
# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

# DEVELOPMENT OF A FACE RECOGNITION SYSTEM FOR ATTENDANCE VERIFICATION USING MATLAB

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Computer Engineering Technology (Computer Systems) with Honours.

by

**CHUA WEI CONG**

**B071610460**

**960405016827**

FACULTY OF ELECTRICAL AND ELECTRONIC

ENGINEERING TECHNOLOGY

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# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Tajuk: Development of a face recognition system for attendance verification using Matlab

Sesi Pengajian: 2019

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I hereby, declared this report entitled Development of a face recognition system for attendance verification using Matlab is the results of my own research except as cited in references.

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## APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Computer Engineering Technology (Computer System) with Honours. The member of the supervisory is as follow:

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## ABSTRACT

Face recognition is a system for pairing and matching characteristic of face. Attendance is a proven for the student attend the lecture. In this project, the face recognition technology will develop a system to replace traditional attendance's list. The traditional attendance's list shows a poor accuracy for prove of student's attend and it can easily to lose and broke. The purpose for this project is development face recognition system for attendance verification and understanding the face recognition's process. In the process of system, face of student can be detected by the system and the recognition will carry out. The PCA algorithm used for recognition with determine the Eigen's value and specific the Euclidean distance from the test image and sample. MATLAB is a useful tool for developing face recognition system which it can provides a lot of resources such as library of function and toolbox. GUI is an interface from multiple of function and show the figure to able the user can use and observe the system. As results, the face recognition can success to prove the student's attendance.

## ABSTRAK

Pengecaman muka adalah satu sistem untuk pasangan dan padanan ciri wajah. Kehadiran adalah terbukti untuk pelajar menghadiri kuliah. Dalam projek ini, teknologi pengenalan muka akan membangunkan sistem untuk menggantikan senarai kehadiran tradisional. Senarai kehadiran tradisional menunjukkan ketepatan yang tidak baik untuk membuktikan kehadiran pelajar dan mudah dikalahkan dan dipecahkan. Tujuan projek ini adalah pembangunan sistem pengenalan wajah untuk pengesahan kehadiran dan memahami proses pengenalan muka. Dalam proses sistem, wajah pelajar dapat dikesan oleh sistem dan pengiktirafan akan dilaksanakan. Algoritma PCA digunakan untuk pengiktirafan dengan menentukan nilai Eigen dan spesifik jarak Euclidean dari imej dan sampel ujian. MATLAB adalah alat yang berguna untuk membangunkan sistem pengenalan wajah yang dapat menyediakan banyak sumber daya seperti perpustakaan fungsi dan kotak peralatan. GUI adalah antara muka dari pelbagai fungsi dan menunjukkan angka untuk dapat pengguna dapat menggunakan dan mematuhi sistem. Sebagai hasil, pengecaman muka dapat berjaya untuk membuktikan kehadiran pelajar.

## DEDICATION

**To My Parents**

Thank you for your sacrifice and love until the end of life. Your souls have always remained forever in my heart.

**To My Supervisor and Lecturer**

Thank you for all the knowledge and support. Your support, patience, and encouragement give me strength throughout the whole course

**To All Friends**

Thank you for your support, advice and motivation.

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## LIST OF SYMBOLS

PCA - Principal Component Analysis

ICA - Independent Component Analysis

LBPH - Local Binary Patterns Histograms

TCP/IP - Transmission Control Protocol/Internet Protocol

OpenCV- Open Source Computer Vision Library

LR - logistic regression

LDA - Linear discriminant analysis

K-NN -K-nearest neighbor (K-NN).

QR code - Quick Response code

MATLAB - MATrix LABoratory

# CHAPTER 1

# INTRODUCTION

## 1.0 Background

Verification of student attendance is one of the major important factors dealt with any academics such as school, university, college or tuition class. In the past, students needed to sign an attendance form provided by the university or school. The attendance information can only be taken based on these who had signed the attendance. In this case, it was inaccurate and inefficient because some students might help his friend or may accidentally sign another student's name. Besides that, the lecturer might accidentally lose the hardcopy sheet and the attendance is needed to retake. In this state, the student might lie to lecturer and sign all attendance to show fully attended to all lecture sessions. Now, some of them still use the traditional method but some of the technology universities are using a new technology which it is the Facial Recognition System to verify the attendance of student.

Historically, there were three notable great scientists who created the facial recognition technology who are Woody Bledsoe, Helen Chan Wolf and Charles Bisson. During 1966, their work was to use the computer to recognize faces. But there was a problem where they needed to search or select a small set of records from the large database of images. The difficulties were described as "this recognition problem is made difficult by the great variability in head rotation and tilt, lighting intensity and angle, facial expression, aging, etc. Some other attempts at face recognition by

machine have allowed for little or no variability in these quantities. Yet the method of correlation (or pattern matching) of unprocessed optical data, which is often used by some researchers, is certain to fail in cases where the variability is great. In particular, the correlation is very low between two pictures of the same person with two different head rotations." (Woody Bledsoe, 1966).

In 1997, Christoph von der Malsburg successfully developed the Face Recognition system based on a large database of image photo of human. The system was sold to the operator of airport, bank and some busy location. These operators used the system to match the passenger's information and determine the fake ID is used in security at those locations.

In 2006, the face recognition is developed by a few new features algorithm such as Face Recognition Grand Challenge (FRGC), High-resolution face images, 3-D face scans and Iris image. The accuracy of the result is improved by new algorithm about 10 times of system in 2002 and 100 times of system in 1995.

## 1.1 Problem Statement

Nowadays, the technology improves the human life by replacing the hand work with high-tech machine. Even in university, face recognition system for verification attendance is much needed to replace the flaw in today's attendance-taking system. There are some problems might be occurring in using sign of attendance.

Firstly, students can help their friends to sign attendance and cheat lecturer. In this statement, students can always skip class because their friends can always help him to sign.

Besides, the paper of attendance can be easily crumpled or gone missing and this is will lose the attendance of students. From this case, students have a chance to re-sign the attendance for skipping class. It shows that paper of attendance is less efficient than the face recognition system.

## 1.2 Objective

1. To design and develop a face recognition system which to match the face of student for recording and verifying attendance by using MATLAB.
2. To analyze the image processing for matching face of student in face recognition system.

## 1.3 Scope of project

In order to achieve the objective of project, there are a few scopes is needed to outline. This project consist of software is made by MATLAB and hardware will be considered as web Camera of laptop. There are some limitations in the project during the testing section.

Firstly, the photos are taking by web cam have low quality. This is because the low camera resolution causes the quality of photo become low and blur. From this state, the web cam can replace with any camera which it contains high camera resolution to improve the quality of photo.

Besides, the lighting condition of room for testing face recognition system might affect the results. In this case, the poor lighting condition will directly affect the camera which it might take poor quality of photo.

# CHAPTER 2

# LITERATURE REVIEW

## 2.0 Introduction

In this generation, there are several types of application being implemented in different field of place. Face recognition system is used for security checking, but nowadays it is also implemented for attendance verification system in working area, university and transportation sector. Facial recognition is a way of recognizing a biometric of human face through the technology by mapping the facial features from the videos or photographs. Face recognition system is a common technology to replace the traditional hardcopy of attendance or machine printing at the time interval of attendance. In this case, accuracy of face recognition is needed to be concerned because the accuracy of the matches can be affected by various reasons. For example, the quality of camera, the bug of program, the photo taking error and cheat from the worker. Thus, the accuracy of system is needed to concern and improve to achieve the best efficiency of the system.

This chapter will list out the concept and technique of system that is related to the project. The reference books, journals, articles, and researches that have been studied is related to the method used, software used, and the technique used will be shown. In general, this chapter reviews the recent knowledge that was studied for

face recognition system including major finding in both methodological and theoretical.

## 2.1 Overview of face recognition system

Figure 2.1 show the implementation of basic process of face recognition system. First and foremost, the input photo is required to compare with the database of image. Before the detection section, there are some processes will be included which is the quality of photo can be improved by using the median filter. The aim of using median filter is to reduce the noise of photo and make the photo becomes focus. In detection, the program will analyze the photo based on the algorithm of program. For example, the algorithm uses eigenfaces, linear discriminant analysis, elastic bunch graph matching using the Fisherface algorithm, the hidden Markov model, the multilinear subspace learning using tensor representation, and the neuronal motivated dynamic link matching. From the analysis of algorithm, the features of faces are indicated, and the next section will compare and match with the database of image. Therefore, the result of matching will show the information of user.

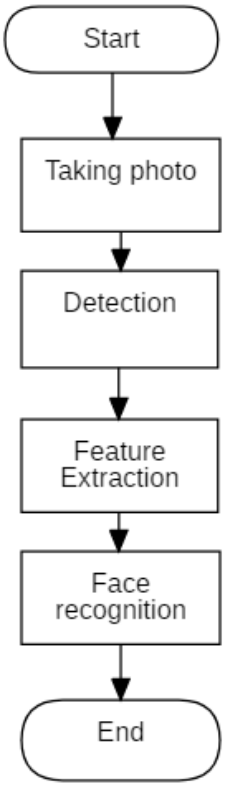


**Figure 2.1 General flow chart of the face recognition system**

After several of research is found, there are various of method for face recognition system have been discussed. For example, Automated Attendance System Using OpenCV (Kar *et al.*, 2012), An android based course attendance system using face recognition (Sunaryono, Siswantoro and Anggoro, 2019), Raspberry Pi and computers-based face detection and recognition system (Wazwaz *et al.*, 2018), Face Detection and Recognition for Automatic Attendance System Using Artificial Intelligence Concept (Pradeepa and Kumar, 2018) ,Deep Face Recognition (Parkhi, Vedaldi and Zisserman, 2015) and Biometric Attendance Prediction using Face Recognition (Uma *et al.*, 2017).

## 2.2 Overview of algorithm of Face Recognition System

Algorithm is the specification of this project which introduces the mechanisms used in the project. It is also a method to solve specific problem of the project which the suggestion way is given for solving. Face Recognition system uses a few of algorithm to improve the accuracy of result. For example, Principal Component Analysis (PCA), Independent Component Analysis (ICA) and Local Binary Patterns Histograms (LBPH).

### 2.2.1 Principal Component Analysis (PCA)

Principal Component Analysis is a statistical method for dimensionality-reduction, handing and analyzing data (Moon and Phillips, 2001). The idea of PCA is when the program can transform a certain variable to a new variable set which is the principal component in the original photograph, and it decreases due to the moving down in the order. In the algorithm of PCA, there are a few steps for implementation. Firstly, the normalization is needed to resolve the data from photo. In this step, a new dataset is produced which means that the mean of data is zero. Besides, the calculation of covariance matrix is carried out for preparation to calculate the eigenvalues and eigenvectors. Formula is used as below:

$$Matrix(Covariance) = \begin{bmatrix} Var[X_1] & Cov[X_1, X_2] \\ Cov[X_2, X_1] & Var[X_2] \end{bmatrix}$$

**Figure 2.2 Formula of covariance matrix**

Source: dezyre.com

From the statement of eigenvalues and eigenvectors, they are the characteristics of a linear transformation of photo by changing with scalar factor. Calculation of eigenvalues and eigenvectors uses the determinant as

$$det(\lambda I - A) = 0$$

$$(\lambda I - A)v = 0$$

**Figure 2.3 Formula of calcute eigenvalues and eigenvectors**

Source: dezyre.com

(Matthew&Alex,1991) From the equation, the $\lambda$ is the eigenvalue and V is eigenvectors. After that, the algorithm will choose the component of dataset to form a new feature vector. In this process, the first p eignvalues will be selected to reduce the dimensionality of image. Last step is the chosen feature vector will combine with the scaled data to form a principal component. Hence, the PCA gives user a lower-dimensional picture when they view from most informative viewpoint.

### 2.2.2 Independent Component Analysis (ICA)

(Lead, 2011) Independent Component Analysis is one of algorithms used in facial recognition system which is a method for separating the various signal from photo into additive subcomponents. (Hyvärinen and Oja, 2013) states the ICA model is a generative model where the program illustrates the way of data set produced by a process of mixing the components.

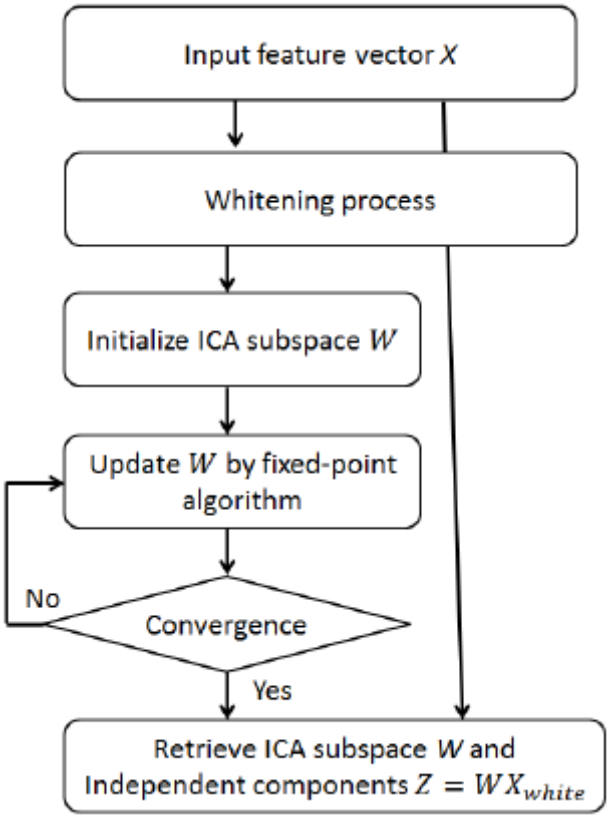


**Figure 2.4 Flow chart of ICA algorithm**

Source: Researchgate.net

From the flowchart, the preprocessing is needed to further function. Firstly, centering is a necessary preprocessing which estimates the mixing matrix and addition of mean vector to complete the estimation. In addition, whitening is a useful preprocessing where it allows the program to observe the variable with decorrelation method for converting a covariance matrix of data set into an specific matrix. Therefore, the fixed-point algorithm is used for transcendental equation to transform into fixed-point equation. Lastly, independent component is formed and the data is needed for other process in face recogniton system.

### 2.2.3 Local Binary Patterns Histograms(LBPH)

Local Binary Patterns is the algorithm usually used in face recognition system because it can accelerate the performance and robustness. (Sontakke *et al.*, 2018) LBP is an effective texture operator which points out the pixel of photo and contemplates the result to be binary number. In this case, the LBP can consolidate the traditionally divergent statistical and structural texture analysis models.

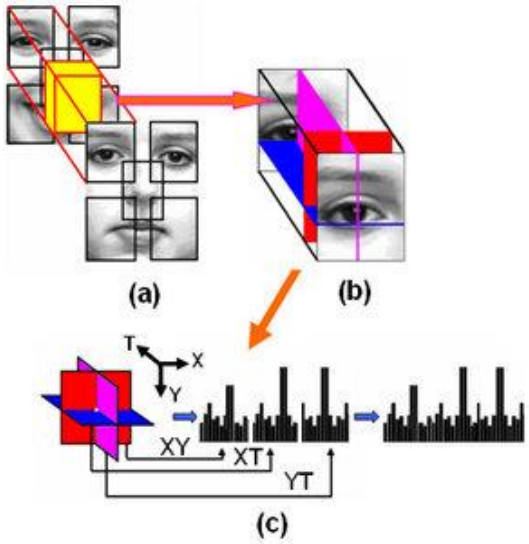


**Figure 2.5 Description of facial expressions with local binary patterns.**

Source: scholarpedia.org

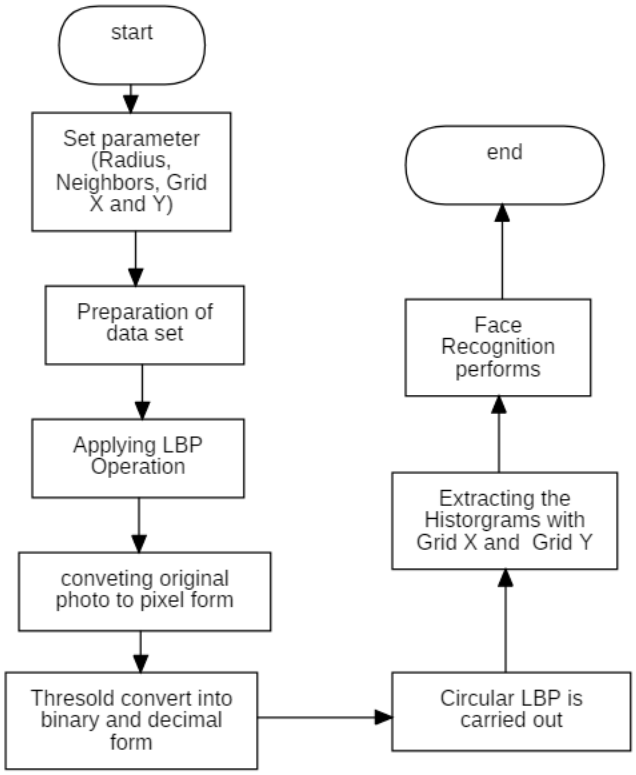


**Figure 2.6 Flow chart LBP algorithm**

From the flow chart, parameter for the algorithm can be set as Radius, Neighbors, Grid x and Grid Y. Radius is radius of cicular local binary pattern and neighbors is number of sample points to create the circular. Grid X and Y only represent the number of cell for the vertical and horizontal. Moreover, the orignal photo is tranformed to the specific form using the operator. Therefore, the circular is created and the Grid X and Grid Y is plotted into histograms. Furthermore, the matching of the histogram will be used to calculate the euclidean distance, chi-square and absolute value.