A Review On: Facial Identification System Using Eigen Faces

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Abstract — Principal component analysis (PCA) method called Eigenface is used to identify faces. The Eigenface technique finds the optimal vector for dispersing the facial image in the facial space while lowering the number of dimensions. This technique has been widely used and put to use in earlier studies to identify images of human faces. PCA can recognize photographs with various expressions in addition to detecting human faces in usual circumstances. Even images of faces that have been altered in some way can be recognized using techniques like combining photos of faces after plastic surgery with facial image restoration. This study's goal is to assess how well the PCAEigenface technique performs when recognizing human faces in pictures from various datasets. each with a unique set of challenges. Each database's well-known accuracy spans from 99% to 67%, with an average identification rate of around 85%.

Keywords: Face recognition, JAFFE, PCA, Eigenface, Euclidian, Yale

I. INTRODUCTION

Face recognition has become a significant research issue in recent years. Biometric face recognition systems are a part of the facial imaging process. Computer vision, pattern recognition, and the processing and comprehension of image data all have significant functions. It is widely believed that advances in computer vision research will lead to important new understandings of how the human brain works. One of the few biometric processes that is both very accurate and non- intrusive is face recognition. The main goal of this method is to provide the system with information about a specific face so that it can be distinguished from the enormous number of recorded faces while yet allowing for some real-time adjustments.

Face recognition consists of three major processes:

1) Feature extraction - extracting the most significant features present in the image that make it easily identifiable from other images.
2) Face reduction - A procedure that reduces large photographs to small, easily presentable images of the right size while simultaneously guaranteeing that the knowledge contained within the image is not damaged.
3) Feature recognition - The process of picking the correct classifier, in this case the Manhattan distance classifier, to classify the feature of images in the trained database and hence the provided test image.

Because the given face data is typically of very high dimension, adequate care must be made to select the effectively visible features for extraction and reduction. Hence Principal component analysis, due to its simplicity, speed, and ability to learn quickly, is the best suited method for feature extraction and reduction without causing data damage. Because of the complexity of the calculation, facial extraction in face recognition necessitates a high computing cost. Face features, such as hue and intensity in numerical values, save memory during symbolic feature computation time.

Image characteristics frequently have no direct connection to an image's component. A face image extraction technique is the feature. In the classification process, feature extraction provides a set of features, eliminates input data and redundancy, and creates dimensional representations.

The majority of the eigenvectors are used to create a collection of eigenfaces because the covariance matrix of face pictures that are transformed to vectors undergoes a decomposition process. A group of eigenfaces creates a face representation space with less dimensions than a face picture.

By decomposing the matrix's eigenvector, covariance can yield an eigenvector. The principle component analysis (PCA) method is used to reduce data using linear modifications before producing new coordinates with the greatest variation. PCA is made up of a set of eigenvectors. It computes the covariance matrix from multiple portions of a training set of face photos.

II. RELATED WORK

Sr. No	Title of Paper	Author	Method	Remark
1	Half-face based recognition using Principal component analysis	Ahmed M. Alkababji1, Sara Raed Abd (2021)	They did have used PCA but the the first step they have used is to divide the face image into two halves, then the left half is Processed using the principal component analysis (PCA) algorithm, and the results are Compared by using Euclidian distance to distinguish the person.	The algorithm analyzes several half-face photos before attempting to identify the subject. The outcome demonstrated that this face recognition system's use of half-face in conjunction with principal component analysis and euclidian distance is effective. The suggested technique increased recognition speed and accuracy while reducing database size.

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2	Using Eigenfaces for Face Recognition	Mohd Noah A. Rahman, Armanadurni Abd Rahman, Afzaal H. Seyal (2020)	To find success rate it was conducted using the PCA algorithm on eigenfaces on 30 students using different images stored in a training database.	the system has managed to meet the aims and objectives. It works not only on static images but also on dynamic images including capturing face using webcam. In addition, it can recognize multiple face images of the same student and able to measure the successful rate of FR.
3	Face Recognition based Feature Extraction using Principal Component Analysis (PCA)	Muhammad Zulfahmi Nasution (2020-Jan)	In this research, a program they have been designed to test some samples of face data stored in a digital image database so that it can provide a similarity in the face patterns being observed and its introduction using PCA	The PCA method was used for construct digital face input patterns using deep propagation techniques facial recognition. In the process pattern construction and facial recognition starting from objects in the form of facial images, edge detection, finite pattern construction can determine the characteristics and features of the face. Meanwhile, the Euclidean Distance Method used as the matching method
4	Face recognition on surgically altered faces using principal component analysis	G. George, R. Boben, B. Radhakrishnan, and L. P. Suresh H. (2019)	Author proposed the PCA Approach for face recognition. Face recognition is performed on the original face image as well as the facial image created by plastic surgery as well	They have used Naive Bayes classifier for recognition of local plastic surgical faces The Naïve Bayes classifier individually has given better recognition rate compared to the combination of Naive Bayes classifier with EM algorithm. But Neural Network Classifier has given better recognition than Naive Bayes classifier.
5	Face Recognition method of Machine vision System by Using Eigenfaces	Jalled,F. (2017)	This research compares face recognition performance using Normalised Principal Component Analysis method (N-PCA) and Principal Component Analysis method (PCA).	The Eigenfaces method is one of the most widely used linear statistical techniques. It can be explained as categorizing a known or unknown face after comparing it to known people who have been saved in a database. Basically, NPCA is an expansion of linear PCA. To minimize alterations in lighting and background effects, it has image normalization. Eigenvalue decomposition (EVD) is also replaced by singular value decomposition (SVD).
6	Face recognition By using Eigenfaces	V.P.Kshirsagar, M. R. Baviskar, and M. E. Gaikwad, (2011)	In their study they proposed employing the eigenfaces technique to recognise facial images.	They have used the eigenfaces to represent the features vectors for human faces. The features are extracted from the original image to represents unique identity used as inputs to the neural network to measure similarity in classification and recognition. The Eigen faces has proven the capability to provide the significant features and reduces the input size for neural network. as a result, the network speed for recognition is raise.
7	Face Recognition using Principal Component Analysis	R. Kaur and E. Himanshi R.	Authors has introduced PCA method by using Eigenfaces By evaluating Euclidean distance	The author has used PCA way of face recognition because it is really simplest and the easiest approach known to implement also provide extremely fast computation time.

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				PCA is an activity that extracts most relevant information within a face
8	Fast L1-eigenfaces for robust face recognition,	M. Johnson and A. Savakis	Suggested a modified eigenface technique for recognising human faces. The PCA L1 method is combined with greedy search techniques in this strategy.	According to this 20% of the data in all datasets is obscured by noise. The remaining 20% of the data is then recreated based on the recognition in the complete dataset.

III. RESEARCH METHODOLOGY

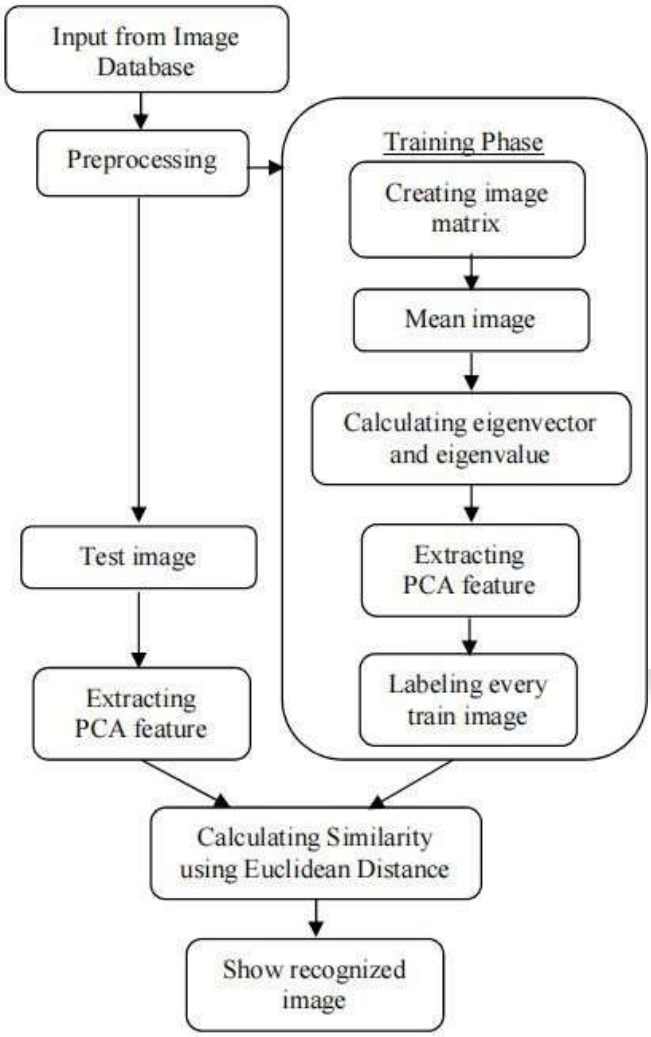

Fig. 1: The face recognition process

The face recognition process is describe in these few steps I have elaborate this process step by step.

The step is retrieval of data, to form data set and then it will consider for face recognition (in simple terms this is the step for saving all the images in database)

Is to find mean image of the dataset, so the mean image is calculated using this formula. And it is denoted by (Ψ)-psi.

$$\text{i.e., } \Psi = \frac{\sum_{i=1}^{n} \Gamma_i}{M}$$

Find the deviation between, the input image and the mean image which is computed using this formula phi (Φ), then the centred image matrix is found based on this formula.

$$\phi_i = \sqrt{\sum_{k=1}^{i} \left(\frac{\Gamma k - \Psi}{k}\right)^2}, i = 1, 2, 3, \ldots, M$$

Then in the next step, eigenvectors which are less then specific threshold value are eliminated by PCA method, PCA stands for principles components analysis and it is used for dimension reduction purpose and hence, by this process, Eigen faces are formed.

The step is of recognition of image, so here the image that needs to be identified is submitted into the software.

In the last step, we compute the Euclidean distance, so the distance between Eigen faces of test image, and Eigen faces of previously computed image are evaluated here, after that the minimum Euclidean distance among all is found. In case if it is greater than some threshold value then we declare, that image is not available in database .and if distance is less than threshold value then matching images which has minimum Euclidean value is displayed.

We compute Eigen faces here in this , the covariance matrix is found using centred image and then calculated using formula which is denoted by C , again the Eigen value for this specific covariance matrix are discovered ,as a result, Eigen vectors are generated .

By using the results of the above step 3 the matrix A is computed.

$$\text{i.e., } A = [\phi_1 \ \phi_2 \ldots . \phi_M]$$

Multiplying A by its transpose yields the matrix C (covariance matrix).

$$\text{i.e., } C = AA^T$$

For sizes of normal image, the "dimension of the C matrix can be and to determining the N2 Eigen vectors and the Eigen values is an intractable task." If the number of information that focuses in the image space is not exactly the element of the space

IV. CONCLUSION

According to Ahmed M. Alkababji and his co-authors before they try attempting to identify the subject, their algorithm examines a number of half-face pictures. The results showed that the half-face, principal component analysis, and Euclidian distance used in this face recognition system are efficient. The suggested method decreased database size while increasing recognition speed and accuracy.

The author Muhammad Zulfahmi Nasution proposed the study and according to that Deep propagation facial recognition algorithms have been used together with the PCA method to create digital face input patterns. The traits and attributes of the face can be determined throughout the pattern creation and facial recognition processes starting

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from objects in the form of facial images, edge detection, and finite pattern construction. The matching method utilized at the time was the Euclidean Distance Method.

All and all we have concluded that the purpose of this study is to investigate the performance of eigenface algorithms in recognising facial photographs. Three times in this study, testing is based on a public database of diverse facial photographs. Based on the results of all studies, it is possible to conclude that the eigenface algorithm is capable of correctly recognising face photos under normal situations also it is capable of recognizing the normal faces as well as faces after plastic surgery of corresponding individual.

The is demonstrated conducted by the several authors has reached the accuracy of recognising face photos reached 99% in experiment conducted by R.Kaur and Himanshi E, these authors has introduced PCA method by using Eigenfaces By evaluating Euclidean distance their accuracy reaches over 99%.

The experiment conducted by V. P. Kshirsagar, M. R. Baviskar, and M. E. Gaikwad, despite the fact that the images utilised had low lighting and considerable differences in expression. The findings of the second experiment's recognising accuracy are still quite strong, with only two errors recognised from 20 test photographs. This is possible because variations in the intensity of lighting variations in facial expressions are applied to facial photographs.

The eigenface algorithm performed poorly in the third experiment by M. Johnson and A. Savakis. Because just 67% of photos are correctly recognised, it is clear that the recognisable findings are slightly poor. This is achievable since training data for each individual differs substantially. Where the lighting direction is harsh, as well as planned testing data that includes facial photos captured with glasses. This type of facial recognition procedure is more difficult, and in the future, a more sophisticated recognition process may be required to improve security.

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