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Survey on Secure Iris-Recogniton Based Human Authentication System

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ABSTRACT

The iris is regarded as the most trustworthy biometric trait due to its individuality and resistance to manipulation. Iris recognition systems are widely used in both commercial and public organisations for physical access control. In addition, the usage of iris recognition technology is expanding in national identification schemes, transportation, and healthcare. Yet, processing noisy data and maintaining high accuracy despite fluctuations in picture quality and security assaults are two key research problems posed by these applications.

The components of an iris recognition system include feature extraction, pre-processing, and classification. Pre-processing is the process of segmenting and normalising the annular iris region of an ocular picture in order to facilitate feature extraction. Near-infrared or visible light was utilised in this work to take photographs in limited, less constrained, and unrestrained situations. Noise distortions and intensity changes in images taken in uncontrolled conditions might result in poor picture quality. Because of changes in picture quality, accurate and timely segmentation of the iris component is a difficult problem. This thesis proposes a reliable and efficient approach for localising the iris as a solution to this problem.

Keywords: ***Iris, Biometric, Recognition, Iris Features, Iris Pattern***.

I. INTRODUCTION

Biometrics are automated techniques that are used to identify persons based on physiological or behavioural characteristics. Although behavioural characteristics are connected to a person's patterns of behaviour, physiological characteristics are linked to the structure of the body. Biometric IDs based on physiological or behavioural features are more reliable than traditional methods such as passwords, card keys, or PINs.

Bertillonage, the first sort of biometrics, was invented in the 19th century by Alphonse Bertillon and involved identifying criminals by documenting the shapes of their bodies, including scars and birthmarks. Nevertheless, with the presentation of Dr. Henry Faulds' idea on fingerprints as a biometric property, this technique was overtaken by fingerprint-based identification. Bertillonage was subsequently shown to be less reliable than the initial physiological characteristic-based fingerprint recognition system. Subsequently, J. H. Doggort discovered that, like fingerprints, each sample of an eye's iris has unique variations.

When selecting a biometric for use in identifying a person in a certain application, a range of factors such as universality, permanence, uniqueness, usefulness, measurability, circumvention, and acceptance are weighted. There is no one biometric technique that can meet all of the criteria listed above. Table 1.1 contrasts and illustrates several biometric technologies.

Table 1.1: The comparison of biometric traits

Biometric (trait)	Universality	Uniqueness	Permanence	Collectability	Performance	Acceptability	Circumvention
Iris (iris patterns)	H	H	H	M	H	L	H
Fingerprint (ridges & valleys)	M	H	H	M	H	M	H
Retina (blood vessels)	H	H	M	L	H	L	H
Signature (writing style)	L	L	L	H	L	H	L
Voice (tone or timbre)	M	L	L	M	L	H	L
Hand geometry (shape)	M	M	M	H	M	M	M
Face (facial features)	H	L	M	H	L	H	L

* H – High, M – Medium, L – Low

The underlying principles provide an overview of the traits of biometrics, which include universality, uniqueness, permanence, collectability, performance, acceptability, and circumvention. Each individual must possess the biometric traits in order for it to be universal, whereas for it to be unique, each individual must possess a characteristic that sets them apart from others. Collectability is the simplicity of data collection, measurement, and processing, whereas permanence refers to the biometric attribute being consistent throughout time. Acceptability refers to how well the technology will be received by the user community and covers terms like security, correctness, and robustness. Overall, the simplicity of utilising a replacement is related to circumvention. Because the complex random patterns of the iris are distinctive and stable and do not change over the course of a person's lifetime, iris recognition is the most accurate biometric technology currently available. As every individual's iris is different when it is studied, iris identification relies on the fact that the human iris has distinctive characteristics. Even people who are genetically similar have very different iris textures. The anatomical anatomy of the eye is seen in Figure 1.1, which has distinctive complex patterns including deep radial furrows, crypts, and collarette.

II. LITERATURE SURVEY

Iris recognition is a best biometric identification technology that recognises persons based on their different eye iris patterns. And Numerous studies have proposed several techniques to improve the precision and efficacy of iris recognition systems.

A approach for iris identification proposed by Jorge E. Zambrano and Daniel P. Benalcazar[1] use low-level convolutional neural network (CNN) layers. Because it uses a layer from a CNN for feature extraction, its method does not require training. They used Daugman's rubber sheet model, as well as image preparation procedures such as masking and image enhancement, for segmentation and normalisation. Feature extractor methods such as DenseNet, Inception, Inception ResNet, NASNet Mobile, ResNet, and Xception were used to extract features. They next evaluated each convolutional layer using a random selection of the CASIA iris Lamp dataset. They improved accuracy on datasets containing persons who had substantial dilation changes.

Francesco Zola and Jose Alvaro Fernandez-Carrasco[2] introduced ideas related to iris classification and Siamese Neural Networks to provide a novel technique for low-resolution (LR) iris verification (SNN). They used graph analysis using Graph Siamese Neural Networks in this method (GSNN). In the first stage, they pre-processed the LR iris images and converted them into graph-based structures. They used graph data in the second step to train a GSNN that could analyse graph similarities and identify whether two graphs were linked to the same issue or not.

Improved iris recognition is difficult due to data augmentation employed by Winston J.J., Hemanth D.J., Angelopoulou A., and Kapetanios E.[10] to create massive datasets of people for deep learning models. They employed deep convolutional networks and a mixed convolutional network with the ADAM optimizer, which creates gradients using adaptive momentum. As a consequence, they were able to outperform the Stochastic Gradient Descent with Momentum in terms of learning methodology and process (SGDM). In terms of accuracy, the hybrid CNN with SVM beat the basic CNN design. Although the hybrid structure needed too many calculations, it did away with manual segmentation, which is a common practise in deep learning systems.

Iris Localization Network (ILN), a technique put forth by Takahiro Toizumi[3], directly localises thepupil, iris, and eyelid points from down-sampled iris pictures without the need of segmentation maps. He recognised the pupil and iris circles using a landmark detection technique, and he also picked out the eyelid points. The method outperforms conventional iris segmentation techniques in terms of localization performance and is quick and reliable.

Alaslani[8]evaluated the extracted learning features from a pre-trained CNN (Alex-Net) and a multi-class support vector machine (SVM) approach in order to accomplish iris recognition. For normalisation, they used the rubber sheet model, and for iris segmentation, they used the circular Hough transform

(HT). The proposed method was tested on publically accessible datasets including CASIA-Iris-V1, IITD iris databases, CASIA-Iris-Interval, and CASIA-Iris-thousand. The data revealed that the suggested approach outperforms normalised image characterisation in terms of accuracy.

Danlami[12]used the Legendre Wavelet filter instead of the Gabor Wavelet filter to improve the accuracy of iris detection. They used the HT, Rubber sheet, and HD approaches for segmentation, normalisation, and matching, as well as the CASIA V4 distances and intervals databases.

Qasmieh, Alquran, and Alqudah [6] proposed an accurate and fast iris recognition method to deal with noisy iris images, particularly those with ocular occlusion and specular reflection. They categorised the photos using a few key criteria based on singular value decomposition (SVD) analysis, then segmented the iris locations using the iterative randomised Hough transform (IRHT). The Hamming distance was used to calculate.

III. ALGORITHMS

The literature includes detailed segmentation methods that have been presented. The literature has a wide range of segmentation methods that can deal with the aforementioned noise artefacts. The segmentation approaches may be divided into four categories depending on the characteristics of iris pictures.

- Edge-based methodologies.
- Techniques for thresholding and histograms.
- Techniques for contour evolution and clustering.

Edge Based Techniques

In this section, several authors' segmentation methods based on an image's edge details are discussed. Daugman presented the concept of using an integro-differential operator to detect the iris, which led to the creation of the first patented iris model, which was later adopted by practically all major firms. It is a successful method for finding the best iris photos. The circular Hough transform (CHT), which may be applied to a gradient-based edge-mapped picture, is another common technique introduced by Wildes for iris localisation. It costs a lot to compute using this system.

Edge detection-based CHT to segment the iris picture is described by Li Ma et al. a large number of symmetric filters to extract the iris's characteristics (different frequencies for different regions). An eyelid procedure is suggested. Quick feature extraction is the innovation in this approach. Zhaofeng He et al. used an Adaboost-cascade iris sensor and pulling and pushing elastic models for accurate iris detection as another method of dealing with the computational time. We locate the non-circular iris borders and localise the eyelids using a smoothing spline-based border matching approach and curve fitting, respectively.

Histogram and Thresholding Based Methods

The detection is still being addressed in this study, although threshold-based segmentation techniques are straightforward and available. In their alternative strategy, Li Ma et al. described an algorithm for iris authentication based on characterising important regional variants. To find iris borders, Masek & Kovesi proposed a CHT based on clever edge detection. The detection of eyelashes and eyelids is done using straightforward thresholding methods. A technique for offangle picture segmentation was suggested by Schuckers et al. The picture is transformed into a frontal view for subsequent processing, and geometrical transformations are used to estimate the off-angle look. Dorairaj et almethod .'s for estimating off-angle gaze uses Daugman's IDO and hamming distance (HD), as well as a novel technique for extracting the texture of the iris.

In the recognition framework, Bouaziz et al. presented a presegmentation phase that makes use of multilevel thresholding based on the Artificial Bee Colony (ABC) metaheuristic.Hanfei and Jiang explain that the iris may be readily targeted by using a combination of Otsu's thresholding and the Laplacian-of-Gaussian operator since the sclera is white and includes maximum intensity pixels. The local histogram and standard deviation approaches were employed in an approach suggested by Ibrahim et al. to identify iris borders. To reduce the processing time, Soliman et al. suggested using adaptive thresholding and morphological processes.

According to Zainal et al., an additional comparable approach that has been proposed uses adaptive thresholding for pupil localisation. A PCA-based K-means clustering for video iris images was suggested by Yingzi et al. to improve segmentation.

Clustering Based Methods

Cluster-Based Approaches Another method for separating the objects in an image into numerous separate components for processing is by clustering. Because of its efficiency and speed, clustering (grouping) is one of the most often utilised segmentation techniques among those described in the literature. The goal of clustering is to divide up the picture pixels into several groupings, or clusters. Similar properties must be shared by image pixel intensities belonging to the same subset, whereas the maximum difference must be shared by two different groups.

The fuzzy c-means surpass the current clustering-based methods for iris identification applications, according to Jayalakshmi et alcomparative .'s examination of FCM and Kmeans clustering segmentation methodologies. Li et al. revealed how to segment iris pictures taken while moving and from a distance. The iris is segmented using enhanced HT and K-means clustering based on co-occurrence of grey levels. Li et al. have proposed the RANSAC approach for reliable iris detection in a distinct study. Tan et al. suggested using IDO for segmenting iris borders detection together with an eight neighbourhood connection based clustering pre-segmentation phase. This study also discusses reflections and eyelids/eyelashes. Reddy et al. suggested a method for effectively segmenting the iris using a mix of CHT and K-means clustering. In addition, the CLAHE approach is used to account for illuminating variations in the images.

Contour Evolution Methods

The idea that the iris borders are circular is the foundation for the majority of the strategies mentioned above. The most of authors thus concentrated on the models that best support this notion. Very few writers make an exception to this presumption and provide techniques for separating non-circular iris borders. For efficient non-ideal iris image identification, Vatsa et al. adopted the Mumford-Shah based curve evolution approach. In order to segment non-circular iris borders, Daugman proposed a method. used discrete Fourier series expansion-based active forms to locate the borders of the iris. Another method utilised by Roy et al. to discover inner and outer boundaries was level set-based curve evolution that was performed using a halting function and Mumford-shah model-based curve evolution.

In order to separate on-the-move and off-angle pictures, Chen et al. presented a hybrid technique that combined an adaptive mean shift (AMS) & merged active contour (MAC) models. Geodesic active contours (GAC) are another intriguing technique Shah & Ross suggest using to separate non-circular iris borders. The authors Abdullah et al. suggested distinct methods to segment the inner and outer margins of the iris. The pupil border of near-infrared (NIR) pictures may be detected using a fairly straightforward thresholding technique, and the pupil boundary of visible light can be segmented using an active contour model. To segment the iris border, gradient vector flow (GVF) active contours with a fresh pressure force are used.

IV. CONCLUSION

In any iris identification system, accurate segmentation and localisation of the iris are essential. Diverse noise abnormalities, such as specular reflections, eyelash/eyelid occlusions, off-angle rotation, motion blur, low contrast, and overlapping intensities, can contaminate iris photographs taken in the visible spectrum. Traditional segmentation techniques are predicated on the notion that the iris is round. The introduction of a pre-segmentation phase in a new framework, however, significantly aids in segmenting the iris from less-than-ideal datasets.

The techniques used were effective in segmenting noisy and non-circular iris pictures. After qualitative and quantitative evaluation, IDSA-MRFCM was shown to be successful in both segmentation and recognition. Proper segmentation is critical for improving the functionality of iris recognition systems, particularly when working with imperfect datasets.

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