# A Review on Face Recognition Techniques

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*Abstract*— The human face is a complicated multidimensional visual model and hence it is very difficult to develop a computational model for recognizing it. The paper presents a methodology for recognizing the human face based on the features derived from the image. Face recognition is related to the field of the machine learning, computer vision & image analysis. Face recognition comprehensively uses a wide range of methods which are mentioned in this paper. This review is of present methodology of face recognition techniques like Principle Component Analysis(PCA), Linear Discriminant Analysis(LDA), Local Binary Pattern(LBP). Nowadays, there are a lot of face recognition techniques and algorithms found and developed around the world. Facial recognition becomes an interesting research topic. It is proven by numerous number of published papers related with facial recognition including facial feature extraction, facial algorithm improvements, and facial recognition implementations.

***Keywords:*** face recognition, Local Binary Pattern (LBP), Linear Discriminant Analysis (LDA), Principle Component Analysis (PCA)

## I. INTRODUCTION

Face recognition is a major challenge encountered in multidimensional visual model analysis. The art of recognizing the human face is quite difficult as it exhibits varying characteristics like expressions, age, change in hairstyle. Face recognition plays a crucial role in applications such as security system, credit card verification, identifying criminals in airport, railway stations etc. Although many methods have been proposed to detect and recognize human face developing a computational model for a large data base is still a challenging task

The proposed methodology is implemented in two stages. Since the human face can be identified by certain facial characters in the first step the relevant features from the facial image are extracted. Face recognition is from the face detection. Face recognition has main two task- verification & identification. Face verification means a 1:1match that compares a face image against a template face image. To recognize the face detected fusion of principal component analysis algorithm and artificial neural network are used to obtain accurate result.

## II. PROPOSED METHODOLOGY

The proposed method implement an efficient Face Detection and Recognition technique which is independent of variations in features like colour, hairstyle, different facial expressions etc using Viola Jones algorithm, PCA and ANN. The process flow of the proposed methodology is as shown in Figure 1.

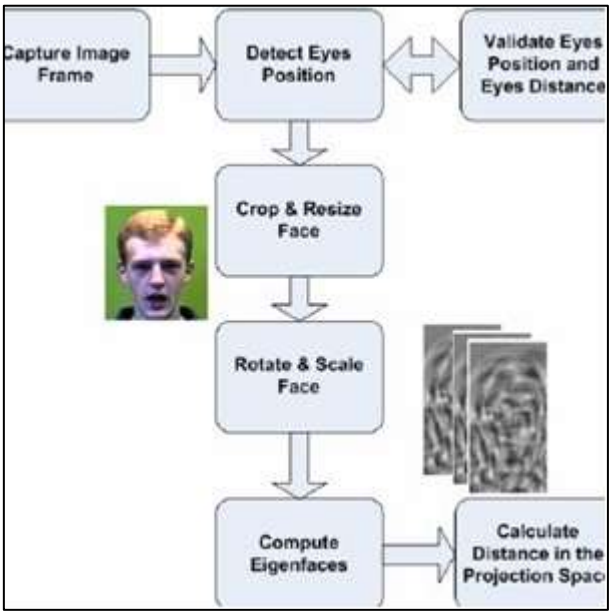


Fig. 1: Flowchart of the proposed methodology

The proposed methodology uses the Bio-ID Face Database as the standard image data base. The dataset consists of 1521 grey level images with resolution of 384*28

Fig. 2: Bio-ID Face Database

## III. PREPROCESSING

A standard image database which is readily available either in colour or grey scale is considered. In the Pre-processing stage contrast stretching is performed on the acquired image where the white pixels are made whiter and black pixels are made blacker.

## IV. FACE DETECTION

The skin colour detection pick the skin colour blocks in input image, and turn it to binary. But under complicated background environment, still there are skin colour blocks. So morphologic processing is needed to make the binary image pixel erosion and dilation, in this way, mottle in skin colour blocks would be reduced and internal pixel would be dilated. Most computer users are relatively close to the computer, so the face skin colour will have big blocks by skin

 

colour detection. Thus, we can take method of linking block to reserve the biggest one and wipe off the smallest on. In the end, the face image is orientated and used to recognize human Face.

The Integral Image is an algorithm for cost-effective generation of the sum of pixel intensities in a specified rectangle in an image. It is used for rapid computation of Haar-like features. Calculation of the sum of a rectangular area inside the original image is extremely efficient, requiring only four additions for any arbitrary rectangle size. AdaBoost is used for construction of strong classifiers as linear combination of weak classifiers

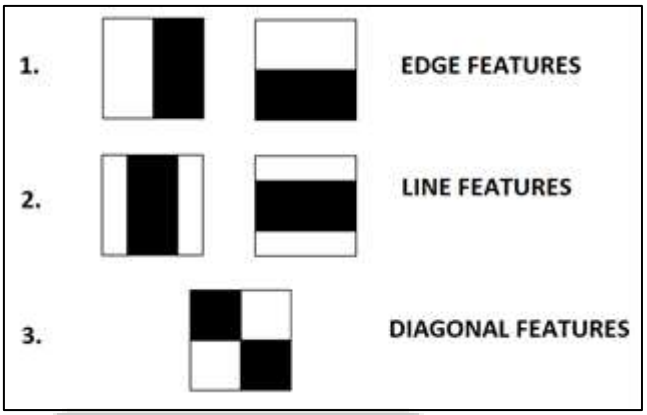


Fig. 3: Haar features in viola-Jones

From the Haar feature applied to the face the sum of black pixel and sum of white pixel are calculated and they are subtracted to get a single value. If this value is more in that region, then it represent a part of the face and is identified as eyes, nose, cheek etc. Haar features are calculated all over the image which will be almost 160000+ features per image.

Summing up the entire image pixel and then subtracting them to get a single value is not efficient in real time applications. This can be reduced by using Ada boost classifier. Ada boost reduces the redundant features. Here instead of summing up all the pixels the integral image is used as shown in figure 4.

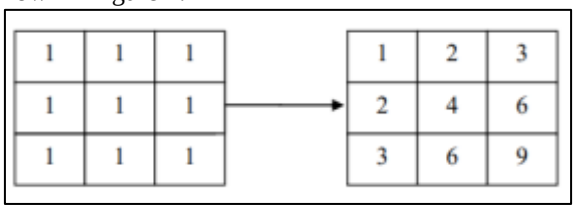


Fig. 4: Integral image

To get a new pixel value the top pixels and left pixels are added then all the values around the patch are added to obtain the sum of all pixel value.

Ada boost determines relevant features and irrelevant features. After identifying relevant features and irrelevant features the Ada boost assigns a weight to all of them.

Weak classifier = 1; Identified a feature (ex: nose) Weak classifier = 0; Not Identified any feature (ex: no nose in image)

Almost 2500 features are calculated. Further the number of computations can be reduced by cascading. Here set of features are kept in another set of classifier and so on in a cascading format. By this method one can detect whether it is a face or not in a quicker time and can reject it if one classifier fails to provide a required output to the next stage. The detected face is cropped and resized to a standard resolution of 100x100. The next step is to identify the detected image using principle component analysis and artificial neural network algorithm

## V. FEATURE EXTRACTION

Principal Component Analysis (PCA): PCA is used to extract features from an image of human face. The Flow chart of PCA Algorithm is as shown in the Fig 5.

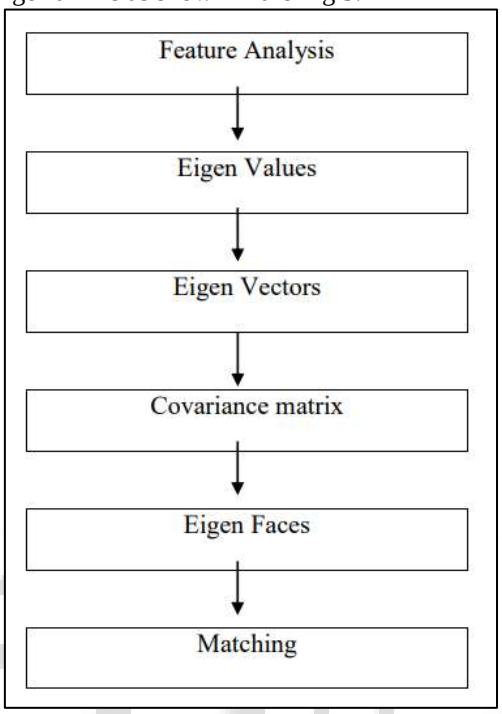


Fig. 5: Flow chart of PCA Algorithm

Principal component analysis (PCA) algorithm is used to extract features from a cropped and resized face image. It is used as a tool in predictive analysis and in explanatory data analysis and is used to transform higher dimensional data into lower dimensional data. A bunch of facial images in a training set of size M x M are converted into lower dimensional face images by applying principal component analysis technique.

For the face recognition application the Principal component analysis is one of the mathematical procedures used to convert a set of correlated N face images into a set of uncorrelated k face images called as Eigen faces. The number of principal components will be less than or equal to number of original values i.e., K<N.

To reduce the number of calculations the dimension of the original images has to be reduced before calculating the principal components. Since principal components show less direction and more noise, only first few principal components (say N) are selected and the remaining components can be neglected as they contain more noise.

A training set of M images is represented by the best Eigen faces with largest Eigen values and accounts for the most variance with in the set of face images and best approximate the face. After finding Eigen faces each image in training set can be represented by a linear combination of Eigen faces and will be represented as vectors. The input

 

image features are compared with standard database features for recognition.

## VI. FACE RECOGNITION

Linear Binary Pattern (LBP) - Linear binary pattern is visual description of an image used for face recognition put forth by Ojala for texture classification. Linear binary pattern operates on the image as it assigns or divides the image into number of small blocks. The linear binary pattern operator gives a notation to each pixel of the image with center value of 3x3 neighborhood thresholding and gives the binary values as output [5]. This linear binary pattern works by comparing the pixels with the center pixels. At the end, it gives a binary number which will be converted into decimal format. For this, we eight neighbor pixels, so for comparison we use the following formula Networks, one should know how the natural neural network system in brain works. Natural Neural Networks system in the brain has neurons.

$$LBP(x_c, y_c) = \sum_{n=0}^{7} s(i_n - i_c)2^n$$

Where,

$$s(x) = \begin{cases} 1 & \text{if} \quad x \geq 0 \\ 0 & \text{if} \quad x < 0 \end{cases}$$

These formulas applied on the images as,

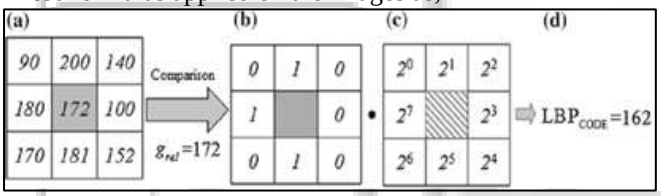


Fig. 6: Linear Binary Pattern

Linear Discriminant Analysis(LDA):Ronald Fisher invented this concept linear discriminant analysis (LDA) is a generalization of linear discriminant, a method used in statistics, pattern recognition and machine learning Linear Discriminant Analysis groups the image with the help of the features and the class. It determines the features of images are low-dimensional to high-dimensional. This linear discriminant differentiates the images of the different class and groups the images of the same class. Linear discriminant analysis related to regression analysis and ANOVA(analysis of variance), it gives a linear combination of various measurements as a dependent variable.

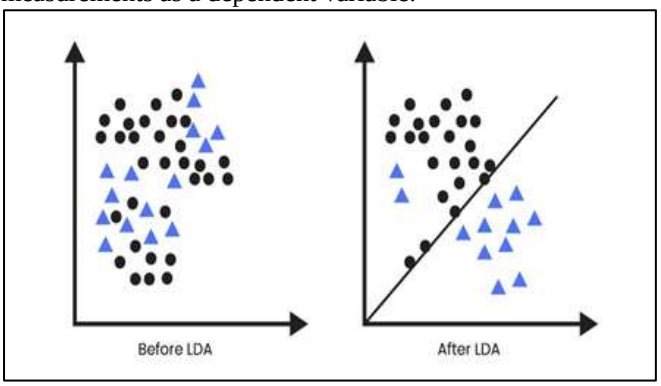


Fig. 7: Linear Discriminat Analysis

LDA works when the measurements made on independent variables for each observation are continuous quantities.

Haar Feature Based Cascade Classifier:The Haar feature based cascade classifier invented by Paul Viola and Michael Jones in 2001. This figure shows the how the Haar cascade classifier method works with a various numbers of positive images and negative images to train it's cascade function where it is based on machine learning. This Haar cascade classifier recognizes the face via skin colour i.e. color of eye pupils is darker than skin color so identifies the faces.

## VII. CONCLUSION

Face recognition technique is a vast research and development topic today. This paper covers the recent face recognition technique after significant reviews of various numbers of papers related to face recognition field. According to requirement & application orientation, suitable techniques are used which are PCA, LDA, LBP, Haar cascade classifier, etc

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