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Iris Recognition Based on Human-Interpretable Features

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ABSTRACT

In a biometric system a person is identified automatically by processing the unique features that are posed by the individual. Iris Recognition is regarded as the most reliable and accurate biometric identification system available. This model uses 1080 iris images of 108 different people to detect iris features. It is built on CNN model using transfer and machine learnings. In Iris Recognition a person is identified by the iris which is the part of eye using pattern matching or image processing using concepts of neural networks. This model detects nearly 240 features in an iris image like; size of iris, complexity of iris, melanin-colored ring pattern etc. The aim is to identify a person by analyzing the random patters visible within the iris.

KEYWORDS: CNN model, Machine learning, Neural Networks

1. INTRODUCTION

Iris recognition is one of the most reliable techniques in biometrics for human identification. The Daugman algorithm [1] can achieve a false match rate of less than 1 in 200 billions [2]. Iris recognition techniques have been used widely by governments, such as the Aadhaar project in India [3].

However, the iris is still under assessment as a biometric trait in law enforcement applications. One reason that hinders the forensic deployment of iris is that iris recognition results are not easily interpretable to examiners. As discussed in [4], "Iris Examiner Workstation" may be built analogously to the "Tenprint Examiner Workstation", which has been used in forensics [5]. In fingerprint recognition, a human examiner bases a decision on the number of matched minutiae on two fingerprints [6]. In contrast, common iris recognition techniques, such as Daugman's framework [1], perform matching on an iris code, which is the result of applying a bandpass filter and quantizer to grayscale images. In this scenario, the whole procedure appears as a black-box to an examiner without the knowledge of image processing.

Experiments have shown that human examiners can perform well in identity verification using iris images [7].

In the literature, the study of iris recognition relevant to forensics includes the recognition of iris captured in visible wavelength [8] or non-ideal conditions, such as on the move or at a distance [9]. There are very few results on investigating iris recognition using human-friendly features. Known feature based iris recognition methods, such as ordinal features [10], SIFT descriptors [11], and pseudo-structures [12], are neither easily interpretable nor corresponding to any physically visible features.

A. Iris Crypts and the Human-in-the-loop System Overview

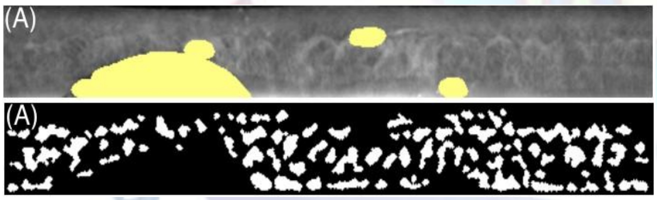
Recently, Shen [13] developed a new human-in-the-loop iris biometric system which performs iris recognition by detecting and matching crypts in iris images. Iris crypts are certain relatively thin areas of iris tissue, which may appear near the collarette or in the periphery of the iris. The visibility of iris crypts stems from their relationship with the pigmentation and structure of the iris.

In iris images captured under near infrared (NIR) illumination, the appearance of iris crypts has the following characteristics (see Figure 1):

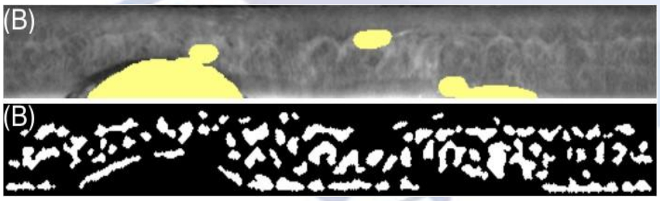
• The interior has a relatively homogeneous intensity that is lower than that of the neighboring pixels in the exterior.

• The boundary exhibits stronger edge evidence than either the interior or the exterior.

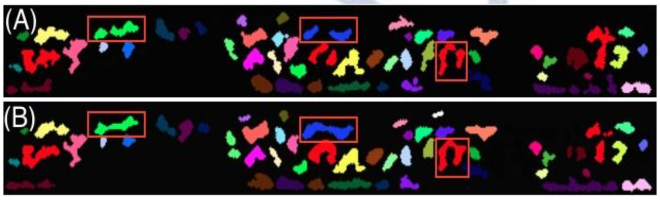
Fig. 1: Demonstration of the characteristics of iris crypts. Four examples of iris crypts are shown in red boxes.



(a) Raw image and Segmentation of A.



(b) Raw image and segmentation of B.



(c) Matched features in A and B.

Fig. 2: (a)-(b) Unwrapped images and segmentation of two iris images, A and B, from the same eye. (c) The matched features in A and B computed by our proposed matching algorithm. Each pair of matched features has the same color. Examples of multiple-to-one correspondence are marked by red boxes.

B. Our Contributions

In this paper, we seek to improve the performance of the automated iris recognition process, i.e., the first three steps of the ACE-V framework. Specifically, we propose a new fully automated approach to: (1) extract human-interpretable features in iris images, and (2) match the features with the images in the database to determine the identity. Our proposed approach can provide reliable aid to human evaluation in a human-in-the-loop iris recognition system.

There are two main tasks in our approach: crypt detection and crypt matching. Our detection (or segmentation) algorithm is designed to handle multi-scale crypts. It applies a key morphological operation in a hierarchical manner. Human annotated training data is used to determine the major parameters, so that the detected crypts are similar to those obtained by human inspection.

C. Organization of the Paper

The rest of this paper is organized as follows. Section II describes the approach proposed for feature detection and feature matching. Section III reports experimental results Section IV concludes the paper and discusses directions for possible further improvement.

2. METHODOLOGY

A. Dataset enrollment

An available image database on the Internet, called CASIA-IrisV 1, to replace the costly camera. In this database, there are 108 people, each person has 10 eye images. All testing experiments are carried out using images in this database.

Typically, a recognition system involves two operation modes, namely Enrollment and Verification. The former is extracting features from an eye image and save it into a template database, while the latter allows users extract their features and match with existing entities in the template database to identify the origination of the input image. Totally 756 images i.e., 70% of dataset is given to this model as training dataset and 324 images i.e., 30% of dataset is given to this model as testing dataset.

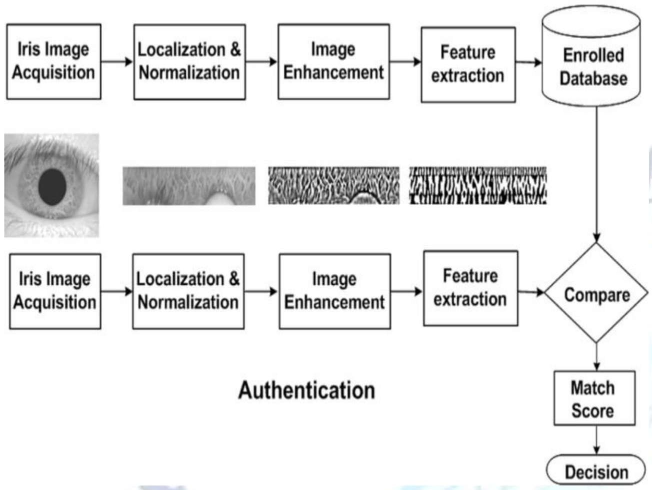


Fig. 3

B. Image Acquisition

Image acquisition is the process of converting an analogue image into digital form. This usually happens in a camera or scanner, but it can be done with any device that produces analog images. Image acquisition is often used to create a digital representation of data from surveys and experiments.

C. Localization and Normalization

In image processing, normalization is a process that changes the range of pixel intensity values. Normalization is sometimes called contrast stretching or histogram stretching.

D. Image Enhancement

Image enhancement refers to process of highlighting certain information of an image, as well as weakening or removing any unnecessary information according to specific needs.

Image enhancement techniques can be divided into two broad categories

- Spatial domain
- Frequency domain

E. Feature Extraction

Feature extraction is a part of the dimensionality reduction process, in which, an initial set of the raw data is divided and reduced to more manageable groups. The technique of extracting the features is useful when you have a large data set and need to reduce the number of resources without losing any important or relevant information.

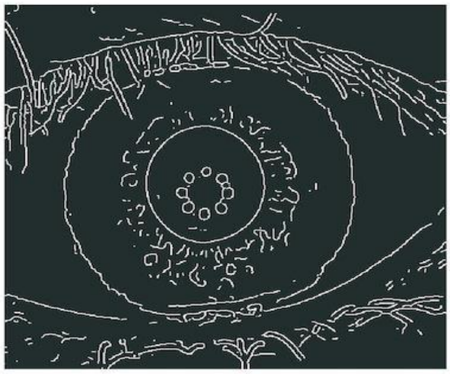


Fig. 4: Extracted features in Iris Image

F. Compare and Decision

Enrolled dataset extracted features are stored in memory and during authentication/verification those extracted features are used. Whenever an input is given to this model then this model will extract the features of that input image and compares with the features of enrolled dataset and then displays the output either as number of matched images or as whether the input image is matching with trained images or not. This type of output is displayed based on dissimilarity score or similarity score.

3. Experimental Results

G. Enrollment of iris images

This system was trained with 756 iris images where 108 people with seven iris image each. This size of testing dataset is 324 images.

Nearly it takes 128 seconds to enroll the 324 images to the model and approximately 10 seconds to verify the image and in addition with that number of matched images were displayed.

Fig. 5: Enrollment of iris images

H. Verification Results

Fig. 6: Verification

I. Features maximum score

Maximum Fscore : 0.95009

Best Eye-Threshold value : 80.0

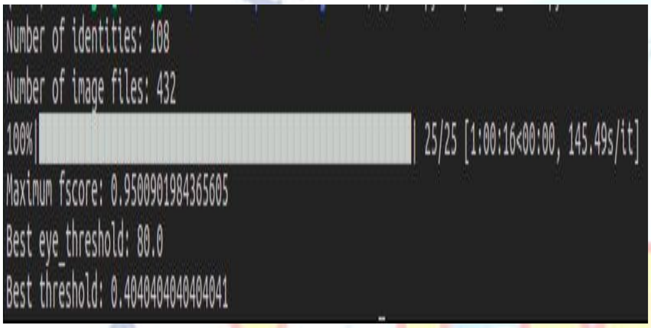


Fig. 7:Features maximum score

4. Conclusion

Iris recognition stands as a vital topic in biometrics, holding marvelous potential intended for a vast array of real-life applications. Although the iris scanner is useful because of its touchless feature, the further the individual stands, the less effective the scanner. This disadvantage requires that users stand within a specific distance range before they can be verified.

Some technologies have the power to capture iris data even on the move. This ability raises concerns about privacy and exposing people's data to unauthorized bodies. It also makes it difficult to restore privacy as people cannot get new eyes like they would get a new card number

Due to their high-level accuracy, iris scanners are often on the pricey end. Under certain circumstances, facial recognition and fingerprint recognition technologies may be affordable alternatives.

Iris access control remains one of the leading industries in biometric technology. The most pressing area of development is in improving non-invasive recognition by developing high-tech sensors. Because it is relatively easier to implement cloud biometrics than on-premises biometric solutions, many companies are in the race to migrate and integrate their biometric identification system to the cloud.

In order to implement efficient cloud scenarios, A person need a system that allows the person quickly and securely connect a remote biometric scanner to the cloud server.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

References

[1] J. Daugman, "How iris recognition works," IEEE Trans. Circuits and Systems for Video Technology, vol. 14, no. 1, pp. 21–30, 2004.

[2] ——, "Probing the uniqueness and randomness of IrisCodes: Results from 200 billion iris pair comparisons," Proc. IEEE, vol. 94, no. 11, pp. 1927–1935, 2006.

[3] Unique Identification Authority of India. [Online]. Available: http://uidai.gov.in.

[4] K. R. Nobel, "The state of the art in algorithms, fast identification solutions and forensic applications," MorphTrush USA, Tech. Rep., January 2013. [Online]. Available: http://www.planetbiometrics.com/ article-details/i/1446/

[5] P. E. Peterson, C. B. Dreyfus, M. R. Gische, M. Hollars, M. A. Roberts, R. M. Ruth, H. M. Webster, and G. L. Soltis, "Latent prints: A perspective on the state of the science," Forensic Science Communications, vol. 11, no. 4, 2009.

[6] C. Champod, "Edmond Locard — numerical standards and "probable" identifications," Journal of Forensic Identification, vol. 45, no. 2, pp. 136–163, 1995.

[7] K. McGinn, S. Tarin, and K. W. Bowyer, "Identity verification using iris images: Performance of human examiners," in IEEE Conf. on Biometrics: Theory, Applications and Systems (BTAS), 2013, pp. 1–6.

[8] H. Proenca, "Iris recognition: On the segmentation of degraded images acquired in the visible wavelength," IEEE Trans on Pattern Analysis and Machine Intelligence, vol. 32, no. 8, pp. 1502–1516, 2010.

[9] H. Proenca, S. Filipe, R. Santos, J. Oliveira, and L. Alexandre, "The ubiris. v2: A database of visible wavelength iris images captured on-themove and at-a-distance," IEEE Trans on Pattern Analysis and Machine Intelligence, vol. 32, no. 8, pp. 1529–1535, 2010.

[10] Z. Sun, L. Wang, and T. Tan, "Ordinal feature selection for iris and palmprint recognition," IEEE Trans. Image Processing, vol. 23, no. 9, pp. 3922–3934, 2014.

[11] M. Sunder and A. Ross, "Iris image retrieval based on macro-features," in Proc. International Conf. Pattern Recognition,, 2010, pp. 1318–1321.

[12] J. D. Mira and J. Mayer, "Image feature extraction for application of biometric identification of iris — a morphological approach," in Proc. Brazilian Symp. Computer Graphics and Image Processing, 2003, pp. 391–398.

[13] F. Shen, "A visually interpretable iris recognition system with crypt features," Ph.D. dissertation, University of Notre Dame, 2014.