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Face Identification and Recognition

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ABSTRACT: This paper presents a basic approach to identify and recognize human faces using Eigen faces and by comparing the biometrics of a human being, which can be used to detect a face of an individual and automatically identifying or verifying it from an image or a video frame from a digital source . The main objective of the proposed system is to work with the primary features of a particular human face, identify it and retrieve information stored in database and therefore, provide an advanced but simpler technology for security purpose. This is an independent system using the PCA algorithm, LDA algorithm, Elastic Bunch Graph Matching, Fisherface Algorithm and Grayscale algorithm. The proposed system will not affect the operation of already existing systems.

KEYWORDS: Eigenface, eigenvectors, biometrics, face recognition, PCA algorithm, LDA algorithm, Elastic Bunch Graph Matching, Fisherface algorithm, Grayscale algorithm

I. INTRODUCTION

Face recognition is performed routinely and effortless in our daily lives. Wide availability of powerful and low-cost desktop and embedded computing systems has created an enormous interest in automatic processing of digital images in a variety of applications, including biometric authentication, surveillance, human computer interaction and multimedia management. Research and development in automatic face recognition follows automatically.

A face recognize an individual by matching the input image of all user in a database and finding the best match Face recognition has received great attention in the last 15years, due to increasing of demand in market of commercial and law enforcement application required reliable personal authentication and availability of low-cost recording devices.

What is biometrics?

Biometrics is the measurement and statistical analysis of people‟s physical and behavioral characteristics. The technology is mainly used for identification and access control, or identifying individuals that are under surveillance. The basic premise of biometric authentication is that everyone is unique and an individual can be identified by his or her intrinsic physical or behavioral traits. There are many more biometric recognition technique such as fingerprint and iris recognition, these techniques causing disruption and their success depend highly on user cooperation and in face recognition does not cause disruption as it is based on image captured by a distance camera. The human face is no doubt is the most common characteristic used by human to recognize everyone individually and that why personal identification based on facial image is consider the friendly among all biometrics.

II. LITERATURE SURVEY

Face recognition system is a computer application capable of identifying or verifying a person from digital image or a video frame from a video source. One way to do this by comparing selected facial features from the input image and database image

Face detection is the first stage of automatic face recognition system , face has to be located in the input image before It is recognized. Basically face detection is of two-step procedure:first the whole image is examined to findout regions that are identified as “face”and then the rough position and the size of the face are estimated , localization procedure are followed which provide more accurate estimation of the exact position and scale of the face.

Face recognition technique is divided into two main categories that are global approaches and feature based technique

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.global techniques are Eigen faces ,linear discriminant analysis(LDA),support vector machines(SVM) and neural network.

- Global Approaches For Face Recognition

Approaches model the variability of the face by analyzing its statistical properties based on a large set of training images . Representative global technique are Eigen faces , linear discriminant analysis(LDA),support vector machines(SVM) etc.

- Linear Discriminant Analysis (LDA)

Face recognition technique using Linear/Fisher Discriminant Analysis (LDA) were developed. LDA is used to determine a subspace in which the extra personal variability as much large as possible, while the intrapersonal variability is kept constant. In this case, the subspace obtained by LDA optimally discriminates the variability of classes-faces. A combination of PDA and LDA was also proposed. Global techniques include Support Vector Machines(SVM) and Neural Networks(NN).

- Principle Component Analysis (PCA)

A set of eigenvector is known as eigenface. They are used in the computer vision problem of human face recognition. The concept of eigenface was first developed by Sirovich and Kirby(1987) and was first used by Matthew and Alex Pentland in face classification.

Principle Component Analysis, commonly uses the concept of eigenfaces. The probe and gallery images must be the same size and is to be brought to its standard state.

In PCA, various data compression techniques are used to reduce the dimension of the data and thus results in the lowest dimensional structure of facial patterns. This reduction in dimensions removes information that is not useful and precisely decomposes the face structure into orthogonal (uncorrelated) components known as eigenfaces.

Every face image may be represented as weighted sum of the eigenfaces, which are stored in a 1D array.

A probe image is compared against a gallery image by measuring the distance between their respective feature vectors.

The PCA approach typically requires the full frontal face to be presented each time otherwise the image results in poor performance.

The main advantage of this technique is that it can reduce the data need to identify the individual to $1/1000^{th}$ of the data presented.

- Feature based face recognition technique

The main idea of feature-based techniques is to discriminate among various faces based on measurement of structural attributes of the face . Most recent approaches is Embedded Hidden Markov Model(EHMMs), the Elastic Graph Matching and Dynamic Link Architecture.

- Fisherface algorithm

This algorithm is given by Belhumeur. Both PCA as well as LDA is used to produce subspace projection matrix, as in the eigenface method. This particular method minimizes class variation but also, maximizes the class separation. The first step in fisherface method is to take each (NxM) image array and reshape

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into a ((NxM)xl) vector. Then, using the $x_k$values, the class mean $\boldsymbol{u_k}$and the mean of all the samples $\boldsymbol{u}$ is calculated.

$$\mu = \frac{1}{N}\sum_{k=1}^{N} x_k = Mean$$

$$\mu_k = \frac{1}{N_k}\sum_{m=1}^{N_k} x_{k_m}$$

Where:

$\boldsymbol{N}$ = Total Number of images

N_k = Number of images in class k

x_{k_m} = Image at index m of class k

Now, both the between-class scatter matrix(S_B) and within-class matrix (S_w) is determined.

$$S_B = \sum^{C} N_k (\mu_k - \mu)(\mu_k - \mu)^T$$

$$S_W = \sum_{k=1}^{C} \sum_{x \in X_k} (x_k - \mu_k)(x_k - \mu_k)^T$$

Where :

$\boldsymbol{C}$ = Number of classes

The maximum eigenvectors can be obtained by the following equation.

The simplification of the above equation can be done as follows:

$$S_B u_i = \lambda_i S_W u_i : i = 1,2,\ldots, m$$

Then, feature vectors can be established as follows:

$$y_k = U^T x_k : k = 1,2\ldots, m$$

$$|U^T S_W U|$$

The fisherfacemethod maximize the ratio of the between-class scatter to the within-class scatter. This results in the projections such that there is a maximum distance between the class but a minimum distance between the samples. The main disadvantage of this method is that the between-class scatter is directly proportional to the within-class scatter i.e, if the between-class scatter is large then, the within-class scatter will also be relatively large.

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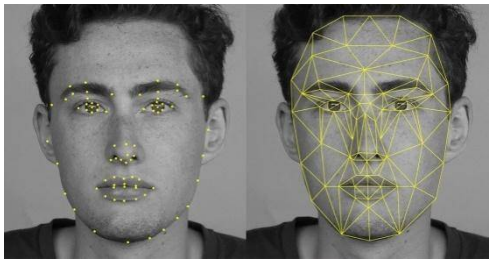
- Elastic Bunch Graph Matching

The most successful feature-based technique is elastic bunch graph matching, which is based on Dynamic Link Architecture(DLA). The basic idea of EGM is the representation of face using local image features extracted from intensity image over fiducial image point and compare it with their database using a connected graph .Every node in the graph is assigned a set of Gabor wavelet coefficient , over different scales and orientations, extracted from image function . The graph is compared to every face from the database by minimization of a cost function that locally deforms the graph.



- Grayscale algorithm

This algorithm is used to convert a coloured image into a grayscale image. Mainly, there are two methods to do so. They are:

- Average method
- Weighted method or luminosity method

- Average method

It is the simplest method. We just have to take the average of the three primary colors i.e. RGB colors to get the required grayscale image.

Grayscale=(R+G+B)/3

Example:

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The result of using the average method is as follows:

As we can see, this is not as expected.

We wanted the image to converted into a grayscale but rather it came out as black image.

This is due to the fact that we take the average of the three colors. All three colors have different wavelength and different shares of their contributions.

But right now, we take equal contributions as we take the average of three. Right now, we take it as 33% Red, 33% Green and 33% Blue but this is not the case in reality.

This problem is solved in the lumonisity method.

- Weighted or lumonisity method

This method provides a solution to the average method.

Since red color has the highest wavelength compared to blue and green. And, green color has the least wavelength as well as it has more soothing effect compared to others, we decrease the contribution made by red color and increase that for green color and put blue color contribution in between.

So, the equation becomes:

Grayscale image=((0.3*R)+(0.59*G)+(0.11*B))

According to this equation, Red, Green and Blue contributes 30%,59% and 11% respectively.

When the equation is applied to an image, we get the following output:

RGB image

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Grayscale image

Hence, we can conclude that lumonisity method is better than average method comparatively as the conversion from RBG image to grayscale image is better.

Face recognition is used for security system and can be compare to other biometrics technique. It has also become popular as a commercial identification and marketing tool.

III. APPLICATION

The application of face recognition technique can be worked on either identification or verification mode. Face identification mode is used to recognize an individual by matching the input image against image of all user in it database and find the best match in verification mode user claims an identify and the system respond by accepting or rejecting their claim by matching the input image against the image that correspond to that specific identity , which can be stored in database or identification card(example smart card).face recognition technique is used to identify the person such „who is that person n that person is in there database‟ this process is done for verification.

IV. ADVANTAGES AND DISADVANTAGES

Advantages

- There are many benefits of face recognition system such as its convenience and social acceptability. All you need is your image taken for it to work.
- Face recognition is easy to use and in many cases it can be performed without person even knowing it.
- Face recognition is also one of the most inexpensive biometric in the market and price should continue to go down.

Disadvantage

- Face recognition system cannot tell the difference between identical twins.

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- Changes in acquisition environment reduce matching accuracy.
- Changes in physiological characteristics reduce matching accuracy.
- It has the potential for privacy abuse due to noncooperative enrolment and identification characteristics.

V. CONCLUSION

Face recognition technologies have been associated generally with very costly top secure application. Today the core technologies have been developing and the increasing process power.Certain application in face recognition technology are now cost effective, reliable and highly accurate. As a result there are no technological or financial barriers for stepping from the pilot project to wide spread deployment.

The behavioural aspect of this system relates the attitude behind different expression as property base. The property bases are alienated as exposed and hidden category in genetic algorithmic genes. The gene training set evaluates the expressional recognition model in the field of biometrics security.

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