

Face Recognition Using K2DSPCA

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Abstract. Face recognition is one of biometric methods, to identify given face image using main features of face. In

this paper, a neural based algorithm is presented, to detect frontal views of faces. The dimensionality of face image is reduced by the Kernel based 2 dimensional symmetrical principal component analysis (K2DSPCA) and the recognition is done by the Back propagation Neural Network (BPNN). Here 200 face images from Yale database is taken and some performance metrics like Acceptance ratio and Execution time are calculated. Neural based Face recognition is robust and has better performance of more than 90 % acceptance ratio.

Keywords: Face recognition- Kernel based 2D symmetrical Principal Component Analysis- Back Propagation Neural Network -Acceptance ratio-Execution time

1. Introduction

A face recognition system is a computer vision and it automatically identifies a human face from database images. The face recognition problem is challenging as it needs to account for all possible appearance variation caused by change in illumination, facial features, occlusions, etc. This paper gives a Neural and K2DSPCA based algorithm for efficient and robust face recognition. Holistic approach, feature-based approach and hybrid approach are some of the approaches for face recognition. Here, a holistic approach is used in which the whole face region is taken into account as input data. This is based on kernel based 2 dimensional symmetrical principal component-analysis (K2DSPCA) technique, which is used to simplify a dataset into lower dimension while retaining the characteristics of dataset. Pre-processing, Principal component analysis and Back Propagation Neural Algorithm are the major implementations of this paper. Pre-processing is done for two purposes

- (i) To reduce noise and possible convolute effects of interfering system,
- (ii) To transform the image into a different space where classification may prove easier by exploitation of certain features.

K2DSPCA is a common statistical technique for finding the patterns in high dimensional data's [1].

Feature extraction, also called Dimensionality Reduction, is done by K2DSPCA for a three main purposes like

- i) To reduce dimension of the data to more tractable limits
- ii) To capture salient class-specific features of the data,
- iii) To eliminate redundancy.

Here recognition is performed by both K2DSPCA and Back propagation Neural Networks [3].

BPNN mathematically models the behavior of the feature vectors by appropriate descriptions and then exploits the statistical behavior of the feature vectors to define decision regions corresponding to different classes. Any new pattern can be classified depending on which decision region it would be falling in. All these processes are implemented for Face Recognition,

based on the basic block diagram as shown in fig 1.

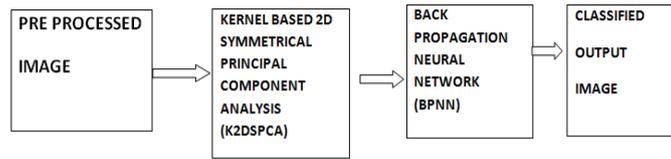


FIG: BLOCK DIAGRAM

The Algorithm for Face recognition using neural classifier is as follows:

- a) Pre-processing stage –Images are made zero-mean and unit-variance.
- b) Dimensionality Reduction stage: K2DSPCA - Input data is reduced to a lower dimension to facilitate classification.
- c) Classification stage - The reduced vectors from K2DSPCA are applied to train BPNN classifier to obtain the recognized image.

In this paper, Section 2 describes about Principal component analysis, Section 3 explains about Back Propagation Neural Networks, Section 4 demonstrates experimentation and results

2. Kernel Based S2DPCA Algorithm

2.1. Concept

IN K2DSPCA algorithm generalize the S2DPCA algorithm from input space to kernel space, i.e., we map the input space into the feature space (or kernel space) by a nonlinear function decompose X_i into X_{ei} and X_{oi} using odd-even decomposition theory into input space. This paper mainly focuses on the family of polynomial function.

Theorem 1: For any polynomial function ϕ and any two vectors X_a and X_b if $(X_a, X_b) = 0$

A typical back propagation network [4] with Multi-layer, feed-forward supervised learning is as shown in the figure. 2. Here learning process in Back propagation requires pairs of input and target vectors. The output vector ‘o’ is compared with target vector ‘t’. In case of difference of ‘o’ and ‘t’ vectors, the weights are adjusted to minimize the difference. Initially random weights and thresholds are assigned to the network. These weights are updated every iteration in order to minimize the mean square error between the output vector and the target vector.

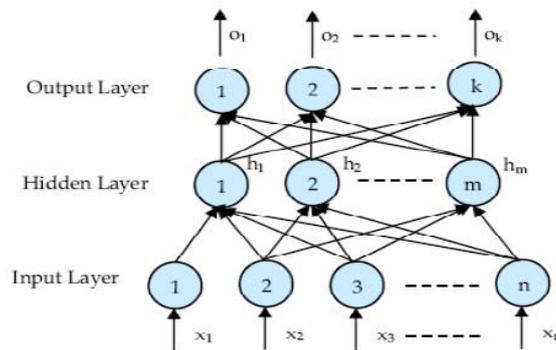


Fig. 2 Basic Block of Back propagation neural network

Input for hidden layer is given by

$$net_m = \sum_{z=1}^n x_z w_{mz}$$

The units of output vector of hidden layer after passing through the activation are given by

$$h_n = \frac{1}{1 + \exp(-net_n)}$$

In the same manner, input for the output layer is given by

$$o_k = \frac{1}{1 + \exp(-net_k)}$$

For updating the weights, we need to calculate the error. This can be done by

$$E = \frac{1}{2} \sum_{i=1}^k (o_i - t_i)^2$$

Where o_i and t_i represents the output and target output at neuron in i th output layer respectively. If the error is predefined than a predefined limit, training process will stop; otherwise weights need to be updated. For weights between hidden layer and output layer, the change in weights is given by

$$\Delta w_{ij} = \alpha \delta_i h_j$$

Where α is training rate coefficient that is restricted to the range $[0.01, 1.0]$ is the output of the neuron j in the hidden layer and

$$\delta_i = (t_i - o_i) o_i (1 - o_i)$$

$$w_{ij}(\text{new}) = w_{ij}(\text{old}) + \Delta w_{ij}$$

Selection of Training Parameters

For the efficient operation of the back propagation network it is necessary for the appropriate selection of the parameters used for training. Initial Weights This initial weight will influence whether the net reaches a global or local minima of the error and if so how rapidly it converges. To get the best result the initial weights are set to random numbers

between -1 and 1.

No. of Input unit = 1 feature matrix

Accuracy = 0.001

learning rate = 0.4

No. of epochs = 400

No. of hidden neurons = 70

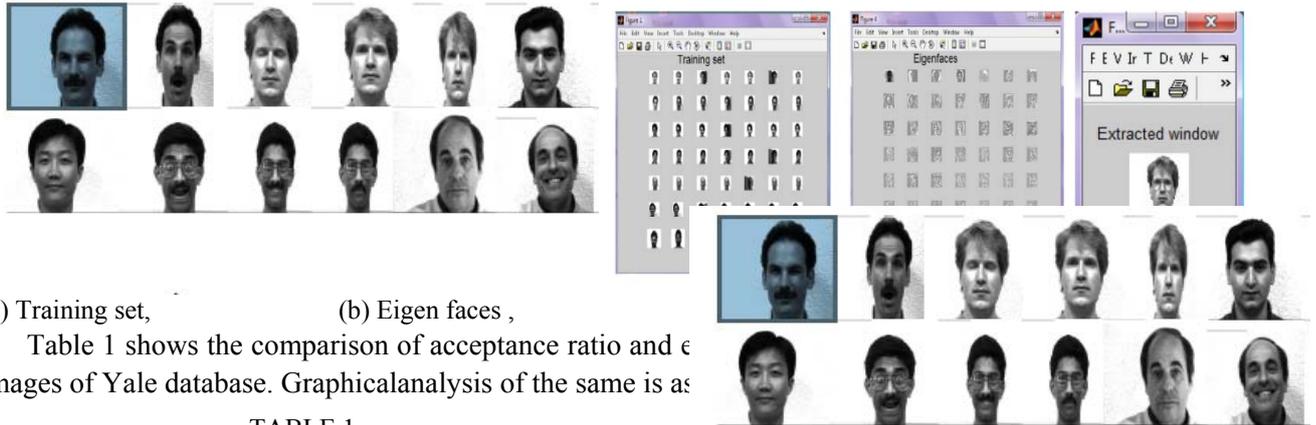
No. of output unit = 1

Main advantage of this back propagation algorithm is that it can identify the given image as a face image or non face image and then recognizes the given input image. Thus the back propagation neural network classifies the input image as recognized image.

Experimentation and Results

In this paper for experimentation, 200 images from Yale database are taken and a sample of 20 face images is as shown in fig 3. One of the images as shown in fig 4a is taken as the Input image. The mean image and reconstructed output image by K2DSPCA, is as shown in fig b and c.

In BPNN, a training set of 50 images is as shown in fig a and the Eigen faces and recognized output image are as shown in fig b,c.



(a) Training set, (b) Eigen faces ,

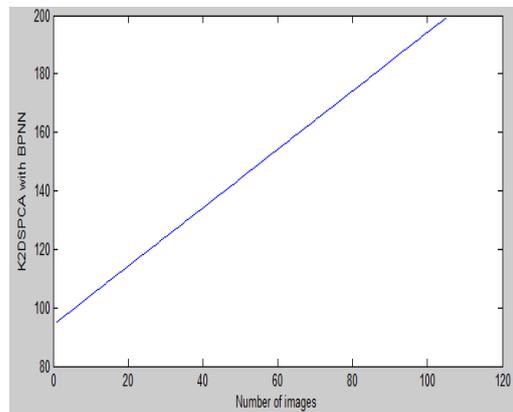
Table 1 shows the comparison of acceptance ratio and execution time of images of Yale database. Graphical analysis of the same is as

TABLE 1

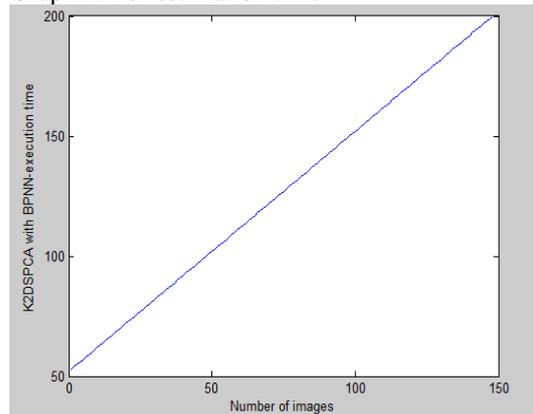
NO OF IMAGES	Acceptance ratio (%)		Execution Time (seconds)	
	K2DSPCA	K2DSPCA with BPNN	K2DSPCA	K2DSPCA with BPNN
120	93.4	95.2	55	53
160	94.8	96.7	67	59
200	95.7	97.6	74	67

A) WITH BPNN network

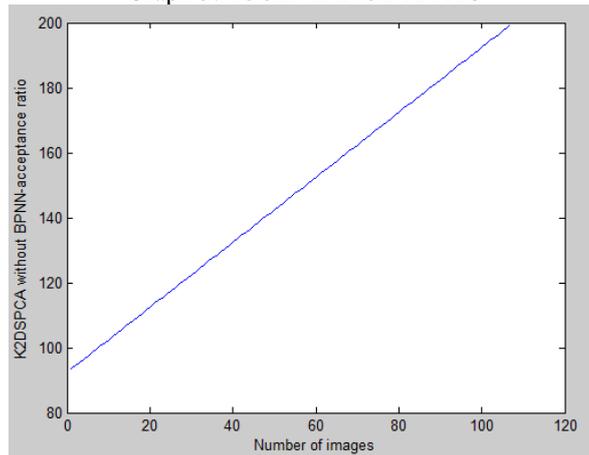
Graph 1: For acceptance ratio



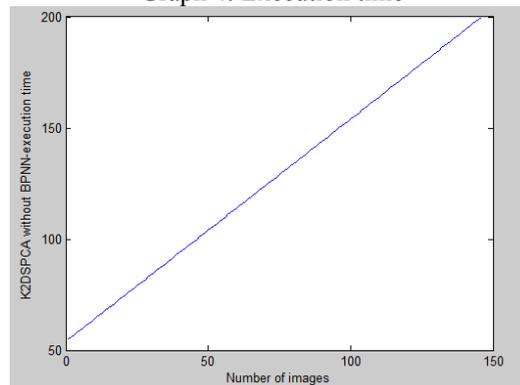
Graph 2: For estimation time



Graph 3:ACCEPTANCE RATIO



Graph 4: Execution time



3. Conclusion

Face recognition has received substantial attention from researches in biometrics, pattern recognition field and computer vision communities. In this paper, Face recognition using Eigen faces has been shown to be accurate and fast. When BPNN technique is combined with K2DSPCA, non linear face images can be recognized easily. Hence it is concluded that this method has the acceptance ratio is more than 90 % and execution time of only few seconds. Face recognition can be applied in Security measure at Air ports, Passport verification, Criminals list verification in police department, Visa processing , Verification of Electoral identification and Card Security measure at ATM's..

4. References

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