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Facial gender recognition, deferent approaches

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Abstract

Gender recognition is one of the most interesting problems in face processing. Gender recognition can be used as a preprocessing phase in many applications. In this work we compare different approaches for gender recognition task, in accuracy and generalizing. First, we use principle component analysis (PCA) and discrete cosine transformation (DCT), for feature extraction and dimension reduction. Additionally, we used Bayesian approach and support vector machine (SVM) too. Finally, we compare these approaches in accuracy and generalizing.

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Introduction:

Identifying the gender by using face images, is part of data classification and pattern recognition issues. We should try to classify test data correctly with trained algorithms that provide by training data set and determine their gender.
In this article some different method have been implemented to extract the features and then classifying the faces. DCT and PCA equations have been used for extracting the features and reducing the dimensions. Also, various methods like neural network, linear determinant and closest match for classification have been used. The following, Bayesian method with image segmentation and also support vector machine method will be investigated. Eventually, the accuracy and generalizing of these methods will be compared to each other.

General procedure

Apart from the specific algorithm used, general procedure in most methods is as follows:

- In the first step, we should apply various filters, acts like normalizing and resizing the picture and prepare the image for processing
- The next step is image segmentation, we should identify the parts of the face that are important, and calculate the determining relationships between components. Extracting the appropriate features is the main job that is being done in this step.
- In the next step we should create template vectors. These vectors, are training pattern vectors. We need to create the average vector pattern. These vectors are created with the extracted features from the previous step.
- And finally, the last step is pattern matching. Closet match, correlation and optimized statistical classifiers, are common methods. Usually Gaussian function, covariance matrix and mean vector pattern use for this work.

Previous studies

Various methods have been used to identify the gender. For example, neural network has been used for compression and reducing the dimensions. In this method, a network function for gender has been defined. The accuracy of this method is 88 percent [1].
Also in some methods, the physical features of the face have been used to identify the face. Features like: Chin width, Eyebrow width, Nose width, etc. The classification accuracy in this method is 79 percent [2].
Gaussian classifier is another method used. The classification accuracy in this method reaches up to 90 percent with the help of Bayesian classifier and support vector machine [3]. Also, local binary patterns

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histogram, used for the extraction of section and segmentation. The classification accuracy in this method is 96 percent [4].
Using the certain parts of the face is also effective and the accuracy reaches to 92% [5]. In another method, the Haar Wavelets have been used for reconstruction of facial features and adaboost algorithm has been used for choosing more important features and classification accuracy is 88 percent [6].
Meanwhile, the use of statistical transformations like PCA and ICA and support vector machine is more common. For example, in one of these methods by applying these two transformations, the classification accuracy reaches up to 90 percent [7].

Classification

In order to implement the desired methods, the database of the images of the students of Stanford which includes 200 instances for each men and women, has been used. This collection of images have been used for training and testing. And also, in order to investigate the generalizing, the independent database of FBI that diversely includes 131 images of both men and women has been used.

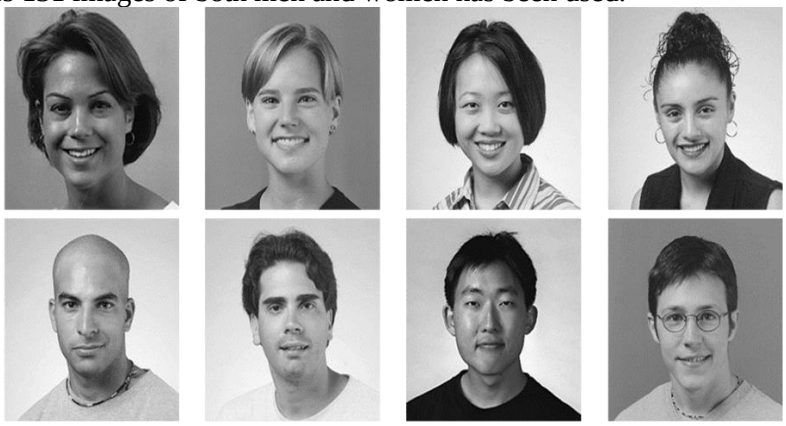


Figure (1) Stanford student dataset.



Figure (2) FBI faces dataset

Using PCA and DCT equations

In this section, we have used the Eigenfaces method for gender classification. And we used the methods of KCT and DCT for reducing the dimensions and extracting the features and the efficiency of these two methods have been compared to each other and also various classification algorithms have been used [8][9].
Classification algorithms include: neural network, linear discriminant and closest match, that their accuracy for both DCT and PCA have been tested. Also, cross-validation has been used to obtain the expected accuracy and classification accuracy variance [8] [9].
Figure (3) shows primary eight PCA equations and their Eigenfaces.

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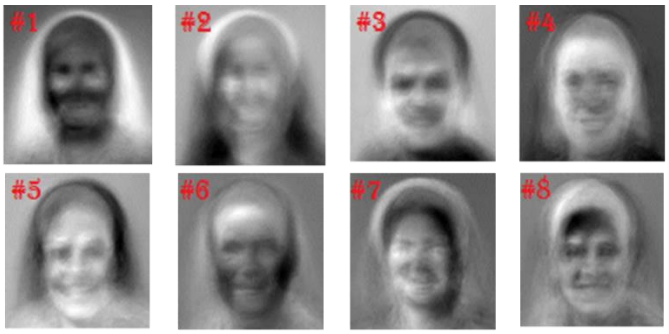


Figure (3) Eigenfaces

Linear discriminant

Classification with linear discriminant methods has a simple idea that in the training step is being used to determine the weight of vectors (x), to solve a linear equation; $Xw=y$.

In this equation, X is an n×p matrix of basic equations. Each row of X is a viewing with the size of P. For gender classification in each row, entry y is either zero or one (Zero for men and one for women).

Closet match

The one thing about this method is that training data are always being classified correctly. Because this model basically remembers all training vectors and finds the best possible match. This algorithm works with calculating the Euclidean distance between testing face and all pictures of training faces.

Neural network

Another classifier that has been used, is perceptron neural network with Error Back propagation. This neural network has been used with a hidden layer and 70 hidden repeated nodes. Neural network performance is almost equal to the closest match method and it is somewhat better.

In Figure 4 we see that in the PCA equations, linear discriminant has the best performance.

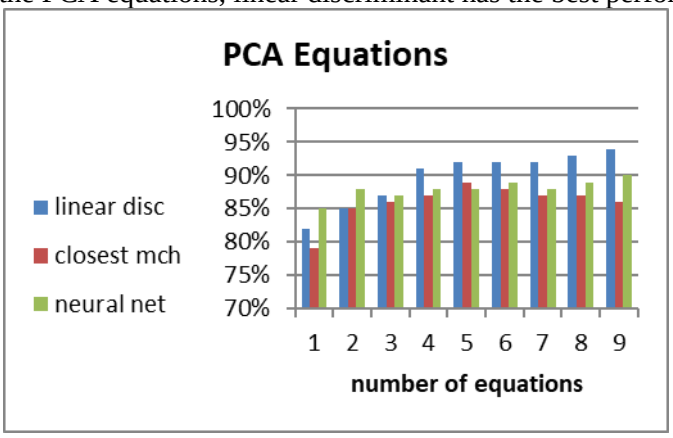


Figure (4) PCA equations classification results

In Figure 5 we see that in the DCT equations, neural network has the best Performance. In the method based on Bayesian framework, the most important issue is Calculation time. This method has higher Calculation time than two previous methods. The amount of accuracy in this method is 90%.

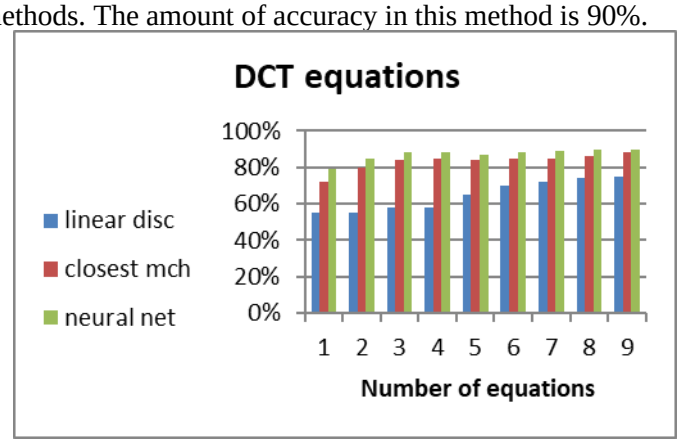


Figure (5) DCT equation classification result

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Figure 6 show some generalizing cases that classify wrongly with DCT and PCA equation.

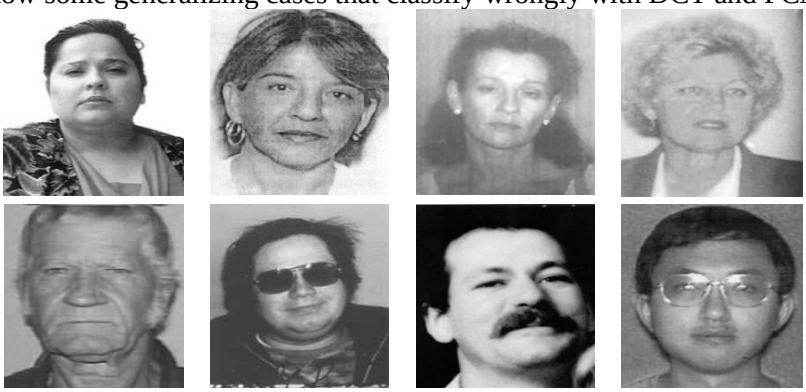


Figure (6) mismatch faces in DCT & PCA generalizing

Bayesian method

In this method, Images are represented as a regular grid of non-overlapping patches. Each of these patches are being processed separately, and provide independent information on class label. At the core of our algorithm is a predefined library of object instances (face images). The library can be considered as a palette from which image patches can be taken [10].

Relationships between patches in test image and library patches, are being used to determine the class. Classification accuracy in this method is 90%. And generalizing of this method is 83%.



Figure (7) mismatch faces in Bayesian method generalizing

Support vector machine

In this method, face images have been represented as row vectors. Matrix of these vectors, is given to the support vector machine as input. Also an index of gender images is created, so by using cross-validation functions, test and training instances being selected randomly. And finally, classification accuracy has been investigated.

In this method the database is also Stanford students. We did the test and classification. The results were very significant. The accuracy in this method was between 90 to 95 percent, which is a high accuracy. In most methods based on the support vector, mainly transformations like PCA and ICA have been used [11].

Conclusion

The first two methods of extraction; DCT and PCA have a lot of similarities in general procedures. The first thing that can be said about these two methods is that the Calculation time of PCA equations is much more than DCT. On the other hand, in some classification methods, like linear discriminant, this Calculation time should be accepted. Because accuracy of PCA with less equations is more than DCT.

In the closest match method, again PCA equations present an acceptable accuracy with less equations. Neural network with fewer number of equations in both PCA and DCT methods have considerable efficiency and accuracy.

Selecting Bayesian method or methods based on PCA and DCT equations, depend on our desired accuracy. In the method based on the support vector, the range of classification accuracy was between 90 percent and 95 percent. But generalizing was almost low and was about 70 percent. The method based on Bayesian has a high generalizing while the methods based on DCT and PCA equations by applying either one of

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classification algorithms, has a low generalizing. In these methods, generalizing in the best case in nearly 60 percent. While in the Bayesian method generalizing is 83 percent.

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