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A COMPARATIVE STUDY ON EDGE DETECTION TECHNIQUES IN DIGITAL IMAGE PROCESSING USING MATLAB.

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Abstract: Edge detection is a technique which is widely used for image segmentation and data extraction in areas such as image processing, computer vision, machine vision[1]. Simplifying the image data and reducing the amount of data to be processed are the major role of edge detection technique. A comparative study on the analysis of gradient based edge detection techniques is presented in this paper. This study is carried out with an experiment using MATLAB software.
KEYWORDS - edge detection, gradients, image processing, MATLAB.

I. INTRODUCTION

Finding/Detecting the boundaries of objects within the images is the task carried out by the edge detection technique. It works by detecting discontinuities in brightness. Generally, if a boundary pixel can connect two separate regions of changing image amplitude attributes, it forms an edge[2]. The initial stage in local discontinuity at each pixel element. The discontinuities can be immediate changes in pixel concentration which distinguish boundaries of objects in a scene[3]. The gradient of the image is one of the fundamental building blocks of image processing. There are various types of edge detection techniques available. Variables involved in selecting an edge detection operator consists of edge orientation, edge structure and noise environment[10].

Mathematically, the gradients of two-variable function (here the image intensity function) at each image point is a 2D vector with the components given by the derivatives in the horizontal and vertical components [9]. The various edge detection operators includes sobel, canny, prewitt. The comparison between these operators has carried out and their performance has been found using MATLAB software. In this paper the section II describes the edge detection preliminaries. Section III introduces the steps involved in the edge detection techniques. Section IV gives a brief description on edge detection techniques and explains different computational approaches to edge detection. Section V provides the experimental results and discussion. Finally section VI visualizes the conclusion.

II. EDGE DETECTION PRELIMINARIES

There are few edge variables involved in choosing a sensitive edge detector they include are,

- Edge orientation.
- Noise environment.
- Edge structure.

A characteristic direction in which it is most sensitive to edges is determined by the geometry of operator. Operators are optimized to look for horizontal, vertical, and diagonal edges[1]. Edge detection works differently in noisy images. If the noise is reduced it results in blurred and distorted edges because, both noise and edges have high frequency content. Typically, larger scope operators are used on noisy images so that they can average enough data to discount localized noisy images[1,3]. Finally, a less accurate localization of the detached edges are produced. Most of the edges involve step change in intensity effects like refraction and poor focus. So, it is necessary for an operator to responsible for such gradual/step changes. This helps to overcome the false edge detection, missing true edges, edge localization and computational time[1,10].

III. STEPS INVOLVED IN EDGE DETECTION

Edge detection consists of three major steps which are,

- Filtering.
- Enhancement
- Detection.

Due to change in intensity values (noise), images may destroy. If the variations occur randomly in both white and black intensity values, it forms the salt and pepper noise. Despite of all, loss of edge strength occurs, if more filtering is done[12]. Determination of the intensity variations in neighbourhood of a point is very important. By identifying the gradient magnitude, enhancement emphasizes pixels where there is significant change in intensity values[11]. In any particular application, not all the points can form the edges. So, a method is created to find the edge points. Thresholding provides the criteria for edge detection[7].

IV. EDGE DETECTION TECHNIQUES

1. Sobel: The sobel method finds edges using the sobel approximation to the derivative. This method is introduced by Sobel in 1970[3]. Using the discrete differences between rows and columns of a 3x3 neighbourhood, the gradient is computed by the sobel edge detector. The Sobel operator works by convolving the image with a small, seperable, and integer valued filter.

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

Table I: G_x

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

Table II: G_Y

The above Sobel edge detection mask can compute the gradient in X(vertical) and Y(horizontal) direction.

2. Canny: Among the already discussed edge detection algorithm, the canny edge detection algorithm is widely used. It was developed by John Canny in 1983[3]. Canny edge detection algorithm is otherwise known as optimal edge detector. This algorithm follows three criteria while performing the edge detection operation.

- The first criterion is to filter out the unwanted information and low error rate.
- The second criterion conveys that there should be the lower variation in between the original and the processed image as possible.
- The third criterion is to remove the multiple responses of an image.

The algorithm of canny edge detector is as follows,

- Using Gaussian function, convolve the image f(r,c) to produce smooth image f^(r,c) = f(r,c)*G(r,c,6).
- Apply first difference gradient operator to compute edge strength.
- Non-maximal or critical suppression is applied to the gradient.
- Thresholding is done to the non-maximal suppression image.
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3. Prewitt: The prewitt method finds edge using the prewitt approximation to the derivative. The Prewitt edge detection is proposed by Prewitt in 1970[3].Prewitt operator detects the vertical and horizontal edges and estimates the magnitude and orientation of an edge in images. The prewitt operator limits up to eight possible orientations, eventhough most possible orientations is not exactly accurate. Given below is the Prewitt edge detection mask used to compute the gradient in the X(vertical) and Y(horizontal) direction.

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

Table I: G_x

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

Table II: $\mathbf{G_y}$

V.APPROACH

The steps for generating gradient images is given below in a step by step manner.

Step 1:

Pick a colour image in MATLAB software.

Step 2:

Converting the colour image into the gray scale image.

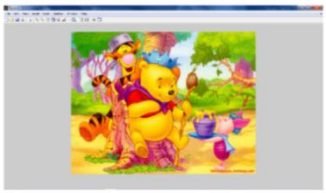
(Note: The black image have low intensity value and the white image have high intensity value. The variation in this intensity levels forms the edges of object/objects.)

Step 3:

Apply different edge detection operators to generate the gradients.

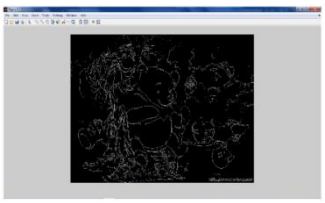
VI.RESULTS

Edge detection has been performed on the image shown below using MATLAB software and the three algorithms discussed above were implemented on that image.

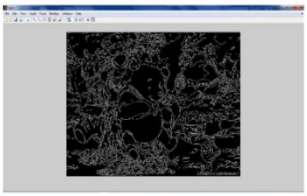


Colour image

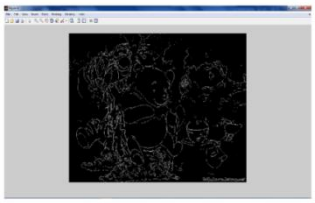
Gray scale image



Sobel



Canny



Prewitt

VII. CONCLUSION

Edge detection is a very important technique in image processing because, it is used to analyze and measure the basic properties like area, perimeter and shape of an object or objects. By performing a study and comparative analysis of various edge detection techniques using gradients, it is concluded that Canny edge detector performs well in all the edges when compared to other two edge detection operators.

VIII. REFERENCE

[1]. Indrajeet Kumar, Jyoti Rawat, Dr. H. S. Bhadauria. A Conventional study of edge detection technique in digital image processing, IJCSMC, Vol. 3, Issue. 4, April 2014,pg.328-334.
[2]. Firas A.Jasmine. semi Optimal Detector based on simple Standard Deviation with Adjusted thresholding, International Journal of Computer Applications, vol.68 – No.2, April 2013.
[3]. Muthukrishnan. R and M. Radha. Edge detection techniques for image segmentation, IJCSIT, Vol.3, no 6, Dec 2011.
[4]. I. Sobel, Neighbourhood coding of binary images fast contour following and general array binary processing, Computer graphics and image processing vol. 8, pp. 127-135, 1978.
[5]. J. Canny. A computational approach to edge detection, IEEE Transactions in pattern analysis and machine intelligence vol. 8 pp. 679-698, 1986.
[6]. M. C. Shin, D. Goldgof and K. W. Bowyer. Comparision of edge detector performance through use in an object recognition task, computer vision and image understanding vol.84, no 1.pp 160-178, 2001.
[7]. M. paulinas and A. Usnskas, A survey of generic algorithm application for image enhancement and segmentation, information technology and control vol. 36, no 3,pp. 278-284,2007.
[8]. Gao W., Yang L., Zhang X. and Liu H. 2010. An Improved Sobel Edge Detection. IEEE international conference on computer science and information technology (ICCSIT), vol. 5, 67-71.
[9]. Pinaki Pratim Acharjya, Ritaban Das, Dibyendu Ghoshal. A study on Image Detection using the gradients. International Journal of Scientific and Research Publications, Vol. 2, Issue 12, December 2012, ISSN 2250-3153.
[10]. Mahbubun Nahar, Md. Sujan Ali. An Improved Approach for Digital Image Edge Detection. IJRDET Vol.2, Issue 3,March 2014.
[11]. X. BIN Wen,H.Zheng and Tao.Multiscale Unsupervised Segmentation of SAR Imagery using the genetic algorithm, Sensors, vol8,pp.1704-1711,2008.
[12]. N. Senthilkumaran and R. Rajesh. A study on split and merge for region based image segmentation, proceedings of UGC sponsored national conference network security (NCNS – 08) pp57 – 61, 2008.