International Journal of Research in Engineering, Science and Management
Volume-2, Issue-11, November-2019
www.ijresm.com | ISSN (Online): 2581-5792

A Review on Various Iris Recognition Techniques Using Image Processing

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***Abstract*: Biometric is defined as study of various methods for measurement of physiological and behavioral characteristics that can be considered to identify a person. Biometric identification of a person gained major importance in the world from its application such as access control and security. The iris recognition is the process of recognition of individual by analyzing random pattern of iris. As compared to several other biometrics, iris recognition system is believed to be more reliable, accurate and scalable for person identification. Iris recognition is one of the booming biometric modalities due to its unique characteristics. The iris structure from human eye can be used for biometric authentication and identification at reduced resolution, iris under uncontrolled illumination, iris at a distance, iris off axis, presence of eyelashes, low accuracy. These type of visible wavelength based iris recognition system eliminate the limitation of iris recognition system that require close range iris imaging under infrared illumination which can be hazardous. I prefer image processing technique for overcoming these difficulties. The challenges emerge when the iris images acquired in one domain is matched against the images acquired in different domain. Such cross-domain iris recognition problem includes the cases when the images in one domain represent the sensor-specific iris images or wavelength-specific iris images. Here a new class of bi-spectral iris recognition system that can simultaneously acquire visible and near infra-red images with pixel-to-pixel correspondences is proposed and evaluated. This paper describes the approaches used by other research group around the world in related area. It also presents a brief overview of digital image processing techniques such as image segmentation, normalization, feature extraction, image restoration and image enhancement.**

***Keywords*: Segmentation, normalization, feature extraction**

1. Introduction

Biometric characteristic has highly reliable and unique features that make it best suited for security systems over a conventional security system. Jain et al (1999) identified seven factors that would be used to identify a person's physical or behavioral characteristics. A biometric trait to be used in biometric security systems. The biometric iris recognition is considering to be best identifier for biometric identification. These property makes the biometric as best identifier that are universality, uniqueness, performance, performance quality for being efficient. Sometimes though a biometric trait cannot satisfy all above property, some of them must be satisfied to make a characteristic a biometric trait.

Iris satisfies almost all the factors hence used as a popular biometric trait in biometric recognition systems among various other identifiers. Iris is a well-protected muscle present inside the eye with unique and rich patterns like rings, freckles and crypts. It has a distinguishable color which is immutable and invariant over time. It has been proved that for an individual. There are differences in iris patterns even between right and left eye. Even iris patterns differ for twins who are identical. Thus recognition techniques developed using iris patterns could be considered as a best suited identification and authentication technique especially in areas like personal authentication systems, time and attendance maintenance systems, law enforcement systems and banking application.

Basic principles of operations of an iris recognition technique are image acquisition, pre-processing iris segmentation, normalization, feature extraction and comparison of templates against enrolled data for recognition or authentication purpose.

Move on to iris recognition history in the ancient civilizations Egypt to Chaldea in Babylonia, China and Greece believed in a divination concept called Iridology which deals with iris patterns of the eye to predict the health status of an organ in the body. They used to compare the iris of the subject with Iris charts and predict the nature of the behavior of the body organs. In (1885) a French police official, Alphonse Bertillon suggested the use of iris for personal identification based on its texture and color. Later in (1949), James Doggart, examined iris pattern complexity and suggested that it can be used instead of finger print. In (1987) two ophthalmologists Leonard Flom and Aran Safir thorough study they patented Doggart's concept. Variation in iris patterns were observed and was suggested to be used for personal identification for the past one century. A practical or commercial iris recognition algorithm was developed and patented by John Daugman who is a computer scientist only in (1988). After which there is a sudden growth for the past two decades in developing several automated iris recognition systems. But still John Daugman's algorithm forms the basis for all the commercially available iris recognition systems.

The research growth in various sections of the automated iris recognition techniques have been classified into,

- New iris recognition algorithm development

- Segmenting the iris portion from the eye with or without noise factors.
- Extracting the features and normalizing them.
- Creating models for iris recognition system using machine learning algorithms.
- Multimodal and fusion of biometric techniques.

All the algorithms developed so far could be considered advantageous or disadvantageous based on considering the domain area in which it will be applied to work.

In this above system thee feature extraction and the iris template matching stage. Normally, a single iris is said to have more than 266 distinct information in its patterns, where approximately 173 are used in creating templates. This information must be extracted from the normalized iris and should be used for comparison purposes for either personal authentication or identification based on the application area. Thus at the end of the feature extraction stage, a biometric template is created, which is then used for template matching. A biometric template could be an iris code, or an iris signature or a decision tree. These templates are then matched with the help of several available matching techniques, which helps in identifying the similarity levels of two different iris templates. When the two different templates belonging to same eye are matched, it results in a range of values called "intra class variations. Similarly, if the templates are from different eyes, range of values is called "inter class variations". Based on these two variation a decision can be made whether the templates belong to sane or two different iris or irises respectively.

2. Literature Review

In [1], [2] Daugman (1993) design an iris recognition system which is a basis for most developmental activities in this area. Here he acquires human eye with the help of camera and identifies it. It localizes two boundaries before segmenting an iris, inner pupillary boundary and outer boundary with the help of integro differential operation. In most eyes pupil is not in the center of the iris so pseudo polar coordinates system is bring down to a homogenous rubber sheet model by analyzing the annular rings of the iris and assigning a doubly dimensionless real coordinates. A 2D Gabber filter is used to extract the features from this doubly dimensionless polar coordinates system resulting in a 256 bite iris codes. Main problem arises here is the problem of recognizing a given code as belonging to particular subject or not. Here forms a normalized Hamming distance matrix which uses a fraction of bits that disagree and helps in finding similarity between two codes. The iris code generated by normalized hamming distance matrix helps in easy handling of the iris bit and its matching. This approach provides a noise detection model at the segmentation stage thus resulting with better performance rate. The main challenges in this approaches are presence of noises in image processing technique effects the identification system and eyelid eyelashes occlusion also effect here.

In [3] Wilde (1997) propose an approach which a LED point source was used while acquiring the eye image of the subject along with a video camera. Inner and outer iris boundary is computed with the help of a gradient based binary edge map followed by circular Hough transform. Wilde approaches an isotropic band pass decomposition. This decomposition derived from Laplacian of Gaussian at multiple scales to develop an iris template. Here through this method, this template is used for finding similarity through normalized correlation of the appropriate match. Wildes done his experiments through 60 irises acquired from 40 subjects. Comparing with this work Daugman's approach is simple. The segmentation process done by Wilde is more stable pertaining to noise disturbances. This segmentation approach is the main advantage of this system. Wilde's approaches mainly emphasis toward it's segmentation technique and normalized correlation matching techniques. One of the limitation for this approach is that there is a presence of noise due to specular reflection.

In [4] Kong and Zhang (2001) developed a system. This method mainly concentrated on the noise disturbances, occlusion of eye lashes and specular reflections, involved while segmenting an iris image. Hough transform was use to isolate an iris. 1 D Gabor filters in spatial domain and thresholding functions are to detect eyelid occlusion and specular reflection respectively. Multiple eyelashes were detected with the help of variance of intensity values. 2D Gabor filters were used to extract features and then to design a binary feature vector. A matching score is obtained to find the dissimilarity between any two irises. This approach provides a noise detection model at the segmentation stage thus resulting with better performance rates. The main limitation in this field are accuracy is less comparing with other approaches. Uncontrolled illumination cannot overcome through this above mentioned algorithm.

In [5] Huang et al. Y. Wang, T. Tang and J. Cui (2004) proposed a new segmentation method which involves both segmenting the iris accurately. This approach eliminates the noise factors for better performance in the subsequent stages. To increase the speed of segmentation stage a rough localization of iris is performed. These localization is obtained through simple filtering, edge detection and Hough transform. After that the noise factors such as occlusion of eyelids and eyelashes and specular reflections are detected and eliminated. After the localization of the iris image 2-d log Gabor filters are used to extract the edges. It is followed by infusing the edge details with region details to remove the eyelid, eyelash and reflection noises. Here they have used the CASIA dataset to verify the results and found to provide better speed and accuracy. Here also developed an algorithm for off angle iris images using PCA and global ICA image encoding techniques. During the pre-processing stage they have used hamming distance to calculate gazing angle followed by Daugman's integro differential operator to segment this iris. They have tested their result using 100 iris class images from CASIA data set and special data base having off angle iris images and checked the performance of this non ideal recognition

technique.

In [6] Daugman (2007) has proposed a new image processing algorithm to be used during the segmentation stage which helps in handling off-axis iris images. This approach is become an improvement of his early work. Iris localization is done in three stages. First one is segmenting iris as a whole second is gaze estimation for off-axis eye images and the third is exclusion of upper eyelid eyelashes. Features are extracted using 1D Log Gabor filters and test for statistical independence is performed to check the match score between two iris codes using the UAE databases.

In [7] Wang et al. (2012), designed a recognition system meant for noisy irises using ad boost and multi orientation 2-d Gabor filters. Iris outer boundary is isolated using a binary segmentation mask. Noises are removed using Circular Gabor and upper and lower eyelids are detected and removed with the help of Random Sample Consensus (RANSAC) technique. Circular integro-differential operator is used to isolate the pupillary boundary. Two types of images are said to be segmented one is accurately segmented iris and inaccurately segmented iris. All the processing is performed separately hereafter for these two types of irises. Rubber sheet model is used to normalize the AS iris whereas a technique called Simplified Rubber sheet model is used for inaccurately segmented iris. 2D Gabor filters are used to identify both the global and local texture information and then an ad boost classifier is mused to perform the match score. Experimental results were tested in the database provided by NICE II competition with 810 images and the system won 2nd place among all 67 participations.

In [8] Z.Z. Abidin et al. (2013) proposed a feature extraction technique based on the epigenetic traits using several edge detection operators. Edge detection operators like Sobel, Prewitt and Canny were applied to extract the features from the iris. Among them Canny operator was found to provide a more accurate results. By applying these operators, the PSNR values of iris texture information before and after processing were calculated. From the experimental results performed using CASIA database, it was found that by applying proper edge detection techniques iris recognition system could achieve higher accuracy rates.

In [9] Zhou et al. (2013) proposed a new code matching technique. During segmentation stage following steps were followed to localize pupil boundary histogram analysis and morphological processing were performed, outer boundary was considered to have twice the size of pupillary boundary and to detect and remove upper and lower eyelids, Canny edge operator followed by polynomial curve fitting algorithm were used. After segmenting the iris, it was unwrapped to a rectangular block of fixed size with the help of a convolution operator.1-d Log Gabor filter were applied to extract the texture information and were then store in a k-dimension tree structure. With the help of this k-d tree code matching was performed to find the similarity or dissimilarity match between any two codes.

In [10] N Pattabhi Rama and Ajay Kumar proposed a cross spectral matching approach such as cross domain iris recognition. Several challenges emerge when iris image acquired in one domain is matched against images acquired in another domain. As compared to several other biometrics, iris recognition system is believed to be more reliable, accurate and scalable for person identification. Challenges emerge when the iris images acquired in one domain is matched against the images acquired in different domain. Such cross-domain iris recognition problem includes the cases when the images in one domain represent the sensor-specific iris images or wavelength-specific iris images. Here a new class of bi-spectral iris recognition system that can simultaneously acquire visible and near infra-red images with pixel-to-pixel correspondences is proposed and evaluated. Here present reproducible experimental results from three publicly available databases; Poly U cross spectral iris image database, IIITD CLI and UND data base, and achieve outperforming results for the cross-sensor and cross spectral iris matching.

In [11] MahaSharkas (2016) developed an approach for neural network based approach for iris recognition based on both eyes. In this method use canny edge detection and hough transform to detect and enhance the image. 2D DWT and fourier transform techniques are used for feature extraction. Here ANN is used as a classifier. The limitation in this field are arises due to poor resolution problem. In this method they do not prefer a method for overcoming uncontrolled illumination.

In [12] Aparna Gale, Suresh Salankar (2016) introduce evolution of analysis of iris recognition system by using hybrid method of feature extraction and matching by hybrid classifier for iris recognition system. In this approach they use Gaussian filter to enhance quality of iris images. Combination of HAAR transform and block sum algorithm descriptors are used to extract final features. Here they use ANN classifier. The main limitation of this approaches are poor resolution condition and uncontrolled illumination.

In [13] Suchitra Patil, Ujwala Bhangale, Nilkamal More (2017) develop a performance evaluation approach in terms of accuracy and execution time is performed for iris recognition process. Different feature extraction techniques such as DCT, LBG and KFCG algorithm are applied. Efficiency of two color spaces like RGB and HSV are evaluated. This proposed approach does not require iris localization on input images. Iris matching using any feature extraction technique give better result in HSV color space. Vector quantization method is more efficient than transformation method Algorithm gives about 95% accuracy in HSV color space.

3. Conclusion

This review discusses a detailed history of how iris has been started to be treated as a biometric trait and a general framework of iris recognition system which are currently being used. The main aim of this work is to provide a timeline view of various

iris recognition techniques. Based on this view it is concluded that most of the works carried on iris recognition is more or less similar but the focus was mainly made into 4 major areas namely iris segmentation, normalization which includes noise removal, feature extraction and classification of iris templates. During 1993 - 2002, researchers focused on developing algorithms for all the 4 major areas and were interested in developing their own systems. During 2003 - 2009, major research works had taken place on segmentation stage which involves segmenting the iris and reducing the noises present in it. During 2007 - 2012, majority of the research works were done on developing new feature extraction algorithms and classification of iris further. Until 2006 most of the research works were done on developing new filters and image processing algorithms to enhance the accuracy of the system. But after 2006, this field had seen a tremendous change in which researchers started implementing machine learning algorithms to improve the system accuracy. Recently the focus has moved towards multimodal biometric techniques. A detailed study on various publicly available iris databases is also included after the time-line review. Based on this work it is concluded that though this area has seen a tremendous growth in the past two decades, there are still more possible domain areas available in which this technology can be used by modifying few approaches. The next decade will be more interesting since many robust spontaneous iris recognition systems will be developed and will be deployed in various domain areas like border security systems, immigration checking systems, access control systems both to premises and devices, time and attendance maintenance system.

References

[1] Daugman J.," High confidence visual recognition of persons by test of statistical Independence". IEEE Trans. Pattern Anal. Machine Intell., 15 -1148-1161, 1993.
[2] Daugman J., "Biometric personal identification system based on iris analysis", United State Patent Number: 5291560, 1994.
[3] Wildes et al. "Automated noninvasive iris recognition system and method. "U. S. Patent No. 5572596 and 5751836.
[4] W.K. Kong, D. Zhang, B.T Centre and H. Kong" Accurate Iris Segmentation Based on Novel Reflection and Eyelashes Detection Model," pp. 3-6.
[5] J. Haung, Y. Wang, T. Tang and J. Cui, "A New Iris Segmentation Method for Recognition," in proceedings- International Conference on Pattern Recognition, 2004, vol.3, pp. 554-557.
[6] Daugman, John. "A new Methods in Iris Recognition. "System, Man and Cybernetics Part B: Cybernetics, IEEE Transaction on 37, no.5 (2007): 1167-1175.
[7] Q. Wang, X. Zhang, M. Li, X. Dong, Q. Zhou, and Y. Yin, "Ad boost and multi- Orientation 2D Gabor-based noisy iris recognition," Pattern Recognit. Lett. vol. 33, no. 8, pp. 978–983, Jun. 2012.
[8] Z. Z. Abidin, M. Manaf, A. S. Shibghatullah, S. Anawar, and R. Ahmad, "Feature Extraction from epigenetic traits using edge detection in iris recognition system," IEEE Int. Conf. Signal Image Process. Appl., pp. 145–149, Oct. 2013.
[9] Zhou, Steve and Junping Sun. "A novel approach for code match in iris recognition." In Computer and Information Science (ICIS), 2013 IEEE/ACIS 12th International Conference on, pp. 123-128. IEEE, 2013.
[10] P. R. Nalla and A. Kumar, "Toward More Accurate Iris Recognition Using Cross-Spectral Matching," in IEEE Transactions on Image Processing, vol. 26, no. 1, pp. 208-221, Jan. 2017.
[11] Maha Sharkas, "Neural Network based approach for Iris Recognition based on both Eyes" IEEE International conference on SAI Computing, pp. 253-258, 2016.
[12] Aparna Gale and Suresh Salankar, "Evolution of performance Analysis of Iris Recognition System by using Hybrid method of Feature Extraction and matching by Hybrid Classifier for Iris Recognition system", IEEE International Conference on Electrical, Electronics and Optimization Techniques, pp. 3259-3263, 2016.
[13] [13] Suchitra Patil, Ujwala Bhangale, Nilkamal More. "Comparative Study of colour Iris Recognition DCT vs Vector Quantization approaches in RGB and HSV Colour Spaced", IEEE International Conference on Information Technology 2017.