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Efficient Face Features Extraction and Recognition Using Principal Component Analysis

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Abstract: *Face recognition is a common issue in artificial intelligence. This program was widely used in our daily lives. Several smart phones used facial recognition to open them. Face identification system is intended to protect personal information. When Face book people appear in photos, you may instantly recognize them. Face recognition has already been tackled in a number of ways. Until recently, it has been recommended, but it is still quite tough in the real world Circumstances. A key strategy for distinguishing persons is based on under a variety of conditions, such as partial facial blockage, lighting, and a wide range of postures. The goal of this paper is to create a face recognition system using a machine learning system. A method named principal component analysis (PCA) has been developed to recognize faces. Furthermore, it has been successful tested with 97 percent recognition accuracy by using PCA.*

Key Word*: Face recognition, Machine learning, principal component analysis.*

I. Introduction

Face recognition is one of the many marvels that artificial intelligence technology has brought to the world. Every input object's category must be determined. Face recognition software compares photos of people's faces to a database of people's faces. A dataset is a collection of photographs. The use of facial recognition software has becoming increasingly popular. It has become one of the most fascinating topics of inquiry for professionals in applications involving human-computer interaction [1]. In actuality, the identification of people has been done using facial recognition technology. Qualities that have existed from the beginning of time Images of people's faces are used to acknowledge people who have citizenship all across the world identification, identification cards, social security card, detection of intrusions, etc.

Segmentation, isolation, and validation are all steps in this principal component analysis. A set of face traits resulting from the unsteady environment and most likely genuine people's faces. The first attempt to recognize a face was made by calculating distinct facial features of a person. It uses principal component analysis for feature extraction purposes.

II. Literature Review

Z. B. Lahaw [4] introduced a way for face recognition. The suggested work uses linear discriminant analysis, independent component analysis, principal component analysis, and support vector machine algorithms. The experiment is administrated on AT & T Database. This database comprises of 400 face pictures of 40 subjects, every one of which has 10 pictures taken at various stages and with different stances and circumstances of subjects wearing shades. These pictures are grayscale with measurement (112×92). The authors achieved recognition accuracy of 96 %

by implementing a hybrid method counting on the Discrete Wavelet Transform (DWT) and principal component analysis (PCA) or linear discriminant analysis (LDA) method for reducing dimension and support vector machine is employed for classification of faces.

N. Sabri [5] present work to match four different machine learning algorithm Multi Linear Perceptron (MLP), Naive Bayes and Support Vector Machine (SVM) classifiers to classify the face using distance measurements of face geometry. the result of all the experiments reveals that The Naive Bayes eliminates the MLP and SVM classification with the utmost precision. This can be due to a comprehensive process of SVM and MLP system. Findings show that Naive Bayes achieved a high precision of 93.16 percent.

Face discovery could be a significant segment of any facial recognition model as a starting advance to get faces. A.Adouani [6] Presents a scientific review of three widely used face detection approaches, namely Oriented Gradient Histogram, hair-like cascade Oriented Gradient Histogram with Linear Binary Pattern cascade and Support Vector Machine. The recommended methods are developed utilizing Dlib and OpenCV libraries in Python language. The result shows that the HOG+SVM approach is more robust and efficient than LBP and haar approaches with a 92.68 percent total recognition score.

J. Fan [7] discusses the multiple, manifold training graph- based method of face recognition l. The approach suggested is known as Enhanced Adaptive Locality Preserving Projections (EALPP). Two methods are incorporated into EALPP: Maximum Margin Criterion (MMC) and Locality Preserving Projections (LPP). The experiment is performed on four different face datasets (YALE, ORL, UMIST, and AR). Preprocessing was performed during the tests to see the face between all four database objects. All objects are matched in size, alignment and therefore the two eyes within the same place.

Sujata G. Bhele and V.H. Mankar [8] have attempted to examine a big number of papers covering the most recent developments within the area of face recognition. This study demonstrates that new algorithms must develop using hybrid techniques of sentimental computing tools like ANN, SVM, SOM that produces better output for better face recognition. The author has attempted to look at a major number of papers covering the most recent developments within the area of face recognition. This analysis examines all of those techniques with criteria that face recognition problems like lighting, variation, facial expressions. PCA recognized because the Karhunen-Loeve technique is among the foremost common techniques for choosing features and reducing dimensions. The technique of recognition, defined because the eigenface technique, describes a facial characteristics location which diminishes existing data space dimensionality. A dominant technique for automatic face recognition is that the linear discriminant analysis (LDA). It produces an appropriate representation that converts the present data space linearly into a low-dimension feature domain where the information is well isolated. Support Vector Machines (SVM) are among the foremost valuable classification problem methods. One perfect example is face recognition. The additional benefit of the SVM classifier with a customary neural network is that SVMs can attain better generalization precision.

Face detection could be a technique of analyzing a face from a picture that has numerous features in this image [9]. Face detection could be a difficult task as faces don't seem to be static and modify in size, appearance, color, etc. Face detection becomes more difficult when the image isn't visible and obscured by anything else and no proper lighting, camera focusing, etc. Viola Jones method is used to spot a face and principal component analysis for face recognition. By combining the Viola Jones algorithm and Principal component analysis results in quick detection and high precision. The algorithm has been checked on the database with way more than 1000 images but with some false positives, it gives 90% accuracy. That Eigenvalue is an Eigenvector, and it shows what number images are different from the typical image. it's possible to eliminate the first vector which corresponds to the tiny. Eigenvalue because it has no vital information.

III. Methodology

Machine Learning

Machine learning is among the subcategories in artificial intelligence, which continue with an algorithm that enables systems to acknowledge. This includes, supervised learning and unsupervised learning [12]. Supervised machine learning method involves employing a defined feature set to take care of some classification features and requires

feature learning from the test including its input and output. Using labeled training data, a supervised learning algorithm learns, allows us to estimate unanticipated data results. The unsupervised approach involves an input learning system and no predicted output variables are given. Cluster analysis, association mining algorithms are several samples of unsupervised learning approaches. Unattended learning algorithms enable us to execute more complicated tasks than supervised learning.

Principal Component Analysis

A principal component analysis (PCA) is an extracted feature algorithm that's dedicated to improving and using during this research work. This approach is predicted to look at the dataset collectively, which suggests that the image won't be evaluated and its attributes won't be extracted individually due to the intensity of (PCA), which sets the inspiration for extracting a feature supported evaluating all datasets. Thus, the empirical data set has to be properly selected not just for the training stage but also to get rid of the feature needed to evaluate the info set. It also implies that the feature for one examine image cannot be extracted individually the test results must be compared and also the PCA algorithm applied to the database and also the test image must be applied to extract its features.

PCA could be a computational empirical strategy that's mostly utilized in image recognition, and there are various reports within the literature about the primary use of PCA. Pearson's usually best-known early paper was in 1901[10]. It focuses itself, however, actually on strategies established to research scientists and engineers, focused normally and particularly on the analysis of the eigenvector. This emphasizes matrices related to present-day numerical algorithms. PCA is among the key ways of improving the information element with the smallest amount of knowledge being lost. Across several ways, this approach is employed including mathematical modeling, computational biology, image analysis, processing, etc..[11]. Faces are described within the PCA system as a linear arrangement of weighted eigenvectors termed as Eigen faces. Such eigenvectors are generated from the image database's covariance matrix. The proportion of Eigen faces obtained will be such as the total amount of images within the database. PCA may be a useful method for multidimensional hyperspace data analysis. Data extraction is experimental as an unsupervised technique of learning, assuming that there's no prior information of the computer file structure.

Olivetti Face

The ORL Database of Faces comprises a compilation of facial images captured at the laboratory from April 1992 to April 1994. there have been 400 images from 40 different subjects within the ORL database. Face dataset includes 10 PGM-format grayscale images with a 92 x 112-pixel size of 40 people [3]. This database poses difficulties due to variants like facial expression (eyes closed or open, neutral or smiling face) and countenance (no glasses/glasses) with a threshold of close to ten degrees for lateral movement. the photographs are arranged in 40 folders (one for every subject) with type SX names, where x denotes the topic number (between 1 and 40). The gathering of sample images is represented in Figure 1.

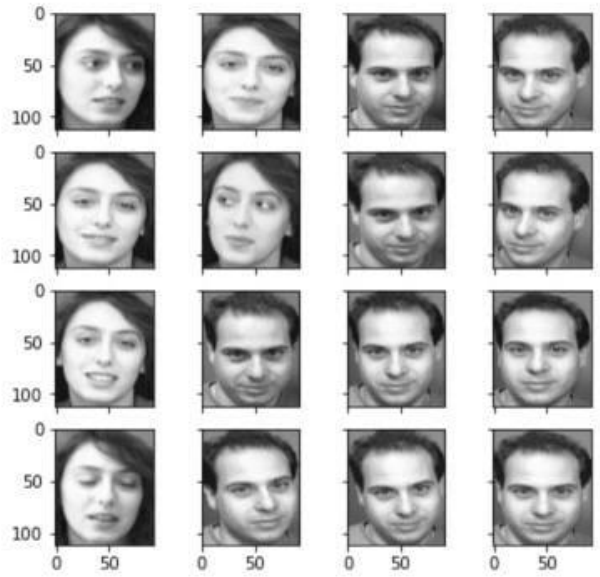


Figure.1 Sample Input Images

IV. Experimental Setup And Result Analysis

A. Face Recognition Approach

In general, face recognition using PCA consists of three modules:

INPUT IMAGE: Face picture is used as input to the extraction process of the feature.

FEATURE EXTRACTION: Transforming the particular image towards amore lightweight, and so more fundamentally different illustration. Here, principal component analysis (PCA) is employed. PCA considers a special set of parameters such all the parameters are orthogonal and measured by the deviation of the data within them. It implies that, first, there's a more essential principal axis.

EXTRACTED FEATURES: This can be the output of the Feature Extracted method. Extracted features will give as input for the classifier.

CLASSIFIER: Evaluating the facial features is achieved by the classifier for a specified feature matrix. The machine-learning algorithm is employed as a classifier. it's been experiment educing linear discriminant analysis, multilayer perceptron, naive bayes, and support vector machine.

CLASSIFIED CLASS: Different face identity is employed as classified classes, it's 40 classified classes one for every individual in the dataset.

B. TRAINING THE DATASET USING PRINCIPAL COMPONENT ANALYSIS:

Splitting the data into training set and testing set, we train the model using the training set using principal component analysis. By fitting the training set to the PCA after importing it from the sklearn module, the training will be completed. The following code:

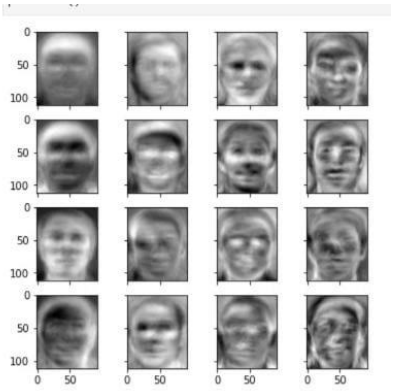


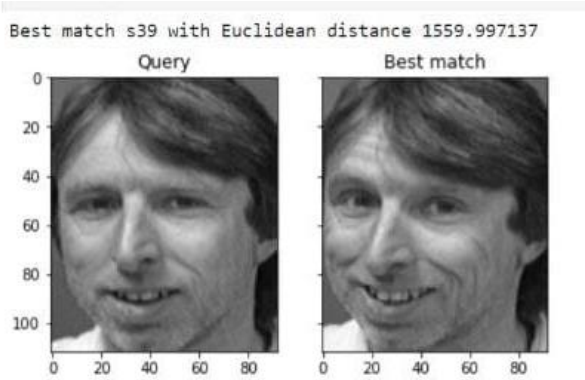
Figure 3: Feature extracted Images using PCA

weights = eigenfaces @ (facematrix - pca.mean_).T

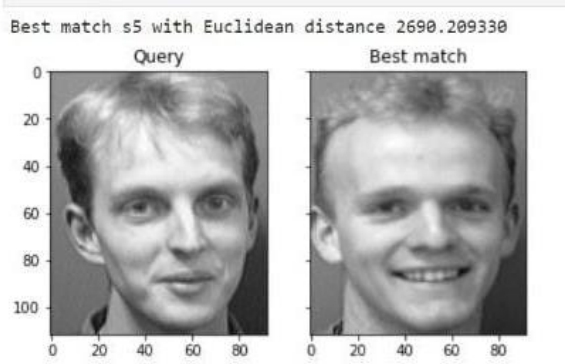
Eigenface is beneficial to extract useful facial information that might or may not necessarily relate to human perception official characteristics like nose, mouth, and eyes. This eigenfaces faces are the most component of a facial distribution, or identically, the covariance matrix of a collection of facial images, where N-pixel image is regarded to be a degree in N-dimensional space.

C. TESTING AND EXPERIMENT RESULTS:

Once the model is trained, it is tested using testing set to check the accuracy of the trained model in order to build the system.



Result from training section of data:



Result from testing section of data

V. CONCLUSION AND FUTURE WORK

In this paper, an investigation is employed to automatically detect the face of the person. The ORL dataset is employed for performing experiments. Firstly, the dataset is segmented into two sections in three different configurations A (60:40), B (70:40), and C (90:10). The primary set is employed for the purpose of training the model and therefore the second set is used for system testing purpose. The necessary output is extracted from the input images using PCA. These have achieved recognition accuracy of 97% on configuration B by using PCA. Subsequently and on future research, by reviewing other databases like GTF and YALE dataset, more face detection challenges like orientation variation, lighting, poses, and facial expression variations are found.

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