

Principle Component Analysis From Multiple Data Representation

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Abstract: *For improving accuracy and increasing efficiency of classifier, there are available many effective techniques. One of them combining multiple classifier technique is used for this purpose. In this paper I present a novel approach to a combining algorithm designed to improve the accuracy of principle component classifier. This novel approach combines multiple PCA classifiers, each of using a subset of feature. In contrast other combining algorithms usually manipulate the training pattern.*

Keywords: PCA classifier, Eigenface, Eigenvector, Voting, Covariance matrix, new projected data, face recognition.

1. Introduction

The PCA classifier is one of the oldest and simplest methods for classification. PCA involves a mathematical course of action that transform a number of possible correlated variable into a smaller no of uncorrelated variable called principle component. PCA is mathematically defined as an orthogonal linear transform that transform the data to a new coordinate system such that greatest variance by any projection of the statistics comes to lie on the first coordinate. The second greatest variance on the second coordinate and so on [10].

1.1. Method of Pronouncement PCA.

Step 1: Acquire some data
Step 2: Subtract the mean
Step 3: Compute the covariance matrix
Step4: Compute the eigenvectors and eigenvalues of the covariance Matrix
Step 5: Choosing components and forming a feature vector
Step 6: Deriving the new data set.

1.2. Related work

Image classification is a thorny task because images are multidimensional. There are many classifiers although there are a number of face recognition algorithms which works well in constrained situation; face recognition is still an

open and very challenging dilemma in real application. The area of face recognition has focused on detecting individual feature such as the eyes, nose, mouth, lips and head outline and defining face model by the position, size, perimeter and relationship among features. Bledsoe's [3] and Kanade's [4] recognition based on these parameter. A Mathew A. Turk and Alex P. Pentland [1] track a subject's and then recognizes the person by comparing characteristics of the face to those of known individuals. Face images are projected onto a feature space that best encodes the variation among known face images. The face space is defined by the "eigenface" which are the eigenvectors of the set of faces; they do not necessarily correspond to isolated feature such as eyes, ear and nose. The framework provides the ability to learn to recognize new faces in an unsupervised manner.

In mathematical terms, we want to find the principle component of the distribution of faces or the eigenvectors of the covariance matrix of set of face images. These eigenvectors can be thought of as a set of feature which together characterizes the variation between face images. Each image location contributes more or less to each eigenvector so that we can display the eigenvector as a sort of ghostly face which we call an eigenfaces.

There are many approaches available to combining the classifier such as Stephen O.Bay, "Nearest Neighbor Classification from Multiple Feature Subset" [7] and Bing-Yu-Sun- Xiao-Ming Zhang and Rujing Wans, "Training SVMs for Multiple Feature Classifier Problem" [5] but there in no any approach available to combining the base classifiers. Actually the combination of classifier can be implemented at two levels, feature level and decision level. Xiaoguang Lu, Yunhong Wang, Anil K. Jain, "combining classifier for face recognition"[4] provide frameworks to combine different Classifier on feature based .We are using feature level combination and want to present combination of classifier which works on low level feature in this approach.

2. Classification amalgamation

2.1. Training Phase

In the training phase we extract feature vector for each subset of images in training data set. Let T_1 be a training subset in which every image has pixel resolution of M by N (M row, N column). In order to extract PCA features of T_1 we will first convert image into a pixel vector by concatenating each of M rows into single vector V_1 . The length of pixel vector V_1 will be $M*N$. we will use the PCA algorithm as a dimensionality reduction technique which transform the vector V_1 to a vector W_1 . Which has dimensionality d where $d \leq M*N$. For each training image subset T_i , we will calculate and store these feature vector W_i .

2.2 Recognition Phase

In the recognition phase, we will be given a test set of images T_j of known person. As in the training phase we will compute the feature vector of this test set using PCA and match the identity name of persons. In order to identify we will compute the similarities between test set and training subset. For this we will use the combining algorithm method.

2.3. Combining algorithm.

The algorithm for PCA classification from multiple feature subsets is simple and can be treated as:

Using voting, combining the output from multiple PCA classifiers each having access each subset of feature.

We select the subset of features by sampling from original set of features we use two different sampling functions: sampling with replacement and sampling without replacement. In sampling with replacement a feature can be selected more than once which we treat as increasing its weight.

Each of the PCA classifiers uses the same number of features. This is parameter of algorithm which we set by cross confirmation performance estimates on the training set.

The similarity among new projected data can be calculated using euclidean distance the identity of most similar W_i will be output of our classifier. If $i=j$ it means that we have correctly identified the subset otherwise we have misclassified the subset. The schematic diagram of this presented in figure 1.

2.4. Pseudo code of combining algorithm

1. Prepare training set which contains subset of images
2. Set PCA dimensionality parameter
3. Read training subset
4. Form training data matrix.
5. Form training class label matrix
6. Calculate PCA transform Matrix
7. Calculate feature vector , projected data of all subset of training set by using PCA transformation matrix

8. Store training feature vector and projected data in a matrix.
9. Read test set

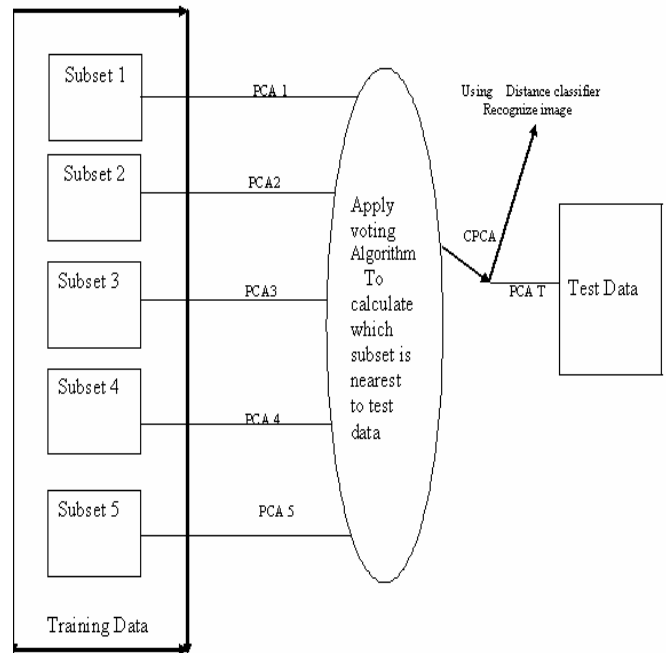


Figure 1

10. Calculate the feature vector of test set and also calculate new projected data by using PCA transformation matrix.
11. Compute the similarity between subset and test set by using voting method.
12. store the similarity
13. Now we go the subset test set which have lowest similarity factors determine the person id and match the id between training subset and test set.
14. Initialize error count to zero
15. For each test face If the id is match then recognition done and accuracy will be hundred percent.
16. If the id of any test face image is not equal to id of training subset of each image then increment in error count.
17. Compute the accuracy by using error count value.

3. Experiment Discussion

To access the possibility of this approach to face recognition, we have performed experiments .we used the ORL database [9] which available in public domain. We also used image processing tool of MATLAB 7.6. Using ORL database we have conducted 3 experiments to access the accuracy of recognition by formula:

$$(1 - (\text{error count} / \text{total test image count})) * 100$$

In the experiments we take 5 training subset of face image. Each subset contains 20 face images of 4 different person and one test set which contains 5 images of a person. In the first experiment we set up 60 percent accuracy. In the

second experiment we set up 80 percent accuracy and at last in third experiment we found 60 % accuracy.

As can be seen my result are no where near perfect yet with my best outcomes in with almost 80 percent matches.

If we study this approach in the view of complexity then definitely I assured both time and space complexity will be reduced because we are using multiple feature subset concepts as like in nearest neighbor classifier from multiple feature subsets [7]. The nearest neighbor classifier from multiple feature subsets supports lower complexity.

4. Conclusion and future work

As can be seen my results are near to perfect while these results may be improve. Conceptually this approach reduced the complexity also but this approach has two limitations one voting can only improve accuracy if the classifier select the correct class more often than only other class. Another algorithm has two parameter value need to be set first is size of features subset and second is number of classifier. So in the near future we can also improve the accuracy and complexity of this approach.

5. References

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