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A Survey on Face Recognition Eigen face and PCA method

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Abstract: ***Face recognition is technique which is used to identify person by their face. Identifying the person is performed with different types of Biometric like iris scan, finger print, face recognition, Gait recognition; Signature etc. face recognition is widely spread in world since some year for recognition of person for authentication and security purpose. There are many problems are occurred when it perform face recognition like illumination, light intensity, blurred face, noisy image, tilted face, different head pose & scale. Face recognition is combination of two system face detection and face recognition. Face detection is performed using color space like RGB, YCbCr. RGB is sensitive to light and YCbCr is not sensitive to light. By detecting intensity of color it can detect skin and then applying classifier it can detect facial candidate. If facial candidate are detect than it have to remove non-face image. It has to apply PCA method with Generating eigenfaces in eigen spaces for recognition of person from database. It will check the input facial image weight and compare Euclidian distance with all subspaces. Eigen face which is near to input face by Euclidian distance of weight is providing as result of recognition.***

Keywords: PCA (Principle Component Analysis): Eigenface; Eigenvalue; Nearest Neighbor classifier.

I. INTRODUCTION

Face recognition systems are part of facial image processing applications and their importance as a research area are rising recently. They use biometric information of the humans face and are applicable easily instead of fingerprint, iris, signature etc., because these types of biometrics are not much suitable for no mutual people. Face recognition systems are usually applied and preferred for people and security cameras. These systems can be used for video surveillance, crime prevention, person verification, and other similar security activities. Face recognition system is a complex image-processing which face problem in real world of occlusion, illumination, and imaging condition on light and angels. It is a combination of two methods face detection and recognition techniques in Image analyzing. Detection application is used to find possibility and position of the faces in a input image. Recognition algorithm is used to classify given images with known structured properties, which are used commonly in most of the computer vision applications. These images have some known properties like same facial feature components, same distance between facial candidate and similar eye alignment. Recognition applications uses normal images and detection algorithms detect the faces and extract face images which include eyes, nose, eyebrows, and mouth. It makes the algorithm more complicated than single process of detection or recognition algorithm. The first step for face recognition system is to get an image as input. Second step is face detection from the input image. Third step of face recognition is that takes the face images from output of face detection part. Final step is identifying person from result of recognition part.

Face recognition is used in many ways.

- For the security purpose by enhancing of surveillance camera with face recognition.
- At the entry level of hotel or any company for identifying the person.
- Checking the criminal record by input image in branch of investigation.

- To find the lost people or children using image which get from CCTV camera fitted in public places.

Some cases affect on face recognition are given below.

Illumination: The illumination variation has been widely discussed in many face detection and recognition researches. This variation is caused by various lighting environments and is mentioned to have larger appearance difference than the difference caused by different identities. We can neither assure the identification nor accurately point out the positions of facial features.

Pose: The pose variation results from different angles and locations during the image acquisition process. This variation changes the spatial relations among facial features and causes serious distortion on the traditional appearance-based face recognition algorithms such as eigen-faces and fisherfaces.

Expression: Human uses different facial expressions to express their feelings or tempers. The expression variation results in not only the spatial relation change, but also the facial-feature shape change.

RST variation: The RST (rotation, scaling, and translation) variation is also caused by the variation in image acquisition process. It results in difficulties both in face detection and recognition, and may require exhaustive searching in the detection process over all possible RST parameters.

Occlusion: The occlusion is possibly the most difficult problem in face recognition and face detection. It means that some parts of human faces are unnoticed, especially the facial features.

Humans have a remarkable ability to recognize face based on facial appearance. So, face is a natural human trait for automated biometric recognition. Face recognition systems generate relationship among the locations of facial features such as eyes, nose, lips and the global appearance of a face. An excellent survey of existing face recognition technologies and challenges is done. The problems associated with illumination, gesture, facial makeup, occlusion, and pose variations affect the face recognition performance. While face recognition is provides acceptable levels of recognition performance in controlled environments, robust face recognition in non-ideal situations continues to pose challenges.

II. FACE RECOGNITION

Facial recognition is a visual pattern recognition task. The three-dimensional human face, which is subject to varying illumination, pose, expression etc. has to be recognized. This recognition can be performed on a variety of input data sources such as:

• A single 2D image.

• Stereo 2D images (two or more 2D images).

• 3D laser scans.

Also, soon Time of Flight (TOF) 3D cameras will be accurate enough to be used as well. The dimensionality of these sources can be increased by one by the inclusion of a time dimension. A still image with a time dimension is a video sequence. The advantage is that the identification of a person can be determined more precisely from a video sequence than from a picture since the identity of a person can't change from two frames taken in sequence from a video sequence.

Facial recognition systems usually consist of four steps

- face detection (localization)
- face preprocessing (face normalization, light correction and etc.),
- feature extraction
- feature matching.

These steps are described in the following sections.

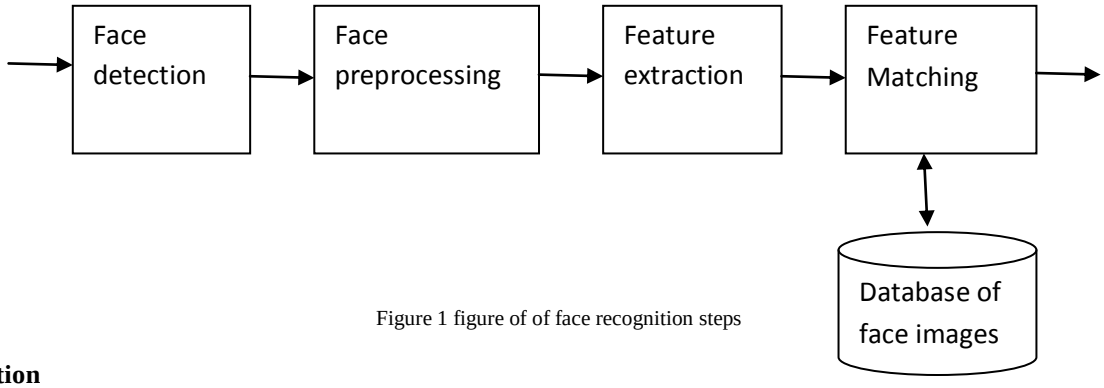

Figure 1 figure of of face recognition steps

Face Detection

The aim of face detection is localization of the face in a image. In the case of video input, it can be an advantage to track the face in between multiple frames, to reduce computational time and preserve the identity of a face (person) between frames. Methods used for face detection includes: Shape templates, neural networks and Active Appearance Models (AAM).

Preprocessing

The aim of the face preprocessing step is to normalize the coarse face detection, so that a robust feature extraction can be achieved. Depending of the application, face preprocessing includes: Alignment (translation, rotation, scaling) and light normalization/correlation.

Feature Extraction

The aim of feature extraction is to extract a compact set of interpersonal discriminating geometrical or/and photometrical features of the face. Methods for feature extraction include: PCA, FLDA and Locality Preserving Projections (LPP)

Feature Matching

Feature matching is the actual recognition process. The feature vector obtained from the feature extraction is matched to classes (persons) of facial images already enrolled in a database. The matching algorithms vary from the fairly obvious Nearest Neighbor to advanced schemes like Neural Networks.

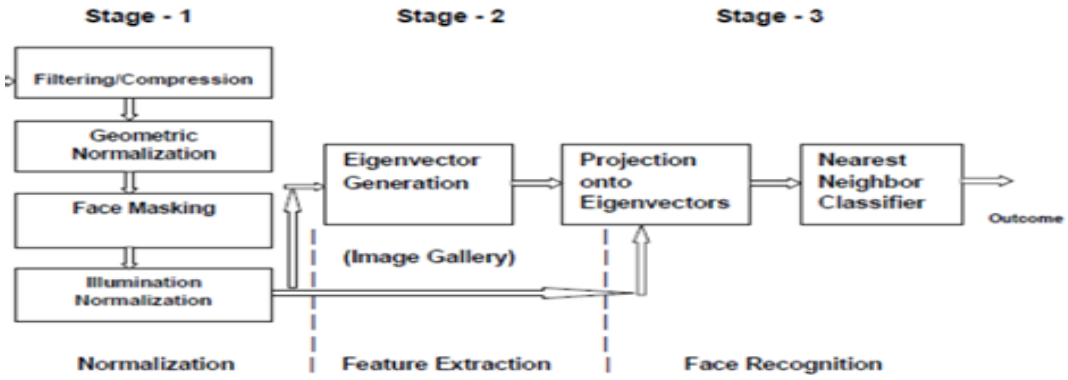

Figure 2 Block diagram for PCA based face recognition

Figure (2) show face recognition in real time under different conditions and provide result of the method. It used PCA method for face detection and recognition. It used canny edged detection for outline order of face image in various conditions like illumination, occlusion, tilted poses and various head scales. It used PCA for reduce the dimension of group or face. This method worked in three step, first geometry normalization face masking and illumination normalization then second part is for Eigen vector generation and projection onto Eigen vectors. Third step is for similarity matching using nearest neighbor

classifier. Result for various illuminations tilted and occlusion was good but in case of different background and head scale result is poor.

Modified face image which is obtained in the Face recognition system, should to be classified to identify the person in the database. This is face recognition part of a Face Recognition System. Face recognition part is composed of preprocessing face image, vectorizing image matrix, database generation, and then classification. The classification is achieved by using Feed Forward Neural Network.

Before classifying the face image, it should be preprocessed. Preprocessing operations are histogram equalizing of grayscale face image, resizing to 30-by-30 pixels, and finally vectorizing the matrix image. Histogram equalizing is used for contrast adjustment. After histogram equalization is applied, input face image is similar to faces in database. Input face image has a resolution about 110-by-130 pixels which is large for computation of classifier. So, dimension reduction is made with resizing images to 30-by-30 pixels image to reduce computational time in classification. After resizing, image matrix should be converted to vector because classifier does not work with two-dimensional input. Input vector size will be 900- by-1 vector to classifier.

III. EIGENFACES USED FOR RECOGNITION

The idea of using eigen-faces was motivated by a technique for efficiently representing images of faces using principal component analysis. It is argued that a collection of face images can be approximately reconstructed by storing a small collection of weights for each face and a small set of standard images. Therefore, if a multitude of face images can be reconstructed by weighted sum of a small collection of characteristic images, then an efficient way to learn and recognize faces might be to build the characteristic features from known face images and to recognize particular faces by comparing the feature weights needed to (approximately) reconstruct them with the weights associated with the known individuals.

Face recognition with eigenfaces approach involves the following initialization operations:

1. Acquire a set of training images.
2. Calculate the eigenfaces from the training set and keep only the best *M* images with the highest eigenvalues. These *M* images describe the “face space”. As new faces are found, the eigenfaces can be updated.
3. Calculate the matching distribution in *M*-dimensional weight space for each known individual training image, by projecting their face images onto the face space.

After initialized the system, the following steps are used to recognize new face images:

1. Given an image to be recognized, calculate a set of weights of the *M* eigenfaces by projecting the it onto each of the eigenfaces.
2. find out if the image is a face at all by checking to see if the image is sufficiently close to the face space.
3. If it is a face, classify the weight pattern as either a known person or as unknown.
4. Update the eigenfaces and/or weight patterns(it is optional).
5. (Optional) Calculate the characteristic weight pattern of the new face image, and incorporate into the known faces.

IV. CONCLUSION

After studying the different papers of face recognition I concluded that so many methods are used for face recognition and it is not possible to face recognition in all conditions. Face recognition faces the many problems of illumination, occlusion and pose variation. PCA method is used for face recognition by generating eigenfaces. Appearance based approach is used for face

recognition with nearest neighbor method on facial candidates in database. It provides low result in case of various head scales and different background.

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