A REVIEW ON DIFFERENT APPROACHES FOR HUMAN FACE RECOGNITION

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ABSTRACT

Face recognition has been a very active research area in the field of Biometric. Face recognition by the human being is a complex task and to simulate this task by computer, a number of studies have been extensively done in the last two decades. Many algorithms have been developed in order to make computer system, recognize a human face. But human face is quite complex and have a number of attributes and these attributes changes with the time. It is widely accepted that face recognition may depend on both componential information (such as eyes, mouth and nose) and non-componential/holistic information (the spatial relations between these features), though how these cues should be optimally integrated remains unclear. In this paper, we have taken a view of different approaches used for face recognition system in the last two decades.

Keyword: Face recognition, biometric, Eigenface, Artificial neural network, Fisherface.

[1] INTRODUCTION

Human face recognition intend at make use of face images to recognize human subjects. A number of approaches such as appearance/holistic based, feature/component based and hybrid face recognition approaches have been proposed in literature for automated face recognition and these three approaches are discussed in the following sections.

[2] HOLISTIC APPROACH

PCA and LDA are very popular among appearance-based face recognition approaches and have been applied broadly. Face recognition using PCA [1], [2], [3], LDA [4], [5], [6], [7] Independent Component Analysis (ICA) [8] are among the representative techniques that have been developed in the last two decades. In order to extract features from original face images and for dimension reduction, PCA is widely used in face recognition system. PCA captures the variance between training samples and turns them into a small set of characteristic feature images called principal components or ‘eigenfaces’ [2].
A subspace thus formed by these eigenfaces is used to project training and testing face images into lower dimensional face templates for classification. Successful demonstration of this method resulted in growth of research in holistic based face recognition since 1991 [9].

The main drawbacks of PCA are its lack of discrimination ability and retention of unwanted features such as light variation facial expression etc. Belhumeur [4] proposed fisher face method (FLD) to enhance discriminating ability by utilizing class information. The algorithms are heavily based on maximizing the ratio of ‘between class scatter matrix’ to that of ‘within class scatter matrix’ to find another subspace that best discriminates input data. Similar works [5-6] have shared the same basic idea in which LDA is applied on PCA-transformed face data for classification, so called ‘PCA+LDA’.

PCA and LDA face recognition methods involves matrix calculations with very high dimension of face image. If the face image is represented by an \( m \times n \) matrix, the covariance matrix of PCA and the between-class and within-class scatter matrices will all be \( m \times n \) by \( m \times n \) matrices. Note that face images are usually much fewer than dimensions of the covariance matrix of PCA and the between-class and within-class scatter matrices. As a result, these very high \( m \)-dimensional matrices cannot be evaluated accurately [8] and it is difficult for LDA-based face recognition to obtain a high accuracy. LDA-based face recognition usually also suffers from the small sample size (SSS) problem [10], [11], [12], [13], [14] i.e. if face images in the training set are fewer than dimensions of the between-class and within-class scatter matrices, the within-class scatter matrix will be singular and the transforming axes of LDA cannot be obtained directly. This mathematical complexity can be reduced by different dimension-reduction techniques. In [15] it is found that resizing conventional face images into smaller sizes allowed discriminating performance of LDA to be improved.

In face classification, ANN is widely used with PCA/LDA for its good learning ability and generalization. In face recognition, PCA or LDA is used to extract facial features and is classified by ANN using radial basis function (RBF) network [16], [17] or back-propagation (BP) [18], [19]. In paper [20] when back-propagation neural network was used to classify 40 subjects of human faces using facial features provided by both PCA & LDA, the face recognition results have been proven to be better than Euclidean distance.

Recently, work has been done on face recognition [21] using holistic approach with large dimensional reduction using low resolution and single neural network, but recognition rate is only 90.25% for 40 images. In low resolution neural network, face has been resized to 400 samples using Bi-cubic Interpolation. These 400 samples are used as inputs to artificial neural networks. In this method, as equal emphasis is given (uniform sampling is used in image resizing) on all the parts of a face, there has been a redundancy of the image data from discrimination point of view and hence suffers from unwanted equal weightage on whole face portion of the image, resulting in low recognition rate. In the proposed method, this problem is overwhelmed by using different samplings for different components based on their significance in face recognition.

[3] COMPONENT BASED APPROACH

For the component-based algorithms, the main idea is to compensate for pose changes by allowing a flexible geometrical relation among the components in the classification stage. In paper [22] face recognition was performed by independently matching templates of three facial regions (eyes, nose and mouth). The configuration of the components during classification was unstrained since the system did not include a geometrical model of the face.

A method of face recognition using a Weighted Modular Principle Component Analysis (WMPCA) is presented in paper [23]. The proposed method has a better recognition rate, compared to conventional PCA, for faces with large variation in expression and illumination. The face is divided into horizontal sub-regions such as forehead, eyes, nose and mouth. Then each of them is separately analyzed using PCA.
The final decision is taken based on a weighted sum of errors obtained from each sub-region. A method to calculate these weights is proposed, which is based on the assumption that different regions in a face vary at different rates with expression, pose and illumination.

[4] HYBRID APPROACH

In paper [24], Mehrtash proposed a hybrid recognition system which tries to find the human recognition behavior by efficiently combining the facial components in the recognition task. In this method the decision system uses he weighted majority strategy to fuse the results of whole image and facial component classifier. Simulation studies justify the superior performance of the proposed method as compared to that of Eigenface method.

In paper [25] Mazloom presents a hybrid approach for face recognition by handling three issues put together. For preprocessing and feature extraction stages, a combination of wavelet transform and PCA are applied. During the classification phase, the Neural Network (MLP) is explored for robust decision in the presence of wide facial variations.

The experiments that have been conducted on the Yale database and ORL database vindicated that the combination of Wavelet, PCA and MLP exhibits the most favorable performance. This is on account of the fact that it has the lowest overall training time, the lowest redundant data, and the highest recognition rates compared to similar methods introduced so far. The proposed method in comparison with the present hybrid methods enjoys a low computation load in both training and recognizing stages.

In paper [26], Suvendu Mandal has proposed a hybrid face recognition system. The proposed method combines the structural features with holistic features. In that experiment, the facial image is partitioned into a number petals considering nose tip as the origin. From each petal, intensity profile is computed by radial projection and then they are more compactly represented by applying Discrete Cosine Transform (DCT) on them. To classify the images, correlation between the vectors is used as the ‘similarity’ measure. The proposed method is simple to implement and is efficient. The performance of the proposed method is encouraging and gives scope for further study.

In paper [27], Nayeem S., has proposed a novel algorithm for recognizing human faces using Genetic Algorithms. The proposed method produces better results than PCA and LDA for one sample per person. For Face 1999, which contained images with different background, the recognition rate is not quite good. But for all the other databases like Essex Face Database-Face94, Indian Face Database, Yale Database, FACE 1999 and UMIST Face Database, the test produces more than 90% recognition accuracy rate. From the result obtained, it is observed that the proposed system does not need more number of images per person. Here the same recognition rate is achieved in around 5 images per person instead of around 10 images per person in basic PCA and LDA.

[5] CONCLUSION

Human face recognition plays a vital role in biometrics for human authentication as it is one of the biometric technique used for different purposed especially security. In this paper a review has been carried out for different approaches for face recognition. Through a large number of algorithms has been proposed but still there are a lot of worked need to be done in order to come up with a real time application.

REFERENCES


