



Iris localization using Hybrid Algorithm containing Circular Hough Transform, Fuzzy Clustering Method and Canny Edge Detector

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Abstract: Iris segmentation comprises of a sequence of operations including initial Iris and pupil detection as a most prominent region of image with pronounced round shape, outlining outer iris border and final refinement of visible iris part by rejecting regions occluded by reflection spots, eyelids and eyelashes. The results are mask of iris region i.e. set of pixels, which are visible points of iris together with its inner and outer borders. This paper presents an efficient hybrid algorithm to segment iris in unconstrained environment where human recognition is developing for images which can be captured without asking humans i.e. CCTV surveillance etc. by removing noise such as eyelashes and eyelids. It is a challenging task to get proper iris region from input image to get it recognized from trained dataset of the individuals. The proposed algorithm gives high accuracy rates in classification and matching.

Keywords: Circular Hough Transform, Fuzzy Clustering, edge detector, sclera region

1. INTRODUCTION

With an expanding regard for security, the requirement for an automatic personal identification system taking into account biometrics has expanded in light of the fact that traditional identification systems based on cards or passwords can be broken by losing cards, taking them or forgetting passwords. Iris recognition is getting to be a standout amongst the most critical biometrics utilized as a part of recognition. This significance is because of its high unwavering quality for individual ID [1] [3]. Human iris examples are extremely steady all through a man's life [4] [5]. Further-all the more, every iris is one of a kind and even irises of indistinguishable twins are likewise diverse. This is on account of the human iris is a mind boggling design and contains numerous unmistakable components, for example, ridges, arching ligaments, furrows, crypts, freckles, rings, and a zigzag collarets, in this way iris patterns have a high level of irregularity.

Since the idea of automatic iris recognition was proposed in 1987 numerous analysts have proposed a great deal of intense calculations in this field. The vast majority of these calculations need client participation to get a fantastic and high quality image and to furnish the clients with criticism to guarantee that they are appropriately situated for picture catch. The most significant calculations and generally utilized as a part of current genuine applications are those created by Daugman [1][2], which require NIF camera to catch the iris images.

At the point when current iris recognition algorithms deal with noisy iris pictures taken in noticeable wavelength under non-perfect imaging conditions, the calculations precision fundamentally diminishes in light of the fact that the division stage is highly influenced with noise and non-perfect lighting conditions. Fig. 1(a) demonstrates a picture brought under perfect conditions with NIF(neutron) camera, where the picture in Fig. 1(b) was taken in noticeable wavelength under non-perfect conditions, and in this way it is to a great degree testing to segmentation process.

The primary inspiration in this work is to propose powerful iris segmentation algorithms ready to manage exceptionally noisy iris pictures caught under unconstrained conditions and non-perfect environments, which can't be taken care of utilizing current iris segmentation algorithm, for example, Daugman algorithm. The Circular Hough Transform (CHT) is the best circles restricting operator in the noisy images yet it is exceptionally costly in time. In this manner, the proposed calculation includes another pre-preparing step utilizing Fuzzy Clustering Method (FCM) algorithms to separate the iris picture into three areas in particular iris region, skin region and sclera region. The FCM pre-preparing step could bar the non-iris areas which cause numerous mistakes and reduction the looking time of the CHT. Besides, various new techniques are proposed to upgrade the execution of the segmentation in noisy pictures, for example, a strategy to limit the upper eyelid through identifying it in the sclera region as that will empower the algorithm to arrangement all the more viably with boisterous iris pictures. The proposed algorithm sections the noisy iris pictures and decreases the execution time, empowering it to be utilized as a part of ongoing applications.



Fig.1 (a) Correlation of iris pictures from the UBIRIS.v2



(b) Correlation of iris pictures from CASIA (form 4).

2. RELATED WORK

Numerous analysts have tremendously contributed in iris segmentation [6]. They have utilized diverse procedures to expand the performance of their calculations. Past calculations have been classified as indicated by two criteria. The main order is as per the area of beginning in division, while the second is as indicated by the administrators or strategies utilized as a part of depicting the shapes inside the eye. In this segment, we introduce the most unmistakable works in these two grouping.

2.1. The region of starting the segmentation

There are three classes of scientists relying upon where they begin the segmentation. The primary classification of specialists begins from pupils [7] [8] in light of the fact that it is the darkest area in the picture. Taking into account this, pupil is localized to start with, and after that the iris is resolved utilizing distinctive procedures. At long last, commotions are identified and detached from the iris area. In the second classification [9], the division begins from the sclera region since it is observed to be less immersed (white) than different parts of the eye and after that the iris is distinguished utilizing any sort of administrators. At long last, the pupil and noises are distinguished and segregated from iris region. The third class [10][11] of analysts scans for the iris locale straightforwardly by utilizing edge administrators or applying clustering algorithm calculations to concentrate iris texture features.

2.2. The techniques used to describe the shapes inside the eye

As indicated by the methods and administrators that are utilized as a part of iris segmentation, there are two normal methodologies utilized as a part of localizing the iris area. The main methodology [12] [13] applies a sort of edge discovery tool after by CHT or one of its subsidiaries to identify the state of iris and pupil. A last stage can be connected to revise the state of iris or pupil. The principle issue with this methodology is that the CHT is for all intents and purposes extremely costly in time. The second approach [14] utilizes diverse sorts of operators to identify the edges of iris like Daugman's Integro-Differential administrator [15] or Camus and Wildes [16] administrator and after that the noises and pupil are distinguished and confined. Be that as it may, these operators are influenced by noisy and distinctness amongst iris and sclera. Therefore, it couldn't be utilized with noisy iris images.

3. PROPOSED WORK

Biometric recognition is utilized to naturally perceive people in light of the distinctive and one of a kind physiological qualities, for example ear, face, unique mark, iris, walk, palm prints, and voice. Human's iris example can be utilized as a perfect biometric character because of its

uniqueness amongst people and its focused example for the duration of individual's life. The iris recognition plan comprises of six stages: eye picture catch, iris extraction, standardization, preprocessing, coordinating, and highlight extraction. Precise iris extraction is presumably the most imperative stride since it incredibly impacts the general recognition exactness and handling speed. The iris is regularly encompassed by noise, for example, the pupil, sclera, eyelashes, and eyebrows, which should be evacuated in like manner to accomplish exact iris extraction. In this work we have proposed an efficient technique to extract the iris region from input eye image and matched it with the associated personnel from the training dataset. The steps in the proposed work has been described below

3.1 Proposed Algorithm

- Step 1.** Enhance the input image using filtering and contrast adjustment methods
- Step 2.** Cluster the eye image using Fuzzy-C mean clustering and choose the cluster having minimum intensity and exclude other regions
- Step 3.** Apply CHT to get the rough iris circle and crop a window around this circle
- Step 4.** Apply Canny edge detector to the iris window.
- Step 5.** Apply Circular Hough Transform to get the iris region accurately.
- Step 6.** Localize the upper eyelids by using intensity contrast between the eyelids and the sclera region. Determine the coordinates of upper eyelid and mark a line
- Step 7.** To localize the lower eyelid of the iris, the intensity metric has been used in which pixels from below has been checked which starts iris region and line has been drawn at that point which represents the lower eyelid.
- Step 8.** Then apply circular Hough Transform to get the pupil region as iris has been found and center of the iris region helps in detecting the pupil region. Pupil region has been removed as it does not contain any features.
- Step 9.** A template has been created and matched using Hamming Distance
- Step 10.** Performance evaluation has been carried out in which accuracy has been checked for the query database

4. RESULTS

To implement iris segmentation and matching, a multi-stage approach has been used. It involves preprocessing of image, filtering, edge detection, segmentation, finding iris circle, removing pupil, removing upper eyelid and lower eyelids, generating template and finally matching with the previous stored database. Matching has been done using Hamming Distance of the template.

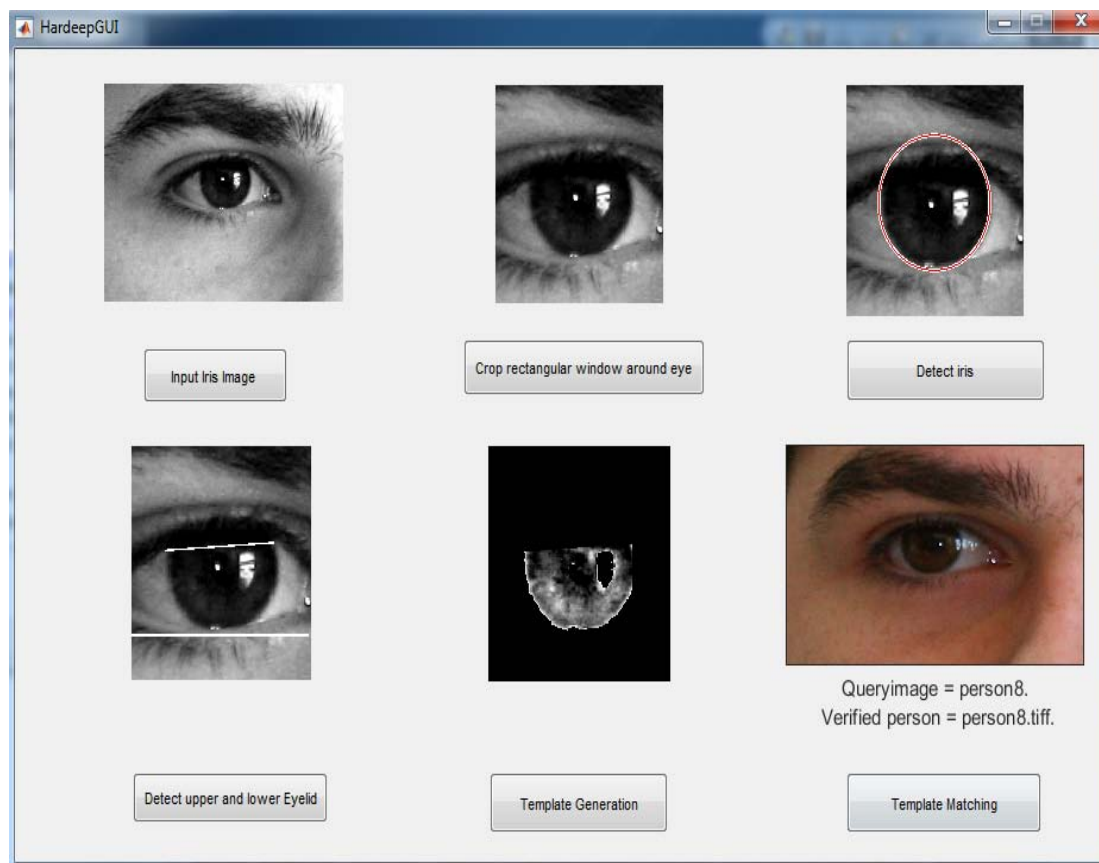


Fig. 2: GUI of the proposed work

4.1 Classification Accuracy

The classification accuracy is the extent to which the classifier is able to correctly classify the iris query images and is summarized in the form of confusion matrix to the test data. This is defined as the ratio of the number of correctly classified images (TP and TN) to the total number of datasets (individuals) classified.

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

4.2 Sensitivity

The sensitivity of a classifier is the fraction of the image samples correctly classified as that specific individual. It is defined by equation below :

$$Se = \frac{TP}{TP + FN}$$

4.3 Specificity

The specificity is the fraction of normal individual query images correctly classified as normal class. It is also called selectivity.

$$Sp = \frac{TN}{TN + FP}$$

4.4 Overall Classification Accuracy

It is defined as the mean of the summation of sensitivity and specificity values

$$Accuracy = \frac{S_e + S_p}{2}$$

Experimental results for a database of eight people taken from internet are shown in table 1.

Table 1: Table one showing different parameters for evaluating performance of the algorithm

Database individual	True Positive	False Negative	True Negative	False positive	Sensitivity	Specificity	Accuracy
Person 1	4	0	4	0	100%	100%	100%
Person 2	4	0	4	0	100%	100%	100%
Person 3	4	0	4	0	100%	100%	100%
Person 4	3	1	4	0	75%	100%	87.5%
Person 5	4	0	4	0	100%	100%	100%
Person 6	4	0	4	0	100%	100%	100%
Person 7	4	0	4	0	100%	100%	100%
Person 8	4	0	4	0	100%	100%	100%

Person 4 gives less results as it is not matched properly, which indicates that person is not present or wrongly matched. It is 75% truly identified and 25% wrongly matched. As person 4 image is wrongly matched with person 7

Table 2: Approximate overall Classifier Accuracy

Overall accuracy	98.44%
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The overall accuracy indicates the features of person 4 are correctly identified ie. correctly segment iris but wrongly matched with other person iris.

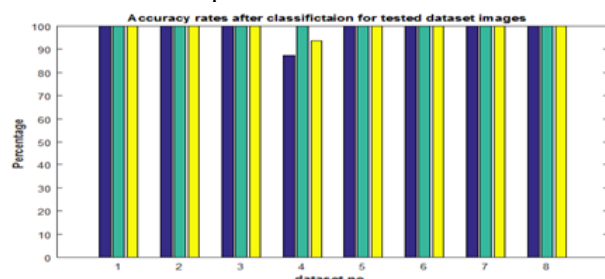


Figure 3: Bar graph shows sensitivity, specificity and accuracy values detected after matching the query images with trained dataset of individuals Iris images

A Hybrid algorithm of CHT, FCM and CED is applied on the test images to evaluate results both visual as well as quantitatively.

5. CONCLUSION

In the current age, Security is dependably a critical issue in any divisions like bank, International air terminal; web based advertising and so on. Precise and dependable individual recognizable proof course of action and biometrics have turned into a critical innovation for the security in the cutting edge propelled world. Programmed acknowledgment and confirmation of a distinct individual in light or something to that affect of particular components or qualities is offered in a biometric framework. There are a few sorts of Biometrics framework accessible like fingerprints, face recognition, voice recognition, hand geometry, penmanship, the retina and the iris. The vast majority of the current techniques have constrained capacities in perceiving moderately complex components in practical realworld circumstances. Iris recognition has been mulled over as one of the most reliable biometrics advances. In order to carry out better accuracy in iris biometric systems, there is a need of better algorithm which can accurately detect iris and pupil in eye along with excluding of upper and lower eyelid areas.

In this work, a hybrid technique is proposed to efficiently segment out the iris region and pupil region. Filtering methods for pre-processing, Fuzzy Clustering Method (FCM) for segmentation, Circular Hough Transform (CHT) for circle finding in order to detect iris in eye area. Intensity properties of sclera region and iris is used to detect upper and lower eyelids and in the end template matching has been carried using hamming distance measure out to

check the efficiency of proposed algorithm. Experimental results show that proposed work gives 98.44 % accuracy in verification of iris query images.

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