Local Binary Patterns Histograms (LBPH) Based Face Recognition

Satya Bhushan Verma, Nidhi Tiwari

Abstract: ***The human face has been broadly used in computer vision field for individual recognition. The face recognition is one of the secure ways to protect the data over the internet. In this paper we use (LBPH) Local Binary Patterns Histogram based Face Recognition. We use Yale face database for experiment and it contains 165 grey images in the GIF format of 15 person and 11 image per person and in this experiment we use only normal image in 180*180 at grey scale images and in this research article in the verification phase the difference between two histograms are calculated by Chi-square distance, Manhattan distance. The proposed technique has achieved TSR=98.8% in Chi-square and TSR=98.5% in Manhattan distance parameter. Person Identification using their physical structure or behavioral characteristic is known as the biometric.***

Index Terms: Biometric, Face recognition, LBPH, Gabor filter.

I. INTRODUCTION

Tscience of calculating and analyzing physiological and behavioral data is known as biometric. In any biometric recognition system uses these behavioral and physiological data for validation. The fingerprint, iris, face, palm print, ear, etc. are classified as behavioral characteristics [2]. The behavioral and physiological characteristics are unique and can effectively used in any application related to biometric.

Generic Structure of Biometric: There are four main modules in any biometric recognition system those are [11]

(i) Sensor: The samples are taken from the sensor.

(ii) Feature extraction module: Feature extraction module extracts the certain salient features from the biometric traits taken by sensor.

(iii) Database for templates: The database stores the features extracted by the feature extraction module.

(iv) Feature matcher module: Feature matcher module matches the features taken from the biometric samples with the features stored in the database which are taken during the enrollment.

Only face recognition is the biometric method which gives the opportunity to recognize a person at the distance, without make user discomfort about touching a gadget. This system can use images taken from different devices such as standard video cameras or taken from CCTV cameras.

Today so many applications used for security purposes and interconnected world need to be maintaining the information secure. The use of face recognition makes secure transaction over the internet. The face verification also can be used in the place of PIN number and password because the it is very difficult to password and PIN are difficult to remember or they are very helpful for authentication but they can be easily stolen.

II. LITERATURE REVIEW

Timo Ahonen et al. [14] proposed a method for description with LBP. The LBP operator also used as a texture descriptor. The operator was originally designed for texture description. Operator assigns a label to every pixel of an image by thresholding the 3*3-neighborhood of each pixel with the center pixel. They tested this method publicly available CSU face identification evaluation system they achieved highest recognition rates 0.81 in LBP.

A. Vinoth and S. Saravana Kumar [1] proposed fingerprint forgery detection for health care based on minutiae mass measure. Firstly, they capture the fingerprint through the capturing device, and then they apply a Gabor filter for enhancing and removing the noise from the fingerprint image. After the applying the Gabor filter they split fingerprint image into several regions, and they extract various minutiae features like ridge island, number of ridge dots, ridge ends, ridge enclosures, and ridge bifurcation from each section, then they estimate the Minutiae mass value for each section. Based on the minutiae mass value they detect the forged fingerprint.

Wang Xuan et al. proposed a [17] palmprint recognition based on 2D – Gabor wavelet on contact palm print. They used pulse-coupled neural network for feature extraction and classification by support vector machine.

Szidonia lefkovits et.al [13] proposed a Gabor feature selection based on information gain using numerous Gabor filter extraction they specially tuned for global face and local eye detection .the created system is a aspect based detection approach consisting of three parts: detection of interest points, local descriptor and the object model and the goal is to select those Gabor filters which extract different frequencies from the same image. During this experiment they have compared the classification result of the Gentle Boost algorithm. First without including the information gain observation, second including the information gain-based ranking of the filters and finally eliminating the redundant filters form the classification process. And the result come from compared to the Gentle Boost algorithm the feature with the highest information gain can be obtained 97.78% with simple probability calculus.

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K.Vasantha and J. Ravichander proposed [4] image quality assessment for the fake biometric detection, this technique is useful for to iris, fingerprint, and face recognition.

Muhammad SHARIF et.al [5] proposed Face Recognition using Gabor filter this research that successfully implements face recognition using Gabor filters the in the proposed system, on an image they used 40 different Gabor filters. They divided techniques into two different classes: Holistic method and local feature-based methods are used, in the first step applying rescaling and the second step pixels adjustment than the third step Borders are smoothed than the measure the accuracy of proposed Gabor face recognition algorithm the standard database face is used for this. And the proposed technique compares 70 images. The accuracy rate of proposed system is 94.29% result achieved which is much better than the previous system.

Meiru Mua et al. proposed a palmprint identification technique. They used complex directional wavelet and LBP [6] in his propsoed method. Shift and grey scale invariant local features extracted by the combination of shiftable CDFB Transform and LBP. As a classifier for palmprint identification they Used Fisher Linear Discriminant analysis. Hong Kong PolyU palmprint database used for the experiment and they achieved 99.32 % accuracy and takes 0.022 seconds.

Wai Kin Kong, David Zhang, and Wenxin [16] used 2-D Gabor filter for palmprint feature extraction. Digital scanner is used for capturing the palmprint image. Then set coordinate system on the basis of boundaries of fingers for extracting the ROI. For the extraction of textured feature and distance matching they used 2-D Gabor filter. After his experiment they found filter 11 is the best of 12 filter in term of accuracy.

Satya Bhushan Verma et al. [10] proposed a contactless palmprint verification system using 2D Gabor filter and PCA. They used Sobel Edge Detection, 2D Gabor filter, and Principal Component Analysis (PCA).

They used segmented palmprint and they applied pre-processing and the first step in the pre-processing step is the binarization of a segmented palmprint. Then the second step in the pre-processing step is the contour analysis is applied on the binarized palm image than the 3rd step in the pre-processing step is the Sobel edge detector and they applied 2D Gabor filter and PCA feature

They considered this method the IIT Delhi database for the experiment consists of 300*300 segmented images. Total of 40 Gabor filters (8 orientation and 5 frequencies) are used in this experiment and also Indian Institute of Technology Delhi (IITD) database is used in this experiment. They proposed palmprint verification system gives a higher TST. The value of TSR=99.50%, EER=0.50% and this newly proposed verification technique takes an average time=3.016 seconds for recognition. The Gabor filter is powerful tool in computer vision and pattern recognition [12]. It gives many advantages like variation of rotation, translation, and illumination, which is raised by capturing device and face structure.

Gabor Filter:

The Gabor filter is a renowned isotropic filter. 2D-Gabor filter is the common texture descriptor introduced by Gabor in the year 1946. The Gabor filter is powerful tool in computer

The Gabor filter is allowing extracting features by investigating the frequency domain form images. Gabor filter uses Gaussian function modified by the complex sinusoidal of frequency domain. The Gabor filter successfully works in both spatial and the frequency domain works in any number of dimensions. Gabor filter works by captivating result of Fourier transform of image and multiply with Gaussian function at the several frequencies and apply Inverse fast Fourier transform (IFFT) of the results. In this proposed method 2D Gabor filter is applied on the pre-processed image.

Local Binary Pattern:

Local Binary Pattern is a visual descriptor which is used in pattern recognition and computer vision as a texture descriptor. Firstly, Timo Ojala et al. [7, 9] introduced the Local Binary Pattern it has been used as main texture analyzer for analysis of images mainly for its representation of discriminative information.

III. PROPOSED TECHNIQUE

The Yale Face Database consists of 165 taken from 15 person [18]. Those images are in grayscale and in GIF format. This database contains 11 face images per person in different facial expression or configuration such as Centre-light, w/glasses, happy, w/no glasses, left-light, right-light, normal, sad, surprised, sleepy, and wink. In this experiment we use only normal image in 180X180 at grey scale image. Following figure shows some sample images from Yale face database and figure shows the segmented ROI respectively.

Fig1. Sample face mages from Yale Face Database (A) Original Image (B) Segmented ROI

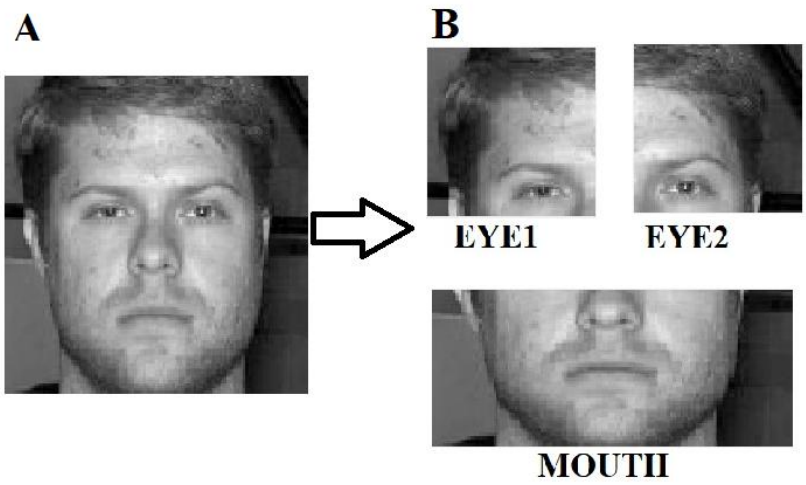

Fig 2. (A) Original Segmented image, (B) Divided in to 3 subregions.

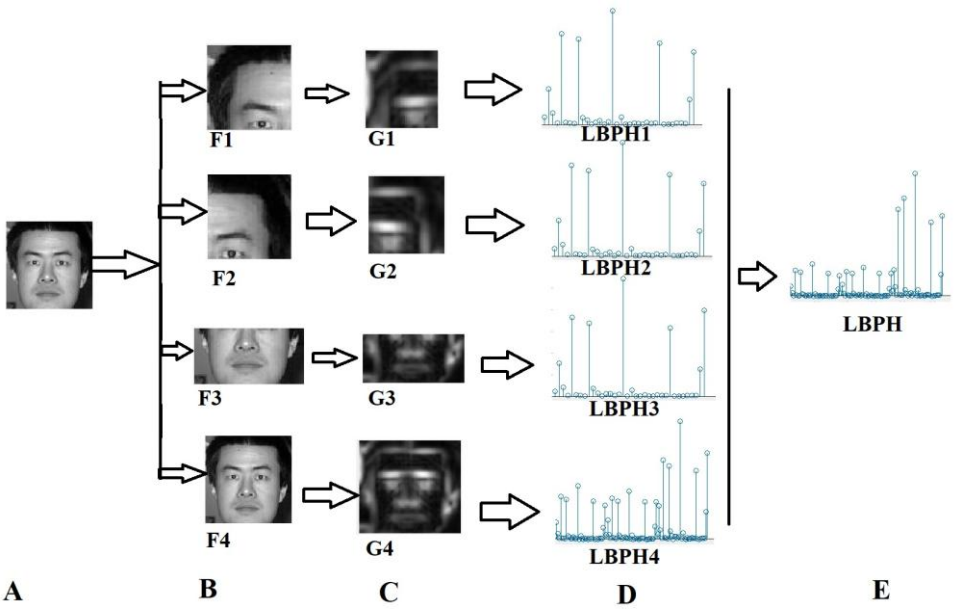

Fig 3. Process of the face feature extraction

In this research article, in verification phase the distance between two histograms are calculated by Chi-square distance, and Manhattan Distance.

The Chi-Square distance between two histograms H1 and H2 are defined as

$$D(H_1H_2) = \sum_I \frac{(H_1(I)-H_2(I))^2}{H_1(I)}$$

The Manhattan distance between two histograms H1 and H2 are defined as

$$D(H_1H_2) = \sum_{j=1}^{N} |H_1^j - H_2^j|$$

FAR (False Acceptance Rate), FRR (False Rejection Rate), TSR (Total Success Rate) and EER (Equal Error Rate) has been used for evaluating the proposed method for verification. In any biometric scheme, the FAR determines the rate of invalid persons who are incorrectly accepted, while FRR determine the total rejection rate for the right persons. The TSR (Total Success Rate) determine the correctness of any biometric system while determine total error in any biometric system.

FRR = (NFR / NEA) X100 %
FAR = (NFA/NIA) X100 %
TSR = (1 – (FAR+FRR)/TNA) X100 %
Where,
NFR= Number of false rejection,
NEA=Number of Enrollee Attempts,
NFA=Number of False Acceptance,
NIA=Number of Impostor Attempts,
TNA=Total Number of Attempts.

The segmented face image is divided in to 3 sub-regions namely eye1, eye2, and mouth as shown in figure.

IV. RESULT AND ANALYSIS

The following table 1 shows the experiment results of the proposed model in FAR, FRR, TSR, and EER by using Yale face Database at the Chi-square distance, Manhattan Distance parameter.

The proposed method has achieved FAR=2.5% and

FRR=2.0% and TSR= 98.8% in Chi-square Distance parameter and FAR=3.5% and FRR=2.5% and TSR= 98.5% in Manhattan Distance parameter.

TABLE I. **COMPARISON OF FAR, FRR, AND TSR OF THE PROPOSED MODAL USING YALE FACE DATABASE.**

Distance Parameter	FAR	FRR	TSR
Chi-square Distance	2.5%	2.0%	98.8%
Manhattan Distance	3.5%	2.5%	98.5%

The experiment of the proposed model is carried out by using MATLAB R2015a on desktop computer with Intel® core i7-4690 3.5 GHz processor and 4 GB RAM. The proposed method takes 0.66 second for face image verification which is quite fast when compared with the other methods. The experiment results confirm that the proposed model is more suitable for real time face verification than other models.

V. CONCLUSION

The security is play important role in any industry. This proposed work is most mainly for the person verification. The face recognition is highly preferable biometric compared to the other biometric technique, because of hygiene, time, cost, speed, and no need to any extra effort. A new face based biometric technique by using Gabor filter and LBPH (Local Binary Pattern Histogram) is proposed, conducted an experiment and discussed the results in detail in this paper. In this proposed method is tested in the experiment by using Yale face database. In this proposed modal achieved FAR= 2.5% FRR=2.0%, and TSR=98.8% in chi-square distance parameter. The proposed method takes 0.88 seconds for face image verification which is quite fast techniques. Thus, the experiment of the proposed model assures that the proposed model is more suitable for real time face based biometric applications.

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