ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

PERFORMANCE EVALUATION AND EFFECTIVE ANALYSIS OF EDGE DETECTION ALGORITHMS

Sneha Kumari *
* Computer Science Department, Banasthali University, India

DOI: 10.5281/zenodo.809170

ABSTRACT

Edge detection in a digital image is one of the important jobs in digital image processing. Edges in the image are the significance of discontinuity present in the image. Detecting the accurate edges or boundaries ease the location of objects in the image and parameters like shape, area can be measured easily. This paper presents a brief study on different edge detection techniques like Canny Operator, Sobel Operator, Prewitt Operator and Roberts Operator. Quality Assessment research is to measure the image quality. Unclear boundaries are produced due to low quality and other possible factors present in the image. Brief analysis of different edge detection algorithms are discussed here. The experimental results are produced and validated with the help of MATLAB Software

KEYWORDS: Edge Detection, Canny Operator, Sobel Operator, Prewitt Operator, Robert Operator.

I. INTRODUCTION

Edges are the significance of discontinuity present in the digital image. Edge detection plays very important role in image analysis and feature extraction. These days, it is the most interesting working area for the researchers who are working in the field of digital image processing. There are several edge detection mechanism are proposed such as Canny Operator, Sobel Operator, Prewitt Operator, Robert Operator etc[16]. All of these operators are based on intensity change in the digital image. The point at which there is a sharp intensity change in the image depicts edge presence. Edge detection is a neighborhood operation which shows the extent to which each pixel neighborhood can be partitioned. This is a similarity based process. Pixels having similar properties are grouped together. Canny Operator is the optimal edge detector. This operation works on three ethics:

a) *Localization of Edge*
b) *Low Error Rate*
c) *Single Edge Detection*

Canny operator uses two new methods in comparison to older methods these are as follows:

a) *Double Thresholding Technique*
b) *Suppression and Non-maximum*

Edge detection is done for the feature extraction of the edges present in the digital image. These days few more techniques are being used in digital image processing such as particle swarm algorithm, genetic algorithm, wavelet transform, clone selection and cellular neural network. Edge detection methods are mainly grouped into two categories.

1. *Gradient:* It detects the edges by taking maximum and minimum in the first derivative of the image.
2. *Laplacian:* It searches for zero crossing in the second derivative of the image. It is an efficient method to determine sharp edge transition in image.

II. STEPS FOLLOWED IN EDGE DETECTION PROCESS

To enhance the performance of an edge detector Filtering-Filtering are commonly used.

a) *Enhancement:* It works on computing gradient magnitude, emphasizes pixels where there is a sharp local intensity change.
b) *Detection:* Edge point pixels are detected. Based on threshold value it is determined that a pixel is an edge point pixel or not.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

c) *Localization:* If required location of the edge can be estimated for the application.

III. EDGE DDETECTION ALGORITHMS

1) *Sobel Operator:* It is a form of filtering operator, used to identify edges. A 2-D spatial gradient measurement performed to emphasize regions having high spatial gradient that correspond to edges. In gray scale image, absolute gradient is measured at each point [17]. In the image each point has two nuclear convolutions. Two kernels that is G_x and G_y check maximum response of the vertical and horizontal edge respectively.

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

Gx

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

Gy

It is easy to achieve in space and has smoothing effect on the noise. Provide more accurate edge direction information but at the time it may result in many false edges with coarse edge width. The gradient magnitude is given in the equation1.

$$|G|= (Gx^2+Gy^2)^{1/2} \qquad (1)$$

Fig. 1 shows the performance of Sobel Operator on the basis of both x and y axis detection in which edge is traced with the help of size and direction.

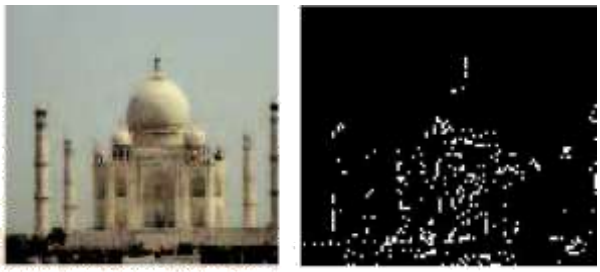


Fig.1. Result of Sobel Operator

2) *Canny Edge Detector:* Canny edge detection algorithm also known as optimal edge detection algorithm. It is the most frequently used technique in digital image processing (Canny, 1986). Canny has worked and used several techniques to enhance the edge detection algorithm [18]. Furthermore canny proposed three criteria for the algorithm:

a) The real edge detection probability is higher and non-edge points meant to be lower the probability of edge points as a result output of the ratio of the signal to noise is maximum.
b) Low error rate. High probability of finding the correct edges and no response to false edges.
c) Response to a single edge, in the other words probability multiple response in single edge is low.

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

Gx

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

Gy

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

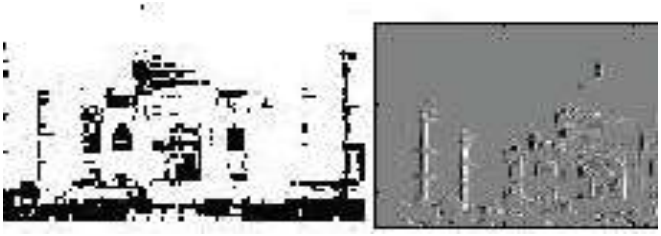


Fig.2. Result of Canny Operator

3) *Prewitt Operator:* Prewitt Operator is similar to the Sobel Operator and evaluates intensity of image that gives largest possible solution to increase intensity from dark to light [19]. The operator has a pair of 3×3 convolution kernels as shown in the fig. 3.

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

Gx

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

Gy

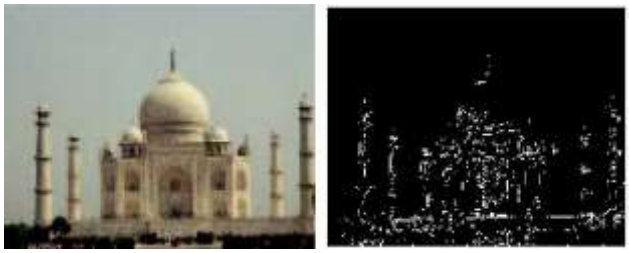


Fig.3. Result of Prewitt Operator

Comparing with Sobel Operator, it does not place any emphasis on pixels that are near to the center to the mask.

4) *Robert's Operator:* Robert edge detection operator has a fast and simple structure that estimates the gradient of an image by discrete method [20]. The vertical and horizontal edges are taken separately and then put together for resulting edge detection. The 2-D spatial gradient measurements are done very fast. The operator has a pair of 2×2 convolution kernels as shown in Fig. 4.

+1	0
0	-1

Gx

0	+1
-1	0

Gy

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

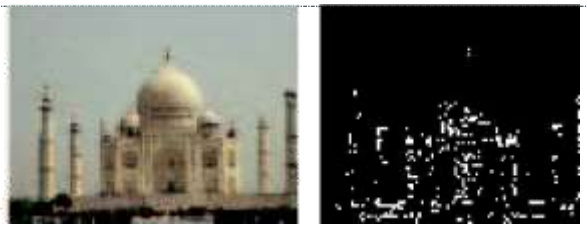


Fig.4. Result of Robert's Operator

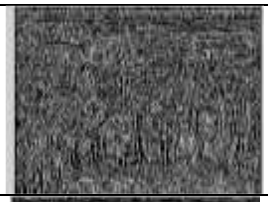
These two gradients can be combined together to get absolute magnitude, and it is given by the following equation.

IV. EDGE DDETECTION ALGORITHMS

The proposed approach is based on MATLAB Software. The flowchart for the proposed approach is given below. At first a colored image is chosen and imported into the MATLAB Software. A gray scale image is produced; gray scale image is a combination of black and white color. Then by applying different edge detection algorithms, edges are detected.

V. COMPARISON OF EDGE DDETECTION ALGORITHMS

Table I shows the difference between various edge detection techniques on different threshold values.

Edge Detection Technique	Original Image	Threshold=0.00	Threshold= 0.05	Threshold= 0.03
Sobel Operator				
Canny Operator				
Prewitt Operator				
Roberts's Operator				

VI. CONCLUSION

This paper presents a comparative study on different edge detection algorithms based on discontinuity of intensity levels. The performance of various edge detection techniques is carried out with the help of MATLAB Software. On the basis of experimental results it is observed that canny edge detector operator produces higher

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

accuracy in edge detection as compared to other edge detection algorithms. It performs better in noisy and blurs condition but results are dependent on adjustable parameters.

VII. REFERENCES

[1] Akash Kumar Bhoi, Pradeep Kumar Mallick, S. Saravana Kumar, Karma Sonam Sherpa, Brain Tumor Detection: A Comparative Analysis of Edge Detection Techniques, International Journal Of Applied Engineering Research, ISSN 0973-4562 Vol:10 Iss:44 pp:31569-31574,August 2015.
[2] G Canny J. A "Computational Approach to Edge Detection", IEEE Transaction on Pattern Analysis Machine Inatelligence, vol. 8, no. 6, pp. 679– 698, 1986.
[3] Om Prakash Verma, Rishabh Sharma, Deepak Kumar "Binarization Based Image Edge Detection Using Bacterial Foraging Algorithm", Procedia Technology 6, pp. 315 – 323, 2012.
[4] H.A. Firpi, E.D. Goodman, "Designing templates for cellular neural networks using particle swarm optimization", ISIT, pp. 119–123, 2004
[5] A. A. Gulhane and A. S. Alvi, "Noise Reduction of an Image by using Function Approximation Techniques", International Journal of Soft Computing and Engineering (IJSCE) Volume-2, Issue-1, 2012.
[6] X.S. Tian, "A novel image edge detection algorithm based on prewitt operator and wavelet transform", Intl. J. Adv. Comput. Technol. 4, pp. 73–82, 2012.
[7] E.M. Javad, P. Hossein, "A novel automatic synthetic segmentation algorithm based on mean shift clustering and canny edge detector for aerial and satellite images", Int. Rev. Comput. Softw. 7, pp. 1122–1129, 2012.
[8] G. Vishnuvarthanana, M. Pallikonda Rajasekaranb, P.Subbarajc, Anitha Vishnuvarthanand, An Unsupervised Learning Method with a Clustering Approach for Tumor identification and Tissue Segmentation in Magnetic Resonance Brain Images India Applied Soft Computing 38 (2016),ISSN: 1568-4946,© 2015 Elsevier B.V. pp:190– 212,2015.
[9] Rajni Nema, Dr A.K Saxena, "Edge Detection Operators in Digital Image", IJESRT, SRCEM Bangalore ,ISN 2277-9655, **(2013)** June.
[10] R. Maini & Dr. H. Aggarwal, "Study and Comparison of Various Image Edge Detection Techniques",
[11] M. A. Oskoei and H. Hu, "A Survey on Edge Detection Methods", Technical Report: CES-506, **(2010)** Feb 29.
[12] B. Kaur and Mr. A. Garg, "Comparative study of different edge detection technique", International Journal of Engineering Science and Technology (IJEST).
[13] R. D. Daruwala; Gofane Manoj S Shodganga, "Image Processing Chapters", Infibnet, **(2010)**.
[14] E. Nadernejad, S. Sharifzadeh and H. Hassanpour, "Edge Detection Techniques Evaluations and Comparisons", Applied Mathematical Sciences, vol. 2, no. 31, **(2008)**, pp. 1507 – 1520.
[15] S. Lakshmi and Dr. V. Sankaranarayanan, "A study of Edge Detection Techniques for Segmentation Computing Approaches", IJCA Special Issue on "Computer Aided Soft Computing Techniques for Imaging and Biomedical Applications CASCT, **(2010)**.
[16] Li Bin and Mehdi samieei Yeganeh, " comparison for Image Edge Detection Algorithms", IOSR Journal of Computer Engineering, Vol. 2, issue 6(July-Aug.-2012).
[17] A. R Jasmine begum and Dr. T abdul Razak, "Segmentation Techniques: AComparison and Evaluation om MR Image for Brain Tumour detection", IJARCS, Vol. 7, No. 2, March-April 2016.
[18] Shashidhar Ram joshi and Roshan Koju, " Study and Comparison of Edge Detection Algorithms", IEEE-2012.
[19] Pinaki Pratim Acharjya, Ritaban das and Dibyendu Ghoshal, " Study and Comparison of Different Edge Detection detectors for Image Segmentation", Global Journal of Computer Science and Technology Graphics & Vision, Vol. 12 Issue 13, Version 1.0 2012.
[20] Mr. P. Selvakumar and Dr. S Hariganesh, " The performance Analysis of Edge Detection Algorithms for Image Processing", IEEE- 2016.

CITE AN ARTICLE

Kumari, S. (2017). PERFORMANCE EVALUATION AND EFFECTIVE ANALYSIS OF EDGE DETECTION ALGORITHMS. *INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY, 6*(6), 282-287. doi:10.5281/zenodo.809170