

**GRAPHICAL USER INTERFACE DEVELOPMENT FOR ENERGY  
SAVING AIR-CONDITIONING CONTROL SYSTEM**

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requirements for the award of the degree of  
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## **ABSTRACT**

Graphical User Interface development for energy saving air-conditioning control system means we can control the air-conditioning system by using software to reduce electricity cost. The air-conditioning system use a lot of electricity compares to other appliances and this was proved by research. We all know user sometimes did not turn off the air-conditioning either they forgot or not before leaving the room. My developed air-conditioning control software makes things easier. User can turn on or turn off the air-conditioning system by clicking one button and they also can set the time for the air-conditioning to automatically off. User can reduce their electricity bill by reduce the air-conditioning usage. This software can control up to six air-conditioning. User can control the air-conditioning by using their laptop or personal computer (PC). This software is very user friendly. The software been connected to the air-conditioning system by a circuit consist PIC 16F84 and RS232 communication module. The circuit connected to the PC using serial communication port (comm1).

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Introduction**

Nowadays the electricity is one of the most important elements in our life. What will happen if suddenly there is no more electricity supply for our daily life? Most people will lose their job and will not know what to do. Without we realize it, people used electricity everyday but they do not realize that we must pay for the electricity. Most people do not know that sometimes they wasting the electricity and must pay extra money for their own ignorance. People do not realize that by do not turn off the electrical appliance for a minute it cost them extra money.

Energy consumption for room air-conditioning and lighting system accounts for about 60% of the total energy used in the building equipment area. Energy wasting occurrences in the campus are significant, especially in the air-conditioning and lighting system. Hence, there is a need for better control strategies associated with the air-conditioning and lighting system to reduce energy wasting and energy consumption. [9]

## **1.2 Problem Statement**

Electricity is very important in nowadays life. So electricity must be used smartly and efficiently. Currently, UMP has not applied energy efficiency in its buildings and the result is electricity been wastes, especially in the air-conditioning system.

We all know user sometimes did not turn off the air-conditioning either they forgot or not before leaving the room. My developed air-conditioning control software makes things easier. User can turn on or turn off the air-conditioning system by clicking one button and they also can set the time for the air-conditioning to automatically off. User can reduce their electricity bill by reduce the air-conditioning usage. This software can control up to six air-conditioning. User can control the air-conditioning by using their laptop or personal computer (PC)

## **1.3 Project Objectives**

The objectives of this project are to:

- i. To develop Graphical User Interface (GUI) for an air-conditioning control system to optimize energy saving;
- ii. To build a working prototype of an air-conditioning control system using GUI.

## 1.4 Scope of Project

This project aims to develop a **Graphical User Interface** of an air-conditioning control system for **energy saving application**. Microcontroller will be the heart of the system and it will communicate with Graphical User Interface using RS 232 communication module. The main target of this project is **to switch off the air conditioning system at pre-designated time** using graphical user interface (if no people inside the area). The scopes of the project are:

- i. Software development on microcontroller and GUI using Visual Basic (VB).
- ii. Hardware design for the complete control air conditioning system circuit.
- iii. Complete circuit of the control system will be tested in UMP laboratory.

## 1.5 Thesis Outline

### I. Chapter 1 (Introduction):

- a. In this chapter discussed about why this project been developed.
- b. The problem statement discussed about the problem been faced by user that cause this project has to be develop.
- c. The project objective and the project scope discussed about the project target at the end of the developing.

### II. Chapter 2 (Literature Review)

- a. In the literature review part discussed about prove of energy wasting in air-conditioning system, Visual Basic 6.0, Graphical User Interface (GUI) and circuit example.

### III. Chapter 3 (Methodology)

- a. In this chapter review all the method been used while developed this project.
- b. This chapter include flowchart, block diagram, circuit diagram and software descriptions.

### IV. Chapter 4 (Result and Analysis)

- a. In this chapter review all the project result and analysis of this developed project.

### V. Chapter 5 (Conclusion and Recommendation)

- a. In this chapter conclude all about this project with feature recommendation.
- b. This chapter also offers the cost and potential commercialization of this project.

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## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction.**

Approximately half of the energy consumption in a building is due to the air-conditioning in trying to achieve a comfortable and conducive work environment. Clearly, a major energy saving can be obtained if the air conditioning systems can be made more energy efficient through better control. This has been proven to be true as in the case of Malaysia's Security Commission Building, Sultan Zanariah Library U.T.M, Takeuchi MDF Sdn. Bhd. and Universiti Kebangsaan Malaysia. [8]

### **2.1.1 Home air conditioning systems around the world**

Resident in Japan, South Korea, Taiwan, Singapore and Hong Kong use a large amount unit of air conditioning especially for people that live in small high-rise flats in warm climates. In this area, with soaring summer temperatures and a high standard of living, air conditioning is considered a necessity and not a luxury. Air conditioners are usually window or split types, the latter being more modern and expensive. It is also increasing in popularity with the change of lifestyle in other tropical Asian nations such as India, Indonesia, Malaysia, and the Philippines.

In North America, home air conditioning is more prevalent in the South, Midwest, East Coast, the Great Lakes States and South-Eastern Canada, (Southern Ontario, and Southern Quebec), in most parts of which it has reached the ubiquity it enjoys in East Asia. Central air systems are most common in the United States, and are virtually standard in all new dwellings in most states. Older houses and buildings not retro-fitted with central air often still use window or through-wall units.

In most parts of Australia, central evaporative coolers were a popular choice, as Australia's dry climate makes this form of air conditioning very effective and economical. However, in recent times low cost reverse cycle units have led to an increase in their use, creating extreme load factor issues for the National Electricity Market (NEM) in wide heat wave conditions.

In Europe, home air conditioning is less common in part due to a more clement northern climate. Although in the southern European countries with a high standard of living, like Spain and Italy, air conditioning is becoming a necessity. Still, the lack of air conditioning in homes, in residential care homes, and in medical facilities was identified as a contributing factor to the estimated 35,000 deaths left in the wake of the 2003 heat wave. There were almost 15,000 deaths in France and 2,000 in the UK; in contrast, only 141 died in Spain despite the higher temperatures, in part due to the extensive use of air conditioning. Due to the 2003 and the 2006 heat waves, portable air conditioners have become more popular in France. [6]



## 2.2 Case Study: Power Utilization In Dewan Kuliah 13 UMP

The case study of power utilization in Dewan Kuliah 13 UMP can be seen in Table 2.1. [8]

**Table 2.1: Power Utilization In Dewan Kuliah 13 UMP**

Date	Time	Meter (kWh)	Air-Cond.					
			Unit 1		Unit 2		Unit 3	
			ON	OFF	ON	OFF	ON	OFF
7/8/2006	7:45	736		x		x		x
	13:56	763		x		x		x
	17:30	785		x		x		x
8/8/2006	7:50	785		x		x		x
	13:45	810		x		x		x
	17:55	821		x	x		x	
9/8/2006	7:40	831		x		x		x
	13:01	861	x			x		x
	17:30	877	x		x		x	
10/8/2006	7:00	none						
	13:09	943	x		x		x	
	17:30	960		x		x		x
11/8/2006	8:30	980	x		x		x	
	13:00	none						
	18:00	991		x		x		x
14/8/2006	8:15	991		x		x		x
	13:00	none						
	18:21	1024	x		x		x	
15/8/2006	7:57	1040	x		x		x	
	13:00	none						
	18:00	1079.6		x		x		x
16/8/2006	7:55	1094		x		x		x
	13:45	1125	x		x		x	

17/8/2006	17:48	1151.5	x		x		x	
	7:50	1173		x		x		x
	13:00	none						
18/8/2006	18:15	1217.8		x		x		x
	7:50	1217.8		x		x		x
	13:00	none						
21/8/2006	18:00	none						
	7:50	1318.5	x		x		x	
	13:00	none						
22/8/2006	17:15	1372	x		x		x	
	7:50	1374.5	x		x		x	
	13:00	none						
23/8/2006	17:52	1430		x		x		x
	7:50	1430.5		x		x		x
	13:00	none						
24/8/2006	17:40	1463.5		x		x		x
	8:50	1476.5	x		x		x	
	13:00	none						
25/8/2006	17:30	1523.3		x		x		x
	7:55	1532.1		x		x		x
	13:00	none						
28/8/2006	18:00	none						
	8:30	1653	x		x		x	
	13:00	none						
29/8/2006	18:20	1711	x		x		x	
	7:55	1722	x		x		x	
	13:00	none						
30/8/2006	18:00	none						
	7:50	1773		x		x		x

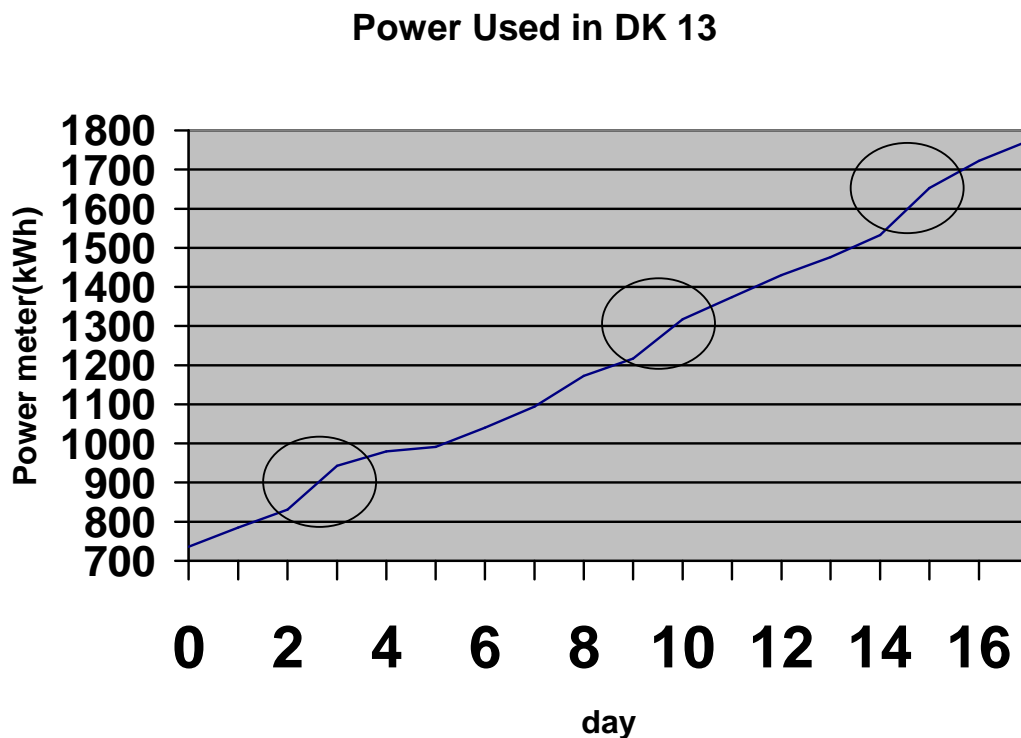
Calculation:

$$\text{Tariff} = (1773 - 736 \text{ kWh}) * 29.00 \text{ sen/kWh}$$

$$\text{Tariff} = 30073 \text{ sen}$$

$$\text{RM } 300.73 \quad (\text{Tariff D - Low voltage industrial Tariff})$$

Source: <http://www2.tnb.com.my/tariff/index.htm>. Accessed on 26th September 2006



**Figure 2.1** Graph for Power Used In DK 13

This graph is develop from the data from case study on power utilization in DK 13 by Prof. Sh. Nasir bin Sh. Ab Rahman, Mohd Syawal bin Jadin, Mrs. Norhafidzah binti Mohd Saad, Abdul Halim bin Mohd Hanafi and Abdul Latip bin Hj Dris (UMP FKEE staffs)

This graph show that the increases of the electrical power used in DK 13 in the graph there are some point that the gradient increase drastically. There is the point where the electrical been waste.

### 2.3.1 Visual Basic 6.0 (VB 6.0)

#### History

Microsoft released Visual Basic in 1987. It was the first visual development tool from Microsoft, and it was to compete with C, C++, Pascal and other well-known programming languages. From the start, Visual Basic wasn't a hit. It wasn't until release 2.0 in 1991 that people really discovered the potential of the language, and with release 3.0 it had become the fastest-growing programming language on the market. [1]

Programmers have undergone a major change in many years of programming various machines. For example what could be created in minutes with Visual Basic could take days in other languages such: as "C" or "Pascal". Visual Basic provides many interesting sets of tools to aid you in building exciting applications. Visual Basic provides these tools to make your life far easier because all the real hard code is already written for you. [1]

Even though people tend to say Visual Basic's compiler is far behind the compilers of Pascal and C, it has earned itself the status of a professional programming language, and has almost freed BASIC of the reputation of a children's language. Overall you would class Visual Basic as a Graphics User Interface(GUI). Because as you draw, you write for the program. This must always be remembered in any kind of creation of a Visual Basic program. All in all, VB is the preferred language of many future program mers. If you want to start programming Windows, and don't know how to start, give Visual Basic a shot. [2]

Visual basic is an event driven programming language and associated development environment from Microsoft for its COM programming model. VB has been replaced by Visual Basic .NET. The older version of VB was derived heavily from BASIC and enables the rapid application development (RAD) of graphical user interface (GUI) applications, access to databases using DAO, RDO, or ADO, and creation of ActiveX controls and objects. [2]

The three main things that we wish to accomplish through the use of Visual Basic are: [2]

1. Execute and perform the tasks correctly as per our objectives.
2. Create a user friendly GUI that allows any person with little technical knowledge to successfully use our application.

## **2.4 Graphical User Interface (GUI)**

A GUI (usually pronounced GOO-ee) is a graphical (rather than purely textual) user interface to a computer. As you read this, you are looking at the GUI or graphical user interface of your particular Web browser. The term came into existence because the first interactive user interfaces to computers were not graphical; they were text-and-keyboard oriented and usually consisted of commands you had to remember and computer responses that were infamously brief. The command interface of the DOS operating system (which you can still get to from your Windows operating system) is an example of the typical user-computer interface before GUIs arrived. An intermediate step in user interfaces between the command line interface and the GUI was the non-graphical *menu-based interface*, which let you interact by using a mouse rather than by having to type in keyboard commands. [3]

The precursor to GUIs was invented by researchers at the Stanford Research Institute led by Doug Engelbart. They developed use of text-based hyperlinks manipulated with a mouse for the On-Line System. The concept of hyperlinks was further refined and extended to graphics by researchers at Xerox PARC, who went beyond text-based hyperlinks and used GUIs as the primary interface for the Xerox Alto computer. Most modern general-purpose GUIs are derived from this system. For this reason some people call this class of interface a PARC User Interface (PUI) (note that PUI is also an acronym for perceptual user interface). [3]

The GUIs familiar to most people today are the Macintosh, the X Window System, or Windows interfaces. Their applications originated at the Xerox PARC (Palo Alto Research Center) in the late 1970s and was copied by Apple who used it in their first Macintosh computers. Later IBM and Microsoft borrowed many of Apple's ideas to develop the Common User Access specifications, which formed the basis of the user interface found in Microsoft Windows, IBM OS/2 Presentation Manager, and the Unix Motif toolkit and window manager. These ideas evolved to create the interface found in current versions of the Windows operating system. Thus most current graphical user interfaces have largely common idioms. [3]

Today's major operating systems provide a graphical user interface. Applications typically use the elements of the GUI that come with the operating system and add their own graphical user interface elements and ideas. A GUI sometimes uses one or more metaphors for objects familiar in real life, such as the desktop, the view through a window, or the physical layout in a building. Elements of a GUI include such things as: windows, pull-down menus, buttons, scroll bars, iconic images, wizards, the mouse, and no doubt many things that haven't been invented yet. With the increasing use of multimedia as part of the GUI, sound, voice, motion video, and virtual reality interfaces seem likely to become part of the GUI for many applications. [3]

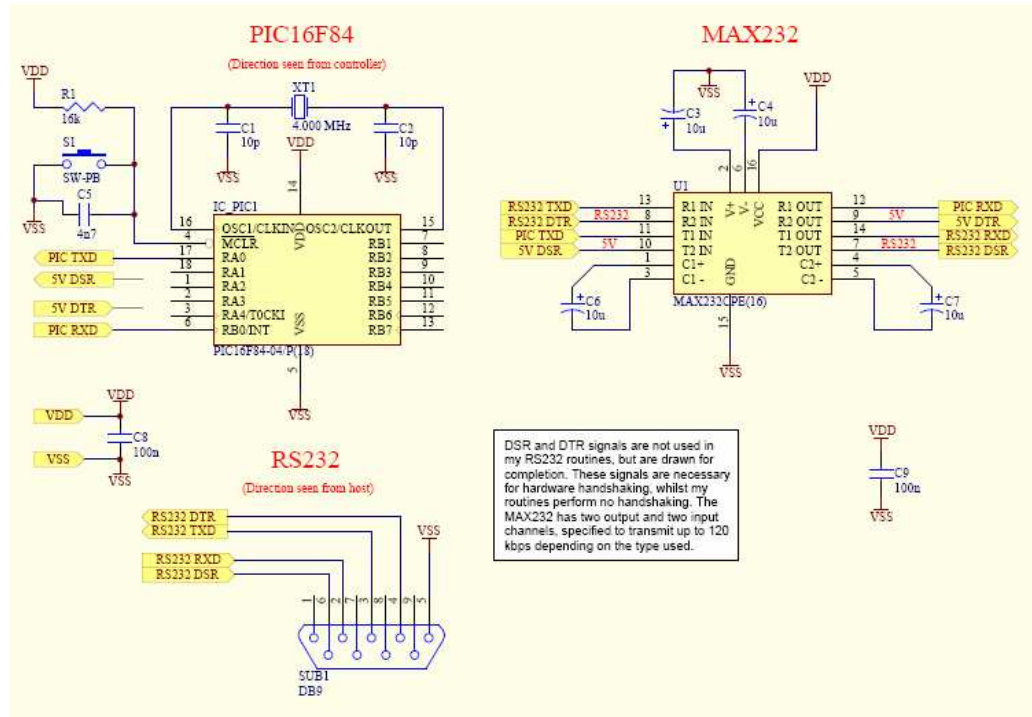
The GUI familiar to most of us today in either the Mac or the Windows operating systems and their applications originated at the Xerox Palo Alto Research Laboratory in the late 1970s. Apple used it in their first Macintosh computers. Later, Microsoft used many of the same ideas in their first version of the Windows operating system for IBM-compatible PCs. [3]

When creating an application, many object-oriented tools exist that facilitate writing a graphical user interface. Each GUI element is defined as a class widget from which you can create object instances for your application. You can code or modify prepackaged methods that an object will use to respond to user stimuli. [3]

GUI represents a graphical user interface that acts as a front end to various programming function and procedures. Most GUIs consist of windows containing buttons, labels, text boxes, images, menus, and other controls. [3]

A GUI is a graphical (rather than purely textual) user interface to a computer. The term came into existence because the first interactive user interfaces to computers were not graphical; they were text-and-keyboard oriented and usually consisted of commands you had to remember and computer responses that were infamously brief. The command interface of the DOS operating system is an example of the typical user-computer interface before GUIs arrived. An intermediate step in user interfaces between the command line interface and the GUI was the non-graphical *menu-based interface*, which let you interact by using a mouse rather than by having to type in keyboard commands. [3]

## 2.5 Example circuit for PIC-RS232 Interface using MAX232



**Figure 2.2** Circuit for PIC-RS232 Interface using MAX232

Figure 2.2 shows the connection of the circuit for PIC-RS232 Interface using MAX232. This figure will help us to design the hardware of this project.

## 2.6 Conclusion

As conclusion, this chapter defines the literature review for this project. The literature reviews about prove energy wasting in air-conditioning system, Visual Basic 6.0, Graphical User Interface (GUI) and circuit example.



## CHAPTER 3

### METHODOLOGY

#### 3.1 Introduction

Methodologies is one of the most important element to be consider to make sure that the development of the project is smooth and get the expected result. The methodology for this project is divided into five phase:

Phase I : Literature review

- i. Surfing internet
- ii. Books and writing materials
- iii. Discussion with supervisor and lecturers

Phase II : Software specification

- based on literature review and discussion with supervisor.

Phase III : Design and develop GUI.

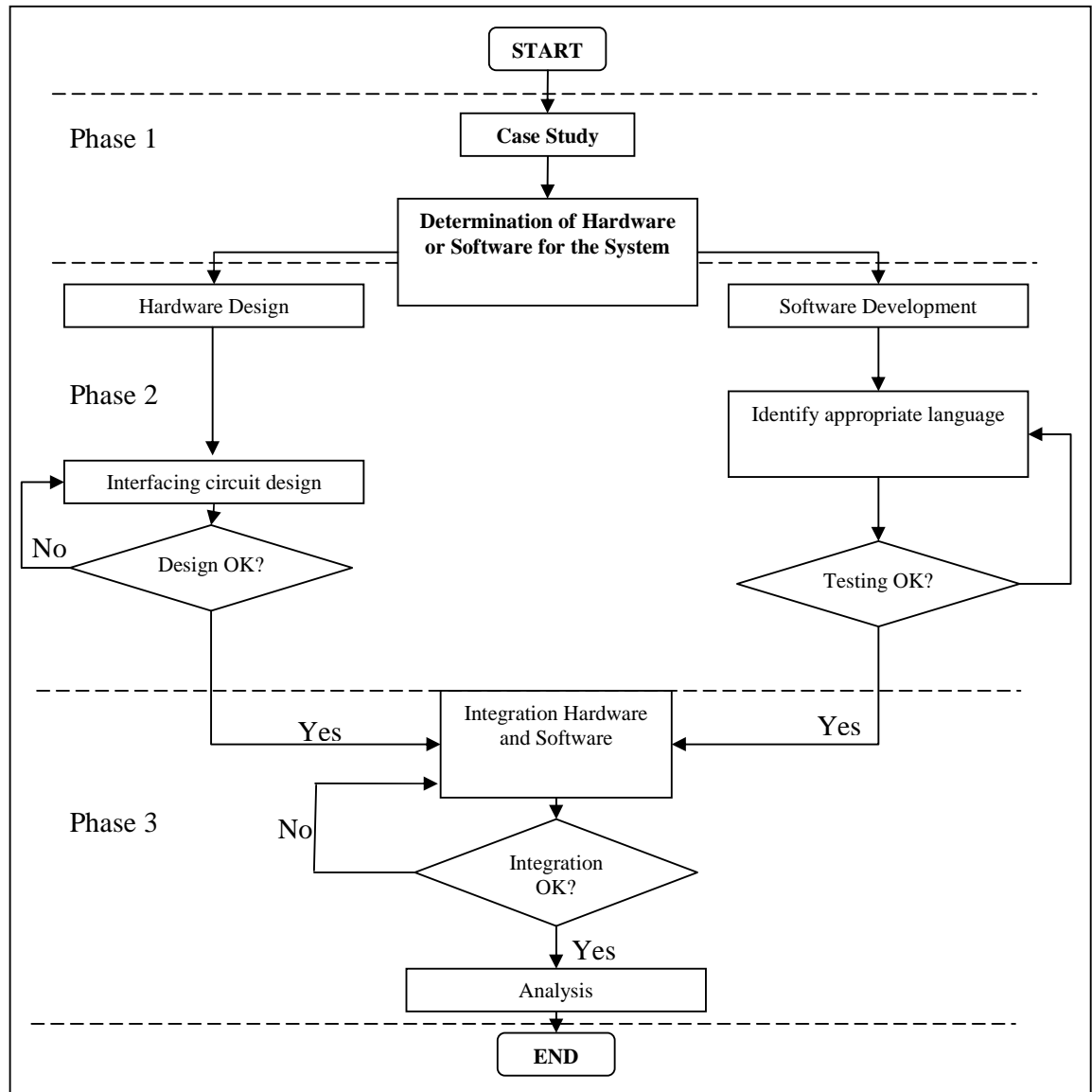
- i. Learn how to use Visual Basic as selected program to develop GUI.
- ii. Design the draft of the GUI and its flow chart.
- iii. Starts develop GUI.

Phase IV : Integrate both systems and test whether the system archive the goal or not.

Phase V : Result Analysis

- i. Data collection
- ii. Data analysis

Figure 3.1 shows the flow chart of methodology for this project.



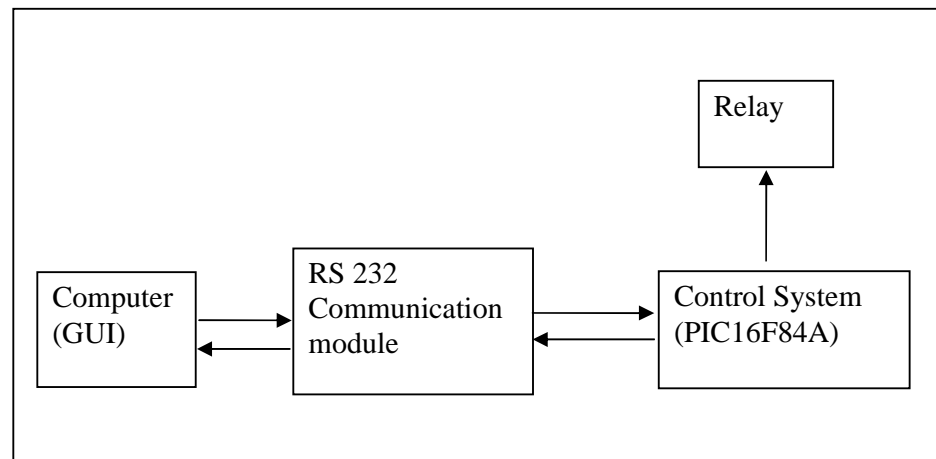
**Figure 3.1** Flow of Development

## 3.2 System Design

### 3.2.1 Hardware Development

#### 3.2.1.1 Block Diagram for Hardware.

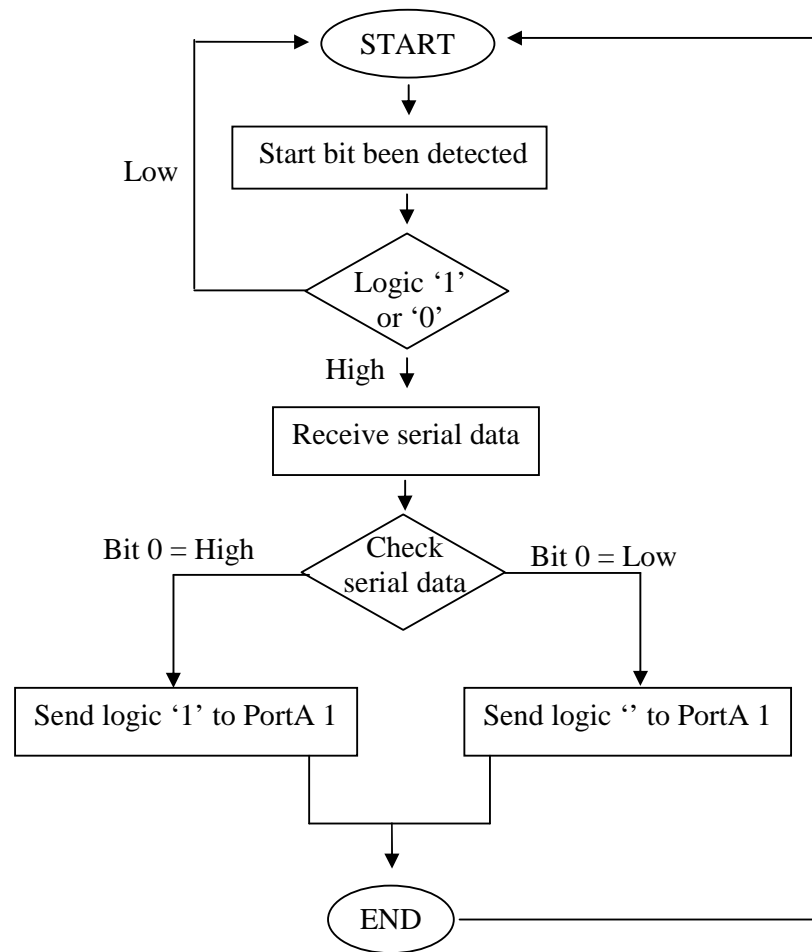
The hardware been connected to computer by using RS 232 Communication module. Relay is connected to the testing device that replaces air conditioner function. The block diagram for the hardware is shown in Figure 3.2.



**Figure 3.2** Block Diagram for Hardware

#### 3.2.1.2 Flow Chart for Hardware.

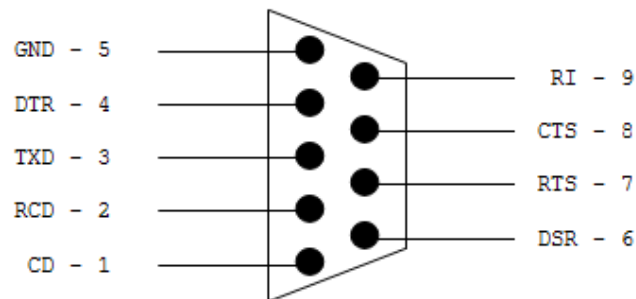
The data that been send from DB9 connector will be send to Port B 1. The PIC will scan for start bit. When the start bit been detected, PIC will receive serial data from Port B 1. Then the PIC will scan for bit 0 of the transferred data. If bit 0 is high, PIC will send logic '1' to Port A 1. If bit 0 is low, PIC will send logic '0' to Port A 1. The flowchart for the program in the PIC is shown in Figure 3.3. The coding in the PIC is shown in appendix C.



**Figure 3.3** Flowchart for program in PIC

### 3.2.2 Pins and Names for Serial Port (Comm1)

Figure 3.4 shows the pin connections (pin outs) of a 9-way serial port. Each pin has a two of three letter mnemonic as follows:



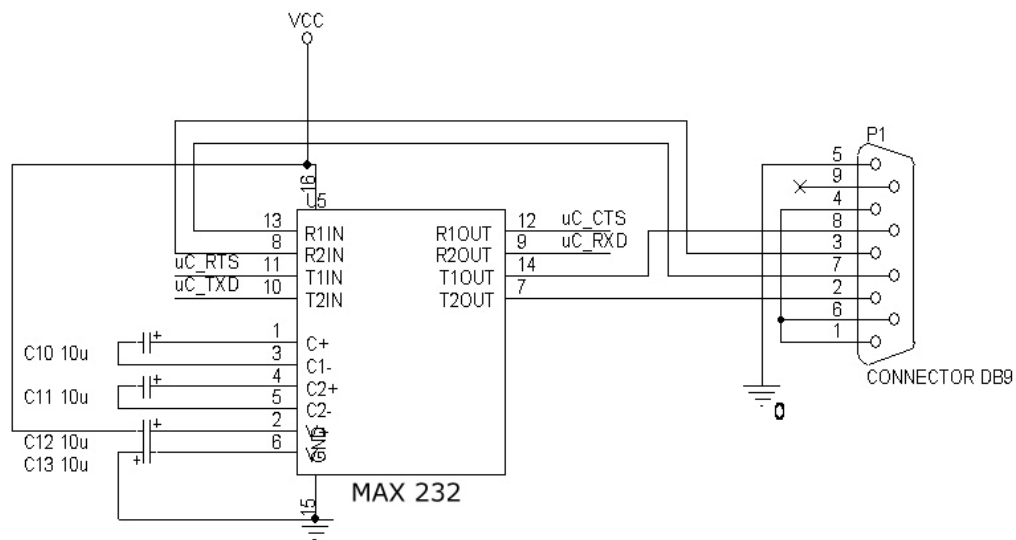
**Figure 3.4** Pin Connections

Pin #	Mnemonic	Full name
1	CD	Carrier Detect
2	RCD	Receive Data
3	TXD	Transmit Data
4	DTR	Data Terminal Ready
5	GND	Ground
6	DSR	Data Set Ready
7	RTS	Request To Send
8	CTS	Clear To Send
9	RI	Ring Indicator

**Table 3.1** Pin Names and Number

### 3.2.3 Circuit For RS-232 Communication Module

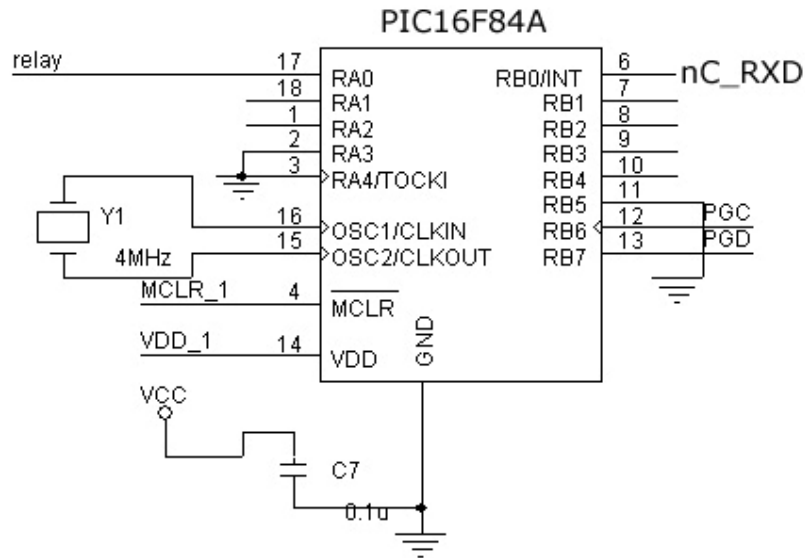
The RS-232 communication module is used to communicate the PIC 16F84A circuit with serial port (Comm1). MAX232 act as a latch. Pin 7 DB9 been connected to pin 13 MAX 232 (R1 IN). Pin3 DB9 been connected to pin 8 MAX 232 (R2 IN). The circuit for RS-232 communication module is shown in Figure 3.5



**Figure 3.5** The Circuit For RS-232 Communication Module

### 3.2.4 Circuit For PIC16F84

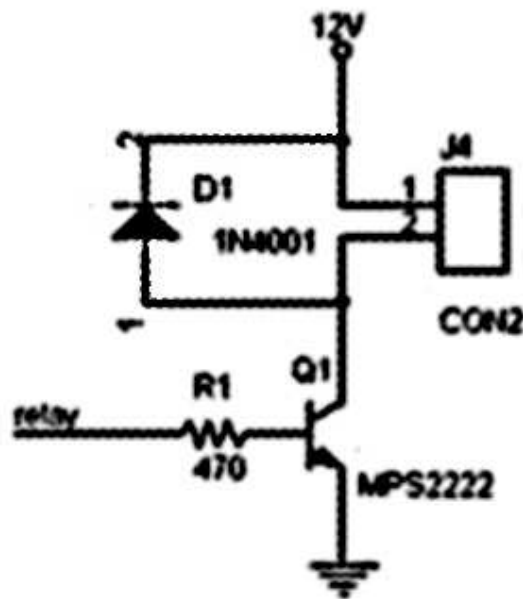
Pin 14 and 4 (MCLR and VDD) must be connected to +5V to enable the PIC. In this circuit, the PIC use 4 MHz crystal clock as oscillator. Pin 17 (Port A 0) been connected to relay circuit. Pin 6 (Port B 0) been connected to RS-232 communication module circuit. The datasheet for PIC16F84A is in the appendix. The circuit for PIC16F84 is shown in Figure 3.6.



**Figure 3.6** The Circuit for PIC16F84

### 3.2.5 Circuit For Relay Interface

This circuit is used to connect the 12 V relay to Port A 0. MPS222 transistor used to connect 12 V voltage input to the relay that been connected to connector labeled CON2 when Port A 0 give logic '1' output. This circuit is important to make sure 12 V voltage did not go to PIC to avoid IC damage. The relay interface circuit is shown in Figure 3.7.

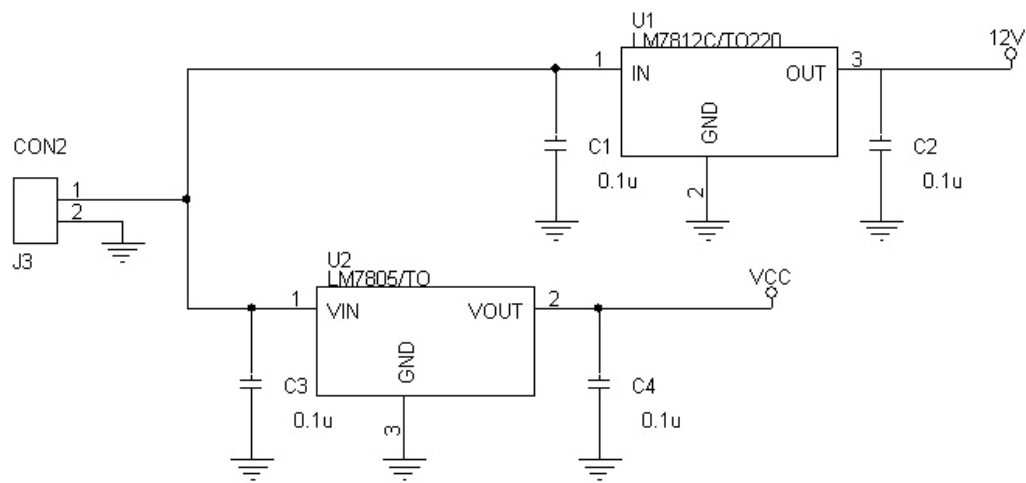


**Figure 3.7** The Relay Interface Circuit



### 3.2.6 Power Supply Interface Circuit

This circuit is used to produce two values of voltage, 12 V and 5 V. The 5 V voltage is for all the ICs power supply and the 12 V is for the relay interface circuit. The voltage input for this circuit must be bigger than 12 V but cannot be bigger than 30 V. The higher voltage will damage the circuit. The power supply interface circuit is shown in Figure 3.8.



**Figure 3.8** The Power Supply Interface Circuit

### **3.2.7 Analysis for Constructing the Circuit.**

While constructing the circuit, make sure the connection for the DB9 is correct. Then all connection from RS-232 communication module circuit to PIC 16F84A circuit must be check. The connection can be check using multimeter.

The circuit for the hardware must be understood before writing the coding for the PIC. Must make sure which pin can be use as the output and input. All connection to enable the ICs must be check to make sure it been correctly connect.

The input and output for the PIC ca be set by using the coding for the PIC. After all the connection has been check, coding for the application can be write. PIC 16F84A did not have serial port register, so the coding for receive the serial data from serial port (Comm 1) must be develop. The coding for the PIC can be write base on flowchart that is shown in Figure 3.3.

After all coding for our application been finished, we can test the system.