

Analysis on Feature Extraction of Periocular Region(Soft biometrics) using LBP, PCA, ICA & Gabour filters

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Abstract- In this paper we analyse the various methods of feature extraction. In iris recognition there are several steps to perform identification. Similarly these steps are used in periocular region i.e. defined as the fixed region surrounding the iris of the individual. This region encompasses the eyelids, eyelashes, eyebrows and the surrounding skin area. LBP is defined as Local Binary Pattern used for feature extraction. The LBP features are firstly extracted from the original facial expression images. The LBP operator was introduced as a complementary measure for local image contrast, and it was developed as a grayscale invariant pattern measure adding harmonizing information to the “amount” of texture in images. The independent component analysis (ICA) is a technique that extracts the original signals from mixtures of many independent sources without a priori information on the sources and the process of the mixture. Gabor features encode facial shape over a broader range of scales. In the commonly adopted PCA representation, the pixel grey values are normalized based on equalized value of histogram, to have a mean of zero and a standard deviation of one.

Keywords: LBP, ICA, PCA, Gabor Filters, Periocular region

I. INTRODUCTION

As we all know security is very important in today's scenario. For security purpose we use various biometrics and others features of individual is used such as signature of an individual, passwords, special cards, biometrics etc. password

is weak method for security purposes as somebody also knows the password. Special cards, keys are also not a good method for

high security authentication as these are not always with the person. So biometrics are much better way than other method for authentication purposes. Biometrics are of various types like fingerprints, face. Speech, iris etc. iris biometric authentication uses iris of an individual for recognition. Periocular region is also one of the method for authentication. Periocular is defined as the region surrounding the eye like eyelids, eyelashes, eyebrows and surrounding skin area. This region of an individual is different from all others so we use this region for authentication purposes[1]. Human Iris exhibits the complex pattern on its interior surface. An iris recognition employs the uniqueness of different individual. The steps involved in iris recognition are:

- (a) collecting images of iris.
- (b) locating and segmenting the iris
- (c) Encoding the iris and periocular region for detecting the identity.
- (d) match the iris with the iris that is present in database

In spite of the wonderful progress made in periocular biometrics (especially iris), these systems encounter challenges[2]:

1. As we all know eye is a moving object and it is located within other moving object that is head. So it is very difficult to localizing the iris in eye images.

2. Retinal vasculature cannot be easily imaged.

So we used periocular region to improve the recognition rate of authentication of a person.



Fig.1 perioocular images from two different subjects (a)(b)without eyebrows and (c)(d)with eyebrows

II. PREVIOUS WORK.

- *Ashish Kumar Dewangan, Majid Ahmed Siddhiqui, 2012[3]* presents Iris Recognition - An Efficient Biometric for Human Identification and Verification, 1:2249-8958. This paper stated that for 'CASIA-a', iris templates produced are highly unique, in that comparing any two templates generated from different irises. It is equivalent to examine two random bit patterns.
- *Damon L. Woodard Shrinivas Pundlik Philip Miller[1]* presents On the Fusion of Perioocular and Iris Biometrics in Non-ideal Imagery This paper present work on iris with the fusion of perioocular region. Perioocular region define as the fixed region surrounding the iris of an individual. By using perioocular region we can calculate the information regarding the shape of the eye and texture of the skin around as it can vary across individuals. In this experiment, The near Infra Red (NIR) face videos of Multi Biometric Grand Challenge (MBGC) database are used.
- *Baker et al. [4]* present evidence of a significant effect of time-lapse between images on iris recognition. Their experiments used images taken by an LG 2200 camera [4] from data acquisitions in 2004 through 2008, acquired approximately weekly throughout the semester. The datasets used in this experiments contains only 26 iris or in other words 13 pair of iris.
- *Zhu E., Yin J., and Zhang G.[5]* presents paper on Fingerprint Matching Based on Global Alignment of Multiple Reference Minutiae The most widely used method for representing a fingerprint is minutiae pattern.
- *A. K. Jain and U. Park[6]*. presents paper on Facial marks: soft biometric for face recognition. Author detects micro-features such as moles, scars or freckles and used them as soft biometric traits.

- *C. Sanchez-Avila, R. Sanchez-Reillo[7]* presented paper in Two different approaches for iris recognition using Gabor filters and multiscale zero-crossing representation. Based on Daugman work, the authors followed Gabor filters and Hamming distance. But in addition, they have also included zero-crossing representation of the dyadic wavelet transform applied to two different iris signatures: one based on a single virtual circle of the iris; the other one based on an annular region. Results will show a classification success up to 99.6% achieving an equal error rate down to 0.12% and the possibility of having null false acceptance rates with very low false rejection rates.
- *Jie Zou [8]* A Comparative Study of Local Matching Approach for Face Recognition. In this paper, comparison between different matching techniques were done. Three commonly used local feature representations: eigen (PCA) features, Gabor features, and local binary pattern (LBP) features.

III. METHODOLOGY OF PERIOCCULAR RECOGNITION

As we all know eyes are the ideal part of human body and it is taken a very good biometric for identification because of following reasons:

- Eye is the internal organ and well protected with transparent membrane called cornea so that it can't be damaged easily. As we all know fingerprints are not recognizing when the person doing lots of labor work. So it is better method than fingerprints.
- The iris is mostly flat, and its geometric configuration is only controlled by two complementary muscles (the sphincter pupillae and dilator pupillae) that control the diameter of the pupil. So eyes is more predictable than other parts of the human body.
- The iris has a fine texture same as fingerprints but it can't be damaged after doing lots of work and recognize after doing labor work unless like fingerprints is determined randomly during embryonic gestation

Iris recognition is taken as one of the best techniques for one's identity. Many approaches were proposed for iris recognition. Perioocular region is also very good biometric used for person identification. Sometimes our images are taken from distance so iris recognition is not better for authentication. So we use perioocular region with the fusion of iris to recognize the correct

person. A fixed region surrounding the iris of an individual is referred to as the periocular region¹. Depending on the size of the image used, this region usually encompasses the eyelids, eyelashes, eyebrows, and the neighboring skin area. Using the periocular region has the following advantages:

(a) the information regarding the shape of the eye and texture of the skin around it can vary across individuals; which can be used as a soft biometric trait.

(b) there is no additional scanner is required for periocular data.

Periocular skin texture has been used for human identification in various ways. Jain et al. [6] detect micro features such as moles, scars, or freckles and use them as soft biometric traits. Others adopt a more general representation of the overall texture to facilitate recognition using popular texture measures such as LBP, PCA, ICA and Gabor filters.

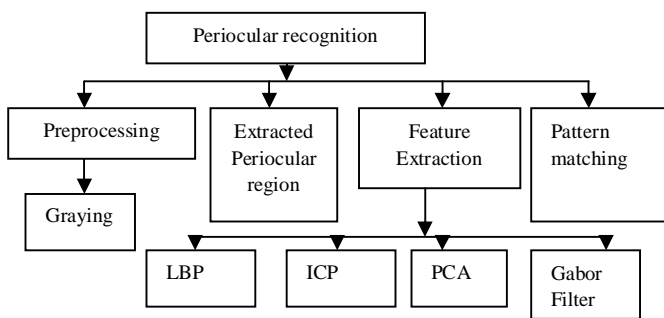


Fig 2: Steps of periocular extraction

- Preprocessing: Extracting the area around eye from the face image

Graying: In this colored image is converted in gray-pattern. Method of converting an image in gray color is by selecting two appropriate numbers that are indicated to two upper and lower thresholds (L,U). For K=1: iteration number following things are done:

1. Intensity of each pixel is seen, and if it seems lower than the smaller $L + K$, convert it to 0 and if it is bigger than $U - K$, convert it to 255.

2. Otherwise the intensity is filtered to the lower one by a scaling factor. The logical image is developed through processed image that means a Black & White type image

will be obtained. As all images are colored first we have to convert these color images into grey images.

- Extracted Periocular region images are tessellated into blocks, for which the texture features are computed locally
- Feature Extraction : Local Binary Patterns(LBPs) are used as the periocular texture measure.

LBP

- Independent evaluation of the contribution of the periocular texture towards overall recognition performance, is done through interior eye regions that are masked with an ellipse of fixed dimensions.

LBP The basic local binary pattern operator, introduced by Ojala et al. , was based on the assumption that texture has locally two balancing aspects, a pattern and its strength. In that work, the LBP was proposed as a two-level version of the texture unit to describe the local textural patterns.

The original version of the local binary pattern operator works in a 3×3 pixel block of an image. The center pixel value are used to threshold the pixel in this block, they are summed up after Multiplying by powers of two, to obtain a label for the center pixel.

Total of $2^8 = 256$ different labels can be obtained, as the neighborhood consist of 8 pixels, depending on the relative gray values of the center and the pixels in the neighborhood. As shown in fig. 4 and fig. 5

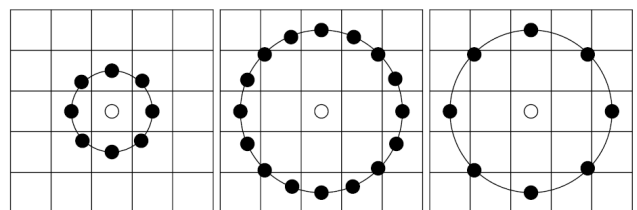


Fig:3 The circular (8, 1), (16, 2) and (8, 2) neighborhoods. The pixel values are bilinear interpolated whenever the sampling point is not in the center of a pixel



Fig 4: interior eye region masked with an ellipse

- Suppose preprocessed input periocular region image is I .
- An LBP vector is computed for each pixel in an image patch $I(i)$, which is in turn encoded into a histogram of bt bins, where $bt = p(p-1)+3$
- The overall texture feature representation of the image is given by an ordered set $T(I) = T(1), \dots, T(N)$, where $T(1), \dots, T(N)$ are the texture histograms corresponding to the N blocks.

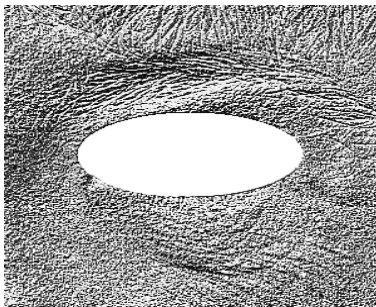


Fig 5: LBP image of masked eye image

- Matching : The city block metric is used to calculate the matching score.
- For matching two periocular texture representations, $T(I)$ is converted to its vectorized form $T(I)$ of $N \times bt$ dimensions

A distance function $D(T(I1), T(I2))$ is used to compare the texture features for two images ($I1$ and $I2$).

Of the various commonly used histogram comparison functions, the city-block metric is used.

$$d(x,y) = |x_1 - y_1| + \dots + |x_n - y_n|$$

Gabor filter

- To extract textural features of the iris a 2-d Gabor filter is convolved with the unwrapped iris image.
- The output of this operation is encoded as a matrix of bits known as the iris code.
- Two dimensional gabor filters over the image domain (x,y) have the functional form

Independent Component Analysis (ICA) and Principal Component analysis (PCA)

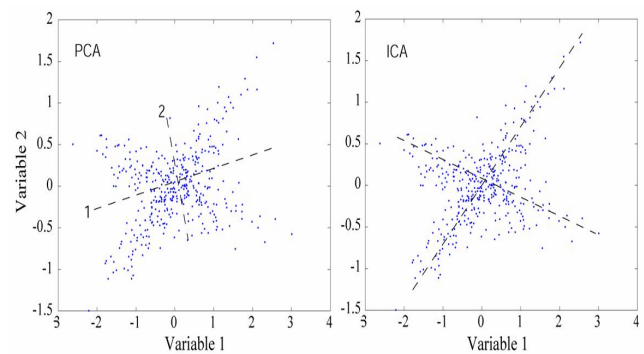
ICA is a method to recover a version, of the original sources by multiplying the data by a unmixing matrix,

$$u = Wx,$$

where x is our observed signals, a linear mixtures of sources,

$$x = As.$$

While PCA simply decorrelates the outputs (using an orthogonal matrix W), ICA attempts to make the outputs **statistically independent**, while placing no constraints on the matrix W .



IV. COMPARISON BETWEEN ALL FEATURE EXTRACTION USING DIFFERENT EXPERIMENTAL RESULTS

In this experiment the author uses images of CASIA[10], In this, there are images of 30 persons and each person has 10 images of eye. The different feature techniques are used i.e. ICA(Independent Component Analysis), PCA(Principal

Component Analysis) and Gabor Filter. These feature extraction techniques have different recognition rate as shown in table 1.

ICA	PCA	Gabor Filter
92.2%	89.5%	94%

Table 1: Recognition rate of ICA, PCA, Gabor Filter

There are other experiments that compares the feature extraction i.e PCA, LBP(Local Binary Pattern) and Gabor Filter. In this experiment, the three local features are compared. In this original image is cropped into 203*251 pixels. Now 37*37 local patch for each of four local component (2 eyes, nose, mouth) is cropped. The comparison of all feature extraction is done on these four 37 by 37 local patches. In this FERET database is used. In this results of left eye and right eye is shown in table 2. From the table, it is shown that PCA result is worst and LBP result is best. The FERET test is conducted with the left eye and right eye.

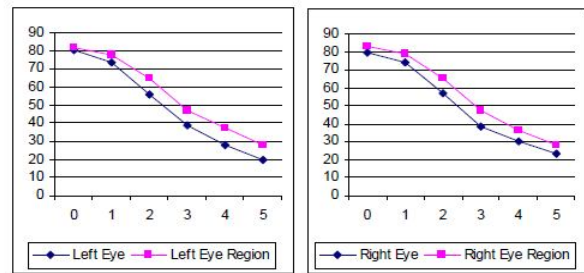
	Fb	Fc	Dup1	Dup2
PCA	30.4	41.2	9.8	6.8
Gabor	71.1	81.4	36.7	31.6
LBP	80.4	38.7	26.2	13.7

(a) Left Eye

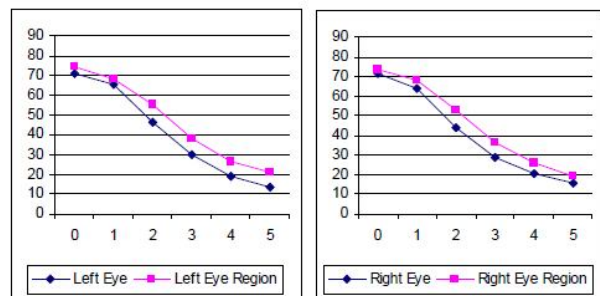
	Fb	Fc	Dup1	Dup2
PCA	21.2	25.3	10.1	9.8
Gabor	41.1	74.2	44.5	50.4
LBP	52.8	9.3	35.5	41.0

(b) Right Eye

Now through graph we compare the performance of Local components and local region. In general, accuracies of local components drop faster than those of their corresponding local region. In graph (a) LBP is used feature extraction and in graph (b) Gabor filter is used for feature extraction



(a) LBP



(b) Gabor

V. CONCLUSION

In this paper we have study all the feature extraction techniques and from all we find out which one is best. Through this paper we discuss the techniques like LBP(Local binary Pattern), ICA(Independent Component Analysis), PCA(Principal Component Analysis) and Gabor filters for feature extraction.

VI. REFERENCES

- [1] Damon L. Woodard Shrinivas Pundlik Philip Miller . “On the Fusion of Periocular and Iris Biometrics in Non-ideal Images”, In *proceeding of 20th International Conference on Pattern Recognition, Istanbul, Turkey, August 2010*, pp. 23-26.
- [2] U. Park, A. Ross, and A.K. Jain, “Periocular Biometrics in the Visible Spectrum: a Feasibility Study”, in *Proceedings of the 3rd IEEE International Conference on Biometrics: Theory, Applications and systems*, 2009, pp. 153–158.
- [3] Ashish Kumar Dewangan, Majid Ahmed Siddhiqui , Iris Recognition - An Efficient Biometric for Human Identification and Verification,1:2249-8958, 2012.
- [4] S. Baker, K. W. Bowyer, and P. J. Flynn, “Empirical evidence for correct iris match score degradation with increased time-lapse between gallery and probe matches,”in *Proc. Int. Conf. on Biometrics*, pp. 1170-1179, 2009.
- [5] Zhu E., Yin J., and Zhang G., “Fingerprint Matching Based on Global Alignment of Multiple Reference Minutiae,” *Computer Journal of Pattern Recognition*, vol. 38 no. 10, pp. 1685-1694, 2005.
- [6] A.K.Jain and U. Park. Facial marks: soft biometric for face recognition. In *ICIP*, 2009.
- [7] C. Sanchez-Avila , R. Sanchez-Reillo, “Two different approaches for iris recognition using Gabor filters and multiscale zero-crossing representation”, *The journal of pattern recognition society*, 23 July 2005, pp.231-240.
- [8] Jie Zou, “A Comparative Study of Local Matching Approach for Face Recognition”, *IEEE Transactions on Image Processing*, Vol. 16, No. 10, October 2007, pp. 2617-2628.
- [9] XIAO-FENG GU JIN-XIN SHI “The Comparison of Iris Recognition Using Principal Component Analysis,Independent Component Analysis and Gabor Wavelets”, *Computer Science and Information Technology (ICCSIT)*, 2010 3rd IEEE International Conference, 9-11 July 2010 pp.:61 – 64
- [10]Institute of Automation Chinese Academy of Sciences. Database of CASIA iris image [EB/OL].