IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 10, Issue 1, Ver. 1 (Jan - Feb. 2015), PP 01-04
www.iosrjournals.org

Algorithm for the Comparison of Different Types of First Order Edge Detection Techniques

Vinay Thakur [1] Som Raj Thakur [1] Naman Sood [1]
[1]*Department of ECE SRI SAI University Palampur V.P.O. Sungal Distt. Kangra (H.P.) India PIN Code176062*

Abstract: *We propose a algorithm for rigorously comparing the different types of edge detection techniques. The computed results and detailed comparison is analytically calculated. The results are verified by simulation. The algorithm is used to evaluate four edge detection techniques. Simulated results of two-dimensional image give the idea about perfect edge technique for reorganization of noisy image. The experiment with several methods shows the ability to detect weak edges.*
Keywords: *Canny, Sobel, Roberts, Prewitt etc.*

I. Introduction

Edge detection is the method which identify points in a digital image at which the brightness of image changes and has discontinuities. Edge detection is a fundamental tool in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction.[1] Edge detection method detects the discontinuities, sharp changes, variations in scene. Results of edge detection lead to the set of connected curves that indicates the boundaries of the objects, as well as curves that corresponds to the discontinuities of the images.

The information content of the original image can be simplified successfully by edge detection techniques. Edge detection is fundamental step in image processing, image analysis, image pattern recognition, and computer vision techniques. Edges of an image are basically local changes in the intensity of an image. These differences in the intensity can locate object in an image.

Fig. 1 Original Image.

II. Steps For Edge Detection

Smoothing can be used to suppress as much noise as possible, without destroying the true edges. Enhancement can also apply by a filter to enhance the quality of the edges in the image (sharpening). Detection is used to determine which edge pixels should be discarded as noise and which should be retained (usually, thresholding provides the criterion used for detection).

Localization determines the exact location of an edge (sub-pixel resolution might be required for some applications, that is, estimate the location of an edge to better than the spacing between pixels).

III. Methodology

The edge detection can be performed by different ways either by gradient method or laplacian method. The gradient method is use to detects the edges by looking for the maximum and minimum in the first derivative of the image. The Laplacian method detects edges by searching for the zero crossings in the second derivative of the image. Gradient method can be performed by various techniques like Canny edge detection, Prewitt edge detection, Roberts edge detection, Sobel edge detection. Different types of edge detection methods are illustrated in fig.1.

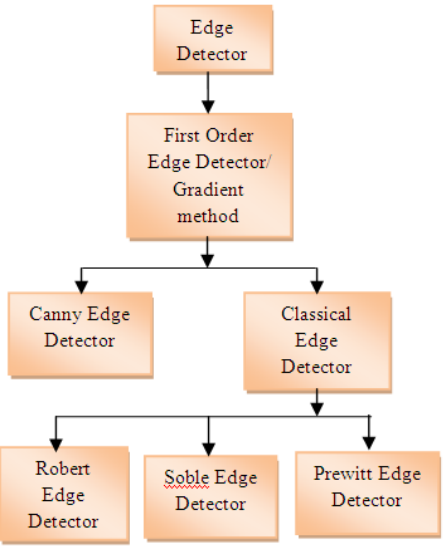

Fig. 2 Types of edge detection methods.

IV. Gradient Method

The gradient method detects the edges by looking for the maximum and minimum in the first derivative of the image[4].

A. Canny Edge Detection

Canny detection technique is used to detect wide edges in an image. It is introduced in 1986 by John F. Canny. There are four basic steps for Canny's algorithm like to remove noise and speckles of the image by Gaussian blur, obtain gradient intensity and direction by gradient operator, finding the better pixel for edge detection than its neighbour by Non-maximum suppression ,finding beginning and end of edges by hysteresis thresholding.

For smoothing, assume that $I[i, j]$ is the image and $G[i, j, \sigma]$ is the Gaussian smoothing filter, σ controls the degree of smoothing. The convolution of $I[i, j]$ and $G[i, j, \sigma]$ resulted into smooth data:

$$S[i, j] = I[i, j,] \otimes G[i, j, \sigma]$$

To obtain gradient intensity and direction by gradient operator the smooth data $S[i, j]$ is used to produced partial derivatives $R[i, j]$ and $T[i, j]$ respectively as

$$R[i, j] \approx [S(i, j+1) - S(i, j) + S(i+1, j+1) - S(i+1, j)]/2$$
$$T[i, j] \approx [S(i, j) - S(i+1, j) + S(i, j+1) - S(i+1, j+1)]/2$$

The magnitude of gradient is

$$M[i, j] = \sqrt{R[i, j]^2} + \sqrt{T[i, j]^2}$$

The non-maximum suppression can be calculated using the magnitude.
As per the canny Edge Detection Filters, the image shown below:

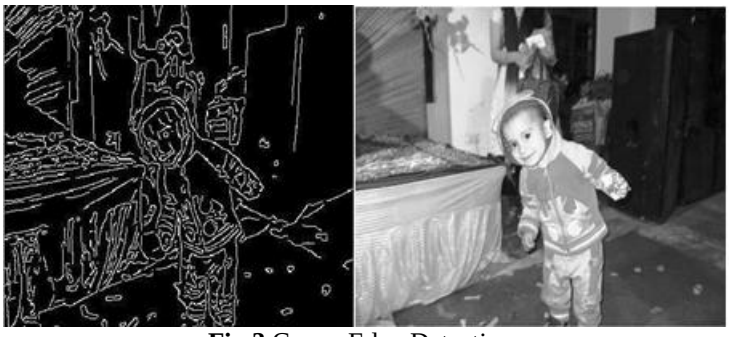

Fig.3 Canny Edge Detection.

B. Classical Edge Detectors

1) Sobel Detection

Sobel detector computes the approximation of the gradient of the image intensity function. In soble detector, convolving the image with a small and integer valued filter in vertical and horizontal direction. To detect gradients in these directions the 3×3 convolution mask is used. G_x and G_y are respectively given below:

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

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

The absolute magnitude of the gradient can be finding by combining G_x and G_y. The gradient magnitude is given as

$$|G| = \sqrt{G_x^{\,2}} + \sqrt{G_y^{\,2}}$$

As per the Sobel Edge Detection Filters, the image shown below:

Fig.4 Sobel Edge Detection.

2) Prewitt Detection

The Prewitt method finds edges using the Prewitt approximation to the derivative. It returns edges at those points where the gradient of the image is maximum. [2] Unlike, the Sobel operator, this operator does not place any emphasis on pixels that are closer to the centre of the masks [3]. To detect gradients in X and Y directions the 3×3 convolution mask is used.

-1	0	+1
-1	0	+1
-1	0	+1

+1	+1	+1
0	0	0
-1	-1	-1

As per the Prewitt Edge Detection Filters, the image shown below:

Fig. 5 Prewitt Edge Detection.

3) Roberts Detection

The Roberts cross operator provide a simple approximation to the gradient magnitude i.e. highlighting region of high spatial frequency which often corresponds to edges. At each point the pixel values in the output represents the magnitude of the spatial gradient of the input image at that point.

$$G[f(i,j)] = |f(i,j) - f(i+1,j+1)| + |f(i+1,j) - f(i,j+1)|$$

After convolution the above equation become

$$G[f(i,j)] = |G_x| + |G_y|$$

Here G_x and G_y are computed using following mask:

+1	0
0	-1

0	+1
-1	0

As per the Roberts Edge Detection Filters, the image shown below:

Fig. 6 Roberts Edge Detection.

V. Conclusion

Edge Detection technique is basic step used to distinguish objects presented in an image. In this paper we use first order detectors/Gradient methods to detect the edges of objects in image. Results of edge detection lead to the set of connected curves that indicates the boundaries of the objects, as well as curves that corresponds to the discontinuities of the images. In this paper we use an image of many objects to find edges and compare results of various edge detection techniques. On comparing these all techniques we conclude that canny filter gives better results than other filters. Instead of it, to obtain much better results, we can vary the different parameters of image. Parameters values can be changed according to user requirements.

Acknowledgment

We wish to acknowledge faculty of Sri Sai University, Palampur and other contributors to prepare this paper. We also like to thank our friends, without their help this paper could not be possible. We are also thankful to our parents for their continuous support and boost. We could not imagine this paper possible without the help of all contributors. We would like to thank Er.Vinay Thakur for his most support and encouragement. He kindly read my paper and offered invaluable detailed advices on organization, and the theme of the paper.

References

[1]. Umbaugh, Scott E (2010). Digital image processing and analysis : human and computer vision with CVIP tools (2nd ed. ed.). Boca Raton, FL: CRC Press. ISBN 9-7814-3980-2.

[2]. Mamta Juneja , Parvinder Singh Sandhu. "Performance Evaluation of Edge Detection Techniques for Images in Spatial Domain". International Journal of Computer Theory and Engineering, Vol. 1, No. 5, December, 2009.

[3]. Seif, A.,et.al. ;"A hardware architecture of Prewitt edge detection", Sustainable Utilization and Development in Engineering and Technology (STUDENT), 2010 IEEE Conference, Malaysia, pp. 99 – 101, 20-21 Nov.2010.

[4]. Canny, J., "A Computational Approach to Edge Detection", IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 8:679-714, November 1986.