**INTELLIGENT BURGLAR ALARM SYSTEM**

By

AZZUHA NAJWA HOZAMI

FINAL PROJECT REPORT

Submitted to the Electrical & Electronics Engineering Programme
in Partial Fulfillment of the Requirements
for the Degree
Bachelor of Engineering (Hons)
(Electrical & Electronics Engineering)

Universiti Teknologi Petronas
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# CERTIFICATION OF APPROVAL

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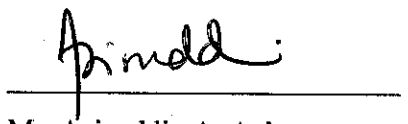
Approved:



Mr. Azizuddin A. Aziz
Project Supervisor

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TRONOH, PERAK

December 2006

## 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.

Azzuha Najwa Hozami

# ABSTRACT

**INTELLIGENT BURGLAR ALARM SYSTEM (IBAS)** is done to accomplish three vital requirements on giving best burglar alarm service; which are the reliability, cost effectiveness of the system and also avoiding false alarm. It brings the objectives to study the limitation on the existing burglar alarm system and innovates them in order to enhance its performance and affordability.This system has two modes in which the system will be able to stay 'ON' for 24 hours. With the purchasing cost for just around RM250, this system will automatically inform the neighbors' pager and dial the nearest police station once it is triggered. With the victim's address displayed at police station and conformation from the neighbor (third party), the policemen can take immediate action. Another new feature added is the locket size transmitter for the premise holders which will trigger the alarm loudly in case of emergency such as when the intruder is trying to threaten their life. This project focuses on four main areas; sensors, alarm system control unit, wireless technology and microcontroller. The methodologies that will be used in completing this project are reviewing the existing circuit, designing, constructing, testing and troubleshooting the circuit. Finally the whole system will be implemented on the scaled premise model. This project focuses on the urban residential area and also rural community. In all, this project would be very useful in various aspects since it is reliable, affordable and effective.

# ACKNOWLEDGEMENTS

First of all, I would like to express my gratitude and praises to Allah Almighty, for answering my prayers and giving me the chance to get through the final year successfully and also for the strength, will and determination to carry out the project tasks and make it through the challenges I have faced while I am completing my final year project. My heartiest thanks and utmost appreciation goes to these individuals who have contributed immeasurable amount of guidance, advice and assistance along this semester;

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| | |
|---|---|
| **GUI** | Graphical User Interface |
| **IBAS** | Intelligent Burglar Alarm System |
| **ILD** | Infrared Laser Diode |
| **IR** | Infrared |
| **LCD** | Light Crystal Display |
| **LED** | Light Emitting Diode |
| **PCB** | Printed Circuit Board |
| **PIC** | Programmable Integrated Circuit |
| **PRSS** | PETRONAS Research & Scientific Services |
| **RF** | Radio Frequency |
| **UTP** | Universiti Teknologi PETRONAS |

# CHAPTER 1
# INTRODUCTION

## 1.1 Background of Study

Home security is a rapidly growing field, and there are new and improved burglar alarms popping up all the time. For the most part, these systems are all built around the same basic structure. A central control box monitors several motion detectors and sounds an alarm when any of them are triggered [1].

INTELLIGENT BURGLAR ALARM SYSTEM (IBAS) focuses on four main areas; sensors, alarm system control unit, wireless technology and auto dialler. This system is all about an alarm system with a small pager for neighbour and also a direct auto dialler to the police station. It has two modes in which the system will be able to stay 'ON' for 24 hours.

| NO | MODE | DESCRIPTION | OBJECTIVES |
|---|---|---|---|
| 1. | MODE 1 : LEAVING<br>• nobody is at home<br>• Sleeping time. | No sound is emitted from the house but it will be hissing on the pager and alert the neighbour. It will also automatically inform nearby police station. | • Call police without intruder's awareness<br>• Alert the neighbor and prevent intruder from disconnect phone line. |
| 2. | MODE 2 :<br>AT HOME<br>• will be on 24 hours<br>• locket transmitter. | It will alarm loudly from the house as loud as fire alarm and automatically inform nearby police station | • Panicking the intruder; in emergency case.<br>• Acknowledge the police and neighbour. |

Table 1 : Modes of Alarm System

IBAS system will instantly alert three parties whom are the householder himself, his neighbour and also the nearest police station should the intrusion occur. With the victim's address displayed at police station and conformation from the neighbor, the policemen can take the immediate action. It has a locket size transmitter for the premise holders which will trigger the alarm loudly in case of emergency such as when the intruder is trying to threaten their life. The sudden alarm will gives psychologically nerves to the intruder, thus make them panic.

Some of the features installed in the system are as below:

| NO | FEATURES | MODE | DESCRIPTION |
|---|---|---|---|
| 1. | Sensors | 1 & 2 | Magnetic switch; attached to doors and windows to sense the open or close. |
| 2. | Alarm pager | 1 | To inform the neighbour. |
| 3. | Alarm (bell) | 2 | To give nerves to the intruders. |
| 4. | Auto dialler | 1 & 2 | To automatically inform the nearest police station once the alarm is triggered |
| 5. | Locket transmitter | 2 | To trigger the alarm in case of :<br>• seeing stranger in the house<br>• safety of children outside the house<br>• emergency threatening life case |
| 6. | PIC & LCD | 1 & 2 | To show the address of the premise to police. |
| 7. | Battery indicator | 1 & 2 | To indicate the battery power. |

Table 2 : Features of Intelligent Burglar Alarm System

This project would be very useful in various aspects since wireless feature is added and it concerns on three main requirements which are reliability, cost effectiveness and also avoiding false alarm. These three main requirements will suit the needs of security in the targeted urban residential and also rural community area.

## 1.2 Problem Statement

It is a sad comments on our present civilization that one of the main boom 'industries' is that of crime especially on breaking the premises[4]. Even if little is taken, much damage can be caused, not only by breaking in, but by acts of vandalism which are common when the haul is poor. The most destruction could be the lost of precious life.

Knowing that, 85% of the people from the survey done said that it is very important to have an alarm system in every house. This result comes from a survey done with the objective of understanding the perceptive and perspective of Malaysian on the existing burglar alarm system and IBAS. Please refer to appendix C for the questions asked. The survey is done on 133 peoples from the targeted urban residential and also rural community area around places as follows:

i. Batu Gajah, Perak

ii. Batu Pahat, Johor

iii. Pekan, Pahang

iv. Balik Pulau, Pulau Pinang

v. Ayer Itam, Pulau Pinang

vi. Bangi, Selangor

vii. Kajang, Selangor

In spite of the high result on burglar alarm importancy percentage, burglar alarm system is not very popular used in Malaysia. Most of the causes are as depicted in the chart below:

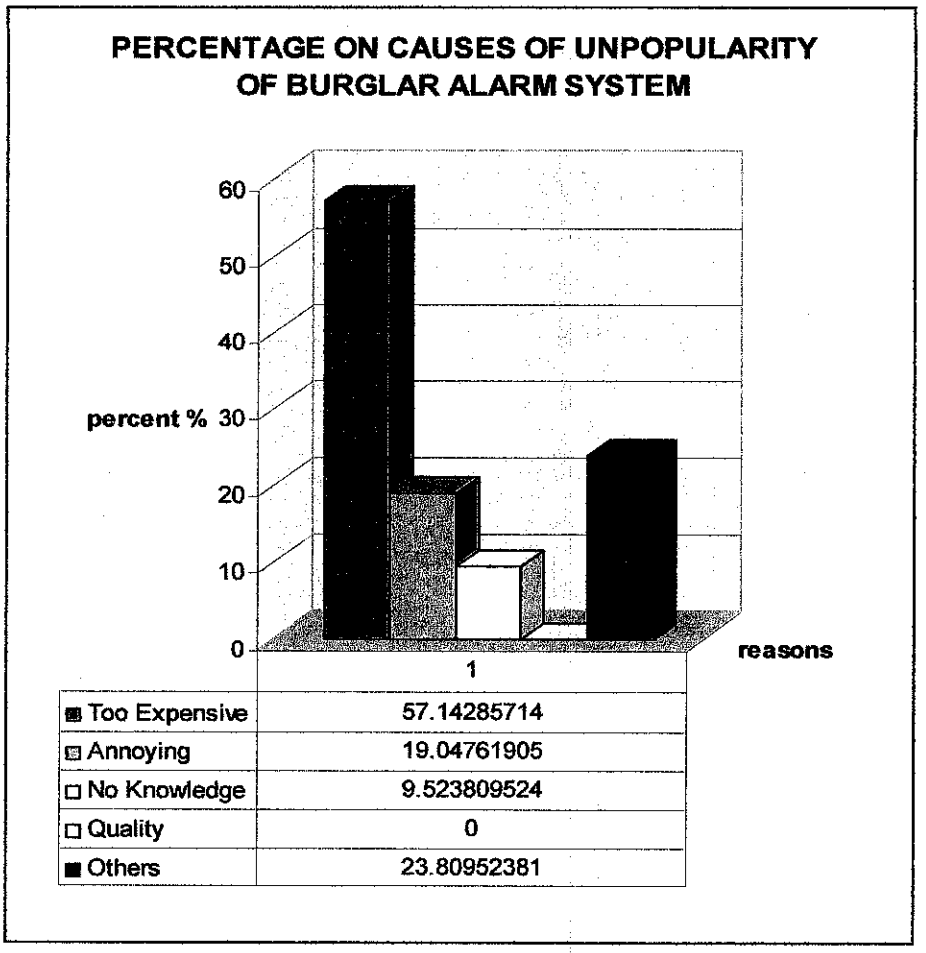



Figure 1 : Cause of Unpopularity of Burglar Alarm System

From the result, about 57% said that the existing reliable burglar alarm system is too expensive. 48% said that the existing burglar alarm system costs around RM1000 to RM1500 per system which is not worthwhile for the common residence. It overlooked the balance between the level of appropriate security and the cost. Thus, IBAS is designed such that it will be reliable, affordable and effective.

### *1.2.1 Problem Identification*

Thus, in order to complete the system three main aspects are put into consideration, which are:

**RELIABILITY**

A vital factor in this project is reliability. It follows that the more components the control unit has and the more complex it is, the more likely, statistically, it is to fail [2]. Second, it depends on the installation, its wiring and auxiliary equipment including the sound devices. Thus, this project is attempting to use the trivial circuit, in the same time ensuring the circuit boards' stability and reliability.

Other consideration on the reliability of this system is the phone line used for auto dialer. If the phone line is cut the alarm will be unable to call the police but for this system, the phone line is tapped somewhere the intruder couldn't know and this makes their cutting act worthless.

**COST EFFECTIVENESS**

Quite high degree of security can be achieved, sufficient enough to defeat the efforts of such individuals, at moderate cost. The needs of security in the targeted urban and rural community area would not be worthwhile for a high considerable recurring sum of installation and maintenance cost. This project should target the cost before mass production for around below RM500.

**FALSE ALARM**

One of the biggest problems with alarm systems is that of the false alarm. With that, for the passive type of alarm (without monitoring centre), police's immediate response needs the confirmation that an intruder is on the premises and that the alarm is not false [2]. Thus, the difference in this system is that the alerted neighbor could be the witness to fulfill those requirements.

### *1.2.2 Significant of the Project*

Wireless feature in alarm system is essential especially when distance between the control unit and the pager is taking into consideration. Complex units having many features are now offered at quite reasonable prices compared to what they were at one time. This is partly due to the use of dedicated (specially designed) silicon chips which carry out most of the functions [3]. However, a host of features you will never use could be obtained at the cost of higher liability to failure. This is not to say that the present generation of alarm unit is basically unreliable, only that the chances of a breakdown are greater with a more complex unit. So the trivial and less complex circuit yet cost effective will be built for this project.

The microcontroller is used at the police station where it detects the incoming phone number, analyzes the number according to programme installed in it and then displays the victim's address on LCD (liquid crystal display). The study on connection between the premise and police station is required in order to pevent the intruder from disconnecting the phone line to police station.

## 1.3 Objectives and Scope of Study

The objectives focused for this final year project are as below:

1. To study the limitation of the existing burglar alarm system
2. To innovate the system for enhancement of the performance and affordability.
3. To do simulation and implementation of the system in scaled premise model.

Scopes of studies are including the sensors, wireless technology, telephone system and microcontroller. Finally is the simulation and implementation of the system in scaled premise model to make it more presentable in marketizing the product.

# CHAPTER 2
# LITERATURE REVIEW

## 2.1 Basic Alarm System

Burglar alarms have become standard equipment in stores and other businesses, and they're becoming increasingly common in private homes as well. But, as it turns out, most alarm systems are actually built around the same basic design concepts; a central control box monitors several sensors and sounds an alarm when any of them are triggered [4].

In a burglar alarm, the switch detects the act of intrusion such as opening a door or window, for example. These sorts of alarms are divided into two categories [4]:

- In a closed-circuit system, the electric circuit is closed when the door is shut. This means that as long as the door is closed, electricity can flow from one end of the circuit to the other. But if somebody opens the door, the circuit is opened, and electricity can't flow. This triggers an alarm.
- In an open-circuit system, opening the door closes the circuit, so electricity begins to flow. In this system, the alarm is triggered when the circuit is completed.

Using this basic concept, all sorts of alarm systems can be created. Just imagine what a burglar might do to break into a house, and then turn that action into the circuit switch. When somebody opens the door, the button is released, changing the circuit and sounding the alarm. With just a battery and buzzer, these designs make for fairly flawed security systems. After all, the burglar only needs to close the door again to turn the buzzer off. That's why most modern burglar alarms incorporate another piece into the circuit which is the control box.

The control box is hooked up to one or more alarm circuits, but it also has its own power supply. It monitors the circuits and sounds the alarm when they are closed or opened (depending on the design). But once the alarm is triggered, the control box won't cut it off until somebody enters a security code or in this case push the reset button. For added security, the control box is usually positioned in an out-of-the-way spot, so the intruder can't find it and attempt to destroy it.

## 2.2 Sensor

There are a number of ways to build this sort of circuit into an entry way. Closed circuits are normally a better choice than open circuits because an intruder can deactivate the open circuit by simply cutting the connected wires [2]. A magnetic sensor in a closed circuit consists of a few simple components.

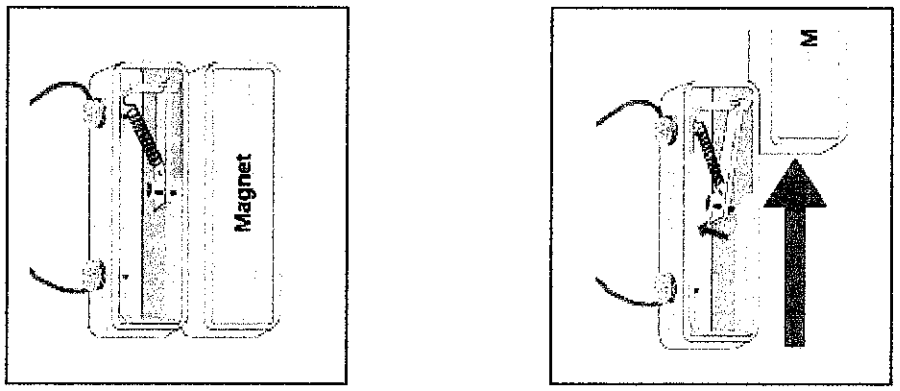



Figure 2 : Closed-circuit magnetic sensor

When the door is closed, the magnet pulls the metal switch closed so the circuit is complete. The current powers the relay's electromagnet, so the buzzer circuit stays open. When you move the magnet by opening the door, the spring snaps the switch back into the open position. This cuts off the current and closes the relay, sounding the alarm. This sort of system also can be build into a window. If an intruder pushes a window open, the magnet slides out of line with the switch and then activated the buzzer

## 2.3 Transmission Type -The infrared (IR).

Infrared light lies between the visible and microwave portions of the electromagnetic spectrum [3]. Infrared light has a range of wavelengths, just like visible light has wavelengths that range from red light to violet. "Near infrared" light is closest in wavelength to visible light and "far infrared" is closer to the microwave region of the electromagnetic spectrum.

Far infrared waves are thermal [6]. In other words, we experience this type of infrared radiation every day in the form of heat. The heat that we feel from sunlight, a fire, a radiator or a warm sidewalk is infrared. Infrared light is even used to heat food sometimes where there is special lamps that emit thermal infrared waves are often used in fast food restaurants.

Shorter, near infrared waves are not hot at all and in fact you cannot even feel them. These shorter wavelengths are the ones used in TV's remote control [3]. Since the primary source of infrared radiation is heat or thermal radiation, any object which has a temperature radiates in the infrared [6]. Humans, at normal body temperature, radiate most strongly in the infrared at a wavelength of about 10 microns [6]. (A micron is the term commonly used in astronomy for a micrometer or one millionth of a meter.)

## 2.4 Telephone

A telephone is one of the simplest devices in the house. It is so simple because the telephone connection to our house has not changed in nearly a century. It only contains three parts [7]:

- A **switch** to connect and disconnect the phone from the network - This switch is generally called the hook switch. It connects when you lift the handset.
- A **speaker** - This is generally a little 50-cent, 8-ohm speaker of some sort.

- A **microphone** - In the past, telephone microphones have been as simple as carbon granules compressed between two thin metal plates. Sound waves from your voice compress and decompress the granules, changing the resistance of the granules and modulating the current flowing through the microphone.

The only problem with the simplest phone is that when there's redundant voice through the speaker [7]. Most people find that is annoying, so nowadays a real phone contains a device called a duplex coil or something functionally equivalent to block the sound of your own voice from reaching your ear. A modern telephone also includes a bell so it can ring and a touch-tone keypad and frequency generator. A "real" phone looks like in figure below:

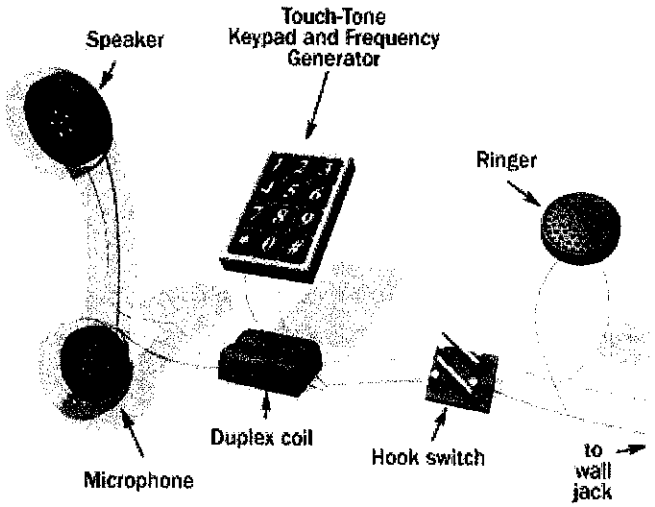



Figure 3 : Telephone

In order to allow more long-distance calls to be transmitted, the frequencies transmitted are limited to a bandwidth of about 3,000 hertz [7]. All of the frequencies in your voice below 400 hertz and above 3,400 hertz are eliminated. That's why someone's voice on a phone has a distinctive sound.

## 2.5 Alarm types and Police Response

The table below briefs the type of alarms available and the police's response that could be expected from the systems [8]:

| NO | ALARM TYPE | DESCRIPTION | POLICE RESPONCE |
|---|---|---|---|
| 1. | BELLS ONLY | An external bell rings for up to 20 minutes once triggered.<br>• Being ignored<br>• Nuisance<br>• No response for premises that is away from others. | No Automatic Police Response<br>• Need confirmation by third party. |
| 2. | PASSIVE MONITORING | Alarm system connected to monitoring centre and then they call the police. | 'Phone-Line-Dependent' Police Response<br>• Couldn't connect to police if the phone line is cut. |
| 3. | ACTIVE MONITORING | Alarm connected to monitoring centre and has function of checking whether the phone line is cut or not. | Immediate Police Response<br>• The system verified the incidents. |

Table 3 : Alarm System and Police Response.

# CHAPTER 3
# METHODOLOGY

The figure below depicts the methods used in completing 'Intelligent Burglar Alarm System:

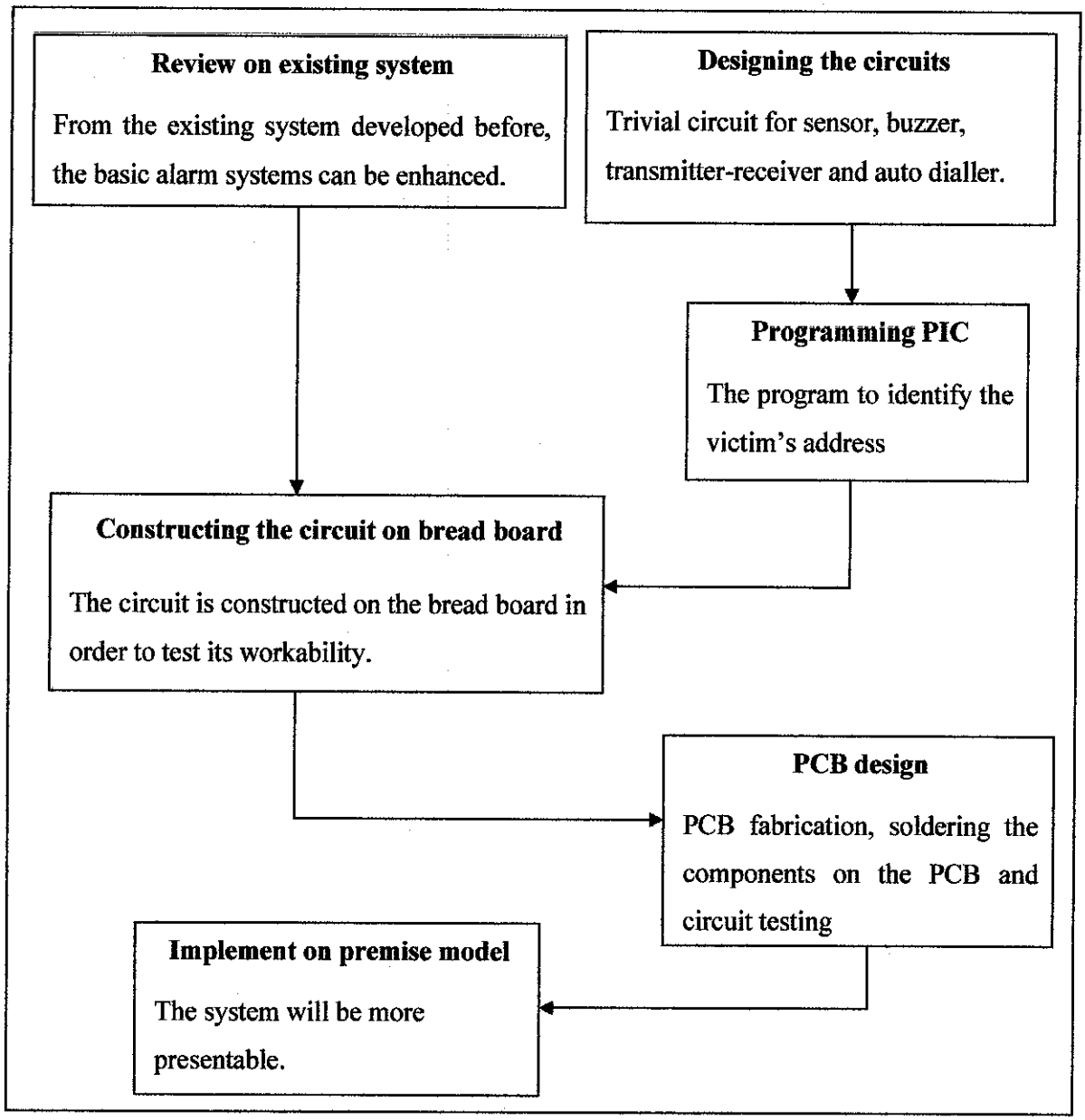



Figure 4 : Methodology for IBAS

### 3.1 Review on existing system.

From the existing system developed before, the basic alarm systems can be enhanced on tree areas:

- Adding wireless features while concerning the cost effectiveness.
- Auto dialer system to inform police immediately.
- Alarm locket transmitter for emergency used.

The result of reviewing and reverse engineering the existing sytem lead towards designing IBAS's algorithm and also circuitry system.

### 3.2 Designing a Circuit

The principal function is usually considered to warn or inform others that an intrusion has taken place in the premises concerned. The main function of this circuit is as control units consist of sensors to activate alarm and transmission line to the pager. Trivial circuit is done to balance the reliability, cost and functionality.

The following diagram depicts the overview of the circuit design

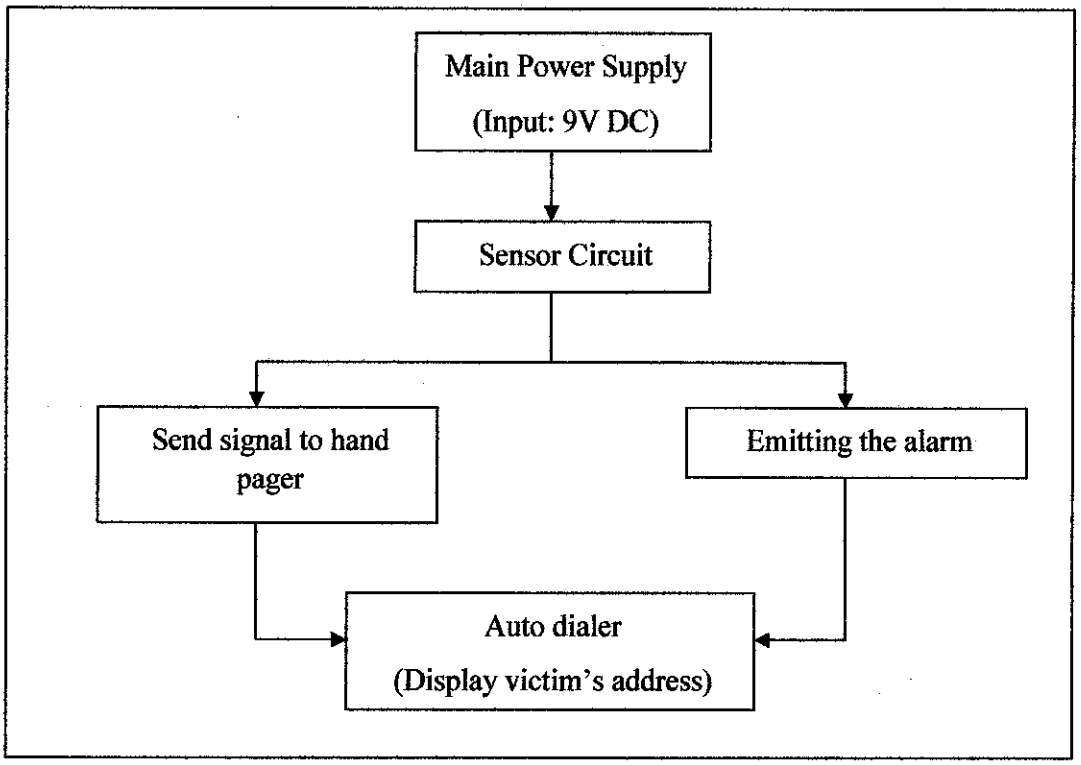



Figure 5 : Overview of the Circuit Design

### 3.3 Programming PIC

For the auto dialer circuit design, a programmable microcontroller PIC16F877/A is used. The program is done to identify the victim's address and display it on the 4-line LCD (Liquid Crystal Display).

The programming style used is PIC Basic Pro language with CD Lite software as the compiler. In order to burn the program to the microcontroller, Epic Win software is used as the interface between computer and burner. The hardware whih is the burner is as shown in figure 6 below. The burner is connected to the computer through RS232 connector and computer's parallel communication port.

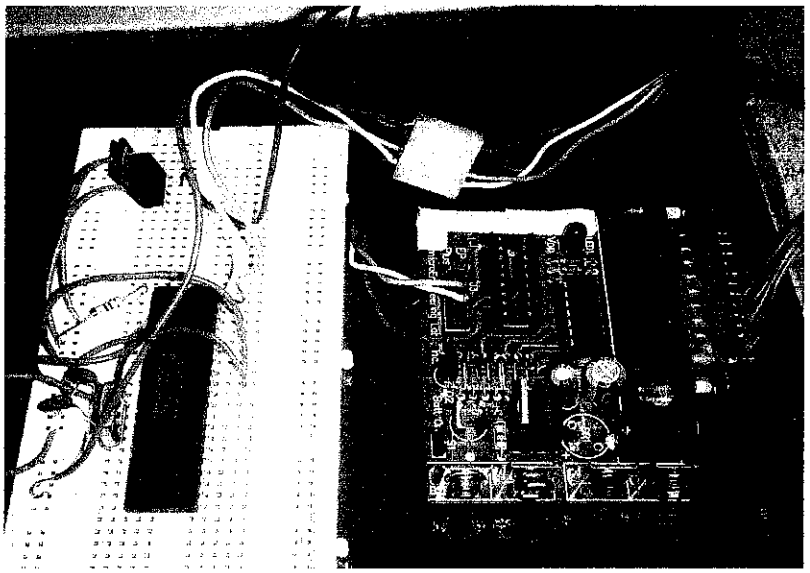


Figure 6 : PIC microrontroller burner.

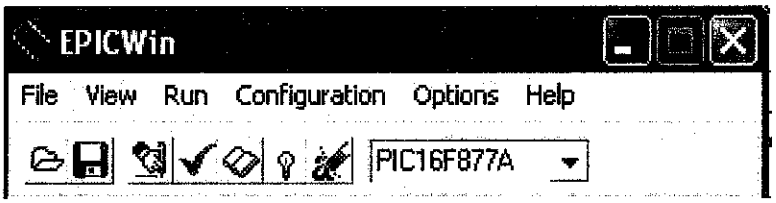



Figure 7 : Epic Win software interface

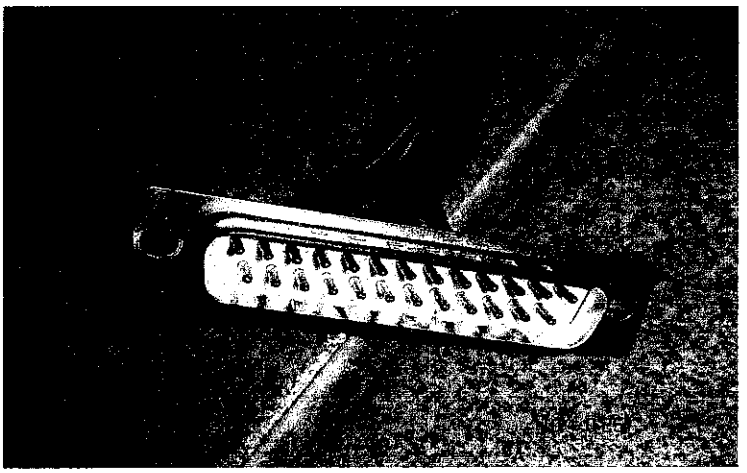


Figure 8 : RS232 connector

### 3.4 Constructing and Testing the Circuit & PCB Design

The circuit is constructed on the bread board in order to test the workability. After the circuit functions as expected, Printed Circuit Board (PCB) design will be started followed by PCB fabrication, soldering the components on the PCB and circuit testing. PCB fabication is done at UTP's laboratory. For the more complex multilayer board, the fabrication is done at the address below:

Asia Printed Circuit (APC) Sdn. Bhd.

203, Jln Tembusu (Industrial Area)

Taman Melayu Jaya

31900, Kampar

Perak Darul Ridzuan

### 3.5 Implementation of the system into scaled premise model.

This project is being implemented on the scaled premise model as one of the marketing strategies in order to show the reliability of the system during presentation. The implementation is on a residential area model including houses, door and police station with scale of 1: 50 to the real building.

# CHAPTER 4
# RESULTS & DISCUSSIONS

## 4.1 Comparing existing systems' prices

The price comparison on some of the available security system with high rating from consumers is needed to show the range of prices for existing system as one of their limitation. Refer to appendix B for the example of burglar alarm system's price list for comparison. Most of such reliable existing burglar alarm system cost around RM1000.

## 4.2 Survey

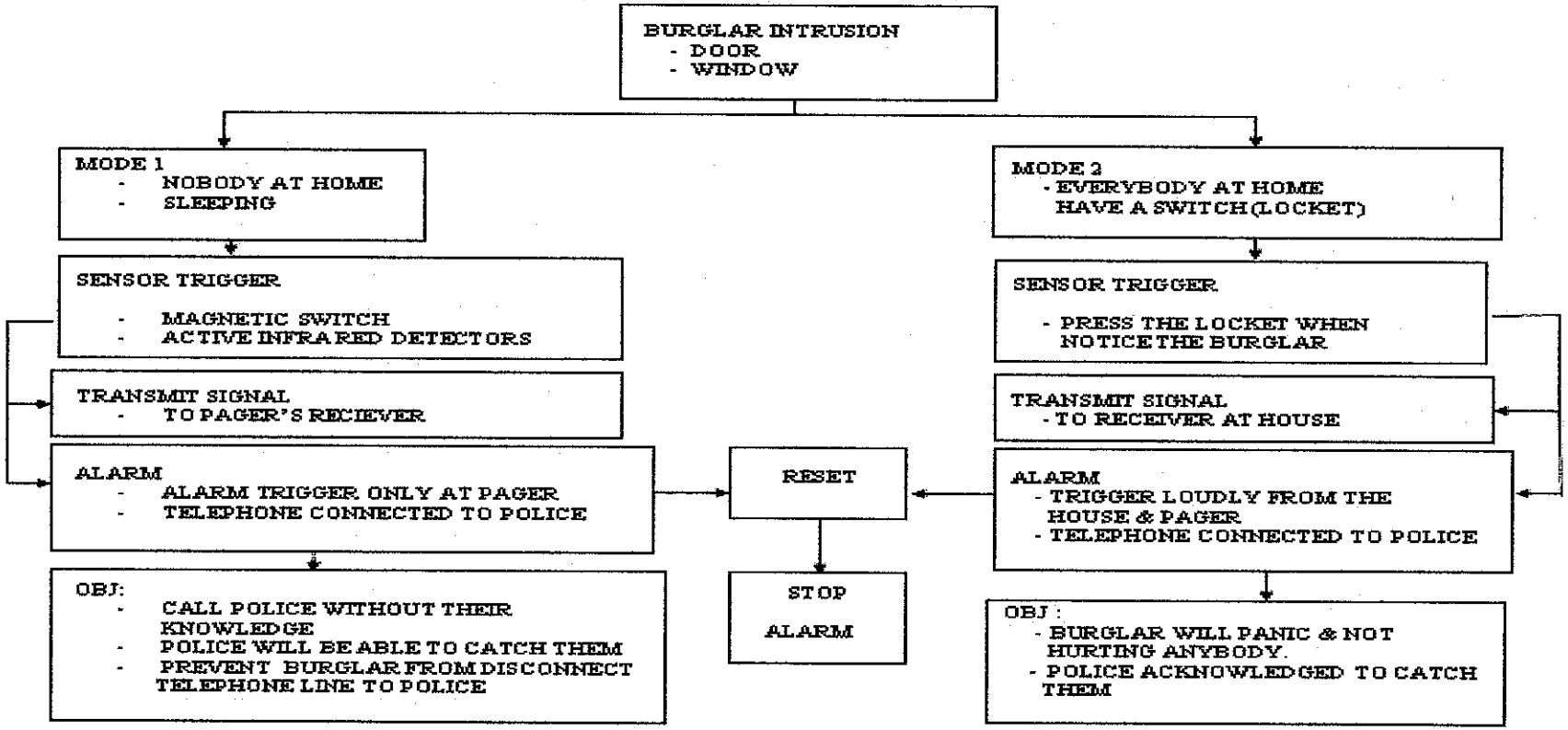
The survey regarding the knowledge on burglar alarm system and attraction on IBAS is done on 133 residents around Malaysia. Refer to the appendix C for the survey question. The results from survey are as below:

- 85% choose scale of 5 for importancy of burglar alarm system..
- 48% said such existing reliable system costs around RM1000 – RM1500.
- 60 % attracted to purchase the IBAS system.

## 4.3 Algorithm and Circuit Layout of the project

Algorithm is a necessary step in starting a project to show the path in which each project is going to take following the conditions and requirements of the project. From this algorithm, the layout of the circuit for IBAS is done as the referrece in designing and constructing circuit boards for IBAS. The algorithm of IBAS is as shown in next page. For more understanding on IBAS function, refer to appendix D and E for the circuit layout and chronology of intrusion versus IBAS respectively.

## ALGORITHM OF INTELLIGENT BURGLAR ALARM SYSTEM



ALGORITHM OF IBAS

For algorithm of this project (Intelligent burglar alarm system), please refer to the page before. As stated before, this system has two modes including reset system. The first mode, with the objective to let the neighbour to inform the police without the intruder(s)' acknowledgement once they enter our house when we are not at home or when we are sleeping. The method is by using magnetic switch and active infra red detectors as sensors at door and windows. Once the switch is activated, the signal is sent to receiver at neighbours' house and triggered the pager.

The second method is used when the householder and any of his family members is at the house. Considering that there might be children or guest that will use the door, all the sensors at the door and windows are closed in this mode. In this mode, it will trigger the alarm loudly from the house so that the thief will be panicked and run away without hurting anyone especially the children. The switch will be given to the members of the house in the form of such as locket or keychain. The switch is used to trigger the alarm once they've seen the suspicious one in the house. The reset mode is used to turn off the alarm once it is triggered.

To overcome the problem for getting immediate action from police, the supplementary function added which is instead of just activating the pager at neighbours', the triggering function also connected to the telephone line and display the victim's address to nearby police station.

Consider a situation where a burglar has entered the owner's house and snapped the telephone wires, leaving them with no means of communication with the outside world. In such an emergency, consumers will find this intruder alarm to be very handy as in this case, the phone line used is tapped way before it can be reached by the intruder. Same as for mode 2, it will also acknowledge the police to catch the intruder instead of panicking them only.

## 4.4 Designing burglar alarm Circuit

The principal function in designing alarm system is usually considered to warn or inform others that an intrusion has taken place in the premises concerned [2]. The main circuit is that of a control unit consist of sensors to activate alarm and transmission line to the pager.

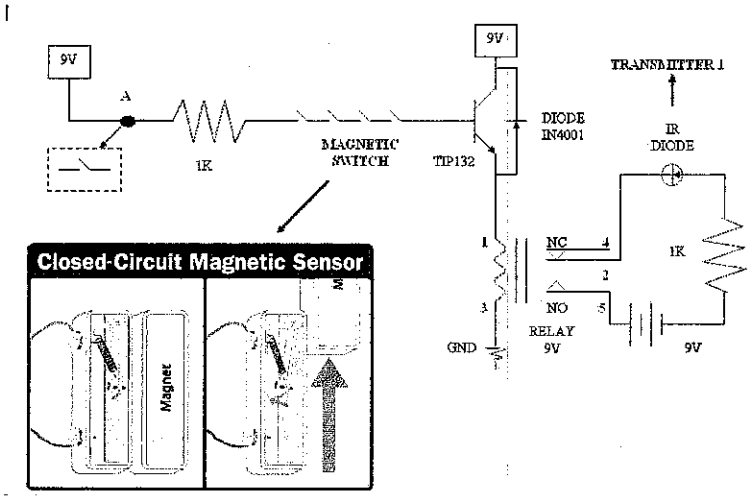



Figure 9 : Sensor & Transmitter circuit

The circuit shows that when the sensor (magnetic switch) is opened; indicates there's an intrusion either through door or window, the NPN transistor will allow the supply goes to the relay, activates it and then send infra red signal to the receiver at neighbor's pager. At receiver circuit, the signal received activates or complete the close loop circuit and thus activates the siren subcircuit.

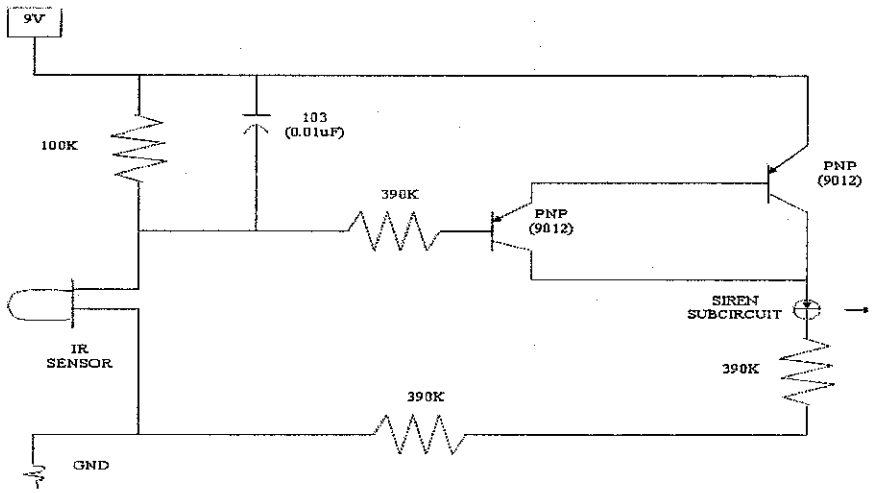



Figure 10 : Receiver 1 & 2 Circuit

## 4.5 Enhancing IR (Infra Red) circuit

For IR circuit, the enhancement is done in order to make it send its signal to some further distant. Refer to figure below:

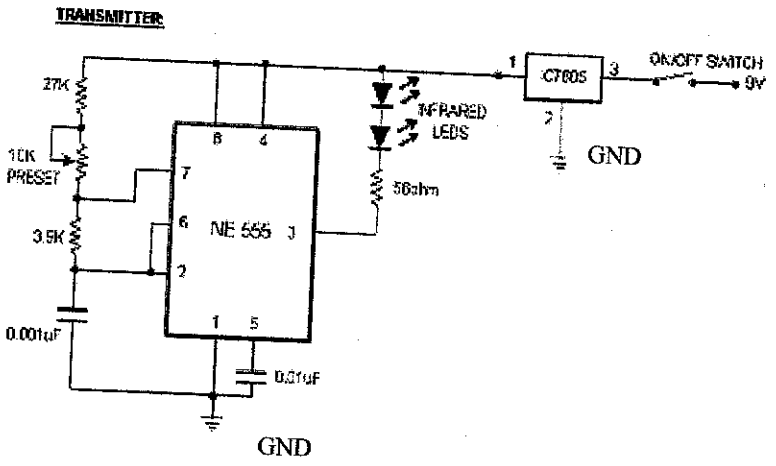



Figure 11 : New IR Transmitter circuit

The circuit is connected so that it will trigger itself and run as a multivibrator [10]. The 0.01uF capacitor charges through the external resistor at pin 7 and discharges through 3.9K ohm resistor. With this, the duty cycle is about 10%. It gives more current pass through the LEDs and gives longer range. For this circuit, it gives 3.8 metres radius range.

## 4.6 Connection from alarm to PIC (auto dialer)

The idea to accomplish the auto dialer part is once the alarm is triggered (in other words, intrusion happened), the system will tap the victim's phone line and automatically dialling the 999 emergency number. The established communication system in this country is useful in this case where dialling 999 will connect the phone line to the nearest police station's operator. At the police station, the phone will detect the victim's phone number and convert it to be the binary input for PIC microcontroller [11]. In this project, keypad is used to replace the input converter. The programme installed in microcontroller will define the input number and thus display the victim's address on LCD as well as blinking the LED (light emmiting diode) and trigger the alarm (buzzer).

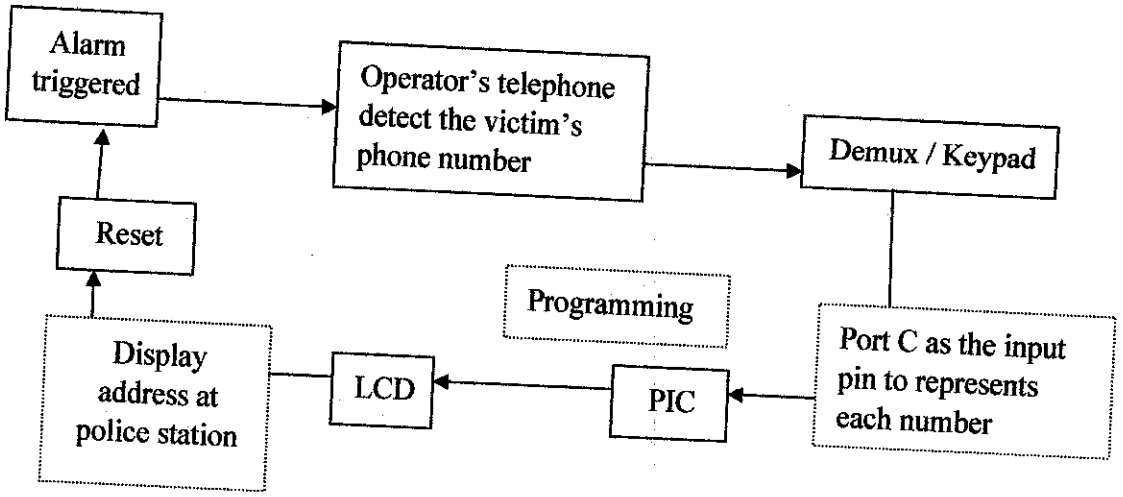



Figure 12 : Layout for auto dialler phase

### 4.7 Programming outline

Figure below shows the outline of the program for PIC16F877 microcontroller. The outline is used to direct the programming path and also for determining the end results [12]. Refer to appendix F for the complete PIC Basic Pro program.

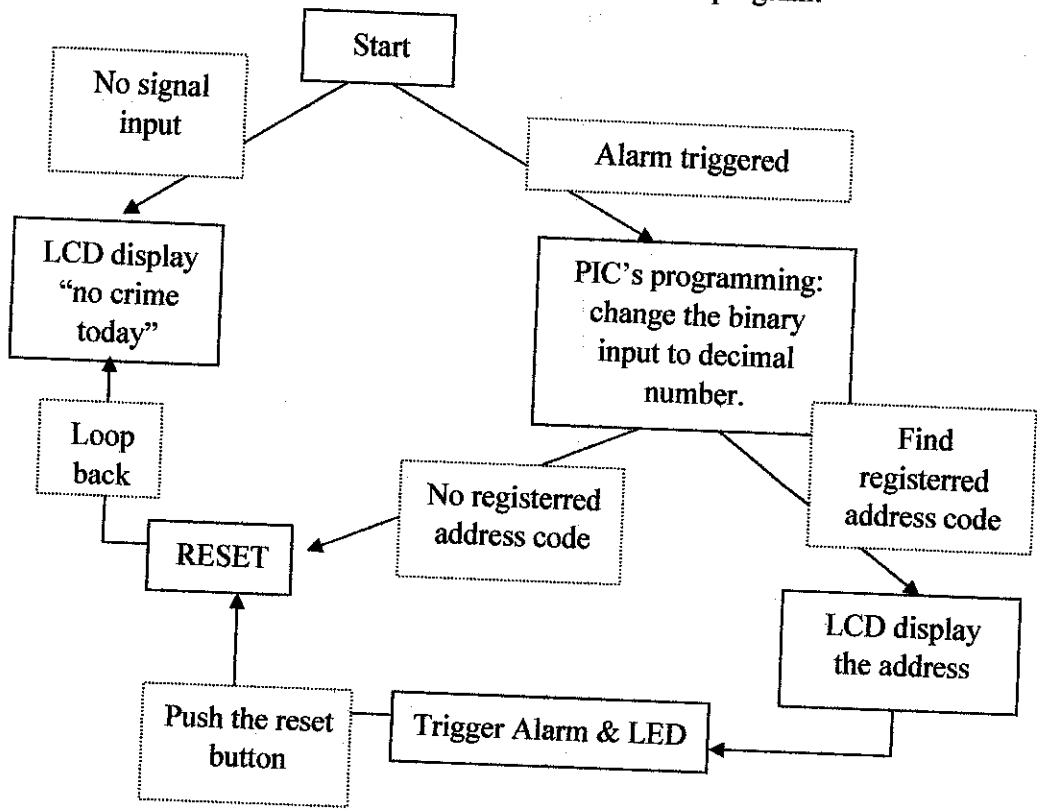



Figure 13 : PIC16F877/A programming outline

### 4.8 Schematic circuit diagram

The circuit is constructed on the bread board in order to test the workability. The schematic diagram design is to draw back the schematic of this project's circuits in order to make the netlist and convert it to Geber file where PCB layout design is done. It shows the circuit connection neatly and simulation can be done by using the sofware. The software used is PSPICE but for PIC microcontroller circuit, PROTEUS software named ISIS is used as the PSPICE trial software used could not recognized the component when netlisting it to PCB design. Refer to appendix G for the diagrams.

### 4.9 Printed Circuit Board (PCB) design layout.

After completing the schematic diagram, the next step in PCB (printed circuit board) design is making the layout for the circuits. The softwares used are GC Cam Powerstation and PROTEUS-ARES (refer to appendix H for the layouts).

These are the advantages of using PCB in circuit design process:

- Reduce circuit malfunction
- To design from a simple to complicated circuit on board
- To make prototyping on the projects
- To reduce space areas in design application
- To improve signal integrity and conductivity

The process in fabricating a PCB is [13]:

1. Schematic diagram – refer to appendix F
2. Layout diagram – refer to appendix G
3. Film artwork
4. Milling and drilling

5. Chemical fabrication process
    i. Dry film lamination
    ii. Photopolymer dev.
    iii. Bubble etching
    iv. Photo resist stripping
    v. Tin immersion
6. Final tested product

For the picture of complete PCB with soldered components, refer to appendix I.

### 4.10 Circuit implementation in scaled premise model.

This project is being implemented on the scaled premise model as one of the marketing strategies in order to show the reliability of the system during presentation. For the sketch plan and picture of the model, refer to appendix J.

### 4.11 Cost analysis

The analysis for components used is done by refering the RS company catalogue book for 2005. Other referrences are the State and Mayor companies' price at Pasir Putih. For the complete price, refer to appendix K.

| NO | CIRCUIT | COST |
|---|---|---|
| 1. | MODE 1 | RM80.53 |
| 2. | MODE 2 | RM47.57 |
| 3. | AUTO DIALLER | RM77.27 |
| 4. | BATTERY INDICATOR | RM13.02 |
| **TOTAL COST** | | **RM218.39** |

Table 4 : Cost for IBAS

# CHAPTER 5
# RECOMMENDATIONS

This project can be improved in term of circuit and also the software design. Below are the recommendations for this project.

- Smaller size of the circuit should be very convenient to the user especially for the locket transmitter.

- More advanced battery shall be used so that the battery will require less space but produce more supply power. This is essential for auto dialer system since the usage of normal battery will lag the timing or displaying victim's address.

- Ehancing the address display system where the address shall be displayed on the computer instead of directly display on the LCD. This requires modification on the software design but give more systematic database and also space for analyzing the intrusion trend.

- Radio frequency (RF) can be used as the transmission type instead of infra read (IR). IR needs the line of sight and has shorter transmission range compare to RF.

- Other kind of sensors could be added such as the motion detector and fingerprint sensor.

# CHAPTER 6
# CONCLUSION

Two semesters that have been allocated to complete the project entitled "Intelligent Burglar Alarm System". During the first semester, this project focused on the sensor and the trivial circuit of the alarm system which is to transmit the signal to hand pager and triggering the alarm. The final semester focuses on the enhancement of the project's autodialer features to inform the nearby police station automatically once the circuit is triggered. This feature gives a good combination with pager where informing the neighbourhood will not just having witness to confirm that it is not a false alarm but also assist the victim faster. The overall cost for IBAS is around RM250 which gives good attraction for the customers. This brings about 60% of the person surveyed feel attracted in purchasing IBAS. In conclusion, this project would be very useful in various aspects since wireless feature is added, cheaper, affordable, and effective for police act. It also concerns on three main requirements which are reliability, cost effectiveness and also avoiding false alarm. These three main requirements will suit the needs of security in the targeted urban and rural community area. For the future work, some areas that can be overlooked are the circuit design, power supply, transmission type and GUI interface.

# REFERENCES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[2] Security, ID Systems and Locks, Joel Konicek & Karen Little

Butterworth-Heinemann, 1997

[3] The Consumer's Guide to Wireless Security, Joseph Moses & Lou Sepulveda

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[4] http://www.aaaremotes.com/chandusfiand.html

[5] http://www.ciaalarms.co.uk/intruder_alarms.html

[6] http://www.infraredheaters.com/basic.htm#Theory%20of%20Infrared

[7] Wayne Tomasi, Electronic Communication Systems,

Prentice Hall, 5th Edition, pg 687 – 770

[8] http://www.its-home-security.co.uk/monitored.htm

[9] http://www.surveysystem.com/sdesign.htm

[10] NE 555 Timer IC Datasheet

[11] PIC16F877/A Datasheet

[12] Final Year Project (FYP) Leture Series: Testing & Troubleshooting

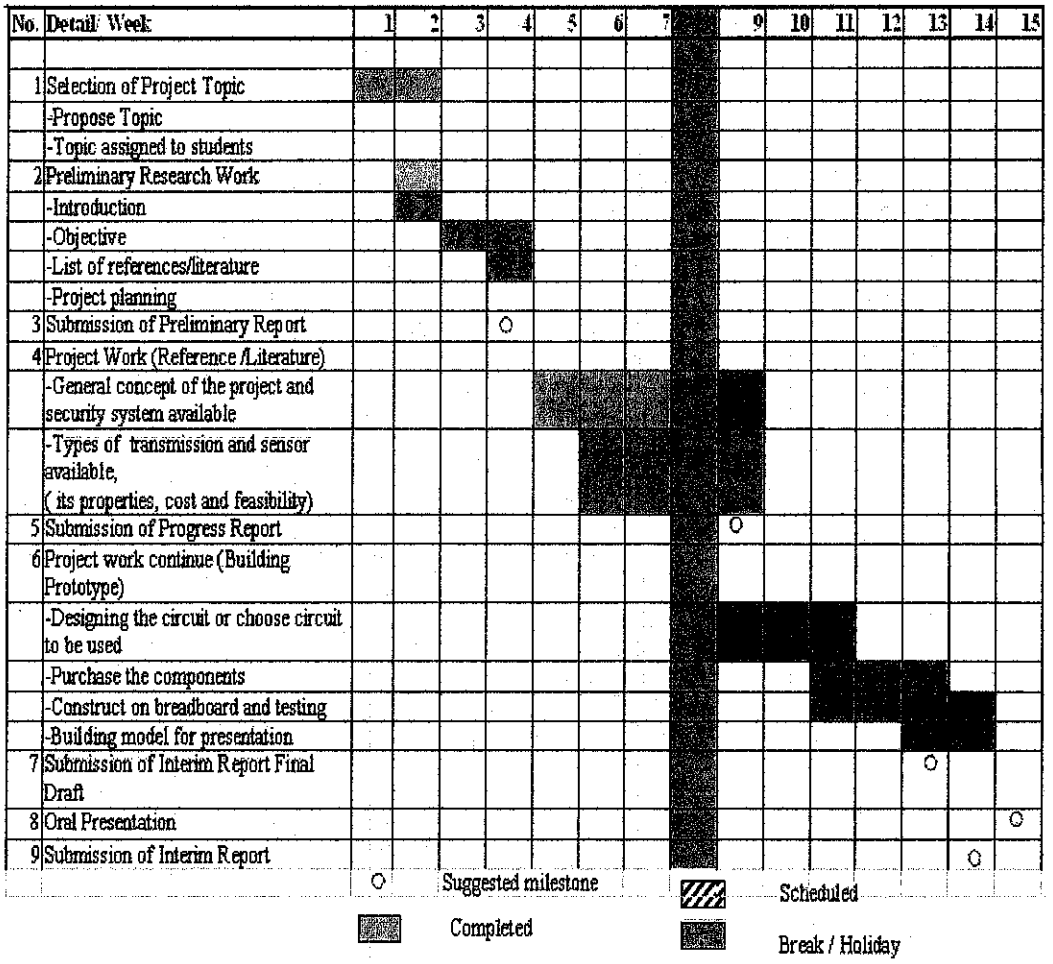
[13] http://www.asiapcb.com.my

[14] http://eburglaralarm.info/

# APPENDIX A

# MILESTONE FOR IBAS

## Suggested Milestone for the First Semester of 2 Semester Final Year Project



**Suggested Milestone for the Second Semester of 2 Semester Final Year Project**

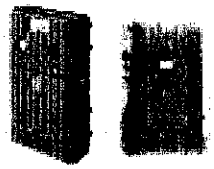
| NO. | TASK | WEEK | DATE | COMMENTS |
|---|---|---|---|---|
| 1. | Review FYP1 | 1 | 24/7 – 30/7 | • Review the system |
| 2. | Proposal FYP2 | 2 | 31/7 – 4/8 | • Propose the next step for the project |
| 3. | IR Circuit | 2-3 | 1/8 – 11/8 | • Improvise the circuit<br>• Requirement 15m |
| 4. | Progress report 1 | 4 | 19/8 | ○ |
| 5. | Autodialler | 4 | 14/8 – 19/8 | • Configure connection between alarm and police station. |
| 6. | PIC circuit | 5-7 | 21/8 – 6/9 | • Circuit design<br>• PIC C programming<br>• Compiling & testing |
| 7. | PSPICE | 9 | 18/9 – 22/9 | • Schematic diagram<br>• Layout diagram |
| 8. | PCB design | 9-10 | 18/9 – 29-/9 | • Software<br>• Film artwork<br>• Drilling<br>• Chemical fabrication<br>• Soldering |
| 9. | Progress report 2 | 9 | 22/9 | ○ |
| 10. | Testing | 10-11 | 25/9 – 7/10 | • Final product testing<br>• Troubleshooting |
| 11. | Model | 11 | 2/10 – 6/10 | • Improve model<br>• Packaging |
| 12. | Demonstration | 11 | 5/10 | • Demo to supervisor |
| 13. | Pre-EDX | 12 | 9/10 – 13/10 | • Preparation for presentation |
| 14. | Draft report | 13 | 16/10 | ○ |
| 15. | Final Report 1 | 14 | 4/11 | ○ |
| 16. | Oral presentation | - | 4/12 | ○ |
| 17. | Technical Report | - | 11/12 | ○ |
| 18. | Final report | - | 22/12 | ○ |

○ Milestone

# APPENDIX B

# EXISTING BURGLAR ALARM PRICE LIST

1) Trail Scout 2.1MP w/nightvision



Capture the movement! There's more than one way to scout a range, and the Bushnell digital Trail Scout 2.1 megapixel trail camera with night vision...
**Rating**

Want more info? Click on the picture!

**$267.00**
see it

from

Binoculars.com

2) Trail Scout Pro 3.0 MP Trail Camera w/Night Vision

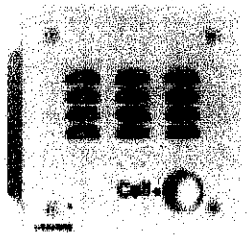
Trail Scout Pro 3.0 MP Trail Camera w/Night Vision - Throw the switch on that trophy's hangout. It's never been easier to know exactly what's roaming...
**Rating**

Want more info? Click on the picture!

**$289.00**
see it

from

3) Viking Stainless Steel Handsfree Door Intercom



Answer your Door from any Phone in your Home or Office. In addition to many of the features found in the W-1000/2000A, the W-3000 provides a night li...
**Rating**

Want more info? Click on the picture!

**$204.95**
see it

4) Viking Feedback Eliminator VK-FBI-1A

Now your paging amplifier can be turned up to any level and your phones can be located anywhere--even directly under a high-power paging horn.
**Rating**

Want more info? Click on the picture!

**$229.95**
see it

5) Wireless Door/Window Sensor

Motorola accessory wireless door/window sensor for use with the HomeSight wireless easy start kit (MOT-HMEZ2000).
**Rating**

**$34.80**

reference : [14]

# APPENDIX C

# SURVEY QUESTION

For questions below, please circle your answer:

Sila bulatkan jawapan anda untuk soalan-soalan berikut :

1. How important do you think the burglar alarm system for residence :
   Pada pendapat anda, pentingkah penggunaan sistem penggera keselamatan di rumah:

| Not important at all | | | | Extremely important |
|---|---|---|---|---|
| (Tidak penting) | | | | (Sangat penting) |
| **1** | **2** | **3** | **4** | **5** |

2. Why don't you use the existing burglar alarm system?
   Mengapakah anda tidak menggunakan sistem penggera keselamatan?
   a. It's too expensive.
      Terlalu mahal
   b. The quality is poor.
      Kurang berkualiti
   c. Don't know where to get
      Tidak tahu cara mendapatkannya
   d. Annoying with the false alarm
      Terganggu oleh bunyi penggera
   e. Other(please explain):
      Lain-lain (Sila jelaskan): _____

3. How did you first hear about burglar alarm system?
   Bagaimana anda mendapat maklumat mengenai sistem penggera keselamatan?
   a. Television
   b. Radio
   c. Newspaper
   d. Word-of-mouth
   e. Internet
   f. Other (please specify) :
      Lain-lain (sila nyatakan) : _____

4. Which of the following categories best describes your last experience handling with false alarm? Would you say that your experience was :
   Yang mana satu di antara pilihan berikut mencerminkan perassaan anda menghadapi kesilapan bunyi penggera keselamatan :

a. Very unpleasant
   Sangat terganggu

b. Somewhat unpleasant
   Terganggu sedikit

c. Neither pleasant nor unpleasant.
   Tidak tahu

5. Please write a number between 1 and 5 next to each item below. Put a 1 next to the item that is MOST important to you in selecting a burglar alarm system. Put a 5 next to the item that is LEAST important.
   Sila susun nombor 1 hingga 5 untuk jawapan di bawah menurut kepentingan dalam anda memilih / menilai sistem penggera keselamatan.

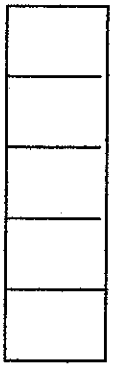
   a. Price
      Harga

   b. Quality / reliability
      Kualiti

   c. Features
      Ciri-ciri / kemudahan

   d. Recommendations / comments
      Komen pengguna lain

   e. Easy to use
      Mudah dikendalikan



## OUR PRODUCT : INTELLIGENT BURGLAR ALARM SYSTEM

6. When thinking about IBAS, do you think that the word 'innovative' aptly to describe the product?
   Adakah anda rasa perkataan 'inovatif' sesuai digubakan terhadap produk IBAS?

   Very well describe — poorly describe

   Sangat sesuai — inovatif — tidak sesuai

   **+5 +4 +3 +2 +1 -1 -2 -3 -4 -5**

7. Would you say our product is :
   Apakah pendapat anda tentang produk ini?

| | | | | |
|---|---|---|---|---|
| Very attractive | | | | very unattractive |
| Sangat menarik | | | | tidak menarik langsung |
| **5** | **4** | **3** | **2** | **1** |

8. With an affordable price, do you think that this product is a necessity to your house?
   Dangan harga yang berpatutan, adakah anda berpendapat bahawa produk ini satu keperluan untuk rumah anda?

| | | | | |
|---|---|---|---|---|
| Very necessary | | | | very unnecessary |
| Amat diperlukan | | | | tidak diperlukan |
| **5** | **4** | **3** | **2** | **1** |

9. Based upon what you have seen, heard, and experienced, can you state the current price for such reliable alarm system developed at the market.
   Berdasarkan apa yang anda telah lihat, dengar dan alami, sila nyatakan harga sistem penggera keselamatan yang lengkap.

_____

10. What do you think when comparing the existing product with IBAS?
    Apakah pendapat anda tentang produk IBAS dibandingkan dengan sistem yang telah ada?

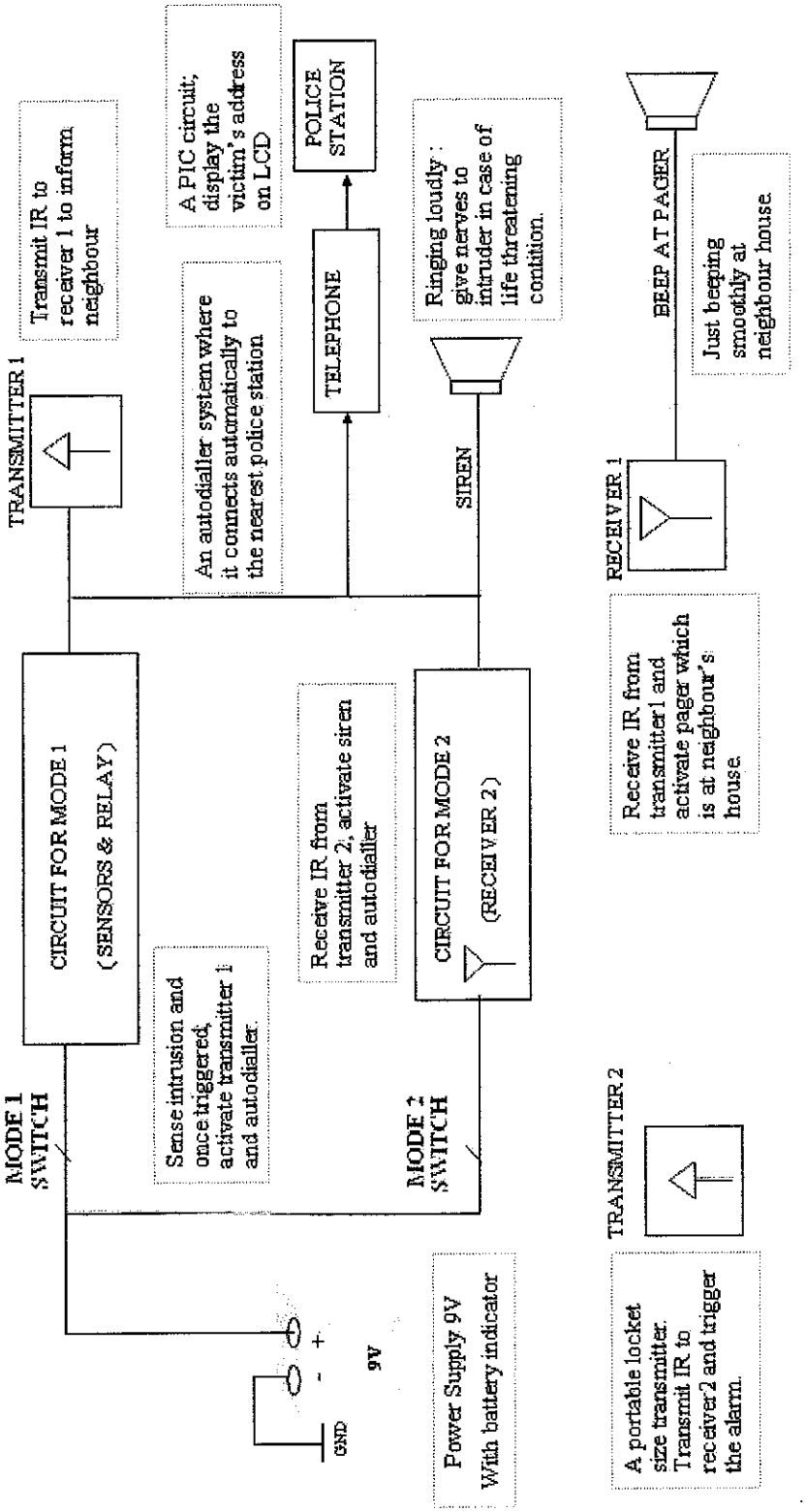
_____

_____

_____

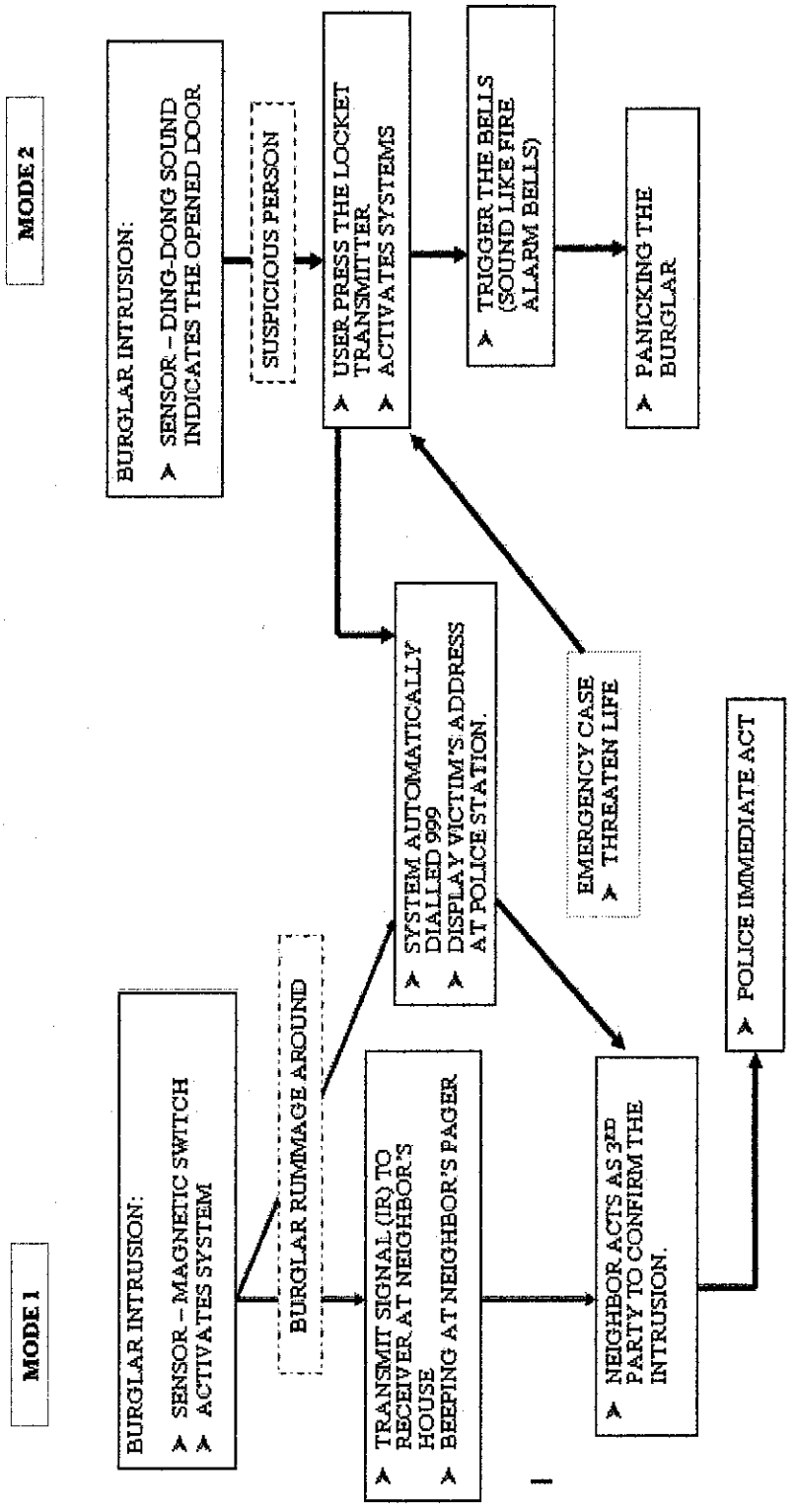
# APPENDIX D

# LAYOUT OF IBAS



# APPENDIX E

## CHRONOLOGY OF INTRUSION VS IBAS



# APPENDIX F

## PIC BASIC PRO PROGRAMMING

```
' define 4 line lcd to display at port B

DEFINE LCD_DREG         PORTB
DEFINE LCD_DBIT 0
DEFINE LCD_RSREG PORTB
DEFINE LCD_RSBIT 4
DEFINE LCD_EREG PORTB
DEFINE LCD_EBIT 5
DEFINE LCD_BITS 4
DEFINE LCD_LINES 2
DEFINE LCD_COMMANDUS 2000
DEFINE LCD_DATAUS 50
  Pause 500      ' Wait for LCD to startup

WORDS       bvar1
WORDS       bvar2
WORDS       bvar3
WORDS       bvar4
WORDS       bvar5

'**********************************
'define Port A as input
'define Port B & C as output

TRISA = %11111111
TRISB = %00000000
TRISC = %00000000
```

```
memory:
        'Binary          ⇒ use prefix %
PortB.1= %a
If  %a*(2^4)=3416                                   'detected phone umber
bvar1 = V4e-g1                                      ' address
          Universiti Teknologi PETRONAS
          Tronoh, Perak

else
goto main                ' reset if no address stored

'**********************************

main:
                pause 100
                Low PORTC. 'used for buzzer and LED

                LCDOut $fe, 1          ' Clear LCD
                LCDOut $FE,$80,"no crime today"
                Pause 5000

Goto num1
'*****************************************
 'to detect & display the address

num1 :
BUTTON PORTB.0,0,100,bvar2,num2
LCDOut $fe, 1
LCDOut $FE,$80, bvar2       ' detect 1st number
Pause 100
goto main                ' reset
```

```
num2:
BUTTON PORTB.1,0,100,bvar3,num3
LCDOut $FE,$80, bvar3                'detect 2nd number
Pause 100
goto num1


num3:
BUTTON PORTB.1,0,100,bvar4,num4
LCDOut $FE,$80, bvar4                ' detect 3rd number
Pause 100
goto num2

num4:
BUTTON PORTB.1,0,100,bvar5,display
LCDOut $FE,$80, bvar5                ' detect 4th number
Pause 100
goto num3

display :
        pause 100
        LCDOut $fe, 1                ' Clear LCD
        LCDOut $FE,$80,"The address is :  "
        LCDOut $FE,$C0,bvar1
        Pause 10000

High portC.1   'lights up LED
HighportC.2    'trigger alarm

Go to display ' display until reset

'*****************************************
```

# APPENDIX G

# SCHEMATIC CIRCUIT DIAGRAM FOR IBAS

## SCHEMATIC DIAGRAM – PSPICE

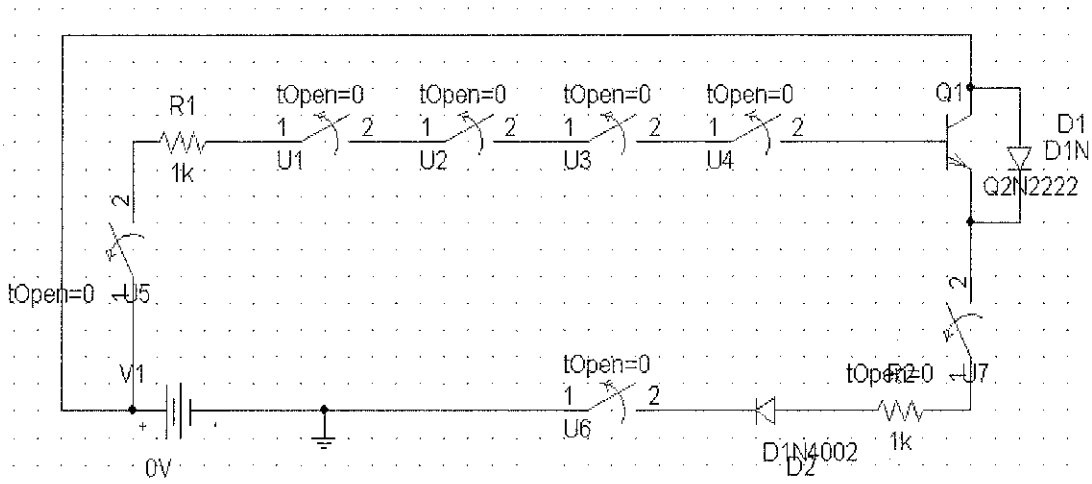



Figure 14 : Schematic diagram for sensor circuit

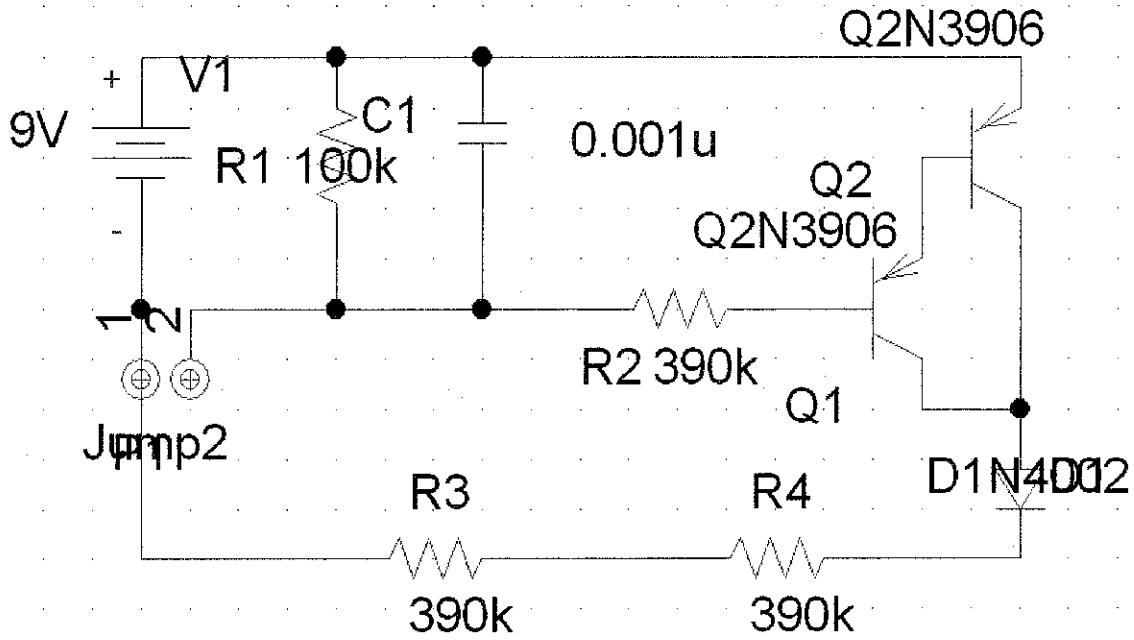



Figure 15 : Schematic diagram for receiver circuit

## SCHEMATIC DIAGRAM- PROTEUS (ISIS)

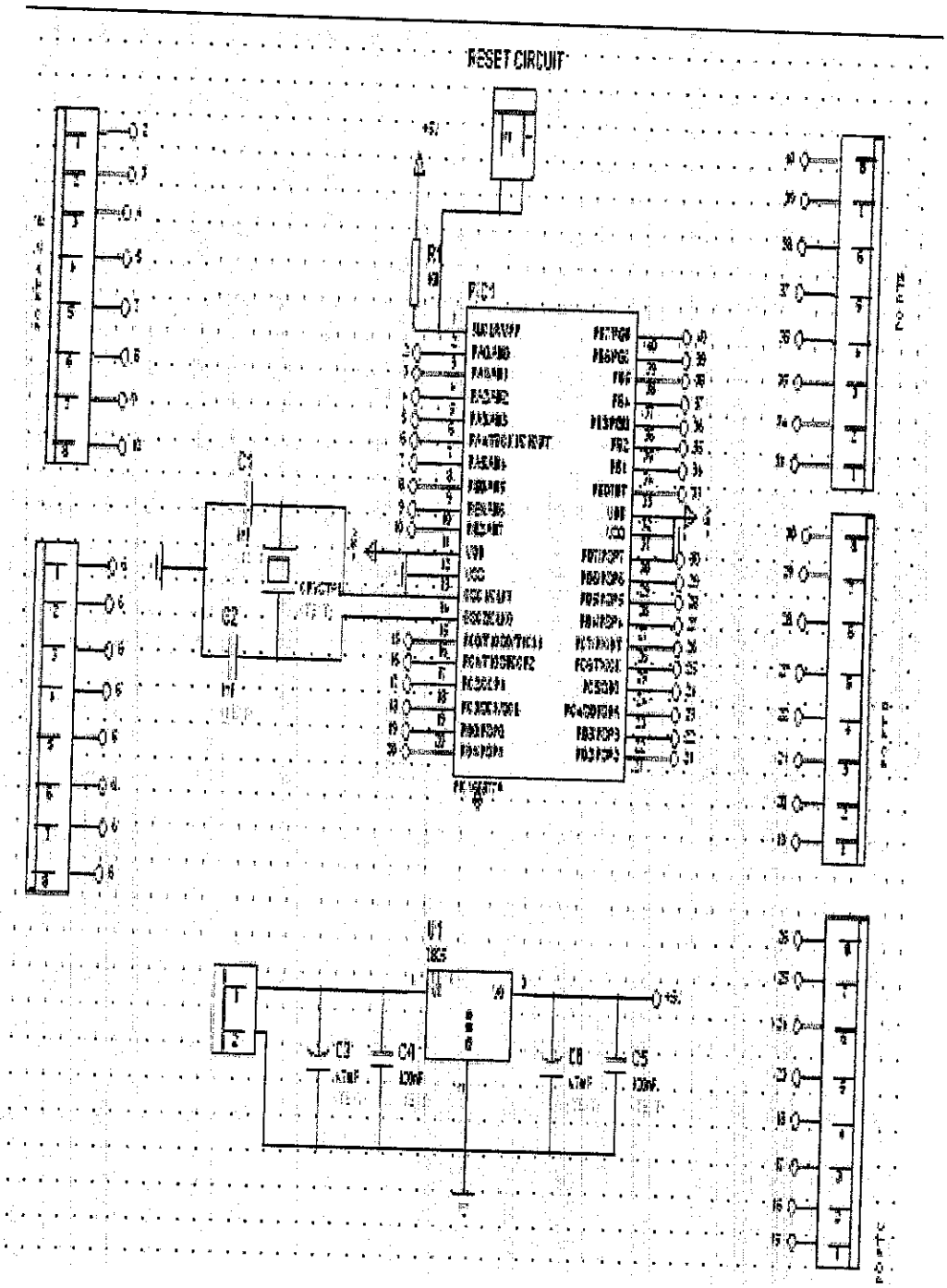



Figure 16 : Schematic diagram for PIC16F877/A

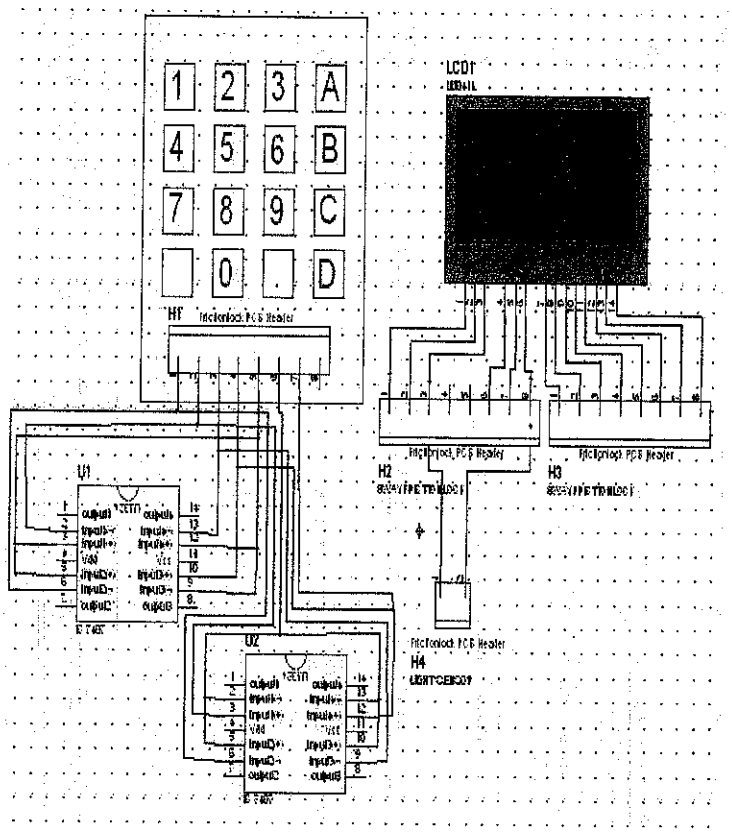



Figure 17 : Schematic diagram for keypad and LCD

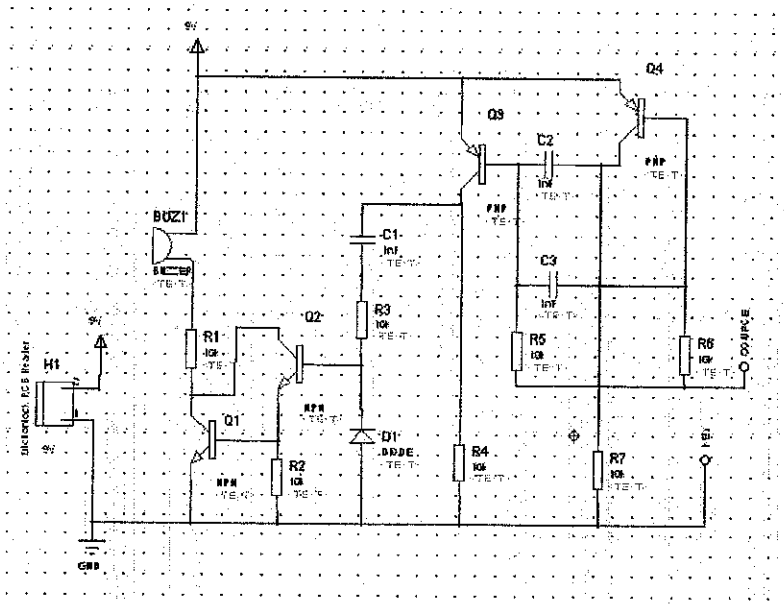



Figure 18 : Schematic diagram for transmitter

# APPENDIX H

# PCB DESIGN FOR IBAS

## PCB LAYOUT – GC CAM POWERSTATION

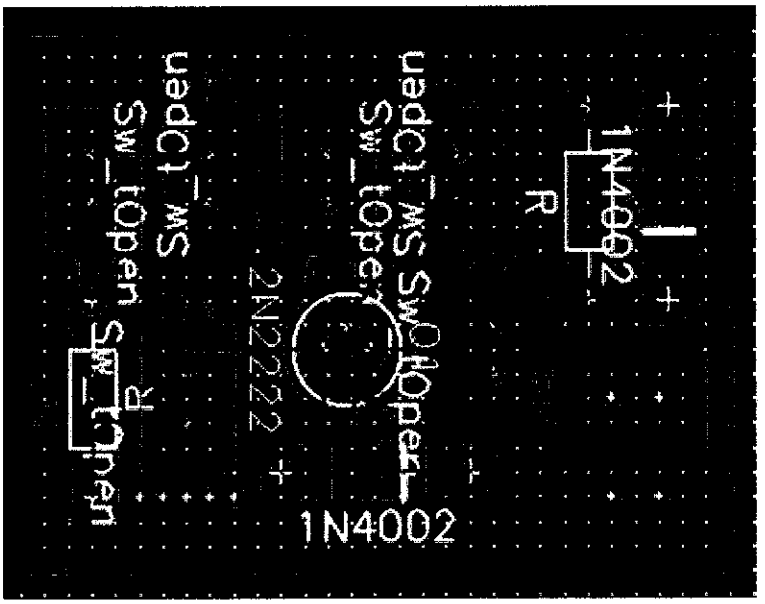



Figure 19 : PCB layout for sensor circuit

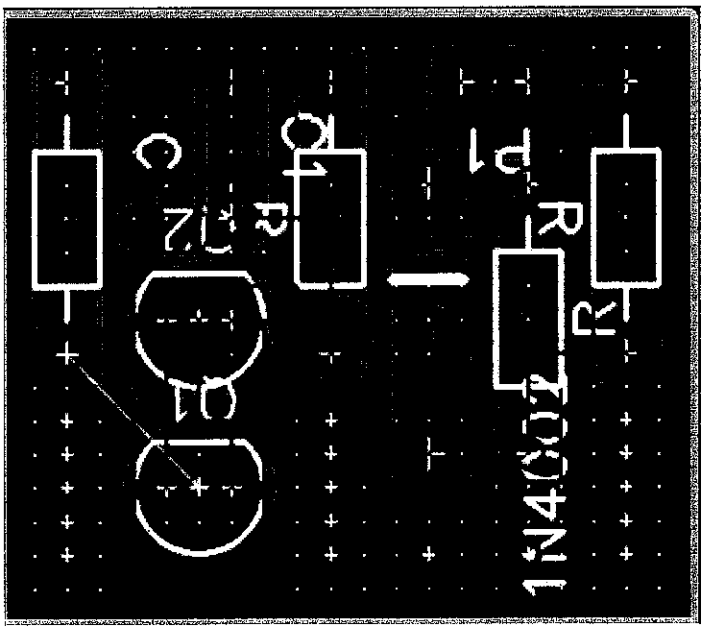



Figure 20 : PCB layout for receiver circuit

**PCB LAYOUT – PROTEUS (ARES)**

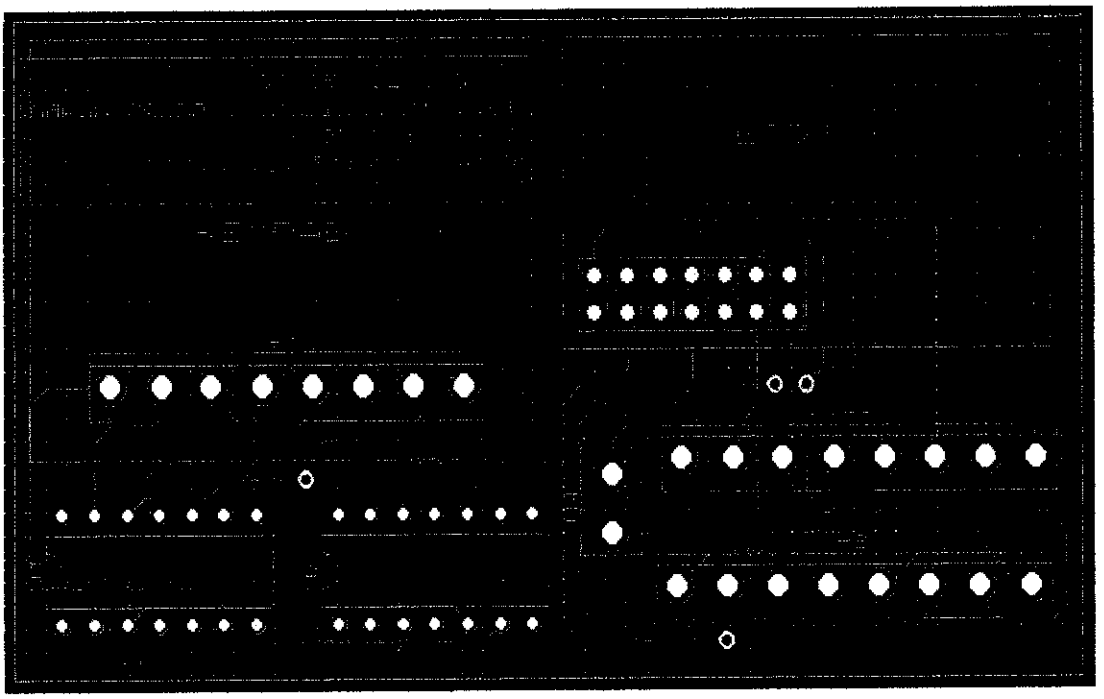


Figure 21 : PCB layout for keypad and LCD

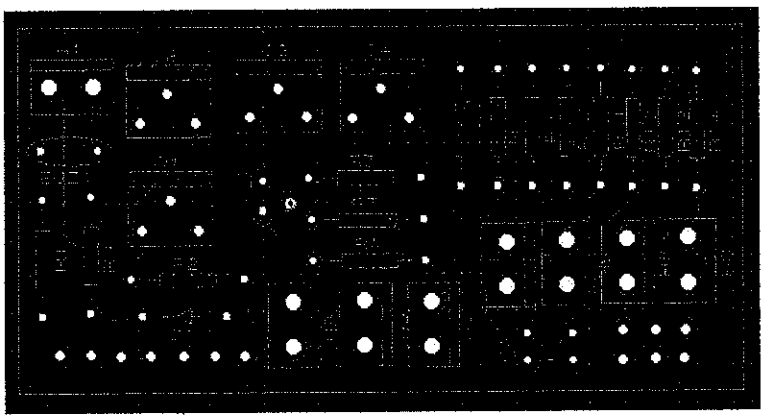


Figure 22 : PCB layout for transmitter

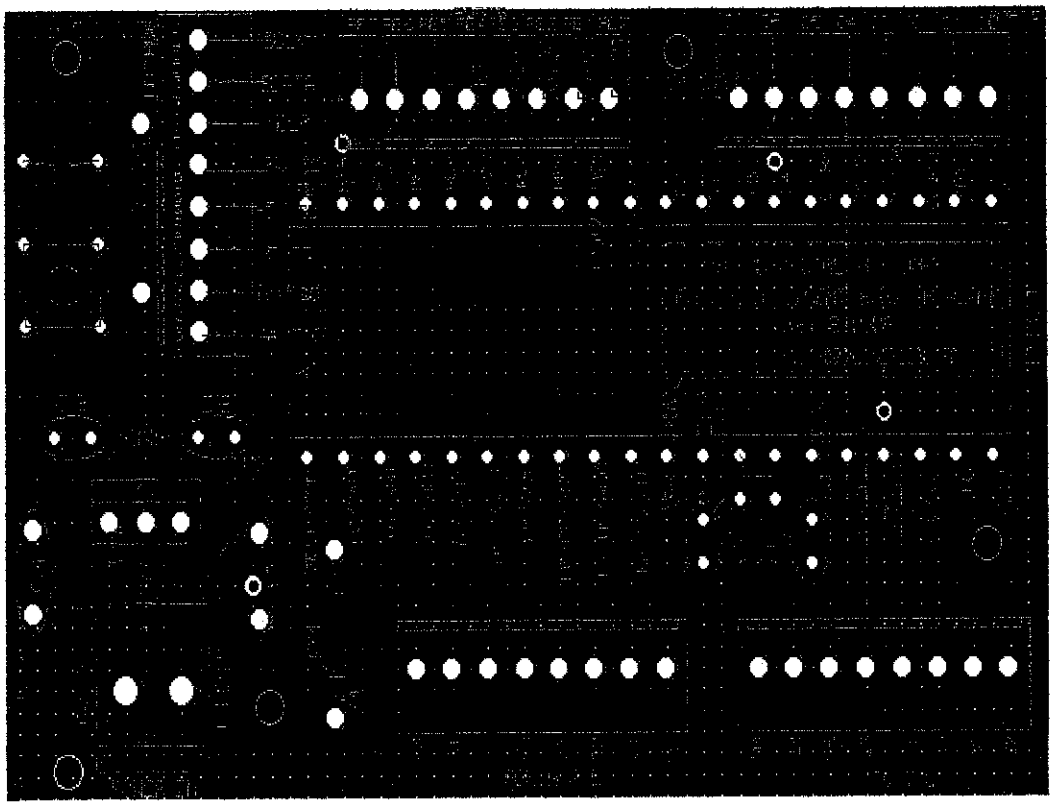


Figure 23 : PCB layout for PIC 16F877/A

# APPENDIX I

# IBAS CIRCUIT BOARDS

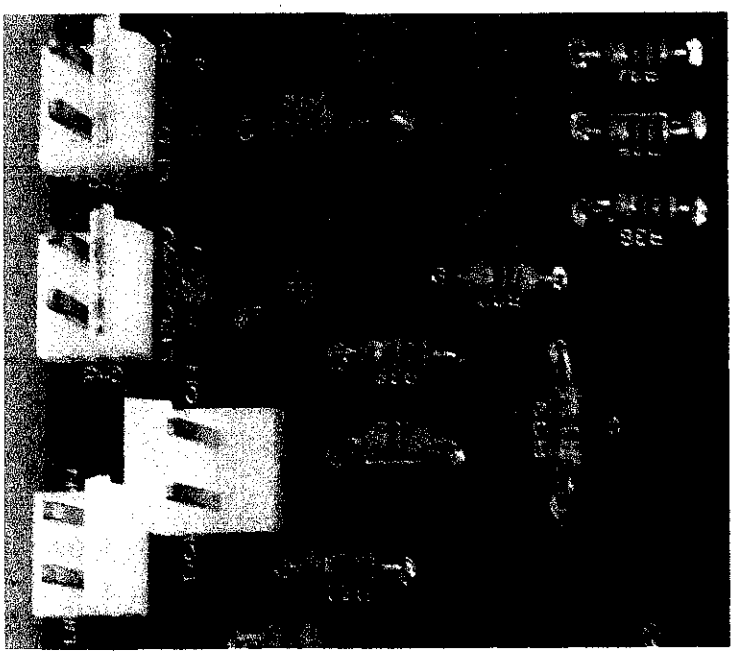


Figure 24 : Sensor circuit for mode 1

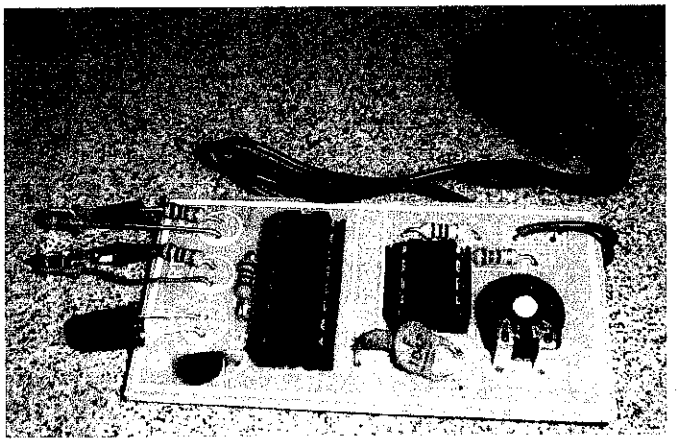


Figure 25 : Transmitter circuit

Figure 26 : Locket alarm (transmitter) casing

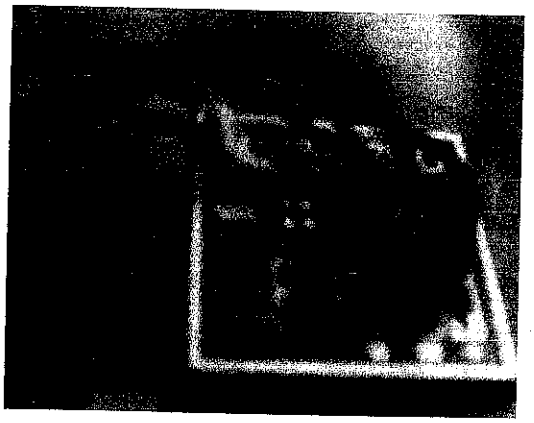


Figure 27 : Receiver circuit

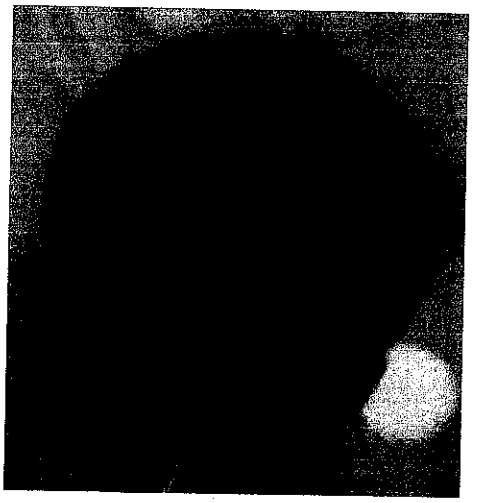


Figure 28 : 97dB buzzer

Figure 29 : Auto dialer circuit (PIC, keyad & 4-line LCD)

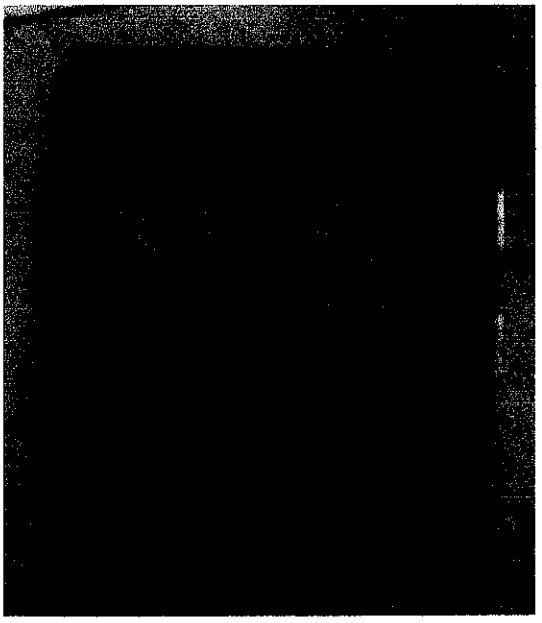


Figure 30 : Battery indicator

# APPENDIX J

# MODEL FOR IBAS

MODEL'S PLAN SKETCH

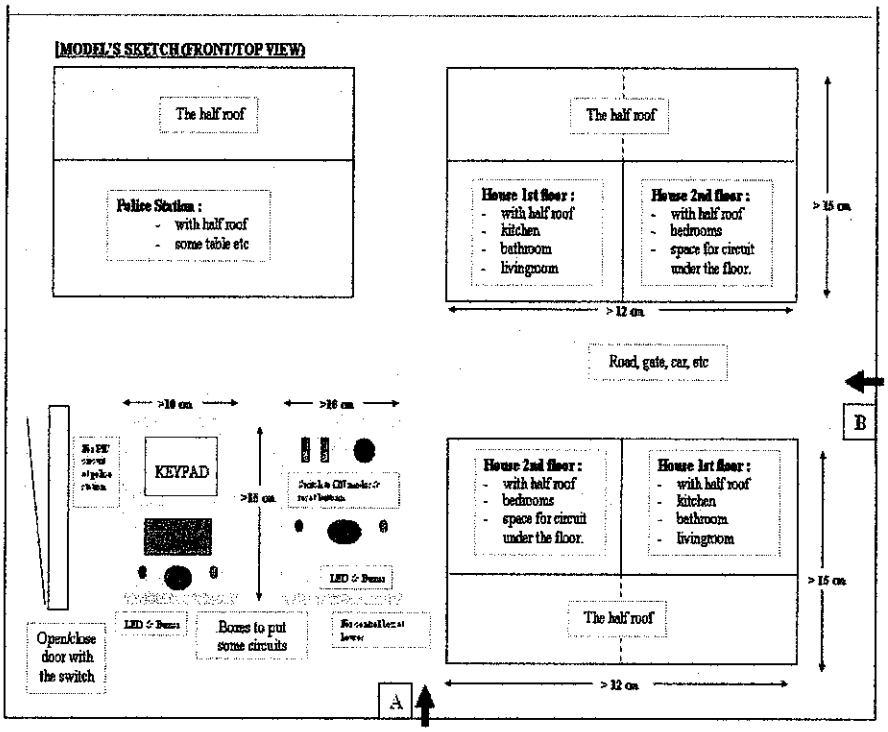



Figure 31 : Top / front view of IBAS model

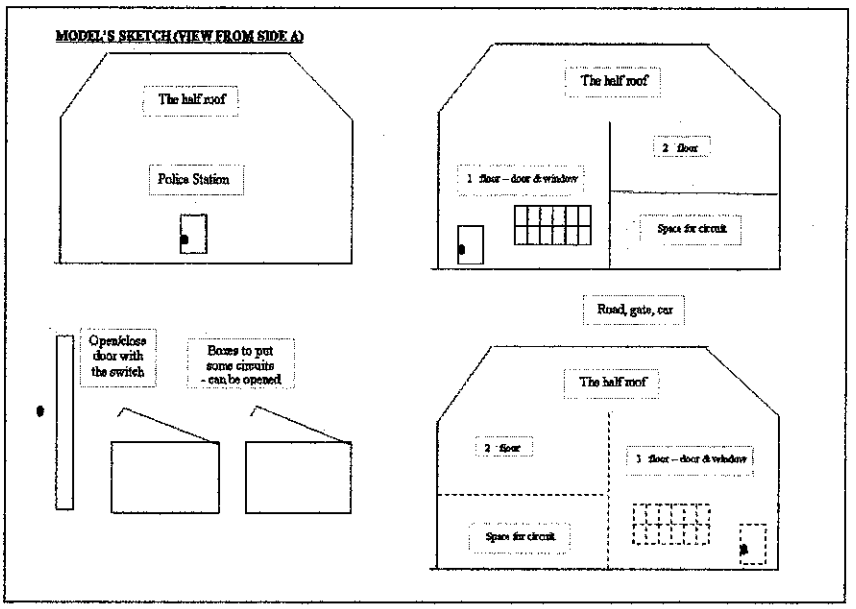



Figure 32 : Side A view of IBAS model

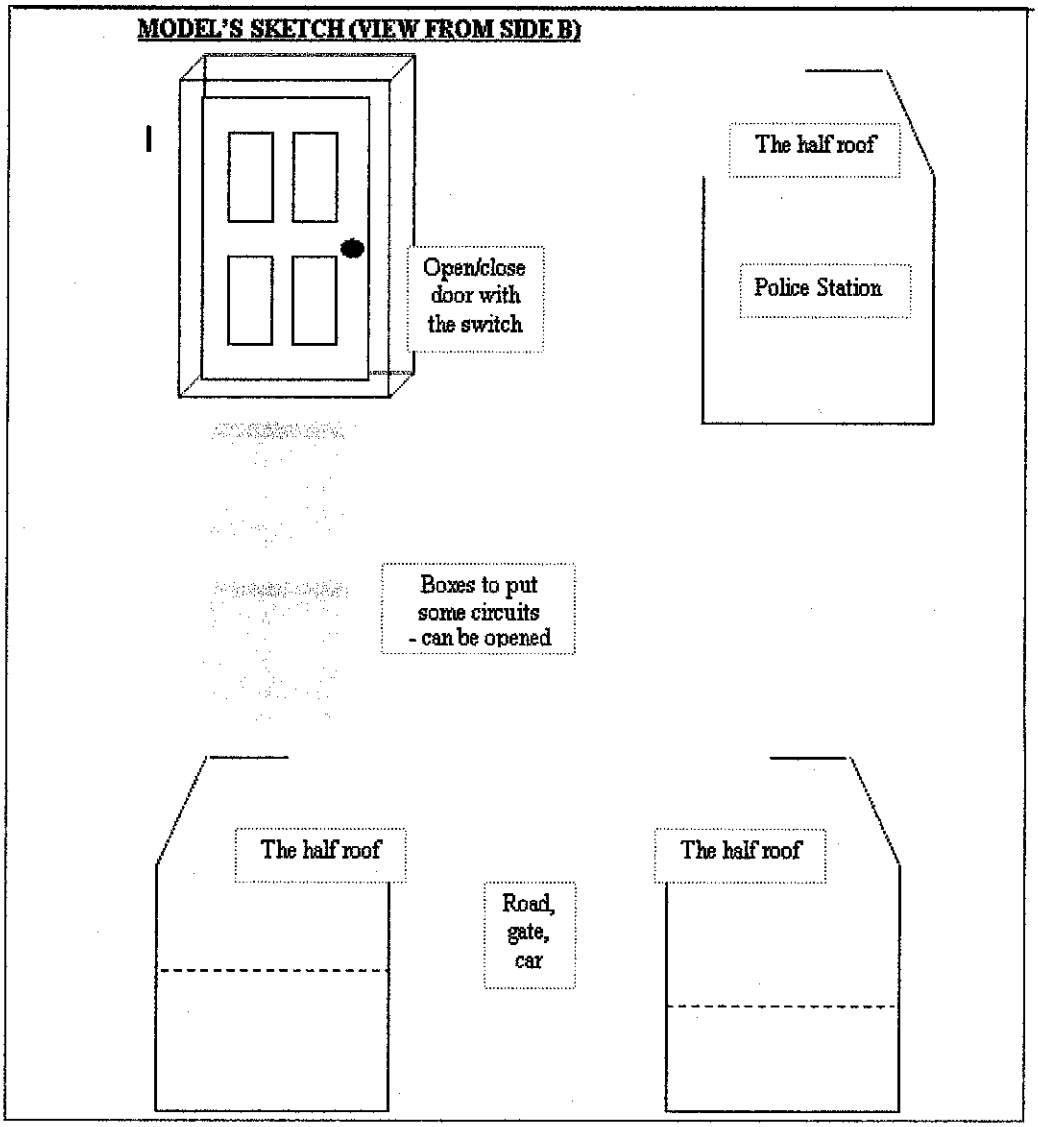



Figure 33 : Side B view of IBAS model

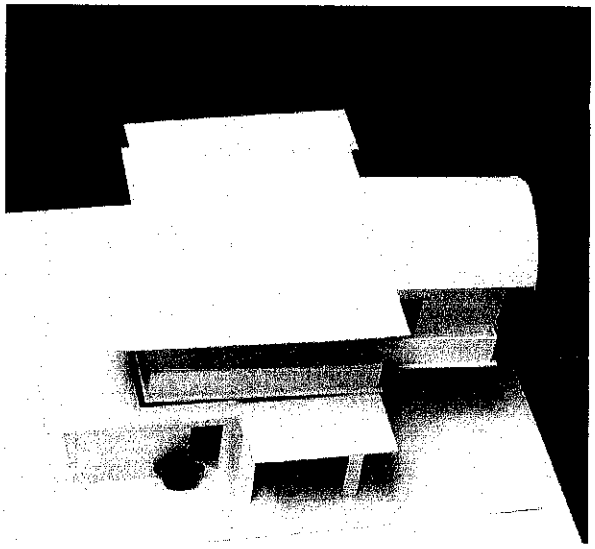


Figure 34 : House

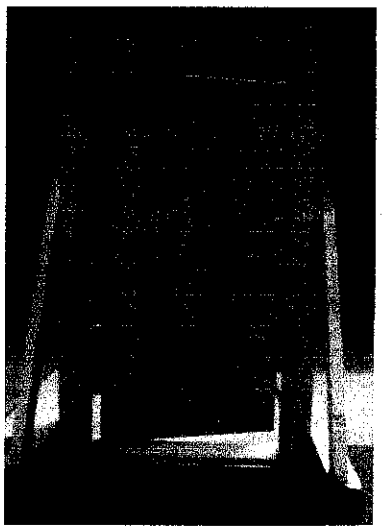


Figure 35 : Door

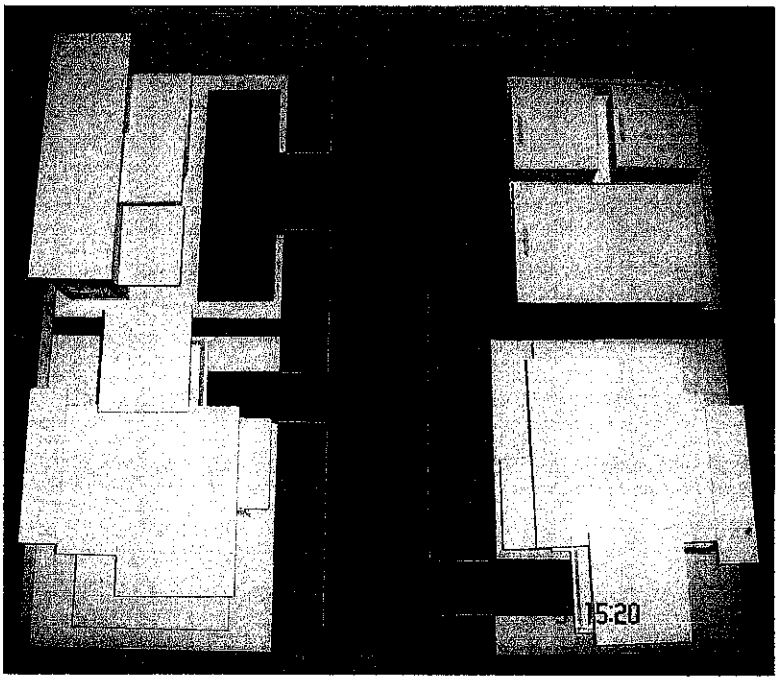


Figure 36 : Complete IBAS model (top view)

Figure 37 : Complete IBAS model (side view)

# APPENDIX K

# COST ANALYSIS

| NO | ITEM | SPECS | QTY | UNIT COST | TOTAL COST |
|---|---|---|---|---|---|
| 1. | RESISTOR | 1 KΩ, 0.33W,5% | 3 | RM 0.11 | RM0.33 |
| | | 100 KΩ, 0.33W,5% | 1 | RM 0.32 | RM 0.32 |
| | | 390 KΩ, 0.33W,5% | 3 | RM 0.32 | RM0.96 |
| 2. | CAPACITOR | 103 cement coated (0.01uF) | 1 | RM0.36 | RM0.36 |
| 3. | IR | 3.1mm LED transmitter | 1 | RM5.50 | RM5.50 |
| | | Receiver | 1 | RM6.00 | RM6.00 |
| 4. | SWITCH (PUSH BUTTON) | 4 PIN TACTILE (6x6x4.3mm) | 1 | RM1.56 | RM1.56 |
| | | Magnetic switch | 5 | RM2.00 | RM10.00 |
| 5. | TRANSISTOR | TIP 132 | 1 | RM3.02 | RM3.02 |
| | | PNP 9012 | 2 | RM2.50 | RM5.00 |
| 6. | DIODE | IN 4001 | 1 | RM0.60 | RM0.60 |
| 7. | RELAY | LE-12TW 10A, 12VDC | 1 | RM3.00 | RM3.00 |
| 8. | BUZZER | KB-26, 4mA, 3-28Vdc, 88dB | 1 | RM10.00 | RM10.00 |
| 9. | IC | Ne555 | 2 | RM15.00 | RM30.00 |
| 10. | BATTERY | 9v | 2 | RM 1.50 | RM3.00 |
| | | Battery Holder | 2 | RM0.60 | RM1.20 |
| **TOTAL COST** | | | | | **RM 80.53** |

Table 5 : Cost for circuit mode 1

| NO | ITEM | SPECS | QTY | UNIT COST | TOTAL COST |
|---|---|---|---|---|---|
| 11. | RESISTOR | 1 KΩ, 0.33W,5% | 1 | RM 0.11 | RM0.11 |
| | | 100 KΩ, 0.33W,5% | 1 | RM 0.32 | RM 0.32 |
| | | 390 KΩ, 0.33W,5% | 3 | RM 0.32 | RM0.96 |
| 12. | CAPACITOR | 103 cement coated (0.01uF) | 1 | RM0.36 | RM0.36 |
| 13. | IR | 3.1mm LED transmitter | 1 | RM5.50 | RM5.50 |
| | | Receiver | 5 | RM3.00 | RM15.00 |
| 14. | SWITCH (PUSH BUTTON) | 4 PIN TACTILE (6x6x4.3mm) | 2 | RM1.56 | RM3.12 |
| 15. | TRANSISTOR | PNP 9012 | 2 | RM2.50 | RM5.00 |
| 16. | RELAY | LE-12TW 10A, 12VDC | 1 | RM3.00 | RM3.00 |
| 17. | BUZZER | KB-26, 4mA, 3-28Vdc, 88dB | 1 | RM10.00 | RM10.00 |
| 18. | BATTERY | 9v | 2 | RM 1.50 | RM3.00 |
| | | Battery Holder | 2 | RM0.60 | RM1.20 |
| TOTAL COST | | | | | RM 47.57 |

Table 6 : Cost for circuit mode 2

| NO | ITEM | SPECS | QTY | UNIT COST | TOTAL COST |
|---|---|---|---|---|---|
| 1. | RESISTOR | 1 KΩ, 0.33W,5% | 1 | RM 0.11 | RM0.11 |
| | | 10 KΩ, 0.33W,5% | 2 | RM 0.11 | RM0.22 |
| 2. | REGULATOR | LM7805CT, 5V | 1 | RM3.47 | RM3.47 |
| 3. | LED | Bi-colour, 3mm | 2 | RM2.66 | RM2.66 |
| 4. | IC | LM264 | 1 | RM5.00 | RM5.00 |
| 5. | SWITCH | 4 PIN TACTILE (6x6x4.3mm) | 1 | RM1.56 | RM1.56 |
| TOTAL COST | | | | | RM 13.02 |

Table 7 : Cost for Battery Indicator circuit.

| NO | ITEM | SPECS | QTY | UNIT COST | TOTAL COST |
|---|---|---|---|---|---|
| 1. | RESISTOR | 1 KΩ, 0.33W,5% | 1 | RM 0.11 | RM0.11 |
| | | 10 KΩ, 0.33W,5% | 1 | RM 0.11 | RM 0.11 |
| 2. | CAPACITOR | 22 cement coated | 2 | RM0.36 | RM0.72 |
| 3. | CLOCK | 4MHz (32.768W) MEC (CRYSTAL) | 1 | RM6.44 | RM6.44 |
| 4. | REGULATOR | LM7805CT, 5V | 1 | RM3.47 | RM3.47 |
| 5. | LED | Bi-colour, 3mm | 2 | RM2.66 | RM2.66 |
| 6. | IC | PIC16F877/A | 1 | RM25.00 | RM25.00 |
| 7. | LCD | Dual line | 1 | RM15.00 | RM15.00 |
| 8. | KEYPAD | 4 x 4 | 3 | RM4.00 | RM12.00 |
| 9. | SWITCH | 4 PIN TACTILE (6x6x4.3mm) | 2 | RM1.56 | RM3.12 |
| 10. | FRICTION LOCK | 4 PIN- HEADER | 4 | RM1.85 | RM7.40 |
| 11. | RECEPTICLES | 3.96mm pitchKK Crimp Contacts | 4 | RM0.31 | RM1.24 |
| TOTAL COST | | | | | RM 77.27 |

Table 8 : Cost for Auto Dialer circuit.

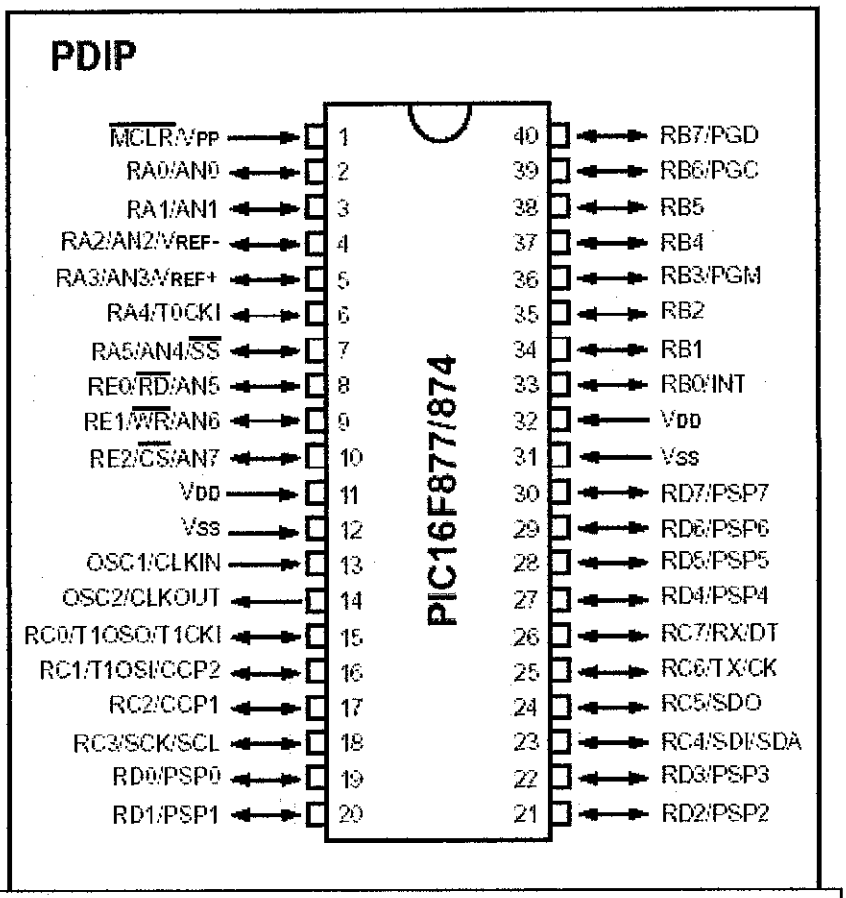
| NO | CIRCUIT | COST |
|---|---|---|
| 5. | MODE 1 | RM80.53 |
| 6. | MODE 2 | RM47.57 |
| 7. | AUTO DIALLER | RM77.27 |
| 8. | BATTERY INDICATOR | RM13.02 |
| **TOTAL COST** | | **RM218.39** |

Table 9 : Cost for the whole system

# APPENDIX L

# DATASHEET

PIC16F877/A




| | | |
|---|---|---|
| 1) | Vpp / MCLR | : pull-up resistor and 5V supply |
| 2) | Vdd | : 5V Supply |
| 3) | Vss | : Ground |
| 4) | SD | : data line |
| 5) | SCLK | : clock line |
| 6) | PA | : Port A – connected to KEYPAD |
| 7) | PB | : Port B – connected to LCD |
| 8) | PC | : Port C – connected to LED & BUZZER |

## INTERFACE PIN CONNECTIONS

| PIN NO. | SYMBOL | LEVEL | DESCRIPTION |
|---|---|---|---|
| 1 | $V_{SS}$ | 0V | Ground |
| 2 | $V_{DD}$ | 5.0V | Supply voltage for logic and LCD (+) |
| 3 | $V_O$ | --- | Operating voltage for LCD (variable) |
| 4 | RS | H/L | H : Data, L : Instruction code |
| 5 | R/W | H/L | H : Read (MPU ← Module), L : Write (MPU → Module) |
| 6 | E | H, H → L | Chip enable signal |
| 7 | DB0 | H/L | Data bit 0 |
| 8 | DB1 | H/L | Data bit 1 |
| 9 | DB2 | H/L | Data bit 2 |
| 10 | DB3 | H/L | Data bit 3 |
| 11 | DB4 | H/L | Data bit 4 |
| 12 | DB5 | H/L | Data bit 5 |
| 13 | DB6 | H/L | Data bit 6 |
| 14 | DB7 | H/L | Data bit 7 |
| 15 | BLK | 0V | Back-Light Cathode |
| 16 | BLA | 4.5V * | Back-Light Anode |

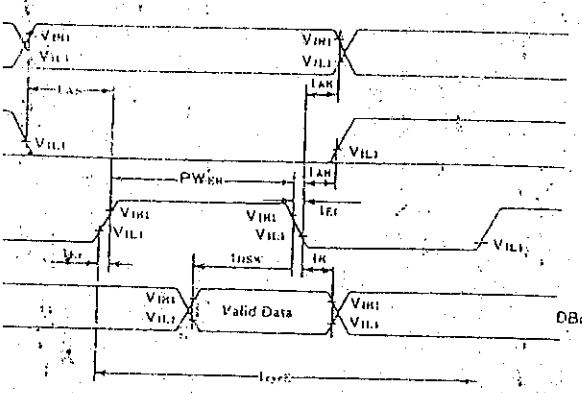
* For LED back-light.

## TIMING CHART

| Item | Symbol | Measuring Condition | Standard Value min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| iable Cycle Time | TcycE | Figs.1,2 | 1000 | — | — | ns |
| iable Pulse Width, High Level | PWEH | Figs.1,2 | 450 | — | — | ns |
| able Rise and Decay Time | tR,tF | Figs.1,2 | — | — | 25 | ns |
| ldress Setup Time,RS,R/W–E | tAS | Figs.1,2 | 140 | — | — | ns |
| ta Delay Time | tDDR | Fig.2 | — | — | 320 | ns |
| ta Setup Time | tDSW | Fig.1 | 95 | — | — | ns |
| | | | 10 | | | |
| ta Hold Time | tDHR | Fig.2 | 20 | — | — | ns |
| dress Hold Time | tAH | Figs.1,2 | 10 | — | — | ns |

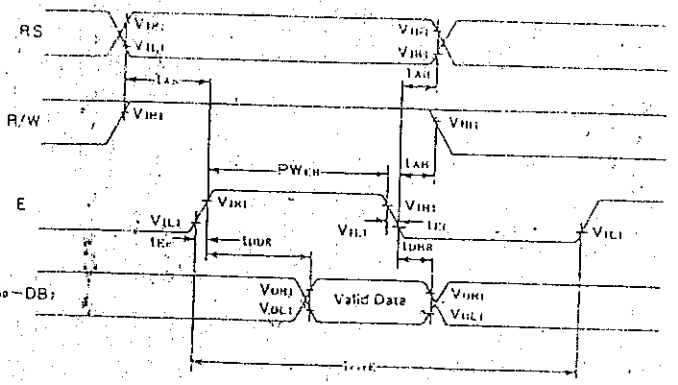
=5.0V ± 5%, Ta=25°C

### FIG. 1 WRITE OPERATION




ta from MPU to MODULE)

### FIG. 2 READ OPERATION




(Reading Data from MODULE to MPU)

## ASSIGNMENT

| Symbol | Level | Function | |
|---|---|---|---|
| Vss | — | Power Supply | 0V(GND) |
| Vcc | — | | +5V |
| Vee | — | | for Liquid Crystal Drive |
| RS | H/L | Register H:Data Input<br>Select L:Instruction Input | |
| R/W | H/L | H:Data Read (Module→MPU)<br>L:Data Write (Module←MPU) | |
| E | H/H←L | Enable Signal | |
| DB 4 | H/L | | |
| DB 5 | H/L | | |
| DB 6 | H/L | | |
| DB 7 | H/L | | |

■ In the data bus line, data transfer is performed two times by the 4-bit or one time by the 8-bit in order to interface with 4-bit or 8-bit MPU.

■ In case interface data length is 4-bit. The data is transferred by using only four buses of DB4~DB7 and the buses of DB0~DB3 are not used. The data transfer to MPU is completed by transferring the data of 4-bits twice. Transfer of upper four bits and low four bits is performed in sequence.

■ In case interface data length is 8-bit. Data transfer is performed by using eight buses of DB0~DB7.

## ICTION SET

| ON | CODE RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | DESCRIPTION | TYPICAL EXECUTION TIME |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ø | Ø | Ø | Ø | Ø | Ø | Ø | Ø | Ø | 1 | Clears display and returns the cursor to home position (Address Ø). Sets I/D=1 of Entry Mode. | 1.64 ms |
| | Ø | Ø | Ø | Ø | Ø | Ø | Ø | Ø | 1 | ● | Return the cursor to the home position (Address Ø). Also returns the display being shifted to the original position. DD RAM contents remain unchanged. Set DD RAM addresses to zero. | 1.64 ms |
| | Ø | Ø | Ø | Ø | Ø | Ø | Ø | 1 | I/D | S | Set the cursor move direction and specifies to shift the display. These operations are performed during data write and read of DD RAM/CG RAM. FOR NORMAL OPERATION, SET S TO Ø | 40 µs |
| ff | Ø | Ø | Ø | Ø | Ø | Ø | 1 | D | C | B | Sets ON/OFF all display (D), cursor ON/OFF (C), and blink of cursor position character (B). | 40 µs |
| | Ø | Ø | Ø | Ø | Ø | 1 | S/C | R/L | ● | ● | Moves the cursor and shifts the display without changing DD RAM contents. | 40 µs |
| | Ø | Ø | Ø | Ø | 1 | DL | N | F | ● | ● | Sets interface data length (DL) number of display lines (N) and character font (F). | 40 µs |
| | Ø | Ø | Ø | 1 | MSB | ACG | | | | LSB | Sets the CG RAM address. CG RAM data is sent and received after this setting. | 40 µs |
| | Ø | Ø | 1 | MSB | ADD | | | | | LSB | Sets the DD RAM address. DD RAM data is sent and received after this setting. | 40 µs |
| g | Ø | 1 | BF | MSB | AC | | | | | LSB | Reads Busy flag (BF) indicating internal operation is being performed and reads address counter contents. | 40 µs |
| | 1 | Ø | MSB | | | | | | | LSB | Writes data into DD RAM or CG RAM. | 40 µs |
| m | 1 | 1 | MSB | | | | | | | LSB | Reads data from DD RAM or CG RAM. | 40 µs |

S =1: Accompanies display shift when data is written. For normal operation, set to Ø
I/D=1: Increment
I/D=Ø: Decrement
S/C=1: Display shift
S/C=Ø: Cursor move
R/L=1: Shift to the right
R/L=Ø: Shift to the left
BF =1: Internally operating
BF =Ø: Can accept instruction

DL=1 : 8 bits
DL=Ø : 4 bits
N =1 : 2 (1) line
N =Ø : 1 line
F =1 : 5x10 dots
F =Ø : 5x7 dots

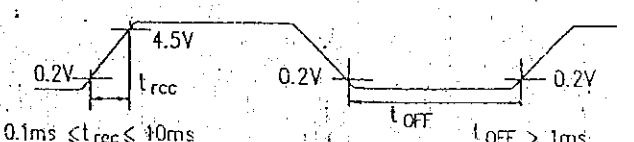
DD RAM : Display data RAM
CG RAM : Character generator RAM
ACG : CG RAM address
ADD : DD RAM address corresponds to cursor address
AC : Address counter used for both DD and CG RAM address
B : 1=ON Ø=OFF (Blinking cursor)
C : 1=ON Ø=OFF (Cursor)
D : 1=ON Ø=OFF (Display)

● Don't Care

## ZATION

automatically performed initialization when powered
ternal reset circuit). The following instructions are
ing initialization :—
PLAY
Flag is kept in the Busy State (BF=1) until
on ends. The time is 15 ms.
Set ——— DL= 1: 8-bits ing interface data
N = Ø : 1 Line display
ON/OFF CONTROL — D = Ø : Display OFF
C = Ø : Cursor OFF
B = Ø : Blink OFF
DE SET ——— I/D= 1 : +1(INCREMENT)
S = Ø : NO SHIFT
S SELECTED
Initialization depends on rise time of the supply when
ed on. The following time relationship must be satisfied.

| | SYMBOL | STANDARD TIME MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|




Power On Timing Diagram

NOTE
When the above power supply condition is not satisfied, the internal reset circuitry does not operate correctly. In this case, perform the needed initialization by sending function set instructions thrice from MPU after turning the power on. For example, to designate a 8-bits data length, send the following instructions thrice.

| RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|---|---|---|---|---|---|---|---|---|---|
| Ø | Ø | Ø | Ø | 1 | 1 | ● | ● | ● | ● |
| Ø | Ø | Ø | Ø | 1 | 1 | ● | ● | ● | ● |
| Ø | Ø | Ø | Ø | 1 | 1 | ● | ● | ● | ● |

When this ends, the module enters 8-bits data length mode without

## DISPLAY CHARACTER POSITION AND DD RAM ADDRESS (CONTINUE

### 16 DMM, 1/16 MUX

N=1 : 2-LINE DISPLAY  F=0 : 5X7 DOTS

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FIRST LINE | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | ← DD RAM ADDRESS |
| SECOND LINE | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F | |

← DISPLAY POSITION

WHEN THE DISPLAY SHIFT OPERATION IS PERFOMED, THE DD RAM ADDRESS MOVED AS FOLLOW :

AFTER THE LEFT SHIFT INSTRUCTION

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [illegible] | | | | | | | | | | | | | | | | ← DD RAM ADDRESS |
| | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F | 50 | |

← DISPLAY POSITION

AFTER THE RIGHT SHIFT INSTRUCTION

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 27 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | ← DD RAM ADDRESS |
| | 67 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | |

← DISPLAY POSITION

### 20 DMM, 1/16 MUX

N=1 : 2-LINE DISPLAY  F=0 : 5X7 DOTS

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FIRST LINE | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | 10 | 11 | 12 | 13 | ← DD RAM ADDRESS |
| SECOND LINE | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F | 50 | 51 | 52 | 53 | |

← DISPLAY POSITION

### 24 DMM, 1/16 MUX

N=1 : 2-LINE DISPLAY  F=0 : 5X7 DOTS

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IRST NE | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | ← DD RAM ADDRESS |
| ECOND NE | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | |

← DISPLAY POSITION

### 1 DMM, 1/16 MUX

N=1 : 2-LINE DISPLAY  F=0 : 5X7 DOTS

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ST E | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | ← DD RAM ADDRESS |
| COND E | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | |

← DISPLAY POSITION

### DMM, 1/16 MUX

N=1 : 2-LINE DISPLAY  F=0 : 5X7 DOTS

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FIRST LINE | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | ← DD RAM ADDRESS |
| SECOND LINE | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F | |
| THIRD LINE | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 1A | 1B | 1C | 1D | 1E | 1F | |
| FOURTH LINE | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 5A | 5B | 5C | 5D | 5E | 5F | |

← DISPLAY POSITION

### DMM, 1/16 MUX

N=1 : 2-LINE DISPLAY  F=0 : 5X7 DOTS

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LINE | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | 10 | 11 | 12 | 13 | ← DD RAM ADDRESS |
| ND LINE | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F | 50 | 51 | 52 | 53 | |
| D LINE | 14 | 15 | 16 | 17 | 18 | 19 | 1A | 1B | 1C | 1D | 1E | 1F | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | |

← DISPLAY POSITION

# APPENDIX M
# PROCEDURES OF IBAS

**Procedure Identification**

IBAS has four main project works;

- Research
- Prototype design and fabrication
- Experiments / Testing
- Troubleshooting / Modification

For the project milestone, refer to Appendix A.

**Research**

Research is necessary in every project as it name indicates. For this project, the topics highlighted are about the existing burglar alarm system for home, its configuration and how it works, type police response towards alarm system, transmission technology available, systems' limitations and how IBAS is going to enhance the performance of the burglar alarm system. The books, papers or journals and also market survey are also sources of research study in order to widen the knowledge and ideas on the project. From research, the types of sensor and transmission technology that could be used for the system is listed in the Literature Review section.

**System design and experiment**

System design is done after knowing the required enhancement from research activity. In designing a system, the algorithm and layout are very important as the guideline. The hardware and software prototype design will follow the requirement in the algorithm and layout. Then the experiment will be done according to the scheduled time line and is done by following the sequences as stated in page 61:

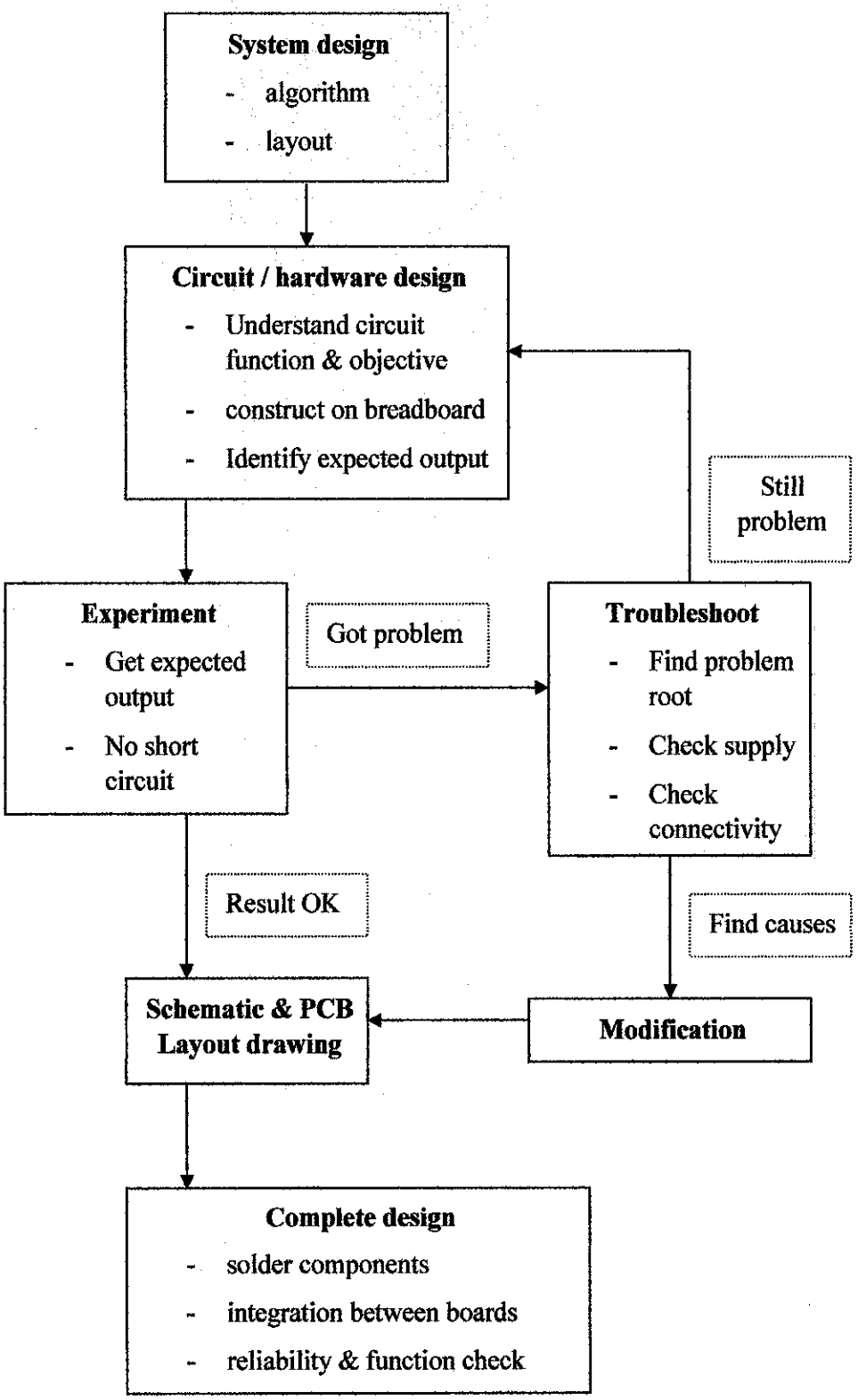



Figure 38 : Experiment sequences.

**Tools and Equipments**

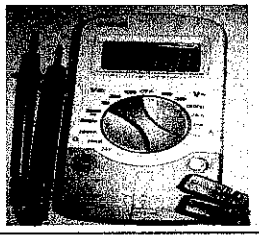
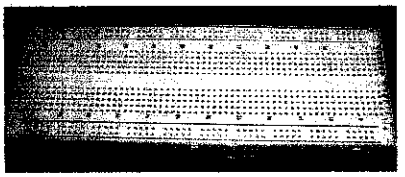
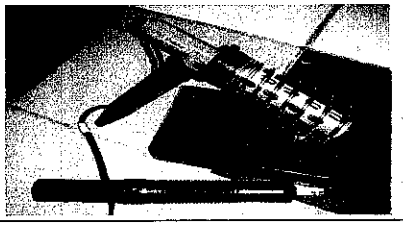
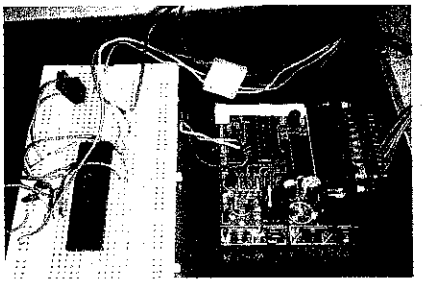
| Equipment | Picture | Description |
|---|---|---|
| DC Power Supply / 9V battery |   | Act as input power supply for the circuit |
| Multimeter |  | To measure voltage / output and check connectivity |
| Breadboard |  | To test the circuit before soldering it |
| Soldering iron & lead |  | To solder components on PCB boards |
| Long nose & cutter |  | To hold components & to cut excessive part of them |
| PIC compiler / burner |  | To compile / burn program into microcontroller (PIC16F877/A) |

Table 10 : Experimental equipments

**Software**

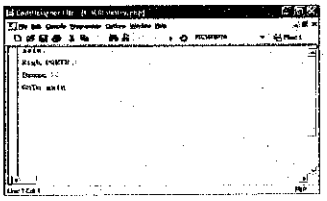
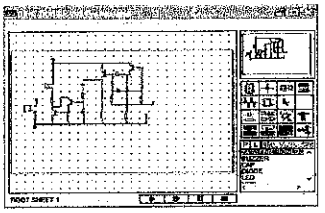
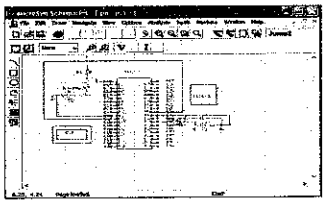
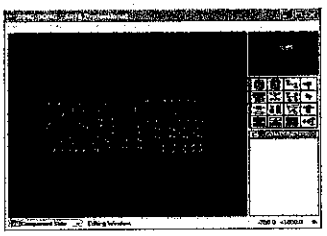
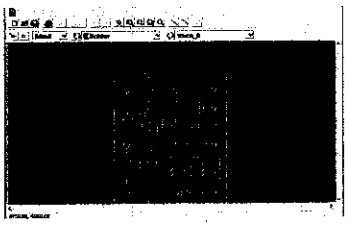
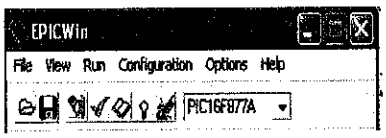
| Software | Picture | Description |
|---|---|---|
| CD Lite |  | As the compiler for PIC Basic Pro programming language. |
| PROTEUS (ISIS) |  | To draw the circuit's schematic diagram. |
| PSPICE |  | To draw the circuit's schematic diagram. |
| PROTEUS (ARES) |  | To draw the circuit's PCB layout diagram. |
| GC Cam Powerstation |  | To draw the circuit's PCB layout diagram. |
| EPIC Win |  | As interface between computer and PIC burner. |

Table 11 : List of softwares