A Study on Non Circular Iris Pattern and Pupils Texture Classification of Certain Animals and Birds by Local Edge Patterns

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Abstract- It has been observed that there are certain species among various human races, various species of animals and birds have iris pattern geometry which can't be approximated by a circular shape, especially for the external boundary of the irises and pupils. The well-established Daugmans methods is mainly based on the assumption that the iris patterns basically consist of two circles in which inner one is non-concentric to the outer one .In the present study the existing 2D spatial filter has been transformed into a fully Cartesian coordinate system with the assumption that the iris patterns have almost square shaped except at the corners and pupils are non-circular in shape.

Keywords – Pattern, Hamming Distance, Circular, Texture

I. INTRODUCTION

Not all animals have circular pupils. Some have slits or ovals which may be oriented vertically, as in crocodiles, vipers, cats and foxes or mongooses and artiodactyls such as sheep, red deer, reindeer and hippopotamus as well as the domestic horse. Goats, toads and octopus pupils tend to be horizontal and rectangular with rounded corners. Some skates and rays have crescent shaped pupils, gecko pupils range from circular, to a slit, to a series of pinholes, and the cuttlefish pupil is a smoothly-curving W shape.

Although a good number of scientist and researchers have done a considerable work on Iris pattern recognition by assuming the geometry as a Circular Iris and pupils, no such study as the present one is available either in published or online literature.

(a) (b) (c)

Figure 1.(a) a goat with rectangularpupils (b)a crocodile with vertical slits pupilsand (c) a gecko with strings of pearls pupils

In this study percentage of error is found to occour by taking the present study assumption and in this the paper the Daugmans rubbersheet theory fails to a certain level.

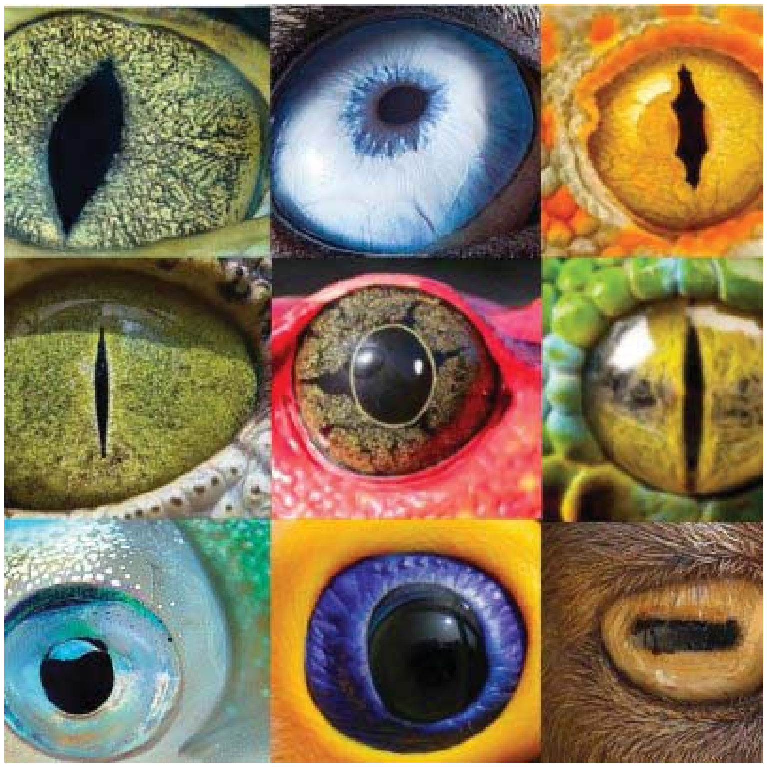


Figure2. Pupils which are non-concentric to Iris

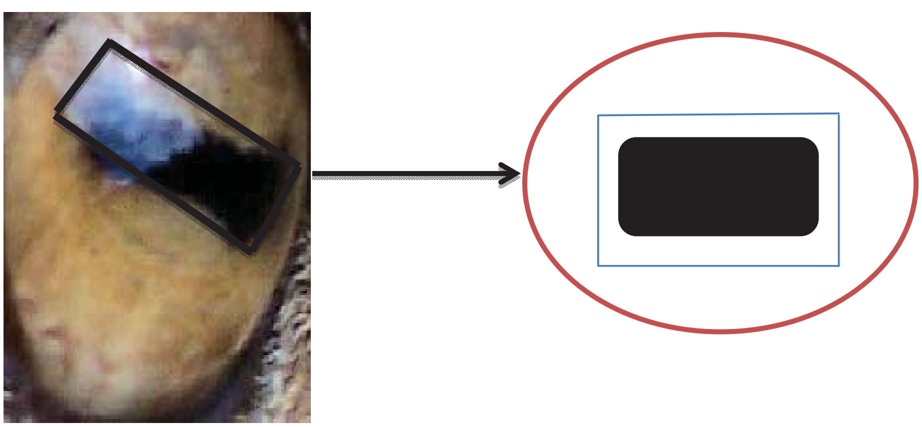


Figure 3.A Noncircular shaped Pupil with respect to Iris which is non-concentric

II. Proposed Algorithm

A. Iris texture analysis and pattern matching process-

Image Texture defined as a function of the spatial variation in pixel intensities is useful in many applications and has been a subject of intense study by many researcher .One important application of image texture is the recognition of image regions by their texture properties.

Texture is the most visual cue in identifying these types of homogeneous regions. This is called as texture classification. The goal of Texture classification is to produce a classification map of the input image where each uniform textured region is identified with the texture class it belongs.

B. Image Acquisition-

First of all different images of non-circular iris images of many animals are taken from various angles. Among these the best eye image is selected for iris segmentation for further processing which would lead to iris recognition in a meaningful way.

C. Preprocessing-

An iris image contains some irrelevant parts such as eyelids sclera and pupil. Also, the size of an iris may vary depending on camera-to-eye distance, illumination level and amount of reflections. Therefore, the original image needs to be normalized

Here as the pupil is rectangular in shape we have to find out the area of the Iris and pupil. Let the length and breadth of the iris/sclera boundary region be L, B and while the length and breadth of the iris /pupil boundary be l, b respectively. The area of the Iris portion i.e. ROI can be measured as 2(l+b) for both the rectangle. To find the inner rectangular area we subtract the value from the bigger rectangular area.

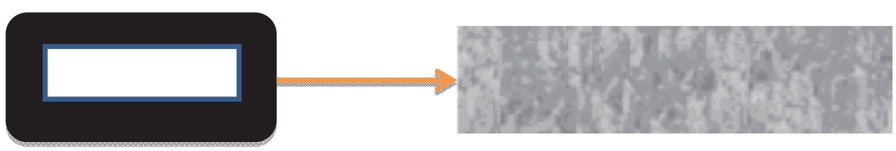
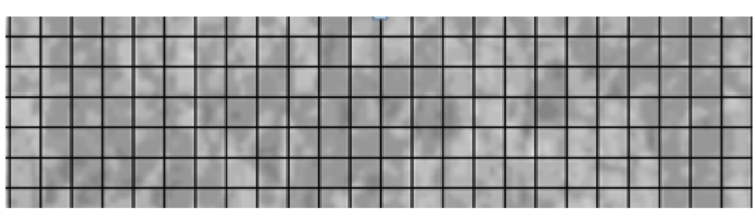


Figure 4.Conversion of Iris Region into normalized Iris Pattern



D. Local Edge Pattern -

From the viewpoint of texture analysis, local spatial patterns in an iris mainly involve frequency and orientation information. Thus, we present a new model of texture analysis to detect high frequency part of iris texture. It provides a robust way for describing local edge patterns (LEP) in an iris texture. The Local edge represents the qualitative intensity relationship between a pixel and its neighbour hoods. It is robust, discriminative, and computationally efficient, so it is well suited for texture analysis. We used LEP to represent iris image blocks' distinctive information because iris patterns can be seen as textures constituted by many minute image structures. The LEP operator is represented by 16 mask patterns, as shown in Fig. We restrict the range of displacement to within a local 3x3 window that extracts the local information mainly. The feature values are calculated by scanning each image block by the 16 local 3x3 mask patterns individually and computing the sums of the intensities of corresponding pixels. Each pixel x_{ij} in the image is considered as the centre of LEP and the corresponding edge and corner intensity is represented by L_p

Where p= 1,2,…,16 . Every feature value is calculated by

$$L_p = \sum_{j=1}^{m}\sum_{i=1}^{n} L_{p(i,j)}\ , \qquad L_{p(i,j)} = \sum_{j=1}^{m}\sum_{i=1}^{n} \left| x_{ij} * G_p \right|$$

Where *n* and *m* are the width and height of the image block, and x_{ij} is the image pixel value, G_p is one of the local edge patterns. We can employ the 16 local edge patterns to find out the 16 feature values that represent various edge or corner patterns in the normalized iris image. Since LEP features use the information of two dimensional distributions as well as the directions, they can analyse an image more closely. Furthermore, the feature values of LEP operator are invariant to translation (shift) due to the geometrical feature extraction. The LEP operator is regarded as basis functions of frequency analysis. Those feature values represent high frequency part of the iris image.

$$\begin{bmatrix}0&-1&0\\0&0&0\\0&1&0\end{bmatrix}\begin{bmatrix}0&0&0\\-1&0&1\\0&0&0\end{bmatrix}\begin{bmatrix}-1&0&0\\0&0&0\\0&0&1\end{bmatrix}\begin{bmatrix}0&0&-1\\0&0&0\\1&0&0\end{bmatrix}\begin{bmatrix}-1&0&-1\\0&2&0\\0&0&0\end{bmatrix}\begin{bmatrix}0&0&0\\0&2&0\\-1&0&-1\end{bmatrix}\begin{bmatrix}-1&0&0\\0&2&0\\-1&0&0\end{bmatrix}\begin{bmatrix}0&0&-1\\0&2&0\\0&0&-1\end{bmatrix}$$

$$\begin{bmatrix}0&-1&0\\0&0&0\\0&0&1\end{bmatrix}\begin{bmatrix}0&-1&0\\0&0&0\\1&0&0\end{bmatrix}\begin{bmatrix}0&0&1\\-1&0&0\\0&0&0\end{bmatrix}\begin{bmatrix}0&0&0\\-1&0&0\\0&0&1\end{bmatrix}\begin{bmatrix}0&0&0\\0&2&-1\\0&-1&0\end{bmatrix}\begin{bmatrix}0&-1&0\\-1&2&0\\0&0&0\end{bmatrix}\begin{bmatrix}0&-1&0\\0&2&-1\\0&0&0\end{bmatrix}\begin{bmatrix}0&0&0\\-1&2&0\\0&-1&0\end{bmatrix}$$

D. Classification and Matching-

Comparison of the bit patterns generated is done to check if the two irises belong to the same monkey from the area. Calculation of Hamming Distance (HD) is done for this comparison. HD is a fractional measure of the number of bits disagreeing between two binary patterns. Since this code comparison uses the iris code data and the noisy mask bits, the modified form of the HD is given by

$$HD = \frac{1}{N}\sum_{j=1}^{N} X_j \oplus Y_j$$

Where X_j and Y_j are the two iris codes and N is the number of bits in each template[2]. Since an individual iris region contains features with high degrees of freedom, each iris region will produce a bit-pattern which is independent to that produced by another iris, on the other hand, two iris codes produced from the same iris will be highly correlated [12-13].

If two bits patterns are completely independent, such as iris templates generated from different irises, the Hamming distance between the two patterns should equal 0.5. This occurs because independence implies the two bit patterns will be totally random, so there is 50 percent probability of setting any bit to 1, and vice-versa. Therefore, half of the bits will agree and half will disagree between the two patterns. If two patterns are derived from the same iris, the Hamming distance between them will be close to 0 as they are highly correlated and the bits should agree between the two iris codes.

III. EXPERIMENT AND RESULT

Experiments are performed in two different stages: Iris segmentation and Iris recognition. At first stage the localization of Irises using MATLAB is shown. Average time for localization is 48 Sec and accuracy rate was 90.34% and Iris matching accuracy rate is 94%. Table here shows the comparison for different techniques used for Iris localization and matching accuracy rate.

Table -1 Accuracy Rate for Iris Segmentation and Recognition

Methodology	Accuracy Rate	Average Time(s)	Matching Accuracy Rate
Daugman	**76 %**	**85**	**100 %**
Wildes	**83 %**	**93**	**88.25 %**
Masek	**86 %**	**70**	**90.20 %**
Proposed	**90.34**	**50**	**94%**

IV.CONCLUSION

Biometric identification of different animals will be helpful to make a clear note of wild life preservation and also to make the census of these extinct species. Moreover differentiating of two species and also gender recognition will be possible in further studies. Continuous study of different algorithm needs to be carried out for further progress and continuously developed and improved.

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