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Review Article

The Performance Analysis of Edge Detection Algorithms for Image Processing Based on Improved Canny Operator

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Abstract *- Identifying the edges of digital images is an important step toward identifying human organs objects, such as skeletons of bone. Usually, once a bone fracture image is obtained, various algorithms are used to extract useful information. This information is particularly useful for identifying tumour boundaries for planning operations, etc. There are many edge detection algorithms based purely on the differential operators, such as Canny Operator, Robert operator, Sobel operator, Prewitt operator, etc. These operators are simple, easy to implement and have a good execution time. On the other hand, they are sensitive to noise; thus, edge detection accuracy should be improved. The canny operator represents the improvement of the traditional single threshold method, in which the high and low threshold is selected according to the gradient of the image histogram.*

Keywords *- PSNR, MAE, CT, CAD*

I.INTRODUCTION

Malignant and benign tumours of bone in the foot have traditionally been rare or unusual. When these lesions appear, mostly used foot and ankle tumours detection methods are Ultrasound, Computed Tomography (CT), and Magnetic Resonance Imaging (MRI). There is a lot of image segmentation techniques available. In this paper, we are analyzing Computed Tomography images through Computer-Aided Diagnosing (CAD) system. And for edge detection in the image, a Canny edge detector is used. Canny edge detector has some limitations like it is not distinguished edges occurring around objects but is still more beneficial than other traditional edge detector methods. But to make the Canny edge detector better at identifying contours in natural images, some improved canny edge detector is analyzed in this paper.

II. SOBEL

It extracts all edges of an image, despite direction. It provides the advantage of both a differencing and smoothing effect. It is implemented as the sum of two-directional edge enhancement operations. The resulting image appears as a unidirectional outline of the objects in the original image. Black is Constant brightness regions while changing brightness regions become highlighted.

III. CANNY EDGE DETECTOR

Identifying the edges of medical images is an important step toward identifying human organs objects, such as skeletons or bones. Usually, once an MRI image is obtained, various algorithms are used to extract useful information. This information is particularly useful for identifying tumour boundaries for planning operations, etc. Many edge detection algorithms are purely based on the differential operators, such as the Robert operator, Sobel operator, Prewitt operator, etc. These operators are simple, easy to implement and have a good execution time. On the other hand, they are sensitive to noise; thus, edge detection accuracy should be improved. The canny operator represents the improvement of the traditional single threshold method[1], in which the high and low threshold is selected according to the gradient of the image histogram.

IV. OBJECTIVES

- To propose an improved Canny Operator, this will be able to preserve the sharpness of edges.
- Analysis of the bone fracture images' visual quality with proposed and other methods based on various performance metrics.
- To find the clear edges in a bone fracture image horizontally and vertically using the improved Canny Operator.

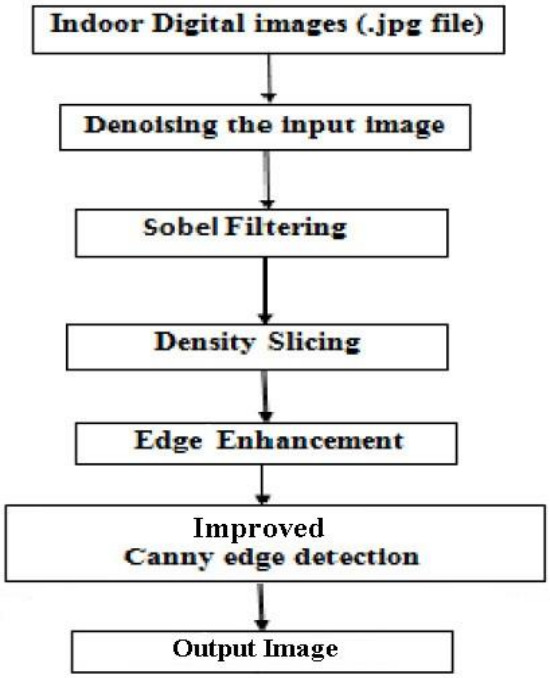
V. METHODOLOGY

Qualitative assessment

Peak Signal to Noise Ratio (PSNR), Structural Similarity Index Measurement (SSIM), and computational complexity measurements are carefully chosen for the performance assessment. PSNR is an error based model and is widely used to measure the distortion of the image. The SSIM provides the similarity information on the features and pixel level. The PSNR always considers the image edges and the characteristics of the errors around the edges. However, it is unable to reflect the visual quality of the image.

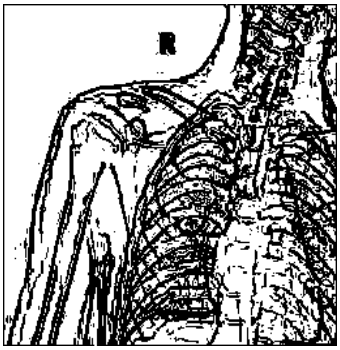
$$PSNR = 20\log_{10}(\frac{MAX_I^2}{\sqrt{MSE}})dB$$

VI. FLOW CHART OF PROPOSED METHODOLOGY

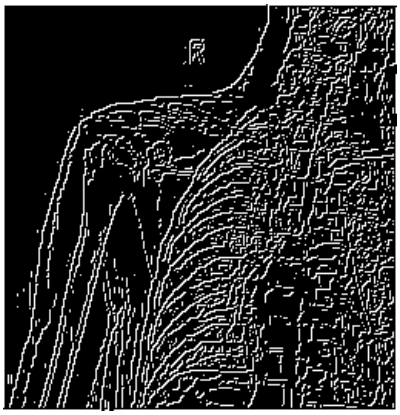


VII. Results and Discussion

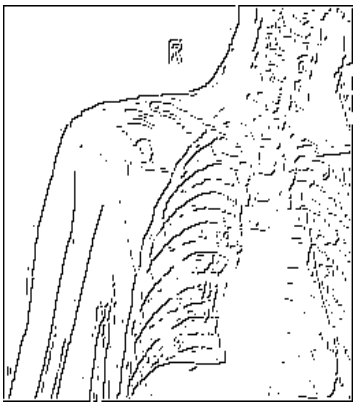
Original Image



Sobel Operator



Improved Canny Operator



Canny Operator

Fig. 1 Implementation of Sobel Operator, Improved Canny Operator, and Canny Operator on Original Bone Fracture image A.

Table1. Performance analysis of PSNR values using Sobel, Improved Canny and Canny Operator

Parameter	Sobel Operator	Improved Canny Operator	Canny Operator
PSNR	4.08	5.85	4.41

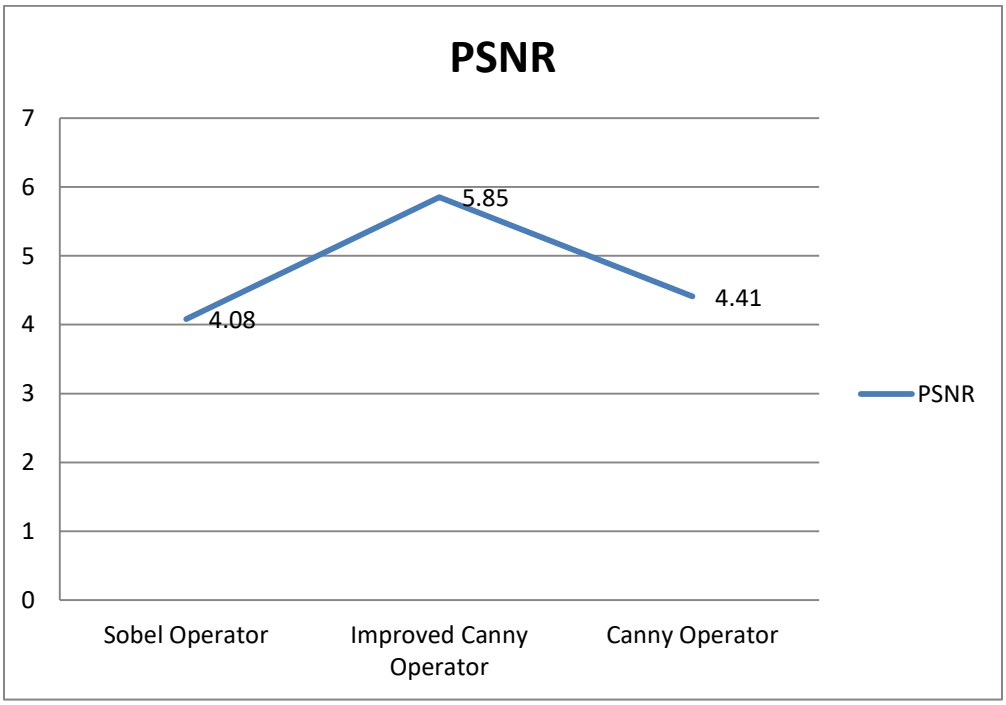


Fig. 2 Performance Analysis of PSNR Values using Sobel, Improved Canny and Canny Operator

Table 2. Performance analysis of MAE values using Sobel, Improved Canny and Canny Operator

Parameter	Sobel Operator	Improved Canny Operator	Canny Operator
MAE	146.19	112.76	138.83

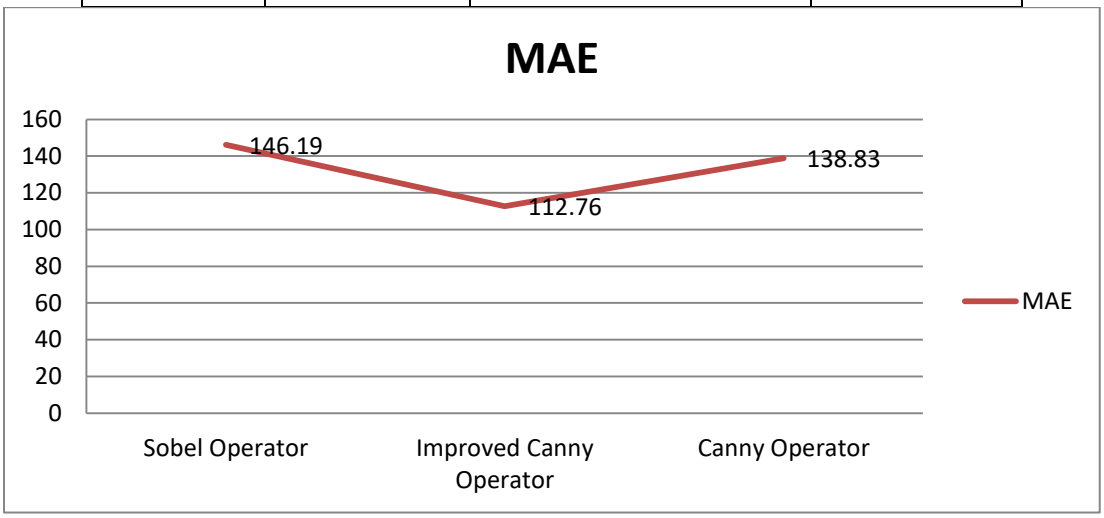
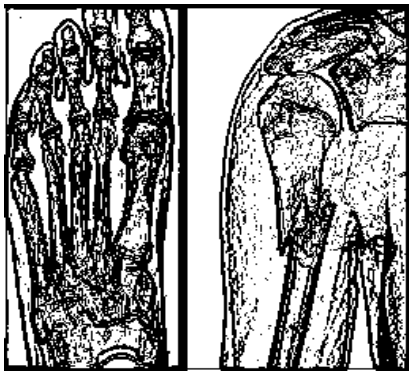


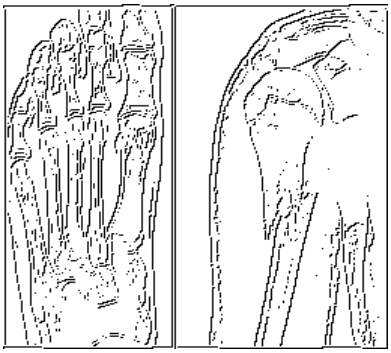
Fig. 3 Performance Analysis of MAE Values using Sobel, Improved Canny and Canny Operator

Original Image



Sobel Operator

Improved Canny Operator



Canny Operator

Fig. 4 Implementation of Sobel Operator, Improved Canny Operator, and Canny Operator on Original Bone Fracture image B.

Table 3. Performance Analysis of PSNR values using Sobel, Improved Canny and Canny Operator

Parameter	Sobel Operator	Improved Canny Operator	Canny Operator
PSNR	3.84	5.9	3.82

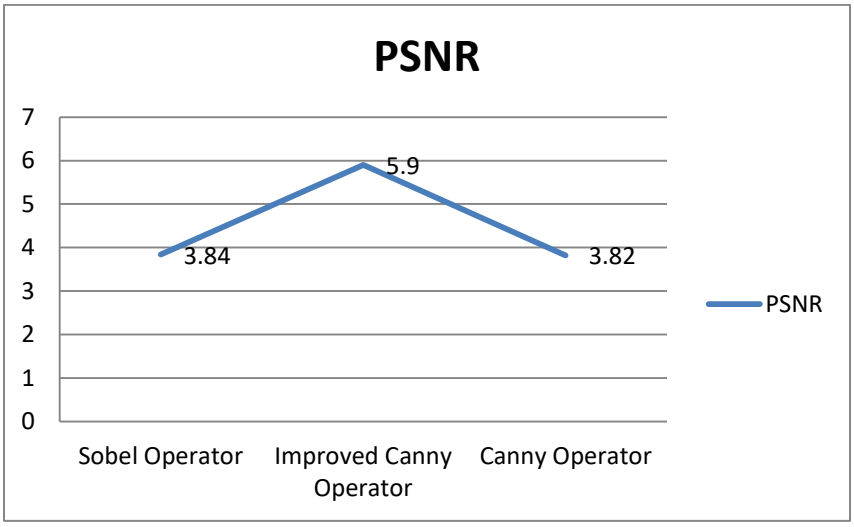


Fig. 5 Performance Analysis of PSNR Values using Sobel, Improved Canny and Canny Operator

Table 4. Performance Analysis of MAE values using Sobel, Improved Canny and Canny Operator

Parameter	Sobel Operator	Improved Canny Operator	Canny Operator
MAE	145.3	105.67	145.92

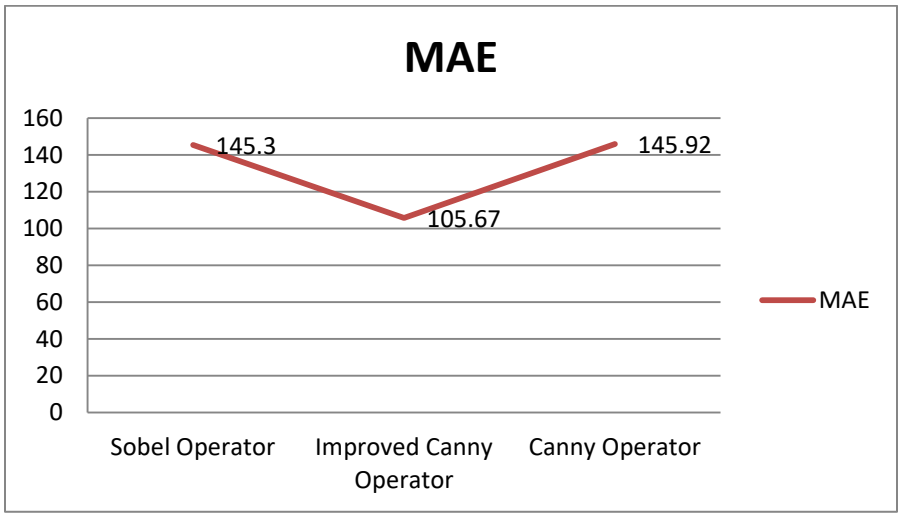


Fig. 6 Performance Analysis of MAE Values using Sobel, Improved Canny and Canny Operator

Peak Signal to Noise Ratio (PSNR), Structural Similarity Index Measurement (SSIM), and computational complexity measurements are carefully chosen for the performance assessment. PSNR is an error based model and is widely used to measure the distortion of the image. To obtain accurate results from an enhanced image, it is necessary to do a preprocessing technique. Among the number of operators used in preprocessing technique of image processing, a comparative analysis of commonly used operators like Sobel, canny, and improved canny operators is carried out on bone fracture images, and optimal PSNR and MAE is determined

VIII. CONCLUSION AND FUTURE SCOPE

A Computerized fracture detection system is designed to remove noise, enhance images in order to increase the quality of image, detect edges in images using edge detection algorithms like Sobel, Canny, and Improved Canny Operator finally identify the fractured area (if it exists) in the x-ray image of the bone using edge detection. This helps the orthopaedician to identify the fractured area of the bone accurately in no time. Identification of the fracture type in the bone can be found using the proposed system, saving more time for the radiologists and dealing with a smooth and accurate image.

Applied various operators to the input image, and its PSNR and MAE values are determined, which shows that the Improved Canny Operator shows better performance in PSNR and MAE of the output image.

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