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A Survey Paper :Segmentation Process of Iris Recognition

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Abstract: The Iris Recognition System is very interesting and today it is widely used for the security point of view. Iris recognition gives accurate results. It never takes false value, so it is really very good for security purpose. Iris recognition is amongst the most robust and accurate biometric technologies available in the market today with existing large scale applications supporting databases in excess of millions of people. Daugman is the first one to give an algorithm for iris recognition. . The algorithm was based on Iris Codes. Integro-differential operators are then used to detect the centre and diameter of the iris, then the pupil is also detected using the differential operators, for conversion from Cartesian to polar transform, rectangular representation of the required area is made. Wildes proposed iris recognition based on texture analysis. High quality iris images was captured using silicon intensified target camera coupled with a standard frame grabber and resolution of 512x480 pixels.

Keywords: Iris recognition, Integro-differential, Grabber, Iris Codes, Grabber.

I. INTRODUCTION

Iris recognition is a method of biometric authentication that recognizes a person by pattern of the iris. Of all the biometric technologies used for human authentication today, it is generally conceded that iris recognition is the most accurate. The purpose of 'Iris Recognition', a biometrical based technology for personal identification and verification, is to recognize a person from his/her iris prints. In fact, iris patterns are characterized by high level of stability and distinctiveness. Each individual has a unique iris. The difference even exists between identical twins and between the left and right eye of the same person. Irises are also stable; unlike other identifying characteristics that can change with age, the pattern of one's iris is fully formed by ten months of age and remains the same for the duration of their lifetime. Iris recognition is rarely impeded by glasses or contact lenses and can be scanned from 10cm to a few meters away.

Image processing techniques can be employed to extract the unique iris pattern from a digitized image of the eye, and encode it into a biometric template, which can be stored in a database. This biometric template contains an objective mathematical representation of the unique information stored in the iris, and allows comparisons to be made between templates. When a subject wishes to be identified by iris recognition system, their eye is first photographed, and then a template created for their iris region. This template is then compared with the other templates stored in a database until either a matching template is found and the subject is identified, or no match is found and the subject remains unidentified. [1]

II. SEGMENTATION PROCESS METHOD

Segmentation subdivides an image into its constituent regions or objects [5]. The first stage of iris recognition is to isolate circular iris region. Iris is isolated using concentric circles, one circle is defined by the edge between sclera and iris and other is defined by the edge between pupil and iris. The process involves the extraction of circular boundaries of pupil and iris from the edge map using Circular Hough Transform (CHT).Usually, pre-segmentation process involves blurring the image using low-pass filter to remove the noise.

A. Edge Detection:

Edge detection is the approach for detecting meaningful discontinuities in an image. Intuitively, an edge is a set of connected pixels that lie on the boundary between two regions. To be classified as a meaningful edge point, the transition in gray level associated with that point has to be significantly stronger than the background at that point. The method of choice to determine whether a value is "significant" or not is to use a threshold.

In practice, edges are usually blurred, due to the quality of image acquisition system, the sampling rate, Gaussian blur etc. As a result, edges are modeled using "ramp-like" profile as shown in the Figure 1. Therefore, in practice, thickness of the edge is determined by the length of the ramp.

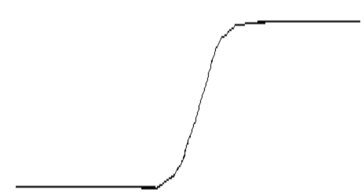

Figure 1: Function f (i)

The derivative of the signal gives local maxima at the discontinuities and is zero at constant gray level. The first derivative is positive at the points of transition into and out of the ramp; and is zero in areas of constant gray level. Hence, the magnitude of the first derivative given in figure 2 is used to detect the presence of an edge at a point in an image i.e. to determine if a point is on the ramp.

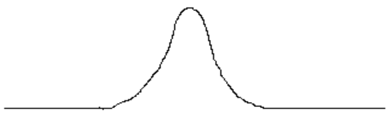

Figure 2: First Derivatives

a. Canny Edge Detector:

Edges characterize boundaries and are therefore a problem of fundamental importance in image processing. Edges in images are areas with strong intensity contrasts – a jump in intensity from one pixel to the next. Edge detecting an image significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image.

The Canny edge detection algorithm is known to many as the optimal edge detector. A list of criteria to improve current methods of edge detection is the first and most obvious is low error rate. It is important that edges occurring in images should not be missed and that there be NO responses to non-edges. The second criterion is that the edge points be well localized. In other words, the distance between the edge pixels as found by the detector and the actual edge is to be at a minimum. A third criterion is to have only one response to a single edge. This was implemented because the first 2 were not substantial enough to completely eliminate the possibility of multiple responses to an edge. [2]

Step1: In order to implement the canny edge detector algorithm, a series of steps must be followed. The first step is to filter out any noise in the original image before trying to locate and detect any edges. And because the Gaussian filter can be computed using a simple mask, it is used exclusively in the Canny algorithm. Once a suitable mask has been calculated, the Gaussian smoothing can be performed using standard convolution methods. The Gaussian mask used is shown in figure 3.

Step2: Gradient operators are used to detect discontinuities in an image. Image matrix is convolved with gradient kernel. First-order derivatives of a digital image are based on various approximations of the 2-D gradient. The Sobel operator performs a 2-D spatial gradient measurement on an image and so emphasizes regions of high spatial frequency that correspond to edges i.e. use a weight of two in the center co-efficient. Typically it is used to find the approximate absolute gradient magnitude at each point in an input grayscale image. Computation of the gradient of an image is based on obtaining the partial derivatives σf/σx and σf/σy.

	2	4	5	4	2
	4	9	12	9	4
1/115	5	12	15	12	5
	4	9	12	9	4
	2	4	5	4	2

Figure 3: Gaussian mask [2]

a. Sobel operator: The Sobel operator is an algorithm for edge detection in images. It is an image processing technique to discover the boundaries between regions in an image. It’s an important part of detecting features and objects in an image. Simply put, edge detection algorithms help us to determine and separate objects from background, in an image.

The Sobel operator does this in a rather clever way. An image gradient is a change in intensity (or color) of an image (I’m over simplifying but bear with me). An edge in an image occurs when the gradient is greatest and the Sobel operator makes use of this fact to find the edges in an image. The Sobel operator calculates the approximate image gradient of each pixel by convolving the image with a pair of 3×3 filters. These filters estimate the gradients in the horizontal (x) and vertical (y) directions and the magnitude of the gradient is simply the sum of these 2 gradients. Here, is the3X3 kernel of Sobel Operators given in equation 1 and 2 equation,

$$\mathrm{Gx} = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} \tag{1}$$

$$\mathrm{Gy} = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix} \tag{2}$$

Gradient operators are usually two pass operators, horizontal operator, Gx detects the vertical edges and vertical operator, Gy detects the horizontal edges in the image.[3]

Therefore, the gradient of an image f(x, y) at location (x, y) is given by the resultant equation 3 and 4

$$\mathrm{G} = \left| G_x^2 + G_y^2 \right| \tag{3}$$

Where $\mathrm{Gx} = \frac{\sigma f}{\sigma x}$ and $\mathrm{Gy} = \frac{\sigma f}{\sigma y}$ (4)

The direction of the gradient vector is given by,

$$\alpha(x, y) = \tan^{-1}\frac{G_y}{G_x}$$

(5)

B. Circular Hough Transform:

The Hough Transform (HT) (Hough, 1962) is a technique that locates shapes in images. In particular, it has been used to extract lines, circles and ellipses (or conic sections). In the case of lines, its mathematical definition is equivalent to the Radon transform. Its prime advantage is that it can deliver the same result as that for template matching, but faster. This is achieved by a reformulation of the template matching process, based on an evidence gathering approach where the evidence is the votes cast in an accumulator array.

The HT implementation defines a mapping from the image points into an accumulator space (Hough space). The mapping is achieved in a computationally efficient manner, based on the function that describes the target shape. This mapping requires much less computational resources than template matching. However, it still requires significant storage and high computational requirements. The fact that the HT is equivalent to template matching has given sufficient impetus for the technique to be amongst the most popular of all existing shape extraction techniques.

The Hough Transform (HT) falls into the midrange of vision-processing hierarchy. It is applied to images which have already been freed from irrelevant detail by some combination of filtering, thresholding and edge detection. This method can be viewed as a segmentation procedure.

The idea behind the method is simple, parametric shapes in an image are detected by looking for accumulation points in the parameter space. If a particular shape is present in the image, then the mapping of all of its points into the parameter space must cluster around the parameter values which correspond to that shape.

a. Working of circular Hough Transform:

Hough transform converts a point in the x, y-plane to the parameter space. The parameter space is defined according to the shape of the object of interest. The CHT can be defined by considering the equation for a circle given by

$$r^2 = (x-a)^2 + (y-b)^2 \tag{6}$$

This equation defines a locus of points (x, y) centered on an origin (a, b) and with radius r. This equation can again be visualized in two dual ways: as a locus of points (x, y) in an image, or as a locus of points (a, b) centered on (x, y) with radius r.

Each edge point defines a set of circles in the accumulator space. These circles are defined by all possible values of the radius and they are centered on the co-ordinates of the edge point. Figure 4 (a) shows three circles defined by three edge points. These circles are defined for a given radius value. Actually, each edge point defines circles for the other values of the radius. This implies that the accumulator space is three dimensional (for the three parameters of interest) and that edge points map to a cone of votes in the accumulator space. After gathering evidence of all the edge points, the maximum in the accumulator space again corresponds to the parameters of the circle in the original image. [6]

The votes are generated in cones, according to Equation

The parametric representation of the equation of the circle is given in equation 7

$$x = a + r\cos\theta \qquad y = b + r\sin\theta \tag{7}$$

Thus, the HT mapping is defined by

$$a = x - r\cos\theta \quad b = y - r\sin\theta \tag{8}$$

These equations define the points in the accumulator space (dependent on the radius r. Note that θ is not a free parameter, but defines the trace of the curve.

b. Finding circle from the Hough Transform data:

Although this is not a part of the Hough Transform it is desirable to be able to find circles from the accumulator data.

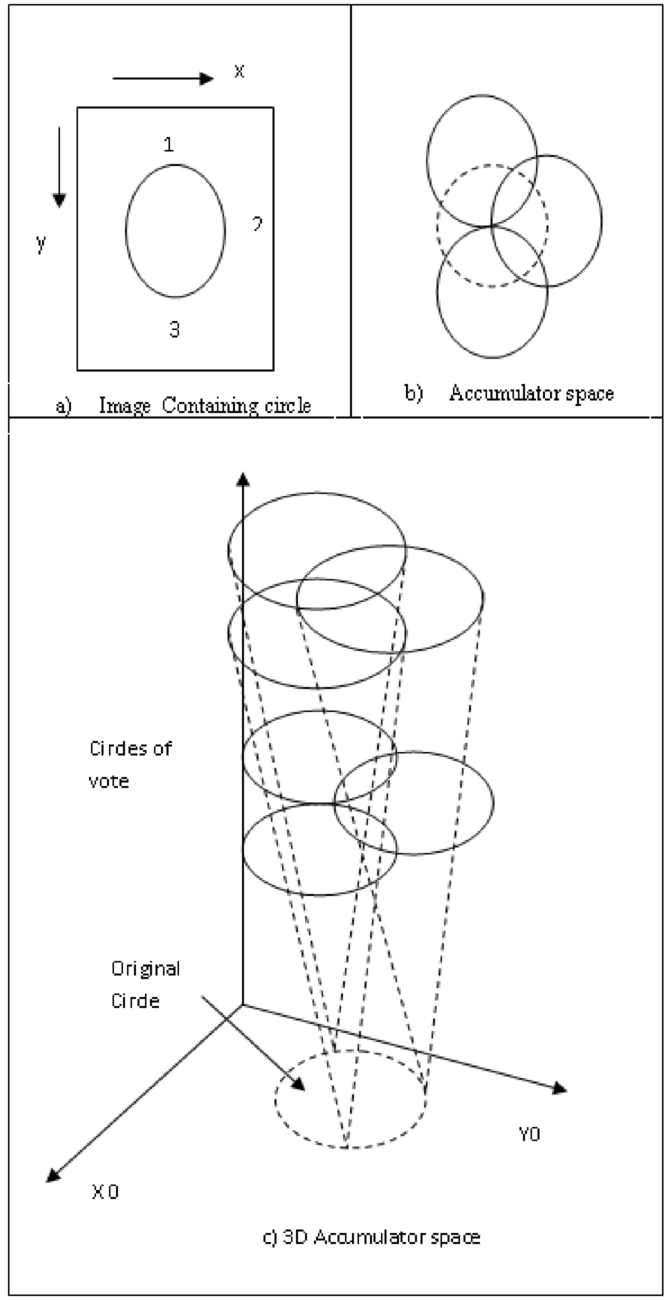

Figure 4: Illustrating Circular Hough Transform [4] [6]

If no prior knowledge is known about the number of circle and their radii then this process can be quite challenging. One approach is to find the highest peaks for each a, b plane corresponding to a particular radius, in the accumulator data. If the height of the peak(s) is equal compared to the number of edge pixels for a circle with the particular radius, the coordinates of the peak(s) does probably correspond to the center of such a circle. But the center of a circle can also be represented by a peak with a height less than the number of edge pixels, if for instance the circle is not complete or is ellipse shaped. If it is difficult to locate exact peaks, the accumulator data can be smoothed. [6]

III. CONCLUSION

Due to favorable comparisons with other biometric traits, the popularity of the iris has grown considerably and efforts are concentrated in the development of systems that are less constrained to subjects, using images captured at-a-distance and on-the-move. These are extremely ambitious conditions that lead to severely degraded image data, which can be especially challenging for image segmentation. Due to performance concerns, we aimed to preserve the linear and deterministic computational complexity of our method, offering the ability to handle real-time data. IT is conclude that, using a relatively small set of data for learning, our method accomplished its major goals and achieved acceptable results when compared with other state-of-the-art techniques at significantly lower computational cost. For the future work the image segmentation techniques or noise removal methods can be improved, so that the input image to the feature extraction stage could be made better which can improve the final outcome. Also, the system should be tested on a larger database to validate the robustness of the system.

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