Differential thresh holding algorithm for edge detection in noisy environment

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Abstract—**Edge detection is an important step of image processing and is particularly used in the application of feature extraction. One major application of edge detection is in the field of medical image processing. Edge detection is basically the process of detection of those regions in the image where there is an abrupt change in the brightness of the image. In this work a differential thresh holding algorithm for edge detection is proposed. Major advantage of this technique is its good performance in the presence of noise as compared to other well known conventional algorithms. Proposed algorithm is applied to images with different noise levels along with the conventional methods. Visual performance is very good as compared to other methods. This algorithm can be applied for edge detection generally and in noisy environment especially due to its excellent performance.**

***Index Terms*— Image processing, edge detection, noisy image edge detection**

I. INTRODUCTION

Since from the last few decades, application of computer vision is enormously increasing in almost all fields of life. From sorting products in the industry, to surveillance in the security zones, car parking systems to medical image processing etc. Therefore, automatic visual inspection of images is necessary [1- 4] which is used in industry for detecting defects in textile design, glass industry and steel re-rolling mills, due to the fact that comparing of numbers is more easy than comparing images [5]. Thus image analysis is very important and necessary.

One main image analysis technique is the edge detection process, in which abrupt variation of the image intensity is detected [6]. Different techniques are used for detecting the edges in which the most common and computationally light technique is the Linear Time Invariant filters. In case of the first order filters, the goal is to find first order derivative where its magnitude is high [7]. There are other well known techniques for edge detection which can be grouped mainly in two categories i.e. search based techniques and zero crossing algorithms [8]. In zero crossing detectors second order derivative is computed for edge detection while in case of search based methods first order derivatives are computed. The most well known conventional methods like Sobel, Canny, Prewitt, and Laplacian belong to one of the above classes. In this work we are first going to review the conventional methods and then present the proposed differential thresh holding algorithm for edge detection. Finally the results of the proposed method are compared with conventional methods.

A. Sobel

Sobel is the well known simple conventional edge detection technique in which 3x3 convolution masks are used for detection of the edges in *x* and *y* directions. These masks are shown in Figure 1.

Both masks can be applied to the images independently and the output magnitudes are combined to find the absolute magnitude of the whole image [9].

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

G_x

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

G_y

Figure 1. Sobel Masks

B. Canny

Canny is another well known conventional edge detection algorithm which is popular due to its optimum performance. It is basically an optimization problem with constraints. Three different criteria are addressed in this detector i.e. low error rate, localization and single response to a single edge. These parameters were implemented by canny [10].

C. Prewitt

Prewitt edge detection method is almost similar to Sobel operator. In this case 3x3 masks are used to find the gradients in *x* and *y* directions. This method is computationally efficient and suitable for images with high resolution [11].

Masks of Prewitt detector are shown in Figure 2.

D. Laplacian

Laplacian operator is from the zero crossing category of the edge detection techniques. The detector detects the zero crossing in the second derivative to find edges.

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

G_x

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

G_y

Figure 2. Prewitt Masks

II. PROPOSED DIFFRENTIAL THRESH HOLDING ALGORITHM

This algorithm is based on the difference of pixels with its neighbors. A thresh holding is applied and based on the results it is decided that the pixel belongs to an edge or not.

To find edges using the proposed algorithm, a window size is selected first which may be of size 3x3 or 5x5. The intensity of the center pixel is subtracted from all its neighbors. A thresh hold value which in this case is 200 is applied. If the pixel value is greater than 200 then a 1 is allotted otherwise zero is assigned to the pixel. It must be clear that the value of the center pixel is zero after taking the difference from its self. After assigning ones and zeros all pixel values in the window are added. If the answer is 4 then it is decided that the center pixel is an edge otherwise it is declared as non edge. In this way all pixel of the image are processed and a decision about its edge or non edge is made. For further clarification of the method pseudo code is mentioned as under.

Pseudo code

1. Load image.
2. Pad image.
3. Make 3x3 cell array from image.
4. Take one cell and subtract center pixel value from its self and all its neighbors.
5. Thus you will get 0 in center and some values in neighbors.
6. Take a thresh hold of 200 and if a value is greater than 200 then put 1 else zero.
7. Sum all pixels of the cells and see if sum is greater than 4 the put 1 in the image in place of center pixel else zero.
8. Perform this process on all cells and put the corresponding values in the image.
9. Plot the image and the result will be an edge of very good quality as compared to conventional edge algorithms.

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III. RESULTS

To check the performance of the proposed algorithm, it is necessary to apply it to simple non-noisy and noisy images and compare its results with the conventional methods on the same images. In this regard the first image is taken from an online resource and its edges are detected using the proposed method and also using the conventional methods and the results are shown in Fig. 3. It can be seen that the performance on non noisy image is the same for all methods. Now same image is corrupted by salt and pepper noise and edges are detected using the proposed and conventional methods and the results are shown in Fig. 4. It can be seen that the results of the proposed method are far better than the conventional methods.

Another image which is basically a gear and is also available online is corrupted with noise. The non-noisy and noisy versions of the image are edge detected using proposed and conventional methods and the results are shown in Fig. 5 and Fig. 6 respectively.

IV. CONCLUSION

Edge detection is a very important technique used for image analysis. Some time images may be corrupted by noise and we need such techniques which can be equally implemented on noisy images as well. Differential thresh holding based edge detector introduced in this work is equally good in noisy and non-noisy environment and can be implemented on images for edge detection with good results.

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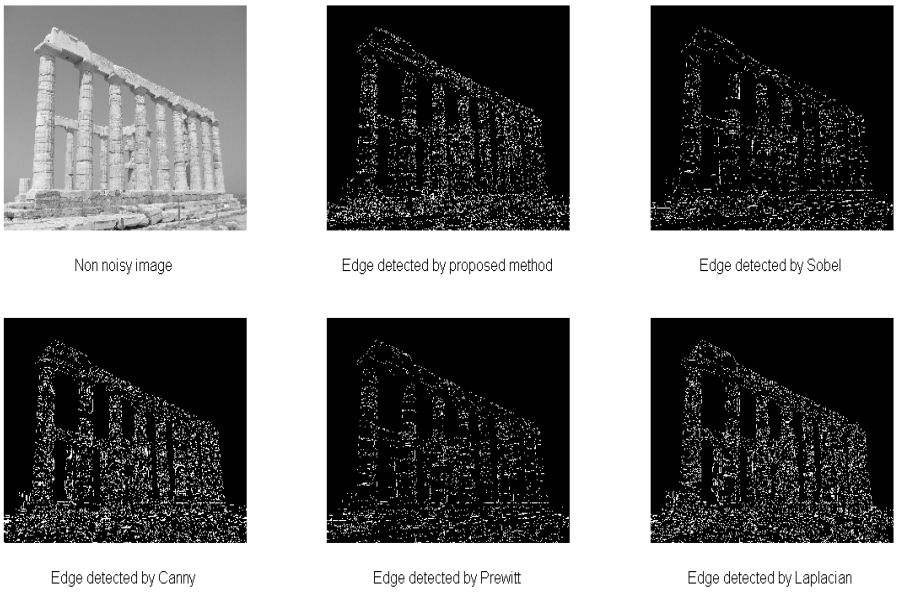

Figure 3 Non noisy image and edge detected by proposed and conventional methods

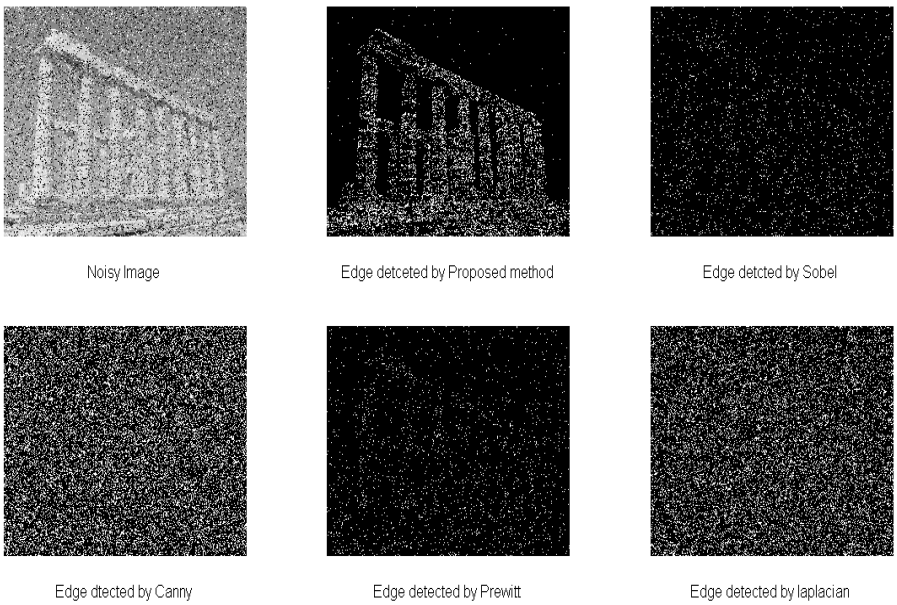

Figure 4 Noisy image and edge detection by proposed and conventional methods

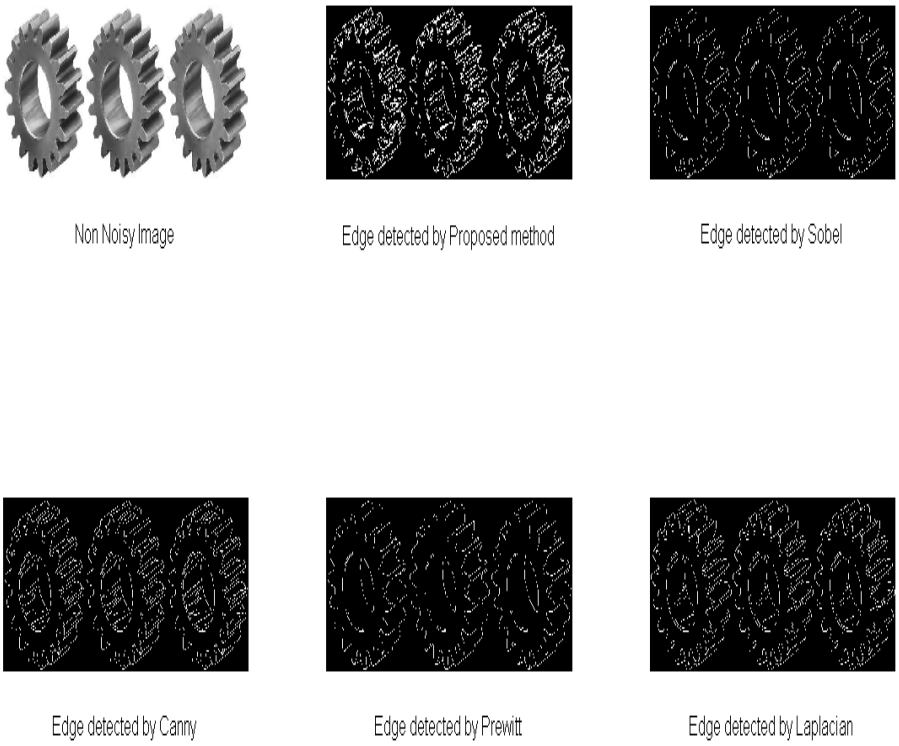

Figure 5 Non noisy image and edge detection by proposed and conventional methods

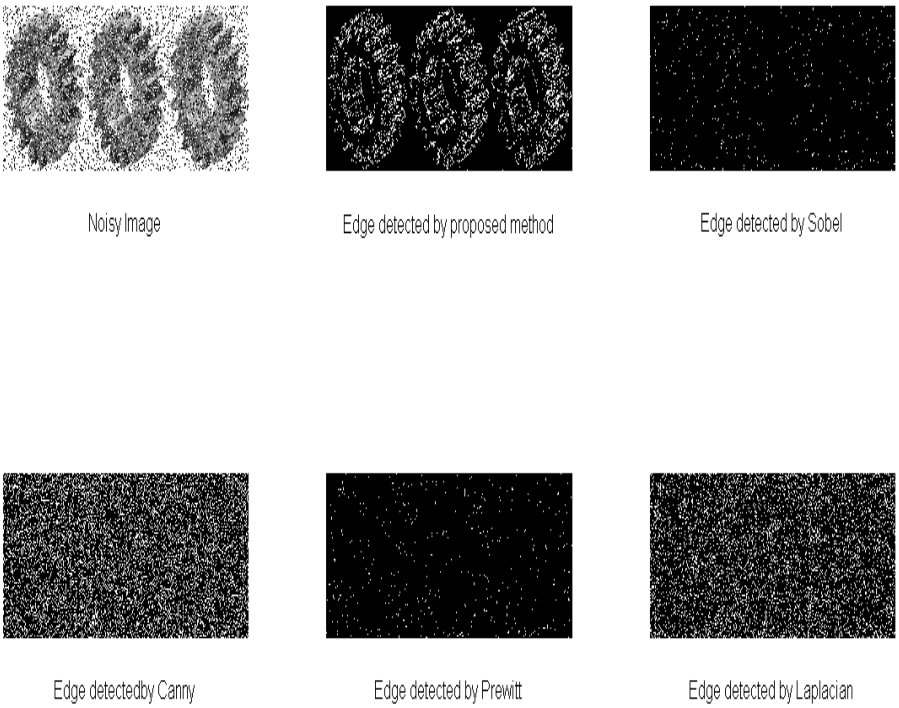

Figure 6 Noisy image and edge detection by proposed and conventional methods