Distributed Personal Authentication Systems (DPAS)

By

Mohd Shahadan Bin Mokhtar

Dissertation submitted in partial fulfillment of
the requirements for the
Bachelor of Engineering (Hons)
(Electrical Engineering)

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Universiti Teknologi PETRONAS
Bandar Seri Iskandar
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Perak Darul Ridzuan

Dedicated to

My parents who always give encouraging words

Hj. Mokhtar Bin Hj. Mohamed

Hjh. Nor Asiah Binti Hj. Aris Jamali

My siblings who have always been my pride and joy

Umairah Arina Binti Hj. Mokhtar

Umairah Izzati Binti Hj. Mokhtar

My friend & other half whom I always rely on

Miss Nur Syahadah Binti Mohd Sapli

My dear friend who always listens

Ms Siti Hawa Hj Tahir

All friends with whom I share five wonderful years of my life in UTP

Thank you all for the great gifts that each of you have bestowed upon me

-active11-

http://shahadan-active11.blogspot.com

DISTRIBUTED PERSONAL AUTHENTICATION SYSTEMS (DPAS)

By

MOHD SHAHADAN BIN MOKHTAR

FINAL PROJECT REPORT

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

Universiti Teknologi PETRONAS
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CERTIFICATION OF APPROVAL

DISTRIBUTED PERSONAL AUTHENTICATION SYSTEMS
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A project dissertation submitted to the
Electrical & Electronics Engineering Programme
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Approved:

DR MUMTAJ BEGAM
Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK

June 2008

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.

Mohd Shahadan Bin Mokhtar

ABSTRACT

Authentication systems, especially in forensic areas are essential towards this modern life nowadays. It is also giving human an opportunity to study and learn more about remote environment. Besides that, this authentication technology also helps various fields to perform their special task that cannot be achieved by human. The use of smart authentication technology replacing an individual is a very exciting field to be explored. This project presents the use of the forensic application namely fingerprint recognition systems and how its automatic features help to perform its task using Digital Image Processing techniques and MATLAB coding. The objective of this project is to build a simple prototype of Distributed Personal Authentication Systems (DPAS) that can perform a basic recognition process, enhanced with the ability to send a signal to communication cable for further development in the future. The project undergoes several processes of designing and modifying before it reaches to the prototype state. As the result, the simulation was able to perform the authentication and recognition operation using simple programming language which is MATLAB coding.

ACKNOWLEDGEMENTS

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Not to forget my fellow friends who help in gaining information and knowledge on the course and as well as things I have never studied before. I also want to thank my family for the moral support and keep on reminding me to give my best for the project. Special thanks go to Miss Nur Syahadah Mohd Sapli for her words and encouragement towards the project.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

CVID	Computer Vision and Image Data
DPAS	Distributed Personal Authentication Systems
PC	Personal Computer
PIN	Personal Identification Numbers
UTP	Universiti Teknologi PETRONAS

CHAPTER 1
INTRODUCTION

1.1 Background of Study

Authentication is the fundamental element of human interaction with computers. Traditionally, authentication by using the computer is closely related with the usage of passwords and personal identification numbers (PINs) and it seems to dominate the market for years until the coming of the new technology which uses Biometrics methods. Biometric is the term of applying statistic and mathematical techniques to data analysis problem in biological sciences [1]. Moreover, Biometric is also referred to as the emerging field of technology devoted to identification of individual using biological traits [2]. Biometric world consists of several portions such as face, voice, fingerprint, signature, and many more. But, throughout the project, focuses will be on the fingerprint method and the study of car ignition systems as pre-application of the end-prototype.

The unique traits of the method will be the main advantage and challenges to integrate both systems, Central Locking Systems and authentication systems. Besides, other advantages of using Biometrics are reduced cost, increased accuracy, and increase ease of use. All those criteria have combined to make biometrics an increasingly feasible solution for securing access in many applications [1].

The idea of the research is to apply the biometrics techniques into real working environment for authentication purposes and defines how biometrics deployments can be privacy enhancing and privacy invasive.

1.2 Problem Statement

The cases of car that are stolen keep on increasing day by day and it gives a big question mark on the reliability of the conventional security system attached to our cars. Car owners, manufacturers and even government put very strong attention to overcome the problem and one of the suitable solutions is to implement smart authentication systems such as biometric methods to the vehicles [3]. The existence of the frequently used authentication technologies such as passwords and PINs bring secure access to personal information data, PCs and many applications. However, all those techniques have a number of problems that question their suitability for modern applications, particularly high-security applications such as access to automobile and military devices [1]. As the result, scientists and engineers work together to take advantage of using Biometric method as the authentication alternatives [1]. In this project, finger print method will be highlighted throughout the assignment and intensive effort should be put to ensure the effectiveness of the smart authentication systems and benefited the community as the main target at the end of the implementation.

The significance of the project is relatively coherent with the objectives of this research works which are to study the basic implementation of Computer Vision and Image Processing techniques to build a DPAS prototype and enhance the security level of the real world applications, increase convenience of the systems compared to traditional methods and improve the accountability of the distributed personal authentication systems. At the end of the day, hopefully the project gives good contribution in order to tackle theft of identity, stolen car problem and gives people a huge comfort zone to run daily life peacefully.

1.3 Objective and Scope

The objective of this project is to develop a simulation of the Distributed Personal Authentication Systems (DPAS) that can snap a picture and compare with a set of database pictures using Computer Vision and Image Processing techniques. This simulation is also equipped with automatic features that are capable to give a valuable signal to communication cable which is attached to car ignition systems obstacle. The main maneuver for the project is MATLAB coding and digital camera in connection to the personal computer (PC). The minor objective of the project is to study the car ignition systems as the pre-application model for further development of the whole project. As the scope of the project are:-

1. Research and Analysis – to research and analyze the topics background to collect information and ideas.
2. Design Concept – to design and analyze several potential design that suit the prototype requirement and the feasibility of the design regarding the cost, availability of materials and time constraint.
3. Building the Prototype – to build the prototype starting with the construction of the thrusters, the body-frame and the maneuverability capability of the prototype.
4. Testing – to test the prototype functionality and durability.
5. Product Enhancement – to enhance the prototype with appropriate functionality to meet requirement given.

The allocated time-frame of approximately one year is sufficient to carry out the entire task required in the project. With well-planned schedule and consistency of asking opinions and guidance from supervisor and field-related-person would helps in archiving the success in this project. **Appendix A** summarized the allocated time frames for all tasks performed throughout the two semesters in a Gantt chart.

CHAPTER 2
LITERATURE REVIEW AND THEORY

2.1 DPAS

Distributed Personal Authentication Systems (DPAS) is the accepted name for this whole project. DPAS consists of digital camera and personal computer as the main maneuver throughout the project and also equipped with communication cable (RS 232) and car ignition systems for the research purposes. They are linked together to stand on their own as recognition device to interpret data given by an individual. For the purpose of the project, DPAS is considerable as the replacement of car keys to activate car ignition systems.

2.2 Digital Image Processing

Digital image processing is basically done to satisfy one or both conditions which are to give a better human perception or render the image more suitable for machine perception. This involves using a computer to change the nature of the image. There are many procedures to satisfy the conditions, and these procedures are called digital image processing techniques. It is done because humans generally would prefer a sharper, clearer and more detailed image so that it is more accessible for the human and machines prefer a simple and less messy and would take up lesser memory so that it is easier to compute for the machine.

There are several techniques which could be used. Some of them include edge enhancement, which make the image looks sharper. For example, take Figure 1, and Figure 2 and compare both pictures.

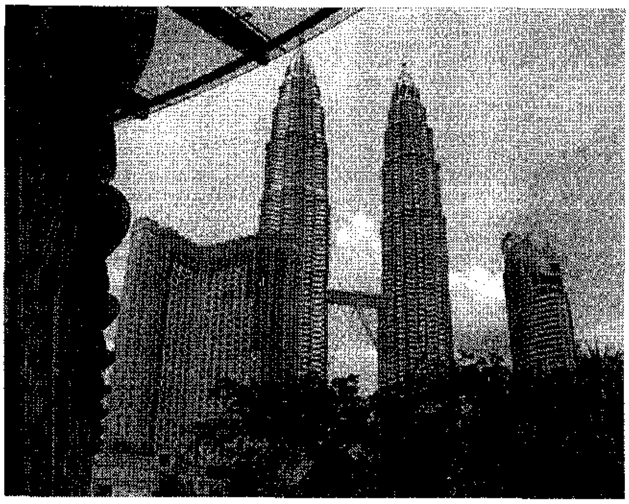


Figure 1 : Original Image

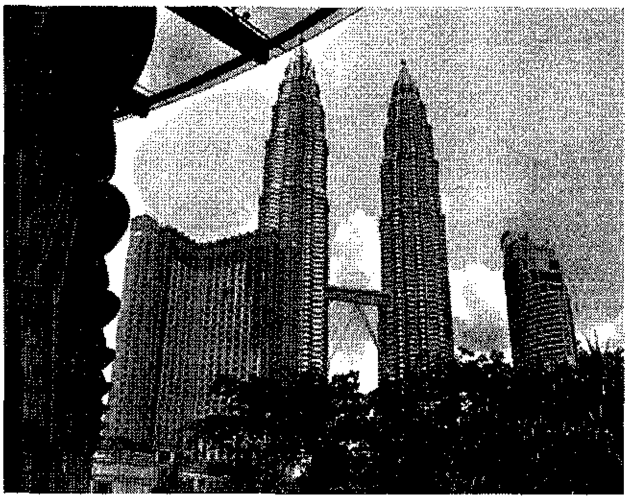


Figure 2 : Sharpened Image

The sharpened image appears to be clearer and more pleasant to the human eye in Figure 2 rather than Figure 1. Same goes to the machine interpretation, it will more easily to the machine such as computers or any optical devices to compare sharpened and well treated images.

2.3 Biometric

Biometrics is the automated use of physiological or behavioral characteristics to determine or verify identity. Most of the high degrees of security application are using the Biometrics methods and it is proven to be the leading technologies in personal authentication areas [2].

2.3.1 Automated Use

Biometrics methods are used to verify or determine identity through behavioral or physiological characteristics. Since the process is automated, biometric authentication generally requires only a few seconds, and biometrics systems are able to compare thousands of records per second [1, 2, 3].

2.3.2 Physiological or Behavioral Characteristics

Biometrics is based on the measurement of distinctive physiological and behavioral characteristics. Common example of physiological biometrics are finger-scan, facial scan, iris-scan and hand scan. They are basically examined by direct measurement of a part of the human body while voice and signature are considered as indirect measurement of human body. This is because they receive data derived from an action and not from physiological or behavioral characteristic [2].

2.4 Fingerprint

A fingerprint is the feature pattern of one finger, Finger 3. It is believed with strong evidences that each fingerprint is unique. Each person has his own fingerprints with the permanent uniqueness. So fingerprints have being used for identification and forensic investigation for a long time.

Figure 3: A fingerprint image acquired by an Optical Sensor

A fingerprint is composed of many ridges and furrows. These ridges and furrows present good similarities in each small local window, like parallelism and average width. However, shown by intensive research on fingerprint recognition, fingerprints are not distinguished by their ridges and furrows, but by Minutia, which are some abnormal points on the ridges (Figure 4). Among the variety of minutia types reported in literatures, two are mostly significant and in heavy usage: one is called termination, which is the immediate ending of a ridge; the other is called bifurcation, which is the point on the ridge from which two branches derive. Valley is also referred as furrow, termination is also called ending, and Bifurcation is also called branch.

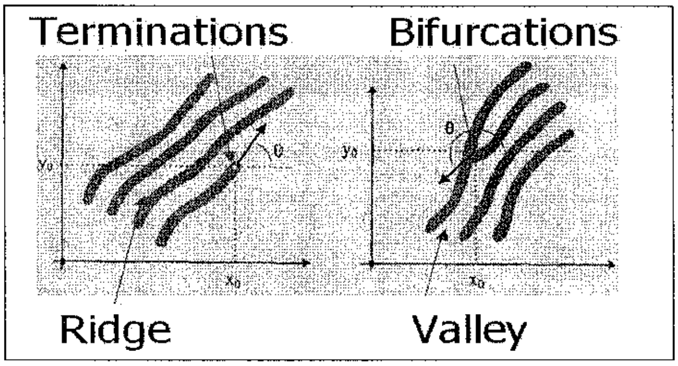


Figure 4 : Minutia

2.4.1 Fingerprint identification

This is the process of comparing questioned and known friction skin ridge impressions of fingers, palms, and toes to determine if the impressions are from the same finger. The flexibility of friction ridge skin means that no two finger or palm prints are ever exactly alike, even two impressions recorded immediately after each other. Fingerprint identification (individualization) occurs when an expert computer system operating under threshold scoring rules determines that two friction ridge impressions originated from the same finger or palm (or toe, sole) to the exclusion of all others [4].

2.5 Car Ignition System

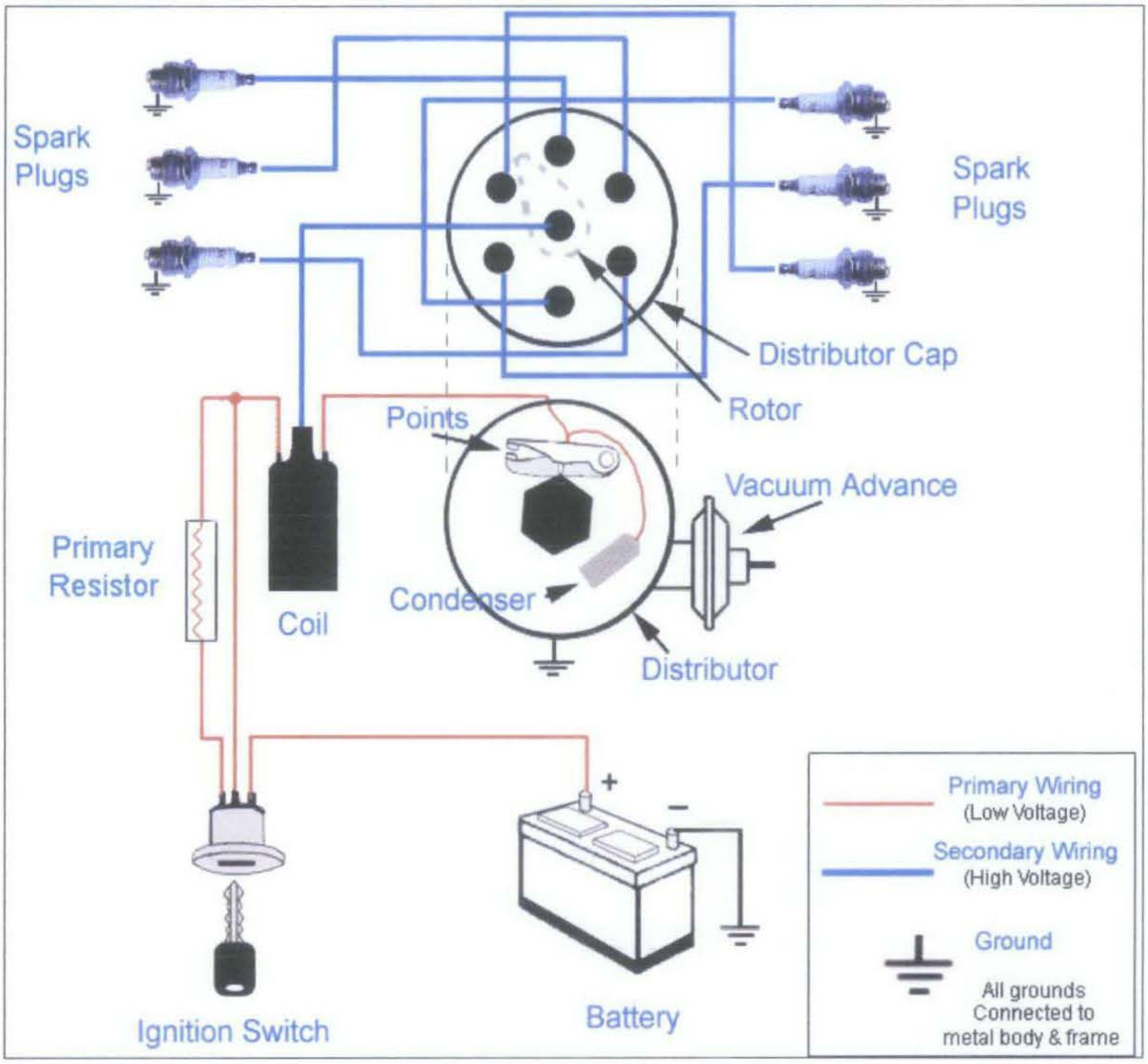


Figure 5 : Car Ignition Systems

The purpose of the ignition system (Figure 5) is to create a spark that will ignite the fuel-air mixture in the cylinder of an engine. It must do this at exactly the right instance and do it at the rate of up to several thousand times per minute for each cylinder in the engine. If the timing of that spark is off by a small fraction of a second, the engine will run poorly or will not run at all. The ignition system sends an extremely high voltage to the spark plug in each cylinder when the piston is at the top of its compression stroke. The tip of each spark plug contains a gap that the voltage must jump across in order to reach ground.

That is where the spark occurs. The voltage that is available to the spark plug is somewhere between 20,000 volts and 50,000 volts or higher. The job of the ignition system is to produce that high voltage from a 12 volt source and send it to each cylinder in a specific order, at exactly the right time [5].

2.5.1 Battery

The automotive battery, well known as lead-acid storage battery, is an electrochemical device that produces voltage and delivers current. An automotive battery can works in reverse electrochemical action, thereby recharging the battery, which will then give us many years of services. The purpose of the battery is to supply current to the starter motor, provide current to the ignition system while cranking, to supply additional current when the demand is higher than the alternator can supply and to act as electrical reservoir.

2.5.2 Ignition Switch

The ignition switch allows the driver to distribute electrical current to where it is needed. There are generally five-key switch positions that are used :

- ✓ LOCK – All circuits are open (no current supplied) and the steering wheel is the lock position. In some cars,
- ✓ OFF – All circuits are open, but the steering wheel can be turned and the key cannot extracted.
- ✓ RUN- All circuits, except the starter circuit, are closed and current is allowed to pass through. Current is supplied to all but the starter circuit.
- ✓ START- Power is supplied to the ignition circuit and the starter motor only. That is why radio stops playing if the key in START mode. This position of the ignition switch is spring loaded so the starter is not engaged while the engine is running. This position is used momentarily, just to active the starter.

✓ ACCESSORY – Power is supplied to all but the ignition and starter circuit. This allows you to play the radio, work the power windows and some other thing while the engine is not running. Most ignition switches are mounted on the steering column. Some switches are actually two separate parts :

- The LOCK into which you insert the key. This component also contains the mechanism to lock the steering wheel and shifter.
- The SWITCH which contains the actual electrical circuits It is usually mounted on the top of the steering column just behind the dash and is connected to the lock by a linkage or rod.

2.5.3 Neutral Safety Switch

This switch opens and denies current to flow through the starter circuit when the transmission is in any gear but Neutral or Park on automatic transmission. This switch is normally connected to the transmission linkage or directly on the transmission. Most cars utilize this same switch to apply current to the back up light when the transmission is put in reverse. Standard transmission cars will connect this switch to the clutch pedal so that the starter will not engage unless the clutch pedal is depressed.

2.5.4 Starter Motor

The starter motor is a powerful electric motor, with the small gear attached to the end. When activated, the gear is meshed with the larger gear, which attached to the engine. The starter motor then spins the engine over so that the piston can draw in a fuel and air mixture, which is then ignited to start the engine. When the engine starts to spin faster than the starter, a device called an overrunning clutch automatically disengages the starter gear from the engine gear.

2.6 NPN Type Transistor as a Switch

NPN Type Transistor is the proposed switch for further implementation of the project. NPN Type Transistor can be operated in two conditions, which is Cut-off condition for open circuits switch function and Saturation condition as close circuit switch function.

2.7 DPAS Model

Figure 6 below mentioned about the Distributed Personal Authentication Systems (DPAS) Model. Basically the system consists of the authentication devices such as digital camera, the Personal Computer for circulating the data stored and ignition system to activate the vehicles. When the Digital Camera detects the fingerprint, the authentication systems send data to Personal Computer. Automatically, the Personal Computer will figure out the calculation and make judgments between the data that is already stored in the database. Once the comparison between current fingerprint and data stored are exactly the same, the controller will send signal to Car Ignition Systems by RS232 Cable in order to give the right access for user to run the car. However, if the comparison came up with a lot of difference between data stored and the fingerprint, the Personal Computer will act as the medium to stop the access to the car ignition systems based on the output from the authentication systems [4].

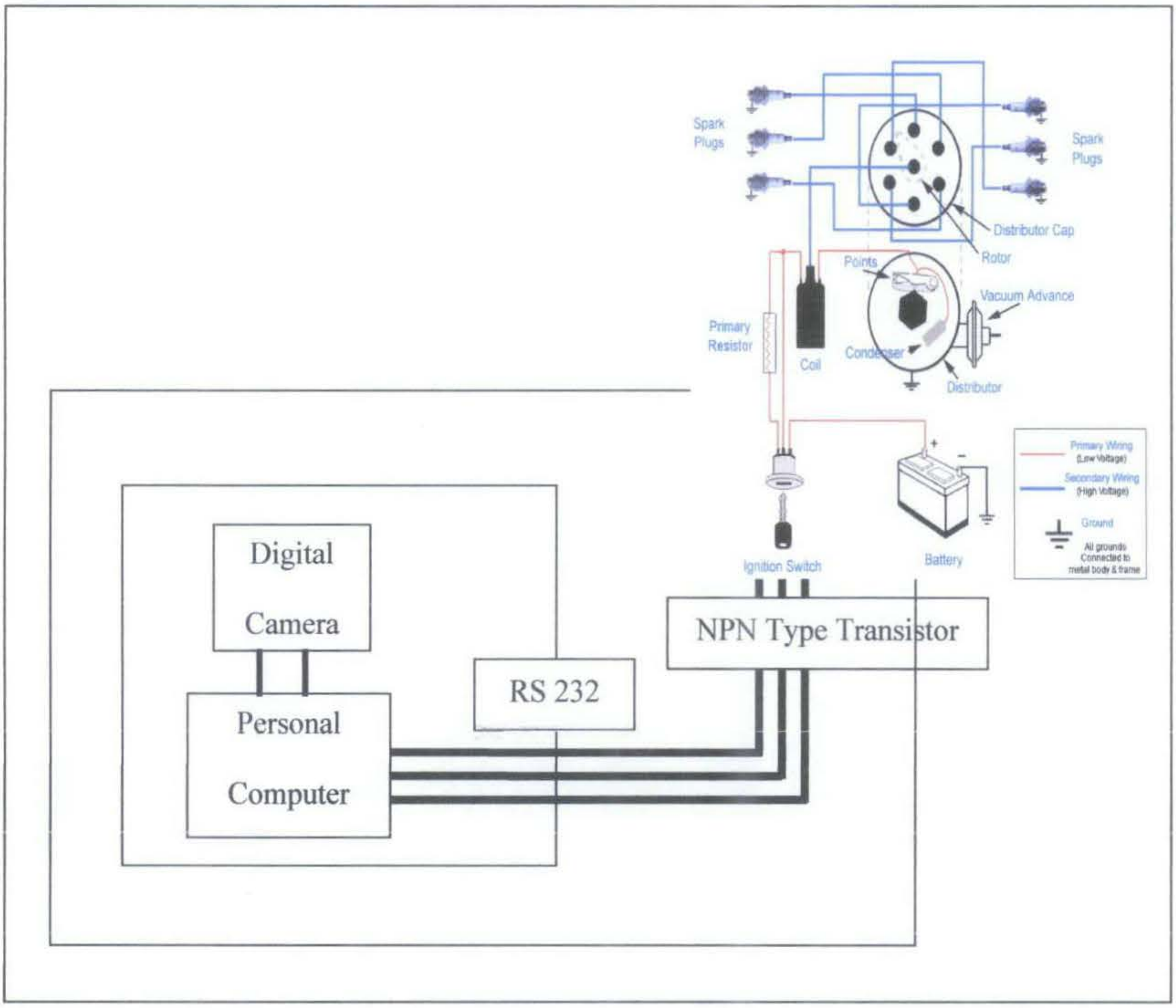


Figure 6 : DPAS Model

CHAPTER 3
METHODOLOGY

3.1 Sequence of Methodology

The flow of the project methodology is shown Figure 7. The methodology of the whole project is divided into two phases which are Stage 1 and Stage 2. Below is the overview of the project methodology.

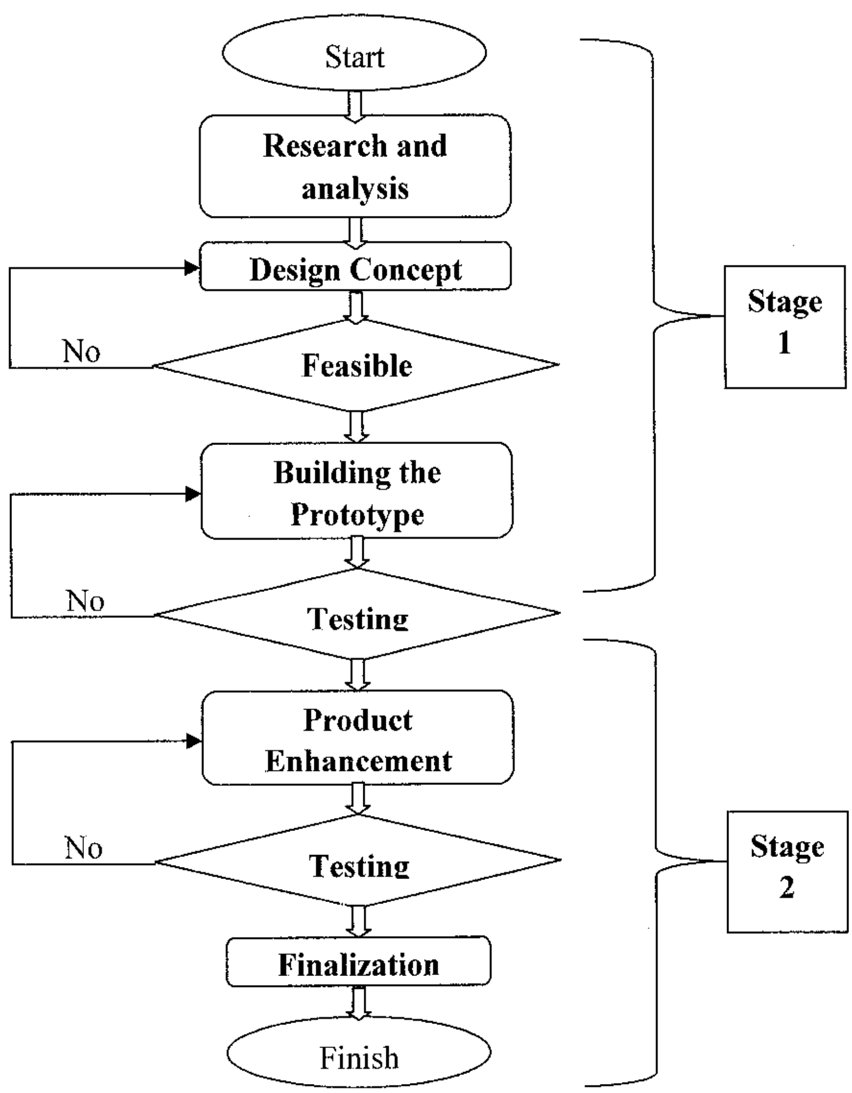


Figure 7 : Sequence of Methodology

3.1.1 Stage 1

The project started by defining project titles and scope. Then the schedule is planned into two stages. For the first stage, literature review of the DPAS was carried out for the first three weeks. Then, it continued with design concept and several theoretical aspects that could be needed to achieve a satisfying product towards the end. Determination of crucial components availability such as used digital camera, RS 232 communication cables, personal computer, MATLAB software, and car starter (further research and development) need to be done in the first stage of the project cycle.

Within the first stage, the aims are to complete the design concept and collect all necessary equipment within limited budget of RM500.

3.1.2 Stage 2

For the second stage of the project, it was planned that this prototype will be enhanced with intelligent function with the use of digital camera and personal computer.

At this stage, all the troubleshooting need to be done correctly as it may affect the performance of the prototype. Then the prototype will be finalized and be tested to perform its capabilities. Most of the work load for second stage is with MATLAB Coding. There are some procedures need to be repeated tremendously in order to satisfy the project overall requirement. The test area for this purpose was initially planned in the lab since there is still in research development stage and further studies need to be done in order to implement it to real vehicle.

3.2 Computer Vision and Image Processing Methodology

The methodology of Computer Vision and Image Processing method is shown in Figure 8. There are several types of processing unit algorithms which can be implemented to the project. Due to the availability and simplicity of the basic procedure, DPAS is built with respect to the fundamental concept which emphasized the feedback control to enhance the overall performance of the process. Fundamental steps for CVID method are as follows:-

Image Acquisition	- At the beginning of the process, input is required and the file should be compatible with the minimum specification needed. Normally, the medium for the input shall be in MPEG or RAW.
Image Enhancement	- The properties of the medium than could be modified by several algorithms. The reason of the image enhancement is to reduce the noise of the image.
Pre-processing & Image segmentation	- The procedure to reduce the area required to be compared with database. The narrower the area, the complexity is easier to be determined to distinguish the different.
Feature Extraction	- The most important part of CVID method. The key extraction is identified such as minutia, ridge and texture pattern of the finger skin.
Image Analysis	- The comparison phase is take places. Where the images in database is required to ensure the similarities between input image and saved images in database.
Image Description & Object Recognition	- After the input is successfully undergoes all procedures, it will come to the image recognition phase. During this phase, the input is determined either it is under reasonable specification or not acceptable at all.

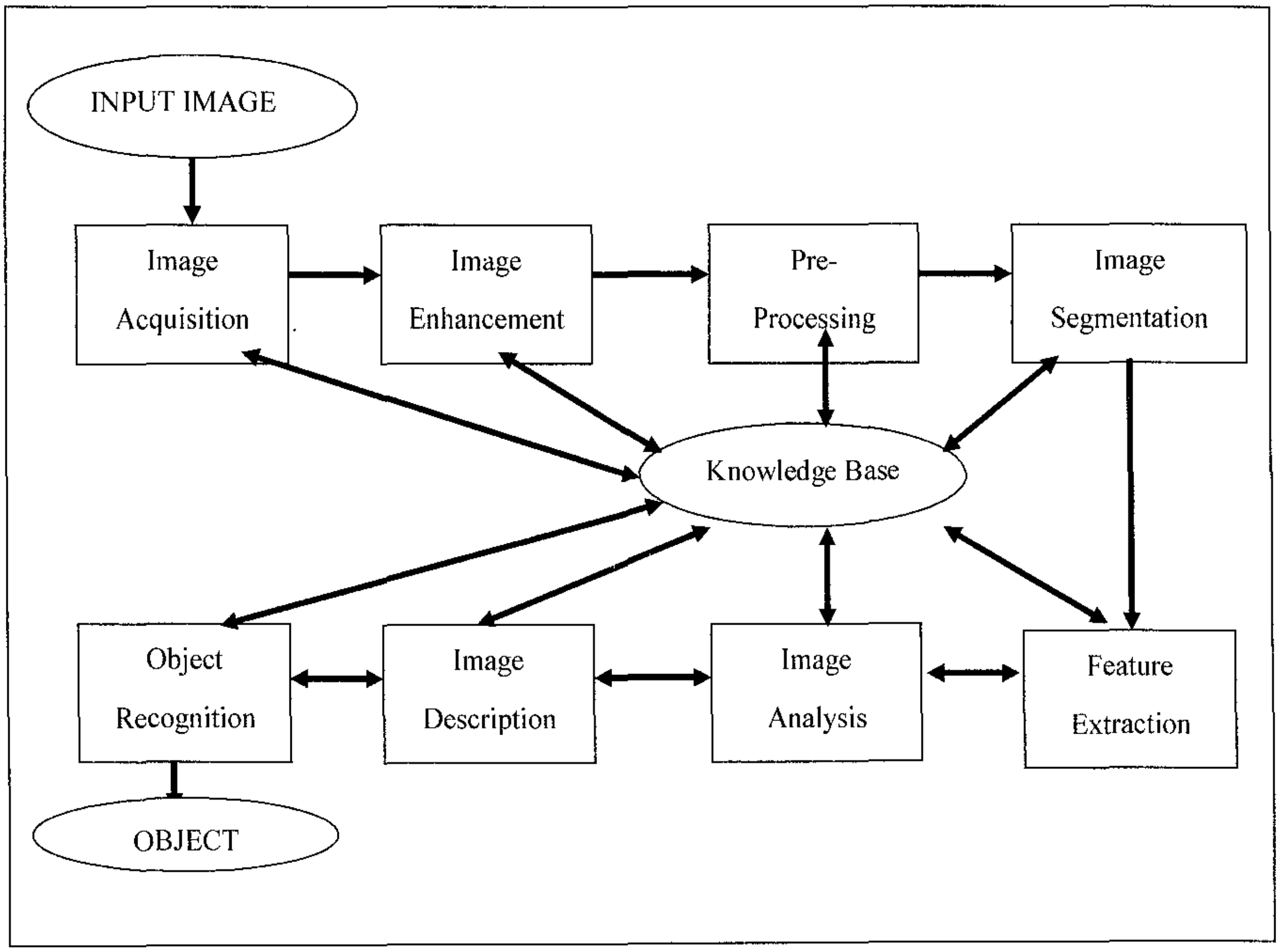


Figure 8 : CVID Technique

3.2.1 Fingerprint Image Processing using CVID Methods

Fingerprint Image enhancement is to make the image clearer to boost further operations. Since the fingerprint images acquired from sensors or other medium are not assured with perfect quality, those enhancement methods, for increasing the contrast between ridges and furrows and for connecting the false broken points of ridges due to insufficient amount of ink, are very useful for keep a higher accuracy to fingerprint recognition. There are several alternatives that are able to enhance the quality of the raw picture. Throughout the project, the method that is adopted in the project is Histogram Equalization.

3.2.2 *Histogram Equalization*

Histogram equalization is to expand the pixel value distribution of an image so as to increase the perceptional information. The original histogram of a fingerprint image has the bimodal type Figure 9, the histogram after the histogram equalization occupies all the range from 0 to 255 and the visualization effect is enhanced, Figure 10.

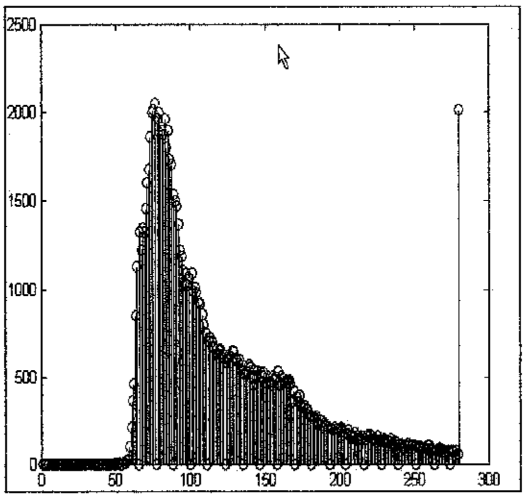


Figure 9 : The Original histogram of a fingerprint image

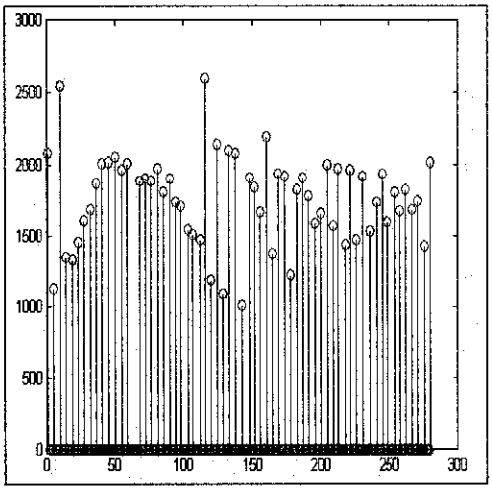


Figure 10 : Histogram after the Histogram Equalization

The right side of the following figure [Figure 12] is the output after the histogram equalization. From the figure provided, the figure, Figure 12 on the right gives more precise and sharpened image. Furthermore, it is reduces the uncertainty black area from Left Figure, Figure 11 and increase the resolution and overall performance of the picture.

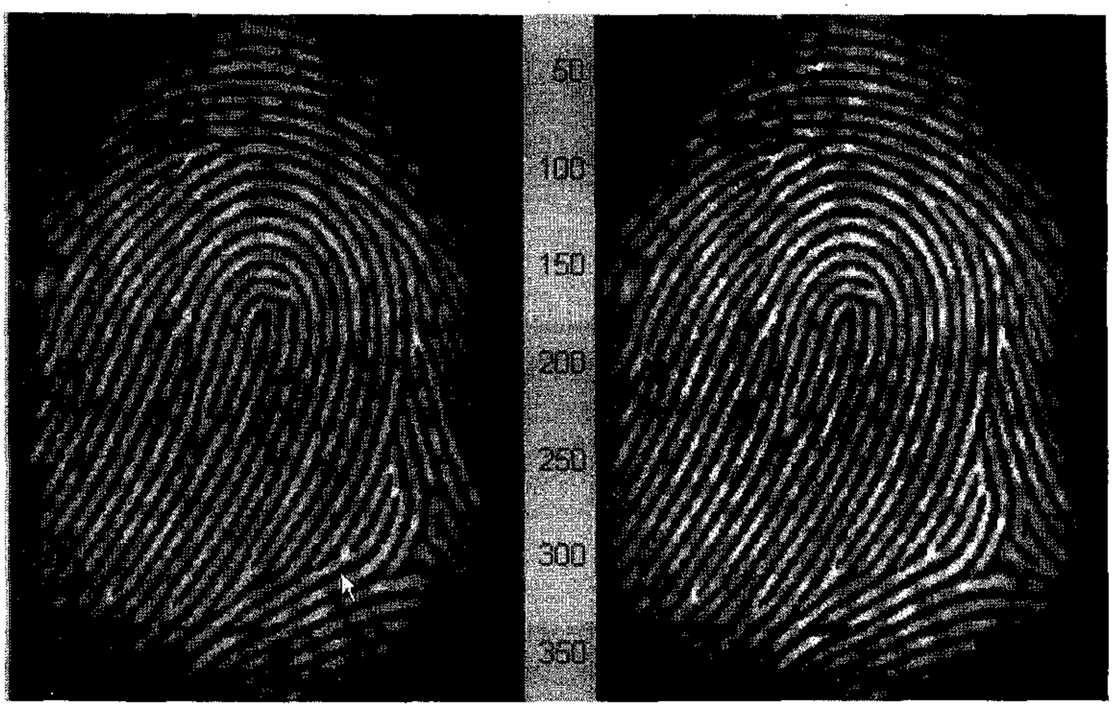


Figure 11 : Before Histogram Equalization   Figure 12 : After Histogram Equalization

3.3 Project Development

Referring to Figure 13, it can be seen that the first stage of project development is researching on background studies, problem identification and also literature review. With all information needed in hand, the mechanical structure was designed according to the localized material available in the market. Fortunately, I am using UTP lab computer and my own Personal Computer, so it reduces the cost of about one thousand Ringgit Malaysia.

When all the structure is finalized and tested, the circuit and the algorithm of the controller are designed. The program algorithm was designed using MATLAB compiler using C language. Then the finished program is tested using a simulated software called Simulator/Simulink to simulated the effect of the program to the desired controller's I/O system. After that, the program is compiled into database files and uploaded (flash) into the MATLAB Works. Next, the digital camera is connected to PC and functionality test been conducted and several programs timing to the real application also been calibrated. If the functionality of the algorithm is not as desired, the process of reprogram the algorithm need to taken. This process is repeated until the program and smooth functioning accordingly.

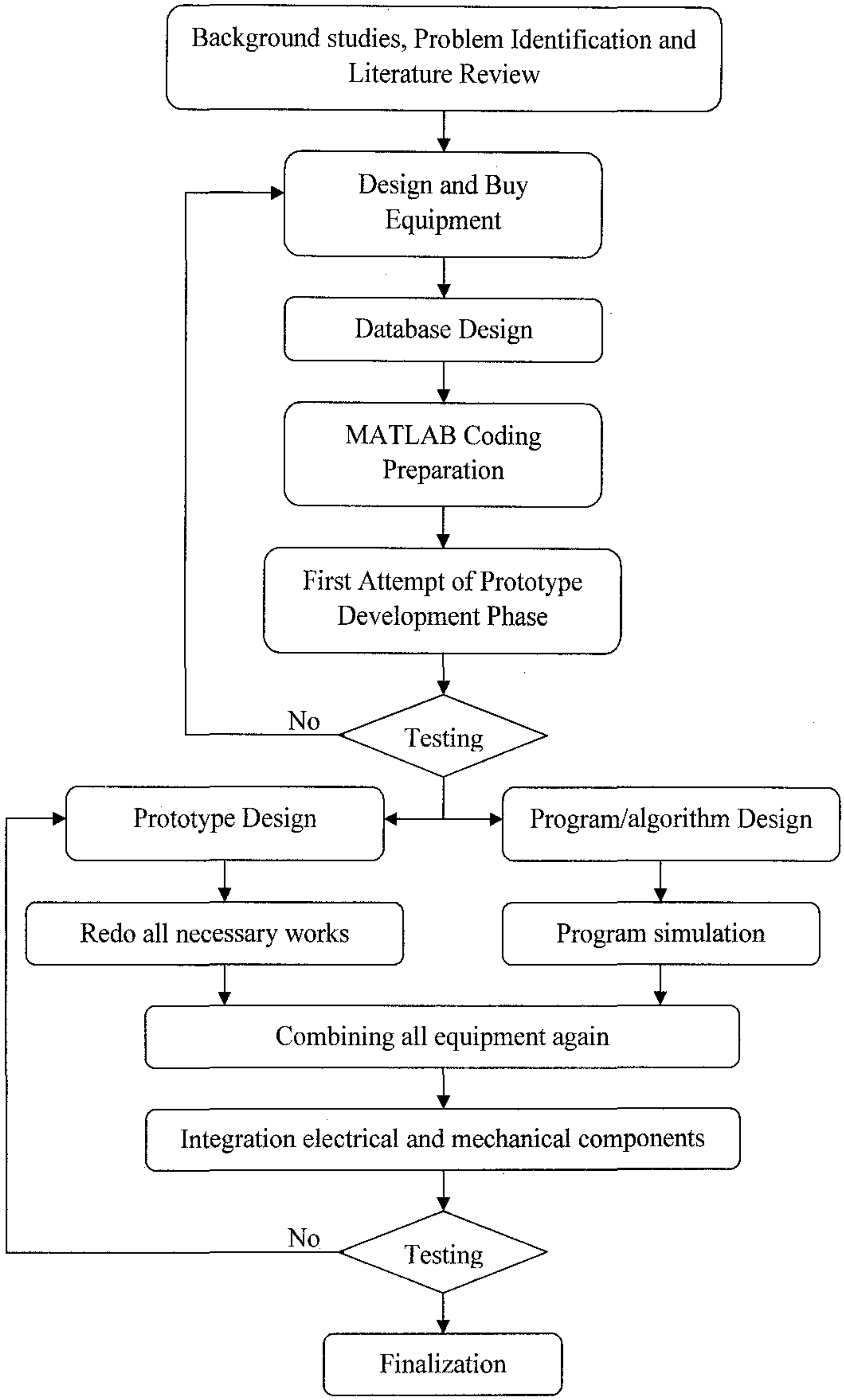


Figure 13 : Project Development Flow Chart

CHAPTER 4
RESULT AND DISCUSSION

4.1 FINDINGS

Finger skin is made of friction ridges, with pores (sweat glands). Friction ridges are created during fœtal live and only the general shape is genetically defined. Friction ridges remain the same all life long, only growing up to adult size [4]. Figure 14 (below) is the Finger Print Sample.

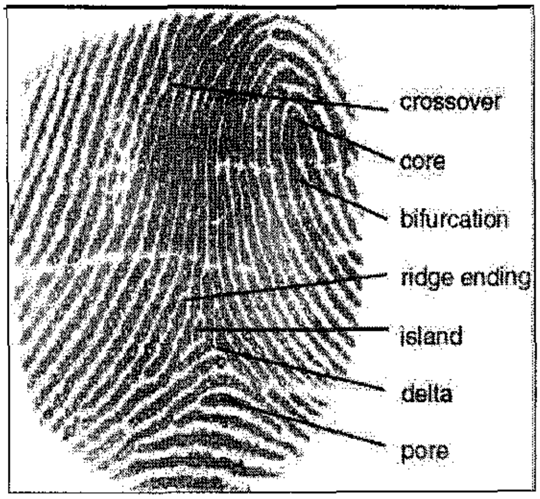


Figure 14 : Finger Print Sample

- Endings, the points at which a ridge stops
- Bifurcations, the point at which one ridge divides into two
- Dots, very small ridges

- Islands, ridges slightly longer than dots, occupying a middle space between two temporarily divergent ridges
- Ponds or lakes, empty spaces between two temporarily divergent ridges
- Spurs, a notch protruding from a ridge
- Bridges, small ridges joining two longer adjacent ridges
- Crossovers, two ridges which cross each other
- The core is the inner point, normally in the middle of the print, around which swirls, loops, or arches center. It is frequently characterized by a ridge ending and several acutely curved ridges.
- Deltas are the points, normally at the lower left and right hand of the fingerprint, around which a triangular series of ridges center.

Table 2 : Fingerprint Capture Types [2]

Rolled Fingerprint	- The user rolls his/her finger in order to get the maximum fingerprint area. - The main objective of rolling the finger is to get the whole fingerprint of the finger, from "nail to nail", in order to maximize the recognition rate.
Static Sensing	- The user just puts his/her finger on the sensor. - Pro & cons of static sensing: • Obvious use: just put your finger on the sensor. • The user do not know what pressure to apply. It is generally necessary to press a little bit to make sure that a large area of the skin touches the sensor. • If the capture time is long, then the user has a natural tendency to press more and more, which is not necessary most of the

	time, but may break the sensor in worst cases. • If the user apply at the same time a rotation (which is never recommended), the skin plasticity makes a distorted image. • After a while, the sensor becomes dirty (especially on the edge) which may be a problem for the acquisition, and users may become reluctant to use it.
Sweeping Reading	The user sweeps his/her finger on the sensor. • This is not a natural way of acquisition, user has to learn how to use it. • The reader is always clean: each swipe cleans the sensor. • No latent print on the sensor. • No feeling of "leaving" his/her fingerprint: the swipe is short

4.2 MATLAB Coding

This part includes some information regarding to the MATLAB coding for authentication systems. The program is able to execute and compare between stored data base with a new one and find the similarities between them. So only authorized consumer may have the access to enter the ignition system for the vehicle. Below is the MATLAB Coding for DPAS throughout the project. Modification and adjustment to the system are based on this MATLAB Coding.

THE PROGRAM

```
clear all
close all
clc
% maximum number of student's ID
M=5000;

I=input('Please enter your Driver's ID: \n', 's');
num = str2num(I);

  if ((num <= 7000) & (num >= 5000))

      %targets the filename of the database image
      str = strcat('C:\Program Files\MATLAB71\work\trial1\',I,'.jpg');
      New_Image = imread(str);
      imshow(New_Image),title (['Original Image']);

      [irow icol pln]= size(New_Image);

      %resize image to 320x243
      Resized_Image = imresize(New_Image,[243 320]);
      New_Image = Resized_Image;
      imwrite(New_Image,str);

      %cropping the image
      Crop_Image = imcrop(New_Image,[60 60 200 180]);
      Resized_Crop_Image = imresize(Crop_Image,[243 287]);
      Crop_Image = Resized_Crop_Image;
      figure,imshow(Crop_Image),title (['Cropped image']);
```

```
    %convert image to black and white if image is colour image(RGB)

if  pln>1

    %image preprocess
    Gray_Image = rgb2gray(Crop_Image);
    figure,imshow(Gray_Image),title (['Gray image']);

    Equalized_Image = adapthisteq(Gray_Image);
    figure, imhist(Equalized_Image),title (['Histogram of the image']);
    figure,imshow(Equalized_Image),title (['After histogram equalization
image']);

    Filter_Image = medfilt2(Equalized_Image, [3 3]);
    figure,imshow(Filter_Image),title (['Median filtered image']);

    Graythresh_Image = graythresh(Filter_Image);
    Black_and_White_Image = im2bw(Filter_Image,Graythresh_Image);
    figure,imshow(Black_and_White_Image),title (['Black and White image']);

else
    %image preprocess
    Equalized_Image = adapthisteq(Gray_Image);
    figure, imhist(Equalized_Image),title (['Histogram of the images']);
    Filter_Image = medfilt2(Equalized_Image, [3 3]);
    figure,imshow(Filter_Image),title (['Median filtered image']);

    Graythresh_Image =graythresh(Filter_Image);
    Black_and_White_Image = im2bw(Filter_Image,Graythresh_Image);
    figure,imshow(Black_and_White_Image),title (['Black and White image']);

end
```

```
% comparing image
total1 = bwarea(Black_and_White_Image);

str2 = strcat('C:\Program Files\MATLAB71\work\NewFolder1\',I,'.jpg');
Compare_Image = imread(str2);
Gray_Image = graythresh(Compare_Image);
Compare_Image_Black_and_White = im2bw(Compare_Image,Gray_Image);
total2 = bwarea(Compare_Image_Black_and_White);

total = abs(total1-total2);

   if num==5525

   K = strvcat('First Driver','5745','BFJ 8403');

   else

   if num==5576

   K = strvcat('Second Driver','5983','BFJ 8403');

      end
   end

str = strcat('C:\Program Files\work\image\',I,'.jpg');
Face = imread(str);
imshow(Face),title (K);


   if ((total <= 5000) & (total >= 5))
```

```
    disp('Engine Activated','Remain Calm and Place Your Seal Belt. Thank
you.')

  else

    disp ('ACCESS DENIED!!! Please Try Again.')

  end

  else
    disp('SORRY, YOU ARE NOT AN AUTHORIZED DRIVER');
  end
```

4.3 Result

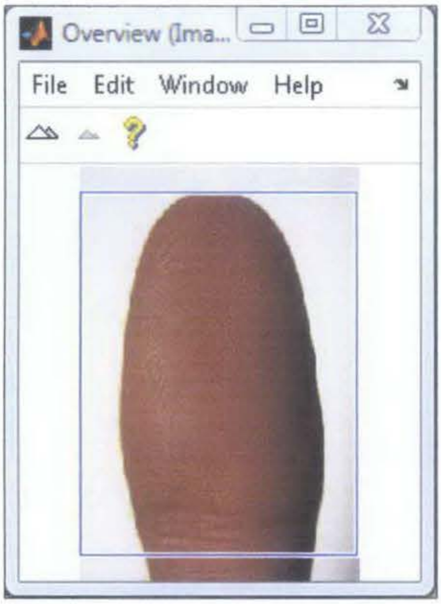
Below is the coding design and brief description for each part for the whole process. This would be the actual MATLAB Coding for the whole implementation process.

```
==================================================
Database
I=input('Please enter your student ID:\n','s');
        num=str2num(I);
        if((num<=7000)&(num>=5000)
str=strcat('C:\Program Files\work\trial1\',I',.jpg');
NewImg=imread(str);
imshow(NewImg),title(['Origanal Database']);

==================================================
```

The command above is to create a database in order to store details for each input image. In this case, the information for each fingerprint will be stored and called-out from the MATLAB file itself. The reason behind the design is to ensure the MATLAB is able to compare essential information whenever needed. The authentication of the whole system also starts with the database that is pre-installed in the systems.

```
==================================================

I=imread('New.jpg');

figure,imshow(I);

title('Mohd Shahadan');

imtool(I);
==================================================
```

This command acquires the user to provide information to the systems. Command *imread* actually focuses on the task of reading an image from graphic file. In this case, the camera system will actually be linked to one file in MATLAB.



Process Stage

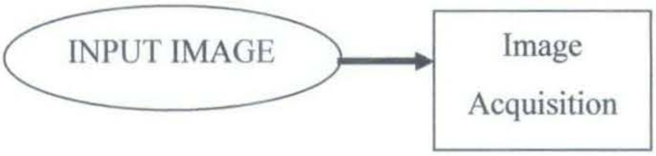


Figure 15 : Output from Image Acquisition

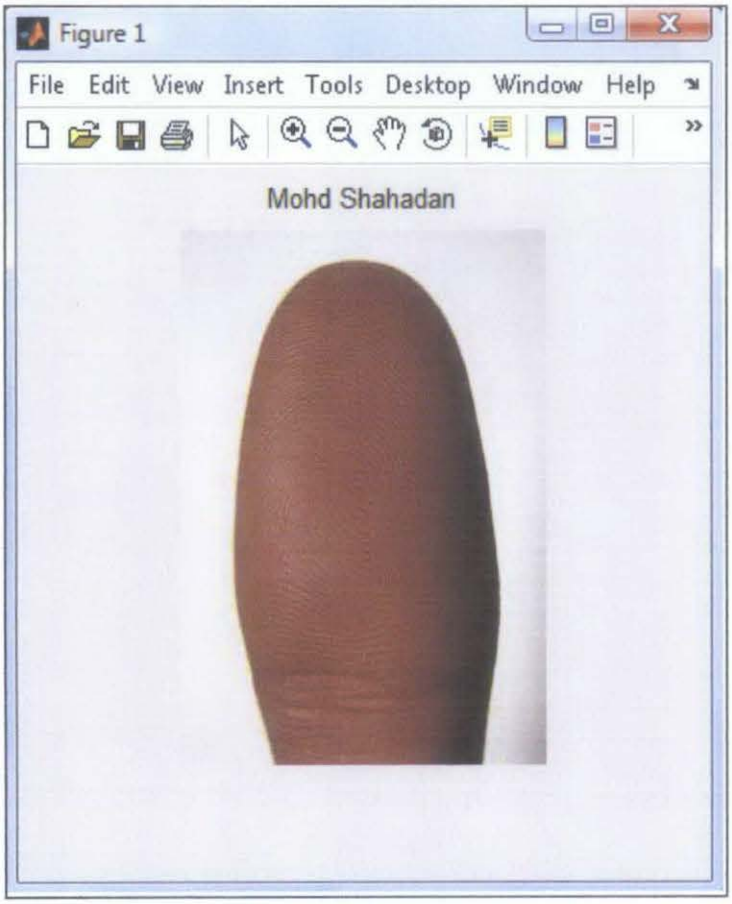


Figure 16 : Enlarged Image

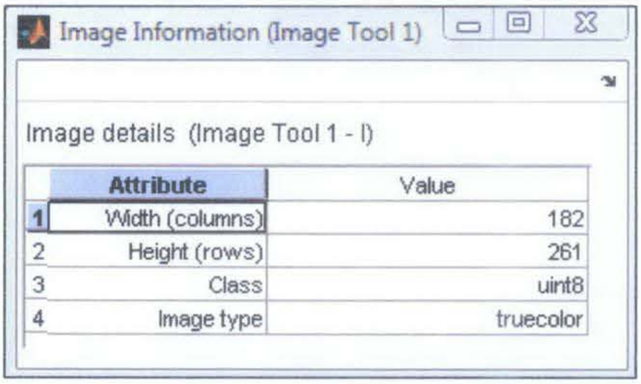


Image Information (Image Tool 1)

Image details (Image Tool 1 - I)

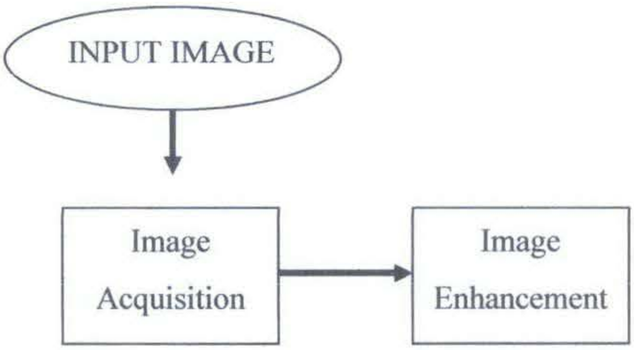
	Attribute	Value
1	Width (columns)	182
2	Height (rows)	261
3	Class	uint8
4	Image type	truecolor

Figure 17: Image Information Tool

Image Information will show us about the attributes of the picture taken by the digital camera during the authentication process. As mentioned above, the actual image type is true color and pure from the user's fingerprint. The two procedures that take place during this process are Input Image and Image Acquisition.

```
=====================================================
converted=rgb2gray(I);
figure,imshow(converted);
imtool(converted);
title('Converted to gray color');
=====================================================
```

Process Stage



Output

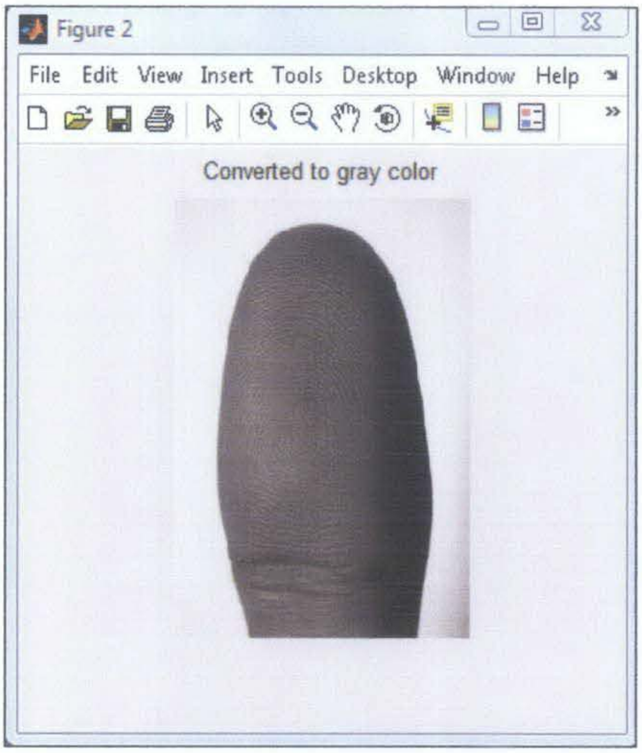


Figure 18 : Gray image

Image Information (Image Tool 2)

Image details (Image Tool 2 - converted)

	Attribute	Value
1	Width (columns)	182
2	Height (rows)	261
3	Class	uint8
4	Image type	intensity
5	Minimum intensity	18
6	Maximum intensity	225

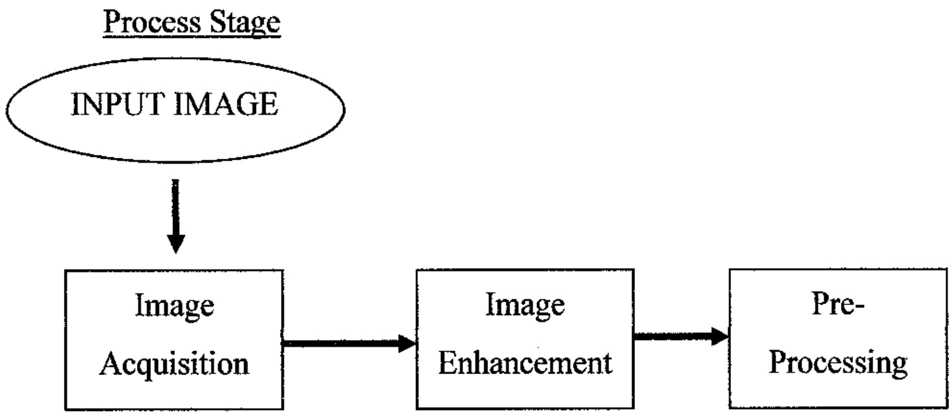
Figure 19 : Image Information for Gray Image

As shown above, the Image type of the pictures has changed from ***truecolor*** to ***intensity***. Moreover, ***intensity level*** also had been introduced for the programmer to analyze the data provided.

==

```
histo=adapthisteq(converted);
figure,imshow(histo);
imtool(histo);

filter=medfilt2(histo);
figure,imshow(filter);
imtool(filter);
title('After filtering process');
```

==



Output of Histogram Equalization

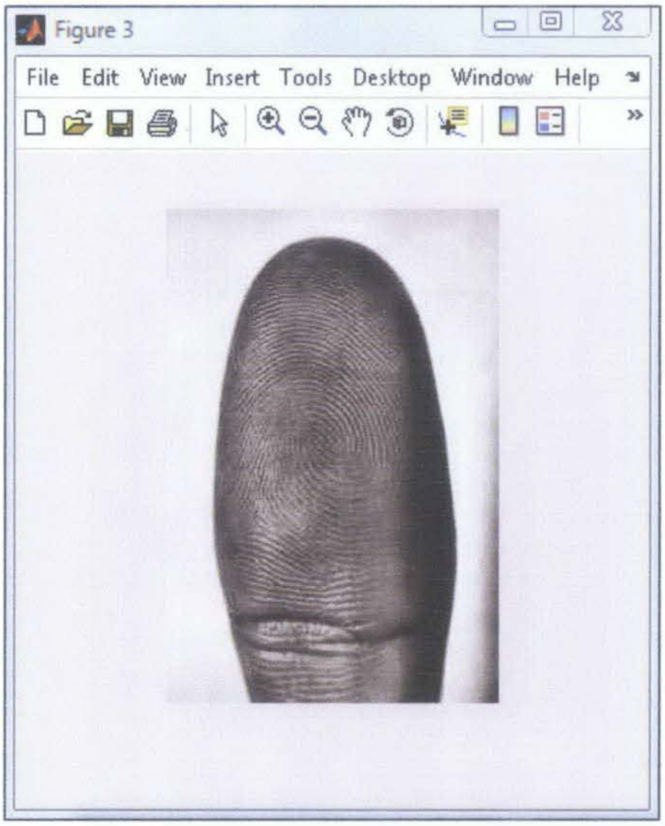


Figure 20 : Output from Image Histogram

Image Information (Image Tool 3)

Image details (Image Tool 3 - histo)

	Attribute	Value
1	Width (columns)	182
2	Height (rows)	261
3	Class	uint8
4	Image type	intensity
5	Minimum intensity	9
6	Maximum intensity	245

Figure 21 : Image Detail for Figure 20

For the pre-processing procedure, *minimum and maximum intensity* has changed due to enhancement of grayscale picture in the previous procedure. The picture changed to be more precise on the ridges ending and bifurcation. So, this will enable the processing unit more flexibility when they reach ***Image Analysis*** procedure.

<u>Filtered Image</u>

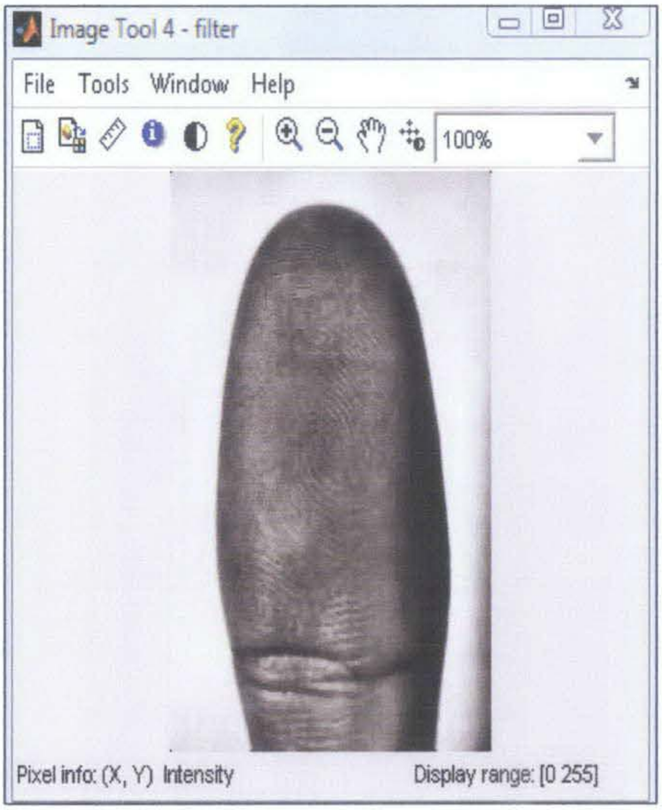


Figure 22 : Filtered Image

Image Information (Image Tool 4)

Image details (Image Tool 4 - filter)

	Attribute	Value
1	Width (columns)	182
2	Height (rows)	261
3	Class	uint8
4	Image type	intensity
5	Minimum intensity	0
6	Maximum intensity	239

Figure 23 : Image Information for the Filtered Image

The filtering process removes the noise to further enhance the ridges ending and bifurcation of fingerprint. This actually gives a more presentable data for the MATLAB to differentiate between data that are pre-installed with the data prompt during authentication activity.

There are several parts that still are in progress up to this point. For instance, below is the picture of ***Feature Extraction and Image Analysis*** processes. The failure of the processor to distinguish the key bifurcation and ridges ending at the middle of the fingerprint are due to the low resolution of the camera.

Output of Feature Extraction

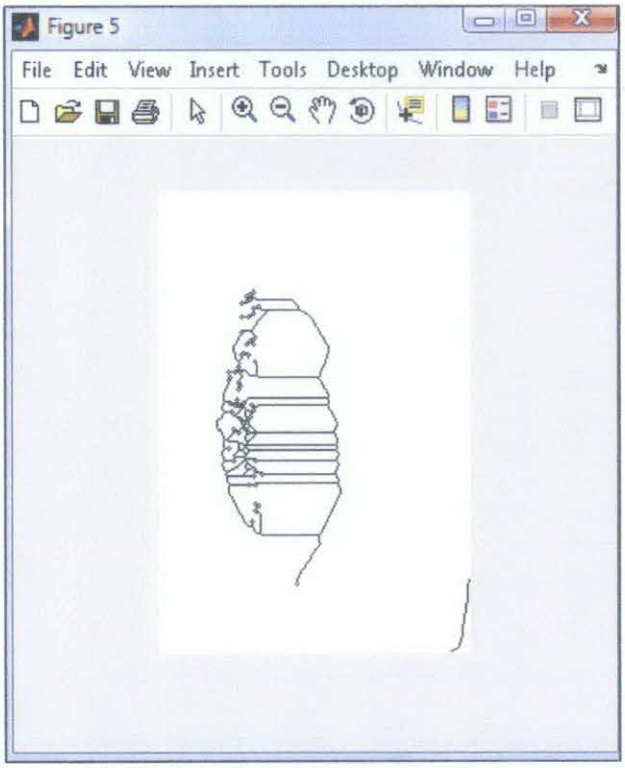


Figure 24 : Output from Feature Extraction

4.4 Discussion

There are several components that should be taken care throughout the project. The main objective is to develop a simple project prototype which is able to simulate and run fingerprint authentication system. Moreover, the study of integration of car ignition systems also needs to be done as a pre requirement of the overall project. Unfortunately, the cost constraint and time limitation would be hassle along the project cycle. The end result from the MATLAB Coding seems not encouraging due to the parameter given from used digital camera. The output did not precisely show the fingerprint layer and only concentrated at the left side of the picture (Figure24). The expected result of the real simulation and testing is the successful fingerprint layer that is compared with database and reflected from the raw picture of digital camera. Then in the other hand, the succeed result will send a signal to car ignition systems by RS232 communication cable. Furthermore, MATLAB coding that is implemented in the project also can be improved by some modification of the algorithms. The used digital camera gives about four-mega pixel output compared with actual fingerprint scanner which is using advanced optical devices provided with heat detector. So the end result can be improved by using high end optical devices and modification of MATLAB coding.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Personal Authentication Systems plays a vital role in enhancing the security systems in human life. Due to that matter, the advanced systems need to be invented in order to increase the reliability of the technology and maintain the effectiveness of the systems. Research of the current systems will enable us to determine the best solution to boost the technology into maximum capacity. Besides that, the application of the systems also might be wider since human are able to explore new approaches for design and integration of the systems into some other complex technologies. The critical parameters to be looked into are the architecture of the authentication systems, devices, peripheral and the overall application of output systems. Further progress of the project would be the enhancement of the output quality and MATLAB modification before the final presentation.

5.2 Recommendation

The fingerprint authentication systems could be improved by some methods. One of the main considerations for improvement is the usage of Digital Camera which equipped with higher pixel capability to increase accuracy and precision of consumer's fingers. Moreover, the Matlab coding also can have a huge boost by some modification in the Computer Vision and Image Processing Techniques. Other than that the communications interface for human and Personal Computer also can be increased its capability by adding some buttons for user-friendly and increased accuracy.

For a recommendation, more research and upgraded techniques is needed to ensure their reliability as well as maintenance-friendly. Furthermore, the second part of the project which includes the integration of Car Ignition Systems is not well established for prototype, so hopefully some other students will continue this project in some other time. For future planning, there should be another back-up system if failure occurs during the start up process.

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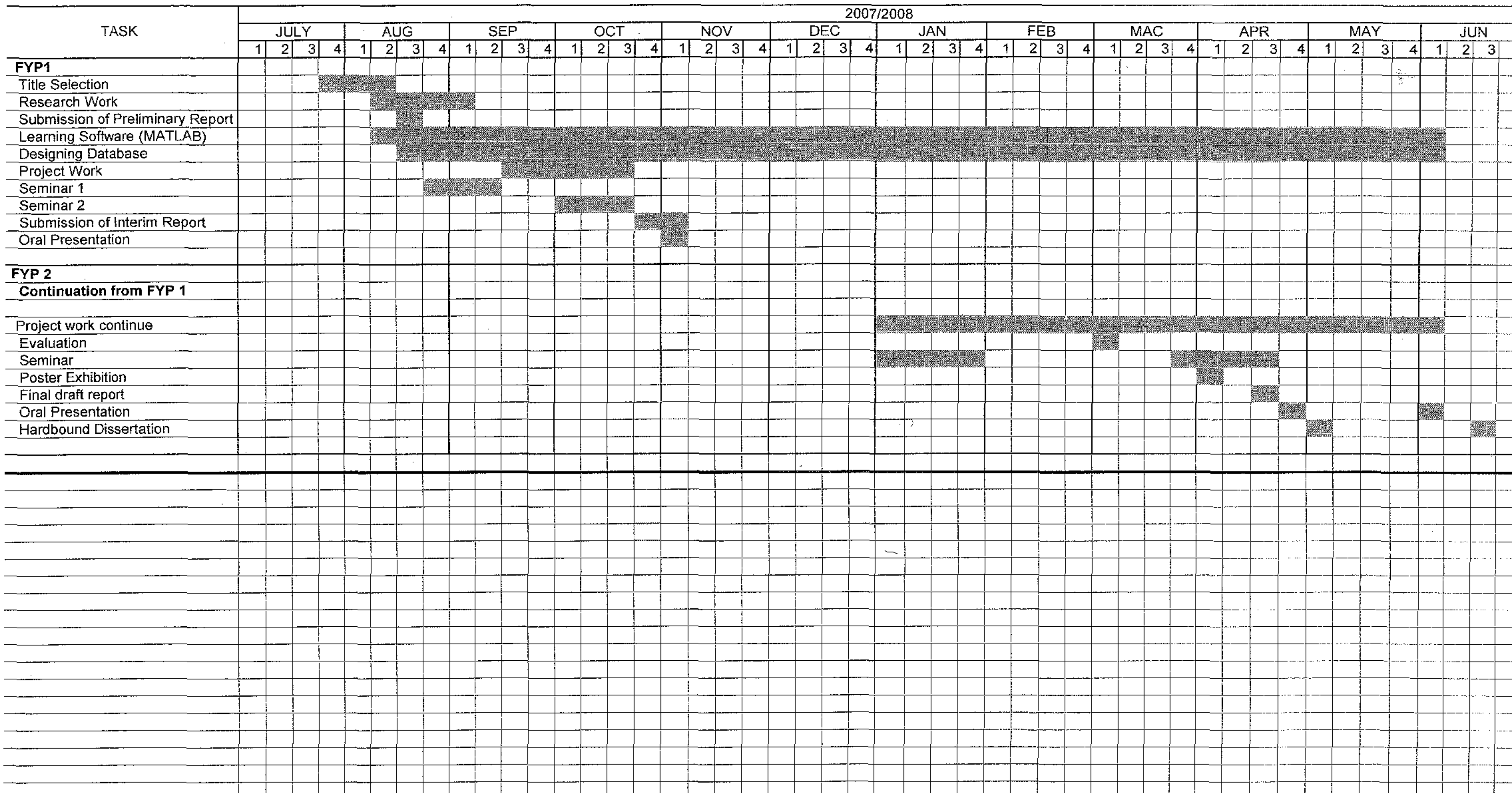
APPENDICES

APPENDIX A

GANNT CHART

FINAL YEAR DESIGN PROJECT SCHEDULE



APPENDIX B

CAMERA SPECIFICATION

12 Appendix

Camera Specifications

Kodak EasyShare DX6440 zoom digital camera		
Color		24-bit, millions of colors
Color modes		Color, black & white, sepia
Communication with computer		USB, via: USB cable; EasyShare camera dock 6000; or printer dock 6000
Dimensions	Width	4.3 in. (109 mm)
	Depth	1.5 in. (38 mm)
	Height	2.5 in. (64.5 mm)
	Weight	7.8 oz (220 g) with battery and card
Exposure metering		Multi-pattern/Center weighted, center spot TTL-AE with program modes
File format	Still	JPEG/EXIF v2.2
	Video	QuickTime
	Audio	G.711
Flash	Modes	Auto, Fill, Red-eye, Off
	Range	Wide: 1.6-16.7 ft (0.5-5.1 m) f/2.4 Tele: 2.5-8.5 ft (0.75-2.6 m) f/4.8
	Charging Time	Less than 9.0 seconds with charged battery
Focus zone		Multi-zone, center zone
Image sensor	1/2.5 in. interline transfer CCD, 4:3 aspect ratio, RGB Bayer CFA, 4.23 M pixels (2408 x 1758 pixels)	

Kodak EasyShare DX6440 zoom digital camera		
ISO speed	Automatic	100 to 200
	Manual	100, 200, or 400
	Long time exposure	100
	Flash	120 or 180 (Automatic)
	Video	100 to 800
Lens	Type	Optical quality glass, 6 groups/7 elements (2 aspherical lenses)
	Aperture	Wide: f/2.2 - f/5.6; Tele: f/4.8 - f/13
	Focal Length	33 - 132 mm
	Focus Distance	Standard Wide: 19.7 in. (50 cm) to infinity Standard Tele: 29.5 in. (75 cm) to infinity Close-up Wide: 3.9 to 23.6 in. (10 cm to 60 cm) Close-up Tele: 9.8 to 33.5 in. (25 cm to 85 cm) Landscape: Fixed focus
Liquid Crystal Display, LCD (Camera screen)		1.8 in. (45.7 mm), color, 560 x 240 (134k) pixels. Preview rate: 24 fps
Operating Temperature		32 to 104° F (0 to 40° C)
Picture/Video storage		16 MB internal; optional SD Card or MMC
Pixel resolution	Best ★★★	2304 x 1728 (4.0 M) pixels
	Best (3:2) ★★★	2304 x 1536 (3.5 M) pixels
	Better ★★	1656 x 1242 (2.1 M) pixels
	Good ★	1200 x 900 (1.1 M) pixels

Kodak EasyShare DX6440 zoom digital camera		
Power	Battery: CRV3 (included), 2-AA lithium, 2-AA Ni-MH, Ni-MH rechargeable battery pack (included with camera dock 6000 and printer dock 6000)	
	AC adapter: 3V DC (purchase separately)	
Self Timer		10 seconds
Tripod socket		Yes
Video Out		NTSC or PAL selectable
Video resolution		320 x 240 pixels, 15 fps
Viewfinder		Optical, with diopter adjustment
White balance		Auto, Daylight, Tungsten, Fluorescent
Zoom (still capture)		4X optical, 3.8X digital

Shutter Speeds

For shutter speeds slower than 1/30 second, place the camera on a flat, steady surface or use a tripod.

Picture Taking Mode	Available Shutter Speeds
Auto, Portrait, Landscape*, Close-up, PAS-Program and Aperture priority modes	Wide: 1/2200-1/60 sec., Tele: 1/2200-1/125 sec. Wide: 1/2200-1/8 sec., Tele: 1/2200-1/8 sec. (Flash: Off) *Long Time Exposure: 4 sec. max. (Landscape only)
Night	1/2200 to 1/2 sec.
Sport	Wide: 1/2200 to 1/60 sec., Tele: 1/2200 to 1/125 sec. Wide: 1/2200 to 1/30 sec., Tele: 1/2200 to 1/60 sec. (Flash: Off)
PAS-Shutter priority	1/2200 to 4 sec.

Original Factory Settings

Feature	Factory Setting
Adv. Digital Zoom initiation	Pause
Color Mode	Color
Date/Time	2003/01/01; 12:00
Date/Time Stamp	Off
Default Print Quantity	1
Exposure Compensation	0.0
Exposure Metering Mode	Multi-pattern
Flash	Auto, Sport, Portrait, Night, PAS: Auto Landscape, Close-up, Video, Burst: Off
Focus Zone	Multi-zone
Image Storage	Auto
ISO Speed	Auto
Language	English
Liveview	Off
Long Time Exposure	None
Manual (PAS) mode	Program mode (P)
Orientation Sensor	On
PAS - Aperture PAS - Exposure Compensation PAS - Shutter Speed	f2.8 0.0 1/60
Picture Quality	Best
Quickview	On