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Face Recognition using Radial Basis Neural Network

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Abstract: *In this paper, we propose four techniques for extraction of facial features namely PCA, 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 PCA for face feature extraction, LDA for making class labels and NN with RBF for face recognition. Similarly we used the three more techniques namely LDA, KPCA and KFA for face feature extraction and then NN with RBF for face recognition.* The proposed method is tested on the ORL database
Keywords: *2DPCA, LDA, KPCA, FFNN and KFA.*

I. Introduction

Image Processing is the processing of images using mathematical operations by using any form of processing in which image is considered as input. [2] The Digital Image Processing deals with developing a digital system that performs operations on the digital image.

Image is defined as a two dimensional signal in the form of f(x, y) where x and y are the two coordinates horizontally and vertically and f is the amplitude at any pair of coordinate (x, y) which is called the intensity at that particular coordinates.

The image is called the digital Image if the coordinates x and y and f are having the discrete values. Image processing mainly deals with the manipulation of Images.

There are many operations that are included in Image processing as follow: - [3]

a) Contrast Enhancement
b) Remove blurring from the image
c) Smoothening of the image
d) Geometric Correction
e) Image correction for efficient storage or transmission

Computer Vision

It is basically the branch of image processing and artificial processing also known as machine vision of the images from the real world. It requires a combination of low level processing to enhance the image quality and high level pattern recognition to recognize the features that are present in the images [4].

Example of Computer Vision [5]

1) Robotics:-

- Localization:- In this the location of Robot is determined automatically
- Navigation
- Human Robotics Interaction: - Intelligent robotics to connect with people and serve them.

2) Security

- Biometrics
- Surveillance-detection of different activities and behavior

3) Human Computer Interface

- Face recognition
- Head and Hand gesture recognition
- Finding Faces in a group, crowd, etc.

II. Previous Work

Seerapu and Srinivas [6] proposed a neural network for face recognition that contains noises. In this they applied Radial Basis Neural Network that mainly distinguishes between face and the non face patterns. Here they used the robust PCA which gives effective and good results even in different environments of illumination. Robust PCA gives much better results as compared to conventional PCA. The eigen features are extracted by

using robust PCA and then they are put into an modified RBF. This method gives better speed and dimensionality and complexity is reduced as compared to native methods.

Shamla Mantri et al [7] measured image similarity by using Self Organizing Maps. They worked on 400 images of AT&T database. Input image is integrated, features are extracted and then training and mapping is done. SOM is an ANN which became tuned according to the various classes through unsupervised learning method. SOM used in this paper are topologically ordered and leads to better extracting feature ability.

V. Radha et al [8] detect the frontal view of faces by using Radial Basis neural network. Features are initially extracted by using LDA and then RBF is used as a neural network. 200 images of ORL database is used. Face recognition when done with eigen faces produce better results.

Ren, Jian et al [9] proposed a face verification system for the security purposes of the mobile devices. The main three steps covers under this are face detection, alignment and verification. The databases used are AR, O2FN and CS-PEAL. The results are better for O2FN database as compared to AR database as the eyes are detected as they are marked manually. To improve the system in future work a larger mobile database is necessary.

Revathy et al [10] proposed a back propagation neural network which is a feed forward neural network. The signals are received by the input signals and propagated in each hidden neuron where the activation is compared and the output is produced. The system is implemented using the Matlab Tool. Neural Network toolbox is used for further processing. As per the results the conventional eigen face algorithm works well when light variation is small and the performance degrades when the light variation increases. But this proposed system works with the light variations.

Rowley et al [11] proposed a system in which a neural network is use to examine the small window of the image whether the window contains face or not. Bootstrap algorithm for training the networks are used which helps to eliminate the difficulty in manually eliminating the non face images. The main limitation comes under this is that it only detects the upright faces looking at the camera. This may be overcome in their future work. Media Technology is one of the applications of this system as it provides much cheaper and more efficient ways of storing information.

Latha et al [12] proposed a technique in which frontal faces are detected using the neural network based algorithm. In this paper the dimensionality is reduced by using the Principal Component analysis and then recognition is being carried out by Back propagation Neural Network. In this paper it is shown that by using eigen faces face recognition has been much fast and accurate. When PCA is combined with BPNN then the recognition of non linear face images can be recognized very easily.

III. Methodology

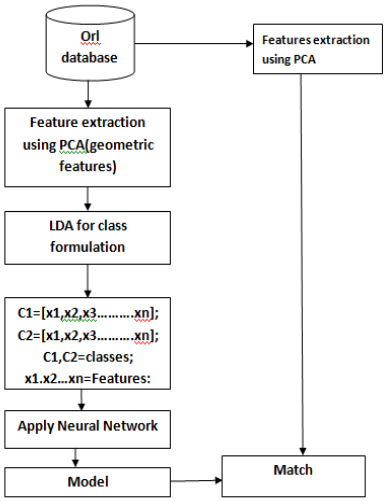
Principal Component Analysis

In this approach the techniques are applied on ORL Dataset. The complete ORL Dataset is divided into two parts i.e. training and testing sets. They are divided as 80% of the images in one set and 20% of the images are in another set.

The 80% of the images are undergone through Principal Component Analysis for the feature extraction. The extracted features are then undergone through Linear Discriminant Analysis, in LDA the feature classes has been formed. This forms the training set.

Then the other set of 20% of images are undergone through Principal Component Analysis to test the feature set.

Then the radial basis neural network is applied to check whether the image is matched or not in the data set.



Proposed Algorithm

Algorithm:1(PCA)
Image_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_PCA(Training_set);
}
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_PCA(Test_set);
}
Step5: k□ m
Step6: analyze the predicted results by model m.

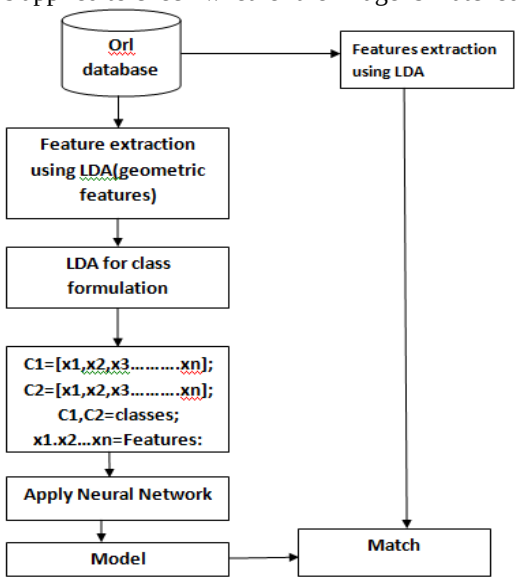
Linear Discriminant Analysis

In this approach the techniques are applied on ORL Dataset. The complete ORL Dataset is divided into two parts i.e. training and testing sets. They are divided as 80% of the images in one set and 20% of the images are in another set.

The 80% of the images are undergone through Linear Discriminant Analysis for the feature extraction. The extracted features are then undergone through Linear Discriminant Analysis, in LDA the feature classes has been formed. This forms the training set.

Then the other set of 20% of images are undergone through Linear Discriminant Analysis to test the feature set.

Then the radial basis neural network is applied to check whether the image is matched or not in the data set.



Proposed Algorithm

Algorithm:1(LDA)
Image_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_LDA (Training_set);
}
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_LDA (Test_set);
}
Step5: k□m
Step6: analyze the predicted results by model m.

IV. Experiment and Results

In the proposed work the four approaches have been followed i.e. PCA+NN (RBF), LDA+NN (RBF), KPCA+NN (RBF) and KFA+NN (RBF). In each case four different target goal error values are taken and the accuracy is measured on the basis of their performance. The system is tested on ORL dataset.

Each technique is applied in this approach for feature extraction and then Radial Basis Neural Network is applied for face Recognition. The accuracy is measured depending upon the four target goal error values i.e. 0.01, 0.02, 0.03, 0.04.

V. Results

PCA+NN (RBF)

Table1: Comparison of PCA+NN (RBF) for different target values

Target	PCA+NN(RBF)
0.02	80
0.01	91.66
0.03	70
0.04	61.66

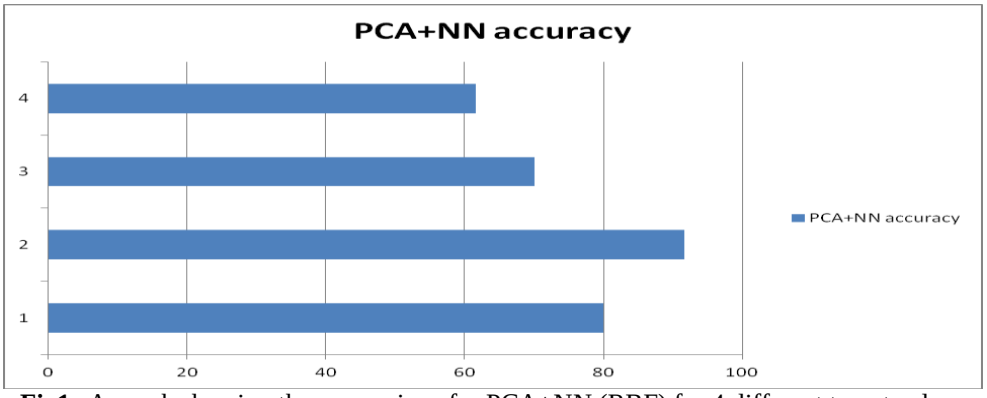


Fig1:-A graph showing the comparison for PCA+NN (RBF) for 4 different target values

LDA+NN (RBF)

Table 2:- Comparison of LDA+NN (RBF) for different target values

Target	LDA+NN(RBF)
0.01	90
0.02	83.33
0.03	66.66
0.04	58.33

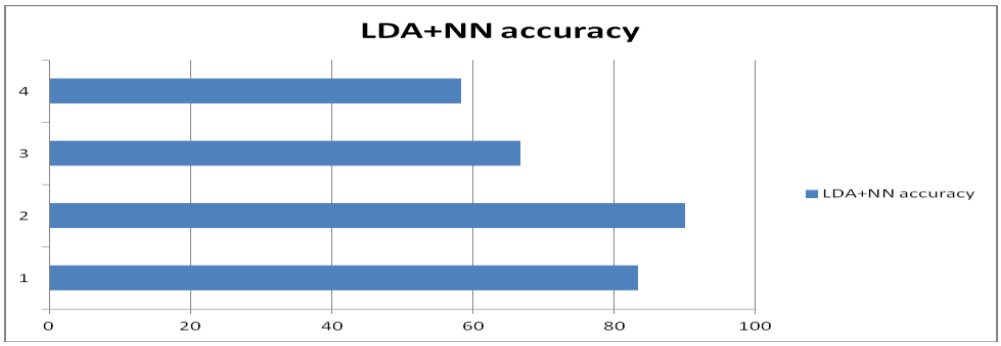


Fig2:-A graph showing the comparison for LDA+NN (RBF) for 4 different target values

KPCA+NN (RBF)

Table3:- Comparison of KPCA+NN (RBF) for different target values

Target	KPCA+NN(RBF)
0.01	91.66
0.02	83.33
0.03	75
0.04	70

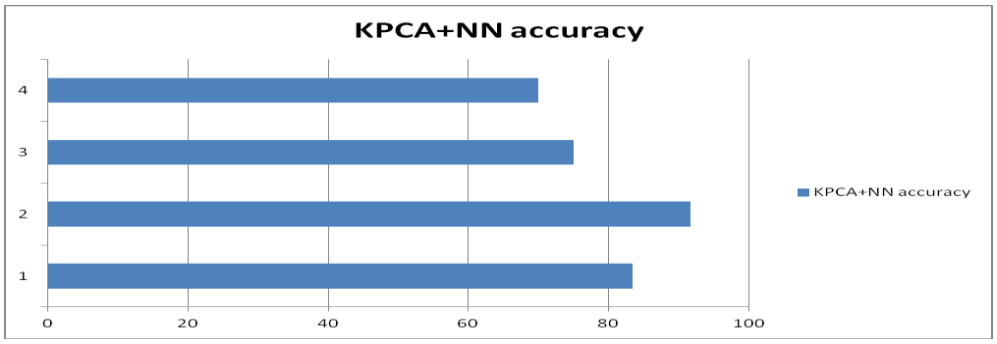


Fig3:-A graph showing the comparison for KPCA+NN (RBF) for 4 different target values

KFA+NN (RBF)

Table4:- Comparison of KFA+NN(RBF) for different target values

Target	KFA+NN(RBF)
0.01	88.33
0.02	78.33
0.03	65
0.04	51.66

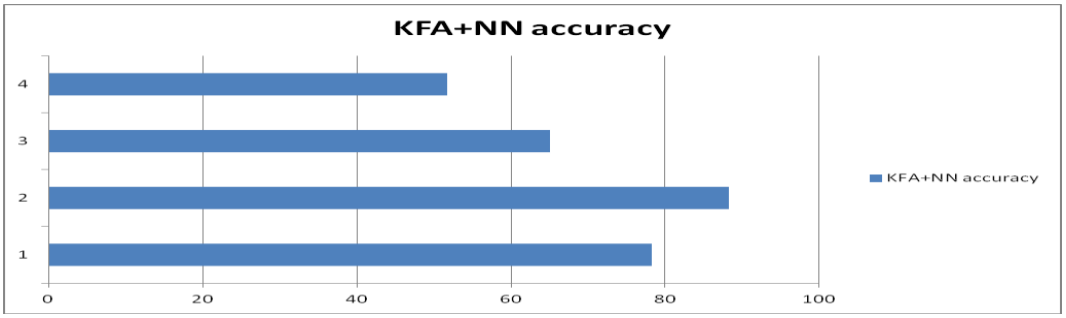


Fig4:-A graph showing the comparison for KFA+NN (RBF) for 4 different target values

Table5:- Comparison of PCA+NN (RBF), LDA+NN (RBF), KPCA+NN (RBF) and KFA+NN (RBF) for different target values

Target	PCA+NN(RBF)	KPCA+NN(RBF)	LDA+NN(RBF)	KFA+NN(RBF)
0.01	**91.66**	**91.66**	**90**	**88.33**
0.02	**80**	**83.33**	**83.33**	**78.33**
0.03	**70**	**75**	**66.66**	**65**
0.04	**61.66**	**70**	**58.33**	**51.66**

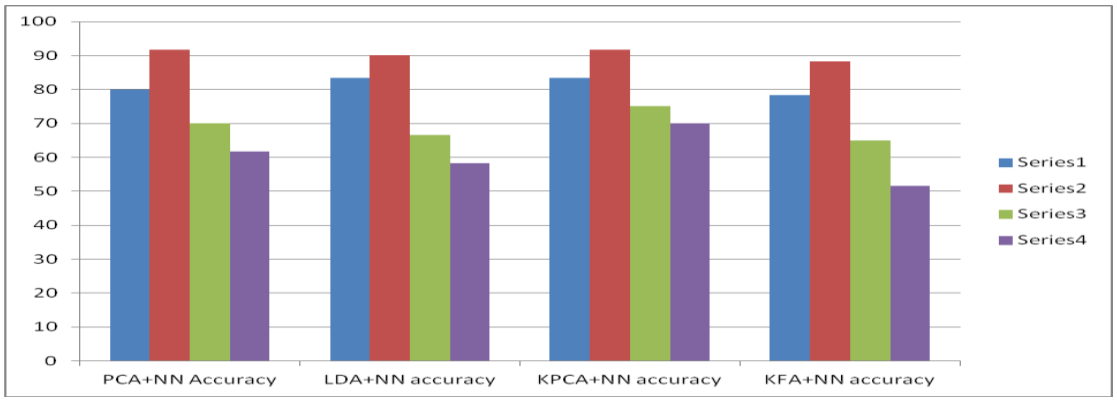


Fig5:-A graph showing the comparison for PCA+NN (RBF), LDA+NN (RBF), KPCA+NN (RBF) and KFA+NN (RBF) for 4 different target values

Here in all the above comparisons of four different target values of 0.01, 0.02, 0.03, 0.04 and among the four techniques of PCA+NN (RBF), KPCA+NN (RBF), LDA+NN (RBF), KFA+NN (RBF), KPCA+NN (RBF) gives the best results.

VI. Conclusion

The goal is reached and we have implemented it on ORL database. Different techniques i.e. 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.

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