"[CMSC828C] Project-1"

Statistical Pattern Recognition

PROJECT REPORT

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Objective-

Given a set of faces and their labels, implement different classifiers to achieve facial recognition.

The classifiers implemented-

a) Bayes' Classifier
b) K-NN Rule Classifier
c) SVM
d) Boosted SVM

Principal Component Analysis(PCA) and Multiple Discriminant Analysis(MDA) before applying the data to each classifier.

Dataset in consideration-

DATA- Cropped images of 200 subjects, 3 images each, each image of size 24x21.

POSE- Cropped images of 68 subjects under 13 different poses.

ILLUMINATION- Cropped images of 68 subjects under 21 different illuminations.

A) Bayes Classifier-

The dataset has 3 images of each subject with the first being neutral face and the rest with expressions. Thus, dividing the dataset into 'neutral' and 'with expression' classes Flattened the 2-D image for faster calculations.

The covariance matrices formed were made invertible by using the regularization technique and adding noise to the diagonal elements.

The test results for which were as follows-

Training Size	Accuracy
50	84.33%
100	87.00%
125	87.33%
150	82%

Applying PCA and MDA before classification-

PCA projects each data point onto first few principal components to achieve maximum covariances and good features for classification. Which is why it is necessary to include only the components corresponding to the maximum Eigen values.

In MDA in addition to achieving maximum covariances we also maximize the spread between classes.

Results of PCA to achieve maximum covariance-

Principal Components	Accuracy
20	82%
35	82%
50	85%
70	87%
75	89.5%
100	83.5%
120	81%

With PCA the classification achieves **maximum accuracy around 70-75 Principal components.**

B) k-NN Rule classifier-

The K nearest neighbor classification is based on the plurality of the k neighborhood, i.e., the object is classified to the class based on the majority in the neighborhood.

The results of k-NN on given data and after applying PCA and MDA before classification are as follows-

K	Raw Data	After PCA	After MDA
1	77%	78.5%	79.5%
3	78%	85.5%	79.5%
5	82%	86.5%	79.5%
8	85.5%	86.5%	82%

Keeping K=8 and varying number of principal components-

Principal Components	Accuracy
15	84.5%
20	89%
22	89%
24	87%
35	86.5%

C) Kernel SVM Classifier-

The Kernel SVM is implemented by solving the Dual optimization form using lagrangian form.

Radial Basis Function(RBF)-

Data being linearly separable, RBF boosted the accuracy over linear SVM

σ^2	**Accuracy**
1	85.5%
0.01	82%
0.02	86.5%
0.06	85.5%
0.001	82%

Polynomial Kernel-

r	**Accuracy**
1	86%
0.9	81%
0.7	81%
0.6	79%
0.1	75.5%

D) Boosted SVM-

Could not generate appropriate results.

MULTICLASS CLASSIFICATION:

Multiclass classification was studied using data.mat with 3 images for each subject and 200 subjects in total. The 2 samples were chosen for training and 1 for testing in case of each subject. The accuracy was not very good because of less amount of data available for each class.
Different settings were chosen for train-test sets to study the performance over the dataset.

Training Set	Testing Set	Accuracy
Neutral + illumination	expression	68%
Neutral + expression	illumination	63%
Expression + illumination	Neutral	72%

Conclusions-

The choice of classification techniques highly depends upon the problem that one is trying to solve.

Transformations such as LDA, PCA and kernel trick are more likely to improve the performance since they try to exploit linear separability in higher and lower dimensions respectively but not always.

- Training accuracy and error should be carefully chosen to avoid overfitting of the data.
- The Kernel SVM and Boosted SVM were two of the very powerful classification techniques since they employ a lot of tricks to perform classification in a better way and takes full advantages of the dimensionalities of the data.
- Varying results could be obtained by making different combinations of kernelizations and transformation techniques along with Bayesian, KNN and SVM classification.