# Segmentation of Iris from Human Eye Image using Active Contour Model

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# Segmentation of Iris from Human Eye Image using Active Contour Model

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## Abstract

*Biometric system provides automatic identification of an individual based on a unique features or characteristic possessed by the individual. Iris recognition is one of the important biometric recognition systems that identify people based on their eyes and iris. In this paper, we proposed a method to segment the iris in the eye image using active contour method. We evaluated our proposed method using the image obtained from the internet.*

**Keywords**: Iris Segmentation, Active Contour method, Biometric Authentication System, Iris Recognition.

## 1. Introduction

As the technology improves day by day, the need for powerful security and authentication has also become vital. Authentication is a fundamental component of human interaction with computers and the identification of individuals has become crucial. An individual is uniquely identified with either Password, PIN, Smart card, token, finger print, iris, speech etc. These features are categorized into physiological or behavioral characteristic. Biometric system is a pattern recognition system that recognizes a person either by physiological characteristics or behavioral characterization. It compares the current biometric data captured with stored, confirmed authentic data in the database. Among the various biometric authentication methods, iris recognition is more reliable and accurate method because of its high recognition rate and uniqueness in recognition [1] [2].

Daugman's [3] proposed an integral differential operator for proper segmentation of an iris. Iris recognition algorithm is implemented using hybrid techniques. A method proposed in [4] used hybrid technique using histogram and wavelet analysis to segment the iris images obtained from phoenix database. Jiali et.al.,[5] have proposed iris recognition algorithm based on PCA (Principal Component Analysis). They first introduced this approach on synthesis iris images. The synthesis images constructs coarse iris images with the given coefficients then, synthesis iris images are enhanced using super resolution. Through controlling the coefficients, they create many iris images with specified classes. Extensive experiments of this method show that the synthesized iris images have satisfactory cluster for segmenting the iris. Paul et. al.,[6] presented an iris recognition system in order to verify the uniqueness of the person's iris and also its performance as a biometric indication. The iris recognition system consist of an automatic segmentation that is based on the Hough transform is able to focus the circular iris and pupil region including eyelids and eyelashes and reflection [7]. Kalavathi and Bhonesh Narayani [8] developed active contour based bi-Level segmentation of iris from the human eye images. In this paper iris is recognized based on some computational algorithm. A method to segment the iris in the eye image using localized energy-based active contour method is proposed in [9] [10]. In order to reduce the implementation time and increase the segmentation accuracy, a new segmentation, method based on active contour method is proposed in this paper. The following part of the paper is organized as follows; The methodological details are given in section 2. The results and conclusions are given in section 3 and 4 respectively.

## 2. Methodology

This proposed method uses a active contour [11] method to segment the iris in eye image. The overall flowchart of the proposed method is given in Fig.1. This method first read input image and convert it into grayscale image if the input image is color image. Active Contour Model (ACM) is a most widely used segmentation technique in the area of image segmentation. ACM method detect closed curve for defining the complete boundary of an object present in the image. ACM starts its curve evaluation from the initial curve. In general, an active contour requires to define initial contour inside the object need to be segmented. In this method, we defined the initial curve by computing the width and height of the eye in the eye image. Once the initial curve is defined, the ACM compute energy to evolve the curve to reach the boundary. Energy function defines the contour based on the image properties such as gradient, intensity, distance etc. This method computes statistical information based on intensity value of the image pixel to minimize the energy in order detect the contour. Different active contour model use different energy function to evolve the curve.


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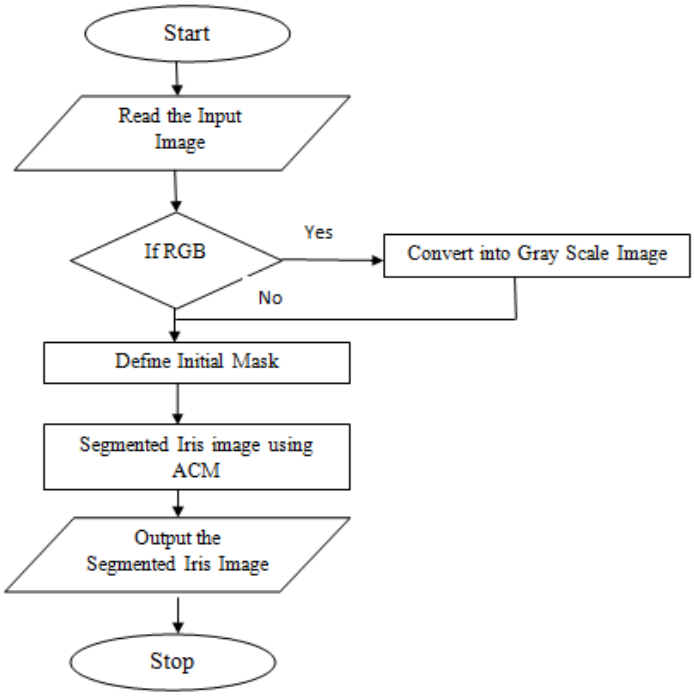


**Figure 1: Overall Flowchart by proposed method**

The defined initial contour is represented as C, the actual contour of the object is denoted as $c_0$. The ACM model compute the average intensities namely $C_1$ and $C_2$ representing the average intensities inside and outside of the initial curve. The energy functional of an active contour model for an image $U$ at any points $(x, y)$ is defined as:

$$F(C_1, C_2, C) = F_1(C) + F_2(C) = \sum_{interior\,(c)} |U(x,y) - C_1|^2 + \sum_{exterior\,(c)} |U(x,y) - C_2|^2 \quad (1)$$

The object boundary can be detected by minimizing F in terms of $C_1$ , $C_2$ and C starting with the initial curve C. The Process of iris segmentation using ACM method is illustrated in Figure 2.

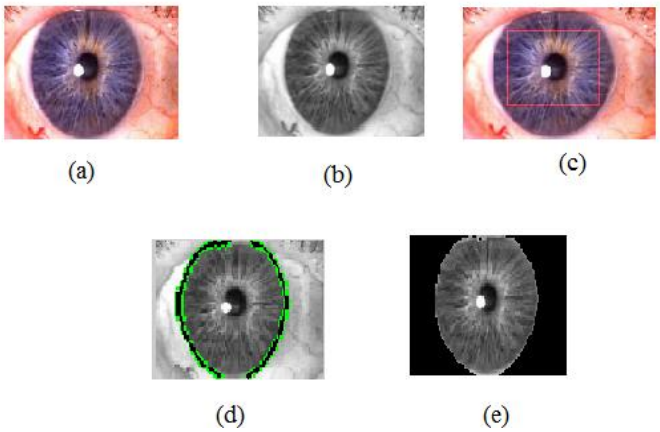


**Figure 2: Process of Iris Segmentation; (a) Original image (b) Converted Gray Scale Image (c) Defined Initial Mask (d) Segmented Curve (e) Output Iris Image**

In Figure 2, the original input image in show in Figure 2(a), the Gray scale image is given in Figure 2(b), the defined initial mask is given in Figure 2(c), the segmented curve image is given in Figure 2(d), the output iris image is shown in Figure 2(e).

**The summary of the steps involved in this proposed method is given below:**

Step 1: Read the input image
Step 2: If the input image is color image then convert it into grayscale image
Step 3: Define the initial curve for the segmentation of iris image
Step 4: Segment the iris using ACM
Step 5: Obtain the segmented iris image.

## 3. Results and Discussion

To evaluate the performance of this proposed method, we used eye images collected from the internet. We applied the ACM to segment the iris region in the eye image. Some selected eye image along with the segmented iris region are shown in Figure 3.

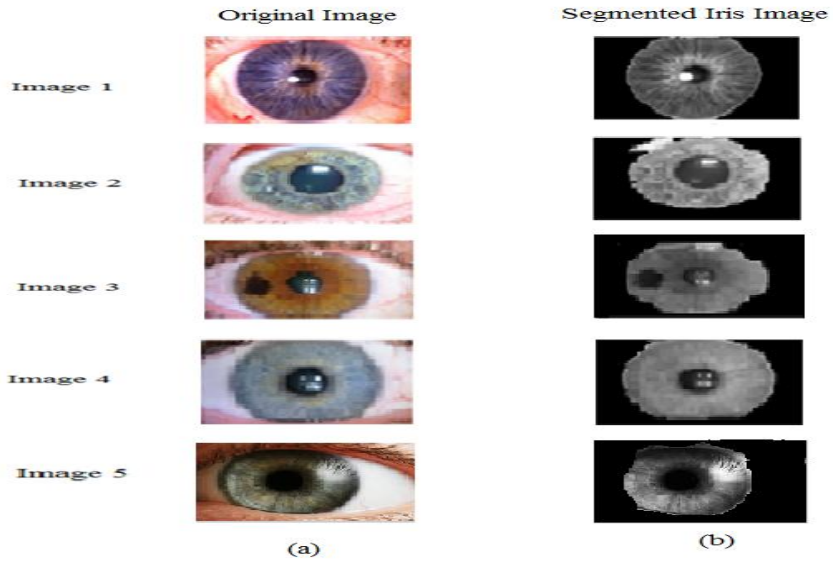


**Figure 3: Process of Iris Segmentation; (a) Original Image (b) Segmented Iris Image**

In Figure 3, the original image is given in column (a). Here, we have sample of 5 eye images, their corresponding segmented rough iris is shown in figure 3(b). Among this 5 images, this ACM based segmentation method produced accurate segmentation for image1, Image 3, Image 4, and Image 5. Since, this is a simple ACM method, we have not applied any preprocessing such as edge enhancement, image sharpening etc, so that for the images 2, it has included the non-iris portion also. This may be avoided in future by applying some pre-processing techniques before ACM.

## 4. Conclusion

This paper present human iris segmentation method based on active contour method. The iris is segmented by evolving the active contour from the defined initial curve. Since this method is a simple approach and does not included any preprocessing steps, and thus it has not produced accurate segmentation for some of the selected images. This may be overcome in our future work.

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