The Performance Analysis of Edge Detection Algorithms For Color Image Processing In HSV Domain

Shaik Jani Basha[1], Munwar Ali Shaik[2]
[1]Dept of ECE
[2]Assistant Professor, Dept of ECE
[1, 2]ESWAR college of Engineering , Narasaraopet , A.P, India

Abstract- *Edge detection is one of the important and most frequently used approaches for Image segmentation in Digital Image Processing. Detecting edges for a color image is a bit difficult than the same in a gray image . This paper mainly focus on brief study of different edge detection Techniques for Color Images. In this paper we have studied prewitt, sobel, Robert's and canny edge detection algorithms. Finally by comparing the experimental results the canny edge detection algorithm gives better results .*

Keywords- Edge detection, Sobel operator, Prewitt operator, Robert operator, Canny edge detector

I. INTRODUCTION

Image segmentation is used to extract features of the image which can be split in order to build objects of interest on which analysis can be performed. Edge detection is one of the most widely used Image segmentation technique and also a very important area in the field of the image processing .Edge based segmentation exploits spatial information by detecting the edge in an image. Edges are significant changes of intensity in an image .Edges are very important portion of the perceptual information content in an image .Color edge detection process include features extraction identification of object in a scene. Therefore edge detection becomes an essential one. In latest research work it becomes an effective field of the Digital Image processing there are different types of edge detection operators available like sobel, prewitt, Robert, canny edge detection etc.

II. EDGE DETECTION PROCESS

The three fundamental steps performed in edge detection process are

(a).Smoothing of Image for Reduction of noise
(b).Detection of Edge points
(c).Localization of Edges in Image

Edge Detection is achieved by different types of edge detectors which are classified in to two categories as shown below
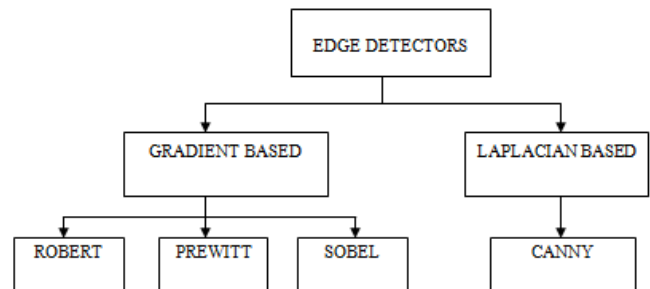
II A. SOBEL OPERATOR:

Sobel operator is a Gradient based operator.it is used to compare an approximation of the gradient of image intensity function for edge detection. It convolves the kernel with input image to compute magnitude and direction of the gradient. Sobel operator uses two 3x3 kernels represented as Gx and Gy. Gx and Gy are used for horizontal and vertical derivative approximation. The magnitude of the Gradient at each point can be calculated by $|G|= (G_{x}^{2} + G_{y}^{2})^{1/2}$ The direction of the gradient vector given by $\alpha = Tan^{-1} (G_y / G_x)$ where α is the angle at which maximum rate of change occurs Sobel edge detector masks given as

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

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

II B. PREWITT OPERATOR:

The two 3x3 kernels Gx and Gy are given as

Gx

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

Gy

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

Gy is obtained by rotating Gx by 90^0 .compare to Sobel operator It is simpler to implement but it produces noisy results compare to sobel operator.

II C. ROBERT OPERATOR:

The earliest edge detector operator is Robert operator .It is Simpler in implementation compare to Sobel and prewitt edge detector operators. It uses only 2x2 kernel masks to calculate gradient of image highlighting the regions related to edges. Due to having small kernel size it is highly sensitive to noise

The two 2x2 kernels given as

Gx

-1	0
0	-1

Gy

0	-1
+1	0

II D. CANNY EDGE DETECTOR:

It was developed by John .F. Canny in 1986.It was most frequently used edge detection technique in digital image processing. It is a more advanced technique for edge detection with provision made for edge characteristics and noise content. The basic objective of Canny detector is to minimize the error rate ,single edge point response and excellent localization of edge points

The Canny detection algorithm executed by first removing the noise from image by passing the image through Gaussian filter then calculating the magnitude and angle of the image gradients next applying non-maxima suppression to the image to thin the edges. Then finally by double tresholding and connectivity analysis to detect and linking edges.

III. STEPS INVOLVED IN THE PROPOSED APPROACH

The steps involved in the proposed algorithm are described below:
[1] Input RGB Color Image.
[2] RGB to HSV Conversion.
[3] Extract the V-Channel of the HSV Converted Image.
[4] Employ Different edge detection operators to the Extracted V-Channel for detecting the edges.
[5] The old V-channel (obtained at step 3) has been replaced by the V-Channel obtained at step 4.
[6] HSV image at step 5 has been converted back to RGB color space to obtain the final edge detected image of the original color image.

IV. EXPERIMENTAL RESULTS

The work is executed on MATLAB Software with various images. They are Color images of size 512x512,identified as Image1,2,3. First the different edge detectors mentioned in the previous section are applied to the above images in In both the case the performance of edge detectors are Analyzed .
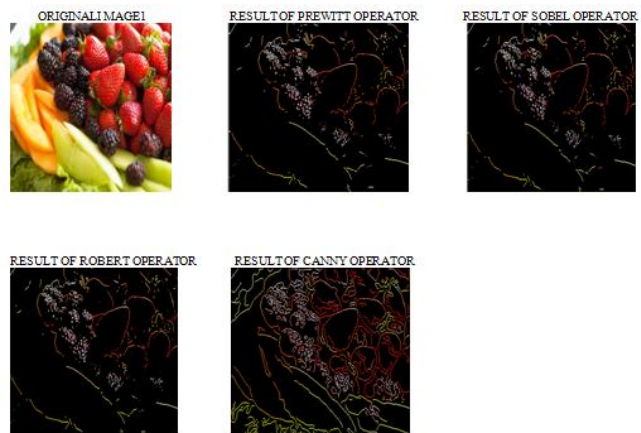
IV A. IMAGE1:

Fig1: Performance of Prewitt, Sobel, Robert, Canny edge detectors on Image1

IV B. IMAGE2:

Fig2: Performance of Prewitt, Sobel , Robert, Canny edge detectors on Image2
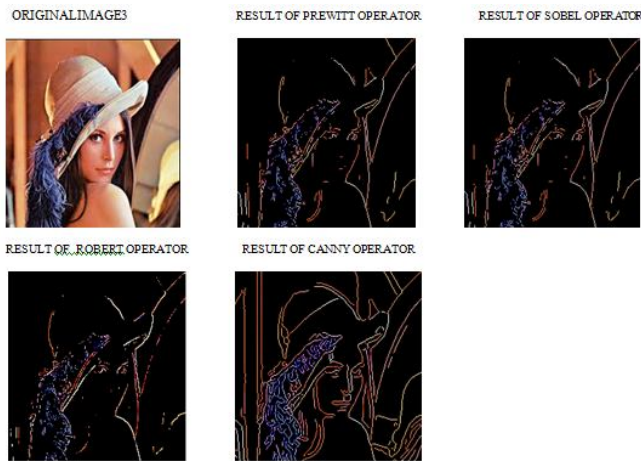
IV C. IMAGE3:

Fig3: Performance of Prewitt, Sobel , Robert, Canny edge detectors on image3

V. COMPARISON OF DIFFERENT EDGE DETECTORS

S.NO	NAME OF THE OPERATOR	ADVANTAGES	DISADVANTAGES
1	CANNY OPERATOR	Excellent performance compare to other operators and Insensitive to noise	Complex method
2	PREWITT AND SOBEL OPERATORS	Simple to implement	Inaccurate sometimes And Sensitive to noise
3	ROBERT OPERATOR	Very simple to implement	Very Inaccurate and more sensitive to noise

VI. CONCLUSION

In this Work Different Edge detecting Algorithms are applied on different color images. It was clearly observed that Canny edge detection algorithm produce better results compare to Prewitt, Sobel , Robert Edge detecting operators. Future work focus on extending the algorithms by using advanced methods to improve the results

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