AUTOMATED CONTROL FOR ELECTRICAL APPLIANCES BY USING RFID

MOHD YAZID BIN MOHD YOHANI

ELECTRICAL & ELECTRONICS ENGINEERING
UNIVERSITI TEKNOLOGI PETRONAS
JUNE 2010

AUTOMATED CONTROL FOR ELECTRICAL APPLIANCES BY USING RFID

By

MOHD YAZID BIN MOHD YOHANI

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
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

Automated Control For Electrical Appliances By Using RFID

by

Mohd Yazid Bin Mohd Yohani

A project dissertation submitted to the
Electrical & Electronics Engineering Programme
Universiti Teknologi PETRONAS
in partial fulfilment of the requirement for the
Bachelor of Engineering (Hons)
(Electrical & Electronics Engineering)

Approved:

____

Dr. Mohd Zuki Yusoff
Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK

June 2010

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.

Mohd Yazid Bin Mohd Yohani

ABSTRACT

This study features the implementation of a security system utilizing Radio Frequency Identification (RFID) which, through the basic interface provided by ASCII technology, allows interoperability with the tag (smart card). The RFID Automated Control for Electrical Appliances system is an access system that enables entry using a smart card, suitable for minimizing and reducing the electrical usage inside houses, offices and factories to ensure that only authorized personnel is allowed access. In terms of system design and development, this study consists of a combination of both hardware (circuit design) and software (program design). This project is completed successfully. Normal switches which uses manual controls are prone to waste the electrical energy, and the other hand, an RFID-based automated control adopt contactless technology that utilizes smartcards embedded with encrypted serial keys that can turn on the electrical appliances automatically. This feature ensures the reliability of RFID automated control for electrical appliances, providing a save energy control. The tags' ability to withstand environmental conditions such as intense heat, humidity, corrosive chemicals, mechanical vibration and shock also increases the reliability of the system.

ACKNOWLEDGEMENTS

The greatest pleasure in writing such report is when it comes to acknowledge the efforts of many people whose names may not appear on the cover, but without their hard work, cooperation, support and understanding, producing this report would be impossible.

First of all, I would like to thanks to my supervisor, Dr. Mohd Zuki Bin Yusoff for all the support that he gave on the project. Not forgetting to Ms Siti Hawa for providing guidance and technical support on this project.

Last but not least, warmest gratitude to my friends and family who never ending believe in my capability and never stop to give an inspiration and encouragement for me to move forward in completing this project.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

RFID	Radio Frequency Identification
RO	Read Only
WORM	Write Only, Read Many
RW	Read Write
LF	Low Frequency
HF	High Frequency
UHF	Ultra High Frequency

CHAPTER 1

INTRODUCTION

1.1 Background of Study

The electronic access control industry has been shifting from basic systems to more complex mechanisms. In the past, switch and remote control were used simply to turn on the lighting. These technologies are being phased out as more sophisticated systems such as smart cards and biometrics provide more convenience and more functionality like tracking of individuals entering and exiting buildings.

This project uses an RFID authentication system to communicate with a microcontroller which turns on the lighting if access is permitted. .

Home automation systems, or domotics, have the goal of minimizing and reducing the electricity used while focusing on aspects such as energy and environmental controls [1]. There are products on the market that can adjust systems such as lighting, climate, audio, and video, such as the Cortexa My Home, which allows users to control these systems from one location [2]. Typically these automation systems require manual user input or make adjustments on a schedule, whether it is a learned schedule or pre-programmed timing. IVCi [3] sells a system specifically dealing with the automation of lighting. Pre-set lighting conditions can be stored, but still require the user to select the desired settings.

1.2 Problem Statement

Nowadays, all the electrical appliances at home are controlled by a switch and a remote control. Sometimes, some people say that to turn on and to turn off the light by switch is a hassle. This situation can happen when people forget to turn off the light when they leave their home. In addition, it can be a waste of the electrical energy. Therefore, implementing adaptable lighting based on the user requesting entry and on the present natural light conditions will allow lights to be turned off when they normally would be left on in the absence of an occupant. For example, if it is dark just inside the door when an individual enters the unit, the entry light will automatically turn on upon entrance, eliminating the need to manually turn the light on. Sometimes, a user may inadvertently leave electrical appliances on while the individual is away. Removing the need to leave such a light on will reduce the amount of electricity used, enabling both the user and building complex to save money.

1.3 Objective

The purpose of this project is to automate control in Multiple Dwelling Units (MDUs) and office buildings using RFID technology. This technology will be used in order to customize lighting conditions based on the individual who is attempting entry. This system may primarily be purchased and installed by builders and developers of MDUs and offices, although it can be adapted to single family residences.

CHAPTER 2
LITERATURE REVIEW

2.1 RFID

RFID stands for radio frequency identification. The concept of using radio frequency (RF) to identify objects dates back to World War II when the RF was used to distinguish between returning English airplanes and the German ones. IFF or Identification Friend or Foe (IFF) is another area where a device aboard an aircraft is queried by a ground based device. The returned reply contains a code which identifies the aircraft as a 'friendly' one. If the code is wrong, the ground control system treats the intruding aircraft as potentially hostile.

RFID technology captures data using tiny tracking chips that are affixed to products. RFID applications range from potential areas such as security, manufacturing, logistics, animal tagging, waste management, postal tracking to airline baggage and road toll management.

RFID tags are creating a revolution in tracking systems. RFID is not just for smart store shelves alone - they can also aid in locating children in amusement parks. Combined with GPS and active RFID technology they can be the wonder application of this century [4].

2.2 RFID Technology

A typical RFID system consists of an antenna, a transceiver and a transponder (RF tag). The transceiver reads the radio frequency and transfers information to a processing device. The transponder or RFID tag is an integrated circuit that contains information to be transmitted. RFID technology uses radio waves for identification. An RFID tag is made up of a chip and antenna. The antenna allows the chip to transmit the information that is used for identification. The reader sends electromagnetic waves, which are received by the tag antenna. RFID technology differs from bar code systems in that it is not a line of sight technology. Radio Frequency Identification (RFID) technology uses radio waves to identify object by retrieving data embedded within RFID tag [5]. It is a contactless technology that uses radio waves to retrieve labeled tagged to a product, animal or person. A unique serial number that identifies a product, person, or object is stored on a microchip which is encased together with an antenna to form a tag or transponder. An RFID system is comprised of two sub-systems which are the tag and the reader, both of which have their own antennas.

Bar codes have to be seen and read by the scanner. Besides they do not uniquely identify each item. The RFID technology works on overcoming this shortcoming of line-of-sight technology. All types of RFID systems use non-contact and non line-of-sight technology. RFID tags can be read through snow, fog, ice, paint and other environmental conditions.

2.3 RFID Tag

RFID tags are helpful in tracking an individual item through the different locations it moves. A case in example is the use of RFID systems to move cars through an assembly line. At different stages of the production process, it keeps the computers informed about the next step in the assembly line. An RFID tag can be either active or passive. Passive RFID tags use the electrical current induced in the antenna by the incoming radio frequency scan. This means that the response of a passive RFID tag is brief [4].

The commercially available RFID products using passive RFID tags are thinner than a sheet of paper. Active RFID tags have their own power sources that enable longer range frequency as well as larger memory capacity. This allows them to store additional information. A typical RFID active tag has a battery life of several years. Passive RFID tags are more commonly available on account of their cheaper cost of manufacture. With passive RFID tags costing about RM1, it is poised for wider commercial applications. Varying levels of radio frequencies give rise to different kinds of RFID tags:

- Low frequency tags (between 125 to 134 KHz)
- High frequency tags (13.56 MHz)
- UHF tags (868 to 956 MHz)
- Microwave tags (2.45 GHz)

Active RFID tags are used to track high-value goods that need scanning over long ranges. A read-only RFID tag does not allow for any change to the information stored on it. Read-write RFID tag allows additional information to be added on to it [4].

2.4 RFID Applications

RFID applications help in tracking goods in the supply chain and during the manufacturing process. Another useful RFID application is one that allows controlled access to buildings and networks. Low frequency RFID applications are ideal for scanning objects with high water contents at close range. UHF tags are best for scanning boxes of goods. Any company seeking to implement RFID applications must choose the right frequency. RFID applications extend to triggering equipment deep down in the oil wells as well as reusable containers and high value tools.

Thousands of companies worldwide have resorted to RFID systems to improve efficiency in production as well as security features. Intelligent software agents are used with RFID applications so as to automate routine decision-making. Only situations that are out of the ordinary will be brought to notice. The FDA has issued a ruling in July 2004 that will review the use of RFID systems to identify patients and regulate the access of hospital staff.

2.5 Microchip PIC 16F877/16F877A

This powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC® architecture into an 40-pin package, as shown in Figure 1 and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices.

Feature of the device:

- 256 bytes of EEPROM data memory
- Self programming
- *10*-bit multi-channel Analog-to-Digital converter
- Two Capture, Compare, PWM functions
- Synchronous Serial Port (SSP) with SPI (Master mode) and I2C (Master/Slave)
- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection

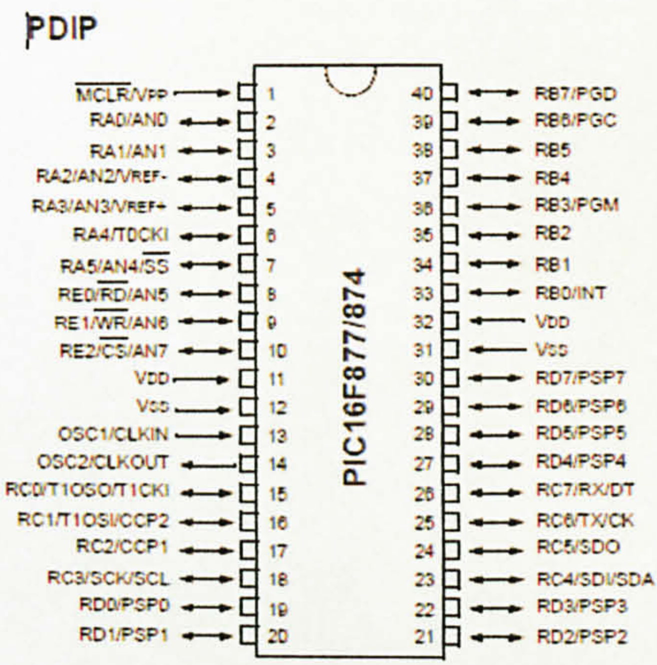

Figure 1 PIC 16F877A or 16F877

CHAPTER 3
METHODOLOGY AND PROJECT WORK

3.1 Procedure Identification & Flowchart

This project will go through the steps as shown in Figure 1 given on the next page. Basically this project will start with research and studies conducted based on journals, books and articles obtained from both resource center and the internet. Later on, a suitable tracking mechanism is chosen and the basic concept of the system is designed.

From the design of the system, each part of the system needs further research and studies. There have two types of design. Firstly, the hardware design and secondly is the software design. Hardware design is focused on how to construct and design the prototype of the circuit. After complete the hardware design, the software design should be followed. Software design is focused on how to program the system design to achieve the objective of this project.

After that, all the circuit design and programming language is going to be developed. Lastly, when all analysis of the system has been completed, the prototype of this project will be completed successfully.

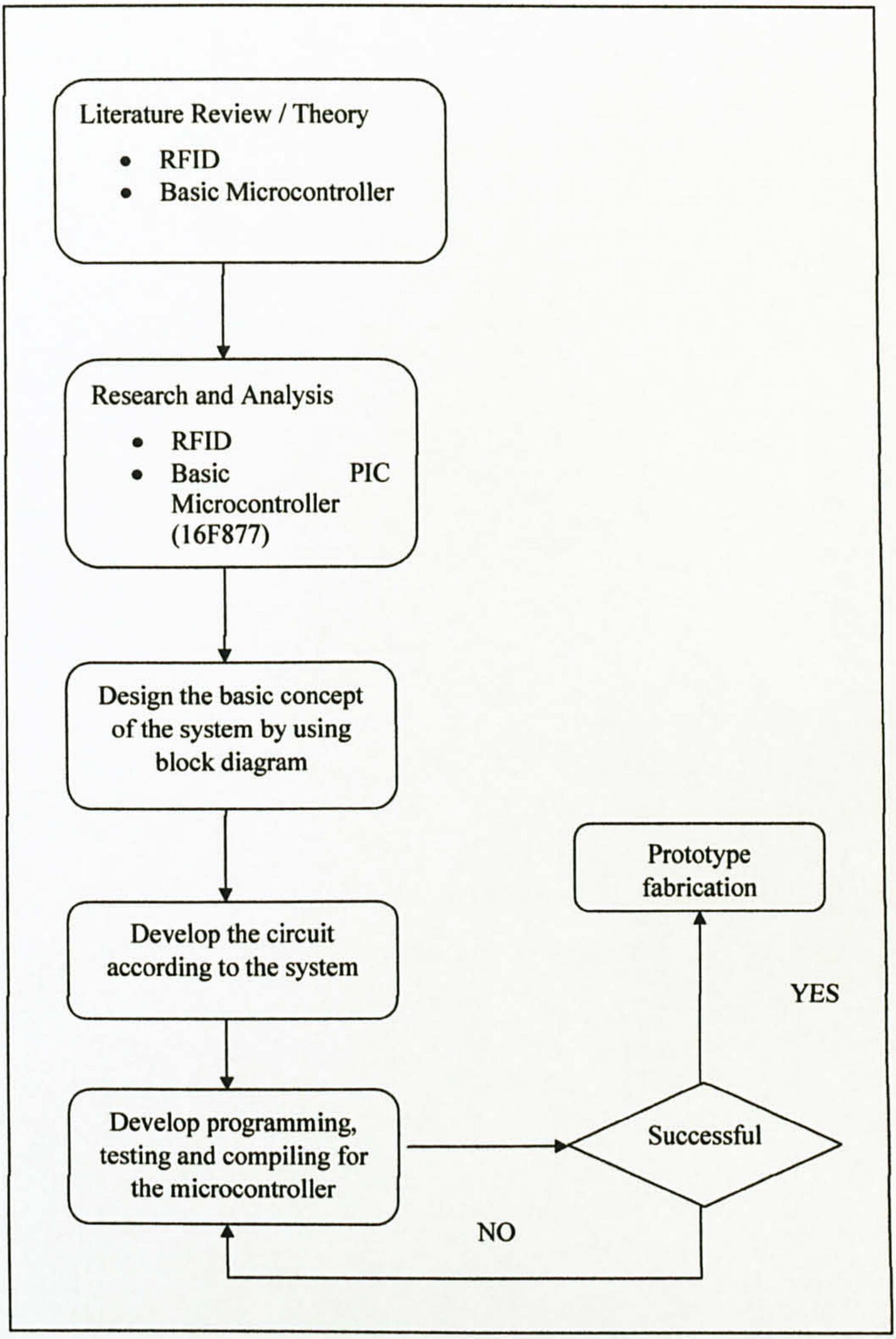

Figure 2 Flowchart for procedure identification

3.2 Technical Specifications

The RFID tag in conjunction with the RFID reader (IDR-232) will be used for keyless access or switch to turn on the electrical appliances at the building. The reader will communicate with the microcontroller, energizing the relay to control the electrical appliances within a house. The 12V relays are to connect to the NPN Darlington Array which serves as an interface between the low voltages signals from the microcontroller and 120 VAC line power.

3.2.1 RFID authentication

The RFID reader (IDR-232) receives data from the passive RFID tag. Communicating with the microcontroller, the former will compare the tag ID with a pre-determined database. Specifications for the RFID reader and RFID tag can be found in Table 1 below.

Table 1 RFID tag and RFID reader specifications

Item	**Specification**	**Description**
RFID Tag	EM4102 protocol	Specifies tag to be passive, read only with frequency of 125 kHz
RFID Read Range	3-4 inches	Typical range for passive RFID
RFID Reader Spacing	1 meter	Necessary spacing to prevent interference between readers

The other specifications for the RFID reader (IDR-232) are:

- Low cost solution for reading passive RFID transponder tags
- Industrial grade casing for better outlook and protection
- Integrated RFID reader, antenna, LED, power, cable and data cable
- 9600 baud RS232 serial interface (output only to PC)
- Fully operation with 5VDC power supply
- Buzzer as sound indication of activity
- Bi-color LED for visual indication of activity

Figure 3 below illustrates the RFID reader used in this project.

Figure 3 RFID reader (IDR-232)

3.2.2 Microcontroller

The program in the microcontroller will activate the appropriate outputs, energizing a set of relays that control the outputs. The specifications of these components can be found below in Table 2.

Table 2 Microcontroller and Electrical Components

Item	**Specification**	**Description**
Microcontroller	16F877A	Control the circuit
Relay Operation	80 – 100%	Operating voltage range for relay

3.3 System Overview

Figure 4 shows a complete block diagram of the RFID Automated Control for Electrical Appliances. The automated control comprises four modules which are attached to the PIC 16F877A microcontroller. They are the RFID reader module, a 2x16 LCD Display, 4 relays (RWH-SH-112), LEDs and a cooler fan. A scan mode LED and the system LED are implemented as indicators of the operation. All processing and data handling is performed by the PIC 16F877A microcontroller. For software implementation, the source codes are written in PIC Basic and compiled into assembly language to be programmed into the PIC 16F877A.

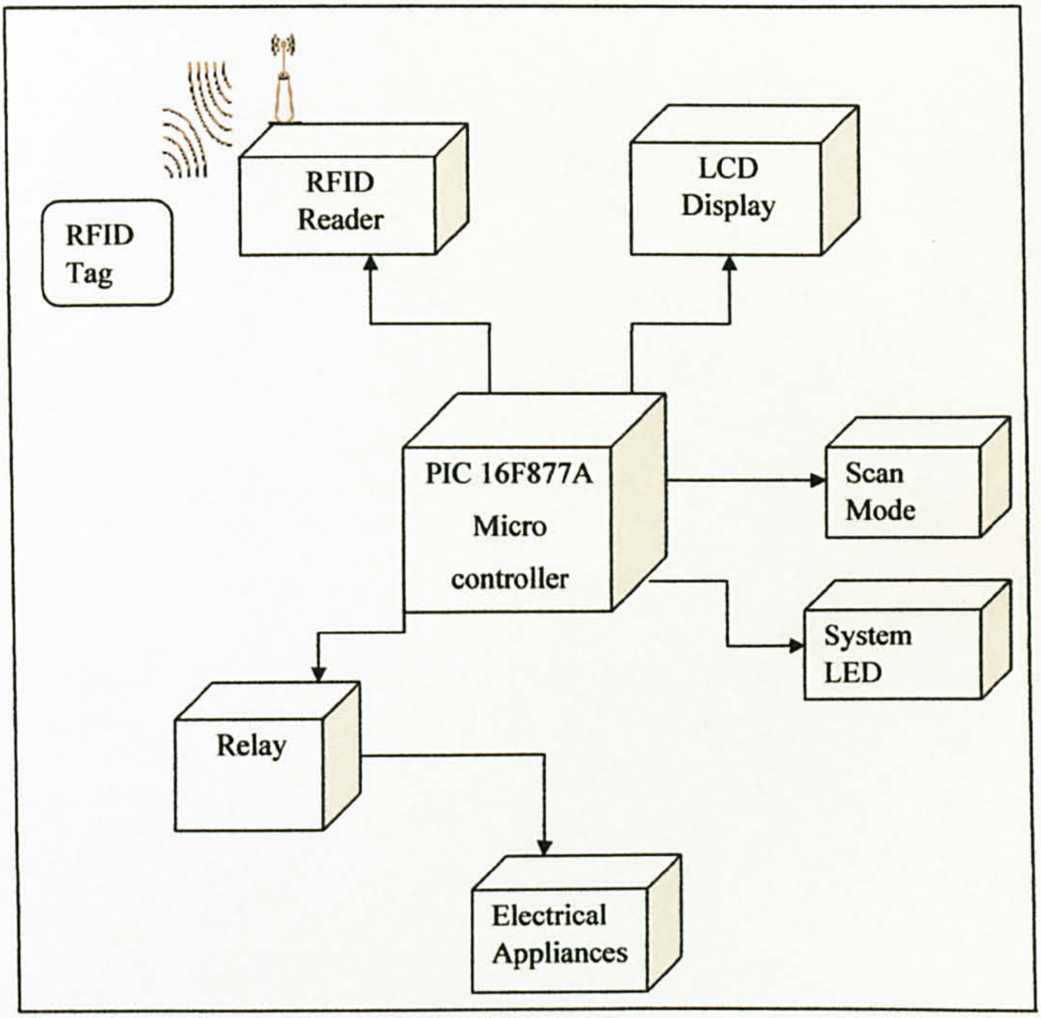

Figure 4 Block diagram of RFID automated control for electrical appliances

Figure 5 shows the operational overview of the system. Upon successful power on, the system LED will continuously blink to indicate readiness for processing a smartcard. To gain entry access, the user is required to place the tag in close proximity with the RFID reader. Each tag is assigned a unique serial number that identifies the respective tag user. Once the reader detects the presence of a tag, the scan mode LED will light up once to indicate success in reading the serial key for the tag. The data will then be transferred to the microcontroller for verification.

If a valid serial key is verified, a forward relay is triggered to enable the electrical appliances at home to be turned on. The name of the user will then be displayed on the LCD. Once the user leaves his/her home, the signal will be sent to the microcontroller, which then triggers the reverse relay to turn off all the electrical appliances.

If an invalid tag is placed near the reader, the system will treat it as an unauthorized entry attempt. The LCD then displays "ACCESS DENIED" and the electrical appliances remain turned off.

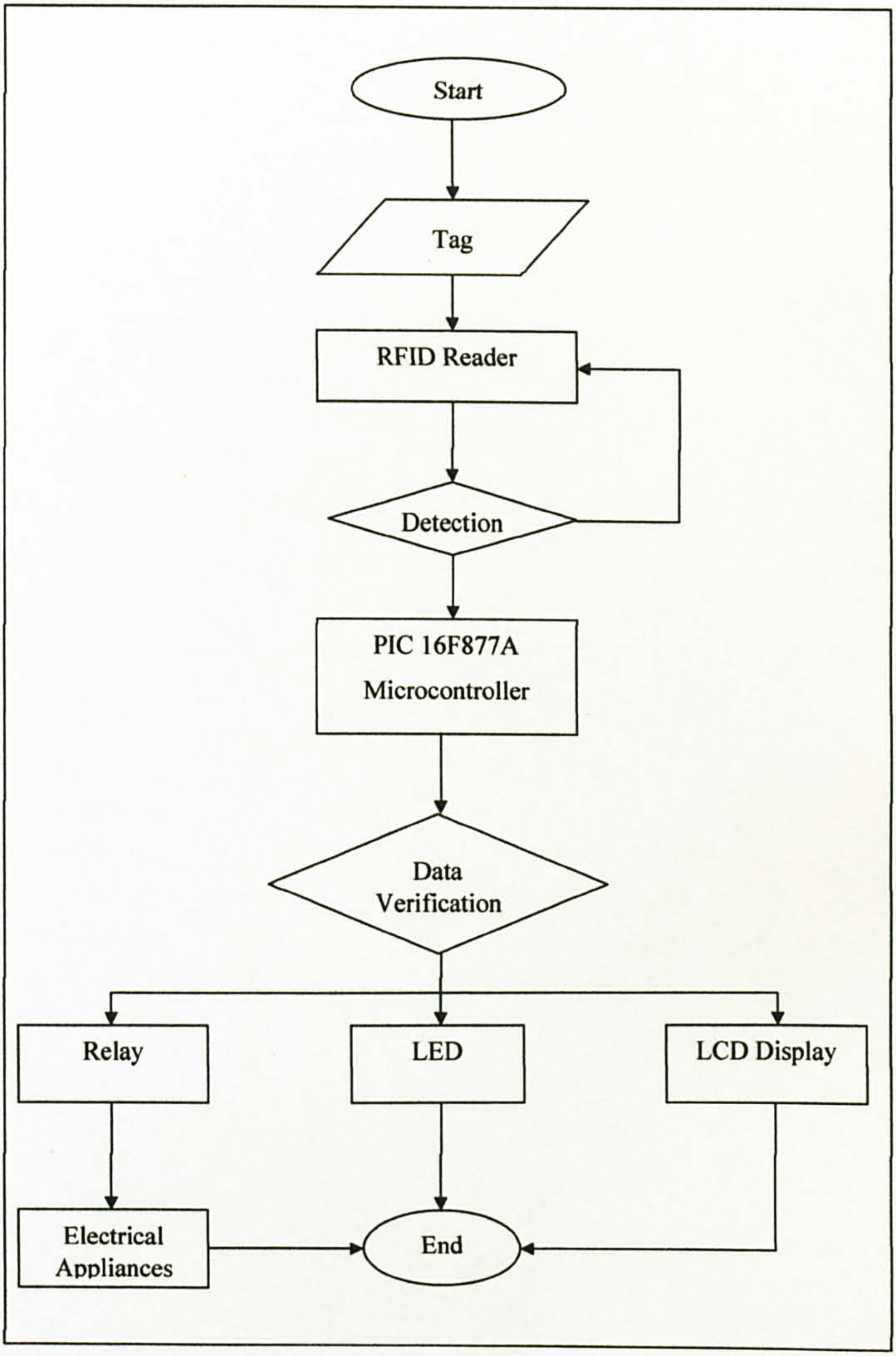

Figure 5 Overview of system operation

3.4 Data Coding / Encoding

The key ID in the RFID tag is encoded and wirelessly transmitted as a digital data stream. The receiver then decodes the incoming data to obtain the key on the tag. In RFID systems, the most common coding schemes used is the Manchester Coding.

The Manchester coding defines transition in the middle of each bit interval. When a '1' bit is present, there is a transition from high to low in the middle of the interval. When a '0' bit is present, there is a transition from low to high in the middle of the transition [6].

3.5 Hardware Design

3.5.1 Power supply for the circuit

Figure 6 shows the schematic power supply for the system's circuit. For power requirement, we choose AC to DC adaptor to power up the circuit. A 9V-12V dc voltage is required for activating the electrical appliance mechanisms. A higher input voltage will produce more heat at LM7805 voltage regulator. A typical voltage is 12V. Anyhow, the LM7805 will still generate some heat at 12V. There are two types of power connector for the circuit namely the DC plug (JI) and the 2510-02 connector at the RFID reader module. Normally AC to DC adaptor can be plugged to JI type connector.

As shown in Figure 6, the diode D2 is used to protect the circuit from wrong polarity of the power supply. The two capacitors C11 and C7 are used to stabilize the voltage at the input side of the LM7805 voltage regulator, while the capacitors C8 and C12 are used to stabilize the voltage at the output side of the LM7805 voltage regulator. The red LED is to indicate the power status of the circuit. The R13 resistor is to protect the red LED from over current that will burn the LED.

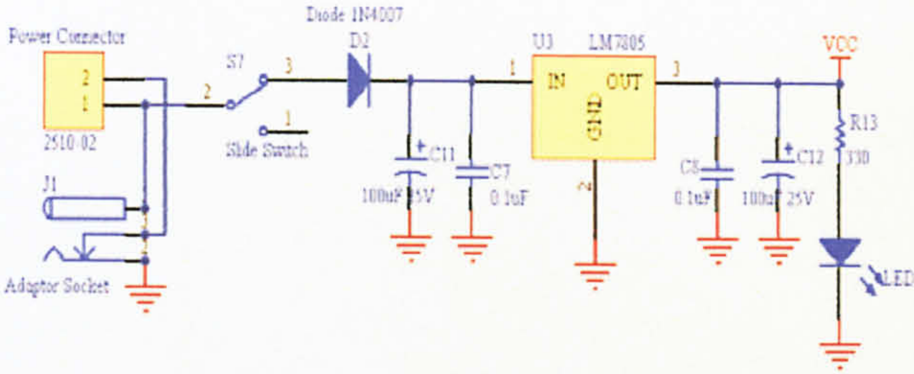

Figure 6 Power Supply for the Circuit

3.5.2 Interfacing of RFID reader (IDR-232) with PIC16F877A

The RFID reader comes with a serial port for data communication and a PS2 connector to supply 5V to the reader. For this project, we have to cut the wire of the RFID reader and connect the wire to a 2510-04 female connector. Different types of RFID reader sometimes have different color of output wire. There are four output wires coming from the RFID reader, but only three wires are terminated at the 2510-04 connector. Figure 7 depicts the output wires of the RFID reader.

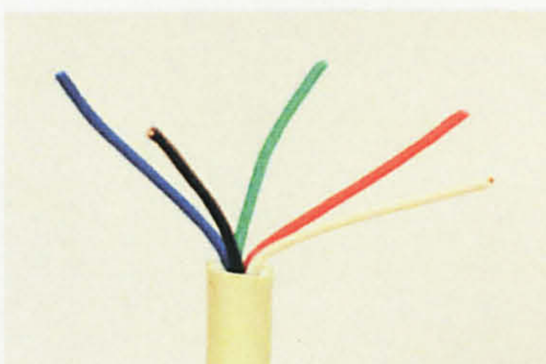

Figure 7 Output wire for RFID Reader

Table 3 The color of output wire

Color	Pin Function	Connection	Pin Number at 2510-04 connector
Blue	NC	NC	1
White	TX	RC7	2
Red	Vcc (5V)	5V	3
Black	Ground	GND	4

*NC = not connected

We are to utilize all the three wires (white, red and black) from 2510-04 female connector.

The output of the RFID reader is serial USART using logic +10V/-10V, and the baud rate is 9600 bps. The Figure 8 below is used to convert the +10V/-10V logic to the +5V/0V logic for suitable PIC circuit.

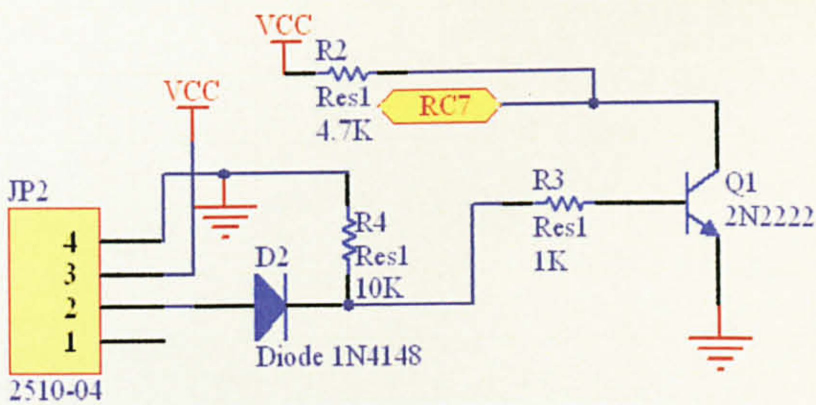

Figure 8 RFID reader connection

As shown in Figure 9, the PIC microcontroller operates at 4 MHz using an external crystal oscillator. The PIC 16F877A microcontroller's pin 29 (RX/RC7) connected to the reader will verify the information by decoding the data stream from the tag.

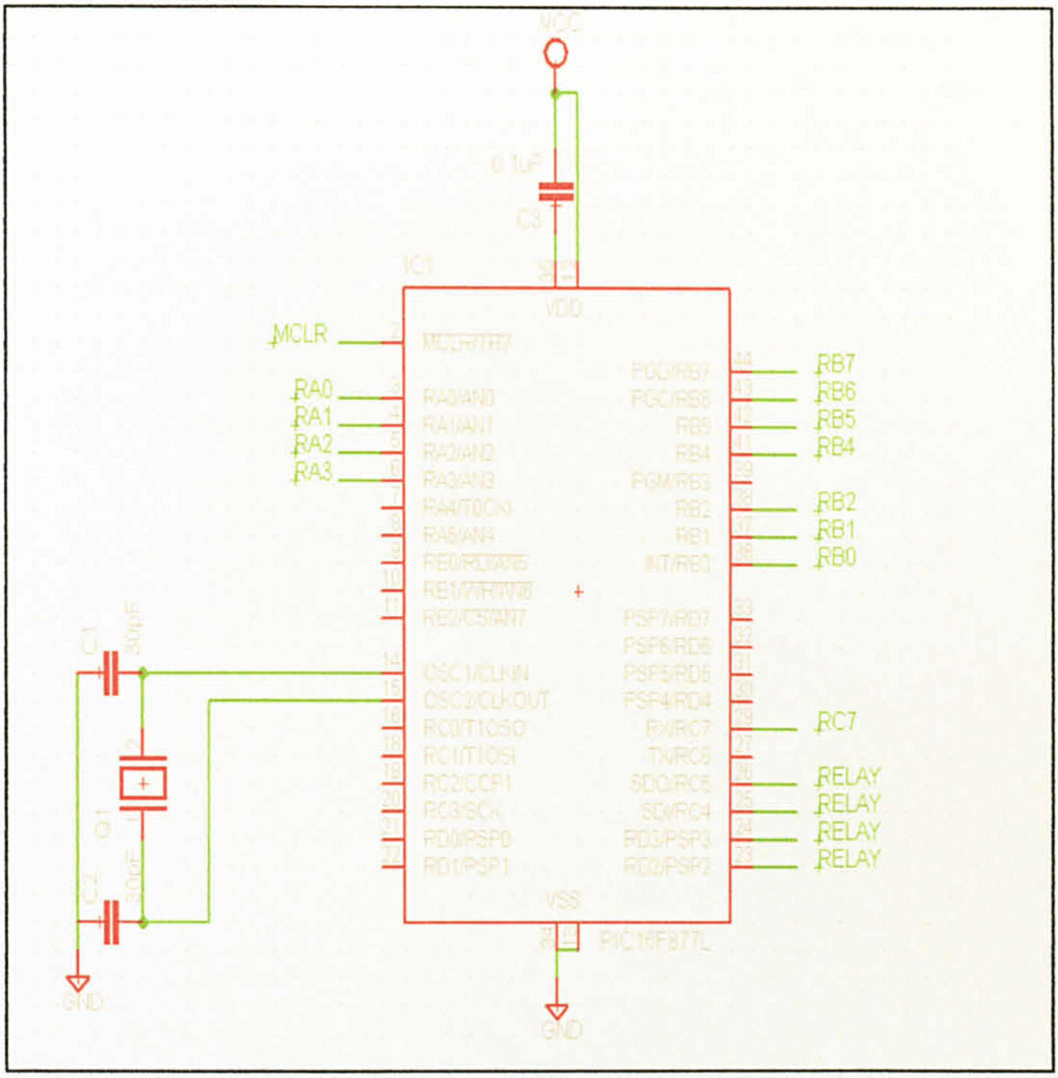

Figure 9 Schematic of the PIC 16F877A microcontroller

3.5.3 Interfacing of LCD with PIC 16F877A

To use the LCD, we have to solder 16 header pins to the LCD. The LCD used in the project is a 2x16 (JHD162A) as illustrated in Figure 10 below.

Figure 10 LCD Display JHD162A

Based on Figure 10, there are 16 different pins. The details LCD pin outs are listed in Table 4 below.

Table 4 The list of LCD pin

Pin	Name	Pin Function	Connection
1	VSS	Ground	GND
2	VCC	Positive supply for LCD	5V
3	VEE	Brightness adjust	Connected to a preset to adjust brightness
4	RS	Select register	RB1
5	R/W	Select read or write	RB2
6	E	Start data read or write	RB0
7	DB0	Data bus pin	NC
8	DB1	Data bus pin	NC
9	DB2	Data bus pin	NC
10	DB3	Data bus pin	NC
11	DB4	Data bus pin	RB4
12	DB5	Data bus pin	RB5
13	DB6	Data bus pin	RB6
14	DB7	Data bus pin	RB7
15	LED+	Backlight positive input	VCC

16	LED-	Backlight negative input	GND

*NC = not connected

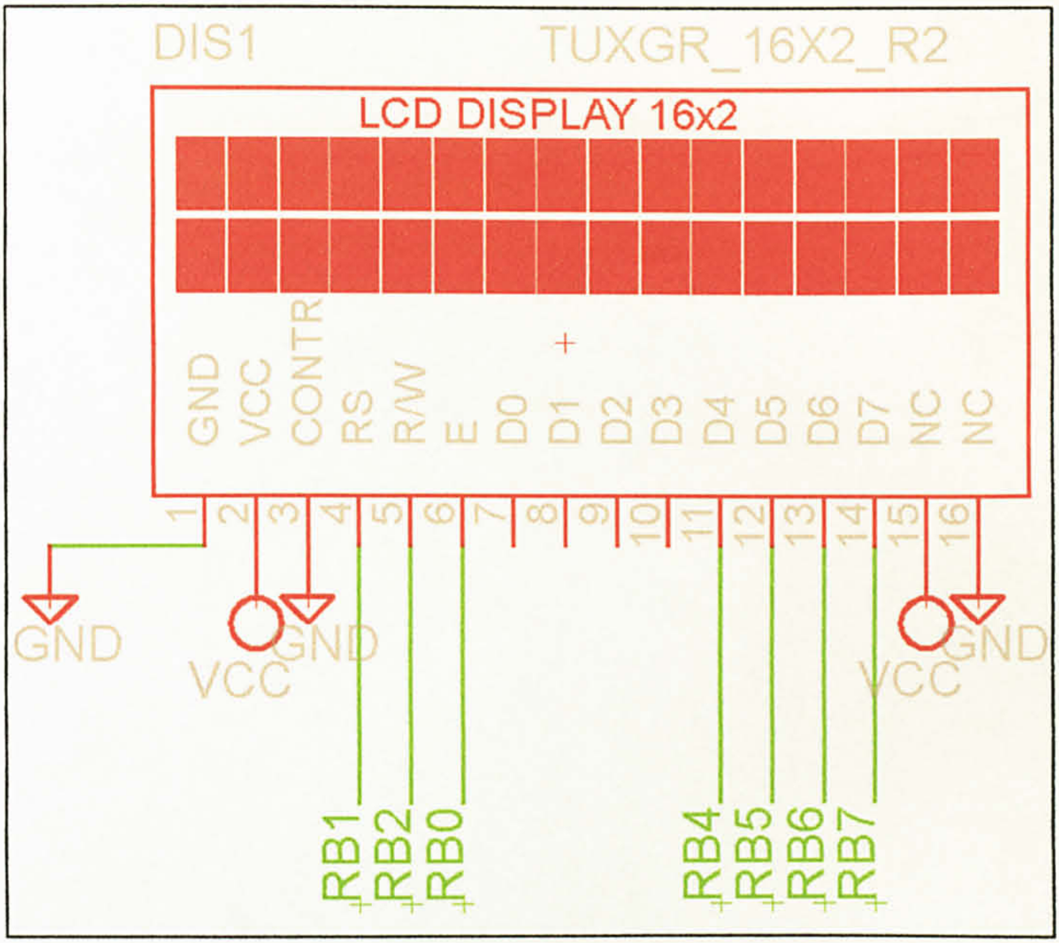

Figure 11 The schematic of a LCD display

3.5.4 Push button as input for PIC 16F877A

One I/O pin is designated for a push button serving as input to the PIC microcontroller. The connection of the push button to the I/O pin is shown in Figure 12. The I/O pin should be pull up to 5V using a resistor (with value range 1k-10k). This configuration will result in an active low input. When the button is pressed, reading of I/O pin will be in logic 0 (0V). On the other hand if the button is not pressed, reading of that I/O will be logic 1 (5V).

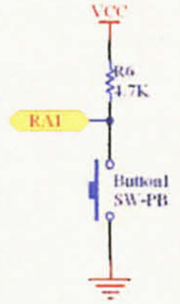

Figure 12 Push button

3.5.5 LEDs and buzzer as output for PIC microcontroller

Three I/O pins are designated for LEDs as output PIC microcontroller. The connection for a LED and buzzer to I/O pin is shown as Figure 13. The function of R10 and R11 are to protect the LED from over current that will burn the LED. When the output is logic 1, the LED will ON and the buzzer will activate (beep), while the output is logic 0, the LED will OFF and the buzzer will deactivate.

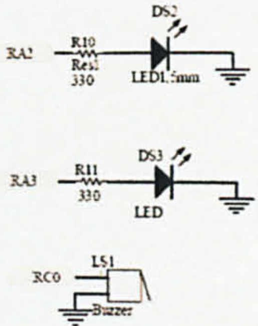

Figure 13 Schematic of LED and buzzer

3.5.6 The relay connection

Figure 14 shows the schematic of relay connections. Four normally-open relay are used to activate the lamp, fan, computer, etc. The relays are connected to the PIC microcontroller through four transistor circuits, which ensure that the relays are not accidentally activated.

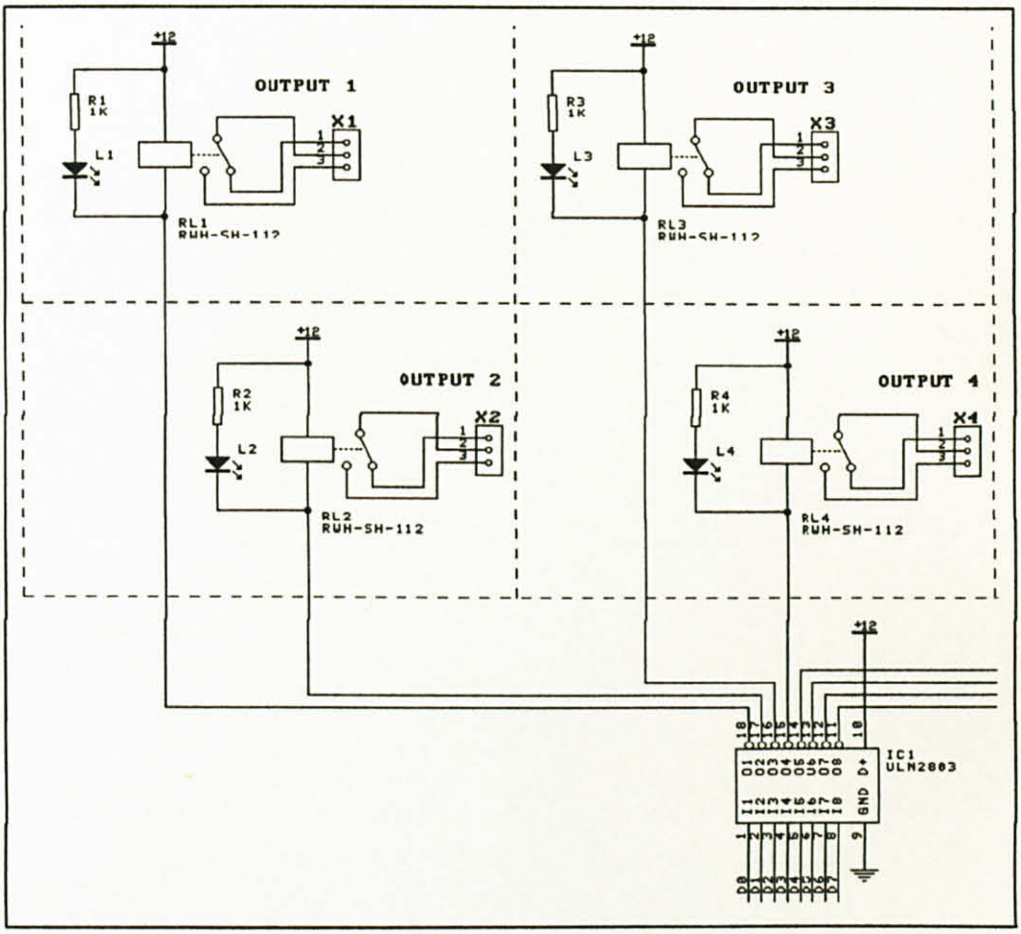

Figure 14 Schematic of relay from microcontroller

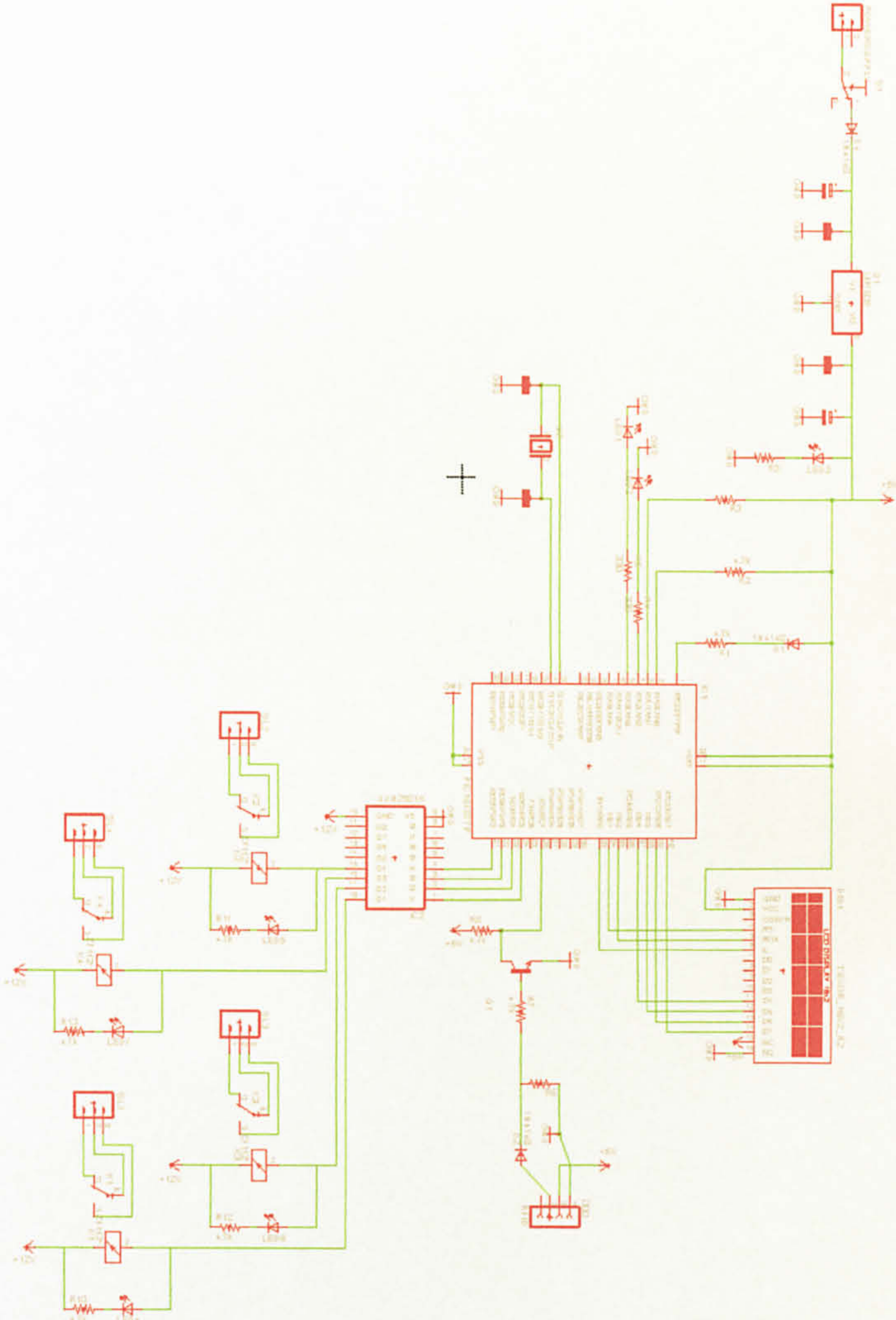

Figure 15 Full schematic for my project

3.6 Development of the 16F877A program

Before developing the program, it is essential to understand the mechanism of the RFID system. The RFID has a transmitter and receiver (transceiver) module which is used to receive the signal from the tag RFID tag. The RFID tag must be the correct ID to activate the circuit to be turn on the electrical appliances. The wrong tag or ID number cannot to turn on the system of the circuit.

Later on, the programming of the controller is developed. The PIC Basic software is used for the programming. This language is simple to develop compared to assembly language, which needs a lot of initialization. The program for controlling the RFID circuit is attached in **Appendix B**.

In this program, the RFID reader is to be synchronous with the ID tag numbers. In the program, we need to define 'XTAL=4' as the crystal used is 4 MHz. The input and output should be digital make it easy to control and define which ones are 0's and which ones are logic 1's.

Also in the program, we define SPBRG = 6. SPBRG is a register to control the period of a free running 8-bit timer. In asynchronous mode bit BRGH (TXSTA<2>) also controls the baud rate. In synchronous mode bit BRGH is ignored. Given the desired baud rate and FOSC, the nearest integer value for the SPBRG register can be calculated using the formula in Table 5. From this, the error in baud rate can be determined.

Table 5 Baud rate formula

Sync	BRGH= 0 (Low Speed)	BRGH =1 (high Speed)
0	(Asynchronous) Baud Rate = FOSC/(64(X+1))	Baud Rate = FOSC/(X+1))
1	(Synchronous) Baud Rate = FOSC/(4(X+1))	N/A

It may be advantageous to use the high baud rate (BRGH = 1), even for slower baud clocks. This is because the FOSC/ (16(X + 1)) equation can reduce the baud rate error in some cases. Writing a new value to the SPBRG register causes the BRG timer to be reset (or cleared). This ensures the BRG does not wait for a timer overflow before outputting the new baud rate. So, we used for the low speed. The formula in Figure 16 below shows the formula for computation of the baud rate for different USART modes which only apply in master mode (internal clock). The BRG supports both the Asynchronous and Synchronous modes of the USART. It is a dedicated 8-bit baud rate generator.

FOSC = 4 MHz
Desired Baud Rate = 9600

Desired Baud rate = Fosc / (64 (X + 1))
9600 = 4000000 / (64 (X + 1))
X = 6

Figure 16 The baud rate formula

RCSTA as shown in Figure 17 is Receive Status and Control Register that is defined in my programming. This register is used to connect to the receiver such as the RFID reader, via the PIC microcontroller's RC7/RX/DT pin (pin 29). The SPEN (bit 7) of RCSTA is enabled to receive the data and drives the data recovery block. Once Asynchronous mode is selected, reception is enabled by setting the CREN (bit.4).

SPEN	RX9	SREN	CREN	ADDEN	FERR	OERR	RX9D
Bit 7							Bit 0

Figure 17 RCSTA: Receive Status and Control Register

TXSTA as shown in Figure 18 is the Transmitter Status and Control Register. Transmission is enabled by enabling the TXEN (bit 5) of TXSTA. The actual transmission will not occur until the TXREG register has been loaded with data and the baud rate generator (BRG) has produced a shift clock.

CSRC	TX9	TXEN	SYNC	-	BRGH	TRMT	TX9D

Bit 7 Bit 0

Figure 18 TXSTA: Transmit Status and Control Register

Last but not least for programming, we put the ten numbers as a character. The ten numbers are the ones written on the individual RFID tag. Each RFID tag has a different ID tag number.

3.7 State Machine for the Program

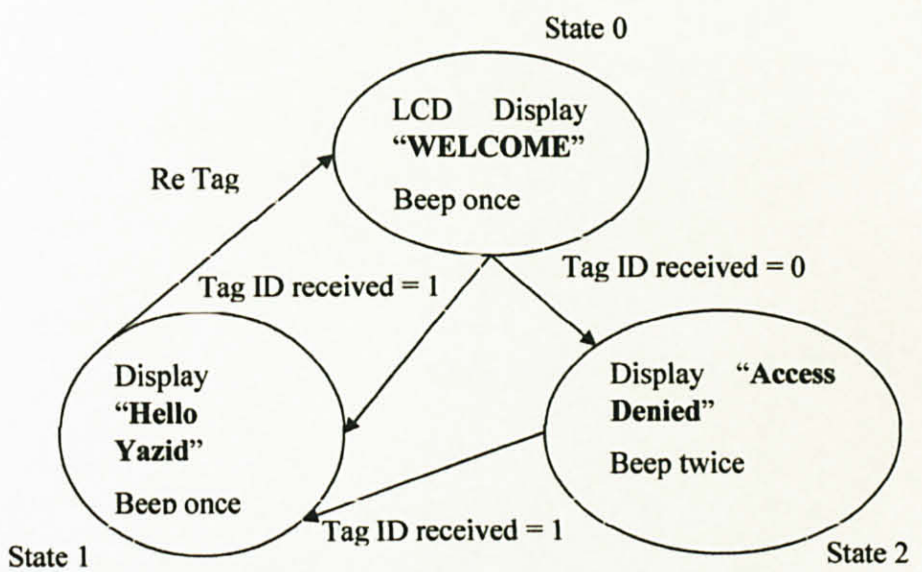

Figure 19 The three state machine conditions for programming

Figure 19 shows the three conditions for the programming; the message to be display on the LCD display will follow the state condition. The state 0 condition indicates when the power supply is connected. During this time the output is logic 1, to the LED (RA2). When the output is logic 1, the LED is ON and the LCD display will display "WELCOME". When the reader received the tag ID, there are another two conditions that the programming can be state either *State 1* or *State 2*.

State 1 indicates when the tag ID is correct. As an example, if RFID card (tag) bearing a code ID "0004274923" is tagged to the RFID reader, pertinent data will be sent from the card to the reader. The reader will then decide whether the sent data contain a valid code. For this, the same ID is pre-programmed in the memory of the 16F877A microcontroller. This serves as a database for authenticating any attempt from the user to access the electrical appliances. When the put character of "0004274923" = 1, the LCD display will display "Hello Yazid", the buzzer will activate (beep) and the relay is activated as well. When the tag ID is retagged to the reader, the microcontroller will return to *State 0.* This means that the input to the relay will toggle causing the relay to deactivate and the LCD display to display "WELCOME".

State 2 shows when an invalid card being tagged to the reader. In this case, the code ID is not the same as the previous tag ID. Therefore, in the programming we put the character number as "0004274923 = 0. Here, the LCD display will display "Access Denied", the buzzer will activate (twice beep) and the relay will not energized. From *State 2* can be returned to *State 1* when the RFID reader detected the valid card and the LCD display to display "Hello Yazid"

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Results and Discussion

When the valid test tag data are verified, the relay is activated to power up and turn on the electrical appliances. to The maximum reading distance between the tag and reader is about 7.5 cm, with a carrier frequency of 125 kHz. Figure 20 below shows a scenario where the reader detects the RFID tag within the distance is 7.5cm.

Figure 20 The maximum distance between tag and reader

The RFID reader is able to read only one card at a time. When multiple tags are placed on the reader simultaneously, the tags will reflect back their signals at the same time to the reader thus causing an overload; under these circumstances, no data is transferred to the reader.

After the user turn on the system, the RFID reader detects the valid tag, and the PIC microcontroller then triggers the relay, to turn on the AC socket (the AC extension) as the output. Figures 20 and 21 below illustrated the results before and after the successful detection of the valid card, respectively.

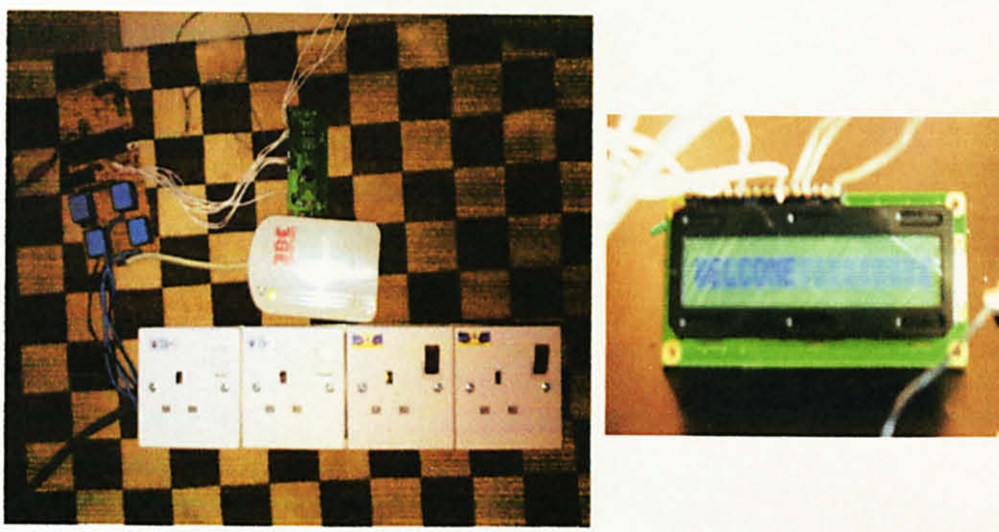

Figure 21 Before the RFID reader detect the valid tag

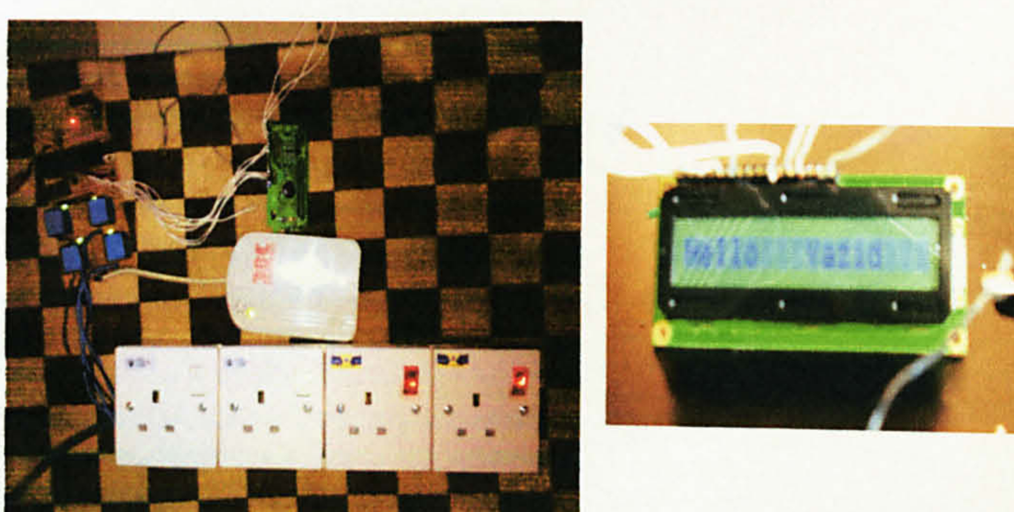

Figure 22 After the RFID reader detect the valid tag

When the RFID reader detects the invalid tag and the PIC microcontroller then the relay not triggered, not to turn on the AC socket (the AC extension) as the output. Figure 23 below illustrated the result after the successful detection of the invalid card.

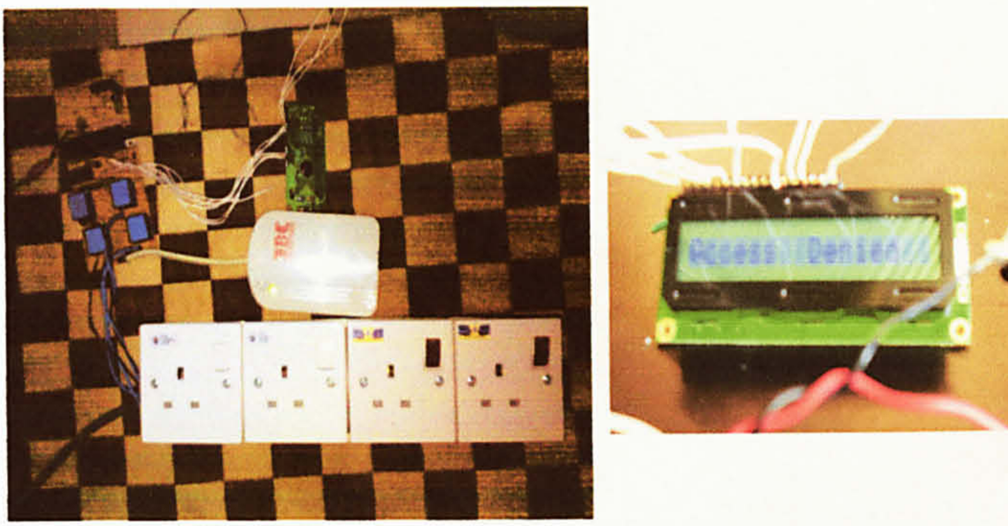

Figure 23 After the RFID reader detect the invalid tag

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The system design and software implementation have proven to be effective and efficient. It provides access only to authorized personnel, and displays the identity of the user as soon as the tag is within activation range of the reader. The adoption of RFID technology in automation control applications is feasible, and provides a more secure, as the contact-less technology minimizes the risk of tag cloning. Although RFID is a relatively new technology, its performance and reliability has proven its potential to be integrated in various applications.

5.2 Future Work

Further improvements can be implemented on this system to enhance its features and functionality. A sensor could be used to this system to automate close the system without tagging the card to the RFID reader. The sensor will detect that there is no movement in the building and all the electrical appliances will be turned off automatically.

REFERENCES

[1] K. Sangani, "It's No Place Like Home," Engineering and Technology, vol. 1, issue 9, pp.46-48, Dec. 2006.

[2] Cortexa Systems, "Cortexa Intelligent Home Management: Products," [Company Website],[cited 2008 Sept 2],Available HTTP: http://www.cortexatechnology.com/products.php

[3] IVCi Home LLC, "Lighting Control: Q and A with Richard Hollander, Managing Director, IVCi Home," [Online interview], [cited 2008 Aug 30], Available HTTP: http://www.ivcihome.com/newsletter0307part3.html

[4] http://www.targetwoman.com/articles/rfid.html#rfid-technology

[5] Sandip Lahiri, RFID Sourcebook, IBM Press Publication, First Printing 2005.

[6] William Stalling, Data and Computer Communication, Pearson Prentice Hall Publication, International Edition, 7th Edition, 2004

[7] http://www.rentron.com/PicBasic-LCD.htm

APPENDICES

APPENDIX A

GANTT CHART

Details / Week	Semester 1														Semester 2														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Selection of project title/ supervisor	■		HINI HOLIDAY						MIDSEM BREAK													MIDSEM BREAK							
Preliminary research → Project planning → Introduction to RFID → Literature Review		■		■																									
Research on how to design the automated system by using RFID				■	■																								
Submission of Prelim Report				■																									
Project work → Survey equipment for RFID → Study about PIC microcontroller						■	■																						
Submission of progress report								■																					
Project work → Basic design concept → Identify which PIC should be use → Do schematic diagram of this system								■		■	■	■	■																
Seminar											■																		
Submission of final interim report														■															
Oral Presentation														■															
Design prototype for automated control system for RFID															■	■	■	■	■	■	■								
Submission of progress report																					■								
Prototype construction and development																							■	■	■				
Poster exhibition																										■			
Draft report submission																											■		
Submission of dissertation (Soft bound)																												■	
Final presentation																													■
Submission of dissertation (Hard bound)																													■

APPENDIX B

SOURCE CODE

```
'============== DEVICE DEFINE =======================

Device 16F877A
Dim B1 As Byte
Dim B2 As Byte
Dim B3 As Byte
Dim B4 As Byte
Dim B5 As Byte
Dim B6 As Byte
Dim B7 As Byte
Dim B8 As Byte
Dim B9 As Byte
Dim BA As Byte

REMARKS OFF
Declare LCD_TYPE ALPHA
Declare LCD_DTPORT PORTB
Declare LCD_DTPIN Portb.4       'Lcd Data bit From Portb.4
Declare LCD_RSPIN Portb.1       'Lcd Register Select at Portb.4
Declare LCD_ENPIN Portb.0       'LCD Enable Pin at Portb.4
Declare LCD_INTERFACE    4      'LCD 4 Bit Interface
Declare LCD_LINES 2             'Lcd 2x  Line

XTAL = 4
ALL_DIGITAL = TRUE

'============= PORT SETTING===========================

SPBRG = 6
TrisA = %11000011
TRISC = %10000000
TrisD = %11100011

RCSTA = %10010000      'serial comunication rx setting

TXSTA = %00100000      'serial comunication tx setting

'============= INITIAL LED ON/OFF & Relay off ===============
PortC.0 = 1                                  ' Beep On
PortA.3 = 1 :DELAYMS 200               ' Off ON
PortC.0 = 0
PortA.3 = 0
PortA.1 = 1
PortA.0 = 1

Portd.2 = 0               'control relay
Portd.3 = 0
PortD.4 = 0
Portc.5 = 0
Portc.6 = 0
```

```
cls
Cursor 1,1:Print "WELCOME"        'Display Welcome Message
delayms 300


'============= RFID PORT GET DATA  ====================

Loop:   B1 = 0                    ' Preset to no character received
If PortA.0 = 0 Then                     ' switch press, Ra.0 = 0
PortA.2 = 0
Portd.2 = 0
Portd.3 = 0
PortD.4 = 0
Portc.5 = 0
Portc.6 = 0
Endif

        If PIR1.5 = 1 Then B1 = RCREG
        If B1 = 0 Then Loop
Loop2:  B2 = 0
        If PIR1.5 = 1 Then B2 = RCREG
        If B2 = 0 Then Loop2
Loop3:  B3 = 0
        If PIR1.5 = 1 Then B3 = RCREG
        If B3 = 0 Then Loop3
Loop4:  B4 = 0
        If PIR1.5 = 1 Then B4 = RCREG
            If B4 = 0 Then Loop4
Loop5:  B5 = 0
        If PIR1.5 = 1 Then B5 = RCREG
        If B5 = 0 Then Loop5
Loop6:  B6 = 0
        If PIR1.5 = 1 Then B6 = RCREG
        If B6 = 0 Then Loop6
Loop7:  B7 = 0
        If PIR1.5 = 1 Then B7 = RCREG
        If B7 = 0 Then Loop7
Loop8:  B8 = 0
        If PIR1.5 = 1 Then B8 = RCREG
        If B8 = 0 Then Loop8
Loop9:  B9 = 0
        If PIR1.5 = 1 Then B9 = RCREG
        If B9 = 0 Then Loop9
LoopA:  BA = 0
        If PIR1.5 = 1 Then BA = RCREG
        If BA = 0 Then LoopA


PUTCHAR:IF B1="0" AND B2="0" AND B3="0" AND B4="4" AND B5="2"
AND B6="7" AND B7="4" AND B8="9" AND B9="2" AND BA="3" THEN
{
Toggle PortA.2
Toggle PortD.2
Toggle PortD.3
Toggle Portc.5
Toggle Portc.6
Toggle Portd.4

CLS
Cursor 1,1:Print "Hello"
Cursor 2,1:Print "Yazid"
delayms 100
```

```
ELSE
PortC.0 = 1 : delayms 100
PortC.0 = 0 : delayms 100
PortC.0 = 1 : delayms 100
PortC.0 = 0 : delayms 100

CLS
Cursor 1,1:Print "Access"
Cursor 2,1:Print "Denied"
delayms 100 "
}

ENDIF
Goto LOOP
```