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Research Article

Image edge detection techniques

Badri Narayan Mohapatra*
Assistant Professor Instrumentation & Control department AISSMS IOIT, Pune, India

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Abstract
Edge detection from image is an important study focus now a days. Particularly in medical image analysis and processing purpose exact detection will give meaningful information. The solid zones of the image with solid contrasts can be detected by edge detection technique. Edge detection technique is a high pass channel for detecting edge which focus in the image picture. For biometric application finger image authentication and identification is very essential. Edge detection technique is very applicable for abrupt change in intensity value of a picture image. For an image corners, curves and lines are important and can be extracted by edge detection technique. Basically, brings down the volume and significant require information of an image, edge detection plays a significant role in image analysis. In this paper we have discussed different edge detection technique and analysed its importance. Also, simulation carried on simple images and results are presented.

Keywords
Edge detection, Canny edge, Roberts edge, Sobel edge detection.

1.Introduction
Sudden changes of discontinuities are known as the edge of the image. Basically, three types of edges in an image, they are named vertical, diagonal and horizontal edge. Normally shape of an image is enclosed with the edges. Detection of an image is very important then there will be required of sharpness to be increased for further analysis. Here simple technique like canny, Robert, Sobel, Prewitt and Laplacian operator are analyzed. To extract significant data from the image is the best relevant method or technique is an image processing like image enhancement, image acquisition or image segmentation. For accurate result image conversion, image filtering, histogram analysis, edge detection-based segmentation and lastly threshold-based segmentation required [1]. Sharp discontinuities in an image can be found out by using Edge detection technique for identifying and locating an exact position [2].

Now a days, so many new industrial tools which acquire images a lot and became handy to an ample number of users [3].

*Author for correspondence

The Prewitt and the Sobel operators offer relatively noise-free outputs, but at the expense of more missing edges. The effect is more severe when the Roberts Cross edge detection is employed because of its smaller operating matrix [4]. The execution time will be less in case Roberts, Prewitt and Sobel as compared to the Marr-Hildreth (Gaussian), Marr-Hildreth (LoG) and Haralick [5]. Gradient-based algorithms have major drawbacks in sensitive to noise and, Canny, LoG, Sobel, Prewitt, Roberts's are exhibited better performance in noisy images [6]. The canny edge detector having lowest PSNR as compare to the other Perwitt edge detector, Robarts edge detector, LoG edge detector and Sobel edge detector [7]. Based on gradient and intensity detection analysis done by Sujatha [8]. Multi stage edge detection technique is canny edge detection [9]. Various techniques are used and that detection also based on objects, illumination or depends on intensities [10]. From 1967 these techniques are there in image processing field [11].

Edge detection, which will filter out useless properties or image information, while keeping exact structural properties for accurate detection. In object detection, edge is the forefront while processing an image. To identify edge location edge detection techniques has been used gradients or thresholding

the intensities. The main objective of this paper to analyze and study of different edge detection techniques.

2.Canny edge detection

Good detection in an image, is the optimal detector must minimize the probability of false positives as well as false negatives. Better Localization is also necessary and it is the edges detected must be as close as possible to the true edges. Single Response Constraint of an image when the detector must return one point only for each edge point.

Smooth by Gaussian, then Compute x and y derivatives and lastly Compute gradient magnitude and orientation required. *Figure 1* indicates different techniques used for edge detection.

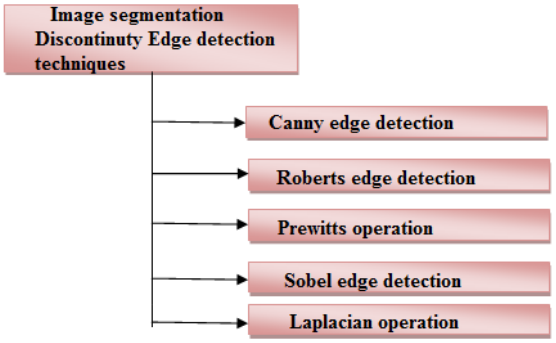

Figure 1 Edge detection technique

Canny edge detection is simple to implement and its fast execution, make it competitiveness among other detection technique. In the case of 3d modeling, image tracking, object recognition edge detection is important.
Gaussian filter is used to smoothen

$$G(X,Y) = G_{\delta}(X,Y) * G(X,Y) \ldots\ldots\ldots (1)$$

$$\text{Where } G_{\delta} = \frac{1}{\sqrt{2\pi\delta^2}} \exp\left(\frac{-X^2+Y^2}{2\delta^2}\right)$$

After that gradient magnitude can be computed from gradient operations

$$M(X,Y) = \sqrt{g_x^2(X,Y) + g_y^2(X,Y)}$$

$$\theta(X,Y) = \tan^{-1}\left[\frac{g_y(x,y)}{g_x(x,y)}\right]$$

For smoothen the image, and for the removable error Gaussian filter is used. Then after finding the gradient label, to get the desired output.

Figure 2 Lena image and its canny edge result output

Figure 3 Goat image and its canny edge result output

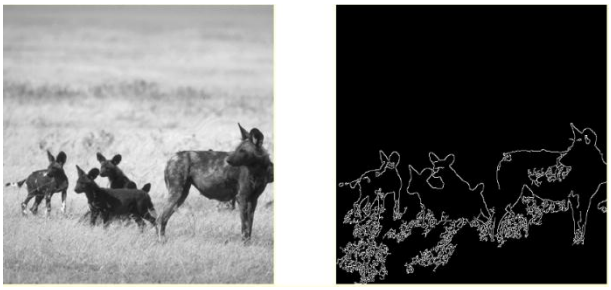

Figure 4 Hyena image and its canny edge result output

Here *Figure 2, 3* and *4* represents the result of the canny edge detection technique

3.Robert, Sobel and Prewitt edge detection

Robert edge detection

It plays a basic 2D spatial inclination estimation on a picture [8].

$$\Delta X = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$$

$$\Delta Y = \begin{bmatrix} 0 & +1 \\ -1 & 0 \end{bmatrix}$$

Figure 5 (a) Original own image (b) Roberts cross edge detector simulation result for own image

Sobel edge detection

It utilized a small part of picture and preparing predominantly strategies in edge discovery. Here it utilizes two 3×3 bits and gives a first picture with approximates one for vertical and one for even change [8].

Normally the Laplacian method of Gaussian technique locates the edge, then zero crossing in double edge.

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

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

Figure 6 Original own image and its Sobel edge detector simulation result

Figure 7 Original image and its Laplace edge detector simulation result

Figure 5, 6 and 7 are the result of Roberts cross edge, Sobel and Laplace edge detection techniques.

Prewitt edge detector

For this type of edge detection, one convolves a picture into two subsidiary pictures (dx and dy). One for identifying picture subordinate in Y and another for reorganization image subordinates X.

$$\Delta X = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$$

$$\Delta Y = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$$

Figure 8 is the original Lena image and figure 9 is about the results of Canny edge detection, Hen Casten edge detection and Sobel edge detection.

Figure 8 Original Lena image

Sobel normally depends on the central difference, but in the Prewitt technique measure the magnitude and find the edge orientation.

Figure 9 10 and *11* shows the different stepwise analysis like Gaussian smoothing gradient magnitude, non-maximum suppression and effect on the hysteresis threshold analysis of own image is analyzed.

4.Discussion

As after the simulation of various techniques of edge detection, we will find the canny detection can provide good image quality with good visual perception. Better continuous outer lines only can be produced by Sobel edge and good resistance to noise

that can possible only through canny edge detection. In Roberts it can produce more accurate position of the edge. Preitt have less vulnerable to noise, where in canny it will take some time to give suitable output. In future filter technique can be introduced for making the image noise free and more suitable for advancement in image processing.

5.Conclusion

Different technique for edge detection can be implemented as per necessary application. Edge detection technique is very useful for object recognition in the image or it is used to distinguish different objects in a specific considered image. Basically, edge detection is highly dependent on image intensity and detection technique is a very fundamental tool for machine vision, computer vision and in image processing. In this paper, we use different images for finding edge by using different edge detection technique. For any technique computational intricacy increments as with the spatial determination expansions. Different conditions as different edge detection technique will be working better, as the technological growth has been fuelled by advances in detection techniques in the field of computer processor, storage device or in digital imaging. As it is a basic tool and plays a vital role in image segmentation. Finally, we conclude that to fulfil the crucial factor one should choose a suitable technique to fulfil the require application. It is a challenging task to use effective implementation to detect the exact image without noise from an original image.

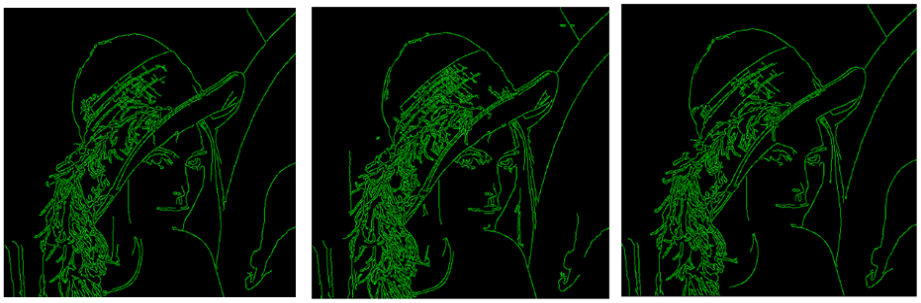

Figure 9 Results of Canny edge detection, Hen Casten edge detection and Sobel edge detection

Figure 10 (a) Gaussian smoothing (b) Gradient magnitude (c) Gradient in X

Figure 11 (d) Gradient in my (e) Non maximum suppression (f) Hysteresis threshold

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Conflicts of interest
The authors have no conflicts of interest to declare.

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Badri Narayan Mohapatra started his research on communication in Centurian University, Odisha. He did his B.E. from Berhempur University and M.Tech from Biju Pattnaik University of Technology. His research area covers Light Propagation, Digital Signal and Image Processing. Currently working in AISSMS IOIT, Pune, India.
Email: badri1.mohapatra@gmail.com