Automatic Face Naming System: Using PCA And LBP With BPNN Classifier

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Abstract- *Face recognition systems are widely used for access control, border control, surveillance and in law enforcement..For given collection of images or video, which contains several faces, the face naming is done for each face it contains. In this paper, a face recognition system is analyzed using Principal Component Analysis (PCA) and local binary pattern with Back Propagation Neural Networks (BPNN) and then it is labeled. Frontal view of the faces can be recognized by using Neural network algorithms. PCA technique is used to reduce multi-variant data set. For efficient and robust face recognition BPNN is used for training and learning the data set. The BPNN classifier consist of parameters like hidden layers , weights and learning rate which increases the efficiency of the system.*

Keywords- Face recognition, Back propagation Neural network, Principal component analysis.

I. INTRODUCTION

Face recognition and feature extraction and recognition is not so much important feature of human being. Human beings have ability to instantaneously and correctly recognize things around them. The need of Automated Face Recognition (AFR) system is to decrease the manpower and make efficient system.

There is need to perform some preprocessing steps for image before feature extraction. Automatic face naming is still a challenging, even after successfully performing pre-processing steps. Initially, most of the research related part was based on detecting eyes, nose and mouth. As research area increased, mathematical approaches developed which lead to focus on the facial features, statistical features. Today's face recognition systems are based on different approaches like feature based approach, appearance based approach and etc.

The main contributions described in this paper are:

1) A model is developed which is based on PCA algorithm and LBP descriptor.;
2) High-level framework design;
3) Both PCA and LBP used for feature extraction simultaneously ;
4) BPNN is used as classifier.

II. LITERATURE SURVEY

A scheme for Face Recognition using PCA and BPNN has been proposed by Rajath Kumar, Keerthi Sravan in Artificial Neural Networks for Face Recognition using PCA and BPNN. This paper consists of classification of faces using PCA for feature extraction and feed-forward back propagation neural network is used for classification.

PengPeng , Paulo Alencar, Donald Cowan proposed a Software Framework for PCA-based Face Recognition in 2016 IEEE International Conference on Software Science, Technology and Engineering. This paper contains a software framework which focuses on face recognition based on PCA algorithm in area of image processing. In this principal component analysis (PCA) is used for data dimensionality reduction approach. PCA efficiently works for face recognition.

Md. Abdur Rahim, Md. Najmul Hossain, Tanzillah Wahid & Md. Shafiul Azam proposed method of face recognition in Face Recognition using Local Binary Patterns (LBP). The researcher explained how the LBP-method can be applied on images (of faces) to extract features which can be used to get a measure for the similarity between these images In this research has been done to the performance of a face recognition system by making use of feature extraction with Local Binary Patterns. The accuracy of the system is above 100% by the Local Binary Patterns algorithm.

Xiao Zhang, Lei Zhang proposed a methodology that focuses on finding the celebrities in billions of web images It's a challenging task of collecting and labelling celebrity faces from general web images. The noise in web data is responsible for the major difficulties. In this process images and names are matched using database and language techniques.

III.AUTOMATIC FACE NAMING SYSTEM

Fig 1 shows the block schematic for Automatic face naming in Video signal and images. Mainly it contains three main functional blocks: 1) Face detection. 2) Feature Extraction and 3) Face recognition by BPNN as a classifier. From fig 1 it is easily observed before face detection, video input is converted into series of images.

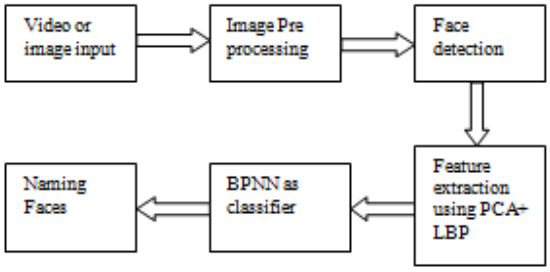

Fig 1: Block Diagram

A. Image Preprocessing

The various conditions like illumination of light affect the real-world performance of a face verification system. Varying illumination is the most important condition which affects most of the face verification systems, others are facial expressions and appearance. This hinders the accuracy and performance of feature extraction of a system. The only pre-processing that was done here was to crop the images of the subjects as per requirement and to convert video signal into series of frames.

B. Dimensionality Reduction using PCA

In the methodology we are using PCA algorithm for face recognition. Karl Pearson invented the concepts behind PCA in 1901. The PCA uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components.

PCA consists of Eigen faces, which is used frequently in face recognition research. The most significant information is extracted from face images which then can be used to form a sub-space named feature space. The dimensionality of the new formed sub-space is much smaller than that of original images, but components which are used for identifying a face are retained. The image set used to build this sub-space is called a training set, and the image set reflecting the components in the sub-space is called eigenfaces. After establishing the sub-space, a testing image can be projected onto the space to generate a new image. The similarity of this new image and the original image can be used for the verification step.

Computation of the eigenfaces**:**

- For computation of Eigen faces, first training data set is considered. Each image is first resized in N×N pixels.
- Then N×N pixels of an Image is converted in N^2 ×1 Vectors
- Suppose Γ is an N^2x1 vector, corresponding to an *N*x*N* face image *I*.

The idea is to represent Γ(Φ=Γ - mean face) into a low-dimensional space:

Φ ^- *mean* = $w_1u_1+ w_2u_2+\cdots w_Ku_K (K<<N^2)$

Step 1: obtain face images $I_1, I_2, ...,I_M$ (training faces)
Step 2: Show every image I_i as a vector Γ_i
Step 3: Compute the average face vector Ψ:

$$\Psi = 1/M \sum_{i=1}^{M} \Gamma i$$

Step 4: Subtract the mean face:

$$\Phi i = \Gamma_i - \Psi$$

Step 5: Compute the covariance matrix *C*:

$$C = 1/M \sum_{n=1}^{M} \Phi n \Phi n^{\wedge}T = AA^T \quad (N^2 x N^2 \text{ matrix})$$

Step 6: Compute the eigenvectors u_i of AA^T

The matrix AA^T is very large so that it is not practical !!

Step 6.1: Consider the matrix A^TA (*M*x*M* matrix)
Step 6.2: Compute the eigenvectors v_i of A^TA

Note3:The *M* eigenvalues of A^TA (along with their corresponding eigenvectors) correspond to the Mlargest eigenvalues of AA^T (along with their corresponding eigenvectors).

Step 6.3: Compute the *M* best eigenvectors of AA^T : u_i+Av_i

Step 7: Keep only *K* eigenvectors (corresponding to the *K* largest eigenvalues).

C. Local Binary Pattern for Feature extraction

The LBP originally appeared as a generic texture descriptor. The operator assigns a label to each pixel of an image by thresholding a 3x3 neighborhood with the centre

pixel value and considering the result as a binary number. In different publications, the circular 0 and 1 resulting values are read either clockwise or counter clockwise. In this research, the binary result will be obtained by reading the values clockwise, starting from the top left neighbor.

In order to treat textures at different scales, the LBP operator was extended to make use of neighborhoods at different sizes. Using circular neighborhoods and bilinear interpolation of the pixel values, any radius and number of samples in the neighborhood can be handled.

Therefore, the following notation is defined:

(P, R) which means P sampling points on a circle of R radius.

The following figure shows some examples of different sampling points and radius:

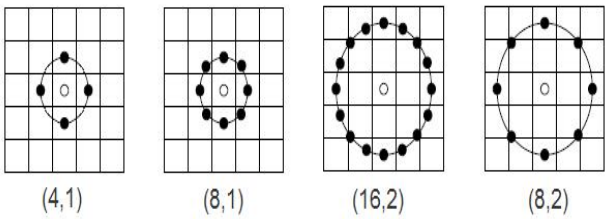

Figure 2. LBP different sampling point and radius examples.

The features are extracted from PCA algorithm and LBP descriptor. These all features are parallelly given as input to feed-forward back propagation neural network.

D. Back Propagation Neural Network

The accuracy and efficiency of a face recognition system depends on its ability to learn real-world data. Pattern classifier is the cause to learn the ability of real world data. Back Propagation Algorithm (BPNN) is a very widely used and well-known learning algorithm in training. Multilayer Perceptron's (MLP). The MLP network is consists of a set of sensory mathematical units which form the input layer, hidden layer(s) and a single output layer. The input signal has unidirectional flow, from left to right, through the multiple layers of the network.

1. MLP in BPNN

BPNN is a multi-layer feed-forward and supervised learning algorithm that has inbuilt the gradient descent learning rule. The important concern while implementing BPNN is to assure that there is a balance between quick responses and accurate responses.

In this process, error is calculated till it reaches to its minima. Weights, training Neural network, Hidden layers and learning rate are the important parameters of the BPNN

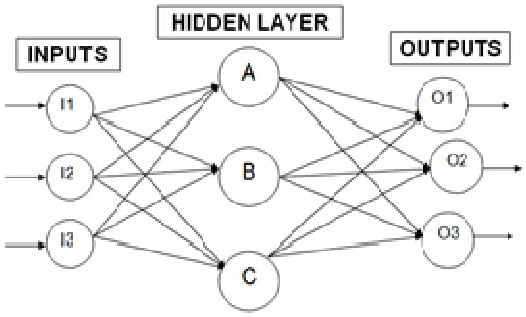

Fig. 3 BPNN network

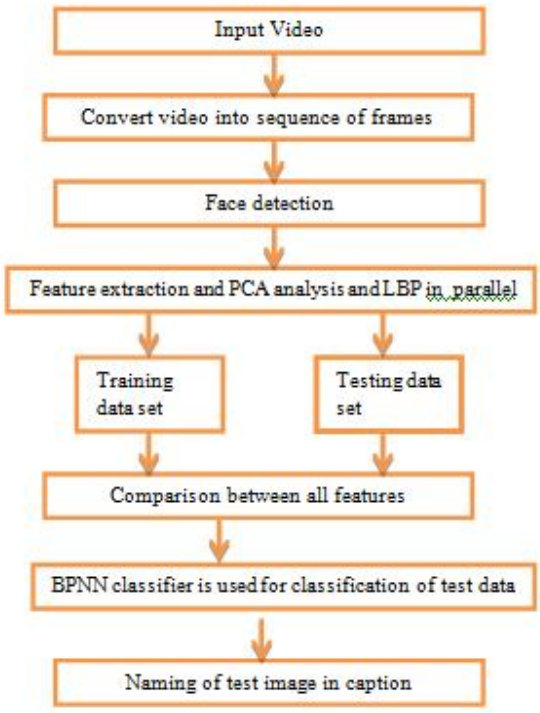

Fig 4 Flow chart

IV. RESULTS

E. Dataset:

Database for proposed work have been collected from social network. Videos are collected as database. We have used 5 videos per subject up to 30 sec duration. While training we have taken 25 subjects means more than 105 videos.

F. Fusion of PCA features and LBP features

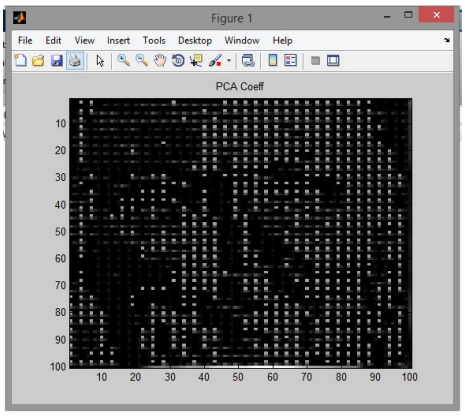

Fig 5.2 : PCA coefficients in the form of binary values

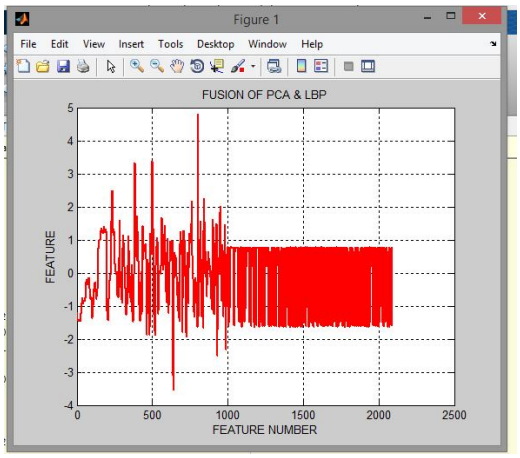

Fig 5.3 : Plot of Fusion of PCA features and LBP feature

G. Result after the classification:

H. Confusion matrix.:

	Class name	No class name
Number of faces	79	0
Number of non faces	6	81

1) Accuracy = (TP+TN)/(P+N) = 96.38%
2) Sensitivity (TPR) = 1
3) Specificity (TNR) = 0.06

V. CONCLUSION

Proposed method is simple and robust for face detection and recognition. The key idea of proposed method is to automatic naming of faces in video with reference to data base. It uses PCA algorithm and LBP to recognize the face. BPNN efficiently classifies the face images with respect to names. As proposed method will perform well compared to previous methods which are based on Automatic face naming by learning discriminative affinity matrix.

According to literature temporal information greatly enhances the performance of system.

The time of computation depends on the size of data set, if data size increased time required will be more. This future work may reduce the processing time. That makes system faster.computation depends on the size of data set, if data size increased time required will be more. This future work may reduce the processing time. That makes system faster.

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