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Face Recognition using Feed Forward Neural Network

Pooja Rani
(Department of computer science/ Punjabi university, India)

Abstract: *In this paper, we propose four techniques for extraction of facial features namely 2DPCA, LDA, KPCA and KFA. The purpose of face feature extraction is to capture certain discriminative features that are unique for a person. In the previous works that uses PCA for face feature extraction involves merging the features and reducing the dimensions that results in some information loss. To overcome this problem, in the first method we used 2D-PCA for face feature extraction, LDA for making class labels and FFNN for face recognition. Similarly we used the three more techniques namely LDA, KPCA and KFA for face feature extraction and then FFNN for face recognition.The proposed method is tested on the ORL database. Results involve the comparison of face recognition rate of the different feature extraction techniques with FFNN using 10, 20, 30 and 40 hidden neurons. The results on ORL database shows that FFNN with 30 hidden neurons performs best by extracting features using KPCA.*

Keywords: *2DPCA, LDA, KPCA, FFNN and KFA.*

I. Introduction

Face Recognition is the emerging technology in the field of pattern recognition and computer vision. Digital image processing always remained a hot topic for many researches. The work we carried out involves the use of digital image processing for feature extraction and pattern recognition technology for recognizing faces using FFNN (feed forward neural networks). The strong adaptability, high security and robustness of face recognition system makes it very useful for providing security to the computer systems, military and crime investigation.

After the years of developments, there have been various systems for face recognition with various methods of feature extraction and classification [1]. Various face recognition techniques have its base from classical feature extraction method using eigen faces [2] since 1991, fisher faces [3] [4], independent component analysis (ICA) [5] and so on. Various popular classifiers include support vector machine(SVM) [6], feed forward neural networks [7] .

All the above methods of feature extraction and classification involves the formation of row or column vector,as the images in a computer system are stored in the form of matrix i.e 2D form, so it becomes easy to directly manipulate the image as in 2D form, it also prevents the information loss held in the classical methods of face recognition. Researchers proposed the new techniques that operates directly on the two dimensional data such that two-dimensional principal component analysis (2DPCA) [8] and two dimensional linear discriminant analysis (2DLDA) [9]. These techniques are useful for reducing the computational complexity during the feature extraction. To overcome the disadvantages of classical techniques, A new method KPCA for performing a nonlinear form of principal component analysis was proposed[10], By the use of integral operator kernel functions, one can efficiently compute principal components in high-dimensional feature spaces, related to input space by some nonlinear map. Another feature extraction method called Non linear factor analysis (KFA) [11] method was studied by Mercer kernel function which can map the data in the original space to a high-dimensional feature space.

II. proposed method

So studying the above concepts in section I, we proposed to develop a system using the recent feature extraction methods i.e. 2DPCA, LDA, KPCA and KFA. A classical LDA to form class labels and Feed forward neural network (FFNN) to train and test the images for classification. Comparison of the recognition rates to form the results.

2.1 Flowchart for the proposed method

The proposed method flow is shown as:

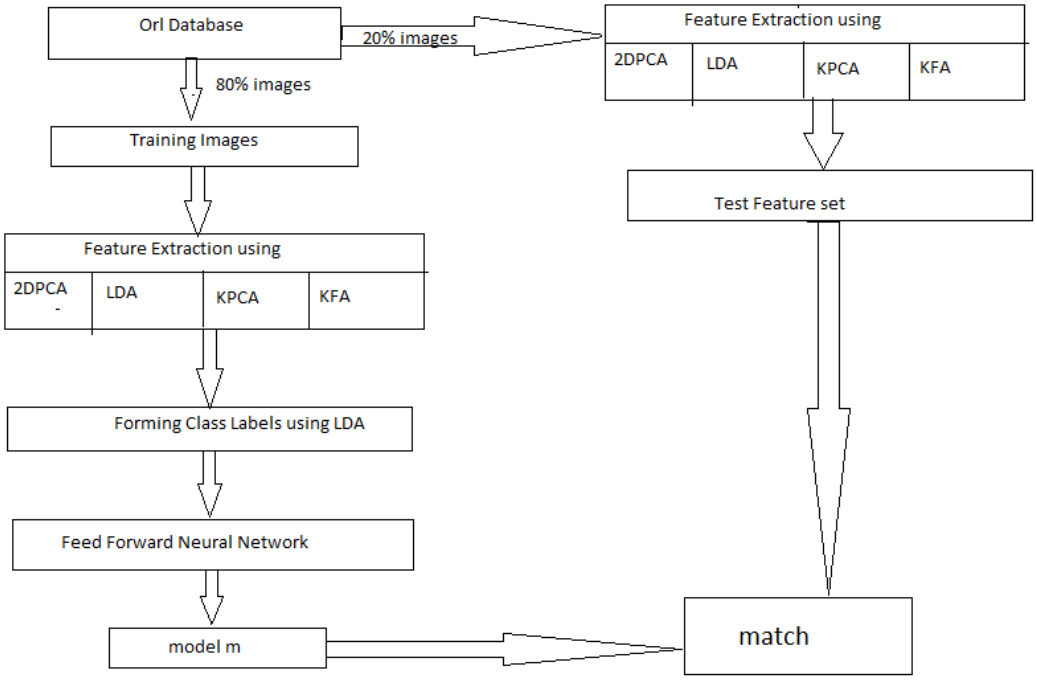

Fig 1: workflow of the proposed method

2.2 Algorithm for the proposed method:

Algorithm developed to construct the system proposed in the above flowchart is shown as:

Face_Recognition(Orl_Database)
Step1: n=length(orl_database)
Step2: for(i=0;i<n;i++), divide the images into
{Training_set(80% images);
Test_set(20% images);}
Step3: y=length(Training_set)
Step3a: for(i=0;i<y;i++)
{ x=extractfeatures_2D-PCA(Training_set); // LDA/KPCA and KFA for other approaches respectively }
Step3b: for(i=0;i<x;i++)
{Feature_classes=Apply_LDA(x);}
Step3c: Send feature classes to neural network for training.
Step3d: Make model m.
Step4: z=length(Test_set);
Step4a: for(j=0;j<z;j++)
{k=extractfeatures_2D-PCA(Test_set); // LDA/KPCA and KFA for other approaches respectively }
Step5: k□ m
Step6: Analyze the predicted results by model m.

III. experiments and results

we have used AT&T Database "the family of faces" is formally called the ORL database [12]. In this database ten different images of each of 40 distinct subjects. For some subjects, the images were taken at different times, varying the lighting, facial expressions (open / closed eyes, smiling / not smiling) and facial details (glasses / no glasses). All the images were taken against a dark homogeneous background with the subjects in an upright, frontal position (with tolerance for some side movement).

Fig 2: A sample of ORL database

The recognition accuracy for all four techniques of feature extraction with LDA for class formation and FFNN for recognition is taken with the different number of hidden neurons i.e. 10, 20, 30 and 40 hidden neurons. Then a comparison between all techniques with different number of neurons is shown.

3.1 Result of recognition of different approaches with 10 hidden neurons is given as

To calculate the best results the system was tested 10 times and average of 10 readings is taken as the accuracy result of each technique.

Technique	Recognition Rate (%)	Error Rate(%)
2D-PCA	**91.82**	**8.16**
LDA	**90.84**	**9.15**
KPCA	**90.82**	**9.17**
KFA	**91.16**	**8.83**

Table 1

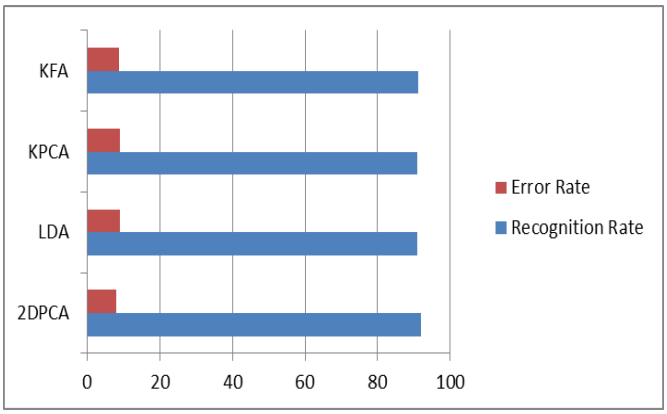

Figure 3: Recognition Rate of different approaches with 10 hidden neurons

Comparison of different techniques using 10 hidden neurons shows that 2D-PCA gives best recognition rate of 91.82%.

3.2 Result of recognition of different approaches with 20 hidden neurons is given as

Technique	Recognition Rate	Error Rate
2D-PCA	**92.83**	**7.17**
LDA	**90.99**	**9.00**
KPCA	**94.82**	**5.17**
KFA	**92.49**	**7.58**

Table 2

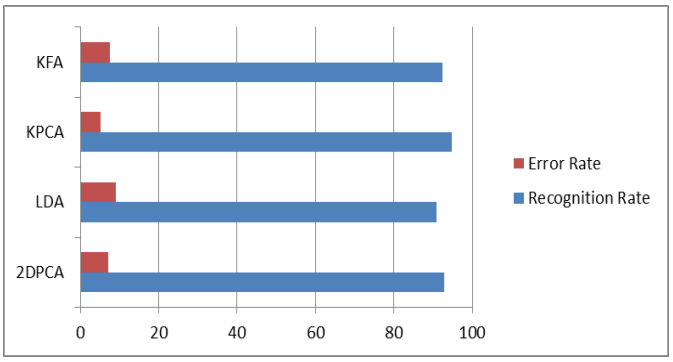

Figure 4: Recognition Rate of different approaches with 20 hidden neurons

Comparison of different techniques using 20 hidden neurons shows that KPCA gives best recognition rate of 94.82%.

3.3 Result of recognition of different approaches with 30 hidden neurons is given as

Technique	Recognition Rate	Error Rate
2D-PCA	**93.49**	**6.50**
LDA	**91.83**	**8.16**
KPCA	**94.16**	**5.83**
KFA	**89.49**	**10.50**

Table 3

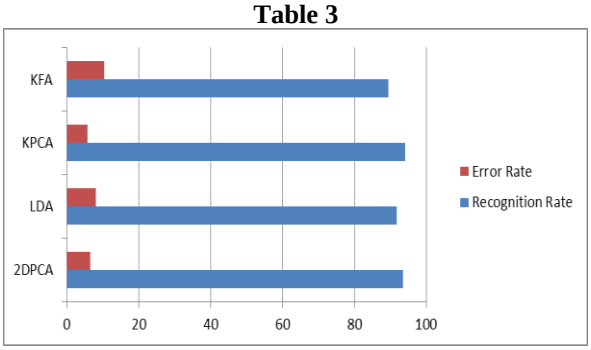

Figure 5: Recognition Rate of different approaches with 30 hidden neurons

Comparison of different techniques using 20 hidden neurons shows that KPCA gives best recognition rate of 94.16%.

Result of recognition of different approaches with 40 hidden neurons is given as

Technique	Recognition Rate	Error Rate
2D-PCA	**92.16**	**7.83**
LDA	**91.83**	**8.16**
KPCA	**94.66**	**5.33**
KFA	**91.99**	**8.00**

Table 4

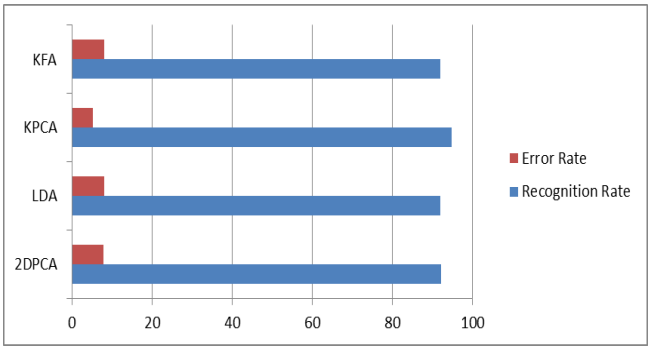

Figure 6: Recognition Rate of different approaches with 40 hidden neurons

Comparison of different techniques using 40 hidden neurons shows that KPCA gives best recognition rate of 94.66%.

Result of Recognition Rate of different approaches with 10/20/30 and 40 hidden neurons is given as

No of Hidden Neurons	2D-PCA	LDA	KPCA	KFA
10	**91.82**	**90.84**	**90.82**	**91.16**
20	**92.83**	**90.99**	**94.82**	**92.49**
30	**92.16**	**91.83**	**94.16**	**89.49**
40	**93.49**	**91.83**	**94.66**	**91.99**

Table 5

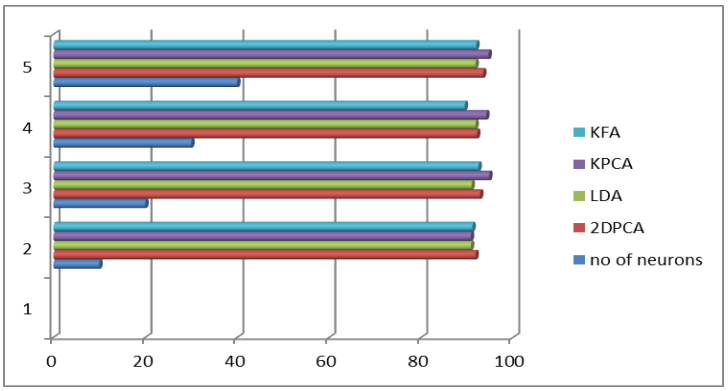

Figure 7: Recognition Rate of different approaches with 10,20,30 and 40 hidden neurons

Comparison of different techniques using 10/20/30 and 40 hidden neurons shows that KPCA gives best recognition rate of 94.82% using 20 neurons.

IV. Conclusion

The goal is reached and we have implemented it on ORL database. Different techniques i.e. 2D-PCA, LDA,KPCA and KFA are used for extracting geometric face features, after extracting the face features the LDA is used for making class labels. FFNN is performed to classify to solve pattern recognition problem since face recognition is a kind of pattern recognition. Classification result is accurate.

We have done the comparison of different techniques with different number of neurons. The results are accurate providing the best recognition rate by KPCA extracted features approach of 94.82% using 20 hidden neurons.

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