Face Recognition System

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ABSTRACT

Face is a important part through which we can identify who we are and how people identify us. Face is a person's most valuable and unique physical characteristics through which we can identify someone very easily. While humans have the innate ability to distinguish the different faces for millions of years for adding the new technology computers are just now catching up. A face recognition system is a computer application that is capable of identifying or verifying the person from a digital image or a video frame from video source. One of the way is to do this is by compare with the selected facial features and also a face database. Humans are having good tendency to recognizing faces.

Keywords: Thermal cameras, Principle Component analysis, Eigen faces Face detection, Face recognition.

I.   INTRODUCTION

Face recognition is typically used in the and it can be compared to other biometrics viz fingerprint or through retina of the eye iris recognition Systems. Recently it has also become popular in an organization for identification and also with the marketing tool. It is probably one of the most user friendly biometrics authentication Methods currently available. In order Face Recognition System to work it has to know that what a basic face must looks like. Different faces has numerous, distinguish landmarks, the different peaks that make up facial features. It acts like a landmarks as nodal points. Each human face have approximate 83 nodal points. Some of the measured by the software are:

➢ Distance between the human eyes
➢ The nose
➢ Depth of the eye sockets
➢ The shape of cheekbones
➢ The length of the jaw

The face in human life is primary focus of attention in society which is a major role to identifying persons. Although face recognition is important and challenging, the human ability to recognize face is remarkable. We can recognize thousands of faces learned throughout our lifetime and identify faces even after years of gap. This skill is quite robust despite large changes in the visual stimulus due to viewing conditions, expression, aging such as glasses, beards or changes in hair style.

Face recognition has fundamental importance in our social relationship being extremely important for our simple everyday activities. It is a very high level task and has many applications. Developing a computational model of face recognition is quite difficult because faces are complex multi-dimensional visual stimuli.

II.   *Traditional*

Some of the face recognition algorithms that identifies the facial features by extracting the landmarks or from an image subject's face. Example an algorithm analyze the relative positions, size, or shape of the eyes, cheekbones, jaw and nose. These features are then used to search for the other images with matching of the features. The probe image is compared with the face data. One of the earliest systems is based upon the template matching techniques which is to be applied to a set of salient facial features, providing a sort of compress face representation. The Other algorithm normalizes a gallery of face images then compress the face data, that only saving the data in the image that is

useful for face recognition. Recognition algorithms can be divided into two main approaches i.e. Geometric and Photometric."Geometric" is a term which looks like the distinguishing features and "Photometric" is a term which is a statistical approach that distills an image into values and also compares the values with templates to eliminate variances. Popular recognition algorithms that include the hidden Markov model, Eigen faces, the principal component analysis using the linear discriminant analysis, elastic bunch graph matching using the Fisher face algorithm, and the neuronal motivated dynamic link matching.

a) 3-Dimensional recognition

3 dimensional face recognition technique that uses the 3D sensor to capture the information about the shape of a face. This of the information is then used to identify the distinctive feature on the surface of a face such as the nose, chin, contour of the eye sockets. The advantage of 3D face recognition is that its not affected by the changes in lighting like other of the techniques. 3-dimensional recognition can also identify a face from a range of viewing the angles including a profile view.3D research is enhanced by the development of sophisticated sensors that do a better job of capturing the 3D face imagery. The sensor work by projecting the structured light onto the face. More of these image sensors can be placed on the same CMOS chip each sensor captures a different part of the spectrum.3D data points from a face vastly it improves the precision of face recognition. Even though a perfect 3 dimensional matching technique could be sensitive to the expressions. A new method is to introduce a way to capture a 3Dimensional picture by using three tracking cameras that point at different angles, one camera will be pointing at the front of the subject, second one to the side, and third one at an angle. All these cameras will work together so it can track a subject's face in real time and be able to face detect and recognize.

b) Thermal cameras

The different form of taking input data for the face recognition is by using the thermal cameras. By using this procedure the cameras will only detect the shape of the head and it will ignore the subject accessories such as hats, glasses or make up. The problem arises by using the thermal pictures for face recognition is that the databases for face recognition is limited. Andrea Selinger (2004) research the use of thermal face recognition in real life and build a new database of thermal face images. The research uses (LWIR) i.e.

low resolution Ferro electric sensors that are capable of acquire long wave thermal infrared, low-sensitive. Results shows the fusion of LWIR and regular visual cameras that has the great results in outdoor probes.

III. Eigenfaces and Eigenvector

Eigen faces are the set of eigenvectors which used in computer vision problem for human face recognition. They can be simply defined as the eigenvectors which represent one of the dimension of face image space. All eigenvectors have an eigenvalue associated to it and the eigenvectors with the largest eigenvalues provide more information on the face variation than the ones with smaller eigenvalues.

"Eigen" is a German word meaning "proper" or "own". An eigenvector of a matrix is a vector such that, if multiplied with the matrix, the result is always an integer multiple of that vector. This integer value is the corresponding eigenvalue of the eigenvector. This relationship can be described by the equation $M \times u = c \times u$, where u is an eigenvector of the matrix M and c is the corresponding eigenvalue.

a) Principle Component Analysis (PCA) Technique

PCA is one of the most successful techniques that have been used in face recognition. The objective of the Principal Component Analysis is to take the total variation on the training set of faces and to represent this variation with just some little variables. When we are working with great amounts of images, reduction of space dimension is very important. PCA intends to reduce the dimension of a group or to space it better so that the new base describes the typical model of the group. The maximum number of principal components is the number of variables in the original space. Even so to reduce the dimension, some principal components should be omitted.

IV. FACE DETECTION

To locate the face, an image pyramid is formed from the original image. An image pyramid is a set of copies of the original image at different scale, thus representing a set of different resolutions. A mask is moved pixel wise over each image in the pyramid and at each position, the image section under the mask is passed to a function that assesses the similarity of the image section to a face. If the similarity value is high enough, the presence of a face at that position and resolution is assumed. From the position of the face, a first estimate of the eye position can be derived. A search for the exact eye position is started. The

positions yielding the highest similarity values are taken as final estimates of the eye positions.

b) Face Image Normalization

After the face area has been detected, it is normalized before passing to the face recognition module. We apply a sequence of image pre processing techniques so that the image is light and noise invariant. We also need to apply some standard face recognition pre-requisite such as grey image conversion and scaling into a suitable sized image.

c) *Conversion to Gray Image and Scaling*

Detected face is converted to grayscale using equation (1) and scaled to 60 x 60 pixel using equation (2) and saved as a grey jpg image. Linear interpolation technique was employed to determine the scaled output image.

$$G = \frac{R + G + B}{3}, i, \ldots\ldots M \times N \qquad (1)$$

Where *Gri* is the gray level value of *i* pixel of the gray image. Ri, Bi, Gi corresponds to red green blue value of the ith pixel in color image.

$$Q(x^q \; y^q) = P\left(\frac{x^p}{60}x^q, \frac{y^p}{60}y^q\right) \qquad (2)$$

Type of image	Red	Green	Blue
RGB			
Grayscale			

Conversion to gray scale

V. FACE RECOGNITION

The simple approach extracting the information that contained an image of a face is to somehow capture the variation in collection of face images, independent of any judgement of features and use this information to encode and compare individual face images. The Individual faces can be represent exactly in terms of linear combination of eigenfaces.

Set of training Images

Faces can also be approximate using "best" eigenfaces, that have the large eigenvalues and which account for the most variance within the set of face images. Each image location that contributes more or less to each eigenvector, so that it possible to display these eigenvectors as a sort of face image which is called an "eigenface".

VI. Conclusion

In this paper eigenface based face recognition has been described. The eigenface approach for face recognition process is fast and simple which works well under constrained environment. It is one of the best practical solutions for the problem of face recognition. Eigenfaces method is a principal component analysis approach, where the eigenvectors of the covariance matrix of a small set of characteristic pictures are sought. These eigenvectors are called eigenfaces due to their resemblance of face images.

Recognition is performed by obtaining feature vectors from the eigenvectors space. Many applications which require face recognition do not require perfect identification but just low error rate. So instead of searching large database of faces, it is better to give small set of likely matches.

By using Eigenface approach, this small set of likely matches for given images can be easily obtained. For given set of images, due to high dimensionality of images, the space spanned is very large. But in reality, all these images are closely related and actually span a lower dimensional space.

By using eigenface approach, we try to reduce this dimensionality. The lower the dimensionality of this image space, the easier it would be for face recognition.

One of the limitation for eigenface approach is in the treatment of face images with varied facial expressions and with glasses. Also as images may have different illumination conditions. This can be removed by RMS (root mean square) contrast stretching and histogram equalization.

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