**CERTIFICATION OF APPROVAL**

Fingerprint Recognition for Pawnshop Management System

by

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A project dissertation submitted to the

Information Communication Technology Programme

Universiti Teknologi PETRONAS

in partial fulfillment of the requirement for the

BACHELOR OF TECHNOLOGY (Hons)

(INFORMATION COMMUNICATION TECHNOLOGY)

Approved by,

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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.

ศิวนาถ รักดี

SIVANART RAKDEE

## ABSTRACT

Nowadays, Biometric technology has become a mature technology due to its security, reliability etc. And one example of Biometric technology is Fingerprint recognition for identity the right person when they want to pledge the assets at Pawnshop. This applies fingerprint verification concept which provides easy usage and security to uses or customers and low cost of hardware.

This project is aimed the system will be designed for pawnbrokers, thus the system will reduce the process and time for checking the profile and fingerprint of customer. Additionally, the system can prevent the crime because there are a lot of population in Thailand have same name and surname, so it will be easy for officer or pawnbrokers to substantiate that is the right person or not.

The throwaway prototyping is the chosen method in developing this system to ensure that the final system will go well with the end users. The result from the studies is converted to the draft design, storyboards of the system and finally implemented as the result shows later in the report.

In conclusion the system is not only decrease the process of work for the officers but also help for the offices in analyzing and correct identify people.

## ACKNOWLEDGEMENT

I would like to express my gratitude to Universiti Teknologi PETRONAS for giving me this precious opportunity in learning new things through accomplishing the final year project.

I'm deeply indebted to the Government Pawnshop Songkhla, Songkhla Province, Thailand and all the officers there for all their helps, interests and valuable information and suggestions.

Last but not least, I would like to send many thanks to my supervisor, Mr. Jale Bin Ahmad for giving me advises, suggestions and always being helpful to his students.

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# CHAPTER 1

# INTRODUCTION

## 1.1 BACKGROUND OF THE STUDY

Biometrics identify people by measuring some aspect of individual anatomy, physiology or personal trait of an individual that can be used to identify, or verify the claimed identity of, that individual. Measurable means that the characteristic or trait can be easily presented to a sensor and converted into a quantifiable, digital format.

Identification differs significantly from verification. Identification is when the device asks and endeavors to answer the question, "Who is that person?" When biometrics is used to identify an individual, the biometric device reads a sample and contrast that sample against every template in the database. The device will either find a match and subsequently identify the person or not find a match and fail to identify the person.

All biometric systems consist of three basic elements: templates, matching, and enrollment. Enrollment is the process of collecting biometric samples from a person and the subsequent generation of a pattern. Typically, the device takes three samples of the same biometric and then averages them to produce an enrollment pattern. The patterns are the data representing the enrollee's biometrics. They are created by the biometric device, which uses a proprietary algorithm to extract features appropriate to that technology from the enrollee's samples. These features are also referred to as minutiae points for some technologies, such as fingerprint systems. Because templates are only a record of distinguishing features of a person's biometric characteristic or trait, the template is usually small and allows for the near-instantaneous processing time characteristic of biometric authentication. Matching is the process of comparing a submitted biometric sample against one (verification) or many (identification) templates in the system's database.

An essential issue in designing a practical system is to determine how an individual is identified. Depending on the context, a biometric system can be either a verification system or an identification system. A variety of biometric systems are being used for real-time identification; the most popular are based on face, fingerprint and iris matching.

The author's project will be fingerprint recognition for Pawnshop management system. The aim of this project is to facilitate the officer's work in pawnshop, increase accuracy in pawn and to develop the fingerprint recognition for Pawnshop management system. Since the system will be designed for pawnbrokers, thus the system will reduce the process and time for checking the profile and fingerprint of customer.

## 1.2 PROBLEM STATEMENT

One common, the pawnshops in Thailand still use the manual way in order to process the customer's information. So that the error can occur because of miss verifying the fingerprint and lead to chance of the crime. Furthermore, the officers need to take time for compare the fingerprint of each customer.

## 1.3 OBJECTIVES

The objectives of this project are show as follow;

1. To reduce the process and time for checking the profile and fingerprint of customer.
2. To develop the fingerprint recognition for Pawnshop management system.
3. To increase accuracy in pawn.

## 1.4 SCOPE OF STUDY

The aim of this project is to facilitate the officer's work in pawnshop, increase accuracy in pawn and to develop the fingerprint recognition for Pawnshop management system. Since the system will be designed for pawnbrokers, thus the system will reduce the process and time for checking the profile and fingerprint of customer. Additionally, the system can prevent the crime because there are a lot of population in Thailand have same name and surname, so it will be easy for officer or pawnbrokers to substantiate that is the right person or not.

## 1.5 FEASIBILITY STUDY

### 1.5.1 Technical Feasibility

The project is moderate technical feasible from the point of the developer view, by taking in to account the familiarity with application and technology, project size and compatibility with the existing way of recognition and matching system.

For familiarity with application and technology, both the developer and the users are familiar with the fingerprint reader and also function of the system thus the combination of these both should not generate a problem for the users in understanding and using the system.

And discussing about the project size, it is consider not small from the beginning requirement given and the estimation of the developer.

Lastly, the compatibility with the pawn shop, both the developer and the pawn shop officer agreed that the system will be compatible with the existing activities based matching fingerprint concept of the pawn shop.

### 1.5.2 Economic Feasibility

This system is first aimed to be facilitating the officer's work in pawnshop. During the development process, there is some cost occurred for fingerprint reader. Just to mention about the maintenance where by the system is a application that store a lot of database thus the only cost will be the service for maintenance the system. As a result, the project is economic feasible.

### 1.5.3 Organizational Feasibility

As in every pawn shop, the use of the fingerprint in pledging, deposits and redemption process exist and the officer are always face with many problems and eager to learn new thing especially about technology. From the perspective of the pawn shop officer the system is organizational feasible.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 WHAT IS BIOMETRICS?

Biometrics is the science and technology of measuring and analyzing biological data. In information technology, biometrics refers to technologies that measure and analyze human body characteristics, such as fingerprints, DNA, eye retinas and irises, voice patterns, facial patterns and hand measurements, for verification mode or identification mode [1].

**Verification mode:** the system involves comparing the acquired biometric information with only those templates corresponding to the claimed identity [3]. The match of verification must be adequately high when the test input is matched to determine whether the claim is true or not [2].

**Identification mode:** the system involves comparing the acquired biometric information against templates corresponding to all users in the database [3]. A prospective the huge database is searched and the top match score of individual corresponding are returned [2].

A biometric-based authentication system operates in two distinct stages: the enrollment stage and the authentication stage. During the enrollment state, a user's biometric data (e.g. fingerprints) is acquired and processed to extract a feature set (e.g. minutiae points) that is stored in the database. The stored feature set, labeled with the user's identity, is referred to as a template. In order to account for variations in the biometric data of a user, multiple templates corresponding to each user may be stored. While authentication, a user's biometric data is once again acquired and processed, and the extracted feature set is matched against the template(s) stored in the database in order to identify a previously enrolled individual or to validate a claimed identity. The matching accuracy of a biometrics-based authentication system

relies on the stability of the biometric d ata associated with an individual over time [3].

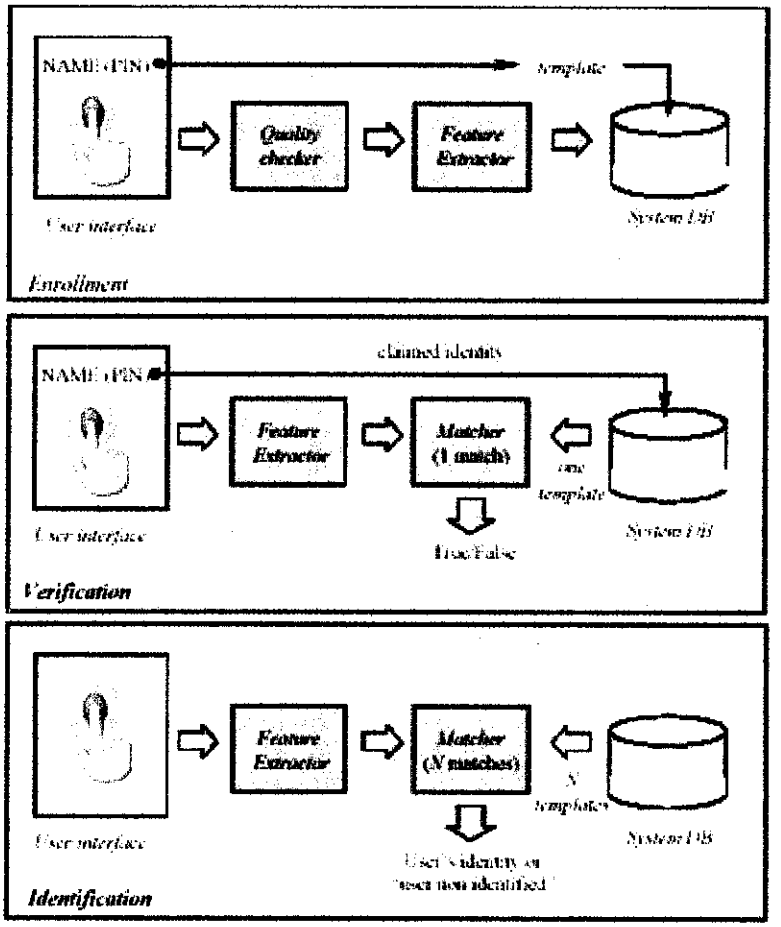


Figure 2.1: Block diagrams of enrollment, verification and identification tasks are shown using the four main modules of a biometric system, i.e., sensor, feature extraction, matcher, and system database.

## 2.2 CATEGORIES OF BIOMETRICS

Biometrics can be sorted into two classes: Physical and Behavioral which *Behavioral biometrics* – signature verification and voice recognition –is generally used for verification and *Physical biometrics* - face recognition, fingerprint, iris recognition and hand geometry etc. – are used for either identification or verification. The examples of commonly used biometrics are given below:

### 2.2.1 Fingerprint

It is one of the most famous biometrics due to their uniqueness. Fingerprint identification is popular because of the inherent ease in acquisition; the numerous sources are available for collection and their established use and collections by laws enforcement and immigration. This technology uses the pattern of friction ridges and valley on individual's fingertips. Which patterns are regard as unique to a specific personal, even the twins fingerprint will also not be same.

### 2.2.2 Face Recognition

This technology will analyze the characteristic of an individual's face image through a digital video camera which measure features from the central portion of a facial image, distance between eyes, nose, mouth and jaw edges. The advantages of face recognition are that it is hands-free, non-intrusive, provide for continuous verification and is also approbated by the most users [5].

### 2.2.3 Signature Verification

It examines the way how people sign their signatures by asking users signs on a tablet or paper that laying over a sensor tablet. The device records the signature and compares it to the database. The signature will be measured by its features like speed, pressure and angle used when they sign. This technology is focus on e-business application [5].

### 2.2.4 Hand Geometry

Hand Geometry recognition is one of the oldest method biometric implementation. One of disadvantages of the hand geometry is that it is not highly unique, limiting the application of the hand geometry to verify task only. This technology works with a simple concept of measuring and recording length, width, thickness and surface area of personal's hand while guides on a plate. Hand Geometry uses a camera to capture a silhouette image of the hand [4].

### 2.2.5 Voice Recognition

For voice recognition or speaker recognition, it is quite problem if we have to identify from the short speech. According to Ross Andreson, this technology uses the acoustic features of speech that have been found to vary between individuals. These acoustic patterns reflect both anatomies (e.g. size and shape of the throat and mouth) and learned behavioral pattern (e.g. voice pith, speaking style). The drawback of this technology is that there are factors which effects to speech features such as background noise. Furthermore, the difficulty in using voice as an input to a computer simulation lies in the fundamental differences between human speech and the more usual forms of computer input [6].

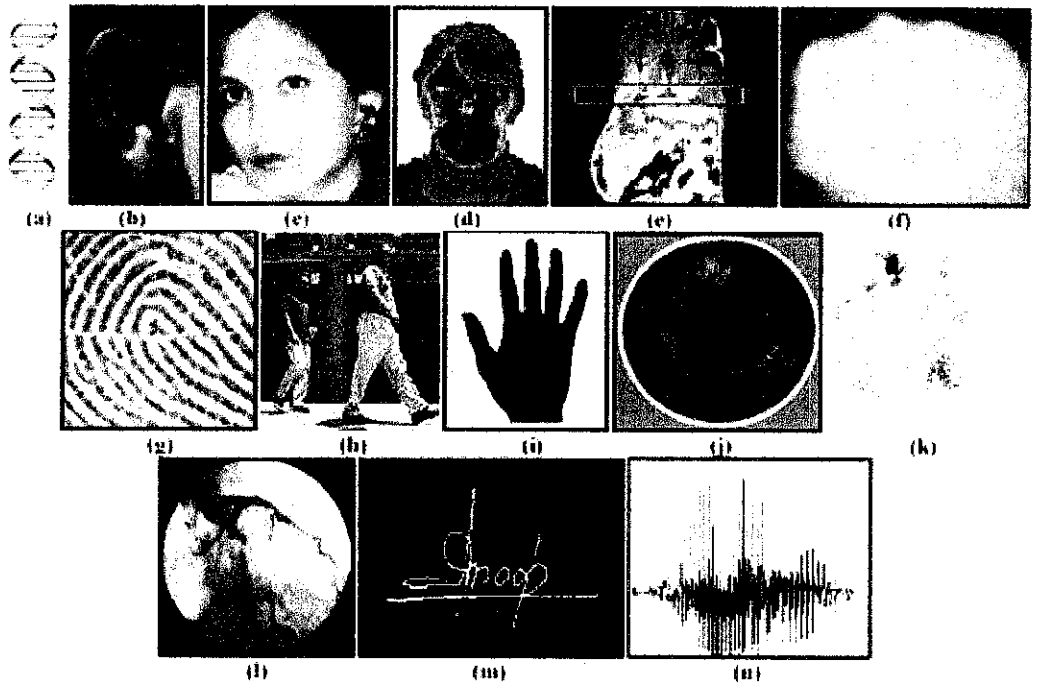

Figure 2.2: Examples of biometric characteristics: a) DNA, b) ear, c) face, d) facial thermogram, e) hand thermogram, f) hand vein, g) fingerprint, h) gait, i) hand geometry, j) iris, k) palmprint, l) retina, m) signature, and n) voice.

## 2.3 HOW TO PAY BY FINGER SYSTEM WORKS

Biometric payment technology allows the customer to pay with the touch of a finger on a fingerprint scanner linked to a payment file. The template of fingerprint is connected with a router and transmission media to clear the transaction [5]. While many biometric payment transaction providers focus on grocery, home improvement and convenience stores, others have indicated interest in quick-serve eateries, car wash locations and select vending operations.

Biometric payment providers (e.g., Pay-by-Touch and BioPay) require completion of a pre-enrollment process in which index fingers are scanned and driver's license and banking information is recorded in an account database. This process reportedly takes less than two minutes. In addition to transaction settlement, biometric payment providers may also link captured transactions to loyalty reward programs, gift cards, discount coupons and Web access services [10].

### 2.3.1 Fingerprint template

The first step in fingerprint identification is collecting the fingerprint using a special sensor device. We can call this step as enrollment step which the fingerprint is acquired for authentication. The captured image or fingerprint template will be stored directly as an image or will be stored as a biometric algorithm [5].

In biometric algorithm, several points of data on the fingerprint pattern are scientifically measured and stored, thereby leading to discarding of the actual fingerprint. Algorithm software measures 40 or more data points for each fingerprint and may store these measurements as data coordinates or encrypt them into a digital certificate for future authentication [5].

When we establish identify by using the mathematical representation of the fingerprint, a higher level of reliability will be realized. However, the consumer may be required by some biometric payment systems to swipe or touch a smart card beside authenticates a transaction. This method will make system more security instead of completely relying on fingerprint matching.

## 2.4 HOW TO RECOGNIZE FINGERPRINT

Identification the use of one's fingerprints has existed long before its usage today in the area of criminal investigation. Many centuries ago, fingerprints were mainly used only as a signature for signifying authorship or ownership. Other applications were not recognized until about 1860 when William Hershel was frequently imprinting the handprints of those engaged in his contracts. It was not until 1881 when Henry Faulds recognized that fingerprints found at crime scenes may be used to identify the perpetrator [7]. The FBI has collected about 30 million sets of fingerprints that make the matching of a single fingerprint with such a collection very difficult since 1924. With the advanced computer technology recently, automated fingerprint identification systems (AFIS) can effectively perform what would be a difficult and time consuming task [5].

### 2.4.1 Fingerprint uniqueness

What actually makes a fingerprint unique depends on one main factor. Fingerprints basically consist of ridges (raised skin) and furrows (lowered skin) that twist to form a distinct pattern. When an inked imprint of a finger is made, the impression created is of the ridges while the furrows are the unlinked areas between the ridges. Although the manner in which the ridges flow is distinctive, other characteristics of the fingerprint called 'minutiae' are what is most unique to the individual (See Figure 2.3 for several minutiae representations) [5].

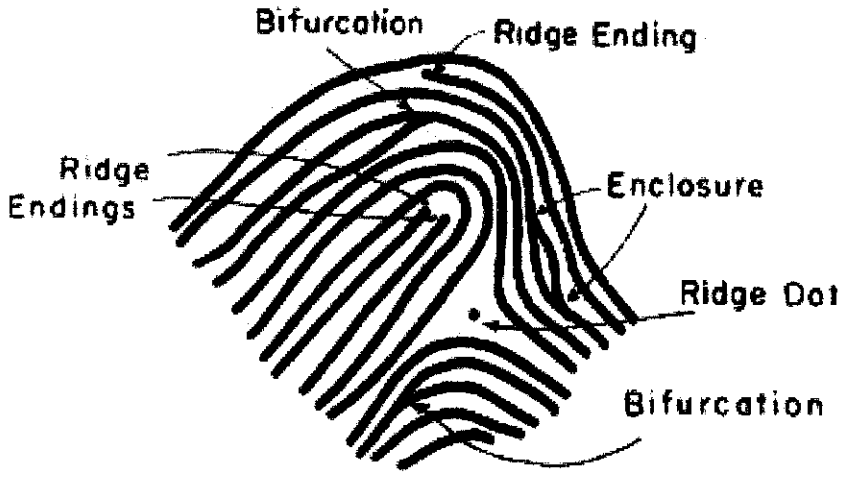


Figure 2.3: Minutiae examples

The major Minutia features of fingerprint ridges are: ridge ending, bifurcation, and short ridge (or ridge dot). The ridge ending is the point at which a ridge terminates. Bifurcations are points at which a single ridge splits into two ridges. Short ridges (or ridge dots) are ridges which are significantly shorter than the average ridge length on the fingerprint. Minutiae and patterns are very important in the analysis of fingerprints since no two fingers have been shown to be identical.

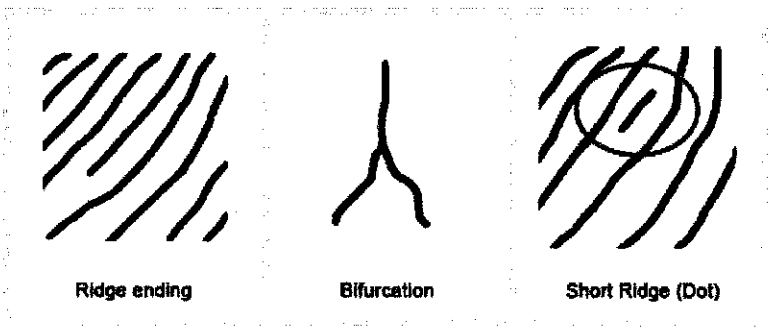


Figure 2.4: The major Minutia features of fingerprint ridges

Furthermore, all fingerprints can be classified into three types based on their major central typical. These typical are the arch, loop, and whorl, which are shown in Figure 2.5.

Arch Loop Whorl

Figure 2.5: Three major of fingerprint classifiers

An image, such as that of a fingerprint, may be considered as a two-dimensional continuous signal. By this, it can have an infinite number of brightness intensities in an infinitesimal area. In order for an image to be handled by a computer, it must first be digitized. For this study, the image had to be sampled in a different

manner. Instead of sampling in the general Cartesian space, the image is sampled through a pattern consisting of concentric circles. It may be considered that this technique is sampling in a polar coordinate space. Under this approach, the sampling resolutions are the distance between the concentric circles and the sampling interval within the circumference of the circles.

## 2.5 FIHGERPRINT IDENTIFICATION

Among all the biometric techniques, fingerprint-based identification is the oldest method which has been successfully used in numerous applications. Everyone is known to have unique, immutable fingerprints. A fingerprint is made of a series of ridges and furrows on the surface of the finger. The uniqueness of a fingerprint can be determined by the pattern of ridges and furrows as well as the minutiae points. Minutiae points are local ridge characteristics that occur at either a ridge bifurcation or a ridge ending.

### 2.5.1 Fingerprint Matching

Fingerprint matching techniques can be placed into two categories: minutiae-based and correlation based. Minutiae-based techniques first find minutiae points and then map their relative placement on the finger. On the other hand, there are some difficulties when using this approach. When the fingerprint is of low quality, it is difficult to extract the minutiae points accurately. Also this method does not take into account the global pattern of ridges and furrows. The correlation-based method is able to overcome some of the difficulties of the minutiae-based approach. However, it has some of its own shortcomings. Correlation-based techniques require the accurate location of a registration point and are affected by image translation and rotation as shown in Figure 2.6 [9].

The fingerprint matching is based on the Euclidean distance between the two corresponding FingerCodes and hence is extremely fast. We are able to achieve a verification accuracy which is only marginally inferior to the best results of minutiae-based algorithms published in the open literature. Our system performs better than a state-of-the-art minutiae-based system when the performance requirement of the application system does not demand a very low false acceptance

rate. Finally, we show that the matching performance can be improved by combining the decisions of the matchers based on complementary (minutiae-based and filter-based) fingerprint information [15].

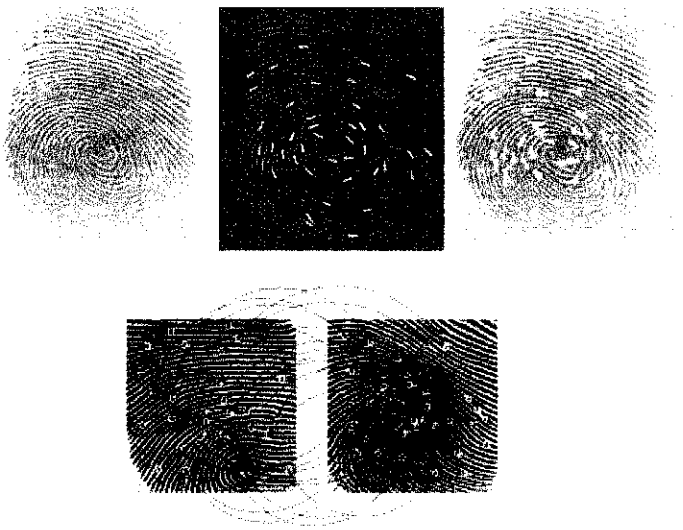

Figure 2.6: Fingerprint matching

### 2.5.2 Fingerprint Classification

Fingerprint classification is a technique to assign a fingerprint into one of the several pre-specified types already established in the literature which can provide an indexing mechanism. Fingerprint classification can be viewed as a coarse level matching of the fingerprints. An input fingerprint is first matched at a coarse level to one of the pre-specified types and then, at a finer level, it is compared to the subset of the database containing that type of fingerprints only. Fingerprints are classified into five classes, namely, whorl, right loop, left loop, arch, and tented arch as shown in Figure 2.7 [5]. The indexing approach is based on novel features derived from triplets of minutiae [12].

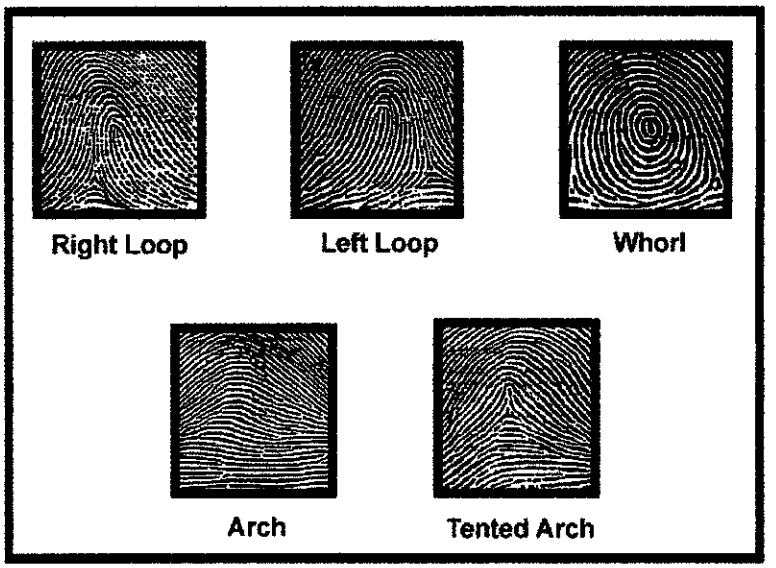


Figure 2.7: Five classes of fingerprints

### 2.5.3 Fingerprint Image Enhancement

A critical step in usual fingerprint matching is to automatically and reliably extract minutiae from the input fingerprint images. However, the performance of a minutiae extraction algorithm relies heavily on the quality of the input fingerprint images. In order to ensure that the performance of an automatic fingerprint identification/verification system will be vigorous with respect to the quality of the fingerprint images, it is essential to incorporate a fingerprint enhancement algorithm in the minutiae extraction module [11].

A. B.

Figure 2.8: Fingerprint obtained after preprocessing: (A.) Original image, (B.) Enhanced image

## 2.6 EXAMPLE OF RELATED WORK

### 2.6.1 Developed a method for enhancing the ridge pattern

Robert Hastings developed a method for enhancing the ridge pattern by using a process of oriented diffusion by adaptation of anisotropic diffusion to smooth the image in the direction parallel to the ridge flow. The image intensity varies smoothly as one traverse along the ridges or valleys by removing most of the small irregularities and breaks but with the identity of the individual ridges and valleys preserved [13].

### 2.6.2 Proposed a method for fingerprint verification

Jinwei Gu, et al., proposed a method for fingerprint verification which includes both minutiae and model based orientation field is used. It gives robust discriminatory information other than minutiae points. Fingerprint matching is done by combining the decisions of the matchers based on the orientation field and minutiae [14].

### 2.6.3 Problems associated with Existing System

Above method work very efficiently when we have palm prints of all fingers of both hands. We assign weights to the person prints and calculate PGR. On the basis on PGR factor the search goes to particular domain and identified the proper match. But if we have only one finger print as input print, then there will be problem as in this case we can't find PGR factor. Further the problem can also arise if the criminal is made some trick while giving its input prints to the system. He can change the order of his fingerprint while giving input print, if this happen then his print can't be matched anywhere in the system [16].

### 2.6.4 Explanation of the Henry Classification System

The Henry Classification System allows for logical categorization of ten-print fingerprint records into primary groupings based on fingerprint pattern types. This system reduces the effort necessary to search large numbers of fingerprint records by classifying fingerprint records according to gross physiological characteristics [16].

# CHAPTER 3

# METHODOLOGY

## 3.1 SYSTEM DEVELOPMENTMETHODOLOGY

### 3.1.1 Methodology Selected

After considered above factors, the Throwaway Prototyping Methodology is selected for the development of this system.

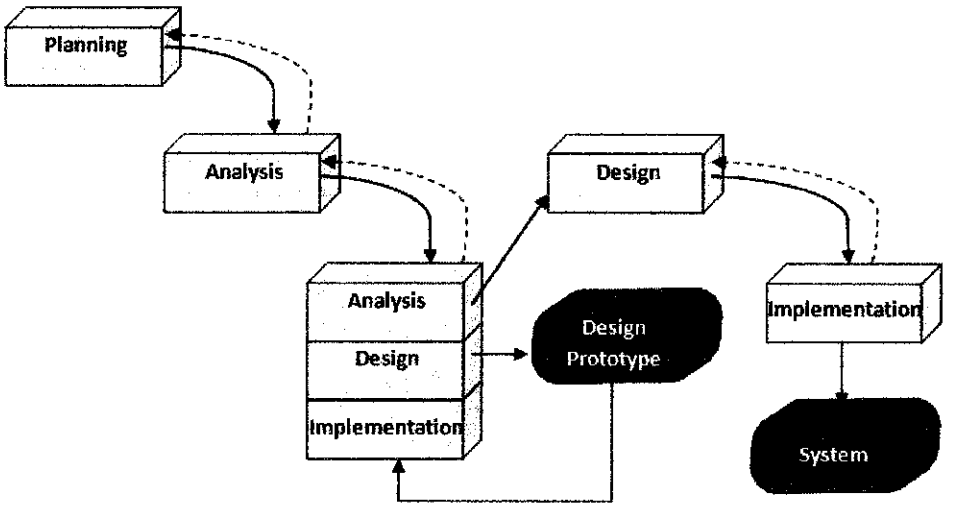


Figure 3.1: Throwaway Prototyping Methodology

#### 3.1.1.1. Planning

The developer has engaged with a person who requested the system to conduct a feasibility study and also a simple system pre-test. Then the developer also prepares related literature and research for supporting project. Furthermore the project plan for the first three phases i.e. planning, analysis and design are also created.

#### 3.1.1.2. Analysis

The first task of this phase is for the developer to analyze the requirements of the users which are the pawnshop's officer or pawnbrokers and the customer thus there will be an information gathering by both doing research from published papers/journals and also interview and observation sessions. After understand the as-is system available of the problem then the developer will identify the improvement and develop a to-be system requirement by consulting the pawnshop's officer.

#### 3.1.1.3. Design

Based on the information gathered and the to-be requirement from the analysis phase, the developer then will starts the design phase. This phase of the development need high concerning from the pawnshop's officer. The deliverables of this phase will be the designed prototype to be use in the implementation phase.

**(a) System Architecture**

The design of the system architecture for Fingerprint Recognition for Pawnshop management system is shown in figure 3.2. From the figure, there is user interface which consist of fingerprint processing for user to enrol and fingerprint capture for capturing user's fingerprint. And there is log in process and payment transaction management which will connect to the central database (Government database) and can identify the customer who has the court case, if that person is in this case the office will not allow him/her to any activities in pawnshop.

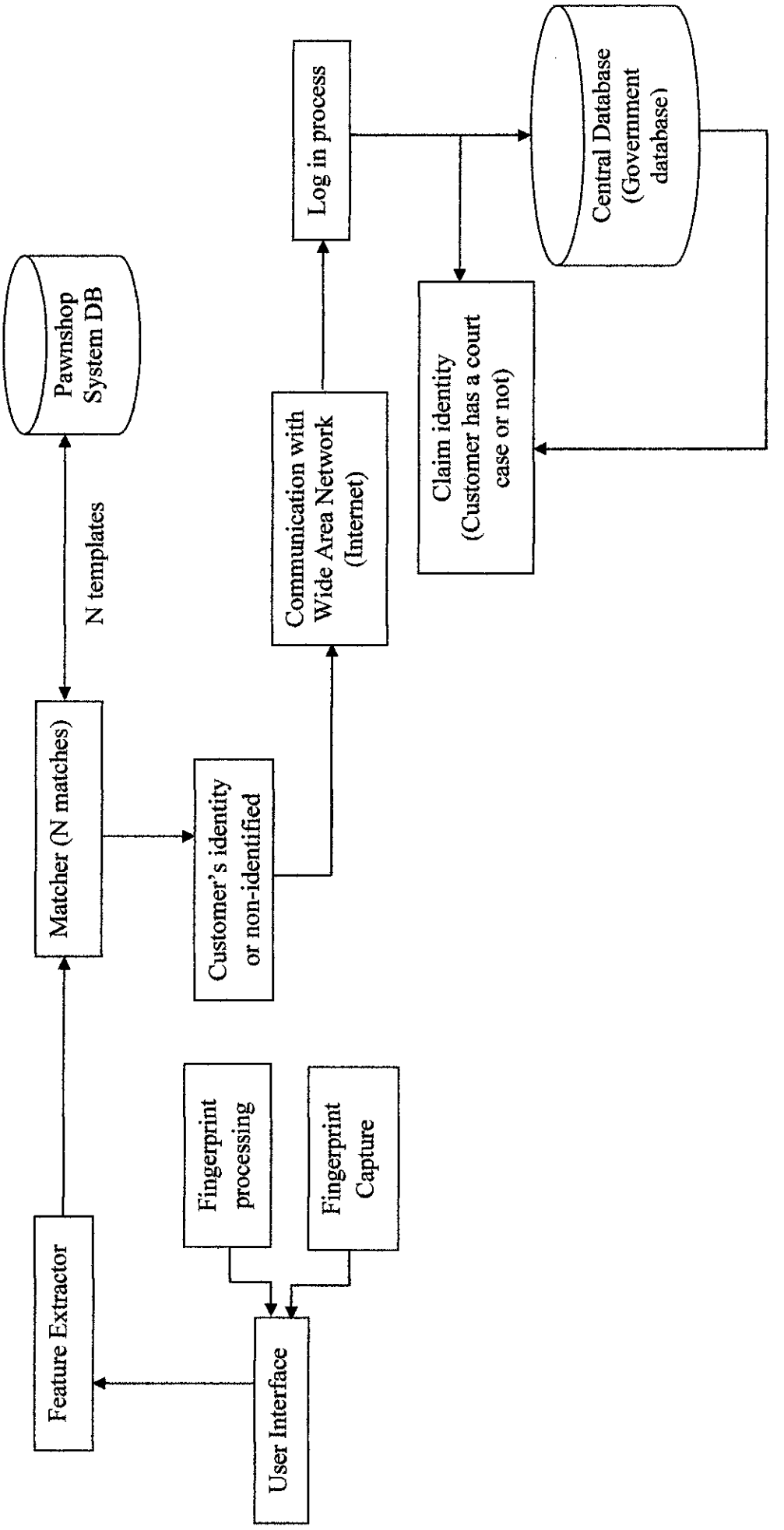


Figure 3.2: Fingerprint Recognition for e-Pawnshop management system's System Architecture

**(b) Use Case Diagram**

User will interact with the system by requesting enrol and requesting verify himself/herself and then the system will store new data into database and will match existing data with requested and return result. After he/she was verify, he/she can make transaction with other activities in pawnshop such as pledge, pay interest or redeem assets. And the system will store your fingerprint and information to database. There are four chosen activities for the development of the system shown as follow.

- Enroll for pledge (new customer)
- Enroll for deposits-redemption (verification fingerprint)
- Enroll for pay interest of assets (verification fingerprint)
- Checking the customer's background (verification fingerprint)

The result from the system requirement and literature review were then translated into the system models by using the Unified Modelling Language (UML) as shown in figure 3.3 in the following pages.

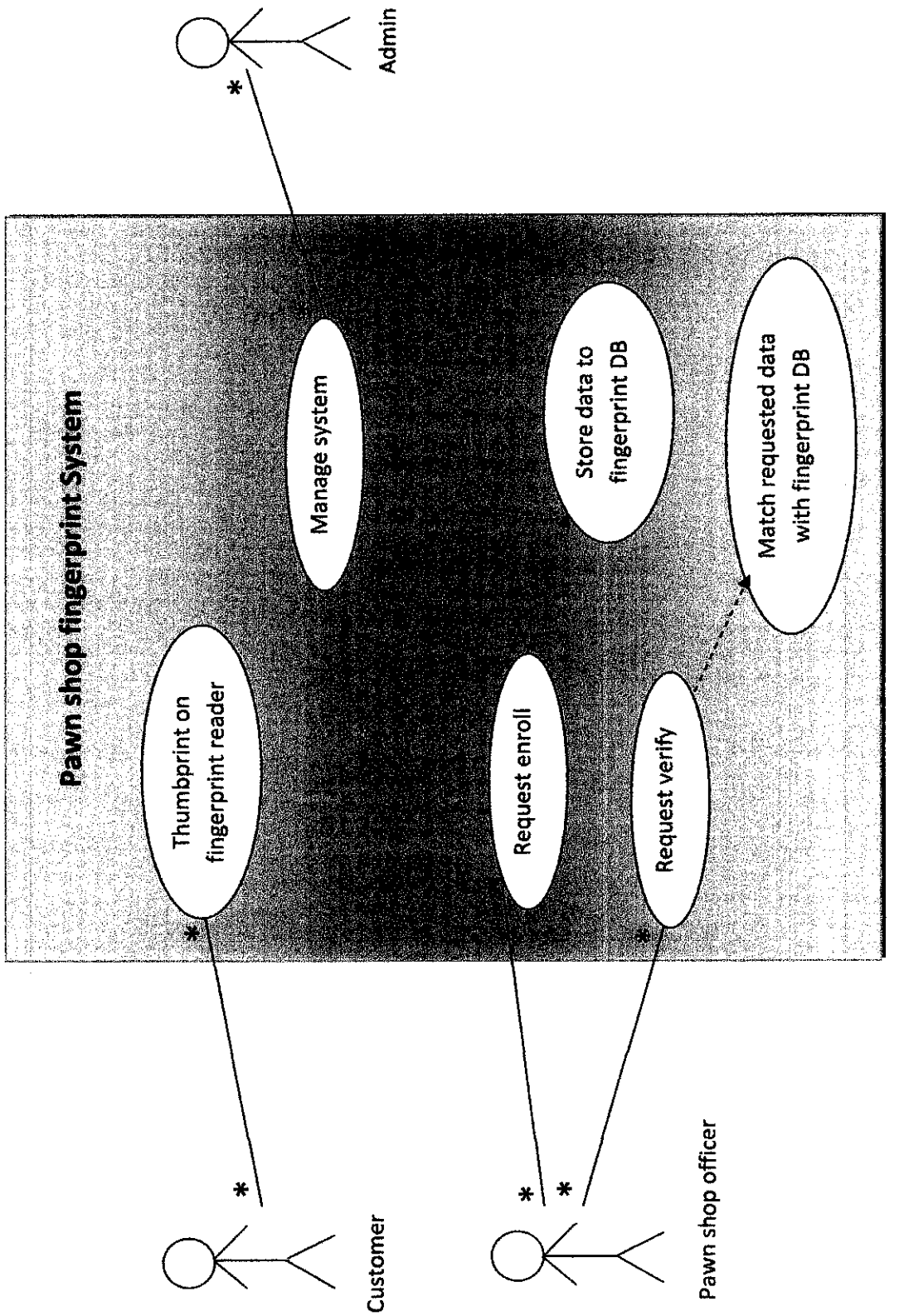


Figure 3.3 Use case Diagram

#### 3.1.1.4. Implementation

A design prototyped will be implemented in this phase and refine again and again based on the clearer requirements. Create database for storing the information such as personal information, individual fingerprint image etc. Create interface for user to interact with system and test the system see how it will give the result. At that moment, the developer should train the user how to use the system and get the feedback of them.

## 3.2 TOOLS REQUIREMENT

Tools requirement as for development of the proposed website are shown below.

### 3.2.1 Hardware

- Computer
- U.R.U 4000 Fingerprint reader with SDK

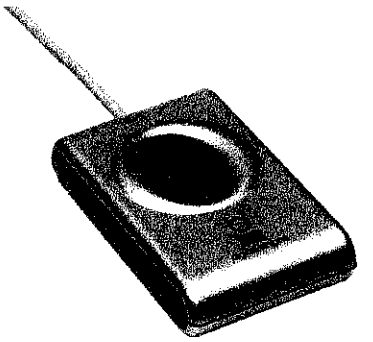

Figure 3.4: Fingerprint reader

### 3.2.2 Software

- Delphi
- Firebird ( Database Server)

# CHAPTER 4

# RESULT AND DISCUSSION

## 4.1 PRELIMINARY STUDY

### 4.1.1 Survey and Observation

For the first semester of the final year project, few preliminary studies have been conducted. The objectives of these studies were to understand the problems existing in the environment and instrument of the Pawnshop in Thailand, the interview session and the observation are conducted at the Pawnshop government, Songkhla Province. This study found that the Pawnshop officers take long time to process their work and they are not feeling want to do their work when there are a lot of customers.

### 4.1.2 Interview

The interview session is aimed to uncover further the problems regarding testing and gaining participation from officers and customers whom always face the problems. It also helps to understand the concept and approach being use by the officers and customers in handling these problems too.

The session is conducted with two pawn shop officer as the interviewees. The first officer is Mrs. Wanida the pawn shop government officer with 32 years experience working in the pawn shop government of Songkhla Province. The second is Mr. Nimid with six years experience working in the pawn shop government of Songkhla Province.

Based on the interview session, the problems of officer who always work with fingerprint will result in work and finish their work slow and get more problems when they want to analyze people. Most of the time, they will start after they see what others do and follow. The officers again face difficulties in expressing their opinion, feeling and experiences when they have a lot of customers in each day.

The method using by Mr. Nimit in fingerprint of each person to pledge, deposits - redemption and pay interest of assets and then find the old database for check that the customers already redeem their asset. He found that, with using the fingerprint recognition by fingerprint reader makes it easier for him in interacting with customers and can finish his work earlier than use manual fingerprint.

In addition to the interview session, the two-day observation is conducted. It aim is to observe the officer and customer's attention span and the type and duration of the work the officers normally use. Mover, customer's attention and response regarding the use of fingerprint reader and technology are to be examined during the processing of pledge.

## 4.2 SURVEY RESULT

To be more attentive before designing this system, the developer have conducted second interview based on the system pre-test survey with the pawn shop officers about their familiarity with fingerprint and fingerprint reader and also their opinion in implementing the fingerprint recognition/matching system to encourage officer to analyze fingerprint of each person. See Appendix B for Fingerprint Recognition for e-Pawn shop management System Pre-Test Survey.

From the survey conducted with the pawn shop officers, the result found that most of the officers are moderately familiar with the use of fingerprint and fingerprint reader. However, from their opinion and information found that they face a lot of problem if they still use the old function to analyze fingerprint. Thus the suggestion from the officers is to make the system and interface of the system for the officer who is quite old as easy and clearly as possible since they have problem about eyesight and some may not use it before.

The author has made questionnaire for interview the officers and customers who facing the problems during their activity. The result shows in following part:

1. Please rate yourself for the familiarity with fingerprint recognition/matching system and fingerprint reader.

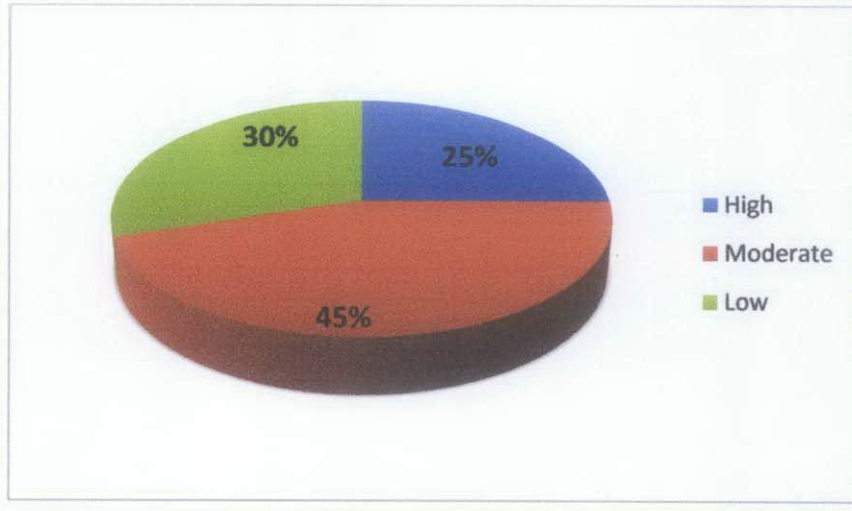


Figure 4.1: The officer familiarity with system and fingerprint reader

2. Have you faced any problems with services in pawn shop? (Pledge, deposits - redemption and pay interest of assets)

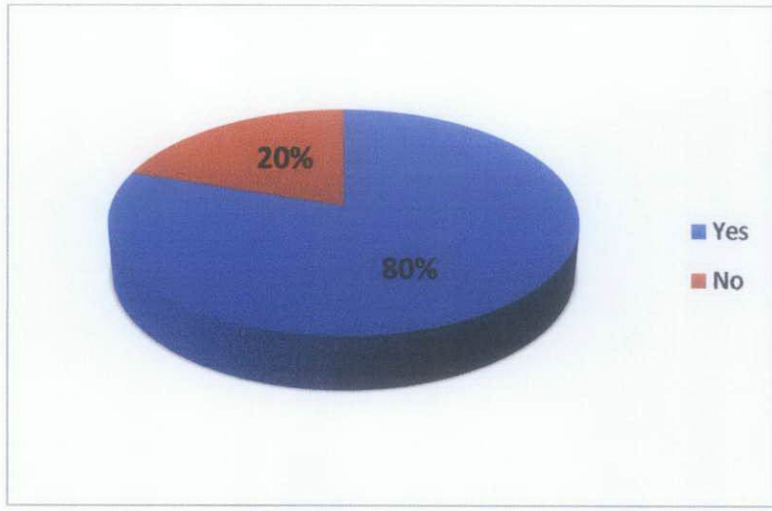


Figure 4.2: Opinions of officers and customers on services in pawn shop

3. Do you think the fingerprint recognition system will reduce the time for analyses the different of each person?

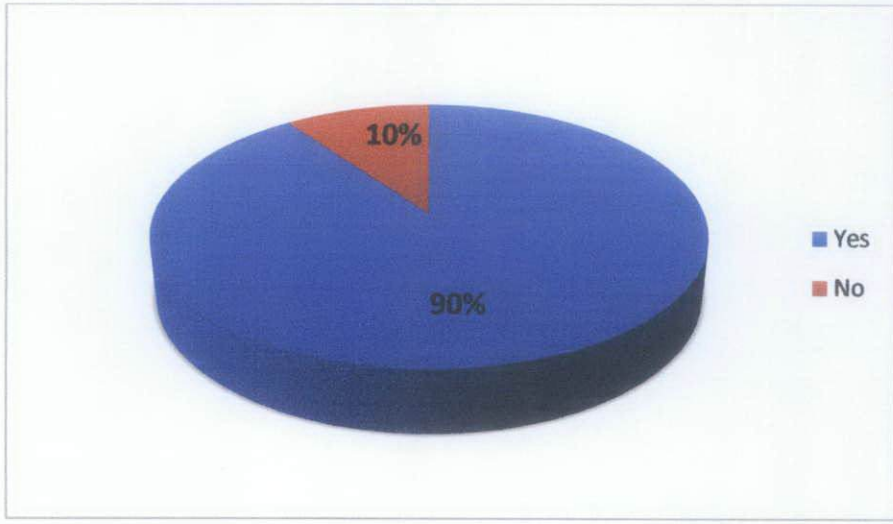


Figure 4.3: Officers' Opinions on working with services in pawn shop

4. Are there a lot of customers who have same name and surname?

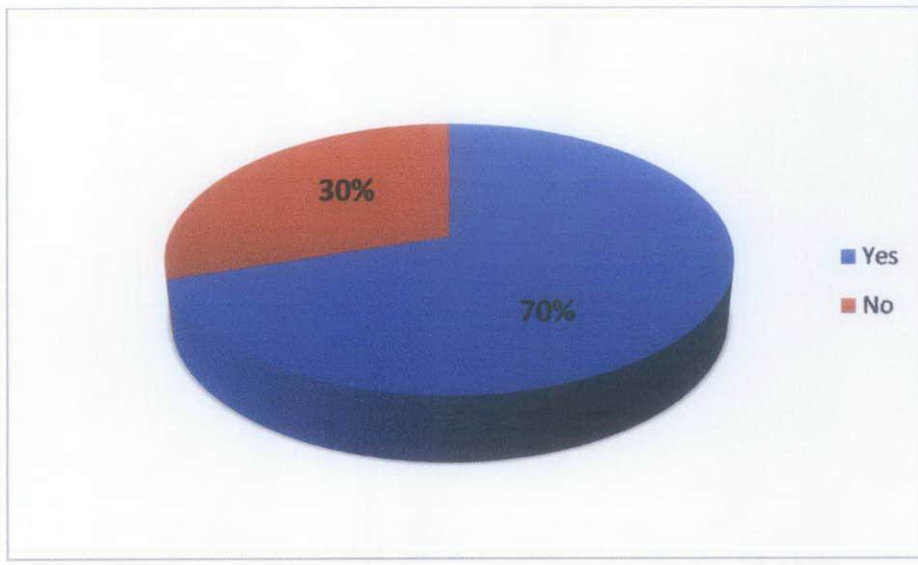


Figure 4.4: Officers' opinion on number of customers who have same name and surname

5. How do you store customer's detail?

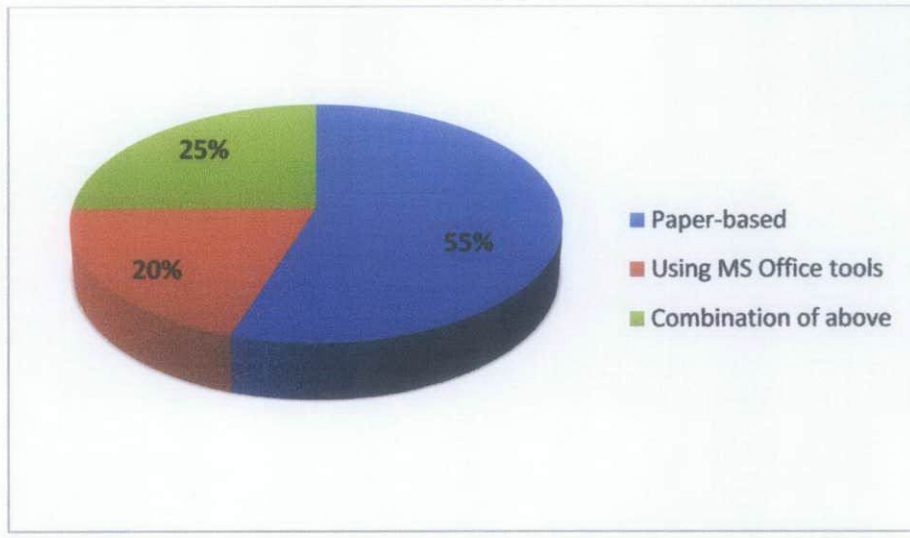


Figure 4.5: Where the officer store database

6. What is your opinion in implementing the fingerprint as fingerprint recognition/matching system in pawn shop?

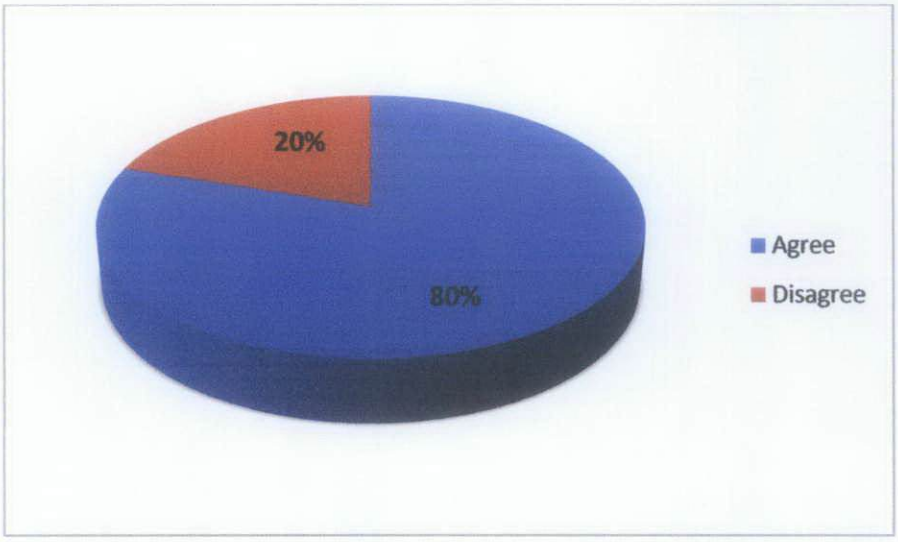


Figure 4.6: Officer's opinion to use the fingerprint as a system in pawn shop

## 4.3 SYSTEM PROTOTYPE TESTING

Before developing full system and all the activities of each session, a prototype of activities is developed to test the ability of the Pawnshop officers and also their response towards this kind of system. The small experiment is conducted with the Pawnshop officers at the Government Pawnshop, Songkhla province shows in Figure 4.7 below.

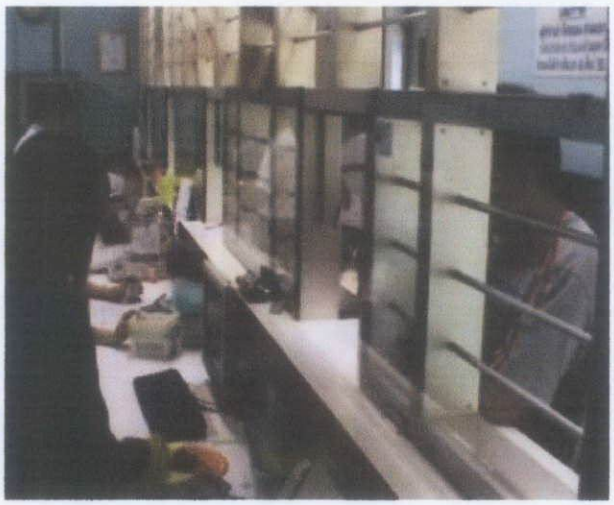

Figure 4.7 Small experiment for a prototype testing

The system is tested with 6 persons whose works regarding front shop and must to verify fingerprint. Three of officers can use the prototype fluency because they have experience and know how to use computer. Others I need to teach and explain them methodical.

## 4.4 SYSTEM INTERFACE

The system interface was designed using Dephi (object-oriented). The following figures show the interface's screen shots of the system developed.

### 4.4.1 Registration Page for Customer

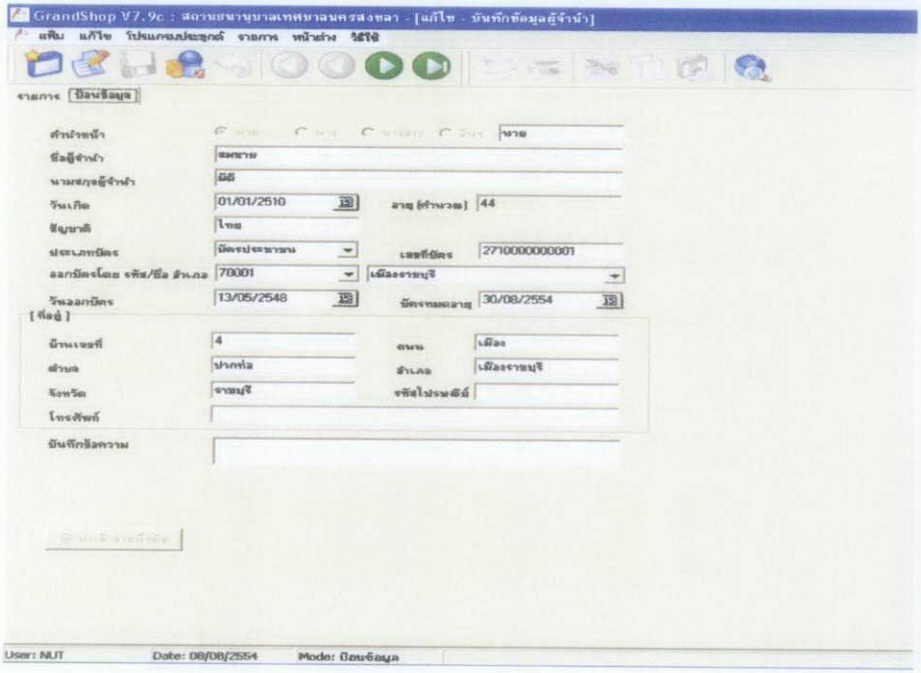


Figure 4.8: Registration page

The officer has to go to this page if the customer never uses the Pawnshop service. The officer must to key in all the information after that can import the customer's fingerprint and save all information.

### 4.4.2 Pledge page

This page allows officer to make the service (pledge) for customer. The officer must to key in IC and enter if IC correct customer's name will show automatic and fingerprint also appears. Then the officer key detail of asset and click print pawn ticket after that the system will show pop up message that have to put thump print before you print pawn ticket. If it is correct person the system will allow the officer to print the ticket.

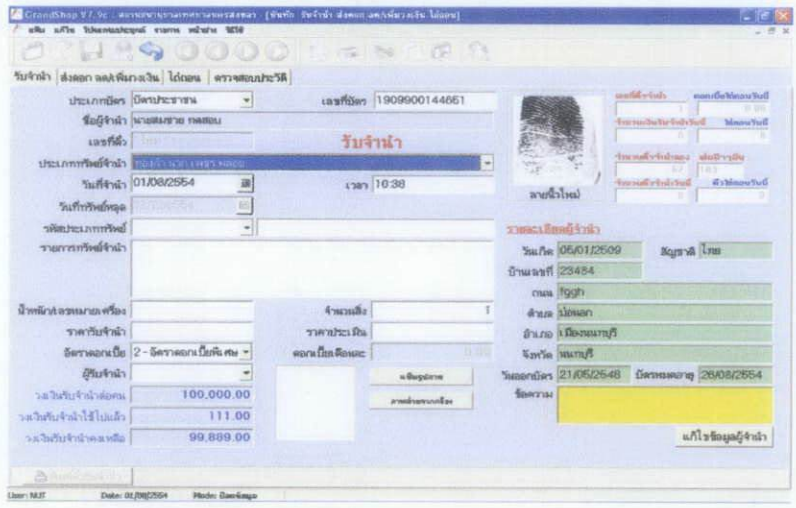


Figure 4.9: Pledge page

### 4.4.3 Pay interest page

For this page, the customers will tap their finger on the sensor device or fingerprint reader. Then, if the fingerprint matching the officer can process the work to deposits or pay interest up to the customer offer.

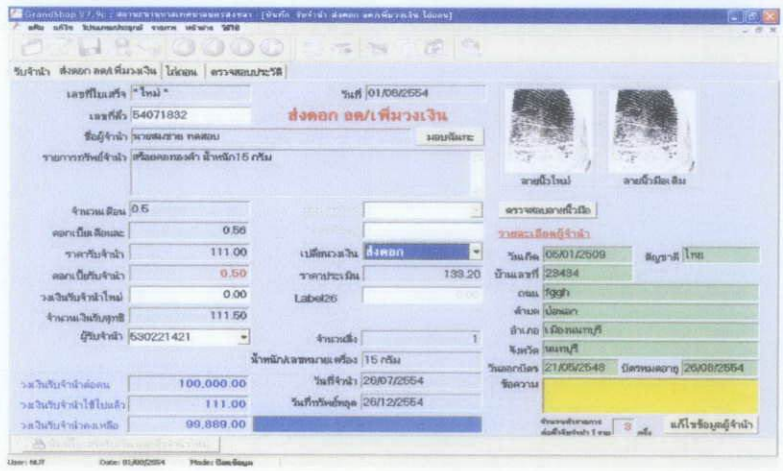


Figure 4.10: Pay interest page

### 4.4.4 Redemption page

For this page, the customers will tap their finger on the sensor device or fingerprint reader. Then, if the fingerprint matches the officer can process the work with their customer.

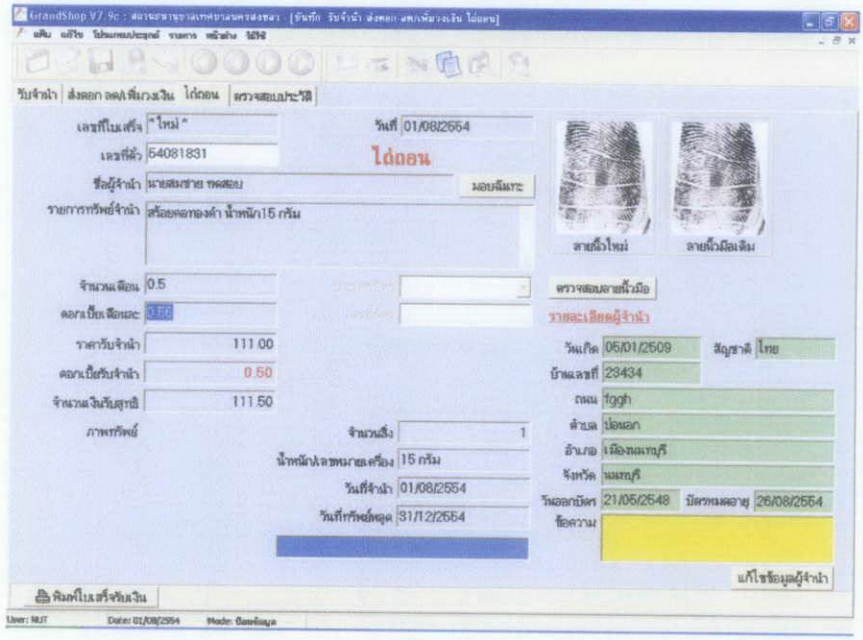


Figure 4.11: Redemption page

### 4.4.5 Checking customer background page

For this page, the officer can check the customer background if he/she do not sure that is the right person or not.

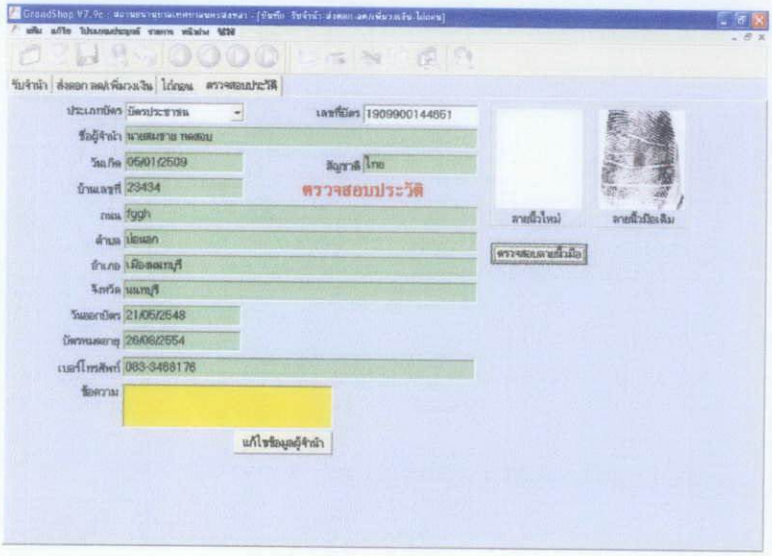


Figure 4.12: Checking customer background page

### 4.4.6 Pawn Ticket and Pawn Receipt

After the system identify fingerprint and it matching, the officer can print pawn ticket and pawn receipt for keep it be reference.


**(a)**


**(b)**

Figure 4.13: Pawn Ticket (a) and Pawn Receipt (b)

## 4.5 DISCUSSION

The system has been tested with the pawnshop officer again after the small experiment when the system was almost completed. The system is tested by 6 officers under the instructions of the manager and the developer.

Figures 4.14 System Testing

After the testing, a developer conducted a feedback collecting session. The session aimed to be a session to collect the feedback from the officers regarding the usage of the system. The results from the session are summarized as shown in the bar chart below.

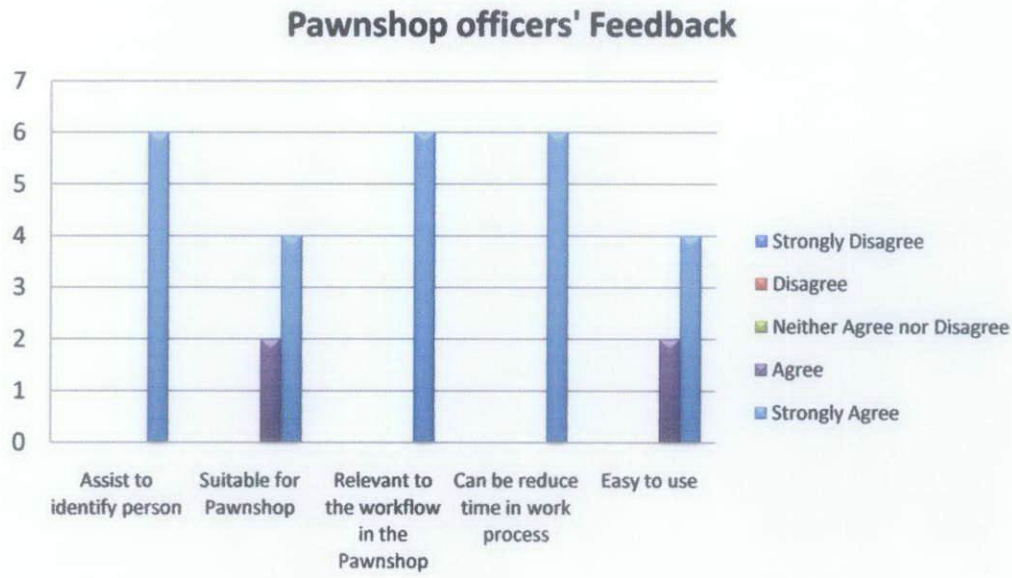


Figure 4.15 Officers' feedback for the system testing

The evaluation of the officers showing the pawnshop management system can assist to identify person, relevant to the workflow, reduce time in work process and easy to use in the pawnshop thus they can really apply it as a pawnshop system. The ease of use is rated highly because the developer designed the system in term of user friendly. Thus the officers believed that the system will make their work easy and happy with works.

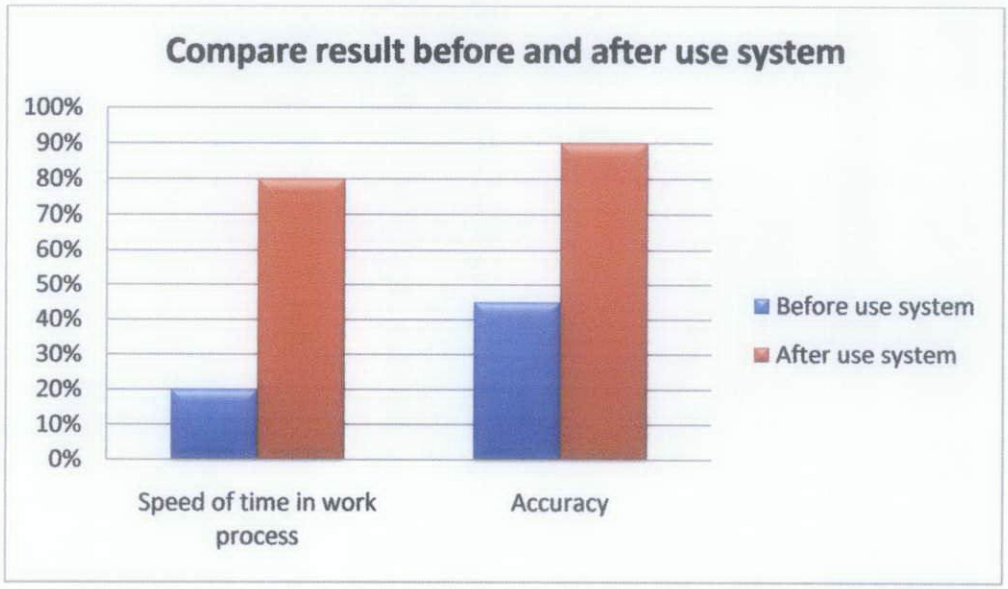


Figure 4.16 Compare result before and after use system

The system can reduce the process and time for checking the profile and fingerprint of customer. Then the system also increases accuracy in pawn. Thus, the system can achieve objective by my observation and asking from officers. Before they use system, speed of time in work process is 20 % its means their work process so slow compare to after they use system that shows the result of speed increase to 80%. Another one is about accuracy; the result shows that the system can increase accuracy in pawn. By before they use system, the accuracy in pawn is 45 % but after they use system the accuracy in pawn increase to 90%.

# CHAPTER 5

# CONCLUSIONS AND RECOMMENDATIONS

## 5.1 CONCLUSIONS

Biometrics technology is widely used nowadays in human identification. The biometric method measure and analyze unique physical and behavioral part of the individual. E.g. face recognition, voice recognition, signature verification etc. in order to identify the individuals.

After a semester of researching on a 'Fingerprint Recognition for Pawnshop Management System' is a system that will assist the process of verify and matching fingerprint for the pawn shop's officers. The system will provide easy usage, reliability, feasibility and ease of authorization to everyone by tapping their finger on the fingerprint reader/sensor device. In addition, the system will facilitate the officer's work in pawnshop, increase accuracy in pawn and to develop the fingerprint recognition for Pawnshop management system. Using biometric technology to make all services is more secure than use manual way to verify fingerprint.

The preliminary study and experiment are conducted with the prototype of the system in Government Pawnshop Songkhla to gain better understanding regarding the problems exist and the Pawnshop approach using in Thai Government Pawnshop.

The prototype system is also tested with 6 officers in Government Pawnshop Songkhla under the instruction of the developer and manager. The result of the testing showed the excitement of the officer towards the system which is a good sign for the implementation in the real identify person of the Government Pawnshop later on.

## 5.2 RECCOMMENDATIONS

For future improvement of the system, the recommendation made by the officers is to add the function which is the customers can check their status by themselves. For example when they forget date for pay interest or they already redeem the asset or not.

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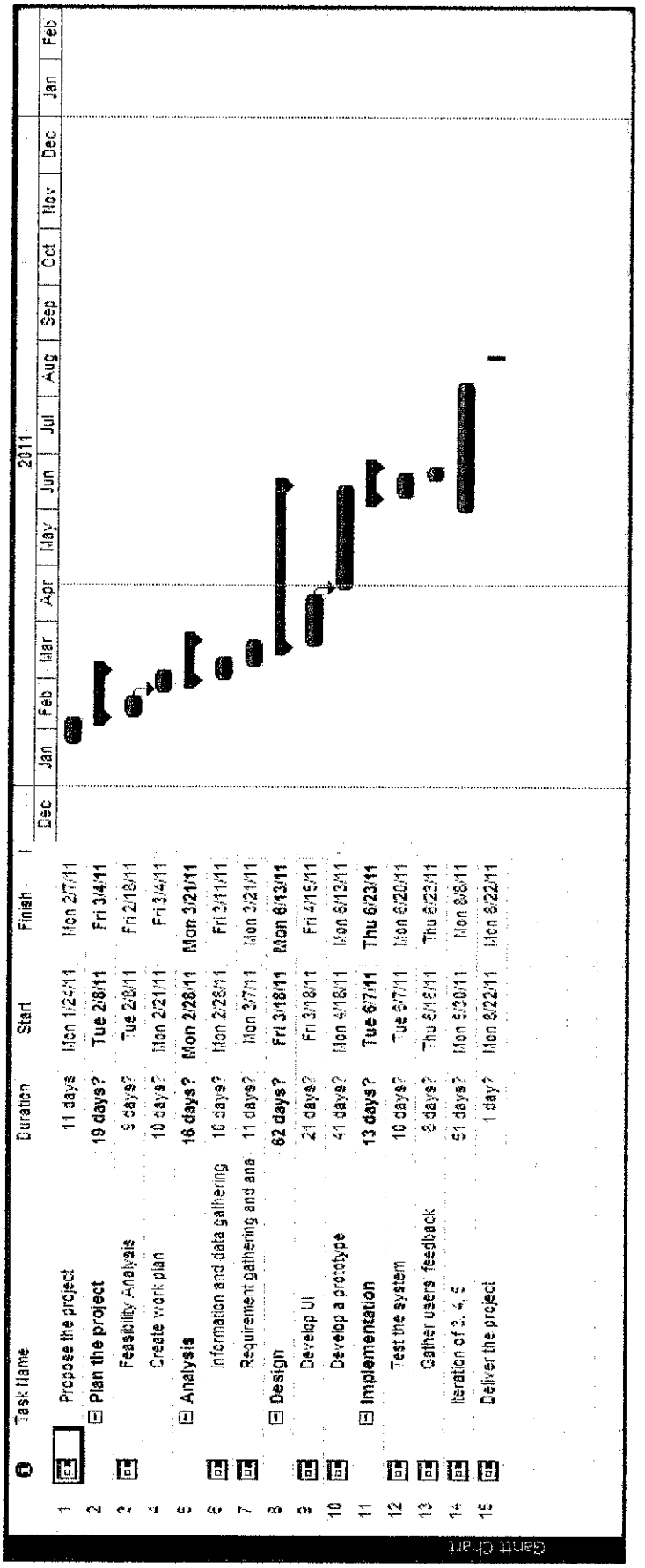
## Appendix A: Project's Gantt chart



**Appendix B: System Pre-Test Survey** (Original in Thai Language)

**Section A : General Information**

1. Position: _____
2. Gender: ☐ Male ☐ Female
3. Year of experience in Government Pawnshop

   ☐ less than 5 years ☐ 5-10 years ☐ over 10 years

**Section B : System Familiarity**

1. Please rate yourself for the familiarity with fingerprint recognition/matching system and fingerprint reader.

   ☐ High ☐ Moderate ☐ Low
2. Have you face any problems with services in pawn shop? (Pledge, deposits-redemption and pay interest of assets)

   ☐ Yes ☐ No
3. Do you think the fingerprint recognition/matching system will reduce the time for analyses the different of each person?

   ☐ Yes ☐ No
4. Are there a lot of customers who have same name and surname?

   ☐ Yes ☐ No
5. How do you store customer's detail?

   ☐ Paper-based

   ☐ Using Microsoft Office tools

   ☐ Combination of above
6. What is your opinion in implementing the fingerprint as fingerprint recognition/matching system in pawn shop?

   ☐ Agree ☐ Disagree

   Please state the reason:

   _____

   _____

   _____
7. Other comment/suggestion

   _____

   _____

   _____

***-Thank you for completing this survey-***

**Appendix C: System Feedback Survey** (Original in Thai Language)

**Section A: General Information**

1. Position: _____
2. Gender: ☐ Male ☐ Female
3. Year of experience in Government Pawnshop

   ☐ less than 5 years ☐ 5-10 years ☐ over 10 years

**Section B: System Feedback**

Please rate the following according to your opinion.

*(1 = Strongly Disagree to 5 = Strongly Agree)*

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1. The system is able to assist the officers to identify person. | | | | | |
| 2. The system is suitable for pawnshop. | | | | | |
| 3. The system is relevant to the workflow in the pawnshop. | | | | | |
| 4. The system is can be reduce time in work process. | | | | | |
| 5. The system is easy to use | | | | | |

***-Thank you for completing this survey-***