

Face Recognition Using Eigen Face Feature of Viola Jones

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Abstract

The demand of smart cameras for various applications in surveillance for security purpose is growing rapidly. However till now, the handling required for real time face detection prohibits integration of the complete application into a small sized camera. The Real Time Face Tracking and Identification for Surveillance System proposed in this research work has originated ahead with a simple and an efficient approach to satisfy the handling requirements and enable constant and precise face detection. The core functionality of the proposed system is to allow tracking and identification of various human faces in a video stream and thereby provide a centralized, cost effective and robust mechanism of securing business and government premises. The primary objective of the proposed system is to reduce detection redundancy, minimize misclassification risk, provide huge processing capacity and work within a reasonable computational budget.

Keywords: Face Recognition, Camera Security, Multiple face detection, Descriptor, Viola-Jones, SVM feature classifier.

1. Introduction

The demand for authentication and access control has been increasing tremendously since last few years. Face recognition plays an important role in this field. Many algorithms have been established to build the face detection task easier but in real setup this task is very difficult. A well-ordered face recognition system must be capable to deal with variations of face images in position, illumination and expression. The variation in the images of the same face due to clarification and posture are always larger than variant owed to face identity. This makes face recognition task very challenging. In this paper, a powerful multiple face recognition system has been proposed. The system has build up with coordination of HOG feature descriptor and SVM feature classifier including Viola-Jones face detection framework. After pre-processing of image using the equalization technique, the original size of image is taken. Viola Jones is object detection framework which is utilized for detection of human faces. Histogram of oriented gradients (HOG) descriptor is utilized for face highlight extraction. The picture is segregated into little – related locales called cells, and for the pixels inside each phone, a histogram of slope headings is incorporated. The outcome results into better light and shadowing.

Support vector machines (SVMs) which is a capable apparatus for creating design arrangement and capacity estimate systems is used for face identification.

2. Methodologies

A. Principal Component Analysis (PCA)[5]

Principal component analysis (PCA) utilizes an orthogonal change procedure. It is utilized to change over a course of action of impression of potentially related elements into an essential segment. The quantity of essential segments is not completely equivalent to the quantity of unique factors. This change is means that the primary important part has the greatest possible fluctuation and each succeeding segment thus has the most significant difference possible under the limitation that it is orthogonal to the previous segments. PCA is sensitive to the relative scaling of the first factors. ”

B. Hidden Markov model (HMM)[3]

In hidden Markov model (HMM) the modelled system is thought to be a Markov procedure with shrouded states. While in a concealed Markov display, the state is not specifically unmistakable, but rather the yield, subject to the state, is obvious. Every state has a likelihood conveyance over the conceivable yield tokens. In this manner, the arrangement of tokens created by a HMM gives some data about the progression of states.

These models are mainly known for their application in speech, gesture recognition and handwriting. Hidden Markov models have been generalized recently to a triplet Markov models and a pair wise Markov models, which allow non-stationary data modelling.

C. Viola Jones[8]

This algorithm is developed for face detection. It is commonly implemented in Open CV to detect the faces from printed image. To detect a face, the face must point towards the camera and it should not be tilted to either side, as Viola Jones algorithm mostly deals with full view frontal upright faces. It seems that these constraints could lower the algorithm's utility to a certain extent, but in practice these limits are quite acceptable.

The main characteristics of Viola–Jones algorithm due to which it is an appropriate detection algorithm are:

- Real time - At least 2 frames per second must be processed, for practical applications.
- Only face detection (not recognition) - The goal is to distinguish faces from non-faces (detection is the first step in the recognition process).

The face detection process undergoes four stages:

- i. Haar Feature Selection
- ii. Creating an Image
- iii. ADA boost Training
- iv. Cascading Classifiers

The features gathered by the detection framework involve the sum of image pixels within rectangular areas. As such, they bear some resemblance to Haar basis functions, which have been used previously in the realm of image-based object detection.

a) Haar Features

Every human face shares few properties like, the upper cheeks are brighter than the eye region and the eye region is darker than the nose bridge region. The similarities in all human faces can be matched by using Haar features. The features matched by this algorithm are then sought in the image of a face.

b) **Viola & Jones uses rectangle features:**

The rectangle feature: Value = Σ (pixels in black area) - Σ (pixels in white area). Every feature is related to a specific location in the sub-window.

c) **The rectangular features**

They are evaluated by an image representation called the integral image in short time, which gives a considerable speed advantage. The sum of the pixels above and to the left of (x,y), gives the integral image at location (x,y).

3. Proposed Block Diagram

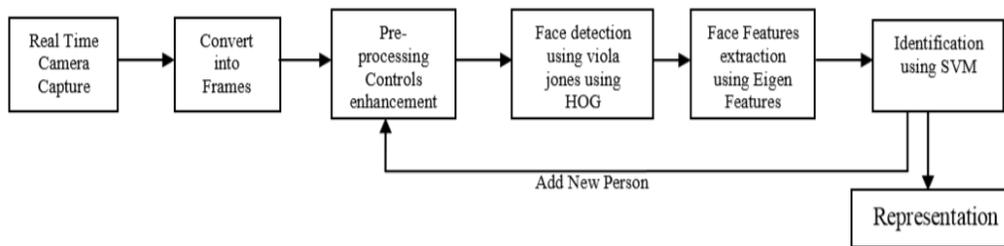


Figure 1. Proposed System Flow

i. **Real time camera capture**

Real time camera capture can be done with some options like Real Time Streaming or Real Time Recording. The electronic messages are transmitted through a LAN or across the Internet. This transmission of a video and/or audio from a source to a PC, Smart Phone or a mobile device, is called as Live Video Streaming. Streaming is a process of using the Internet for transmitting content by encoding it into a number of decodable formats.

Real time recording is simply a security DVR (Digital Video Recorder) that displays and record 30 frames per second i.e. each channel on the DVR can capture and record at least 30 frames per second. This is called full motion recording. The main purpose is to have smoothest and clear picture because in security we cannot afford to have glitch, unclear video.

ii. **Convert to frames**

After extracting all frames from a video clip, capturing image one by one is wasteful, ineffective and time consuming. For that purpose a program that can extract image and save it in format like jpg or png, is needed.

Pre-preparing controls: Equalization procedure is utilized for improvement as a part of pre-processing of picture. The technique is helpful in pictures with foundations and forefronts that are both brilliant and both dull. This technique as a rule expands difference of pictures and forces can be better circulated. This considers territories of lower nearby complexity to pick up a higher difference. Histogram evening out fulfils this by adequately spreading out the most incessant force values.

iii. Face detection using Viola Jones

The Viola Jones framework is the first object detection framework that provides accurate object detection rates for face detection (distinguish from non-faces).

Although Viola Jones framework can be trained to identify a variety of object classes, it is motivated primarily for face recognition. During the learning stage, cascades of detectors are trained so as to gain the desired accuracy. Robustness is one of the main characteristics of Viola Jones algorithms which make it a good detection algorithm i.e. Because of very high detection rate (true-positive rate) & very low false-positive rates .

iv. Face feature extraction using Eigen value

The variation between face images are characterized by a set of Eigen vectors. In terms of a face, the Eigen vector can be represented as an Eigen-face.

The faces can also be approximated using only the "best" Eigen faces - i.e., those faces that account for the most of variance within the set of face images.

In the Eigen-face approach, the important aspects for identification are considered, i.e., to extract the relevant information in a face image, encode it most efficiently and then compare one face encoding with the database of models encoded similarly.

v. Identification using SVM

A support vector machine (SVMs) is a powerful tool for evolving pattern classification. SVM are used to hold the face recognition problem. SVMs have achieved knowingly advanced search accuracy than traditional query refinement schemes.

Main applications of these techniques are speech and image analysis, character recognition, person identification, industrial supervision, etc.

4. Comparison Analysis

Comparison between various face detection techniques PCA, HOG, HAAR and Eigen are as follow:

Table 1. Face Detection Techniques Methods Face Detection

<i>Methods</i>	<i>PCA</i>	<i>HOG</i>	<i>HAAR</i>	<i>Eigen</i>
<i>Face detection</i>	89.5	95.22	91.45	93.6

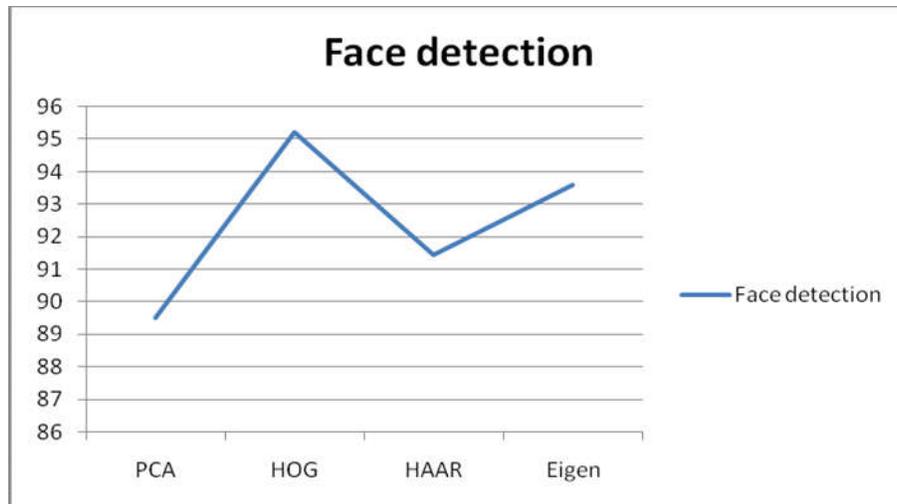


Figure 2. Analysis of Various Face Detection Techniques

Comparison between various face identification techniques are as follows:

Table 2. Face Identification Techniques

Methods	ANN+ Eigen	SVM+ Eigen
Face Identification	96.23	98.23

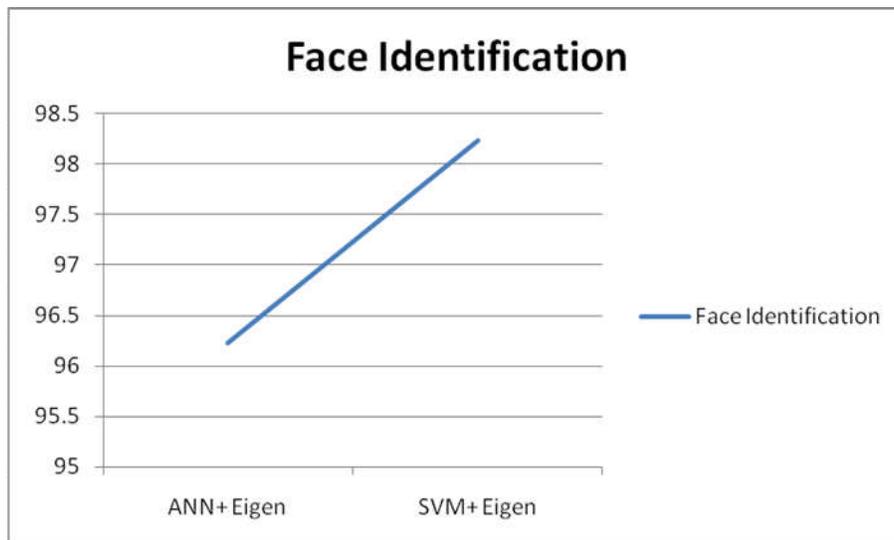


Figure 3. Analysis of Various Face Identification Techniques

Conclusion

The proposed system has come up with a new approach where Eigen features are incorporated into the Viola- Jones face detection algorithm, allowing us to detect multiple faces with greater efficiency. The system deals with various face poses and lightening conditions using SVM classifier. The process of matching faces in photo databases and then automatically detecting face features and identifying faces on still images and video streams in real time system, fulfils the requirements of various security

models such as criminal detection, government confidential security, etc. It can also be useful for attendance management systems. The new technology proposed here has come up with a reliable and huge processing power. The system works efficiently for large databases. As a result there are no technological barriers for stepping from the pilot project to a wide spread deployment.

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