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Face Recognition Using Improved Histogram And Comparative Study Of Various Face Recognition Algorithms

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***Abstract*—Shape and textures are two approaches to present a face. Face is divided into small regions from which from which local binary pattern (LBP) histogram are extracted and concatenated. Face recognition is a task human performs in easy way and successfully. Automatic face recognition is very difficult as compare to perform by human being. The challenges associated with face recognition can be attributed to the following factors like pose and facial expression and emotions etc. The existing approach shows the clear majority over the existing algorithms like PCA, Advance Histogram and gradient. In the existing approach the main concern is to first calculate the LBP Histogram and then find the chi-square distance with the help of histogram which has been calculated from histogram of the training images.**

***Keywords*—PCA**, *LBP operator,eigenvector, eigenvalue etc.*

I. INTRODUCTION

Face recognition problem automatically can be formulated as follows: The given texture or video images of a scene recognize or match with one or more persons in the scene using a stored database of faces. Face recognition is one of the most active and widely used technique [1-2] because of its constancy and dependability in the process of recognizing and identifying a person's verification. The demand of the face recognition is becoming important since people are getting aware of security and privacy. For the Researchers Face Recognition is among the tedious work.

It is all because the human face is very prospering in nature in fact, a person's facial expression may be change very much during short periods of time like one day to another and because of long periods of time like a difference of months and year. Actually the problem of face recognition is the fact that different faces could seem very similar therefore, a tolerance task is needed. As another way, when we analyse the same face many characteristics may have changed due to the various challenges associated with face recognition. These challenges might be because of changes in the different parameters. The parameters are Presence or absence of structural components, variability in facial expressions, the presence of accessories (glasses, beards, etc) poses, age, finally background. Face recognition [7-8] techniques can be divided into two big groups, first the applications that required face Identification and the second that need face recognition. The difference is that the first one uses a face to match with other one on a database on the other hand the verification technique tries to verify a human face from a given sample of that face.

A. Face Recognition

Face recognition is one of the few biometric methods that possess the merits of both high accuracy and low concern. This approach has the accuracy of a physiological approach without being intrusive. For this reason, in the previous decades, face recognition has drawn the attention of researchers in fields from security and image processing, to automation. Different algorithms have been proposed for face recognition

The variety of wide applications in the areas Various Applications of Face Recognition are

- Public security
- Law enforcement and commerce
- Credit card verification
- Criminal identification
- Access control
- Network security and access control
- People surveillance(in crowded areas)
- Entrance security, etc
- Personal identification

B. Principal Component Analysis (PCA)

PCA approach for faces is To find vectors that best account for variation of face images in the total image space.-The following vectors are called Eigen vectors.-Now construct a face space and project the images into this face space (Eigen faces).One of the mostly used face recognition models is the Principal Component Analysis (PCA) or Eigen faces [12], which is based on the mathematical properties of the digitized image and captures the invariant characteristics of faces. It is interesting to study and analyse this technique for the following reasons: Simplicity of the implementation and good results in large data bases. It is a technique tolerant to the previously Mentioned variations. It is carried out under a purely automatic process.

A face contains a number of features of interest like nose, mouth, eyes, ears, eyebrows etc; and each of these features has some values or weights. In our implementation we use nose width and mouth width instead of other. In the proposed algorithm, the faces are sub-categorized based on

the weights of these features in the training database. Any face to be recognized, is compared with in a sub-group, in which it falls.

Assumptions are as follows:

1. Create Eigen space

Transform the face images: As a first step, the face images are transformed from 2D matrix of size M*M to generate 1D image vector of size N*1 by placing the image matrix columns consecutively. To quote an example, for the training image the image vector is given by

$$a^i = [\, a^i_1, a^i_{2,\ldots} a^i_N \,]^T$$

Where in which is the total number of images in the face database. Then the transformed images are stored into a data matrix A of size N*n, wherein each single image is a column vector. Similarly, the image matrices of test images are transformed from 2D to 1D column vectors of image data.

2. Centred data:

Each of the training images must be cantered. Subtracting the mean image from each of the training images centres the training images as shown in the equation

$$\bar{a} = a^t - m \quad \text{, where} \quad m = \frac{1}{n}\sum_{i=1}^{n} ai$$

Therefore the given mean image is a column vector such that each entry is the mean of all corresponding pixels of the training images.

3. Prepare Data Matrix:

Prepare Data Matrix of cantered images Once the training images are cantered, the column vectors of n images are placed, column wise to prepare the data matrix of cantered images as given below

$$\bar{A} = [\bar{a}^1 \mid \bar{a}^2 \mid \ldots\ldots \mid \bar{a}^N]$$

4. Construct covariance matrix:

Therefore the data matrix is multiplied by its transpose to create a covariance matrix Ω as under

$$\Omega = \bar{A}\,\bar{A}^T$$

5. Obtain eigenvalues and eigenvector:

Therefore the Eigen values and their corresponding eigen vectors are determined from the covariance matrix as under

$$\Omega V = \Lambda V$$

6. Sort eigenvectors: Sort the eigenvectors according to $V_i \in V$ their corresponding Eigen values $\lambda_I \in \Lambda$ in an ascending order. The eigenvectors associated with only non-zero Eigen values are taken. The given matrix of eigenvector is the eigenspace V, where each column of V is an eigenvector

$$v = [\, v_1 \mid v_2 \mid_{\ldots} \mid v_n \,]$$

C. *Local binary pattern*

LBP (i.e. local binary patterns) is a powerful means of image scene description. The original LBP operator is developed by Ojala et al. [6].The LBP operator labels the pixels of an image by thresholding the 3x3-neighbourhood of each pixel with the centre value and considering the array result as a binary number. Then the binary number transformed to Decimal number. Finally the histogram of the labels can be used as a texture lemma An analogy of the basic LBP operator is shown in Figure 1.

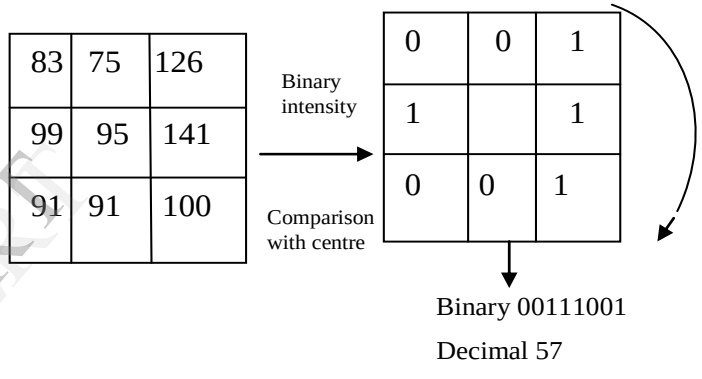

Figure 1: The LBP operator.

D. *Histogram Method for Face Detection*

As per, RGB colour space is commonly used in image processing because of its basic property and direct uses in display of images. According to the requirements of different image processing tasks, RGB colour space can be often transformed to other cooler spaces. The first is how to best match the distance of data representation to human approach. It is desirable that numerical color distance is proportional to affective difference. The another problem is how to best quantize the colors such that the reproductions from these quantized colors is the most faithful to the original. In this approach, we adopt a meaningful color space, HMMD color space, and used a worked out quantization scheme of the MPEG-7 standard.

II. Flow Chart of Various Algorithm

Flow Chart Describing PCA based face recognition

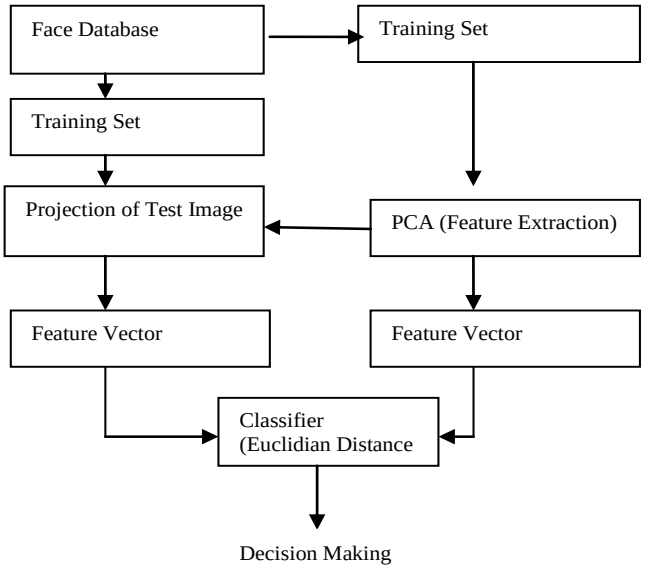

Figure 2 : Flow Chart of PCA

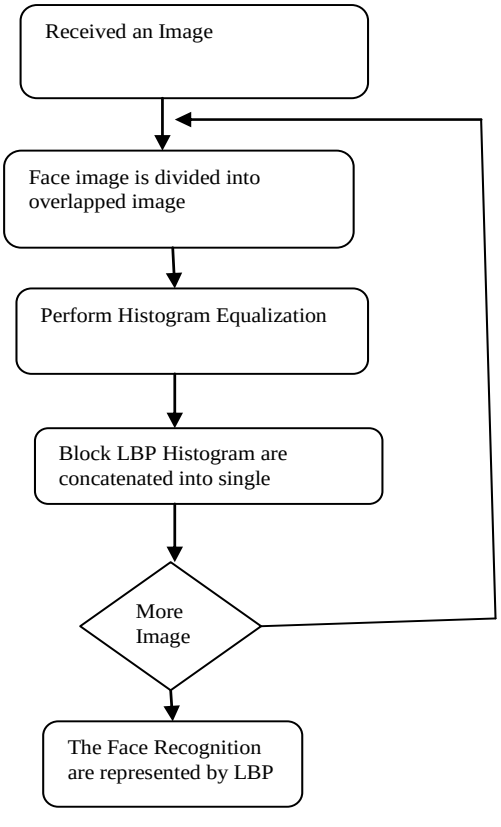

Figure 3 : Flow Chart of LBP

III. Algorithms

A. *Algorithms for PCA*

Identifying images through eigenspace projection takes three steps.

1) The Eigen space must be created using training images.

2) Next, the training images are projected into the Eigen space.

3) Finally, these test images are identified by projecting them into the Eigen space and comparing them to the projected training images. The detailed steps are described below:

B. *Algorithm for proposed Histogram*

1. Step 1: Take input image I

2. Step 2.Test the gray level ,For I1=1: N %where N is number of Images

3. Step3: Compute Eigen Value ,For I2=1: N

4. Step 4: Make eigen vector,ForI3=1:M %where M is the dimension of Eigen Vector

5. Step5: Calculate mean or mean difference Md, Md=Trained image –Test image

If Md= 0 then , Matched

Got to Step 7

Else

%Again check for the next image

Go to step 4

End if

End for &Go-to step 3

. End for & go-to step 2

End for& got to step 6

Step 6: Print Not Matched & Stop

Step 7: Show the Mapped Output in GUI & Stop

C. Algorithm of LBP

1. Compute the histogram of the query image $\boldsymbol{H_i}$
2. Let the total number of data base image be $\boldsymbol{L}$
3. *For J= I to L*

a) Compute histogram of the ***j-th*** database image, $\boldsymbol{T_j}$

b) Find the similarity value $\boldsymbol{D}$ between $\boldsymbol{H_i}$ and $\boldsymbol{T_j}$

c) Let ***D(j)*** be the distance between the query image H_i and the database image T_j

d) Repeat steps a) to c) for all images

END

4. Find the minimum of the distance ***d[j]***. Let the index j_{min} has the minimum value

5. The j_{min} image is the closest image to the query image

D. Comparison with various Algorithms

- Let there be ***N (100)*** images in the training set, i.e. in image database.
- Along with each image, its LBP histogram ***(256 bins)*** are also computed and saved.
- Let there be ***M(100)*** test images.
- We take a test image and do the following.
- Compute its histogram.
- Find its χ^2 (Chi-square) distance with the histogram of each of the training images.
- Let the distance be ***d(i), i=1, 2,...,N***.
- Find the minimum distance from ***d(i)***.
- The training image having the minimum distance will be the image closest to the test image.
- If the closest image is the correctly recognized image, then the number of correctly recognized image ***n*** is increased by 1.
- The process is repeated for all test images.

Euclidean Distance

$$D = \sum_{i=1}^{N}(Hi - Ti)^2$$

The closest image is the one which has the smallest value of ***D***

Histogram Intersection

$$D = \frac{\sum_{i=1}^{N} min\ (Hi\ ,Ti)}{\sum_{i=1}^{N} max\ (Hi,Ti)}$$

For similar images value of S will be lowest.

Chi-Square) Distance χ^2

Chi-square Distance : The normalized Chi-square distance is given by

$$D = \frac{\sum_{i=1}^{N}(Hi - Ti)^2}{\sum_{i=1}^{N}(Hi + Ti)}$$

A Challenges in the Field of Face Recognition

The challenges blend with face recognition can be defined by the following factors:

- Existence or Non Existence of structural components: Facial features such as beards, moustaches, and glasses may or may not be present and there is a great deal of variability among these components containing shape, color and size.
- Pose: The images of a face vary due to the relative camera-face pose (frontal, tilted, profile, upside down).
- Facial expression and emotions: The appearance of faces is directly affected by a person's facial poses and expressions.
- Occlusion: Faces may be partially occluded by other objects. For an example, in an image containing a group of peoples, few faces may partially occlude other faces (face identification).
- Image position: Facial images directly vary for different rotations about the camera's optical axis.
- Imaging Factors: At the time when image is formed, factors such as lightning and camera characteristics affect the appearance of a face.
- Age: Images taken after one or two year's gap may not match with the database images.

IV Conclusion and Future work

We will use the integral Property of Histogram which is "The Histogram of an image & face & its flipped idea are always proportional", means that histogram will not change for the same image. So we will employ the same Technique for image matching i.e. the image under Training or more Specifically the Trained histogram will be matched with the testing Histogram, if the both are same the image will be said "Matched" else "not-matched".

To collect the database having different face expressions with different illumination characterization and to Recognize the Face using Hybrid Histogram & Eigen Values Approach. To compare the proposed approach with existing techniques like PCA and LBP Histogram and gradient .

Enlightened by various algorithms like PCA, LBP Improved histogram an optimized path even in a complex environment. The results prove that proposed approach effectively extracts the obstacles and finds the exact algorithm to detect the face and find the best algorithm for face recognition. The simulation results show that it is a simple, quick algorithm. This proposed algorithm may further be used for enemy detection, autonomous navigation, GIS mapping etc.

V. Future of Face Recognition

- Next generation person recognition systems will need to recognize people in real-time and in much less constrained situations.
- Face Recognition Research still face challenges in pose and illumination changes. Age is the major domain of challenge.
- Algorithms those work well with one situation should work for other variation types also.
- Researchers are always ready to demonstrate that unobtrusive audio-and-video based person identification systems can achieve high recognition rates without requiring the user to be in highly controlled environments

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