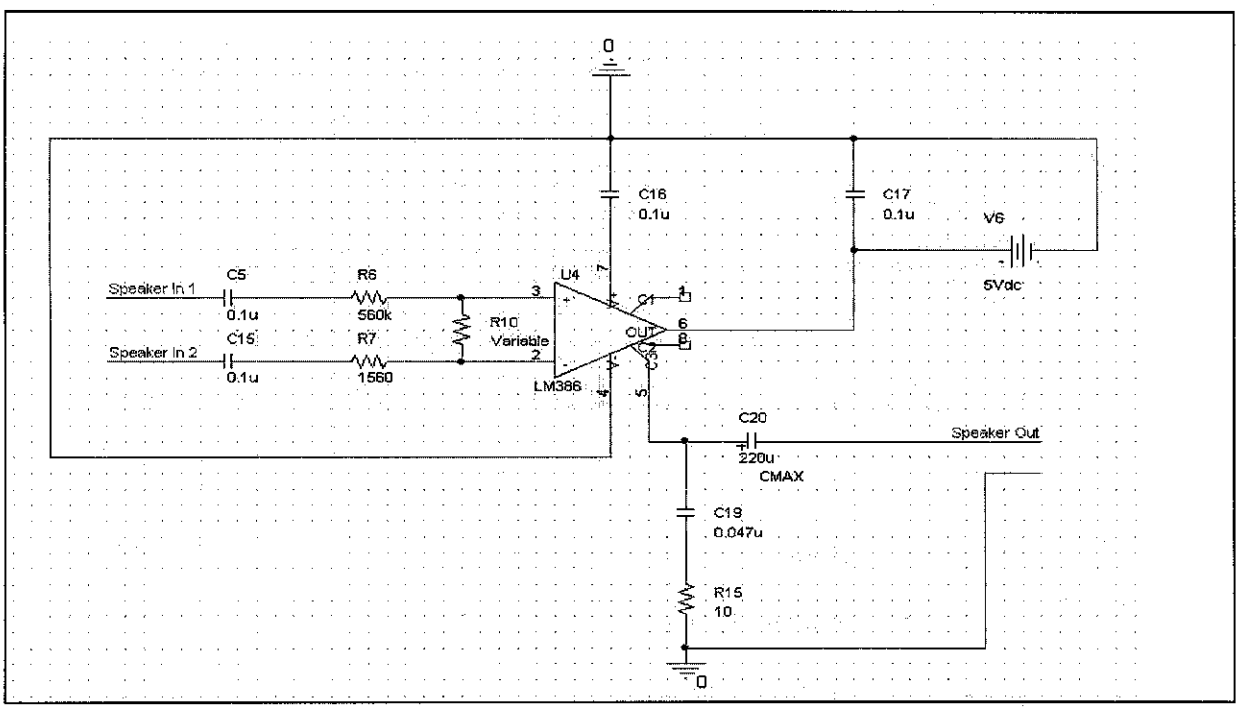



Figure 4.5: 8 Ohm Speaker Driver

### 4.2.2 False Alarm Minimizer

The main reason a false alarm minimizer is added as a feature in the security system, is to reduce, if not avoid, false alarm. As being explained earlier the role played by false alarm in making alarm system become useless, it will help greatly if the false alarm can be avoided or reduced greatly. False alarm is explained in section 2.5.1.

False alarm minimizer is installed to avoid any false alarm when no one is around the car. The alarm will be triggered by the same sources mention in section 2.5.1, which includes thunder. However, with false alarm minimizer, the sensor will detect if there is anyone around the car especially near the driver seat door. The alarm will only sound when the security system is triggered and someone is detected to be around the car. This will reduce the chances of having false alarm.

With chances of false alarm to happen greatly reduced, this will change the perception of people, expecting a false alarm when a real carjacking is in process. With this perception being erased, passers-by will pay more attention to the car, which the alarm is triggered. Good Samaritans will be able to take action to help to either catch the thieves or scare them away. The least false alarm happens, the more secure the car. Therefore, the effectiveness of the security system will be greatly increased. Now, with this false alarm minimizer, the car is protected not only by the owner himself or herself, but also by the public who is kind-hearted.

#### 4.2.2.1 Circuitry of False Alarm Minimizer

The false alarm minimizer circuit is designed by using a Light Dependant Resistor (LDR) or it is also known as motion sensor. LDR under bright light will have a low resistance value. Conversely, when under low intensity of light or in dark area, LDR will have a higher resistance value. LDR is used as sensor to check if anyone is nearby. When someone is nearby, the LDR will receive low intensity light and the resistance increases. By using voltage divider circuit, difference in resistance can make the output voltage to be different as well.

$$Vo = \frac{R_{LDR}}{(R+R_{LDR})} Vi \qquad \text{(Eq. 4.1)}$$

From the equation above, when $R_{LDR}$ is increased, the output voltage value will increase as well. The output voltage is then connected to a comparator. The purpose of a comparator is to compare two input voltage. If positive input is higher than negative input, the output of the comparator will be 5V. Conversely, the output will be 0V. One of the inputs is connected to the LDR circuit, while another one is connected to a constant voltage value circuit. The constant voltage value circuit is configured in a way that when LDR is under total brightness, the output voltage $V_{0LDR}$ will be higher than the constant voltage value ($V_{CV}$). The following are the experiment results for LDR motion sensor circuit:

Total Brightness: $V_{0LDR} > V_{CV}$ ➔ $V_{0COM} = 0.75V$ (Logic '0')

Brightness level low: $V_{0LDR} < V_{CV}$ ➔ $V_{0COM} = 4.6V$ (Logic '1')

The 5V is connected to a PIC microcontroller. The PIC use is 16F84A PIC, which is a basic PIC. This 5V input is considered as HIGH (logic 1) by the PIC. This input will then be sensed every time the alarm is triggered. Every time when both inputs are HIGH, the alarm will only be sounded through a voice recording IC, ISD2590. This is

to avoid any false alarm, which occurs when alarm is triggered but no one is nearby the car. It is almost impossible for someone to steal a car when he or she is not near the car.

Besides, this motion sensor LDR output is further use to make the siren continuous until the owner disable it or no risk of car theft is sensed. For the original module, the alarm will only sound for 40s. After that, the alarm will stop. If someone attempts to steal the car after the alarm stops, no one will actually realize this. Therefore, by using the motion sensor, when someone is sensed nearby even though the alarm stops (after 40s), the alarm will continue to sound for extra 10s until no one is sensed nearby the car. This feature is done by using programming in PIC to control the alarm system (please refer to section 4.2.4.1 on PIC). The circuit for motion sensor is shown in the following figure:

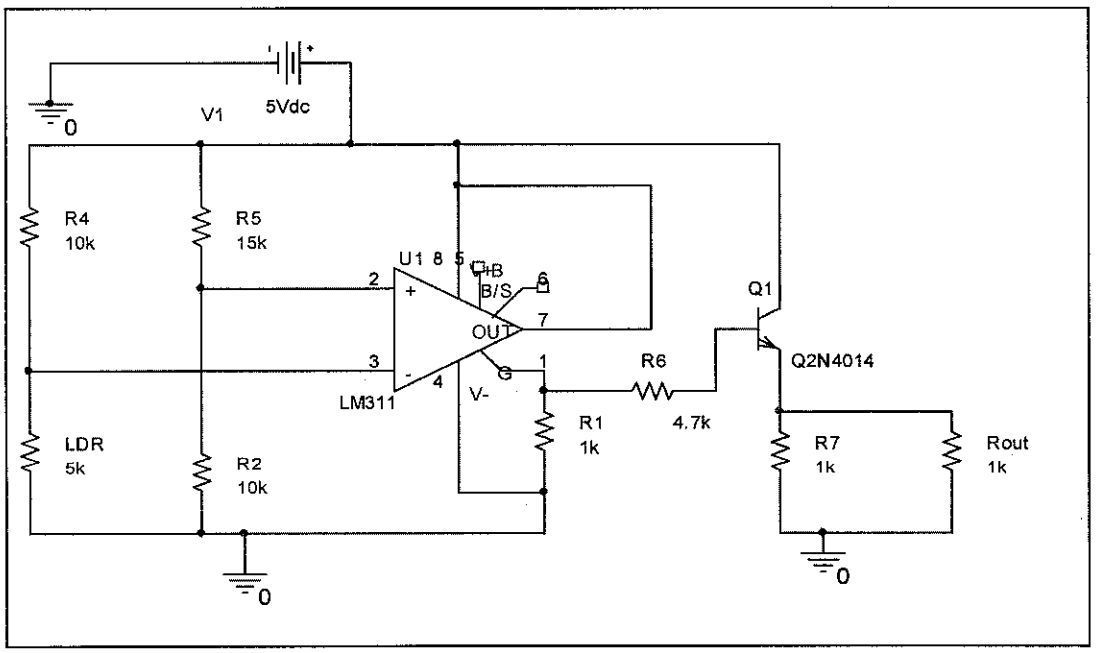



Figure 4.6: Circuit diagram for Motion Sensor

#### 4.2.2.2 Algorithm for False Alarm Minimizer

As mentioned earlier, false alarm minimizer is used to reduce, if not avoid false alarm. In order for the car alarm system to actually give out warning message, it requires 2 conditions. First, since the enhancements are made to be integrated with an alarm module, the original module's alarm must be triggered. With the alarm triggered, it will need the false alarm minimizer circuit to give a High to the PIC in order to send out warning message. In practical, this means that a car's alarm is being triggered. Motion sensor senses whether there is anyone near the car especially the driver seat door area. If there is nobody sensed, the alarm triggered is a false alarm. This is because no one can steal a car away without being near to the car door to access the car. If someone is sensed near the car, the car may be on the brink of being stolen away. Even though the people sensed might be a passer-by, but it is better to take precaution by the owner.

When the warning message is sounded, at the same time, a SMS is being sent to the car owner to alert the owner. With the SMS, the owner can get to his precious car in time to prevent the car theft. The sending of SMS is done by using the mobile phone available in the car (section 4.2.3). Next, since the original alarm module will only give out signal for 40s, this might not be long enough to attract the attention of public or for the owner to reach the car in time. Therefore, the algorithm is set to make warning message to extend for further 20s every time one of the following 3 conditions is met. The 3 conditions are listed below:

1. Original alarm is retriggered
2. False alarm minimizer circuit triggered
3. One of the car doors is open

If the original alarm is retriggered or anyone is sensed nearby, the warning message will continue to alert the public for further.

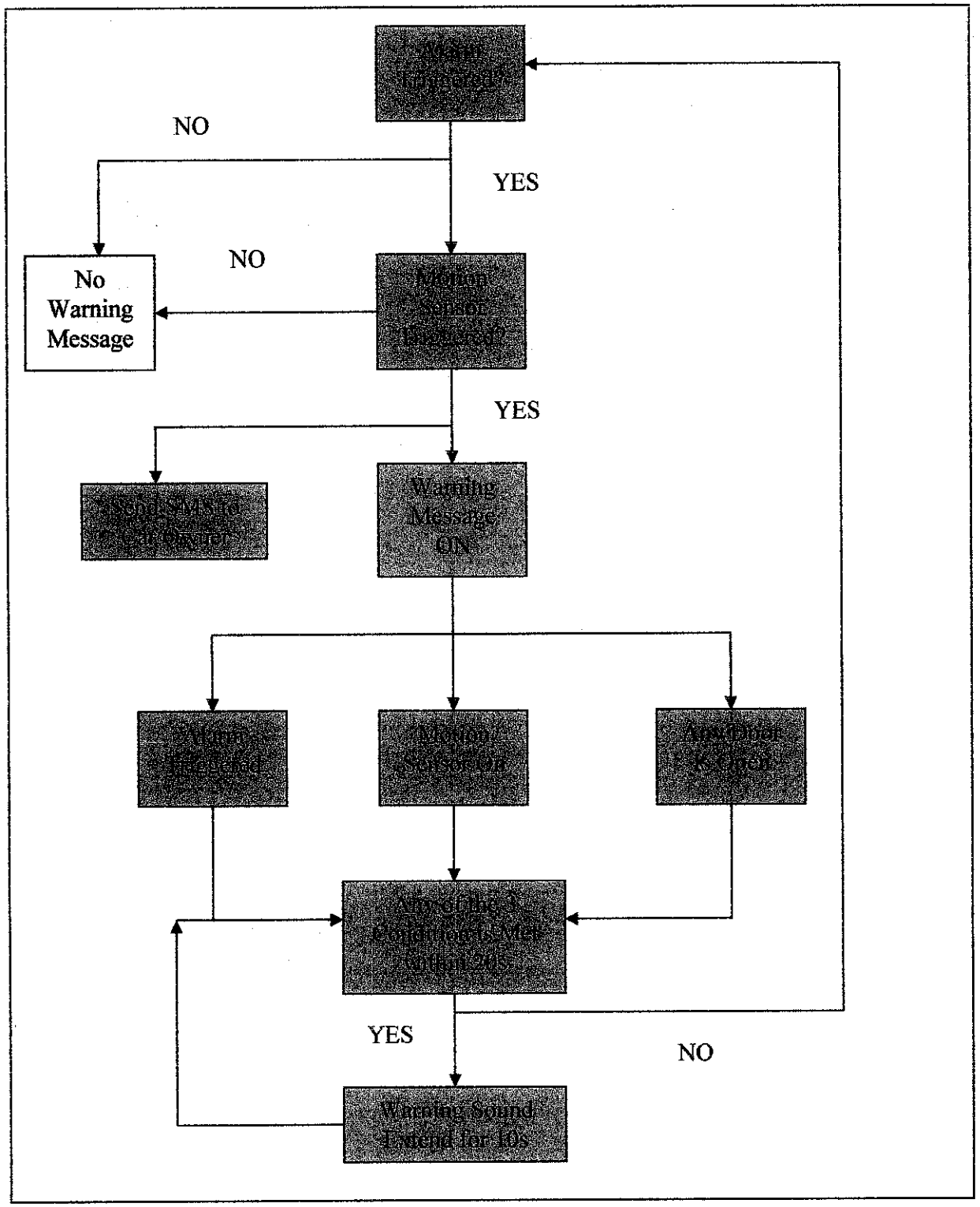



Figure 4.7: Algorithm of Enhanced Alarm System

### 4.2.3 SMS System

The enhancement of the security system includes a new technology, which is the SMS system. It can be seen that mobile phone has now become very popular in this world. Almost everyone owns a mobile phone, including little kid with age less than 12 years old. With increasing popularity in mobile phone, new technology is focusing on mobile phone. Therefore, mobile phone is used to play a role in helping car security system by using the SMS system which is available in every mobile phone.

Mobile phone uses **Global System for Mobile Communications (GSM)** frequency of 900MHz (in Malaysia) to operate and the signal can be received throughout Malaysia as long as there is coverage. Up to now, only areas which are deserted will not have coverage. Therefore, owner can receive the SMS even if he is far away. As far as the security system is concerned, the SMS system is used to alert the owner of the car whenever the alarm is triggered. When car alarm is triggered, if the owner of the car is notified as soon as possible, the owner will have more time to react to the situation, either by approaching the car to check it out, of perhaps he can activate some other systems, such as tracking systems, which is equipped. It is very important for the owner to be notified as early as possible about the potential car theft as no one else can help best to protect the car besides the owner himself.

For this project, the sending of SMS is done by using a computer and a mobile phone. This SMS system is a prototyping idea as in practical, a personal computer and an extra mobile phone must be available in the car before this feature can be used. When a personal computer and mobile phone is in a car and the car is left unattended, this actually encourage thieves to attempt to steal away the expensive computer or mobile phone, if not the car. As the technology improves day by day, 3$^{rd}$ Generation (3G)

phone is now available in market, sooner or later, the car surveillance system using SMS will be replaced by the more powerful 3G real time video monitoring via a mobile phone. In future, when 3G phone becomes common in market, SMS surveillance system will no longer be used. Therefore, for this project, the idea of having this system is to have surveillance system. As mentioned earlier, almost each individual possess a mobile phone, therefore utilizing mobile phone will not cause extra burden to the user, as the mobile phone will be with the user everywhere he or she goes. So far, SMS system is the easiest yet efficient way of notifying the user from distance, this SMS system is being absorbed into the features.

#### 4.2.3.1 Setting up Nokia PC Suite

For prototyping purposes, the SMS is sent using a Nokia 6610i mobile phone. For hardware interface, the designated data cable is used to enable communication between the mobile phone and a personal computer. Different version of mobile phone uses different type of data cable. For Nokia 6610i, the data cable used is DKU-5, which is available in Nokia mobile phone center. DKU-5 data cable enables communication between the Nokia 6610i and the USB port of the personal computer. For software interface, since the computer used is using Microsoft Windows XP version, plug and play feature is available and the Windows can automatically detect the mobile phone is plugged in. The driver for DKU-5 is available together with the cable itself. With the driver being installed, DKU-5 can be used to access controls in the phone. The features available in the phone can be controlled via software - Nokia PC Suite. Nokia PC Suite is available in the same CD as the DKU-5 driver.

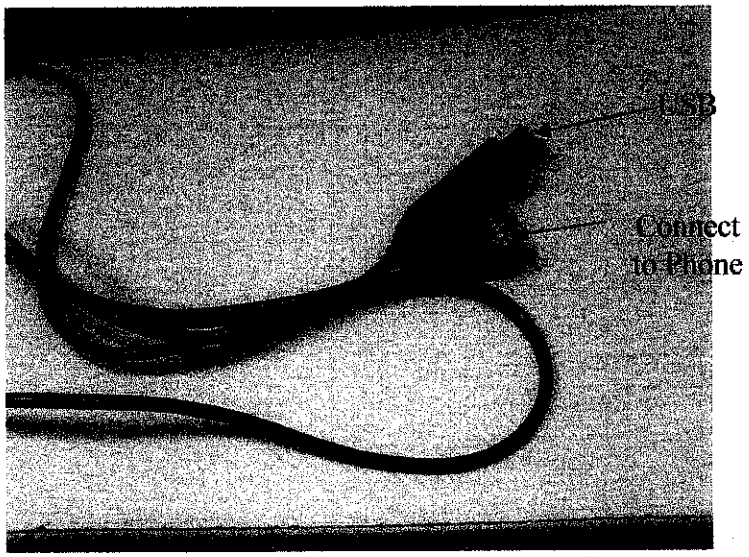



Figure 4.8: Picture of DKU-5 USB Cable

#### 4.2.3.2 Sending SMS via Nokia PC Suite

Nokia PC Suite enables user to access features in the Nokia 6610i, and control the phone as if the user is pressing on the phone keypad. The text message sending is done based on the following procedures.

Procedure:

1) The application of Nokia PC Suite is opened.
2) Connectivity is checked to see if the phone is connected to the computer (refer to Figure 4.8).
3) If no connectivity, the Manage Connection icon is clicked to select the necessary port (Comm Port4 (USB)).
4) With phone connected to the PC, the Send Text icon is clicked and the text window will appear (Figure 4.9).
5) Recipient's phone number is added in the 'To' space and message is added in the space below.

6) User can choose either to send the message, or save the text message for future use.

7) By having the message saved, the same message can be opened and reuse by double clicking on the saved message file (refer to Figure 4.10). A 'message sent' message will appear once the message is sent to the recipient.

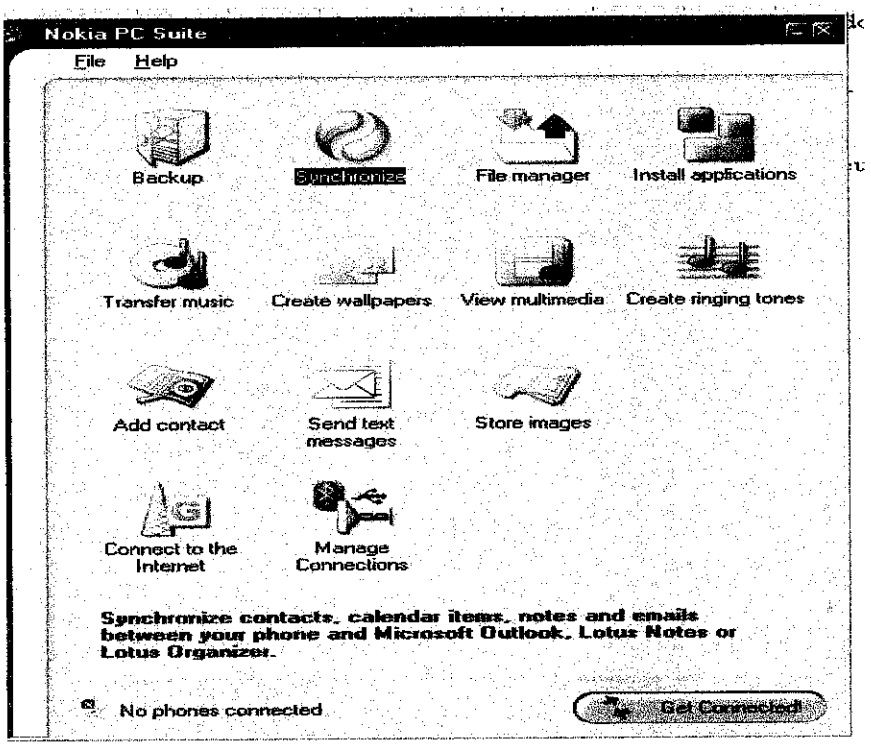



Figure 4.9: Nokia PC Suite Software Interface

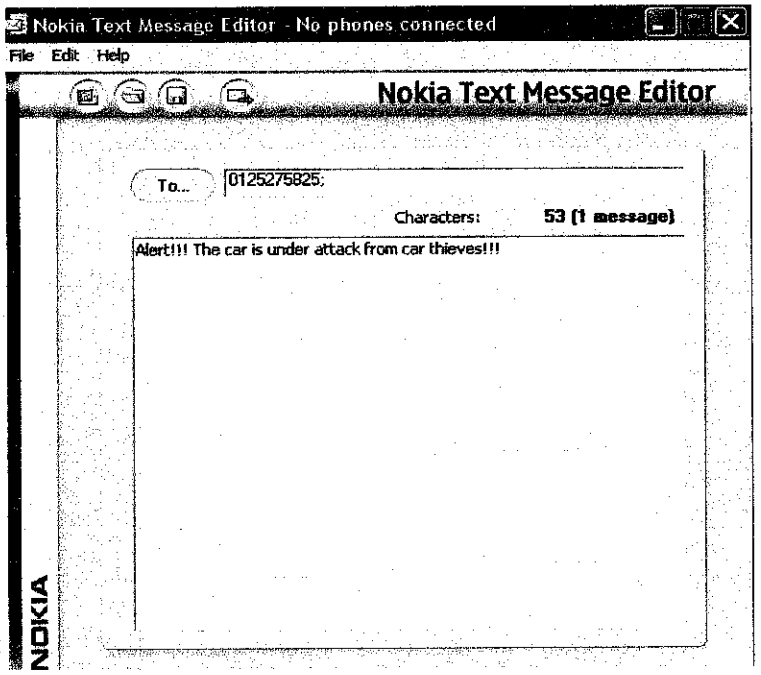



Figure 4.10: Text Message Editor

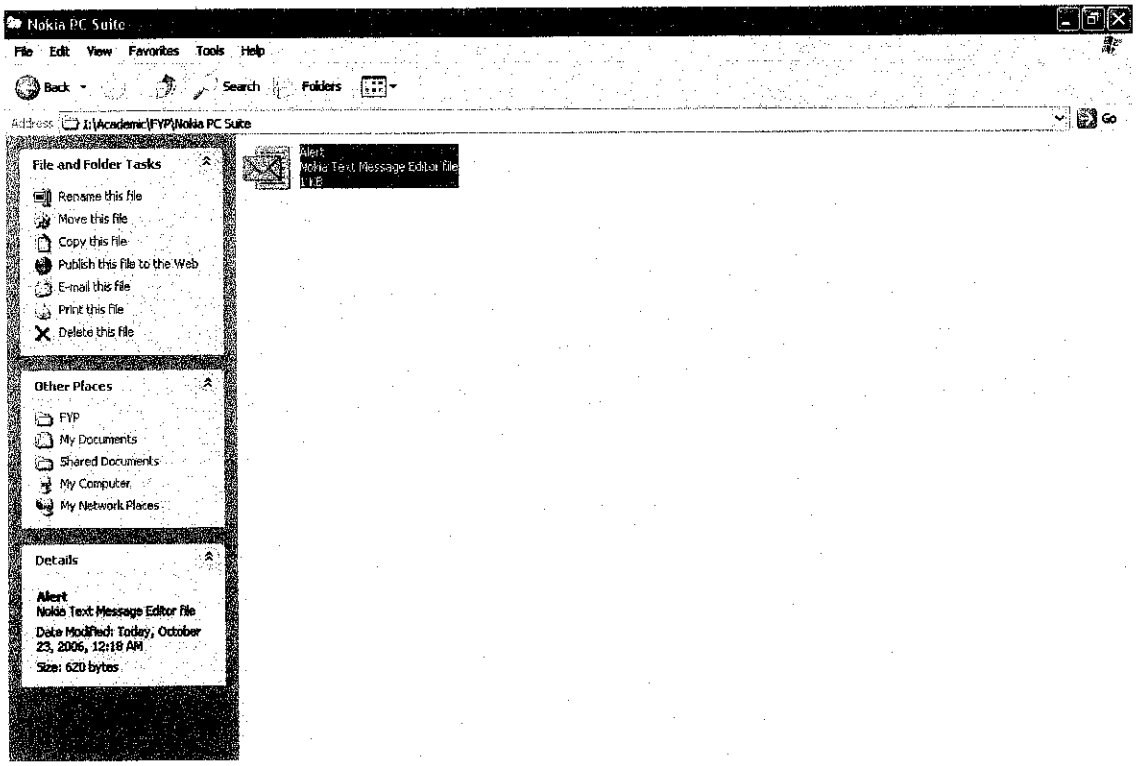



Figure 4.11: Saved Text Message

#### 4.2.3.3 Automatic SMS System

For sending of SMS explained in section 4.2.3.2, the SMS is sent by clicking on the 'send' command in the 'File' function of Text editor. This is not enough to be used for a security system. For the security system, the SMS must be sent when no one is around to control to computer. SMS is sent automatically once the alarm is triggered (without any false alarm situation). Automatic SMS can only be done by using the software Microsoft Visual Basic.

First, there is a pin in PIC which will send out the signal to send SMS. The output of the pin is a 5V signal. This signal is picked up by connecting the pin to the serial port of the computer via a serial port circuit. The circuit consists of the important MAX232 which is the necessary hardware interface between circuitry and serial port. Serial port recognizes only positive voltage and negative voltage as signals for logic High and logic Low, whereas for digital circuits, logic High is 5V and logic Low is 0V. A standard serial interfacing for personal computer requires negative logic, ranged from -3V to -12V for logic '1' while 3V to 12V (positive voltage) for logic '0'. MAX232 receives the digital signals from PIC and translate the signals to correspond signals recognized by serial port. The configuration for serial port circuit is shown in Figure 4.11.

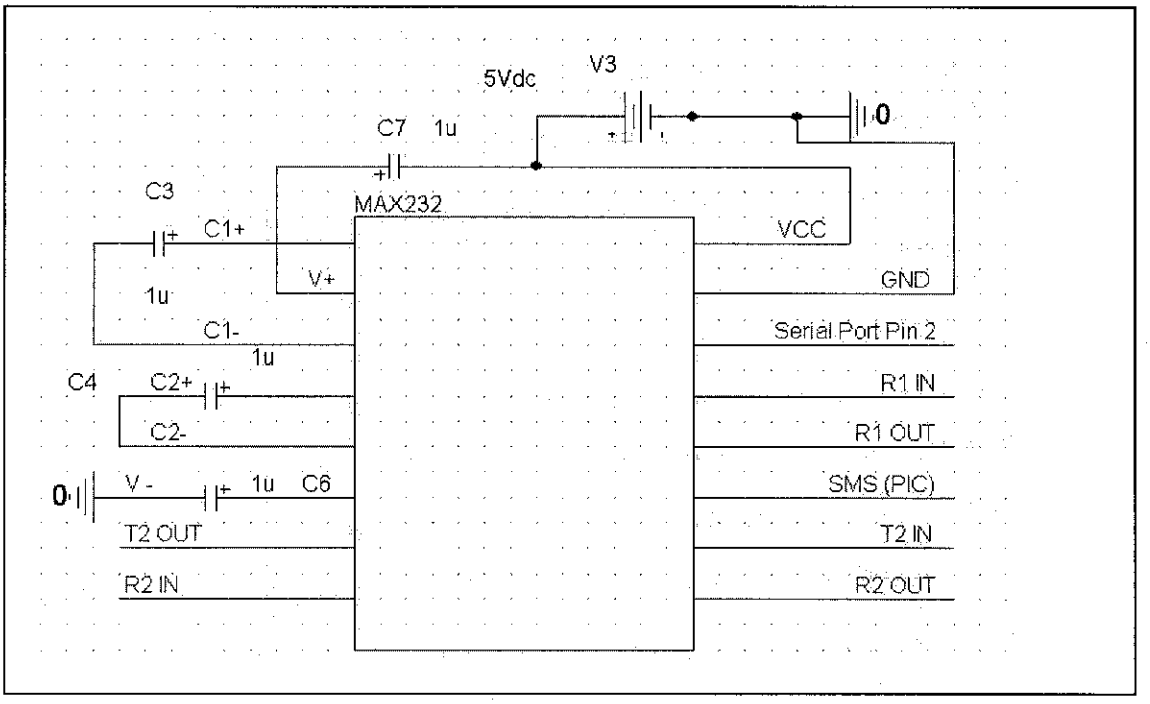



Figure 4.12: Serial Port Circuit

The signal from PIC is connected to pin SMS (PIC) at MAX232, while the output of pin Serial Port Pin2 is connected to a DB9 female connector. DB9 female connector is needed to connect the output of MAX232 to serial port of a computer. Since the serial port is only used to receive signal from MAX232, the receiving pins of MAX232 are not connected. The configuration at DB9 is shown in Figure 4.12.

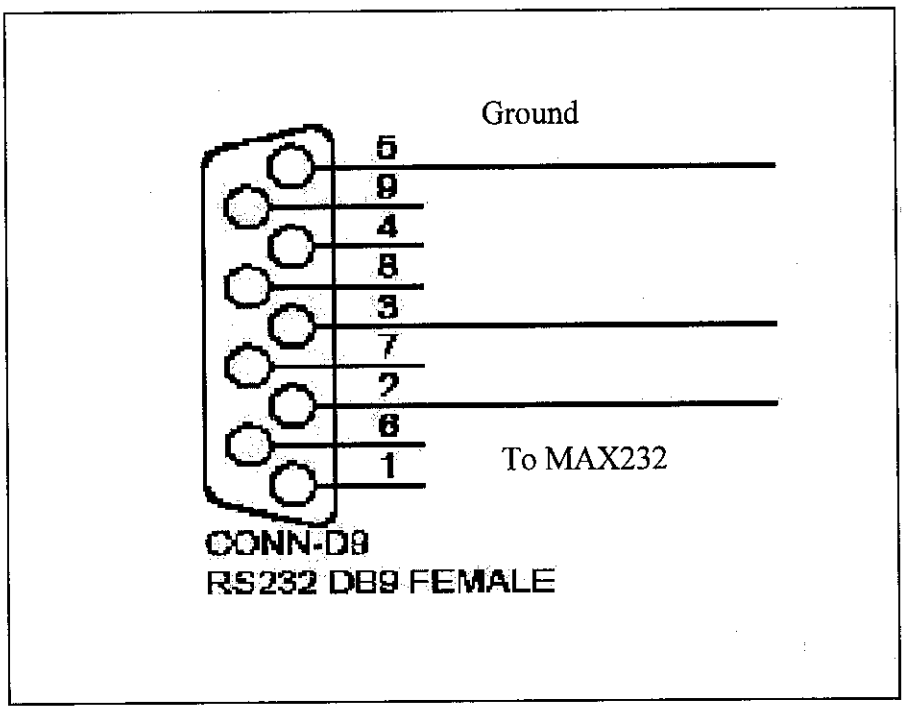



Figure 4.13: Connection of DB9

The purpose of using Microsoft Visual Basic (VB) is to use the 'sendkey' function, which is supported by VB to send the message as if someone is typing on the keyboard of a computer. Sendkey function can be triggered by the signal received from serial port. The signal received is an ASCII character of 'A'. Once the character 'A' is received, the VB will carry out the sendkey function to send the SMS. The sendkey sent by VB is '%FE', which simulate the 'Alt+F' follows with 'E' character on the keyboard. This sendkey will then enable the sending of SMS via the text message editor. The code for VB is available in Appendix F.

For this to work, there are 2 conditions: one of them is VB must be running in the background of Windows, while the second condition is the text message to be sent must be opened and active. Although with these conditions, it seems that the SMS sending feature is not practical. However, as explained earlier, this is a prototype of SMS

system idea and the process of sending SMS is a simulation process. The sample of results obtained is shown in the following figure:

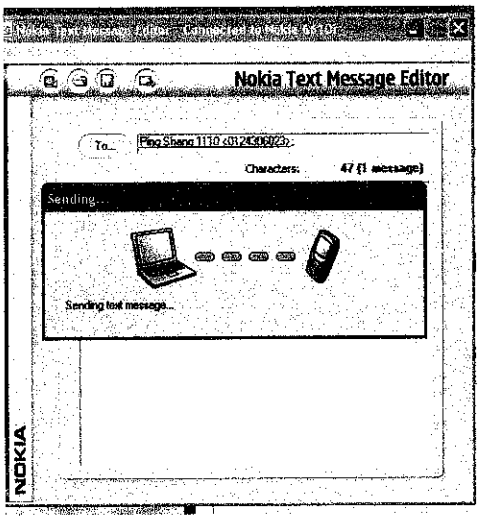



Figure 4.14: SMS in Sending Process

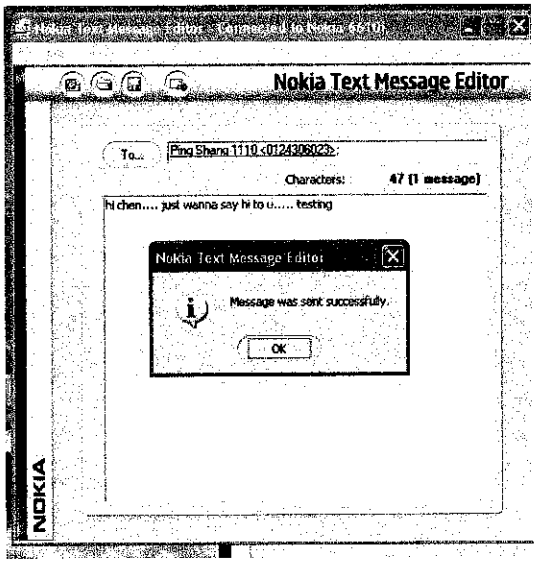



Figure 4.15: SMS Sent

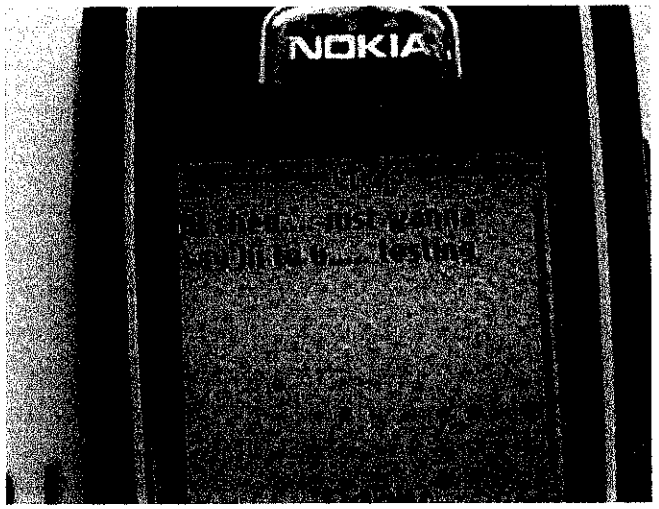



Figure 4.16: SMS Received

### 4.2.4 Overall Circuit

For the overall project, the circuits are very important. Besides the car alarm module, other circuits are necessary to make up the enhancement to the car alarm system. Basically it can be divided into 5 parts:

- Car Alarm Module
- ISD2590
- SMS System
- PIC
- Regulator

For car alarm module, ISD 2590 and SMS system, the circuits are explained in earlier part of this section.

### 4.2.4.1 PIC

PIC microcontroller is basically the main processor and controller of the entire circuit. The PIC used is PIC16F84A, an 18 pins IC. This PIC is used to control some of the switching of circuits and also giving some pulses to certain circuits. Switching can be done by using discrete components as well, but by using PIC, the outputs are more stable and the current sourced will be sufficient. Besides, this makes the circuits components to reduce, and thus reduce the power consumed from power supply.

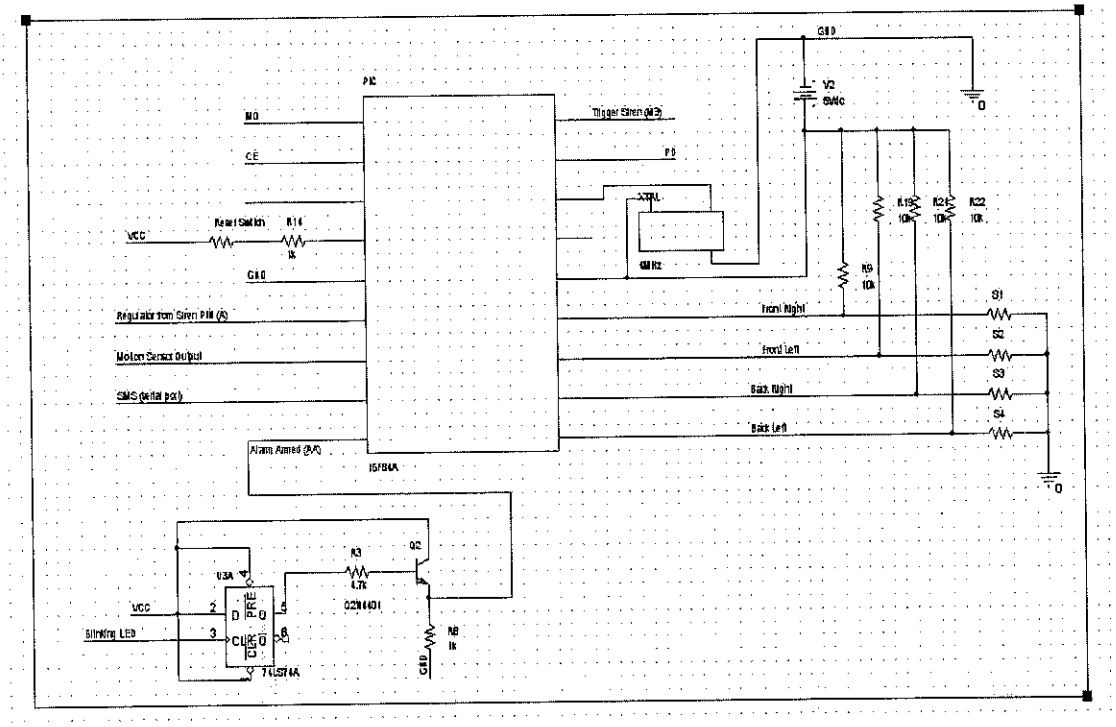



Figure 4.17: Circuit Diagram for PIC with Inputs and Outputs

From the diagram, those IC pins and circuit which need certain complicated type of control, the respective pins are connected to the PIC. PIC can detect signals from the input and then process the signal to send output signal to the IC through the respective output pins. All this complicated controls are done by programming the PIC in C

language and burn the code into the PIC. The source code is written with respect to the algorithm desired. The algorithm is shown in section 4.2.2.3. With the source code, the PIC will be able to carry out the job which is wanted. The source code is attached in Appendix E.

#### 4.2.4.2 Regulator

The original module works with power supply from car battery, which is 12V. However, the digital ICs and discrete components work with 5V power source; there is a need to provide the 5V power source together with the 12V battery source. Initially, the 5V supply is supply from a different source from the 12V battery by using AA batteries together with 5V relay. The relay is used to convert 12Vsiren output signal, to 5V for PIC to recognize as High. However, after some analysis, it is found out that extra 5V source will need a way to recharge it. Besides, using relay, switching of relay can cause noise into the voice IC. The noise is very easy to be coupled together with the voice signal and to filter the noise; a lot of effort is needed. After consideration, a 5V regulator is used as voltage converter.

The regulator consists of a single 3-legged chip, LM317. The schematic for the regulator is shown in the figure next page.

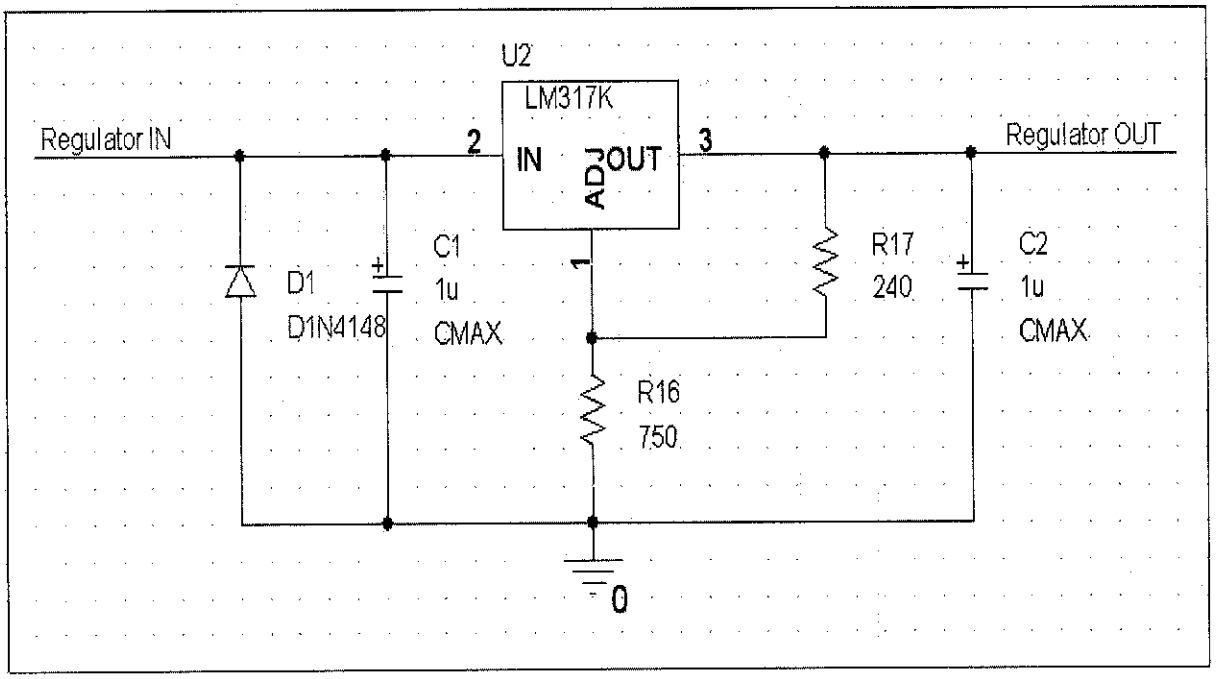



Figure 4.18: 5V regulator from 12V input

The regulator is used in 2 part: first is to convert 12V to 5V for digital ICs' $V_{CC}$ and the second part is to convert 12V output from siren pin to 5V for a logic '1' to PIC (refer to PIC schematic for connection). The 5V is needed as digital IC recognizes only 0V or 5V. 12V supply will cause overvoltage to happen and will then cause the ICs to burn. R16 is supposed to be a variable resistor to control the output voltage value. For 5V output voltage, resistor value of 112 Ohm is used. However, there is no 112 Ohm value available in the market; therefore 110 Ohm is used to replace the resistor value. The output will not differ much and still within the acceptable region for digital IC.

# CHAPTER 5

## CONCLUSION AND RECOMMENDATIONS

The original built-in module is analyzed thoroughly to identify the features available, the weaknesses, and the circuitry. For the project, 3 enhancements are added to the Proton built-in car alarm module. The enhancements are made into additional module which will be easily integrated with the original module. The additional module can be installed without much wiring needed. Self-diagnose system is designed using ISD2590 IC, which enable voice recording and playback. Sensors at the doors and alarm module manage to sense for faults in car model and the corresponding voice messages are played. The problems of the car model are easily noticed and identified.

False alarm minimizer utilizing LDR motion sensor, manage to solve false alarm situation based on the algorithm set. However, the testing is done based on arbitrary situation which might happen in reality. In practical, there will be more factors which can lead to false alarm. Therefore, false alarm minimizer is considered to be able to reduce or minimize false alarm situation instead of entirely solving the problem. Overall, with false alarm situation being reduced, it does help a lot in enhancing the security system. SMS system is designed using Mobile Phone. Mobile Phone is controlled to send a SMS, using a personal computer, to the owner once the car is identified to be under risk of getting stolen away. The SMS is sent and owner is able to receive the SMS from a far distance.

## 5.1 Recommendations

With the enhancements added to the Proton car built-in alarm module, the module is now better in protecting the car as user has more time to react to save the car while at the same time receiving help from public. Besides, carelessness is now reduced to a minimal value with the self diagnose system. However, there are still rooms for improvements.

Regarding the SMS system, the only thing the user of this module will be able to know is whether the car is under the risk of being stolen away. Sometimes, if this happens to be a false alarm (low possibility but still might happen), it will be troublesome for the user as well. A good way to improve this is by installing a surveillance camera in the car and the images or videos captured can be sent via a mobile phone to a user's handheld mobile phone. However, this will require detail analysis on a 3G supported mobile phone to receive real time videos or images. With this, user can monitor the surrounding of the car to check if any potential car thieves nearby.

Besides, with the sensors, additional circuits can be added to, for example, automatically seal off the door locks whenever metal tools are detected at the car door. By setting up more unexpected resistances for car theft, the thieves might give up on stealing the car or might provide more precious time for the user to react to car theft situation. With these improvements especially the surveillance camera, it is believed that the car is now much more protected from getting stolen away.

## REFERENCES

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# APPENDIX A

Figure A1: Key Hole on the Car Door

Figure A2: Side Door

Figure A3: Light Switch

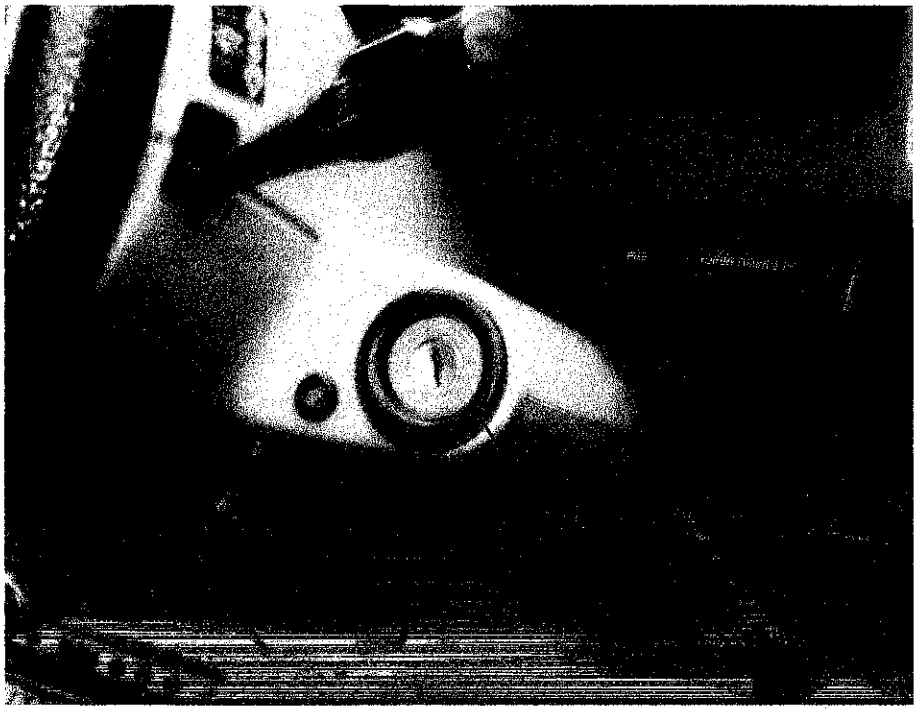

Figure A4: Ignition Switch

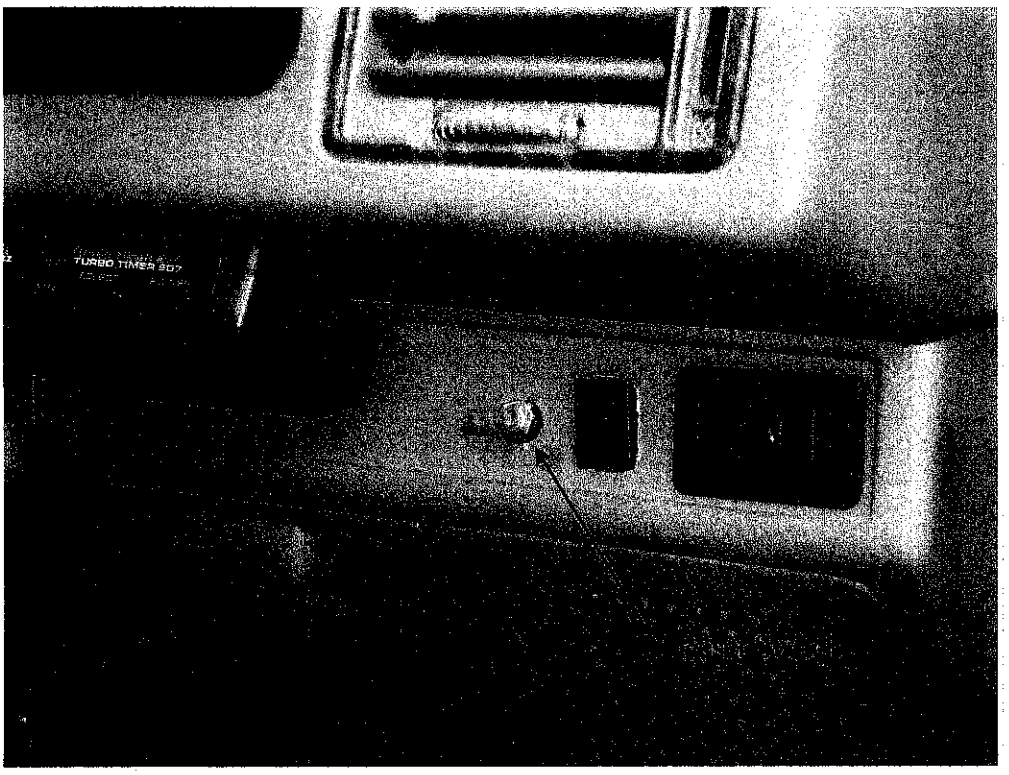


Figure A5: Reset Button for Car Alarm

# APPENDIX B

ISD2590

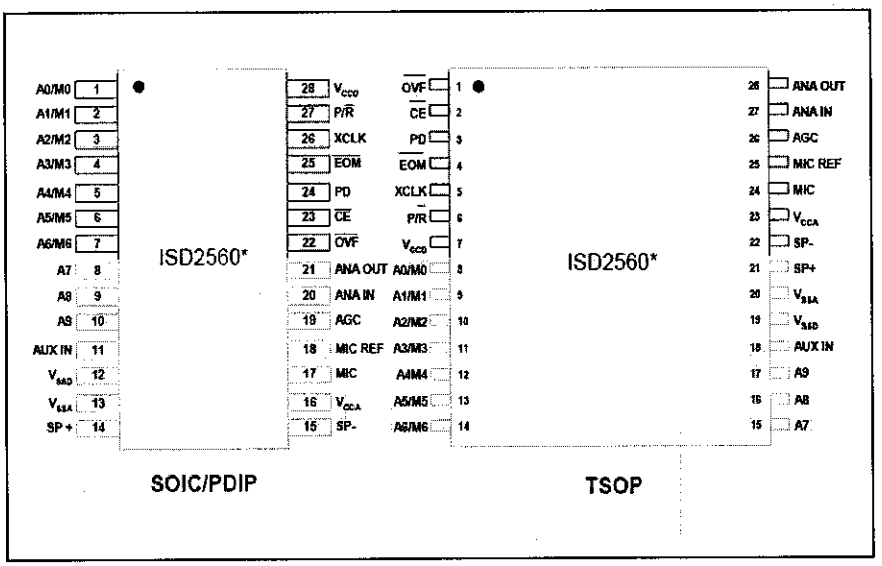


Figure B1: Pin Configuration for ISD2590

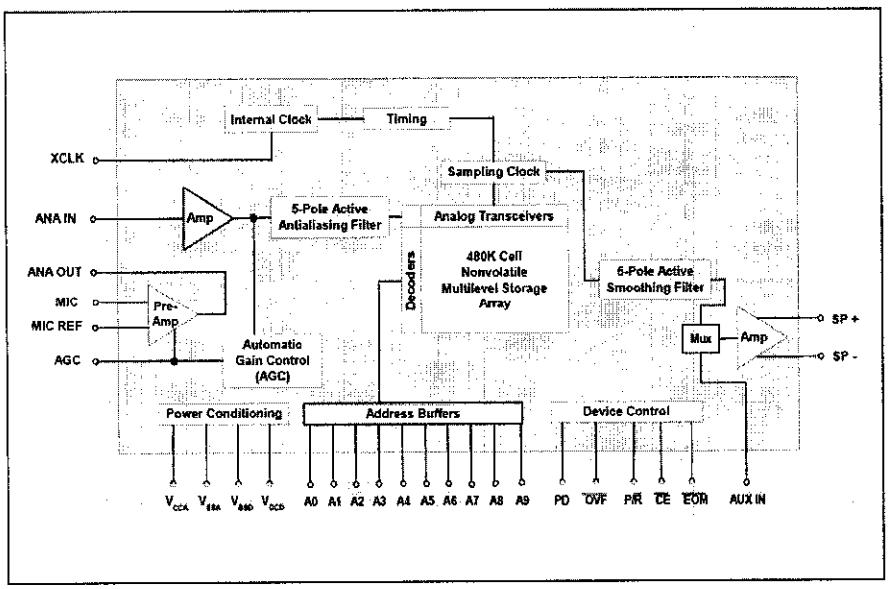


Figure B2: ISD2590 IC Block Diagram

| Mode [1] | Function | Typical Use | Jointly Compatible [2] |
|---|---|---|---|
| M0 | Message cueing | Fast-forward through messages | M4, M5, M6 |
| M1 | Delete $\overline{\text{EOM}}$ markers | Position $\overline{\text{EOM}}$ marker at the end of the last message | M3, M4, M5, M6 |
| M2 | Not applicable | Reserved | N/A |
| M3 | Looping | Continuous playback from Address 0 | M1, M5, M6 |
| M4 | Consecutive addressing | Record/playback multiple consecutive messages | M0, M1, M5 |
| M5 | $\overline{\text{CE}}$ level-activated | Allows message pausing | M0, M1, M3, M4 |
| M6 | Push-button control | Simplified device interface | M0, M1, M3 |

Figure B3: Operation Modes Supported by ISD2590

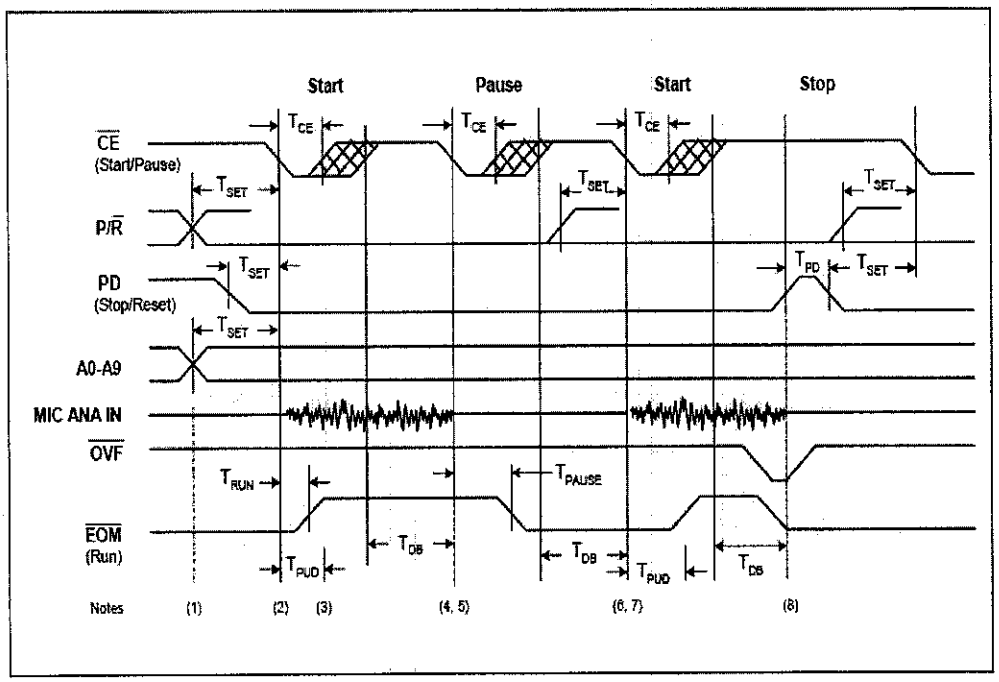


Figure B4: Timing Diagram for ISD2590

## Pin Diagrams

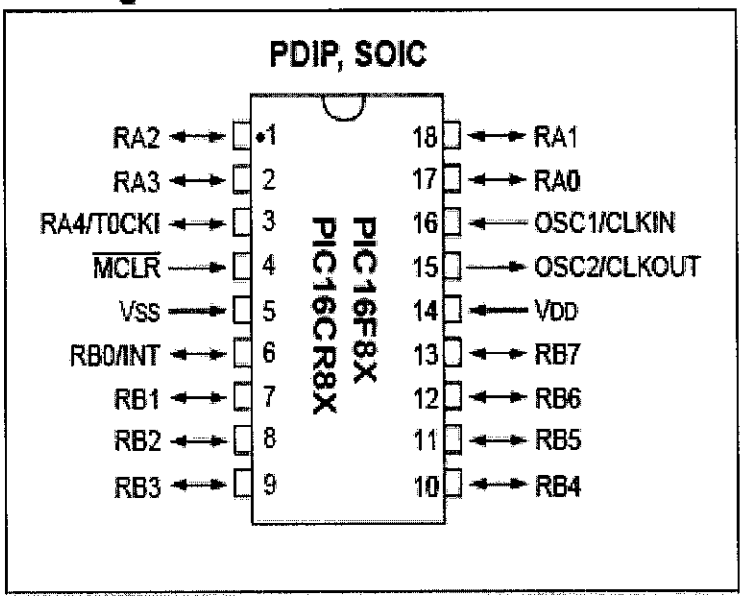


Figure B5: Pin Configuration for PIC16F84A

| Device | Program Memory (words) | Data RAM (bytes) | Data EEPROM (bytes) | Max. Freq (MHz) |
|---|---|---|---|---|
| PIC16F83 | 512 Flash | 36 | 64 | 10 |
| PIC16F84 | 1 K Flash | 68 | 64 | 10 |
| PIC16CR83 | 512 ROM | 36 | 64 | 10 |
| PIC16CR84 | 1 K ROM | 68 | 64 | 10 |

Figure B6: Electrical Characteristic of PIC16F84A

## LM386 – LV Audio Power Amplifier

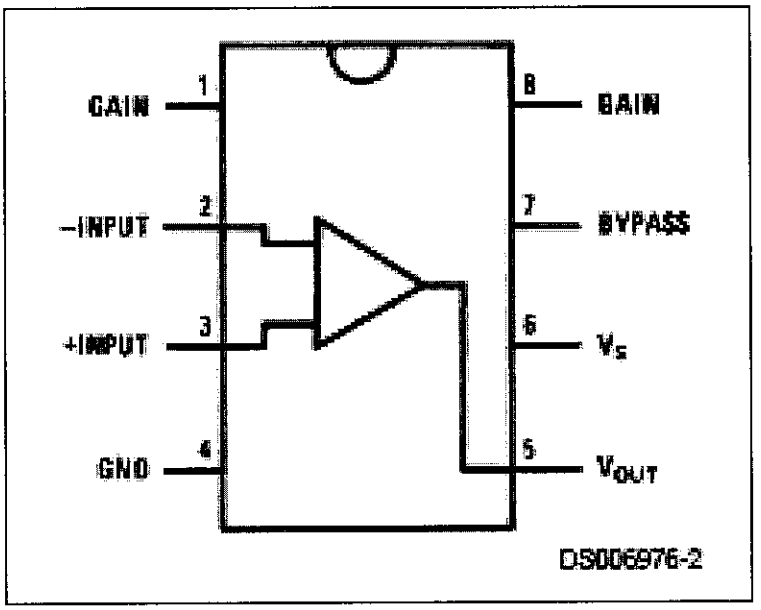


Figure B7: Pin Configuration for LM386 Amplifier

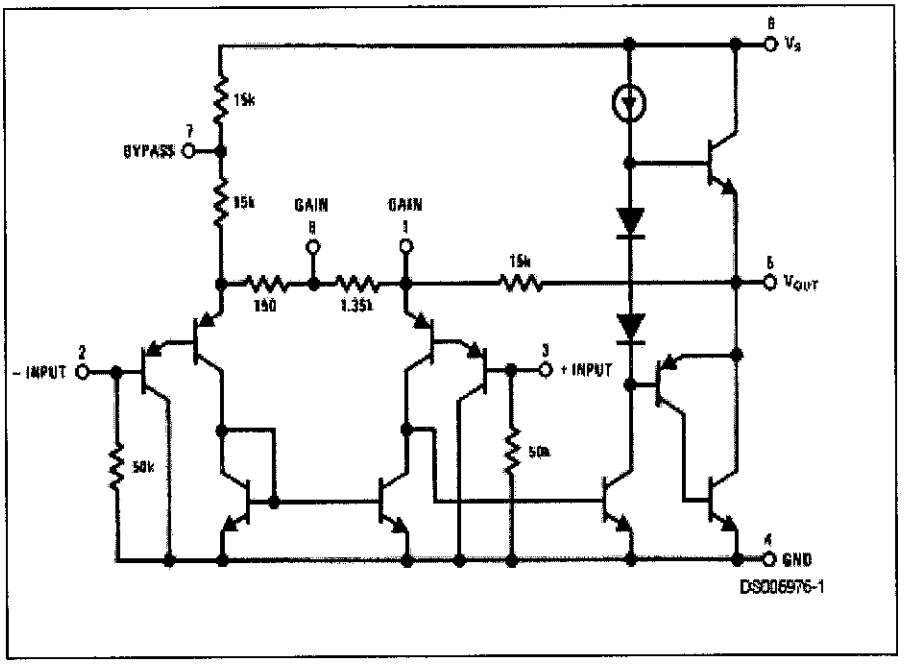


Figure B9: Electrical Equivalent of LM386

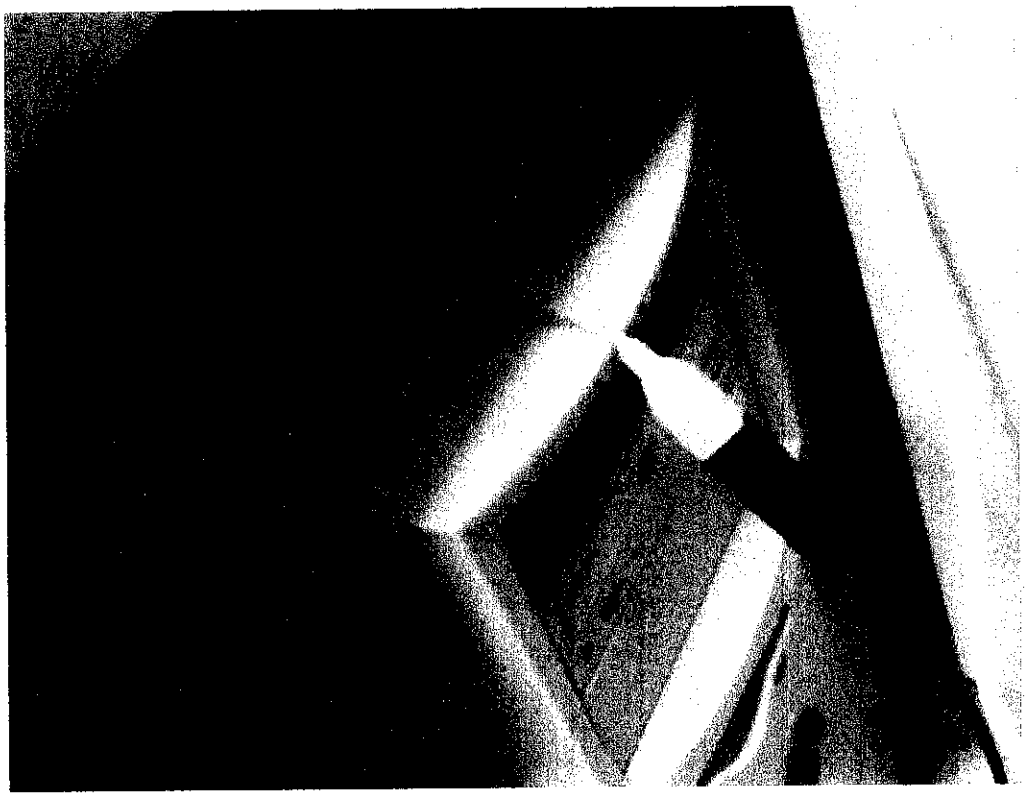

Figure B10: Setup for sending SMS

## APPENDIX C

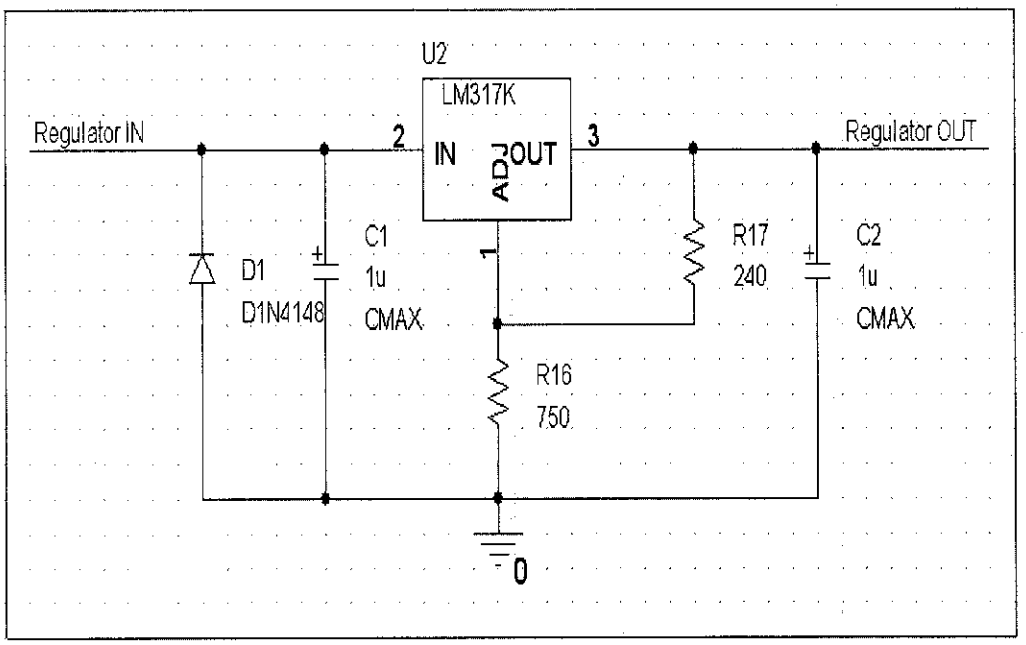


Figure C1: Circuits for 5V Voltage Regulator

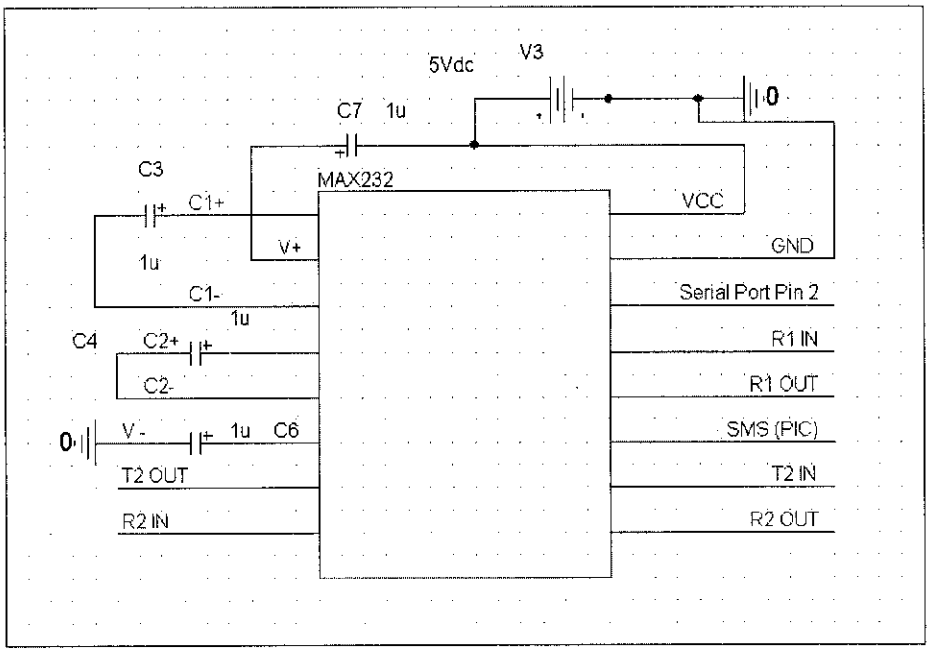


Figure C2: Circuits for MAX232

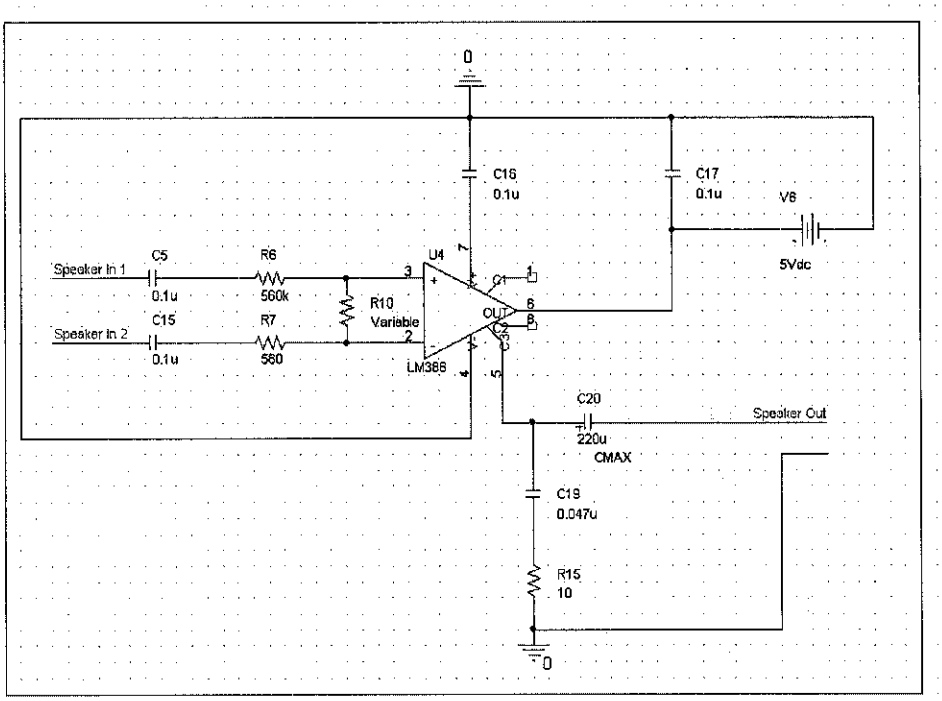


Figure C3: Circuit for Speaker Driver

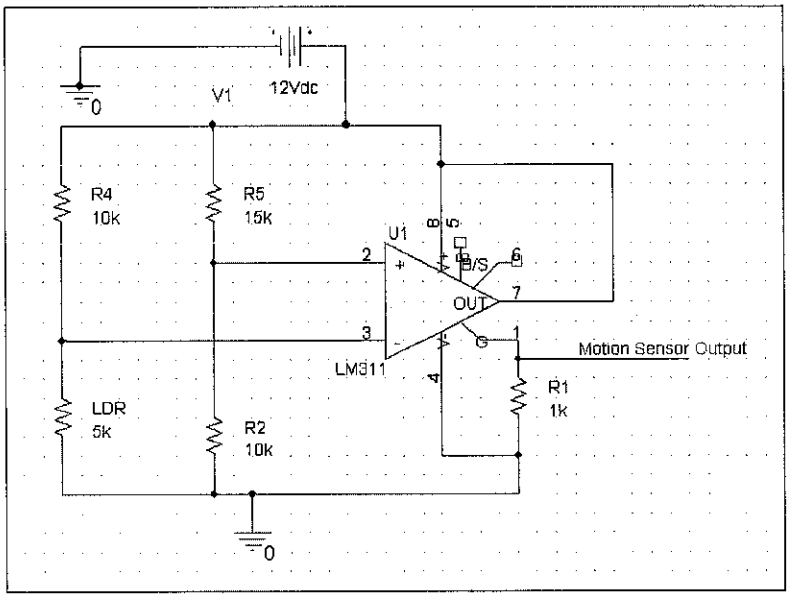


Figure C4: Circuit for Motion Sensor (False Alarm Minimizer)

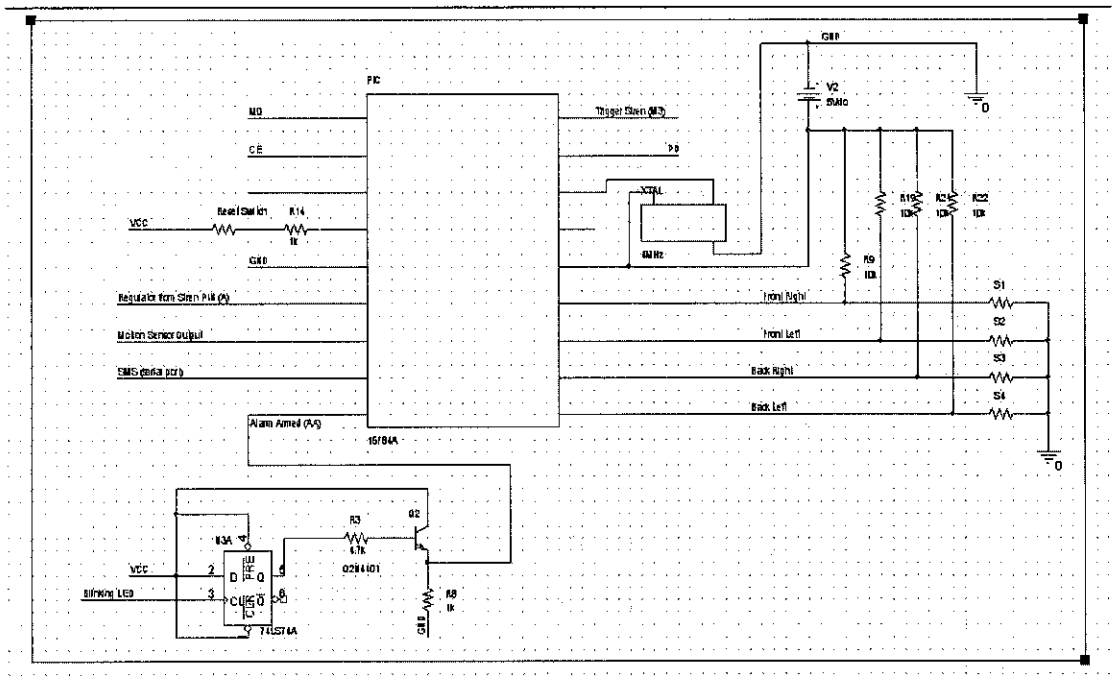


Figure C5: Circuit for PIC16F84A

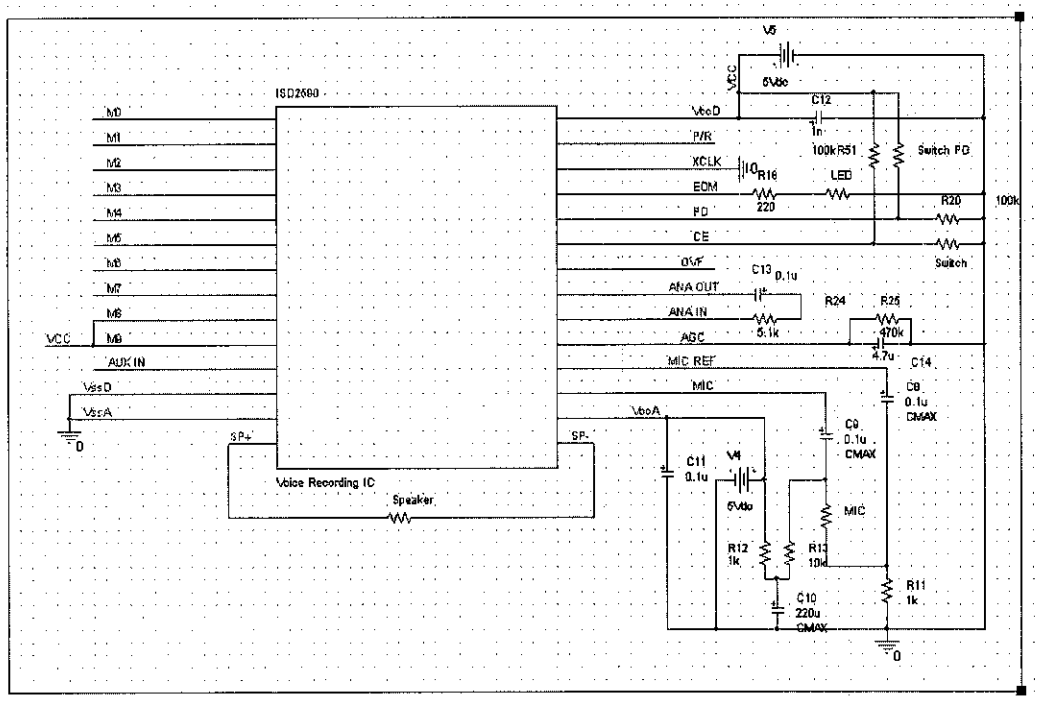


Figure C6: Circuit for ISD 2590

# APPENDIX D

Table D1: Bill of Material for Electronic Component

| Bill of Material ( Electronics) | | |
|---|---|---|
| **Components** | **Value / Part** | **Quantity** |
| Capacitor | 1u | 3 |
| | 1u (Elec) | 1 |
| | 1n | 4 |
| | 1n (Elec) | 5 |
| | 0.1u | 7 |
| | 0.1u (Elec) | 1 |
| | 0.047u | 1 |
| | 220u (Elec) | 2 |
| | 4.7u | 1 |
| Resistor | 10 | 1 |
| | 112 | 2 |
| | 220 | 1 |
| | 240 | 2 |
| | 560 | 1 |
| | 100k | 2 |
| | 10k | 4 |
| | 15k | 1 |
| | 1k | 5 |
| | 4.7k | 1 |
| | 470k | 1 |
| | 5.1k | 1 |
| Diode | 1N4148 | 2 |
| | LED (White) | 2 |
| | LDR | 1 |
| IC | 74LS74 | 1 |
| | Max232 | 1 |
| | ISD2590 | 1 |
| Regulator | LM317 | 2 |
| Varistor | 1k | 1 |
| Op Amp | LM386 | 1 |
| Comprator | LM311 | 1 |
| Transistor | 2N4401 | 1 |
| XTAL | 4MHz | 1 |
| PIC | 16F84A | 1 |

Table D2: Bill of Material for Miscellaneous

| Bill of Material (Miscellaneous) | | |
|---|---|---|
| **Components** | **Value / Part** | **Quantity** |
| Push Button | | 2 |
| Switch | Toggle | 4 |
| PCB | | 5 |
| DB9 | Female | 1 |
| Microphone | | 1 |
| Speaker | 8Ohm | 1 |
| Perspect | | 5 |
| Battery | 12V 5A | 1 |
| Screws and Nuts | | 30 |
| Phone Cable | DKU-5 | 1 |

## APPENDIX E
## Code for PIC16F84A

```
#include <16F84A.h>
#use delay (clock=4000000)
#use standard_io (b_inputs = PIN_B0, PIN_B1, PIN_B2, PIN_B4, PIN_B5, PIN_B6, PIN_B7)
#use fixed_io (a_outputs = PIN_A0, PIN_A1, PIN_A2, PIN_A3)
#use rs232(baud=9600, xmit=PIN_B3)
#fuses XT, NOWDT, NOPROTECT, NOPUT
void main ()
{
    int i; int j; int fl=0; int br=0; int bl=0;
    int count; int counter; int cou;

    while (1)
    {

     start:
     counter=0;
     if (input(PIN_B0) && input(PIN_B1))   // A and M is both ON
     {
          resense:
          if(counter==0)
          {
            putc('A');                     // CTRL P
            delay_ms(1000);
            putc('G');                     // ALT TAB
            delay_ms(1000);
            putc('C');                     // ALT F
            delay_ms(1000);
            putc('F');                     // E
            delay_ms(5000);                // 5s for SMS to be sent
            putc('H');                     // ENTER
            delay_ms(1000);
            putc('G');                      // ALT TAB
            counter++;
          }

          if (!input(PIN_B0))               // A is OFF
          {
            putc('B');                      // CTRL S
            delay_ms(1000);
            sense:
            cou=0; count=0;
            for (j=0; j<10; j++)            // Sense every sec for 10s
            {
               delay_ms(1000);
               if (input(PIN_B0))           // A is ON again
               {
               goto start;                  // Repeat voice msg
               }
```

```
        else if (input(PIN_B1) || input(PIN_B7))
                                        // M is still ON of FR door open
            {
              if (count==0)
              {
              putc('A');                // CTRL P
              }
              for (i=0; i<20; i++)      // Delay 10s
              {
              delay_ms(500);
              }
              if (cou==0)
              {
              putc('B');                // CTRL S
              cou++; count++;
              goto sense;               // Sense for Ppl again
              }
            }
       }goto start;                     // System restart
      }goto resense;                    // Sense for A

}

else if (input(PIN_B7))                 // Sensing Front Right Door
    {
      putc('E');
      delay_ms(1000);
      putc('A');
      delay_ms(20000);
      putc('B');
      delay_ms(1000);
      putc('D');
      delay_ms(1000);
    }
    else if (input(PIN_B6))             // Sensing Front Left Door
    {
      putc('E');
      delay_ms(1000);
      putc('E');
      delay_ms(1000);
      putc('A');
      delay_ms(20000);
      putc('B');
      delay_ms(1000);
      for (fl=0; fl<2; fl++)
      {
         putc('D');
         delay_ms(1000);
      }
    }
    else if (input(PIN_B5))             // Sensing Back Right Door
    {
      for (br=0; br<3; br++)
```

```
    {
       putc('E');
       delay_ms(1000);
    }
    putc('A');
    delay_ms(20000);
    putc('B');
    delay_ms(1000);
    for (br=0; br<3; br++)
    {
       putc('D');
       delay_ms(1000);
    }
  }
  else if (input(PIN_B4))              // Sensing Back Left Door
  {
    for (bl=0; bl<4; bl++)
    {
      putc('E');
      delay_ms(1000);
    }
    putc('A');
    delay_ms(20000);
    putc('B');
    delay_ms(1000);
    for (bl=0; bl<2; bl++)
    {
       putc('E');
       delay_ms(1000);
    }
  }
  else if (!input(PIN_B2))              // Sensing Alarm System
  {
    putc('D');
    delay_ms(1000);
    putc('A');
    delay_ms(20000);
    putc('B');
    delay_ms(1000);
    putc('E');
    delay_ms(1000);
  }

 }
}
```

## APPENDIX F
## Code for Visual Basic

```
'1st
Private Sub Form_Load()
   'Initialize
   Comm.InputMode = 0 'take ascii as input
   Comm.CommPort = 1
   Comm.Settings = "9600,N,8,1"
   Comm.PortOpen = True 'open port
   Comm.InputLen = 1 'limitation for input
   Comm.RThreshold = 1

End Sub
'idle(listen state)
'2nd
Private Sub Comm_OnComm() 'sumthing happen to comm port
   If Comm.CommEvent = comEvReceive Then 'check event (receive data)
      Select Case Comm.Input
         Case "A"
            SendKeys "^(p)", True
         Case "B"
            SendKeys "^(s)", True
         Case "C"
            SendKeys "%(f)", True
         Case "D"
            SendKeys "^(b)", True
         Case "E"
            SendKeys "^(f)", True
         Case "F"
            SendKeys "(e)", True
         Case "G"
            SendKeys "%{TAB}", True
         Case "H"
            SendKeys "ENTER", True
         Case Else
      End Select
   End If
End Sub
Private Sub Form_Unload(Cancel As Integer)

   If Comm.PortOpen = True Then 'double check if port still open
      Comm.PortOpen = False 'close port
   End If
   End Sub

Private Sub Form_Terminate()
   If Comm.PortOpen = True Then 'double check if port still open
      Comm.PortOpen = False 'close port
   End If
   End
End Sub
```

# APPENDIX G

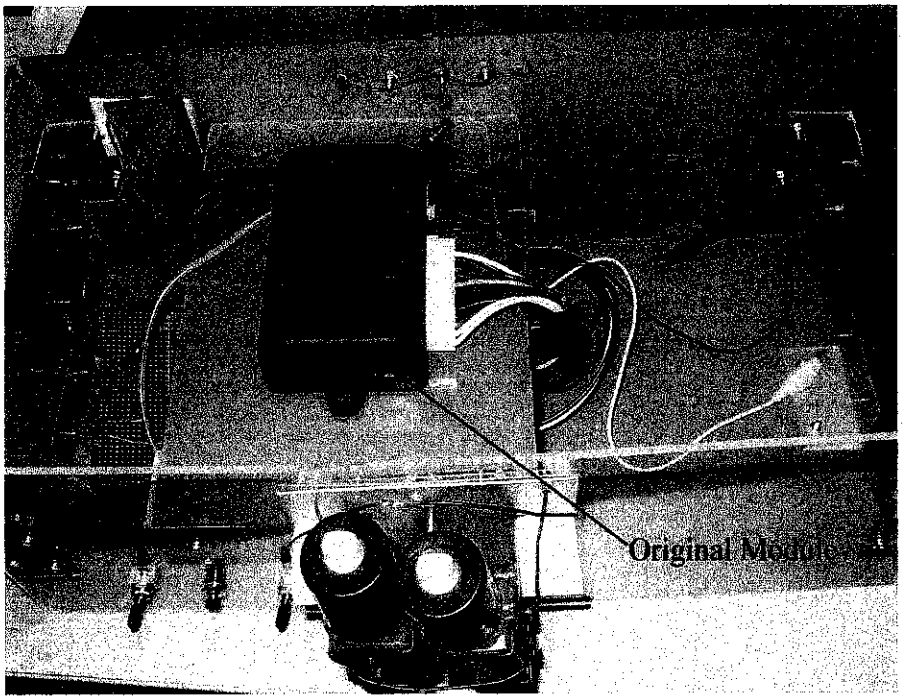


Figure G1: Top View of the Overall System

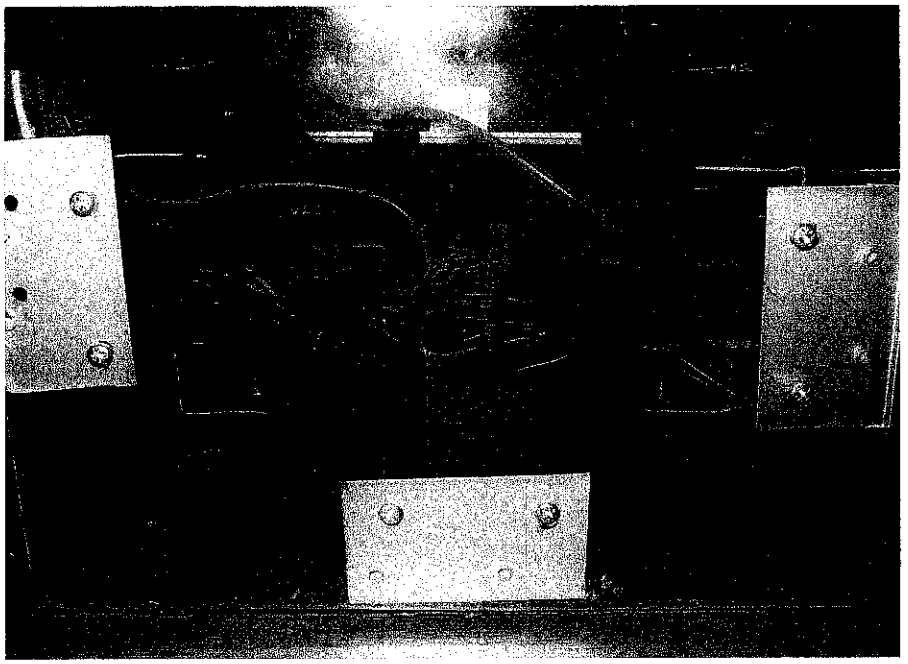

Figure G2: Front View of the Overall System

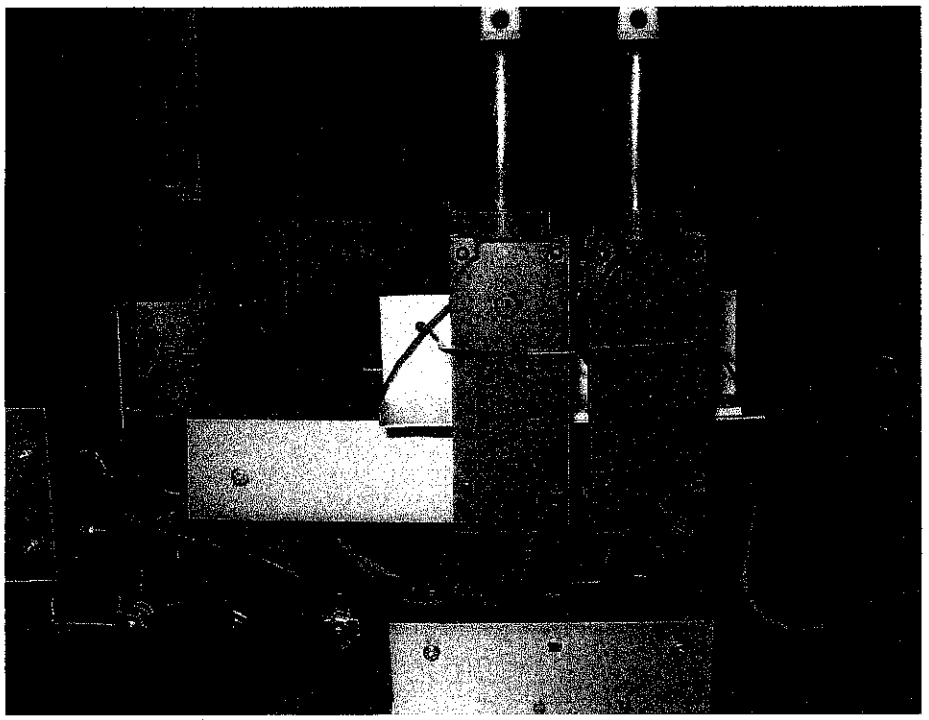

Figure G3: Side View of the Overall System with Actuators

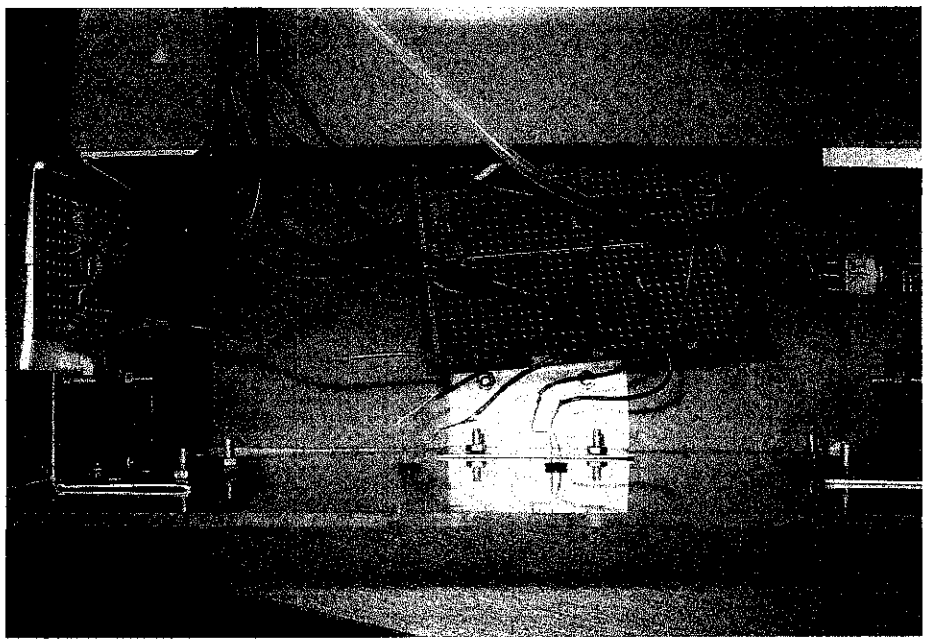

Figure G4: Picture of the Circuits for the System