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DOUBLE SECURITY SYSTEM USED M TOUCHPAD AND RFID

AMY WONG AI LING

This thesis is submitted in part fulfillment
of the requirements for the awarding of Degree of
Bachelor of Engineering (Electrical - Electronics)

Faculty of Electrical Engineering
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Dedicated and thankful to my beloved family, lecturers and friends for their advice, encouragement and support

ACKNOWLEDGEMENT

First and foremost, I would like to express my deepest gratitude to my supervisor, Dr Muhammad Nasir bin Ibrahim for the guidance, encouragement, enthusiasm, patient, invaluable support and motivation throughout the progress of this project. This project would not be success without continue support from him. In completing this project within whole year, I had learned a lot, not only in how to complete the project but in many other part of life also.

Second, I would like to drop my sincere appreciation to thank all my friends who have directly or indirectly do me a favor in completing this project. Their useful and worth opinions, ideas, advice, encourage and support are accompanying me in completing this project.

Last but not least, to all my beloved family members who were always, stand by my side to encourage and support me during this entire project. Sincere appreciation goes to them who has been so supportive either morally or financially.

Lastly, I really appreciate to have this chance to finish this topic of project. It lets me gain an experience and a lot of knowledge which I never learn before and it is valuable for me in future career.

ABSTRACT

Security elements are an important aspect to prevent the unauthorized or unknown users to access the house. Traditionally, the conventional lock and key is a simple method for security purpose. But the increasing number of unauthorized entry cases over this few years, cause manufacturers to provide one level security. This project provides two levels of securities which are entering the 6 digit numerical number password and identification number scanning through RFID. Correct numerical password is required in order to proceed to the next level of security which is identification process. The system cannot be access without the correct numerical password and identification number of RFID passive tag. M Touchpad is used to replace the mechanical button keypad in this project. The main advantage of m Touchpad (first level of security) is the numerical number on pad can be arranged according to the preference of designer. Besides, the cost for m Touchpad is low and it is longer lasting. The capacitive sensing concept used to operate the m Touchpad. RFID is used for identification process. Processor chosen in this project is a microcontroller which can provide efficient interactions between hardware and software. The special features of PIC16F727 such as powerful I/O port, capacitive sensing channel and UART ability add some value to the system. The cost and power requirement is low compared to the other microcontroller or microprocessor family. MPLAB IDE software is used to write program and IC PROG is used as burning tools. Based on the overall results obtained, the proposed system is verified to be functioning correctly.

ABSTRAK

Unsur- unsur keselamatan merupakan aspek penting untuk menghalang pengguna yang tidak diketahui daripada memasuki rumah. Kunci dan alat untuk mengunci adalah kaedah yang mudah untuk tujuan keselamatan. Kes pemasuk haram semakin meningkat kebelakangan ini menyebabkan para pengilang mengeluarkan sistem keselamatan yang melibatkan satu peringkat. Projek ini menyediakan dua peringkat keselamatan dimana peringkat pertama ialah menekan 6 kata laluan dan peringkat kedua ialah pengenalan proses berlaku. Nombor pengesahan boleh diimbas dengan RFID. Kata laluan yang betul adalah diperlukan supaya boleh terus ke peringkat seterusnya iaitu pengesahan nombor pada RFID pasif kad. Sistem tidak dapat diakses sekiranya tidak ada kata laluan dan pengenalan nombor yang betul. M touchpad digunakan untuk mengganti mekanik butang keypad dalam projek ini. Kebaikan utama menggunakan m Touchpad (peringkat pertama keselamatan) adalah nombor bagi setiap butang boleh ditentukan berdasarkan kesukaan pereka. Selain itu, kos buatan untuk m Touchpad adalah rendah dan lebih tahan lama. Konsep pengesanan kapasitif digunakan untuk pengendalian operasi m Tocuhpad. RFID digunakan untuk proses pengenalan. Prosesor yang dipilih dalam projek ini adalah pengawal micro dimana ia dapat menyediakan interaksi yang berkesan antara peranti keras dan perisian. Ciri – ciri PIC 16F727 seperti banyak I/O port, saluran bagi pengesanan kapasitif dan UART kemampuan menambahkan nilai kepada sistem ini. Kos dan kuasa yang diperlukan adalah rendah berbanding dengan pengawal micro lain ataupun keluarga prosesor micro. MPLAB IDE perisian digunakan untuk menulis program dan IC PROG digunakan sebagai alat pembakaran. Berdasarkan keseluruhan hasil yang diperolehi, sistem yang dicadangkan disahkan berfungsi dengan betul.

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CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays, the security systems are an important aspect to prevent unauthorized users to access the system security door. Traditional security system involves the use a conventional locked and keys. The lock and key is a simple method to access control system. Over the last several past years, many manufactured have provided an electronic access control system. The most well-known access control systems are magnetic card and keypad system. The basic concept for the magnetic card system is the reader interprets the information encoded on the card and sends it to the controller to accept the information and unlock the door.

However, the system security provide for one level security. Combination two level securities which are m Touchpad (use capacitive sensing concept) and RFID passive tag identification through the use of RFID reader will improve the security system. Perhaps the most prevalent form of safety security system is by using a numerical code for authentication; the correct code must be entered in order for the lock to deactivate. Usually keypad is used for such locks which relates with entering password code and there are some feature an audible response to each press. In this project, m Touchpad is used to replace keypad. M Touch, known also as capacitive touch sensor, can replace mechanical buttons with capacitive alternative. In addition, it helps in cost reduction. M Touch has become more prevalent and in demand for commercial applications such as mobile devices and mp3 players. Some more, the numerical number of m Touchpad can be arranged according to the preference of designer. So, the thieves or criminals find it harder to hack the password and break in. Break in case can be reduced by using this double security system.

Even the thieves successful hack the password; there still have another level of security which is RFID passive tag identification. Identification process begins with bringing the RFID passive tag towards the RFID reader, followed by a scanning process. By scanning the RFID passive tag on the RFID reader, the identification number will be obtained. Every passive tag has its own specific identification number. The correct identification number can cause the scanning process success. The door only can unlock or opened once the password and identification number is match and correct.

In this era, the system security is an important aspect to prevent the luxurious asset from unauthorized person. Besides, the most important is it can protect everyone within house from any dangerous events such as robber, murder, raping and any unexpected criminal activities. Providing two level securities will improve the control access system. This system will give a high level of security for user to prevent their luxurious asset especially for home user being stolen by thieves and protect everyone from danger.

There are few reason why security system is important, reason one is for the peace of mind. Security systems employing house monitoring, intercom systems, CCTV camera surveillance, and control access are the finest methods to guarantee that peace of mind. Burglars and thieves can be anywhere. They may be the person that had bumped into yesterday at the grocery store or someone who is in fact residing in the owner neighborhood. Installing a security system can help the owner and family rest at night because the system routinely will be observing over your house, so doesn't need to be relied on guard. Being worry free is really worth a lot to the owner all round wellness and happiness. Second reason is to protect property, especially if the owner is from town or taking a holiday. Security systems and burglar alarm system not only safeguard the owner life but additionally help safeguard the owner property and valuable possessions. Lastly, if a criminal sees a CCTV camera system or a camera surveillance system at house, these folks are less likely to try to bust in. CCTV video cameras work to capture burglars in the act, but also help to avert burglaries from ever happening.

1.2 Product Overview

This project includes two level securities which is capacitive sensing security used m Touchpad with microcontroller and RFID passive card through RFID reader. The numerical numbers on m Touchpad can be randomly arranged according to the preference of designers. Plus, it can reduce cost and more efficient compared with keypad. User must have personal key to access the first level security. Then read the ID of passive tag by using RFID reader. There are specific numbers for each passive tag. The user must have the correct ID number of passive tag to open the door and lock automatically as second level of security.

1.3 Project Objective

In general, the objective for this project is to design a double security door. The main objective is providing two level securities which is password system security used m Touchpad and ID identification through RFID. Capacitive sensing concept has been applied for entering the password using m touchpad. Radio frequency identification (RFID) is an automatic identification method where the data is stored in the RFID tag. The user must have personal key to access the first level security which is capacitive sensing system and ID card for second level security to unlock the door.

1.4 Problem Statement

In our country, Malaysia, there are many criminal activities such as stealing, murdering, raping and breaking cases happen among the citizen, especially at Johor Bharu. Because of these problems, resident from various sectors need the security system to ensure safety of their own self, family member, cash money or valuable things.

In this project, a double security system used m Touch pad (capacitive touch sensor) and RFID will be introduced which gives enough security protection and is low-cost, user-friendly and lasting. So, it is suit whether a well off or rich family and either single story or double story house. The market can apply this kind of technologies, so that every level of resident can protect themselves and safe from dangerous.

1.5 Project Scope

This project involves hardware and software development as explained below:

1.5.1 Hardware Development

This project consists of three parts: Input part for this project is m Touchpad and RFID. One m touchpad is being built. The heart or main processor of this project is microcontroller. Microcontroller chose is PIC 16F727A. Last part is the output of microcontroller or indicator devices which includes LCD display, LED, buzzer, alarm and relay.

Besides the main parts mentioned above, there are some other parts required to operate the PIC and whole project such as power regulator circuit, clock circuit and reset circuit. After determining which components being used in project, next is their connection and building a complete hardware which contain the entire component.

1.5.2 Software Development

Microcontroller is a lump of plastic, metal and purified sand, which without any software does nothing. When software controls a microcontroller, it has almost unlimited applications. “C Programming” will be used to develop the firmware to PIC microcontroller. MPLAB Compiler used to compile the C-programming. The range of C code for this system includes setting code which is for capacitive sensing, frequency measurement, timer interrupt. All of this is for setting of m touchpad. Then, setting code for LCD display, microcontroller PIC16F727, RFID (UART) need be designed also.

Program will be started with initialize, then introduce project by displaying specific sentence on LCD display. Prompt user to enter 6 digit password numbers. Some operation occurs when the password is correct or wrong. Next stage is prompt user to scan the RFID passive card, the identification number of the card will be read by using RFID reader. The identification number obtained will be transmitted to the controller. The controller will receive the transmitted number. There are operations happen when the identification number match or not match with the stall value. Some identify code is required in this project. It is needed to show what would going to happen when password is correct or wrong, and whether the identification number obtained is match with the database information or not. The identification device used in this project includes LED, buzzer, LCD display and relay.

Besides, DXP Protel 2006 software used to design the schematic diagram for double security system. The reason used DXP Protel is it is more convenient and efficient compared with other.

1.5.3 Interface In Between Hardware and Software

Once complete the hardware and software, the next stage is interface in between hardware and software. The software coding will be burned into PIC programmer and then from PIC programmer writes into microcontroller PIC. Once the microcontroller PIC16F727A had been completely programmed, user can test the hardware. If the output is as desired, this project had successfully completed. Otherwise, troubleshoot step is required until desired output obtained.

1.6 Thesis Organization

Chapter 1 begins with background or brief introduce about the security system, then is the objective or the purpose of doing this project, continue with the problem statement which give an idea on doing this title, the scope of project and the last is the time duration to complete this project. Chapter 2 begins with literature review whereby some related information or previous works are included. Chapter 3 discusses the methodology to achieve the objective of this project. Chapter 4 shows the result and some discussion which related with the result. The related output figure will be showed in this chapter. Chapter 5 shows the conclusion; some possible future works will be suggested.

1.7 Project Contribution

Since the breaking case is keep increasing nowadays, residents from any sectors have a strong needed on good security system. This project which design a double security system is a good solution to a wide range of cases happened in Malaysia. Demand on a home security system which is affordable and reliable for them is high also. So, this project is worth to proceed and introduce to everyone.

1.8 Project Planning

The project is planned by dividing into several tasks. The duration of each task has been done and it has been described in Gantt chart below.

No	Activities	Semester 1					Semester 2				
		Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	Literature Review										
2	Understand the family of PIC 16F which include features, specification and so on.										
3	Design schematic diagram for hardware.										
4	Construction of double security system hardware.										
5	Design software coding.										
6	Debug and troubleshoot Software coding.										
7	Interface in between hardware and software.										
8	Result and analysis.										
9	Presentation preparation										
10	Report preparation.										

Figure 1.1 Gantt chart for the project

Follow Up

Execute

CHAPTER 2

LITERATURE REVIEW AND THEORY

2.1 Introduction

The increasing number of unauthorized entry cases over the years, have prompted many companies to design and manufacture automated door security systems. Door security systems are designed to protect houses, shops, offices and other buildings from forced entry and minimized the chances of robbery. Door security systems can be installed on different types of doors such as metal, wood, plastic, glass and fiberglass. They are available in different specifications to suit the security requirements of different types of buildings. Household security systems may consist of a password enabled electronic locking device, whereas high-end door security systems are often combined with intruder alarms and security lock to provide enhanced security.

This chapter reviews some of the journal which related with this topic such as how efficient use RFID technologies nowadays in some application, importance of a password in security system, how efficient apply memory aids in memorize the multiple password used in different ways. Besides, this chapter reviews some theories for the important device used in this project. Some more, some conventional door security system also had been described here.

2.2 Potential of RFID

According to Zeydin Pala and Nihat Inan in journal entitle smart parking applications using RFID technologies, by using Radio Frequency Identification (RFID) technology in automation, the transaction costs will be reduced and shortage in stock. Most of the RFID networks include a wide range of automation technologies. These technologies consist of RFID readers, RFID writers, RFID barcode scanners, RFID smart sensors and RFID controllers. The check-ins and check-outs of the car parking-lots will be under control by using RFID readers, labels and barriers. Personnel costs will be reduced significantly using this technology. It will be possible to see unmanned, secure, automized parking-lots functioning with RFID technology in the future.

Check-ins and check-outs will be handled in a fast manner without having to stop the cars with RFID technology, so that traffic jam problem will be avoided during these processes. This is because drivers no need stop at the circulation points and parking tickets will be out of usage during check-ins and check-outs. By using this system, ticket jamming problems can be avoided. This is because vehicle owners will not have to make any payments at each check-out thus a faster traffic flow will be possible.

RFID is one of the most fundamental technologies that enable wireless data transmission. RFID technologies not often used in industry due to the price are very expensive. But nowadays, RFID technologies had widely introduced and used. The intention use RFID technology has been encouraged. RFID technology is universal, useful and efficient, RFID technology increases company efficiency and provides advantages on both company and client-wise, RFID technology is much more secure compared to other networks and RFID system allows vehicles to check-in and check-out under fast, secure and convenient conditions. This is because the timing of the gates and additional sensors enables a one by one parking-lot circulation thus preventing multi check-ins or check-outs at a time; RFID is a technology that collects parking fees without having to stop vehicles.

There are two important processes in this project which is vehicles check in and check out from the parking lot. Figure 2.1 shows the check in process and figure 2.2 shows the check out process. Both are almost same.

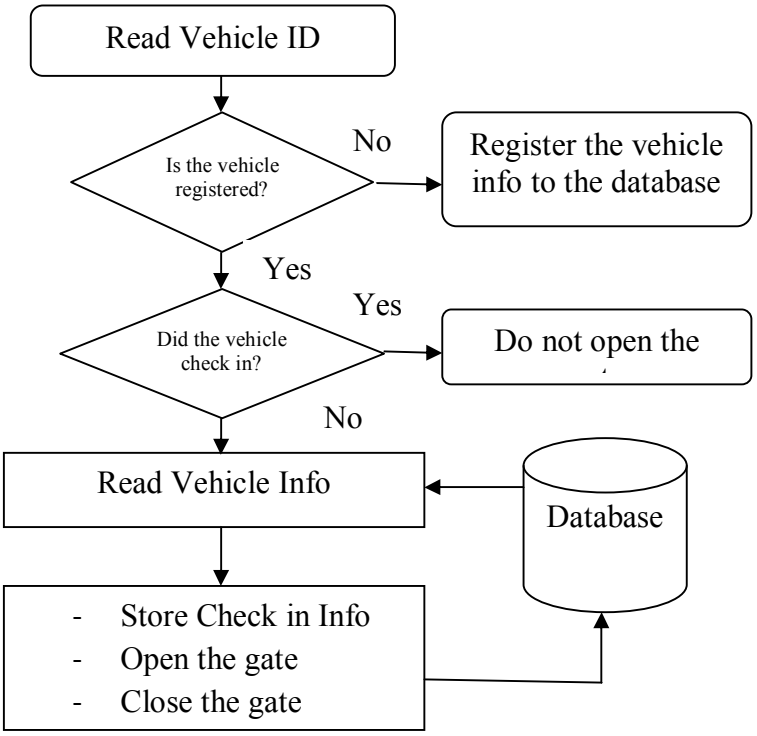


Figure 2.1 Parking-lot check-in process

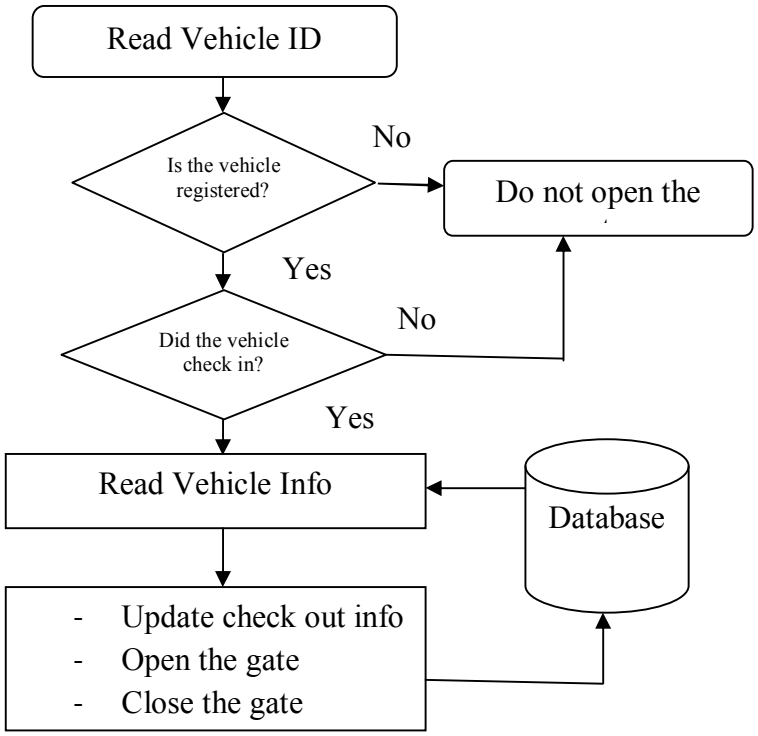


Figure 2.2 Parking-lot check out process

The system will check whether any registered vehicles come to the parking lot check in have registered or not. This step is very important as if it had registered; means the vehicles doesn't have to check in again. And in the other case, if it is unregistered, and it doesn't have any check-in or check-out records available, the check-in information is stored in the database and the barrier will lift off for the vehicle to drive in

Same process for registered car checks out. The identification information for a checking out vehicle will be searched on the database first. The system will find out the registered vehicles check in with the date and time and updates it with the check out date and time. If it is a registered vehicle and it didn't have an unauthorized access, the system will allow its check-out.

Seems RFID technology is secure, convenient, fast and efficient, so it is suitable use in security system which security system only can unlock or open the door in the fastest way when it had detect correct identification ID of the passive tag.

2.3 Security Analysis

According to Xun Yi in the journal entitle security analysis of Yang et al.'s practical password based two server authentication and key exchange system, the usual or typical protocols for password-based authentication assume a single server which stores all the passwords which is necessary to authenticate users. If the server is compromised, then the user passwords are disclosed. In order to address this issue, Yang et al. have proposed a system which a practical password is based on two-server authentication and key exchange protocol, where a front-end server, keeping one share of a password, and a back-end server, holding another share of the password, cooperate in authenticating a user and, meanwhile, establishing a secret key with the user. The user passwords can be determined once the backend server is compromised. Therefore, the latest or Yang et al.'s protocol has no essential difference from a password-based single server authentication protocol.

Password-based user authentication is where a user and a server, who share a password, authenticate each other by exchange of messages. Typical protocols for password-based authentication assume a single server stores all the passwords which are necessary to authenticate users. If the server is compromised, due to hacking or being attack with virus such as Trojan horse, then the user passwords stored in the server are disclosed.

In Yang et al.'s protocol, a frontend server, keeping one share of a password, and a backend server, holding another share of the password, cooperate in authenticating a user and, meanwhile, establishing a secret key with the user. This protocol assumes that the two servers never collude and aims to keep user passwords secret even if either of the two servers is compromised. But in practically, attackers may try all kinds of alternatives to achieve their purpose which is to determine user password. So, this paper have introduce two ways which are "half-online and half-offline" to attack Yang et al.'s

protocol and show that user passwords can be determined once the back-end server is compromised.

Another support material is from Art Conklin, Glenn Dietrich and Diane Walz in the journal entitle password based authentication, the concept of a user id and password is a cost effective and efficient method of maintaining a shared secret between a user and a computer system. One of the key elements in the password solution for security is a reliance on human cognitive ability to remember the shared secret.

Traditionally, ability human to remember the password is limited. But with the introducing of the Internet, e-commerce, and the proliferation of PCs in offices and schools, the user base has grown both in number and in demographic base. Individual users no longer have single passwords for single systems, but are presented with the challenge of remembering numerous passwords for numerous systems, whether from email, to web accounts, to banking and financial services. Users must to remember multiple IDs and multiple passwords for the wide range of computer based services they use. Have a different password for separate use of ways is important to prevent password being hacked by stranger or criminal to do some unwanted purpose. So, all of this has placed a strain on user memory and users have developed memory aides, such as password lists, to assist them in the task of keeping accounts and passwords straight.

The purpose of this paper is to present a conceptual model of password-based security across multiple systems connected by user activity. Besides, the effect of user generated schemes to assist in the user's management of IDs and passwords, and the effect of these memory aides on system security have been emphasized. In more details, it have presents a conceptual model depicting how users and systems can work together in this function and examines the consequences of the expanding user base and the use of password memory aids. To achieve desired levels of system wide security will require an understanding of the cognitive limitations of users and the behaviors which result from these limitations. The conceptual model presented here illustrates some opportunities for system wide improvement of password-based risk.

There are some conceptual model presented here such as authentication and human cognitive ability. This entire can illustrates some opportunities for system wide improvement of password-based risk. The purpose of authentication is to verify that the specific information presented represents a request to be authentic from a specified entity. It is important purposely for verifying the identity of an entity which is the basis for all future rights and privileges granted to the entity. In the basic authentication process, the entity desiring authentication presents credentials, usually an account ID and some additional information, to prove that the request is coming from a legitimate owner of the ID. Today, with grow of the internet and some other technologies, users interact with multiple systems and can act as a bridge between them connecting their security mechanisms through password memory aids. Different memory aids can result in different system cross connections, as does differing system level security implementations. A common password type memory aid can bridge two or more systems. If one of these 'connected' systems has a lower level of security implementation, then this can be carried over to a higher level system. The actual degree of system connection depends upon the memory aid and the level of security implementation on each system.

2.4 Low noise Capacitive Sensing Sensor

According to the Seunghoon Ko, Hyungcheol Shin, Jaemin Lee, Hongjae Jang and Kwyro Lee in the paper named low noise capacitive sensor for multi touch mobile handset's application, the touch sensor has become the most important and high demand technology in touch based applications such as mobile device, portable media player and laptop PC over the last few years. Capacitive sensor which based on the conductive property of fingers has been widely used in order to realize multi touch recognition such as zoom in, zoom out and resizing.

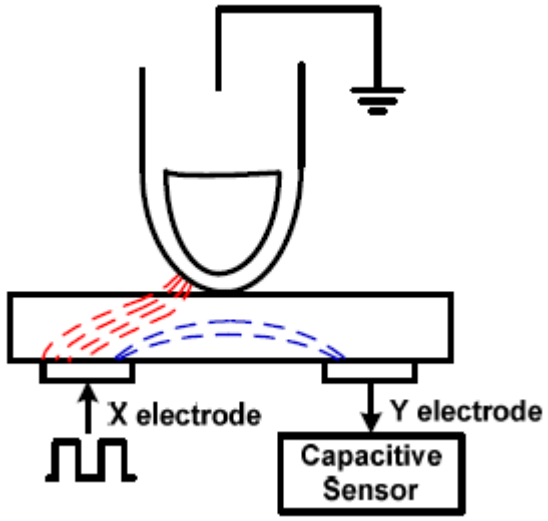


Figure 2.3 Behavioral model of capacitive sensing

When a conductive object such as finger approaches to the electrode as shown in figure 2.3, the fringing fields between two electrodes are directed to the finger, causing the decrease in capacitance. The touch point can be determined by detecting the largest change of capacitance and then interpolation scheme will be conducted.

This journal has mentioned the detection of touch point which is infected with distributed noises such as RF, LCD and EMI interferences. Mostly it is induced from finger and then coupled to the ITO electrodes. There are several techniques used to suppress these noises. The difficulty with these approaches is inherent nonlinearity and

their performance is limited by low scanning frequency, which can disable the multi touch recognition.

A new interface which is more effective will be proposed in this paper. Multi capacitance to voltage converters (C-VC) are operated as time interleaved scheme which used to enhance the data rate and reject noises. Moreover, the calibration technique is used to compensate the RC delay of ITO layers also.

The block diagram for the proposed time interleaved architecture of the sensor interface will be displayed in this paper. It consist of four C-VC, calibration comparators, programmable multiplexer and ITO driving logic. Every component has its own function. C-VCs convert the capacitance changes of ITO electrodes into the voltage level. CVs amplify the wanted DC voltage level and reject the interferences coupled to the ITO. The resulting signal level will be converted by SAR-ADC and filtered once again by IIR filter in DSP. Depending on the touch panel size, the number of channels and operating C-VC blocks can be controlled by programmable multiplexer. The output of the C-VCs connects to the calibration comparators, and compared with controllable V_{ref} to decide the number of conversion times of C-VCs for each channel.

For the calibration circuit, at the channel which is far from the interface, the ITO electrodes are highly resistive and have much parasitic capacitance to adjacent electrodes. This can cause the error being detected. This detection error will be worsened as the touch panel size increases. Other than that, the C-VCs output formula considering ITO's series resistors and parasitic capacitors can be approximated and it had been described also in this paper.

In general, this paper has demonstrates an effective filtering technique which can attenuate and ease noises induced to the ITO layers with 37dB rejection at 50 kHz frequency. Besides, the time interleaved architecture of C-VCs which can enhance the data rate up 65Hz of the scanning frequency will be discussed in this paper. It purposely

enables the multi touch recognition. The calibration technique used to achieve the compatibility with all commercial ITO products. Due to its simplicity and low power consumption cause it suited for touch screen systems which can operate in harsh environment.

2.5 Conventional Door Security System

Conventional key interlock system is the well known system in the previous year. In this era, the manufacturer found the new alternatives for door security system such as electronic access control system. There are much kind of electronic access control system for security door such as magnetic stripe card, smart card and keypad system.

2.5.1 Key Interlock Conventional

An interlock system is a most well-known security for over past year and it also is a series of key interlocks applied to associated equipment in such a manner as to allow operation of the equipment only in a prearranged sequence. Interlocks are applicable to practically any field wherein human life or protecting property, by an improper operation or improper sequence of operations. It is necessary to fully appreciate how a keyed interlock operates and how it works in conjunction with the equipment on which is mounted.

A typical keyed interlock is comprised of a lock cylinder, support housing, a moveable locking bolt, and a cam arranged to move the bolt in response to operation of the correct key. Various styles of interlock housings are available and each style is designed to mount in a different way depending upon the equipment to which the interlock is to be installed.

One of the most important features a keyed interlock is that key cannot be removed from all position of the lock bolt. A conventional lockset may allow free removal of the key regardless of the position of the lock bolt. The function of an interlock, however, dictates that key be held in the lock cylinder unless the lock bolt is in a predetermined position. Possession of the key ensures that the associated device has been locked in a known safe position.

About the operating principle of interlock system, there are four steps to unlock the lock. Figure 2.4 illustrates how an individual interlock typically works in conjunction with the equipment to which it is installed. In figure 2.4 (a), the controlled device (such as a switch) cannot move from its normal position (whether open or closed) because of the position of the lock bolt. When the key is turned to withdraw the lock bolt (figure 2.4 (b)), the key becomes “trapped” and the controlled device is moved, the key remains held because the lock bolt can no longer be physically extended so as to free the key (figure 2.4 (c)) .

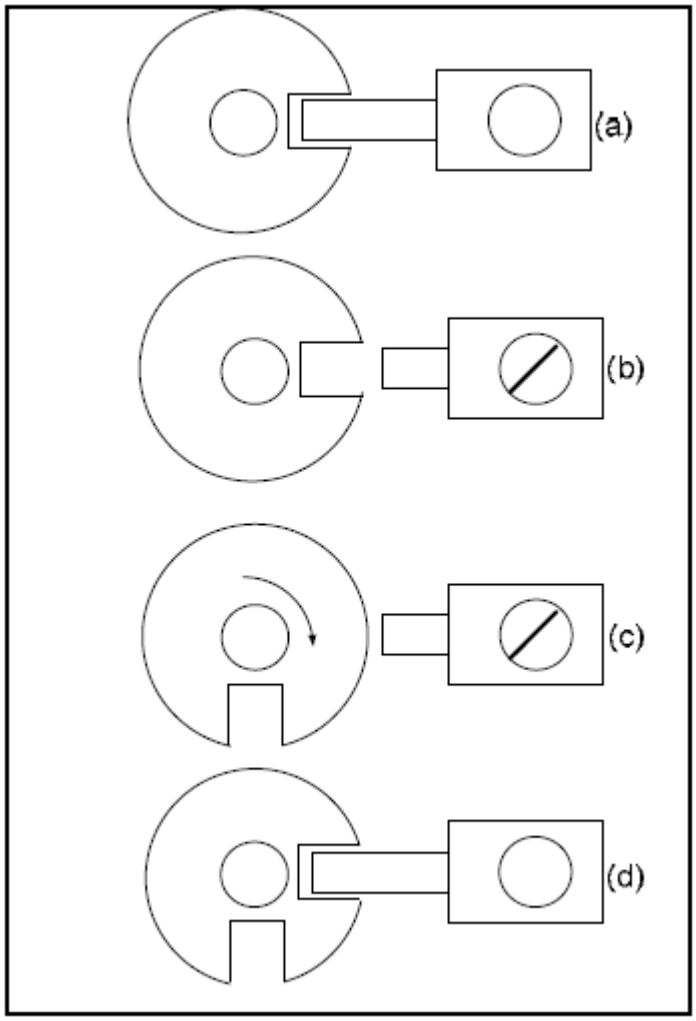


Figure 2.4 Operating principle of a simple key interlock mechanism

The typically controlled device has two operating positions. If the intent is to lock the controlled device in either position, the arrangement of figure 2.4(a) may instead provide a recess on two opposite sides of the rotating member. In this manner, the lock bolt can be extended and the key released with the controlled device in either of two positions. Such an arrangement is described as (L-O-C) locked open or closed (see figure 2.4(d)).

2.5.2 Magnetic and Smart Card

The magnetic card is the one of electronic access control system widely used in door security system. A basic access control system consists of a card reader and a controller. When the system user presents or put a card to the reader, the reader interprets the information encoded on the card and sends it to the controller. The controller accepts the information from the reader and compares it to information stored in its memory. The controller then grants or denies access by commanding electric locking device on the door to unlock or remain locked.

There are many kinds of magnetic card such as a magnetic stripe card. This card is very similar to a standard credit card; the information is encoded on a strip of magnetic material applied to one side of the card, exactly like a conventional credit card. The information is written on the magnetic strip in a manner similar to tape used in a tape recorder. When the card is inserted into the reader, this head rides on the magnetic stripe and reads the information it.

Nowadays the manufactured found a new method for security access system they call a smart card. The advantage smart cards have over magnetic stripe cards is that the smart card contains the computer chip which stores the password or PIN. Smart card is convenient for security purpose. The only disadvantage for this kind of security system is user needs report directly to police or related organization once found disappear the card. It is very dangerous when someone picks up the card, and unexpected thing may occur. To prevent all of this unwanted thing from happening, double security system are going to introduce, no need to worry when the card is disappear, but requiring user to report to police also for further action. The only reason for no need to worry when the card is disappear compared with one level of security is the criminal or thieves still need to know the 6 digit password just can break in the house. Some more, the number on pad can be arranged based on preference of designers. So, it is hard to break the password.

2. 6 Keypad Security System

In this era, keypad security system is the most well known method for security system widely used for door security system. A basic access control system consists of a key personal or information that user key in and a controller. When the user key in the personal key, the information encoded sends it to the controller. The controller accepts the information from the reader and compares it to information stored in its memory. The controller then grants or denies access by commanding electric locking device on the door to unlock or remain locked.

There are many kinds of keypad security system in the market. Mostly the keypad systems using a digital system to encoded the information and compare it to information or password number stored in its memory. When the user key in the personal key, the information encoded and sends it to the controller. The controller accepts the information from the reader and compares it to information stored in its memory. The controller then grants or denies access by commanding electric locking device on the door to unlock or remain locked.

If a valid code is entered on the keypad, the lock release will operate for a preset duration. The keypad has one green and one red LED to indicate the system status to the user; besides, buzzer and LCD display use as an indicator also. The green LED indicates that the lock release is operating, while the red LED indicates an invalid entry. Buzzer will beep once when the password entered is correct. Otherwise, alarm on when the password entered is wrong. LCD display will display the instruction for user to follow.

2.7 Microcontroller PIC16F727A

This section reviews the reason of choosing microcontroller. A microcontroller (or MCU) is a computer-on-a-chip. It is a type of microprocessor emphasizing self-sufficiency and cost-effectiveness, in contrast to a general-purpose microprocessor (the kind used in a PC). The only difference between a microcontroller and a microprocessor is that a microprocessor has three parts - ALU, Control Unit and registers (like memory), while the microcontroller has additional elements like ROM, RAM etc. So, the circuit for microcontroller is simpler compared with microprocessor. Microcontroller processors are designed to fill a smaller, more focused variety of roles while making use of less expensive and less complex circuitry. The main advantage of a microcontroller is that it allows electronic automation in situations where a full-sized computer is not needed.

Besides, microcontroller is cheaper compared with microprocessor. Fully functional personal computer microprocessor is a complex device containing densely packed micro circuitry. Most microprocessors also require gold plating on every single processor pin used to connect to the computer's motherboard, adding yet another expense to an already difficult to produce item. When compared to the simple circuit architecture found in the microprocessors of microcontrollers, it is easy to see that microcontrollers save money. When the most modern technical engineering is applied to a microcontroller it allows the device to be extremely compact, making microcontrollers popular within mobile devices such as cell phones and PDAs.

2.7.1 Microcontroller PIC16F727 Special Features

Simplify features of microcontroller PIC16F727 is as below:

a) Interrupt capability
b) 8-Level Deep Hardware Stack
c) Direct, Indirect or Relative Addressing modes
d) Processor Read Access to Program Memory
e) Precision Internal Oscillator
    a. 16MHz or 500kHz operation
    b. Factory calibrated to ±1%, typical
    c. Software tunable
    d. Software selectable +1, +2, +4 or +8 divider
f) Multiplexed Master Clear with Pull-up or Input Pin
g) 14 channels of 8-bit Analog-to-Digital (A/D) converter where conversion is also available during sleep mode
h) Enhanced Timer1:
    a. Dedicated low-power 32 kHz oscillator
    b. 16-bit timer/counter with pre-scaler
    c. External Gate Input mode with toggle and single shot modes
    d. Interrupt-on-gate completion
i) 2 capture/compare/PWM functions
j) Synchronous Serial Port (SSP):
    a. SPI (Master/Slave)
    b. I²C™ (Slave) with Address Mask
k) Addressable Universal Asynchronous Receiver Transmitter (AUART).
l) mTouch™ Sensing Oscillator Module which is up to 16 input channels.

2.7.2 Pin Diagram

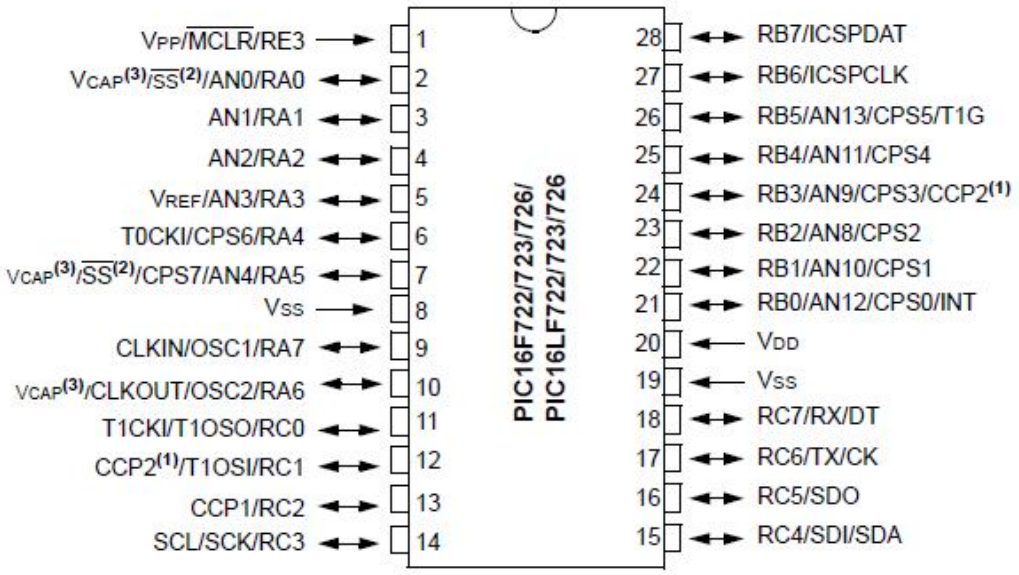


Figure 2.5 Pin Diagram of PIC16F727

The pin diagram for the PIC 16F727A is as shown in figure 2.5. In this project, PIC16F727 is being chosen due to its powerful I/O port, Addressable Universal Synchronous Asynchronous Receiver Transmitter (AUSART) and capacitive sensing module (m touch). Capacitive sensing module used to replace keypad in usual password security system. So, it might reduce cost and more convenient and efficient compared to 4X4 keypad. AUSART is needed due to the second level of security involve the scanning the passive tag on RFID reader. The specific identification number of passive tag will be read; the data then will sent and process in microcontroller. So, microcontroller chose need have a capability to receive the data from external. Comparison will be occurred and the data will be displayed on LCD display. Since this project have many identify signal such as LED, buzzer, relay, LCD display and motor, so powerful I/O port is needed. Overall, PIC16F727 is the suitable microcontroller which can fulfill all of the requirements.

2.8 Microchip MPLAB ICD 2

The MPLAB ICD 2 is a low-cost in-circuit debugger (ICD) and in-circuit serial programmer. MPLAB ICD 2 is intended to be used as an evaluation, debugging and programming purpose in a laboratory environment. It can provide features which consist of real time and single step code execution, breakpoints, register and variable watch or modify, in circuit debugging, target VDD monitor, diagnostic LED, MPLAB IDE user interface and RS 232 serial or USB interface to a host PC.

MPLAB ICD 2 can be used for debugging source code in own application, debugging hardware in real time and it becomes a supported device used Microchip's ICSP protocol.

2.8.1 Modular Interface Connections

MPLAB ICD 2 is connected to the target PIC MCU with the modular interface cable, which is a six conductor cable. The pin numbering for the MPLAB ICD 2 connector is shown from the bottom of the target PC board in Figure 2.6.

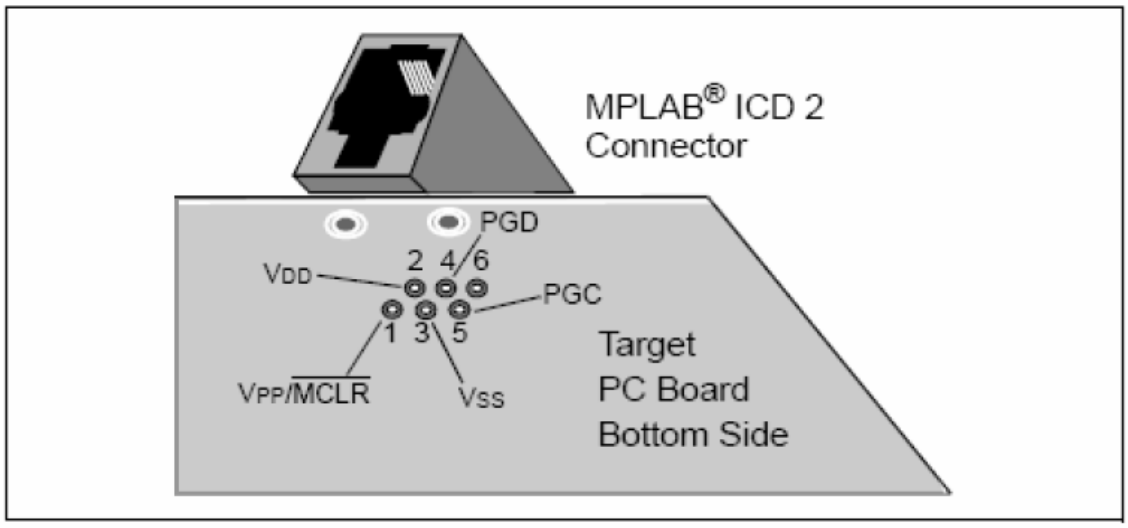


Figure 2.6 Pin numbering for modular connector

Figure 2.6 shows the interconnections of the MPLAB ICD 2 to the modular connector on the target board. There are six pins on the ICD connector, but only five are used. The diagram also shows the wiring from the connector to the PIC MCU device on the target PC board. A pull-up resistor (usually around 10k Ohm) is recommended to be connected from the VPP/MCLR line to VDD so that the line may be strobe low to reset the PIC MCU. Although pin 2 (VDD) can supply a limited amount of power to the target application under certain conditions, for the purposes of these descriptions, pins 2 and 3 (VSS) are omitted. They are shown on the diagram for completeness, but in the following descriptions only three lines are active and relevant to core MPLAB ICD 2 operation: VPP/MCLR, PGC and PGD.

2.8.2 Debug Mode

There are two steps to use MPLAB ICD 2 as a debugger. The first requires that an application be programmed into the target PIC MCU. The second uses the internal in-circuit debug hardware of the target Flash PIC MCU to run and test the application program. These two steps are directly related to the MPLAB IDE operations which include program the code into the target and use the debugger to set breakpoints and run.

If the target PIC MCU cannot be programmed correctly, MPLAB ICD 2 will not be able to debug. Figure 2.7 shows the basic interconnections required for programming.

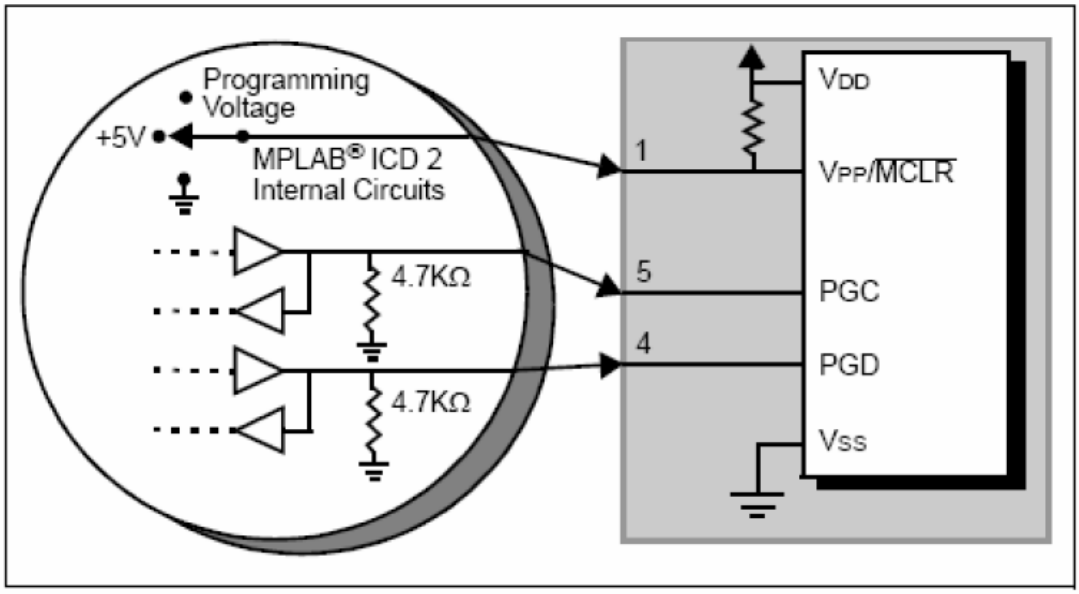


Figure 2.7 Connections for programming

A simplified diagram of some of the internal interface circuitry of the MPLAB ICD 2 is shown. No clock is needed on the target PIC MCU if it is for programming, but power must be supplied. When in the programming mode, MPLAB ICD 2 puts programming levels on VPP, sends clock pulses on PGC and serial data via PGD. To verify that the part has been programmed correctly, clocks are sent to PGC and data is read back from PGD. This conforms to the ICSP protocol of the PIC MCU under development. Figure 2.8 illustrates the MPLAB ICD 2 ready for debugging.

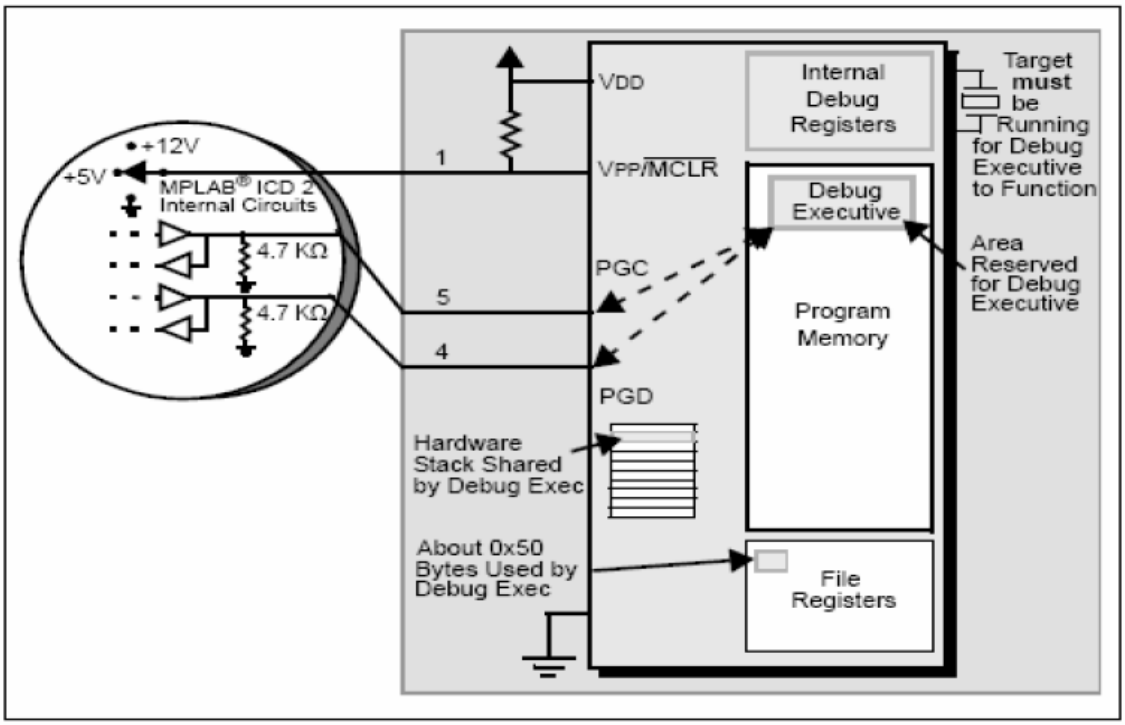


Figure 2.8 Illustrates the MPLAB ICD 2 ready for debugging.

2.8.3 Programmer Mode

When use the Programmer, the in circuit debug registers should be disabled in the MPLAB IDE so the MPLAB ICD 2 will program only when the target application code and the configuration bits (and EEPROM data, if available and selected) have burnt into the target PIC MCU. The debug executive will not be loaded. In this mode the MPLAB ICD 2 can only toggle the MCLR line to reset and start the target. A breakpoint cannot be set, and register contents cannot be seen or altered. The MPLAB ICD 2 programs the target using ICSP. No clock is required while programming, and all modes of the processor can be programmed, including code-protect, watchdog Timer enabled and table read protect.

2.9 M Touchpad (Capacitive Touch Sensor)

Touch sensing becoming alternatives to traditional mechanical button or push button switch user interfaces, because it requires no mechanical movement, and it enables a completely sealed and modern-looking design. Expanding beyond the consumer market, touch sensing is beginning to take hold in medical, industrial and automotive applications for reasons such as improved aesthetics, reduced maintenance and lower cost.

A capacitive touch sensor is a copper pad area created on the surface of a printed circuit board. It creates a parasitic capacitance to ground. When a person touches the sensor, or it's covering such as plastic, glass, etc, the person's finger introduces an additional glass-finger-ground capacitance. That capacitance is in parallel to the parasitic one. As capacitors in parallel are added, a finger approaching the pad will increase the total capacitance. This change is the criteria needed to detect a touch.

Being a microcontroller based solution; capacitive touch can also be used to drive a LED, a buzzer, LCD Display or to communicate with the main processor or the rest of the system.

On the microcontroller PIC16F, the on chip capacitor sense module used to create a relaxation oscillator to perform touch sensing. The period or frequency of the relaxation oscillator can be measured, and when the sensor is touched, the frequency will drop and the period will increase, indicating a touched condition.

Since capacitive sensing module (CSM) is a frequency-based method, timer method is used. Basically, Timer 2 is used as the timer resource instead of using Timer 0 due to it has greater flexibility in defining time base. On the other hand, Timer 1 gate is used as a counter. It will increment at every rising edge of capacitive sensing module output frequency. The value on the Timer 1 will be a measure for CSM oscillator

frequency. The completion of Timer 1 gate event, triggered by Timer 2 overflow, will generate a Timer 1 gate interrupt. When servicing the interrupt, the value from the Timer 1 can be read to determine the oscillator frequency. In detailed, capacitance of the pad alone results in a corresponding square wave frequency. When the PR2 value is matched, the current count value in Timer 1 will be read and stored as reference. Once the finger is touched, the RC time constant of the oscillator increases and thus results in a decrease of frequency of the square wave output. Therefore, on the next interrupt, the Timer 1 value will be smaller. Using a software algorithm to compare the difference between these values, the sensor can be identified as pressed or not pressed.

When a pad is touched, the frequency on the CSM changes due to the extra capacitance from the finger. The change in frequency is noted, number of password was being identified, comparison occurred and result will be shown on LCD display.

Microchip's mTouch sensing solutions allow designers to integrate touch sensing with application code in a single microcontroller, reducing total system cost. Microchip offers a broad portfolio of low power, low cost & flexible solutions for keys or sliders and touch screen controllers. Get to market faster using our easy GUI-based tools, free source code and low-cost development tools.

There are two types of mTouch which consist of:

i) mTouch Capacitive Sensing technology

It has longer battery life with eXtreme Low Power MCUs; capacitive sensing in less than 5 μA; high noise immunity and emissions and no external components required.

ii) mTouch Inductive Sensing technology

It use polished or brushed metal surfaces which including stainless steel and aluminum. Besides it can sense through gloves, create water proof designs and deploy the Braille friendly interfaces.

The response of the sensor to fingertip touch is influenced by many factors which include touch areas, voltage and current levels, ambient humidity, static buildup, and so on. Most of these factors have been accounted for in designing the demo application firmware, and are based on typical environmental values, and certain assumed constants.

2.10 RFID

RFID (Radio Frequency Identification) is a technology which is used to identify or detect an object. The purpose of an RFID system is to enable data to be transmitted by a portable device, called a tag, which is read by an RFID reader and processed according to the needs of a particular application. In other word, the communication takes place between a reader (interrogator) and a transponder (tag). The data transmitted by the tag may provide identification or location information, or specifics about the product tagged, such as price, color, date of purchase, etc. RFID quickly gained attention because of its ability to track moving objects. Therefore, RFID technology has been used by thousands of companies for a decade or more. RFID technology is similar to the bar code identification systems we see in retail stores everyday; however one big difference between RFID and bar code technology is that RFID does not rely on the line-of-sight reading that bar code scanning requires to work.

There are two kinds of tag involved and which is active tag or passive tag. Figure 2.9 shows a diagram of RFID system. To retrieve the data stored on an RFID tag, RFID reader is needed. A typical reader is a device that has one or more antennas that emit radio waves and receive signals back from the tag. The reader then passes the information in digital form to a computer system. In more details, when the tag enters the reader reading field, the tag will be activated by the electromagnetic wave from the reader. The passive tag converts the electromagnetic field to power up its internal circuits. Then the circuit in the tag will modulate the waves and transmit back the stored information. After that, the reader will decode the data and send it to CPU for processing.

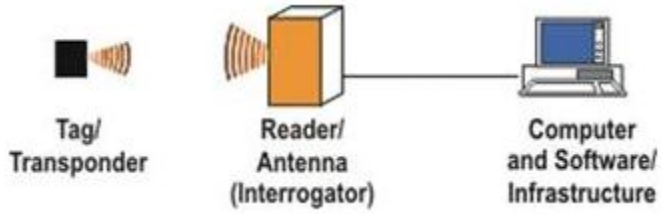


Figure 2.9 Diagram of RFID system

RFID system consists of three components (Refer to Figure 2.10):

a) The antenna (Interrogator) emits radio signals to activate the tag and to read and write data to it.
b) The reader emits radio waves in ranges of anywhere from one inch to 100 feet or more, depending upon its power output and the radio frequency used. When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal.
c) The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer for processing

A reader typically contains a radio frequency module (transmitter and receiver), a control unit and a coupling element to the transponder. In addition, many readers are fitted with an additional interface (RS 232, RS 485, etc) to enable them to forward the data received to another system (PC, robot control system, etc).

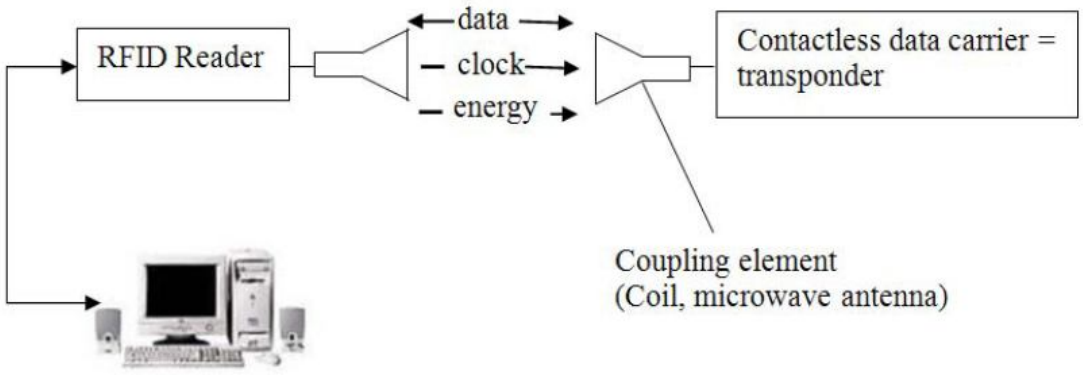


Figure 2.10 Transponder and Reader of RFID system

The transponder, which represents the actual data-carrying device of an RFID system, normally consists of a coupling element and an electronic microchip. When the transponder, which does not usually possess its own voltage supply (battery), is not within the interrogation zone of a reader it is totally passive. The power required to activate the transponder is supplied to the transponder through the coupling unit (contactless), as are the timing pulse and data.

The RFID tag is essentially a memory device with a means of revealing and communicating its memory contents, when prompted (scanned) to do so. The memory consist of a plurality of binary (two state) digits, also known as bits, and the communication comprises RF reception and transmissions means. The binary data (bits) are formed into binary words comprising typically 8, 16 or 32 bits that can make up letters and numbers in the same manner as in computing, the Internet and 'texts' on a mobile phone. The tag may comprise an electronic circuit (printed circuit board) with its own power supply – an active device; or be a very low power integrated circuit that is able to gain enough energy from the scanner/reader RF signal to actually power itself for long enough to transmit the contents of its memory, so called passive device. In its passive embodiment RFID tag transmission power is very low and measured in millionths of a watt i.e. microwatts (μW).

2.10.1 Type of RFID Tag and Its Frequencies

2.10.1.1 Type of RFID Tag

The tags communicate to a RFID reader via radio frequency. The typical types of RFID technologies are active, semi passive and passive. The terms active, semi passive and passive is referring to the RFID tags. Below are details of each type of RFID tag.

Passive

No internal supply is needed. The minute the electrical current induced in the antenna by the incoming radio frequency signal provides just enough power for the CMOS integrated circuit in the tag to power up and transmits a response. The antenna has to be designed to both collect powers from incoming signal and also to transmit the outbound backscatter signal. The response of the RFID tag is not just an ID number the tag can contain nonvolatile EEPROM for storing data.

It uses the radio frequency from the reader to transmit their signal. Passive tags will generally have their data permanently burned into the tag when it is made, although some can be rewritten.

Semi Passive

It is similar to passive tag, the only difference is it have addition of a small battery. This battery allows the tag IC to be constantly powered which removes the need of an aerial to be designed to collect power from the incoming signal. As semi passive tag is pre-energized, they can be read more reliably in this more difficult environment.

Active

Active tag has their own internal power source which is used to power any ICs that generate the outgoing signal. They are more reliable and sophisticated (fewer errors) due to the ability for active tag to conduct a session with a reader. Because of their onboard power supply also transmit at higher power level than passive tags, allowing them to be more effective in "RF challenged" environments such as water, metal or at longer distances. Active tags have on board battery for power to transmit data signal over a greater distance and power random access memory (RAM) giving them the ability to store up to 32,000 bytes of data. A battery can live up to 10 years and have practical ranges of hundred of meters. Types of tags that were used in the RFID system are ISO card, clamshell card and also soft label.

Tag used in this project is passive tag and the model of RFID reader is RFID-IDR-232N.

Benefits of RFID tag:

a) Tags can be read from a distance and from any orientation.
b) Capabilities of read and write, which allow data to be changed dynamically at any time.
c) Multiple tags can be read simultaneously and in bulk very quickly.
d) RF tags can easily embed into any non-metallic product. This feature allows the tag to work in harsh environment providing permanent identification for the life of the product.

CHAPTER 3

METHODOLOGY

3.1 Process Flow for Double Security System Used M Touchpad and RFID

The flow diagram as shown in Figure 3.1 shows the process flow of the project. All the process mentioned are important in completing the project. First of all, the project requires study of basic principles capacitive sensing concept, frequency measurement, microcontroller PIC family, LCD display and RFID (UART concept). Next, additional system consists of hardware and software is designed. Install the safety security system to the door. Double security system plays an important role to ensure the safety of house. Previous project always involves one level of security, but this project involves two level of security. First level is entering 6 digit password by touching the number on m touchpad while second level is scanning the passive tag on RFID reader. The project is considered done when all of the requirements are fulfilled. The flow of project is as shown in figure 3.1.

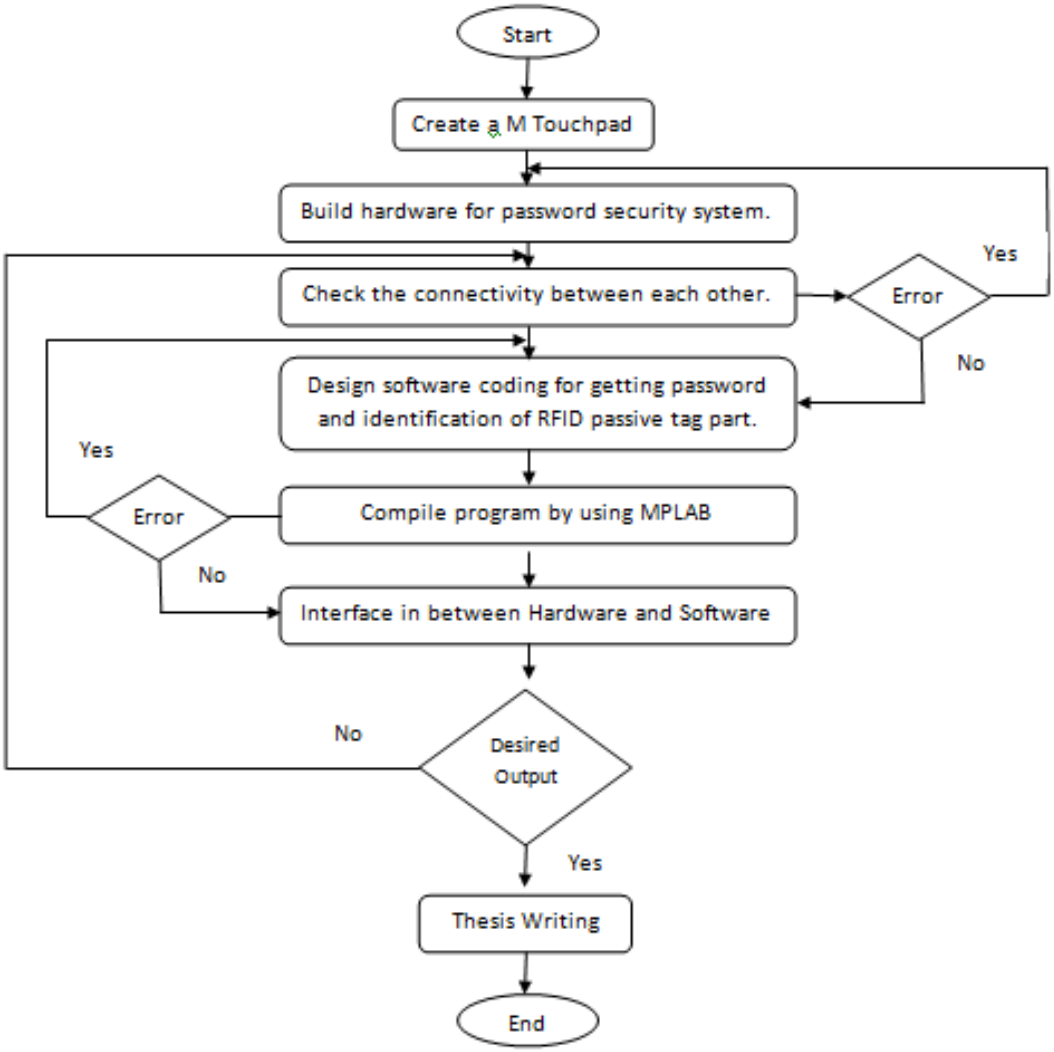


Figure 3.1: Flow diagram of the project

Figure 3.1 The methodology and approach of the project

3.2 Hardware Design for Double Security System

Microcontroller PIC 16F727A is known as a central processing Unit or CPU. There are many others supporting devices that been used on this project which includes power regulator circuit, reset circuit, clock circuit, some input and output interface devices. Besides, there are other components that must also be included so that the system will operate without any problem.

System clock generate the correct and stable frequency to supply it to PIC16F727. The reset circuit determines when to stop or initialize the PIC16F727. Power regulator circuit will supply the voltage for PIC16F727 and whole circuit. The block diagram for the double security system used m Touchpad and RFID is as shown in Figure 3.2.

Figure 3.2 shows the basic design concept of the project. The heart of the system is the PIC16F727A. Double security system used m Touchpad and RFID have divided into several parts. Every part has its specific function and role in the security system.

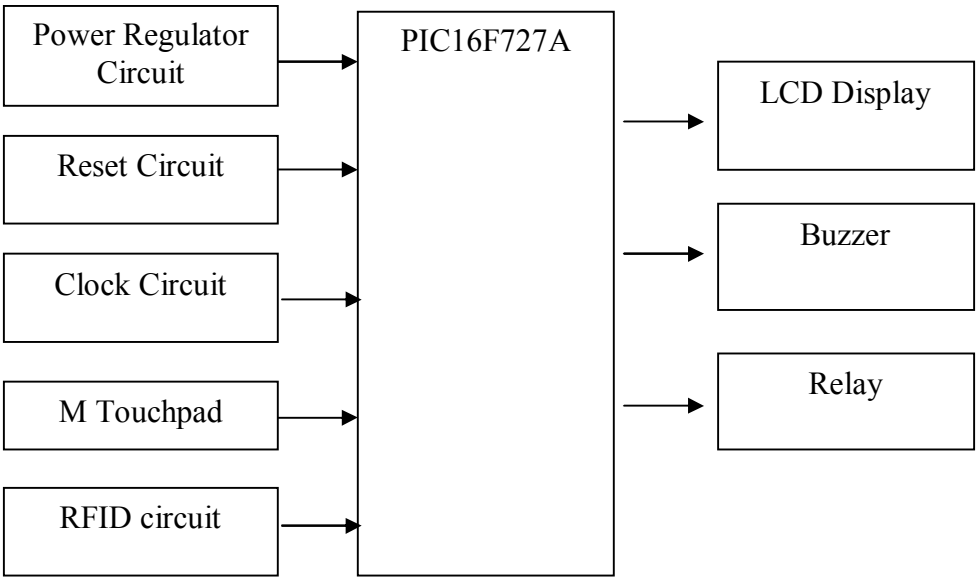


Figure 3.2 The design concept of the double security system

3.2.1 Power Supply Unit

PIC16F727A used power around 1.75W or 350mA at 5V to function. The design of this power circuit enough for supporting the whole system without any additional devices in the circuit board. If the output voltage drops a while, it means the supplied current is not enough. An additional power supply unit need be added so the system can perform properly. Designer can either choose to use AC to DC adaptor or 12V battery to power up the circuit. In this project, AC to DC adaptor chose as power supply. However, higher input voltage will produce more heat at LM7805 voltage regulator. The voltage regulator will broke easily if the power is turn on for a long time. The typical voltage is 12V. Anyhow, LM7805 will generate some heat at 12V also. Only the amount of heat generated is not much as other value of input voltage. For more user friendly, it is better to have both power connector in circuit which consist of AC to DC adaptor and 12 V battery. Diode D1 is used to protect the circuit from wrong polarity supply. C1 and C3 are used to stabilize the voltage at the input side of the

LM7805 voltage regulator, while another two capacitor C2 and C4 used to stabilize the voltage at the output side of the LM7805 voltage regulator. LED yellow used to indicate the power status of circuit; it will turn on when the power is in correct polarity. R1 is a resistor used to protect LED from excessive current that will burn the LED. The voltage regulator circuit is as show in figure 3.3.

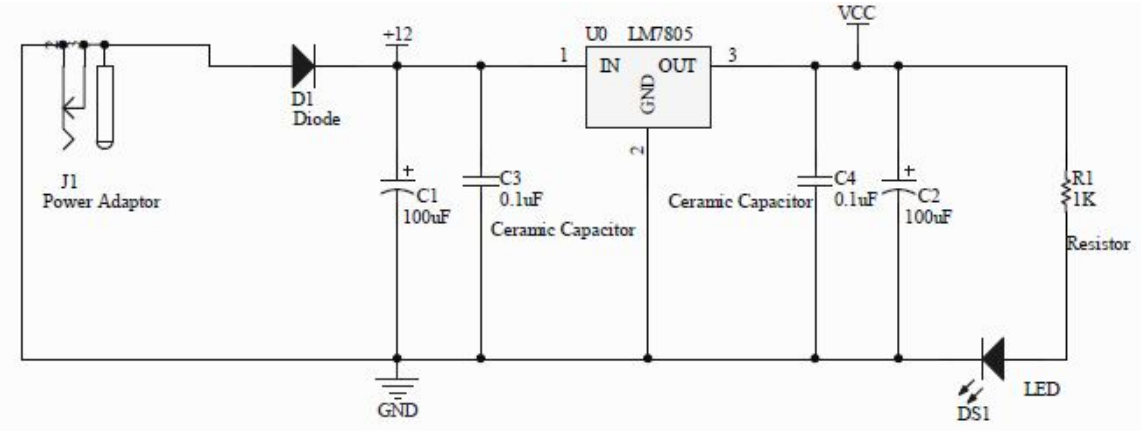


Figure 3.3 The voltage regulator circuit

3.2.2 Clock Generator Unit

Clock system should able to produce and supply stable and nice clock signal to the CPU. There are 2 methods to build the clock system which include digital oscillator and another method is used of crystal and discrete component. The design by using crystal and discrete components as the clock system is more economy compared with the digital oscillator. If any other devices need the clock signal, please use a different inverter. By doing this, we can reduce the load effect on the oscillator which could disturb the operation. The clock generator circuit is shown in Figure 3.4.

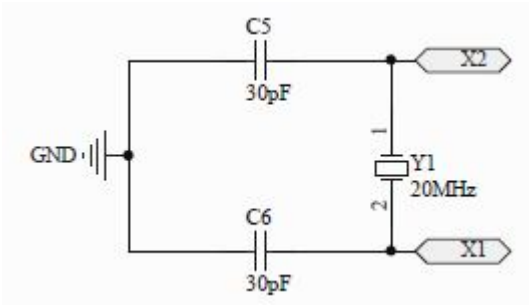


Figure 3.4 The clock generator circuit

3.2.3 Reset Circuit

The circuit will reset once the push button had been pressed. One push button needs one I/O pin to be used as an input for PIC microcontroller. The connection of the push button to the I/O pin is shown in Figure 3.5. The I/O pin should be pulled up to 5V using a resistor (with value range 1K-10K) and this configuration will result in an active-low input. When the button is being pressed, reading of I/O pin will be in logic 0, while when the button is not pressed, reading of that I/O pin will be logic 1. The RESET circuit is shown in Figure 3.5.

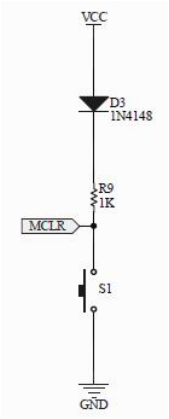


Figure 3.5 The reset circuit

3.2.3 Interface circuit

3.2.3.1 Interface m Touch with PIC16F727

To utilize the capacitive sensing module in PIC16F727, all the copper pads must be connected to the capacitive channels of PIC microcontroller and set those pins to analog pins. This step is very vital before proceeding to software algorithm. In this project, the m Touch or touch pad is connected as shown in Figure3.6.

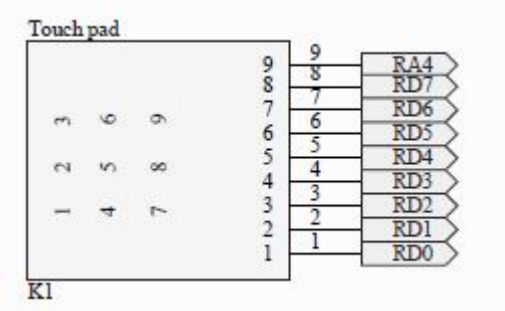


Figure 3.6 The m Touchpad connection

Theoretically, to know whether the touch pad has been touched or not is by determining the change of capacitance. Before a finger presses the pad, the PCB pad itself has a capacitance, Cp. However, if a finger presses the copper pad, another capacitance, Cf is introduced where it is in parallel with Cp. Thus, the equivalent of capacitance increases after finger press. Additionally, the capacitance change will result in change in frequency. To scan a pad, frequency change on copper pad is measured. In this project, the touch pad is sensed by capacitive sensing module (CSM) at fixed time interval. The benefit of this method is that it does not need external oscillator since the module has its own oscillator embedded. The frequency of each pad at rest is averaged. It is low cost and user friendly. The material required to make the m touchpad is just a pieces of copper pad.

3.2.3.2 Interface RFID reader (RFID-IDR-232N) with PIC16F876A

The RFID reader comes with a cable for data communication. The cable is consist DB9 serial port for data communication to PC, RJ-11 connector to connect to RFID Reader and a USB connector to supply 5V for the reader. Figure 3.7 illustrates the RFID connection. There is a circuit required connect to the PIC in this project in order to receive the identification number of passive tag.

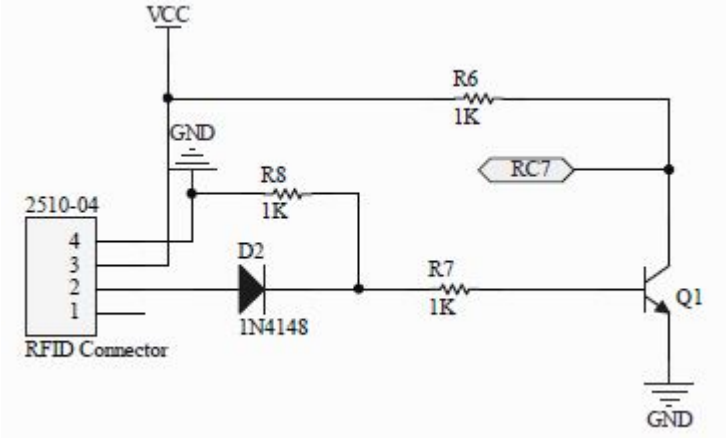


Figure 3.7 The RFID connection

For this project, designer has to cut the wire of the DB9 Serial Port and connect the wire to a 2510-04 female connector. Table 3.1 is example of output wire when user cut the wire of female DB9 Serial Port.

Example of wire color output

Table 3.1: Indication of RFID wire color

Color	Pin function	Connection
Red	Ground	GND
Yellow	Vcc	VCC/ +5V
White	Rx	Not Connected
Green	Tx	Data

The function for each color of wires for RFID reader model IDR-232N is as shown in table 3.1. However, different types of RFID reader sometimes have different color of output wire. So, it is important to refer user manual.

3.2.3.3 Interface LCD (2x 16 Character) with PIC16F727

To use the LCD, First of all has to solder 16 pin header pin to it. LCD model used in this project is JHD162A. LCD connection pin and function of each pin is shown in table 3.2 and the connection shows in figure 3.8.

Table 3.2: Function indication of each pin on LCD display

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, select instruction or data register	RE0
5	R/W	Select read or write	GND
6	E	Start data read or write	RE1
7	DB0	Data bus pin	RB0
8	DB1	Data bus pin	RB1
9	DB2	Data bus pin	RB2
10	DB3	Data bus pin	RB3
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	a resistor to limit excessive current
16	LED-	Backlight negative input	GND

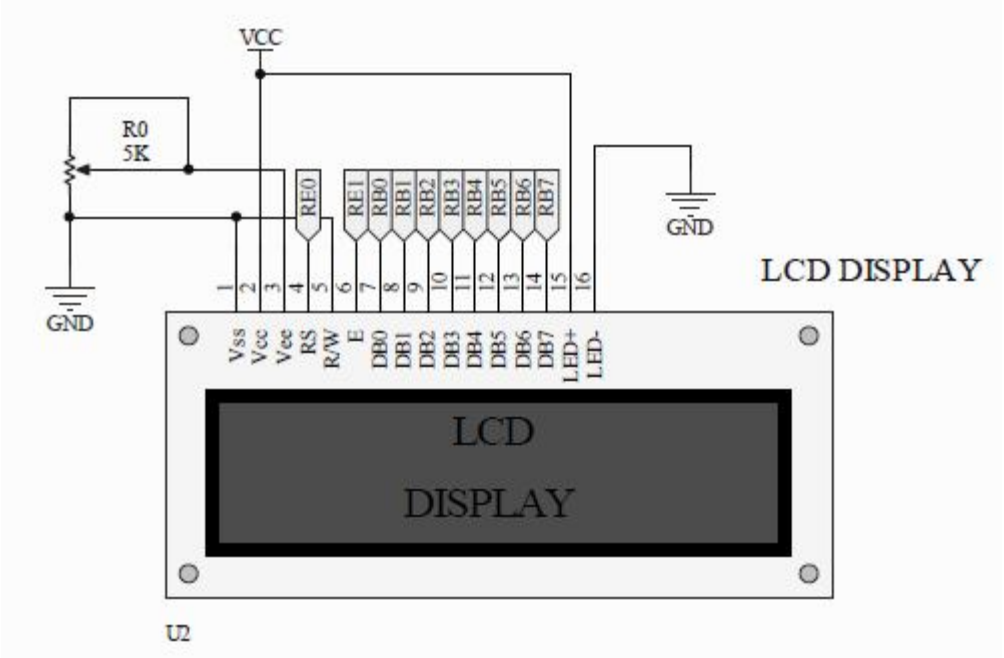


Figure 3.8 LCD display connection

3.2.4 Output Circuit

3.2.4.1 LED as output for PIC microcontroller

LED connection shows in figure 3.9 is for output result showing of m Touchpad. Once the 6 digit password entered is correct, LED green will on, otherwise, the LED red will on.

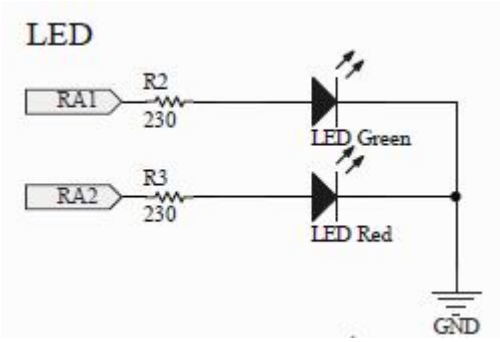


Figure 3.9 LED connection for first level of security

LED connection shows in figure 3.10 is for output result showing of RFID. Once it is processing, LED blue is on. LED red will on when the ID is incorrect.

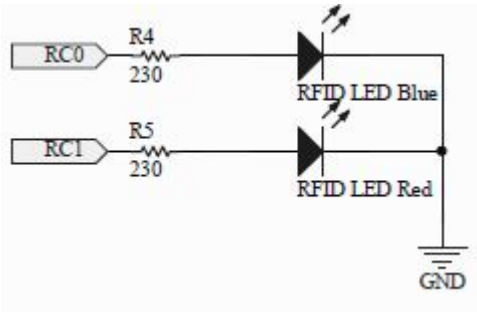


Figure 3.10 LED connection for second level of security

3.2.4.2 Buzzer as output for PIC microcontroller

When the output is in logic 1, the buzzer will activate (beep), while when the output is in logic 0, the buzzer will deactivate. In project, it used as an indicator to indicate whether the password and ID is correct and match. When the 6 digit password entered is correct, buzzer will beep once. Otherwise, when the password entered is wrong, the buzzer will off and alarm will on. Connection for buzzer is as shown in figure 3.11.

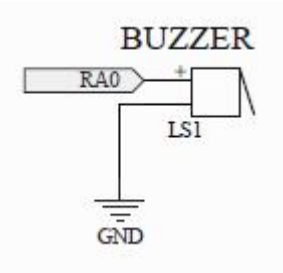


Figure 3.11 Buzzer connection

3.2.4.3 Relay as output of PIC microcontroller

Relay required for output to connect with solenoid at the door in real application. In other name, A relay also known as an electrically operated switch. Relay is the one of electromechanical tools which converts electrical signal to mechanical movement. Relays are used where it is necessary to control a circuit by a low-power signal. There is included wire coil at steel core and connector. When the power has been supply to the coil, the current will be flow and magnetic density will be produce a movement for close one of connector.

Microcontroller cannot control relay indirect. Transistor has been requirement for interface. High rate at base transistor will be on the transistor and enable the relay. Relay can be connecting to the other electric devices at connector. In real application

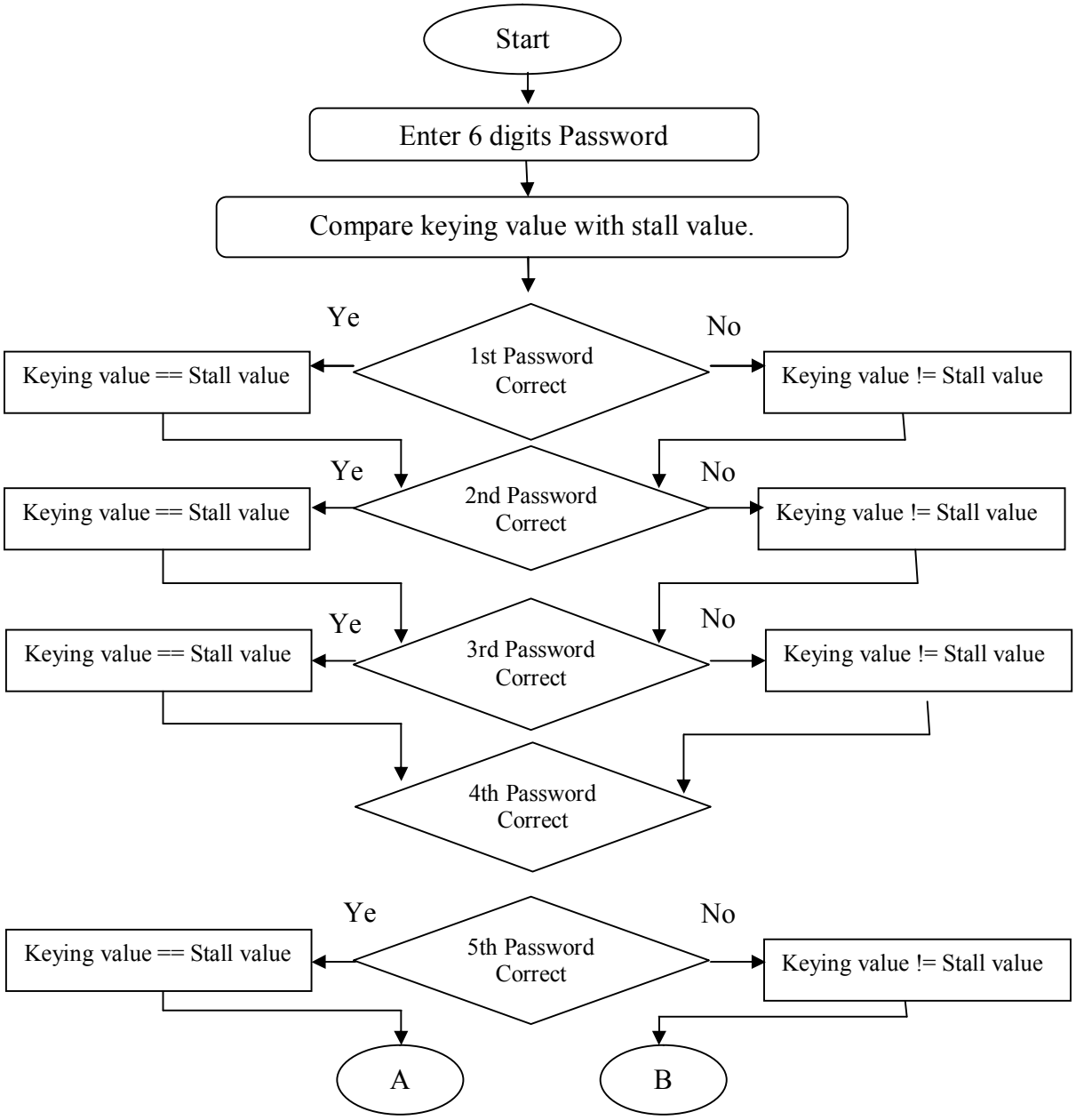
relay must be connected to the solenoid for control the door. Transistor requirement for connection to the solenoid, increase the volt from 5V to 12V to enable the solenoid. When the relay closed the connector which is sent high logic to port RA5 at microcontroller, solenoid will be pushed the load.

3.3 Software Implementation

A flow chart of the password entering system operation is drawn first before the coding work begins. The flow chart is shows in figure 3.12.

First level of security (Password Entering)

First of all, prompt the user to enter 6 digits password, and then compare the entering numerical password with the stall value. 6 digits password are ensured match with the stall value. If the result is correct, then the string "CORRECT PASSWORD" will be displayed on LCD display. Green LED turn on, buzzer will beep once and can proceed to the next step which is RFID identification. Otherwise, string "ERROR" will be displayed on LCD display, LED red and alarm will turn on.



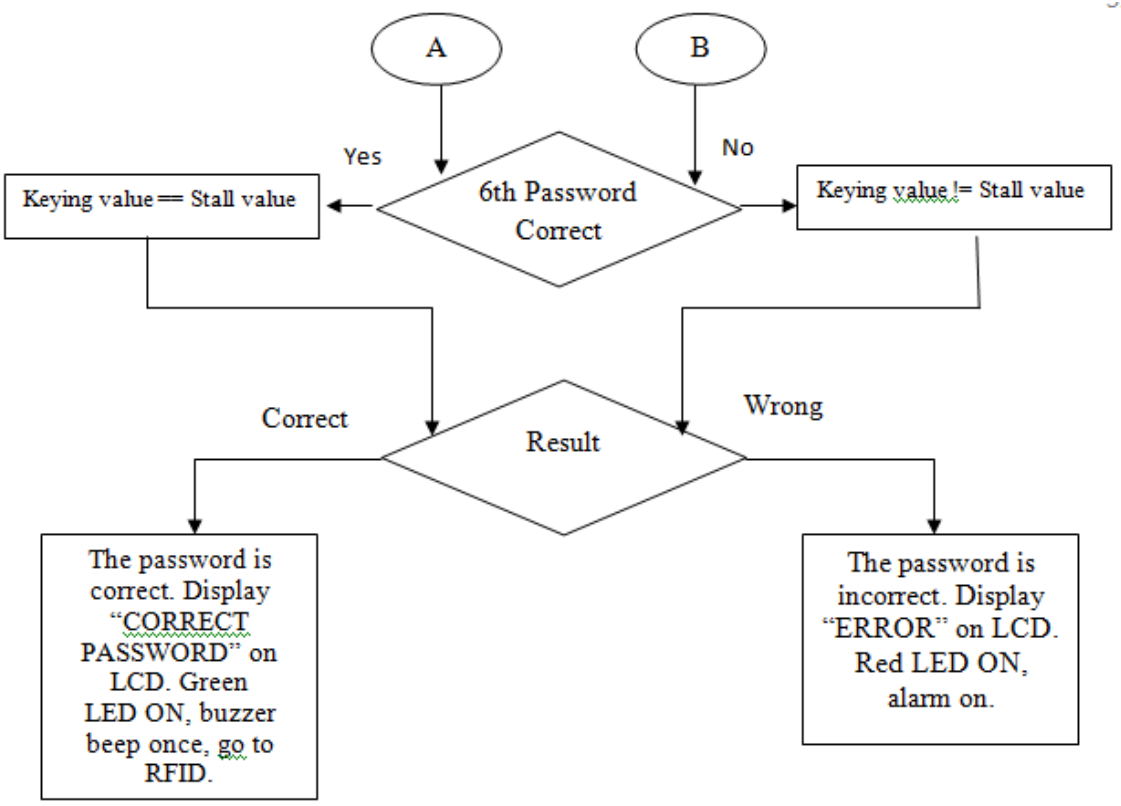


Figure 3.12 The password entering circuit

Second Level of Security (Identification)

Identification process will only begin once the entering numerical password in the first stage success. RFID identification process starting with scanning the RFID passive tags on RFID reader. Next step is doing a comparison between the RFID passive tags ID with the stalling value. RFID identification number and user name will be displayed on LCD display, buzzer will beep once and relay will turn on. Otherwise, the tag ID and string "user not found" will be displayed.

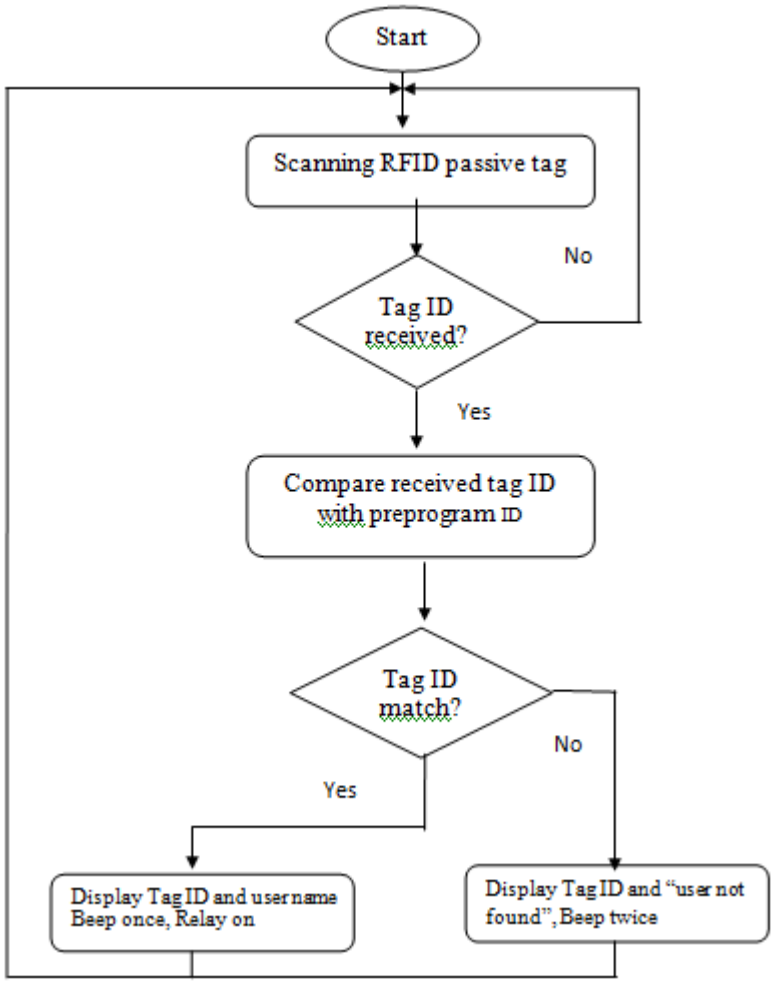


Figure 3.13 The identification scanning circuit

CHAPTER 4

RESULTS AND DISCUSSION

Chapter 4 will show the results from the proposed system. There are some figure shows the respond of output or indicator device once the password is correct and fail. After entering password, next stage is scanning passive tag on RFID reader, some indicator device also for the second level of security. Instructions on how to use the double security system are introduced in this chapter.

In this project, PIC microcontroller was using as the main controller in the double security system. It acts as the heart for the whole project. First of all, PIC used to identify which button (touch sensor) had been pressed on m Touchpad. The m Touchpad used the capacitive sensing concept to operate. Capacitive sensing module is a frequency based method. The capacitance will change when the finger had pressed on the pad. Changing of capacitance will lead to the change of frequency. Frequency change on copper pad is measured in order to determine which pad being touched. The numerical number on the m Touchpad can be arranged according to the preference of designers. Plus, the number won't be shown on the pad. Designer only needs to change software coding in order to achieve this purpose. The percentage of breaking case can be reduced. It becomes a tough and hard work to hack and break the unknown password.

Even the password had been hacked; still have another level of security which is through magnetic card (RFID passive tag). Every passive tag has its own identification number. Without the original passive tag, break in still can be preventing. There are 2 parts in the security system. If someone tries to break in the house, the alarm siren will be on. Besides, PIC will be programmed to identify or change or set the code. All of the instruction such as prompt user to enter the password or place the passive tag on the RFID reader will be displayed on LCD Display. With the displaying on LCD, the owner will be more easy or convenient to operate the system. When the code is right, the motor will be trigger to unlock the door. The diagram for whole project is as shown in figure 4.1.

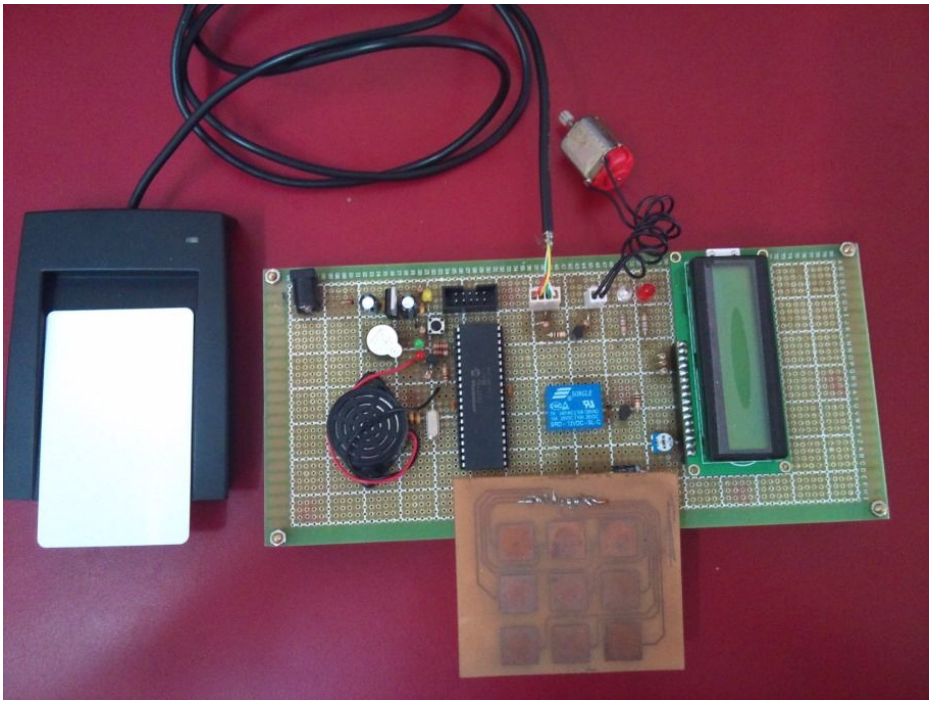


Figure 4.1 Project overview

When the power supply is 'on', the yellow LED will turn on immediately, means the power regulator circuit is in correct polarity and +5V is pass through whole circuit and PIC16F727A. Then, string "2011 FYP PROJECT" will be displayed on LCD display, and it is in shifting form. It aims to identify which year the model of products had been published. Once finish shifting, "DOUBLE SECURITY SYSTEM" will be

displayed on LCD for 2 second. This aims to introduce the title of the proposed project and next sentence is “PLEASE ENTER 6 DIGIT PASSWORD”. User need enter the 6 digit password. When the correct and valid password is entered, the LCD will display “SUCCESS PASSWORD”, LED green turn on and buzzer will beep once shows the password is correct and can go to the next security stage which is scan the passive tag on RFID reader. Any information encoded in the passive tag will be obtained and receive by controller. The identification number will be compared with the stall information value. Figure 4.2 shows the respond of output device when the password is correct.

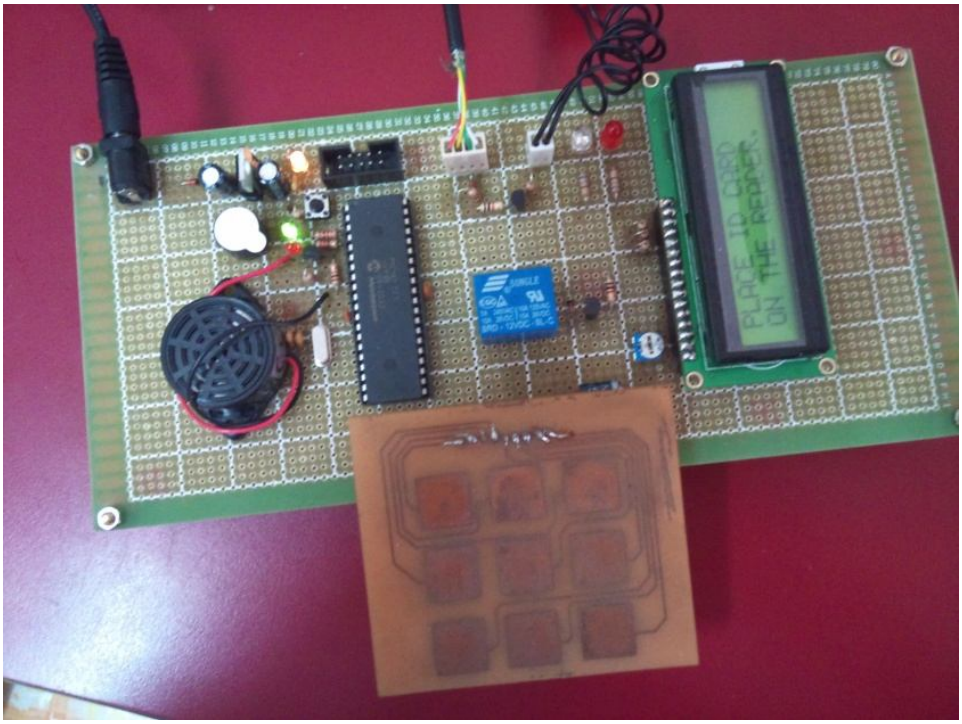


Figure 4.2 Project overview when the password is correct.

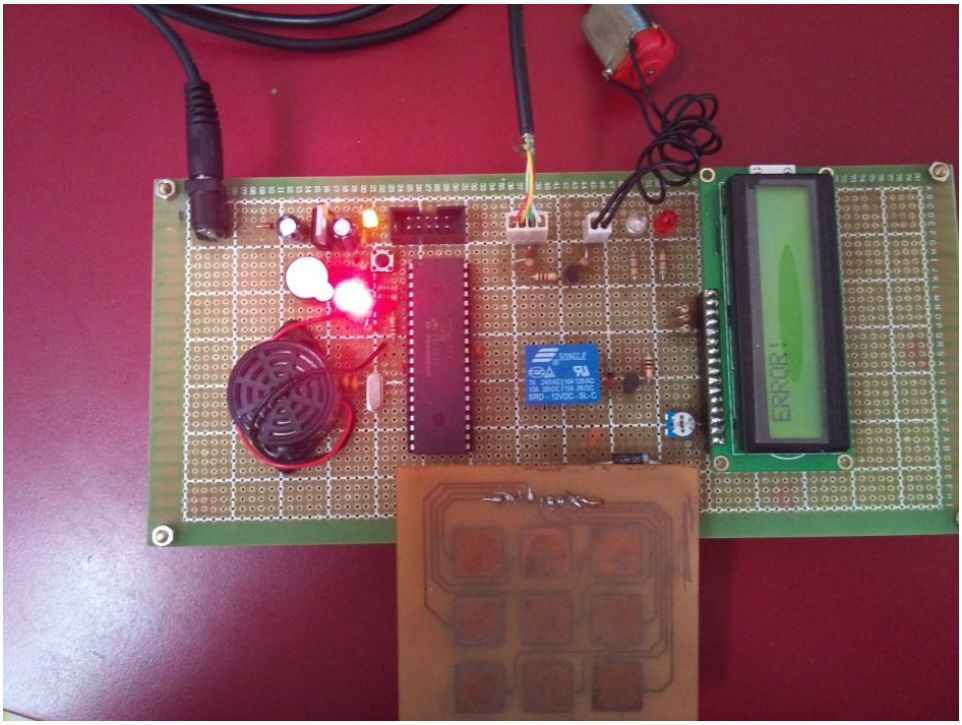


Figure 4.3 Project overview when the password is wrong

If the 6 digit password entered is wrong, “ERROR” will be displayed on LCD display, LED red will turn on and the buzzer will beep twice. Whole circuit need reset again to enter the password again. Figure 3 shows the respond of output device when the password is wrong.

From this chapter, the double security system used m Touchpad and RFID had been fully explained. Hence the users can understand the whole development of this alarm system. The complete source code had attached in the appendix. Users can refer appendix to know more detail about the operation of double security system.

Figure 4.4 shows the schematic diagram of whole double security system. The schematic diagram had drawn by using DXP Protel software.

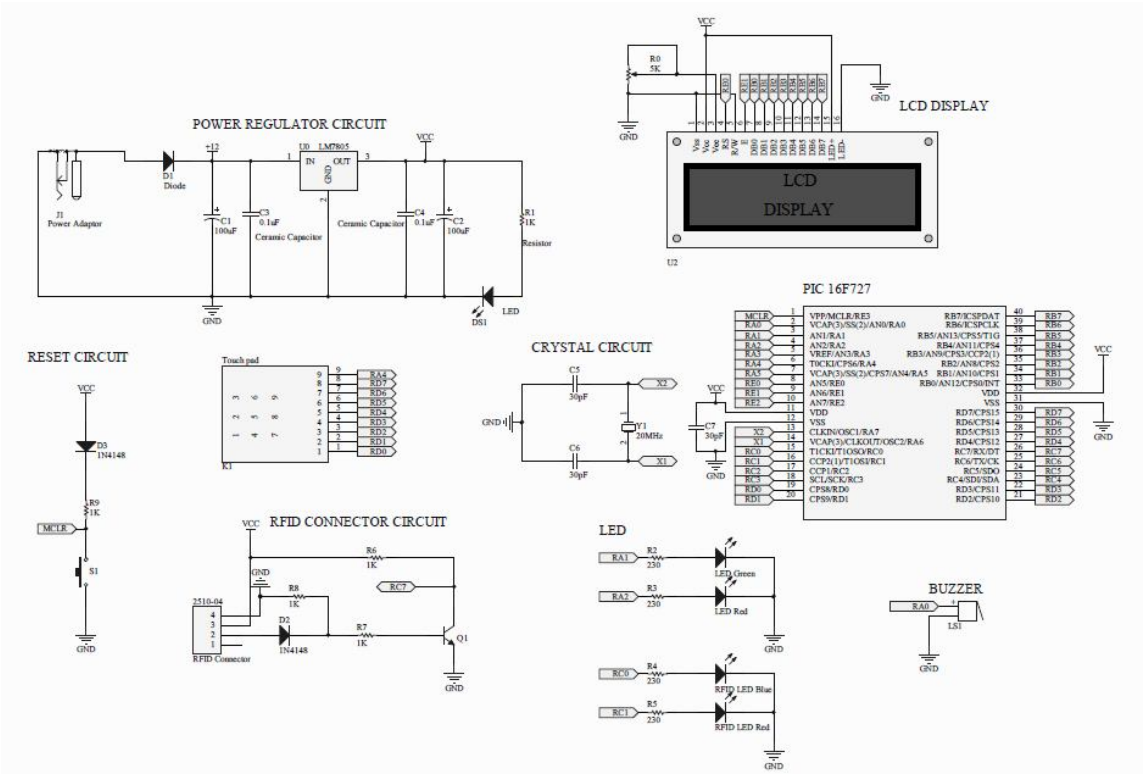


Figure 4.4 Schematic diagram of double security system

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

As a conclusion, the capacitive sensing concept which is based on the frequency measurement had applied in this project. One complete hardware of double security system used m Touchpad and RFID had completely built. Software used to control the project successfully designed. This project can work and give a desired output. Since it is double level of security, the safety of house will be increased and make society feel secure. The specifications of the security system are universal LCD alarm system, keyless, flexible, low cost, repairable, reprogrammable auto reset.

Limitation

This version of security system is designed in conjunction to the current Malaysian demand at this point of time. Breaking case nowadays is dangerous, although it is best suited to the targeted group so far but it may be irrelevant and ineffective to the future generation. However, breaking case or criminal activities sure is more serious in future, so this level of security scare cannot guarantee safety for the future generation. In my opinion, this system design can be further enhanced and upgraded to another level.

Future work/ Recommendations

Home security is something to not take lightly, especially given today's faltering and unstable economy. As people get desperate to make a quick buck some will turn to crime, making our homes, businesses, and families more vulnerable than ever before. That's why it's time to take action and be pro-active. Below are some recommendations to make the security system better and more secure.

a) Manual Authentication

If black out occurs, the users still can certain manual key to activate the lock and access the door. When break out, owner or users many times cannot unlock the lock and enter the house. So, it become not fully efficient because user only can unlock the door when have current.

b) Wireless home security

Low cost, user-friendly and lasting. Plus, it is suitable for double story house. It can ensure safety for big area of housing.

c) Face recognize home security system

The door only can be access once the system detects the match face (image processing). This method is very efficient because the system only recognize the correct face which is match with the stall image.

d) Finger print security system

Fingerprint identification systems are biometric solutions that contain digital fingerprint records of authorized personnel and do not open the door, unless the user's fingerprint matches with the stored digital print. The latest door

security systems record the iris patterns of authorized users, and use alarms to alert the control room in case an unauthorized person tries to open the door. Usually, this kind of security system used in large organizations and government agencies that are manufactured according to the security needs of the organization.

e) Laser technologies

Laser technology is also used in some door security systems, in which an invisible beam of laser surrounds the door. If an intruder or any other thing gets in the way of these beams, the circuit is interrupted and an alarm is activated to alert security. Door security systems also use motion sensors to detect movement in front and around a door.

From this project, I gain a lot of knowledge whether in software (various types of software such as DXP PROTEL, MPLAB, C programming) or hardware (various types of components, solder skill, testing and troubleshoot). All of this knowledge will be useful for me to prepare myself for the future career especially in electronic industry which is changing rapidly.

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Appendix A

PROGRAM CODING OF DOUBLE SECURITY SYSTEM USED M TOUCHPAD AND RFID

```
//============================================================
//          NAME: AMY WONG AI LING
//          COURSE: 4 SEL
//          DEPARTMENT: MICE
//          FYP TITLE: DOUBLE SECURITY SYSTEM USED M TOUCHPAD AND RFID
//          SUPERVISOR: DR MUHAMMAD NASIR BIN IBRAHIM
//============================================================

#include        <pic.h>
#include        "FYP_Lib.h"

//============================================================
//          CONFIGURATION FOR MICROCONTROLLER
//============================================================

__CONFIG(0x3CE4);

//============================================================
//          DEFINE
//============================================================
#define NUM_ROW                                 3
#define NUM_COL                                 3

//============================================================
//          VARIABLE USED IN PROGRAM
//============================================================
unsigned int        reading[NUM_BTTNS];
unsigned int        average[NUM_BTTNS];
unsigned int        threshold;
unsigned char       index;
unsigned int        threshold4;
BButtons Buttons;
unsigned int        bigval;
unsigned int        smallavg;
unsigned char       matrix[NUM_ROW][NUM_COL];
unsigned char       password_count=0;
unsigned char       key_password[6];
unsigned char       stall_password[6]={"873195"};
unsigned char       idNum;
unsigned char       temp;
unsigned char       database;
unsigned char       id[10]={"0013067592"};
unsigned char       user[10]={"AMY WONG  "};
unsigned char       data[12];
```

```
//=============================================================
//          FUNCTION PROTOTYPE
//=============================================================
void Init(void);
void RestartTimers(void);
void RestartTimer1(void);
void SetNextChannel(void);
void CapInit(void);
void interrupt isr(void);
void SLEEP_NOP(void);
void delay(unsigned long data);
void send_config(unsigned char data);
void send_char(unsigned char data);
void lcd_goto(unsigned char data);
void lcd_clr(void);
void lcd_shift(void);
void send_string(const char *s);
void e_pulse(void);
void GetReading(void);
void GetPassword(void);
void beep(void);
void AlarmBeep(void);
void RFID(void);
unsigned char uart_rec(void);


//=============================================================
//          MAIN PROGRAM
//=============================================================

void main(void) {

          Init();

          //LCD CONFIGURATION
          send_config(0b00000001);
          send_config(0b00000010);
          send_config(0b00000110);
          send_config(0b00001100);
          send_config(0b00111000);


          // Start Program

          lcd_clr();
          lcd_goto(0);
          send_string("2011 FYP PROJECT");
          for (int i = 0; i <16 ; i++)
          {
                              lcd_shift();
          }
          delay(20000);
          lcd_clr();
          lcd_goto(0);
          send_string(" PASSWORD DOOR ");
          lcd_goto(20);
```

```
send_string("SECURITY SYSTEM");
delay(20000);
lcd_clr();
lcd_goto(0);
send_string("PLEASE ENTER");
lcd_goto(20);
send_string("6-DIGIT PASSWORD");

// Initialise Button
Buttons.BTN0 = Buttons.BTN1 = Buttons.BTN2 = Buttons.BTN3 = 0;
Buttons.BTN4 = Buttons.BTN5 = Buttons.BTN6 = Buttons.BTN7 = 0;
Buttons.BTN8 = 0;

while(1){
GetPassword();
        if(password_count==6)
        {
                password_count=0;

if((key_password[0]==stall_password[0])&&(key_password[1]==stall_password[1])&&

(key_password[2]==stall_password[2])&&(key_password[3]==stall_password[3])&&

(key_password[4]==stall_password[4])&&(key_password[5]==stall_password[5]))
                {
                        lcd_clr();

                        lcd_goto(0);
                        send_string("CORRECT PASSWORD!");
                        led_green=1;
                        led_red=0;

                        beep();
                        RFID();

                }

                else
                {
                        lcd_clr();
                        lcd_goto(0);
                        send_string("ERROR!");
                        led_red=1;
                        led_green=0;
                        AlarmBeep();

                }
        }
}
}
```

```
// Purpose: Initialize PORTS, Capacitive Sensing Module and Selected Time Base

void Init(void)
{

        TRISA = 0b00010000;
        TRISB = 0b00000000;
        TRISC = 0b10000000;
        TRISD = 0b11111111;
        TRISE = 0b00000000;
        PORTB = 0;
        PORTE = 0;

        ANSELA = 0x10;
        ANSELB = 0x00;
        ANSELE = 0x00;
        ANSELD = 0b11111111;

        OSCCON  = 0x10;

        // Initialize Cap Module

        GIE = 1;
        CPSCON0 = 0b10001101;
        CPSCON1 = 0b00001000;
        CapInit();
        PEIE = 1;

        // Initialise USART (For RFID Purpose)

        TXEN = 1;
        CREN = 1;
        SPEN = 1;

        // Setup ADC

        ADCON1 = 0b00000110;

}

// Purpose: Initialize the Capacitive Sense Module and Time Base Modules

void CapInit(void)
 {
        // Set up variables
        for (index=0; index<9; index++) {
                average[index] = 0;
                reading[index] = 0;
    }
        for(int i=0; i<3; i++){
        for(int j=0; j<3; j++){
        matrix[i][j] = ' ';
        }
        }
```

```
        // Initialize for Timer2 time base and Timer 1 Gate

        T2CON = 0b01110110;
        PR2   = 0xB4;
        TMR2IF = 0;
        TMR2IE = 1;
        T1CON  = 0b11000101;
        T1GCON = 0b11100010;
        TMR1GIF = 0;
        TMR1GIE   = 1;
        }


// Interrupt Service Routine

void interrupt isr(void)
  {

        while (TMR1GIF )
        {
                // Perform touch reading
                TMR2ON =0;
                TMR1ON = 0;
                TMR1GIF = 0;
                GetReading();
        }
}

// Record which position has been pressed

void store(void)
{

        if(Buttons.BTN0 == 1) { matrix[0][0] = '8';}
        if(Buttons.BTN1 == 1) { matrix[0][1] = '7';}
        if(Buttons.BTN2 == 1) { matrix[0][2] = '0';}
        if(Buttons.BTN3 == 1) { matrix[1][0] = '3';}
        if(Buttons.BTN4 == 1) { matrix[1][1] = '1';}
        if(Buttons.BTN5 == 1) { matrix[1][2] = '9';}
        if(Buttons.BTN6 == 1) { matrix[2][0] = '5';}
        if(Buttons.BTN7 == 1) { matrix[2][1] = '2';}
        if(Buttons.BTN8 == 1) { matrix[2][2] = '6';}
}

// Determine which button has been pressed

void GetReading(void){
        bigval = TMR1L + (unsigned int)(TMR1H << 8);
        bigval = bigval * 16;

        reading[index] = bigval;
        smallavg = average[index] / 16;
        threshold4     = average[index] >> 2;
        threshold = threshold4;
```

```
if (bigval < average[index] - threshold)
                {
                switch (index)
                        {
                        case 0:         Buttons.BTN0  = 1;  break;
                        case 1:         Buttons.BTN1  = 1;  break;
                        case 2:         Buttons.BTN2  = 1;  break;
                        case 3:         Buttons.BTN3  = 1;  break;
                        case 4:         Buttons.BTN4  = 1;  break;
                        case 5:         Buttons.BTN5  = 1;  break;
                        case 6:         Buttons.BTN6  = 1;  break;
                        case 7:         Buttons.BTN7  = 1;  break;
                        case 8:         Buttons.BTN8  = 1;  break;

                        default:  break;
                        }
                }

else
                {
                // Button unpressed (no hysteresis provided)
                switch (index)
                        {
                        case 0:         Buttons.BTN0  = 0;  break;
                        case 1:         Buttons.BTN1  = 0;  break;
                        case 2:         Buttons.BTN2  = 0;  break;
                        case 3:         Buttons.BTN3  = 0;  break;
                        case 4:         Buttons.BTN4  = 0;  break;
                        case 5:         Buttons.BTN5  = 0;  break;
                        case 6:         Buttons.BTN6  = 0;  break;
                        case 7:         Buttons.BTN7  = 0;  break;
                        case 8:         Buttons.BTN8  = 0;  break;

                        default:  break;
                        }

                // Perform average after detection comparison
                average[index] += bigval/16 - smallavg;
                }
        SetNextChannel();
        RestartTimer1();
}



// Store the password had been pressed and display "*" on LCD Display

void GetPassword(void)
{
        if(Buttons.BTN0 ==1)
        {
                while(Buttons.BTN0 ==1)continue;
                store();
                if(password_count==0)lcd_clr();
                lcd_goto(password_count);
                send_char('*');
```

```
            key_password[password_count]='8';
            password_count+=1;
}
else if(Buttons.BTN1 ==1)
{
            while(Buttons.BTN1 ==1)continue;
            store();
            if(password_count==0)lcd_clr();
            lcd_goto(password_count);
            send_char('*');
            key_password[password_count]='7';
            password_count+=1;
}
else if(Buttons.BTN2 ==1)
{
            while(Buttons.BTN1 ==1)continue;
            store();
            if(password_count==0)lcd_clr();
            lcd_goto(password_count);
            send_char('*');
            key_password[password_count]='0';
            password_count+=1;
}
else if(Buttons.BTN3 ==1)
{
             while(Buttons.BTN3 ==1)continue;
            store();
            if(password_count==0)lcd_clr();
            lcd_goto(password_count);
            send_char('*');
            key_password[password_count]='3';
            password_count+=1;
}



else if(Buttons.BTN4 ==1)
{
            while(Buttons.BTN4 ==1)continue;
            store();
            if(password_count==0)lcd_clr();
            lcd_goto(password_count);
            send_char('*');
            key_password[password_count]='1';
            password_count+=1;
}
else if(Buttons.BTN5 ==1)
{
            while(Buttons.BTN5 ==1)continue;
            store();
            if(password_count==0)lcd_clr();
            lcd_goto(password_count);
            send_char('*');
            key_password[password_count]='9';
            password_count+=1;
}
```

```
else if(Buttons.BTN6 ==1)
{
        while(Buttons.BTN6 ==1)continue;
        store();
        if(password_count==0)lcd_clr();
        lcd_goto(password_count);
        send_char('*');
        key_password[password_count]='5';
        password_count+=1;
}
else if(Buttons.BTN7 ==1)
{
        while(Buttons.BTN7 ==1)continue;
        store();
        if(password_count==0)lcd_clr();
        lcd_goto(password_count);
        send_char('*');
        key_password[password_count]='2';
        password_count+=1;
}
else if(Buttons.BTN8 ==1)
{

        while(Buttons.BTN8 ==1)continue;
        store();
        if(password_count==0)lcd_clr();
        lcd_goto(password_count);
        send_char('*');
        key_password[password_count]='6';
        password_count+=1;
}
}
```

```
// Read and Display the identification number of RFID passive tag on LCD display

void RFID(void){

        //Set initial condition
        buzzer=0;
        alarm=0;
        led1=0;
        led2=0;
        lcd_clr();
        lcd_goto(0);
        send_string("   RFID DOOR");
        lcd_goto(20);
        send_string("   SECURITY");
        beep();
        delay(20000);

        //infinity loop
        while(1)
        {
                CREN = 1;
                SYNC = 0;
```

```
	SPEN = 1;
	lcd_clr();
	lcd_goto(0);
	send_string("PLACE ID CARD");
	lcd_goto(20);
	send_string("ON THE READER.");

	for(idNum=0;idNum<12;idNum+=1)data[idNum]=uart_rec();

				led1=1;

	lcd_clr();
	lcd_goto(20);
	send_string("PROCESSING.....");
	delay(40000);

	database=0;


	//comparing with the 1st id
temp=0;


	for(idNum=1;idNum<11;idNum+=1)

	{
		if((data[idNum])==(id[idNum-1]))database =1;

	}

	if(temp==0) database=1;
	database=1;
	lcd_clr();

	CREN = 0;


switch (database){
	case 1:

				led2=0;
				lcd_goto(0);
				send_string("ID:");

				for(idNum=0;idNum<10;idNum+=1)
					send_char(id[idNum]);
					lcd_goto(20);
					send_string("User Name: ");

				for(idNum=0;idNum<10;idNum+=1)send_char(user[idNum]);
				send_string("SUCCESS, ID MATCH ");
				beep();
				relay=1;
	break;
```

```
                default:

                                led_green=0;
                                led1=0;
                                led2=1;
                                lcd_goto(0);
                                send_string("ID: ");

                                for(idNum=1;idNum<11;idNum+=1)send_char(data[idNum]);

                                        lcd_goto(20);
                                        send_string("user not found");
                                        AlarmBeep();

                                break;
                }
                delay(300000);
                led1=0;
                led2=0;
        }

}

//Purpose: Resets and restarts timers 1 & 2 used for capacitive sensing.

void RestartTimer1(void)
  {
        TMR1L = 0;
        TMR1H = 0;
        TMR2 = 0;
        TMR2IF  = 0;
        TMR1ON = 1;
        TMR2ON = 1;
  }

//      Sets the next channel for the oscillator to measure,

void SetNextChannel(void)
        {
        if (++index>= NUM_BTTNS)
                index = 0;
                else;
                if(index==0)
                        CPSCON1 = 0b00001000;
                if(index==1)
                        CPSCON1 = 0b00001001;
                if(index==2)
                        CPSCON1 = 0b00001010;
                if(index == 3)
                        CPSCON1 = 0b00001011;
                if(index== 4)
                        CPSCON1 = 0b00001100;
                if(index == 5)
                        CPSCON1 = 0b00001101;
                if(index ==6)
                        CPSCON1 = 0b00001110;
```

```
                if (index ==7)
                        CPSCON1 = 0b00001111;
                if (index == 8)
                        CPSCON1 = 0b00000110;
        }

// delay routine

void delay(unsigned long data)
{
        for( ;data>0;data-=1);
}

// send the configuration of LCD

void send_config(unsigned char data)
{
        rs=0;
        lcd_data=data;
        delay(50);
        e_pulse();
}

// send character to LCD

void send_char(unsigned char data)
{
        rs=1;
        lcd_data=data;
        delay(50);
        e_pulse();
}

void e_pulse(void)
{
        e=1;
        delay(50);
        e=0;
        delay(50);
}

// Determine the location of string to be displayed at LCD

void lcd_goto(unsigned char data)
{
        if(data<16)
        {
                send_config(0x80+data);
        }
        else
        {
                data=data-20;
                send_config(0xc0+data);
        }
}
```

```
// Shift LCD character display to the left

void lcd_shift(void)
{
        send_config(0x18);
        delay(6000);
}

// Clear LCD display

void lcd_clr(void)
{
        send_config(0x01);
        delay(50);
}


// Send string to LCD

void send_string(const char *s)
{
        //unsigned char i=0;
        while (s && *s)send_char (*s++);

}

// Receive identification number of RFID passive tag by using RFID reader

unsigned char uart_rec(void)
{
        unsigned char rec_data;
        while(RCIF==0);
        rec_data = RCREG;
        return rec_data;
}


// The buzzer will beep one time

void beep(void)
{
        buzzer=1;
        delay(10000);
        buzzer=0;
        delay(10000);
}

// The buzzer will beep long

void AlarmBeep(void)
{
        buzzer=1;
        delay(100000);
        alarm=0;
        delay(100000);
}
```