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Study of Iris Pattern Matching and Detection of the Persons having Squint

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Abstract

Objectives: The present paper has attempted a quantitative study to measure the amount of off centricity of the iris from its normal position. **Methods/Statistical Analysis:** The eye image having squint has been taken from real life image (CASIA DATABASE). First of all the central position of the eye opening between the eyelids are detected by Matlab code. Then the distance between the locations of the squint eye are taken by using 3X3 spatial filter with a local searching method. **Findings:** Squint is the off centre location of iris and pupils and may occur either in one eye or both of the eyes and both male and female persons may have squint. The local searching method terminates when the centre of the filter coincides with the centre of the pupil of the squint eye. The filters are moved from the centre of the eye by coinciding the centre of the spatial filter with the centre of the eye in vertical, horizontal and angular directions. **Application/Improvement:** By this process noises will be reduced which are prevalent in squint eye. The number of pixels responsible for the exact locations may be compensated by making the successive position of the filters bit overlapping which will in turn reduce the possibility of having checker board appearance in the output of the image.

Keywords: Detection, Iris, Pattern Matching, Squint

1. Introduction

Squint is a congenital or hereditary disease and it may be found in any part of the world. It has got the symptoms of off-centric location of the Irises and can occur in any one of the eyes or both as shown in Figure 1. Male and female beings are prone to be effected by squint[1,2]. However it has been reported in the medical jargons that the male human beings suffer more from squint than the female persons. Iris pattern is a reliable biometric for a person and used for various socio legal purposes. It always possess some problem to capture the Iris pattern biometric as the camera and the logistics setup for acquiring iris biometrics are normally done for persons having centric positions of irises within front side of the eye.

So far the present authors have gathered information, no special arrangements are made for acquiring biometrics of the persons having squint problem. There is no specific image database with squint eye images. Biometric system functions first by capturing a sample of the feature or descriptor such as any digital color image having various shape and texture.

Figure 1. Image of a squint eye.

In[3] reported work based on a Pyramid Laplacian to perform the 2-D band pass decomposition in order to

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represent iris images. A mapping function provided the correct correspondence between them and the Fischer's Discriminant evaluated their similarities. In[1] system was implemented into hardware and commercial products from Iris Scan are currently available in the market[3].

In[4] built up an iris recognition framework so as to check uniqueness of the human iris and furthermore its execution as a biometric. The iris recognition system comprises of a programmed division framework that depends on the Hough change which can limit the roundabout pupil portion and iris disposing of impediments from eyelids and eyelashes in order to decrease commotion and reflections. In order to acknowledge iris recognition, system performances of the two databases of digitized grayscale eye pictures were utilized. The iris portion being extricated was then standardized into a rectangular piece with steady measurements to represent imaging irregularities. At last, the stage information from 1D Log-Gabor channels was removed and quantized to four levels to encode the unique pattern of the iris into somewhat insightful biometric format so as to apply and utilize Hamming distance for order of iris layouts and if statistical independence test was failed[4,5] there was a match between the two templates.

The purpose of the present study is to propose an algorithm by which the location of the squint eye can be properly obtained such that subsequent or modified procedures can be followed for squint eye classification and recognition. Possibly the proposed study is the first or first lines of work in the field of squint eye location. The paper organization is as follows: Section 2 gives the detailed descriptors of proposed algorithm followed by the subsequent process steps for remaining part of pattern classification Section 3 describes the result and discussions with necessary images, tables, graphs etc. Lastly Section 4 describes the conclusion.

2. Proposed Algorithm for Squint Eye Location in the Cornea

2.1 Eye Image Acquisition

In the present study, 256 level grey scale images of squint eye have been acquired from real world and 995 people were considered and it added a lot of labour and time to search for persons. First of all off centre difference is measured by sliding the 3X3 window with weight w(I,j) at any location (I,j) in the window[4,5] as shown in Figure 2.

The searching methods are described below.

a. Find the center of the cornea by simple dot per inch count.
b. Put the windows in such a way so that the central pixel coincides with eye center, the center of pupil for the normal person.
c. Start to slide the window in anti-clockwise direction through spatial convolution in such a way to encounter the squint eye. If touched then the filter response will give some different value than that would be got for plain region. This is shown in Figure 3.
d. Move the window around the center of the cornea to find the desired half portion (may be right or left). The figure shows the rotation in counter clockwise direction.
e. Discard the half that does not contain the squint iris.
f. Drag the windows in the selected half (as is shown in Figure 3) in horizontal vertical and angular direction.
g. The movement of spatial window along horizontal and vertical direction will determine the broad location
h. Step g will find the quadrant of the cornea where squint eye lies.
i. Move the window in angular direction with smaller angular step so that the actual position of the squint eye can be located as shown in Figure 4.

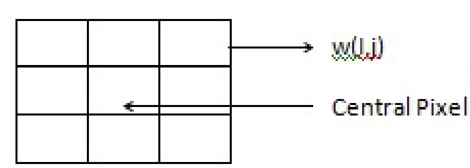

Figure 2. 3X3 window.

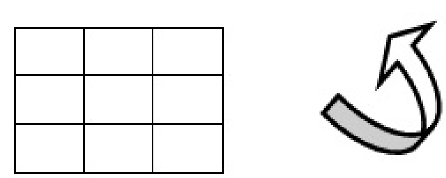

Figure 3. Circular search to locate desired half portion.

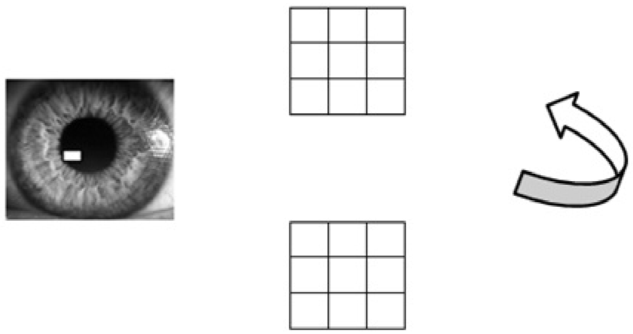

Figure 4. Movement of window in horizontal valued and angular position.

2.2 Iris Recognition Systems

2.2.1 Iris Localization

Image of squint eye is acquired by camera (Sony Cybershot 16 megapixel). Pre-processing includes low pass filtering to reduce noises, cropping of the cornea portions only to delete the eye brow portion. High pass filtering to remove the eye lashes. Segmentation for canny edge detection can be done for properly demarcating the boundary between upper and lower eye lids with the cornea surface and to locate the boundaries between outer part of Iris and cornea and inner part of iris and pupil[4,5]. Normalization process helps to create the image with constant dimensions which may vary due to eyeball movement, variations and intensity on the iris image etc shown in Figure 5.

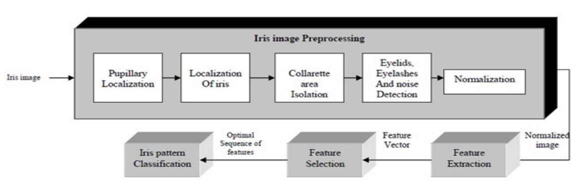

Figure 5. Block diagram for Iris pattern recognition.

2.2.2 Feature Selection

The off centricity measures would act as feature for squint eye location. The horizontal, vertical, and angular position of iris and pupil would be obtained from the searching of squint eye by spatial window which has been mentioned in 2.1 (d).

2.2.3 Iris Recognition

The feature obtained during searching process is compared by simple Euclidean distance method (Gonzalez and woods)[6,7].

3. Results and Discussions

Squint patients suffer from abnormal location of their Iris and Irises along with pupil in the cornea in an off centric location. To locate the position, the first work is to find the side (left or right) of the Iris for which the spatial 3X3 window is moved along counter clockwise direction over 360 degree cantering the central locus of the cornea which can be identified through circular Hough transform. The latter is a standardized computer vision based strategy that can be used to discover the parameters of straightforward geometric items, for instance, lines and circles present in any computerized picture. Initially, an edge guide is made by figuring the primary request subordinates of the pixel intensities in the eye picture and after that thresholding the last result. The circular Hough change can be connected to conclude the range and focus directions of the iris and the pupil locales of the ordinary eye and these eventually will lead towards the area of the focal point of the cornea segment as it is in Figure 6. From the edge map decisions are put in Hough space for the parameters of the circle going through every edge point. These parameters are the centre coordinates X_c and Y_c and the radius r_c which can define any circle according to the equation given below:

$$X_c^2 + Y_c^2 - r_c^2 = 0 \tag{1}$$

A highest point in Hough (parameter) space would represent central coordinate of the circle and also correspond to the circle radius that is best defined by the edge points. The 3X3 window after being dragged over the half circle does not encounter the squint eye, discards that half of the cornea and then moves again in the next half of the cornea. Then it searches for the quadrant where squint is located shown in Figure 7.

The squint eye portion is then searched by 3X3 window further to find the location of squint further. The smaller is the angle of movement of the window finer will be the location of the squint eye. After encountering the filler process will get some response[8,9].

R = w1z1+w2z2+w3z3+… w9z9

$$= \sum_{k=1}^{9} (wk, zk) \tag{2}$$

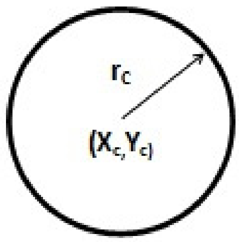

Figure 6. Parameter space in circular hough transform.

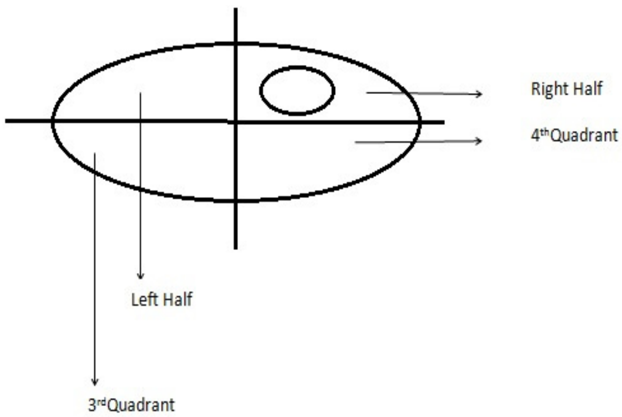

Figure 7. Arbitrary position of the squint iris which may fall between two quadrants.

The feature of the squint effected eye will be determined by circular Hough Transformed parameter space when the transform is applied on the squint eye. The linear distance along the horizontal and vertical directions will be obtained by the number of sliding of the 3X3 window along the horizontal and vertical directions, respectively shown in Figure 8. The angular distance may be obtained according to same algorithm. If the distance is not a multiple of 3X3 window dimensions, then while getting the first response the number of pixels in the window may be counted from the central pixels of the 3X3 window and digital distance will be counted according to the standard formula of Pythagoras theorem based equation as given below:

$$\mathbf{H^2 = A^2 + B^2} \tag{3}$$

The angular digital distance would be required to find the angular location of the squint iris from the centre pixel of the cornea. The standard and suited geometric elements might be taken as

- The even separation between cornea focus and the focal point of the pupil of the squint eye.
- The vertical span between cornea focus and the focal point of the pupil of the squint eye.
- The angular extent between cornea focus and focal point of the student of the squint eye.
- The radius of the squint iris acquired from circular Hough transform.
- The location of the pupil of the squint eye acquired from Circular Hough Transform.

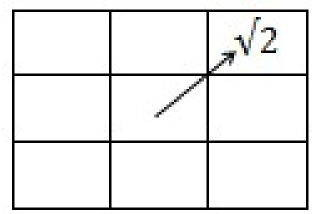

Figure 8. Measurement of digital diagonal.

4. Matching

In this present paper, matching is done by Hamming distance which is given by the equation given below:

$$HD = \frac{1}{N}\sum_{j=1}^{N} X_j (XOR) Y_j \tag{4}$$

Calculation of Hamming Distance (HD) is accomplished for this evaluation. HD is a fractional measure of the number of bits differing between two binary patterns[10–12]. In the event that the two bits patterns are wholly unbiased in comparison to iris templates generated from distinctive irises, the Hamming distance between the 2 patterns should approach 0.5. This happens due to the fact independence implies the 2 bit patterns will likely be thoroughly random, so there is 50% likelihood of setting any bit to 1 and vice versa. Consequently, half of the bits will agree and 1/2 will differ between the 2 patterns. If two patterns are acquired from the same iris, the Hamming distance between them will near to 0 as they're particularly correlated and the bits must concur between the two iris codes[13].

4.1 Comparative Study

As no study on squint iris was found, the comparison is made by other standard technique of pattern classification. The comparative study is shown as Table 1.

Table 1. The comparative study of different algorithms with proposed algorithm

Methods	Recognition Rate	Equal error Rate	False Acceptance Rate	False rejection ratio
SVM	94.12%	1.93%	2.4%	3.1%
PCA	92.48%	2.1%	2.2%	4.2%
ICA	93.28%	2.2%	1.46%	4.1%
PA	96.98%	2.4%	1.78%	3.15%

FAR AND FRR Calculations

FAR= Imposter scores exceeding threshold/All imposter score

FRR= Genuine score failing below threshold/All genuine score

5. Conclusion

The present work is quite novel and simple methodologies have been followed. It is expected that the study would provide some basic hints for the classification of squints effected iris pattern. The same technique may be applied when squint would affect both the eyes. Also separation of normal iris with squint iris may be found with different parameters.

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