Enhanced Face Recognition Using Principal Component analysis (PCA) and Discrete Wavelet Transform

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Abstract

In this paper, Principal Component Analysis and Discrete Wavelet Transform (DWT) were utilized as a part of Face recognition. Recognition execution as far as recognition rate of the proposed face recognition method was tried by leading experiments utilizing MATLAB on Jafee database. The Jafee database has images with a varying pose, occlusion and illumination intensity. The essential highlights are separated by utilizing PCA and DWT techniques. For image classification utilizing SVM, target vectors are produced by figuring the mean estimation of the highlights put away in the image include database. These mean values are separated into two gatherings for classification. The desired mapping between the mean values of the highlights put away in the image include database and ordered gatherings are prepared amid the support vector machine training phase.

Keywords: Face Recognition, Principal Component Analysis, Feature Extraction, DWT, SVM.

1. INTRODUCTION

The face is one of the most essential optical objects in our life which assumes a key role in conveying identity and emotion. Although the capability to infer intelligence or character from facial appearance is suspect and the human capability to recognize faces...
is outstanding [1]. We can recognize a large number of faces learned all through our lifetime and identity natural faces at a glance even after separation.

One of the best challenges for machine intelligence and biometrics is to know, however individual method and recognize faces to develop automated and reliable facial recognition systems. Biometrics have become the significant component of complex decision-making processes associated with security applications [2]. The goal of face recognition is to identify people in images or videos from their facial appearance. Compared to different biometrics, face recognition is passive and doesn't need cooperative subjects who are close to or in grips with a sensing element. Face recognition has numerous applications together with access control, human-computer interfaces, security and surveillance, e-commerce, amusement, annotation of photographic and video databases, etc. Consequently, it has been a horny analysis drawback [3]. Computational models of face recognition, specifically, are interesting because they can contribute to theoretical bits of knowledge as well as to practical applications.

Current face recognition systems are ready to perform very well in controlled environments, e.g., frontal face recognition, wherever face images are noninheritable under frontal pose with strict limitations as outlined in related face recognition benchmarks. However, in unconstrained circumstances where a face may be captured in out of doors environments, below impulsive illumination and huge pose varieties these systems neglect to work. With the present focal point of analysis to cope with these problems, a lot of attention has been dedicated to the facial feature extraction stage. Facial feature extraction is that the most important step in face recognition. many studies are created to answer the queries like what features to use, how to describe them and several other feature extraction techniques are projected. while various comprehensive literature reviews exist for face recognition an entire reference for various feature extraction techniques and their advantages/disadvantages with regards to a typical face recognition undertaking in unconstrained situations is genuinely necessary.

A recognition method involves two essential computational stages. Within the main stage, an appropriate illustration is
chosen, which should make the following process computational feasibility as well as robustness to certain varieties in images. Previously, various faces illustration approaches have been studied, such as, geometric features based on the relative places of the eyes, nose, and mouth [4]. The necessity for the success of this approach is a correct facial feature detection theme, which, however, remains a very troublesome problem up until now. Another known method of face representation makes an attempt to capture and define the face as an entire and exploit the applied mathematics regularities of picture element intensity varieties. Principal component analysis (PCA) is that the typical technique, by which faces are represented by a linear mixture of weighted eigenvectors, called eigenfaces. To apply, there are many impediments going with PCA-based methods. Basically, PCA representations write in code second-order dependencies of patterns. For face recognition, the pixel-wise variance among the pixels might not be sufficient for recognition. PCA typically offers high similarities indiscriminately images from a single person or from two totally different persons.

Crafted by facial expression primarily started in the nineteenth century. In 1872 Darwin [5], introduced an idea that there are definite inherent emotions that are derived from allied habits and are stated as essential emotions. basically facial expressions are examined and analyzed by psychologists [6], nevertheless in 1978, Suwa et al. [7] were the first to aim automatic face recognition utilizing image sequence. Later the analysis on facial expression matured in 1990s (nineties) by the efforts of Mase and Pentland [8]. Generally, the attention on facial expression was centered Associate in Nursing excessive variety of social psychologists, clinical and medical practitioners, actors and artists etc., . Later within the twentieth century facial expression became an active purpose that was thoroughly researched below the development of artificial intelligence, computer graphics, computer visions and animators etc., [9].

2. PCA and DWT

2.1 Principal Component Analysis

One of the important problems in the face recognition field is characteristic a technique to utilize high-dimensional data, for example, image data. Once the size of the data is within the order of hundreds or even a large number of pixels, the time interval will increase considerably. Figure 1 explains the 2D facial image into 1D high-
dimensional vector. Moreover, unwanted information enclosed in the high-dimensional raw data might interfere with the processes that follow processing [10]. So as to solve this problem, feature analysis methods need to be used to extract low-dimensional data features that contain essential data in the high-dimensional data information. By utilizing feature analysis methods, we will reduce memory usage and process complexity. The classification performance will be improved by eliminating redundant information and characterizing simply with the essential information.

Statistical feature analysis methods, as an example, PCA (Principal component Analysis) extract global features which will explain a number of the statistical characteristics of the given data set from holistic images.

### 2.2 Discrete Wavelet Transform (DWT)

DWT is multi-resolution decompositions which will be used to analyze signals and images. It describes a symbol of the ability at every scale and position. DWT has been tested to be a awfully helpful device for image compression in the recent years. Wavelet transform exploits both the spatial and frequency correlation of data of information by expansions and interpretations of the mother wavelet on the information data. It supports the multiresolution analysis of data, that permits progressive transmission and zooming of the image without the requirement for further storage. Another encouraging feature of the wavelet transform is its symmetric nature that is both the forward and also the inverse transform has a similar complexity, fabricating fast compression and decompression routines.

The primary inspiration behind image processing is to alter an image into significant information. Image enhancement is an essential step that must be carried out in all images dealing with applications. The
transformation of a digital image becomes a noteworthy method of correspondence in a modern age, yet the image obtained after transmission the data tends to get loud and thereby the further processing does not lead to great results. Hence, pre-processing of an image is very essential. The pre-processing being worked upon is the denoising of an image. The conventional image needs processing before it can be used in applications. Image denoising assimilates the manipulation of image data to create a high-quality image and wavelet transform has been applied[11].

3. Design and Databases

As the flow chart appeared in Figure 2, the face recognition using PCA based support vector machine (SVM) receives images for training in the classification phase. The training images are preprocessed by using fuzzy logic edge detection technique for edge detection. The detected training image edges are further processed by the DWT and PCA for feature extraction. The extracted features of the training images are stored in image feature database. Each segment of the image feature database gives the features of each training image.

Figure 2: Flow chart of PCA based face recognition system

For image classification using SVM, target vectors are generated by computing the mean value of the features stored in the image feature database. These mean values are divided into two gatherings for classification. The desired mapping between the mean values of the features stored in the image feature database and classified gatherings are trained during the support vector machine training phase.

The test image/input image is preprocessed in the same manner as mentioned in the flowchart and pre-processing of the training images. The mean value of the PCA feature of the
training image is given to the SVM classification for identifying the gathering.

After gathering identification, the Euclidean distance between the input image PCA feature and the training images PCA features are computed. The image giving minimum Euclidean distance can be considered as the matched image.

**Database:**

The JAFEE dataset is used to evaluate our proposed method. Those images were taken in uncontrolled environments in which the pose, illumination, expression changed significantly.

**Figure 3: Jafee Database**

4. **Results and Discussion**

In this section, the performances of PCA-based algorithm and SVM Classifier are evaluated with Jafee face image database. A query image is selected from a database. Then the query image was compared with the database stored images. The matched images will be appeared in the following Figure 4 and 5. This section provides an overview of about the experiment. The proposed algorithms are explained and the evaluated results are presented.

**Figure 4: Input Image**

**Figure 5: Recognized Image**

The following Figure 6 will show the classification results using the SVM classifier.
5. Conclusion

In this paper, we implemented accuracy recognition rate and correctly coordinate the similarity faces using the dimensionality reduction method on PCA. It is quick, relatively simple and the computational time reduced and has been appeared to function admirably in constrained environments. For the Face Recognition using PCA based SVM classification, we collected 25 images for training the SVM classifier. Then we tested the classification performance for each input test image. After testing 25 images, we got 20 correct and 5 wrong results. From this we inferred that the finished classification requires modification on the preprocessing and selected classifier.

References:


