ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 3, Issue 4, pp: (9-12), Month: October - December 2015, Available at: www.researchpublish.com

Edge Detection Algorithms- A Review

Pragya Tiwari

Amity School of Engineering & Technology, Amity University, Jaipur, India

Abstract: **Edge detection technique plays an important role in the processing and analysis of image. In the last few decades, lots of research has been done in this field and various edge detection algorithms have been developed in the process. This paper provides a brief idea about various edge detection algorithms developed over the time period in image processing field. The comparison is done for real images. This paper also provides the advantages and disadvantages of various algorithms.**

Keywords: **Edge Detection, Fuzzy logic, Image Processing, Sobel Detector.**

I. INTRODUCTION

Image processing refers to a signal processing where input is an image and output is an image or some characteristics of the image. It is basically an analysis or manipulation done to an image, to obtain certain features or to improve quality of the image. Image processing can be namely include Image Segmentation, Image Restoration, Image Compression, Image Enhancement, etc.[1] Edge detection technique plays an important role in the processing and analysis of image. Edges can be defined as geometrical changes or sharp intensity changes in the image. Edge Detection has a number of application in the real world namely in medical field or in forensics. A lot of research work has been done in the field of edge detection and various algorithms have been developed. Section 2 describes different edge detection algorithms. Section 3 provides a comparison of the algorithms for real images. Section 4 provides the advantages and disadvantages of the algorithms. Section 5 provides the conclusion.

II. EDGE DETECTION ALGORITHMS

In this section, famous edge detection algorithms are described.

Sobel: Sobel filter is a simple approximation to the concept of gradient with smoothing. The 3x3 convolution mask is usually used to detect gradients in X and Y directions. The operator consists of a pair of 3×3 convolution kernels. One kernel is simply the other rotated by 90°.[2]

$$\begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix} \qquad \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

(Horizontal) (Vertical)

Fig1- Masks Used by Sobel Operator

The gradient magnitude is given by:

$$G = \text{sqrt}[|Gx|^2 + Gy^2]$$

Typically, an approximate magnitude is computed using:

$$|G| = |Gx| + |Gy|$$

ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 3, Issue 4, pp: (9-12), Month: October - December 2015, Available at: www.researchpublish.com

Which is much faster to compute.

Prewitt: The Prewitt filter is very similar to Sobel filter. The 3x3 total convolution mask is used to detect gradient in the X, Y directions. Prewitt filter is a fast method for edge detection. The difference with respect to Sobel filter is the spectral response. It is only suitable for well-contrasted noiseless images.[2]

$$\begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix} \qquad \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$$

Horizontal Vertical

Fig2- Mask used by Prewitt Operator

Laplacian of Gaussian: The Laplacian filter uses second derivative of an image. The Laplacian of an image highlights regions of rapid intensity change and is therefore often used for edge detection. The Laplacian is often applied to an image that has first been smoothed with something approximating a Gaussian Smoothing filter in order to reduce its sensitivity to noise. The operator normally takes a single gray level image as input and produces another gray level image as output.[3]

The Laplacian *L(x,y)* of an image with pixel intensity values *I(x,y)* is given by:

$$L(x,y)= \partial^2 I/ \partial x^2 + \partial^2 I/\partial y^2$$

Since the input image is represented as a set of discrete pixels, we have to find a discrete convolution kernel that can approximate the second derivatives in the definition of the Laplacian. The commonly used small kernels are shown in figure. In this algorithm the image is often Gaussian Smoothed before applying the Laplacian filter.

1	1	1
1	-8	1
1	1	1

-1	2	-1
2	-4	2
-1	2	-1

Fig3- Masks Commonly used by Laplacian Filter

Canny: The Canny edge detection algorithm is known to many as the optimal edge detector. Various steps are involved in the algorithm. [3]

Step 1- The image is smoothen and noise are removed.

Step 2- The gradients of image are taken out.

Step 3-The gradients are further reduced. Then based upon threshold value edges are calculated.

Fuzzy : Edge detection using fuzzy logic has emerged as an effective edge detection algorithm in the last few years. This technique uses a fuzzy inference system where input image can be checked over a range of values rather than crisp input. [4]

Step 1-The gradients of a gray scale image are calculated and entered to the fuzzy system.

Step 2- The membership functions are specified .

Step 3- Fuzzy rules are defined for the system.

Step 4- The edges are determined based on membership function and fuzzy rules.

ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 3, Issue 4, pp: (9-12), Month: October - December 2015, Available at: www.researchpublish.com

III. COMPARISON FOR REAL IMAGES

The algorithms are implemented on real images and compared to one another.

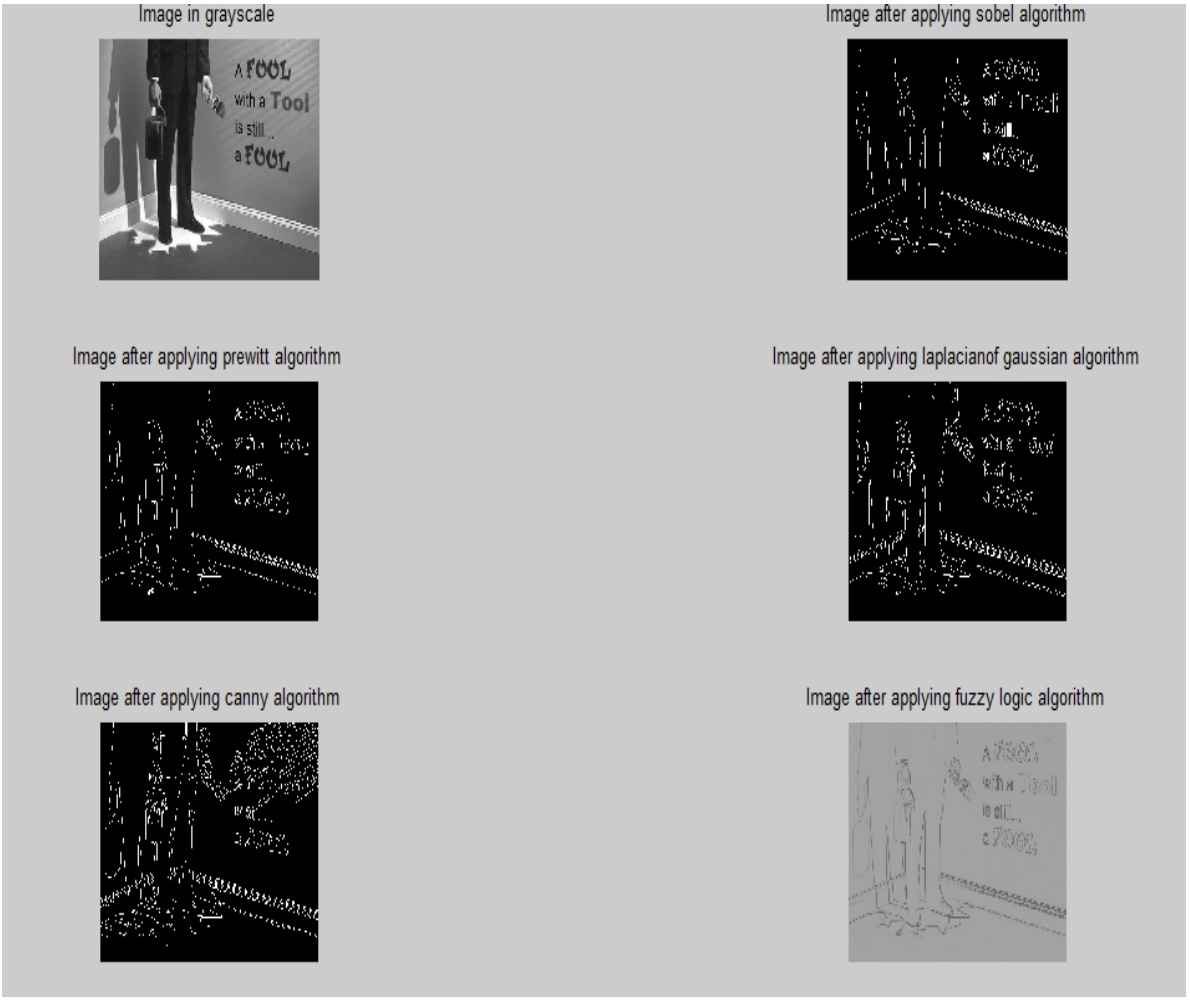

Fig 4- Comparison of various edge detection algorithms on real image

IV. ADVANTAGES AND DISADVANTAGES OF ALGORITHMS

Table 1- Advantages& Disadvantages of edge detection algorithms

S No.	Operator	Advantages	Disadvantages
1	Sobel, Prewitt	Simple and easy to implement	Sensitive to noise
2	Laplacian	Tests wider area around the pixel and find the edges correctly	Malfunctions at corners and curves
3	Canny	Gives better edge detection specially in presence of noise	It is time consuming and requires a lot of parameter setting.
4	Fuzzy Logic	Helpful for complex or nonlinear processes & provides a range of values to judge from rather than crisp boundaries.	Sometimes results are unexpected and become hard to debug.

V. CONCLUSION

Edge Detection plays a significant role in the field of image processing. Hence, it is very important to choose the best algorithm to enhance the performance. In this paper we have discussed some of the famous edge detection algorithms and have compared the algorithms using real images. The paper can be used to get knowledge about some of the famous edge detection algorithms that are been used now-a-days in the image processing field. We can see that sobel and prewitt

algorithms are easy to implement but are sensitive to noise. Canny algorithm is not sensitive to noise but is time consuming and requires a lot of parameter setting. Fuzzy logic Technique is seen to be the optimal solution to edge detection. On visual perception also, it can be seen that fuzzy logic gives the best output.

REFERENCES

[1] Iqbal, J.; mehmood, A.K.; Saadia, T.; Sabahat, z.; "IMPLEMENTING BALL BALANCING BEAM USING DIGITAL IMAGE PROCESSING AND FUZZY LOGIC", 2005 IEEE, may 2005 canadian conference on electrical and computer engineering, pp. 2241 - 2244.

[2] Mamta Juneja and 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 1793-8201.

[3] Raman Maini & Dr. Himanshu Aggarwal, Study and Comparison of Various Image Edge Detection Techniques , International Journal of Image Processing (IJIP), Volume (3) : Issue (1) .

[4] Richa Garg and Beant Kaur, Detection of Edges using Fuzzy Logic, International Journal of Emerging Technology and Advanced Engineering (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 9, September 2014).