A Review on Various Approaches of Face Recognition

Abhishek Kumar[1], Dr. S. A. Khan [2], Er. Ashish Chand[3], Er. Parwinder Kaur[4]

[1]M.Tech Scholar Department of Electronics and Communication SSIET, Patti Tarn Taran-Punjab(India)
[2]Associate Professor Department of Electronics & Communication SSIET, Patti Tarn Taran-Punjab(India)
[3]Assistant Professor Department of Electronics & Communication SSIET, Patti Tarn Taran-Punjab(India)
[4]Assistant Professor Department of Electronics & Communication SSIET, Patti Tarn Taran-Punjab(India)

Abstract - *Face recognition based on low resolution images provide low accuracy as compare to various approaches that provide better results under high-resolution parameters. A method for face recognition by using the principal component analysis with Eigen vectors have been used in recent research. Euclidean distance classifier is used for the matching between the training and testing images. The purpose of the research is to improve the accuracy for the low resolution images. By analysing various approaches for face recognition there is need to develop a new approach which can provide better results using texture features for blurred images.*

Key Words: *Face Recognition, DCT, DWT, LTP, PCA, ELTP, FAR,*

1. INTRODUCTION

The face plays a major role in our social intercourse in conveying identity and emotion. The human ability to recognize faces is remarkable. We can recognize thousands of faces learned Throughout our lifetime and identify familiar faces at a glance even after years of separation. The skill is quite robust, despite large changes in the visual stimulus due to viewing conditions, expression, aging, and distractions such as glasses or changes in hairstyle. Computational models of faces have been an active area of research since late 1980s, for they can contribute not only to theoretical insights but also to practical applications, such as criminal identification, security systems, image and film processing, and human-computer interaction, etc. However, developing a computational model of face recognition is quite difficult, because faces are complex, multidimensional, and subject to change over time. Generally, there are three phases for face recognition, mainly face representation, face detection, and face identification.

1.1 Face representation

Face Representation is the first task, that is, how to model a face. The way to represent a face determines the successive algorithms of detection and identification. For the entry-level recognition (that is, to determine whether or not the given image represents a face), a face category should be characterized by generic properties of all faces; and for the subordinate-level recognition (in other words, which face class the new face belongs to), detailed features of eyes, nose, and mouth have to be assigned to each individual face. There are a variety of approaches for face representation, which can be roughly classified into three categories: template-based, feature-based, and appearance-based. The simplest template-matching approaches represent a whole face using a single template, i.e., a 2-D array of intensity, which is usually an edge map of the original face image. In a more complex way of template-matching, multiple templates may be used for each face to account for recognition from different viewpoints. Another important variation is to employ a set of smaller facial feature templates that correspond to eyes, nose, and mouth, for a single viewpoint. The most attractive advantage of template-matching is the simplicity; however, it suffers from large memory requirement and inefficient matching. In feature-based approaches, geometric features, such as position and width of eyes, nose, and mouth, eyebrow's thickness and arches, face breadth, or invariant moments, are extracted to represent a face. Feature-based approaches have smaller memory requirement and a higher recognition speed than template-based ones do. They are particularly useful for face scale normalization and 3D head model-based pose estimation.

1.2 Types of Face Recognition

Face recognition scenario has been classified into two different categories. These categories are basically matching of face image with single image or group of images. These two scenario of face recognition has been explained below.

1.2.1 Face verification (or authentication)

Face verification is the process to verify person's identity that has been claimed to be matched with template. Face verification is the process of one to one match that comparing a query face with claiming face. Verification is to be done on the basis of features of template image and query image. To evaluate performance of the face verification different parameters have to be classified that has been used for different ROC curves. False acceptance and false rejection rate has to be computed to compute verification rate of the claimed query. A good verification system should balance these two rates based on operational needs.

1.2.2 Face identification (or recognition)

Face identification is the process of matching of single person image with multiple images available in the database. This face identification process is also known as one too many matching process. In this process query face image is compared with all the template images available in the face image database. The image that is closest match with the database images is most identifying image that match with test image. The query face image features has been compared with the database face images so that can identify that maximum matched image on the basis of distance. The distance has been computed with all the images available in the database of facial images. These distances have been arranged numerically in ascending order. The top level image distance is maximum matched image with the test image available in the database. If the top arranged distance is minimum then that define maximum matched image has been found with test image. On the basis of these test results the parameters for face recognition system. False Acceptance Rate (FAR) and False Rejection Rate (FRR) had to be computed for performance evolution of face identification system.

1.3 Challenges In Face Recognition

- **Scale:** The scale of a face can be handled by a rescaling process. In Eigen face approach, the scaling factor can be determined by multiple trials. The idea is to use multi scale Eigen faces, in which a test face image is compared with Eigen faces at a number of scales. In this case, the image will appear to be near face space of only the closest scaled Eigen faces. Equivalently, we can scale the test image to multiple sizes and use the scaling factor that results in the smallest distance to face space.

- **Variation in Poses:** Varying poses result from the change of viewpoint or head orientation. Different identification algorithms illustrate different sensitivities to pose variation.
- **Variation in Iluminance:** To identify faces in different luminance conditions is a challenging problem for face recognition. The same person, with the same facial expression, and seen from the same viewpoint, can appear dramatically different as lighting condition changes. In recent years, two approaches, the fisher face space approach and the illumination subspace approach, have been proposed to handle different lighting conditions

- **Disguise:** Disguise is another problem encountered by face recognition in practice. Glasses, hairstyle, and makeup all change the appearance of a face. Most research work so far has only addressed the problem of glasses.

1.4 Parameters Used

False acceptance rate (FAR) is the measure of rate that a biometric system will incorrectly accept the access attempted by an unauthorised user. False acceptance rate is computed by using the ratio between the false accepted and identification attempts done.

False rejection rate (FRR) is the measure in the biometric security system is that when a system incorrectly rejects the authentication done by an authorised person. FRR is computed by using the ratio between the false rejections done by system that are made by authorised person to the total attempts done.

2. APPROACHES USED

2.1 Appearance Based Recognition Approaches

Appearance based face recognition process consist of Eigen faces that preserves global structure of image sub space, Fischer face that preserves discriminating information and laplacian face that preserves local structure of image subspace. These approaches have been used for face recognition based on appearance based recognition.

2.1.1 Principal Component Analysis (PCA)

PCA was invented by Karl Pearson for reduction of dimensions of the dataset that contain redundant information. This leads to reduction in variables from dataset that known as principal components from the dataset which accounts most variation occurred in different variables of dataset. Eigen faces are the principal components from the distribution of the faces or Eigen vectors are the 2-dimessional feature subspace from N*N covariance image of facial part. Each face image is a linear combination of different face images in Eigen sub space. Eigen face cosmists mean of all the images that are available in the dataset images that has been used for matching process. Eigen values of query image have been matched with dataset Eigen values for recognition process.
In this process of Eigen face mean image has been computed from all the images available in the dataset that has been represented by X1, X2…………………Xn.

$$\Psi = \frac{1}{N}\sum_{i=1}^{N} X_i \qquad (1)$$

After computation of mean image dataset images subtracted image has been reconstituted for the images that has been used for development of covariance matrix.

$$\Phi = X - \Psi \qquad (2)$$

Eq. (2) represents subtracted image the group of images have been used for reconstructions of facial images covariance matrix

$$M = A.A^T \qquad (3)$$

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 06 | June 2019 www.irjet.net p-ISSN: 2395-0072

Fig -1: Training dataset images

After this process the Eigen features and the Eigen values for the face image was computed The Eigen value μ_i and Eigen vector v_i has been computed on the basis different equations that are represented as.

Fig -2: Mean image constructed from dataset images

By using the Eigen values and Eigen vectors Eigen face matrix has been generated that is used as features for matching purposes.

Fig -3: Eigen faces from all images

After the generation of Eigen space, the matrix is computed by using different face samples. The database features has been stored. These feature sub spaces have been used for recognition purpose using distance classifier represented in eq. (4)

$$d = \sum_{i=1}^{N} |x_I - y_i| \quad (4)$$

2.1.2 Local Discriminant Analysis (LDA)

LDA was an approach that had been developed for preserving local discriminating information from facial image. Face images can be divided into two different division that are spatial and frequency division. In the process of face recognition various factors have been considered for recognition that varies due to variation in age, gender and person's characteristics. These issues are not comprised in PCA so to overcome this major issue in recognition new approach had been purposed that works on the principal of Fischer-face.

In this process face images available in the dataset are belongs to different classes. Multiple images under different condition must be available in a single class. At least one image must be available in test image dataset.

After this instances each available image with two-dimensionalm X narray of intensity valuesI(x,y), LDA approach construct the lexicographic vector expansion $\phi \in R^{mXn}$. This vector represents values of initial faces. Thus the set of all faces in the feature space is treated as a high-dimensional vector space.

$$M = \sum_{i=0}^{c} M_i \quad (5)$$

$$S_w = \sum_{i=1}^{c} \sum_{j=1}^{M_i} (y_j - \mu_i)(y_j - \mu_i)^T \quad (6)$$

$$S_b = \sum_{i=1}^{c} (\mu_i - \mu)(\mu_j - \mu)^T \quad (7)$$

$$\mu = {}^{1}/_{c} \sum_{i=1}^{c} \mu_i \quad (8)$$

By using these different equation LDA approach computes a transformation coefficients that increases between class scattering and decreases within class scattering.

$$T_c = \max_i \frac{Det(S_w)}{Det(S_b)} \quad (9)$$

The linear transformation is given by a matrix U whose columns are the eigenvectors of $S_w^{-1}S_b$(called Fischerfaces). These fischerfaces have been computed using eq. (9).

$$S_w^{-1} S_b \mu_k = \gamma_k \mu_k \quad (10)$$

By using above mathematical expression fischerfaces features for dataset has been a measure that has been used for computation of face recognition accuracy based on threshold values.

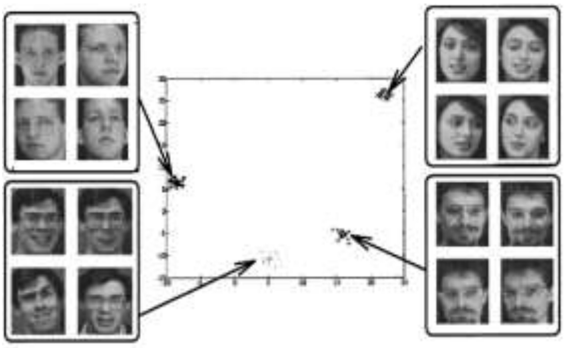

Fig -4: Separation of feature sub space cluster

Fig 4 represents separation of different person's classes in a clustered view using ORL face dataset.

2.1.3 Texture Feature Based Recognition Approaches

Face modalities have been recognized using different approaches that compute texture features from facial images that have been used for face matching. In this process facial part contain images have been used and features points from whole face image has been computed for computation of texture features that has been used with machine learning approaches or distance classifier approaches for recognition process. In the process of texture feature analysis Local Binary Patterns (LBP), Local Ternary Pattern (LTP) and Equalized Uniform Local Binary Pattern (EULBP) have been used for feature extraction.

3. BINARY PATTERN (LBP)

Local Binary pattern operator was designed for extraction of texture description from images. This operator assigns a label to every pixel available in the image using a window of 3*3 moving on all the images pixels. This window use center pixels and neighbor pixel values for assigning a label to each pixel available in the image. These labels have been considered for result in binary format. Later on research had been done to increase window size for huge image so that time [] complexity for features extraction can be reduced. In this extension window size can be used a set of pixels that are evenly spaced on a circle centered at the pixel that allows any radius and number of sampling points. To find out optimized solution bilinear interpolation has been used where neighboring points does not fall into the center pixel. In the following, the notation (P, R) will be used for pixel neighborhoods which mean P sampling points on a circle of radius of R.

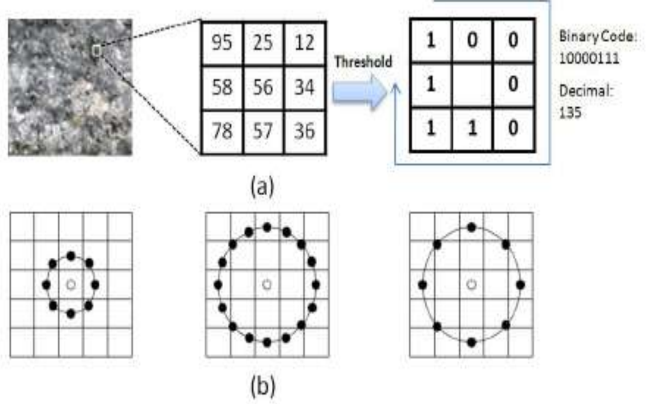

Fig -4: **(a)** basic LBP operator, **(b)** the circular

Figure 7(a) represents binary code computation using LBP operator on single image mask using 3 * 3 neighbor pixel values and fig 7(b) repents extended (P,R) used for radius of selection of higher number of sampling point in a single window.

Let S (u) is the binary matrix that has to be computed based on center pixel values that has been donated by I_c, N_i denotes the neighbor pixel values under a window.

$$u = \sum_{i=0}^{7} I_c - N_i \quad (11)$$

$$S(u) = \begin{cases} 1 & if u > 0 \\ 0 & otherwise \end{cases} \quad (12)$$

After computation of all the binary codes for the entire image these codes have been histogram concatenated to compute feature sub space using binary labels. These feature sub spaces have been used for recognition process. Various contents available in the face images can affect recognition accuracy so that weight age can be associated to all the images contents that play vital role in recognition process.

4. CONCLUSION

Face recognition under different condition is a challenging problem that causes mismatching in investigation process. In this paper novel approaches have been discussed that has been used based on the basis of appearance and texture based face recognition. By analyzing feature of various approaches and texture based approaches LDA is an approach that is exhausted over the PCA in the process of whole image based recognition. LDA consist of lower feature dimensions that cause less time complexity and provides better accuracy, whereas in texture based face recognition LTP is much better than other approaches because prone to noise, and uniform regions.

REFERENCES

[1] Tomasz Marciniak, AgataChmielewska, RadoslawWeychan, Marianna Parzych, Adam Dabrowski, (2015), "*Influence of low resolution of images on reliability of face detection and recognition*", International Journal of Multimedia tools applications, Vol. 74, pp. 4329-4349

[2] MuweiJian, Kin-Man Lam (2015), "*Simultaneous Hallucination and Recognition of Low-Resolution Faces Based on Singular Value Decomposition*", IEEE Transactions on Circuits and Systems for Video Technology, pp. 1-14

[3] Rizwan Ahmed Khan, Alexandre Meyer, Hubert Konik, SaidaBouakaz (2013), "*Framework for reliable, real-time facial expression recognition for low resolution images*", international journal of pattern recognition, pp. 1-34

[4] Hae Min Moon and Sung Bum Pan (2013), *"The LDA-based Face Recognition at a Distance using Multiple Distance Image"*, International Conference onInnovative Mobile and Internet Services in Ubiquitous Computing, pp. 249-255, DOI 10.1109/IMIS.2013.50.

[5] Shengcai Liao, Jain, A. K. and Li, S. Z. (2013), *"Partial-Face Recognition: Alignment Free Approach"* IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 35, Issue 5, pp. 1193-1205, ISSN 0162-8828.

[6] Nazari, S. and Moin, M.-S. (2013) *"Face Recognition Using Global and Local Gabor Features"*, Iranian Conference on Electrical Engineering, pp. 1-4, DOI 10.1109/IranianCEE.2013.6599704.

[7] Baohua Yuan, Honggen Cao and Jiuliang Chu (2012), *"Combining Local Binary Pattern and Local Phase Quantization for Face Recognition"* International Symposium on Biometrics and Security Technologies, pp. 51-53, ISBN 978-1-4673-0917-2.

[8] Rashid, R.D., Jassim, S.A. and Sellahewa, H. (2013) *"LBP Based on Multi Wavelet Sub-Bands Feature Extraction Used for Face Recognition"*, IEEE International Workshop on Machine Learning for Signal Processing, pp. 1-6, ISSN 1551-2541.