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A Review On Advance Methods Of Feature Extraction In Iris Recognition System

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ABSTRACT*: Iris recognition is one of the most accurate identity verification system. Since its initial introduction by J. Daughman, many methods have been proposed to enhance the performance. Many methods have been proposed to feature extraction by many researchers. We present an overview of the latest research of feature extraction of iris recognition. We present the latest development in terms of accuracy, relaxibility and complexity explaining advances to solve problems existing of feature extraction stage o iris recognition system.*

Keywords*: Biometric, iris recognition, Gabor Wavelet, DCT, Haar Transform, LBP, PCA, Log Gabor Wavelet, feature extraction.*

I. INTRODUCTION

In recent years, accurate automatic personal identification is becoming more and more significant to the operation of security system. Biometric employs physiological or behavioral characteristics to accurately identify each subject. A commonly used biometric feature includes face, fingerprints, voice, iris, retina, gait, palm print, hand geometry, dental radiograph, etc. of all these biometrics. Iris recognition is a newly emergent approach to person identification in last decade.

The iris is a thin diaphragm which lies between the cornea and the lens of the human eye. A front on view of iris is shown in fig.1. The iris is perforated close to its centre by a circular aperture known as pupil. The function of the iris is to control the amount of light entering through the pupil. The average diameter of the iris is 12mm and the pupil size can vary from 10% to 80% of the iris diameter.

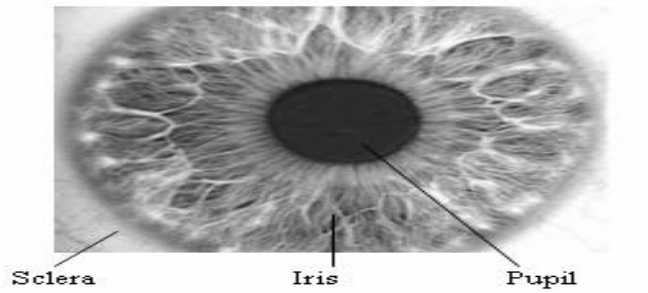

Fig 1: The Human Iris.

In this paper we have made a survey of various existing iris recognition algorithms for feature extraction in iris recognition. We have compared all these algorithms to get which algorithm give more efficient feature extracted vector and compared the accuracy and recognition rate for further classification and after this we have taken which method for feature extraction and it is better than other.

1.1 Primary Iris Recognition Process

A typical iris recognition system is schematically shown in Fig.2. The whole iris recognition process [1], [2], [4], [17] is basically divided into four steps:

1) Image acquisition;
2) iris image preprocessing;
3) iris feature extraction; and
4) matching.

Nowadays, various algorithms for iris recognition have been presented.

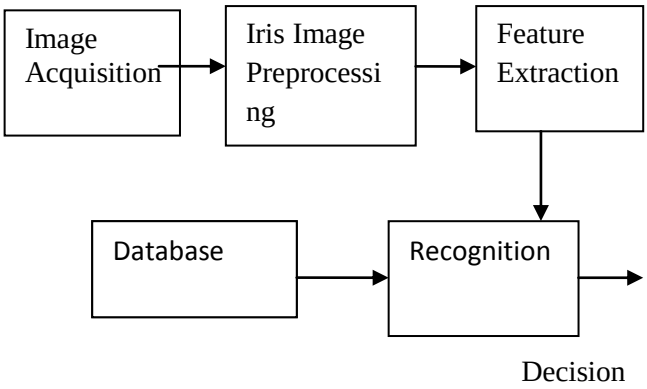

Fig. 2.Typical Iris Recognition system

The preprocessing of iris image includes four aspects: localization, normalization, Enhancement, denoising, and the selection of iris valid areas. There are few papers surveying the latest work / various algorithm of feature extraction on iris recognition based on CASIA database to evaluate accuracy, recognition rate parameters.

1)Pravin S. Patil, S.R.Kolhe, P.M. Patil and R. V. Patil in April 2012 present the paper, "The Comparison of Iris Recognition using Principal Component Analysis, Log Gabor and Gabor Wavelets" Author present three algorithm for feature extraction of iris recognition. An author uses the three algorithms namely Gabor Wavelet, Log Gabor Wavelet & PCA for feature extraction of iris images using CASIA iris database. He has studied above algorithms by taking Hamming distance & Euclidian distance as classifier. He compared the algorithms & results shown in a table 1.He use images of eyes from 30 persons & every persons has 10 images of eyes. He only analyzes & compares the accuracy & computational complexity of feature representation. He used the Euclidean distance & Hamming distance to measure the similarity of iris features & the experimental result shown in table.

Table1. Experimental Results

Method	Feature Vector Length (Bits)	Classifier	Recognition Rate
Gabor Wavelet	2048	Hamming Distance	99%
Log Gabor Wavelet	1024	Hamming Distance	92.4%
PCA	1100	Euclidean Distance	90.2%

By showing experimental result, he concludes that Gabor wavelet is better for feature extraction.

II. CHIA TE CHU AND CHING-HAN CHEN IN JUNE 2012 PRESENT THE PAPER,

" A Novel Iris Recognition Based on LDA and LPCC" Author present LDA and LPCC two algorithms for iris recognition. The LPCC [19] is a well-known algorithm and widely used to extract feature in speech signal. The advantage of feature extraction is for the dimension reduction and representation of original signal. In the paper, the LPCC is firstly presented for iris recognition. The LPCC coefficients can improve the robust and reliability of feature vector. The basic idea of LDA [22] finds a linear transformation such that feature clusters are most separable after the transform. LPCC and LDA to extract the feature vector of iris images evaluated on CASIA iris database and the experimental results are
shown in Table 1.

The 2-D wavelet transform is used for preprocessing. The preprocessing helps to reduce the dimensionality of feature vector and to remove noise. The computational complexity is comparatively high. Thus, the paper proposes 1-D wavelet transform as filter to reduce the dimensionality of feature vector, and it can further reduce the computational complexity.

Table 2. Comparison of performance in LPCC and LDA.

Methods	LPCC	LDA
Average recognition rates (%)	93.66	96.88
Best recognition rates (%)	97.45	99.31
Feature dimension	546	80

As compare to above two methods LDA gives higher recognition rate than LPCC.

III. M. Z. RASHAD, M. Y. SHAMS, AND R. M. EL-AWADY (OCT 2011) PRESENT THE PAPER

" iris recognition based on LBP and Combined LVQ classifier ". The author explains the methods for feature extraction Local Binary Pattern (LBP) and combined LVQ classifier. Also one method by M. Z. Rashad which was based on a Local Binary Pattern and histogram properties as a statistical approaches for feature extraction , and Combined Learning Vector Quantization Classifier as Neural Network approach for classification, in order to build a hybrid model depends on both features. The localization and segmentation techniques are presented using both Canny edge detection and Hough Circular Transform in order to isolate an iris from the whole eye image and for noise detection .Feature vectors results from LBP is applied to a Combined LVQ classifier with different classes to determine the minimum acceptable performance, and the result is based on majority voting among several LVQ classifier. Different iris datasets CASIA, MMU1, MMU2, and LEI with different extensions and size are presented. Since LBP is working on a grayscale level so colored iris images should be transformed into a grayscale level. Above methods gives a high recognition rate 99.87 % on different iris datasets compared with other methods.LBP texture analysis [6][7] operator is defined as a gray scale invariant texture measure derived from a general definition of texture in a local neighborhood. The average of the gray levels below the center pixel is subtracted from that of the gray levels above the center pixel. Two dimensional distributions of the LBP and local contrast measures are used as features. Recognition rate of various algorithms shown in Table 3.

Table 3. Recognition rate of various algorithms

Algorithm	Recognition Rate (%)
Daugman [27]	98.58
Daugman [28]	54.44
Wildes [27]	99.82
Wildes [28]	86.49
Masek [27]	83.92
M. Shamsi [13]	99.34
LBP combined LVQ	99.87

The comparative study shows that the proposed system has a high recognition rate compared with other methods.

IV. MAH MOUD ELGAMA , NASSER AL-BIQAMI (MAY 2013) PRESENT THE PAPER,"

An Efficient Feature Extraction Method for Iris Recognition Based on Wavelet Transformation". In this paper, a robust iris matching system was developed. The technique depends mainly on two stages, iris localization and iris recognition. In the recognition stage a robust algorithm have been introduced which reduces the size of the iris image database and correspondingly the computational cost with high accuracy. The located iris's feature extracted using DWT, and then reduced to a compact size. These feature vectors of small size were inputted to k-NN classifier for the recognition purpose. The recognition rate for pattern classification is 99.5%

Table 4.Recognition rate of various algorithms

Methods	Recognition rate
Daugman	100%
Boles	92.64%
Li Ma	94.9%

Avila	97.89%
Abiyev	99.25%
Proposed[11]	99.5%

In this paper, to evaluate the performance of the proposed system, the following metrics are used:
i. False Acceptance Rate (FAR): is the ratio of the number of false acceptances divided by the total number of identification attempts.
ii. False Rejection Rate (FRR): the percentage of times the system produces a false reject.
iii. Equal Error Rate (EER): The rates at which both accept and reject errors are equal.
To estimate those parameters, a database of 80 persons was divided into two classes, 60 and 20 persons respectively. Every person has a database of 10 images, i.e., 600 database images in total. To calculate FAR, the eleventh image of every individual was compared with 600 database images. Similarly FAR calculated by considering 20 persons as imposters and one was compared with 600 DB images. Table (II) shows the obtained values.
TABLE 5.ESTIMATED VALUES OF FAR AND FRR.

Individual.	FAR(%)	FRR(%)
1-10	0.04	0.03
10-20	0.06	0.04
20-30	0.03	0.04
30-40	0.04	0.04
40-50	0.05	0.07
50-60	0.13	0.06

V. KSHAMARAJ GULMIRE, SANJAY GANORKAR (JULY – 2012) PRESENT THE PAPER,

Iris Recognition Using Gabor Wavelet". In this paper, the main idea of this method is that: firstly we construct two-dimensional Gabor filter, and we take it to filter these images, and after we get phase information, code it into 2048 bits, i.e. 256 bytes.In image processing, a Gabor filter, named after Dennis Gabor, is a linear filter used for edge detection. Frequency and orientation representations of Gabor filter are similar to those of human visual system, and it has been found to be particularly appropriate for texture representation and discrimination. In the spatial domain, a 2D Gabor filter is a Gaussian kernel function modulated by a sinusoidal plane wave. The Gabor filters are self-similar – all filters can be generated from one mother wavelet by dilation and rotation.

The recognition rate is showed in table 6.

Method	Recognition Rate
Gabor Wavelet	96.5%

VI. DOLLY CHOUDHARY, SHAMIK TIWARI, AJAY KUMAR SINGH (NOV. 2012) PRESENT THE PAPER,"

A Survey: Feature Extraction Methods for Iris Recognition". In this paper, the author surveyed the feature extraction methods like Corner Detection Based Iris Encoding, Haar transform, Gabor filter, Statistical pattern recognition and Multichannel Gabor Filter.
A.Corner Detection Based Iris Encoding: In this approach authors presented an iris recognition algorithm using corner detection [8]. Here image is acquired by 3CCD camera so that image is of very good quality because iris texture is used as feature to be extracted.

Fig 3. Steps involved in detection of inner pupil boundary
B. Feature extraction using Haar wavelet:
Singh et al. [6] calculated the features of the iris using Haar wavelet transform for recognition. Authors compared the results using Haar transform with the wavelet tree obtained using other wavelets and found

slightly better results. Authors obtained the five level wavelet tree showing all detail and approximation coefficients using Haar wavelet.

C. Feature extraction using Gabor filter:

Tuama [12] extracted the features of the normalized iris by filtering the normalized iris region. This filtering is performed by convolution with a pair of Gabor filters. A Gabor filter is a sine (or cosine) wave modulated by a Gaussian. This kind of filters optimally extracts information in space as well as in frequency domain. To extract iris features we designed two Gabor filters. First filter is a sine wave modulated by a Gaussian. Second is the same as first but using a cosine wave. In these filters, the central frequency of the filter is specified by the sine (or cosine) wave frequency and bandwidth varies as Gaussian width does. At implementation level, each filter must be a matrix [14].

The 2-D Gabor filters have been used in image processing for feature extraction for texture analysis[15]. Gabor elementary functions are Gaussians modulated by sinusoidal functions. The Gabor filters have adjustable orientation, radial frequency bandwidths, and center frequencies.

By studying five methods of feature extraction, the author conclude that an overall recognition for different feature extraction methods in percent is shown in the Table-7

Table 7: Feature Vectors of Various methods

Group	FAR/FRR	Overall recognition rate (%)
Singh et al.		95
Gupta et al.	4/5	95.4
Greco et al.	3/4	96.3
Amel Saeed Tuama	2.43/3.17	94.85
Li Ma		95.68

VII. CONCLUSION

The physiological characteristics are relatively unique to an individual. Iris patterns may be used for reliable visual recognition. Available feature extraction methods for iris pattern on the basis of CASIA iris database are studied in this paper. This paper is an analysis of the result of the various feature extraction methods based on CASIA iris database. The survey of the techniques provides a platform for the development of the novel techniques in this area as future work.

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