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Automatic Facial Recognition and Surveillance System

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Abstract*: *In this paper we proposed a criminal detection framework that could help policemen to recognize the face of a criminal or a suspect. The framework is a client-server based face recognition surveillance in the real-time. For detecting human faces, we use Viola Jones algorithm which uses haar wavelet classifier and PCA (Principal component analysis). We train computer to automatically identify the human faces from the given images irrespective of the illumination conditions. There were some disadvantages like intensity of light problem and head pose problem. Therefore, to overcome these issues, various techniques like illumination invariant, Viola and Jones algorithm, Principle component analysis are used. The major steps in this system are detecting the faces and recognizing them. After these, the comparison of detected faces can be done by crosschecking with the database

Keywords*: *Viola jones algorithm, PCA (principal component analysis), Feature extraction, Face detection, Eigen vectors.

I. INTRODUCTION

The main objective is to design a system that detects and recognizes the human faces. It is possible to detect various parts of the human body based on the facial features present. Face detection achieves a real-time performance through Viola-Jones framework where its detection rates are competitive with some of the best methods to date in terms of both performance and running time. It is always easy for a human to detect the faces from the given set of images and distinguish them appropriately. But for a system, it should be properly trained such that when a live dataset is given by the use it should be able to detect the face of a human and also various other features like eyes, nose, mouth etc. This can be further applied to real world applications of face recognitions in recognizing the criminal face in online examination and much more.

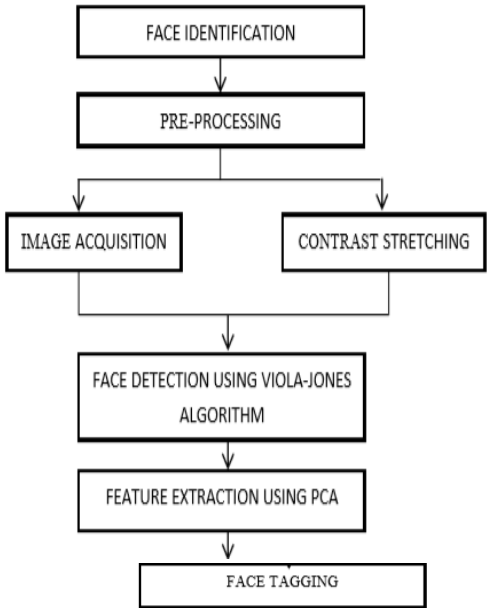
II. RELETED WORK

The research work in [1] proposed the design of an application (Android based) which compares multiple faces. The system matches faces using Eigenfaces algorithm based on Principal Component Analysis (PCA). At the client side, the Android mobile user takes an image or a video as an input and then passes it to the web server using HTTP method. At the server side, an image or video match with the existing criminal information record in a database is done. The proposed system in [2] recognizes the criminal's images from live streaming CCTV video .The system compares these images with the criminal information in database records, then displays a specific information if the image matches with the database content. In the face detection stage, it uses the HAAR's algorithm and for recognition stage it uses the EIGEN values. The Research work in [3] presented a model that is composed of two-mode tracking: short range tracking mode, and long-range tracking mode. This model is used to deal with real-time face tracking situations, face scaling, face pose changes, and face abrupt movements. The first mode is used for changes in scaling and appearance. The second mode is used to capture fast and abrupt motion by particle filter and Continuously Adaptive Mean Shift (CAM Shift). In the face detection stage, they used Viola and Jones to locate the face beforehand and give the tracking system the important face features including corner points and colour histogram. The authors in [4] used three basic detectors that trained by local binary pattern (LBP) and boosting algorithm. They are expanded for multi-view face detection. The authors in [5] developed a real-time head pose estimation solution. Their proposed system has been implemented on Mobile Platforms. Three algorithms are used*:* Viola-Jones for face detection, colour tracking, and an efficient head pose estimation algorithm.

III. PROPOSED WORK

The proposed system uses using Viola Jones algorithm, PCA for Recognition which is independent of features like colour, hairstyle, different facial expressions etc. Viola – Jones algorithm to detect various parts of the human faces. The proposed

system uses the BioID Face Database as the standard image data base. The data set consists of gray level images with resolution of 384*286 pixel**.**



Flowchart of the proposed System

A. Face identification

After contrast stretching viola-Jones algorithm is applied for detecting the face in the image. Viola-Jones detector was chosen as a detection algorithm because of its high detection rate, and its ability to run in real time. Detector is most effective on frontal images of faces and it can cope with 45° face rotation both around the vertical and horizontal axis.
Following are basic methods used by Viola-Jones algorithm.
Haar-like features are used for the feature extraction thus getting an Integral image.
Cascade classifier which can efficiently combine many features. In this, the resultant classifier has several filters
Once the strong classifiers are cascaded, the face and non-face regions can be separated. This object detector also efficiently detects the nose, Upper body, Lips, eyes and pupil. The face detection is controlled by the cascade object detection framework. The advantage of the proposed idea is that it can detect faces irrespective of illumination conditions. The Haar feature extraction is the major part in this process which uses Haar cascade classifier. These Haar feature can tell us if there is any feature present in the given image. Each feature returns a single value which is given by the difference of sum of the pixels in the white region from the sum of pixels in the black region. For the speedy detection of the face features we consider Haar features as the rectangular region.

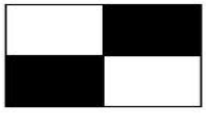
B. Pre-processing

A standard image database which is readily available either in color or gray scale is considered. In the Pre-processing stage contrast stretching is performed on the acquired image

1)Edge Features

2) Line Features

3) Diagonal Line Features



The above Haar features consist of various height and width. The Haar feature applied to the face the sum of pixels (Black & White) are calculated and they are combined to get a single value. If this value is more in that region, then it is a part of the face and is identified as eyes, nose, cheek etc

C. Detection using viola jones algorithm

1)Viola Jones Upper Body Detection : The upper body parts can be detected using this method in the still images based on the successful object detection framework on it that also contains the model for detecting the near and frontal upper bodies. This model has been used to detect the part of the upper body of the human and also it observes the face object detection. The upper body detection in this model detects the upper body region, which consists of the head as well as the region of the shoulder combining with the face. These details of the head and the shoulder region has been encoded using the Haar features and the object detection. Since the object in the head and face uses more type of features, this model is more robust against the pose or the changes in the image, e.g. rotating head/blinking eyes with a tilt.

To detect the upper body using the classification model we have 3 properties:

Create a detector object and their properties

Input image given is read and detects upper body.

Show the detected upper bodies in a bounding box.

2) Viola-Jones Eye Detection : The region of the eye is darker related to other parts of the face, so finding the regions of the eye is based on segmenting a small region of the image which is specified as a darker region. The center part of the eye region is darker than the other region based on this model the eyebrow region has been removed. After the region of the selected eye region is done using the histogram analysis, as the region of eye exhibits two peaks whereas the region of eyebrow shows only one peak. The 2-major axis has the alignment of which is the final constraint here, so that the two eye regions corresponds to the same line.

3) Viola-Jones Nose Detection : The nose has different properties on it to detect easily

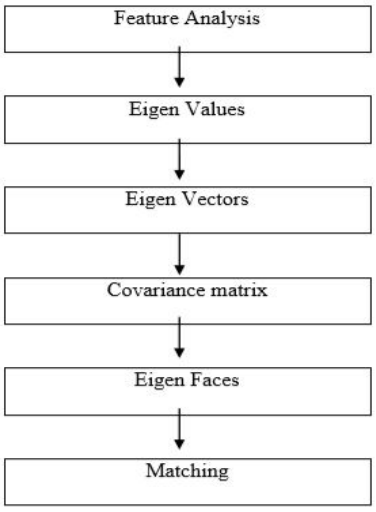
1) Dark White Dark Pixels: When an image is taken and it is convolved with these Dark White Dark Pixels the nostril region will be identified. This is based on the two regions of holes on the nose, which represents the dark pixels and the center region of the nose describes the white pixels.

2) Similarity of region on both the sides: The nostrils have the region of black areas on both the left and right side of the nose which is very same. These properties have been considered as a similarity on both the sides of the region

D. Feature Extraction

PCA is used to extract features from an image of human face

Flow chart of PCA Algorithm



Principal component analysis (PCA) algorithm is used for features extraction from a cropped and resized 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 Principal component analysis is one of the mathematical procedures used to convert a set of correlated N variables into a set of uncorrelated k variables called as principal components.

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.

IV. EXPERIMENTAL RESULT

n this paper, a criminal detection framework is presented. In this paper, a criminal detection framework is presented. The face detection is implemented using Viola-Jones ready-to-use function provided by OpenCV library.
Haar-wavelet classifier are used for the feature extraction thus getting an Integral image. After recognizing the facial detail details are stored in the database and if facial details are already in the database then data is retrieved from the database and result is displayed on the screen.Basically our system tracks the real time location of the criminal and after capturing the criminal image with the help of camera and notification is send via SMS or Email.

Figure1: Reference image from BioID database[1]

Applying the Voila-Jones algorithm to the image in Figure 1 Identified face image shown in Figure 2 is obtained (bounding box on identified face). It is then resized to 100x100 pixels that is the Haar features are calculated and all the related features are extracted

Figure 2: Face identified by Voila-Jones algorithm (Red boundary) [1]

Main features of the face are identified by Voila-Jones algorithm marked by a bounding box as shown in Figure 3 and is used for deciding the nodes corresponding to the identified part of the face

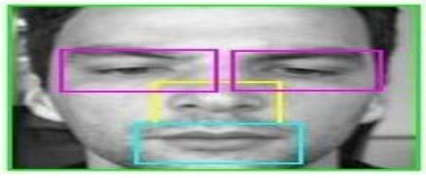


Figure 3: Face features (parts) identified by Voila-Jones algorithm (Boundary box) [1]

The features extracted by Voila-Jones algorithm are represented as nodes and these nodes are joined to form a shape making sure that all nodes
are connected, and the connected lines are named with reference numbers as shown in the Figure 4

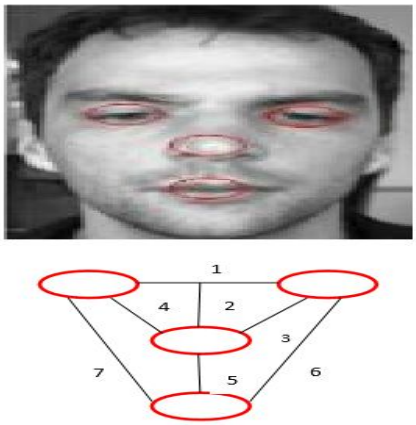


Figure 4: Face feature calculation[1]

V.CONCLUSION

The paper presents an efficient approach for face detection and recognition using Viola-Jones Algorithm, PCA. The performance of the proposed method is compared with other existing face recognition methods and it is observed that better accuracy in recognition is achieved with the proposed method. Face detection and recognition plays a vital role in a wide range of applications. In this paper, a criminal detection framework is presented. This framework is a face recognition surveillance in the real-time.

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