Detecting and Matching Iris Image using Genetic Spectral Clustering Approach

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Abstract— Iris recognition can be used in a wide range of applications in which a person's identity. IRIS recognition is one of the most reliable techniques in biometrics for human identification. Iris recognition techniques have been used widely by governments, such as the Aadhaar project in India. This paper presents a biometric recognition system based on the iris of a human eye which provides a clustering for Iris recognition. This would allow evaluating whether correctly matches in the database or not. This approach under the human in-the-loop iris recognition framework exhibits a promising application of the iris as a biometric trait. For this here clustering approach were used to correctly find the relevant person.

Key words: IRIS, Detection, Matching, Clustering and Accuracy

I. Introduction

IRIS recognition is becoming one of the most crucial biometrics used in recognition when imaging can be done at distances of less than two meters. This importance is due to its high reliability for personal identification. Human iris has great mathematical benefit that its pattern variability among different persons is enormous, because iris patterns possess a high degree of randomness. In addition, iris is very stable over time.

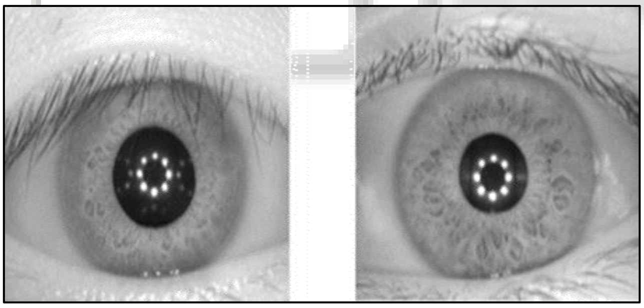

Fig. 1: IRIS Image

Iris recognition depends on the unique patterns of the human iris to identify or verify the identity of an individual. For iris recognition, Iris is detected from the eye and the feature (points or descriptor) are extracted [1]. These features are encoded into pattern which is stored in the database for enrolment and are matched with the database for authentication.

A biometric system provides automatic identification of an individual based on a unique feature or characteristic possessed by the individual. Biometric systems work based on capturing sample records, such as face image, eye Image, hand shape, finger shape. These sample records are transformed using some mathematical function to build biometric training path. These training paths will provide some characteristic property and strong point for identification. The problem with our face is that faces change all the time, and lots of people look very similar [2]. So inter class as well as an intra-class, both types of defects are present in it. Some of the paper says that fingerprint is a more reliable form of biometrics, but even theyre not infallible: illnesses and injuries, as well as the basic wear-and-tear, can alter the pattern of tough ridges, minutia points on our fingers with time. Most of the biometric systems allow two operation modes, which are an enrolment mode to build database by taking first time interaction and identification mode to give access to those databases. Iris recognition is regarded as the most reliable and accurate biometric identification system available. Most commercial iris recognition systems use patented algorithms developed by Daugman, and these algorithms are able to produce perfect recognition rates. Especially it focuses on image segmentation and feature extraction for iris recognition process [3]. The performance of iris recognition system highly depends on edge detection. The Canny Edge Detector is one of the most commonly used image processing tools, detecting edges in a very robust manner. For instance, even an effective feature extraction method would not be able to obtain useful information from an iris image that is not segmented properly. The used method determines an automated global threshold and the pupil center [4]. IRIS recognition is one of the most reliable techniques in biometrics for human identification. Iris recognition techniques have been used widely by governments, such as the Aadhaar project in India. This paper presents a biometric recognition system based on the iris of a human eye which provides a clustering for Iris recognition. Our proposed approach produces promising results on all the three tested datasets, in-house dataset.

II. Literature review

Doye et al. [5] proposed algorithms for iris segmentation, quality enhancement, match score fusion, and indexing to improve both the accuracy and the speed of iris recognition. A curve evolution approach is proposed to effectively segment a non-ideal iris image using the modified MumfordShah functional. Different enhancement algorithms are concurrently applied on the segmented iris image to produce multiple enhanced versions of the iris image. A support-vector-machine-based learning algorithm selects locally enhanced regions from each globally enhanced image and combines these good-quality regions to create a single high-quality iris image. Two distinct features are extracted from the high-quality iris image. The global textural feature is extracted using the 1-D log polar Gabor transform, and the local topological feature is extracted using Euler numbers. An intelligent fusion algorithm combines the textural and topological matching scores to further improve the iris recognition performance and reduce the false rejection rate, whereas an indexing algorithm enables fast and accurate iris identification. The verification and identification performance of the proposed algorithms is validated and compared with other algorithms using the CASIA Version 3, ICE 2005, and UBIRIS iris databases.

Jain et al. [6] proposed Edge detection process has a widespread usage in computer vision applications. But it has a different output when its input image changes from color to grayscale. This changeability of results makes us add modification on edge detection process procedures to correctly detect all those edges in color images that can't be detected in gray ones. This research reviews the proposed solution of Dutta and Chaudhuri on color edge detection algorithm that works using RGB color space, detects problem of a huge set of undetected edges by their proposed algorithm and find solutions for that, and applies complexity and performance analysis and experiments to compare the proposed algorithm with Canny and Sobel edge detection algorithms.

McGinn, S. Tarin [7] presented his work by developing an 'open-source' iris recognition system in order to verify both the uniqueness of the human iris and also its performance as a biometric. For determining the recognition performance of the system one databases of digitized grayscale eye images were used. The iris recognition system consists of an automatic segmentation system that is based on the Hough transform, and is able to localize the circular iris and pupil region, occluding eyelids and eyelashes, and reflections. The extracted iris region was then normalized into a rectangular block with constant dimensions to account for imaging inconsistencies. Finally, the phase data from 1D LogGabor filters was extracted and quantized to four levels to encode the unique pattern of the iris into a bit-wise biometric template.

Boles and Boashash [8] proposed the human iris recently has attracted the attention of biometrics-based identification and verification research and development community. The iris is so unique that no two irises are alike, even among identical twins, in the entire human population. Automated biometrics-based personal identification systems can be classified into two main categories: identification and verification. In a process of verification (1-to-1 comparison), the biometrics information of an individual, who claims certain identity, is compared with the biometrics on the record that represent the identity that this individual claims. The comparison result determines whether the identity claims shall be accepted or rejected. On the other hand, it is often desirable to be able to discover the origin of certain biometrics information to prove or disprove the association of that information with a certain individual. This process is commonly known as identification (1-to-many comparison).

III. PROBLEM DEFINITION

The iris is a complex pattern which contains many distinctive features such as arching ligaments, furrows, ridges, crypts, rings, corona, and freckles. Each iris is unique and even irises of identical twins are different. Furthermore, the iris is more easily imaged than retina; it is extremely difficult to surgically tamper iris texture information and it is possible to detect artificial irises [9]. Although the early iris based identification systems required considerable user participation and were expensive. To obtain a good image of the iris from long distance it may be fail due to mismatch of the images and it provide wrong information. For this issue clustering may helpful to solve this issue.

IV. PROPOSED METHOD

There is a lack of human friendly techniques for iris comparison. Therefore it has not been reported in forensics applications. We need to capture iris of human and similarities between the irises is captured. Recently Human in-the-loop system has been developed based on matching and detection of iris crypts. Our detection is able to capture crypts of various sizes and able to identify any kind of topological changes. Presently iris recognition exists in Aadhar card projects. The proposed system of this model is to provide more accuracy in detecting exact person.

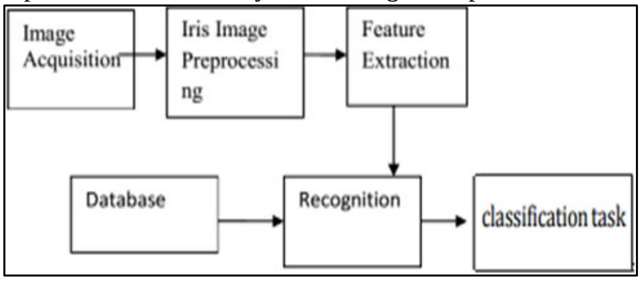

Fig. 2: Architecture Flow

A. Image Attainment

The image of the iris can be captured using a standard camera using both visible and infrared Light and may be either a manual or automated procedure. The camera can be positioned between three and a half inches and one meter to capture the image. In the manual procedure, the user needs to adjust the camera to get the iris in focus and needs to be within six to twelve inches of the camera. This process is much more manually intensive and requires proper user training to be successful [10]. The automatic procedure uses a set of cameras that locate the face and iris automatically thus making this process much more user friendly. Image acquisition: Since iris is small in size and dark in colour, it is difficult to acquire good images for analysis using the standard camera and ordinary lighting. Image acquisition provides iris image of sufficiently high quality.

B. Pre-Processing

The image pre-processing involves segmentation and normalization. The segmentation localizes the iris region that lies in between the boundaries of the pupil and limbus. The segmented region is mapped to a rectangular region of consistent size in normalization. This resized rectangular iris strip is known as normalized iris image. Daugman's system models the pupil and limbus boundaries as two circles [11]. They are represented by the three parameters (xo, yo, r), where (xo, yo) and r are the center and radius respectively. All testing images used in this dissertation are pre-processed into normalized iris images.

C. Feature Extraction

Biometric system feature extraction is one of the most important steps in authentication of biometric system. It is the process of extracting feature of desired images from a large collection to be used in selection and classification task. Feature extraction extract the most distinct features present in an image. Discriminated iris texture information must be extracted and encoded to have correct comparisons between iris templates [12]. Complexity of feature extraction affects the complexity of program and processing speed of iris recognition system. In this paper feature extraction has been done.

D. Matching Using Cluster

The template that is generated in the feature encoding process will also need a corresponding matching metric, which gives a measure of similarity between two iris templates [13]. This metric should give one range of values when comparing templates generated from the same eye, known as intra-class comparisons, and another range of values when comparing templates created from different irises, known as inter-class comparisons. This code has been used here in order to compare two iris codes. For comparing the two iris patterns X and Y. Due to the customary spectral clustering is vulnerable to the original input data, a hereditary Genetic Spectral Clustering algorithm (GSC) is proposed. By the spectral decomposition of the medium, the GSC maps the original dataset to the feature subspace. A similarity function is practical over an original dataset to construct a likeness Graph amongst the information. The GSC proceeds as follows:

Input :B

Step1: Fix B> 1 and 2 ≤ c≤ n -1 and give c initial cluster centers vi . REPEAT

Step 2: Compute µij with .

$$\mu_{ij} = \left(\sum_{k=1}^{c} \frac{\|x_j - v_i\|^{2/(m-1)}}{\|x_j - v_k\|^{2/(m-1)}}\right)^{-1}, \quad i = 1, 2, \dots, c; \quad j = 1, 2, \dots, n$$

$$a_{ij} = \mu_{ij} - \frac{1-\mu_{ij}}{2}$$

Step 3: Compute aij with µij

Step 4: Compute the objective function JT2FCM

by $$J_{T2FCM} = \sum_{i=1}^{c} \sum_{j=1}^{n} a_{ij}{}^{m} \|x_j - v_i\|^2$$

Step 5: Update vi with aij by

$$v_i = \frac{\sum_{j=1}^{n} a_{ij}{}^{m} x_j}{\sum_{j=1}^{n} a_{ij}{}^{m}}, \quad i = 1, 2, \dots, c$$

UNTIL (clustering done).

Algorithm: Genetic Spectral Clustering

These two cases should give distinct and separate values, so that a decision can be made with high confidence as two templates are from the same iris, or from two different irises. After extraction of features, feature vectors are now compared using a similarity measure.

V. EXPERIMENTAL RESULT

In this chapter, the performance of the iris recognition system as a whole is examined. Tests were carried out to find the best separation, so that the false match and false accept rate is minimized, and to confirm that iris recognition can perform accurately as a biometric for recognition of individuals. As well as confirming that the system provides accurate recognition, experiments were also conducted in order to confirm the uniqueness of human iris patterns by reducing the number of degrees of freedom present in the iris template representation. There are a number of parameters in the iris recognition system, and optimum values for these parameters were required in order to provide the best recognition rate. These parameters include; the radial and angular resolution, r and θ respectively, which give the number of data points for encoding each template, and the filter parameters for feature encoding. In the experiments of human identification, each probe image was compared against all gallery images to determine the identity of the probe image. The top m (say 10) candidates with the smallest dissimilarity scores were presented to human examiners for further inspection. This was a closed set comparison. Namely, it was known that at least one image from the same subject had been enrolled in the gallery set. Before selecting the candidates, a pre-check was imposed.

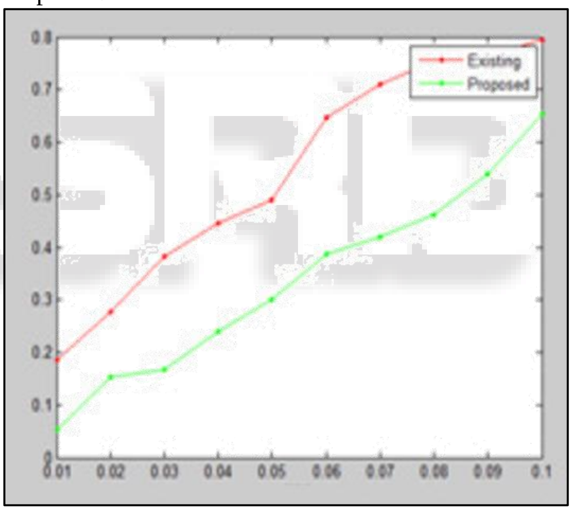

Fig. 3: Difference of Proposed Method

We check the accuracy of the boundaries (including pupil, iris, and lower eyelid) subjectively and the proposed system obtains the success rate of 82.54% (624 images) from 756 images in the experiments for the pre-processing module. It shows the summary of the causes of failure of image pre-processing. It is worth noting that the two main causes of failure come from occlusion by eyelids and non-uniform illumination.

VI. CONCLUSION

Identification of people is getting more and more importance in the increasing network society. Biometrics is the branch of science in which human beings are identified with their behavioral or physical characteristics. Using characteristics, iris recognition is gaining more attention because the iris of every person is unique and it never changes during a person's lifetime. This paper presents a biometric recognition system based on the iris of a human eye using wavelet transform. The proposed system includes three modules: image preprocessing, feature extraction, and recognition modules. The feature extraction module adopts the gradient directions (i.e., angles) on wavelet transform as the discriminating texture features. We present a new approach for detecting and matching iris using clustering method to group the similar feature in one group and non-similar data in another group to easily catch the human using this mechanism.

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