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Performance Evaluation of Edge Detection Methods using Hybrid Approach with Median Filtering

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Abstract:

Edge detection is one of the fundamental problems of lower-level image processing, and essential to the solving of object extraction. Image segmentation technique has widely used for image enhancement and object detection. Edges connect object boundaries and it is a basic image feature and provides significant and important information related to objects present in the scene. There are many different edge detection methods. In these methods, the most commonly used methods are Sobel edge detector, Prewitt edge detector, Laplacian edge detector, Canny edge detector. The Sobel is one of the most commonly used edge detectors. Canny edge detector is probably the most commonly used and most effective method. This paper represents a hybrid approach which combines the Sobel and Canny edge detectors using median filtering. Median filter is used to reduce unwanted noise on an image, and is a nonlinear technique. The performance of proposed system was evaluated with two quantitative measures, Peak Signal-to-Noise Ratio (PSNR), and Signal-to-Noise Ratio (SNR) using Matlab 2018b. A performance comparison has also been shown between the hybrid approach with median filter and without median filter. This median gives better output for flower image.

Keywords — **Canny operator, Median Filter, Sobel operator. PSNR, SNR**

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1. INTRODUCTION

In digital image processing, edge detection is one of the most frequently used techniques, and is a process of identifying and locating sharp interruption in an image. Edges detection is a problem of fundamental importance in object extraction as it reduces image data and facilitates object detection [6] [7]. The boundaries of object change in pixel intensity which characterizes boundaries of objects in a scene. There are many methods in image segmentation and edge detection tasks. To perform these tasks, region growing and edge detection techniques are incorporated. Edge detection is difficult to implement in noisy images because noise and edges contain high frequency content. There are many different edge detection methods such that Sobel edge detector, Prewitt edge detector, Laplacian edge detector, Canny edge detector. Sobel operator is one of the most commonly used detection methods and returns edges at points where the gradient of image intensity is maximum [1] S.K. Katiyar. Prewitt operator is similar to the Sobel operator. This operator is used for detecting vertical and horizontal edges in images. The Laplacian method finds edges. Prewitt method finds edges using the

Prewitt approximation to the derivative and returns edges at those points where gradient ofimage intensity is maximum. Prewitt operator [8] does not place any emphasis on pixels that are closer to the centre of the masks. In image processing, noise is raised the challenges. Noises present in the images have to be removed and unclear objects have to be enhanced. Pre-processing technique was implemented for enhancing the quality of the image. The main purpose of filtering is to improve the visual quality of image. Median filters use median value in its filtering process. The proposed system describes the median filtering in pre-processing techniques. This paper is organized as follows. Section 2, discusses about related works. Section 3, explains about edge detection techniques. Section 4 describes proposed methodology. Section 5 addresses the implementation of the system. Section 6 addresses the performance evolution and section 7 described experimental results of the system. Finally, section 8 presents the conclusion.

2. REALTED WORKS

S.K. Katiyar et al.in [1] presented different edge detection methods. The Laplacian based (second order) methods are more sensitive to noise than their gradient based counterparts. In comparison of each edge detection algorithm, Canny is computationally more complex as it takes more time as well as space.

Saket Bhardwaj et al.in [2] presented a comparison between various edge detection. Canny gives good results. First order derivative operators are very much sensitive to noise. These operators are not better than second order derivative operators. But declivity operator has good performance over canny operator.

Dr. V.S. Manjula [3] proposed method was tested on binary level test images. Edge detection produces satisfactory results for different gray level digital images.

Radhika Chandwadkar et al.in [4] demonstrated the experimental result of Canny edge detection and Sobel edge detection algorithm. Comparison of both algorithm, Canny edge detection overcomes the drawbacks of Sobel operator. Sobel gives faster performance in terms of computation.

3. EDGE DETECTION TECHNIQUES

There are several edge detection operators in the image processing field. Edge detection is an important technique of detecting and identifying by locating sharp discontinuities in an image Dr. V.S. Manjula (2017) [5].

3.1 Sobel edge detection

The Sobel operator measures a 2-Dimensioanal spatial gradient on an image and gives more attention on regions of high spatial gradient corresponding to edges [4]. There are various pairs of Sobel operator such as 3×3, 5x5 convolution kernels.

Sobel operator is based on first order differential. This operator convolves the image with a integer valued, small, separable filter in horizontal and vertical direction.

3.2 Candy edge detection

Canny edge detector is one of the most effective detectors. The implementation process is quite simple it has achieved well-earned recognition for edge detection. we explain the process of Canny Edge detection algorithm in next section. The most important criterion of candy edge detection has three criterions. Fist criterion was to lower the error rate, and to detect all the important edges in the source image**.** The second criterion was that the edge points to be detected as close as possible to the true edge, also called as localization [Radhika Chandwadkar (2016)]. A third criterion was not to have more than one response to a single edge.

4. PROPOSED METHODOLOGY

This paper proposed on accuracy of edge detection and effective noise removal. Input image is RGB image and it convert to gray scale image. A median filter has been used for better removal of noise which filters out the salt and pepper noise efficiently. The hybrid combines in two algorithms such as Sobel and Canny edge detection. The proposed method is described in following figure (1).

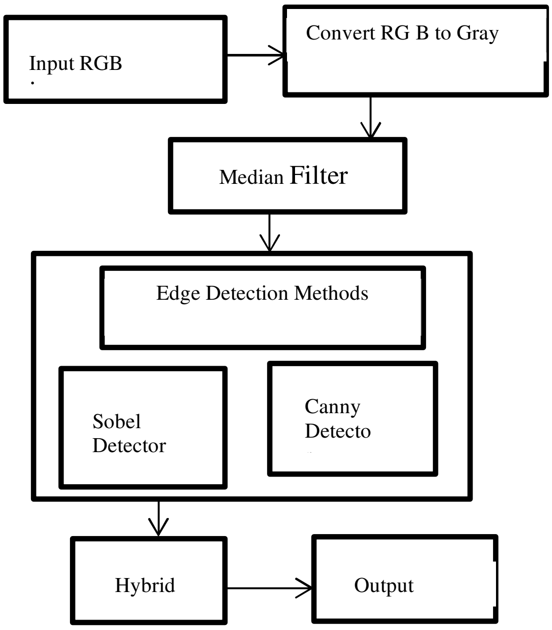

Fig (1) Proposed methodology

5. IMPLEMENTATION

Implementation can be provided to obtaining the successful of system. The following discussed two algorithms are implemented using MATLAB 2018b. The detection results were obtained by Sobel and Canny edge detection algorithm.

Sobel edge detection algorithm can be worked in following:

1. Insert input images
2. Apply mask Gx,Gy to the input image
3. Apply Sobel edge detection algorithm and the gradient
4. Masks manipulation of Gx,Gy separately on the input image
5. Results combined to find the absolute magnitude of the gradient and absolute magnitude is the output edges.

Canny edge detector algorithm can be worked in following:

1. A Gaussian convolution is first applied to the image and to remove the noise from the images.
2. Compute the intensity gradients of the image.
3. Only local maxima should be considered as edges.
4. Apply double threshold to determine potential edges.
5. All the edge pixels not connected to strong edge pixels.

6. Belonging to the weak edge group are all suppressed.

6. PERFORMANCE EVALUATION

Performance of median filtering techniques was evaluated using Peak Signal Noise Ratio (PSNR) and Signal to Noise Ratio (SNR). Peak Signal to Noise Ratio (PSNR) and SNR are the two error metrics used to compare image quality. PSNR represents a measure of the peak error. To compute the PSNR, the block first calculates the mean squared error using the following equation:

$$MSE= \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[A(i,j)-B(i,j)]^2 \quad (1)$$

$$PSNR= 10\ \log_{10}(\frac{R^2}{MSE}) \quad (2)$$

Where m x n is the size of the image, A represents the original image, B denotes the de-noised image, (i, j) represents the processed pixel in the window size R is the maximum possible pixel value of the image. In median filtering technique, we take 3 × 3 windows and find out the median value and replaced center pixel by the median value and then move pixel to pixel and cover all pixel. Median filtering technique used at removing the salt and pepper noise from the image. In our paper we have considered PSNR, SNR and MSE values. When SNR and PSNR increase, the noise will be reduced and if the noise level increases, the PSNR value decreases.

7. EXPERIMENTIAL RESULTS

In this paper, two detection algorithms have studied. After studying, the images were detected by using Sobel and Canny edge detection algorithms.

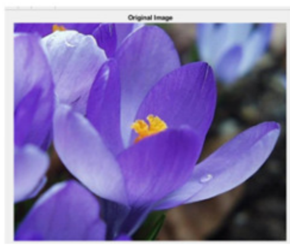

Fig 2(a)

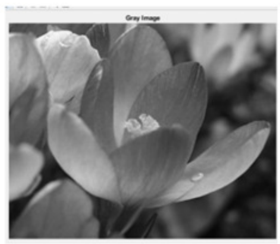

Fig 2(b)

Fig 2(c)

Fig 2(d)

Fig 2(e)

Fig 2(f)

Fig 3(a)

Fig 3(b)

Fig 3(c)

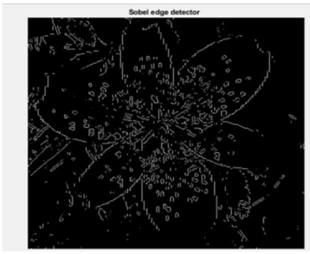

Fig 3(d)

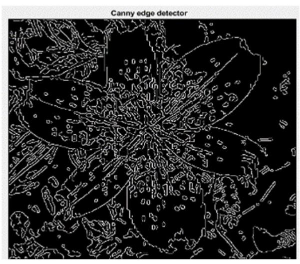

Fig 3(e)

Fig 3(f)

Fig 4(a)

Fig 4(b)

Fig 4(c)

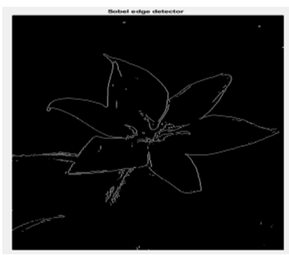

Fig 4(d)

Fig 4(e)

Fig 4(f)

Fig 5(a)

Fig 5(b)

Fig 5(c)

Fig 5(d)

Fig 5(e)

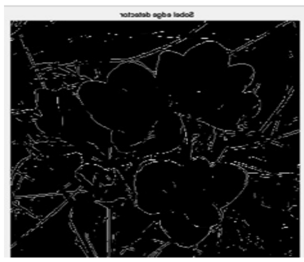
Fig 5(f)

Fig 6(a)

Fig 6(b)

Fig 6(c)

Fig 6(d)

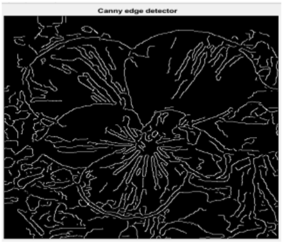

Fig 6(e)

Fig 6(f)

TABLE (1) PERFORMANCE OF PROPOSED SYSTEM

Images	Performance			
	Do not use filter		Use filter	
	PSNR	SNR	PSNR	SNR
Image1	**16.8664**	**7.4887**	**17.0106**	**7.1884**
Image2	**14.3368**	**7.3428**	**14.2609**	**7.1908**
Image3	**17.5252**	**6.8607**	**17.6112**	**6.7638**
Image4	**14.4647**	**7.6287**	**14.5414**	**7.5119**
Image5	**17.3941**	**7.4482**	**17.4324**	**7.3051**

In this experimental work, five different natures of flowers images are used in Kaggle dataset. Figure 2.(a) –6(a) are Input rgb image. Figure 2.(b) –6(b) convert rgb to gray image. Figure 2.(c) –6(c) are used median filtering. Figure 2.(d) – 6(d) are analyzed Sobel edge detection algorithm. Figure 2.(e) – 6(e) are analyzed Canny edge detection algorithm. Figure 2.(f) –6(f) are proposed combination of Sobel edge and Canny edge detection algorithm. The median filter used to removal of noise. If SNR and PSNR increase, the noise will be reduced. Furthermore, the noise level increases the PSNR value decreases. In experimental result, the median filtering technique, which provides greater PSNR, reduces more noise from the corrupted image. The SNR and PSNR value using median filtering methods and do not use median filter are shown in table (1).

8. CONCLUSION

The proposed system was tested with flower images using Kaggle dataset. Experiment results have demonstrated that the proposed algorithm for edge detection produces satisfactory results for different gray level digital images The main purpose of this paper is analyzed in PSNR and SNR value which is adding the salt & pepper noise. Median filter removes to artefacts. Performance of each image evaluated using Matlab 2018b. Median filtering provides the best results for de-noising of flowers image. Therefore, a good recommendation is that the proposed edge detector is suitable for median filter.

9. REFERENCES

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