Face Recognition Based Attendance Managemnet System

Darshan Lal
University of Texas Arlington
Arlington, Texas
darshanlal.1232@gmail.com

Abstract

In this project, the system will scan the face of each person coming in front of the camera(webcam) and the parameter of comparison for recognition of the faces are extracted and then they are compared with the already stored data in the database. If maximum parameter matches with any particular person's data then his/her attendance for that day will be recorded. This system unlike fingerprint scanner cannot be deceived in any way and thus contributes to make a better attendance management system.

1. Introduction

In this project, the system will scan the face of each person coming in front of the camera and the parameter of comparison for recognition of the faces are extracted and then they are compared with the already stored data set. If maximum parameter matches with any particular person's data then his/her attendance for that day will be recorded. This system unlike fingerprint scanner cannot be deceived in any way and thus contributes to make a better attendance management system. These values are given as the input to the training algorithm and then these values are used at the time of recognition of the face of registered user i.e. at the time of giving attendance the features are extracted from the current image and is compared with the previously generated face data set (Generated at the time vo signing up). The attendance of particular person is marked in the excel sheet as soon as the face has been recognized correctly.

1.1. Language

Python3.7 with OpenCV is used for the programming. Where as excel sheets are used to maintain the attendance records.

1.2. Motivation

This project has been developed by getting motivation from the disadvantages of the current attendance management system where pen and paper is used to mark the attendance and generate the reports manually as per the requirement. This system consumes more time as well as paper work. As the world is moving ahead with "Go Green" concept, so the proposed system has also been made to fulfill this concept.

1.3. Aims and Objectives

The project objective is to implement face recognition in such a way that it can be used as a college staff attendance system. The other objectives of the project is to implement face recognition process in an optimum way in terms of run time, various algorithms and methodologies that are studied and hardware resource planning will be done to achieve the goal accordingly.

1.4. Algorithm Overview

The Fisherfaces method learns a class-specific transformation matrix. The Discriminant Analysis instead finds the facial features to discriminate between the persons. The performance of the Fisherfaces heavily depends on the input data as well. if well-illuminated pictures are used the results are more accurate then recognize faces in bad-illuminated scenes.

The Fisherfaces allow a reconstruction of the projected image, But since we only identified the features to distinguish between subjects, one can't expect a nice reconstruction of the original image. For the Fisherfaces method the sample image is projected onto each of the Fisherfaces instead. In order to have a nice visualization.

Algorithm 1: The training algorithm

- Gabor filter face image.
- Apply Gaussian weighting.
- Locate peaks in image.
- Extract feature vector at located peaks.
- If this is first training image of subject, store feature vector, location and class label for all extracted peaks,

else store only those who are misclassified (with respect to the current gallery).

Algorithm 2: The testing algorithm

- Gabor filter face image.
- Apply Gaussian weighting.
- Locate peaks in image.
- Extract feature vector at located peaks.
- For each extracted feature vector, compute distance to all feature vectors in gallery.
- Based on class label to the nearest matching feature vectors, assign points to corresponding class.

1.5. Mathematical Description

Let X be a random vector with samples drawn from c classes:

$$\begin{aligned} X &= \{X_1, X_2, \ldots, X_c\} \\ X_i &= \{x_1, x_2, \ldots, x_n\} \end{aligned}$$

The scatter matrices $S_B and S_W are calculated as$:

$$\begin{aligned} S_B &= \sum_{i=1}^{c} N_i(\mu_i - \mu)(\mu_i - \mu)^T \\ S_W &= \sum_{i=1}^{c} \sum_{x_j \in X_i} (x_j - \mu_i)(x_j - \mu_i)^T \end{aligned}$$

, where $\mu is the total mean$:
$\mu = \frac{1}{N} \sum_{i=1}^{N} x_i$
And $\mu_i is the mean of class i \in \{1, \ldots, c\}$:
$\mu_i = \frac{1}{|X_i|} \sum_{x_j \in X_i} x_j$
Fisher's classic algorithm now looks for a projection W, that maximizes the class separability criterion:
$W_{opt} = \arg\max_W \frac{|W^T S_B W|}{|W^T S_W W|}$
Following [BHK97], a solution for this optimization problem is given by solving the General Eigenvalue Problem:

$$\begin{aligned} S_B v_i &= \lambda_i S_w v_i \\ S_W^{-1} S_B v_i &= \lambda_i v_i \end{aligned}$$

There's one problem left to solve: The rank of Sw is at most N-c, with N samples and c classes. In pattern recognition problems the number of samples N is almost always samller than the dimension of the input data (the number of pixels), so the scatter matrix Sw becomes singular (see [RJ91]). In [BHK97] this was solved by performing a Principal Component Analysis on the data and projecting the samples into the (N-c)-dimensional space. A Linear Discriminant Analysis was then performed on the reduced data, because Sw isn't singular anymore.

The optimization problem can then be rewritten as:

$$\begin{aligned} W_{pca} &= \arg\max_W |W^T S_T W| \\ W_{fld} &= \arg\max_W \frac{|W^T W_{pca}^T S_B W_{pca} W|}{|W^T W_{pca}^T S_W W_{pca} W|} \end{aligned}$$

The transformation matrix W, that projects a sample into the (c-1)-dimensional space is then given by:
$W = W_{fld}^T W_{pca}^T$

1.6. System Architecture

Then, if an image is determined to be a face the system will determine whether it knows the identity of it or not. The previously shown Fig. 3.1 shows the proposed system's architecture which describes the phases in which it has been divided i.e. user registration phase then feature extraction and face recognition phase and the last phase consists of awarding the attendance to the person if his face has been recognized correctly.

Two major phases of this system are:

- Face Recognition System
- Attendance Management System

Face Recognition System

- This Face Recognition system involves several substages:
- Source Stage
- Source Transformation Stage
- Face Extraction Stage
- Pre-recognition Transformation Stage
- Face Recognition Stage
- Presentation Stage

Attendance Management System

Attendance Management System Attendance Management System is software developed for daily student attendance in schools, colleges and institutes. If facilitates to access the attendance information of a particular student in a particular class. The information is sorted by the operators, which will be provided by the teacher for a particular class. This system will also help in evaluating attendance eligibility criteria of a student.

1.7. Result and Conclusion

The existing project extracts the image from a real-time video by face detection and cropping. Then, the features of the current image and the previously stored image in database are compared. If there is match then the matched features are shown on the screen. To complete the existing project various concepts of artificial neural network, digital image processing etc. were taken into consideration. The Attendance Management System is developed using OpenCV with Python that fully meets the objectives of the system which was supposed to be developed. The system has reached a steady state where all bugs have been eliminated. The system is operated at a high level of efficiency The system solves the problem. It was intended to solve as requirement specification. This project also includes attendance management system to submit monthly report to the college authority which reduces the manual submission of attendance of the staff members.

2. Limitations of the study

Image quality affects how well facial-recognition algorithms work. The image quality of scanning video is quite low compared with that of a digital camera. Even high-definition video is, at best, 1080p (progressive scan); usually, it is 720p. The relative angle of the target's face influences the recognition score profoundly. When a face is enrolled in the recognition software, usually multiple angles are used (profile, frontal and 45-degree are common). Anything less than a frontal view affects the algorithm's capability to generate a template for the face. Even though high-definition video is quite low in resolution when compared with digital camera images, it still occupies significant amounts of disk space.

3. Future Scope of Work

As of now this project is for the working members of any organization but if it is considered along a single domain of College or School then this project can be further modified for multiple face recognition at a time and marking the attendance of all the students present in a class. Using this attendance system, Professor can get the attendance of a particular student throughout whole semester, attendance of whole class for a particular day and attendance of whole class throughout the semester in a tabular form within few seconds. To make GUI more user friendly, so that it saves Professors' time in extracting data from updated databases. This attendance system can be extended for marking attendance from 200 students to 400 students or more and can be extended for using in large lecture hall. A neural network architecture (may be together with a feature based approach) can be implemented in which the orientation of the face is first determined, and then the most suitable recognition method is selected, Also the current recognition system acquires face images only from face files located on magnetic mediums. Camera and scanner support should be implemented for greater flexibility.

3.1. References

1. Kaushik S., Dubey R. B. and Madan A. (2014). "Study of Face Recognition Techniques", International Journal of Advanced Computer Research, 4(4).
2. Kanti J. and Papola A. (2014). "Smart Attendance using Face Recognition with Percentage Analyzer", International Journal of Advanced Research in Computer and Communication Engineering,
3. www.ijrmst.org
4. www.docs.opencv.org
5. https://openpyxl.readthedocs.io/en/default/