International Journal of Engineering Research and Development
e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 9, Issue 2 (November 2013), PP. 30-35

Iris feature extraction and recognition based on different transforms

Mrs. Minakshi R. Rajput
Asst. Professor PES College of engg, Aurangabad

Abstract:- This paper reviewed the literature regarding iris recognition. It explains need and significance of this research .Hypothesis on iris recognition is also explored . Different stages of iris recognitions are also explained and at the last it clarifies how Contoulet Transform is more admissible for iris feature extraction.

Keywords:- Biometrics,contourlet transform,feature extraction,iris recognition

I. INTRODUCTION

Iris recognition, the ability to recognize and distinguish individuals by their iris pattern, is one of the most reliable biometrics in terms of recognition and identification performance.

Image feature extraction is one of the basic works for biometric analysis. In different methods of Biometrics, recognition by iris images in recent years has been taken into consideration by researchers as one of the common methods of identification like passwords, credit cards or keys. Iris recognition a new biometric technology has great advantages such as variability, stability and security. Although the area of the iris is small it has enormous pattern variability which makes it unique for every one as shown in figure 1. And hence leads to high reliability [1].

Fig 1: Distinctiveness of Human Iris

In this paper ,different feature extraction method are explained for iris recognition which are based on different transforms .Also a new method based on contourlet transform is proposed. Contourlet transform captures the intrinsic geometrical structures of iris image. It decomposes the iris image into a set of directional sub-bands with texture details captured in different orientations at various scales .So for reducing the feature vector dimensions we can use the method to extract only significant bit and information from normalized iris images. Contourlets not only possess the main features of wavelets (namely, multiscale and time-frequency localization), but also offer a high degree of directionality and anisotropy. For analyzing the desired performance of our proposed method, we use the CASIA dataset, which is comprised of 108 classes with 7 images in each class and each class represented a person.

II. NEED AND SIGNIFICANCE OF THE RESEACH

Research on Iris feature extraction using different tranforms is needed because of following reasons.

1. Iris recognition is the most robust and accurate biometric technologies available in the market today with existing large scale applications supporting databases in excess of millions of people. The Iris is a protected internal organ whose random texture is stable throughout life and can be used as an identity document or a password offering a very high degree of identity assurance. The randomness of Iris patterns has very high dimensionality; recognition decisions are made with very high confidence levels supporting rapid and reliable exhaustive searches through national - sized databases in both 1:1 (verification) and 1: n (identification) mode with no human intervention.

2. Real-time, high confidence recognition of a person's identity is needed now a days. mathematical analysis of the random patterns that are visible within the iris of an eye from some distance is possible and because of this Iris recognition can be used as a real time person identification system. The randomness of iris patterns has very high dimensionality; recognition decisions are made with confidence levels high enough to support rapid and reliable exhaustive searches through national-sized databases.

3. Iris recognition system Perform 1: n identification with no limitation on numbers.

4. Biometric templates once captured do not need to be enrolled again, iris is stable throughout a users.

By considering the above needs, this topic is the significant research in person identification system.

III. SURVEY OF LITERATURE

Different transforms for iris recognition had been introduced using different transforms and algorithms.

1. John Daugman method for iris recognition is based on 2-D Gabor wavelets and test of statistical independence. Daugman has proposed a phase-based method where iris images are decomposed using multi-scale quadrature wavelets, and phase information is extracted from the wavelet coefficients. Hamming distance between phase vectors is then used to discriminate any pair of iris image [1].

The proposed algorithm aims to find out the most efficient wavelet family and its coefficients for encoding the iris template of the experiment samples. The algorithm implemented in software performs segmentation, normalization, feature encoding, data storage, and matching. By using the Haar and Biorthogonal wavelet families at various levels feature encoding is performed by decomposing the normalized iris image. The vertical coefficient is encoded into the iris template and is stored in the database. The performance of the system is evaluated by using the number of degrees of freedom, False Reject Rate (FRR), False Accept Rate (FAR), and Equal Error Rate (EER) and the metrics show that the proposed algorithm can be employed for an iris recognition system.With level 1 Haar wavelet gives FAR of 0.07 and FRR 0.02.And with level 4, FAR and FRR both are 0.02 . Biorthogonal wavelet 1 gives FAR 0.08 and FRR 0.07 and with level 4 it gives FAR 0.08 and FRR 0.03. Haar wavelet with level 1 and 4 gives accuracy 93.6% and 98.2% respectively. Also Biorthogonal wavelet with level 1 and 4 gives accuracy 92.5% and 94.5% respectively [15].

2. SIFT based iris recognition with normalization and enhancement

In this a new method named SIFT-based iris recognition with normalization and enhancement is proposed for achieving better performance. In Comparison with other SIFT-based iris recognition algorithms, the proposed method can overcome the difficulties of extreme point extraction and exclude the noise points without feature loss. Experimental results demonstrate that the normalization and enhancement steps are crucial for SIFT-based iris recognition, and the proposed method can achieve satisfactory recognition performance [14].

3. Novel based scale invariant feature transform (SIFT) method

This method is used for feature extraction. where feature points can be represented well with enhancement and some fake feature points can be excluded with normalization. the CASIA-v1 iris database to compare the results with different methods of different iris recognition methods based on SIFT. The database includes 108 classes and each class has 7 pictures captured in two sessions. All images are stored in BMP format with resolution 320 x 280. Although the accuracy of this method becomes higher, the cost of time consumption will increase compared with method of enhancement without normalization. This method extracted iris features from annular images by iris location and segmentation. However, this algorithm usually tends to find insufficient feature points from iris images, which degrades the performance of recognition system. Belcher and Du tried to apply region-based SIFT to improve accuracy of iris recognition. This method divided each iris image into three parts, from which features can be extracted. However, it introduced additional noisy points and caused features loss inevitably. Feature points are extracted from two iris images to be matched with SIFT algorithm respectively. Based on feature points extracted from each image, the same feature points are selected as matching pairs and the number of matching pairs is used to measure the similarity of these two iris images. Then the suitable threshold T (the number of matching pairs) is selected after testing the matching results of the whole iris database. Two iris images will be classified as the same class if the number of matching pairs is bigger than T, otherwise these two iris images will be classified as different classes. Although the accuracy of this method becomes higher the cost of time consumption will increase compared with method of enhancement without normalization [14].

4.Iris recognition based on 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. The proposed system gives a high recognition rate 99.87 % on different iris datasets compared with other methods.

5.Iris recognition using ridgelet transform

Ridgelet transform also applied for iris recognition which is the combination of Radon transforms and Wavelet transforms. They are suitable for extracting the abundantly present textural data that is in an iris. The technique proposed here uses the ridgelets to form an iris signature and to represent the iris. The Hamming distance (HD) between the input bit stream vector and stored vectors is calculated for iris identification. The HD between two strings of bits is the number of corresponding bit positions that differ. Using the HD between two bit patterns, a decision can be made as to whether the two patterns were generated from the same iris or from different irises. Because we used the HD as a matching algorithm, we need to have binary feature vectors. Therefore, all feature vectors are digitized before using the HD technique. HD can be made using XOR function and feature extraction by ridgelet transform. The algorithm has run by using Matlab 7.6, on a Pentium 4, 2.66 MHZ, 3 Mb RAM computer [11].

This system contributes towards creating an improved iris recognition system. There is a reduction in the feature vector size. Experimental results indicate that this method achieves an accuracy of 99.82%, 0.1309% False Acceptance Rate, and 0.0434% False Rejection Rate. This method skips the process of iris normalization, which contributes towards significant reduction in processing time and thus improving the system performance.

This method gives an accuracy of 99.82%, with a signature of a comparatively very small length. This method also achieves computational inexpensiveness, as the Gabor filter based method is 600 times more expensive than the proposed method in terms of signature size. The future scope of this research is to obtain the highest accuracy with a zero False Acceptance Rate and False Rejection Rate. It can be extended to achieve zero FAR and zero FRR by increasing the levels of decomposition. However, this would cost in terms of signature size [12].

6. IRIS Recognition Using Neural Network

This Iris Recognition based on covariance of discrete wavelet using Competitive Neural Network (LVQ). A set of Edge of Iris profiles are used to build a covariance matrix by discrete wavelet transform using Neural Network. It is found that this method for Iris Recognition design offers good class discriminacy. This method can discriminate noisy Image very well. Simulation results are very promising. LVQ, or Learning Vector Quantization, is a prototype-based supervised classification algorithm.LVQ can be understood as a special case of an artificial neural network

7.Fast discrete curvelet transform based anisotropic feature Extraction for iris recognition

This is a new directional iris texture features based on 2-D Fast Discrete Curvelet Transform (FDCT) is proposed. The proposed approach divides the normalized iris image into six sub-images and the curvelet transform is applied independently on each sub-image. The anisotropic feature vector for each sub-image is derived using the directional energies of the curvelet coefficients. These six feature vectors are combined to create the resultant feature vector. During recognition, the nearest neighbor classifier based on Euclidean distance has been used for authentication. The effectiveness of the proposed approach has been tested on two different databases namely UBIRIS and MMU1. The feature vectors are derived from each of the normalized iris images during enrollment process. The test iris feature vector is compared with stored vectors using Euclidean distance (ED). Recognition rate for 2-D FDCT UBIRIS database is 96.44% and for MMU-1 database is 92.89%. Error rates for local Feature Extraction Algorithms of this methods for UBIRIS database is FAR 4.05% and FRR 4.00% and for MMU-1 database is FAR 10% and FRR 10.22%. Error rates for local Feature Extraction Algorithms of this methods for UBIRIS database is FAR 3.51% and FRR 3.56% and for MMU-1 database is FAR 6.82% and FRR 7.11% [14].

IV. OBJECTIVES OF THE RESEARCH

1.The very first objective of this proposed research is to reduce feature vector dimensions by decomposing the iris image into a set of directional sub-bands with texture details captured in different orientations at various scales. Also to provide good class of discriminacy.

2.To reduce False Acceptance Rate and False Rejection Rate and increase Recognition Rate of Iris Recognition System in case of low quality iris images. The development tool used will be a MATLAB.

3.To reduce person recognition time by this new feature extraction based on contourlet transform , as compared to other methods of feature extraction.

V. HYPOTHESIS

The very first hypothesis in iris recognition is the pupil boundary is noncircular, and usually, the iris outer boundary is noncircular. Performance in iris recognition is significantly improved by relaxing both of those assumptions, replacing them with more disciplined methods for faithfully detecting and modeling those boundaries whatever their shapes are and defining a more flexible and generalized coordinate system on their basis.

Because the iris outer boundary is often partly occluded by eyelids, and the iris inner boundary may be partly occluded by reflections from illumination, and sometimes both boundaries also by reflections from eyeglasses, it is necessary to fit flexible contours that can tolerate interruptions and continue their trajectory across them on a principled basis, which is somehow driven by the data that exist elsewhere. A further constraint is that both the inner and outer boundary models must form closed curves. A final goal is that we would like to impose a constraint on smoothness based on the credibility of any evidence for non smooth curvature.

An excellent way to achieve all of these goals is to describe the iris inner and outer boundaries in terms of "active contours".

For this purpose ,Contourlet transform is used to capture the intrinsic geometrical structures of iris image. It decomposes the iris image into a set of directional sub-bands with texture details captured in different orientations at various scales so for reducing the feature vector dimensions we can use the method to extract only significant bit and information from normalized iris images. In this synopsis, a new feature extraction method for iris recognition based on contourlet transform is introduced.

VI. METHODOLOGY AND TOOLS

In this section, I describe the proposed contourlet-based iris matching system. The flowchart of the proposed system is

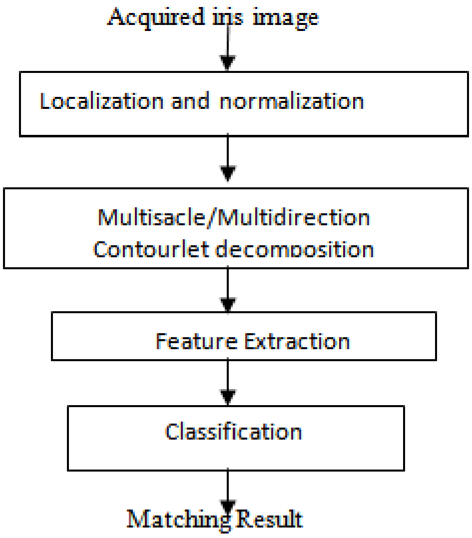

Fig2: flowchart of the proposed technique

1.Firstly, an automatic segmentation algorithm will be used to localize the iris region from an eye image and isolate eyelid, eyelash and reflection areas. Automatic segmentation can be achieved through the use of the circular Hough transform for localizing the iris and pupil regions, and the linear Hough transform for localizing occluding eyelids. Thresholding was also employed for isolating eyelashes and reflections.

2. Pupil elastic deformation affects the iris size. To compensate the iris size variation, iris normalization is an obligation. we can do iris normalization according to Daugman model .This will be achieved by implementing a Daugman's rubber sheet model, where the iris is modelled as a flexible rubber sheet, which will be unwrapped into a rectangular block with constant polar dimensions.

3. Iris images should be enhanced before feature extraction. For this purpose we have different methods such as median filter, histogram equalization, and the 2D wiener filter as well.

4. Finally contourlet transform will be used for feature extraction because of Directionality and anisotropy properties of contourlet transform. The main difference between contourlets and other multiscale directional systems is that the contourlet transform allows for different and flexible number of directions at each scale, while achieving nearly critical sampling . It is implemented by decomposing the image into multiscale with Laplacian Pyramid (LP) and then decomposing subbands at each scale into directional parts with directional filter bank (DFB). Contourlet transform can be used to capture the intrinsic geometrical structures of iris image. Decomposition of the iris image into a set of directional sub-bands with texture details will be captured in different orientations at various scales so for reducing the feature vector dimensions.

CONTOURLET TRANSFORM

Contourlet transform (CT) allows for different and flexible number of directions at each scale. CT is constructed by combining two distinct decomposition stages, a multi-scale decomposition followed by directional decomposition. The grouping of wavelet coefficients suggests that one can obtain a sparse image expansion by applying a multi-scale transform followed by a local directional transform. It gathers the nearby basis functions at the same scale into linear structures. In essence, a wavelet- like transform is used for edge (points) detection, and then a local directional transform for contour segments detection. A double filter bank structure is used in CT in which the Laplacian pyramid (LP) is used to capture the point discontinuities, and a directional filter bank (DFB) to link point discontinuities into linear structures. The combination of this double filter bank is named pyramidal directional filter bank (PDFB) as shown in Fig3.

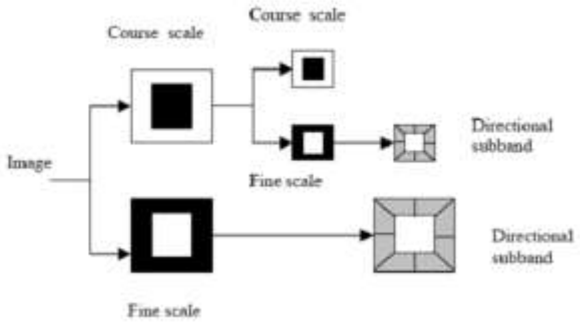

Fig3. Two Level Contourlet Decomposition

After calculating the contourlet coefficients from iris enhanced image, they should be converted to binary codes.

Classification

Finally, classification of the feature vectors will be performed to generate the final matching decision. A mean classifier is employed. This is a relatively simple, yet effective, classifier. First, the mean vector of each class is computed from the training samples. Next, the method employs the distance of each test feature vector from the mean vector of each class and assigns the test sample to the class of the nearest mean vector.
The obtained binary code should enter a comparison process to determine the user whose iris photograph was taken. So the last module of an iris recognition system will be a matching two iris templates. Its purpose is to measure how similar or different templates are and decide whether they belong to the same individual or not. Although there are many different methods for this purpose such as Euclidean distance, weighted Euclidean distance, and Fisher Linear Discriminate, in this work we choose HD. The Hamming distance is chosen as a matching metric, which gave a measure of how many bits disagreed between two templates. A failure of statistical independence between two templates would result in a match, that is, the two templates were deemed to have been generated from the same iris if the Hamming distance produced was lower than a set Hamming distance.
A rapid application development (RAD) approach will be employed in order to produce results quickly. MATLAB provides an excellent RAD environment, with its image processing toolbox, and high level programming methodology.

VII. CONCLUSION

In this proposed topic , firstly different methods which had been used previously for Iris feature extraction are compared and then the potentials of the contourlet transform are discussed for iris texture representation and matching. A new contourlet-based iris recognition system is presented. The iris is first localized, and normalized to a fixed size. Next, the enhanced texture will be subjected to a multiscale, multidirectional contourlet decomposition step. Simple statistical features will be computed from the subbands and stored as a feature vector.
The contourlet transform will be a most effective feature extraction method for iris recognition system which will work for low quality iris images and in high security demanding applications.

REFERENCES

[1]. J. Daugman, "How iris recognition works," IEEE Trans. Circuits Syst. Video Technology., vol. 14, no. 1, pp. 21–30, 2004.
[2]. Chia-Te Chou, Sheng-Wen Shih," Non-Orthogonal View Iris Recognition System", IEEE transactions on circuits and systems for video technology, vol. 20, no. 3, pp 417, March 2010.
[3]. Shreyas Venugopalan," How to Generate Spoofed Irises From an Iris Code Template", IEEE transactions on information forensics and security, vol. 6, no. 2, pp 10,11,23-27,June 2011.
[4]. Yulin Si, Jiangyuan Mei, and Huijun Gao," Novel Approaches to Improve Robustness, Accuracy and Rapidity of Iris Recognition Systems", IEEE transactions on industrial informatics, vol. 8, no. 1, pp.34-37,February 2012.
[5]. Yung-Hui Li," An Automatic Iris Occlusion Estimation Method Based on High-Dimensional Density Estimation", IEEE transactions on pattern analysis and machine intelligence, vol. 35, no. 4,pp.1-10, April 2013.

[6]. Samir Shah and Arun Ross,” Iris Segmentation Using Geodesic Active Contours”, IEEE transactions on information forensics and security, vol. 4, no. 4, pp. 1,10 pp.435,440, December 2009.
[7]. Zhenan Sun, Yunhong Wang, Tieniu Tan, and Jiali Cui,” Improving Iris Recognition Accuracy Via Cascaded Classifiers”, IEEE transactions on systems, man, and cybernetics—part c: applications and reviews, vol. 35, no. 3, pp.435,440, August 2005.
[8]. Minh N. Do,” The Contourlet Transform: An Efficient Directional Multiresolution Image Representation”, pp.54-56.
[9]. Mina Fakhlai , Hamid Reza Pourreza ,” Off line signature recognition based on contourlet transform”, 2009
[10]. International Conference on Machine Learning and Computing IPCSIT vol.3 pp.56-67,(2011) IACSIT Press, Singapore.
[11]. Lenina Birgale* and Manesh Kokare,” Iris Recognition Using Ridgelets”, Journal of Information Processing Systems, Vol.8, No.3, pp.15-17,September 2012.
[12]. Mojtaba Najafi and Sedigheh Ghofrani,” A New Iris Identification Method Based on Ridgelet Transform”, International Journal of Computer Theory and Engineering, Vol. 5, No. 4, pp. 7-9,August 2013.
[13]. Amir Azizi ,Hamid Reza Pourreza,” A novel method for iris feature extraction Based on contourlet transform and co- Occurrence matrix”, IADIS International Conference Intelligent Systems and Agents pp.2-10,2009.
[14]. Ayra Panganiban, Noel Linsangan and Felicito Caluyo Wavelet-based Feature Extraction Algorithm for an Iris Recognition System, Journal of Information Processing Systems, Vol.7, No.3, pp.425-433,September 2011.