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EDGE DETECTION USING THE MAGNITUDE OF THE GRADIENT

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Abstract: An improved scheme for contour detection with better performance measure has been proposed in this paper. A 9x9 Laplacian and Gaussian (LOG) filter has been proposed. The present study has shown that the gradient images obtained by the 9x9 LOG mask appears to be much clearer with sharp and prominent edges than those obtained through 5x5 LOG filter. The method has been applied to a number of digital images and better performance measure of contour detection has been achieved.

Keywords: Digital image processing, Contour detection, gradient.

I.INTRODUCTION

Image segmentation plays a significant role in image processing. Several methods have been proposed in the last few decades but still it is a great problem for automatic image segmentation which is challenging the engineers. Edge detection [1-2] in real life images is a major problem to enable them for subsequent processing by machines. It is a very important field in image processing and image segmentation [3-6]. Edges in digital images are areas with strong intensity contrasts and a jump in intensity from one pixel to the next can create major variation in the picture quality. For those reasons edges [7-9] forms the outline of an object and also indicates the boundary between overlapping objects. Identification of accurate edges of image objects helps to analyze and measure some basic properties related with an objects or objects of an image such as area, perimeter, and shape. As discontinuities in intensity values of an image form the edges of objects. To perform image segmentation and edge detection tasks, there are many detection techniques [10-16]. Among them in gradients is a popular one. It has been observed that the use of standard 5x5 mask of Laplacian of Gaussian edge detector for image segmentation and edge detection does not also solve the main problem that is identification of accurate edges. The gradient [17-19] of the image is one of the fundamental building blocks in image processing. The first- order derivative of choice in image processing is the gradient. Mathematically, the gradient of a two-variable function (here the image intensity function) at each image point is a 2D vector [20-21] with the components given by the derivatives in the horizontal and vertical directions. At each image point, the gradient vector points in the direction of largest possible intensity increase, and the length of the gradient vector corresponds to the rate of change in that direction.

In this paper a modified scheme of Laplacian of Gaussian operator with 9x9 mask for generating gradient images is proposed and produces greater accuracy for edge detection. The entropy which is a statistical measure of randomness that can be used to characterize the texture of the input image is studied along with peak signal to noise ratio (PSNR), mean square ratio (MSE) and execution times are also studied in this paper. The structure of this work is the following: Section 2 introduces a brief description on gradients. Section 3 introduces the conventional 5x5 Laplacian and Gaussian filter. Section 4 presents the proposed scheme of modified Laplacian of Gaussian moderator with9x9 mask. The results are discussed in section 5 and we finish this paper with some concluding remarks with section 6.

II.THE GRADIENT

Edges in digital images are areas with strong intensity contrasts and a jump in intensity from one pixel to the next can create major variation in the picture quality. With the help of first- and second- order derivatives such discontinuities are detected. The first- order derivative of choice in image processing is the gradient. The gradient of a 2-D function, *f*(x,y), is defined as the vector

$$\nabla f = \begin{bmatrix} g_x \\ g_y \end{bmatrix} = \begin{bmatrix} \frac{\partial f}{\partial x} \\ \frac{\partial f}{\partial y} \end{bmatrix}$$

The magnitude of this vector is

$$\nabla f = mag(\nabla f = \left[g_x^2 + g_y^2\right]^{\frac{1}{2}} = \left[\left({}^{\partial f}/_{\partial x}\right)^2 + \left({}^{\partial f}/_{\partial y}\right)^2\right]^{\frac{1}{2}}$$

This quantity is approximated sometimes by omitting the square root operation,

$$\nabla f \approx g_x^2 + g_y^2$$

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Or by using absolute values,

$$\nabla f \approx |g_x^2| + |g_y^2|$$

These approximations still behave as derivatives; that is, they are zero in areas is contrast intensity and their values are related to the degree of intensity change in areas of variable intensity. It is common practice to refer the magnitude of the gradient or its approximations simply as "gradients".

III.LAPLACIAN OF GAUSSIAN (LOG)

This detector finds edges by looking for zero crossings after filtering *f(x, y)* with a Laplacian of Gaussian filter. In this method, the Gaussian filtering is combined with Laplacian to break down the image where the intensity varies to detect the edges effectively. It finds the correct place of edges and testing wider area around the pixel. In below a 5x5 standard Laplacian of Gaussian edge detection mask is given.

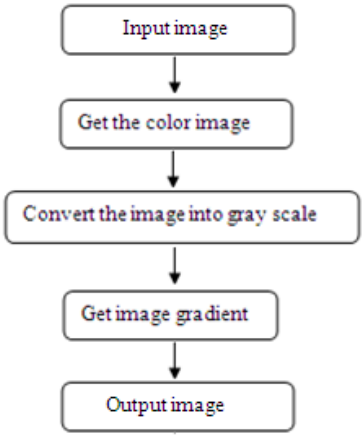
0	0	-1	0	0
0	-1	-2	-1	0
-1	-2	16	-2	-1
0	-1	-2	-1	0
0	0	-1	0	0

IV.PROPOSED SCHEME

In proposed scheme a modified 9x9 mask of Laplacian of Gaussian operator has been presented. After large number of trials using masks of larger dimensions, the size of the optimal mask was obtained and found to have 9x9 in dimensions. The modified mask is shown here.

0	0	0	1	1	1	0	0	0
0	1	3	4	4	4	3	1	0
0	3	4	2	0	2	4	3	0
1	4	2	-10	-13	-10	2	4	1
1	4	0	-10	-30	-10	0	4	1
1	4	2	-10	-13	-10	2	4	1
0	3	4	2	0	2	4	3	0
0	1	3	4	4	4	3	1	0
0	0	0	1	1	1	0	0	0

The flowchart of the proposed scheme is given in below. In initial stage a color image is converted into gray scale or black and white image. The gradient image is accrued from the grayscale image with the help of proposed modified mask of Laplacian of Gaussian edge detection operator.



V.EXPERIMENTAL RESULTS

We ran two real life images through our edge detectors. The resultant images are shown in the figures from figure 1 to figure 3 and statistical analyses are given below in table 1. The first thing to notice about the gradient images obtained using standard Laplacian of Gaussian edge detector of 5x5 mask is that the edges are often spotty and disconnected. On

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the other hand the edges in gradient images obtained by modified Laplacian of Gaussian edge detector having 9x9 mask produces much satisfactory results in terms of clearer edges and . In statistical analysis in respective of Entropy, PSNR and MSE are given below.

Fig. 1: Original Images. (a) Lina. (b) BITM.

Fig. 2: Gradient images obtained using standard 5x5 LoG mask. (a) Lina. (b) BITM.

Fig. 3: Gradient images obtained using proposed 9x9 LoG mask. (a) Lina. (b) BITM.

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Table I- statistical measurement

IMAGE	METHOD USED	ENTROPY	PSNR	MSE
Fig. 2: (a) Lina.	LoG with 5x5 mask	5.0245	6.2983	1.5249e+004
Fig. 2: (b) BITM.	LoG with 5x5 mask	4.3404	5.7677	1.7231e+004
Fig. 3: (a) Lina.	LoG with 9x9 mask	5.2249	6.4520	1.4719e+004
Fig. 2: (b) BITM.	LoG with 9x9 mask	5.3574	5.8109	1.7060e+004

VI.CONCLUSION

Identification of accurate edges of image objects are very important for analyzing and measuring some basic properties related with an objects or objects of an image such as area, perimeter, and shape. The present work introduced the concept of edge detection with gradients and has used it to produce an effective watershed segmentation technique for natural images. The resultant image with the proposed scheme produces with 9x9 Laplacian and Gaussian (LOG) filter produces much higher accuracy to detect object edges compared with the conventional 5x5 Laplacian and Gaussian filter for generating gradients images.

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BIOGRAPHY

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