International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 4 Issue 03, March-2015

Criminal Face Recognition System

Alireza Chevelwalla[1], Ajay Gurav[2] , Sachin Desai[3], Prof. Sumitra Sadhukhan[4]
Department of Computer Engineering
Rajiv Gandhi Institute of Technology.
Versova, Andheri(W), Mumbai-400053.

***Abstract-* Face recognition is one of the most challenging topics in computer vision today. It has applications ranging from security and surveillance to entertainment websites. Face recognition software are useful in banks, airports, and other institutions for screening customers. Germany and Australia have deployed face recognition at borders and customs for Automatic Passport Control.**

Human face is a dynamic object having high degree of variability in its appearance which makes face recognition a difficult problem in computer vision. In this field, accuracy and speed of identification is a main issue.

Many challenges exist for face recognition. The robustness of the system can be obstructed by humans who alter their facial features through wearing colored contact lenses, growing a mustache, putting on intense make-up, etc. Ethical concerns are also related to the process of recording, studying, and recognizing faces. Many individuals do not approve of surveillance systems which take numerous photographs of people who have not authorized this action.

The goal of this paper is to evaluate face detection and recognition techniques and provide a complete solution for image based face detection and recognition with higher accuracy, better response rate and an initial step for video surveillance. Solution is proposed based on performed tests on various face rich databases in terms of subjects, pose, emotions and light.

Keywords- Finger Print, DNA, Neural Networks, Computer Vision.

1. INTRODUCTION

Criminal record contains personal information about a particular person along with photograph. To identify any criminal we need identification regarding that person, which are given by the eyewitness. Identification can be done by finger print, eyes, DNA etc. One of the applications is face identification. The face is our primary focus of attention in social intercourse playing a major role in conveying identity and emotion. Although it is difficult to infer intelligence or character from facial appearance, the human ability to remember and recognize faces is remarkable.

A face recognition system uses a database of images and compares another image against those to find a match, if one exists. For each facial image, identification can be done using the RGB values for the eye color, the width and height of the face and also using various ratios which was done by Kovashka and Martonosi [1].

This system is aimed to identify the criminals in any investigation department. In this system, we are storing the images of criminals in our database along with his details and then these images are segmented into four slices- forehead, eyes, nose and lips. These images are again stored in another database record so as to make the identification process easier. Eyewitnesses will select the slices that appear on the screen and by using it we retrieve the image of the face from the database. Thus this system provides a very friendly environment for both the operator and the eyewitness to easily identify the criminal, if the criminals record exists in the database. This project is intended to identify a person using the images previously taken. The developed system is also a first milestone for video based face detection and recognition for surveillance.

2. CURRENT RESEARCH ON FACE RECOGNITION AND TECHNIQUES AVAILABLE

Key goal of computer vision researchers is to create automated face recognition systems that can equal, and eventually surpass, human performance. To this end, it is imperative that computational researchers know of the keyfindings from experimental studies of face recognition [1]. These findings provide insights into the nature of cues that the human visual system relies upon for achieving its impressive performance and serve as the building blocks for efforts to artificially emulate these abilities.

The face recognition problem has been studied for more than two decades. The approaches proposed in the literature so far can mainly be classified into two categories: model based and appearance based as described by Fu Jie Huang and Zhihua Zhou [5]. The model based method tries to extract geometrical parameters measuring the facial parts while the appearance based approach use the intensity or intensity-derived parameters such as eigen faces coefficients to recognize faces. Due to the changes of lighting condition, expression, occlusion, rotation, etc., the human face appearance could change considerably.

There are existing approaches proposed to recognize faces under varying pose. One is the Active Appearance Model proposed by Cootes [5], which deforms a generic face model to fit with the input image and uses the control parameters as the feature vector to be fed to the classifier. The second approach is based on transforming an input image to the same pose as the stored prototypical faces and then using direct template matching to recognize faces, proposed by Beymer, Poggio and later extended by

Vetter [5]. The third method is the eigenspace from all of the different views, proposed by Murase and Nayar, and later used by Graham and Allinson in face recognition [5].

2.1 Two-Dimensional and Three-Dimensional Techniques

In the early years of the 21st century, we found ourselves continually moving further away from the necessity of physical human interaction playing a major part of everyday tasks. Striding ever closer to an automated society, we interact more frequently with mechanical agents, anonymous users and the electronic information sources of the World Wide Web, than with our human counterparts. It is therefore perhaps ironic that identity has become such an important issue in the 21st century. It would seem that in an age where fraud is costing the public billions of pounds every year and even the most powerful nations are powerless against a few extremists with a flight ticket, it is not who we are that is important, but rather, that we are who we claim to be. For these reasons, biometric authentication has already begun a rapid growth in a wide range of market sectors and will undoubtedly continue to do so, until biometric scans are as commonplace as swiping a credit card or scrawling a signature [4].

2.2 Various categories of facial recognition algorithms:

- Neural networks.
- Feature analysis.
- Graph matching.
- Information theory.

Face recognition has a number of advantages over biometrics, it is non-intrusive. Whereas many biometrics require the subject’s co-operation and awareness in order to perform an identification or verification, such as looking into an eye scanner or placing their hand on a fingerprint reader, face recognition could be performed even without the subject's knowledge as described by the NSTC Committee [4].

2.3 Face Recognition Techniques

The method for acquiring face images depends upon the underlying application. For instance, surveillance applications may best be served by capturing face images by means of a video camera while image database investigations may require static intensity images taken by a standard camera. Some other applications, such as access to top security domains, may even necessitate the forgoing of the nonintrusive quality of face recognition by requiring the user to stand in front of a 3D scanner or an infra-red sensor [4].

2.3.1 Face Recognition from Intensity Images

Face recognition methods from intensity images fall into two main categories: feature-based and holistic. An overview of the well-known methods in these categories is given below.

2.3.1.1 Featured-based

Feature-based approaches first process the input image to identify and extract (and measure) distinctive facial features such as the eyes, mouth, nose, etc., as well as other marks, and then compute the geometric relationships among those facial points, thus reducing the input facial image to a vector of geometric features. Standard statistical pattern recognition techniques are then employed to match faces using these measurements.

2.3.1.2 Holistic

Holistic approaches attempt to identify faces using global representations, i.e., descriptions based on the entire image rather than on local features of the face. These schemes can be subdivided into two groups: statistical and AI approaches.

2.3.1.3 Statistical

In the simplest version of the holistic approaches, the image is represented as a 2D array of intensity values and recognition is performed by direct correlation comparisons between the input face and all the other faces in the database. Though this approach has been shown to work under limited circumstances (i.e., equal illumination, scale, pose, etc.), it is computationally very expensive and suffers from the usual shortcomings of straightforward correlation-based approaches, such as sensitivity to face orientation, size, variable lighting conditions, background clutter, and noise.

2.3.2 Predominant Approaches

There are two predominant approaches to the face recognition problem: geometric (feature based) and photometric (view based). As researcher interest in face recognition continued, many different algorithms were developed, three of which have been well studied in face recognition literature: Principal Components Analysis (PCA), Linear Discriminate Analysis (LDA), and Elastic Bunch Graph Matching (EBGM) [4].

2.3.2.1 PCA:

Principal Components Analysis (PCA) PCA is the technique pioneered by Kirby and Sirivich in 1988. With PCA, the probe and gallery images must be the same size and must be normalized to line up the eyes and mouth of the subjects within the images. The PCA approach is then used to reduce the dimension of the data by means of data compression and reveals the most effective low dimensional structure of facial patterns. This reduction in dimensions removes information that is not useful and precisely decomposes the face structure into orthogonal (uncorrelated) components known as eigen faces. Each face image may be represented as a weighted sum (feature vector) of the eigen faces, which are stored in a 1D array. A probe image is compared against a gallery image by measuring the distance between their respective feature vectors. The PCA approach typically requires the full frontal face to be presented each time, otherwise the image results in poor performance. The primary advantage of this technique is that it can reduce the data needed to identify the individual to 1/1000th of the data presented.

In the training phase, you should extract feature vectors for each image in the training set. Let *A* be a training image of person A which has a pixel resolution of *M £ N* (*M* rows, *N* columns). In order to extract PCA features of *A*, you will first convert the image into a pixel vector *ÁA* by concatenating each of the *M* rows into a single vector. The length (or, dimensionality) of the vector *ÁA* will be *M £N*. In this project, you will use the PCA algorithm as a dimensionality reduction technique which transforms the vector *ÁA* to a vector *A* which has a dimensionality *d*. For each training image *i*, you should calculate and store these feature vectors *I*.

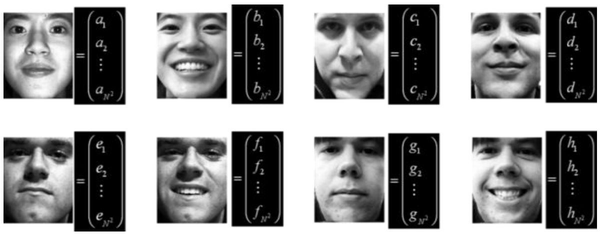

Fig1. Faces with their eigen vectors

In the recognition phase (or, testing phase), you will be given a test image *J* of a known person. Let *J* be the identity (name) of this person. As in the training phase, you should compute the feature vector of this person using PCA and obtain *J*. In order to identify *J*, you should compute the similarities between *J* and all of the feature vectors *I*'s in the training set. The similarity between feature vectors can be computed using Euclidean distance. The identity of the most similar *I* will be the output of our face recognizer. If *I* = *J*, it means that we have correctly identified the person *J*, otherwise if *I!* = J, it means that we have misclassified the person *J*.

2.3.2.2 LDA: Linear Discriminant Analysis

LDA is a statistical approach for classifying samples of unknown classes based on training samples with known classes.(Figure 2) This technique aims to maximize between-class (i.e., across users) variance and minimize within-class (i.e., within user) variance. In Figure where each block represents a class, there are large variances between classes, but little variance within classes. When dealing with high dimensional face data, this technique faces the small sample size problem that arises where there are a small number of available training samples compared to the dimensionality of the sample space.

Fig2. Examples of Six Classes using LDA

2.3.2.3 EBGM: Elastic Bunch Graph Matching

EBGM relies on the concept that real face images have many nonlinear characteristics that are not addressed by the linear analysis methods discussed earlier, such as variations in illumination (outdoor lighting vs. indoor fluorescents), pose (standing straight vs. leaning over) and expression (smile vs. frown). A Gabor wavelet transform creates a dynamic link architecture that projects the face onto an elastic grid. The Gabor jet is a node on the elastic grid, notated by circles on the image below, which describes the behavior around a given pixel. It is the result of a convolution of the image with a Gabor filter, which is used to detect shapes and to extract features using image processing.

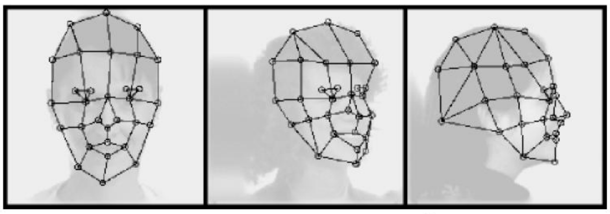

Fig3. Elastic Bunch Graph Matching

2.4 The Viola-Jones face detector

The basic principle of the Viola-Jones algorithm is to scan a sub-window capable of detecting faces across a given input image as demonstrated by Ole Helvig Jensen [2]. The standard image processing approach would be to rescale the input image to different sizes and then run the fixed size detector through these images. This approach turns out to be rather time consuming due to the calculation of the different size images. Contrary to the standard approach Viola-Jones rescale the detector instead of the input image and run the detector many times through the image – each time with a different size. At first one might suspect both approaches to be equally time consuming, but Viola-Jones have devised a scale invariant detector that requires the same number of calculations whatever the size. This detector is constructed using a so-called integral image and simple rectangular features reminiscent of Haar wavelets [2].

Fig4. Face detector, Nose detector, Eye detector output

We are using this algorithm to separate different features of Face from the Image. And we are storing these features into a Database with corresponding face.

2.4.2 The scale invariant detector

The first step of the Viola-Jones face detection algorithm is to turn the input image into an integral image. This is done by making each pixel equal to the entire sum of all pixels above and to the left of the concerned pixel. This is demonstrated in Figure

1	1	1
1	1	1
1	1	1

Input image

1	2	3
2	4	6
3	6	9

Integral image

Fig5. Transform Input image to Integral image

This allows for the calculation of the sum of all pixels inside any given rectangle using only four values. These values are the pixels in the integral image that coincide with the corners of the rectangle in the input image.

The Viola-Jones face detector analyzes a given sub-window using features consisting of two or more rectangles. Each feature results in a single value which is calculated by subtracting the sum of the white rectangle(s) from the sum of the black rectangle(s). Viola-Jones has empirically found that a detector with a base resolution of 24*24 pixels gives satisfactory results. When allowing for all possible sizes and positions of the features total of approximately 160.000 different features can then be constructed. Thus the amount of possible features vastly outnumbers the 576 pixels contained in the detector at base resolution. Following images are Screenshots from our systems module that is Face Recognition along with name of a corresponding face.

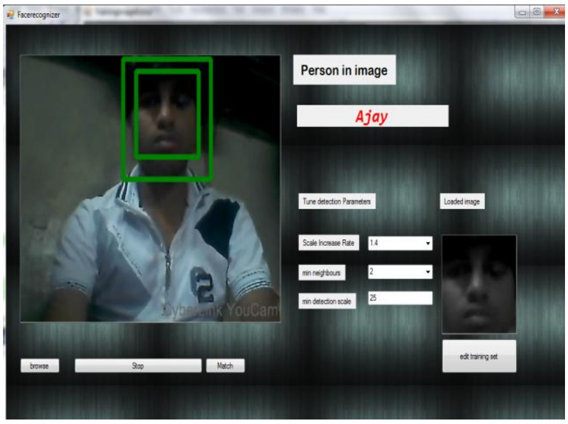

Fig6. Face Recognition from Live video

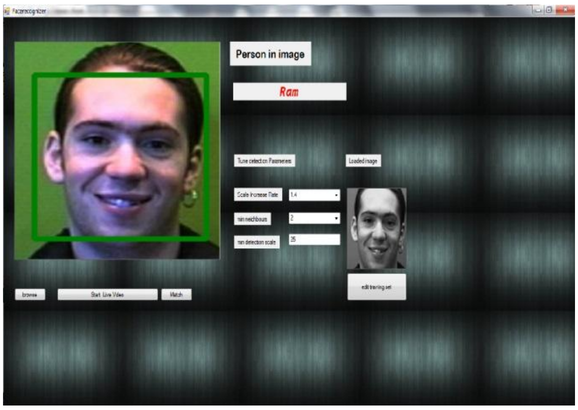

Fig7. Face Recognition with Image

3. CONCLUSION AND FUTURE WORK

This system uses our implementation of a face recognition system using features of a face including colors, features and distances. Using its two degree of freedom, our system allows two modes of operation, one that results in very few false positives and another which results in few false negatives. We have demonstrated various concerns related to the face recognition process, such as the lighting and background conditions in which the facial images are taken. Our system could be improved in the future through the development of a face detection algorithm which is less prone to incorrectness, failure and performs well regardless of the skin color. A more extensive feature set would also prevent the chance of tricking the system through the alteration of facial features.

4. REFERENCES

1. Adriana Kovashka Margaret Martonosi- Feature-Based Face Recognition for Identification of Criminals vs. Identification for Cashless Purchase
2. Ole Helvig Jensen “Implementing the Viola-Jones Face Detection Algorithm”
3. Rabia Jafri* and Hamid R. Arabnia* A Survey of Face Recognition Techniques
4. Face Recognition- NSTC Committee on Technology Committee on Homeland and National Security Subcommittee on Biometrics.
5. Fu Jie Huang Zhihua Zhou “Pose Invariant Face Recognition”.