EIGENFACE TECHNIQUE FOR FACE RECOGNITION

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Abstract

A facial recognition system is built on the idea that every person has a unique face structure, and it can be used to identify them using their facial symmetry. This technology is being used in various security applications, such as for retail and financial transactions. Before implementing a facial recognition system, it should first identify the face's structural properties. This process should be performed in a way that allows the system to convert the resulting image into two-dimensional digital data. In this paper, we present the method known as Eigenfaces. The first step in the recognition process is to create an eigenface, which is a representation of the face's structural characteristics. The distance between the eigenface and its previous stored ones is then calculated. The simulation results show that the eigenface with the smallest distance is the one that resembles the person. The results of the simulations were performed using the computer program, which is known as the MATLAB. The database used for the project was able to achieve a success rate of 95.8%.

Keywords—Biometrics, Facial-scan, Eigenface detector

DOI Number: 10.14704/nq.2022.20.9.NQ44206 **Neuro Quantology 2022; 20(9):1779-1782**

I. INTRODUCTION

Everyday actions are increasingly being handled electronically, instead of pencil and paper or face to face. This growth in electronic transactions results in great demand for fast and accurate user identification and authentication. Access codes for buildings, banks accounts and computer systems often use PINs for identification and security clearances. Using the proper PIN gains access, but the user of the PIN is not verified. When credit and ATM cards are lost or stolen, an unauthorized user can often come up with the correct personal codes. Face recognition technology may solve this problem since a face is undeniably connected to its owner except in the case of identical twins.

A biometric is a unique and measurable characteristic that can be used to identify and verify an individual's identity. It can be used to measure both the behavioral and physiological characteristics of an individual.

One of the most challenging aspects of facial recognition is identifying and locating the faces in a cluttered background. This process involves coming up with a strategy to normalize and recognize the patterns in the human face. While its structure is rigid enough to allow all faces to have the same structure, there are various factors that can affect the appearance of the individual's face. The recognition process is prone to experiencing large variability due to various factors such as the presence of makeup, facial expressions, and the lighting conditions. Images of the same person taken at different times may exhibit more variation because of this. On the other hand, images of individuals from different backgrounds may exhibit more variability due to their individual characteristics and race.

One of the most common ways to deal with intrapersonal variations is by incorporating them in training images. This method is beneficial for certain types of facial expressions, such as facial expressions and the presence of a beard or glasses. However, it may not be able to perform well in cases of illumination or pose variations.

II. RELATED WORK

The paper presents an image database containing 3040 images, and the method is known as the Eigenfaces. It is mainly used to deal with the challenging details such as the background, eyes, and mustache. The eigenfaces method has a success rate of 84.74%. In order to improve its performance, the paper proposes the use of additional information such as the face triangle. The next step is to develop a more accurate and efficient face recognition system for large databases. [1].

Multimodal biometrics is a frontier technology that overcomes the problems of traditional unimodal biometrics. It can be used to address various issues such as intra class variation, spoofing, and noisy data.Despite the numerous advantages of multimodal biometrics, it is still not feasible to design a fully functional and secure system that can be used for authentication. For instance, the selection of appropriate modals and the optimal fusion level are some of the challenges that need to be solved in this technology [2-3].

The concept of the variable reducing theory of PCA is used to account for the smaller face space. In a Multire system, the combination of wavelet and Radon transform is used to recognize faces. The system can provide multiple resolutions due to the combination of the two. The Radon transform is a robust technique for face recognition. It can compute the various features of a face image in different orientations. The wavelet transform also provides multirect solution features. Being line-in-part, the Radon transform improves the performance of low-frequency components in the system [4].

In order to provide a convenient and secure system for personal identification, the researchers developed an iris biometric system. This system can be used for various applications, such as those related to home banking and secure business logons. This paper describes the system's various features and how it can be used in both public and personal-use arenas. The researchers conducted field trials and statistical analysis to evaluate the system's effectiveness [5-7].

A proposed algorithm is used to extract the desired patterns from skeletons by creating unique paths between nodes and end-points. The representation of the patterns is stored in a database. The proposed system was tested to demonstrate its efficiency. It was mainly designed to meet the low storage requirements and minimal complexity requirements[9].

The identification process is divided into four phases: capturing the image, preprocessing, normalizing the image, extracting the eigen finger features, and matching and fusion. The final step involves a decision based on the KNN thresholding and K-L transform [8].

The paper presents a new method for the identification of human irises. It is based on the use of morphology for the processing of the image. This method then allows for the extraction of various features from the skeletons. [10].

The paper proposes a biometric system that can be used to identify people using their hand palm image. It has been studied two methods to obtain the parameters of the hand, one using measures of textures and the other using phalanges. The proposed system exhibited a 99% accuracy in the verification system and a 98% success rate in the identification system. The system is mainly designed to meet the low storage requirements and minimal complexity requirements[11-15].

III. METHODOLOGY

The matrix of pixels in pictures is composed of a set of color coded numbers, and each pixel has its own value. An early attempt at face recognition takes into account the high dimensional detail of the matrix, and then tries to identify the person in the lower dimension using the information vector derived from it. Advanced computer processing techniques have led to the creation of a mechanism that can compress an image to a smaller size, and it can also compare two images that are portraying the same face.

The Principal Component Analysis (PCA) is a method that reduces the overall dimensionality of a large data set by transforming it into a smaller set of variables. This method is commonly used to reduce the amount of information that is stored in a large

set. Although reducing the number of variables is usually beneficial, the trick is to make the data set easier to interpret and visualize. Since smaller data sets are easier to analyze and visualize, they can be used by machine learning algorithms to quickly find and analyze data.

In this paper, we introduce a face recognition algorithm that uses the combination of Eigenvalues and the Principal Component Analysis to reduce the overall dimensionality of a large data set. It can then be used to perform a training sample on small feature space.

An image of a face is referred to as an eigenface, and it is an orthogonal basis set that can be used for constructing most types of faces. These are commonly used in facial recognition and characterization applications. An eigenface is constructed by training a set of real faces, and it can be used to identify various features. Through matrix manipulation, it can also assign a strength level to each of the faces. The goal of this method is to create a set of eigenfaces that will be able to represent the entire training set. If the training set is diverse, the resulting eigenfaces should be capable of representing all of the faces in the image.

IV. RESULTS AND DISCUSSIONS

A visual of pictures is generated by extracting the PGM files into a byte string, which then becomes a numpy array of bytes. This method then passes the bytes into an array of pixels depicted in Fig. 1.

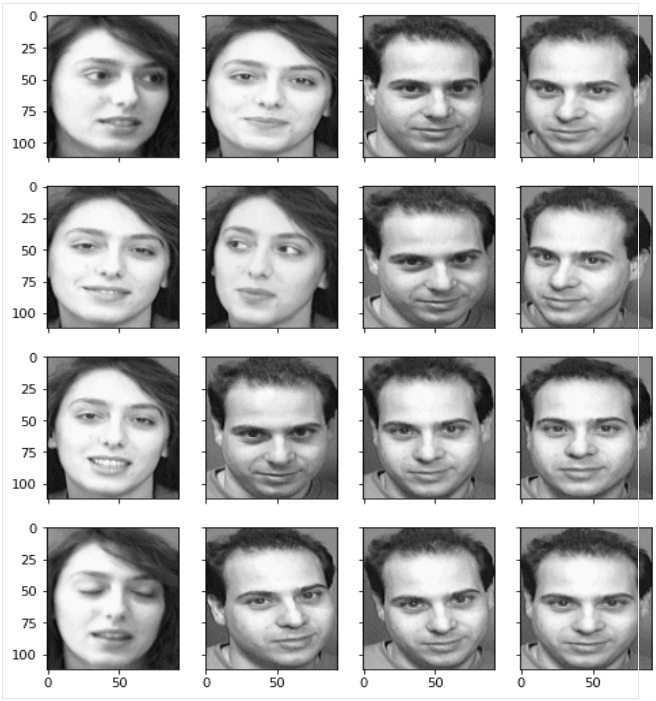

Fig. 1: Sample Images

Although eigenfaces are commonly referred to as blurry faces, they have various facial features that can be used to create a picture. In Fig. 2, there are some of these features.

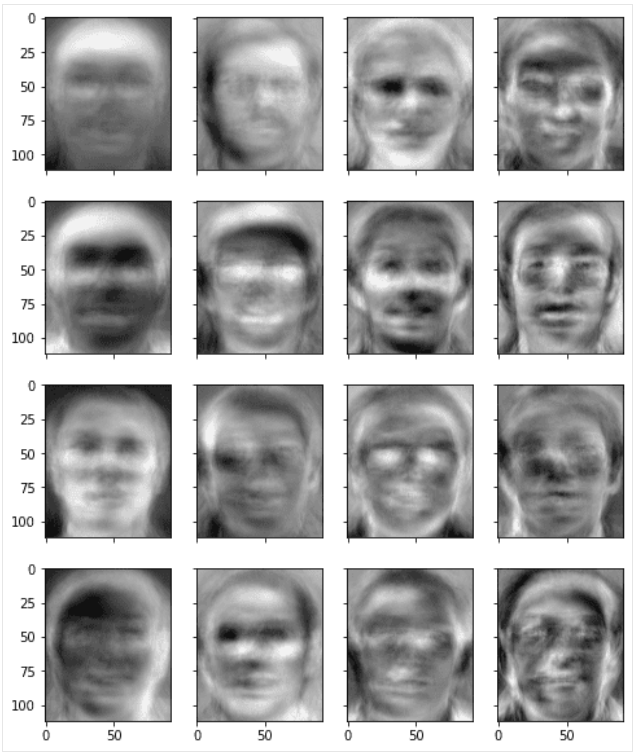

Fig. 2: Sample of first fifty PCA components

The Fig. 3 depict the successfully findings the closest match in the same class.

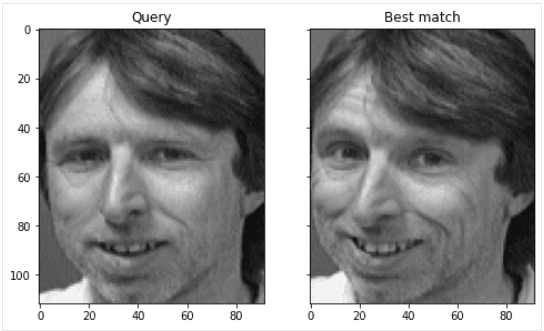

Fig. 3: Successfully findings of best match

In real-time biometric applications, eigenfaces and the Eign method are most appropriate. They can be used to build a picture of a person's face. Unlike other methods, which only compare the common features of a face, eignfaces only focus on the differentiating features of a person's face. This method has a high success rate and avoids errors.

Principal component analysis is a widely used tool in image processing and technology applications. It can help reduce the complexity of various data processing tasks. According to a study, eigenfaces performed well with an accuracy of 95.8% when compared with other methods. It also showed good performance when dealing with orientation and light variation.

Although eigenfaces is a good alternative to a bare minimum facial recognition system, there are still areas of improvement that need to be fixed. For instance, after zooming in and out, the matrix image will get distorted in the principal component domain.

V. CONCLUSION

The eigenfaces method is mainly used to build a picture of a person's face, as it has to deal with various challenging details such as the background, eyeglasses, and mustache. The simulation results of the method show that sometimes, it fails. To improve the performance of the method, it can be fortified with additional information such as the face triangle.

To improve the eigenfaces' success rate, the method can be fortified by adding additional information such as the face triangle. In the future, work will focus on increasing the success rate of the method for large databases. Another alternative is to use a neural network.

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