THE DEVELOPMENT OF STUDENT ATTENDANCE SYSTEM FOR UNIVERSITI TEKNOLOGI PETRONAS

By

NOR AINI BT ZAKARIA

FINAL PROJECT REPORT

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

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CERTIFICATION OF APPROVAL

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Approved:

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Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK

December 2012

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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Nor Aini Bt Zakaria

ABSTRACT

This project is about the portable student attendance system used to record digitally student's attendance in class. This system is dedicated to Universiti Teknologi PETRONAS students which use their matrix cards as medium for recognition. It is chosen to shorten the time of recording attendance compared to the manual method. The student attendance system can be practiced using Radio Frequency Identification (RFID) as a medium for data recording. The microchip-embedded cards use RFID reader to record the attendance in class. This system involves the circuit fabrication as well as the programming. It is found that this system is suitable for students' attendance purpose as well as replacing the existing inefficient method.

ACKNOWLEDGEMENTS

My utmost gratitude goes to my supervisor, Ms. Zazilah May and my co-supervisor, Dr. Nor Zaihar Yahaya for all the guidance, support, ideas and advices given throughout this project. Without their relentless effort to give guidance and supervision, this project will not have been successful.

Special thanks to Honeywell staffs, Mr. Khor Siak Hong and Mr. Mohd Fadzli Rosli for their help in giving information regarding the process of creating UTP matrix card. All the given information really helps in completing this project.

Last but not least, thanks to all colleagues who are directly or indirectly contributed towards the success of this project. With the full cooperation from various people above, all the objectives stated have been successfully achieved.

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LIST OF ABBREVIATIONS

1D	1 dimensional
2D	2 dimensional
AC	Alternating Current
EBI	Enterprise Building Indicator
IC	Identification card
ID	Identification
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LMS	Learning Management System
PC	personal computer
PCB	Printed Circuit Board
PIC	Peripheral Interface Controller
RFID	Radio Frequency Identification
SAS	Student Attendance System
SIM	Subscriber Identity Module
UART	Universal Asynchronous Receiver/Transmitter
UPC	Universal Product Code
USB	Universal Serial Bus
VBA	Microsoft Visual Basic

CHAPTER 1

INTRODUCTION

In coping with technological advancement, the way of recording students attendance is getting more practical. Some methods have been developed to make the attendance recording process easier and the digital student attendance system is one of them.

1.1 Background of study

Portable Student Attendance System (SAS) is a digital attendance system which uses Radio Frequency Identification (RFID) in order to record the presence of students in class. RFID is chosen because this application is widely used in all over the world and by applying this system, it may shorten the time compared to the current method which records the student attendance manually.

RFID has been used before around 1940s for military purposes and civil aviation. According to this study, around 1980s, the same concept is applied for industrial application [1]. This technology is much easier as it can detect the data as long as the reader is within the specific range compared to others such as barcode which requires scanner.

Instead of using the manual method where students need to write their name manually, they can just touch their matrix cards on card reader in order to record their attendance in class. Many researches were conducted before to study the main objectives of this SAS as well as its advantages.

Small RFID chip is the main device that will be embedded in the tag which in this case; the student's matrix card. The RFID chip uses electromagnetic fields for data transfer for tracking and identification purpose. The RFID reader is portable and lecturers may bring it to class to record the student attendance.

As for the second option, the existing barcodes in UTP student's matrix card can be used for this system too. As the current matrix card is mainly used for student identification and library usage only, this barcode can be improved by using it for recording attendance system digitally.

A barcode reader so called special optical scanner is needed to scan the barcodes and provide all information regarding the attendance. The spacing and width of parallel line in the barcode is used to store data.

Once the tag and reader have been scanned, information regarding the student's name and ID number will be displayed on the reader to verify their attendance in class.

1.2 Problem Statement

Irregular attendance of student is becoming one of the problems in UTP as their behaviour may affect the academic performance as well as the university's image. By having this portable attendance system, their attendances will strictly be recorded to avoid barring from sitting final examination.

Basically, the lecturers will ask student to write their name in a sheet of paper or just call their name accordingly. This attendance system may at least shorten the time consuming for taking the attendance manually. Besides, the paper may be torn, misplaced or lost for recording in database system manually. With the RFID-based system, all data will be secured and stored in database.

1.3 Objective and Scope of Study

- To understand the operation of the existing portable student attendance system in market.
- To demonstrate and resemble the data transmission of scanning process in RFID attendance system with data transferring from Microsoft Access 2007 to Microsoft Excel 2007
- To construct a working portable student attendance system device based on the existing devices in market as well as programming student's matrix card.
- To test and troubleshoot the device by scanning the matrix card for recording of students attendance.

1.4 The Relevancy / Significance of the Project

In terms of relevancy of this project, there is no problem for me to carry on with this project since I am currently taking electrical & electronic engineering course. Although I am taking Control System as my major subject, yet I think this type of knowledge should be gained and applied especially in programming and embedded system course.

Before this, I have also taken some electronics subject such as digital electronic and analogue electronic during my second year of engineering. So, I can apply what I learnt before when completing my project. Additionally, I have my supervisor Ms, Zazilah and co-supervisor, Dr. Nor Zaihar who will supervise me throughout this period to complete my project.

1.5 Feasibility of the Project within the Scope and Time frame

Regarding the availability of facility and equipment, most of the components are available in UTP. I bought some components which are not available in lab using the budget given at the electronic shop. For the programming parts, I have referred to the IT Department for simulation tools.

1.6 Contribution of work

Student attendance system is important to UTP for student attendance improvement. The demonstration on how the data transmits from matrix card to reader using Microsoft Excel 2007 and Microsoft Access 2007 as well as the fabricated prototype shows the process of recording student attendance digitally.

CHAPTER 2
LITERATURE REVIEW

The previous traditional method used to record the student attendance such as signing on paper or by calling student's name is a very time consuming and insecured. So, a suitable system needs to be implemented to solve the problem.

2.1 Existing types of Attendance System

There are several types of attendance recognition systems which are already in market such as RFID Based Attendance System, Biometric Attendance System, Real Time Face Detection Algorithms and Barcode-based Attendance System. Understanding the working principle of each existing attendance system is an advantage in order to improvise the current system.

All information from Section 2.1.1 to 2.1.5 refers to my first objective which is to understand the operation of the existing portable student attendance system in market.

2.1.1 RFID Based Attendance System

Radio frequency wave has been widely used in RFID system in order to track any implanted tag in a device which uses electromagnetic and electrostatic coupling for the communication between the tag and reader through modulation and encoding scheme [2].

Basically, RFID is the next wave in the evolution of computing and it is a technology that connects objects to Internet which can be used to track and share data. RFID tags use a silicon microchip to store a unique serial number burned-in during manufacturing process [3]. It is a row of number such as 0011642531 177, 42659 which represent the card identity and every card will have different serial number.

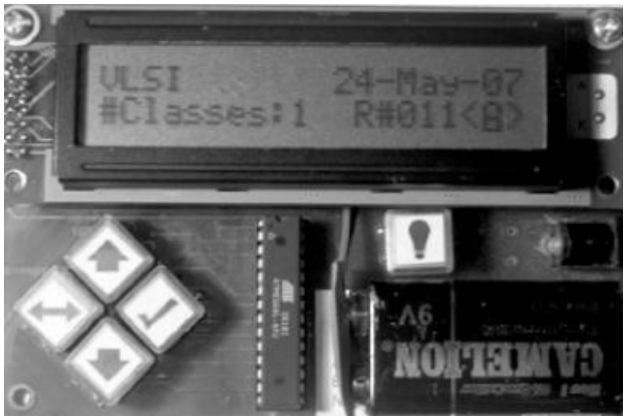
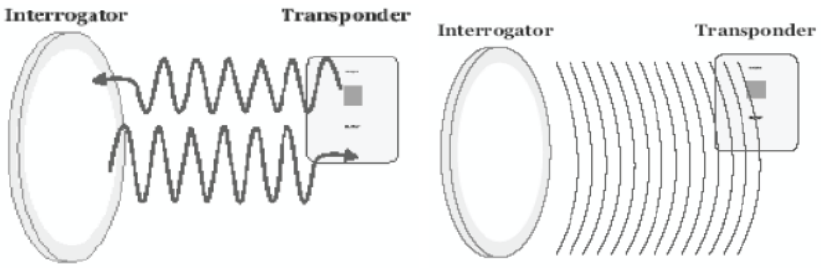


Figure 1: The attendance recorder gadget [4]

As in Figure 1, this is an example which uses RFID to record student attendance. Based on the previous study, this device is efficient and accurate compared to the traditional manual attendance system.

By using RFID, less time is consumed to take the students attendance because the detection only requires about one or two seconds for the reader to track the information contained in the tag. There are two broad categories of RFID systems; passive and active system as shown in Figure 2 (a) and (b) [5] respectively.



(a) (b)

Figure 2: (a) Passive RFID (b) Active RFID [5]

Passive RFID system gains its power from the reader because it does not contain a battery. When radio waves from the interrogator are encountered by a passive RFID transponder, magnetic field is formed by a coiled antenna. The tag or the transponder draws power from it, energizing the circuits in the transponder. The information encoded is then sent to the tag's memory.

The tag is composed of a silicon chip and an antenna coil that includes basic modulation circuitry and non-volatile memory. Time varying electromagnetic Radio Frequency (RF) wave which is also called a carrier signal is transmitted by a reader and energized by the tag. AC voltage will be generated across the coil once the RF field passes through the antenna coil. The voltage generated is rectified to supply power to tag and all information stored in the tag is transmitted back to the reader by detecting the modulated signal [6].

As for the active RFID system, it is equipped with a battery that can be used as a partial or complete source of power for the transponder's circuitry and antenna. Besides, radio waves from the interrogator can be read at distances of one hundred feets or more by the transponder.

Some examples of devices that use RFID are Subscriber Identity Module (SIM) card for mobile phones, credit card and identification card (IC) [7]. Other than that, RFID is also widely used in medical management, small transactions and E-passports [8].

There are two types of smart cards; contact and contactless cards. The one that uses RFID to transfer data is the contactless card. It uses a wireless frequency and embedded small chips to convey information to the card reader. The contact card has a small chip on the front surface and needs to be used together with a smart card reader. The card must be inserted into the card reader and it will make a contact with electrical connectors which allowing the data transfer to and from the chip. Besides, the tag used is embedded with small chip together with antenna that helps the tag to convey information as it is made up of conductive element [9].

The recorded information from the RFID system may help lecturers in calculating the attendance weightage of their students [10]. This somehow will reduce the task of lecturers it is calculated automatically. There is no human intervention involved in this system, hence the error can be reduced making this method be more efficient and effective.

As for the advantage, RFID technology increases the speed of data transfer, contains high identification and accuracy. Besides, by taking the attendance digitally, it is more secure compared to the traditional method [1,10].

2.1.2 Matrix card of UTP's Population

There are some differences between matrix card used by lecturers, local students and foreign students as shown in Figure 16. Lecturer's matrix card in Figure 3 (a) shows the difference in colour compared to student's card. Both Figure 3 (b) and Figure 3 (c) are for foreign and local students respectively. The only difference between the cards is the existence of a thick layer on the left side of the picture (as marked) for foreign student's matrix card as shown in Figure 3 (b).

(a) (b) (c)

Figure 3: (a) Lecturer's matrix card, (b) Foreign student matrix card, (c) Local student matrix card

Figure 4: Matrix card for lecturers

As in Figure 4, the features of lecturers' matrix card are:

- Blue in colour
- Contain serial number and barcode
- Position is stated
- Has a printed barcode

2.1.3 Biometric Attendance System

As for this system, physical and behavioural characteristics such as fingerprints, voice, face, retina, iris, handwriting and hand geometry are used to identify and verify students attendance in class. The most popular for convenient and secured authentication is biometric identification using fingerprint as shown in Figure 5. This method is unique and the problem of forgotten passwords or lost cards can be eliminated [11].

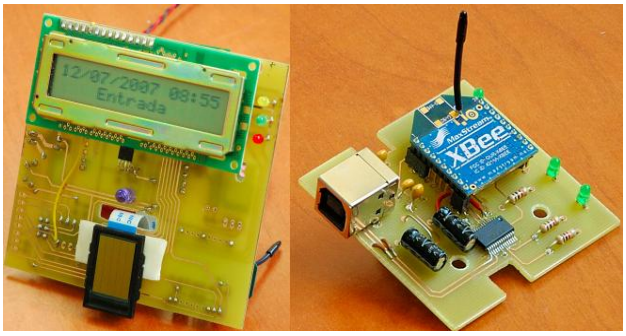


Figure 5: Biometric Attendance System [12]

There are two main types of fingerprint attendance management system in the market; on-line fingerprint attendance system and off-line fingerprint attendance systems. On-line system requires connection with a personal computer (PC) and all fingerprints' templates of users to be verified and stored in PC database. Hence, this gives burden to PC to store data and eventually increases the response time. The off-line fingerprint attendance system is more convenient as it can complete all processes without the support from PC [13].

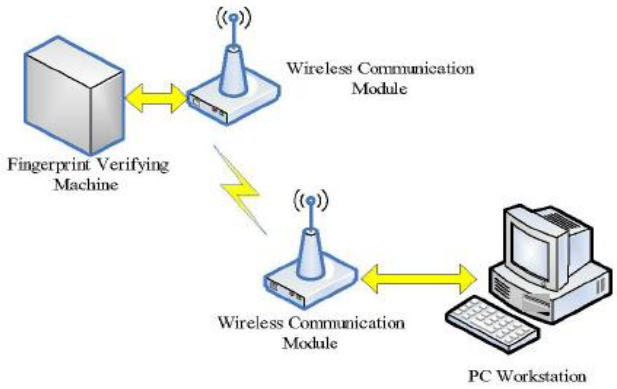


Figure 6: Biometric Attendance System Organisation [13]

Figure 6 shows the block diagram of the biometric attendance system that starts by pressing fingerprints on a sensor of a machine. The system can transmit users' attending records to manage PC after the fingerprints' matching. The software installed on PC will process the attending data as well as carry out the query or print the data [13].

Veridicom Fingerprint Sensor [14] is used in this system as it can detect the structures of a fingerprint and compare it to the one stored in the database system. Image enhancement techniques are used in order to detect the structure of the fingerprint.

Figure 7 shows the flowchart of the biometric attendance system. Once the device is switch on, thumb is put on the reader in order for the device to detect the pattern of thumbprint. The pattern is then being stored in the database. If the recognition of thumbprint is unsuccessful, user needs to repeat the step again.

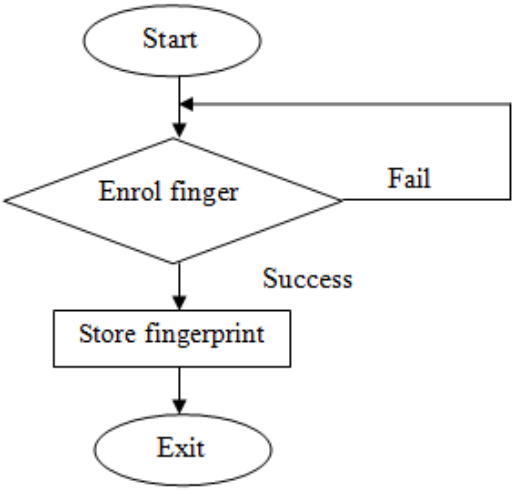


Figure 7: Flow chart of fingerprint enrolment [14]

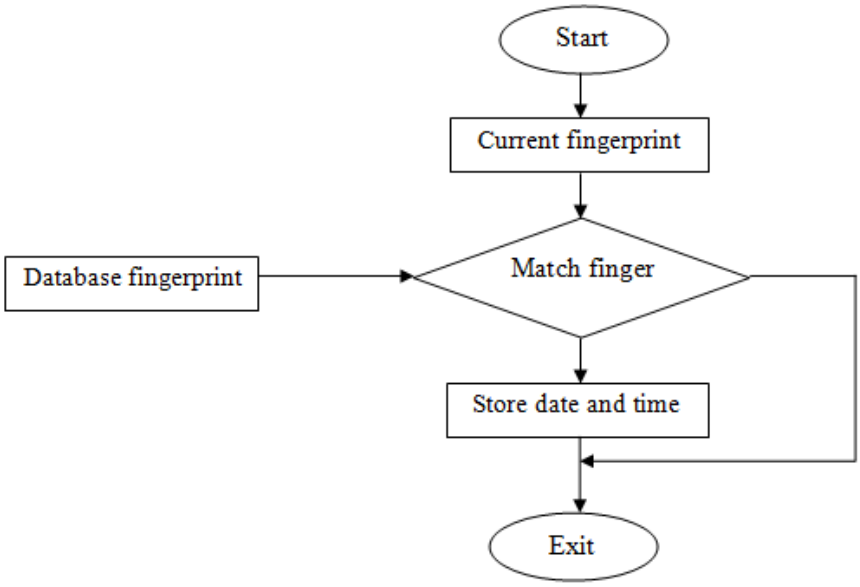


Figure 8: Flow chart of fingerprint matching [14]

The fingerprint matching process is very important in biometric attendance system. Once the current fingerprint matches the database fingerprint, the date and time of the attendance will be stored in the system as shown in Figure 8.

2.1.4 Real time face detection algorithms integrated on an existing Learning Management System (LMS)

This system integrates computer vision and face recognition algorithms into the process of attendance management. The system is implemented using a non intrusive digital camera installed in a classroom, which scans the room, detects and extracts all faces from the acquired images. Similar to the other methods, once faces have been extracted, they are compared with an existing database of student image. A list will be generated based on a successful recognition of a student and saved in a database [15].

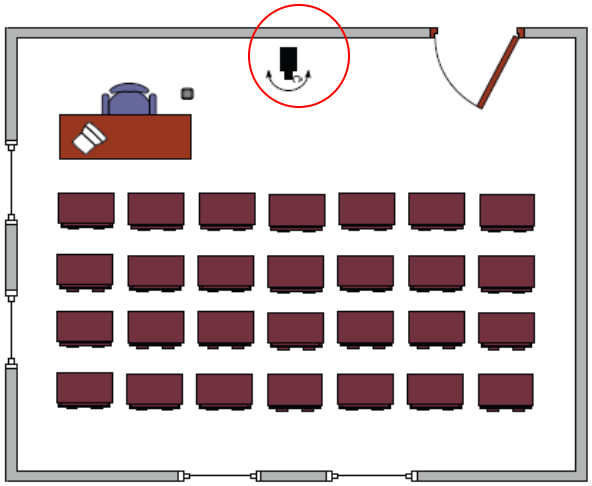


Figure 9: Classroom setup [15]

The infrastructure in classroom requires rotating camera positioned centrally in the front of the classroom such in Figure 9. Using this setup, the camera is capable to capture frontal images from students as shown in Figure 10.

Figure 10: A classroom with students [15]

The camera at the entrance of the classroom would individually detect faces of everyone who enters the classroom. The system requires each classroom to have at least one internet connected computer. This computer communicates with the LMS server, where the captured images are transferred. Figure 11 depicts the physical architecture of this system.

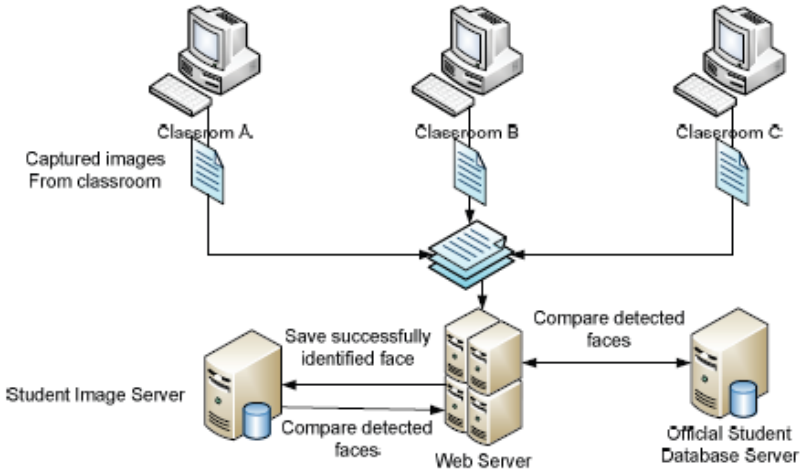


Figure 11: Physical system architecture [15]

Other than using the LMS server, a core algorithm can also be used for face recognition in recording attendance. This algorithm divides the image into block images, which are also called sub-images. Then, the Fisher method is directly employed to the selecting sub-images [16].

Fisher method plays a role in dimensionality reducing and increasing the number of the sub-chart training sample to 2 indexes that solves the problem of complexity of small sample image into large sample image issue. This method reduces the memory capacity and makes the recognition rates higher [16].

2.1.5 Barcode-based Attendance System

Barcodes are machine-readable symbols used to store bits of data and all barcode data can be automatically collected and stored in a database. Barcodes represent data in 1D (1 dimensional) barcodes or 2D (2 dimensional) matrix codes. 1D barcodes refer to the spacing of parallel line whereas 2D is in patterns of squares, dots and hexagon pattern. In order to detect any data, barcode requires a white or solid color background [17].

Table 1: The various barcode type [17]

Barcode Type	Symbology	Description
UPC, EAN, Bookland & ISSN		Numeric-only, have fixed length and include one or more check digit
Code 128		Numeric only and employs simple compression. Support the lowest 128 ASCII characters
Code 39 (Code 3 of 9)		Full ASCII version supports 128 ASCII characters
Interleaved 2 or 5 (ITF)		Relatively compact and is an older barcode that isn't use much today
Codabar		Numeric-only symbology used by FeDex, libraries and blood banks
MSI-Plessey		Numeric symbology used in library

Table 1 provides the various barcode type used nowadays. A barcode reader which is optically laser device needed in order to read and decode the barcode [17]. Universal Product Code (UPC) type of barcode is commonly used nowadays especially at the cash register.

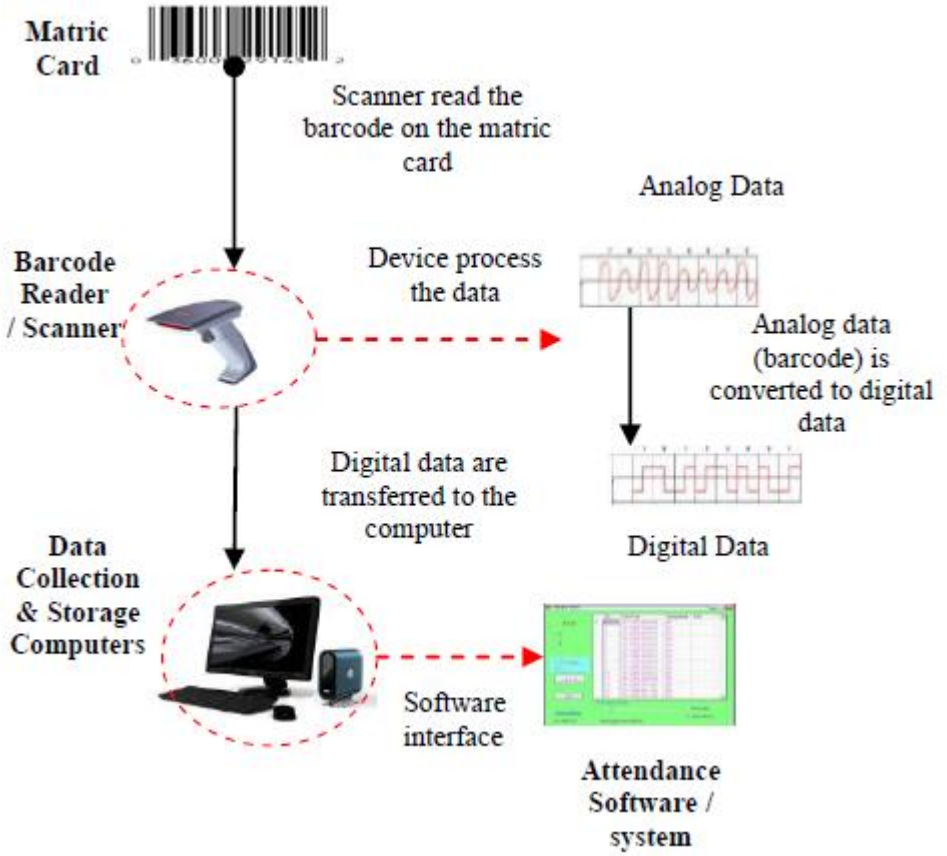


Figure 12: Barcode Scanning Process [17]

As in Figure 12, the student's matrix card will be scanned using the barcode reader as analogue signal. The scanner will then convert it to digital signal to make it available for the computer to receive the data. Then, the data captured will be stored in a database of the host computer [17].

2.2 Visual Basic.net 6

This section is a literature review for the second objective which is demonstrating and resembling the data transmission of scanning process in RFID attendance system with data transfer from Microsoft Access 2007 to Microsoft Excel 2007.

The database as shown in Table 2 is written in Microsoft Access 2007. The information will be transferred to Visual Basic.net 6.

Table 2: Database develop in Microsoft Access [18]

Student

ID	Student ID	Thumbprint	RFID	Name	MobilePhone	EmailAddress
1	8667	222	581	Anith Safura bt Azmi		
2	8696	223	582	Ili Nadiah bt Mhd Nasir		
3	8292	224	584	Nurul Atiqah bt Mat Ayu		
4	8298	225	585	Faizatul Khasanah bt Su		
5	7878	226	586	Ahmad Afiq b Mohd Sai		
6	8643	227	587	Munirah bt A.Jabar		
7	7764	228	588	Siti Nurbalqish bt Samin		
8	8003	229	589	Mohd Rezza Bin Rahma		
9	6009	230	590	Farid Aqmal Bin Azmi		
10	15001	231	591	Mohd Iqbal Bin Azmi		
11	10033	232	592	Amy Samiah bt Zainudd		
12	12006	233	593	Azmi b Aziz		

2.3 Working Prototype of RFID Attendance System

This section refers to the combination of the third and forth objective of my project which is to construct a portable student attendance system, programming student's matrix card as well as testing and troubleshooting.

For hardware implementation, it is a circuit construction using Programmable Integrated Circuit (PIC16F877A) as shown in Figure 13. The required electrical components such as the Liquid Crystal Display (LCD) module are soldered to a strip board [19].

For software point of view, the PIC is programmed using MPLAB IDE and Hi Tech C Compiler as shown in Figure 14. Besides, the RFID reader is communicating with PC/Desktop using Hyper Terminal in Windows XP [19].

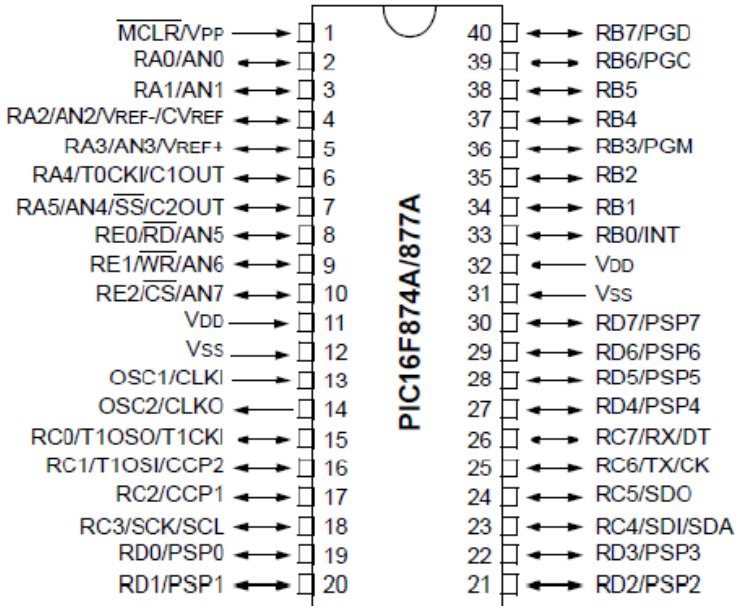


Figure 13: PIC16F877A Pin-out [19]

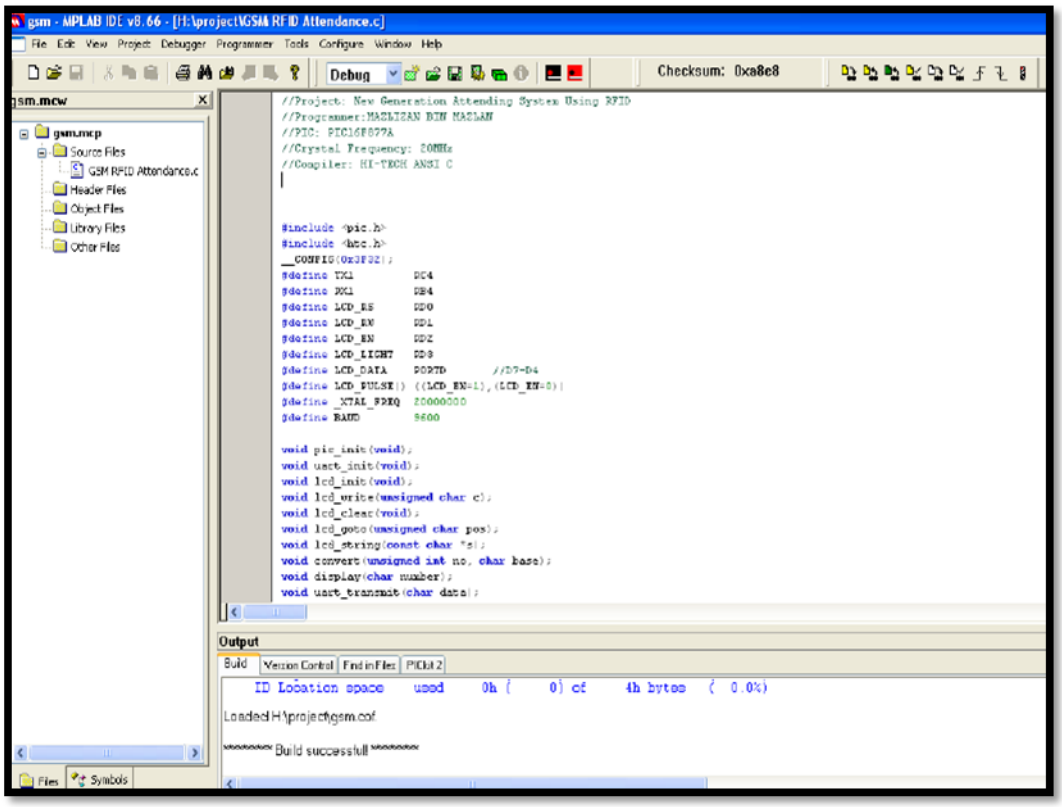


Figure 14: Screenshot of MPLAB IDE software[19]

CHAPTER 3
METHODOLOGY

This project is conducted by gathering all related information of existing Student Attendance System followed by fabricating a proposed circuit. This project is mainly aimed to improve the existing attendance system in Universiti Teknologi PETRONAS.

3.1 Basic Methodology

This project has been started since early June where the most suitable topic has been selected. Some researches were conducted by referring to some existing thesis and journal related to attendance system.

3.1.1 Project activities

Figure 15 shows the steps taken to complete my project which started by identifying the problem. Then, some researches were done regarding the existing student attendance system. As there are many alternatives brainstormed and only after some discussions with my supervisor, the best method has been chosen before starting the project.

Once the circuit construction is done, the device will be programmed using MPLAB IDE, High Tech C Compiler and PICkit2 software to connect the tag and the reader. Finally, when the devices are ready with the program, a testing process is planned using the programmed matrix card. Troubleshooting is needed if the program does not function well.

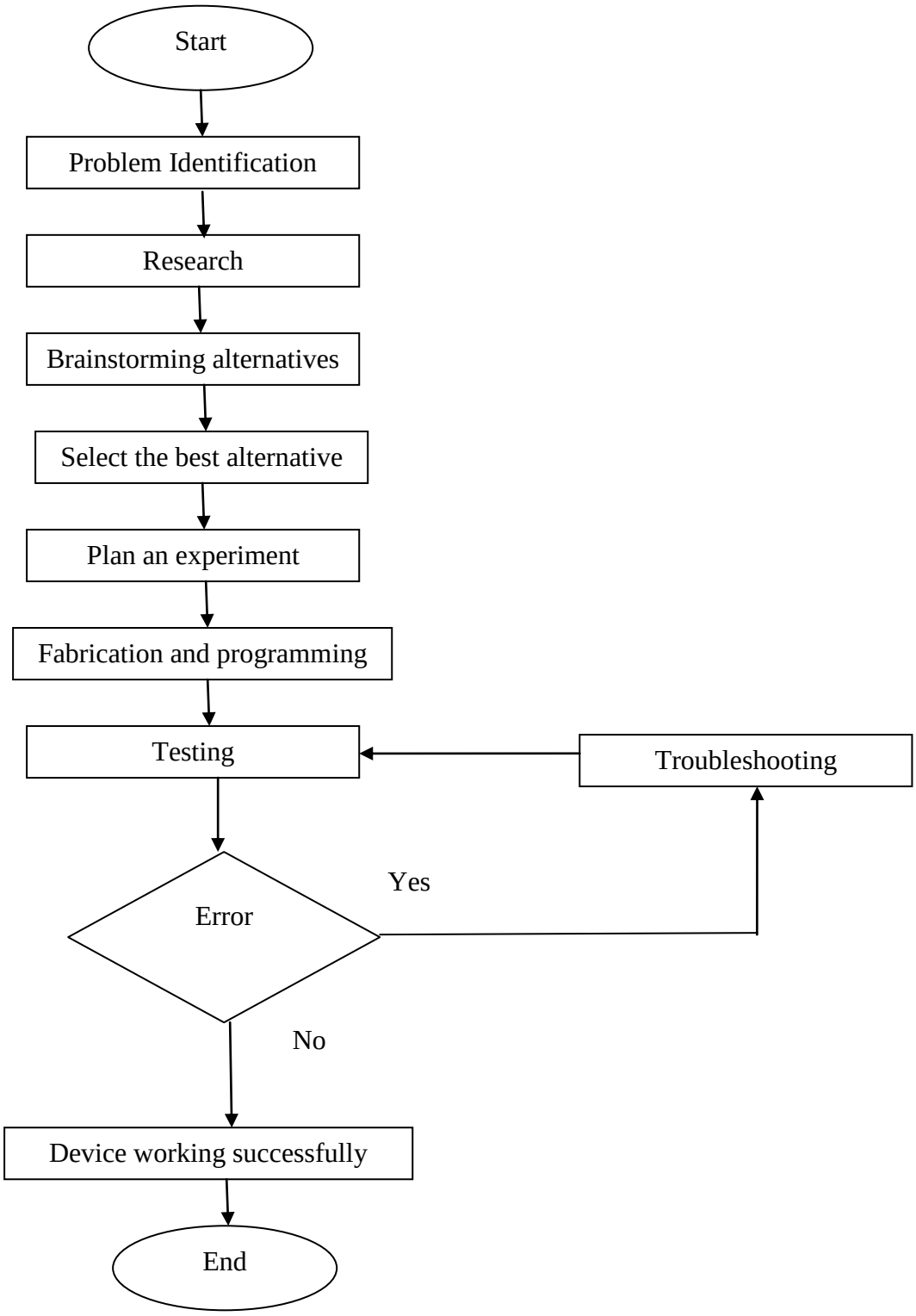


Figure 15: Flow chart of methodology

3.1.2 Key milestone

Table 3: Key Milestone for FYP1

Duration	Activities
Week 1	Title selection / proposal
Week 2	• Project brainstorming • Did some research by referring to related thesis and journals • Asked for opinion from supervisor
Week 3	
Week 4	
Week 5	
Week 6	Extended proposal
Week 7	Look for suitable tools (software and hardware)
Week 8	
Week 9	Viva: Proposal defense and Progress Evaluation
Week 10	• Plan to buy all hardware needed • Start to meet Honeywell staffs
Week 11	Project planning
Week 12	Project planning
Week 13	Draft Report
Week 14	Final Report

Table 3 shows the key milestone of the FYP1 work started from week 1 to week 14. During the first week of the semester, the most suitable project title had been selected which was proposed by my supervisor. Week 2 to week 5 were for brainstorming some new ideas as well as trying to improvise previous related projects. I had completed my extended proposal during week 6. Week 7 to week 8 were then used to decide and determine the suitable tools needed for the project.

A viva on proposal defense had been done in week 9 and Honeywell staffs and me had a meeting on week 10. Week 11 to week 14 were used to plan the next step for project fabrication in FYP2.

Table 4: Key Milestone for FYP2

Duration	Activities
Week 1	Progress from FYP 1
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	
Week 8	Progress Report submission
Week 9	Continuing circuit fabrication
Week 10	
Week 11	Pre-EDX
Week 12	Final results/findings
Week 13	Draft Report submission
Week 14	Final Report and Technical Report submission
Week 15	Viva

Table 4 shows the key milestone of my FYP2 started from week 1 to week 15. From week 1 to week 7, several unfinished tasks from FYP 1 were continued. Progress report had been submitted in week 8. Week 9 up to week 10 were used for circuit construction as well as testing and troubleshooting. By week 12, all results had been completed and presented in Week 15 to the examiners.

3.1.3 Gantt chart

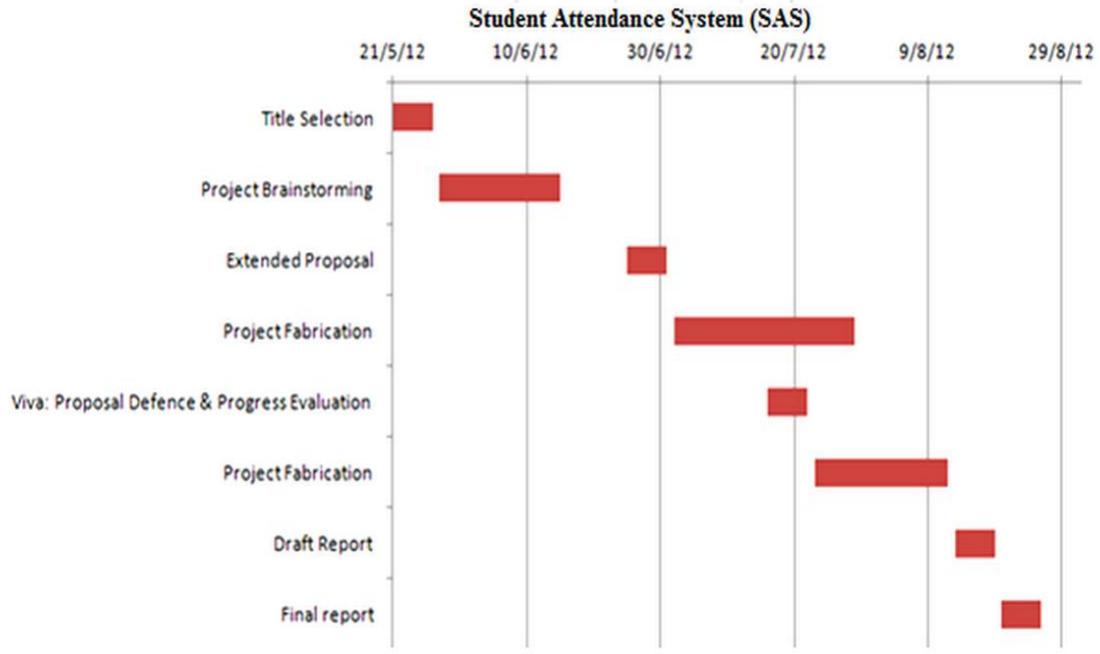


Figure 16: FYP 1 Gantt chart

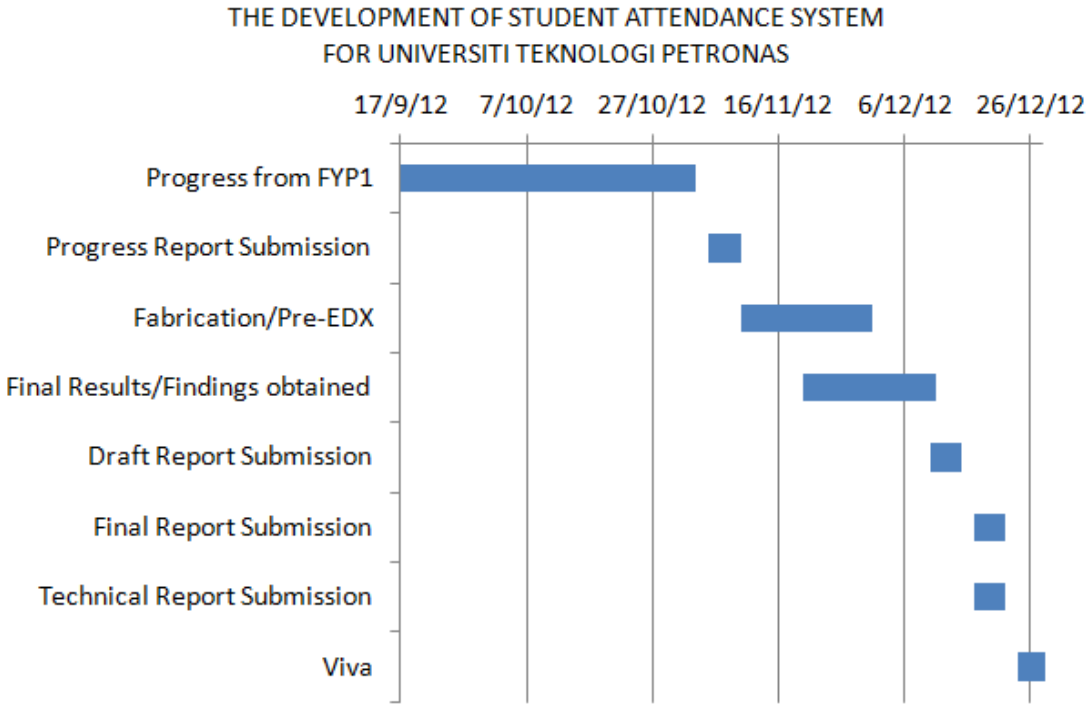


Figure 17: FYP 2 Gantt chart

Gantt chart in Figure 16 shows the overall planning of the project activities for FYP 1 starting from the first week in June 2012 where I have chosen a suitable project title.

For the FYP 2 project, by referring to Figure 17, the last task of FYP 1 continued until the submission of Progress Report in the Week 8. For the following week, I had focused more on circuit fabrication and testing process as well as troubleshooting the circuit.

3.1.4 Tools

Table 5: Tools required for SAS project

Hardware	• RFID : Read & Display V2010Thumb drive • USB ICSP PIC Programmer V2010 • Adapter 12V 1A • A printed matrix card of student
Software	• MPLAB IDE (v8.6) • Hi-Tech C PRO • PICkit2 v2.61 • Microsoft Visual Basic • Microsoft Access 2007 • Microsoft Excel 2007

Table 5 shows the hardware and software used in circuit fabrication for my project. The programmed embedded microchip card using MLAB IDE software is used to store the student's information. Then, the card will be printed out as the standard UTP matrix card.

3.2 Understanding from related research

As in the first objective stated before, methodology used in understanding the operation of the existing portable SAS in market is by reading journals and theses. There are about 17 theses explained the details of the system. 10 of these explained about RFID Based Attendance System, the other 4 mentioned about Biometric Attendance System, 2 theses explained about Face Recognition Attendance System and 1 thesis explained the Barcode-based Attendance System. Brief summary about the theses and their reference numbers is summarized in Table 6.

Table 6: Summarized theses on Attendance System

Sub-section	Total thesis	Reference number
RFID Based Attendance System	10	[2] to [11]
Biometric Attendance System	4	[12] to [15]
Face Recognition	2	[16] and [17]
Barcode-based Attendance System.	1	[18]

3.2.1 Process in creating UTP student matrix card

This section explains the method in collecting information from Honeywell regarding UTP matrix card. Several Honeywell staffs who are responsible to produce matrix card for UTP are available to brief on information and knowledge in creating UTP matrix card for students and lecturers.

The process starts by recording student's details such as student's name, course taken, nationality in software called Enterprise Building Indicator (EBI). Referring to Figure 18, once the recording process is complete, the student's picture is snapped and the card will be printed out.

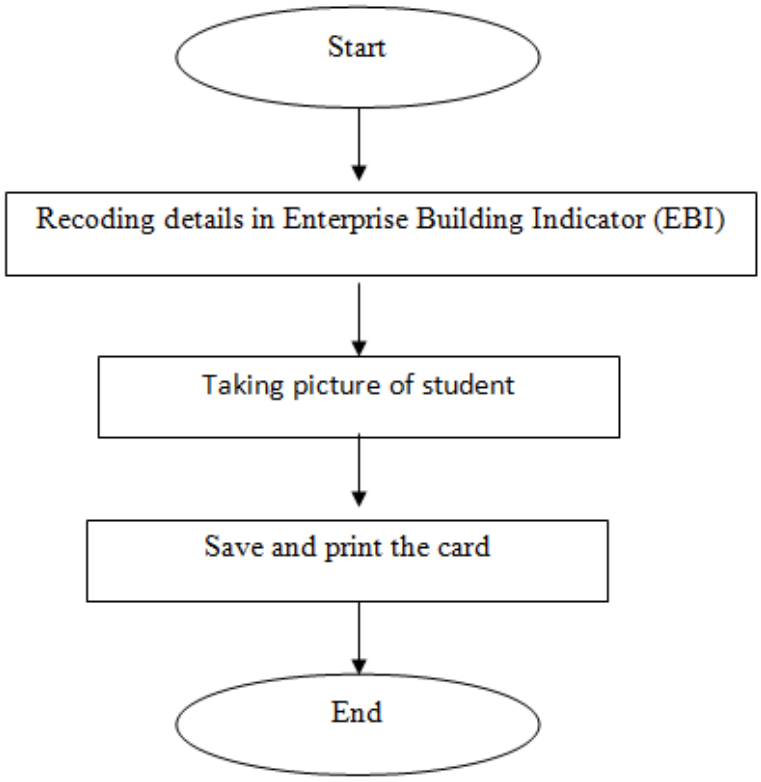
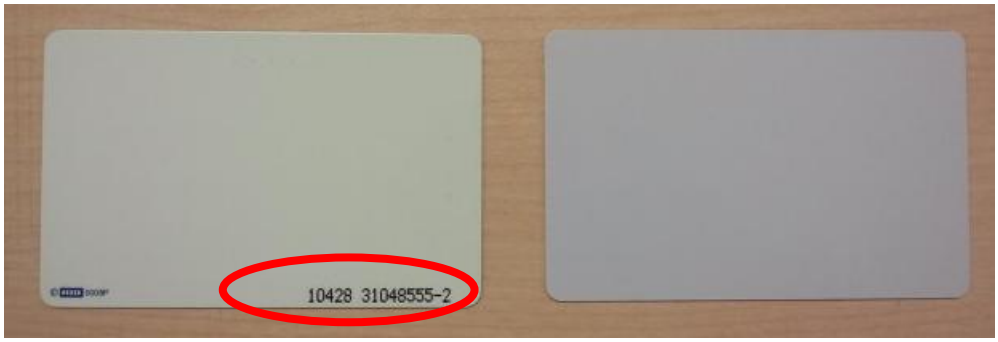


Figure 18: Steps in creating and programming matrix card



(a) (b)

Figure 19: (a) Standard card embedded with microchip, (b) standard card without microchip

In order to create a matrix card for UTP staff, the card in Figure 19 (a) is used. This card has been embedded with a microchip that stores information about the staff. This type of card has unique serial number (as marked) which differentiates it from the other card. Figure 19 (b) is the existing student's matrix card that does not have any microchip embedded in it.

As for the project, in order to have the same function for student and the staff matrix cards, the cards with the embedded chip will be used to store the students' profiles. Then, it will be printed according to student's name and ID number.

Once the card has been chosen, the next process will be the recording process in the software to capture all data such as name, address, state, room, matrix text and others. When all data have been recorded, the card will have its own Access Right as in Figure 20. Access Right is where only the selected places such as building or door that can be entered. If there is no Access Right for any door or building, the user cannot enter the room.

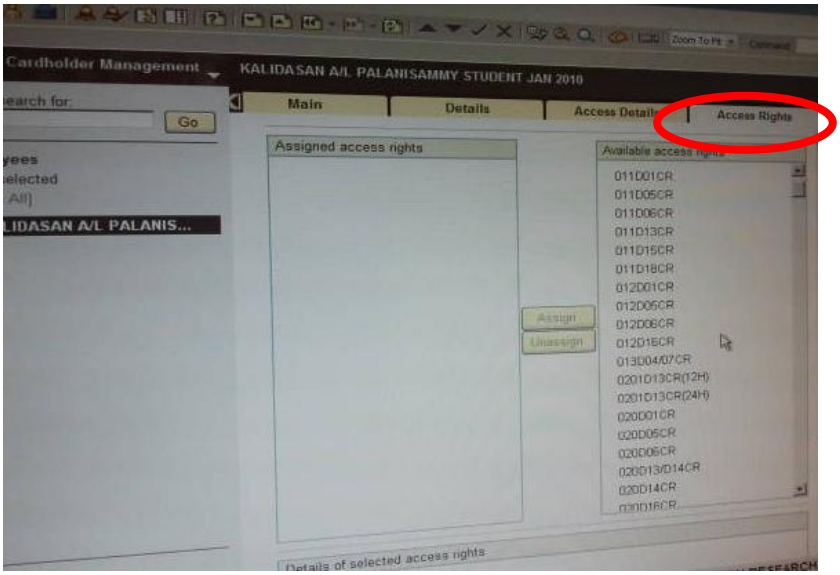


Figure 20: Access Right for matrix card

Once the card is ready with all required details, the embedded card will be placed in a machine shown in Figure 21 for printing.

Figure 21: Printer use to print the matrix card

The card reader is installed in every entrance and the lecturers have access to the selected rooms.

3.3 Call up Excel file from Microsoft Access

During the process of learning how to export data from Microsoft Access 2007 to Microsoft Excel 2007, many steps have been discovered. By referring to some tutorials from Internet sources, the data from Excel 2007 can be easily transferred to Access Database 2007. This data transmission is the way to resemble and demonstrate the tagging process from the matrix card to reader. Apart from referring to the Internet sources, a thesis written by Anith Sapura bt Azmi [19] is referred.

Figure 22 shows the Microsoft Visual Basic command window which is used to create the coding and call up a file as well as transfer data from Microsoft Access to Microsoft Excel.

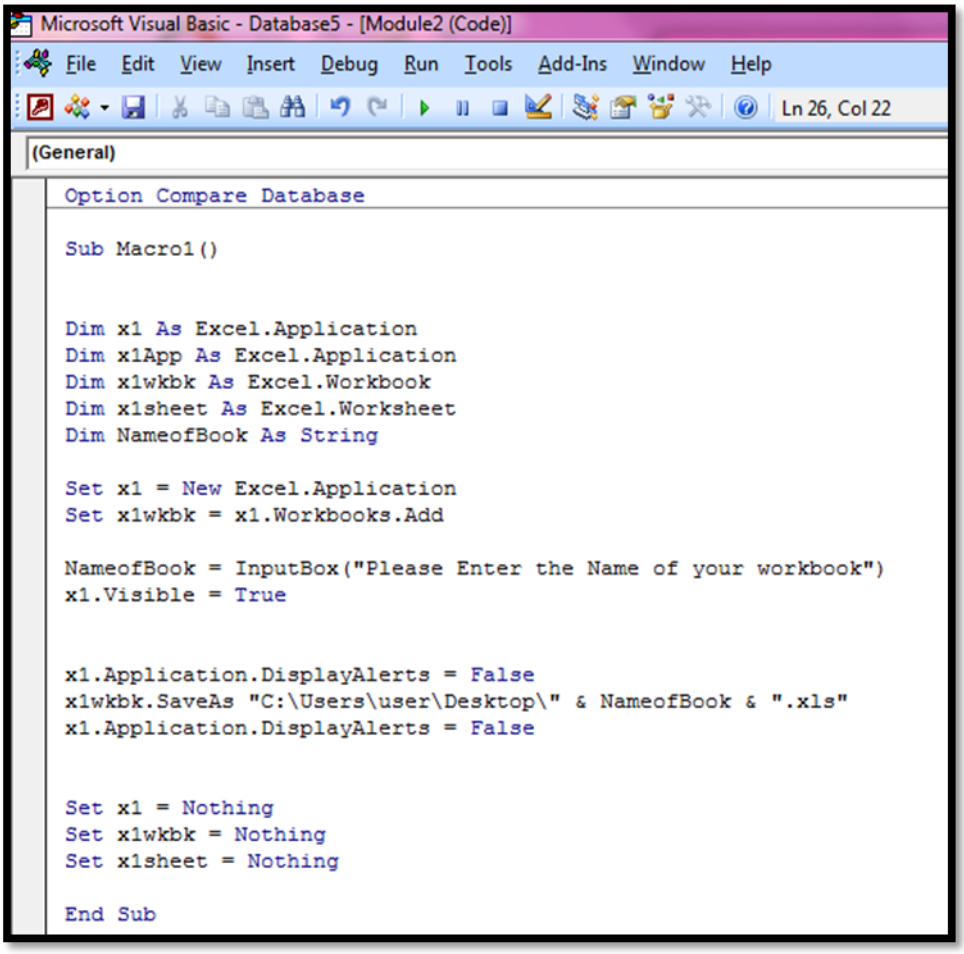


Figure 22: Microsoft Visual Basic command window

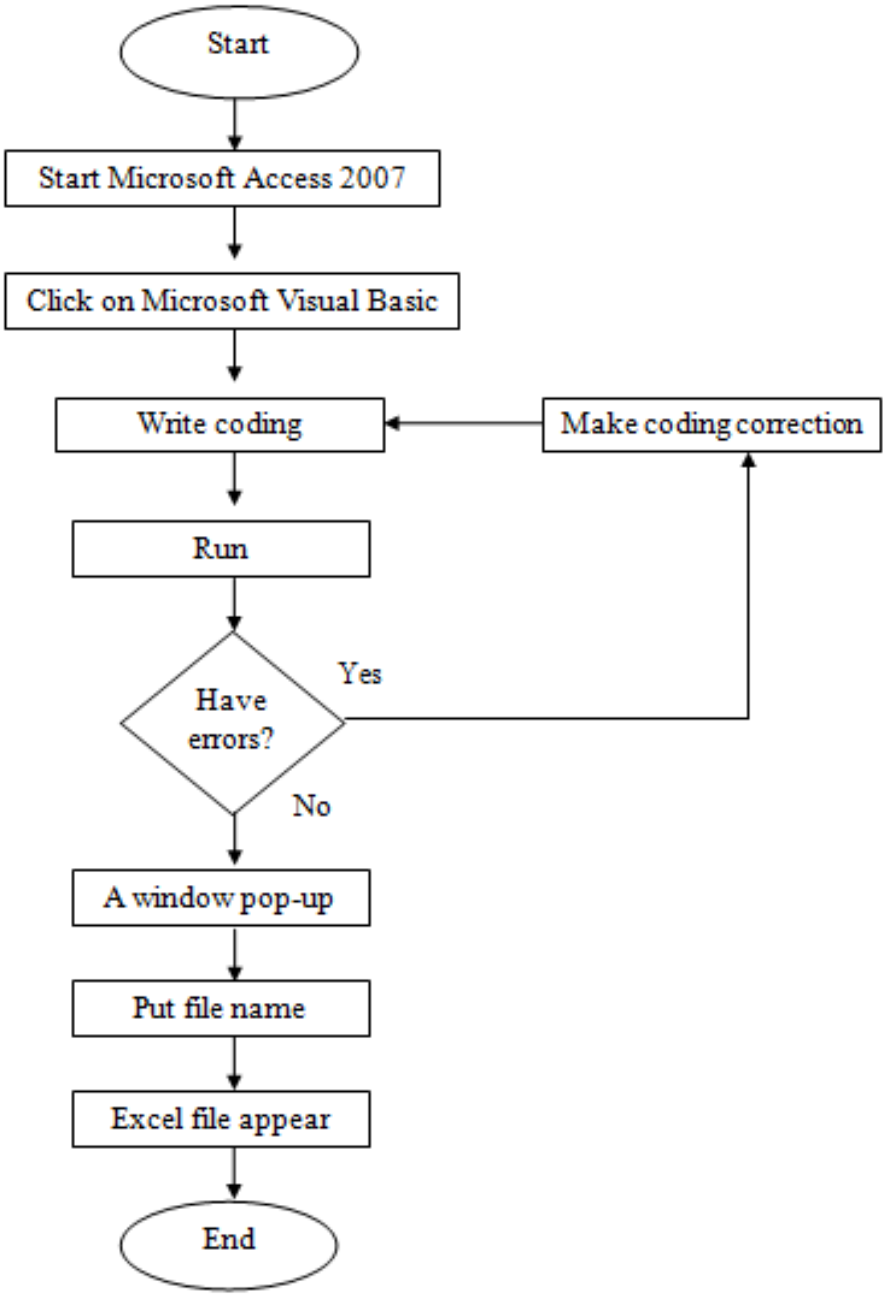


Figure 23: Flow chart of programming process

Referring to Figure 23, all coding are written in Access 2007 and Microsoft Visual Basic. Once the code is entered, a window will appear asking for a file name and an Excel file is automatically popped out.

3.4 Portable student attendance system designation

Hardware and software implementation are two important methods involved in designing this attendance system. Both hardware and software are interfaced with each other using MPLAB IDE, High Tech C Compiler and PICkit2 software.

3.4.1 Hardware Implementation

The third objective of this project is to construct a working portable SAS based on the existing devices in market as well as programming student's matrix card. Methodology involved for device construction is shown in Figure 24. It is started with understanding circuit followed by soldering process of the components and ended with testing and troubleshooting.

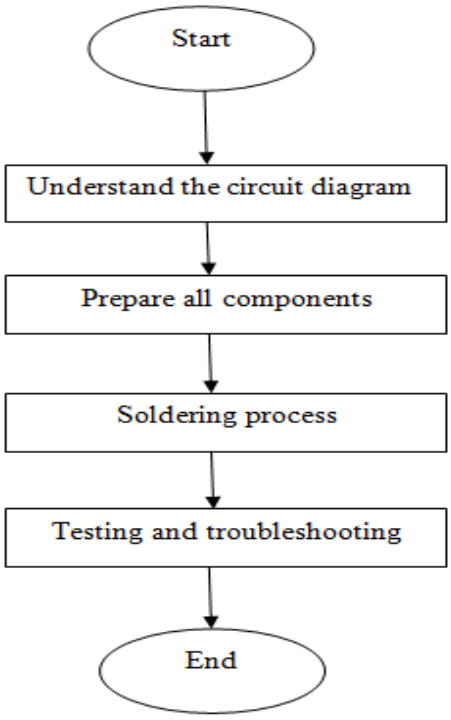


Figure 24: Flow chart of fabrication process

As for the device construction onto the Printed Circuit Board (PCB), the list of all components used is summarized in Table 7.

Table 7: List of components for circuit fabrication

No.	Description	Quantity
1	IC PIC16F876A	1
2	IC Socket-28 pin(slim)	1
3	Voltage Regulator 5 V	1
4	Diode 1N4007	1
5	Diode 1N4148	2
6	LED 3 mm Green	1
7	LED 3 mm Red	2
8	LCD (16x2)	1
9	Ceramic Capacitor 30 pF	2
10	Multilayer Capacitor 0.1 uF	3
11	Electrolytic capacitor 100 uF 25 V	2
12	Push Button 2 Pins	3
13	Mini Slide Switch(3 pin)	1
14	Resistor 0.25 W 5% (330)	3
15	Resistor 0.25 W 5% (4.7 K)	4
16	Resistor 0.25 W 5% (1 K)	3
17	Resistor 0.25 W 5% (10 K)	2
18	Preset	1
19	Connector 2510-02	1
20	Connector 2510-04	1
21	Transistor 2N2222	1
22	Buzzer PCB	1
23	Printed Circuit Board (PCB)	1
24	Header pin 1x16	1

All components are soldered to PCB and the circuit diagrams are explained in the next section of this report.

3.4.2 Circuit Implementation

This section explains the circuit diagram of this project which includes the input from the power supply as well as output of the LCD module.

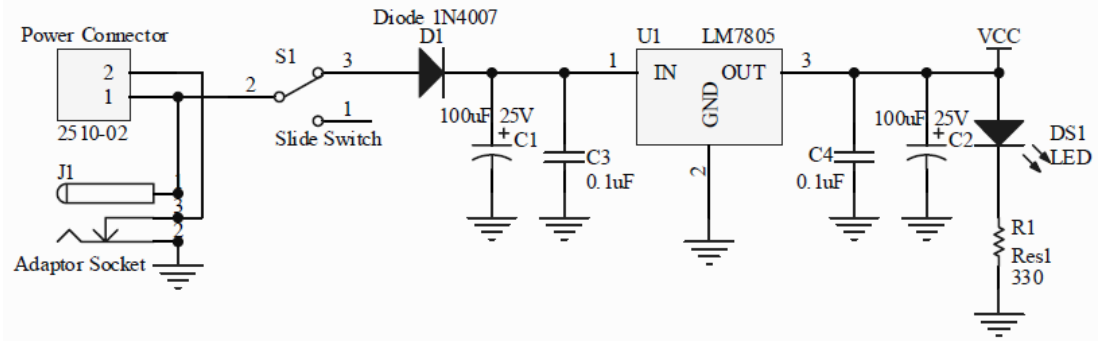


Figure 25: Power supply circuit diagram [20]

As in Figure 25, 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 the C2 and C4 are used to stabilize the voltage at the output side of the LM7805 voltage supply. The LED acts as an indicator to indicate the power status of the circuit whereas Resistor R1 is used to protect the LED from over current that will burn the LED [20].

Figure 26 shows the connection of RFID reader to the main circuit. The output of the RFID reader is serial Universal Asynchronous Receiver/Transmitter **(**UART) in logic +10V/-10V with the baud rate of 9600 bps [20]. Circuit in Figure 26 is used to convert the logic of +10V/-10V to logic of +5V/0V which is compatible to the PIC16F876A.

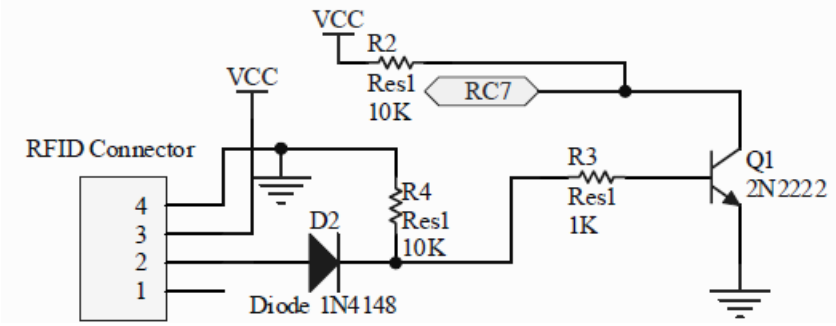


Figure 26: RFID reader circuit diagram [20]

The most important component is the PIC16F876A which stores the student's information. Figure 27 shows the connection circuit diagram for PIC16F876A. The details of the connection can be referred in Appendix A. The PIC16F876A acts as an input to other components in order to produce the desired output such as LCD module display and blinking LEDs.

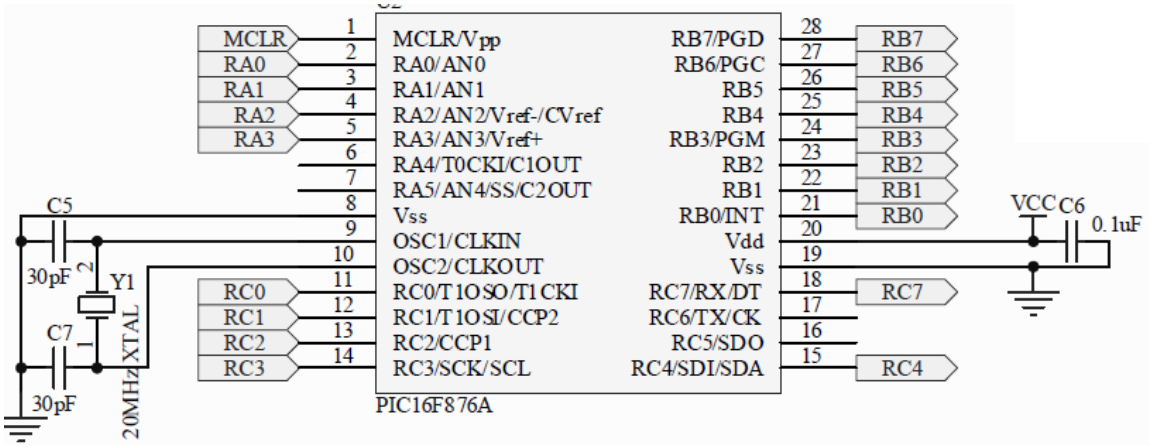


Figure 27: PIC16F876A circuit diagram [20]

Figure 28 illustrates the circuit connection for LCD module where the output from PIC16F876A becomes the input for this component. This is because the programmed information in the PIC16F876A is executed and displayed using LCD module.

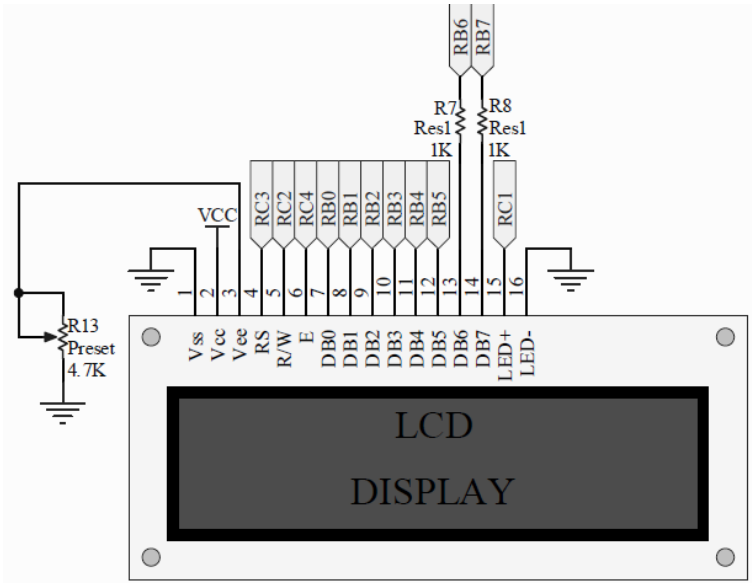
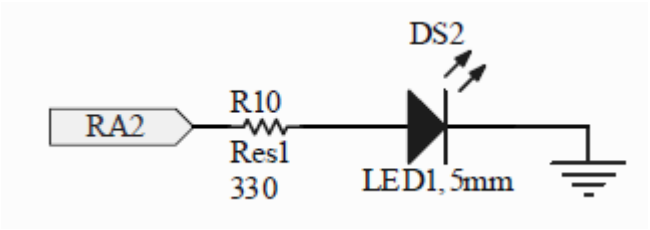
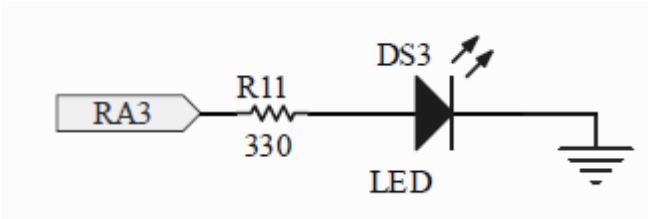


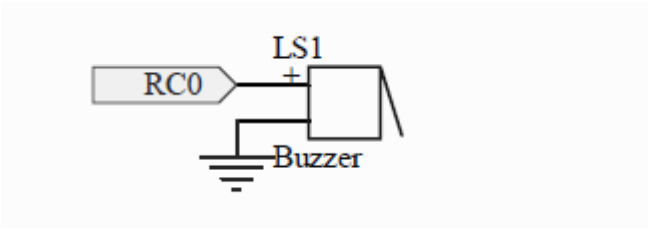
Figure 28: LCD module circuit diagram [20]



(a)



(b)



(c)

Figure 29: (a) LED circuit diagram, (b) LED1 circuit diagram, (c) Buzzer circuit diagram

As mentioned before, once the PIC16F876A is programmed, the output from the device is channelled to other components. From Figure 29(a) and 29(b), the output of RA2 and RA3 from the PIC16F876A are the input of the red LED of DS2 and DS3 respectively. DS2, DS3, R10, and R11 are the diode and resistor from the external circuit of this whole device system respectively. LEDs are used to indicate that the tagging process is currently being executed once the card is scanned to the reader. Buzzer is also designated as another output when the card is scanned to reader by producing a ‘beep’ sound. It gets the input from PIC16F876A as well as shown in Figure 29 (c).

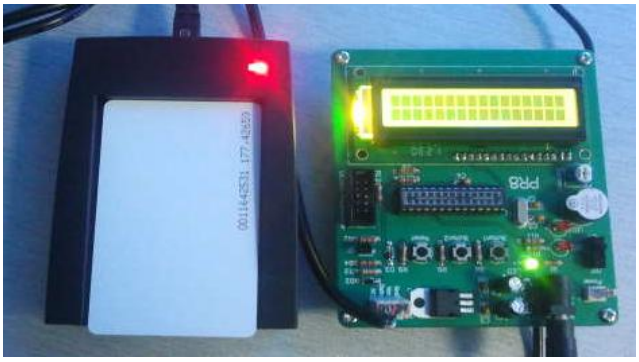


Figure 30: A completed hardware fabrication

Once all components are soldered, the fabricated circuit is connected to the RFID tag and reader as shown in Figure 30. All of these components operate with 5 V supply and a 12 V adapter is the power source of this circuit. Main components of the circuit are PIC Microcontroller PIC16F876A, RFID reader, RFID tag and a LCD (2x 16 characters). PIC16F876A is an 8-bit microcontroller with 22 I/O that operates with 5V supply and has a speed of 20MHz.

3.4.3 Software Implementation

This section explains the methodology for the third and forth objectives for the programming part. Once the circuit is fabricated perfectly, the circuit is then interfaced with computer using MPLAB IDE v8.6, Hi Tech C Compiler, PICkit2 v2.61 softwares and a PIC programmer as shown in Figure 31. The programmer is used to program the PIC16F876A with the student's data. The software involved are MPLAB IDE v8.6, Hi Tech C Compiler and PICkit2 v2.61. The functions of each softwares are summarized in Table 8.

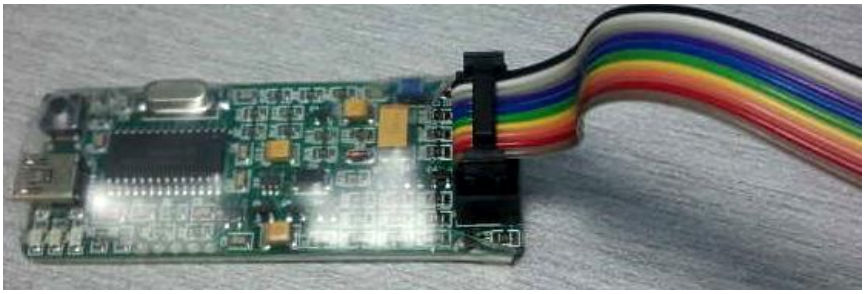
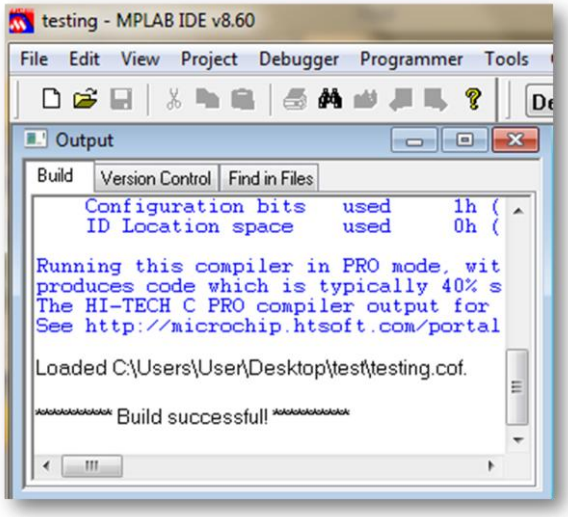


Figure 31: USB ICSP PIC Programmer V2010

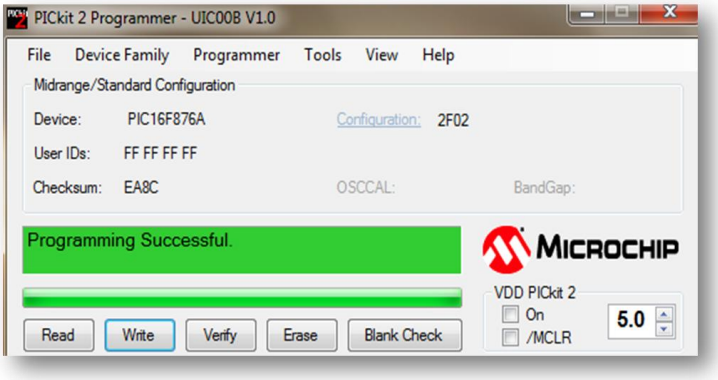
Table 8: Function of software

Software	Function
MPLAB IDE v8.6	Develop C language programming
Hi Tech C Compiler	Convert C language to HEX format
PICkit2 v2.61	Load HEX file into PIC 16F876A

Figure 32 (a) illustrates the C programming language built in MPLAB IDE v8.6 in order to program the PIC microcontroller. The C language is then converted to HEX language programming using High Tech C Compiler. Figure 32 (b) shows the HEX language which is programmed in PICkit2 software.



(a)



(b)

Figure 32: (a) Programming in MPLAB IDE v8.6,
(b) Programming in PICkit2

3.4.4 Testing and Troubleshooting

After the implementation of software, to comply the fourth objective, the circuit is tested and troubleshooted to fix several problems. Figure 33 shows the flow chart of testing process of student authentication once their matrix card is scanned to the reader. The information scanned will be compared to information stored in database. If the user is authorized, LCD module will display their details and the buzzer will be activated but if scanning does not match with any stored data, the authentication fails and no attendance is recorded.

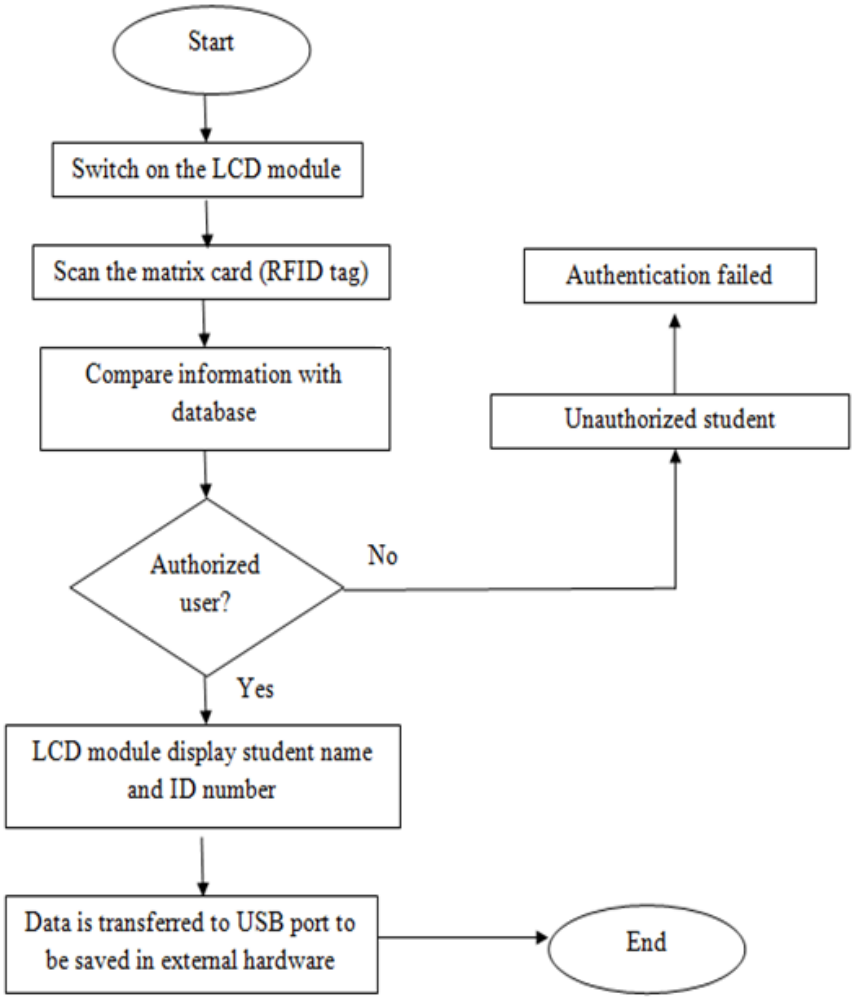


Figure 33: Flow chart of student authentication process

CHAPTER 4
RESULTS AND DISCUSSION

There are several sections which explained the results of this project. First section describes the way to resemble the scanning process of matrix card with the process of calling up a excel file from Access 2007. The next section clarifies the findings on the circuit/hardware implementation and last section enlightens the outcome for the software implementation of this project.

4.1 Microsoft Visual Basic (VBA)

A set of coding is developed in VBA to call up an Excel file from Access 2007.

```
Sub Macro1()

Dim x1 As Excel.Application
Dim x1App As Excel.Application
Dim x1wkbk As Excel.Workbook
Dim x1sheet As Excel.Worksheet
Dim NameofBook As String

Set x1 = New Excel.Application
Set x1wkbk = x1.Workbooks.Add

NameofBook = InputBox("Please Enter the Name of your workbook")
x1.Visible = True
x1.Application.DisplayAlerts = False
x1wkbk.SaveAs "C:\Users\user\Desktop\" & NameofBook & ".xls"
x1.Application.DisplayAlerts = False

Set x1 = Nothing
Set x1wkbk = Nothing
Set x1sheet = Nothing

End Sub
```

Figure 34: Coding used in VBA

The coding in Figure 34 is programmed using Microsoft Access 2007. Variable of *x1, x1app, x1wkbk* and *x1sheet* are declared at the first code. Then, the *string* function is declared. In order to make *x1* the excel function, I have set the *x1* as the new excel application. Besides, I also set the *x1wkbk* as the new workbook application.

In order to call up the Excel file, *NameofBook = InputBox("Please Enter the Name of your workbook")* function is used. A window such in Figure 35 will appear asking for the excel file name.

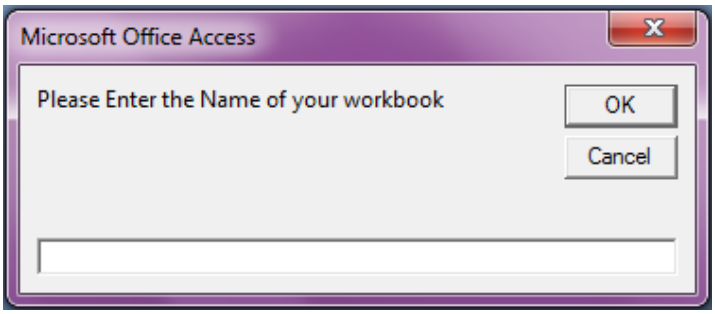


Figure 35: Window box of Microsoft Access

Once the name is entered, this file will be saved in the desired destination as written in the coding of *x1wkbk.SaveAs "C:\Users\user\Desktop\" & NameofBook & ".xls"* which is in this case, the folder will be saved at the PC desktop. *Quit* function is used to close the book.

Set x1 = Nothing, Set x1wkbk = Nothing and Set x1sheet = Nothing function are responsible to clean up memory of previous program.

As for a simple demonstration, the workbook name is typed as FYP2 such in Figure 36. Then, 'Run' button (as marked) is pressed to start the program. The excel folder is called by the program to make the excel file appear automatically. FYP2 folder will be automatically saved in the desktop as marked in Figure 37.

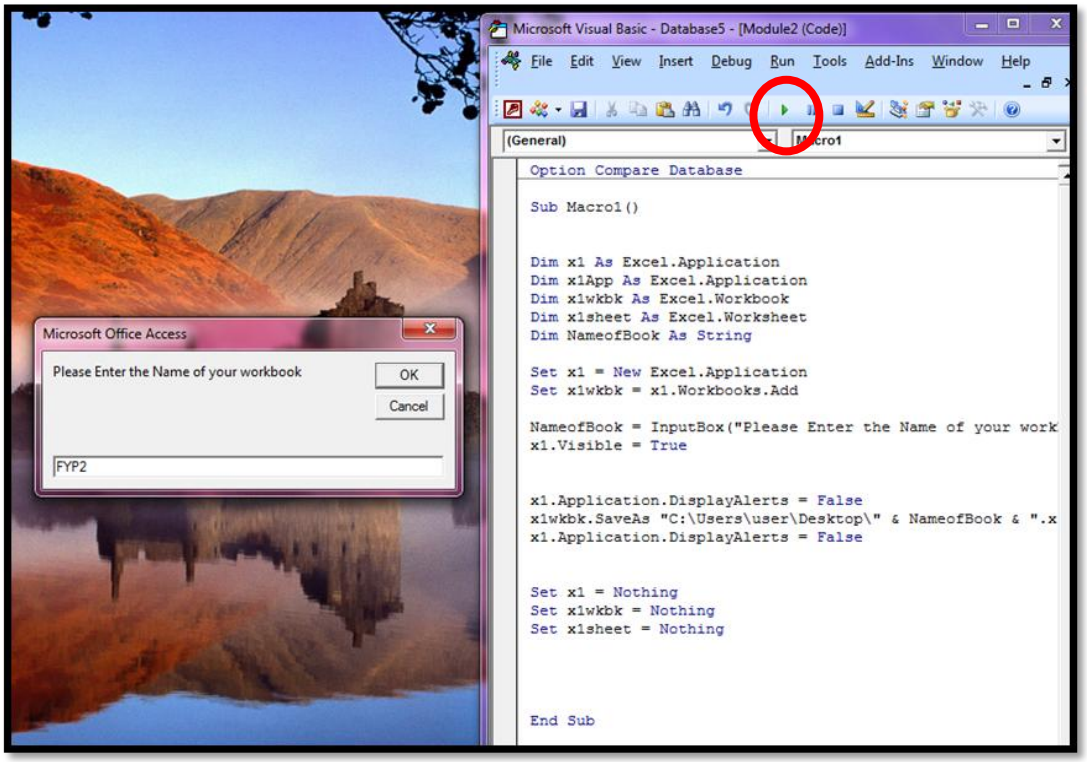


Figure 36: Command window with Run button

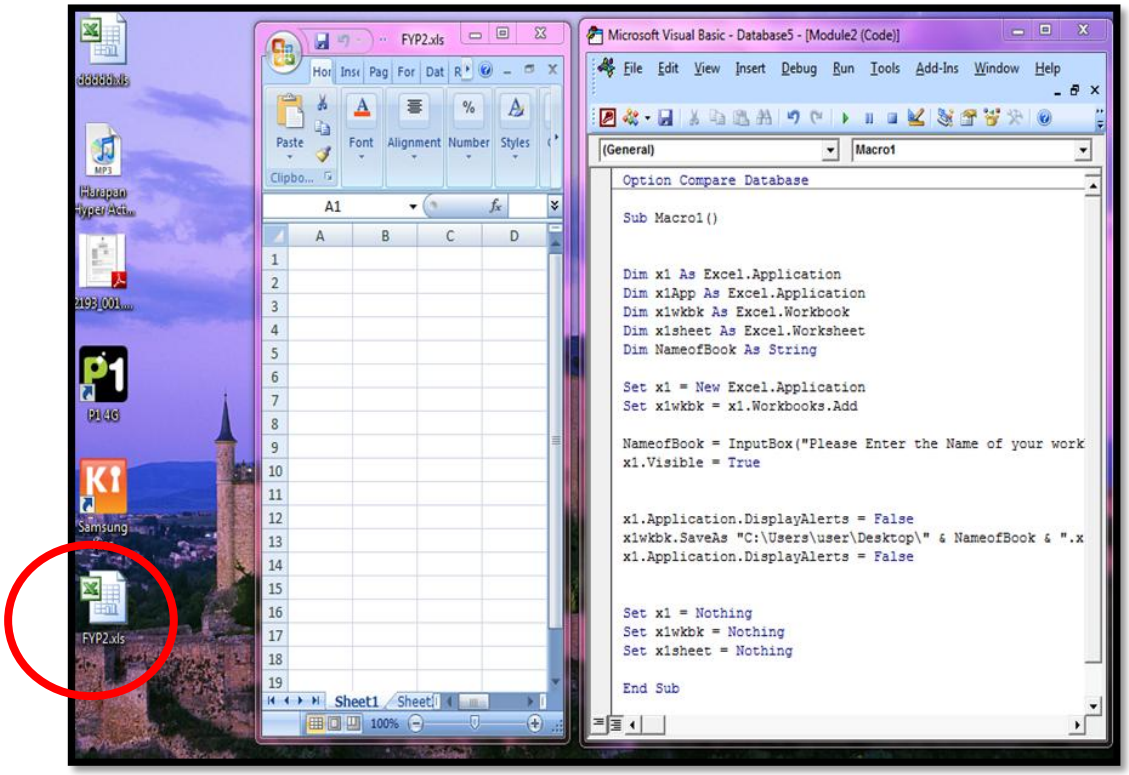


Figure 37: Excel file on desktop

Back to the second objective, by using Access 2007 to call file of Excel 2007, this can be used in resembling the project. Once the matrix card is scanned into the RFID reader, all student information will be transferred to reader and the data will be displayed at the LCD module. Similar concept applies to Access and Excel folder. Once the file is called, the data/ file will be displayed automatically and saved in the database.

4.2 Software execution

As for the third objective, a prototype of portable student attendance system is fabricated and programmed. After the completion of circuit fabrication, the PIC16F876A is programmed with an open-source code using MPLAB IDE, Hi Tech C Compiler and PICkit2 software. The coding is then modified in order to suit the project. The set of coding is shown in Appendix B.

4.3 Hardware execution

As soon as the testing and troubleshooting are completed, the circuit has worked well by displaying the required output on the LCD module once the card is scanned to the reader.

Figure 38 illustrates the output display of the device after the circuit is powered by 12 V DC adaptor. When the switch is pressed, the LCD displays the name of the subject and then the instruction to place the card on the reader comes next.

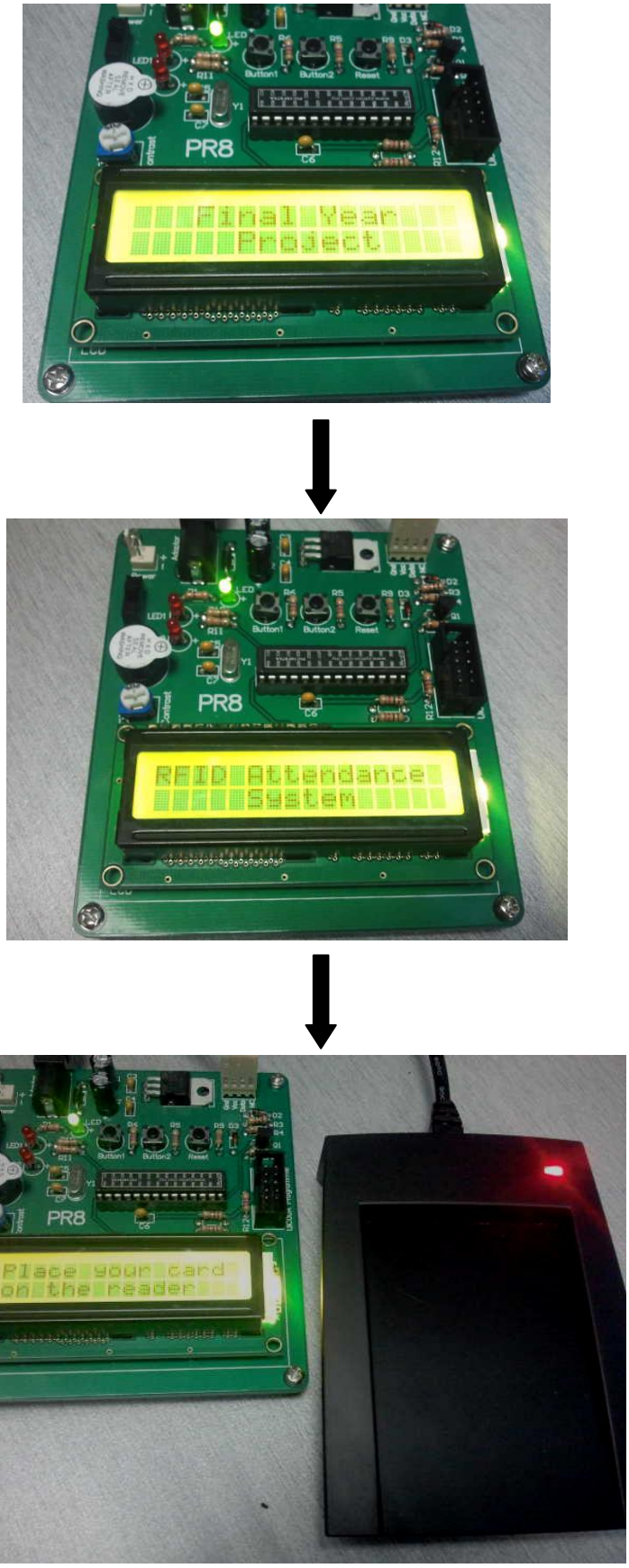


Figure 38: Sequence of output display of LCD module

Figure 37 shows the final output of the LCD module once the student card is scanned to the reader. The LCD module displays the ID which is the card number, student's name as well as the student's matrix number (as marked). The student's details are appeared on the LCD module because it exists in database, which is in this case; the database is the PIC16F876A. So, when the card is scanned, the card details are compared with the information programmed in the PIC16F876A. If the information is validated, the LCD module displays the student info as shown in Figure 39.

Figure 39: Final output of LCD module

CHAPTER 6
CONCLUSION AND RECOMMENDATION

All in all, the operation of the existing attendance system and the methods in fabricating the circuit of the system has been understood. All are based on the knowledge gained from some researches through journals and theses. The circuit have been successfully constructed and the expected output from the hardware and software implementation had been produced. PIC16F876A is managed to be programmed using MPLAB IDE, High Tech C compiler and PICkit2 software. The student's details are also managed to be appeared on the LCD module once the matrix card is scanned to the reader.

As for the recommendation, this system needs a larger database in order to record the student's details. Besides, this system can be improvised by implementing it in every class using wired or wireless portable attendance system. In addition, this system can be installed in UTP if Honeywell Engineering Sdn Bhd is willing to cooperate.

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APPENDICES

APPENDIX A

PIC16F876A DATASHEET

PIC16F87XA
Data Sheet

28/40/44-Pin Enhanced Flash Microcontrollers

DS39582B

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

DNV Certification, Inc. USA — ANSI-RAB QMS ACCREDITED — DNV — DNV MSC The Netherlands Accredited by the RvA

ISO 9001 / QS-9000 REGISTERED FIRM

Microchip received QS-9000 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona in July 1999 and Mountain View, California in March 2002. The Company's quality system processes and procedures are QS-9000 compliant for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, non-volatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001 certified.

MICROCHIP

PIC16F87XA

28/40/44-Pin Enhanced Flash Microcontrollers

Devices Included in this Data Sheet:

- PIC16F873A
- PIC16F874A
- PIC16F876A
- PIC16F877A

High-Performance RISC CPU:

- Only 35 single-word instructions to learn
- All single-cycle instructions except for program branches, which are two-cycle
- Operating speed: DC – 20 MHz clock input
  DC – 200 ns instruction cycle
- Up to 8K x 14 words of Flash Program Memory,
  Up to 368 x 8 bytes of Data Memory (RAM),
  Up to 256 x 8 bytes of EEPROM Data Memory
- Pinout compatible to other 28-pin or 40/44-pin PIC16CXXX and PIC16FXXX microcontrollers

Peripheral Features:

- Timer0: 8-bit timer/counter with 8-bit prescaler
- Timer1: 16-bit timer/counter with prescaler, can be incremented during Sleep via external crystal/clock
- Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler
- Two Capture, Compare, PWM modules
  - Capture is 16-bit, max. resolution is 12.5 ns
  - Compare is 16-bit, max. resolution is 200 ns
  - PWM max. resolution is 10-bit
- Synchronous Serial Port (SSP) with SPI™ (Master mode) and I^2C™ (Master/Slave)
- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection
- Parallel Slave Port (PSP) – 8 bits wide with external $\overline{RD}$, $\overline{WR}$ and $\overline{CS}$ controls (40/44-pin only)
- Brown-out detection circuitry for Brown-out Reset (BOR)

Analog Features:

- 10-bit, up to 8-channel Analog-to-Digital Converter (A/D)
- Brown-out Reset (BOR)
- Analog Comparator module with:
  - Two analog comparators
  - Programmable on-chip voltage reference (V_{REF}) module
  - Programmable input multiplexing from device inputs and internal voltage reference
  - Comparator outputs are externally accessible

Special Microcontroller Features:

- 100,000 erase/write cycle Enhanced Flash program memory typical
- 1,000,000 erase/write cycle Data EEPROM memory typical
- Data EEPROM Retention > 40 years
- Self-reprogrammable under software control
- In-Circuit Serial Programming™ (ICSP™) via two pins
- Single-supply 5V In-Circuit Serial Programming
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options
- In-Circuit Debug (ICD) via two pins

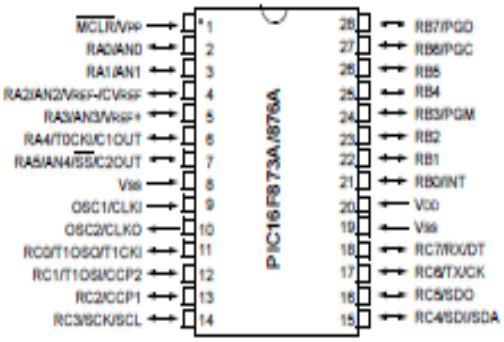
CMOS Technology:

- Low-power, high-speed Flash/EEPROM technology
- Fully static design
- Wide operating voltage range (2.0V to 5.5V)
- Commercial and Industrial temperature ranges
- Low-power consumption

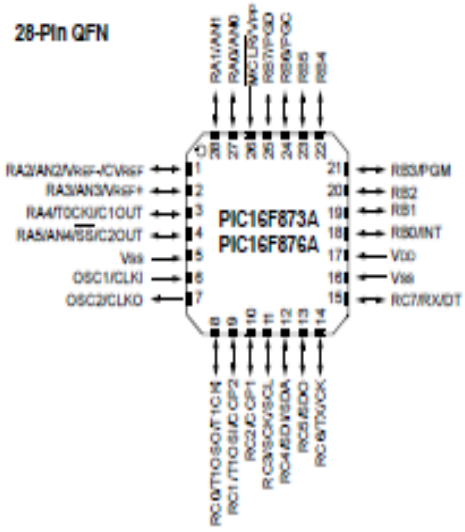
Device	Program Memory		Data SRAM (Bytes)	EEPROM (Bytes)	I/O	10-bit A/D (ch)	CCP (PWM)	MSSP		USART	Timers 8/16-bit	Comparators
	Bytes	# Single Word Instructions						SPI	Master I^2C			
PIC16F873A	7.2K	4096	192	128	22	5	2	Yes	Yes	Yes	2/1	2
PIC16F874A	7.2K	4096	192	128	33	8	2	Yes	Yes	Yes	2/1	2
PIC16F876A	14.3K	8192	368	256	22	5	2	Yes	Yes	Yes	2/1	2
PIC16F877A	14.3K	8192	368	256	33	8	2	Yes	Yes	Yes	2/1	2

Pin Diagrams

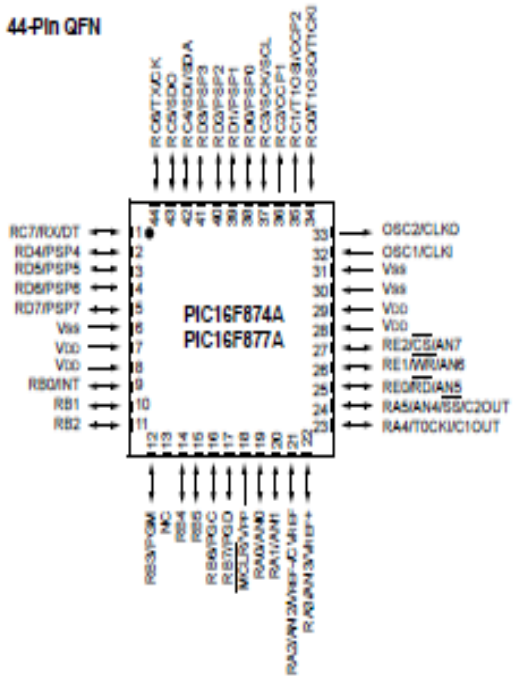
28-Pin PDIP, SOIC, SSOP



28-Pin QFN



44-Pin QFN



APPENDIX B
CODING FOR MPLAB IDE

```
#include <pic.h>
__CONFIG ( 0x3F32 );
#define  rs                          RC3
#define  rw                          RC2
#define  e                           RC4
#define  b_light            RC1
#define  buzzer             RC0
#define  button1            RA0
#define  button2            RA1
#define  lcd_data     PORTB
#define  led1                  RA2
#define  led2                  RA3

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 send_string(const char *s);
unsigned char uart_rec(void);
void beep(void);
void main(void)
{
        unsigned char i,temp,database;
        unsigned char data[12];
        unsigned char id_1[10]={"0011642531"};
        unsigned char id_2[10]={"0011038016"};
        unsigned char user_1[10]={"12113-Aini"};
        unsigned char user_2[10]={"Katy-11954"};
        TRISB = 0b00000000;
        TRISC = 0b10000000;
        TRISA = 0b11110011;
        SPBRG = 0x81;
        BRGH = 1;
        TXEN = 1;
        CREN = 1;
        SPEN = 1;
        ADCON1 = 0b00000110;
        send_config(0b00000001);
        send_config(0b00000010);
        send_config(0b00000110);
        send_config(0b00001100);
        send_config(0b00111000);
        buzzer=0;
        b_light=1;
        led1=0;
        led2=0;
        lcd_clr();
        lcd_goto(0);
        send_string("RFID Attendance");
        lcd_goto(20);
        send_string("   System");
        beep();
        delay(200000);
        while(1)
        {
                CREN = 1;
                lcd_clr();
                lcd_goto(0);
                send_string("Place your card");
                lcd_goto(20);
```

```
                send_string("on the reader");
                for(i=0;i<12;i+=1)data[i]=uart_rec();
                led1=1;
                lcd_clr();
                lcd_goto(20);
                send_string("Processing......");
                delay(40000);
                database=0;
                temp=0;
                for(i=1;i<11;i+=1)
                {
                        if((data[i])!=(id_1[i-1]))temp=1;
                }
                if(temp==0) database=1;
                temp=0;
                for(i=1;i<11;i+=1)
                {
                        if((data[i])!=(id_2[i-1]))temp=1;
                }
                if(temp==0) database=2;
                lcd_clr();
                CREN = 0;
                switch(database)
                {
                        case 1:
                                led2=1;
                                lcd_goto(0);
                                send_string("Card:");
                                for(i=0;i<10;i+=1)send_char(id_1[i]);
                                lcd_goto(20);
                                send_string("ID:");
                                for(i=0;i<10;i+=1)send_char(user_1[i]);
                                beep();
                                break;

                        case 2:
                                led2=1;
                                lcd_goto(0);
                                send_string("Card:");
                                for(i=0;i<10;i+=1)send_char(id_2[i]);
                                lcd_goto(20);
                                send_string("ID:");
                                for(i=0;i<10;i+=1)send_char(user_2[i]);
                                beep();
                                break;
                        default:
                                lcd_goto(0);
                                send_string("ID: ");
                                for(i=1;i<11;i+=1)send_char(data[i]);
                                lcd_goto(20);
                                send_string("user not found");
                                beep();
                                beep();
                                break;
                }
                delay(300000);
                led1=0;
                led2=0;
        }
}
void delay(unsigned long data)
```

```
{
        for( ;data>0;data-=1);
}
void send_config(unsigned char data)
{
        rw=0;
        rs=0;
        lcd_data=data;
        e=1;
        delay(50);
        e=0;
        delay(50);
}
void send_char(unsigned char data)
{
        rw=0;
        rs=1;
        lcd_data=data;
        e=1;
        delay(10);
        e=0;
        delay(10);
}
void lcd_goto(unsigned char data)
{
        if(data<16)
        {
                send_config(0x80+data);
        }
        else
        {
                data=data-20;
                send_config(0xc0+data);
        }
}
void lcd_clr(void)
{
        send_config(0x01);
        delay(600);
}
void send_string(const char *s)
{
        unsigned char i=0;
        while (s && *s)send_char (*s++);
}
unsigned char uart_rec(void)
{
        unsigned char rec_data;
        while(RCIF==0);
        rec_data = RCREG;
        return rec_data;
}
void beep(void)
{
        buzzer=1;
        delay(10000);
        buzzer=0;
        delay(10000);
}
```

APPENDIX C
REFERENCES

APPENDIX D
TECHNICAL PAPER

APPENDIX E
POSTER

APPENDIX F
POWER POINT SLIDES