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PERFORMANCE ANALYSIS OF EDGE DETECTION BASED ON IMPROVED SOBEL OPERATOR AND SOBEL OPERATOR

B. Sasi Prabha*

Asst. professor Department of Computer Application, Nadar Saraswathi College of Arts and Science, Vadapudupatti, Theni.

*Corresponding Author
B. Sasi Prabha
Asst. professor Department of Computer Application, Nadar Saraswathi College of Arts and Science, Vadapudupatti, Theni.

ABSTRACT

Edge detection plays an imperative role in image processing, predominantly in the areas of feature recognition and feature extraction. The edges of image are deliberated to be most imperative image attributes that provide valuable information. The Sobel method uses the derivative appraisal to find edges. An image gradient is a steering change in the intensity or color in an image. Image gradients may be used to validate the information from images. The Sobel operator is initiated based on convolving the image with an undersized and integer-valued filter in the horizontal and vertical directions.[1] In sobel edge detection, 1/8 term is used to get the right gradient value.In this paper,sobel edge detection algorithm is improved by using the gradient value as 1/2.The improved sobel algorithm takes less computational time and supreme PSNR value than the sobel edge detection algorithm.

KEYWORDS: Image processing, Improved sobel edge detection, sobel operator, PSNR Value.

INTRODUCTION

Image processing is defined as, an image is represent as a two dimensional function, f(x,y), where x and y are the spatial (plan) co-ordinates and amplitude value f at any pair of co-ordinates(x, y) is called the intensity or gray level at that point. When x,y and the intensity values of f are all finite, discrete quantities, we call the image a digital image. The field of

digital image processing refers to processing digital image by means of digital computer. An image is composed of finite number of element each of which has a particular location and value. These elements are called picture element, image element and pixels. Image processing is a method to convert an image into digital form and perform some operation on it, in order to get an enhanced image or to extract some useful information from it. In this method, input can be image, video frames, etc and output may be image or characteristic associated with that image. Segmentation means partitioning an image into distinct region contain each pixel with similar attributes.[2] Image segmentation is the method of dividing an image into different regions such as Threshold based segmentation, Edge based segmentation, Clustering techniquesand Model based segmentation.

Edge detection is an image processing technique for verdict the boundary of object within images. It processed by detecting discontinuities in brightness. Edge detection techniques establish the edges where either the first derivative of intensity is greater than a particular threshold or the second derivative has zero crossings.[3] In edge based segmentation methods, first of all the edges are detected and then are connectedtogether to form the object boundaries to segment the required regions. To detect the edgesone of the basic edge detection techniques like sobel operator, prewitt operator and Roberts operator can be used.

Sobel edge operator is in the form of the filtering operator. It is used to mine the edge. Each point in the image is the two nuclear convolutions. One checks maximum retort of the vertical edge, and the other one checks maximum response of the horizontal edge.[4] It computes a 2-D spatial gradient measurement on an image and emphasizes regions of high spatial frequency that correspond to edges. The gradient magnitudes are divided by eight to find the approximate absolute gradient magnitude of an input gray scale image at each point. The maximum value of two convolutions will be referred as output value of the changing point. Sobel operator is easy to achieve in space, has a smoothing effect on the noise, is nearly affected by noise, can provide more accurate edge direction information but it will also detect many false edges with coarse edge width. In Improved sobel edge detection algorithm, the gradient magnitudes are divided by two to find the approximate absolute gradient magnitude of an input gray scale image at each point. Peak signal-to-noise ratio, often abbreviated PSNR, is an engineering term for the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. Because many signals have a very wide dynamic range, PSNR is usually expressed in terms

of the log arithmic decibel scale. PSNR is most commonly used to measure the quality of reconstruction of edge detected image. When comparing compression codec's, PSNR is an approximation to human perception of reconstruction quality.

Improved Sobel Operator

The improved Sobel operator is used in image processing, particularly within edge detection algorithms. The improved Sobel operator is based on convolving the image with a small, separable, and integer valued filter in horizontal and vertical direction and is therefore relatively inexpensive in terms of computations. It computes a 2-D spatial gradient measurement on an image and emphasizes regions of high spatial frequency that correspond to edges. The gradient magnitudes are divided by two to stumble on the approximate absolute gradient magnitude of an input gray scale image at each point. The improved sobel edge filter is used to detect edge based on applying a horizontal and vertical filter in sequence. The improved sobel operator performs a two dimensional spatial gradient measurement on an image and so emphasized region of high spatial frequency that correspond to edge. Typically it is used to find the approximate absolute gradient magnitude at edge point in an input grayscale image. The improved sobel operator consist of 3*3 convolution masks as.

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

Fig. 2: Horizontal filter.

1	2	1
0	0	0
-1	-2	1

Fig. 3: Vertical filter.

The improved sobel operator is used to detect two kind of edge in an image as vertical direction and horizontal direction [5]. In this paper improved sobel edge detection algorithm is proposed, this algorithm is same as that of sobel edge detection algorithm. But the minority differences is that, in sobel edge detection algorithm the dividend value is eight and in improved sobel edge detection algorithm the dividend value is two. The advantage of improved sobel edge detection algorithm takes less computational time than other edge detection algorithm.

2.1 Formulation

The operator used two 3*3 matrix as convolution mask are computed with the original image to evaluate approximation of the derivatives one for horizontal changes and one for vertical changes[6]. For instance A as the source image, GX and GY are two images which at each point contain the horizontal and vertical derivates and the computed value are dividend by two. The computations are as follows,

Sobel operator

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

$+ A/2 =$ output image improved sobel algorithm

The gradient magnitude is given as.

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

$$|G| = |GX| + |GY| / 2.$$

The angle of orientation of a edge are rise to the spatial gradient is given as.

$$\theta = arctan \ (GY/GX)$$

**Comparision of Improved Sobel and Sobel Operator**

Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness. The discontinuities are abrupt changes in pixel intensity which characterize boundaries of object in a scene. In sobel edge detection, 1/8 term is used to get the right gradient value, sobel edge detection algorithm is improved by using the gradient value as 1/2.The improved sobel algorithm takes less computational time and supreme PSNR value than the sobel edge detection algorithm. In this paper, the relative performance of improved Sobel and Sobel edge detection techniques is carried out. It has been observed that improved Sobel edge detection algorithm produces higher accuracy in detection of edges. The improved sobel edge detection and sobel edge detection algorithm are compared based on quality of image and computational time. The image qualities are compared based on PSNR (Peak signal-to-noise ratio) values.

Table 1: comparison of improved sobel and sobel operator.

Sample image	Execution time(sec)		PSNR Value	
	Improved sobel	sobel	Improved sobel	sobel
Sample 1	0.219051	0.579817	64.32	61.37
Sample 2	0.138536	0.215530	66.45	61.43
Sample 3	0.195752	0.226616	64.48	56.49
Sample 4	0.142406	0.174130	67.40	59.70
Sample 5	0.177827	0.216591	62.92	54.93
Sample 6	0.228494	0.288231	61.74	53.74
Sample 7	0.071051	0.106527	69.67	56.42
Sample 8	0.079719	0.121168	70.09	63.04
Sample 9	0.195372	0.224929	62.82	60.12
Sample 10	0.068149	0.091250	70.31	62.05

EXPERIMENTAL RESULT

The various experiment carried out in sample image and the algorithm improved sobel algorithm are used in MATLAB 7.6(2008R). The complete process of edge detection for sample images and the standard are summarized in subsequent figure. In this paper, the improved sobel edge detection algorithm is compared based on quality of image and computational time. The image qualities are compared based on PSNR (Peak signal-to-noise ratio) values.

4(a)   4(b)
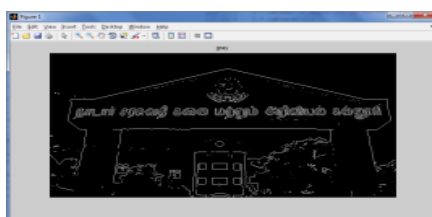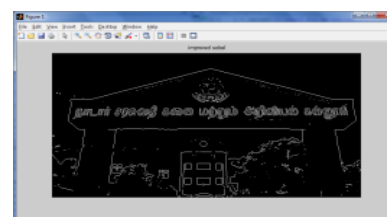
4(c)   4(d)
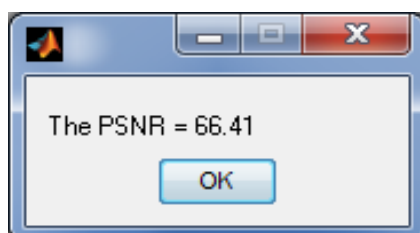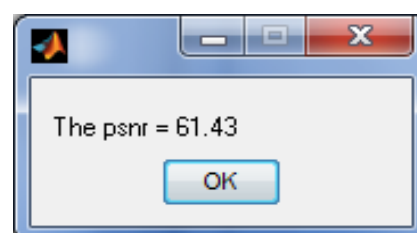
4(e)   4(f)

4(a). Original image, 4(b). Conversion of RGB into gray scale color conversion, 4(c).image edge are detected by using improved sobel algorithm,4(d). image edge are detected by using sobel algorithm. 4(e). PSNR Value for improved sobel edge detection algorithm, 4(f). PSNR Value for sobel edge detection algorithm.

CONCLUSION

Thus, an extensive comparison is made between various edge detection algorithms as Sobel and improved sobel operator for detecting the edges of sample images, the predicted factor is research has its inception in an images and edge detection, which would ultimately results in good identification and unique determination of actual image. And so image processing and edge detection is gaining more prominence in doing research in many fields. The Sobel operator is initiated based on convolving the image with a small and integer-valued filter in the horizontal and vertical directions. In sobel edge detection, 1/8 term is used to get the right gradient value. In this paper, sobel edge detection algorithm is improved by using the gradient value as 1/2.The improved sobel algorithm takes less computational time and supreme PSNR value than the sobel edge detection algorithm.

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