

# Image Processing of Eye to Identify the Iris Using Edge Detection Technique based on ROI and Edge Length

D.Anitha<sup>1</sup>, M.Suganthi<sup>2</sup> and P.Suresh<sup>3</sup>

<sup>1</sup>Department of Information Technology

<sup>2</sup>Centre for Advanced Research, Department of Electronics and Communication Engineering

<sup>3</sup>Department of Mechanical Engineering, Muthayammal Engineering College, Rasipuram – 637 408, India.

E-mail: <sup>1</sup>assvanitha@gmail.com, <sup>2</sup>msuganthib@gmail.com and <sup>3</sup>suresh.me2004@gmail.com

**Abstract.** Iris is one the important Biometric Identification technique and also Iris is one of unique identifier of Human then it is stable throughout a life of the person's. In this work a new method to recognition of the eye have been proposed. Edge detection is one of the important modules of any image processing technique. In this work we have proposed the edge detection technique based on Region of Interest (ROI) and also Edge Length (EL) to recognize the Human eye. The performance of the proposed system has been verified and validated with existing problem. This technique is a novel technique to identify the Iris and also the proposed technique shows significant results and compared with the other conventional technique. Using this technique we can able to predict the Cholesterol inside the eye through image processing.

**Keywords:** Iris, Edge detection, ROI, Edge Length, Eye image and Cholesterol.

## 1. Introduction

Popularity of the iris biometric grew considerably over the past three years. The problems of processing, encoding Iris texture, and designing iris-based recognition systems have attracted the attention of a large number of research teams [1]. On the other side, the iris biometric has been gaining public acceptance. Modern cameras used for iris acquisition are less intrusive compared to earlier iris scanning devices. Iridology is the science of analyzing the delicate structures of the iris of the eye [2,3]. The iris reveals body constitution, inherent weaknesses, and levels of health and transitions that take place in a person's body according to the way one lives [4]. There is an old saying that the eyes are the window of the soul. They can also be a window to one's health. Like fingerprints or faces, no two irises (the colored part of the eye) are exactly alike [5,6,7]. The iris structure is so unique it is now being used for security identification at ATM machines and airports. And for centuries, it has also been used to analyze people's health – past, present and future. The study of the iris for medical purposes is called iridology [8]. The iris contains detailed fibers and pigmentation that reflects our physical and psychological makeup. When an organ or body system is in poor health, the nerve running from that body part will start to recede [9]. When it does, it draws with it various degrees of the layers of fibers which make up the color of the iris of the eyes, leaving darkened marks called lesions [10, 11, 12]. Iris is one the important Biometric Identification technique and also Iris is one of unique identifier of Human then it is stable throughout a life of the person's. In this work a new method to recognition of the eye have been proposed. Edge detection is one of the important modules of any image processing technique. In this work we have proposed the edge detection technique based on Region of Interest (ROI) and also Edge Length (EL) to recognize the Human eye. The performance of the proposed system has been verified and validated with existing problems. This technique is a novel technique to identify the Iris and also the proposed technique shows significant results and compared with the other conventional techniques.

## 2. Proposed Work Sequence

The Block diagram of the proposed system of Iris Edge Detection and ROI prediction is shown in Figure 1. The different process sequence is involved in this process is also given in below. The Original image is obtained from the image centre and then it will be incorporated by using edge detection algorithm. Both the results have been compared and analyzed and also proved this technique also helpful for the Iris prediction. Eye description is shown in Figure 1 and then Right eye original image is shown in Figure 2, Left eye original image is shown in Figure 3 and similarly red eye original image is shown in Figure 4. The proposed method flow diagram is shown in Figure 5 in a sequence manner.

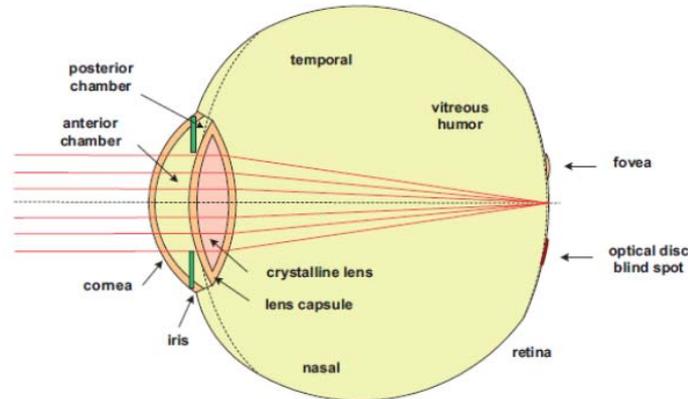


Fig. 1. Eye Description



Fig.2. Right Eye

Fig. 3. Left Eye

Fig. 4. Red Eye

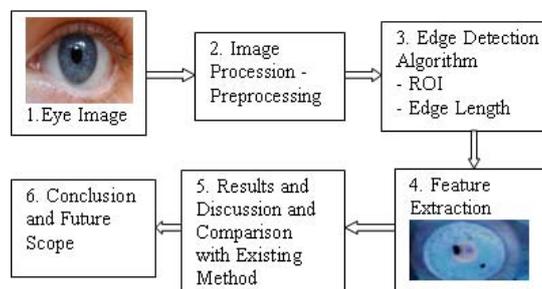


Fig.5. Flow diagram of proposed method

### 3. Edge Detection Algorithm

Segmentation is the process of partitioning a biomedical or digital image into its constituent objects or regions. These types of objects are having some common Characters like colour, density, texture, intensity and size, etc. In the segmentation first step is to predict the edge of the image and parts of the image. Once the edge will be detected from the using edge detection technique then the segmentation will take place. There will be a lot of segmentation techniques will be available. That is Canny edge detection techniques, Genetic Algorithm approach, Random walker method approach, Sobel operator approach, Prewitt operator approach and Roberts operator approach, etc. In this work we have applied only Prewitt operator, Sobel operator and Prewitt operator approach. These techniques will follow the edge based technique.

#### 3.1. Sobel operator:

This technique performs 2D spatial gradient measurement on an image and also it emphasizes regions of high spatial frequency that correspond to edges. Typically it is used to find the approximate absolute gradient magnitude at each point in an input grayscale image. In theory at least, the operator consists of a pair of 3x3 convolution masks as shown in figure. One mask is simply the other rotated by 90°. This is very similar to

the Roberts cross operator. These masks are designed to respond maximally to edges running vertically and horizontally relative to the pixel grid, one mask for each of the two perpendicular orientations. The masks can be applied separately to the input image, to produce separate measurements of the gradient component in each orientation that is  $G_x$  and  $G_y$ . These can be combined together to find the absolute magnitude of the gradient at each point and the orientation of that gradient. The gradient magnitude is given below in Figure 6.

$$|G| = \sqrt{G_x^2 + G_y^2} \quad (1)$$

Although typically, an approximate magnitude is computed using:

$$|G| = |G_x| + |G_y| \quad (2)$$

Which is much faster to compute. The angle of orientation of the edge (relative to the pixel grid) giving rise to the spatial gradient is given by:

$$\alpha = \arctan(G_y/G_x) - 3\pi/4 \quad (3)$$

In this case, orientation 0 is taken to mean that the direction of maximum contrast from black to white runs from left to right on the image, and other angles are measured anti-clockwise from this. Often, this absolute magnitude is the only output the user sees the two components of the gradient are conveniently computed and added in a single pass over the input image using the pseudo convolution operator shown in Figure 7.

Using this mask the approximate magnitude is given by:

$$|G| = |(H_1+2xH_2+H_3)-(H_7+2xH_8+H_9)| + |(H_3+2xH_8+H_9)-(H_1+2xH_4+H_7)| \quad (4)$$

The Sobel operator is slower to compute than the Roberts cross operator, but its larger convolution mask smooth's the input image to a greater extend and so makes the operator less sensitive to noise. The problem can be avoided by using an image type that supports pixel values with a larger range.

### 3.2. Prewitt operator:

The prewitt operator is an approximate way to estimate the magnitude and orientation of the edge. The prewitt operator uses the same equations as the Sobel operator, except the constant  $k = 1$ . Compare than Sobel operator this prewitt operator does not place any emphasis on pixels that are closer to the centre of the masks. This operator will measure the two components. The vertical edge component is calculated with kernel  $G_x$  and the horizontal edge component is calculated with kernel  $G_y$ .  $|G_x| + |G_y|$  give an indication of the intensity of the gradient in the current pixel. The Gradient magnitude is shown in Figure 8.

$$M_x = (a_2 + ca_3 + a_4) - (a_0 + ca_7 + a_6) \quad (5)$$

$$M_y = (a_6 + ca_5 + a_4) - (a_0 + ca_1 + a_2) \quad (6)$$

### 3.3. Roberts operator:

This technique performs 2D spatial gradient measurement on an image and highlights regions of high spatial frequency which often correspond to edges. It performs a simple, quick to compute of an image. It thus highlights regions of high spatial gradient which often correspond to edges. In its most common usage, the input to the operator is a grayscale image, as is the output. Pixel values at each point in the output represent the estimated absolute magnitude of the spatial gradient of the input image at that point. In theory, the operator consists of a pair of 2x2 convolution masks as shown in Figure. One mask is simply the other rotated by 90°. This is very similar to the Sobel operator. The gradient magnitude of the Roberts operator is shown in Figure 9.

These masks are designed to respond maximally to edges running at 45° to the pixel grid, one mask for each of the two perpendicular orientations. The masks can be applied separately to the input image, to produce separate measurements of the gradient component in each orientation (call these  $G_x$  and  $G_y$ ). These can then be combined together to find the absolute magnitude of the gradient at each point and the orientation of that gradient. The gradient magnitude is given by:

$$|G| = |G_x| + |G_y| \quad (7)$$

Often, the absolute magnitude is the only output the user sees the two components of the gradient are conveniently computed and added in a single pass over the input image using pseudo convolution operator shown in Figure 10.

-1	0	1
-2	0	2
-1	0	1

$G_x$

1	2	1
0	0	0
-1	-2	-1

$G_y$

Fig.6. Gradient Magnitude

H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>
H <sub>4</sub>	H <sub>5</sub>	H <sub>6</sub>
H <sub>7</sub>	H <sub>8</sub>	H <sub>9</sub>

Fig.7. Pseudo convolution

-1	0	1
-1	0	1
-1	0	1

$G_x$

1	1	1
0	0	0
-1	-1	-1

$G_y$

Using this mask the approximate magnitude is given by:

$$|G| = |H_1 - H_4| + |H_2 - H_3| \quad (8)$$

$$\frac{\partial y}{\partial x} = y(i, j) - y(i + 1, j + 1) \quad (9)$$

$$\frac{\partial y}{\partial x} = y(i + 1, j) - y(i, j + 1) \quad (10)$$

## 4. Results and Discussion

The performance of the three operator's simulation results shown in below table 1.

Table.1. Comparative Results of Edge mapping

Technique	Original Image	Predicted edge image
Sobel operator		
Prewitt operator		
Roberts operator		

Table. 2 . Statistical Analysis of Results

S.No	Operator	Relative Frequency	ROI	EL
1.	Sobel	2.968	19.82	8.92
2.	Prewitt	3.567	19.88	8.87
3.	<b>Roberts</b>	4.167	19.75	8.63

The best and optimum detector type can be evaluated by calculating the edge maps relative to each other through statistical evaluation. Upon this evaluation, an edge detection method can also be emphasised to characterize edges to represent the image for further analysis. The statistical analysis of results is shown in Table. 2 and the validation of results using existing method is shown in table 3.

Table.3. Validation of results using existing method

S.No	Operator	Relative Frequency	ROI	EL
1.	Roberts	4.167	19.75	8.63
2.	Canny Edge	4.178	19.74	8.64

### 4.1. Future extraction

Apart from the regular Edge detection and Region of Interest calculation, Using the same technique we can able to predict the other diseases and unwanted cholesterol inside the eye. The original image of the eye

is shown in Figure. 11. And the preprocessing of image and the cholesterol black mark is shown in Figure 12. This method is verymuch useful to predict the Cholesterol inside the eye.

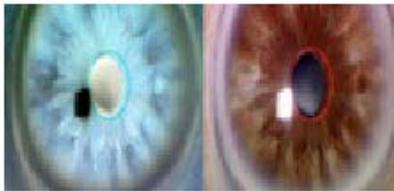


Fig. 11. Eye Image with cholesterol



Fig.12. Prediction of cholesterol inside the eye

## 5. Conclusion

In this work performance comparison of three techniques have been investigated. Edge detection is one of the important modules of any image processing technique. In this work we have proposed the edge detection technique based on Region of Interest (ROI) and also Edge Length (EL) to recognize the Human eye. The performance of the proposed system has been verified and validated with existing problem. This technique is a novel technique to identify the Iris and also the proposed technique shows significant results and compared with the other conventional techniques and also using this technique we have predicted the cholesterol inside the eye as one of the future extraction.

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