AUTOMATED ATTENDANCE SYSTEM BASED ON FACIAL RECOGNITION

ARAVINDAN A/L KANAGASABAI

BANCHELOR OF MECHATRONICS ENGINEERING
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

"Hereby I declare that I have read through this report entitle Automated Attendance System Based on Facial Recognition and found that it has comply the partial fulfilment for awarding the degree of Bachelor of Mechatronics Engineering"

Signature   : ………………………………………………

Supervisor's Name   : ………………………………………………

Date   : ………………………………………………

DEVELOPMENT OF AUTOMATED ATTENDANCE SYSTEM BASED ON FACIAL RECOGNITION

ARAVINDAN A/L KANAGASABAI

A report submitted in partial fulfilment of the requirements for the degree of Mechatronics Engineering

Faculty of Electrical Engineering
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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I declare that this report entitle Development of Automated Attendance System Based on Facial Recognition is the results of my own research except as cited in the reference. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree

Signature   : ……………………………………………

Name   : ……………………………………………

Date   : ……………………………………………

To My Beloved Family and Friends

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ABSTRACT

This Project is stress on the development of automated attendance system based on facial recognition using the principle component analysis (PCA) method with the Eigenface approach. In the past, student's attendance management system is an important task done by every institution in order to maintain the student's academic results and this project able to reduce the chances of forgery attendance marking. The main objective to be achieved is the development of face recognition system based on Eigenface approach using the PCA algorithm which includes the face detection part using the Viola Jones method of detection. To achieve this objective, the MATLAB software build in algorithm such as image processing toolbox and image acquition toolbox is utilized. Using this algorithm, the expected result from this system is the collection of student database through capturing the image of the students for face recognition process which will detect the face of the student from the whole image eliminating background and other elements from the image and save it in the database and ready for face recognition process which will give a message to indicate that the person is recognized or not. The system performance will be analysing based on the accuracy under different lighting condition, varying in number of person and varying the distance between the student and the webcam. The analysis shows that the performance decreases as the number of person in an image is increased. Although the performance decreases, the accuracy obtain for 5 person in an image records a percentage of greater than 80%. Besides that, the analysis results for varying the distance from webcam shows that the increase in the distance between webcam and the students effect the performance of the system where for distance 3 feet the system records a 94% of accuracy but for distance 9 feet records 0% of accuracy. Lastly, the lighting effect under which the image is capture does not affect the systems performance which records 100% of accuracy for both the lighting condition. Therefore, this system perform very well in face recognition which can be used for attendance recording system.

ABSTRAK

Projek ini menekankan pembangunan system kehadiran secara automatic berdasarkan pengecaman wajah yang mengunakan kaedah 'Principle Component Analysis (PCA)' dengan menggunakan 'EigenFace'. Pada zaman dahulu, system pengirisan kehadiran pelajar adalah satu tugas penting yang harus dilakukan oleh setiap institusi untuk mengekalkan keputusan akademik pelajar. Sehubungan dengan itu , projek ini dapat mengurangkan pemalsuan dalam menandakan kehadiran. Objektif utama yang perlu dicapai oleh projek ini ialah membangunkan system pengecaman wajah berdasarkan pendekatan 'EigenFace' dengan mengunakan algoritma PCA yang termasuk pengesanan bahagian muka menggunakan keadah 'Viola Jones'. Untuk mencapai objectif ini, perisian MATLAB digunakan yang menpunyai algoritma 'image processing toolbox' dan 'image acquition toolbox'. Dengan mengunakan algoritma ini, hasil yang dijangkakan dari system ini ialah sistem dapat mengumpulkan pangkalan data pelajar dengan mengambil imej para pelajar untuk proses pengenalan wajah. Seterusnya, sistem akan memproses pengenalan wajah dengan membandingkan wajah dengan wajah asal dalam pangkalan data. Jika wajah tersebut sepadan dengan wajah dalam pangkalan data, sistem akan mengeluarkan mesej bahawa wajah pelajar tersebut terkandung dalam pangkalan data Prestasi sistem akan menganalisis berdasarkan ketepatan perbezaan keadaan pencahayaan, perbezaan jumlah bilangan orang dalam satu imej dan perbezaan jarak di antara pelajar dan 'webcam'. Seiring itu, analisis ini menunjukkan bahawa prestasi sistem berkurang apabila bilangan orang dalam seimej bertambah. Walaubagaimanapun, sistem ini masih berkebolehan untuk merekodkan peratusan prestasi yang besar iaitu 84% jika bilangan orang dalam seimej ialah 5. Selain itu, keputusan analisis bagi perbezaan jarak dari webcam menunjukkan bahawa peningkatan dalam jarak antara webcam dan pelajar boleh memberi kesan kepada prestasi system. Didapati, untuk jarak 3 kaki sistem boleh merekodkan 94% ketepatan sementera untuk jarak 9 kaki rekod ketepatan prestasi didapati 0%. Akhir sekali, kesan pencahayaan pada masa sesuatu imej ditangkap tidak menjejaskan prestasi keseluruhan sistem yang didapati boleh merekodkan 100% ketepatan untuk kedua-dua keadaan pencahayaan.

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CHAPTER 1

INTRODUCTION

1.1   Overview

Face recognition is the current challenging problem face in the field of image analysis and computer vision which received a great attention over the past years because of the applications and uses in various fields. Face recognition techniques mainly divided into three (3) categories based on the face data acquisition methodology, method which operates on intensity images, method that deals with video sequences.

Since the use of image processing is wide, broad research and studies being carried out to utilize its potential and to make new imaginative applications. Facial recognition is the untimely application utilized from this innovation, which is the standout amongst the most demonstrated strategy in human face detection. A face is a multidimensional structure and needs good computational investigation for face recognition. Figure 1.1 shows the various kind of biometric application used in the open world.
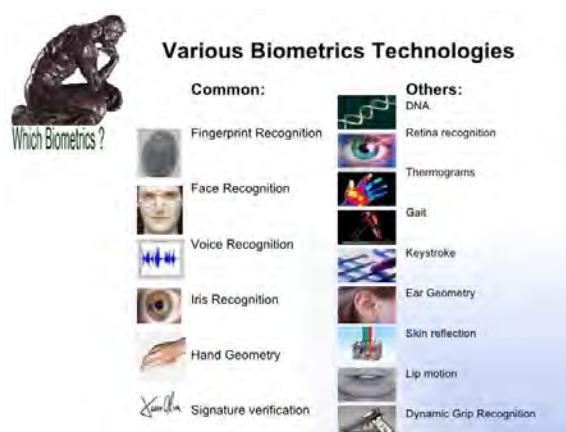

Figure 1.1: Various kind of biometric application

In numerous institution and organization, the attendance is an essential factor to keep up date as this record are referred for salary calculation, over time calculations, performance check etc. Most of the institution and organization take after the manual technique utilizing the old paper and document strategy and some of this institution have moved to biometric method. The present strategy that institutions utilize is that the lecturer passes a sheet or make roll call and mark the attendance of the students and the sheet additionally goes to the administrator office for final entry in excel sheet. This procedure is very wild and tedious.

1.2   Problem Statement

Attendance of every student is an important task to be maintained by every school, college and university throughout the world especially in Asia countries as Asia countries educational systems believes that attendance is the key factor of the students' academic performances. There are also proven results shows that student with poor attendance record will reflect in the examinations results as missing classes by the students will results in limited knowledge of the subject where most of the important lessons and examination preparation are done in a class room[12]

Currently, most of the school, collage, university maintain manual attendance record which said to be inefficient and requires plenty of lecture timing to sort out and compute the average attendance records. Henceforth, there is a necessary to build a framework that able to solve the problem of student's attendance management and average attendance calculation. One of the efficient ways to make student attendance record management automatic is by facial recognition system where the system must be able to recognise the student by analysing their faces.

1.3   Project Objective

The Objective of this project is as follows:

1. To develop a face recognition system based on the Eigenface approach using the Principal Component Analysis (PCA) algorithm.
2. To build an automated attendance system by using the MATLAB function which link with Microsoft Excel Spreadsheet.
3. To perform an analysis on the system performance in term of accuracy and reliability.

1.4   Project Scope

The scope of this project is limited to develop a face recognition algorithm using the Principle Component Analysis (PCA). The image processing function for this project will be done using the MATLAB build in toolbox and using the toolbox available in MATLAB such as image acquition toolbox and computer vision toolbox. The Spreadsheet link EX toolbox is utilized to save the attendance record of the students. An external webcam is used to capture the image of the students before it is process as this is not a real time system. In this project, a total five (5) student's data will be analysis in terms of recognition accuracy, accuracy due to distance of the webcam & student and accuracy due to lighting effect.

1.5   Summary

In this chapter, the introduction of the project, problem statement, project objective, and the scope of the project has been discuss widely. From the objective of this project, we can conclude the main aspect that we gone do in this project and what we want to achieve from this project at the end of this project. On the project scope, we discuss widely on what we do and the limitation on the project when doing this project.

CHAPTER 2

LITERATURE REVIEW

2.1 Theoretical Background

In this cutting edge period of mechanization numerous logical progressions and developments have occurred to spare work, increase the precision and to improve our lives. Automated attendance system is the headway that has occurred in the field of automation supplanting attendance marking system. Automated attendance system is basically a bio-metric based, smart-card based and web based. These frameworks are generally utilized as a part of various associations. Customary technique for attendance checking is extremely tedious and complicated when the quality is more. Automated Attendance System has edge over customary technique as it spares time and furthermore can be utilized for security purposes [1]

Face recognition is an intriguing and fruitful use of pattern recognition and image examination. Facial pictures are fundamental for keen vision-based human computer connection. Face processing depends on the way that the data can be extracted from the images accordingly. Face detection has numerous applications, running from entertainment, information security, and biometrics [2].Various strategies have been proposed to identity faces in a single image. To assemble a completely automated system, strong and effective face detection algorithm required. The face is identified once a man's face comes into view [3]. Once a face is detected, the face district is trimmed from the picture to be utilized as "Test" into the learning to check for conceivable matches.

2.2 Face Recognition using PCA approach

The original way of calculating the Eigenface using the PCA method are as follows:

1. Preparation of database of the face which can be named as training set T_i
2. The average matrix Ψ has to be determine which is then subtracted from the original trainning set data T_i and the results are stored in the variable Φ_i

$$\Psi = \frac{1}{M} \sum_{n-1}^{M} Tn \tag{2.1}$$

$$\phi_i = T_i - \Psi \tag{2.2}$$

3. Next is the calculation of covariance matrix C based on the equation below:

$$C = \frac{1}{M} \sum_{n-1}^{M} \phi_n \phi_n^T \tag{2.2}$$

4. The step continues by calculating the eigenvectors and eigenvalues of the covariance matrix where the eigenvector u_i and the corresponding Eigen values λ_i should be determined. These values must be normalised so that they are called as unit vector.
5. Selection of principle components: The M value with highest value of eigenvalues will be selected. This is because, the higher the eigen value, the higher the characteristic feature of the face where the particular eigen vector is described. The Eigenface which has lower eigenvalues can be eliminated as they explain a minimum amount of the in characteristic feature of the face.

2.2.1 Image Processing Toolbox

The image processing toolbox is a gathering capacity that expands the ability of the MATLAB numeric figuring condition. The tool kit underpins an extensive variety of picture preparing operation, including:

➢ Spatial image transformations
➢ Morphological operations
➢ Neighbourhood and block operations
➢ Linear filtering and filter design
➢ Transforms
➢ Image analysis and enhancement
➢ Image registration
➢ De blurring
➢ Region of interest operations

2.2.2 Computer Vision Toolbox

The field of significance for such different application as independent vehicles, exploring with the assistance of image captured by the attached camera, and high precision estimation utilizing images, taken by the aligned camera. In this paper, we will show various numerical schedules carry out in MATLAB software that are helpful in assortment computer vision toolbox. The accumulation of schedules will be known as the Computer Vision Toolbox. One of the primary issues in Computer Vision is to figure the 3D- structure of the scene and movement of the camera from estimation in the image taken from various views.

2.2.3 Image Acquisition Toolbox

The main functions of image acquition toolbox are as follows:

➢ Acquiring images through many sort of image acquition gadgets, from professional grade frame grabbers to USB based webcam
➢ Preview of the live streaming videos

➢ Triggering acquition

➢ Configuring call back function that execute when certain functions occur

The image acquition toolbox components are shows in Figure 2.1
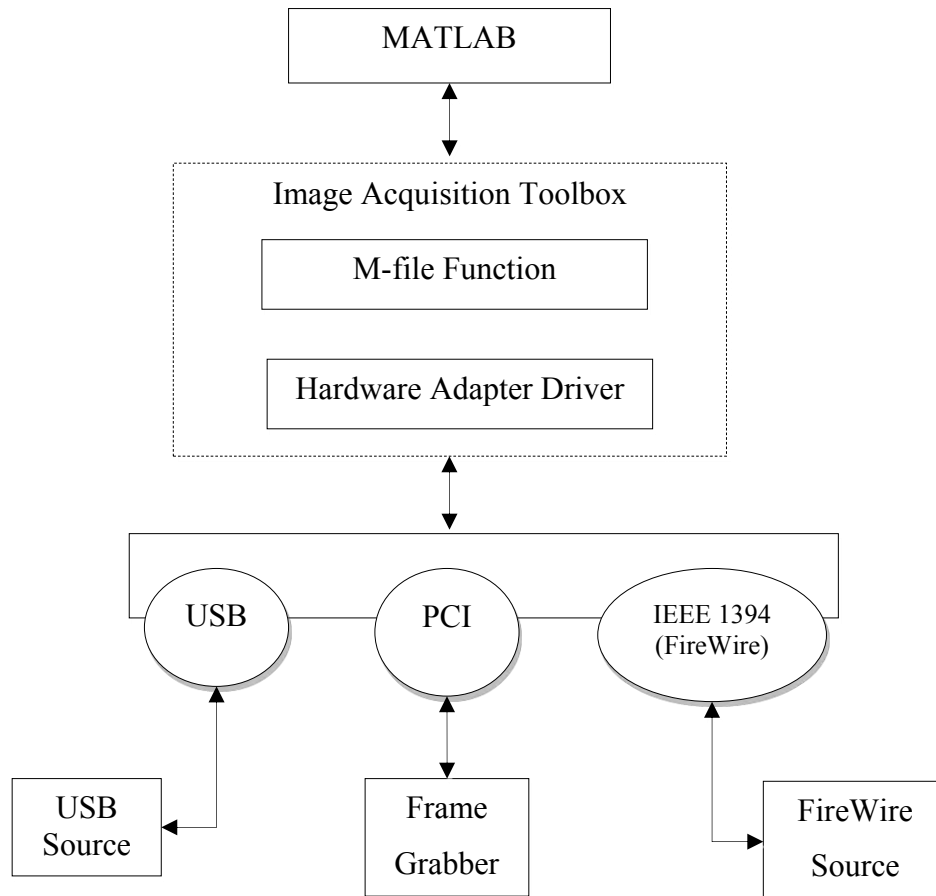

Figure 2.1: Image acquition toolbox components

2.3   Literature Review on Previous Study

Automated attendance system based on facial recognition an important tool to help the learning institution to keep track of the student record to class in a simple way. The important segment in this system is the face recognition done to the person before the attendance record is recorded in the excel spread sheet. From the previous researches, it is learned that they are many method used for face recognition such as

Principle Component Analysis (PCA), Eigenface approach, back propagation neural network and other method.

2.3.1 Face Recognition using principle Component Analysis (PCA)

According to [4], PCA is a statistical method under the title factor analysis. PCA serves the purpose of reducing the large dimensionality of the date space to smaller intrinsic dimension of feature space in which need to describe the data economically. The scope of Principle Components analysis method is able to do prediction, redundancy removal, feature extraction, data compression. Facial recognition has various applicable areas. This can be categorized into face classification, sec determination and face identification. The most helpful application of face recognition is crowd observation, video content ordering. Individual distinguishing proof (ex. International passport), mug shot shots matching, entrance security. The fundamental idea of utilizing PCA for face recognition is to acknowledge is to express the large 1-D vector pixels which is constructed from the 2-D facial image into conservative principle components of the feature space which can be define as eigenspace projection. Eigenspace is ascertained by diagnosing the eigenvectors of the covariance matrix derived from a set of facial images (vectors).

2.3.2 Face recognition using Eigenfaces

According to the researcher [5], the approach to detect and identify a human face and acknowledge framework which track a subject's head and perceive the individual by contrasting quality of the face with those known people. Their approach for face recognition based on the two-dimensional recognition problems. It is described that the fact, faces are normally in upright position thus it may be describes by a small set of 2-D characteristic views.

Building a computational model for face acknowledge is very troublesome, in light of the fact that faces are complex, multidimensional, and important visual stimuli. Consequently dissimilar to most early visual capacities, for which it may be developed point by point models of retinal or striate activity. This research focus towards the development of early preattentive pattern recognition which does not depend on the

full 3-D models or point to point geometry. The aim is to come up with a computational model of face recognition which is fast, simple, and accurate in obliged conditions. Figure 2.2 shows the simplified version of free space diagram
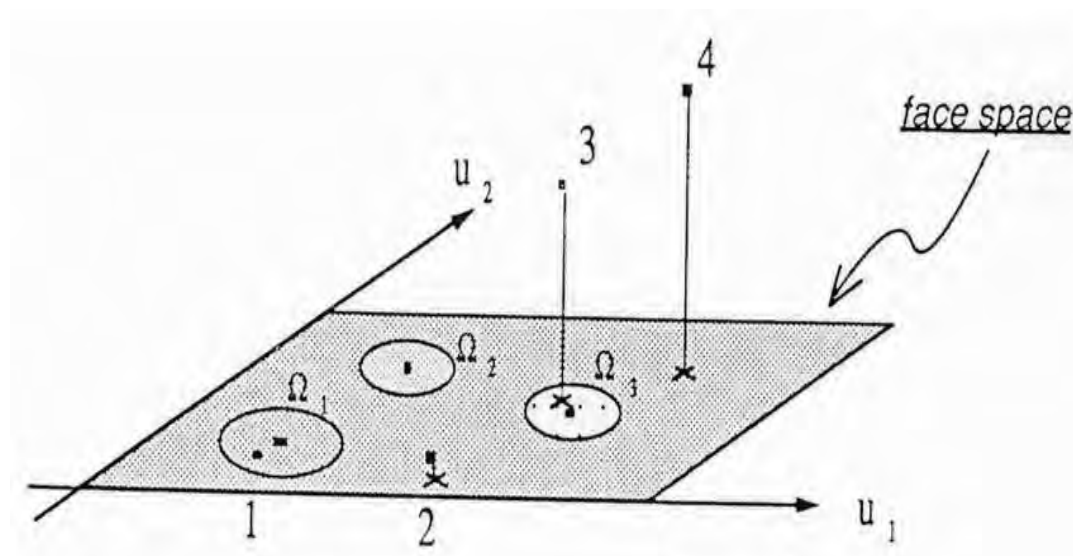

Figure 2.2: Simplified version of face space to illustrate the four results of projecting image into face space

2.3.3 Face Recognition using Eigenface Approach

In this paper [6], the Eigenface is used for the recognition process. They have developed a computational model to recognize the individual face, which are generally basic and simple to actualize. From this paper, it is said that the current system which represents some face space with higher dimensionality and not accurate. It is said that even with high dimension, in real, the span is very low dimensional space. Therefore it is said to concentrate with only the subspace with lower dimensionality to match with the face space.

In this paper, a face recognition system is develop which able to recognize static images which can altered to work with dynamic images. The image which is received from the web camera is converted into the static position and afterwards a similar method can be connected to them. Face recognition process is done by anticipating a new set of image into the subspace spread over by the Eigenfaces (face space).this process is continued by characterizing the face by looking at its position of