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SURVEY ARTICLE

A Survey on Edge Detection Techniques using Different Types of Digital Images

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Abstract: ***Digital image processing can use an image as an input, analyze it and gives an output as in meaningful away. Image segmentation is an important method through which we can analyze the image. It is the process of partitioning a digital image into multiple segments. The important step of image processing is Edge Detection. Edge detection is a well-developed field on its own within image processing. Region boundaries and edges are closely related, since there is often a sharp adjustment in intensity at the region boundaries. Edge detection techniques have therefore been used as the base of another segmentation technique. This research paper has been done to analyze various edge detection techniques applied on a filtered image by applying Salt & Pepper noise. In this paper, the three edge detection techniques are implemented on various types of images and they are analyzed based on the evaluation parameters PSNR, RMSE and CoC.***

Keywords: Edge detection, Region, Noise, PSNR, MSE, CoC

I. INTRODUCTION

Image segmentation is an essential step in image analysis. The goal of image segmentation is to cluster pixels into salient image regions, i.e., regions corresponding to individual surfaces, objects, or natural parts of objects. Detection of edges for an image may help for image segmentation, data compression, and also help for well matching, such as image reconstruction and so on[3].Segmentation separates an image into its objects and background. The level to which the separation is carried depends on the problem being solved. When the objects of interest in an application have been inaccessible the segmentation must stop.

The choice of image segmentation technique is depends on the problem being considered. Edge detection is a part of image segmentation. The effectiveness of many image processing depends on the perfection of detecting meaningful edges. Therefore, the objective is to do the comparison of various edge detection techniques and analyze the performance of the various techniques based on several parameters.

II. EDGE DETECTION TECHNIQUES

Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed *edges*. In this paper three edge detection methods are used to find the better performance on various images.

i)Sobel Edge Detection

In digital images, the approximate partial derivation in gradient is computed by the Sobel operator. In terms of computations, the edge is based on the edge convolving with the integer, separable and small valued filter in vertical and horizontal directions .Mathematically, the approximations of the derivative can be calculated by using two 3*3 kernels which are convolved with the original image.

*ii)**Prewitt Edge Detection***

The maximum responses which are directly from the kernel are obtained by the use of Prewitt Edge Detector. The prewitt edge operator or detectors are used for the measurement of two components i.e. horizontal edge components and vertical edge components. These two components (vertical and horizontal) are used different kernels.

iii) Canny Edge Detection

The Canny Edge detection is introduced by John Canny (1983). Canny edge detection technique is one of the standard edge detection techniques. It is used many of the newer algorithms that have been developed. The noise can be reduced and suppression can be minimum are the stages of canny algorithms which are used in images.

III. PARAMETERS FOR EVALUATION

i)Root Mean Square Error

An estimator is to quantify the difference between an estimator and the true value of the quantity being estimated is called Mean square error. The mean square error is the squared error averaged over the M × N array. M N

MSE=1/MN ΣΣ (f1(i,j)- f2(i,j))2 (1)

i=1j=1

Where f1 is output image and f2 is input image. Its value must be less.

RMSE=√MSE (2)

ii)Peak Signal to Noise Ratio

The ratio between the maximum possible powers to the power of corrupting noise is known as Peak Signal to Noise Ratio. It affects the fidelity of its representation .It can be also said that it is the logarithmic function of peak value of image and mean square error.

PSNR=10 LOG (2552/MSE) (3)

Where MSE is the mean square error. Its value must be high.

iii) Correlation Coefficient

The correlation coefficient a concept from statistics is a measure of how the trends in the predicted values follow trends in past actual values. It is a measure of how well the predicted values from a forecast model "fit" with the real-life data. The correlation coefficient is a number between 0 and 1. If there is no relation-ship between the predicted values and the actual values the correlation coefficient is 0 or vary (the predicted values are no better than random numbers). As the strength of the relationship between the predicted values and actual values increases so does the correlation coefficient. A perfect fit gives a coefficient of 1.0. Thus the higher the correlation coefficient the better.

Correlation(r)=NΣXY-(ΣX)(ΣY)/sqrt([NΣX2-

(ΣX)2][NΣY2 - (ΣY)2])

Where

N = Number of pixels of image
X = input image
Y =output image
ΣXY = Sum of the product of input and
Output image
ΣX =Sum of pixels of input image

ΣY = Sum of pixels of output image

ΣX2 = Sum of square of pixel of input Image

ΣY2 = Sum of square of pixels of output Image

IV. EXPERIMENTAL ANALYSIS

To compare the edge detection methods, three types of images are considered. They are Lena image, Medical image and Satellite image. The steps are:

Step 1: Read the image.

Step 2: Convert the image to double.

Step 3: Apply Salt & Pepper noise to the image.

Step 4: Denoise the image using Median Filter.

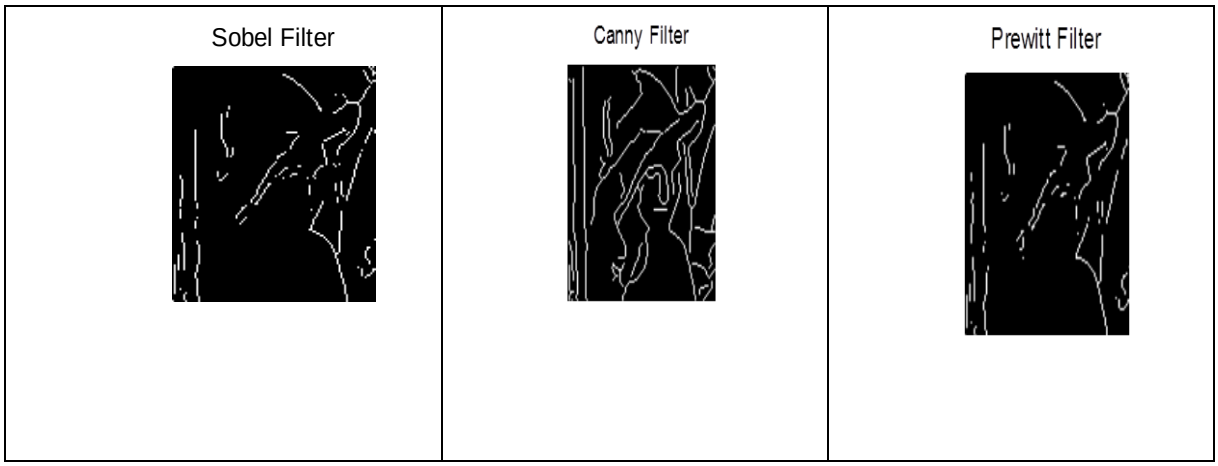
Step 5: Apply the edge detection operator to the filtered image.

Step 5: Evaluate the PSNR, RME and Coc parameters.

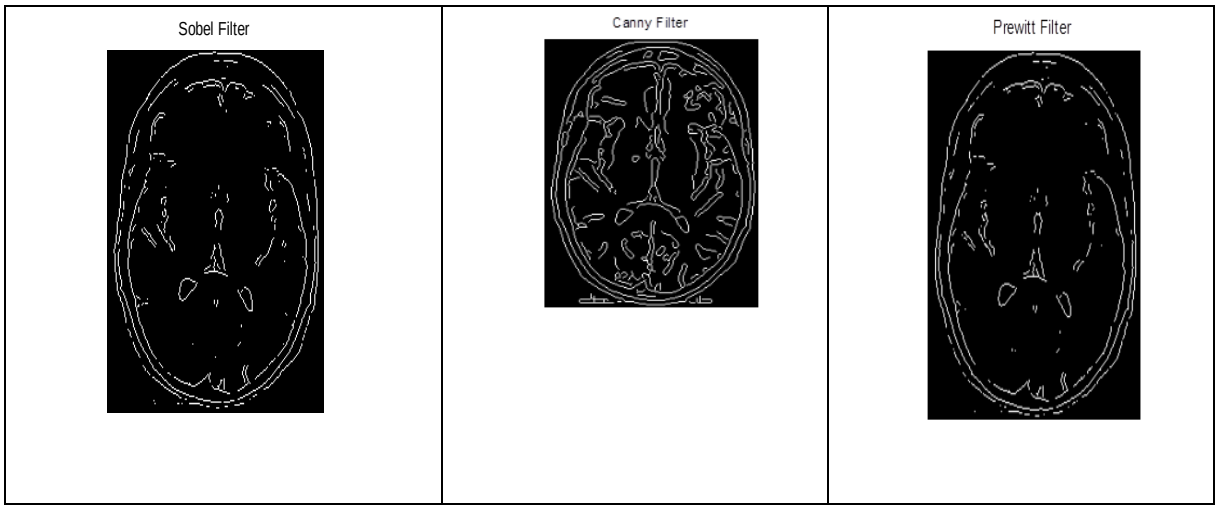
Step 6: Compare the results.

V. RESULTS

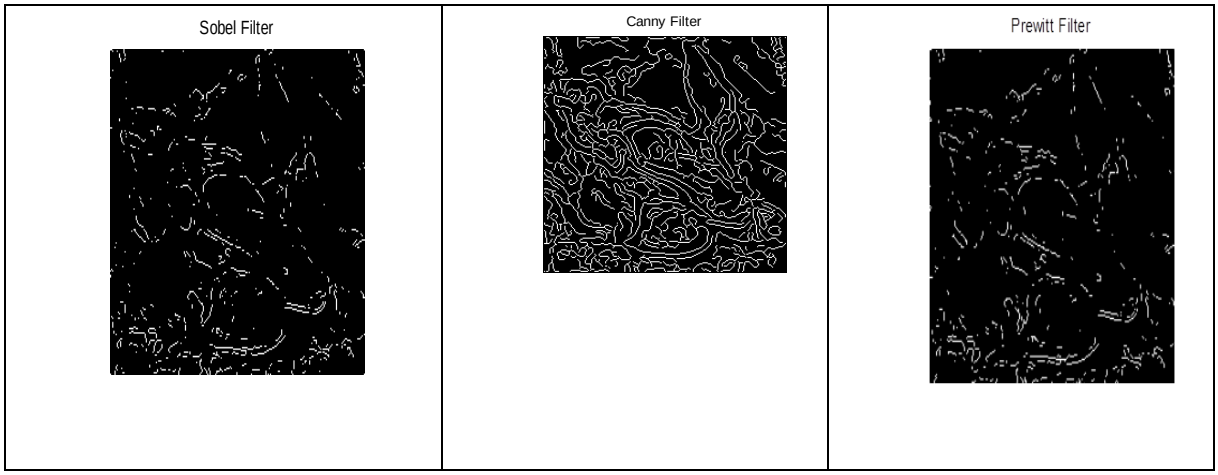
i)Edge Detection on Lena image



ii) Edge Detection on Medical image



iii) Edge Detection on Satellite Image



The performance analysis of various evaluation parameters are tabulated as follows:

Table 1: Comparison of Various Edge Detection Methods

Method	PSNR	RMSE	Coc
Lena Image			
Sobel Operator	54.6340	0.2237	0.0608
Canny Operator	54.4710	0.4032	0.0661
Prewitt Operator	54.6311	0.2239	0.1885

Medical Image (MRI Scan of Brain)			
Sobel Operator	52.9005	0.3348	-0.0057
Canny Operator	57.7949	0.1269	0.0365
Prewitt Operator	57.1046	0.1080	-0.0093
Satellite Image			
Sobel Operator	52.7060	0.3487	0.0174
Canny Operator	52.9005	0.3348	-0.1282
Prewitt Operator	52.7071	0.3486	0.0887

VI. CONCLUSION

From the above discussions, it is concluded that the application of edge detection methods on various images like Lena image, Medical image and Satellite image. The edge detection methods are applied on the filtered image. The image is applied with Salt & Pepper noise and is filtered with Median Filter. The experiment shows that for the filtered image, canny edge detection works well with Medical image and Satellite image. For Lena image Sobel edge detection method works better than other methods to detect the edges of the image.

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