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FACE RECOGNITION TECHNIQUE USING ICA AND LBPH

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Abstract *Most of the image processing techniques such as edge detection, segmentation, object tracking, pattern recognition etc. do not perform well in the occurrence of noise. Thus, image restoration as a preprocessing step is performed before applying the image to any of the beyond mentioned techniques. presents a process of face recognition system using principle analysis with Back propagation neural network where features of face image has been combined by face detection and edge detection technique. In this system, the performance has been analyzed based on the proposed feature fusion technique. At first, the fussed feature has been extracted and the dimension of the feature vector has been reduced using Indepdent Component Analysis method and LBPH*

Key Words: Face Recognition, LBP,ICA,PCA

1.INTRODUCTION

Face recognition concept of feature extraction and detection, is a small capacity for human beings. Human have developed this skill to correctly and instantaneously recognize things around us after millions of years of evolution**.** The necessitate for machine intrusion in face recognition to create the whole process gives rise to Automated Face Recognition (AFR) that simulates the Human Vision System (HVS).[1] The past few decades have seen AFR receive immense attention due to its myriad applications in fields of security and surveillance. Implementations in computers are much more complex though not impossible. Image processing (in this specific case, leading to face recognition) by computers usually takes place in this order:

1. Reduction of high-dimensional real-world data set to lesser dimensions in order to facilitate faster processing speeds on relatively low-end machines.
2. Implementing a machine learning algorithm to train with a test data-set.

Automated Face recognition is a particularly attractive approach. Although research in automatic face recognition has been conducted since the 1960s, this problem [2] is still largely unsolved. Recent years have seen significant progress in this area owing to advances in face modeling and analysis techniques. It has a wide number of applications including security, law enforcement, person verification, Internet communication, Pattern Recognition and computer entertainment. The first large scale application of face recognition was carried out in Florida. Face recognition has two main steps: feature extraction and classification. Image processing technique has been applied to evaluate feature from image [3] database and there are some classification techniques that are applied to recognize the unknown face image. The overview of current system is demonstrated in figure 1.1.

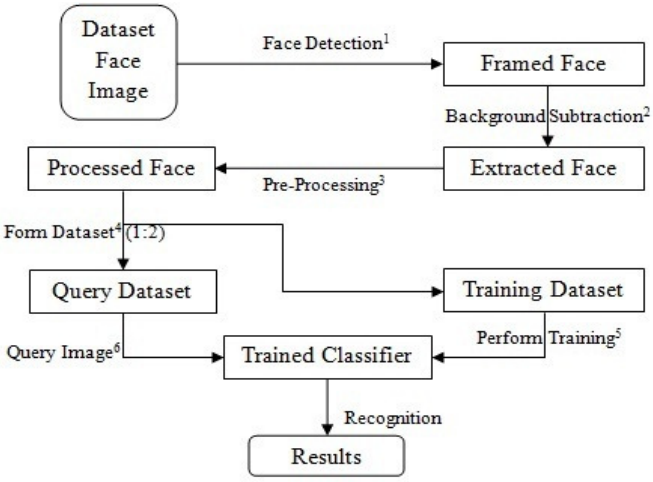

Fig. 1.1: System's overview.

To develop a helpful and appropriate face recognition system numerous factors need to be taken in hand.

1. The overall speed of the system from detection to recognition should be acceptable.
2. The accuracy should be high

II. Local Binary Pattern

There exist several methods for extracting the most useful features from (preprocessed) face images to perform face recognition. One of these feature extraction methods is the Local Binary Pattern (LBP) method. This relative new approach was introduced in 1996 by Ojala et al. [5]. With LBP it is possible to describe the texture and shape of a digital image. This is done by dividing an image into several small regions from which the features are extracted (figure 1.1).

Fig :1.1 A preprocessed image divided into 64 regions

These features consist of binary patterns that describe the surroundings of pixels in the regions. The obtained features from the regions are concatenated into a single feature histogram, which forms a representation of the image. Images can then be compared by measuring the similarity (distance) between their histograms. According to several studies [2, 3, 4] face recognition using the LBP method provides very good results, both in terms of speed and discrimination performance. Because of the way the texture and shape of images is described, the method seems to be quite robust against face images with different facial expressions, different lightening conditions, image rotation and aging of persons.

We 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. The main idea is that for every pixel of an image the LBP-code is calculated. The occurrence of each possible pattern in the image is kept up. The histogram of these patterns, also called labels, forms a feature vector, and is thus a representation for the texture of the image. These histograms can then be used to measure the similarity between the images, by calculating the distance between the histograms.

III. Independent Component Analysis (ICA)

Independent component analysis (ICA) is an overview of PCA. There are a number of algorithms for performing ICA [9],[10] This method is also called blind source separation (BSS), the major objective of this method is to minimizes the second order and higher order dependencies in the input and produces a collection of statistically source vectors. In other word this method is mainly used in high order dependencies. We applied ICA technique on the set of two images architectures

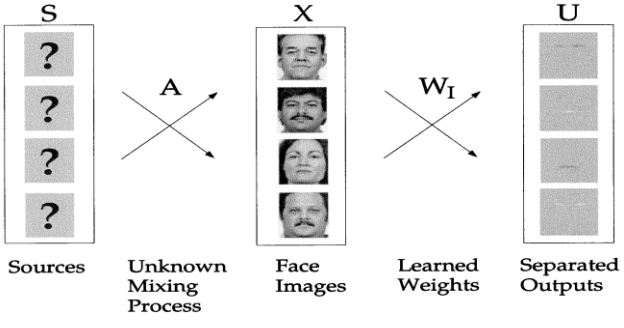

Fig. 3.1: Image synthesis model for Architecture I.

To find a set of IC images, the images in X are considered to be a linear combination of statistically independent basis images, S, where A is an unknown mixing matrix. The basis images were estimated as the learned ICA output U.

Architecture II, based on[11]and[12]..Each image in the dataset was considered to be a linear combination of underlying basis images in the matrix A. The basis images were each associated with a set of independent "causes," given by a vector of coefficients in S. The basis images were estimated by A = W , where W is the learned ICA weight matrix. The Architecture II is below given:

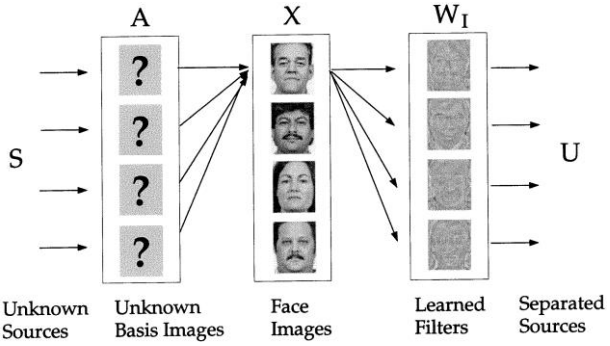

Fig. 3.2: Image synthesis model for Architecture II.

Architecture I treated the images as arbitrary variables and the pixels as outcomes, whereas Architecture II treated the pixels as arbitrary variables and the images as outcomes. Both ICA Architectures gives better to representations based on PCA for recognizing faces across changes in phrase. . Classifiers that joint both the ICA representations gave the greatest performance.

IV Proposed Face Recognition Technique

Face recognition is the current area of research for its wide range of practical applications. There are numerous numbers of face recognition methods. They are further categorized into two categories: appearance-based and feature-based approaches. Feature based techniques extract face feature indicators based on geometrical relationships &properties of each face characteristics like eyes, nose, mouth, and chin. There recognition accuracy depends upon face feature extraction techniques. This is not reliable in practical applications. Appearance-based processes uses global face features depend on intensity vector representation. These approaches widely utilize by many researchers. Face-recognition performance significantly decreases if there are variations in the pose, illumination, and size of the input image.

Many techniques are proposed to tackle this problem. Recognition system using PCA and BPNN provides high recognition rate and fast execution time. PCA is used for feature extraction and space dimension reduction. BPNN is

used for image classifications. Recognition rate and execution time are two main parameters, which are measured during implementation of LBPH+ICA. The working model is made up of three steps as shown in figure

Algorithm LBPH and ICA

To implement the face recognition in this research work, we proposed the Local Binary patterns methodology and ICA . Local Binary Pattern works on local features that uses LBPH and ICA operator which summarizes the local special structure of a face image. LBPH is defined as an orders set of binary comparisons of pixels intensities between the center pixels and its eight surrounding pixels. Local Binary Pattern do this comparison by applying the following formula:

$$LBPH\ (X_c,X_{y)} = \sum^{7}_{n=0} s(i_n\text{-}i_c)\ 2^n$$

Where i_c corresponds to the value of the center pixel (x,y_c), in to the value of eight surrounding pixels. It is used to determine the local features in the face and also works by using basic LBP operator. Feature extracted matrix originally of size 3 x 3, the values are compared by the value of the center pixel, then binary pattern code is produced and also LBP code is obtained by converting the binary code into decimal one.

Input: Training Image set. Output: Feature extracted from face image and compared with center pixel and recognition with unknown face image.

1. Initialize temp = 0
2. FOR each image I in the training image set
3. Initialize the pattern histogram, H = 0
4. FOR each center pixel t_cò I
5. Compute the pattern label of t_c,LBP(1)
6. Increase the corresponding bin by 1.
7. END FOR
8. Find the highest LBPH and ICA feature for each face image and combined into single vector.
9. Compare with test face image.

Algorithm Step ICA :

1. Initialize temp = 0
2. for i=1:R
3. for j=1:C
4. value=I(i,j);
5. freq(value+1)=freq(value+1)+1;
6. probf(value+1)=freq(value+1)/numofpixels;

end
end

7. for i=1:size(probf)
8. sum=sum+freq(i);
cum(i)=sum;
probc(i)=cum(i)/numofpixels;
output(i)=round(probc(i)*no_bins);
end

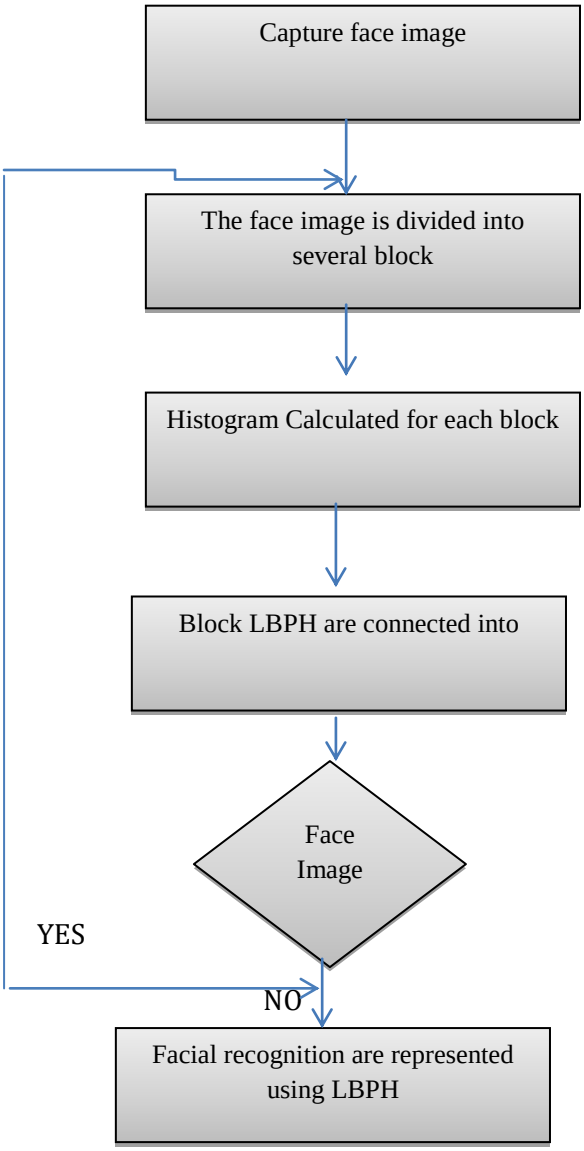

Fig4.1 :Flowchart of the LBP Process

Training and Test Face

Recognized image is obtained by calculating the Euclidean distance between the weight vector of test face and k^{th} training image. The image which has less distance is detected as output image. It must closely resemble the input face.There are 400 images in ORL face database. We have to select 20 training images & one test image. 20 training images are selected randomly form 3 subjects out of 40 subjects. Each subject contains 10 images of same person in different expression, pose and illumination

Figure 5.1: Training set of 20 images from ORL face database

The common feature of all images is calculated by mean image. When we subtract the mean image from all the training images, we get normalized images. Normalize face image represents all the unique features in respective image.

Figure 5.2: Recognise face

We compare our recognition method with the original LBP method, and we use original LBP method by split face image to 4×4 grids. Then we use our method to test face recognition by 53 landmarks of face and we can set the grid of a landmark point as 9×9, 7×7, 5×5 and 3×3. The speed and true positive rate are compared for different

So far we have concerned ourselves by application of ICA in terms of blind source separation. In this section utilization in image processing will be explained [1, 5]. The main concept of ICA applied to images insists on the idea that each image (subimage) may be perceived as linear superposition of features ai(x, y) weighted by coefficients si. In case of ICA, features are represented by columns of mixing matrix A and si are elements of appropriate sources. In addition ICA features are localized and oriented and sensitive to lines and edges of varying thickness of images (see Figures 5.2). Furthermore the sparsity of ICA coefficients should be pointed out. It is expected that suitable soft-thresholding on the ICA coefficients leads to efficient reducing of Gaussian noise.

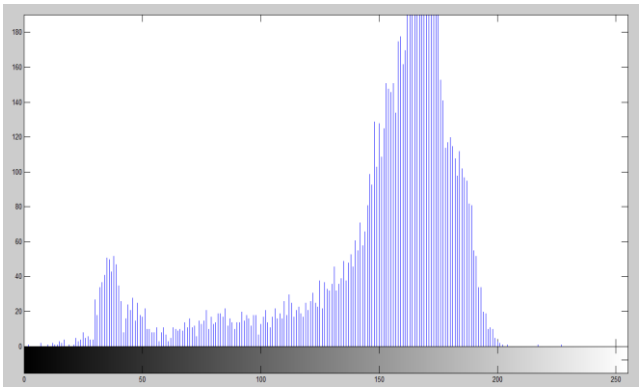

Figure 5.3: Histogram recognize image

Recognized image is obtained by calculating the weight vectors of all training images. Weight vectors denote the contribution of each Eigen face to all training images. Highest weight vector means highest contribution of Eigen face. With the help of weight vectors, we calculate Euclidean distance between the weight vector of test face and kth training image. The image which has lessEuclidean distance is detected as output image. It must closely resemble the input face.

V .Conclusion

The proposed algorithm gives better performance in comparison with LBPH, ICA and other existing noise removal algorithms in terms of MSE However the time required executing this algorithm is bit more than the existing algorithms .The performance of the algorithm is tested against Face Database images at low, medium and high densities, showing the effectiveness how impulse noise is removed through the colour images. It yields better results than existing methods even at very high noise densities of 80% and 90%. Both visual and quantitative results are also demonstrated

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