Comparative Analysis of Noisy Image Edge Detection Techniques using Different Parameters

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Abstract— The most important goal of image processing is to interpret the content of image efficiently and finds the meaningful and significant information from it. The image obtained after transmission is often corrupted with noise. A noise is introduced in the transmission medium due to a noisy channel, errors during the measurement process and during quantization of the data for digital storage. Before applying image processing tools to an image, noise removal from images is done at highest priority. There are various noises like Salt and Pepper, Gaussian noise etc. and various filtering techniques available for removing the noises from the images like Mean filter, Median filter and Gaussian filter etc. So before applying edge detection techniques on an image it must be a noise free image. Edges are the fundamental features of the image and can be formed from the outlines of the object. Edge detection is generally used in image analysis and processing. There are several types of algorithm to detect the edges. In this paper, the comprehensive analysis is done on the several edge detection techniques such as Prewitt, Sobel, Canny, Roberts and Laplacian of Gaussian applied on a filtered image by applying Salt and Pepper noise, Gaussian noise and Speckle noise. They are analyzed based on the evaluation parameters PSNR, MSE and MAE. It is experimentally observed that Canny edge detector is working well than others. This work is implemented on Matlab R2013a.

Keywords: Prewitt, Sobel, LOG, Canny, Roberts, Salt and Pepper Noise, Gaussian Noise, Speckle Noise, PSNR, MSE, MAE

I. INTRODUCTION

Image processing is a process where an image converted into a digital image form and performs some operations on it, in order to acquire an improved image or to extract some useful information from it. Before image processing we first remove the noise from an image which may be occurs due to thermal vibration of atoms and discrete nature of radiation of warm objects, faulty memory locations, malfunctioning pixel elements in the camera sensors, or there can be timing errors in the process of digitization.

In this paper, first remove the noise from an noisy image using different types of noise removal methods and then various techniques of edge detection are studied for identifying the edges in an image and the comparative analysis is also performed among these techniques.

II. NOISE IN IMAGE

A. Gaussian Noise

It is also known as electronic noise because it arises in amplifiers or detectors. Gaussian noise caused due to natural sources such as thermal vibration of atoms and discrete nature of radiation of warm objects. Gaussian noise basically disturbs the gray values in digital images. Because of that Gaussian noise model essentially designed and characteristics by its PDF (Probability Density function) or normalizes histogram with respect to gray value. Gaussian noise is equally distributed over signal. This explains that each and every pixel in the noisy image is the sum of the true pixel value and a random Gaussian distributed noise value. The noise is not dependent of intensity of pixel value at each point.

Gaussian noise: P (Z) = $\frac{1}{\sqrt{2\pi\sigma}} e^{-(z-\mu)^2/2\sigma^2}$

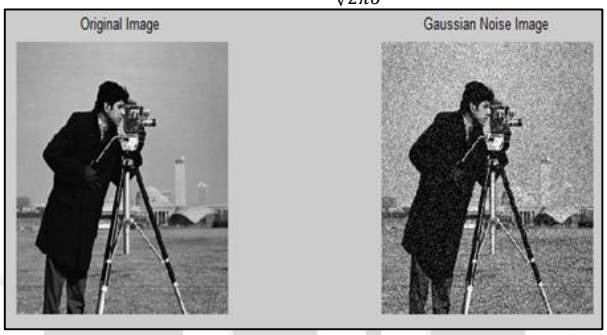

Fig. 1: Example of Gaussian Noise.

B. Impulse (Salt-And-Pepper) Noise

The salt-and-pepper noise are also commonly known as shot noise, impulse noise or spike noise that is usually caused by faulty memory locations , malfunctioning pixel elements in the camera sensors, or there can be timing errors in the process of digitization. In the salt and pepper noise there are only two possible values exists that is a and b and the probability of each is less than 0.2.If the numbers greater than this numbers the noise will swamp out image. For 8-bit image the typical value is 255 for salt-noise and pepper noise is 0.

Fig. 2: Example of Salt and Pepper Noise on Cameraman Image.

C. Speckle Noise

Speckle noise is multiplicative noise which different from the Gaussian and Salt and Pepper noise. This noise can be modeled by random vale multiplications with pixel values of the image and can be expressed as

$$P = I + n * I$$

Where P is the speckle noise distribution image, I is the input image and n is the uniform noise image by mean o

and variance v. Speckle noise is commonly distinguished in radar sensing system, although it may appear in any type of remotely sensed image utilizing coherent radiation. Like the light from a laser, the waves emitted by active sensors travel in phase and interact minimally on their way to the target area. Minimizing the effect of speckle noise permits both better discrimination of scene targets and easier automatic image segmentation.

Fig. 3: Example of Speckle Noise on Cameraman Image.

III. DIFFERENT TYPES OF FILTERS USED TO REMOVE NOISES

Removing noise from an image is very important task in image processing for the analysis of images. One goal in image reconstruction is to remove the noise from the image in such a way that the original image is perceptible. Image filtering is the first and most important pre-processing step that almost all image processing applications demand.

A. Gaussian filter

A Gaussian filter is a linear filter. It's usually used to blur the image or to decrease noise. The Gaussian filter alone will blur edges and reduce contrast. The Gaussian filter is a non-uniform low pass filter.

B. Mean Filter

Mean filter is an averaging linear filter. Here the filter computes the average value of the corrupted image in a predefined area. Then the centre pixel intensity value can be replaced by that average value. The mean filter is also known as simple spatial filter. It is a sliding-window filter that replaces the centre value in the window. It replaces with the average mean of all the pixel values in the window. The window is usually in square shape but it can be of any shape.

C. Median Filter

Median filter is a best order static, non- linear filter, whose response is based on the ranking of pixel values contained in the filter region. Median filter is quite popular for decreasing certain types of noise. The centre value of the pixel is replaced by the median of the pixel values under the filter region. Median filter is used for decreasing the amount of intensity variation between one pixel and the other pixel. In this filter, we do not interchange the pixel value of image with the mean of all neighboring pixel values, we interchange it with the median value. Then the median is calculated by first sorting all the pixel values into ascending order and then replace the pixel being calculated with the middle pixel value. If the neighboring pixel of image which contain an even numbers of pixels, than the average of the two middle pixel values is used to replace. Median filter is good for salt and pepper noise removal from an image.

IV. EDGE DETECTION TECHNIQUES

Edge detection is a process to locate the edges that having good orientation and it is an essential tool of image segmentation. An edge detector is basically a high pass filter that can be applied to extract the edge points in an image. Edge detection method transforms the original image into edge image with the help of different operators. It is a well-known process for identifying the lack of coherence in intensity values. The edge detection technique is a two step process, first the image is inputted and converts that image into gray scale image and the second step is to apply the edge detector operators to detect and extract the edges present within an image as output.

A. Roberts Edge Detection

Lawrence Roberts has proposed the Roberts edge detection technique for detecting the edges within an image in 1965. It is a simple and computationally efficient approach. The Roberts operator performs a simple, quick to compute, 2-D spatial gradient measurement on an image. The pixel value at that point in the resultant image characterizes estimated absolute magnitude value of the spatial gradient of the inputted image at that point. It takes input image as gray scale image and produces edges involving in that image. The main disadvantages of this technique are that it can't detect that type of edges which are multiplies of 45 degrees and it is not symmetric.

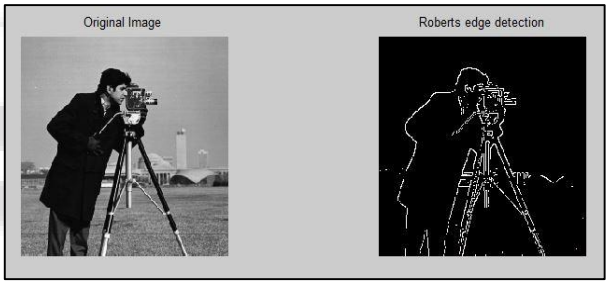

Fig. 4: Example of Roberts edge detection technique.

B. Sobel Edge Detection

Irwin Sobel has proposed the Sobel edge detection technique in 1970. The Sobel kernel depends on the central difference, while averaging it gives more weight to central pixel. The Sobel edge detection operation brings out all edges in an image, regardless of direction. One of the advantages of Sobel kernel over Prewit kernel is that it has better noise suppression characteristics and other advantage is providing both a differencing and smoothing effect.

Fig. 5: Example of Sobel edge detection technique.

C. Prewitt Edge Detection

Prewitt has proposed the Prewitt edge detection technique in 1970. Prewitt edge detection technique is a perfect algorithm

to measure the magnitude and orientation of the edges. Prewitt operator is a discrete differentiation operator, computing an approximation of the gradient of the image intensity function. At each and every point in the image, the result of the Prewitt operator is either the corresponding gradient vector or the normal of this vector. The Prewitt operator is about convulsing the image with a small, separable, and integer valued filter in horizontal and vertical direction. It is therefore relatively inexpensive in terms of computations.

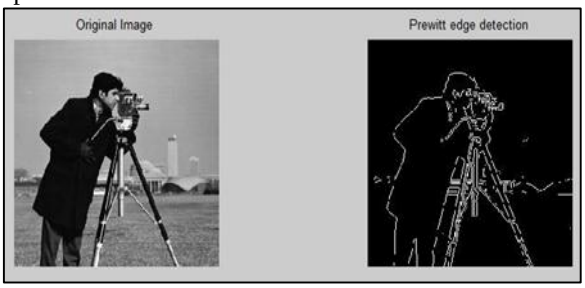

Fig. 6: Example of Prewitt edge detection technique.

D. Canny Edge Detection

John Canny introduced the canny edge detection technique at MIT in 1983. Canny edge detection technique is the standard, powerful and commonly used edge detection method. It is better than other edge detection methods because it separates the noise from the image before extracting edges. Canny is a better method for extracting the edges than other existing methods and produces the good result. The Canny operator can control a number of details of edge image and can suppress the noise efficiently.

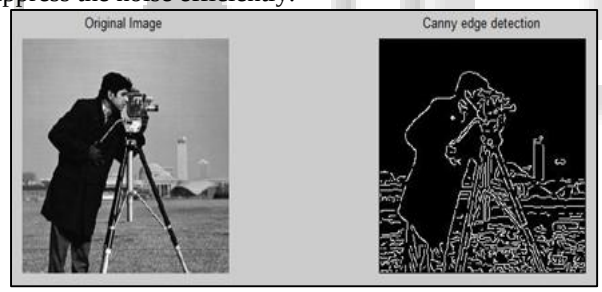

Fig. 7: Example of Canny edge detection technique.

E. Laplacian of Gaussian (LOG) Edge Detection

Marr has introduced the Laplacian of Gaussian (LOG) technique in 1982 .LOG is based on second order derivative. The Laplacian is a 2-D isotropic measure of the 2nd spatial derivative of an image. The Laplacian of an image highlights regions of rapid intensity change and is therefore often used for edge detection. The Laplacian is often applied to an image that has first been smoothed with something approximating a Gaussian Smoothing filter in order to reduce its sensitivity to noise. The operator normally takes a single gray level image as input and produces another gray level image as output. The Laplacian L(x, y) of an image with pixel intensity values I(x, y) is given by:

LOG smoothes the image first then calculate Laplacian. This process produces the double edge image. It locates edges then search the zero crossing between the double edges.

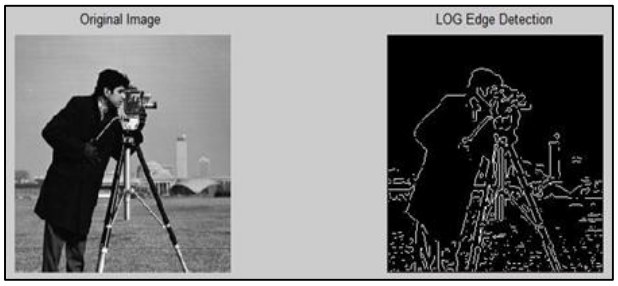

Fig. 8: Example of LOG edge detection technique.

V. PARAMETERS USED FOR COMPARISON OF EDGE DETECTION METHODS

Performance analysis is done to calculate the efficiency by which image is recovered. The analysis of different edge detection techniques are done on the basis of various performance metrics like Peak Signal to Noise Ratio (PSNR), Mean Square Error(MSE) and Mean Absolute Error(MAE).

A. Peak Signal to Noise Ratio (PSNR)

PSNR is measured as the ratio of maximum possible power and occurring noise that can disturb the representation of the image. PSNR is measured in decimal scale. To calculate the quality reconstruction of an image, PSNR is used commonly by the various researchers. It is a case where original data is treated as signal and occurring error is treated as noise. The maximum value of PSNR shows high image quality. The PSNR can be expressed as follows:

$$\text{PSNR} = 10.log_{10}\left(\frac{MAX_1^2}{MSE}\right)$$

Where MAX = Maximum pixel value of image. MSE = Mean square error.

B. Mean Square Error (MSE)

MSE measures the true pixel value of usual information with the degraded picture; it is used for the realistic purpose. Generally, MSE is calculated as the average of square of the error between the genuine image and noisy image. Here, lesser value of MSE shows high and best quality image. The MSE can be expressed as follows:

$$\text{MSE} = \frac{1}{N}\,||\,x - x`\,||^2 = \frac{1}{N}\sum_{i=1}^{N}(\,x - x`\,)^2$$

C. Maximum Absolute Error (MAE)

MAE is defined as the maximum absolute value, the difference between original image and degraded image. Mean Absolute Error (MAE) is the average vertical distance between each point and the identity line. MAE is also the average horizontal distance between each point and the identity line. MAE measures the average magnitude of the errors in a set of predictions, without considering their direction. It's the average over the test sample of the absolute differences between prediction and actual observation where all individual differences have equal weight.

$$\text{MAE} = \frac{1}{n}\sum_{j=1}^{n}|y_j - y'_j|$$

VI. EXPERIMENTAL ANALYSIS

The experiment is done on Matlab R2013a and tested with the Flower image and Person image. The objective is to extract the clear edges map by using the principle edge feature of image. Here different types of experiments done, to detect

and extract the edges, from an image which is with the noise and without noise environment. To compare the edge detection methods, two types of images are considered. We first apply different types of noise like Gaussian noise, Salt and Pepper noise and Speckle noise to the image. Then apply Gaussian filter method, Median filter method and Mean filter method to remove the noise from an image and then help of Sobel, Prewitt, Robart, LOG and Canny operators. At last compare all the performance analysis of different edge detection techniques using PSNR, MSE and MAE parameters. The steps are:

1) Step 1: Read the image.
2) Step 2: Convert the image to double.
3) Step 3: Apply different noises to the image.
4) Step 4: Remove noise from the image using different Filtering techniques.
5) Step 5: Apply the edge detection operator to the edges of filtered image.
6) Step 5: Evaluate the PSNR, MSE and MAE parameters.
7) Step 6: Compare the results.

VII. RESULT

In Figure 09 & 13 the results by applying various edge detection techniques on original person image & on original flower images are displayed respectively. In Figure 10 to Figure 16, the results by applying various edge detection techniques on Salt and Pepper noise, Gaussian noise and Speckle noise affected on person images and flower images are shown.

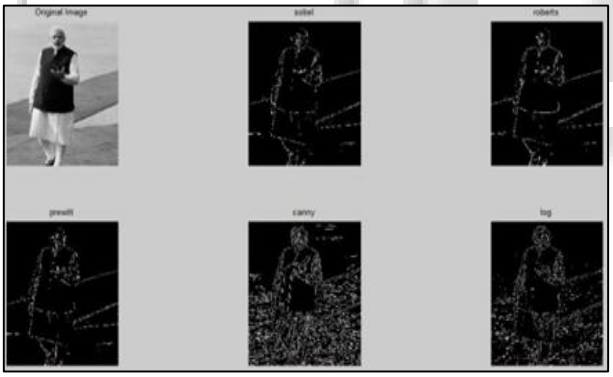

Fig. 9: Edge detection technique on original Image.

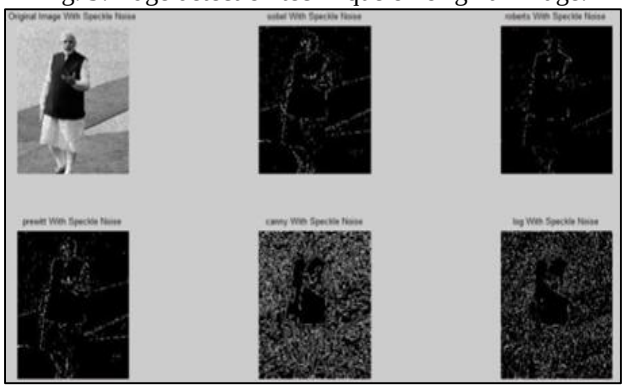

Fig. 10: Edge detection technique with Spackle Nose.

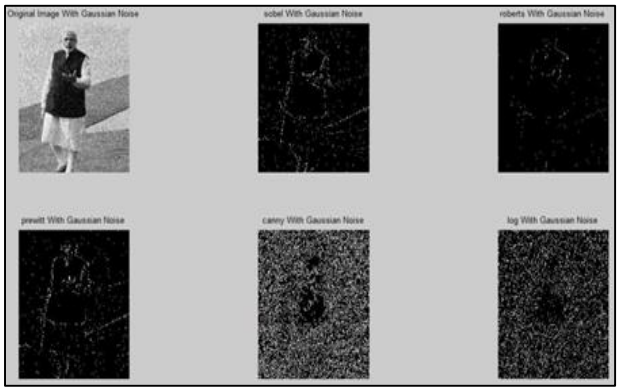

Fig. 11: Edge detection technique with Gaussian Noise.

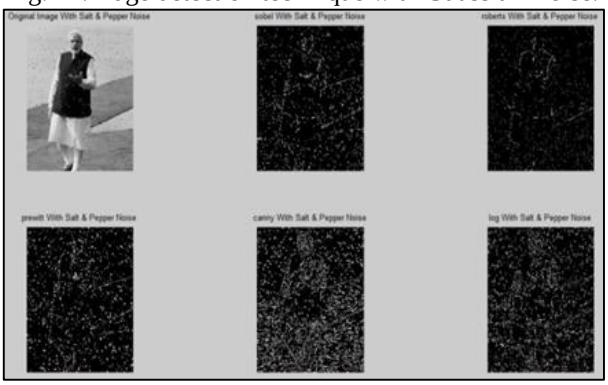

Fig. 12: Edge detection technique with Salt & Pepper Noise.

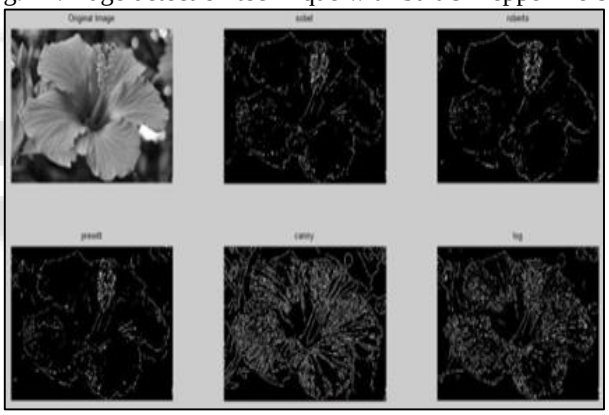

Fig. 13: Edge detection technique on flower Image.

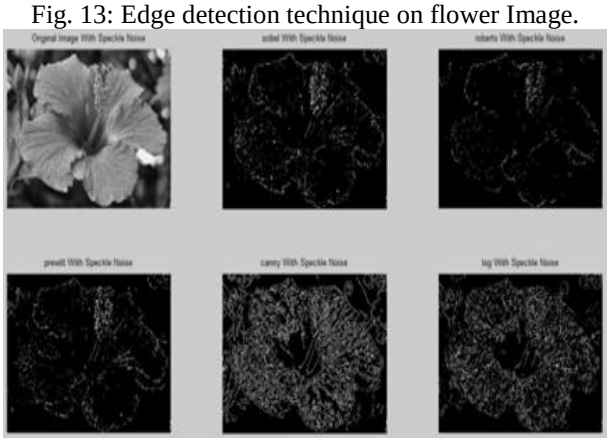

Fig. 14: Edge detection technique with Spackle Noise.

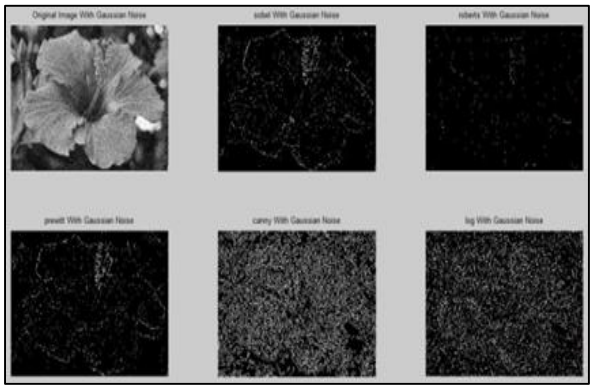

Fig. 15: Edge detection technique with Gaussian Noise.

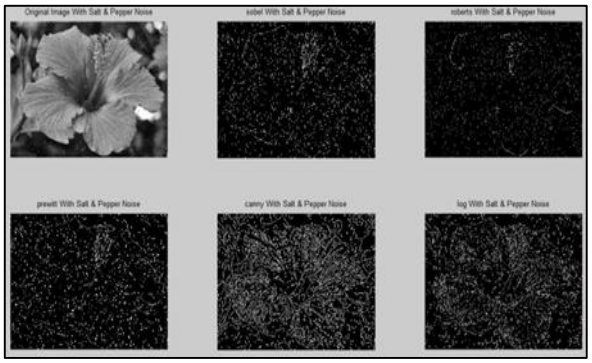

Fig. 16: Edge detection technique with Salt & Pepper Noise.

A. Result and Tables

Here, Table 1 to Table 6 illustrated the PSNR, MAE and MSE value for the results of various edge detection techniques on Person Image and flower Image in present of noise and no noise using Mean, Median and Gaussian filters techniques.

Edge Detection Techniques	Salt and Pepper Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	4.335663848902621	2.396149858710619e+04	1.436021136891428e+02
Sobel	4.335771558527214	2.396090432396884e+04	1.436003514252245e+02
Prewitt	4.335791688086829	2.396079326537742e+04	1.436000123307096e+02
LOG	4.339433961024425	2.394070662672887e+04	1.435321369119793e+02
Canny	4.341447290483126	2.392961061674099e+04	1.434862512587600e+02

Table 1.A: Parameters Value of various edge detection techniques using Mean Filtering Technique on Salt And Pepper Noise.

Edge Detection Techniques	Gaussian Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	4.335469061109980	2.396257332148215e+04	1.436060389650424e+02
Sobel	4.335632718697331	2.396167034361578e+04	1.436033159333320e+02
Prewitt	4.335646423223568	2.396159473067675e+04	1.436030333545696e+02
LOG	4.339615463154461	2.393970610781150e+04	1.435317515773033e+02
Canny	4.344597022920689	2.391226189399700e+04	1.434404323968844e+02

Table 1.B: Parameters Value of various edge detection techniques using Mean Filtering Technique on Gaussian Noise.

Edge Detection Techniques	Speckle Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	4.335449057821515	2.396268369160895e+04	1.436066246737500e+02
Sobel	4.335649552074380	2.396157746768327e+04	1.436036498900512e+02
Prewitt	4.335674232826589	2.396144129554656e+04	1.436031052837091e+02
LOG	4.340663535426424	2.393392949402988e+04	1.435239472656651e+02
Canny	4.346007238521478	2.390449850490146e+04	1.434278396596724e+02

Table 1.C: Parameters Value of various edge detection techniques using Mean Filtering Technique on Speckle Noise.

From table 1, it shows that the Canny edge detection technique always perform better result and produce highest PSNR value i.e 4.341447290483126, 4.344597022920689 and 4.346007238521478 for salt & pepper noise, Gaussian noise and speckle noise images respectively. Then Robert edge detection method also shows good result in both MSE and MAE i.e 2.396257332148215e+04 and 1.436060389650424e+02 respectively in Gaussian noise and speckle noise images.

Edge Detection Techniques	Salt and Pepper Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	4.335441209056140	2.396272699808874e+04	1.436049959925194e+02
Sobel	4.335373527195987	2.396310044390555e+04	1.436069175281037e+02
Prewitt	4.335359407309603	2.396317835343924e+04	1.436071538667050e+02
LOG	4.336784096254988	2.395531859984792e+04	1.435818296717976e+02
Canny	4.338609691001681	2.394525088883865e+04	1.435409996095275e+02

Table 2.A: Parameters Value of various edge detection techniques using Median Filtering Technique on Salt And Pepper Noise.

Edge Detection Techniques	Gaussian Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	4.335177361353361	2.396418285414826e+04	1.436104215047576e+02
Sobel	4.335318716519490	2.396340287511046e+04	1.436080581187447e+02
Prewitt	4.335320427945957	2.396339343184200e+04	1.436079861896052e+02
LOG	4.340021555936509	2.393746769867856e+04	1.435216044308350e+02
Canny	4.345394531041809	2.390787121601348e+04	1.434190488912637e+02

Table 2.B: Parameters Value of various edge detection techniques using Median Filtering Technique on Gaussian Noise.

Edge Detection Techniques	Speckle Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	4.335473695531778	2.396254775067305e+04	1.436081197722929e+02
Sobel	4.335876232138562	2.396032682545880e+04	1.436022832364003e+02
Prewitt	4.335811832639596	2.396068212458127e+04	1.436031772128486e+02
LOG	4.341949118323612	2.392684570685793e+04	1.435033755317619e+02
Canny	4.346846801318595	2.389987781808093e+04	1.434165981627243e+02

Table 2.C: Parameters Value of various edge detection techniques using Median Filtering Technique on Speckle Noise.

From table 2, it shows that the Canny edge detection technique always perform better result and produce highest PSNR value i.e 4.338609691001681, 4.345394531041809 and 4.346846801318595 for salt & pepper noise, Gaussian noise and speckle noise images respectively. Then Roberts edge detection methods also show good result in both MSE and MAE in Gaussian noise and speckle noise images.

Edge Detection Techniques	Salt and Pepper Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	4.335353211483684	2.396321254033170e+04	1.436087054810004e+02
Sobel	4.335360655042373	2.396317146879303e+04	1.436090651266980e+02
Prewitt	4.335358403536785	2.396318389198298e+04	1.436091165046549e+02
LOG	4.335748644690734	2.396103074456935e+04	1.436027867403769e+02
Canny	4.336572830078707	2.395648395466409e+04	1.435837717585647e+02

Table 3.A: Parameters Value of various edge detection techniques using Gaussian Filtering Technique on Salt and Pepper Noise.

Edge Detection Techniques	Gaussian Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	4.335356125960360	2.396319645903122e+04	1.436086438274523e+02
Sobel	4.335352415357008	2.396321693314700e+04	1.436092141227728e+02
Prewitt	4.335362212846549	2.396316287326086e+04	1.436091524692246e+02
LOG	4.335707541448671	2.396125752173287e+04	1.436034906183851e+02
Canny	4.336722036098926	2.395566092089850e+04	1.435813672701864e+02

Table 3.B: Parameters Value of various edge detection techniques using Gaussian Filtering Technique on Gaussian Noise.

Edge Detection Techniques	Speckle Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	4.335364894543035	2.396314807640930e+04	1.436084640046035e+02
Sobel	4.335366966340932	2.396313664481391e+04	1.436089418196017e+02
Prewitt	4.335364411278858	2.396315074292526e+04	1.436090137487412e+02
LOG	4.335679068609180	2.396141461497359e+04	1.436039838467704e+02
Canny	4.336794862890016	2.395525921206765e+04	1.435812182741117e+02

Table 3.C: Parameters Value of various edge detection techniques using Gaussian Filtering Technique on Speckle Noise.

From table 3, it shows that the Canny edge detection technique always perform better result and produce highest PSNR value i.e 4.336572830078707, 4.336722036098926 and 4.336794862890016 for salt & pepper noise, Gaussian noise and speckle noise images respectively. Then Sobel & Roberts edge detection method also shows good result in both MSE and MAE i.e 2.396313664481391e+04 and 1.436089418196017e+02 respectively in Gaussian noise and Prewitt edge detection method shows average result in speckle noise images.

Edge Detection Techniques	Salt and Pepper Noise Effected flower Image

	PSNR	MSE	MAE
Roberts	6.861688348569731	1.339403797777778e+04	1.040178000000000e+02
Sobel	6.861917244886849	1.339333205925926e+04	1.040149185185185e+02
Prewitt	6.861896721570741	1.339339535185185e+04	1.040153222222222e+02
LOG	6.866852800410657	1.337811980370370e+04	1.039477518518519e+02
Canny	6.871136123693428	1.336493184814815e+04	1.038855592592593e+02

Table 4.A: Parameters Value of various edge detection techniques using Mean Filtering Technique on Salt and Pepper Noise.

Edge Detection Techniques	Gaussian Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	6.861372405291643	1.339501241111111e+04	1.040233814814815e+02
Sobel	6.861808577738989	1.339366718518518e+04	1.040178148148148e+02
Prewitt	6.861818235703289	1.339363740000000e+04	1.040178222222222e+02
LOG	6.867203104000530	1.337704076296296e+04	1.039482148148148e+02
Canny	6.872501216872070	1.336073158518519e+04	1.038686814814815e+02

Table 4.B: Parameters Value of various edge detection techniques using Mean Filtering Technique on Gaussian Noise.

Edge Detection Techniques	Speckle Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	6.861653282255578	1.339414612592593e+04	1.040204074074074e+02
Sobel	6.862015252294523	1.339302981481481e+04	1.040162148148148e+02
Prewitt	6.861989852495589	1.339310814444444e+04	1.040165888888889e+02
LOG	6.867472483558379	1.337621105185185e+04	1.039565333333333e+02
Canny	6.871500570063255	1.336381035185185e+04	1.039017370370370e+02

Table 4.C: Parameters Value of various edge detection techniques using Mean Filtering Technique on Speckle Noise.

From table 4, it shows that the Canny edge detection technique always perform better result and produce highest PSNR value i.e 6.871136123693428, 6.872501216872070 and 6.871500570063255 for salt & pepper noise, Gaussian noise and speckle noise images respectively. Then Robert edge detection method also shows good result in both MSE and MAE i.e 1.339501241111111e+04 and 1.339414612592593e+04 respectively in Gaussian noise and speckle noise images.

Edge Detection Techniques	Salt and Pepper Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	6.862048993218911	1.339292576296296e+04	1.040144444444445e+02
Sobel	6.861958804628801	1.339320389259259e+04	1.040159000000000e+02
Prewitt	6.861929283419935	1.339329493333333e+04	1.040161481481482e+02
LOG	6.865272641483672	1.338298825185185e+04	1.039803333333333e+02
Canny	6.867999909684299	1.337458668518519e+04	1.039402703703704e+02

Table 5.A: Parameters Value of various edge detection techniques using Median Filtering Technique on Salt and Pepper Noise.

Edge Detection Techniques	Gaussian Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	6.861470241892897	1.339471065555556e+04	1.040217740740741e+02
Sobel	6.861910402970057	1.339335315925926e+04	1.040162111111111e+02
Prewitt	6.861861923788728	1.339350266666667e+04	1.040169703703704e+02
LOG	6.867490206135420	1.337615646666667e+04	1.039412444444445e+02
Canny	6.872451720021666	1.336088385925926e+04	1.038660148148148e+02

Table 5.B: Parameters Value of various edge detection techniques using Median Filtering Technique on Gaussian Noise.

Edge Detection Techniques	Speckle Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	6.862149279557681	1.339261650000000e+04	1.040167888888889e+02
Sobel	6.862591601877663	1.339125255185185e+04	1.040117518518519e+02
Prewitt	6.862449417386135	1.339169097777778e+04	1.040130592592593e+02
LOG	6.868838021698297	1.337200587407407e+04	1.039429185185185e+02
Canny	6.873734831851714	1.335693700370370e+04	1.038777814814815e+02

Table 5.C: Parameters Value of various edge detection techniques using Median Filtering Technique on Speckle Noise.

Here Median filtering technique is used to remove Salt & Pepper noise, Gaussian noise and Speckle noise from a flower image. From table 5, it shows that the Canny edge detection technique always perform better result and produce highest PSNR value i.e 6.867999909684299, 6.872451720021666 and 6.873734831851714 for salt & pepper noise, Gaussian noise and speckle noise images respectively. Then Prewitt method shows good result in salt & pepper noise. Then Robert edge detection method also shows good result in both MSE and MAE in Gaussian noise and speckle noise images.

Edge Detection Techniques	Salt and Pepper Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	6.861148373132511	1.339570341481481e+04	1.040259777777778e+02
Sobel	6.861170966629607	1.339563372592593e+04	1.040254074074074e+02
Prewitt	6.861156606729102	1.339567801851852e+04	1.040257074074074e+02
LOG	6.861842453965870	1.339356271111111e+04	1.040167629629630e+02
Canny	6.864349890128478	1.338583205555556e+04	1.039784851851852e+02

Table 6.A: Parameters Value of various edge detection techniques using Gaussian Filtering Technique on Salt And Pepper Noise.

Edge Detection Techniques	Gaussian Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	6.861158328617836	1.339567270740741e+04	1.040259962962963e+02
Sobel	6.861172239438531	1.339562980000000e+04	1.040253481481482e+02
Prewitt	6.861158805319370	1.339567123703704e+04	1.040256222222222e+02
LOG	6.861854515109725	1.339352551481482e+04	1.040165592592593e+02
Canny	6.864576277009698	1.338513430370370e+04	1.039758222222222e+02

Table 6.B: Parameters Value of various edge detection techniques using Gaussian Filtering Technique on Gaussian Noise.

Edge Detection Techniques	Speckle Noise Effected flower Image		
	PSNR	MSE	MAE
Roberts	6.861156230891554	1.339567917777778e+04	1.040260000000000e+02
Sobel	6.861167269482024	1.339564512962963e+04	1.040256407407407e+02
Prewitt	6.861155145405657	1.339568252592593e+04	1.040256518518519e+02
LOG	6.861907081095440	1.339336340370371e+04	1.040163592592593e+02
Canny	6.864330097924740	1.338589305925926e+04	1.039800148148148e+02

Table 6.C: Parameters Value of various edge detection techniques using Gaussian Filtering Technique on Speckle Noise.

Here Gaussian filtering technique is used to remove Salt & Pepper noise, Gaussian noise and Speckle noise from a flower image. From table 6, it shows that the Canny edge detection technique always perform better result and produce highest PSNR value i.e 6.864349890128478, 6.864576277009698 and 6.864330097924740 for salt & pepper noise, Gaussian noise and speckle noise images respectively. Then Robert edge detection method also shows good result in both MSE and MAE in Gaussian noise and speckle noise images.

VIII. Conclusion

In this paper, different types of edge detection techniques are studied and compared. After the experimental analysis, it is found that the second order derivatives (Canny and Log) are working well in comparison to first order derivatives (Sobel, Prewitt and Roberts). The Log and Canny edge detection method producing better results for image quality and visual perception. Since, Log edge detection technique is ill-protected to noise. So, it is not providing the better results than canny edge detection technique in presence of different noises in an image. Hence, it is experimentally proved that the canny edge detector is a better edge detector technique of forming the edges for inner as well as outer lines of the object. It has better resistance to noise than Roberts, Prewitt, Sobel and Log edge detection technique. Here, Sobel edge detection technique results for discovering better outer lines (continuous boundary) only of an object.

IX. Future Work

The proposed paper only compare few and some popular edge detection techniques considering three performance parameters i.e PSNR, MSE and MAE applied on noisy image after removing the noise using only three filtering methods. We can design the new filter over the limitation to get better image quality so that the image can be enhanced by removing the noise in our future work. We can also compare other edge detection techniques using different performance parameters to get better methods for image processing.

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