

**ENERGY SAVING CONTROL SYSTEM APPLICATION  
IN LECTURE HALL**

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IN LECTURE HALL**

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**ENERGY SAVING CONTROL SYSTEM APPLICATION IN LECTURE  
HALL**

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**This thesis is submitted as partial fulfillment of the requirement  
for the award of the  
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**NOVEMBER, 2008**

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*To My Beloved Father and Mother & All My Family*

*Roslan Saad*

*Embun Ahmad*

*Nurul Liyana Roslan*

*Nurul Shafika Roslan*

*Iman Shahira Roslan*

*And To All My Friends*

*Thanks For Everything*

*BEP still in memories...*



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## ABSTRACT

Energy Saving Control System is created to reduce the power consumptions in University Malaysia Pahang (UMP). This system is designed to control the lighting system and air-conditioner. The quantity and the consumed of the lighting system and air conditioner can cause a lot of electrical energy wasted everyday. We all know sometimes lecturers or students forget to switch off the lighting system and air-conditioner before leaving the room. This system can control 8 units of lightning system and 6 unit of air conditioner.

This project uses the Passive Infrared Sensor (PIR sensor) to detect the body heat and the movements of humans. The PIR sensor will give signal to hardware. The hardware of this project is PIC18F4620 and RS232 communication module to interface with Visual Basic (VB). When PIC get signal from the sensor, so lighting system and air-conditioner will turn OFF automatically after a delay time off 10 minutes. Within 10 minutes time frames, if the sensor detects human movement or heat in the area, the control system will reset its program not turn OFF the lighting system or air-conditioner system.



## ABSTRAK

Project Sistem Kawalan Penjimatan Elektrik di bina adalah untuk mengurangkan kadar penggunaan tenaga elektrik di University Malaysia Pahang (UMP). Projek ini di bina untuk mengawal system pencahayaan dan juga penghawa dingin. Kadar bilangan dan penggunaan sistem lampu dan penghawa dingin yang tinggi boleh menyebabkan banyak pembaziran tenaga elektrik setiap hari. Seperti diketahui ramai, pensyarah atau pelajar kadangkala terlupa untuk memadam lampu dan penghawa dingin sebelum meninggalkan bilik. Perisian ini dapat mengawal sehingga 8 lampu dan 6 penghawa dingin.

Projek ini menggunakan sensor yang boleh mengesan pergerakan dan haba badan manusia. Sensor ini akan menghantar data ke PIC. PIC18F4620 digunakan untuk mengaturlcaraan dan kemudiannya pengaturlcaraan ini dihantar ke Visual Basic melalui modul komunikasi RS232. When PIC mendapat data daripada sensor, system pencahayaan dan system penghawa dingin akan padam secara automatic selepas 10 minit. Dalam masa 10 minit, sekiranya alat pengesan mengesan pergerakan dan haba dari manusia, system kawalan ini akan berfungsi semula tetapi tidak menghentikan operasi sistem pencahayaan dan sistem penghawa dingin.

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## LIST OF ABBREVIATIONS

PIC	Programmable Interface Controller
MHz	Mega Hertz
IC	Integrated Circuit
VDC	Volt Direct Current
AC	Alternate Current
VB	Visual Basic
kWh	Kilo Watts per Hour
LED	Light Emitting Diode
SPDT	Single Pole Double Throw





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## CHAPTER 1

### INTRODUCTION

#### 1.0 Overview

Nowadays, electricity is the one of the important energy in human life. The usage of electricity in this world is increasing because we do not have the awareness of the importance of electricity. This is the reason of the increasing cost of managing, conserving and distributing. This problem also occurs in all university in Malaysia. The level of electricity usage is high especially at the lecture halls. Students do not aware that how important for them to reduce the cost of electricity. Thus, this energy saving project will be created. From the previous case study, at the end of the lecture session, the lighting system and air-conditioner are left on and unattended. Sometimes lecturers or students forget to switch off the lighting system and air-conditioner. This will increase the waste of electricity in University Malaysia Pahang (UMP). Based on this problem, this energy saving project will be created using PIC microcontroller and Visual Basic V.6 for interface.

This project will be used the Passive Infrared Sensor (PIR sensor) to detect the body heat of humans. These projects also use Visual Basic V.6 to interface with the hardware. When the sensor detects nobody is in the lecture halls so the microcontroller will calculate to 10 minutes. If within this time there are students coming into the lecture hall, the air-conditioner and lighting system will reset its programmed but if the hall

stays empty the lighting system and air conditioner will turn off automatically. Besides that, other features of this system is pre-determine timer. These pre-determined times can be changed at Visual Basic (VB 6.0) software which has been developed for setting of the control system. Lighting system and air-conditioner will turn off automatically at pre-determine time.

## 1.1 Objective

The general objective of the system is to prevent electrical energy wasted that consumer have to pay for it. We can see that a lot of energy wasted happened nowadays. The better energy saving must be made to prevent this problem. The objectives of this project are:

- I. To design and built the energy saving control system for application in University Malaysia Pahang (UMP) lecture halls, in order to reduce energy wasting occurences in lecture halls.
- II. To build an automatic control system by using motion sensor (PIR sensor).

## 1.2 Scope of Work

This energy saving control system consists of 2 parts. First part is hardware development and second part is software development. The scope of project that needs to be proposed:

- I. To develop hardware.
  - The microcontroller that will be used is the PIC18F4620 and the sensor is the Passive Infrared Sensor (PIR sensor).

- II. To develop software using Visual Basic for interface.
  - Software that will be used is Visual Basic. This software is used to interface with the hardware.

### 1.3 Thesis Outlines

This thesis contains 5 chapter which is every chapter have its own purpose. After viewing the entire chapter in this thesis hopefully viewer can understand the whole system design for this project.

Chapter 1 describes the introduction of this project includes, the problem statement of this project, the objective of the project, the scope of the project and the outline of this thesis of every chapter.

Chapter 2 describes the literature review of this energy saving control system. This chapter will explain the information about the article that related to the project design. Besides that, this chapter will be important references to me when do the project. This chapter also include the important information when do the research about the project. The information got from several sources as website, books and others.

Chapter 3 describes about the methodology of this project. The methodology includes the block diagram and flow chart of this system. The project explanation will be explained through block diagram of this project.

Chapter 4 is about the results and the analysis for this project. This chapter explains about the result and the analysis of this project.

Chapter 5 is for conclusion chapter. This chapter will explain the conclusion of the project that is simple explanation of the project. It also includes the application of the project in the real world. This chapter also describes the further improvement can be done for the project. Besides that, this chapter also includes the cost and commercialization of this project.



## CHAPTER 2

### LITERATURE REVIEW

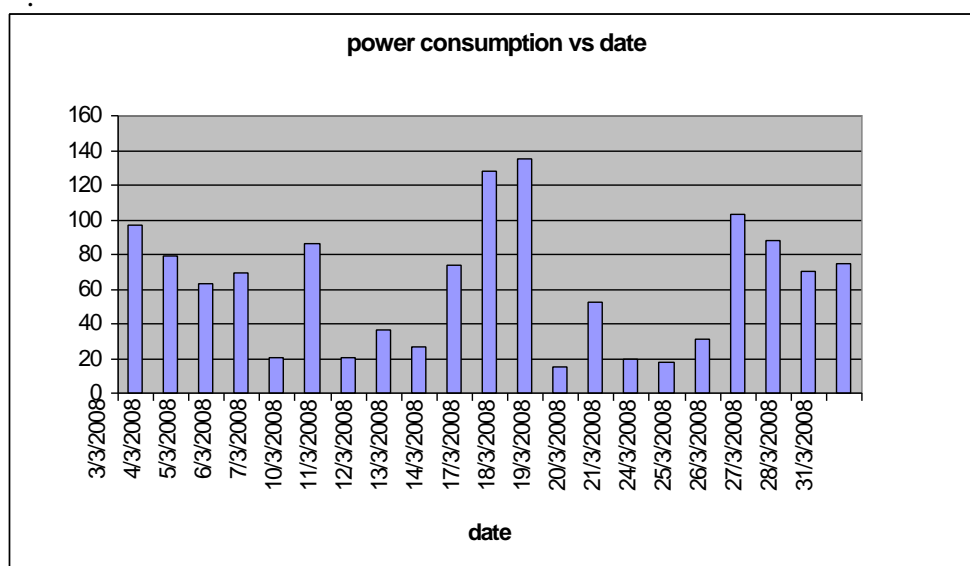
#### 2.1 Introduction

Energy saving control system is the system that created to reduce the uses of electricity in University Malaysia Pahang (UMP). Saving energy is one of the most fundamental things we can do as student of University Malaysia Pahang to save money and help balance our budget. "This is an opportunity to cut expenses without affecting services; I encourage everyone to make energy conservation part of our daily routine", (President Curt Tompkins), [1].

The control system can be applied in lecture halls at UMP. The energy system is designed to satisfy the externally specified demand for useful energy. Although energy systems engineering also deals with, e.g., operation of energy supply systems and development of energy equipment, these issues are not reflected in the research questions and will hence be omitted in this review. So in this literature review, the author will only focus on hardware and software that be used.

## 2.2 Case Study at DK13, UMP Lecture Halls

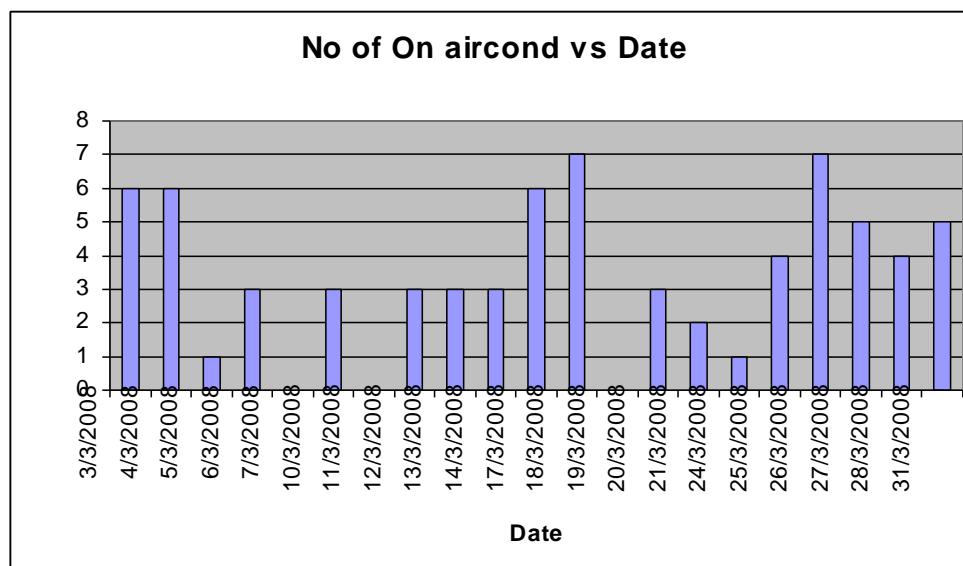
This energy control system is designed to practice it in University Malaysia Pahang (UMP) lecture halls. With this control system, the uses of electricity will be reduced. From the case study, showed that the higher of uses of electricity in UMP because at the end of the lecture session, the lighting system and air-conditioner are left on and unattended. Sometimes lecturers or students forget to switch off the lighting system and air-conditioner. This will increase the waste of electricity in University Malaysia Pahang (UMP). Figure 2.1 show the power consumption versus date in DK13, UMP 's lecture hall [8].



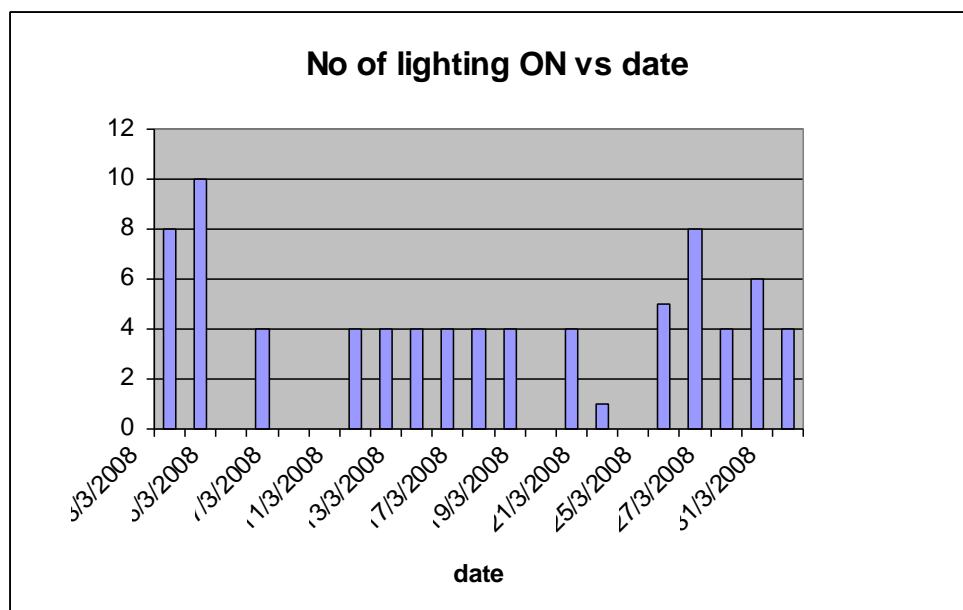
**Figure 2.1** Power Consumption vs. Date

The survey is done in March 2008 at DK13, UMP's lecture hall. The data were collected three times daily, which is after 1300pm, 1700pm and 2300pm. The data were taken when the hall is unoccupied. The highest energy consumption is 135.3 kWh on 18th March 2008. The lowest energy consumption is 15.3 kWh on 19th March 2008 (holiday). 7 units air-conditioning and 4 units of lighting system is ON when the hall was unoccupied on 18th March contribute to high energy consumption. The trend of

graph for power consumption and energy wasting due to air-conditioning are almost same. Figure 2.2 and figure 2.3 show the number of ON air-conditioner and lighting system versus date in DK13 [8].



**Figure 2.2** Number of ON Air Conditioner vs. Date



**Figure 2.3** Number of Lighting ON vs. Date



## 2.3 Sensor

Sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. Sensors are used in everyday objects such as touch-sensitive elevator buttons and lamps which dim or brighten by touching the base. There are also innumerable applications for sensors of which most people are never aware. Applications include cars, machines, aerospace, medicine, manufacturing and robotics [10].

Because sensors are a type of transducer, they change one form of energy into another. For this reason, sensors can be classified according to the type of energy transfer that they detect. There are all types of sensor available for usage: thermal, electromagnetic, mechanical, chemical, optical radiation, acoustic, motion, distance and more.

A good sensor should be sensitive to the measured property, insensitive to any other property and should not influence to the measured property [10].

## 2.4 Passive Infra-Red (PIR) Sensor

This energy saving control system includes hardware and software. Software that be used is Visual Basic and programming in Microcontroller, PIC 18F4550. The sensor is most the important element in this project.

In this project, the PIR sensor will be used to detect the human present in the lecture halls. A Passive Infrared sensor (PIR sensor) is an electronic device which measures infrared light radiating from objects in its field of view. Apparent motion is detected when an infrared source with one temperature, such as a human, passes in front of an infrared source with another temperature, such as a wall [2].

PIR stands for Passive Infra-Red. The sensor is passive because, instead of emitting a beam of light or microwave energy that must be interrupted by a passing person in order to sense that person, the PIR is simply sensitive to the infrared energy emitted by every living thing. When an intruder walks into the detector's field of vision, the detector sees a sharp increase in infrared energy. All objects emit what is known as black body radiation. This energy is invisible to the human eye but can be detected by electronic devices designed for such a purpose. The term 'passive' in this instance means the PIR does not emit energy of any type but merely accepts incoming infrared radiation [3].

The passive infrared (PIR) sensor found in popular integrated-circuit (IC) packages does not lend itself well to achieving wide fields of view. These integrated-circuit sensor packages typically include one or more planar sensing elements which are irradiated through a window on the surface of the IC package. These IC sensor packages are most sensitive to head-on radiation, incident at  $90^\circ$  to the window surface. Their sensitivity drops off the more the incident radiation approaches the sensor from the side, i.e., the more the radiation approaches the sensor at a glancing angle. To achieve a wide field of view, known motion detectors generally require complicated optical arrangements for directing the infrared radiation from the outlying reaches of the desired field of view into the significantly narrower angular reach of the sensor sensitivity. Some motion detectors have achieved wider fields of view by compounding a plurality of integrated-circuit sensor packages, each having its own limited field of view, with optical arrangements that bring the incident radiation to the proper sensor at the proper angle to be perceived. In any event motion detectors with wide fields of view have generally involved a tradeoff among increases in cost, complexity, and the physical size of the motion detector unit, and a compromise in performance. For motion detectors approaching a full  $360^\circ$  field of view the tradeoff is all the more stringent [9].

The Passive Infrared sensors (PIR sensor) have a lot of advantage compare with other sensors. This sensor is simple, being reliable, and having low prices. No motion

detection system is perfect, but PIR sensors are by far the most sensitive and advanced option. PIR sensor lights are ideal additions to any home security system [2].



**Figure 2.4** PIR Sensor

## 2.5 Microcontroller PIC18F4620

The name PIC initially referred to "Programmable Interface Controller", but shortly thereafter was renamed "rogrammable Intelligent Computer" [5].

PIC are popular with developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability. The PIC architecture is distinctively minimalist. It is characterized by the following features:

- separate code and data spaces (Harvard architecture)
- a small number of fixed length instructions

- most instructions are single cycle execution (4 clock cycles), with single delay cycles upon branches and skips
- a single accumulator (W), the use of which (as source operand) is implied (ie is not encoded in the opcode)
- All RAM locations function as registers as both source and/or destination of math and other functions.[6]
- a hardware stack for storing return addresses
- a fairly small amount of addressable data space (typically 256 bytes), extended through banking
- data space mapped CPU, port, and peripheral registers
- the program counter is also mapped into the data space and writable (this is used to implement indirect jumps)

The microcontroller that will be used in this project is the PIC18F4620. This family of devices offers the advantages of all PIC18 microcontrollers – namely, high computational performance at an economical price – with the addition of high endurance, Enhanced Flash program memory. In addition to these features, the PIC18F2455/2550/4455/4620 family introduces design enhancements that make these microcontrollers a logical choice for many high-performances, power sensitive applications [7]. Another advantage from this article is high-performance, enhanced flash, USB Microcontrollers with nanoWatt Technology.

PICs have a set of registers that function as general purpose RAM. RAM is a data memory used by a program during its execution. In RAM are stored all inter-results or temporary data during run-time. RAM contains all the internal registers and a small RAM memory where we can store data temporary. There are several register with different functions. The RAM memory is not large about 64-128 byte. Example: If we make a program loop, then we need a variable to change value each time the loop runs and then we will use a variable defined in the RAM address to hold the counter value. The content in the Register and RAM-info will disappear when the power is off [6].

Special purpose control registers for on-chip hardware resources are also mapped into the data space. The addressability of memory varies depending on device series, and all PIC devices have some banking mechanism to extend the addressing to additional memory. Later series of devices feature move instructions which can cover the whole addressable space, independent of the selected bank. In earlier devices (ie. the baseline and mid-range cores), any register move had to be achieved via the accumulator. To implement indirect addressing, a "file select register" (FSR) and "indirect register" (INDF) are used: A read or write to or from INDF will actually be to or from the register pointed to by FSR. Later devices extended this concept with post- and pre-increment/decrement for greater efficiency in accessing sequentially stored data. This also allows FSR to be treated almost like a stack pointer. The PIC architectures have several limitations:

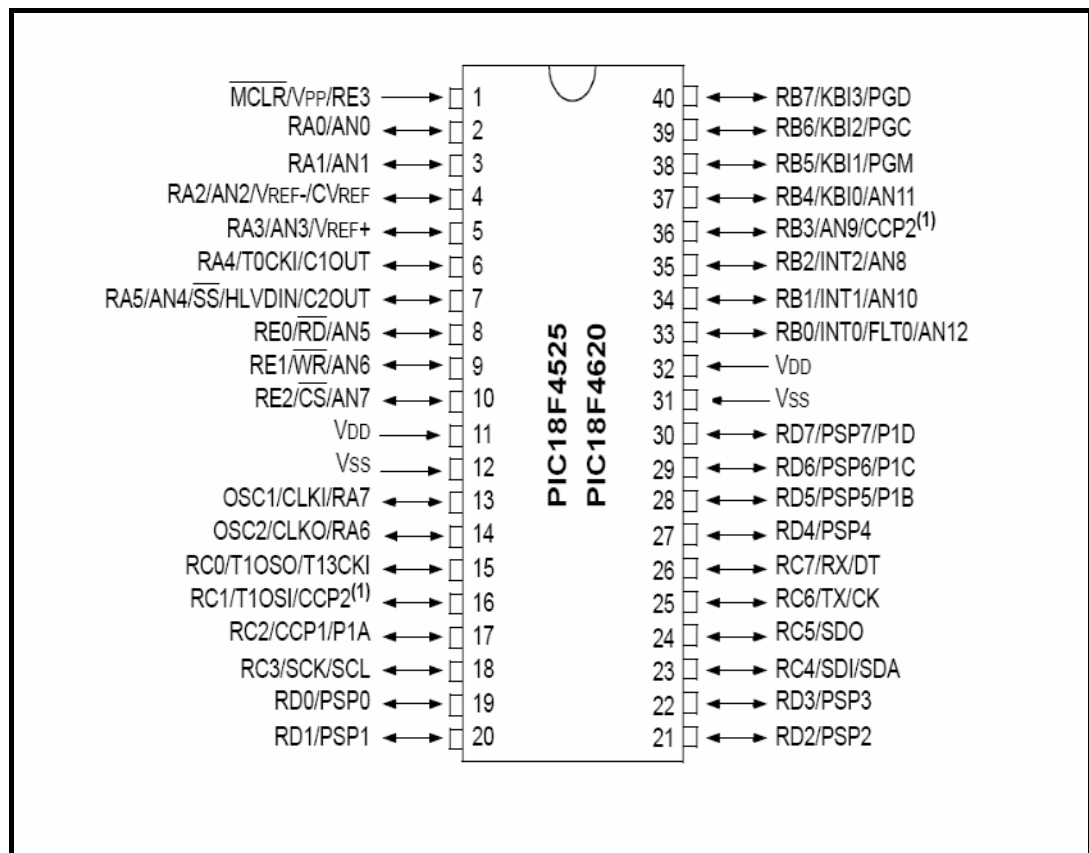
- Only a single accumulator
- A small instruction set
- Operations and registers are not orthogonal; some instructions can address RAM and/or immediate constants, while others can only use the accumulator
- Memory must be directly referenced in arithmetic and logic operations
- Register-bank switching is required to access the entire RAM of many devices, making position-independent code complex and inefficient
- Conditional skip instructions are used instead of conditional branch instructions (as most other architectures use)

All PIC feature Harvard architecture, so the code space and the data space are separate. PIC code space is generally implemented as EPROM, ROM, or flash ROM.

EEPROM memory makes it easier to apply microcontrollers to devices where permanent storage of various parameters is needed (codes for transmitters, motor speed, receiver frequencies, etc.). Low cost, low consumption, easy handling and flexibility make PIC16F84 applicable even in areas where microcontrollers had not previously been considered (example: timer functions, interface replacement in larger systems, coprocessor applications, etc.).

In System Programmability of this chip (along with using only two pins in data transfer) makes possible the flexibility of a product, after assembling and testing have been completed. This capability can be used to create assembly-line production, to store calibration data available only after final testing, or it can be used to improve programs on finished products [13].

PORTA, PORTB, PORTC and PORTD are physical connections between the microcontroller and the outside world. Port A has five, port B has seven, port C has seven and port D has seven pins. The port is the input and output pins of the actual circuit. We can define the pins as input or outputs. By writing or reading to the port we can control each pin as we wish.



**Figure 2.5** The Configuration of PIC 18F4620

## 2.6 Visual Basic Based GUI

The software that will be used in this energy control system is the Visual Basic. The programming in visual basic must interface with hardware. To interface, the RS232 communication module is used as the serial port. The visual basic is used to set the predetermine time which is after 1300pm, 1700pm and after 2300pm. This can't be done using PIC programming because if nobody in lecture hall, so the lamp and air-conditioner will turn OFF. So the time will reset to 0.00. So the time at the computer do not actual with the time outside.

Visual Basic (VB) is the third-generation event-driven programming language and integrated development environment (IDE) from Microsoft for its COM programming model. VB is also considered a relatively easy to learn and use programming language, because of its graphical development features and BASIC heritage. Visual Basic was derived from BASIC and enables the rapid application development (RAD) of graphical user interface (GUI) applications, access to databases using Data Access Objects DAO, Remote Data Objects RDO, or ActiveX Data Objects ADO, and creation of ActiveX controls and objects [11].

### 2.6.1 Language Features

Like the BASIC programming language, Visual Basic was designed to be easy to learn and use. The language not only allows programmers to create simple GUI applications, but can also develop complex applications. Programming in VB is a

combination of visually arranging components or controls on a form, specifying attributes and actions of those components, and writing additional lines of code for more functionality. Since default attributes and actions are defined for the components, a simple program can be created without the programmer having to write many lines of code. Performance problems were experienced by earlier versions, but with faster computers and native code compilation this has become less of an issue.

Although programs can be compiled into native code executables from version 5 onwards, they still require the presence of runtime libraries of approximately 2 MB in size. This runtime is included by default in Windows 2000 and later, but for earlier versions of Windows or Windows Vista, it must be distributed together with the executable.

Forms are created using drag and drop techniques. A tool is used to place controls (e.g., text boxes, buttons, etc.) on the form (window). Controls have attributes and event handlers associated with them. Default values are provided when the control is created, but may be changed by the programmer. Many attribute values can be modified during run time based on user actions or changes in the environment, providing a dynamic application. For example, code can be inserted into the form resize event handler to reposition a control so that it remains centered on the form, expands to fill up the form, etc. By inserting code into the event handler for a key press in a text box, the program can automatically translate the case of the text being entered, or even prevent certain characters from being inserted.

Visual Basic can create executables (EXE files), ActiveX controls, DLL files, but is primarily used to develop Windows applications and to interface web database systems. Dialog boxes with less functionality can be used to provide pop-up capabilities. Controls provide the basic functionality of the application, while programmers can insert additional logic within the appropriate event handlers. For example, a drop-down combination box will automatically display its list and allow the user to select any element. An event handler is called when an item is selected, which can then execute



additional code created by the programmer to perform some action based on which element was selected, such as populating a related list [11].

Alternatively, a Visual Basic component can have no user interface, and instead provide ActiveX objects to other programs via Component Object Model (COM). This allows for server-side processing or an add-in module. The language is garbage collected using reference counting, has a large library of utility objects, and has basic object oriented support. Since the more common components are included in the default project template, the programmer seldom needs to specify additional libraries. Unlike many other programming languages, Visual Basic is generally not case sensitive, although it will transform keywords into a standard case configuration and force the case of variable names to conform to the case of the entry within the symbol table entry. String comparisons are case sensitive by default, but can be made case insensitive if so desired.

The Visual Basic compiler is shared with other Visual Studio languages (C, C++), but restrictions in the IDE do not allow the creation of some targets (Windows model DLL's) and threading models [11].

### 2.6.2 Characteristic Present in Visual Basic

- a) Logical and bitwise operators are unified. This is unlike all the C-derived languages (such as Java or Perl), which have separate logical and bitwise operators. This again is a traditional feature of BASIC.
- b) Variable array base. Arrays are declared by specifying the upper and lower bounds in a way similar to Pascal and Fortran. It is also possible to use the Option Base statement to set the default lower bound.
- c) Relatively strong integration with the Windows operating system and the Component Object Model.

- d) Banker's rounding as the default behavior when converting real numbers to integers with the Round function.
- e) Integers are automatically promoted to real in expressions involving the normal division operator (/) so that division of an odd integer by an even integer produces the intuitively correct result. There is a specific integer divide operator (\) which does truncate.

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 Introduction**

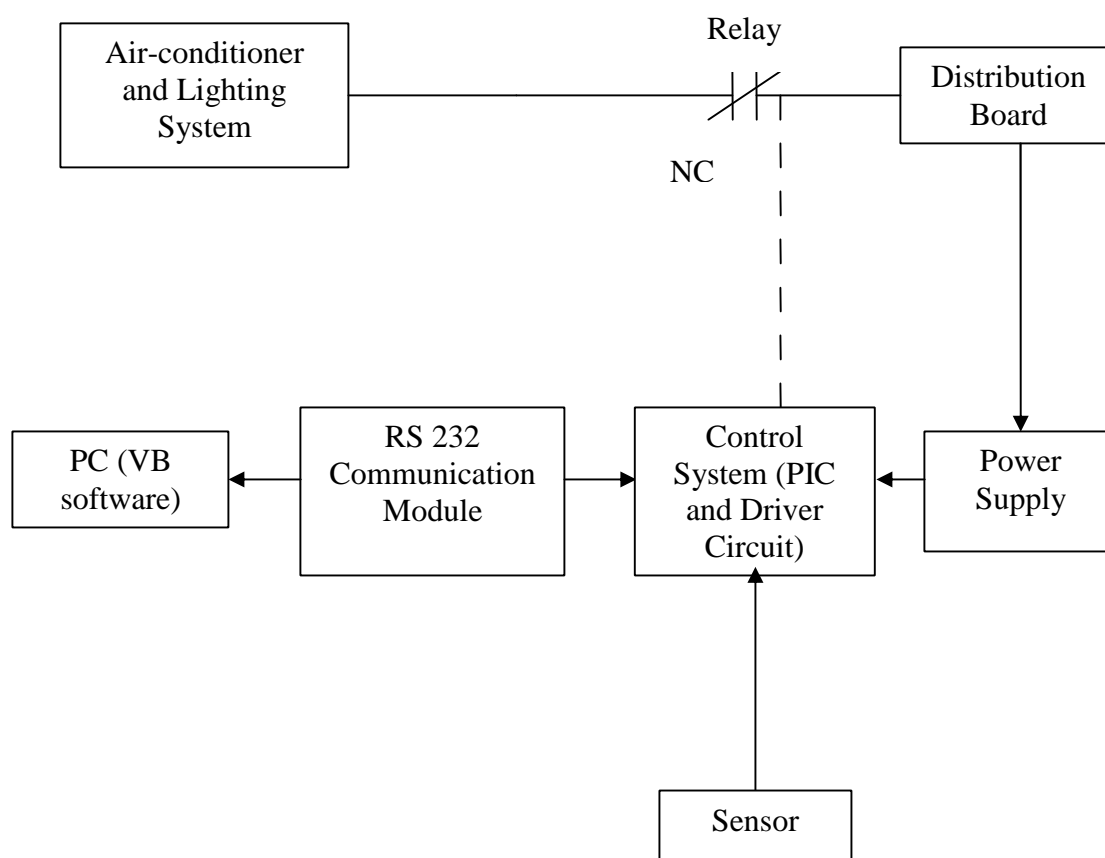
This chapter will explain about the detail of the project. It also includes the project progress and has block diagram, flow chart and also the explanation in detail about the project. The project explanation will be explained through block by block that refer to the block diagram.

#### **3.2 Project Block Diagram**

Conceptually, the energy saving system is programmed to automatically switch off the power supply to the air-conditioning units and lighting system at pre-determined timer, or when no users is detected in the room. A separate passive infra-red (PIR) sensor is installed in the room as the monitoring system. The architecture of the proposed control system is shown in Figure 1.

The GUI based Visual Basic (VB) is designed for setting the pre-determined time of the control system. The pre-determined time is programmed to automatically switch off the power supply of air-conditioning and lighting system at 13.00pm, 1700pm and

2300 pm every day at GUI based. The air-conditioner and lighting system can be manually switched ON again if the lecture hall is still in use.

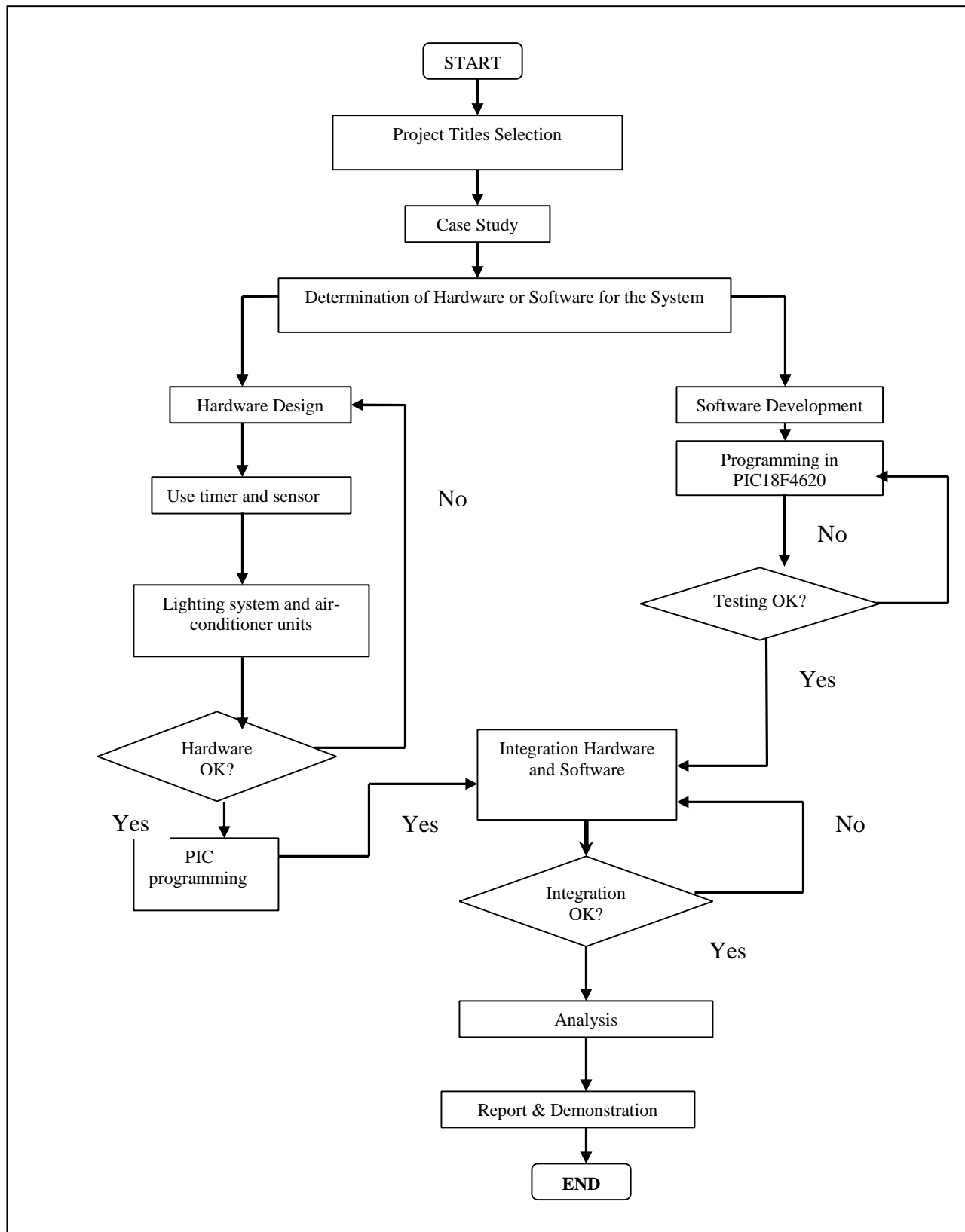


**Figure 3.1** Block Diagram of the System

The control system is designed to manually switch ON the power supply of the air-conditioner or lighting system and to automatically or manually switch OFF the supply. PIR sensor is used to detect the presence of any user in the lecture hall. The power supply to the air-conditioner or lighting system units will be switched off after the sensor detect no users in the room. The GUI is designed in Visual Basic Version 6.0 and interface to the control system via RS232 communication module for setting of the pre-determined time of the control system.

### 3.3 Project Development

Figure 3.2 below is about the project flow chart. The flow chart shows the flow of the project progress until the installation project is complete and tested. The process of developing this project starts with the selection of project titles. After the title selection are done, case study at DK13 will starts.

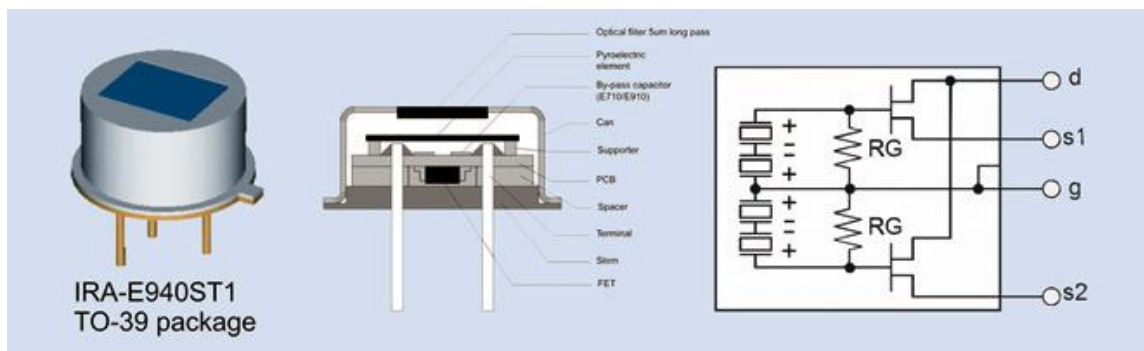


**Figure 3.2** Project Development Flow Chart

### 3.4 Sensor Selection

A Passive Infra-red Sensor is an electronic device that detects the motion or movement of some person or animal by sensing the heat emitted from the body. It sets off an alarm automatically at the approach of these warm beings to within a certain specific radius within its view. The 'passive' in the Passive Infra-red sensor means that the device does not emit the infra-red rays. It merely detects the emission from another source. All objects emit a black body radiation which is not seen by our eye but can be detected by electronic devices like the PIR sensor. The PIR sensor principle is used in motion detectors and lights.

In the PIR sensor motion detector, motion is gauged by the temperature of the object moving into the view of the detector. Should a wall come into view, the PIR sensor detects its presence by its temperature which differs from that of a living being and the interpretation thereby becomes obviously different. The sensor has the electronics to do this. The pet immune PIR sensor does not react to the motions of the pet but a person will be detected.



**Figure 3.3** Internal Structure of a PIR sensor

While a number of technologies for motion detection exist, including ultrasonic and microwave radiation sensors, the PIR sensor is popular for its ease-of-setup and high performance. In addition, PIR sensors are inexpensive and draw little power. Future Electronics expects the rate of adoption of PIR sensors to grow fast, with applications such as surveillance and alarm systems, as well as power saving devices, driving increased usage.



**Figure 3.4** PIR Sensor

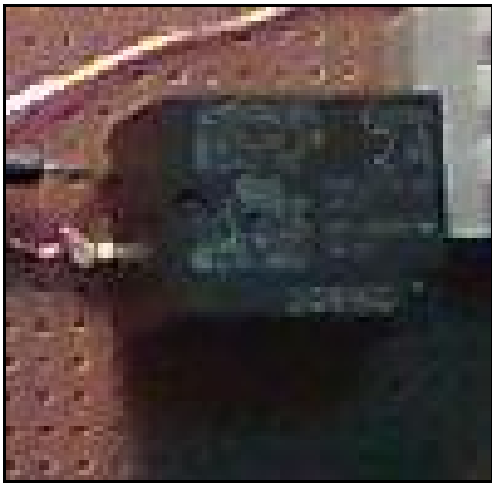
### 3.5 Relay Selection

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. Relay will function as the circuit breaker for the air conditioner and lightning system. Relay SPDT means single pole double throw relay. A common terminal connects to either of two others. Including two for the coil, such a relay has five terminals in total. Specification of relay that we need for this system is:

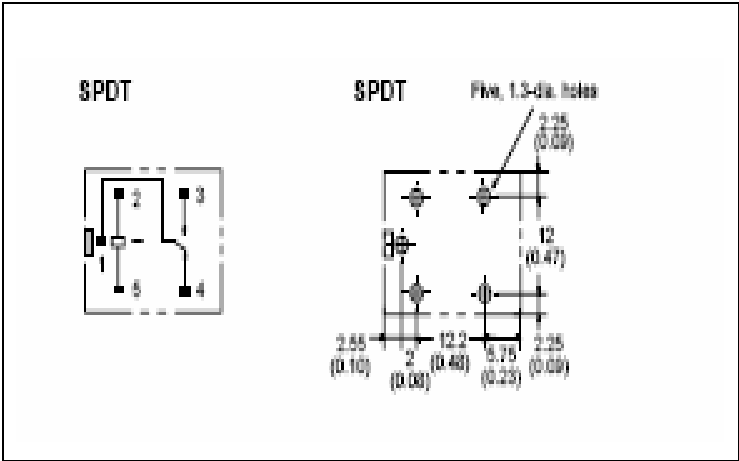


**Table 3.1:** Specification of Relay for this System

Type	SPDT Relay (SPDT - Single Pole Double Throw).
Voltage	12V DC
Poles	1
Rated Current	10A



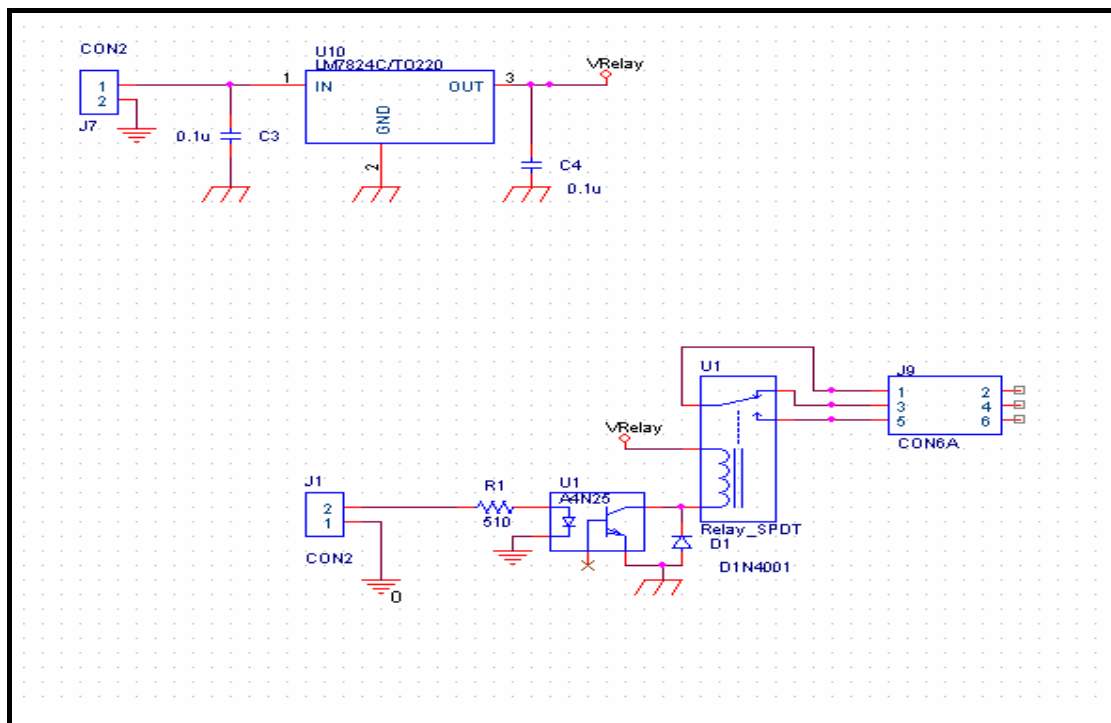
**Figure 3.5** Example of Relay



**Figure 3.6** Architecture of Relay

### 3.6 Relay Interface Circuit

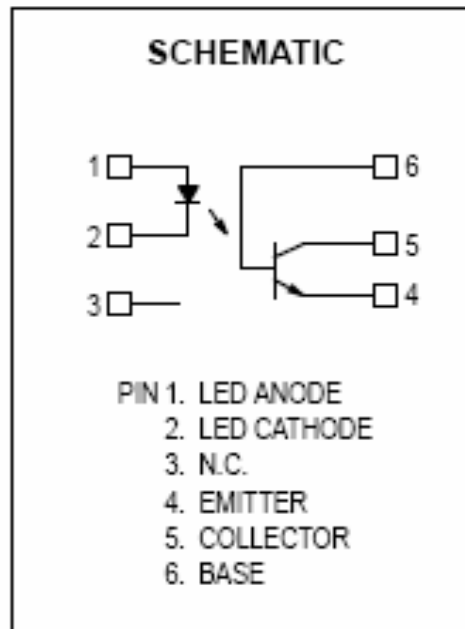
Relay interface circuit is designed as the driver circuit for this control system. The driver circuit includes the voltage regulator LM7824. Voltage regulator, LM7824 used to supply 4Vdc to the relay driver circuit from unregulated DC power supply. In relay circuit, 24V SPDT relay used to energize the lighting system and air-conditioner.



**Figure 3.7** Relay Interface Circuit

The circuit must have protection to reflected signal that might be able to damage the relay. Diode 1N4001 is used as the protector from reflected signal. When energizing the coil of a relay, polarity of the coil does not matter unless there is a diode across the coil. If a diode is not present, important to attach positive voltage to either terminal of

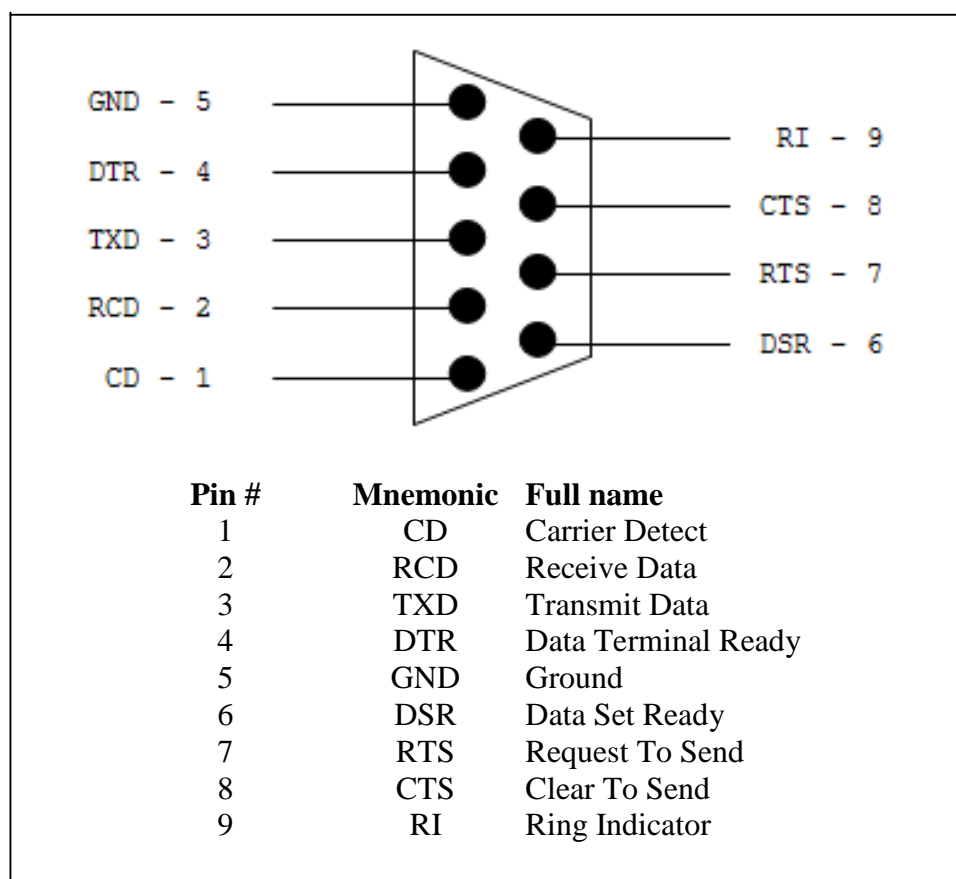
the coil and negative voltage to the other, otherwise connect positive to the side of the coil that the cathode side (side with stripe) of the diode is connected and negative to side of the coil that the anode side of the diode is connected [14]. The opto-isolator is used in this circuit as the general purpose for switching circuit.



**Figure 3.8** Schematic of AN425

### 3.7 RS-232 Connection

Figure 3.9 shows the pin connections (pin outs) of a 9-way serial port. Each pin has a two or three letter mnemonic as follows:

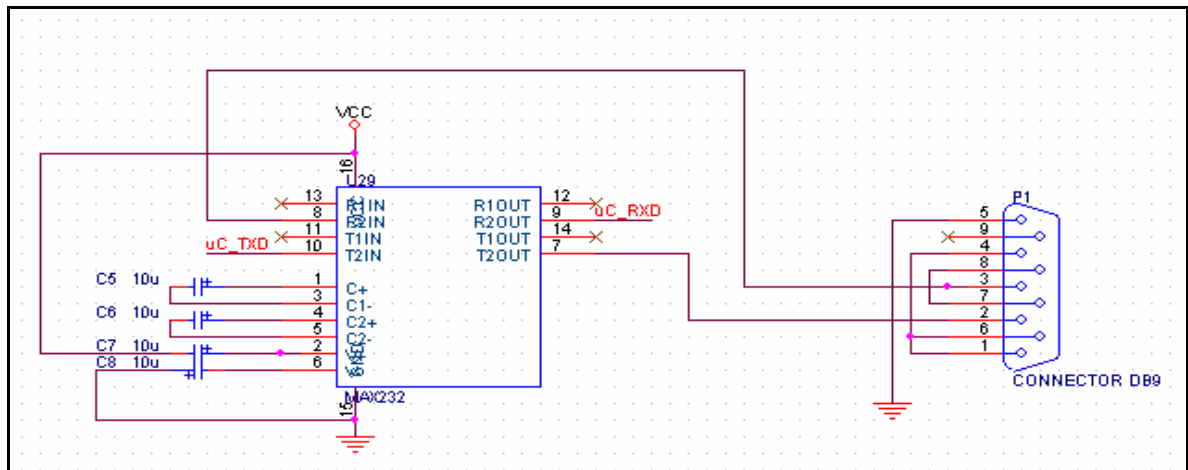


**Figure 3.9** 9-way Serial Port

All pin must be connected correctly because each pin has its own mnemonic. Pins #1, #4, #6 are connected together. The data can only be transmitted or received when mnemonic RTS and CTS are ready to accept data. GND pin must be connected grounded for the safety of the DB-9 connection

### 3.8 RS232 - Interface Circuit

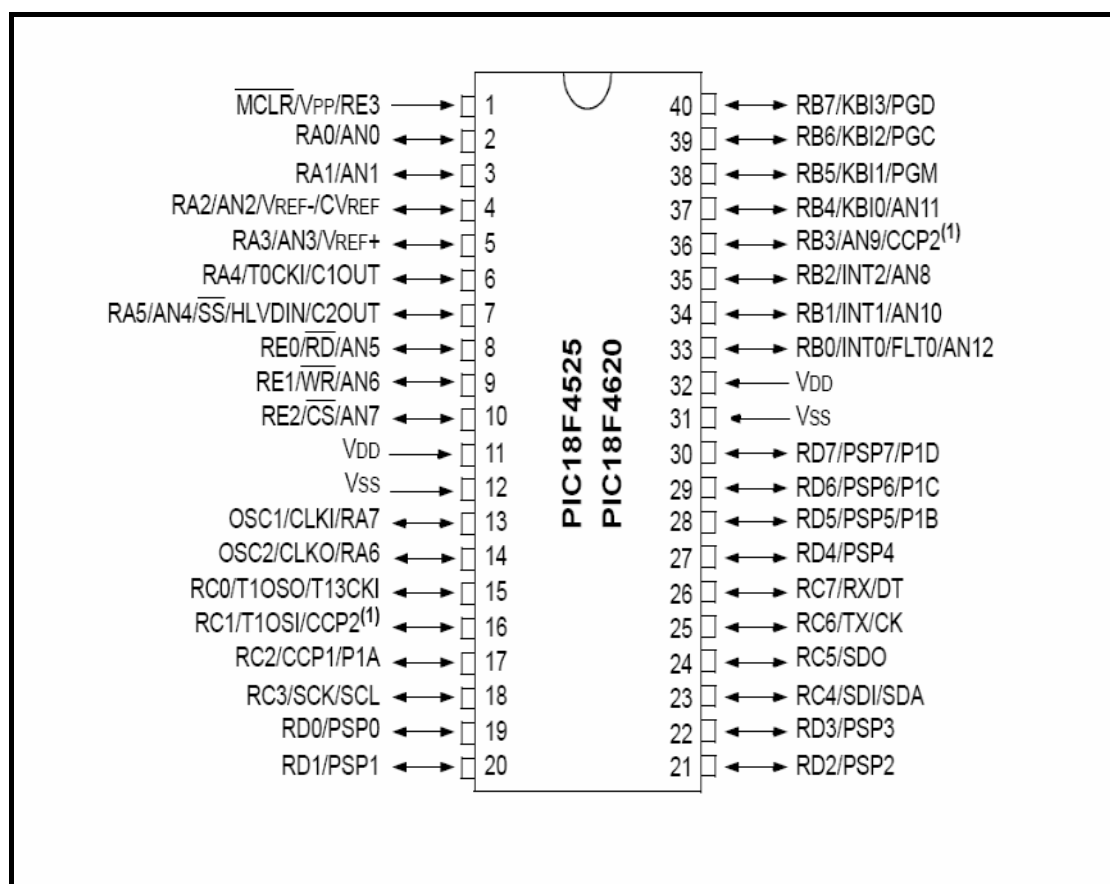
RS232 communication modules include IC MAX232 and 9-way serial port, connector DB9. MAX232 IC is connected to the PIC18F4620. Voltage +5V are needed to energize the MAX232 IC. The function of MAX232 IC is to transmit and receive the data from PIC to serial port. It will be the server for the PIC micro-controller to communicate with computer.



**Figure 3.10** RS232-Interface Hardware and Software

### 3.9 PIC Microcontroller Selection

The PIC use for this project is PIC 18F4620. it has 40 pins. This PIC is chosen for this project because the pins provided are enough to interface with other part in this project. A 20MHz crystal oscillator is used to provide sufficient clock to the PIC.

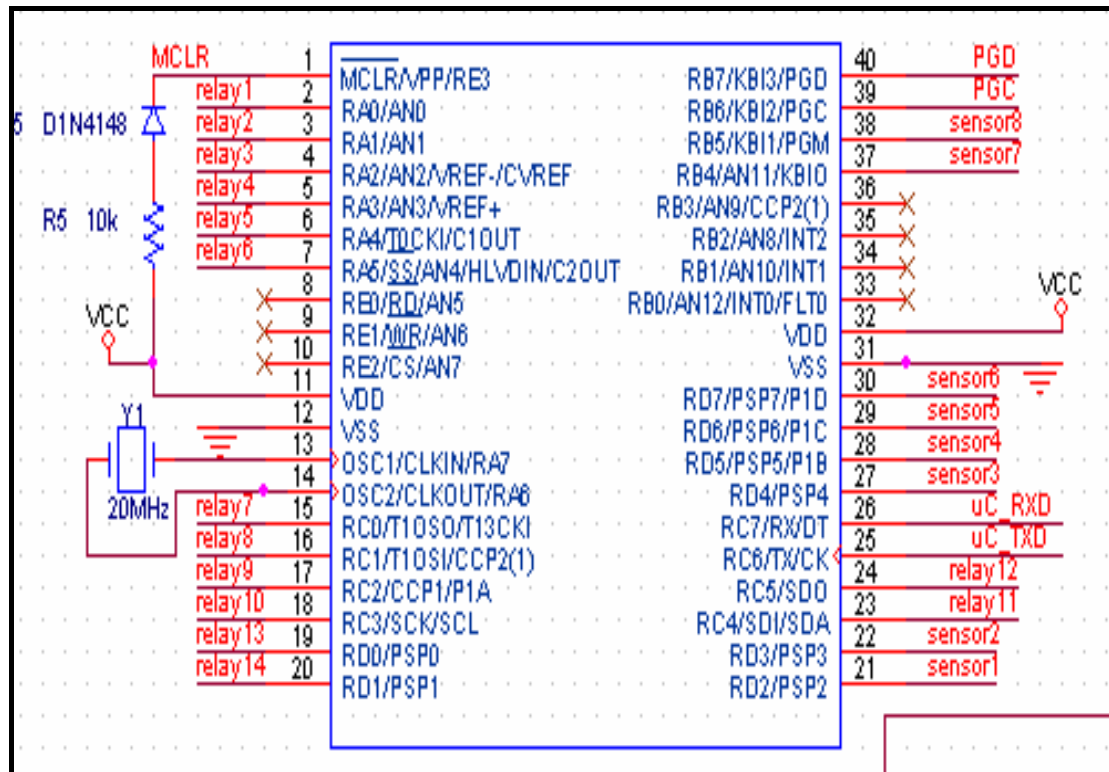


**Figure 3.11** The configuration of PIC 18F4620

### 3.10 PIC Microcontroller Interface Circuit

The designed of circuit is shown in Figure 3.8. The PIC is powered by +5V voltage supply. LM7805 IC is used to regulate the DC voltage to +5V for application in PIC. The voltage supply is connected to the pin 11. 20MHz oscillator is use to provide clock to the PIC and the system. Ports RA0 up to RA5, ports RC0 up to RC5, and port RD0 up to RD1 are used for connection to relay driver circuit. Port RD4 up to RD7 will function as input that receives changes of signal from sensor. For port RC7 and RC8, both of port will be connected to the RS 232 interface circuit. This will provide the system to interface in serial with the computer. Port A and B are used to connect with

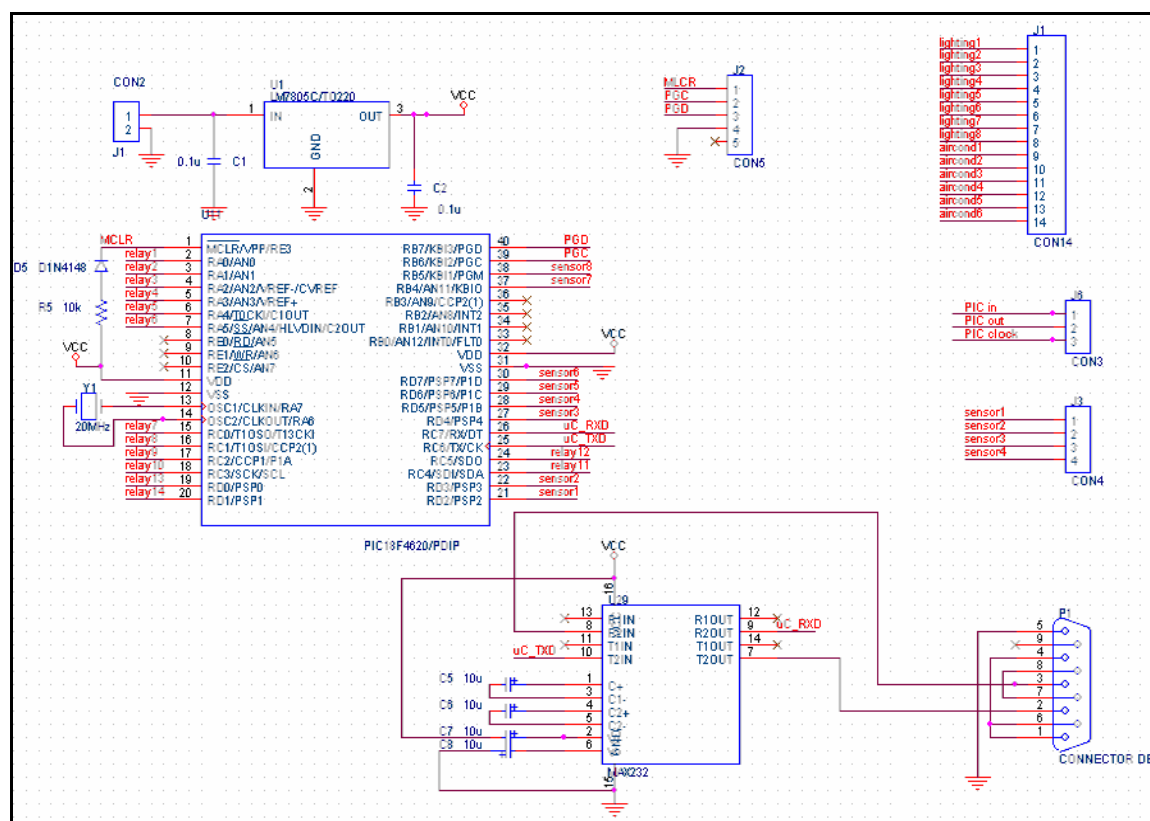
the relay of lighting system. Port C and D are used to connect with the relay of air-conditioner.



**Figure 3.12** PIC Microcontroller Interface Circuit

### 3.11 The Energy Saving Control System Circuit

This is the full circuit design after all parts are combined together to produce a smart energy saving control, system circuit for air conditioning and lighting system.



**Figure 3.13** The Circuit of Energy Saving Control



### **3.12 Software Development**

In developing the software programming for this project, several programmed required in accomplished the software part. The software used in the project is:

- (i) Microsoft Visual Basic 6.0
- (ii) PIC Programming
- (iii) Melabs Programmer Beta

#### **3.12.1 Microsoft Visual Basic 6.0**

Microsoft Visual Basic 6.0 was installed in the laptop or PC to make the programming and to run the software. Learn the manual and learn how to use Visual Basic and make it useful for the project.

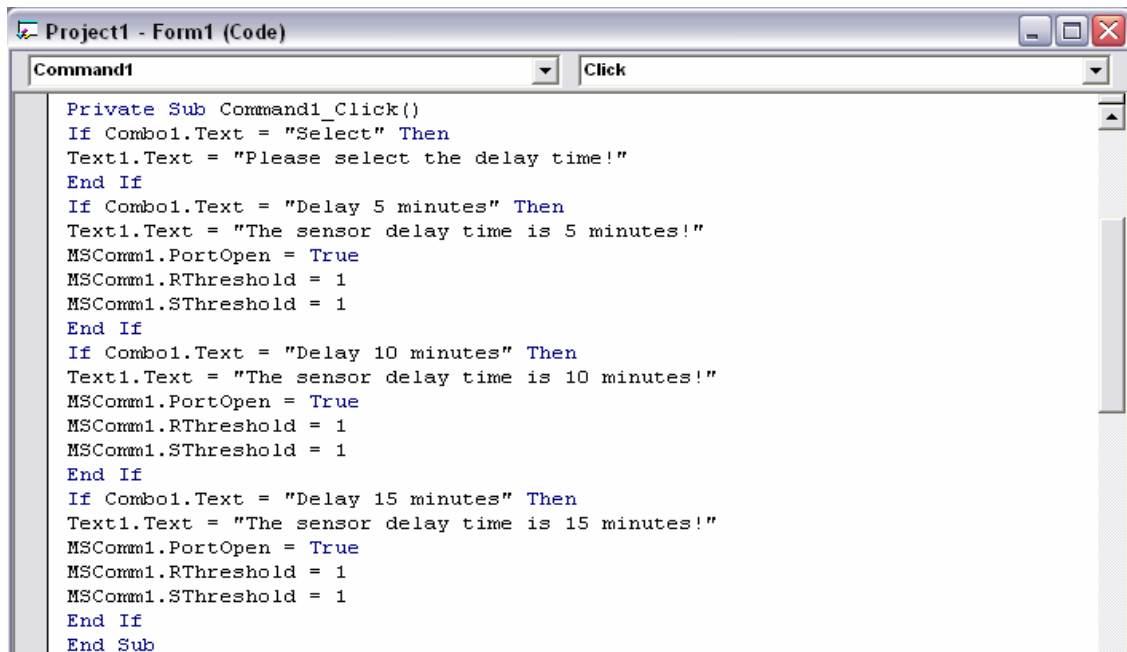
##### **3.12.1.1 Designing Visual Basic**

In designing the control system using Visual Basic 6.0, there are 2 main parts to be done. First, design the layout of the Visual Basic (VB) and second is coding and programming the Visual Basic to perform the instruction.

The layouts of the VB are design by adding and insert the components into the Form page. Drag and drop the shape or model inside the Form page. Design the form page to be look like a touchpad screen and user friendly. Name the shape and define each shape by its design.

To make the control system operate, every single part or buttons that were design before must be coding. Each step has its own coding. The code must be learning before make the coding. Figure 3.13 show the layout of the Main Form and Coding for Main Form.

(a)



(b)

**Figure 3.14** (a) Layout of the Main Form and (b) Coding for Main Form

### 3.12.2 Melabs Programmer Beta

This software is used for burning the PIC coding into the PIC. User must know the step to use this software.

When this software start running, user must set the value for oscillator, watchdog timer, power-up timer and code protect depend on the setting of hardware (PIC circuit). The window for setting all the value has been show in Figure 3.14(a) and Figure 3.14(b).



(a)

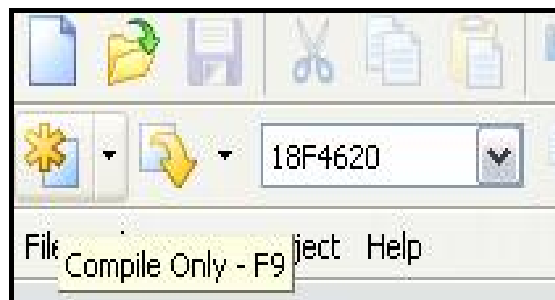
meProg - Configuration	
Oscillator	XT
Fail-Safe Clock Monitor	Disabled
Internal External Switch Over	Disabled
Power-up Timer	Disabled
Brown-out Reset	Disabled
Brown-out Reset Voltage	2.0V
Watchdog Timer	Disabled
Watchdog Timer Postscaler	1:32768
CCP2 Multiplexed with	RC1
PORTB Reset State	Analog Input
Low-Power Timer1 Oscillator	Low-Power
MCLR Pin Function	Input Pin
Stack Overflow/Underflow Reset	Disabled
Low Voltage Programming	Disabled
Enhanced CPU	Disabled

(b)

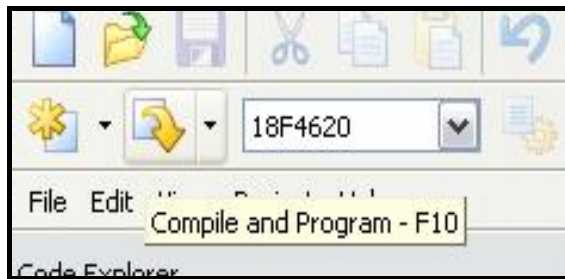
**Figure 3.15** (a) Melabs Programmer Main Windows and (b) Configuration Windows

### 3.12.3 PIC Programming

This program is used for compiling the coding to produce PIC coding that can be burn into the PIC. This program also can assemble the asm coding and detect error in the coding. After that, we must compile and program the programming in PIC. Figure 3.15 show the both of this step.



(a)

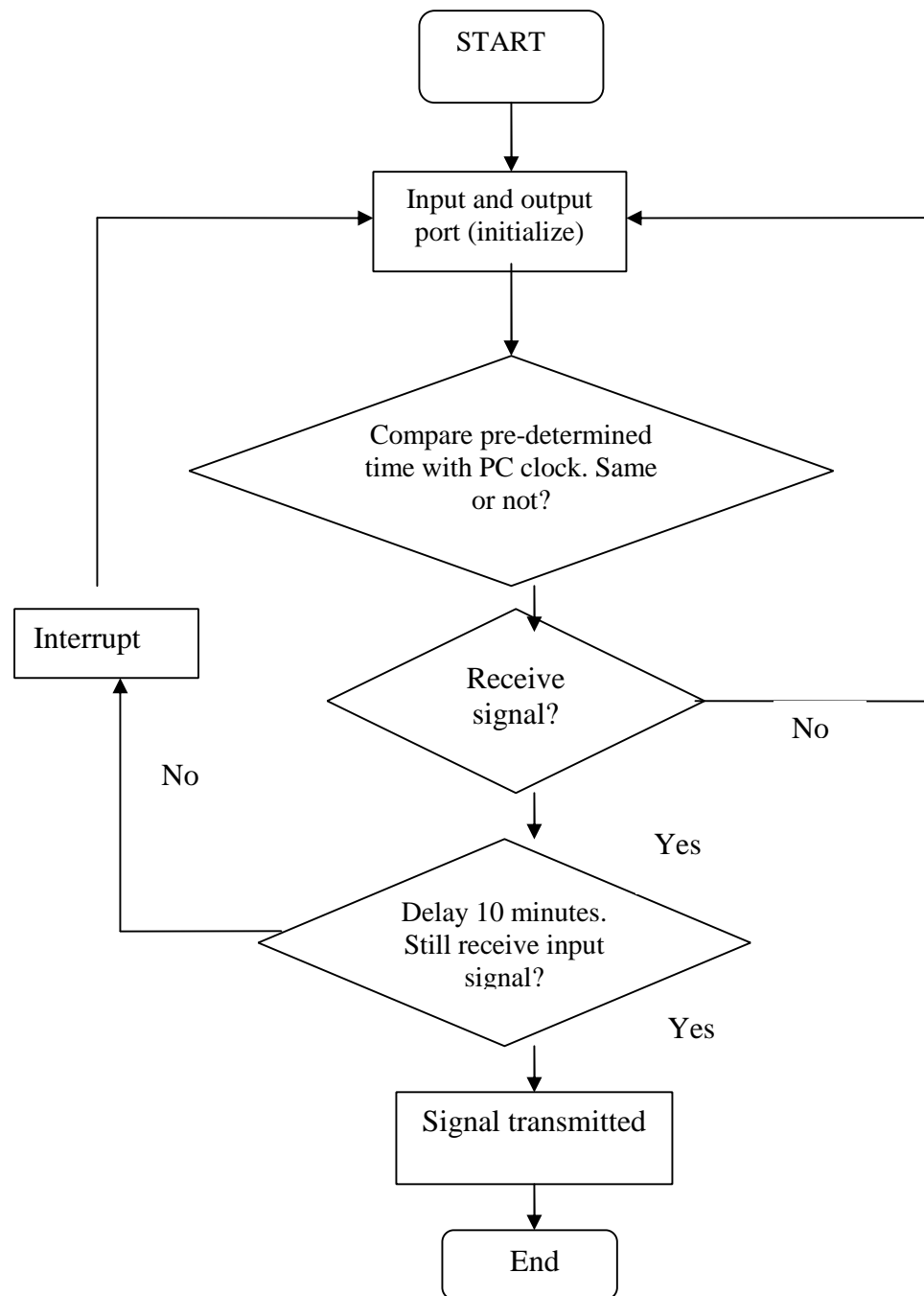


(b)

**Figure 3.16** (a) Compile Only Programmer Main Windows and (b) Compile and Program Windows

### 3.13 Project Flow Chart for PIC Program

The programs start with initialize input and output port at the PIC18F4620. Then the actual time at Personal Computer (PC) will be compare with the clock time. If the time is same so it will receive the signal. If signal still receive at input port (sensor) so it will execute another instruction. The instruction of delay for 10 minutes before port output (relays) transmits signal output. In 10 minutes delay time, if there no signal receives, so the program will interrupt has happened. When this happened, all the system will reset and all port will be initialized again.



**Figure 3.17** Software Flow Chart

### 3.14 Conclusion

This smart control system must be build to solve the energy saving problem in University Malaysia Pahang.



## **CHAPTER 4**

### **RESULT AND ANALYSIS**

#### **4.1 Introduction**

This chapter will explain the result and analysis of the project. The chapter also includes the result on hardware and interface hardware and software.

#### **4.2 Interfaces with Visual Basic**

Visual basic is used for setting delay time of the control system. The lighting system and air conditioners in the area will switch off in 5, 10 or 15 minutes delay time according the delay time set up at the GUI. If within that time frame, human entered to the hall, the lightning system and air conditioner will turn off automatically. Figure 4.1 shows the setting of delays time of the control system. Other than that, Visual Basic (VB) also use to set the time for predetermine time. At predetermine time, we can set the time to off the lighting system and air-conditioner automatically.



**ENERGY SAVING CONTROL SYSTEM**

**Setting Delay Time**

Select  
 Delay 5 minutes  
 Delay 10 minutes  
 Delay 15 minutes

Setting Delay Time  
 Setting

Text1

**Microcontroller date and time**

Text4 Text5

11/14/2008 3:02:09 PM

**CONFIGURATIONS**

TIME OFF 1  
 TIME OFF 2  
 TIME OFF 3

SET CANCEL

EXIT OK CANCEL

**Figure 4.1** Time delay for Lighting System and Air Conditioner OFF.

At delay time, users can select the time delay for automatically off the lightning system and air-conditioner. If the delay has been set, it will save automatically in GUI. This programming will interrupt with PIC coding to turn OFF lighting system and air-conditioner automatically.

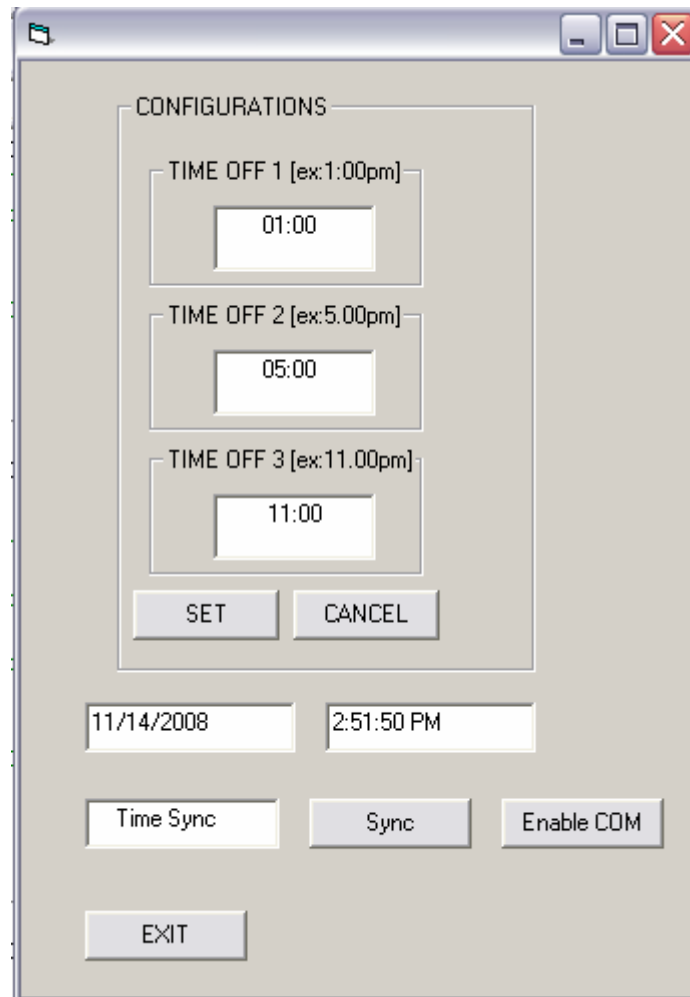
#### 4.2.1 Predetermine Time

Pre-determined time is used to turn off the lighting system and air conditioner automatically.

For this project, the timer is set at three different times. Those are at 01:00, 05:00 and 11:00. This time are selected depend on the working and learning scheduling time at University Malaysia Pahang (UMP).

For a better energy saving, the time will set at 01:10, 15:10 and 11:10. This is for preserving the level comfortable learning environment. The system will reserve 10 minutes for students and lecturers to leave and no human presence around the classroom. The user or administrator can change the time.

After all time are being set, user must make sure to click “Set” button. If user click “Cancel” button, all the changes and setting of the time will not be save and it will continue with former setting. When we use button SET, so the time that was be set will save and then this data will interrupted with PIC programming. The pre-determined time form is shown in Figure 4.20.



**Figure 4.2** Setting Time for 3 Times OFF

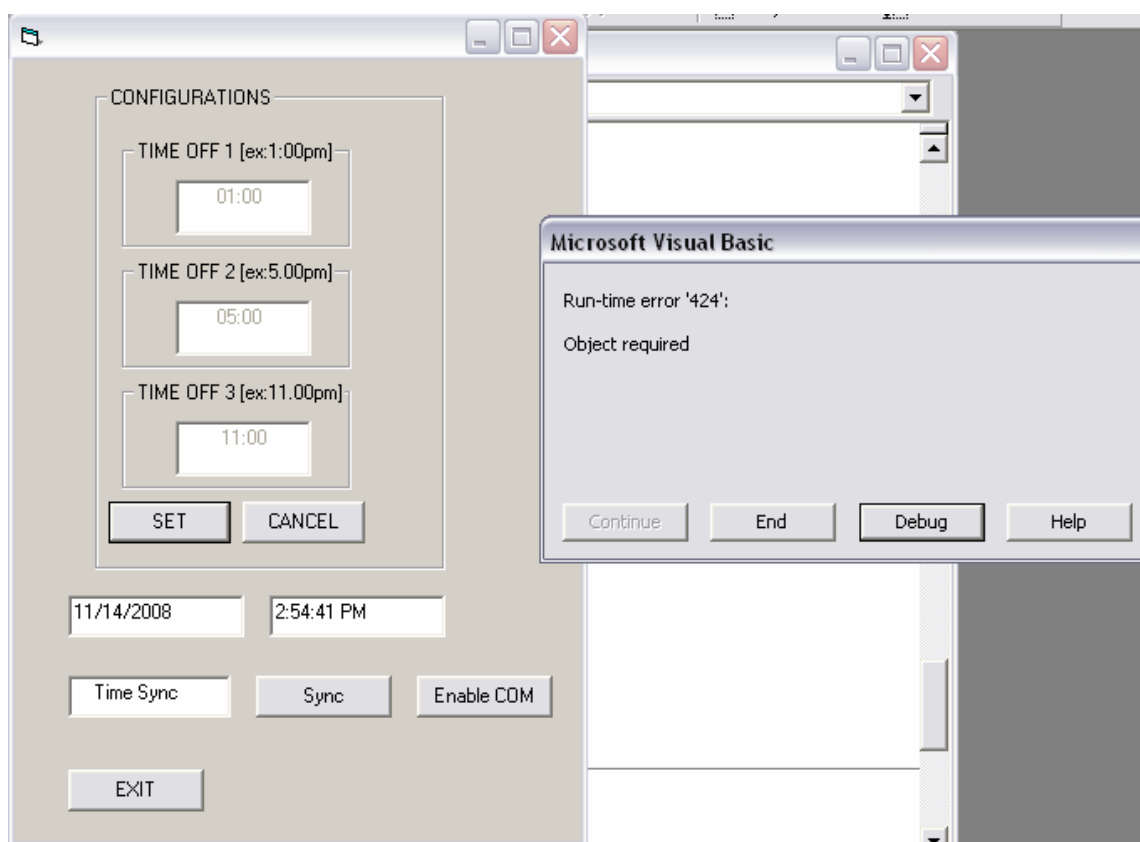
To run the software part, hardware design must be connected to the PC or laptop at DB-9 port via RS232 communication module. If user did not connect the hardware and PC or laptop, user cannot run the software perfectly. The error window as shown in Figure 4.3 will automatically appear. The error is caused when the software send data (ASCII code) and communicate with COMM1. It is because, the coding in the Visual Basic (VB) is includes:

MSComm1.PortOpen = True

MSComm1.RThreshold = 1

MSComm1.SThreshold = 1

This coding is used to open port at COMM1. So, it is only functions when the hardware connected to the PC or laptop.



**Figure 4.3** Runtime Error Windows

### 4.3 PIC Microcontroller Circuit Analysis

The PIC is powered by +5V voltage supply. LM7805 IC is used to regulate the DC voltage to +5V for application in PIC. The voltage supply is connected to the pin 11. 20MHz oscillator is use to provide clock to the PIC and the system. Ports RA0 up to RA5, ports RC0 up to RC5, and port RD0 up to RD1 are used for connection to relay driver circuit. Port RD4 up to RD7 will function as input that receives changes of signal from sensor. For port RC7 and RC8, both of port will be connected to the RS 232 interface circuit. This will provide the system to interface in serial with the computer. Port A and B are used to connect with the relay of lighting system. Port C and D are used to connect with the relay of air-conditioner.

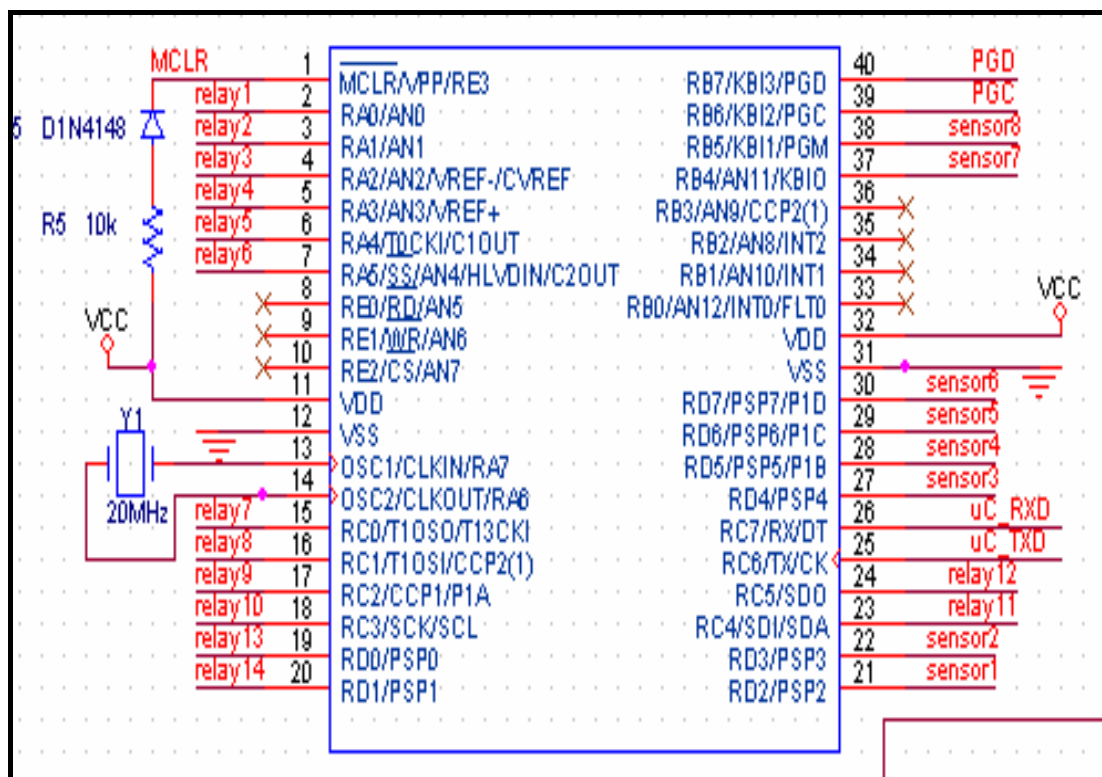


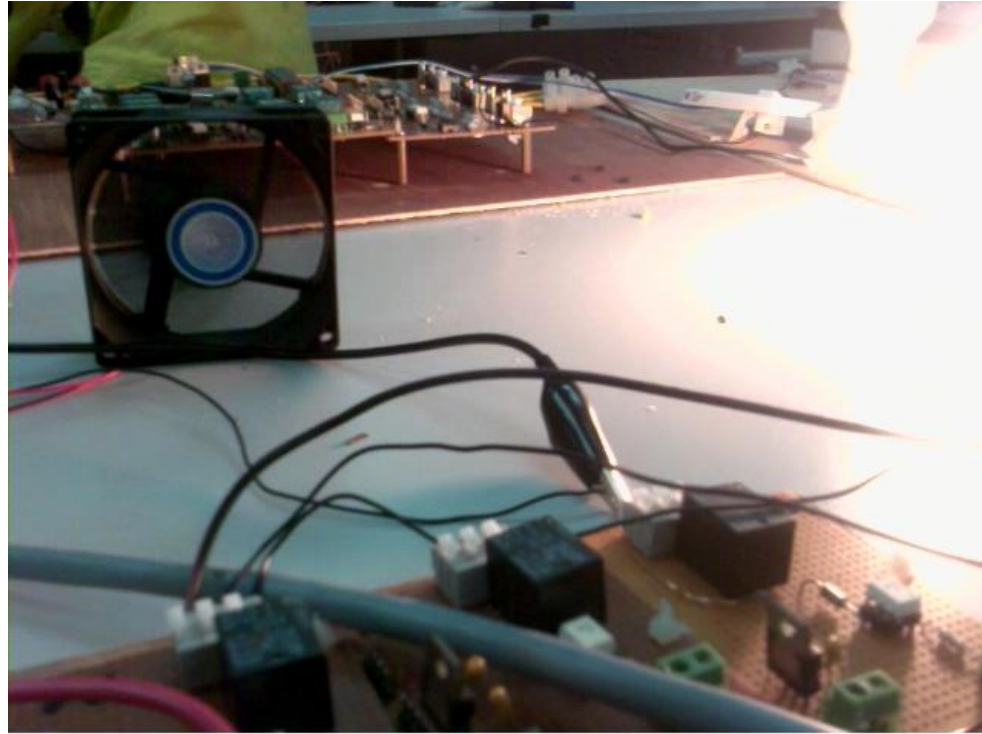
Figure 4.4 PIC Microcontroller Circuit

A tested has been made at all output port with LED to know the result. LED is function as the lighting system and air-conditioner. When sensor detects human presence, logic high will send to the 14 pin of output. This logic high represented by light at 14 units of LED.



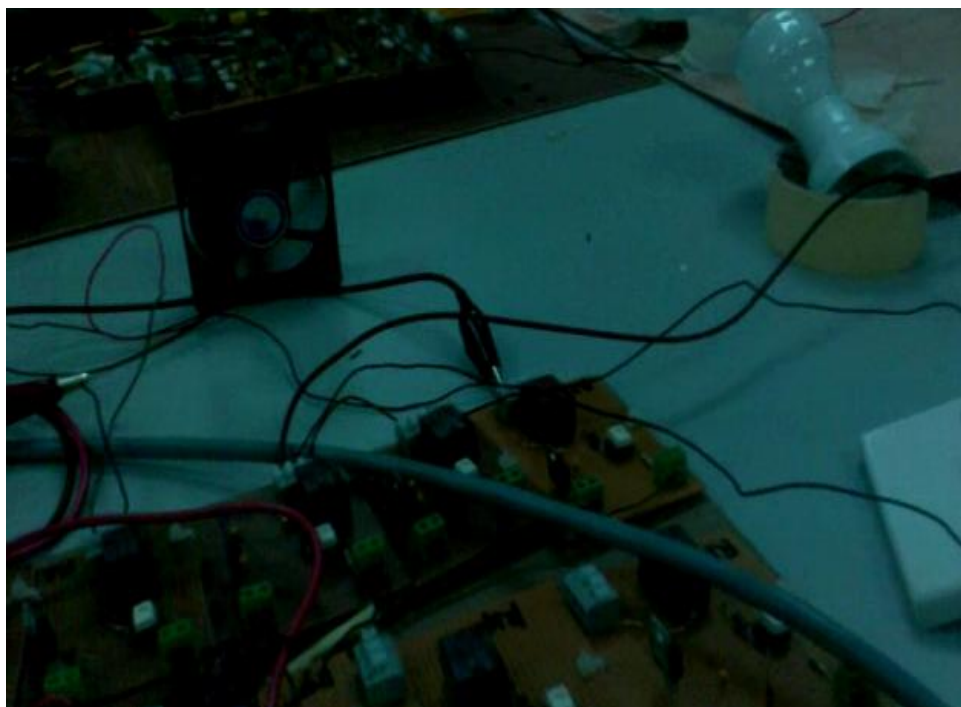
**Figure 4.5** Testing with LED

When sensor detects human presence, logic high will be send to the output pin. The logic high is represented by lamp and fan turn ON.



**Figure 4.6** Sensor detect Human Presence

When the sensor not detects any human presence in the room, logic low will be send to the pin relay lighting system and air-conditioner. The output will came out after 10 minutes. Logic high output that came out from output pin will be triggered the relay and triggered the magnetic contactor. If in 10 minutes, the sensor detects human presence, the logic high signal will not came out from the relay lighting system and air-conditioner.

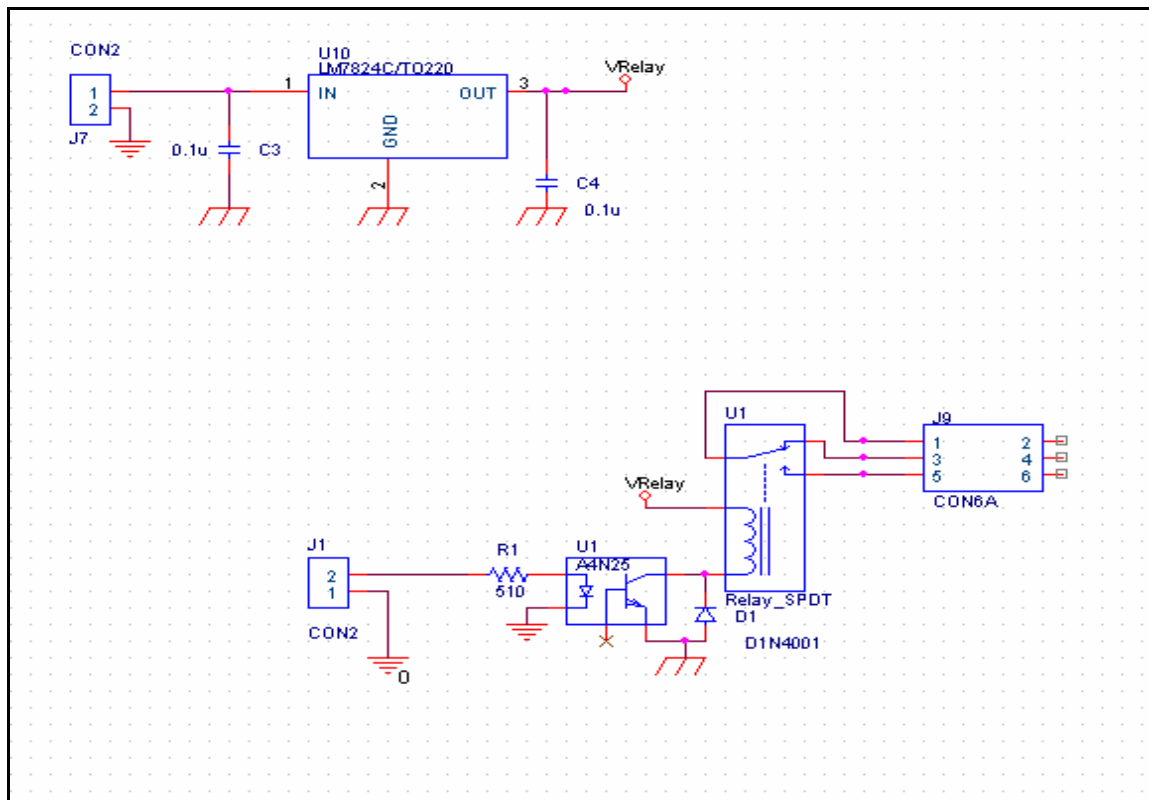


**Figure 4.7** After 10 minutes when no Human Presence



#### 4.4 Relay Interface Circuit Analysis

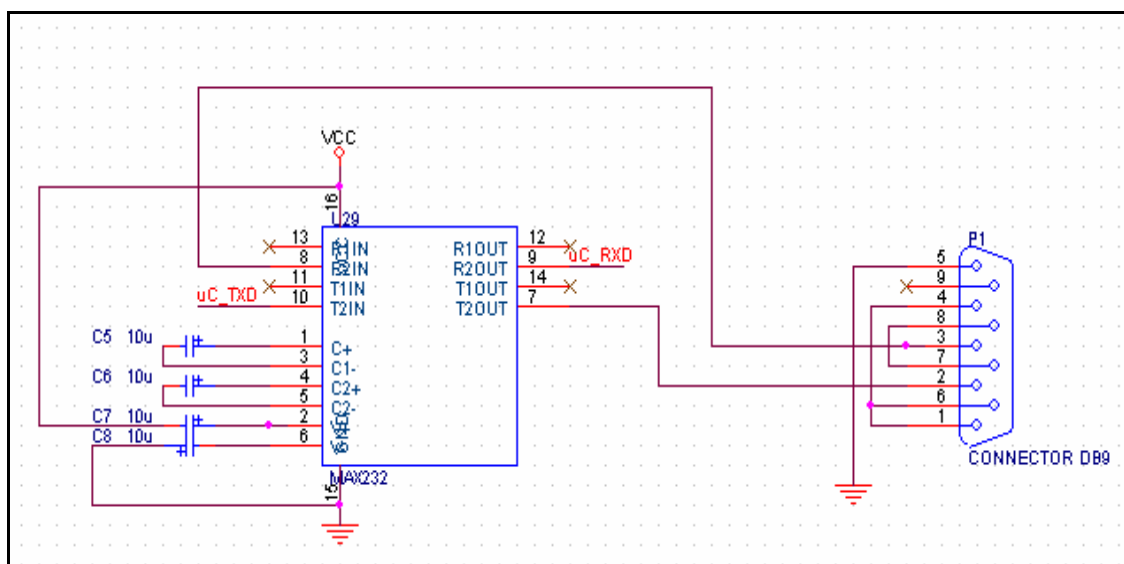
When sensor detects human presence, no output will come out from PIC. So, the relay will not trigger. This situation happened because the 24V that connected to the relay cannot trigger the relay because it not connected to the ground. For this situation, the transistor will function like a switch. For this time, the circuit is open because the switch (transistor) is open. When the sensor not detects any human presence, an output will come out from PIC and switch (transistor) on the circuit. 24V supply will triggered the relay and make the air conditioner and lighting system turn off.



**Figure 4.8** Relay Interface Circuit

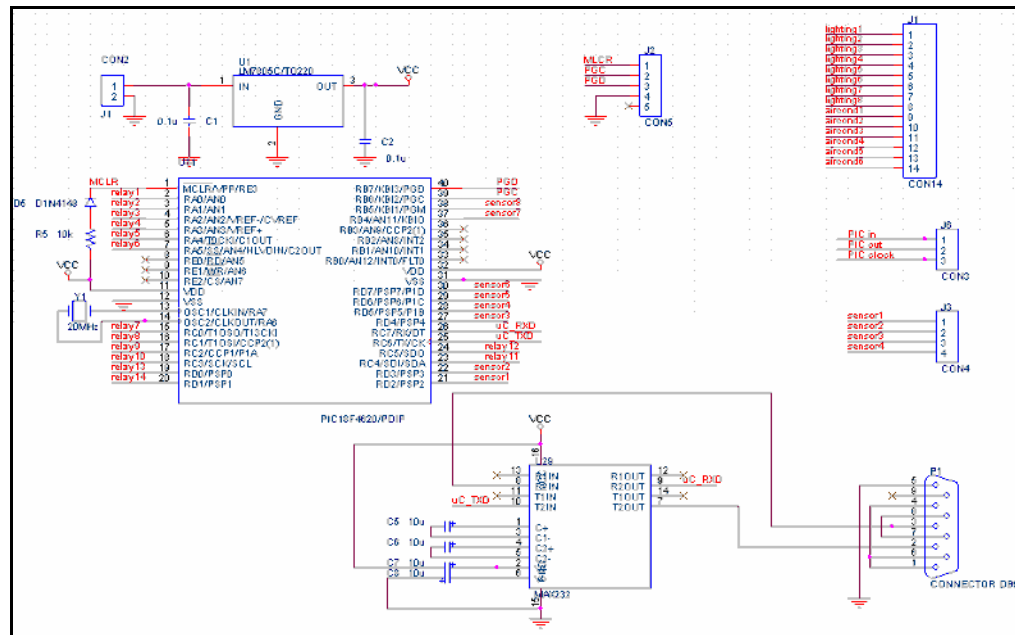
## 4.5 RS232 Communication Module

RS232 communication modules include IC MAX232 and 9-way serial port, connector DB9. MAX232 IC is connected to the PIC18F4620. Voltage +5V are needed to energize the MAX232 IC. The function of MAX232 IC is to transmit and receive the data from PIC to serial port. It will be the server for the PIC micro-controller to the communicate with computer.



**Figure 4.9** RS232-Interface Hardware and Software

## 4.6 Circuit Design and Modeling



**Figure 4.10** System Design Circuit

A 100W incandescent lamp and fan is use to represent the lighting system and air conditioner. Before the supply connects to the 100W incandescent lamp and fan, it will connect to the relay first. Then, from relay it will connect to the lamp and fan. A 24Vdc battery is use for supply a dc voltage to the voltage regulator.



**Figure 4.11** Hardware Design

#### **4.7 Conclusion**

Energy saving control system that has been done for lecture hall gives a full result to reduce the cost of electricity in University Malaysia Pahang (UMP). From this chapter, the theory also adapted to give information before start the project.

## **CHAPTER 5**

### **CONCLUSION**

#### **5.1 Conclusion**

This system was design to control the lightning and air conditioner in a smart way for energy savings and energy efficiency. The energy consumption in University Malaysia Pahang (UMP) can be reduced when this control system is applied in lecture halls. The hardware is completely done and the PIR sensor operates successfully with PIC hardware. The predetermine time cannot function successfully because the programming in Visual Basic cannot interrupt with PIC hardware. This problem make the Visual basic (VB) cannot send data to PIC hardware.

## 5.2 Recommendation and Future Development

For recommendation and future development, this control system can upgrade to make this system more systematically and efficient:

- (i) Testing this control system at wiring bay.
- (ii) Use more sensors for large area. Using more sensor can make this system more energy saving. This entire sensor will make this control more alert on human present.

The system also can be improved and developed for commercial used. It can reduce on electrical expenses and make the system intelligent by automatically controlled it in a building. The system also can use for security system which can activate an alarm to detect an intruder.

### 5.2.1 Cost and Commercialization

The overall costs of this project are shown in Table 5.1, Table 5.2, and Table 5.3 below:

**Table 5.1:** Cost for the Controller Board

Unit name	Component	Qty	Price/ RM	Total price/ RM
Controller Board	PIC 18F4620	1	15.00	15.00
	MAX232 IC	1	4.00	4.00
	40-pin IC holder	1	1.00	1.00
	16-pin IC holder	1	1.00	1.00
	4 MHz Crystal	1	6.00	6.00
	Heat sink	10	1.50	15.00
	LM7805CV	15	1.50	22.50
	10 $\mu$ F capacitor	8	0.60	4.80
	0.1 $\mu$ F capacitor	8	0.40	3.20
	LED	14	0.20	2.80
	Resistor 510	20	0.30	6.00
	Resistor 1 K	10	0.30	3.00
	Resistor 10Kohm	5	0.30	1.50
	Diode 1N4001	20	0.50	10.00
	Diode 1N4148	2	0.80	1.60
	Connector DB-9	1	3.00	3.00
	Relay SPDT	14	4.00	56.00
	Light base	4	4.50	18.00
	100W incandescent lamp	4	3.00	12.00
	Header	10	0.50	5.00
			<b>Total</b>	RM203.00

**Table 5.2:** Cost for Hardware Connection

Unit name	Component	Qty	Price/ RM	Total price/ RM
Connection	5 stands rainbow cable	1	2.00	2.00
	8 pin connector	1	2.00	2.00
	Wrapping wire	1	15.00	15.00
			<b>Total</b>	RM 19.00

**Table 5.3:** Overall Cost of the Project

Unit name	Total price/ RM
Controller board	203.00
Connection	19.00
<b>Total cost</b>	RM 222.00

The design of this project can be improved for commercial used. Below are the commercialization potentials for the Energy Saving Control System:

- (i) Place in the every lecture halls in UMP. So, there is no more energy wasting in UMP.
- (ii) As a security system which can activate alarm to detect an intruder.



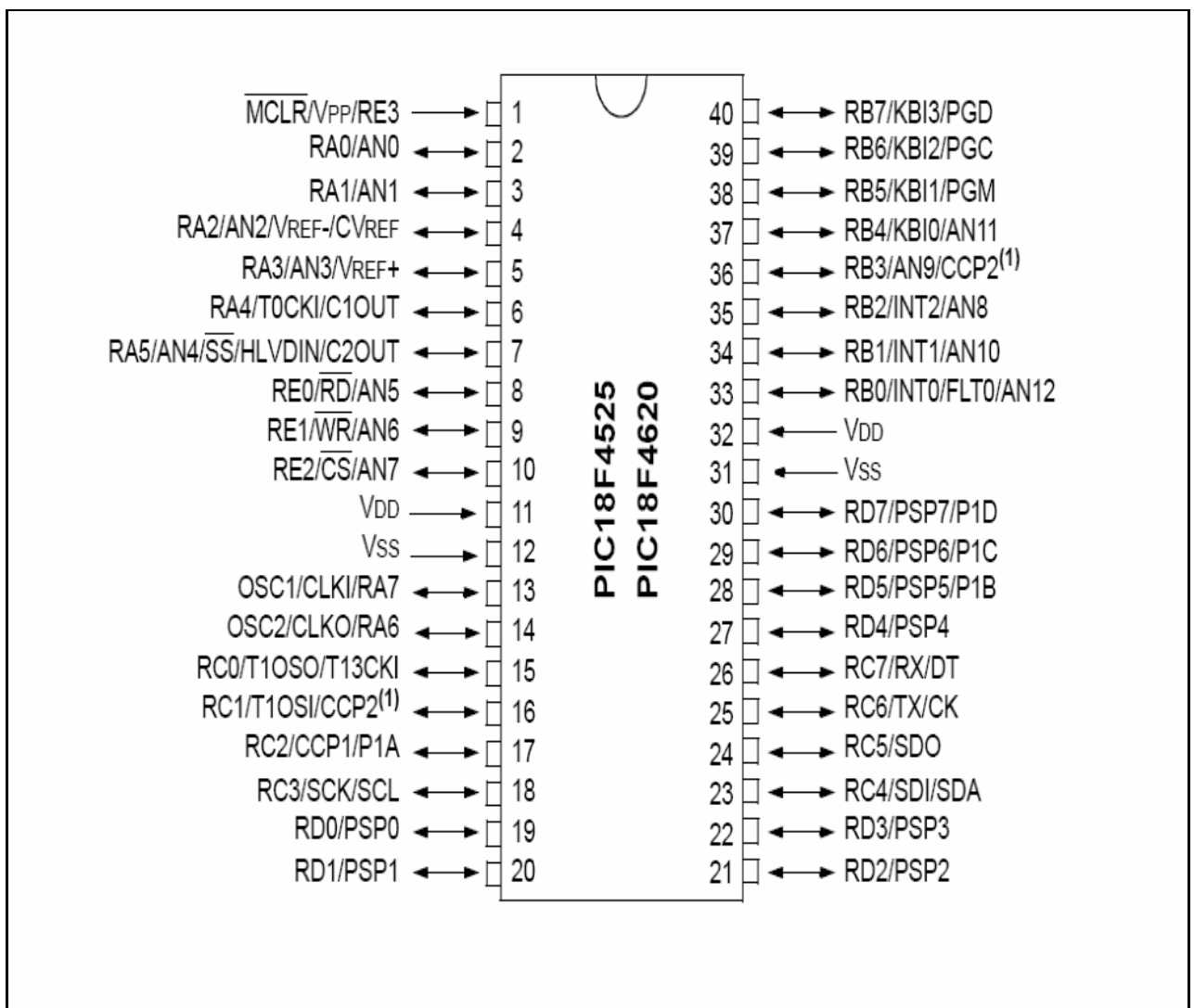
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## APPENDICES

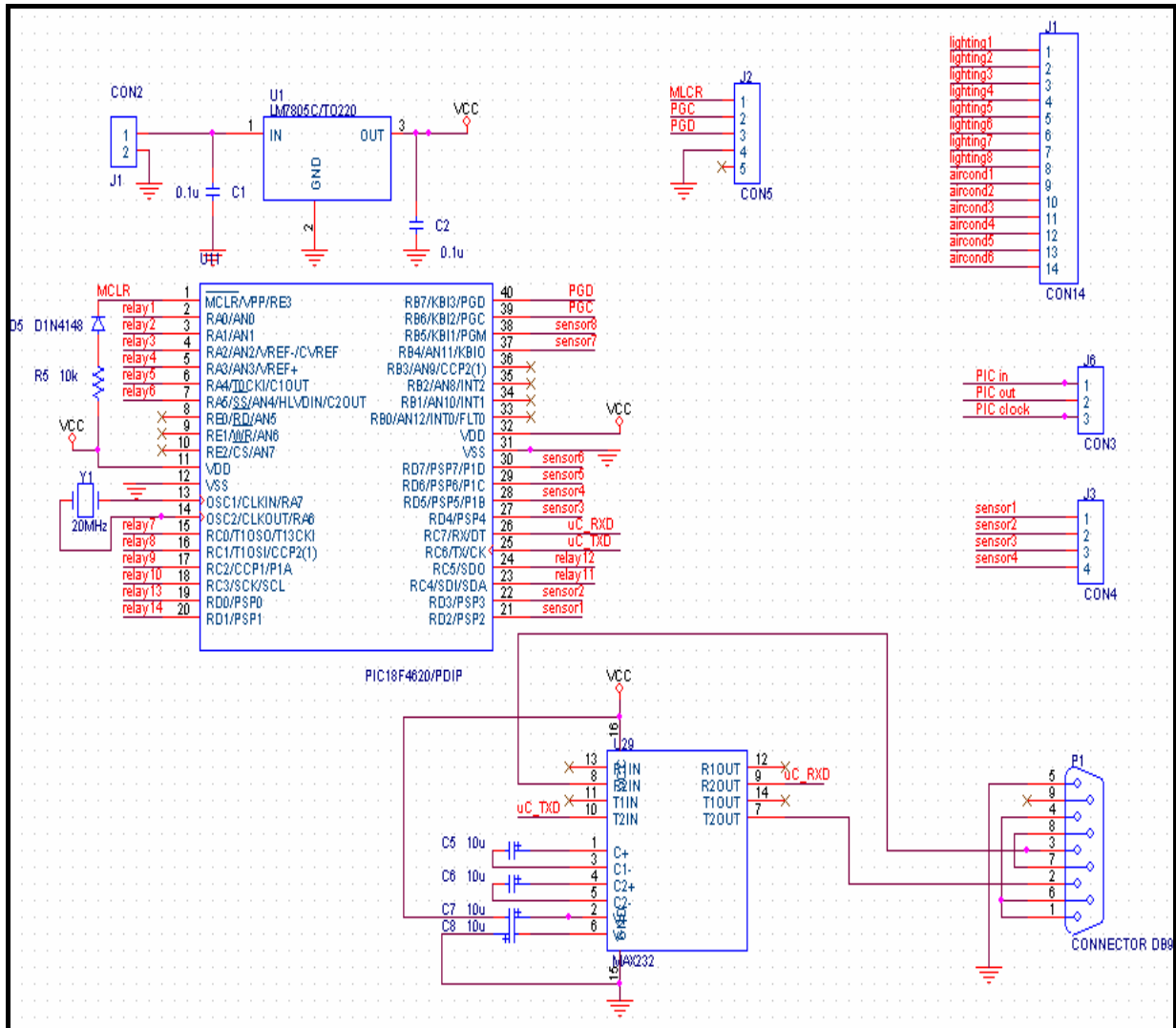
### APPENDIX A

#### PIC18F4620 Pin Diagrams



## APPENDIX B

### Circuit Design of the Project



## APPENDIX C

### Source Code for Visual Basic

```
Dim state As Byte

Private Sub cmdapply_Click()

End Sub

Private Sub cmdcancel_Click()
Unload Me
End Sub

Private Sub CMDCOMM_Click()
    If state = 0 Then
        state = 1
        CMDCOMM.Caption = "Enable COM"
        If MSComm1.PortOpen = True Then
            MSComm1.PortOpen = False
            MSComm1.RThreshold = 0
            MSComm1.SThreshold = 0
        End If
    End If
    If state = 1 Then
        state = 0
        CMDCOMM.Caption = "Disable COM"
        MSComm1.PortOpen = True
    End If
End Sub
```

```
MSComm1.RThreshold = 1
MSComm1.SThreshold = 1
End If
End Sub

Private Sub cmdok_Click()
MsgBox ("Are you sure you want to update configuration?")
End Sub

Private Sub cmdSyn_Click()
Timer4.Enabled = True

' MSComm1.Output = Text3.Text
'Text15.Text = MSComm1.Input
End Sub

Private Sub Command3_Click()
Text9.Text = Text6.Text
Text6.Enabled = False

Text10.Text = Text7.Text
Text7.Enabled = False

Text11.Text = Text8.Text
Text8.Enabled = False

Text12.Text = Text1.Text
Text1.Enabled = False
```

```
End Sub
```

```
Private Sub Command4_Click()
```

```
End
```

```
End Sub
```

```
Private Sub Command5_Click()
```

```
Text6.Enabled = True
```

```
Text7.Enabled = True
```

```
Text8.Enabled = True
```

```
Text1.Enabled = True
```

```
End Sub
```

```
Private Sub Command6_Click()
```

```
Text10.Text = Text9.Text
```

```
End Sub
```

```
Private Sub MSComm3_OnComm()
```

```
End Sub
```

```
Private Sub MSComm2_OnComm()
```

End Sub

Private Sub MSComm1\_OnComm()

Private Sub SerialCom1\_OnComm()

Dim charBuff As String

Dim Reading As Integer

Dim FoundStartFlag As Boolean

Dim splitstrings As Variant

Select Case SerialCom1.CommEvent

Case 2 ' Event messages... only care about event 2 (receive)

charBuff = SerialCom1.Input

Do While (Len(charBuff) > 0)

If WorkingOnAMessage = False Then ' Waiting for start signal... 253 in a byte

FoundStartFlag = False

Do While ((Len(charBuff) > 0) And (FoundStartFlag = False))

If (Asc(Mid(charBuff, 1, 1)) = 253) Then

WorkingOnAMessage = True

FoundStartFlag = True

Chars\_received = ""

End If

ByteNumber = 0

charBuff = Mid(charBuff, 2, Len(charBuff) - 1) ' Truncate buffer by one

Loop

End If

Do While (Len(charBuff) > 0) ' Only enter here if have good data left

ByteNumber = ByteNumber + 1 ' Increment our byte number

Reading = Asc(Mid(charBuff, 1, 1)) ' Get integer value of current character

```

charBuff = Mid(charBuff, 2, Len(charBuff) - 1) ' Truncate buffer by one
If Reading = 255 Then 'The stop byte
    WorkingOnAMessage = False
    ByteNumber = 0
    charBuff = ""

    splitstrings = Split(Chars_received, " ")
    If UBound(splitstrings) = 1 Then
        Adc1value = Val(splitstrings(0))
        Adc2value = Val(splitstrings(1))
        lblADC1.Caption = CStr(Adc1value)
        lblADC2.Caption = CStr(Adc2value)
        pbxArena.Circle (Adc1value, Adc2value), 1
    End If

    Else 'Have data... save it to string
        Chars_received = Chars_received & Chr(Reading)
    End If 'Ends Check for stop byte
    Loop 'Ends looping through good data in charBuffer...
Loop
End Select
End Sub

End Sub

Private Sub Timer1_Timer()
    lblTime.Caption = Format(Time(), "HH:MM")
    Text6.Text = Format(Time)

```



```
' If EventMsg$ = " Receive " Then
'   lblStatus.Caption = "Status Com : "
' End If
```

```
End Sub
```

```
Private Sub Timer2_Timer()
```

```
'If Text7.Text = lblTime.Caption Then
'MSComm1.Output = "!"
'From1.Shape1.FillColor = &HFF&
```

```
'Text7.Text = Format(Time)
```

```
' If EventMsg$ = " Receive " Then
'   lblStatus.Caption = "Status Com : "

' End If
```

```
End Sub
```

```
Private Sub Timer3_Timer()
```

```
'If Text8.Text = lblTime.Caption Then
'MSComm1.Output = "!"
'From1.Shape1.FillColor = &HFF&
```

```
'Text8.Text = Format(Time)
```

```
' If EventMsg$ = " Receive " Then
```

```
'    lblStatus.Caption = "Status Com : "  
' End If  
End Sub
```

```
Private Sub Timer4_Timer()  
    MSComm1.Output = Text3.Text  
    Text15.Text = MSComm1.Input  
End Sub
```

```
Private Sub tmrCPUDATE_Timer()  
    Text2.Text = Date  
    Text3.Text = Time  
  
End Sub
```

## APPENDIX D

### Source code for PIC 18F4620

```

*****
'* Name   : UNTITLED.BAS                               *
'* Author : [select VIEW...EDITOR OPTIONS]              *
'* Notice : Copyright (c) 2008 [select VIEW...EDITOR OPTIONS] *
'*       : All Rights Reserved                           *
'* Date   : 6/13/2008                                   *
'* Version : 1.0                                         *
'* Notes  :                                             *
'*       :                                             *
*****

define OSC 20
include "modedefs.bas"
DEFINE HSER_RCSTA 90h
DEFINE HSER_TXSTA 20h
DEFINE HSER_BAUD 9600
sspcon1.5=0
'adcon0=0 'convert analog to digital
'adcon1=0 'convert analog to digital
'adcon2=0 'convert analog to digital
adcon1=255
W_TEMP VAR BYTE
STATUS_TEMP VAR BYTE
TIME VAR byte[3]
data1 var byte

```

serdata var byte

time[0]=0

time[1]=0

time[2]=0

TIMEMS VAR BYTE

hour var byte[3]

minute var byte[3]

char var byte

trisa=0

trisa.1=0

trisa.2=0

trisa.3=0

trisa.4=0

trisa.5=0

trisc.0=0

trisc.1=0

trisc.2=0

trisc.3=0

trisd.0=0

trisd.1=0

trisc.4=0

trisc.5=0

LIGHT1 VAR PORTA.0

LIGHT2 Var PORTA.1

LIGHT3 var PORTA.2

LIGHT4 var PORTA.3

LIGHT5 var PORTA.4

LIGHT6 var PORTA.5

LIGHT7 var PORTC.0

LIGHT8 var PORTC.1

ACOND1 VAR PORTC.2

ACOND2 VAR PORTC.3

ACOND3 VAR PORTD.0

ACOND4 VAR PORTD.1

ACOND5 VAR PORTC.4

ACOND6 VAR PORTC.5

SENSOR1 VAR PORTD.4

RELAY\_BUFF VAR BYTE

RELAY1\_BUFF VAR BYTE

RELAY2\_BUFF VAR BYTE

RELAY\_PORT VAR PORTA

RELAY1\_PORT VAR PORTC

RELAY2\_PORT VAR PORTD

i var byte      'for counting

hentiflag var byte '1 ada org, 0 takde org

hentiflag = 0

hour[0] = 0

minute[0] = 1

gosub inittimer0

GOTO MAIN

DEFINE INTHAND hahaha

```
asm
```

```
hahaha:
```

```
    MOVWF _W_TEMP      ; Copy W to TEMP register,
    SWAPF STATUS, W     ; Swap status to be saved into W
    MOVWF _STATUS_TEMP
```

```
    BCF  INTCON,7
    BTFSC INTCON,2
    CALL _TimeChg
    BCF  INTCON,2
    BSF  INTCON,7
```

```
    SWAPF _STATUS_TEMP, W ; Swap nibbles in STATUS_TEMP register
                        ; and place result into W
```

```
    MOVWF STATUS ; Move W into STATUS register
                        ; (sets bank to original state)
```

```
    SWAPF _W_TEMP, F ; Swap nibbles in W_TEMP and place result in W_TEMP
```

```
    SWAPF _W_TEMP, W ; Swap nibbles in W_TEMP and place result into W
```

```
    retfie
```

```
endasm
```

```
main:
```

```
PORTA=TIME[2]
```

```
PORTC=TIME[2]
```

```
PORTD=TIME[2]
```

```
HSEROUT ["hai",13,10]
```

```
'hserin [serdata]
```

```
'serin2 portc.7,9600,200,main,[dec3 data1]
```

```
HSEROUT [dec time[0]]
```

```
HSEROUT [":"]
```

```
HSEROUT [dec time[1]]
```

```
HSEROUT [":"]
```

```
HSEROUT [dec time[2],13,10]
```

```
loop:
```

```
  Hserin 10000, main, [char]
```

```
  high LIGHT2  ;led is ON
```

```
  pause 200
```

```
  low LIGHT2  ;led is OFF
```

```
  pause 200
```

```
  Hserout [char]
```

```
  Goto loop
```

```
End
```

```
  pause 10000
```

```
    HIGH portd.3
```

```
    HIGH porta.1
```

```
    HIGH porta.2
```

```
    HIGH porta.3
```

```
    HIGH porta.4
```

```
    HIGH porta.5
```

```
    HIGH portc.1
```

```
    HIGH portc.2
```

```
    HIGH portc.3
```

```
    HIGH portd.0
```

```
    HIGH portd.1
```

```
    HIGH portc.4
```

```
    HIGH portc.5
```

```

' high portd.3

IF SENSOR1=0 THEN ' after 10S when no human_led off

    hentiflag=0
    gosub HENTI ' relay off after 10S
    hentiflag=1
    if hentiflag=1 then goto main

    low portd.3
    low porta.1
    low porta.2
    low porta.3
    low porta.4
    low porta.5
    low portc.1
    low portc.2
    low portc.3
    low portd.0
    low portd.1
    low portc.4
    low portc.5

' RELAY2_buff.3=0 ' led1 off
' RELAY2_PORT = RELAY2_buff
' 'pause 1000

```



```
' RELAY_buff.1=0          'after 1saat led2 off
' RELAY_PORT = RELAY_buff
' 'pause 1000

' RELAY_buff.2=0
' RELAY_PORT = RELAY_buff
' 'pause 1000

' RELAY_buff.3=0
' RELAY_PORT = RELAY_buff
' 'pause 1000

' RELAY_buff.4=0
' RELAY_PORT = RELAY_buff
' 'pause 1000

' RELAY_buff.5=0
' RELAY_PORT = RELAY_buff
' 'pause 1000

' RELAY1_buff.0=0
' RELAY1_PORT = RELAY1_buff
' 'pause 1000

' RELAY1_buff.1=0
' RELAY1_PORT = RELAY1_buff
' 'pause 1000

' RELAY1_buff.2=0
' RELAY1_PORT = RELAY1_buff
' 'pause 1000
```

```

'    RELAY1_buff.3=0
'    RELAY1_PORT = RELAY1_buff
'    'pause 1000

'    RELAY2_buff.0=0
'    RELAY2_PORT = RELAY2_buff
'    'pause 1000

'    RELAY2_buff.1=0
'    RELAY2_PORT = RELAY2_buff
'    'pause 1000

'    RELAY1_buff.4=0
'    RELAY1_PORT = RELAY1_buff
'    'pause 1000

'    RELAY1_buff.5=0
'    RELAY1_PORT = RELAY1_buff
'    'pause 1000

endif
goto main

HENTI: 'hentiflag
    for i=0 to 9      ' count for 10 minutes
        PAUSE 1000
        IF SENSOR1=1 then
            hentiflag=1
            goto henti_end
        endif
    
```

```
'pause 60000
next i
henti_end:
return

pause 500

goto main

'purple:

'low LIGHT1
'low LIGHT2
'low LIGHT3
'low LIGHT4
'low LIGHT5
'low LIGHT6
'low LIGHT7
'low LIGHT8
'low ACOND1
'low ACOND2
'low ACOND3
'low ACOND4
'low ACOND5
'low ACOND6
return

InitTimer0:
    INTCON.7=1
    T0CON.7=0    'STOP TIMER
```

```

T0CON.3=1
T0CON.4=0
T0CON.5=0
T0CON.6=0    '16-BIT
RCON.7=0    ' PRIORITY INTERRUPT DISABLE
INTCON.5=1    'ENABLE TIMER 0 INTERRUPT
INTCON.2=0    'FLAG CLEARED
TMR0L=$B0    ' 15536 '10MS INTERRUPT
TMR0H=$3C
T0CON.7=1    'TIMER ON
INTCON.5=1
return

```

TimeChg:

```

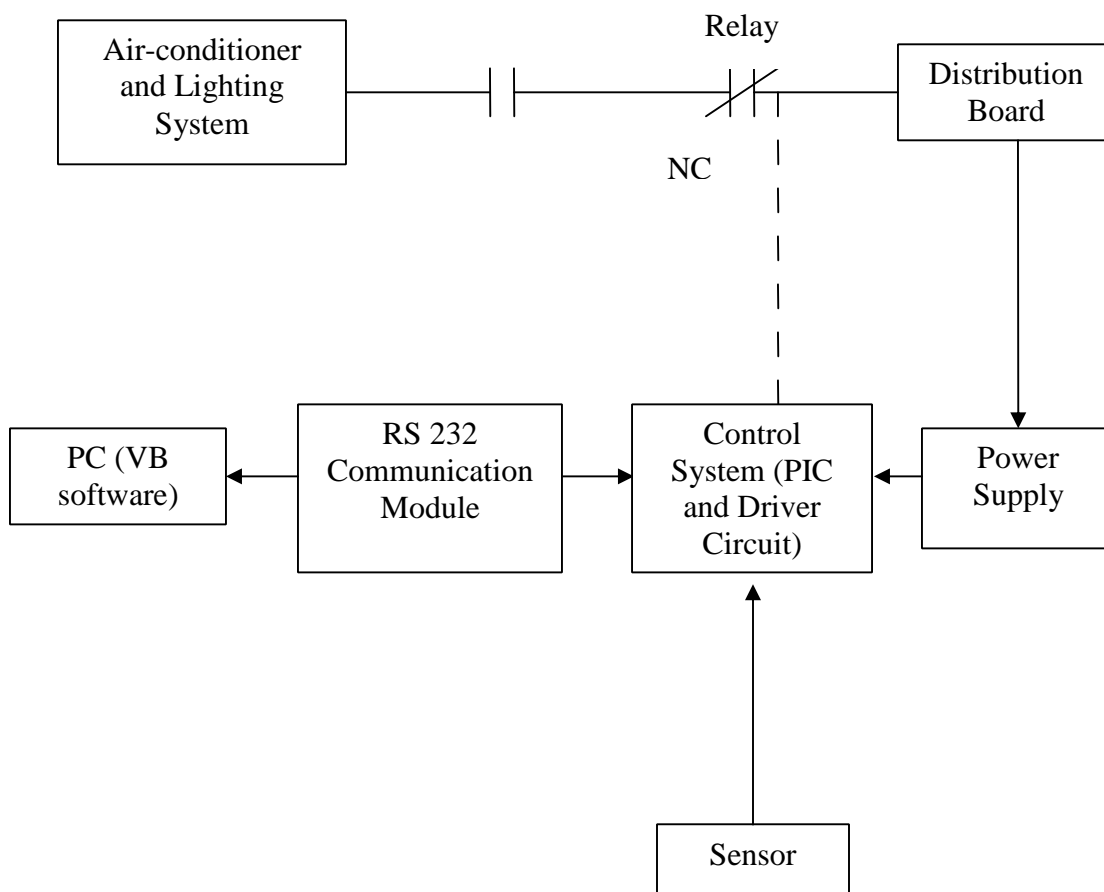
TIMEMS=TIMEMS+1
IF TIMEMS=100 THEN
    IF TIME[2]=59 THEN
        TIME[2]=0
        IF TIME[1]=59 THEN
            TIME[1]=0
            IF TIME[0]=23 THEN
                TIME[0]=0
            ELSE
                TIME[0]=TIME[0]+1
            ENDIF
        ELSE
            TIME[1]=TIME[1]+1
        ENDIF
    ELSE
        TIME[2]=TIME[2]+1
    ENDIF

```

```
TIMEMS=0
ENDIF
TMR0L=$B0    ' 15536 '10MS INTERRUPT
TMR0H=$3C
return
```

## APPENDIX E

## Block Diagram of Control System



## APPENDIX F

### Datasheet of PIR Sensor



#### PIR Motion Detector Module

Motion detector module uses a motion detector IC and PCB mounted Fresnel lens.

**Item: SB0061**

#### General

SB0061 is a pyroelectric sensor module which developed for human body detection. A PIR detector combined with a fresnel lens are mounted on a compact size PCB together with an analog IC, SB0061, and limited components to form the module. High level output of variable width is provided.

#### Features and Electrical Specification

- Compact size (28 x 38 mm)
- Supply current: DC5V-20V(can design DC3V-24V)
- Current drain :< 50uA
- (Other choice: DC0.8V-4.5V; Current drain: 1.5mA-0.1mA)
- Voltage Output: High/Low level signal 3.3V
- (Other choice: Open-Collector Output)
- TTL output
- High sensitivity

- Delay time 5s-18 minute
- Blockade time 0.5s-50s (acquiescently 0 seconds)
- Operation Temperature: -15oC -70Oc
- Infrared sensor: dual element, low noise, high sensitivity
- Light sensor: CdS photocell (can be add as customer requirement)

### **Lens information**

### **Application Note**

1. Power anode
2. Output: High level signal
3. Power cathode

H: Can be spring repeatedly

L: Can not be spring repeatedly

CDS: Photocell

### **Note**

Due to the high sensitivity of PIR sensor device, it is not recommended to use the module in the following or similar condition.

A) in rapid environmental changes

B) in strong shock or vibration

C) in a place where there are obstructing material (eg. glass) through which IR cannot pass within detection area.

D) exposed to direct sun light

E) exposed to direct wind from a heater or air condition



## APPENDIX G

PIC18F4620 Block Diagram

