Edge Detection by Using Canny and Prewitt

Priyam[1], Diganta Dey[2], Shreya[3], Dipanjan Polley[4]

Abstract—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. Edge detection is one of the most important stages in image processing. It enables features such as curves, lines and corners to be extracted for the purpose of image identification. In this paper several masks such as Prewitt and Canny are convolved with various images to extract edge of objects in the images. Comparisons of these edge detectors show that Canny produced the sharpest images and produced the best continuity of the edge lines. Results also showed canny produce sharpest and clear edge then prewitt.

Index Terms— canny, prewitt, gradient vector, edge detection, pixel grid,kernels,convolution.
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1 INTRODUCTION

The point at which image brightness change sharply are typically organised into a set of curve line segment termed edges.Edge detection is the name for a set of mathematical method which aim at identifying points in a digital image at which the image brightness changes sharply has discontinuities.The same problem of finding discontinuities in 1D signal is known as step detection and the problem of finding signal discontinuities over time is known as change detection.Edge detecting is a fundamental tool in image processing ,machine version and computer version,particularly in areas of feature detection and feature extraction

It can assumed that under general assumption for image formation model discontinuities in image brightness are corresponding to
(a) Discontinuous in depth
(b) Discontinuous in surface orientation
(c) Change in material
(d) Variations in scene illumination
The purpose of edge detection [11] is to discover the information about the shapes and the reflectance or transmittance in an image.It is one of the fundamental steps in image processing, image analysis, image pattern recognition, and computer vision,as well as human vision.The correctness[12] and reliability of its results affect directly the comprehension machine system made for objective world.

2 LITERATURE SURVEY

2.1 Sihu Zhu *ET*. Proposed the new method of edge detection based on multi-structure [13] elements morphology and image fusion. Edges are detected using four different orientations SE (structure element) where direction angles of all the structure elements are 0^0,45^0,90^0, 135^0 and final edge result [14] is got by image fusion using entropy weighted method. The proposed method not only /can effectively eliminate the image noise, but also effectively maintain good edge information.

2.2 C.Naga Rajuet. Propose dan edge detection algorithm based on multi-structure elements morphology. The eight different edge detection results are obtained by using morphology gradient algorithm and final edge [13] results are obtained by using synthetic weighted method. The proposed algorithm results are compared with the conventional mathematical morphological edge detection and differential edge detection operators such as Watershed method, Sobel operator and canny operator and obtained the better edges over traditional methods.

2.3 M Rama Bai, Dr V Venkata Krishna described the new morphological approach for noise removal cum edge detection for both binary and gray scale images.

2.4 Mitra [15] Basu presented a survey of Gaussian-based edge detection techniques. This described in a gray level image of an edge. Edge detection is the process which detects the presence and locations of these intensity transitions.

2.5 Mohamed A. described [6] the hybrid entropic edge detector and proposed a method to decrease the computation time and generate high quality of edge detection.

2.6 Peter Wilkins, Paul Ferguson, Alan F. Smeaton and Cathal Gurrin described the approach to reduce the search space for image retrieval. A fair degree of overlap can be achieved in a reduced subset that can be retrieved in a timely manne.

2.7 Khang Siang Tan, Nor Ashidi Mat in 2010 presents a novel histogram thresholding fuzzy C-means hybrid (HTFCM) approach that could find different application in pattern recognition as well as in computer vision to obtain all possible uniform regions in the color image

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3 EDGE DETECTION

3.1 Canny

It is a method of edge detection [1] that uses a multi stage algorithm to detect wide range of edge in image .It was developed by JOHN F.CANNY in 1986[10].The canny edge detection algorithm is known as the optimal edge detector.canny intension was to improve many edge detector that were already working at that time but they were not giving accurate result or accurate deflection.Canny followed a list of criteria to improve current existing method of edge detection.

General criteria for canny edge detection:

(a) Detection of edge with[2] low error rate, it is important that different edges that are occurring inside an image should not be missed and that there are no responses to non-edge.

(b) Edge point will be localized, in other words the distance between the edge pixels as found by the detector and actual edge is to be minimum.

(c) Only one response to a single edge, this was implemented because the first upper two are not enough to completely eliminate the possibility of multiple to an edge.

The Canny Edge Detection Algorithm

The algorithm runs in 5 separate steps:

(a) Smoothing: Blurring of the image to remove noise.

(b) Finding gradients: The edges should be marked where the gradients of the image has large magnitudes.

(c) Non-maximum suppression: Only local maxima should be marked as edges.

(d) Double thresholding: Potential edges are determined by thresholding.

(e) Edge tracking by hysteresis: Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge.

3.2 Prewitt

Prewitt is a discrete differentiation operator computing an approximation of the gradient of image intensity function at each point in the image .the result of prewitt operator is either corresponding gradient vector of the norm of this vector.

The prewitt operator [5] is based on convolving the image with a small, separable and integer value filter in horizontal and vertical direction and is therefore relatively expensive in terms of computation.It was developed by M.S PREWITT.

The prewitt operator is an approximate way to estimate the magnitude and orientation of the edge.

The prewitt operator is an approximate way to estimate the magnitude and orientation of the edge. Equations using by prewitt operator is given below, the constant k = 1. This prewitt operator does not place any emphasis on pixels that are closer to the centre of the masks. This operator will measure two components. The vertical edge component is calculated with kernel Gx and the horizontal edge component is calculated with kernel Gy. |Gx| + |Gy| give an indication of the intensity of the gradient in the current pixel. The convolution masks of the Prewitt detector are given below

The operator consists of a pair of 3×3 convolution kernels as shown in Figure 1. One kernel is simply the other rotated by 90°.

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

G(x)

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

G(y)

FIGURE 1: Masks used by prewitt operator

These kernels are designed to respond maximally to edges running vertically and horizontally relative to the pixel grid, one kernel for each of the two perpendicular orientations. The kernels can be applied separately to the input image, to produce separate measurements of the gradient component in each orientation (call these Gx and Gy). These can then be combined together to find the absolute magnitude of the gradient at each point and

Equations:

$$|\nabla f| = \sqrt{(G^2)X} + \sqrt{(G^2)Y} \quad (1)$$

$$|\nabla f| = |(G^2)X| + |(G^2)Y| \quad (2)$$

The angle of orientation of the edge (relative to the pixel grid) Giving rise to the spatial gradient is given by

$$\text{Angle of } \nabla f = \tan^{-1}(Gy/Gx) \quad (3)$$

Computation of the gradient of an image is based on obtaining the partial derivatives of $\partial f / \partial x$ and $\partial f / \partial y$ at every pixel location.Let the 3×3 are shown in figure .2 represent the grey levels in a neighbourhood of an image.

These derivatives can be implemented for an entire image by using the masks of size 3×3 shown in figure 2 with the procedure of convolution.

$$Gx = (z7+z8+z9)-(z1+z2+z3) \quad (4)$$

And

$$Gy = (z3+z6+z9)-(z1+z4+z7) \quad (5)$$

A slide variation of these two eqution uses a weight of 2 in the center coefficient . A weight value of two is used to achieve some smoothing by giving more importance to the centre point figure 1,called the prewitt operators,is used to implement these two eqution

z1	z2	z3
z4	z5	z6
z7	z8	z9

FIGURE 2: A 3×3 area of an image

4 RESULT

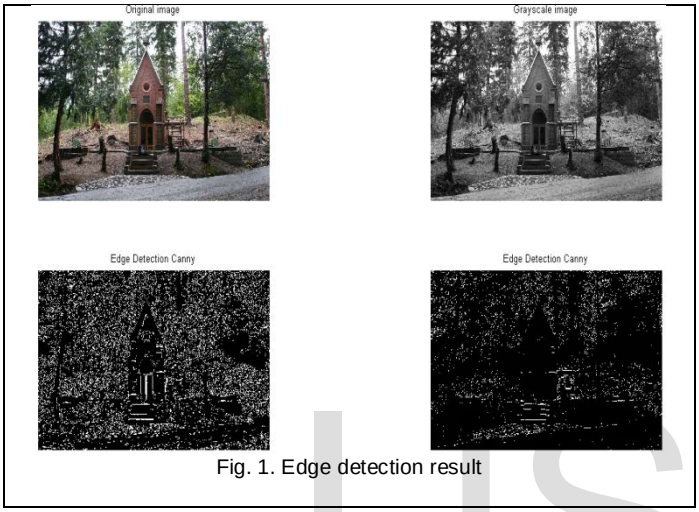

Fig. 1. Edge detection result

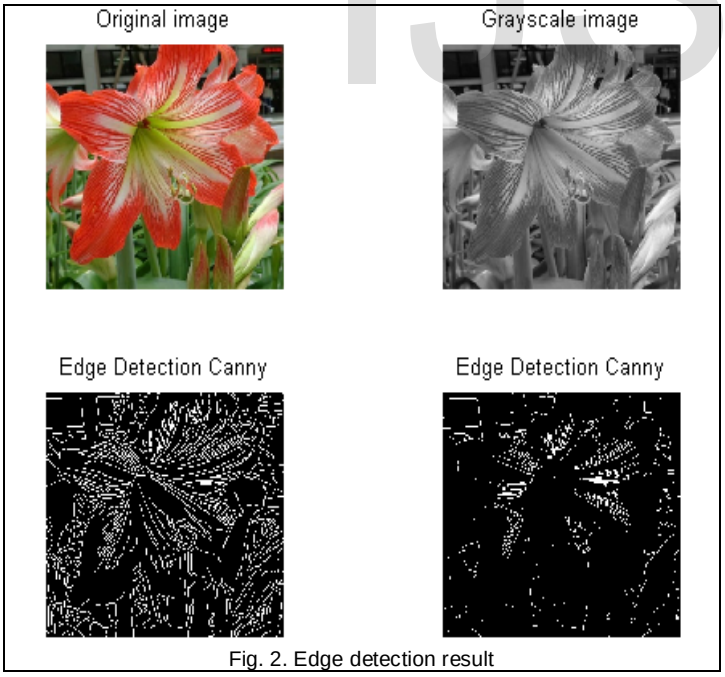

Fig. 2. Edge detection result

4.1) Comparison of prewitt operator and Canny edge detectors

(a)prewitt Operator

The primary advantages of the prewitt operator lie in its simplicity. The prewitt method provides a approximation to the gradient magnitude. Another advantage of the prewitt operator is it can detect edges and their orientations. In this cross operator, the detection of edges and their orientations is said to be simple due to the approximation of the gradient magnitude. On the other hand, there exist some disadvantages of the Sobel method. That is, it is sensitive to the noise. The magnitude of the edges will degrade as the level of noise present in image increases. As a result, prewitt operator accuracy suffers as the magnitude of the edges decreases. Overall, the prewitt method cannot produce accurate edge detection with thin and smooth edge.

(b) Canny Edge Detector

With Gaussian filter, any noise present in an image can be removed. The next advantage is enhancing the signal with respect to the noise ratio. This is done by non-maxima suppression method as it results in one pixel wide ridges as the output. The third advantage is better detection of edges especially in noisy state by applying thresholding method. The effectiveness of canny method is affected by adjustable parameters. Small filters are desirable for detection of small, sharp lines, since it causes fewer instances of blurring. Large filters are desirable for detecting larger, smoother edges. However, it causes higher instances of blurring. The main disadvantage of canny edge detector is that it is time consuming, due to its complex computation.

operator	strengths	weakness
prewitt	Simple,detects Edge and their orientation.	Inaccurate and sensitive to noise.
canny	Smoothing effect to remove Noise.Good localization and Response.Enhances Signal noise ratio. Immune to noisy Environment.	Difficult to Implement to Reach real time response. Time consuming.

5 CONCLUSION

Since edge detection [8] is the initial step in object recognition. Edges characterize boundaries and are therefore a problem of fundamental importance in image processing. Image Edge detection significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image. Since edge detection is in the forefront of image processing for object detection, it is crucial to have a good understanding of edge detection algorithms. it

is important to know the differences between edge detectection .In this paper we studied the most commonly used edge detection techniques of Gradient-based and Laplacian based Edge Detection. The software [4] is developed using MATLAB R2012a. Gradient-based algorithms such as prewitt edge detection cannot produce good edge detection with the thin and smooth edge. It's meaningless information for further study in medical image analysis like segmentation and classification. The quality of the edge totally depends on quality of the picture, in other words the raw picture must be totally filtered from noisy pixels. For Canny edge detection, there are important adjustable parameters, which can affect the computation time and effectiveness of the algorithm, the size of the Gaussian filter and thresholds [7]. The Canny method uses a lot of memory during processing, so may not be appropriate if for very large raster, or if memory is low. Canny edge detection can produce good detection of the edge with the thin and smooth. Canny method is very useful to get optimum border on the image that can give meaningful information in medical image analysis.

6 ACKNOWLEDGMENTS.

The authors are greatly indebted to the Department of Electrical and Electronics Engineering, Camellia Institute of Technology, MAKAUT University, West Bengal for providing excellent lab facilities that make this work possible.

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