

Shopping Mall Membership Using Fingerprint Technology

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the

Business Information Programme

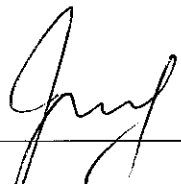
Universiti Teknologi PETRONAS

In partial fulfilment of the requirement for the

BACHELOR OF TECHNOLOGY (Hons)

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Approved by,



AP DR Baharum Baharudin

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

May 2011

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.



MAISARAH BT SAMSUDIN

ABSTRACT

This project emphasizes the usage of finger-scan technology to replace shopping complexes' membership card for customer. The system comprises image acquisition hardware, image processing components, template generation and matching components, and storage components to store customers' data. The data gathered is then stored in a local PC or a central server. Fingerprint quality can vary substantively from person to person and from finger to finger and the image captured has to be matched with the system in order for the system to work. The fingerprint device is compared to find out which device is suitable to be used in this project. The return on investment is calculated to see the revenue gross revenue that they will get if they use the system. The main contribution of this project is a fingerprint technology system is used to capture customer's data and for them to collect points and get discounts without carrying a card everywhere.

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Firstly, I would like to take this opportunity to say Alhamdulillah and thank God for His blessings and for giving me health and strength to complete my Final Year Project (FYP) within two semesters. Not to forget my family and friends for providing everything I need and give advices, which I needed the most.

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CHAPTER I

INTRODUCTION

1.1 Background

Finger-scan technology utilizes the distinctive features of the fingerprint to identify or verify the identity of individuals. Finger-scan technology is the most commonly deployed biometric technology, used in a broad range of physical access and logical access applications. It refers to the programmed method of authenticating a match between two human fingerprints. [1]

There are many strengths of using finger-scan technology. It is a mature and proven core technology, which is, capable of high levels of accuracy compared to other biometric systems. The accuracy of the matching algorithm by using static or artificially generated templates, images and data is important. Finger-scan technology can be deployed in any range of environments. Many devices nowadays are in a reduced size with different power requirements. It is implemented in a range of logical and physical access environments. Almost all of the finger-scan acquisition devices are capable of acquiring and processing images captured by the devices. It is also has the ability to enroll multiple fingers to authenticate different users. This gives fingerprint advantages in security and also flexibility.

This project focuses on the finger-scan technology to capture customers' data into a local server and to replace the membership card for shopping complexes at the same time. Although finger-scan technology weaknesses' affect almost all fingerprint solutions, it can be mitigated through intelligent system design. The technology is used by hundreds of thousands of people daily to access networks and PCs, to enter restricted areas, and to authorize transactions.

1.2 Problem Statement

A traditional way for an organization, company or shopping complex to keep their customers stay with them is by encourages them to apply for membership for that particular party. Joining the membership can benefits the customer in terms of discounts, rewards, and collecting points. They will be given a card and the card will has to be presented each time they purchase goods or products, also applicable for services company such as spas, saloon and many others.

Sometimes this way of bringing the card everywhere can gives troublesome to some customers. When a customer wants to join the membership, they will need to go to customer service center to sign up and wait for the card to be able to be used. And if they forgot to bring the card when they go shopping, they will not get the discounted price for members or gaining points. Using a fingerprint to replace the membership card can bring ease and simplicity to the customers as they do not need to bring the card everywhere they go, they can just use their finger to collect points and get discounts.

1.3 Objectives

- To understand how to catch data from finger-scan to the database.
- To learn how to relate the database to add points and discounts.
- To implement the finger-scan prototype based on the design requirements.

1.4 Scope of Study

The analysis of fingerprints for matching purposes generally requires the comparison of several features of the print pattern. These include patterns, which are aggregate characteristics of ridges, and minutia points, which are unique features found within the patterns. [2] It is also necessary to know the structure and properties of human skin in order to successfully employ some of the imaging technologies.

The essential thing is to acquire a high-quality image of the fingerprint. Image quality is measured in dots per inch (DPI), which means higher resolution image has more DPI. Today's fingerprint peripherals can acquire images as much as 500 DPI and the lowest DPI found in the market is in the range of 300 – 350 DPI. Then it must be converted to a usable format.

1.5 Relevancy of the Project

This project is very useful and convenient for people who likes to go shopping and also for everyone. But it is applicable to branded shop because ordinary shop might not gain revenue if they use this system. It does not need any device or software and installer to be used. A finger is enough to gather all relevant data for the customers without carrying anything everywhere because fingerprint technology is used to grant or limit access to data, resources, or a physical area. From the part for the company or the organization, they might need to install the devices into their local server and all related counters to make it easy to capture customers' data.

1.6 Feasibility of the Project

The scope of this project involves the entire organization, as they will need to learn about the system before it is implemented. Familiarity with the technology is important because there is a greater chance that problems and delays occurred during the development of the system. The length of time needed to complete this project is within two semesters, which is equivalent to eight to twelve months. It might be open to more risk because of the complication to manage or limited time frame.

CHAPTER II

LITERATURE REVIEW

Biometric is widely used nowadays for security and identification purposes specifically using fingerprint recognition. The authentication system has to satisfy certain requirements that are frequently contradictory. Especially for password which is sometimes hard to remember and wrong password can lead to the loss of information. It also results in excess expenditures for password resets and system maintenance (Ammenheuser, 2002; O’Gorman, 2003; Saccomano, 2003; Strassmann, 2002; Zhang, 2002). The password problem has got worst from time to time. In contrast, Schneier [6] compares traditional security systems with biometric systems. The lack of secrecy such as leaving fingerprint impressions on the surfaces we touch, and irreplaceability is identified as the main problems of biometric systems.

Since finger-scan recognition is the oldest biometric system that is being used widely, many researches currently concentrate on finding better solution to person identification, using both emerging and established technologies (Maltoni et al., 2003; Wang and Bhanu, 2007). Fingerprints are extensively used for person identification in a number of commercial, civil, criminal and forensic applications (Park et al., 2008). Such methods are also commonly used all over the world by police departments to fight the criminal world. Biometric technology can be used as a solution to protect information from being used with wrong intention and as a potential security solution. Today many organization applying one of this two methods, “what you have” and “what you know” to identify person who access their physical or logical infrastructure (David R. Lease, 2005). This technique is practiced to address the need for efficient and economical authentication. But in some cases,

authentication based on what one knows does not directly authenticate the user (Chandra & Calderon, 2003; O’Gorman, 2003).

According to C.Lakshmi Deepika, Dr. A Kandaswamy, C. Vimal, and B. Sathish (2010), There are several approaches to deal with Fingerprint Recognition. Because of their computational complexity it is an arduous job to create a global algorithm, which could even deal with incomplete fingerprints. Maltoni et al [7] proposed the algorithm that is focused on image correlation, texture descriptor and filter banks or minutia points which is the most widely used. Feature extraction or texture extraction determine the performance of the biometric. There are several approaches for the detection of singularity points in the literature, among these the most popular is the one proposed by Kawagoe et al [8]. In image enhancement, the most commonly used technique is Histogram equalization. It enhances the contrast of the image in spatial domain (Sonka M, Hlavoc V, Boyle R, 2004).

In the review of published work [10], due to practical consideration and limitation, when multimodal biometric data is not available for improved verification one can uses single features of various sub images of an image of the unimodal biometric to achieve improved performance of verification. This also opens up area of research where multiple features can be obtained from sub images of an image may offer acceptable performance as against multimodal biometrics.

CHAPTER III

METHODOLOGY

This project is using throwaway prototyping and done at different point in system development life cycle. This methodology has a relatively thorough analysis phase that is used to gather information and to develop ideas for system concept. Nonetheless, there might be some challenging technical issues to be solved.

Throwaway prototyping is chosen because if there are some issues, it can be examined by analyzing, designing, and building design prototype before it proceeds to the next phase, which is implementation. [5] A design prototype is not a working system, it is a product that represents a part of the system that needs additional refinement, and contains only enough detail to enable users to understand the issues under consideration. This system will probably rely on several designs of prototypes during the analysis and design phase. Below are the phases:

3.1 Phase 1: Critical review of related works

- This phase contains the planning about what the system will look like, the strategy used to build the system. The feasibility studies are done to review the key aspects of the proposed project. The project is initiated with a detail background study on fingerprint recognition. Fingerprint matching is reviewed to find out what involves the matching technique.

3.2 Phase 2: Choose the right development language

- The development phase needs programming language to proceed. The options are not really wide since this system only used an interface, a database and an algorithm to match the fingerprint. Some development language examples are using Visual Basic, Java, Microsoft Access, Microsoft Excel and Matlab. After doing some research on this program, Microsoft Visual Basic, Microsoft Access and Matlab are chosen.

3.3 Phase 3: Design and develop interface and database.



- In this phase, interface is created using Microsoft Visual Basic. It can also be created using the built in function in Microsoft Access, but since it is limited, Microsoft Access database is linked with the Visual Basic at the end of the interface development. Matlab is used to create a program to match both fingerprint from the database and from the device. The program will only be proceeding if both fingerprints is matched.

3.4 Phase 4: Evaluation, testing, and further enhancements

- In the last phase, Phase 2 and 3 is repeated when some issues arise during the development of the system. Also if there is some unclear information on the system that needs to be tested and developed until it is resolved. Once the issues are understood, the project moves into design and implementation and after it is resolved, the prototype evolves into the final system.

3.5 Analysis Phase

3.5.1 Product Comparison

	USB Fingerprint Scanner VS5000	Fingerprint Reader Fingerspot 4000B
		
Pixel Resolution	512 dpi	512 dpi
Scan Capture Area	15mm (nom. Width at center) 20mm(nom. length)	14.6mm(nom width at center) 18.1mm(nom length)
8-Bit Grayscale	356 levels of gray	256 levels of gray
Compatible	USB 1.0, 1.1, 2.0 (Full Speed)	
Supply Current	Scanning 190mA Idle mode 140 mA Suspend mode 1.5mA (max)	Scanning 190mA Idle mode 140mA Suspend 1.5mA (max)
Supply Voltage	5.0V +- 5% supplied by USB	
ESD Susceptibility	>1.5kV, mounted in case	
Scan Data	8-bit grayscale	
Dimension	63mm x 39mm x 9.1mm	74mm x 49mm x 19mm
Power Requirement	12VDC Sleeping current <50mA Working current <400mA	

Standard Compliance	FCC Class B, CE, ICES, BSMI, MIC, USB, WHQL	FCC Class B, CE, USB, WHQL
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Both of the products have almost the same specifications. USB Fingerprint Scanner VS5000 is most probably use for this project because it is an intelligent USB fingerprint scanner used to capture live fingerprints. It calibrates and encrypts the fingerprint images to ensure high quality and high security images that are transferring to computer. The price of this product is around RM 500 to RM 600.

VS5000 is applied as fingerprint scanning device for various applications such as desktop PC security, mobile PCs, custom applications, point of sales system and many others. The small form size is one of the factors of why it is chosen. This product has an excellent scan quality, based on general overview. It works will with dry, moist or rough fingerprints. Compared to the other product, this fingerprint scanner is compatible with Windows 7, XP, 2000, ME, 98 NT4.0 and Windows Server 2000, 2003.

3.5.2 Return on Investment (ROI)

Return on investment tells you the percentage return you have made over a specified period as a result of investing for a system. It is the ratio of money gained or lost on an investment relative to the amount of money invested. It may be obtained for a specific period according to the organization's planning cycle, maybe a year or two. The period can also be calculated to correspond to the lifetime of the benefits. In this part, the ROI for using normal card and for using fingerprint scanner will be calculated on compared.

ROI for using Normal Card

If the shop has around 1000 to 1500 customers, and the price of each card is about RM 0.50. The product sold is more than RM100 per product. Each day, the product will be purchased around more than 10 products. So,

Benefits will be $RM\ 100 \times 10 = RM\ 1000$

Costs will be $RM\ 0.50 \times 1500 = RM\ 750$

The revenue that the shop will gain is around RM 250 per day.

ROI for using Fingerprint Scanner

One fingerprint device is approximately RM 600 including the system. Same as using card, the product sold is more than RM 100 per product and the customers will purchase 10 products per day. So,

Benefits will be $RM\ 100 \times 10 = RM\ 1000$

Costs will be $RM\ 600$

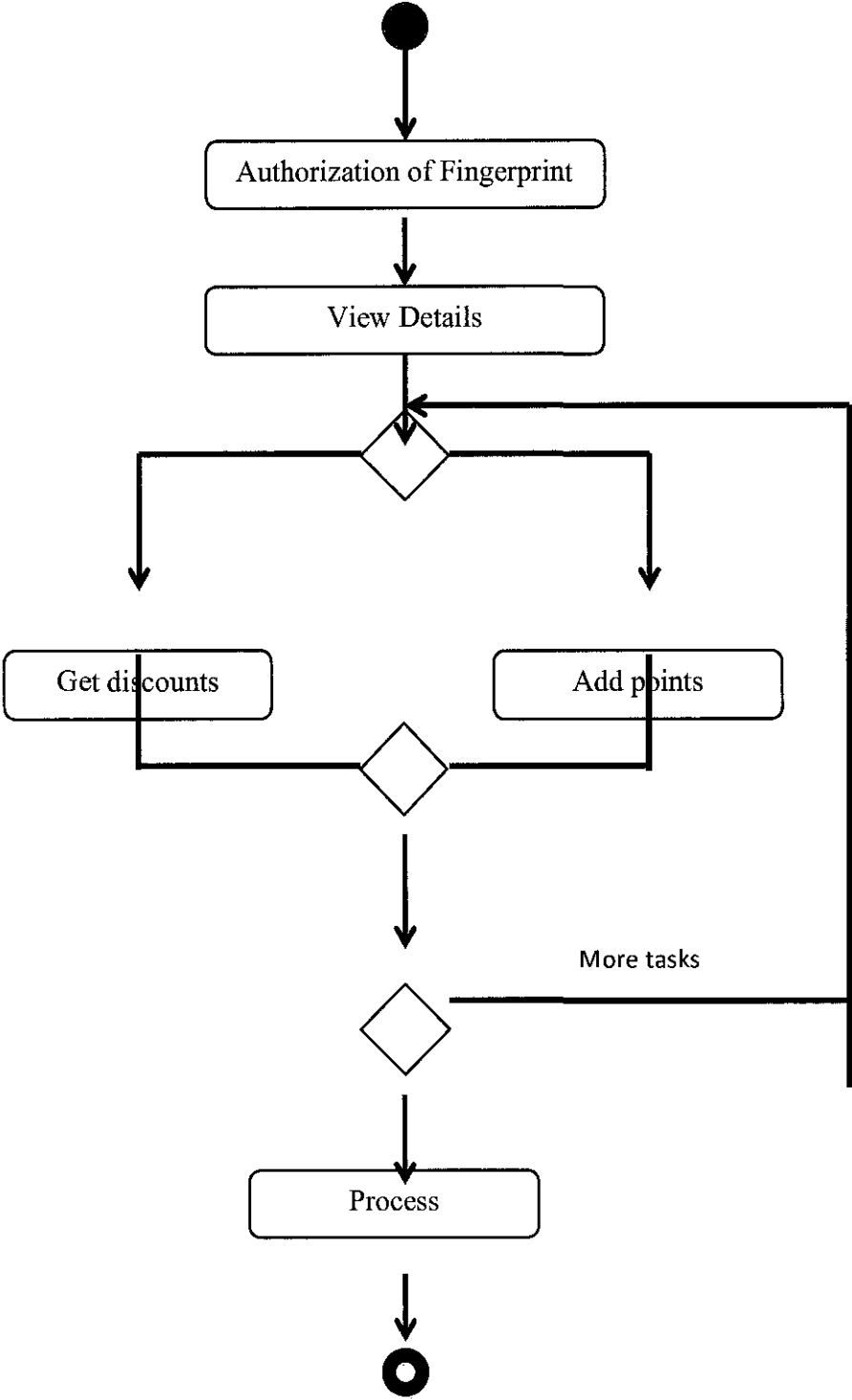
The revenue that the shop will gain is around $RM\ 400$ per day.

Instead of using card, the shop can consider to use fingerprint for their customers. It is easier, plus it will reduce the time of making the card available to use. The revenue is also high, as it does not need card for the shop to buy it for their customers.

3.6 Design Phase

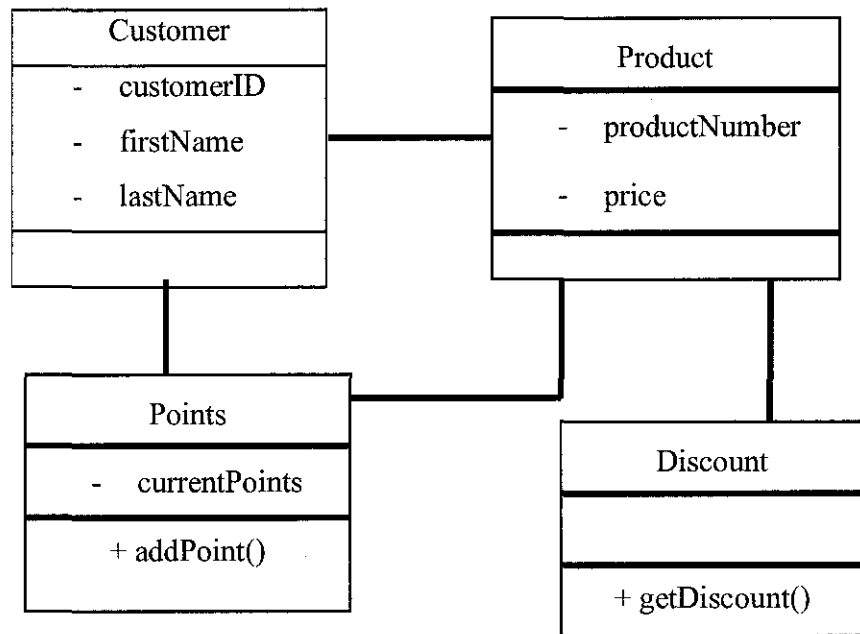
3.6.1 Activity Diagram

The diagram on the next page is activity diagram, which describe the workflow of this system. Firstly, the user will be needed to authorize him/herself. After the authorization, it will be preceded to view the details of the customers. Two options will be given which are to get discounts or add points. Choose one option and if they want to repeat the task, just go back, if not, the process will be terminated.



3.6.2 Database Design

The purpose of database design is to create the data that will be accessed in the system. Mapping the database is important to optimize the system so that it will perform efficiently and to design the necessary data access and manipulation classes. This database will be implemented in the next phase.



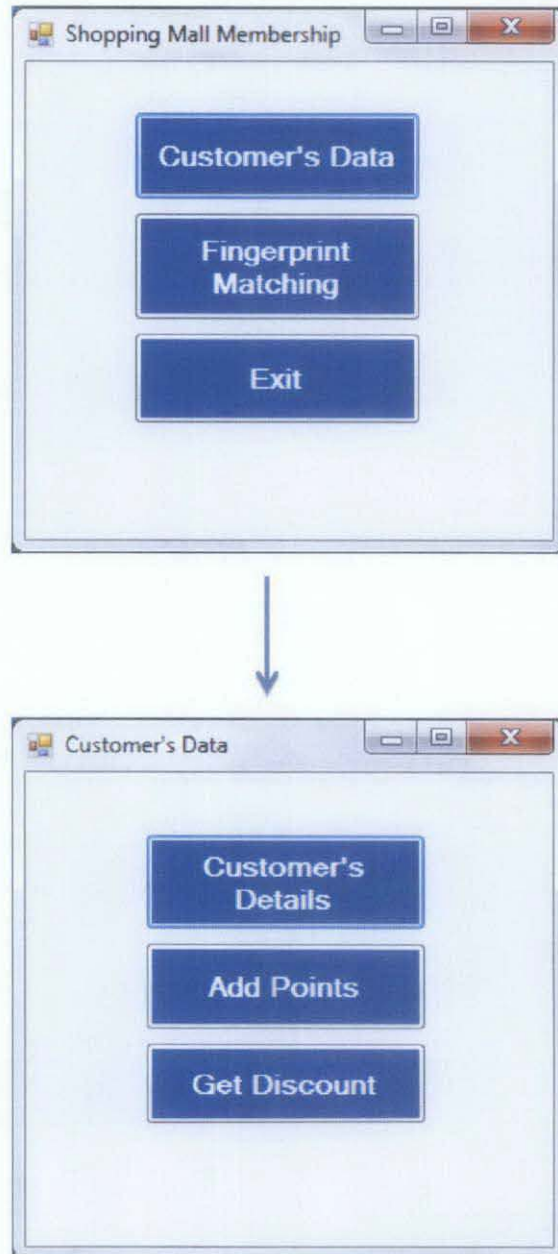
CHAPTER IV

RESULT AND DISCUSSION

The phase that is being completed is in phase 3, which is the development phase. In this phase, algorithm is developed using Matlab, a numerical computing environment and fourth-generation programming language which allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interface and interfacing with programs written in other programming languages, including Visual Basic and Microsoft Access.

Matlab is used to match both fingerprint from the database and from the device. For Visual Basic as an event-driven language, it is used to create a simple Graphical User Interface (GUI) application for the system. It provides Rapid Application Development (RAD) as it can quickly built prototype applications. The application can be put together using components in Visual Basic. Some codes can be added by dragging and dropping controls such as buttons, text boxes and dialog boxes. The appearance and behaviour can be defined afterwards. Microsoft Access is used to create a database specifically for the system. The data will be captured from the Visual Basic and stored in Microsoft Access. It can also analyze the data from Microsoft Access. Microsoft Access also supports Visual Basic, which is called VBA (Visual Basic Access). When Matlab is used, it is a difficult programming language because it never been taught before. It takes time to learn a new programming language.

This is how the interface will look like. User will be needed to choose from the options given below.



On the "Customer's Detail" button, the user will see the database from Microsoft Excel. As for the other two buttons, the "Add Point" will give the points to the customers and "Get Discount" button is for the customer to get the discounted price on certain products. The database of the customers will look like this:

A screenshot of a Windows-style dialog box titled "Add Points". It contains two text input fields: "Customer's ID :" and "Points :". Below the fields are three buttons: "Add", "Reset", and "Back".

A screenshot of a small dialog box titled "FYP". It displays the text "1271 now has 680points." and has an "OK" button at the bottom.

A screenshot of a dialog box titled "Discounts". It has two text input fields: "Price :" with the value "200" and "Discount :" with the value "20". Below the fields are three buttons: "Calculate", "Clear", and "Back".

A screenshot of a dialog box titled "Total". It features an information icon (i) and the text "The amount is RM160". There is an "OK" button at the bottom.

CustomerID	CustomerName	Accumul:	DateofUpda	Click to Add
1271	Maisarah Samsudin	180	8/7/2011	
1417	Amirul Zaid	350	4/5/2010	
1785	Nur Mariam	400	27/6/2010	
1904	Siti Saleha	230	2/3/2011	
2139	Kamarul Ariffin	200	13/7/2011	
4629	Tina Zainuddin	580	19/3/2009	

When the data in Visual Basic is updated, the database will also be updated.

If the user chooses the button “Fingerprint Matching” from the first page of the application, they will see this if the fingerprint is matched:



The system is still in development phase, which needs the Matlab's coding to match both fingerprint. The merging technique and the algorithm is important for the fingerprint matching.

CHAPTER V

CONCLUSION AND RECOMMENDATION

This project emphasizes on the usage of fingerprint technology to replace the current way of membership in a shopping complex or organization. The design and development of the system is performed through a prototyping before it is implemented as the final system. The main contribution of this project is the proposal of the fingerprint identification technology, the components required for the automation of fingerprint searching and matching process of both finger patterns. [4] The details of what will be done on the next phase are included. Further research and also enhancement on the system is stated in this report. Some recommendation for this project is to make it run smoothly without the user have to click on the button. The user will only need to click a button and it will run all the function automatically.

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FYP 2 DISSERTATION

APPENDIX I
GANTT CHART FOR FYP 1

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16	Week 17
Proposal	Progress	Progress															
Approved Proposal			Progress														
Extended Proposal				Progress	Progress	Progress	Progress										
Proposal Defense & Progress Evaluation								Progress	Progress	Progress	Progress	Progress	Progress	Progress			
Interim Report											Progress	Progress	Progress	Progress			
Study Week																	
Final Exam (Jan 11)															Progress	Progress	Progress
Semester Break																	Progress

GANTT CHART FOR FYP 2

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14
Start of May '11 Semester	Progress													
Project Work Continue	Progress	Progress	Progress											
Start developing the system (Planning)				Progress	Progress	Progress	Progress							
Progress Report 1				Progress										
Project Work Continue					Progress	Progress	Progress	Progress	Progress	Progress	Progress	Progress	Progress	Progress
Continue developing the system (Analysis & Design)								Progress	Progress	Progress	Progress	Progress	Progress	Progress
Progress Report 2								Progress	Progress	Progress	Progress	Progress	Progress	Progress
Seminar														
Project Work Continue														
Continue developing the system (Design & Implementation)														
Testing the system and get feedback														
Continue developing the system (Solved issue, Design & Implementation)														
Submission of Dissertation (soft bound)														
Oral Presentation														
Submission of Dissertation (hard bound)														

Dateline
Progress

