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Original Article

Identification of a Person Using Iris Features: Challenges and Trends

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Abstract *- Iris detection has become a very useful biometric feature in today's era when more emphasis is given on the security of data because of the need for authentication of data. Iris identification is among one of the most widely accepted biometric features used for the identification of a person. Here, we are going to review available iris detection techniques with their merits and demerits. The paper contains the basic steps used for iris recognition along with a detailed analysis of each step and focuses on previous works done by different researchers in each step with a conclusion part. In the end, we ensure that the paper will be helpful for new researchers in order to identify the gaps in the existing system and to identify the right path for research.*

Keywords *- Human Eyes, Iris Detection, Segmentation, Pattern Recognition.*

I. INTRODUCTION

Iris is the outer circle beyond the pupil. The iris may have different texture patterns, so it can be used as a very important biometric feature for the recognition of a person. Iris recognition has become a very trustworthy technique in the recent decade because of less accuracy in other biometric systems based on figure print. In iris recognition, both eyes have different patterns, so they can also be used as single or combined features [1,2]. Other biometric features like thumb may get affected according to age, whereas iris features do not have any effect of age and remain the same all over life. In early 2010, some of the biometric features like a thumb, figure print and face recognition became an important method for identification of a person, but all these features get affected with change in age. So, the iris becomes the most important feature for many recognition systems. The centre part of the human eye is known as a pupil, which is generally of black colour and circle in shape. When we go for iris recognition, then we need to apply some pre-processing steps to remove the pupil part and eyelashes from the input image. So, the iris recognition system contains subsequent steps of pre-processing, segmentation and feature extraction for recognition.

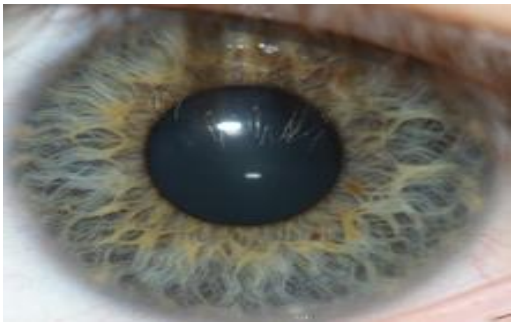

Fig. 1 Human Eye[12]

Every Human eye contains a novel pattern of texture, as shown in figure 2. the biggest issue in such detection is to urge rid of unwanted area and extraction of a region of interest because the iris is found at the middle area of the eyes, so outer layer and an inner layer of the pupil should be subtracted from the input image to get the iris pattern. Another challenge is to convert this circular iris pattern to a rectangular pattern to form is straightforward for recognition. There's always be a requirement of a strong iris recognition system because other similar biometric systems like a fingerprint palm print couldn't perform well as they depend on the impact of the input. If the impact of the finger or palm gets light, then it'll become difficult to spot the person. In such an area iris system may play a really important role in recognition.

This paper is arranged as section 1 contains the introduction of the iris recognition system, why iris recognition is a powerful method for biometric systems and the challenges that occur while iris detection. Whereas section 2 contains the literature survey in which the most

common methods and recent iris detection methods are reviewed along with their limitations and scope of future work, section 3 contains the general methodology used in iris detection and also focus most common way adopted by various researcher for iris recognition, the last section contains the conclusion part which mainly focuses on various paths for the other researchers where they can work.

II. LITERATURE SURVEY

Daugman [4] proposes an Iris detection system by using the Gabor wavelet and pattern recognition method; while testing this method on various iris patterns, it had been found excellent in performance. Then an equivalent author proposes another enhancement in his existing work where he proposed that the human iris also can be identified in-crowd. During this paper, he proposes many statically calculations[5]. Proenca H. proposes an extension to Daugman's work where he proposed a completely unique method which may be implemented in a biometric system and suggested that the iris pattern of each human is different from others, so it is often saved in the device then are often used for matching or verification purposelater[6].

Yu Chen [7] presented a highly efficient method for recognition of a person using biometric features; they use unique segmentation technique for iris segmentation and also a novel approach for pre-processing of images, which can reduce the effect of noise from environment and effect due to distance of the camera and its position. Mohamed et al. [8] propose a replacement technique for iris recognition; in his paper, he suggested the utilization of iris localization and morphological features; for localization features, he used canny edge detection algorithm, and for morphological features, he extracted boundary features, area, opening and shutting etc. Margaret. al. [9] use a novel method to perform localization. To achieve the correct iris segmentation, they first applied the Sobel edge detection method to generate boundaries of iris, then, first-order derivative used for localization, finally, hough transform is used to identify the position of the centre of the pupil and also to predict the radius of the pupil circle. Ajay Kumar et al. [11] propose the use of a sparse matrix to extract the features of the iris pattern. To perform this task, they first divide the images into small patches of 10*10 pixels then apply feature extraction and localization in order to increase the chance of getting better segmentation of the input image.

Shikreet. al. [13] presented a 2 level wavelet transform to recognize the iris of humans from the self-created dataset. They used a complex wavelet transformation technique based on a wavelet tree. This method provides good pre-processing and exact segmentation of the image. They applied this method to the widely used dataset of CASIA. Chun-Wei Tan and Ajay Kumar[14] propose a unique approach for feature extraction from iris images using subsequent processes for iris image clarity. This method uses a very efficient pre-processing technique which can perform better in noisy environments also. They proposed the use of this method for input iris images which are captured in the presence of noise. Another author proposes the use of fast Fourier transform for iris feature extraction and pre-processing. A unique iris comparison method has been proposed by Jain et al. [15], which use the Hough transform and DWT for feature extraction and matching. Here, Fourier transform is used to perform pre-processing on iris image, and Hough transform is used to perform perfect segmentation and feature extraction of iris image.

Planet. al. [16] has proposed the use of binary maps. The binary maps are generated from grey or colour iris images after performing segmentation. The binary maps are very useful in order to reduce the recognition time and also needs less memory. They propose the use of hough transformation for iris localization and to perfectly identify the circular ring of the iris.

III. METHODOLOGY

A general iris detection and recognition system which is adopted in various researches can be comprised in following steps:

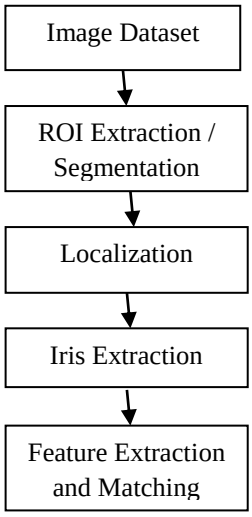

Fig. 2 Iris Detection Methodology

A. Image Dataset

Input images can also be taken directly from any input device like a camera or an integrated device, but most researchers used online verified datasets like CASIA, UCI dataset and datasets online shared by various universities and IITS like IIT Delhi etc. Some other freely available datasets are MMU, Bath, UPOL, and UBIRIS [11,12, 13].

B. *ROI Extraction and Segmentation*

various segmentation techniques are used to get the perfect region of interest. Perfect RIO extraction places a very important role in the detection of the iris because the accuracy of subsequent steps depends on the ROI region. When Hough transform is applied to extract the segmented region, then we need noise removal filters also because Hough transform could not perform well in the presence of noise. Liu et al. [17] used the thresholding technique to separate the region of interest; they used the soft thresholding technique for segmentation. Li et al. [18] proposed the use of the Adaboost method to perfect the detection of boundaries of the eye and also the boundary of iris pattern; they got good results as compared to thresholding approaches. Uhi and Wild [19] use weighted adaptive Hough transforms in place of traditional Hough transform in order to increase the localization accuracy. He et al. [20] use some pre-processing filters and histogram equalization based approaches for noise removal. Liu et al. [21] presented a hybrid model based on an integrodifferential parabolic arc operator and a RANSAC-like algorithm for eyelid detection.

C. *Iris Localization*

Hough transform is the most widely used algorithm for perfectly identifying the boundaries of the iris. Finally, the circular Hough transform was proposed by many other authors in order to increase the localization accuracy. Circular Hough transform has very complex steps and heavy computations. Computations in Hough transform, done in three steps first, random point (x,y) identifies within the image then it identifies every possible circle going through points (x,y) and new matrix of (a,b,r) is created, where a and b are the coordinates of the centre of the circle, and r is the radius of the circle[28]. The problem of mislocalization may occur because of eyebrows, eyelashes, spaces or due to low contrast, so it is very necessary to remove such effects to get the perfect segmentation. To perform this task, Hough transform is used, which can classify the regions into separate clusters like iris, skin region, eyebrow etc. this clustering technique generally uses 8 neighbour method, which is proposed by various authors in their work[29]. To perform clustering, k means clustering mat to be applied, or fuzzy-based clustering may also be used for separating the similar portion of eye images. Elements inside a cluster should include similar properties, like eyelashes may be separated by using the intensity of pixels present in eyelashes. The pixel intensity in the pupil region may have very low intensity because its colour will be near to black always. The region having skin part may also be cluster easily because intensities in such region will be higher than the pupil region and lower than the iris region. Similarly, the colour of the iris region is nearby white, so high-intensity pixels may be grouped together to make a cluster of the iris region. [30].

D. *Iris Extraction*

Iris is the portion between the pupil and outer layer of the human eye. So, to extract the iris portion, we need to subtract the pupil from the input image, and we need to remove the outer layer information by using segmentation and localization techniques. Pupil is the innermost circle in the eye image, and the next outer circle contains iris patterns, whereas the outermost circle contains the segmented eye image. To get the iris from the segmented image, we need to subtract the pupil circle from the input image.

E. *Feature Extraction and Matching*

Ma et al. [22] proposed the use of spatial filters for feature extraction. Noh et al. [23] used wavelet-based Haar transform for feature extraction from iris images. In [24], the DCT method is used to extract texture features from iris images; on comparing the performance of this method, they found that the performance is better than Gabor filters. Sun and Tan [25] propose the use of texture, colour and shape features to recognize the iris patterns texture feature to generate a relationship between pixels, whereas colour features support the intensity of the iris pattern. Some of the authors proposed the use of the Gabor filter for feature extraction. Then discrete wavelet transform is used to get the decomposed image for segmentation [26]. Discrete Cosine Transform (DCT) generates a rectangular window to separate the iris images and then to normalize the image patches of 8x12are created for feature extraction. To remove the effect of noise Hamming window is applied by various authors[27].

IV. CONCLUSION

While surveying lots of research papers, we came to know that iris detection and recognition required collection of algorithms; at the first step, we can take the universal datasets which are freely available online for experiments, the most common dataset used by various researchers is CASIA and for Indian, the most commonly used dataset is released by IIT Delhi. For segmentation purposes, we suggest the use of canny edge detection with global thresholding. Then for localization purposes, the circular Hough transform method was found suitable, and at the last stage, texture and wavelet-based features are found good for recognition purposes. The new researchers can perform the basic experiments using these steps to validate their findings.

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