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Latest development in feature extraction techniques in iris recognition system

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Abstract- Biometric system is a reliable and highly accurate system for identification of individuals. Iris recognition system is a relatively new biometric system which produces better results in comparison with other biometric systems. A primary iris recognition system includes mainly four steps which include image acquisition, image pre-process, feature extraction and matching. Feature extraction is one of the most important steps which must be successfully carried out before iris image is stored as template. This paper gives comprehension review of different iris feature techniques used in iris recognition system. This paper also includes the latest development in terms of accuracy and complexity of iris recognition system in order to solve existing problems in feature extraction process. The information and conclusion drawn in this paper will ease others who are exploring the usefulness of iris recognition system for secure biometric identification.

Key Words: Biometric system, Gabor filter, Normalisation, Feature extraction, Iris recognition, Haar transform, wavelet, Hamming distance.

1 Introduction

Iris recognition system is one of the most accurate systems for identification of individuals. Iris recognition system is relatively new biometric system in comparison with other biometric system. It produces better results in comparison with other biometric system like face, fingerprint, voice retina etc[1]. A primary iris recognition process includes mainly 4 steps.

i. Image acquisition: Capturing an eye image from a high resolution camera.
ii. Image preprocess: Localization, noise removal and normalization of eye image.
iii. Feature extraction: Extracting most distinct feature of iris.
iv. Matching: Comparing iris template for verification

Iris feature extraction is used for extracting most discriminate feature of an iris image. It is a special form of dimensionality reduction and contains most of the information of an original iris image. Once the feature is extracted feature coefficient are encoded so that comparison between templates can be made conveniently and correctly.

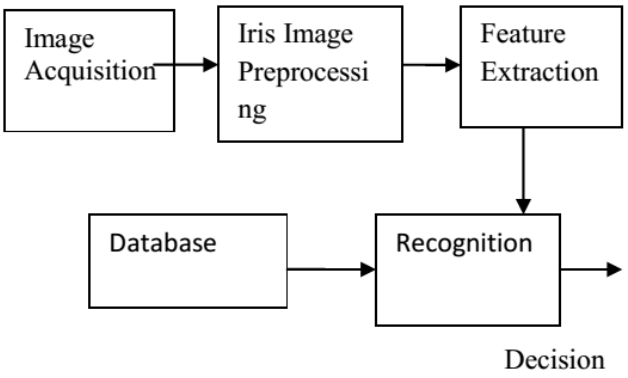

Fig -1: Iris recognition system

2 Feature extraction

Feature can be stated as function of one or more measurement which specifies some quantitative properties of an object and is computed such that it evaluates some significant feature of an object. In biometric technology feature extraction is one of the supreme steps in authentication of biometric system. It is the process of extracting feature of desired images from a large collection to be used in selection and classification task. It is used in selection and classification of task. It is used for dimension reduction and contains most of the information of the original image. Features are broadly classified as general features and domain specific features. General features are application independent feature like color, texture and shape. It is broadly classified into 3 categories:

i. Pixel level features: Features are computed at each pixel.
ii. Local features: Includes feature calculated over the results of image subdivision.

iii. Global features: Includes features calculated over the whole image or on regular sub area of an image.

Domain specific features are application dependent feature such as human face, finger print and conceptual features.

Feature extraction extract the most distinct features present in an image. It gives both local and global information of iris. Discriminated iris texture information must be extracted and encoded to have correct comparisons between iris templates. Complexity of feature extraction affects the complexity of program and processing speed of iris recognition system.

A brief of different journals/articles, providing information about different feature extraction techniques in iris recognition system is presented here.

1. Yong Zhang and Yan Wo [4], [2015] has proposed a new method for iris features extraction. He presented a new method for iris feature extraction by using 2D and 1D feature. 2D Gabor filter extract phase information as 2D and 1D log Gabor filter extract phase information as 1D. Hamming distance is used for the matching of feature vector. He also proposed Fisher's linear discriminate (FLD) to evaluate weights of combination. IITD database is used for conducting experiments which has 224 subjects, each subjects contains 10 images .Upon experiment, this method produces satisfactory results as accuracy was 98.921 which is better than 2D and 1D log-gabor filter alone.

2. Charles O Ukpai[6], [2015] has presented a novel approach for iris feature extraction. It is based on principle texture pattern and dual tree complex wavelet transform. The principal direction of the iris texture using principal component analysis is computed and an angle θ of principal direction is obtained. After that complex wavelet filter are constructed which are situated in the direction θ of principal direction and opposite direction image is decomposed into 12 sub band using dual tree complex wavelet transform. The highest recognition rate of 98.86 % has been achieved by the applied algorithm.

3. In his paper [Tze Wang [3], 2010] has used Haar wavelet decomposition method to analyze the pattern of iris. The proposed iris recognition system has two main module which are feature extraction and iris matching. Haar wavelet transform is chosen for computational simplicity in feature extraction. To produce corresponding coefficients, iris images are filtered using high pass filter and low pass filter for four times. The matching distance algorithm used is hamming distance and his database is of CASIA. The recognition rate of 98.45% is achieved using this algorithm.

4. [Kshamaraj Gulmire and Sanjay Ganorkar [7], 2012] present the paper "Iris recognition using Gabor wavelet the Gabor wavelet for feature extraction in iris recognition system. The two dimensional Gabor filter was constructed and the image was filtered. The phase information produced from the filter was encoded into 2048 bits i.e 256 bytes. It is found to be appropriate for texture representation. The iris database used in this research is CASIA iris database. The hamming distance is used for matching purpose.

5. In this paper [Amir and Hamid] [2] has developed an iris feature extraction method based on contourlet transform. The intrinsic geometrical part of iris is taken into consideration and decomposed into a set of directional sub bands. The sub-band with texture information are captured in different orientation at various scales to reduce the direction of feature vector. It extracts only significant bit and information from normalized iris image. The matching of iris template is done by hamming distance. The proposed algorithm has lower accuracy level of 94.2% against Daugman (100%) and Wilde (94.18%).

6. The paper "An efficient feature extraction method for Iris recognition based on wavelet transformation' by [Mah Mond Elgana and Nasser Al-Biqami [5], 2013] apply wavelet transformation for iris feature extraction in iris recognition system. The technique depends mainly on two stages iris localization and iris normalization. Localization is used for locating the iris and pupil boundary and normalization is used for constant dimension of located iris and pupil. The normalized iris feature has been extracted using DWT and then reduced to a compact size. Total 600 image of CASIA database was taken which comprises 10 images of each individual. The recognition rate was 99.5%.

7. [S. Hariprasad and S. Venkatsubranamian [24], 2010] Present the paper "Iris feature extraction and recognition using wavelet packet analysis". In this paper wavelet packets are used for iris feature extraction process in iris recognition system. The feature of iris texture is encoded into a sequence of 2D wavelet packet coefficients. A novel approach based on 2D wavelet packet transform for iris feature extraction and recognition is proposed. The size of feature vector is 1280 bits. The database used is UBIRIS, which consists of 8 different iris images of 30 persons. For matching of iris template, exclusively OR is used. The result produces low EER values and accuracy of 93%.

8. [J. Daugman [1], 2004] used gabor filter for extracting features of iris images which have different sets of frequencies and different orientations that can be used for extracting useful information from iris images. He demodulated the result produced by convolving the gabor filter by phase quantization ion order to reduce the amount of data that was produced. A biometric template was created by quantizing phase information into four levels. The number of bits used for comparisons was 2048.

Table -1: Different feature extraction algorithms and their recognition rate

Researcher	Algorithm	Year	Recognition rate(in percentage)
S.Hariprasd and S.Venkatsubramian	Wavelet packet	2010	93
Charles O Ukpai	Dual tree complex wavelet transform	2015	98.86
Tze Weng	Haar wavelet	2010	98.45
Yong Zhang and Yan Wo	Fusion of 2D gabor and 1D log-gabour	2013	98.92
Amir and Hamid	Contourlet transform	2009	94.2
Mah Mond Elgana and Nasser Al Biqami	Wavelet transform	2013	99.5
Kshamaraj Gulmire and Sanjay Ganorkar	Gabor wavelet	2012	99
J.Daugman	Gabor filter	2004	100

Table -2: Complexity of different algorithms

Algorithm	Feature vector(bits)
2D Gabor	2048
Log-Gabor	1024
Wavelet transform	400

3. CONCLUSION

Iris recognition system is most accurate biometric methods for identification of individuals. The various methodologies of iris feature extraction had been reviewed in this paper. Different methods reviewed in this paper have their own importance depending on the area of application chosen. The summarized review of feature extraction techniques in iris recognition system can serve as a platform for development of other novel feature extraction methods. This will eventually help to increase the accuracy and reduce the complexity in iris recognition system.

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