PORTABLE ATTENDANCE SYSTEM FOR UNIVERSITY STUDENTS

By

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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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Department of Electrical & Electronic Engineering
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Approved:

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TRONOH, PERAK

May 2013

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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Siti Sakinah Binti Shaffie

ABSTRACT

This project is about to design and develop a portable device for better attendance record of students which indirectly reduce absenteeism problem among university students. It will eliminate much problems on manual attendance system by using papers as well as problem of faking someone's signature which has become a norm among students. This project will ensure the right and authentic person is present in the lecture, lab, as well as tutorial. It will address absenteeism issue in Universiti Teknologi PETRONAS (UTP) by designing a portable device of attendance system for authentic person using one input biometric trait which is by using fingerprint verification. To develop this portable device, fingerprint reader is used to add the fingerprints to form students' database for attendance marking. This device is capable to add, delete, verify, search, upload and download students' fingerprints. Students only need to scan their fingerprint to verify and mark their attendance. This process takes place faster, just within a few seconds. This device is easy to be handled and user-friendly.

ACKNOWLEDGEMENTS

Above all, I would like to express my humble gratitude to Allah S.W.T, for His blessings and guidance throughout my completion period of this final year project. My deepest and sincere gratitude goes to AP Dr. Nor Hisham Hamid for the opportunity to take me to be under his supervision who offered me invaluable assistance, guidance and support It was a precious opportunity to work and allowed me to progress through the challenges set forth by my projects. I also would like to express my gratitude to my university, Universiti Teknologi PETRONAS (UTP) especially the Electrical and Electronic Engineering Department for equipping me with essential theories and important skills for self-learning. Not to forget, I would like to thank all my friends and family for their encouragement and support, and understanding. Finally, I would like to thank my parents for a lifetime of unconditional love and support. They have taught me on the most important lessons in life, and I owe all of my achievements to them.

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LIST OF ABBREVIATIONS

DSP	Digital Signal Processing
CCD	Charged Coupled Device
CIMS III	Comprehensive Information Management for Schools
RFID	Radio Frequency Identification
USB	Universal Serial Bus
LCD	Liquid Crystal Display
IDE	Integrated Development Environment
ID	Identification

CHAPTER 1

INTRODUCTION

As the world is growing with advance technology, the way of recording students' attendance is getting more practical. A lot of new methods have been deployed to make attendance recording faster and easier.

1.1 Background of Study

Skipping class is a very common problem among college students. It can be considered as truancy, and can be categorized as one of the discipline problems in university. According to dictionary of Pearson Education Limited, Longman-Dictionary of Contemporary English 2003, truancy means *"the act or condition of being absent from compulsory education"* or *"any intentional unauthorized absence from compulsory education"*. Poor absenteeism may cause in ineligibility to graduate and the students may be barred from taking final examination. According to studies conducted in Malaysia, it shows that the truancy rate among students is quite high and can reach a critical stage between 20% - 40% [1]. Students who play truant generally suffered from academic problem [2]. Always, reasons of absenteeism for university students from attending their classes are waking up late, and no transport to go to class as the distance between their hostels and lecture building is quite far. These reasons are not valid and cannot be accepted.

Universities have set certain rules in improving student's attendance such as by putting a limit of how many times they can miss certain classes or else, they will be barred from taking final exams for the subject. Attendance monitoring also is done by distributing attendance list for the students to leave their signature to indicate that they are present for the class. However, by taking student's attendance using their signature cannot address this attendance issues as students nowadays tend to fake

someone's signature just to cover their friends who skip the class. Thus, the problem of tracking and preventing absenteeism cannot be solved.

Therefore, a better way or a better system is required to overcome this issue. A system that uses a good authentication to indicate legitimate person present is to be designed to overcome this fake signature to address attendance issues among college or university students.

1.2 Problem Statement

Poor records of absenteeism in universities have lead to poor achievements in student's academic. This may lead to more serious problem such as social problem. Faking someone's signature has become a trend among university students to improve their attendance records. Current attendance record used by most universities is quite tedious by using manual attendance registers using paper based. Usually, students need to write jot down their names with student ID in a sheet of paper or sometimes, their name will be called accordingly for their attendance record. This old method is not a proper way since the paper used for attendance recording might lost, stolen, or torn. In addition, this manual paper based system will be more tedious when the number of students in class is large. Worst case is when the lecturer is teaching more than one class with different student every day.

1.3 Objectives

The main objective of this project is to propose a design and develop a user-friendly attendance management system using single biometrics input which capable for tracking students attendance in more proper and organized way. The other sub-objectives are:

1) To study literature review on various biometrics to obtain the most suitable input to be used
2) To conduct preliminary investigation and gathering of user requirements for a simple attendance management system
3) To implement suitable device to capture authentic student's identity for attendance record
4) To reduce absenteeism problem among students

1.4 Scope of Study

The study is focusing on designing and developing a system using one input of biometric trait that can detect the physical or behavioural traits of a person. This is to ensure that legitimate user is using the system. The system may contain the memories or database of the legitimate students for specific classes. With this system, any absenteeism can easily be tracked by the lecturers to further take actions for students who play truant as the project need to store database captured using the biometric device.

1.5 The relevancy of the project

The employment of this system is relevant for the future application in universities as it is intended to improve student's absenteeism in a way that it reduces time as this system is simple and user friendly. This gives a better solution for lecturers to perform attendance monitoring for their students in order to ensure that their academic performance is good and under control.

1.6 Feasibility of the project within the scope and time frame

This system is expected to be completed according to the accounted time frame given. Two semesters are given to do research and to develop the system. During the first semester, the allocated time focuses mainly on planning and research process while during the second semester, it is the time for the project design, implementation and testing. Gantt chart and regular informal discussion with project supervisor will ensure the project to be right on track as planned.

CHAPTER 2

LITERATURE REVIEW

2.1 Fingerprint

Biometric system is the recognition system in which to determine the identity of individuals based from their physiological or behavioural characteristic presented by the person. Biometric identification has now been widely used in many sectors such as financial and government sectors. Inputs such as fingerprint, iris, face, hand geometry and voice are called biometrics recognition. Among all the biometrics, fingerprint is widely used in access control applications because the algorithm for processing the fingerprint data is not really complicated, the price is cheaper than other biometric equipments, and also the time taken to identify the input data is fast [3]. Fingerprint recognition works by identifying people using their physical structure through the impression made by the minutiae ridge patterns found on the fingertips of each person. This finger pattern gives the image at the fingertips of a person which then the characteristics will be recorded [4].

Human has a very unique design at the fingertips. This design is different from each and every one of us. This unique and special property is being used nowadays as one form of protection against fraudulence. Each and every one of us is given pattern of ridges and 'valleys' on fingers in order to ease our daily routine such as gripping things [5]. Our fingers consist of friction ridges together with pores to excrete sweat through sweat glands. This ridge remains the same for our whole life. Figure 1 shows the example of minutiae on fingerprint. This unique property of fingers with minutiae, ridges pattern and 'valleys' are special because none of us is having the same pattern eventhough they are twins.

Figure 1: Minutiae of Fingerprint

This unique property of biometrics helps to identify the real or legitimate person to be present in the class as this biometric property cannot easily be changed and it is different from each person. It can be used in the designed system to overcome truancy problem among university students.

Before this, private and important information is secured by using password or PIN. This method require user to key in their 'secret' password or PIN that has been created previously. However, this method has many disadvantages such as it is highly exposed to hacking by irresponsible person. Furthermore, password or PIN created can be guessed by other person who is not the legitimate user [6]. A number of 288 first-year students of Cambridge Natural Science have done a study on factors in improving the quality of user passwords [7]. The same study is also conducted through empirical studies until a system called Persuasive Text Password is developed. A number of 83 students from Carleton University in Ottawa is tested using the developed system under this study [8].

2.2 Fingerprint Matching

Fingerprint-based identification is the most popular biometric techniques used. It has been successfully applied in various applications such as in ATM machine, at the airport for verification, and many more. There are two techniques in fingerprint matching, which are minutae-based and correlation based. In minutae-based technique, mapping of minutae points on fingerprint is used. This is done according to the placement of minutae on finger. Meanwhile, correlation-based technique acquires the registration point to compare the location precisely. However, with advanced technology available nowadays, fingerprint matching can be done automatically. This technique apply minutae extraction algorithm using high quality of input fingerprint image.

2.3 Optical Fingerprint Sensor

A fingerprint sensor is one of biometrics fingerprint identification products. There are two types of fingerprint sensor available in the market which is optical sensor and membrane which use silicon mode, pressure sensing mode or other sensor according to the kind of input modules. Optical fingerprint sensor usually used high powered DSP chip which perform all the calculation, algorithm, image rendering, finding the same feature, as well as searching process. This fingerprint sensor works by sending packets of data to take photos based on the principle of ray reflection of glass surface [9]. Once the fingerprint is captured, prints can be detected and searched. An array of light sensitive diodes, CCD-Camera is used in optical fingerprint sensor [10]. It will take picture of fingerprint once finger is placed on the glass plate of fingerprint reader. Arrays of CCD will enlighten the ridges and valleys available on the surface of finger.

Figure 2: Optical Fingerprint Sensor

2.4 Existing Attendance System

2.4.1 Computer Tracking

According to studies made by Gullatt and Lemoine, there is a storage system using computer tracking of attendance records where it has the ability to track attendance pattern. The system is designed to reduce absenteeism rate. School in the United States, the Osiris School Administration Program and Comprehensive Information Management for Schools (CIMS III) are able to retrieve individual schools' records at a central location. The records can be monitored by district personnel. Both this OSIRIS and CIMS III is able to be programmed by sending letters and/or phone parents when students have reached the limit of absence set by the school [11].

2.4.2 Wireless (Zigbee) Technology

There are many attendance systems available nowadays by using different various technologies. Several research groups have done their studies on the concept of fingerprint attendance system. Such research groups, L. Jian-po et al. has developed and proposed a system using wireless technology [12]. In this system, they used Zigbee wireless technology in which a database is created in remote system. Then, all the fingerprint data will be transmitted to the computer. In this Zigbee technology, it requires certain range of area for the system to operate for data transfer. For this case, it can provide 30 to 70 meters range provided that there is no barrier. However, problem will arise if the class room is not in the Zigbee range of area. This makes the students failed to use the system.

2.4.3 RFID Technology

Besides that, there is also a research on an attendance system using RFID technology for university applications [13]. This has been developed by A. Kassem et al. RFID technology works the same as bar code technology. However, unlike bar code, this technology requires the use of RFID tags for students to mark the attendance for university processes. All students database is stored in computer and they need to carry the RFID tag near to the reader. Nonetheless, this device can easily be cheated using proxy method.

For the new system to be designed, person authentication will be defined through LCD interface activity in which the data input will be matched with the stored database. Students need to verify their presence by scanning their fingerprint. The fingerprint detected will be compared with the stored database. Once it is matched, they are considered as present. This data will then transfer to the computer of their lecturers for their record through USB interface. Such system is illustrated using flowchart as given in figure below [14].
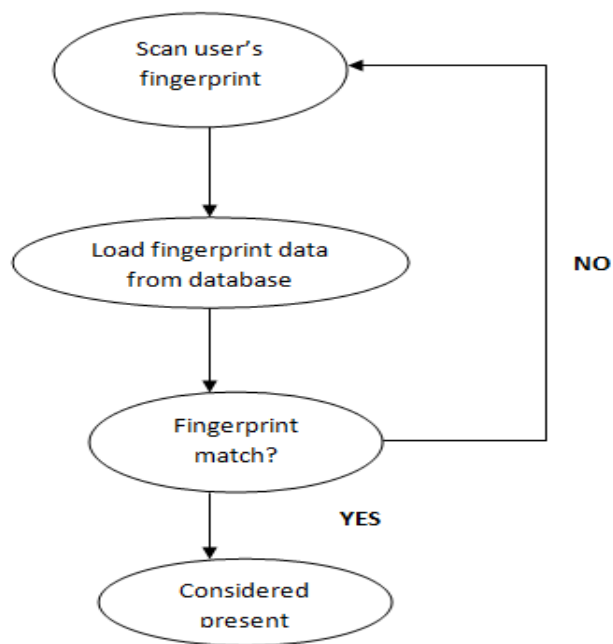
Figure 3: Example of flowchart for the verification process

2.5 Arduino

Arduino is an open-source electronics that is widely used nowadays. It works as a microcontroller board based on the ATmega328 [15]. Arduino is widely chosen nowadays as it is simple, easy to learn, cheap, and there is a lot of tutorial available on the internet on Arduino. It can communicate with other devices using USB connection. Besides, it can also use battery or AC to DC adapter. Like other microcontrollers, Arduino can be programmed using Arduino programming language which can be downloaded freely from the internet. There is a lot of Arduino products such as Arduino Mini, Arduino Mega ADK, Arduino Robot, and many more. But the one used in this project is Arduino Uno.
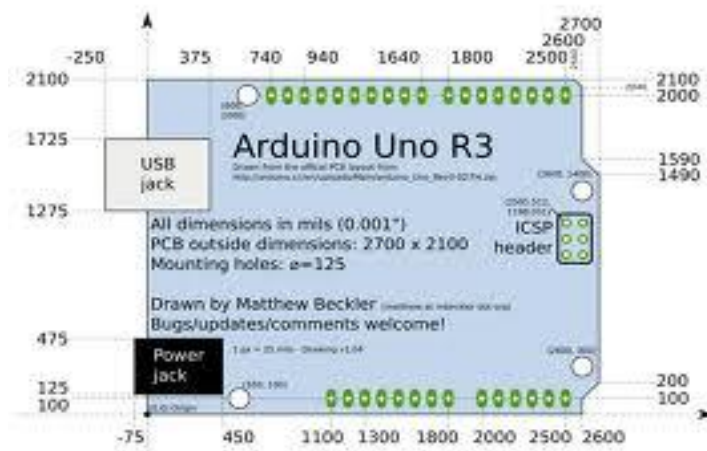
Figure 4: Arduino Uno Board

Figure 5: Parts of Arduino Uno

This Arduino Uno consists of 14 digital input/output as shown in Figure 5. Its operating voltage is 5V, suitable for electronic project. It can be powered simply by using USB connection or external power supply.
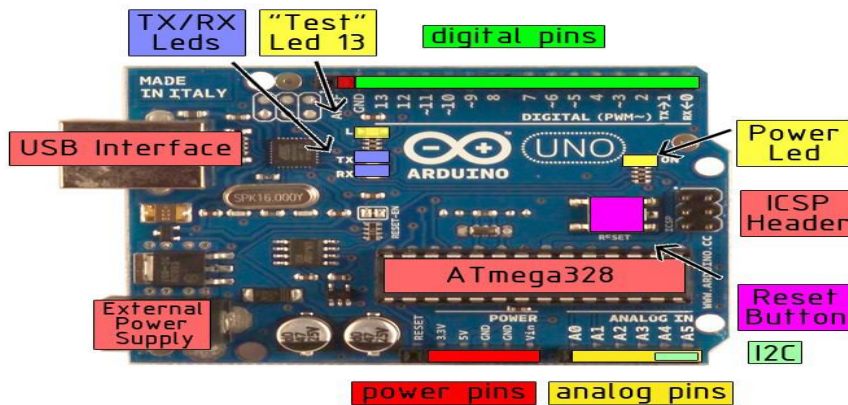

Figure 6: Overall board of Arduino Uno [16]

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2.6 Fingerprint Reader SM630

Fingerprint module is the major part in designing this portable device. Fingerprint Reader Integrated SM630 is used to carry out this project during initial design considerations in choosing the right hardware components. This type of fingerprint is a fingerprint verification module. It is capable to carry out functions such as fingerprint login, fingerprint deletion, fingerprint verification, search fingerprint database information, fingerprint upload, fingerprint download, and empty fingerprint database. This fingerprint module is interfaced with Arduino Uno to carry out the required operation LCD which is used for display purposes. The process of detection is fast which is approximately 1.5 second. It can stores data up to 768 fingerprints with operating voltage of 4.3V to 6V [17].

CHAPTER 3

METHODOLOGY

3.1 Research Methodology

The methodology to be used for this project is waterfall/hierarchy methodology. This project refers to waterfall model whereby first task is finished before being able to move to the next task. Figure 7 below shows the illustration of steps taken in Waterfall Methodology.
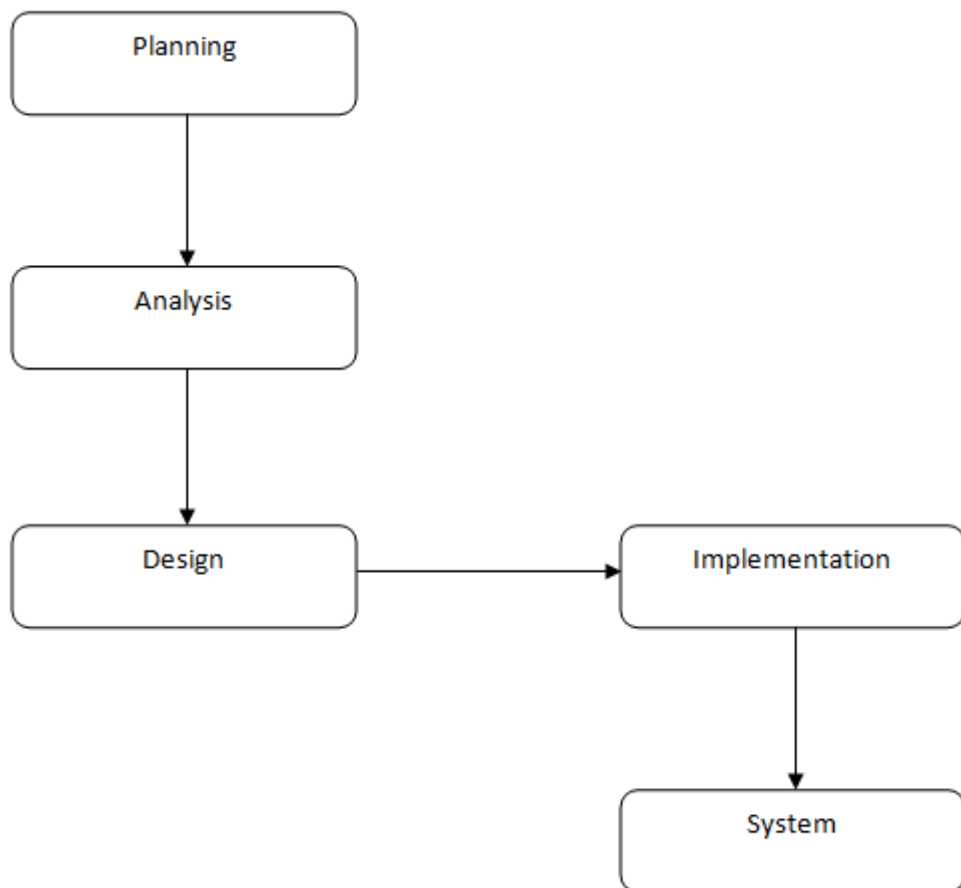

Figure 7: Steps in Waterfall Methodology

3.2 Project Activities

The author has done numerous activities to ensure the success of this project within the time frame. Several activities has been planned and followed religiously. Based from objectives stated earlier, to ensure the main objective of this project is achieved, the goals set for the four sub-objectives that have been discussed earlier must be accomplished.

3.2.1 Data Gathering and Analysis

In designing and developing a user-friendly attendance management system using single biometrics input which capable of tracking student's attendance, detailed literature review on biometrics will be focused to make sure the right biometrics will be chosen as the input. The factors which enable us to chose which biometric traits as the input for the design is taken into account in order for the system to work at its best. Initially, the project is more focused on theoretical readings and comprehension of the project scope as well as familiarization of biometrics which comprise of the function, applications and the system being used nowadays. Studies on the previous work from other researchers and ongoing studies in developing a system on biometrics help the author to gather information on the subject of matter. Literature review on the current attendance system available using different technologies is also focused on. Articles, technical papers, as well as YouTube tutorial related to this project which available on the internet is read and watched.

3.2.2 Project Discussion

For the second sub-objective which is conducting preliminary investigation and gathering of user requirements for a simple attendance management system, regular discussions is done to ensure the design is suitable and meets user's requirement. Discussion with supervisor helps to provide the author with more ideas and motivation to proceed with this project. A few difficulties could arise when conducting this project since the author might not be expert in the project to be done. The author had a meeting with supervisor weekly to report on the progress of the project.

3.2.3 Design and System Test

For the third sub-objective, which is implementing suitable device to capture authentic student's identity for attendance record, the proposed design model will then be tested. Studies on the available attendance system product are done in order to ensure the right choice of components and tools are used for the development of device. This is to ensure that the device will work as intended. The author has searched various fingerprint reader module that match with the requirements of this project in order to ensure the process of fingerprint verification faster. These include fingerprint addition, deletion, empty and search fingerprint database. All data needed is gathered and analysed. The model will be studied in terms of its performance and a few changes will be made on the device when necessary to promote a better function. The design and development test should be carried out in order to ensure that the system will work at best.

3.2.4 Implementation

Finally, for the last sub-objective, the device model produced can help to reduce absenteeism problem among students since they can no longer fake their attendance as they used to in order to improve their attendance record.
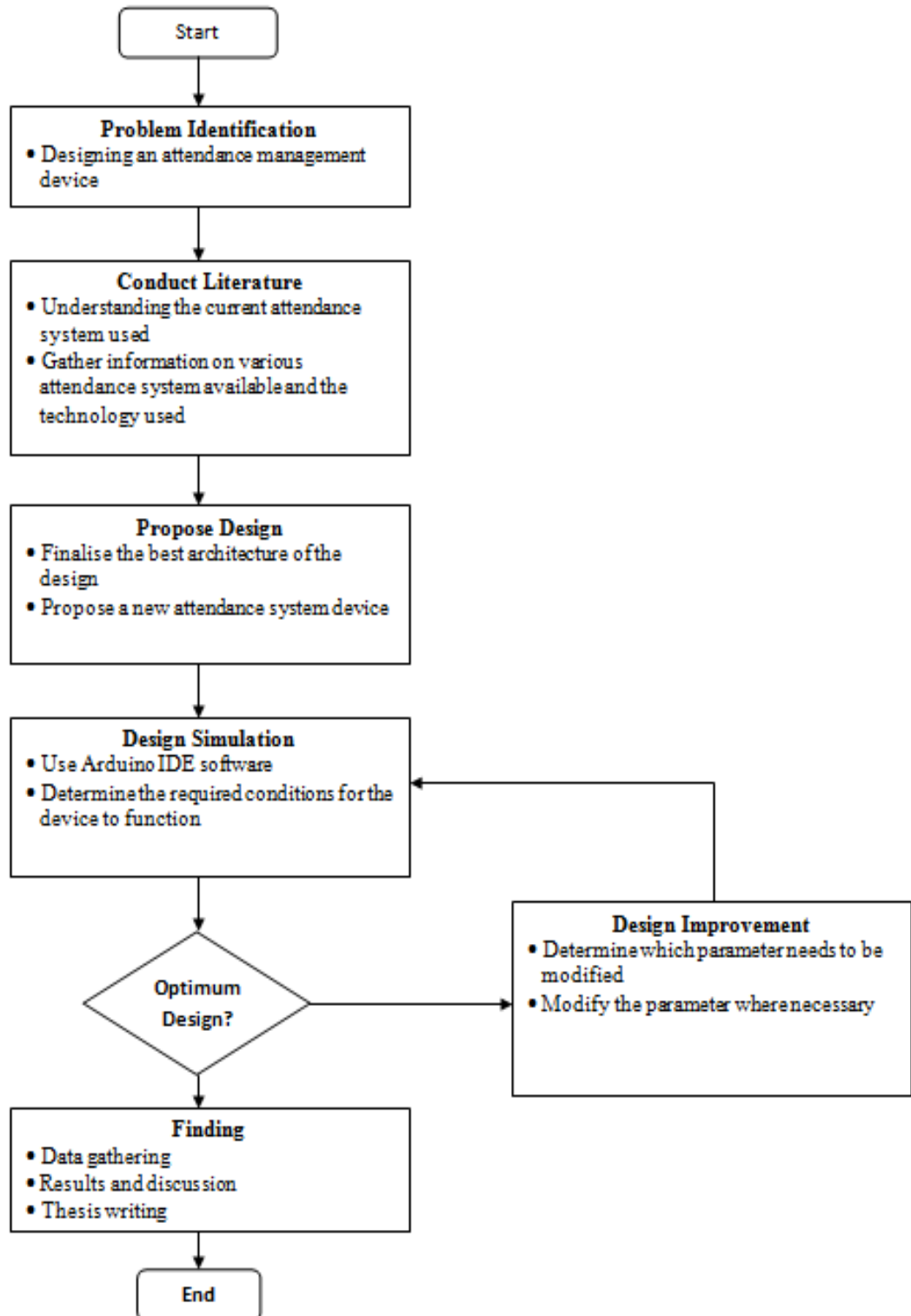
3.2.5 Process Flow

Figure 8: Project Process Flow

3.3 Key Milestone

The following are the key milestones that need to be achieved at the end of semester for both Final Year Project I and Final Year Project II.

Final Year Project I

Key Milestones	Week
Project proposal	3
Extended proposal (10%)	6
Proposal defence (40%)	8
Interim report (50%)	12

Table 1: Key Milestone for FYP I

Final Year Project II

Key Milestones	Week
Progress Report	8
Pre – SEDEX	11
Dissertation	13
VIVA	13
Technical Report	14

Table 2: Key Milestones for FYP II

3.4 Gantt chart

No	ITEM	WEEK													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Title selection	██	██												
2	Discussion with supervisor about selected topic		██												
3	Preliminary research work		██	██	██	██									
4	Submission of Extended Draft Proposal					██	██								
5	Submission of Extended Proposal						██								
6	Project defence and progress evaluation							██	██	██	██	██			
7	Project research and work proceed							██	██	██	██	██			
8	Submission of Interim Draft Report												██		
9	Submission of Interim Report													██	

Table 3: Gantt chart for FYP1

No	ITEM	WEEK														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Developing the system	■	■	■	■											
2	Algorithm Test					■	■	■	■							
3	Submission of progress report								■							
4	Data gathering and analysis									■	■					
5	Pre – EDX											■				
6	Submission of draft final report												■			
7	Submission of dissertation (soft bound)													■		
8	Oral presentation													■		
9	Submission of Technical Paper														■	
10	Submission of project dissertation (hardbound)															■

Table 4: Gantt chart for FYP2

3.5 Tools and Equipment

3.5.1 Hardware:

- Arduino Uno
- Cytron Protyping Shield
- Fingerprint Reader Integrated SM630
- LCD Keypad Shield
- Buzzer – PCB Mount

3.5.2 Software:

- Arduino IDE
- Microsoft Word

3.5.3 Arduino IDE

Arduino IDE is software used for open source electronics called Arduino Uno. Both this software and hardware are easy to be used. They are suitable to design various projects especially for beginners. A lot of tutorials and projects are available on the internet using both software and hardware which can help in the design and completion of this project.

CHAPTER 4

RESULT AND DISCUSSION

As mentioned earlier, the main objective of this project is to propose a design and develop a user-friendly attendance management system using single biometrics input which capable of tracking student's attendance in more proper and organized way. Thus, a few initial design considerations need to be taken into account.

4.1 Conceptual Design

Figure 9 below shows the basic idea of the attendance management device that is about to design. The device will have some features that make it easier to be handled. Biometric input to be used in this design is fingerprint because its identification of input data response is fast as compared to other biometrics.

Figure 9: Example of Portable Fingerprint Attendance Device

It will be portable, so that lecturers can bring it from class to class. This device operation is fast as it will only take a few seconds to scan and detect fingerprints registered in the database. The size is small enough to be kept and it is light. The operation is simple and the interface used is easy to understand, thus promoting a user-friendly device. Data can be transferred from one device to another using USB interface.

Fingerprint Reader	Arduino	Components (LCD Display and buzzer)
Press finger to scan fingerprint	System will identify and search the matched fingerprint from the data stored earlier	Buzzer will give out short beep sound if authentic user is detected and long beep sound otherwise
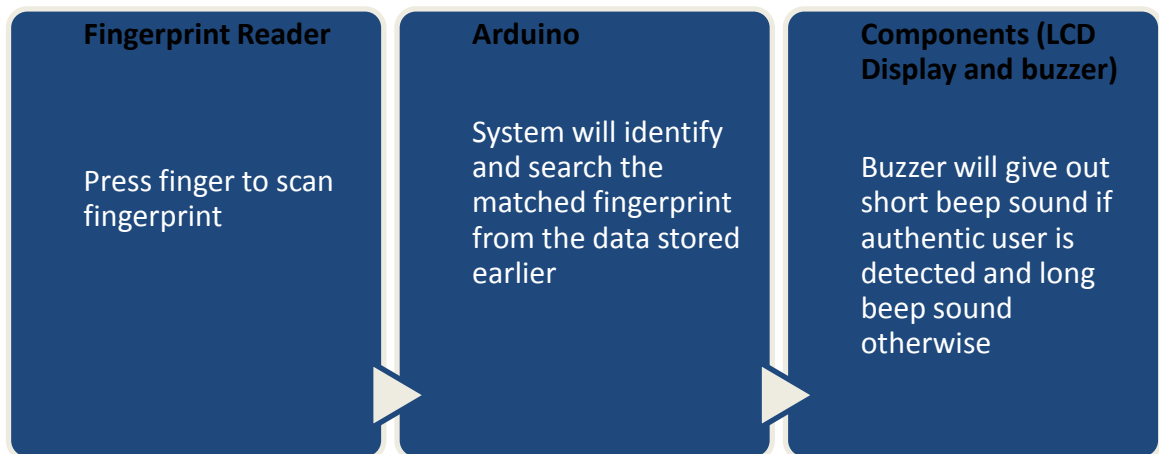
Figure 10: Main process

4.2 Fingerprint Reader

Before the fingerprint reader can carry out its basic operation, buzzer and connector is soldered on the prototyping shield. Buzzer is used in order to indicate whether the action is successfully attempt or not. This can be shown as in Figure 11 and Figure 12 below.
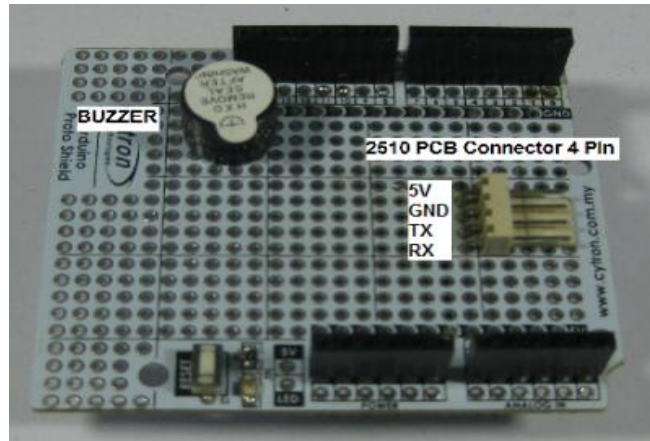
Figure 11: Buzzer and connector connection from front view
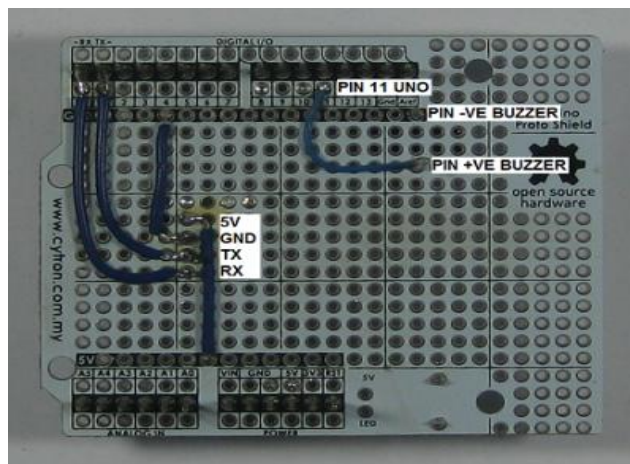
Figure 12: Buzzer and connector connection from back view

The correct connection is ensured so that the fingerprint reader can function as intended.

4.3 Enrolling

Students need to enrol their fingerprint in order to create a database of user. This can be done by using this fingerprint scanner in which the scanner will capture and store the fingerprint. In doing so, every user will be specified with their own ID, from User ID 1 until User ID 768. However, before proceed with the operation, user can chose the fingerprint operation to be carried out through the menu interface since it can carry out operation such as adding, deleting, searching, and empty database. This can be shown as in below.

Figure 13: Fingerprint Module Interfaced with Arduino Uno

4.3.1 Add Fingerprint Operation

Select fingerprint menu of 'Add Fingerprint' by pressing select button. If the student is assigned with fingerprint of user ID number 1, he /she will need to chose user ID number 1 and add the fingerprint. This can be shown visually as in figures below.
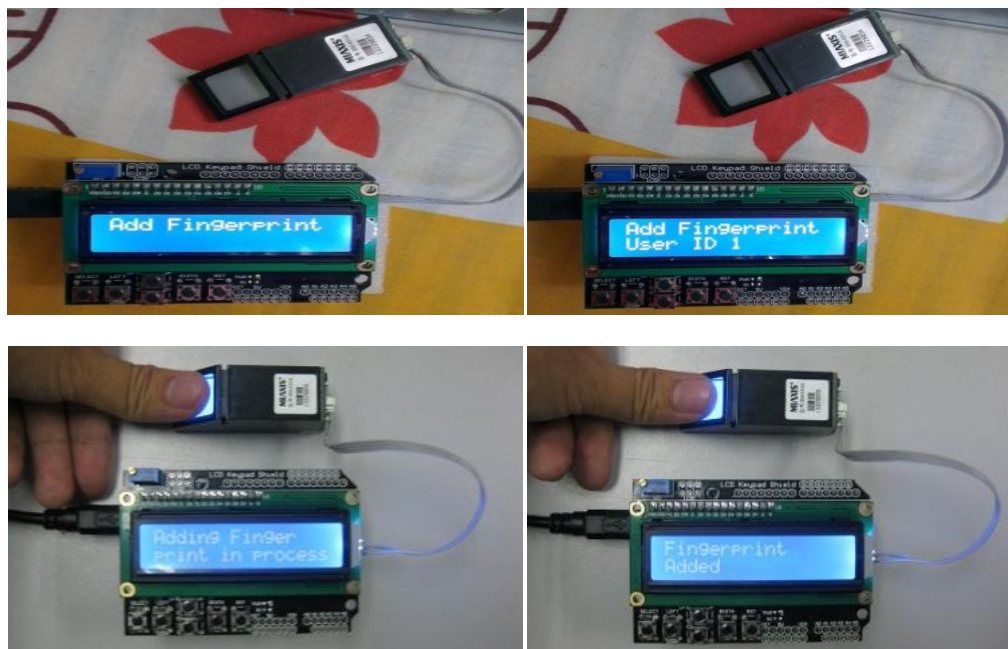
Figure 14: Add Fingerprint Operation

However, when there is no fingerprint is placed on the reader, this means that there is no process of adding fingerprint take place. Thus, LCD will display 'Time out' together with the sound of buzzer. It will give long beep twice to indicate the process is time out.
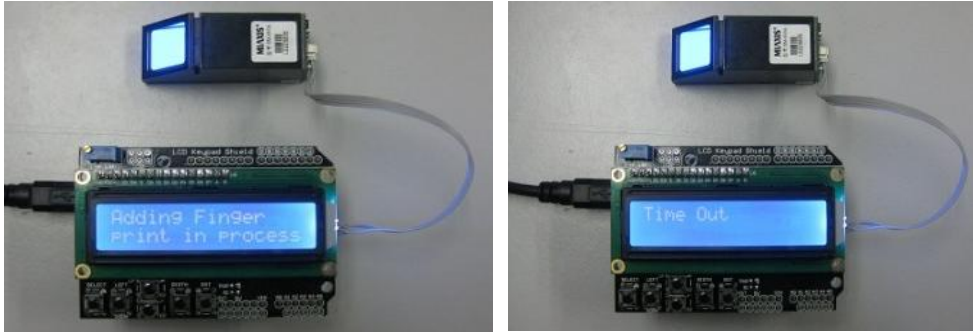
Figure 15: When no Fingerprint is placed on the reader

4.3.2 Delete Fingerprint Operation

Select fingerprint menu of 'Delete Fingerprint' by pressing select button. Choose ID number that needs to be deleted. If the student is assigned with fingerprint of user ID number 2, he /she will need to chose user ID number 2 and delete the fingerprint. This can be shown visually as in figures below.

Figure 16: Delete Fingerprint Operation

4.3.3 Search Fingerprint Operation

Select fingerprint menu of 'Search Fingerprint' by pressing select button. This operation takes place by placing fingerprint on the reader to find out which User ID he or she is. This can be shown visually as in figures below. If the operation is successful, LCD will display 'Search FPrint Operation Success' and display the User ID him /her posses. Then the buzzer will beep shortly for two times. This operation is shown in figures below where fingerprint of User ID 5 is searched.

Figure 17: Search Fingerprint Operation

However, in the case when there is no fingerprint is placed on the reader, this means that there is no process of searching fingerprint takes place. Thus, LCD will display 'Time out' together with the sound of buzzer. It will give long beep twice to indicate the process is time out.
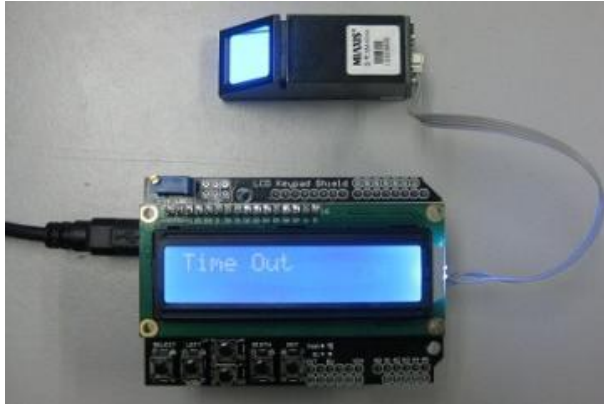
Figure 18: When no Fingerprint is placed on the reader

On the other hand, if fingerprint placed on the reader is not yet added in the reader, 'No Match Found Invalid Fprint' will be displayed since it is not in the database. Buzzer also will beep twice longer than normal beep.

Figure 19: No Match Fingerprint

4.3.4 Search Database

Select fingerprint menu of 'Search Database' by pressing select button. This operation differs from 'Search Fingerprint' operation as it does not need for the user to place their fingerprint on the reader. This operation is mainly to check and ensure whether the User ID is already in the database or not. For example, it is shown in figure below for searching database of User ID 3. If the User ID is already in database, LCD will display 'Database Found' with beeping of buzzer shortly for two times.

Figure 20: Search Database Operation

However, if the User ID is not in database, 'Database Not Found' will be displayed.
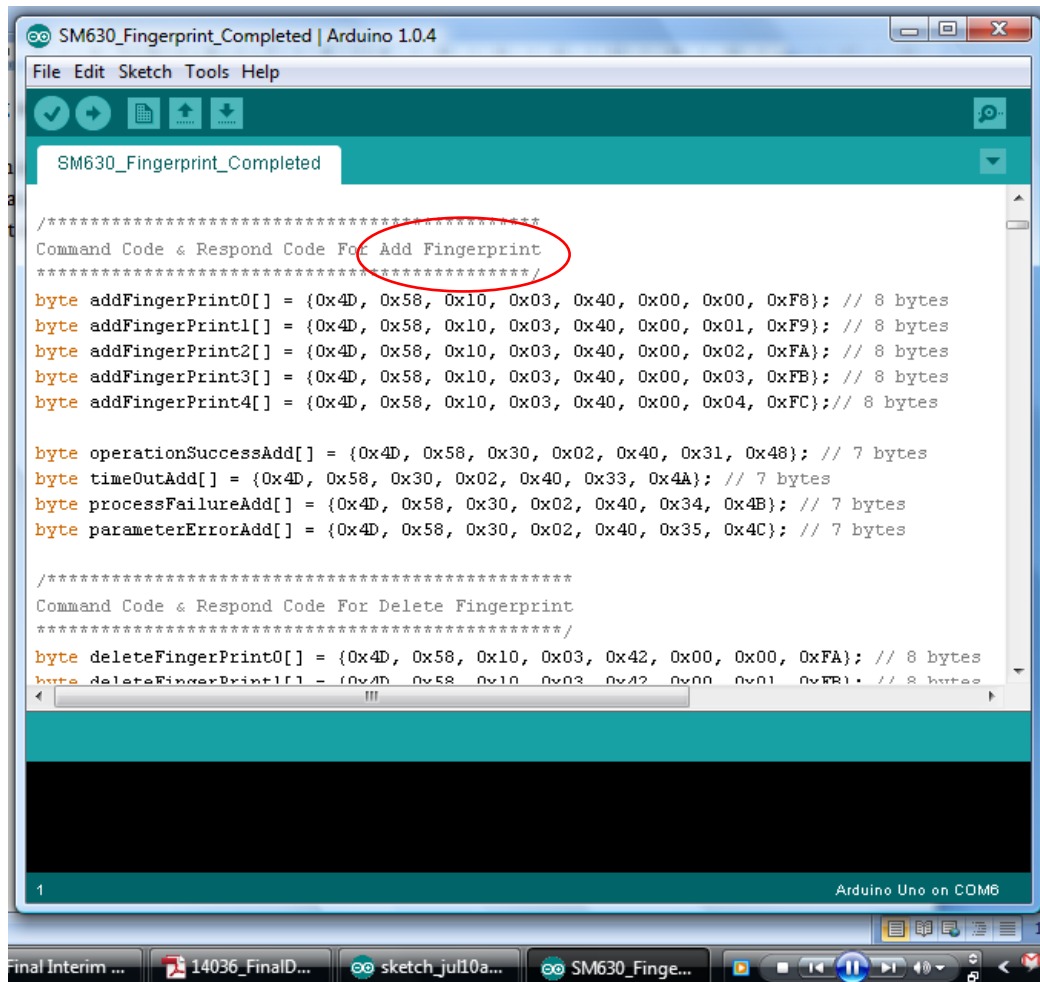
Figure 21: When Database Not Found

Fingerprint operation is almost the same for 'Empty Database'. All these operations are needed in order for this attendance system to function. All these operations is made possible using programming C++ language using Arduino IDE.

4.4 Programming using Arduino IDE

This programming language use simple command for adding, deleting, searching and others. All this command can be learned from the manual of Fingerprint Reader Integrated SM630. All operations take place in sequence.

Figure 22: Code for Add Fingerprint

Figure 23: Add name of students for database

Figure 24: Code for both Delete and Search Fingerprint

Figure 25: Code for both Empty and Search Database

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All these basic operations are necessary for the next stage of development of this system. Basically, the operation of this fingerprint matching is as shown in Figure 26.
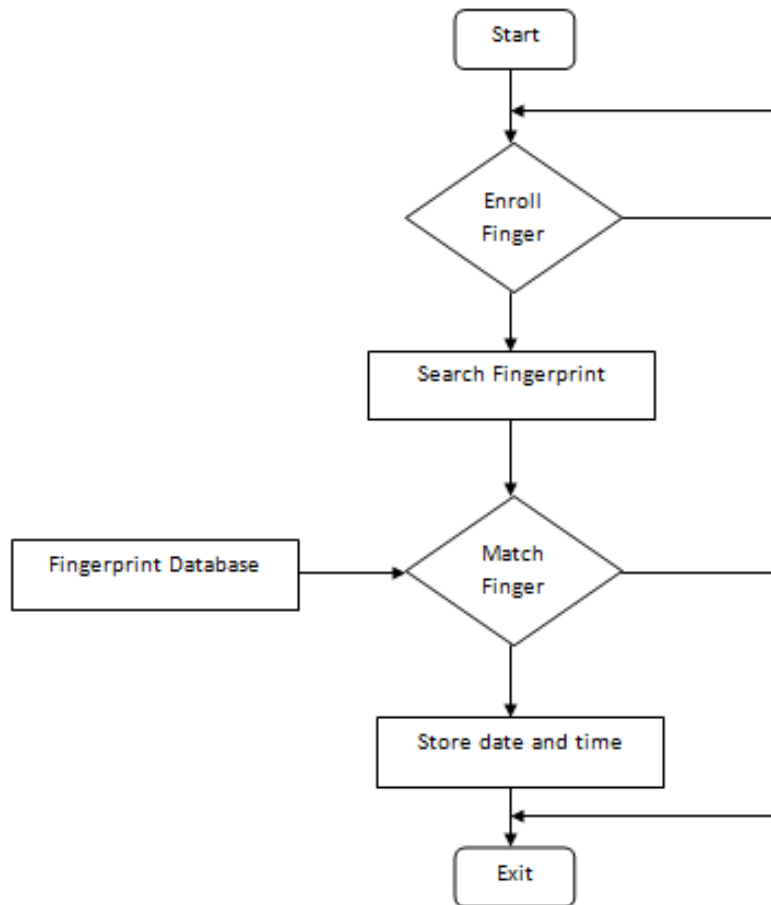
Figure 26: Flow chart of Fingerprint Matching

4.5 Modelling the Project Application

This project is partially completed after some experimentation and modelling process. Most of the testing is done through the software Arduino IDE as mentioned before which will be uploaded directly to the hardware. In order to make it portable, the device is made connected to the battery of 9V as the power supply. This battery can be replaced from time to time.
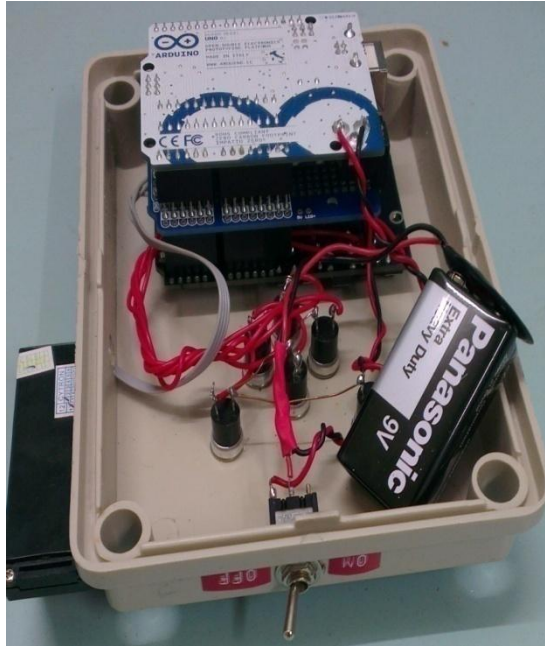
Figure 27: Inside view of the device which is connected to the battery

Figure 28: The Portable Device from the outside

Based on Figure 29, it shows the main interface of the device. There are a few options which are add, delete, search and empty fingerprint database. The user can select for any options which they want to carry out. However, for 'Add Fingerprint', 'Delete Fingerprint', and 'Empty Database' options, it is only for the admin to control. While in class, the students are allowed to use 'Search Fingerprint' option only to make the process faster.

Figure 29: Main Interface

As the database created and finger is pressed at the reader, the student's name will pop out if they are a registered user. This can be shown as in figure below. Or else, the LCD will display 'Database Not Found'.

Figure 30: Student's Name 'Sakinah' is displayed on the screen

CHAPTER 5

CONCLUSION AND RECOMENDATIONS

5.1 Relevancy to the Objectives

The focus of this paper is on reducing or monitoring the rate of absenteeism among university students by using system and device that gives high level authentication of person recognition. This is to ensure that the student is not faking his presence in class and helps to monitor student's academic achievement. A fingerprint reader will be used to detect the fingerprint of a person to verify his or her attendance. The data scanned will be matched with the existing data in the database. The system planned will be implemented on hardware to test the functionality of the system. The main objective of this project is to propose a design and develop a user-friendly attendance management system using single biometrics input which capable for tracking students attendance in more proper and organized way. This main objective, together with another four sub-objectives has been achieved.

5.2 Suggested Future Work

The current design model will be modified and further analyzed step by step during its construction. Modification will be done where necessary to produce fingerprint attendance system with a better performance. The battery can be replaced with rechargeable battery to make it easier as the battery does not need to be changed frequently. For future enhancement, more sophisticated technology can be used to produce better device. The device needs to be checked from time to time so that latest hardware on the market that uses the latest technology can be used. For example for display purposes, LCD keypad shield display can be replaced with the current technology such as touch screen LCD. Besides, this device can be improved by using more powerful DSP processor.

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