Iris Pattern Recognition of the Kingfisher Bird using Discrete Wavelet Transform and Feature Extraction from Histogram Orientation Gradient

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Abstract

Objectives: The present study has dealt with a new idea for recognizing the Iris pattern and their matching of the Kingfisher, a colorful bird. Methods/Statistical Analysis: The investigation has been made to detect, recognize and match the irises through a series of process. The work is centered about the improvement of the matrices concerned; rather than reducing the execution time of the program. For the present paper, MATLAB R2016a is used as the development tool. Findings: The proposed work is expected to give a recognition rate of 93% with a false rejected rate of 1.0. Application/Improvement: The results may be used for the census of Kingfisher birds and also towards wildlife preservation.

Keywords: Circular Hough Transform, Discrete Wavelet Transform, Feature Extraction, Histogram

1. Introduction

Kingfisher, being a bird of colorful appearance, their head and wings become prominent when they fly. They live on fish and other small insects and normally they dwell in the holes dug on the slope of any pond and rivers. They catch their prey i.e. fishes by swooping down the water and their eyesight seems to be very powerful than any other common birds. Iris pattern matching is normally found useful for a human being to be used as a secured biometrics. A large number of studies are found on human iris pattern recognition in journals and published articles. The authors have followed various algorithms for feature extraction and pattern recognition and most of them have obtained acceptable results.

In this present study kingfisher bird is chosen to investigate the specialty of Iris pattern and to find the usefulness of Kingfisher Iris to keep a record of Census about the bird. Iris images of Kingfisher have been obtained from Google database and analyzed in MATLAB platform. The main attraction of the present study is to use of homomorphic filtering process followed by two-dimensional discrete wavelet transformations. The features have been selected by using Histogram orientation Gradient Method. It has been found that the proposed algorithm is capable of yielding nearly equivalent or even better result than those obtained in human pattern recognition.

Although a large number of studies on Iris pattern Recognition has been carried out by various researchers mainly to create a biometric database, some studies on Iris pattern recognition method of an owl, tiger and monkey have already been reported by Parthasarathi De and Dr. Dibyendu Ghoshal.

The main motive of those studies was wildlife preservation at large by taking care of all endangered animals and birds.

The extraordinary eyesight of the kingfisher is mainly
due to the structure of the eye and the optical nerve linking the retina and the vision centre of the brain of the bird. Thus the study of iris pattern and its iris recognition invites a novelty as well as the fulfillment of the practical purpose. Besides, the census of birds and animals etc has become a prime necessity in the modern ecological system. The image of a kingfisher bird’s eye is shown in Figure 1_De.

After this processing, Canny edge of the irises would be obtained. To avoid missing the finer details during Canny operation, the resultant image is subjected to further two-dimensional Discrete Wavelet Transform. Now the Iris edges are linked using circular Hough Transform. The double operation will make the edges more accurate. In the next stage histogram of the Iris, image is obtained and features are selected from Histogram oriented Gradient Method. Finally, matching of the kingfisher Iris features is accomplished by Geometrical Comparison of radii obtained from angle to those which are stored in database.

Figure 2_De. The block diagram for the proposed methodology.

3. Mathematical Formula Short Descriptions of different Processes used in the Study

3.1 Gaussian Low Pass Filtering

The Gaussian filter is used for making an image smooth and also to remove noise from an Image. The Gaussian filtering can be done by the following equation

$$g(x) = \frac{1}{(\sqrt{2\pi}\sigma)}, e^{-\frac{x^2}{2\sigma^2}}$$

3.2 Canny Edge Detector

The Canny Edge Detector is a very efficient tool for detecting edges in Image Processing. This tool helps to detect edges in a very optimize way. The foremost competency of utilizing Canny edge detector is that it identifies the perimeters thoroughly and there’s no feedback from non-edges. The Gradient magnitudes may also be decided through the equation given beneath.
\[ |G| = \sqrt{G_x^2 + G_y^2} \]

### 3.3 Circular Hough Transform

The Hough transform is a process for locating shapes in a photo. The Circle Hough has been applied here which is used to find circles inside a photo. The circular Hough transform is nearly identical to the Hough transform for lines but uses the parametric type for a circle.

### 3.4 Edge Linking Method

The Edge Detection of an image is always followed by an edge linking\[14,15\] methods to assemble edge pixels into meaningful boundaries. The elemental proposal behind this is that all features which are identical are linked forming a boundary of pixels that have similar properties.

Two most important properties for commencing similarity between two pixels are:
1. The strength of response of the gradient operator used to produce the boundary pixels.
2. The gradient direction

### 3.5 Histogram of Gradient

Histogram of Gradient is a feature descriptor tool used in image processing to detect any object. The technique counts occurrences of gradient orientation in localized portions\[16\] of an image computed on a dense grid of uniformly spaced cells and uses overlapping local contrast normalization for improved accuracy. Its advantage is that shape and appearance of a local object can often be classified very well by the distribution of edge directions or local intensity gradients.

### 4. Matching

Once the features are selected from Histogram Orientation Gradient Method then the next step is to match the corresponding iris with the irises stored in the database. The matching in this study is done by weighted arithmetic mean\[17-20\]. The weighted mean for a given set of non-negative data \(\{x_1, x_2, x_3, x_4, \ldots, x_n\}\) with non-negative weights \(\{w_1, w_2, w_3, w_4, \ldots, w_n\}\) can be derived from the formula:

\[ \bar{x} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i} \]

or,

\[ \bar{x} = \frac{w_1 x_1 + w_2 x_2 + \ldots + w_n x_n}{w_1 + w_2 + w_3 + \ldots + w_n} \]

Where \(x\) is the repeating value, \(W\) is the number of occurrence of \(x\).

### 5. Results and Discussions

The present study is done in MATLAB R 2013 platform. The stress is given to achieve the recognition accurately rather than the processing time. The acquired image is shown in Figure 1_De. Figure 2_De shows the block diagram of the proposed methodology. Figure 3_De shows localized Iris Image of the kingfisher bird along with the application of Circular Hough transform\[21\] to extract the Iris pattern. The edge detection of the Iris is done with 2D DWT and the resultant image is shown in Figure 4_De. For Edge linking purposes the Hough Transform is again used and finally Histogram technique is applied on the edge linked pattern of the Irises and the Histogram is obtained. Histogram orientation gradients are calculated.

### 6. 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 in Table 1_De and the
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corresponding graphs are plotted in Figure 5_De, Figure 6_De and Figure 7_De.

![Figure 5](image1)

**Figure 5**. Recognition rate against false recognition rate.

![Figure 6](image2)

**Figure 6**. Equal error rate against recognition rate.

![Figure 7](image3)

**Figure 7**. Recognition rate against false acceptance rate.

| Authors/Scientist | Equal Error Rate | False Acceptance Rate | False Rejection Rate | Recognition Rate |
|------------------|------------------|------------------------|----------------------|-----------------|
| Daugman          | 0.95             | 0.01                   | 0.06                 | 99              |
| Boles            | 2.89             | 2.0                    | 1.02                 | 97              |
| Wildes           | 3.32             | 0.02                   | 0.02                 | 96              |
| Labor Masek      | 4.065            | 1.865                  | 1.06                 | 95              |
| Proposed Work    | 5.039            | 2.0                    | 1.0                  | 93              |

**Table 1**. The comparative study of different algorithms with Proposed Algorithm

- **FAR AND FRR Calculations**:
  - **FAR (False Acceptance Rate)** = Imposter scores exceeding threshold/All imposter score
  - **FRR (False Rejection Rate)** = Real score failing below threshold/All genuine score

The FRR (False Rejection Rate) is the likelihood that the framework incorrectly rejects entry to an authorized person for failing to match the biometric input with a template. EER or Equal Error Rate is the value which indicates that the share of false acceptances is the same as the percentage of false rejections. If the equal error rate price is less, the accuracy of the biometric approach is more i.e. they are inversely proportional.

**7. Conclusion**

A theoretical investigation has been carried out for Iris pattern Recognition of the Kingfisher using Canny edge detector, Circular Hough Transformation, 2D discrete wavelet Transform and the features of the linked edges of the iris patterns have been obtained from Histogram orientation Gradient method in terms of Equal Error rate, False acceptance and rejection rates followed by Recognition rates. Although comparison of those matrices with those obtained by another scientist from Human Iris pattern Recognition, still a comparative study is made to release the applicability of the proposed method. The processing and execution time of the program has been found to be large and it could have been reduced by using less number of blocks in the algorithm or combining any two to one to have similar effects. The study is expected to provide some useful basis which can be used for the preservation of various species of beautiful birds in the world.
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