FACOGNITION

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FACOGNITION

Siew Kok Yee

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2016

DECLARATION

I declare that this thesis entitle "Facognition" is the result of my own research except as cited in the references. This thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

STUDENT : _____ **Date** : 18/8/2016

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I hereby declare that I have read this project report and found this report is sufficient in term of the scope and quality for the award of Bachelor of Computer Science (Artificial Intelligence) With Honours.

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(ZAHRIAH BINTI SAHRI)

DEDICATION

To my beloved family and friends.

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ABSTRACT

Facognition is a computerized system that combine face detection and face recognition technique that detect and recognize human face. Human have an extraordinary ability that recognizes faces in different poses. Unlike human, computers do not have that kind of ability to recognize people and to distinguish what a face is. Therefore, it become highly desirable and challenging that replicate this human ability into a computer in which what we called face detection and recognition. In Facognition, face is detected using Haar cascade algorithm while the algorithm used in face recognition is Principal Component Analysis. The accuracy of face detection of Facogniton is 79.50% while accuracy in face recognition is 68.92%, Facognition can be used as biometric authentication or can be used in other security areas. To conclude, Facognition is successfully developed to detect and recognize multi faces in a picture as well to show information of the recognized face

ABSTRAK

Facognition adalah salah satu sistem yang menggabungkan teknik pengesanan wajah dan pengecaman wajah untuk membantu komputer melaksanakan pengesanan and pengecaman wajah manusia. Manusia mempunyai keupayaana yang luar biasa iaitu dapat mengecam wajah dalam pelbagai posing. Komputer sebaliknya tidak manusia mempunyai keupayaan untuk mengecam wajah dan juga tidak dapat membezakan apa itu wajah. Oleh itu, system computer yang boleh mengesan dan mengecam wajah merupakan salah satu cabaran yang tinggi untuk merealisasikannya. Algoritma yang digunakan dalam Facognition untuk pengesanan wajah ialah Haar Cascade dan algoritma yang digunakan untuk pengecaman wajah ialah Principal Component Analysis. Ketepatan Facognition dalam pengesanan wajah adalah 79.50% dan ketepatan dalam pengecaman wajah adalah 68.92%. Facognition boleh digunakan untuk pengecaman biometrik atau boleh digunakan untuk sistem keselamatan dan lain-lain. Konklusinya, Facognition berjaya dibangunkan dan berupaya melaksanakan mengesan dan mengecam banyak wajah dalam satu gambar serta mengeluarkan informasi yang betul.

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HOG	-	Histogram of Oriented Gradient
LBP	-	Local Binary Pattern
LDA	-	Linear Discriminant Analysis
PCA	-	Principal Component Analysis
RBFN	-	Radial Basis Function Network
SVC	-	Support Vector Classifier
SVMs	-	Support Vector Machines

CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter will discuss the background of facognition. Other than that, this chapter also states the problem statements and aims of this study. The scope will includes the limitation of this study and the software and hardware needed in this study. Last but not least, the commercial value and benefit gained of this study will express in the significance of study.

1.1 Background of the study

Human have an extraordinary ability that to recognize faces in differences of pose (Raut et al., 2015). It became highly desirable and challenging that to replicate the ability into computer in which what we called face detection and recognition (Bakshil and Singhal, 2014; Raut et al., 2015). Singh and Gupta (2015) listed out different kinds of biometric appliance that using face detection and recognition. However, it is complicating to build the computational model of face detection which is affected by internal and external factors as highlighted by Al-allaf (2014), Zhu and Ramanan (2012), Al-Ani and Al-Waisy, 2011, and Sharma et. al.(2011).

Face detection is an examination process that to discover the face from the input image or video (Kumar S.K. et al., 2014; Garrido et al., 2008; Viraktamath et al., 2013) while face recognition is to identify face and verify the person from the input image or video (Singh et al., 2014; Balasuriya and Kodikara, n.d). Sato et al. (2005) demonstrated the two main tasks for face detection. Face detection is widely used in many application where pointed out by Singh et al. (2014), Al-Ani and Al-Waisy (2011) as well as Bhat and Pujari (2013).

Nowadays, face recognition become more famous and getting more attention (Paul and Suman, 2012; Suhas et al., 2012). There are some reason why face recognition become popular have been explained in Zhao et al. (2003) which cited in Suahas et al. (2012). Face recognition is usually used for authentication which are identification and verification, there are many application that using face recognition such as security area, surveillance, and so on (Bakshil and Singhal, 2014; Bhat and Pujari, 2013; Sato et al., 2005).There are many studies showed that before proceeding to face recognition, face detection should be completed (Bhat and Pujari, 2013; Wayman, 2005 cited in Al-Ani and Al-Waisy, 2011; Al-allaf, 2014). Several research found that there are few steps process which is suitable for any algorithm for face detection and recognition in their research (Rao et al., 2015; Bhat and Pujari, 2013; Rahman et al., 2013; Al-allaf, 2014). Bhat and Pujari (2013) explained several methods with supervised and unsupervised learning that can use for face recognition. They also highlighted the difference databases and the limitation of the databases in their research. In addition, Kumar et al. (2011) pointed out 3 type of approach for face recognition to form still image which are holistic approach, hybrid approach, and feature-based approach.

1.2 Problem statements

These studies (Balasuriya and Kodikara, n.d.; Bhusari and Raut, 2014; Philip, 1999 cited in Seisele et al., 2007; Al-Ani and Al-Waisy, 2011) found out that the facial features and illumination or complex background of image will reduce the face detection rate. To address this problems, Singh et al. (2014) used colour model, YCbCr for face detection, because they believe that the pixel value of human skin colour is unique, so that using the colour model will making face detection done efficiently. Al-Ani and Al-Waisy proposed approaches that using kernel method with Principal Component Analysis (PCA) for feature extraction and Support Vector Classifier (SVC) as classifying function in face detection that can solve the illumination condition problem.

In Sato et. al. (2005) and Kumar et. al. (2011) research, they claimed that global image variation (illumination and pose) and local image variation (facial expression) influenced the face recognition accuracy. According to Sato et. al. (2005), global image variation can be solved by using model based approached while local image variation can be solved by develop an adaptive region to map the matches image.

Besides that, Al-allaf (2014) and Balasuriya and Kodikara (n.d.) also stated that face recognition is difficult to get higher accuracy because of the similarities of human faces. Balasuriya and Kodikara (n,d.) suggested that using PCA is a way to increase the face recognition accuracy because PCA are not identifies human faces by using the geometrical differences (for example the length of nose or width of eye bow) but using the Eigen faces.

1.3 Objectives of the research

The aims of this research are:

a) To be able to detect multi people face
b) To display the information (id, name, age, birth of date, gender, education level and course taken) of the person after face recognition had done

1.4 Scopes of the study

- Facognition cannot recognize places, animals and objects
- This system is PC-based
- This system only contain 16 people's information.

1.5 Significance of study

Facognition can used for biometric authentication which using face recognition to authenticate the user. Other than that, this system can also been used in guard-house to authenticate the tenant or student, so that can cut down the rate of unauthorized people enter the private area by passing through guard-house there. Furthermore, this will also very helpful for old man or some people who difficult to remember people faces to recall back their memory from picture, but however they need to keep update their new photo to make system know their new friends.

1.6 Conclusion

Face detection and recognition are widely famous around the world, there are many researcher doing research by using other techniques to meet the desirable of people. However, currently the accuracy of face detection and recognition are unstable due to the quality of image. Therefore, in this project, a module will be created to achieve the aims that listed previously. To conclude, Facognition will benefit to many people. In next chapter, a details of study will be explained detail together with the techniques and process that used for face detection and recognition in Facognition

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter, the techniques, methods, process and approaches for face detection and face recognition from other research are discuss.

2.1 Face detection

Before performing the face recognition, the process of face detection should be completed (Bhat and Pujari, 2013; Wayman, 2005 cited in Al-Ani and Al-Waisy, 2011; Al-allaf, 2014). Several studies showed that face detection is challenging task because it will influenced by some factors such as illumination and complex background, facial features, pose and more (Balasuriya and Kodikara, n.d.; Bhusari and Raut, 2014; Philip, 1999 cited in Seisele et al., 2007; Al-Ani and Al-Waisy, 2011).

There are many research that have proposed some approaches and techniques for face detection in order to overcome the problems of face detection. Al-Ani and Al-Waisy (2011) proposed an idea for multi-view face detection that using kernel method with Principal Component Analysis (PCA) and Support Vector Classifier (SVC). The kernel method will generalize the PCA and SVM from linear to non-linear, and it will also perform the nonlinear mapping in the input space.

Singh et al. (2014) and Rahman (2013) have an opinion on face detection that to perform skin detection first before detect the face region because the pixel value of human skin color is unique, so that it can making face detection efficiently. The method suggested by them is using the color model, YCbCr because the color model can remove the illumination part, the details of the model how exactly how it works was explained in their research.

Huang and Fuh (2009) proposed that using Histogram equalization and Adaboost for face detection. Histogram equalization is a method that to enhance the contrast element in the image which making the darkness area become darker and white area vice versa while Adaboost is used for perform face detection (Huang and Fuh, 2009).

Haar cascade/ classifier is one of the methods of face detector created by Viola and Jones (Huang and Fuh, 2009; Wang, 2014; Cho et al., 2009). There are some explanation of Haar had been explained in the paper of Huang and Fuh (2009) and Cho et al. (2009) and the more details had been highlighted by Wang (2014).

In Ahmad et. al. (2012) research, they using 3 different technique for face detection which are Adaboost with Haar, Adaboost with Local Binary Pattern and Suppot Vector Machines with Histogram of Oriented Gradient. Their result shows that adaboost with haar is most accurate (96.7%) than the adboost with LBP and SVM with HOG. In singh et. al. (2014) research, the percentage of success rate by using YCbCr for face detection with different external factor are only 95%. For Al-ani and Al-waisy (2012) research, the average of success rate in face detection with KPCA and KSVM are only 95%.

2.2 Face recognition

In Kumar et al. (2011) research, they showed the techniques to perform face recognition. They highlighted the five common basic used algorithm that use in face recognition by using Neural Network, Geometrical Feature Matching, Graph Matching, Eigenfaces, and Fisherface, the explanation of the five algorithm have been exaplined well in their research. In addition, they also describe the techniques to do the feature extraction for face recognition.

According to Oommen et al. (2014), face recognition is to identify or authenticate a person from an input (image or video). The mainly process for recognition are feature extraction, data reduction and recognition or classification. The explanation for the three process had been explained in their research. They believe that PCA was the effective method which had been also pointed out in their research.

Paul and Suman (2012) proposed Principal Component Analysis (PCA) and Eigen face approach for face recognition. There are some explanation on PCA have been explained in their research and the benefits to use PCA method is because its simplicity fast, and insensitivity changes on the face such as pose. However, this method can only recognize vertical frontal view face image.

Arora (2012) proposed same method as Paul and Suman (2012) did which she using PCA with Eigen faces on real time application. Her studies showed the elaboration and comparison of some main traditional approaches and some popular techniques of face recognition. From her result, it shows that PCA using Eigen faces are good for face recognition however it limited to some problems which are light variation, size variation and head orientation.

Suhas et al. (2012) have conducted an experiment that to compare the Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) in face recognition. PCA is a technique that can reduce the dimension of an image to remove the redundancy while LDA is a method that to classify object by linearly separated. They conducted two experiments in their research that each experiment using one method and both using different database images. The result show that both are suitable to use for face recognition.

In Paul and Suman's (2012) and Suhas et al.'s (2012) research, they both proposed PCA technique to perform the face recognition, their results showed that PCA can successfully recognize faces even the image is blur or face with pose variation. Singh et. al. (2014) stated that PCA is a recognition technique which is fast algorithm and compare to other techniques, it is simple.

2.2.1 Principal Component Analysis

In Abdullah et.al. (2012) studies, PCA is an approach that decompose the image become small set features characteristics of face which called Eigen faces. The small set of characteristic feature will be used to represent the existing faces image and new faces image. There are several step to perform PCA algorithm.

First of all, the dimension / resolution for all the faces image must same, then It will transform each of image matrix to equal image vector V_i, therefore, the training set, V, that contain vector V_i, are

$$\text{Training set } V = [V_1\ V_2\ \ldots..\ V_M] \quad (1)$$

, where M is the total number of image that store in training set

Next, calculate mean face (Ψ) which is the average of the vector

$$\Psi = \frac{1}{M}\sum_{i=1}^{M} V_i \quad (2)$$

Follow by, calculate each image of the deviation vector

$$\Phi_i = V_{i-} \Psi, \quad i = 1, 2 \ldots M \tag{3}$$

After that, create another matrix A, that to store all the deviation vector, A = [Φ_1, $\Phi_{2,,}$ ……. Φ_M], then calculate the Eigen face with covariance matrix of C.

$$C = A.A^T \tag{4}$$

Since the dimension C is large then we create another matrix L with size (M_T X M_T) which same as matrix C but it reduces the dimension. To obtain the eigenvectors of C by using matrix L with the formula 5.

$$U_i = A*V_i \tag{5}$$

Where U = eigenvector C, V = matrix L

The result of Eigen face, ef are

$$ef = [U_1, U_2, \ldots\ldots U_M] \tag{6}$$

Subsequently by weight all the eigenvector ω_i as image in Eigen space. The Eigen space is selected by highest m' <= M. Later, the weight matrix, Ω and average class projection, Ω_Ψ is calculate.

$$\omega_i = U_i^T (V - \Psi), I = 1, 2, \ldots, m' \tag{7}$$

$$\Omega = [\omega_1, \omega_2, \ldots \Omega_{m'}]^T \tag{8}$$

$$\Omega_\Psi = \frac{1}{X_i} \sum_{i=1}^{X_i} \Omega_i \tag{9}$$

Last but not least, using Euclidean distance, δ_i to find the distance between two face keys vector and the smallest distance will be considered as the match result.

$$\delta i = || \Omega - \Omega_{\Psi i} || = \sum_{k=1}^{M} (\Omega_k - \Omega_{\Psi ik}) \tag{10}$$

2.3 Image pre-procesing

The accuracy of face recognition are always affected by many conditions, and the most troublesome problem on face recognition was the image with complex lighting condition (Anila and Devarajan, 2012; Tan and Bill Triggs, 2007). There are some methods to overcome this problem which are model-based and pre-processing based (Anila and Devarajan, 2012). Other than complex condition, the image quality are also one of the factors that affect the accuracy of face recognition. To address this problem, Dharavath et. al. (2014) recommended that using some technique of the image processing to enhance and increase the quality of image in order to increase the accuracy of face recognition.

Dharavath et. al. (2014) conducted an experiment that to using combination of image processing techniques before perform face recognition, the steps are face detection and cropping, image resizing, image normalization and image De-noising and filtering. In addition, they also demonstrated different feature extraction techniques after pre-processing which are Eigen face based approach, discrete cosine transform and combine approach which is a combination of both techniques. According to them, a pre-processing for the image are necessary to de used before face recognition for getting better accuracy of recognition rate.

Miljkovic (2009) claimed that image pre-processing are the operation of the first level of abstraction for improve image data and enhance important feature for further process. In his research, he stated some of the image pre-processing method that in Matlab. He listed out and explained the used for the methods in details.

In Anila and Devarajan (2012) research, they listed out some of the common used techniques of pre-processing for image recognition. They proposed some combination techniques of pre-processing method that are used for eliminate the problem of variety illumination condition of image and the techniques are gamma correction, DOG filtering and follow by contrast equalization. The method they proposed shows a better result when

compared to logarithmic and histogram equalization when face images were taken in some illumination condition.

Tan and Trigg (2007) suggested that the pre-processing stage using gamma correction, difference of Gaussian filtering, robust contrast equalization and nonlinear function that using hyperbolic tangent function. In their research, the details for the pre-processing process had been explained well, and when using it together with recognition algorithm such as local binary patterns and local ternary patterns, the accuracy of recognition rate with suing FERET dataset was achieved more than 99%.

2.4 Process of face detection and face recognition

According Zuo (2006) cited in Al-Allaf (2014), a processing stages that fulfill the requirements of an application can archive high performance in face detection and recognition. Before proceeding to face recognition, face detection should be completed (Bhat and Pujari, 2013; Wayman, 2005 cited in Al-Ani and Al-Waisy, 2011; Al-allaf, 2014). Rao et al. (2015), Bhat and Pujari (2013), Rahman et al. (2013) and Al-allaf (2014) showed the processing stage for face detection and face recognition. The processing stages for face detection and face recognition are shown as below:

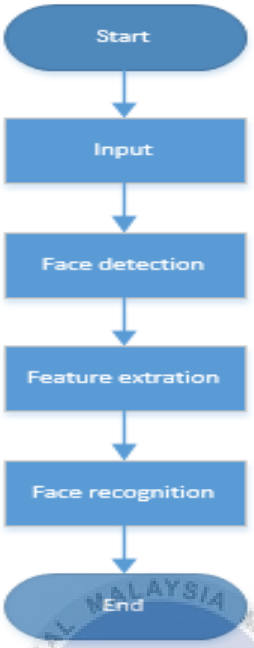

Figure 2.1: Process stages of face recognition

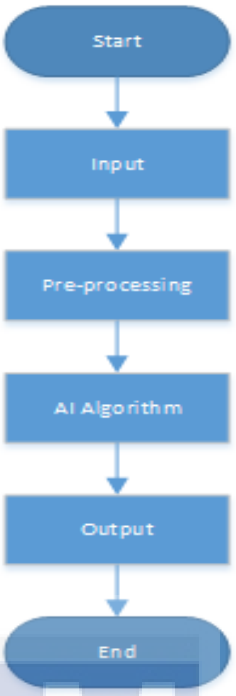

Figure 2.2: Process stages of face detection

There are four stages in face recognition which has shown in Figure 2.1. The initial stage for face recognition is to input image or video. Next is face detection which is to detect faces so that it can focus computational resources in order to increase the speed and performance (Al-Allaf, 2014). The third stage for face recognition is feature extraction which to perform face synthesis that to extract the local feature, the localize images (raw data) is used for next stage. Last stage is face recognition which will compare from database and find the most similar face.

For figure 2.2 is the process of face detection, it consist 4 stages which are input, pre-processing, classifier and output. Firstly is to input image or video. Secondly, some pre-processing is perform to remove the noise and normalize image. Thirdly, after done the pre-processing, it will be calculated by using the AI algorithm to search the faces in the image. Lastly, from input image, specify the position of the face.

2.5 Conclusion

There are many techniques was proposed by many research to increase the accuracy of face detection and recognition. They also suggested some techniques to solve the problems faces by face detection and recognition. Based on the accuracy rate as stated before, the Adaboost with Haar was chosen for face detection in Facognition. In addition, since there are many researcher believe that PCA was the good technique for face recognition because it was most simple and a fast algorithm, therefore the PCA will be used in Facognition for face recognition. Pre-processing for the image is one of the approaches that to increase the quality of image and increase the accuracy of face detection and recognition. Before face recognition, face detection should be do first and we can perform some pre-processing for the image before face detection or after face detection or both. The main process for Facognition will be explained in next chapter and the requirement for Facognition will also listed out.

CHAPTER 3

FACOGNITION

3.0 Introduction

The process that to perform face detection and face recognition for Facognition are list details in this chapter. Other than that, the requirements for Facognition are also explain.

3.1 Proposed framework

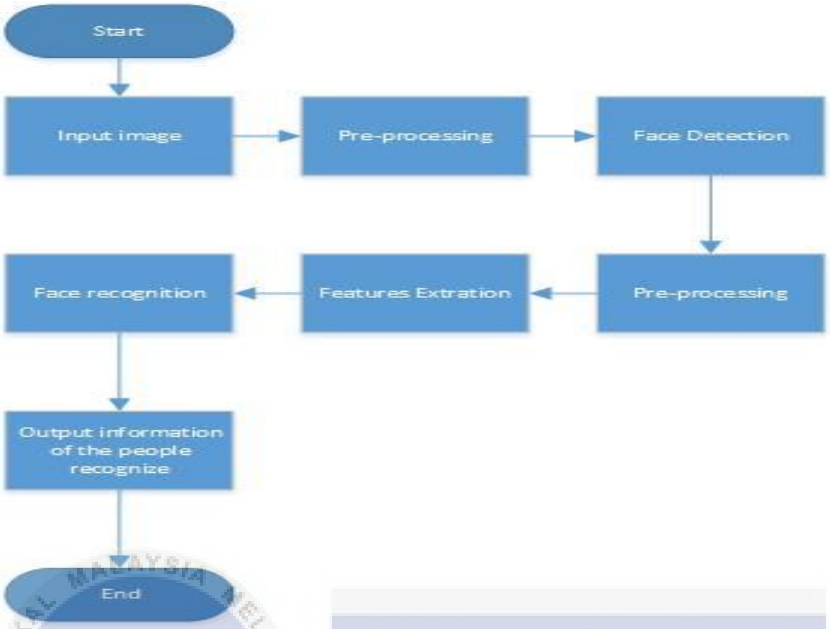

Figure 3.1: Full Process of face detection and recognition

The full process of Facognition are illustrated as Figure 3.1, in the first stage of the process, that is to select an image to perform the face detection and recognition. After input an image, a preprocessing will occur which is to resize the image. In the following stage is face detection which is detect the face/s in the image. The face detection will using the Haar cascade which created by Viola and Jones. After face detection is done, another preprocessing process is occur. In this stage, the faces will be cropped down with a 92 * 112 size and turn it into gray-scale image. Next, the features extraction will be done with Eigen faces and PCA will be the method to perform face recognition. Last, based on the result of recognition, the people being recognized will be showed out his/her information from MySQL database.

3.1.1 Input image

User can select any image with format of jpg or jpeg to undergo the process of face detection and face recognition which shown in Figure 3.2. The selected image should contain the human faces if not Facognition will useless.

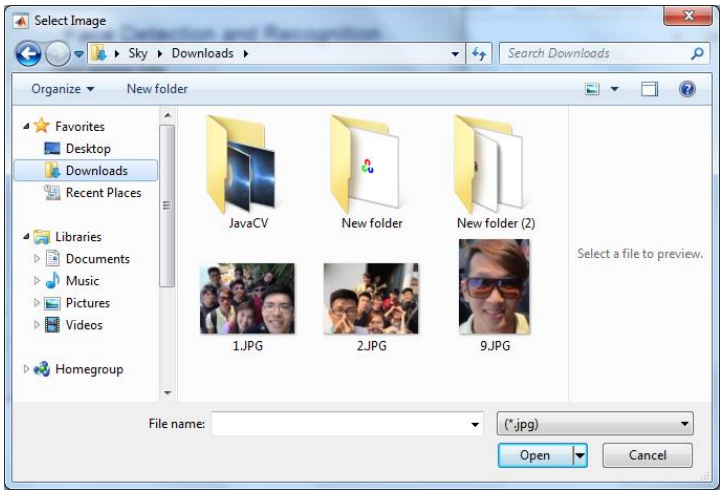

Figure 3.2: Input image

3.1.2 Pre-processing 1

The pre-processing technique for this stage are only using image resize because if the image resolution is too big, it will increase the computation time. Therefore, once user select an image, it will starting to do the image resize which lower down the resolution for image with high resolution while increase resolution for low resolution image.

The coding for resize image in MATLAB coding as shown in Figure 3.3 and its result is shown by Figure 3.4 and Figure 3.5.

```
%% check the size of image
[x,y,z] = size(I);
if(x >= 480 && y >= 640)
    if(x > y )
        A = imresize(I,[640 480]);
    else
        A = imresize(I,[480 640]);
    end
elseif(x < 100 || y < 100)
    A = imresize(I,1.5);
elseif(x < 480 && y < 640)
    A = imresize(I,[279 299]);
else
    A = imresize(I,0.5);
end
```

Figure3.3: Resize Image

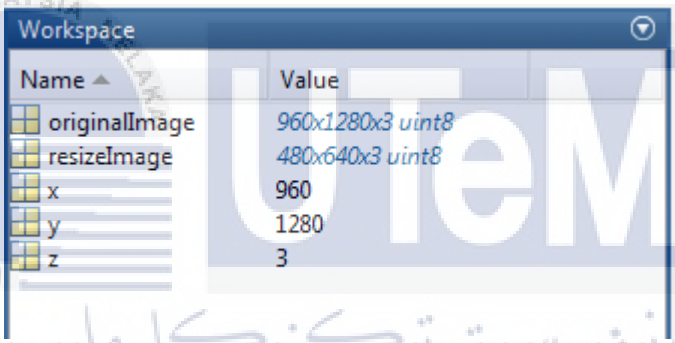

Figure 3.4: Result of image resize 1

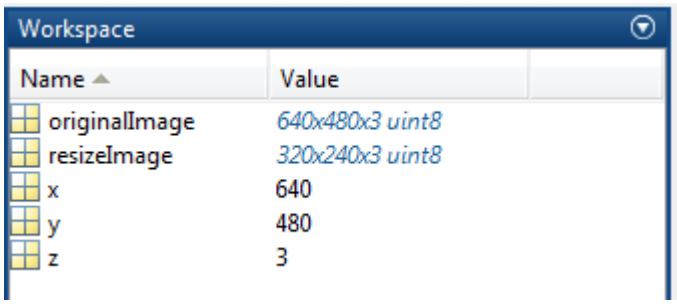

Figure 3.5: Result of image resize 2

3.1.3 Face detection

In Facognition, the face detection is done by using the code in MATLAB which is cascade object detector. Cascade object detector is a techniques that using the method of Viola and jones algorithm to detect the human faces. Wang (2014) has explain details on Viola-Jones face detection algorithm in her research. In MATLAB, the classification model for this techniques is Frontal Face CART and the merge threshold is set to 3. After finished face detection, a bounding box will cover the location of face.

3.1.4 Pre-processing 2

In this stage, the technique that use is only cropping the image and resize the cropped image. The image cropped is based on the bounding box that created from face. The reason to crop the face image is because it can increase the accuracy rate of face recognition based on several experiments did. The cropped image may not contain full face of the image, some process have been added to enlarge the bounding box. After cropped the image, it will resize to 92*112 resolution and in gray-scale a for face recognition PCA purpose. Once finish this process, then it will proceed to face recognition part.

3.1.5 Features extraction and face recognition

In this process, the techniques for features extraction is Eigen vector. It is a part of the Principal Component Analysis (PCA) in face recognition. PCA is to identify the pattern of data and express the data to highlight the similarities and differences. Details information of PCA was highlighted in the research of Smith (2002).

3.1.6 Output

After all process were done, the module will show the information of the people that be recognized from MySQL database. MySQL workbench is used to store the information of the people.

3.2 Conclusion

The main processes for Facognition are started from user to select an image input to the module, then system will starting process the image to perform pre-processing to increase the quality and increase the accuracy for face detection. After face detection, pre-processing 2 will crop the faces image frame for face recognition and later it will show the information of person which have been recognized from the image by Facognition. Next chapter will discussed the system about requirement and how its work and function.

CHAPTER 4

IMPLEMENTATION AND RESULTS

4.0 Introduction

This chapter will discuss the requirement, dataset and function in Facognition, all the function will explain well how to use and the output of the function.

4.1 Requirement analysis

This section is about to explain the requirement of the module.

4.1.1 Data requirement

In Facognition, all input are the image with JPEG and JPG format however, the output for the module are BMP format. The BMP format was in the face database and is used for face recognition where all input image will undergo the recognition algorithm and matching with the face database.

4.1.2 Functional requirement

The functional requirement of Facognition is depicted by Figure 4.1.

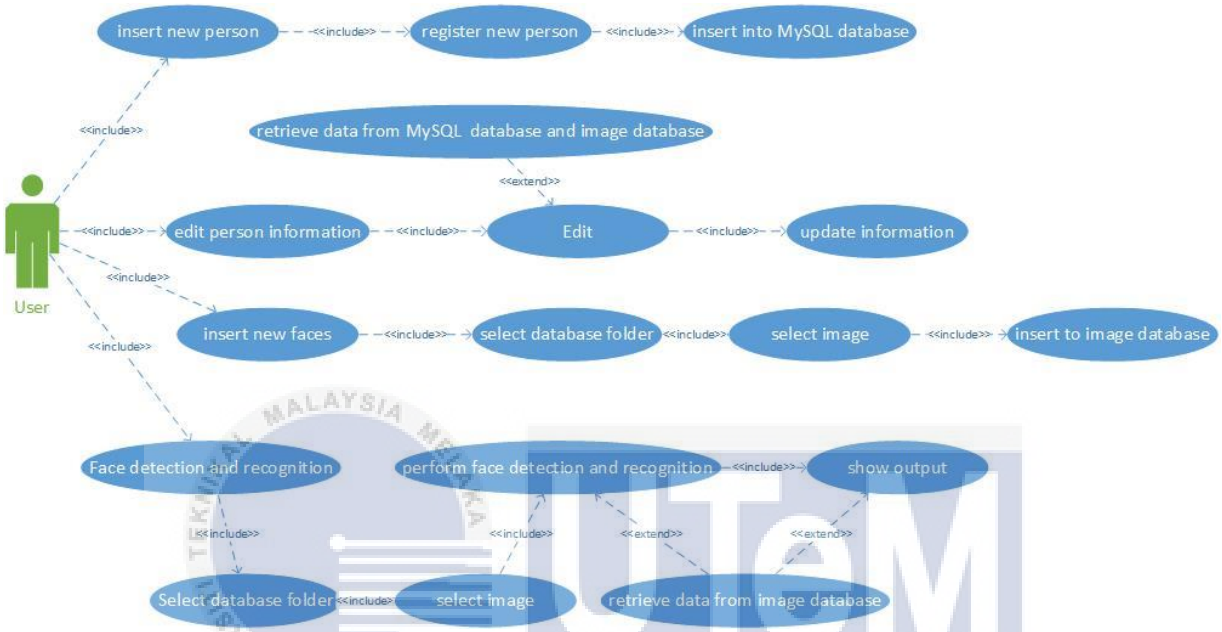

Figure 4.1: Use case diagram

4.1.3 Non-functional requirement

- Operating constraints – Facognition is using MATLAB coding and person information is from MySQL database
- Reliability – Facognition can work in low resolution image or high resolution image
- Usability – Facognition are enable user easy to understand how to use
- Availability – Facognition will only retrieve image with extension jpg or jpeg
- Flexibility: Facognition easy to load an image easily by user

4.1.4 Hardware and software requirement

The hardware requirement of Facognition was stated in Table 4.1.

Laptop / PCs

OS	Windows7
Processor	Intel I5
RAM	4GB RAM
Graphics adapter	8-bit graphics adapter and display (for 256 simultaneous colors

Table 4.1: Laptop / PCs requirement

MATLAB R2015a

Matlab (Matrix Laboratory) a programming package for solving scientific and engineering problem. Matlab provide many tools for solving some certain problem such as NN toolbox, fuzzy toolbox and more importantly image processing toolbox. In Facognition, the image processing toolbox will be used for face detection and recognition.

MySQL Workbench

A database sever that use to store raw data. Facognition will store the information of person such as id, name, age, birth of date, gender, education level and course taken.

4.2 System dataset

This section is to show the dataset from database. There are two database was used which all faces image were stored in folder as shown in Figure 4.2 and the person information were stored in MySQL workbench as stated in Table 4.2.

4.2.1 Faces image

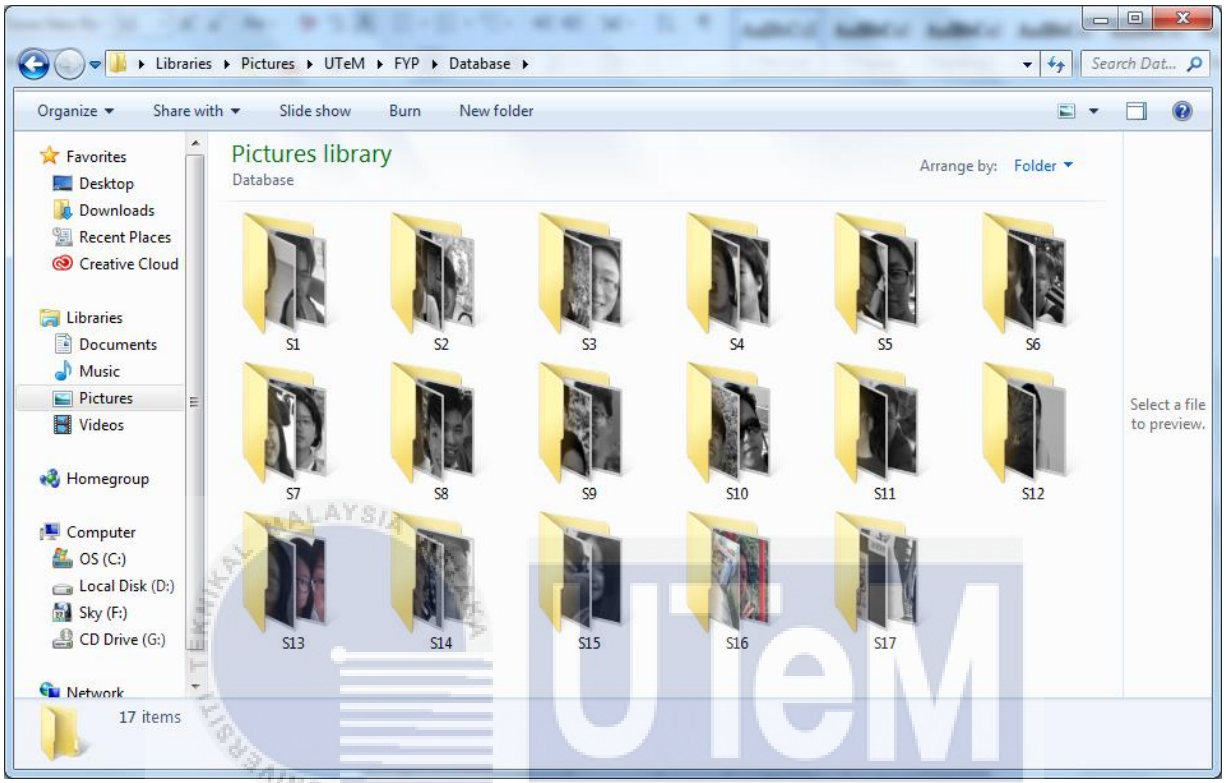

Figure 4.2: Faces database

4.2.2 Personal Information - MySql

id	Name	Age	Birth of date	Gender	Education Level	Course
S1	Siew Kok Yee	23	06-10-1993	male	Bachelor Degree	Artificial Intelligence
S10	Lim Yong Seng	23	30-6-1993	male	Bachelor Degree	Game
S11	Ho Zhen Hong	23	12-04-1993	male	Bachelor Degree	Software
S12	Sim Teong Seng	23	11-6-1993	male	Bachelor Degree	Database
S13	Liau Shuk Yee	22	14-9-1994	female	Bachelor Degree	Database

S14	Leong Chan Yee	23	null	male	Bachelor Degree	Artificial Intelligence
S15	Not recognise		null			
S16	Tan Zhi Wei	23	null	female	Bachelor Degree	Game
S17	Not face	null	null	null	null	null
S2	Chuah Chun Khian	23	null	male	Bachelor Degree	Artificial Intelligence
S3	Chiew Yee Zhi	23	12-04-1993	male	Bachelor Degree	Networking
S4	Loh Jia Jing	23		male	Bachelor Degree	Artificial Intelligence
S5	Lim Chun Heng	23	17-05-1993	male	Bachelor Degree	Artificial Intelligence
S6	Saw Wan Synn	24	06-01-1992	female	Bachelor Degree	Database
S7	Ong Lay Wui	22	17-03-1994	female	null	null
S8	Tan Shi Yuan	23	6-10-1993	male	Bachelor Degree	Game
S9	Leong Jun Jie	23	12-05-1993	male	Bachelor Degree	Game

Table 4.2: Personal Information

4.3 System function

This section will discussed the details in each function.

Figure 4.3: Main menu

In Facognition consists 4 functions which is insert new person, edit person in database, insert new faces to database and face detection and recognition as illustrated in Figure 4.3.

4.3.1 Register new person

Figure 4.4 is to insert new person information into database and create a new folder in faces database for the person.

Figure 4.4: Frame of register new person

4.3.1.1 Insert all information

Figure 4.5: Register new person

After key in all information, click confirm button.

Figure 4.6: Confirm frame

After finish typing al the information as illustrated in Figure 4.5, click confirm button and then select the face database directory. The information will save in database and it will automatic create a folder in face database. It will return to main menu after done.

4.3.2 Edit Person

After select this, user will need to select the face database before proceed to edit person frame as illustrated in Figure 4.7.

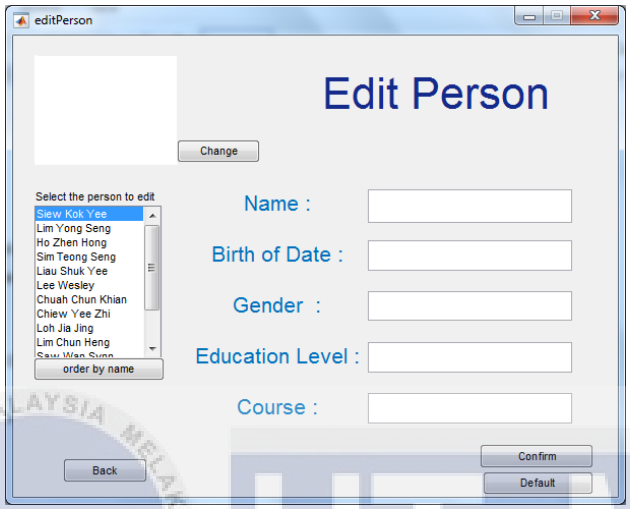

Figure 4.7: Frame for edit person

User can select the person to modify from list box. The "order by name" button is a function that to rearrange the name list from list box alphabetic as depicted in Figure 4.8.

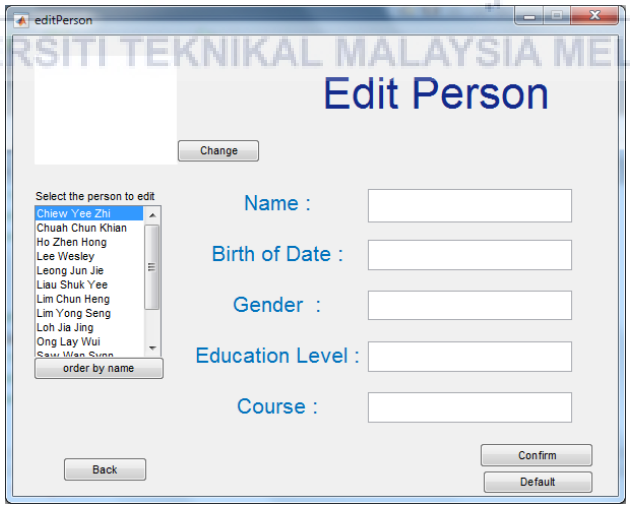

Figure 4.8: Oder by name button

Figure 4.9 is an example of select a person to modify. The information will show after

select.

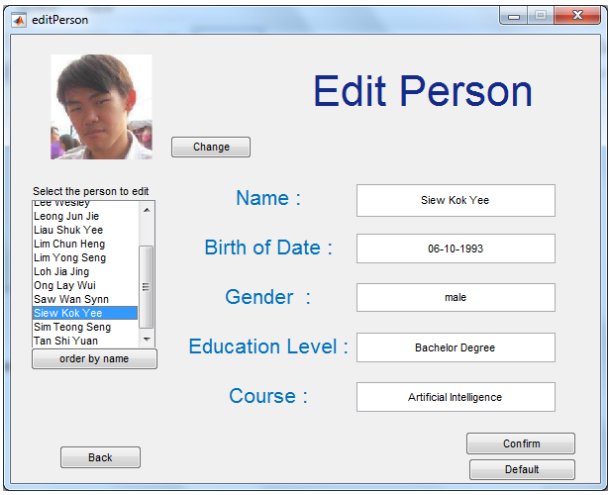

Figure 4.9: Select person to modify

The default button is reset to original information that set in database. Confirm button is alter the information of that person.

4.3.3 Insert new face into database

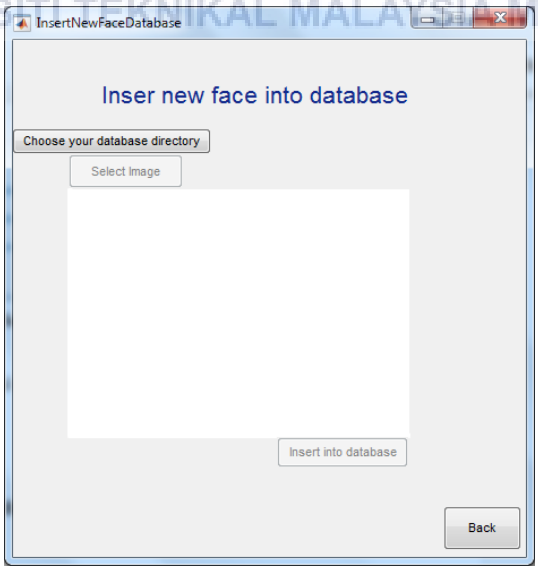

Figure 4.10: Insert new faces frame

Figure 4.10 is the fourth menu in Facogniton. After click it, user need to select the database directory of the faces database. After that, the select image button will enable as shown in Figure 4.11.

Figure 4.11: After select database directory

Select an image that contain 1 faces only to insert into database as shown in Figure 4.12. The insert into database button is enable after select the image.

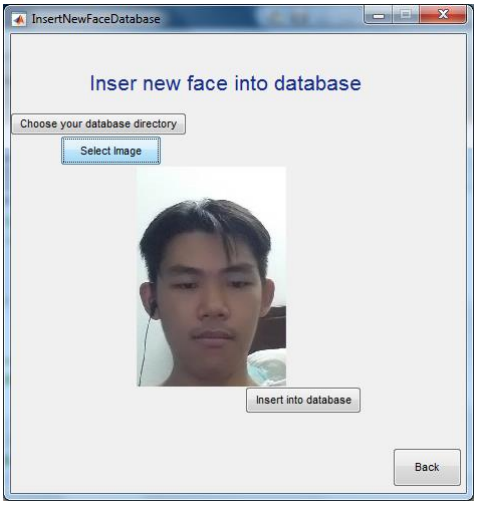

Figure 4.12: Select image

Once selected image, click insert into database. The system will pop up a frame as shown in Figure 4.13 to ask user to insert directly or perform face detection before insert into database.

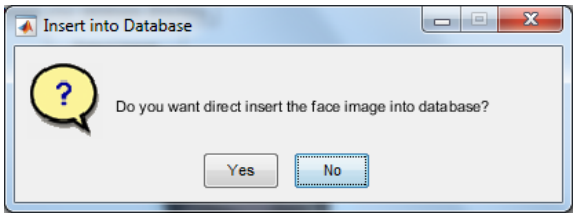

Figure 4.13: Select methods insert into database

If select Yes, the image will directly insert into faces database. User need to select who the person he/she is then the system will insert into the selected folder as depicted in Figure 4.14.

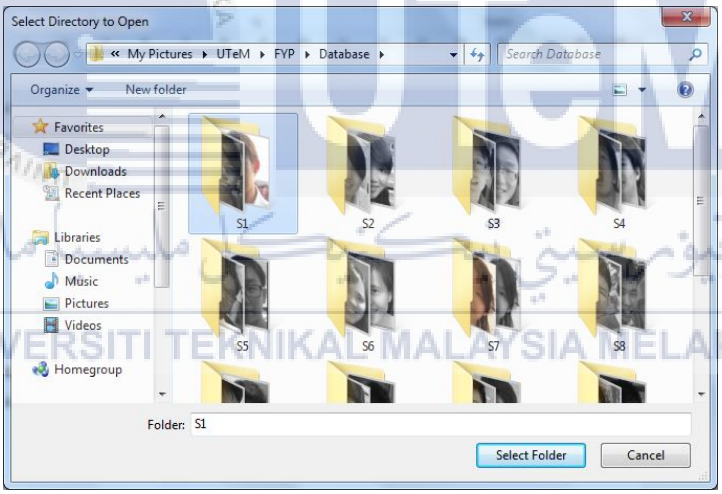

Figure 4.14: Select person

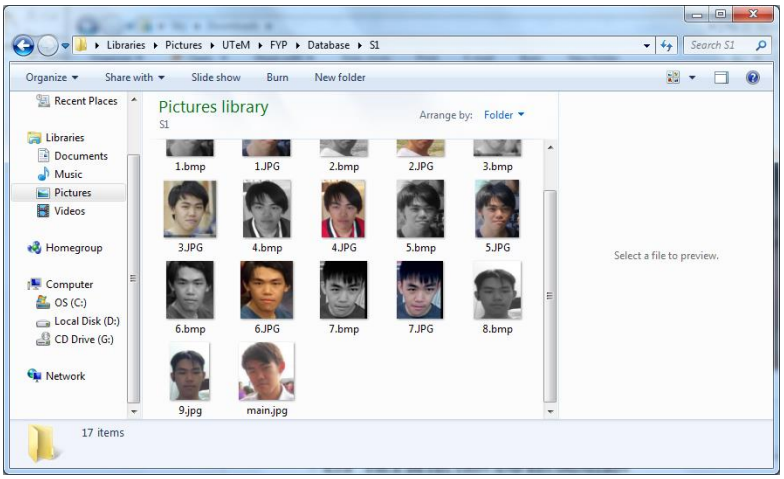

Figure 4.15: Result of direct insert

If user select No, the system will perform face detection for confirm the image contain only 1 face then some pre-processing will proceed before insert into database. After done, the system will ask for the confirmation as depicted in Figure 4.16 for insert the pre-processed image into database. If select yes, the system then will ask for which person an then it will insert into the folder as shown in Figure 4.17..

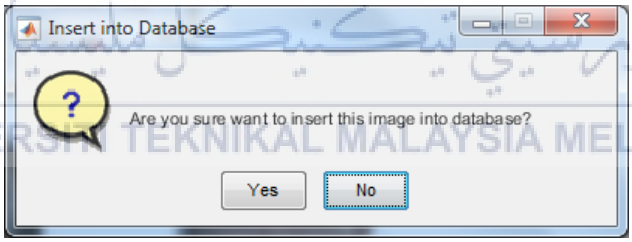

Figure 4.16: Indirect insert into database

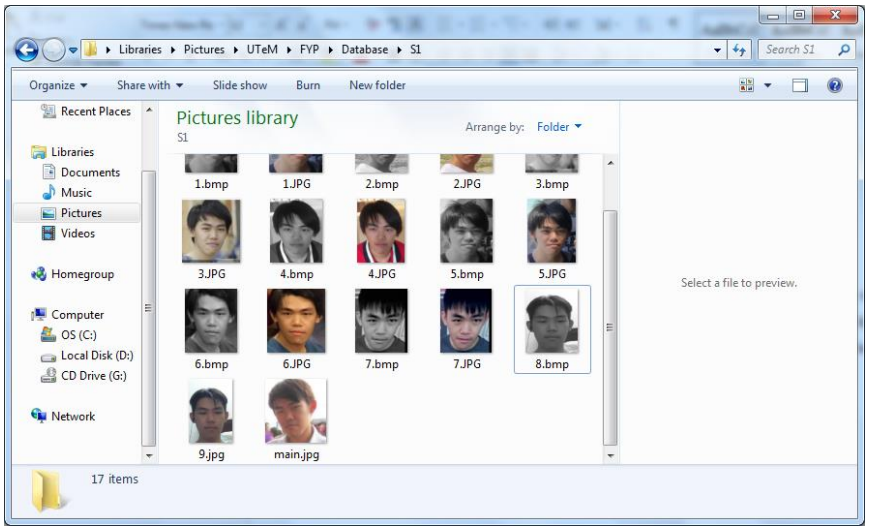

Figure 4.17: Result of indirect insert into database

4.3.4 Face detection and recognition

This part as illustrated in Figure 4.18, is to perform face detection and face recognition based on user selected image.

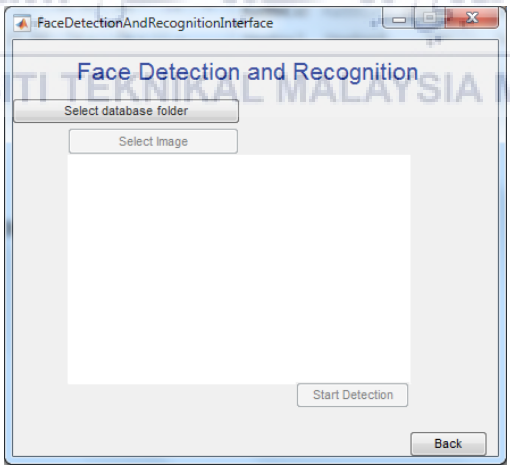

Figure 4.18: Face detection and recognition

4.3.4.1 Select database folder

User need to select the folder that contain all the faces folder as depicted in Figure 4.20. Before select, a warning message box will pop up as shown in Figure 4.19 for 2 second to remind user.

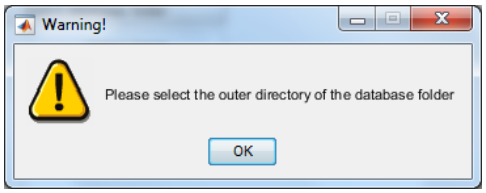

Figure 4.19: Warning for select database folder

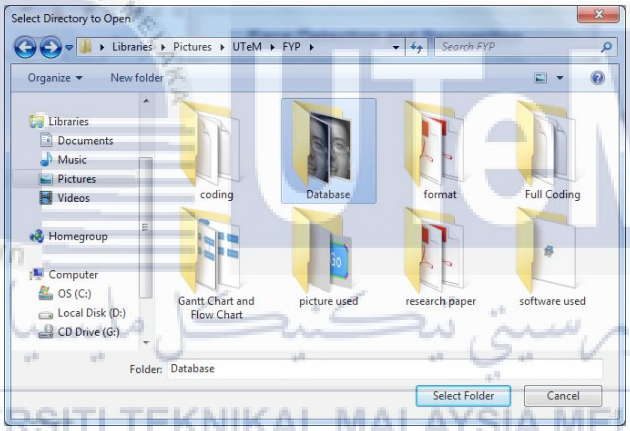

Figure 4.20: Select the folder

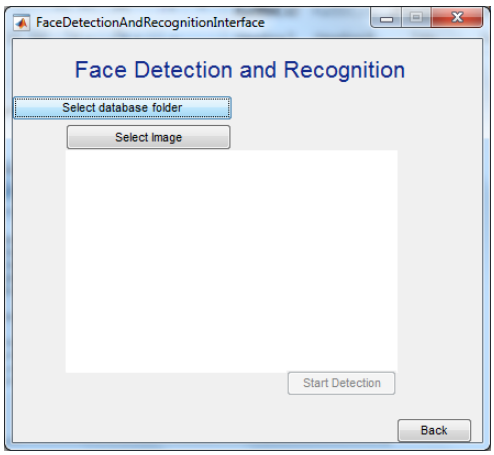

Figure 4.21: After select folder

4.3.4.2 Select image

After select the folder as shown in Figure 4.21, user can start to select image for face detection recognition as illustrated by Figure 4.22. User can select any image with jpg or jpeg format for proceed. After select, the image will show in the middle and the start detection button will visible for user to let the system do the face detection and recognition which as shown in Figure 4.23.

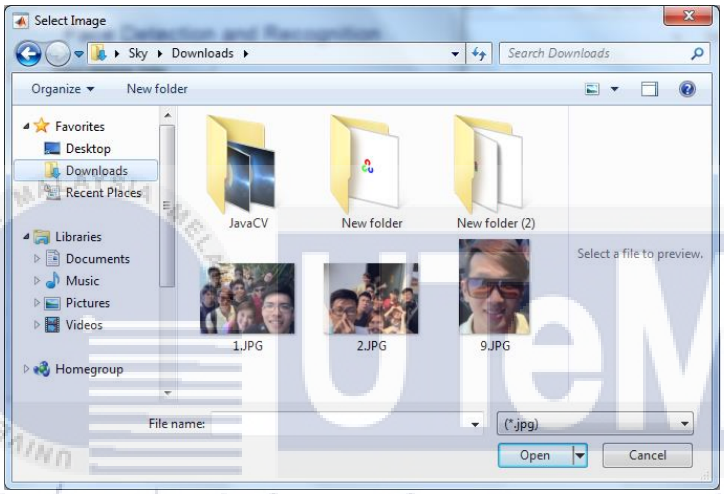

Figure 4.22: Select image

Figure 4.23: After selected image

4.3.4.3 Start detection

After selected image and user push the start detection button, the system will start to perform face detection and recognition as explained in chapter 3. After done, the detected faces figure will be showed as Figure 4.24 and another figure which shown by Figure 4.25 will pop up and shows the information of the people that been recognized as depicted in Figure 4.26.

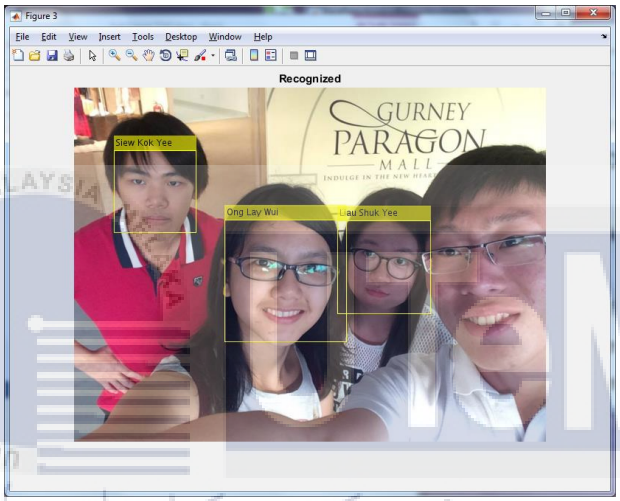

Figure 4.24: Detected faces

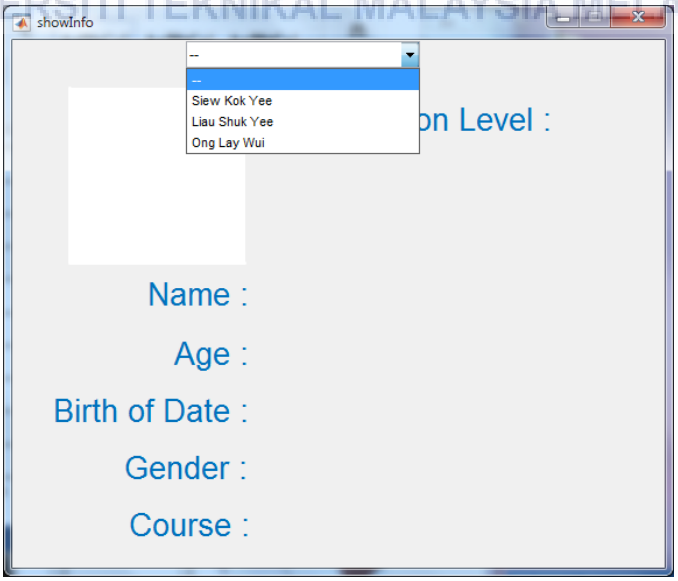

Figure 4.25: Show people information

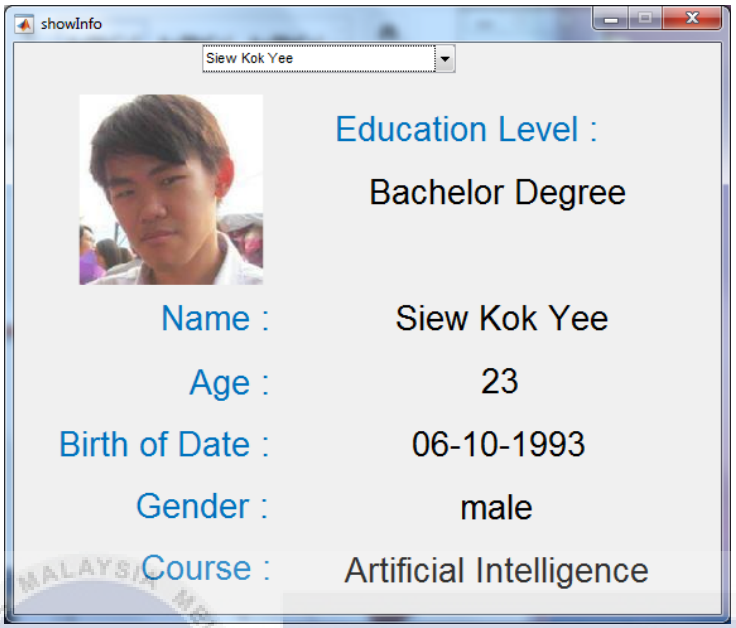

Figure 4.26: Result for face detection and recognition

4.4 Conclusion

Facognition successful to detect multi-people faces and able to show the correct information for the people be recognized. Objective was achieved and completed.

CHAPTER 5

TESTING AND ANALYSIS

5.0 Introduction

This chapter will discuss the way to test this system, and explain the results.

5.1 Test plan

Steps

1. Start the system.
2. Input any image based on test case as in Test strategy in 5.2.
3. Record the result of true detection and false detection. (This result is for face detection)
4. Record the result of correct recognize. (This result is for face recognition)

5.2 Test strategy

There are two results will be used in testing of face detection are number of correct face detected and false detected (incorrect face detected). The number of correct face detected is the

accuracy of total number of face that can detected in a picture correctly while the number of false detected is the total number of non-faces that were detected in a picture. After recorded, these result will be calculated to get their accuracy. For face recognition, the number of correct recognize was recorded and will also be calculated to get its accuracy in face recognition.

There are 8 test case for testing the accuracy of face detection and face recognition:

1. 10 picture with contain no face
2. 10 picture with contain 1 face
3. 10 picture with contain 2 face
4. 10 picture with contain 3 face
5. 10 picture with contain 4 face
6. 10 picture with contain 5 face
7. 10 picture with contain 10 face
8. 10 picture with contain more than 10 face

There are no restriction of selecting the picture for testing. The selection of picture are randomly select.

5.3 Test results and analysis

5.3.1 Testing on face detection

Number of face per picture, a	Total number of picture, b	Total face, b = a * b	Number of face detected, c	Accuracy of face detected, d = c / b	Number of false detected, e	Accuracy of false detected f = e/ b
0	10	0	0	100.00%	0	0.00%
1	10	10	7	70.00%	1	10.00%
2	10	20	12	60.00%	4	40.00%
3	10	30	16	53.33%	2	20.00%
4	10	40	31	77.50%	1	10.00%
5	10	50	31	62.00%	5	50.00%
10	10	100	67	67.00%	2	20.00%
>10	10	113	87	76.47%	0	0.00%
Total accuracy	80	363	251	79.50%	15	18.75%

Table 5.1: Result of face detection

According to Table 5.1, the total accuracy of face detection in this system are 79.50% with successful detected 251 face in total 363 face. In 80 selected picture, there are total 15 object was false detected which mean that Facognition have 18.75% to detect non-faces object. The fourth test case was the lowest percentage of corrected detect face in face detection while the fifth case test was the highest percentage of corrected detect face.

In other research that using haar cascade for face detection, Zhu et.al (2006) achieved 95% accuracy with a 0.1 false detection, Sharman et.al. (2011) achieved 84.4% with 15.58% false detection and in Ahmad et.al. (2012), there are about 96.7% of accuracy in face detection. Overall, haar cascade can be consider as a good algorithm for face detection because the accuracy of this algorithm in face detection that used by other researcher and Facognition are high which achieved about 80%.

5.3.2 Testing on face recognition

Number of face per picture	Number of person should recognize after face detection	Number of correct recognized	Accuracy
1	7	6	85.70%
2	12	10	83.33%
3	16	10	62.50%
4	31	19	61.29%
5	31	23	74.19%
10	67	43	64.18%
>10	87	62	71.26%
Total	251	173	68.92%

Table 5.2: Result of face recognition

From Table 5.2, there are a clearly trend in the result of face recognition which are the increasing the number of face in picture, the lower the accuracy of face recognition. The highest accuracy of face recognition was the second test case while the fifth test case was the lowest accuracy of face recognition. The accuracy of face recognition was 68.92% which 173 face were corrected recognize in 251 face.

According to other researcher, their accuracy by using Principal Component Acnalysis (PCA) in face recognition are also high, for example Ahmad et.al. (2012) has about 71.15% accuracy, Suhas et.al. (2012) achieved 100% accuracy, and Singh, et.al. (2014) gets 96% correctness in face recognition. In Facognition, the accuracy in face recognition is 68.92% in 80 randomly selected picture. PCA are good in face recognition.

5.3 Conclusion

The number of face recognition are depends on the number of correct face detected. In conclusion, Haar cascade are good to use in face detection and PCA are good in face recognition.

CHAPTER 6

CONCLUSION

6.0 Introduction

The strengths and weakness of this system will be listed in this chapter. The way to improve this system and the contribution of this system will also discuss in this chapter.

6.1 Observation on weakness and strengths

Weaknesses

- This system are not able to filter when user insert new image to any folder.
- This system are not able to detect faces when the faces in image are small
- There are low face detection accuracy in some image with complex condition such as dark and illumination and unknown condition
- Before perform face detection and recognition in this system, the faces in image should inserted in specific folder in order to get good accuracy
- Long process time

Strengths

- Good accuracy in face detection and face recognition.
- Able to detect multi people with high accuracy
- Low false detection in face detection

6.2 Propositions for improvement

This system can be improved by upgrading the user interface for making user easy to use and understand how to use. In addition, this system can adding some function such as looking for pictures with insert specific name or filtering the image when insert new person. Last but not least, improved the algorithm or improve the system by adding some pre-processing in either face detection or face recognition or both for getting better accuracy are necessary.

6.3 Project Contribution

Facognition can be used as biometric authentication in security area. Other than that, Facognition can also use in police station to caught WANTED people or in jail for saving the information of criminals.

6.4 Conclusion

Facognition was successful built. Objectives achieved.

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