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ANALYSIS OF EDGE DETECTION TECHNIQUES FOR IMAGE SEGMENTATION

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Abstract - Analysis of content of the image is the primary objective in computer vision, particularly in image processing. In this digital period it has gained much responsiveness of peoples in research. Image Segmentation separates an image into its constituent regions or objects. Process of Image segmentation segments the object from the background to observe the image properly and discover the pels and pixels of the image carefully. In this perspective, edge detection is a primary tool for image segmentation. In this paper an endeavor is made to analyze and compare the performance of frequently applied edge detection parameters for image segmentation

Keywords: Edge detection, image segmentation, MATLAB.

1. INTRODUCTION

Image segmentation is a vital step in image analysis. Segmentation split an image into its constituent parts or objects. Segmentation algorithms for images generally based on the discontinuity and similarity of image intensity values. Discontinuity approach is to partition an image based on immediate changes in intensity and similarity is based on partitioning an image into regions that are similar according to a set of predefined criteria. Thus the process of image segmentation technique highly depends on the problem being considered. Edge detection is a part of image segmentation, which serves as a primary technique for detecting intensity discontinuities in a digital image.

In particular it has its wings specialized in feature extraction and entity or object segmentation, target tracking, image reconstruction, data compression, object recognition and so on. Method of refraction or reduced focus can result in objects through boundaries defined by a regular change in intensity. There are some problems of fake edge detection, which include edge localization, missing

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true edges, problems due to noise and high computational time etc. The focused task is to widely compare various edge detection operators and to make a study over its performances one over the other.

This research paper perceptibly compares four edge detection algorithm namely roberts, sobel, prewitt and canny edge detection operators for extracting edges from a real image.

Targeting to detect the edges of any image and then canny algorithm derives analytically optimal step edge operators and proved it a good approximation. On the other side, sobel edge detection primarily works on a mathematical procedure known as convolution along with estimating the gradients of the image. And hence performance issues are analyzed in terms of accuracy and speed to conclude the best of working algorithm. And from the experiments, it has been concluded that the canny edge detection algorithm out sources the best.

2. Image Segmentation

Image Segmentation is the progression where the digital image would be partitioned in to multi sets of pixels or multiple regions. Thus the resultant set of image segmentation is set of regions that form the entire image together. Obtained set of pixels in a particular region would be similar with respective to color, intensity and texture. There exist unique approach to determine (i) the boundaries between regions depending upon discontinuities in intensity levels; (ii) the threshold depends upon the distribution of pixel properties, and (iii) finding the regions directly. And here the decision depends on the current problem taken.

This method divides the entire image into many sub regions satisfying set of protocols (rules) as all the pixels in a particular region must lie in the same gray scale level. And it relies on common patterns in intensity level within a cluster of neighboring pixels. Applying threshold technique, regions can be fragmented depending on range a value, which highly transforms an input image into an output image-segmented binary image.

3. EDGE DETECION ALGORITHMS

An Edge detection process is a neighborhood operation used to determine the extent to which each pixel's neighbor can be partitioned by passing a simple arc via some other pixels. In which neighboring pixels of one side of the arc possess a predominant value. And the neighboring pixels of e other side of the arc possess a different predominant value.

3.1 ROBERTS EDGE DETECTION

The Roberts edge detection operator was introduced by Lawrence Roberts (1965). This

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method computes spatial gradient measurement on an image with utmost fast and easy access. This technique accentuate on regions of high spatial frequency corresponding to edges. Here the input is a gray scale image and in the output, every pixel represents the estimated complete magnitude of the spatial gradient of the input image at that point.

1	**0**
0	**-1**

GX

0	**1**
-1	**0**

GY

Fig 3.1: Roberts Mask filter in X direction and Y direction.

3.2 SOBEL OPERATOR

Sobel edge detection method was introduced by sobel in 1970.this method is highly applied in many areas. It performs a 2-D spatial gradient quantity on an image and thus it detects the edge regions of high spatial frequency. In this method, 3*3 matrix is used, where the first matrix evaluates the gradient in x-direction and the other estimates the gradient in y-direction. The mask is glided over the image, and manipulates the square of pixels simultaneously. Then the algorithm computes the gradient of the image intensity at all individual point. Finally the sobel algorithm directs to increase the intensity of an image at all the pixel points changing from light to dark. Edge boundaries represent the strong intensity contrast depicting either the darkness orbrightness.

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

G_X

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

G_y

Fig 3.2: Sobel Mask filter in X direction and Y direction

$$|G| = \sqrt{G_X^2 + G_y^2} \quad \ldots\ldots 2.1$$

And its approximation is done by:

$$|G| = |G_X| + |G_Y| \quad \ldots\ldots 2.2$$

The orientation of angle is given by:

$$\theta = \arctan\left(\frac{G_X}{G_Y}\right). \quad \ldots\ldots 2.3$$

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3.3 PREWITT OPERATOR

The Prewitt edge detection was proposed by Prewitt in 1970. For the valid estimation of magnitude and orientation of an edge,prewitt operator would be the right choice. This gradient based edge detector is estimated in the 3x3 neighborhood for eight directions. All the eight convolution masks are calculated. One complication mask is then selected with the purpose of the largest module.

The convolution masks of the Prewitt detector are represented below:

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

P_X

-1	0	+1
-2	0	+2
-1	0	+3

P_Y

Fig 3.3 Mask Filter of Prewitt Operator in X direction and Y direction

ALGORITHM

Input: Any Sample Image.

Output: Edge detected image.

Step 1: Read the input image.

Step 2: Apply mask Gx, Gy to the input image.

Step 3: Apply prewitt edge detection algorithm and the gradient.

Step 4: Gx, Gy mask manipulated separately on the input image.

Step 5: To verify the total magnitude of the gradient, all the resultant values are combined.

Step 6: Then the absolute magnitude is the detected edges as output.

3.4 CANNY EDGE DETECTION

The canny edge Detection method has been widely used and implemented for detecting precision f edges. This method takes the foremost priority in addressing itself as most outstanding in determining the edges from the actual image. As it extracts the specified edges in an image without disturbing its features, it can be proudly stated that the canny has its specialized wings such as lower rate, efficient recognition of edges and a unique-uni response to a single edge.

ALGORITHM

Inception task: Read the input.
Computational task: Mark the edges of largest gradient.
Notification task: only local maxima should be marked as edges.
Obtaining task: All edges are obtained by hyperesthesia threshold.

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Output: finally the output is extracted edge of an image.

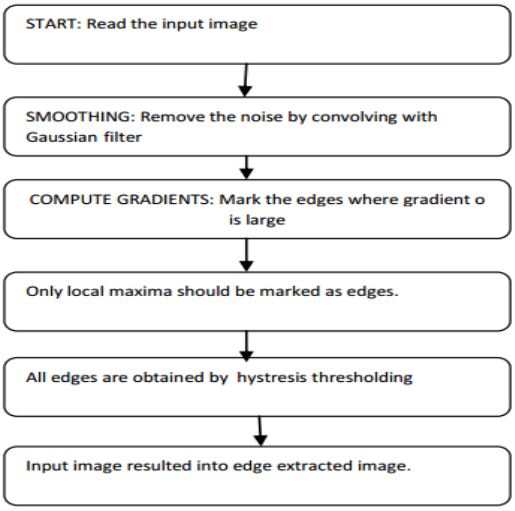
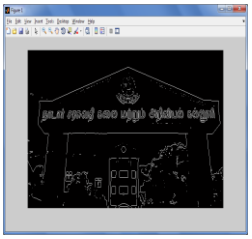


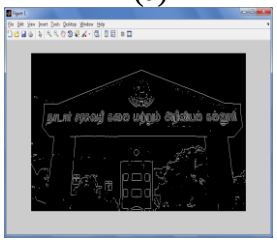
Fig 3.4: Flow chart of canny edge detection.

4. EXPERIMENTAL RESULT

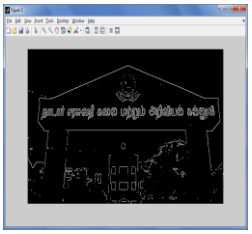
4(a)



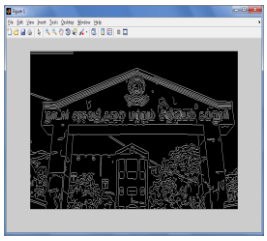
4(b)



4(c)



4(d)



4(e)

4(a). Original image, 4(b). sobel edge detection algorithm 4(c). prewitt edge detection ,4(d). Roberts edge detection, 4(e). canny edge detection.

5. CONCLUSION

This paper presents the wide analysis of various edge detection techniques along with the comparison of Roberts, Sobel, Prewitt, and Canny. And the current scenario of digital image processing is to obtain utmost absolute and vivid-error free edge detected image. Similarly, for appropriate edge extraction, the expected outcome should be more promising in its recognition and noticeable depiction of image. Canny algorithm is more sensitive in detecting the edges than the other operators. And hereby concludes as, this research is followed by canny edge detection technique for appropriate edge extraction would be always superlative in its performance, betterment, recognition of edge, high in computation speed, and efficiency rather than robert , sobel and prewitt.

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