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Face Detection Technique Using Neural Network

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ABSTRACT : Recognition approaches can be divided in pre-processing, invariant face feature extraction, and modelling of face. Pre-processing methods are used for extracting stable face features under different lighting and expressions for face recognition 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 PCA and (PCA+BPNN).Face Recognition using Discrete Cosine Transform (DCT) for Local and Global Features involves recognizing the corresponding face image from the database. The face image obtained from the user is cropped such that only the frontal face image is extracted, eliminating the background. The image is restricted to a size of 128 × 128 pixels. All images in the database are gray level images. DCT is applied to the entire image. This gives DCT coefficients, which are global features.

KEYWORDS : Biometric ,HSV ,BPNN ,PCA ,YUV

I. INTRODUCTION

Soft biometric traits are the characteristics of human being that provide some information about the user, but lack of the distinctiveness and permanence to sufficiently differentiate any two users**.** Soft biometric traits embedded in a face (e.g., gender and facial marks) are ancillary information and are not fully distinctive by themselves in the facial recognition tasks. However, this information can be explicitly combined with facial matching score to improve the overall facial recognition accuracy and efficiency and helps the forensic[1] investigators.

The characteristics of human being like gender, height, weight and age can also be used for the identification purpose. Although these characteristics are not unique and reliable, yet they provide some useful information about the user. These characteristics are known as soft biometric traits and these can be integrated with the primary biometric identifiers[4] like fingerprint, face, iris, signature for the identification purpose. Unimodal biometric systems make just use of a single biometric trait for individual recognition. It is difficult to achieve very high recognition rates using unimodal systems due to problems like noisy sensor data and non-universality or lack of distinctiveness of the selected biometric trait.

Multimodal biometric systems address some of these problems by combining evidence obtained from multiple sources. A multimodal biometric system that utilizes a number of different biometric identifiers like face, fingerprint, hand-geometry, and iris can be more robust to noise and minimize the problem of non-universality and lack of distinctiveness. However, the problem with multimodal system is that it will require a longer verification time thereby causing some inconvenience to the users. A possible solution to the problem of designing a trustworthy.

II. RELATED WORK

With the help of faces, human-being can recognize and communicate with individuals. But advancement and improvement in computing technologies enables identical recognition and verification automatically. Earlier recognition of faces is with the help geometrical and structural models, but facial recognition and verification techniques has now uses complicated mathematical formulation and representation for matching and identification

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process. From past fifteen to twenty years, major advancement in technology has accelerated the facial recognition technique into spotlight. This technology can be used for both identification and verification purpose.

In real world, face recognition has wide range of application like authentication, information security, access control, and law enforcement etc. Most face recognition techniques work best with well aligned and illuminated images. Small changes in size and alignment can effects the recognition rate. Each technique has their advantages and disadvantages. The recognition rate and accuracy of each technique is depend upon many factors like how and where it is used, environment, throughput needs, inter-operability with existing system, vary from application to applications

WeichengShen and Tieniu Tan in their paper "Automated Biometrics-based personal Identification",proposed a typical automated biometrics-based identification/verification system that consists of the following major components [30]:

1. Data acquisition component that acquires the biometric data in digital format by using a sensor.
2. Feature extraction component that uses an algorithm to produce a feature vector in which the components are numerical characterizations of the underlying biometrics. The feature vectors are designed to characterize the biometrics so that biometric data collected from one individual, at different times, are "similar", while those collected from different individuals are "dissimilar". In general, the larger the size of a feature vector (without much redundancy), the higher will be its discrimination power which is defined as the difference between a pair of feature vectors representing two different individuals.
3. Matcher component that compares feature vectors obtained from the feature extraction algorithm to produce a similarity score. This score indicates the degree of similarity between a pair of biometrics data under consideration.
4. Decision-maker component is the last component of the system that finally provides/rejects access to the user based on some pre-determined criterion.

III. FACE DETECTION APPROACHES

Face detection is the first step of face recognition system. Output of the detection can be location of face region as a whole, and location of face region with facial features (i.e. eyes, mouth, eyebrow, nose etc.). Mainly, detection can be classified into two groups as Knowledge-Based Methods and Image-Based Methods. The methods for detection are given in Figure 2.1.

Knowledge-Based methods use information about Facial Features, Skin Color or Template Matching. Facial Features are used to find eyes, mouth, nose or other facial features to detect the human faces. Skin color is different from other colors and unique, and its characteristics do not change with respect to changes in pose and occlusion. Skin color is modeled in each color spaces like RGB (Red-Green-Blue), YCbCr (Luminance-Blue Difference Chroma-Red Difference Chroma), HSV (Hue- Saturation-Value), YUV[6] (Luminance-Blue Luminance Difference-Red Luminance Difference), and in statistical models. Face has a unique pattern to differentiate from other objects and hence a template can be generated to scan and detect faces.

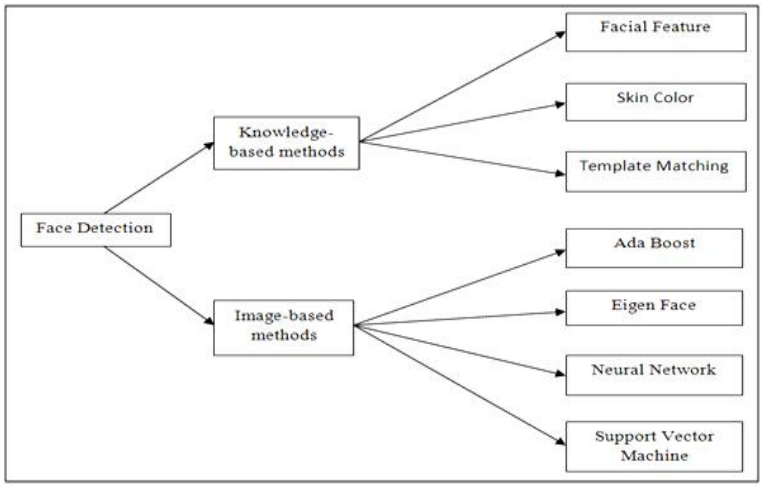

Figure 2.1 Methods for face detection

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A. Face Detection By Neural Network

Neural Nets are essentially networks of simple neural processors, arranged and interconnected in parallel. Neural Networks are based on our current level of knowledge of the human brain, and attract interest from both engineers, who can use Neural Nets to solve a wide range of problems, and scientists who can use them to help further our understanding of the human brain. Since the early stages of development in the 1970's, interest in neural networks has spread through many fields, due to the speed of processing and ability to solve complex problems.

As with all techniques though, there are limitations. They can be slow for complex problems,[12] are often susceptible to noise, and can be too dependent on the training set used, but these effects can be minimized through careful design. Neural Nets can be used to construct systems that are able to classify data into a given set or class, in the case of face detection, a set of images containing one or more face, and a set of images that contains no faces. Neural Networks consist of parallel interconnections of simple neural processors. Neurons have many weighted inputs, that is to say each input (p1, p2, p3… pm) has a related weighting (w1, w2, w3… wm) according to its importance. Each of these inputs is a scalar, representing the data. In the case of face detection, the shade of GRAY of each pixel could be presented to the neuron in parallel (thus for a 10x10 pixel image, there would be 100 input lines p1 to p100, with respective weightings w1 to w100, corresponding to the 100 pixels in the input image).

B. Face Detection By Eigen Face Method

The motivation behind Eigen faces is that it reduces the dimensionality of the training set, leaving only those features that are critical for face recognition.

Definition :

- The Eigen faces method looks at the face as a whole.
- Method, a collection of face images is used to generate a 2-D gray-scale image to produce the biometric template.
- Here, first the face images are processed by the face detector. Then we calculate the Eigen faces from the training set, keeping only the highest Eigen values.
- Finally we calculate the corresponding location in weight space for each known individual, by projecting their face images onto the "face space.

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 PCA[7] and (PCA+BPNN). The working model is made up of three steps as shown in figure:

A. PCA+BPNN

Firstly we have to develop a database for all the training images. Next step, calculate all the common features of all training images in form of average face. Now normalisation step for removing illumination variation. Next part is calculation of unique features means Eigen faces with the help of covariance matrix. This matrix

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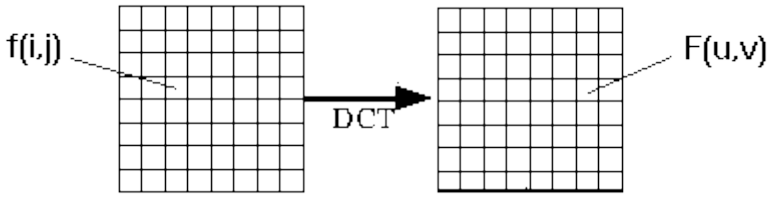
is made up of large dimensions of Eigen vectors[13]. We have to reduce the dimensions using PCA [3]. Euclidean distance is calculated between test and training images. A recognized image has less distance. BPNN is used to train the recognition network. It enhances the recognition accuracy.

B. The discrete cosine transform (DCT)

The discrete cosine transform (DCT) helps separate the image into parts (or spectral sub-bands) of differing importance (with respect to the image's visual quality). The DCT is similar to the discrete Fourier transform: it transforms a signal or image from the spatial domain to the frequency domain



DCT Encoding

The general equation for a 1D (*N* data items) DCT is defined by the following equation:

$$F(u) = \left(\frac{2}{N}\right)^{\frac{1}{2}} \sum_{i=0}^{N-1} \Lambda(i).cos\left[\frac{\pi.u}{2.N}(2i+1)\right] f(i)$$

and the corresponding ***inverse*** 1D DCT transform is simple $F^{-1}(u)$, i.e.:

where

$$\Lambda(i) = \begin{cases} \frac{1}{\sqrt{2}} & \text{for} \xi = 0 \\ 1 & \text{otherwise} \end{cases}$$

The general equation for a 2D (*N* by *M* image) DCT is defined by the following equation:

$$F(u,v) = \left(\frac{2}{N}\right)^{\frac{1}{2}} \left(\frac{2}{M}\right)^{\frac{1}{2}} \sum_{i=0}^{N-1} \sum_{j=0}^{M-1} \Lambda(i).\Lambda(j).cos\left[\frac{\pi.u}{2.N}(2i+1)\right] cos\left[\frac{\pi.v}{2.M}(2j+1)\right] .f(i,j)$$

and the corresponding ***inverse*** 2D DCT transform is simple $F^{-1}(u,v)$, i.e.:

where

$$\Lambda(\xi) = \begin{cases} \frac{1}{\sqrt{2}} & \text{for} \xi = 0 \\ 1 & \text{otherwise} \end{cases}$$

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The basic operation of the DCT is as follows:

- The input image is N by M;
- F(i,j) is the intensity of the pixel in row i and column j;
- F(u,v) is the DCT coefficient in row k1 and column k2 of the DCT matrix.
- For most images, much of the signal energy lies at low frequencies; these appear in the upper left corner of the DCT.
- Compression is achieved since the lower right values represent higher frequencies, and are often small - small enough to be neglected with little visible distortion.
- The DCT input is an 8 by 8 array of integers. This array contains each pixel's gray scale level;
- 8 bit pixels have levels from 0 to 255.
- Therefore an 8 point DCT would be:

where

$$\Lambda(\xi) = \begin{cases} \frac{1}{\sqrt{2}} & \text{for} \xi = 0 \\ 1 & \text{otherwise} \end{cases}$$

V. SIMULATION RESULTS

The simulation of the recognition technique was simulated on MATLAB. The proposed technique is simulated on ORL face database. We have created face database. The database has been separated into two parts: training and testing database. Training of network is done on train images and test image is fed to the network as input image. In ORL face database, there are total 400 images which consists of 40 subjects, each subject having 10 images of single person with different pose, illumination and face expressions. We randomly select 20 images for training purpose. 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 PCA and BPNN.

A. Training and Test Face

Recognized image is obtained by calculating the Euclidean distance between the weight vector of test face and kth 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 4.1: Training set of 20 images from ORL face database

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The common feature of all images is calculated by mean image. When we subtract the mean image from all the training images, we get normalised images. Normalise face image represents all the unique features in respective image. This unique feature is used to calculate the Eigen faces

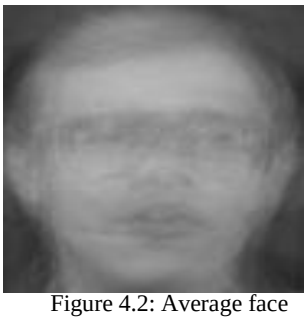

Figure 4.2: Average face

Number of Subjects	Percentage Recognition of PCA
2	100
4	100
6	100
8	100
10	90
12	91.67
14	92.86
16	93.75
18	94.44
20	93

Table 4.1: Percentage recognition rate of PCA

As seen in the table above, the recognition rate for train images for small number of subjects is same. But as we observe, when the number of subjects for recognition increases, the recognition accuracy of (PCA+ BPNN) is greater than PCA. The recognized image by both techniques is shown. PCA+BPNN technique is more accurate than PCA even after contradiction of execution time. The performance is shown in form of graph as below:

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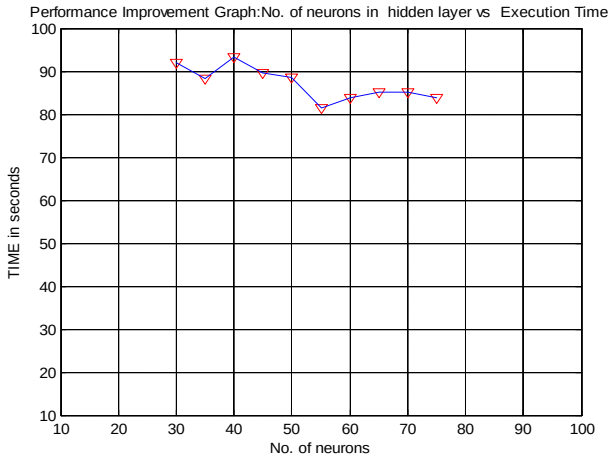

Figure 4.3: Performance improvement graph: No. of neurons in hidden layer v/s Execution Time

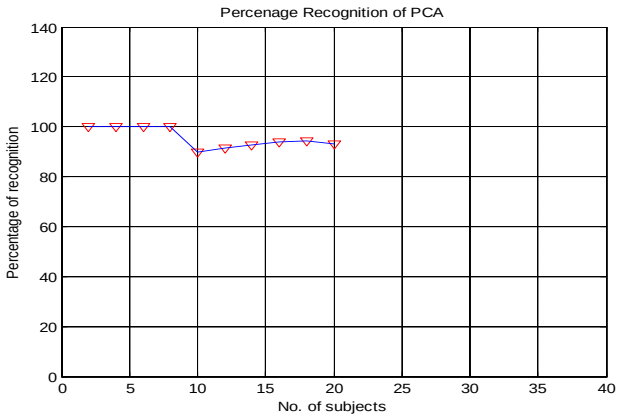

Figure 4.4: Percentage recognition rate of PCA

B. BPNN+PCA Result

Back propagation neural network (BPNN) is one of the best methods in feed-forward neural networks. It is a supervised learning method. It means if there is a wrong output, weights of connection are automatically adjust to limit this error & enhance the chance of correct answer in future. This model is made up of 3 layers: input, hidden & output layer. Each layer is connected to back & next layer fully with the help of weights. Signal propagates through input to output in forward direction. No calculation part takes place at input layer. This means that input vector at input layer is propagated to the hidden layer without any changes.

Figure 4.5: Test face

Figure 4.6: Recognized face

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C. DCT

The database consists of a set of images of 25 people. There are four test images and a single training or registered image. There are 4 different test-methods: GLOBAL, LOCAL, GLOBAL+LOCAL and GLOBAL AND LOCAL. The images are converted to average intensity with respect to the registered image stored in the database, i.e., the images are normalized.

Since the facial images are captured at different instants of the day or on different days, the intensity for each image may exhibit variations. To avoid these light intensity variations, the test images are normalized so as to have an average intensity value with respect to the registered image. The average intensity value of the registered images is calculated as summation of all pixel values divided by the total number of pixels. Similarly, average intensity value of the test image is calculated. The normalization value is calculated as:

Normalization Value = Average value of registered image / Average value of test image

This value is multiplied with each pixel of the test image. Thus we get a normalized image having an average intensity with respect to that of the registered image. The entire image is of size 128 × 128 pixels. Upon applying DCT and performing zigzag scanning, we obtain 16384 coefficients, of which 64 coefficients are taken into account while matching.

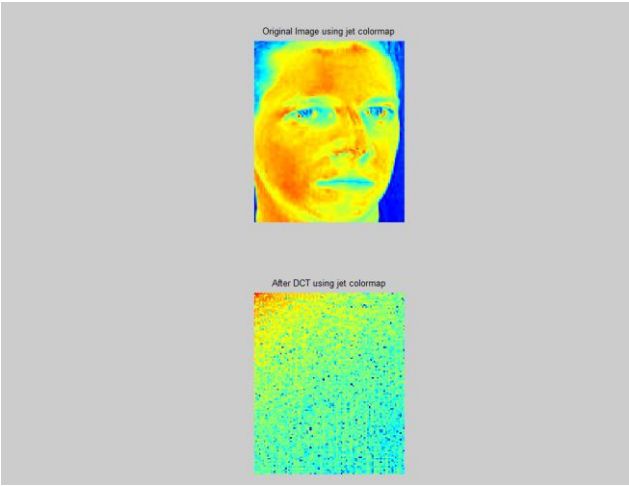

Fig 4.6 : DCT Test Image

VI. CONCLUSION AND FUTURE SCOPE

In this paper, The study shows that 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 PCA and (PCA+BPNN). When using local features for recognition, the false acceptance rate should be minimized and false rejection rate should be maximized as compared to that of global features. The recognition rate for local features and the recognition rate for global features using DCT is calculated. Comparison between DCT global features and DCT local features is done. The recognition rate improves when images are normalized. When local and global features are combined, DCT gives a relatively high recognition rate.

There are many ways where the research work can be expanded. The performance of face recognition can be enhancing by using Soft computing techniques. Soft computing can be combined with artificial neural network to achieve high accurate results. Another area of research is uses of other face feature extraction techniques on same face dataset. In future, two or more face recognition techniques, face feature extraction methods, face classifier indicators can be combined to obtain better results

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REFERENCES

[1]. Anil K. Jain, Brendan Klare and Unsang Park, "Face Recognition: Some Challenges in Forensics", IEEE International Conference on Systems, pp. 726-733, 2011
[2]. Athinodoros S. Georghiades, "From Few to Many: Illumination Cone Models for Face Recognition under Variable Lighting and Pose", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 23, no. 6, June 2001
[3]. A.H. Boualleg, Ch. Bencheriet and H. Tebbikh, "Automatic Face recognition using neural network-PCA", IEEE International Conference on Information and Communication Technology, vol. 1, pp. 1920-1925, 2006
[4]. Athmajan, Rajasinghe, Senerath, Ekanayake, Wijayakulasooriya, "Improved PCA Based Face Recognition Using Similarity Measurement Fusion", IEEE International Conference on Industrial and Information Systems, pp. 360-365, 2015
[5]. Lih-Heng Chan, Sh-HussainSalleh, Chee-Ming Ting, A.K Ari, "PCA And LDA-Based Face Verification using Back-Propagation Neural Network", IEEE International Conference on Information Science, Signal Processing and their Applications, pp. 728-732, 2010.
[6]. Ms. Madhavi R. Bichwe, Ms.RanjanaShende, "Face Recognition in a Video by pose variations", IEEE International Conference on Computer, Communication and Control, pp: 1-5, 2015
[7]. M. Hassaballah, SalehAly, "Face recognition: challenges, achievements and future directions", IEEE IET Computer vision, vol. 9, pp. 614-626, October 2014.
[8]. Miguel A. Ochoa-Villegas, Juan A. Nolazco-Flores, Olivia Barron-Cano, "Addressing the illumination challenge in two dimensional face recognition: a survey" IEEE IET Computer Vision, volume 9, pp. 978-992, 2014
[9]. Rajath Kumar M. P., KeerthiSravan R., K.M. Aishwarya, "Artificial Neural Networks for Face Recognition using PCA and BPNN", IEEE International Conference on Information and Communication Technology,pp.1-6, 2015
[10]. T. RavindraBabu, Chethan S.A. Danivas, S.V.Subrahmanya, "Robust Face Recognition with Illumination Normalization using a Reference Profile", IEEE International Conference on Hybrid Intelligence System, pp. 455-460, 2012
[11]. TahiaFahrinKarim, MollaShahadatHossainLipu, Md. LushanurRahman, Faria Sultana, "Face Recognition Using PCA-Based Method", IEEE International Conference on Advance Management Science, volume 3, pp. 158-162, 2010
[12]. XiaoyangTana, Songcan Chena, Zhi-Hua Zhou, Fuyan Zhang, "Face Recognition from A Single Image Per Person: A Survey", ELSEVIER, pp. 15-21, 2006
[13]. ZahidMahmood, Tauseef Ali, Samee U. Khan, "Effects of pose and image resolution on automatic face recognition", IEEE transaction, vol. 5, pp. 111-119, 2016.