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A Brief Review on Feature Based Approaches for Face Recognition

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Abstract: ***Face recognition is the process of matching one against many face images. In the process of face recognition, face image features have been matched with the database images using different distance classifier. In this paper, various approaches has been studied which has been utilized for the process of face recognition. These approaches use different types of features for various techniques. Some approaches use texture features, other approaches use structure and shape based features for face recognition. On the basis of literature survey one can conclude that texture based features provides better results for same type of images. But with pose variations structure based features provides better accuracy.***

Keywords: Face Recognition, LBP, 2DMLV, FAR and FRR, KNN, PNN, EULBP, LTP.

1. Introduction

1.1 Biometrics

Biometrics is combination of two Greek words Bios (life) and metrikos (measure). In a biometrics system, a person is recognized on the basis of physical and behavioral traits like face, gait, voice etc. These traits can be used for pattern recognition purpose when it satisfies the requirements such as universality, distinctiveness, permanence and collectability [13]. In the process of pattern recognition, human traits are captured on and then matched with the database. Biometric identifiers are the unique, measurable qualities used to mark and depict individuals. Biometric identifiers are regularly sorted as physiological versus behavioral characteristics. Physiological attributes are identified with the state of the body. Behavioral attributes are identified with an example of conduct of an individual, however not constrained to writing, mood, walk, and voice.

The remaining part of the paper is organized as follows: Section 2 gives an overview of the Face recognition approach. Section 3 describes the previous work which has been done in the field of face recognition process. Section 4 gives the approaches used in face recognition technique in which texture, shape and structure features based techniques are explained. Conclusion is given in the Section 5.

2. Face Recognition

Face recognition is a non-nosy technique and facial pictures are most likely and widely recognized biometric trait utilized by humankind to make an individual recognition. Recognition process can be performed using still or video images. Contemporary approaches indirectly hinge on the location, shape and spatial relationships of facial landmarks such as eyes, nose, lips, chin and so on. Signal processing techniques based on localized filter responses on the images have largely replaced earlier techniques which are based on representing the face as a weighted combination of a set of canonical faces. Recognition can be quite good if canonical poses and simple backgrounds are employed, but changes in illumination and angle create challenges to recognition process [11]. The time that elapses between enrolment in a system and when recognition is attempted can also be a challenge, because facial appearance changes over time.

Early face recognition methods utilized different number of calculations based on appearance or the geometry of the face, however the distinguish process has now developed in a study of modern scientific representations and matching methodologies. Significant progressions and activities in the previous 10 to 15 years have impelled face recognition technique into the spotlight. The applications of facial discrimination range from a static, controlled "mug-shot" confirmation to a dynamic, uncontrolled face ID in a jumbled foundation [11], [13]. The most well known methodologies to face differentiation are focused around either: 1) the area and state of facial characteristics, for example, the eyes, eyebrows, nose, lips and button, and their spatial connections or 2) the general (worldwide) investigation of the face picture that depicts a weighted mix of various accepted appearances.

While the recognition of face is accessible easily, however the frameworks faces various challenges due to illumination changes, pose variations and low resolution images and high dimensions images [1],[15]. These frameworks additionally experience issues in perceiving a face from pictures caught from two radically diverse perspectives and under distinctive brightening conditions. It is observed that whether the face itself, without any logical data, is a sufficient premise for perceiving an individual from a miscellaneous number of characters. In a place for a facial representation framework to function admirably, it ought to naturally: 1) discover whether a face is introduced in the obtained picture 2) find the face if there is one and 3) perceive the face from a general view point.

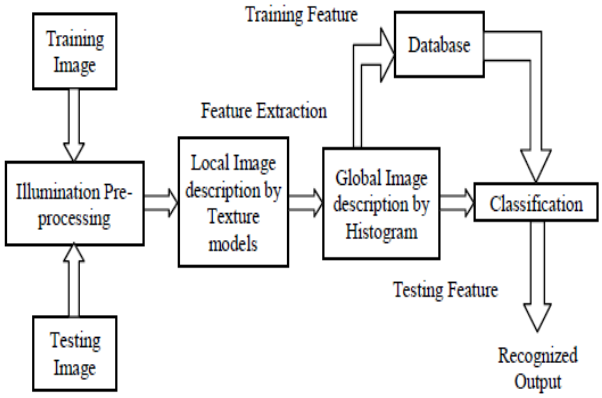

Figure 1: Face Recognition

Figure. 1 [11] depicts the overall processing of the face recognition system. In this system, all the training and testing images are gone through a preprocessing stage to deduct the effect of illumination changes. In this stage various numbers of filters are also used to remove noise. The features of testing images are computed and these features are compared against the training feature stored in the database.

3. Related Work

Kevin W. Bowyer et al [1] propose an approach for matching observation quality facial pictures to high-determination pictures in frontal posture, which are regularly accessible amid enlistment. The proposed methodology utilizes multidimensional scaling, at the same time change the features from the low quality test pictures and the brilliant exhibition pictures in such a way, to point the separations between them and rough the separations in the same conditions to display pictures. It uses Tensor investigation for facial milestone restriction in the low-determination uncontrolled test pictures for figuring the peculiarities. Multi- PIE database is reported.

Quanxue GAO Et Al [2] propose a linear approach, called two-dimensional maximum local variation (2DMLV), for face identification. In 2DMLV, connections are encoded among pixels of pictures utilizing the image Euclidean distance rather than traditional Euclidean distance used for assessing the variety of estimations of pictures and afterward consolidate the neighborhood variations which portraits the assorted qualities of pictures.

M Murugappan et al [3] uses Fast Fourier Transform (FFT) to examine the short time EEG signals for emotion classification. The proposed two measurable features perform better on characterizing the emotions utilizing two basic classifiers (KNN and PNN). K nearest neighbors (KNN) performs well over probabilistic neural network (PNN) with lesser computational complexity and giving the most extreme mean emotion characterization rate of 91.33%. This experimental result demonstrates the brief time span of EEG signals is profoundly vital for catching the emotional state changes of the subjects.

Hae-Min Moon et al [4] propose LDA-based face recognition algorithm for intelligent observation framework. This algorithm uses face images by distance extracted from 1m to 5m for training images rather than short distance images which are used by existing face recognition algorithm. In this, bilinear addition utility for the standardization and Euclidean Distance method is utilized for closeness measure. As a consequence of analysis, it is affirmed that the proposed calculation enhanced face recognition execution 6.1% in short distance and 31% in long distance.

Faten A. Alomar et al [5] propose multi-scale bandlet and local binary pattern (LBP) based method for gender recognition from different images. Bandlet is one of the multi-resolution method that can adjust the orientation of the edges of the face pictures, and in this way it can better catch the surface of a face image. After extracting bandlet coefficients from face pictures at diverse scales, LBP is connected to make a histogram, which is utilized as the feature to a minimum separation classifier. The tests are performed utilizing FERET grayscale face database, and the highest precision of 99.13% is acquired with the proposed system.

Rasber D. Rashid et al [6] propose a feature extraction algorithm based on wavelets and local binary patterns (LBPs). The proposed strategy deteriorates a face picture into numerous sub-groups of frequencies utilizing wavelet change. Each one sub-band in the wavelet area is separated into non-covering sub regions. At that point LBP histograms focused around the conventional 8- neighbor examining focuses are extricated from the rough guess sub-band, whilst 4-neighbor testing focuses are utilized to concentrate Lbphs from subtle element sub-groups. At long last, all Lbphs are linked into a solitary feature histogram to viably speak to the face picture. Euclidean distance is utilized to quantify the likeliness of distinctive peculiarity histograms and the last distinguishment is performed by the closest neighbor classifier. The above method was tried on two freely accessible face databases i.e. Yale and ORL.

4. Approaches Used For Feature Extraction

4.1 Multidimensional scaling (MDS)

Multidimensional scaling (MDS) is a means of visualizing the level of similarity of individual cases of a dataset. It is concerned with set of coordination methods which are performed in information visualization process that is used to display the information contained in distance matrix. In MDS algorithm, each object is sited on the N-Dimensional space such that the distance of objects between them are preserved as much as possible. Coordinates are allocated to each object placed in N-Dimensions. The maximum possible number of dimensions of an MDS plot *N* can exceed up to 2 and then a priori is specified. Selecting a *N*=2 optimizes the object locations for a two-dimensional scatter plot [1].

Multidimensional scaling (MDS) has ended up more well known as a procedure for both multivariate and exploratory information investigation. MDS is a mechanism of information investigation techniques, which permit one to

prevail upon the measurements of the perceptual space of subjects. The crude information going into a MDS investigation is normally a measure of the worldwide similitude or divergence which is under scrutiny. The crucial result of a MDS examination is a spatial arrangement, in which the items are considered to be focused. The focuses in this spatial representation are orchestrated in such a way, that their separations compare to the likenesses of the items, comparative item are considered that are close toward one another, unique properties focuses on that part which are far separated.

4.2 Two dimensional maximum local variations (2DMLV)

In 2DMLV, it encodes the connections among pixels of pictures utilizing the Euclidean distance rather than ordinary Euclidean separation which is used for assessing the variety of estimations of pictures, and after that fuse the nearby variation, which describes the assorted qualities of pictures and segregating data, into the target capacity of dimensionality. Traditional Euclidean distance doesn't consider the property of diversity of images [2]. In 2DMLV, Euclidean distance considers the relationships among the pixels in images and help to give discriminating information of an image. 2DMLV exhibits more time to calculate the Euclidean distance but it does not alter the classification time [2]. This approach doesn't ignore the most important geometrical properties of diversity of images. 2DMLV preserves inherent structure by maximizing the variation of images.

4.3 Fast Fourier Transform (FFT)

A fast Fourier transform (FFT) is an approach responsible for the evaluation of the discrete Fourier transform (DFT) calculations and its inverse can also be computed. In Fourier analysis time or space is converted into frequency or wave number and vice versa. FFT is responsible for computing such transformations swiftly in which DFT matrix is factorized into a product of sparse (mostly zero) factors resulting fast fourier transforms [3]. FFT lies at the heart of image and signal processing techniques poses a different range of applications such as telecommunications, medical imaging, cryptography and spectral analysis. The basic ideas of FFT were popularized in 1965, but some FFTs approaches had been previously known as early as 1805 [16].

There are many different FFT algorithms used in a wide range of mathematical applications, constituting simple, complex-number arithmetic calculations. This concept gives an overview of the available techniques and some of their important properties. The DFT is obtained by decomposing a sequence of values into components having number of different frequencies. This concept is useful in many fields but its direct computation makes too slow from the definition that is often to be practical.

An FFT is a way to give the same result more quickly and precisely, computing the DFT of N points using the definition, takes $O(N^2)$ arithmetical operations, but also a FFT can compute the same DFT in only $O(N \log_2 N)$ operations. The difference in speed can result to be enormous, especially for long data sets where N can be in the number of thousands or millions. In practice, the computational time can be deduced by several orders of magnitude and the improvement is approximately proportional to $N / \log(N)$ in such conditions. This huge improvement made the calculation of DFT to be practical. There are many properties of FFT, for example, Symmetry, linear, odd-even, solving partial differential equations to algorithms for quick multiplication of large integers, time shift features, Scale transformations [14],[16],[17].

4.4 Local Binary Pattern (LBP) Algorithm

Local binary patterns (LBP) is other approach for feature based face recognition used in classification in digital image processing and computer vision. LBP is the particular demonstration of the Texture Spectrum model proposed in 1990. LBP was first expressed in 1994 and did a great impact on the biometric field. It has been found to be influential approach for feature texture classification. It has been analyzed that when LBP is combined with the Histogram descriptor developed while computing, it improves the detection performance regularly and precisely on some datasets [5].

LBP is designed for the texture description. The operator is assigned to every pixel of an image by threshold the 3*3 neighborhood of each pixel against the center pixel value and corresponding result as a binary number. In this algorithm the facial image is divided into the local regions and texture descriptor is extracted from these regions and these are concatenated to form a global description of the face. By utilizing global description of patterns, spatially enhanced histogram is formed which encodes both spatial and appearance relations of the facial image. The spatial enhanced histogram is further used for the distance measure. The each element of histogram is related to the small area of the face, based on the psychophysical findings. Some facial features plays important role for face recognition. Weighted chi square distance is used for measuring the distance [8].

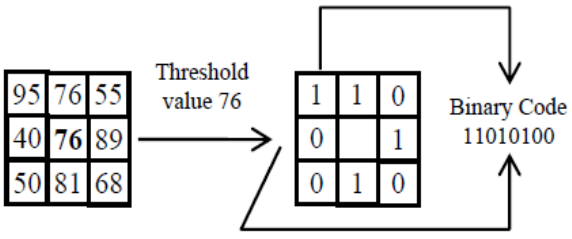

Figure2. LBP decoding

Figure. 2 [11] describes the 3*3 mask containing values. Threshold value is determined and compared with neighboring pixel values. By comparison, binary code is developed and used for recognition process. The LBP feature vector, in its simplest way, is created in the following manner:

- Divide the examined window into cells (e.g. 16x16 pixels for each cell).
- For each pixel in a cell, compare the pixel to each of its 8 neighbors (on its left-top, left-middle, left -bottom, right-

top). Pursue the pixels across a circle, i.e. clockwise or counter-clockwise.

- Where the center pixel's value is greater than the neighbor's value, write "1". Otherwise, write "0". This results an 8-digit binary number (which is usually converted to decimal for convenience).
- Compute the histogram, over the cell, of the frequency of each "number" occurring (i.e., each combination of which pixels are smaller and which are greater than the center).
- Optionally normalize the histogram.
- Concatenate (normalized) histograms of all cells and the feature vector for the window is developed as a result.

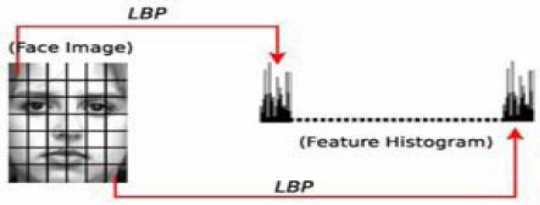

Figure3. Histograms Developed In LBP

Figure. 3 [6] depicts the histogram of each region developed using threshold value and the binary code developed. Histograms are concatenated to recognize the face image.

This approach has been used in number of different applications that includes tasks related to face detection, face recognition, demographic classification and facial expression analysis. In addition to LBP, EULBP is one of extension of this approach. In EULBP, dimensions of histograms are reduced by doubling one- dimensional pattern. It takes the effect of central pixels that improves the discrimination ability [19], [20]. LTP is other type of LBP which is more resistant to noise. In LTP, ternary code is developed and they are divided into upper binary and lower binary pattern. LTP include preprocessing, thresholding, local histograms [10],[12].

5. Conclusion

Face recognition is used in the biometric field for the recognition of different types of images available in the database. In this type of biometric trait the feature values are main constraints for the recognition of face images. On the basis of features the face images has been matched with the data base images. Various approaches have been studied in this paper. By reviewing these approaches one can conclude that 2DMLV approach is better for image matching on the basis of pixel values. FFT approach is beneficial to images having noise variation. Local Binary Patterns has been utilized for the face recognition on the basis of texture features and provides better accuracy for different databases. AR, ORL (Object Relational database) and FERET (The Face Recognition Technology) database has been analyzed for the performance of these algorithms.

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