MULTIPLE CLASSIFIERS: AN APPROACH IN IRIS RECOGNITION SYSTEM

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ABSTRACT: Iris recognition is considered as one of the best biometric methods used for human identification and verification; this is because of its unique features that differ from one person to another, and its importance in security. This study proposes a multi-algorithmic feature extraction technique for personal recognition using iris. The proposed framework was implemented on Matlab R2018a. The localization and segmentation techniques are presented using Hough Circular Transform in order to isolate an iris from the whole eye image and for noise detection. The normalization procedure was carried out using Daugman Rubber Sheet Model, while the feature extraction was done using Continuous Wavelet Transform. At the classification stage, Hamming Distance, Nearest Neighbour and Euclidean Distance Classifier was adopted. The system was trained with five hundred iris images while another unregistered one hundred iris image were used for verification of the system. The propose method have the accuracy of 70%, False Acceptance Rate (FAR) of 0.00% and False Rejection Rate of 0.03% with total execution time of approximately 7.00 sec. The present work can be extended by testing more samples of iris images. Since the images in the CASIA database are mainly eyes of Chinese people, the testing could be done among other ethnic groups. It is also recommended that other feature extraction techniques which are capable of handling resolution problem could be used in conjunction with Continuous Wavelet Transform to eradicate resolution problem and to increase the accuracy.

KEYWORDS: Biometrics, Iris, Feature Extraction, Continuous Wavelet Transform, Classifier.

1. INTRODUCTION

Developing a high end security system for either identification or authentication purpose have always been an active research area and attractive goal in almost all fields. Identification of humans through biometric technologies is becoming common. ([JBP99]) cited by ([NL15]) revealed that biometric traits have highly reliable and unique features that make it best suited for security systems over a traditional or conventional security system, different biometric technologies like finger, face, voice, iris recognition, etc. use different behavioral or psychological characteristics of humans for recognition and identification ([OSO13]). ([SD13]) cited by ([SO19]) highlighted that With increase in the use of information technology and need to safeguard data, the archaic practice of recognition such as Token-based and Knowledge-based system of recognition has played a vital role, but these methods of recognition have flaws. Biometrics provided solution to these issues ([PP09]). Humans have distinctive and unique traits which can be used to differentiate them from other humans ([SO19]). A number of traits characterizing behavioral or physiological characteristics of human can be used for biometric identification. Basic physiological characteristics are face, fingerprint, iris, retina, hand geometry, odour/scent. Voice, signature, typing rhythm, gait are related to behavioral characteristics. The critical attribute of these characteristics for reliably recognition and identification are the variations of selected characteristic across the human population, uniqueness of these characteristics for each individual, their immutability over time ([JBP99]). Human iris is the best characteristic when considering these attributes. An iris is a colored area between dark pupil and bright sclera. Iris has unique features like stability of iris patterns throughout life time, not surgically modifiable. Its probability of uniqueness among all humans has made it a reliable and efficient technique for identifying human. It can be used in many applications like controlled access, airports, ATM, etc. ([Dau94]; [OSO13])

It is particularly good for automatic recognition because of its complex pattern of many distinctive features such as arching ligaments, furrows, ridges, crypts, rings, corona, freckles, and a zigzag collarets ([PP09]). The texture of iris is complex, unique, and very stable throughout life. Iris patterns have a high degree of randomness in their structure. This is what makes them unique. The iris is a protected internal organ and it can be used as an identity document or a password offering a very high degree of identity assurance. Also the human iris is immutable over

time. From one year of age until death, the patterns of the iris are relatively constant ([JBK98]; [Adl65]). This study is highly essential, due to the fact that it will expand academic skill by providing new technique in iris feature extraction. In the previous research by various authors, many feature extraction method has being proposed, likewise different classifier. This study proposed multi-algorithmic feature extraction and classification technique, which implies that it combine different classifier algorithms to attain proper feature extraction and classification. This study centralized its objective in using the developed algorithm to ensure the proper security of life and properties.

2. REVIEW OF RELEVANT LITERATURE

In recent years, iris recognition has become one of the majorly researched recognition technologies since it is the most reliable form of biometrics. Iris patterns are unique and stable, even over a long period of time. Furthermore, iris scanning and recognition systems are very user-friendly. Biometric identification utilizes physiological and behavioral characteristics to authenticate a person's identity. Some common physical characteristics that may be iris recognition is the process of recognizing a person by analyzing that random pattern of automated method of iris recognition is relatively young.

Plenty of works are done on Iris Recognition System, most of the cases; authors claimed the better performance of speed in capturing images and recognition over the existing systems available at that time. To gather the knowledge, this study has considered the following selective works. Daugman is the inventor of the most successful commercial iris recognition system now and published his wonderful results in 1993 ([Dau93]). He proposed an integro-differential operator for localizing iris regions along with removing the possible eyelid noises ([Dau03]).

([Wil97]) processed iris segmentation through simple filtering and histogram operations. Eyelid edges were detected when edge detectors were processed with horizontal and then modeled as parabolas. No direction preference leaded to the pupil boundary. ([BB98]) mainly focused on the iris image representation and feature matching, and did not introduce the information about noise removal. ([G+06]) implemented system was tested on iris images of CASIA database. Iris localization using Hough transform performs better as compared to other localization techniques in case of occlusion due to eyelids and eyelashes. They achieved the overall accuracy of 95.4% with FRR of 5% and FAR 4%.

([G+10]) presents the complete iris recognition system consists of an automatic segmentation system based on the Hough Transform, and is able to localize the circular iris and pupil region, occluding eyelids and eyelashes, and reflections. ([Tua12]) evaluated the performance of the biometric system using FAR and FRR. FAR is the rate at which an imposter print is incorrectly accepted as genuine and FRR is rate at which a genuine print is incorrectly rejected as an imposter. When the number of subject is 60, the FAR and FRR are 2.43% and 3.17% respectively.

3. METHODOLOGY

The method of the research includes:

1. Design of multi- algorithmic Continuous Wavelet Transform (CWT) framework for the feature extraction.
2. Development of an Iris Recognition System where the designed framework is employed.
3. Determination of the recognition accuracy of the Iris Recognition System testing with some sample images.

The framework was designed based on iris recognition system; the sample image will be input, then localization and segmentation will be done using Hough transform in order to detect the inner and the outer boundary of the iris, which estimate that the shape of the iris is circle. This will lead to the normalization, in order to unwrap the iris image. The unwrapped iris image will be converted from Cartesian to polar using Daugman Rubber Sheet Model in order to proceed to the feature extraction stage. For the feature extraction, Continuous Wavelet Transform is employed at three different times on the same normalized iris image. The extracted features are subjected to three different classifiers (that is: Hamming Distance, Nearest Neighbour and Euclidean Distance classifier respectively).

The results were stored in a database and template matching stage imaged using hamming distance algorithm. Based on the matching results from the algorithms, a score is obtained based on matches of the input iris image with the templates stored in database. This score could be a percentage of the matched features out of the total or a scored based on a common based for all algorithms. To improve iris recognition, fusion of the three algorithms is performed, wherein the scores are fused together to obtain a final result and to conclude whether the input image of the iris belongs to an authentic person or not.

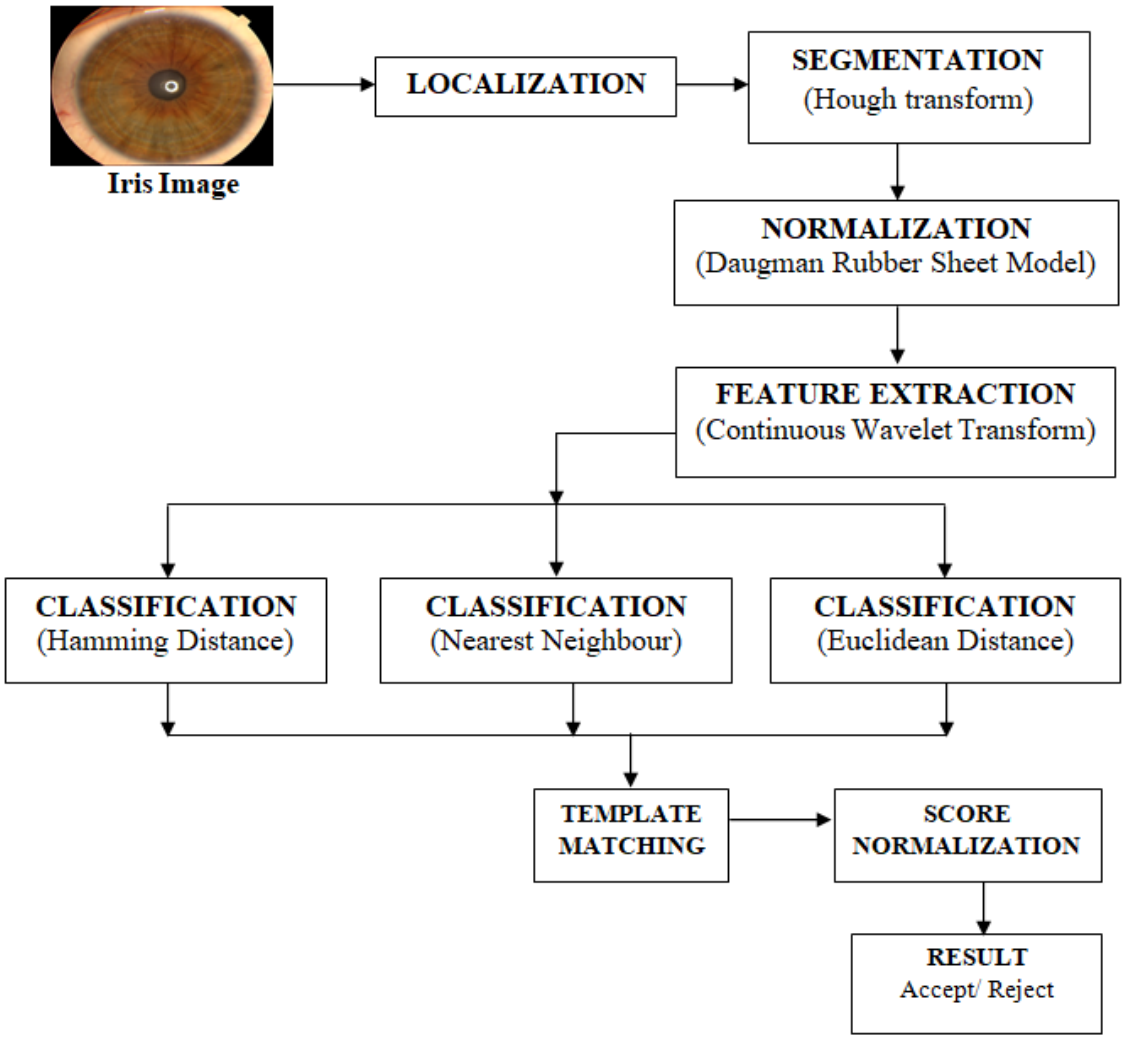

Figure 1: Framework of the Proposed Recognition System

4. RESULT AND DISCUSSION

In order to evaluate the performance of the proposed system, extensive experiment was performed. Iris images are obtained from CASIA database. The experiments are done on MATLAB R2018a. The experiment was conducted using a single image, the iris image was localized and segmented using Hough transform, the segmented iris image was normalized using Daugman Rubber Sheet model. The feature extraction was conducted using Continuous Wavelet Transform.

Table 1: Average Time of the System

	Time (ms)	Percentage of Total Time
Iris Localization	30.1	43%
Normalization	16.0	22.9%
Wavelet to feature vector generation	23.0	32.9%
Template matching	0.9	1.2%
Total time	70 sec	100%

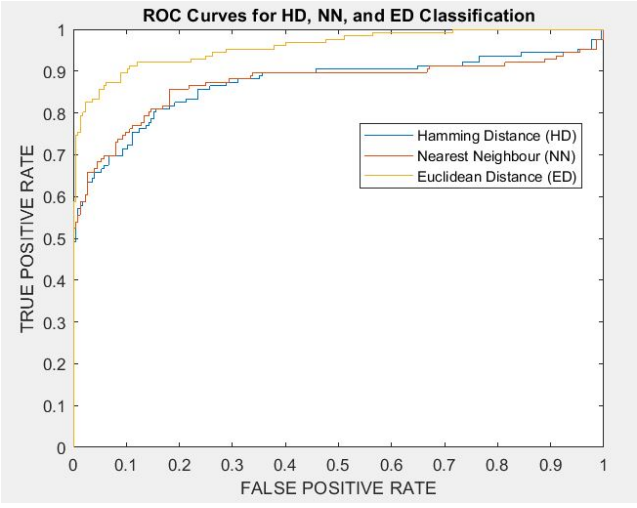

Figure 2: ROC Curve

A. Total Execution Time

The run-time result for the iris recognition is approximately 7.00sec (see table 1), which confirm that the proposed method performs faster than Daugman, Patil *et al* and Wildes etc.

B. Recognition Accuracy

The system was trained with five hundred iris image while another unregistered one hundred iris image

were used for verification of the system. Average correct recognition rate was calculated to be 70%, with False Acceptance Rate (FAR) of 0.00% and False Rejection Rate (FRR) of 0.03% at threshold value of 0.5.

Compared with Fourier and other wavelet transforms, the proposed approach considerably reduces the computation time and improves the accuracy. Furthermore, this identification system is quite simple requiring few components and is effective enough to be integrated within security systems that require an identity check. The experimental results are encouraging and the comparison with some algorithms indicates that the proposed method is comparable to them.

C. Equal Error Rate (EER)

Receiver Operating Characteristics (ROC) curve is used as a yardstick to check the performance of the proposed system. The curve shows all possible system state of FRR and FAR. The curve shows that Hamming Distance has the minimum EER as compared to other classifiers (see Figure 2).

5. CONCLUSION

A multi-algorithmic biometric system by fusion of three algorithms at the feature extraction and classifier stage for iris authentication in a highly secured pervasive environment has been designed and implemented successfully and it is found to overcome the drawbacks of traditional method. Experimental results prove that by combining multiple algorithms, this system improves the matching performance, increase population coverage, deter spoofing and facilitate indexing. An efficient iris recognition system using Continuous Wavelet Transform has been implemented with improvement in segmentation and normalization algorithm.

The accuracy of the proposed approach is 70%, with False Acceptance Rate (FAR) of 0.00% and False Rejection Rate of 0.03%. The proposed approach considerably reduces the computation time and improves the accuracy. Furthermore, this identification system is quite simple requiring few components and is effective enough to be integrated within security systems that require an identity check. The experimental results are encouraging and the comparison with some algorithms indicates that the proposed method is comparable to them, and the outputs of this research are satisfactory.

The Multi- Algorithmic approach combines the features of Hamming distance Classifier, Nearest Neighbour and Euclidean Distance Classifier for authentication of iris patterns. The error rate has been reduced with an improvement in feature extraction procedure.

The present work can be extended by testing more samples of iris images and using different machine and deep learning algorithms. Since the images in the CASIA database are mainly eyes of Chinese people the testing could be done among other ethnic groups. It is also recommended that other feature extraction techniques which are capable of handling issues in resolution should be used in conjunction with Continuous Wavelet Transform to eradicate resolution problem and to increase the accuracy.

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