

# Survey on: Three Dimensional Face Recognition in the Presences of Facial Expression

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**ABSTRACT:** Facial expression classification is becoming one of the foremost challenges in the area of computer vision & artificial intelligence that can be used in the domains of security, entertainment and human machine interface. Normally face recognition process is divided in three phases, first is face detection, and second is feature extraction from input face image and the third is face recognition. This paper contributes to present various approaches/methods applied in 3D face recognition techniques. In this paper some of the popular face recognition algorithms are discussed and reviewed to summarize the existing literature on three dimensional face recognition techniques and is useful to understand the current state of studies on the topic.

**KEYWORDS:** face recognition, Eigen faces, fisher faces, neural network, and elastic bunch method, graph matching, feature matching and template matching.

## I. INTRODUCTION

Three-dimensional face recognition (3D face recognition) may be a modality of automatic face recognition way within which the three-dimensional pure mathematics of the external body part is employed. It's has been shown that 3D face recognition ways can do considerable higher accuracy than their 2D counterparts, rivalling finger prints recognition. 3D face recognition has the potential to realize higher accuracy than its 2D counterpart by activity pure mathematics of rigid options on the face. This avoids such pitfalls of 2D face recognition algorithms as modification in lighting, completely different facial expressions, make-up and head orientation. In additionally, most 3D scanners acquire a 3D mesh and also the corresponding texture. This permits combining the output of pure 3D Matchers with the heap of ancient 2D face recognition algorithms, thus yielding higher performance. The most technological limitations of 3D face recognition methods is that the acquisition of 3D images from completely different angles from a typical camera (e.g. webcam) is also used to produce the 3D model with important post-processing. (See 3D information acquisition and object reconstruction.) [3] This is additionally a reason why 3D face recognition methods have emerged considerably later (in the late 1980s) than 2D methods. Recently industrial solutions have enforced depth perception by projecting a grid onto the face and integration video capture of it into a high resolution 3D model. This permits permanently recognition accuracy with low cost off-the-rack components. 3D face recognition continues to be a full of life analysis field, though many vendors offer commercial solutions.

## II. BASICS OF FACE RECOGNITION

A face recognition system is a computer application capable of identifying or verifying a person from a digital image or a video frame from a video source. This verification can be done by comparing selected facial features from the image and a face database. It is typically used in security systems and can be compared to other biometrics such as fingerprint or eye iris recognition systems [2]. Now days, Face recognitions has also become popular as a commercial detection and marketing tool. The next process is face region identification and feature extraction and then the face region has to be selected. All the data generated in this whole process is saved in a database. After that the saved data is used for classification. After classification it will show the experimental results.

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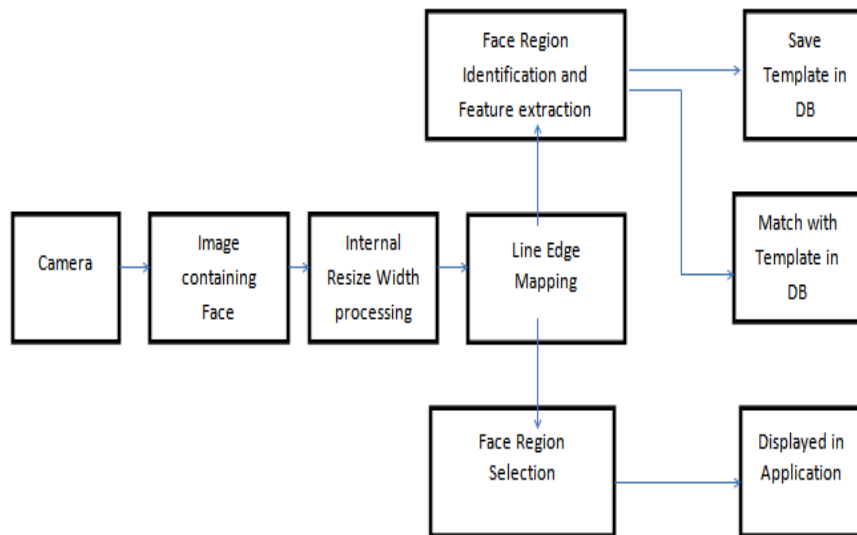


Fig1: Flowchart of Face Recognition

There are various factors that make the face detection a challenging task. Such as pose presence or absence of structural components, Facial expression, Occlusion, Image orientation. The facial feature detection is the process to detect the presence and location of features, like nose, eyebrow, eyes, lips, nostrils, mouth, ears, etc. this is done with the assumptions that there is only a single face in an image. In the face recognition process the input image is compared, designed with the database and data repository is constructed for multidimensional data analysis and data processing. The input image is also called as exploration and the database is called as gallery [3].

### III. FACE RECOGNITION APPROACHES

There are basically three approaches for face recognition that are given below:

➤ **Feature Based Approach**

Local feature like nose, eyes are segmented in feature based technique and it can be used as input data in face detection that will become easier to face recognition.

➤ **Holistic approach**

In holistic approach the whole face taken as the input in the face detection system to perform face recognition.

➤ **Hybrid approach**

Hybrid approach is combination of feature based and holistic approach. In this approach both local and whole face is used as the input to face detection system [1].

### IV. TECHNIQUES FOR FACE RECOGNITION

A. **Eigen-face:-**

The Eigen Face technique is one in all the commonly used algorithms for face recognition. Karhunen-Loeve relies on the Eigen Face technique during which the Principal Component Analysis (PCA) is employed. This method is successfully used to perform dimensionality reduction. Principal Component Analysis is used by face recognition and detection. Mathematically, Eigen-face square measures the principal components divide the face into feature vectors.

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The feature vector information may be obtained from covariance matrix. These Eigenvectors square measure won't to quantify the variation between multiple faces. The faces are characterized by the linear combination of highest Eigen-values. Each face is thought-about as a linear combination of the Eigen-faces. This is often approximated by using the eigenvectors having the biggest Eigen-values. The best M Eigen-faces define an M dimensional space, which is called as the "face space". Principal Component Analysis is also used by L. Sirovich and M. Kirby to efficiently represent pictures of faces. They outlined that a face pictures may be more or less reconstructed employing a tiny assortment of weights for every face and a customary face image. The weights describing each face are obtained by projecting the face image onto the Eigen picture [3]. Eigen-face is a practical approach for face recognition. Because of the simplicity of its algorithmic program, implementation of Associate in nursing Eigen-face recognition system becomes straightforward. It is efficient in processing time and storage. PCA reduces the dimension size of an image in a short period of time. The accuracy of Eigen-face depends on many things. As it takes the pixels worth as comparison for the projection, the accuracy would decrease with variable strength. Pre-processing of image is needed to realize satisfactory result. An advantage of this algorithm is that the Eigen-faces were invented exactly for those purpose what makes the system very efficient [14]. A drawback is that it is sensitive for lightening conditions and the position of the head. Disadvantages-Finding the Eigen vectors and Eigen-values are time consuming on PPC. The size and site of every face image should stay similar PCA (Eigen-face) approach maps options to principle sub-spaces that contain most energy [14].

## B. Neural Network:-

The main objective of the neural network within the face recognition is that the practicable-ness of training a system to capture the complicated category of faces patterns. To advise the foremost effective performance by the neural network, it's to be extensively tuned type of layers, type of nodes, learning rates, etc. In neural networks area the user train a system to recognize the small group of people that is why application of a Multilayer Perceptron (MLP) Neural Network (NN) was studied for this task. Configuration of our MLP was chosen by experiments. It contains three layers. Input for NN is a greyscale image. Number of input units is equal to the number of pixels in the image. Number of hidden units was 30. Number of output units is equal to the number of persons to be recognized. Every output unit is associated with one person. NN is trained to respond "+1" on output unit, corresponding to recognized person and "-1" on other outputs. This is known as perfect output. After training highest output of NN indicates recognized person for test image. Equal Error Rate (EER) is the number of incorrectly accepted and rejected persons is equal to the EER basic measure for performance of access control systems. Using the above-mentioned improvements has lowered EER from 20% without improvements to 6% EER in the best case [18]. So, the feature extraction step may be more efficient than the Principal Component Analysis. [16] Multi-Layer Perceptron (MLP) with feed forward learning algorithms was chosen for the proposed system for its simplicity and its capability in supervised pattern matching. It has been successfully applied to many pattern classification problems [7]. The experimental results have shown that projected methodology achieves higher results compared to different prosperous algorithmic rule just like the graph matching and Eigen-faces ways. A new category of convolution neural network was planned wherever the process cells area unit shunting restrictive neurons. Antecedently shunting restrictive neurons are utilized in standard feed-forward design for classification and non-linear regression and were shown to be a lot of powerful than MLPs i.e. The Self Organized Map (SOM) provides a quantization of the image samples into a topological space where inputs that are nearby in the original space are also nearby in the output space, therefore providing spatial property reduction and un-changeability to minor changes within the image sample. The Convolution Neural Network (CNN) provides partial changelessness to translation, rotation, scale, and deformation. PCA+CNN & SOM+CNN ways area unit each superior to Eigen-faces technique even once there's just training image per person. Using a single network the author had achieved fairly high detection rate and low false positive rate on pictures with complicated backgrounds and comparison with a multilayer perceptron, the performance of PNN is superior. [10] When the sample university and measure them. Mistreatment these techniques we will simply establish the performance of the scholar [9]. Vectors are non-linear SRKDA can efficiently give exact solutions than ordinary subspace learning approaches. It not solely solves high dimensional and little sample size issues, however additionally enhances feature extraction from a face native non-linear structure. [11]

## C. Fisher-faces:-

Fisher-face method uses a class specific linear method, Fisher's Linear Discriminant (FLD), for dimensionality reduction and simple classifiers in the reduced feature space. Whole process is based on appearance method. In 1930

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R.A Fisher developed linear/fisher discriminant analysis for face recognition. [2] LDA method demonstrated in [13]. The disadvantage of LDA is that among the category the scatter matrix is often single; since the amount of pixels in pictures is larger than the amount of pictures therefore it will increase detection of error rate if there is a variation in cause and lighting condition within same pictures. Because the fisher-faces technique uses the advantage of inside-class data thus it minimizes the variation within category, therefore the problem with variations within the same pictures such as lighting variations will be overcome. The fisher-face method is able to take advantage of within-class information, minimizing variation within each class, yet still maximizing class separation. Like the Eigen-face construction methods, the primary step of the fisher-face technique takes every (NxM) image array and reshape into a ((N\*M) x1) vector [14]. Fisher-face is similar to Eigen-face but with enhancement of better classification of different classes image. We have better accuracy in facial expression than Eigen face approach. Besides, Fisher-face removes the first three principal components which are responsible for light intensity changes; it is more invariant to light intensity [3].

#### D. Elastic Bunch-Graph Matching:-

Face recognition using elastic bunch graph matching is predicated on recognizing faces by estimating a group of features employing a data structure known as a bunch graph [5]. Same as for each query image, the landmarks are estimated and located using bunch graph. Then the features area unit extracted by taking the quantity of instances of Gabor filters that is called "face graph". The matching percentage (MSEBGM) is calculated on the basis of similarity between face graphs of database and nodes are labelled with wavelet coefficients in jets. In Gabor wavelets area units, the rank transformation differences of luminance and contrast become compensated for. Furthermore to compensate for the local changes in due facial expression and pose, authors have applied a nonlinear warping of one rank map vis-à-vis another map. A practical way to manoeuvre in the warping parameter, space consists in checking after every warping the score against the previously achieved level of similarity. The warping is continued to the first map if the present score is higher than the previous one; otherwise the warping starts with other parameters [18]. In Elastic graph matching, the basic process is to compare graphs with images and to generate new graphs. The advantage of this is that change or missing any one feature it does not mean that the person will not be recognized. The stored data can be easily extended to a database for storage. When a replacement face pictures is intercalary, no further effort is got to modify templates, because it already keep within the database. Disadvantage of this algorithm is that it is very sensitive to lightening conditions and a lot of graphs have to be placed manually on the face. On the other hand when the changes in lighting are large, the result will have a significant decrease in the recognition rate [14].

#### E. Template Matching:-

In Template Matching the system is evaluated by comparing results from geometrical based algorithms on no. of images of subjects. The Principal Component Analysis using Eigen-face provides the linear arrangement of templates. Existing method is highly effective for larger databases that solve the problem of face recognition under reasonable computational cost. Now the advantage is taken from example primarily based formula for face detection by constructing a general frame work for stratified face detection the features are extracted using PCA from 2D images. Similarly in M. Srinivasan the working of this approach is summed up by saying that further improvements are still required in order to solve the recognition problem that seems to be very common in real world [6].

One will use quite one face example from completely different viewpoints to represent a person's face. The face image of gray levels may also be properly pre-processed before matching In Brunelli and Poggio automatically selected set of four features templates, i.e., the eyes, nose, mouth, and therefore the whole face, for all of the obtainable faces." Some varied issues consists the outline of those templates. When attempting recognition, the unclassified image is compared in turn to all of the database images, returning a vector of match cross correlation. The unknown person is then classified as the one giving Brunelli's selection was done interactively by a human operator, which could select the windows he/she considered to be most distinctive, the selection procedure is entirely automatic, and the same set of features is selected for all of the available images [4].

#### F. Geometrical Feature Matching:-

Geometric feature learning strategies extract distinctive geometric option from pictures. Geometric options area unit options of objects created by a group of geometric components like points, lines, curves or surfaces. There are a lot of geometric features based on the points. Geometric features may be generated by segments, perimeters and areas of some figures formed by the points. Distances in the feature space from a template image to every image in the database

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were calculated. Following to the FERET protocol, 5 nearest face images were derived and if there were photos of the query person then the result was considered positive. Each image was tested as a query and compared with others. Just in one case of 70 tests, there were no any image of the person in the query through the 5 nearest ones, i.e. the recognition rate was 98.5%. The approach is robust, but its main problem is automatic point location. Some problems arise if image is of bad quality or several points are covered by hair [18]. In 2006 Basavaraj and Nagaraj proposed a geometrical model for facial feature extraction. The face model proposed by the ability to identify is divided into four steps. The starting step is pre-processing. The main aim of this step is to reduce the noise and the input image is converted into a binary one. The second step contains labelling of facial features and then finding the origin of these labelled features. In Khalid et al. (2008) the author tries to reduce the search space by minimizing the facial features data. The conferred approach provides smart face illustration by exploring facial data from completely different domains which provides economical face recognition systems.

## V. CONCLUSION

Face recognition may be a difficult downside within the field of image process and computer vision. Because of lots of application in different fields the face recognition has received great attention. In this paper completely different face recognition algorithms square measure are mentioned with their benefits and downsides. Any of them can be used as per the need of application. Further work can be done to improve the efficiency of the discussed algorithms and to improve the performance.

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