Special Issue Published in International Journal of Trend in Research and Development (IJTRD), ISSN: 2394-9333, www.ijtrd.com

A Study on Edge Detection Methods

[1]J. Sophia and [2]J. Maria DivyaInfanta
[1,2]M.phil scholar, Sri sarada college for women, Ariyakulam, TamilNadu, India

Abstract-- Edge is defined as the boundary pixels that connect three separate regions. That is gradient based detection, laplacian based edge detection, marr-hildreth edge detection. Edges characterize boundaries and are therefore a problem of fundamental importance in image processing. Edge detection plays a very important role in image processing. In this Laplacian based edge detector, canny implemented the edge detection problem as a signal processing optimization problem. The solution to this problem was a rather complex exponential function. Variation process on gradient based edge detection have included the Roberts, Prewitt and Sobel operators. The two methods namely Laplacian & Gaussian and Zero crossing are more popular and these are based on Gaussian filter and specified filter respectively. In this paper we would compare the edge detection methods whichgive the best solution for image processing.

Keywords*: Edge, Edge detection, Robert, Sobel, Prewitt, Canny, Marr-hildreth*

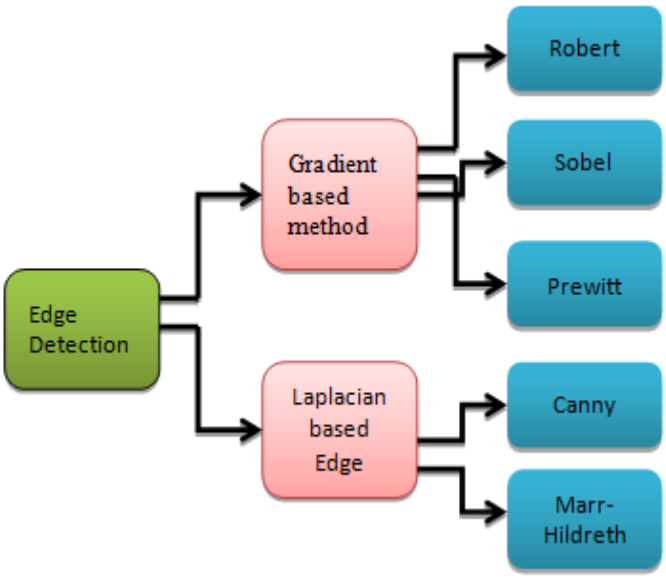
I. INTRODUCTION

Edge detection is a very important area in the field of Computer Vision. Edges define the boundaries between regions in an image, which helps with segmentation and object recognition. Edge detection is a fundamental of low-level image processing and good edges for higher level processing. The quality of edge detection is highly dependent on lighting conditions, the presence of objects of similar intensities, density of edges in the scene, and noise.

The gradient is calculated using the derivative of a Gaussian filter. This method uses two thresholds to detect strong and weak edges, and includes the weak edges in the output only if they are connected to strong edges. This method is therefore less likely than the others to be "fooled" by noise and more likely to detect true weak edges. The Laplacian method searches for zero crossings in the second derivative of the image to find edges since the second derivative is zero when the first derivative is at maximum. However, this method is sensitive to noise, which should be filtered out before edge detection. Based on the filter used, the two methods namely Laplacian& Gaussian and Zero crossing are more popular and these are based on Gaussian filter and specified filter respectively. In this paper we analyses most commonly used Gradient and Laplacian based edge detection techniques for various in the context of object extraction. The comparative advantages and disadvantages of one method over another have been done by visual comparison of image. The band wise analysis is also conducted to find more appropriate band for evolving optimum edge detection methodology.

Since different edge detectors work better under different conditions, it would be ideal to have an algorithm that makes use of multiple edge detectors, applying each one when the scene conditions are most ideal for its method of detection. In order to create this system, you must first know which edge detectors perform better under which conditions. That is the goal of our project.

II. METHODOLOGY



A. Gradient based Edge Detectors

This is symmetric along the edge and reduces the noise by smoothing the image. In first order or gradient method detects the edges by looking for the maximum and minimum in the first derivative of the image. The most well-known conventional methods like Sobel, Prewitt, Robert operators are belong to gradient based edge detection technique.

B. Prewitt Edge Detection

The Prewitt edge detection was proposed by Prewitt in 1970 (Rafael C.Gonzalez..This edge detector is estimated in the 3x3 for eight directions. All the eight convolution masks are calculated.

DxDy

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

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

One kernel is simply the other rotated by 90o. It uses 3 x3 kernels .Prewitt detection is slightly simpler to implement computationally than the Sobel detection, but it tends to produce somewhat noisier results.

C. Sobel Edge Detection

Sobel edge detection method was introduced by Sobel in 1970 (Rafael C.Gonzalez (2004)). This method precedes the edges at those points where the gradient is maximum. Here also 2 kernels that are of 3 x 3 size are

used. One kernel is simply the other rotated by 90o.

DxDy

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

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

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 the orientation of that gradient.The gradient magnitude is given by $\sqrt{Gx^2 + Gy^2} = |G|$

Although typically, an approximate magnitude is computed using:

$$|G| = |Gx| + |Gy|$$

which is much faster to compute. The angle of orientation of the edge giving rise to the spatial gradient (relativeto the pixel grid orientation) is given by:

Θ= arctan(*Gy*/*Gx*)

D. Robert Edge Detection

It is the gradient operator. The simple 2*2 Roberts operators were one of the earliest methods. The Roberts cross calculates a simple, efficient, 2-D spatial gradient measurement on an image highlighting regions corresponding to edges. The Roberts operator is implemented using two convolution masks/kernels, each designed to respond maximum to edges running at ±45º to the pixel grid, which return the image x-derivative and y derivative, Gx and Gy respectively. The Robert having small kernel it is highly sensitive to noise and not much compatible with today's technology.

GyGx

0	+1
-1	0

+1	0
0	-1

The gradient magnitude is given by $\sqrt{Gx^{2\cdot} + Gy^2} = |G|$although typically, an approximate magnitude is computed using:

$$|G| = |Gx| + |Gy|$$

which is much faster to compute. The angle of orientation of the edge giving rise to the spatial gradient (relativeto the pixel grid orientation) is given by:

Θ= arctan(*Gy*/*Gx*) - 3*p* / 4

E. Laplacian method

Laplacian filters are derivative filters used to find areas of rapid change (edges) in images. Since derivative filters are very sensitive to noise, it is common to smooth the image (e.g., using a Gaussian filter) before applying the Laplacian. This two-step process in the Laplacian of Gaussian (LoG) operation.

F. Marr-Hildreth

The Marr-Hildreth edge detector was a very popular edge operator before Canny released his paper. It is a gradient based operator which uses the Laplacian to take the second derivative of an image. The idea is that if there is a step difference in the intensity of the image, it will be represented by in the second derivative by a zero crossing.So the general algorithm for the Marr-Hildreth edge detector is as follows:

$$G(x,y) = -e^{-\frac{x^2+y^2}{2\sigma^2}}$$

1. Smooth the image using a Gaussian. This smoothing reduces the amount of error found due to noise.
2. Apply a two dimensional Laplacian to the image: This Laplacian will be rotation invariant and is often called the "Mexican Hat operator" because of its shape: This operation is the equivalent of taking the second derivative of the image.
3. Loop through every pixel in the Laplacian of the smoothed image and look for sign changes. If there is a sign change and the slope across this sign change is greater than some threshold, mark this pixel as an edge. Alternatively, you can run these changes in slope through a hysteresis (described in the canny edge detector) rather than using a simple threshold.

G. The Canny Edge Detector

The Canny edge detector is widely considered to be the standard edge detection algorithm in the industry. It was first created by John Canny and still many of the newer algorithms that have been developed. Canny saw the edge detection problem as a signal processing optimization problem, so he developed an objective function to be optimized.

$$G_\sigma = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{m^2+n^2}{2\sigma^2}\right)$$

The steps in the canny edge detector are as follows:

1. Good detection: The algorithm should select as many real edges as possible in the original image.
2. Good localization: The edges that are marked should be as close as possible to the edges in the real image.
3. Minimal response: This criterion say that given edge in the image should only be marked once and noise should not create any false edges.

III. PROPOSED SYSTEM

In this paper edge detection is one in which all method is done in the image processing, it may contain a six method of algorithm that are prewitt, sobel, robert, canny and marr-hildreth. In order to compare various methods in edge detectors which work better under different conditions should be investigated. it would be ideal to have an algorithm that make different output for multiple edge detectors, applying each one when the scene conditions are most ideal for implement by direct methods of detection. Let us compare the methods in edge detection.The Sobel method of edge detection for image segmentation finds edges using the Sobel approximation to the derivative. It precedes the edges at those points where the gradient is highest. In Sobel technique performs a 2-D spatial gradient quantity on an image and so highlights regions of high spatial frequency that correspond to edges. In general it is used to find the estimated absolute gradient magnitude at each point in n input grayscale image.

Robert performs a simple, quick to compute, 2-D spatial gradient measurement on an image. This method emphasizes regions of high spatial frequency which often correspond to edges. Prewitt method finds edges using the Prewitt approximation to the derivative and returns edges at those points where gradient of image intensity is maximum image intensity is maximum.

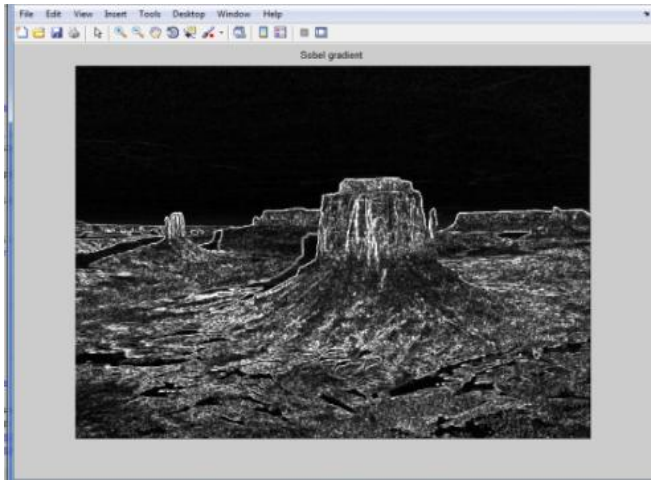
The Marr-Hildreth technique is a method of detecting edges in digital images that is continuous curves wherever there are well-built and fast variations in image brightness. It is a easy and it operates by convolving the image with the LoG function. It uses both Gaussian and laplacian operator.In Canny edge detection technique is one of the standard edge detection techniques. In Canny edge detection still outperforms many of the newer algorithms that have been developed. To find edges by separating noise from the image before find edges of image the Canny is a very important method. Canny method is a better method without disturbing the features of the edges

in the image afterwards it applying the tendency to find the edges and the serious value conditions. That is the future of the edge detection which is used in the image processing.

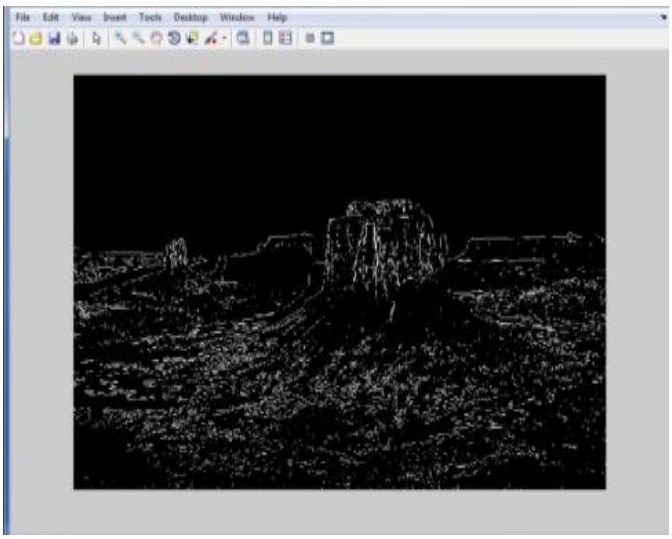
for threshold. So Finally evaluate edge detectors method which perform better under which condition.That is the future of the edge detection which is used in the image processing.

Original

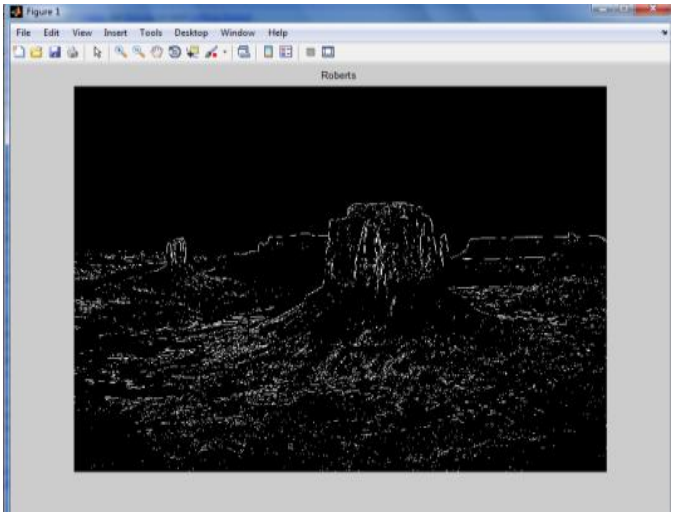
Sobel



Prewitt



Robert



CONCLUSION

In this paper, various edge detection methods are analysed. The methods are applied with the algorithms. No specific texture or shape is specified. It can be shown clearly that the Sobel, Prewitt, and Roberts provide low quality edge maps relative to the others. A representation of the image can be obtained through the Canny and Marr-Hilderth methods. In Marr-Hildreth, locality is not especially good and the edges are not always thin, still this edge detector is much better than the classical ones in cases of low signal to noise ratio. Among the various methods investigated, the Canny method is able to detect strong. The canny edge detector is capable of reducing noise with multistage process. The methods detect pair wise, only Prewitt and Robert, Sobel and Marr-Hildreth have approximately the same edge map. The Canny produces the best edge map market. The best edge detection method should detect error less image and solution for processing image. Using canny edge detection images can be viewed with pure pixel values and process all the edge detection methods.With someimprovements, this method can be used to detect pictures clarity for future use.

COMPARISON TABLE ON DIFFERENT EDGE DETECTION METHODS

S.NO	TECHNIQUE	DISADVANTAGE	ADVANTAGE
1.	Prewitt ,Sobel	• Sensitivity to noise • Sometime inaccurate • Cross operator gives response to some edges	• Operator is intuitiveness and Simplicity • Detection of edges and their orientations
2.	Robert	• Sensitivity to noise • Often Inaccurate	• Simplest edge detector • Quick to computer 2D gradient
3.	Canny	• It is more complicating Time consuming • Complex to Compute • False zero crossing.	• Excellent Edge Detection • Good Localization • Minimal response to noise • Most dominant operator than other detector
4.	Marr-Hildreth	• Malfunctioning at the comers • Inability to find the orientation of edge	• It is used to find the correct places of edges, • Testing broad area around the pixel. • Emphasizes the pixels at the place where intensity changes takes place.

References

[1] R.Danescu,S.Nedevschi,M.Meinecke,andT.Graf,"Stereo Vision Based Vehicle Tracking in Urban Traffic Enviroments",Intelligent Transportation System, IEEE conference on,pp.400-404 ,2007.

[2] N.J.Ferrier,S.M.Rowe,A.Blake,"Real-time traffic monitoring",proceeding of the second IEEE workshop on applications of computer vision",pp.81-88,1994 .

[3] Vu and M.Barth,"catadiopetric omnidirectional vision system integration for vehicle-based sensing",inproc.of IEEE Intelligent Transportation System Conference,2009 .

[4] M.Cao,A.Vu,andM.Barth,"A Novel omni-directional vision sensing technique for traffic surveillance",inproc.of IEEE.

[5] BaohuaJin,DongyaoZou ,Yong Gan,"Research and design of traffic detection based on GPRS".IEEE conf.on advanced computer control(ICACC),March 2010 .

[6] HuiKong,Jean-Yves, Audibert,Jeanounce,"General Road Detection from a single image",IEEE Journal Transactions on image processing,August 2010

[7] Arvind B.K And Dinesh S, ArunKarthik S And Ganga Ambrish "Traffic Gridlock Control Using Canny Algorithm Aided By Fuzzy Logic"3rd International Conference On Advanced In Computing And Emerging Elearning Technologies (ICAC2ET 2013) – Singapore OnNovember 6 – 7, 2013

[8] MadhviArora, V.K Banga,"Real time traffic light control system using morphological edge detection and fuzzy logic", 2nd International Conference on Electrical, Electronics and Civil Engineering, April, 2012.

[9] Wei zhi Wang, Bing-han Liu, "The Vehicle Edge Detection Based On Homomorphism Filtering And Fuzzy Enhancement In Night TimeEnvironments", IEEE International Conference, 2010.

[10] G.T. Shrivakshan and Dr.C. Chandrasekar " A Comparison of various Edge Detection Techniques used in Image Processing"IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 5, No 1, September 2012

[11] Chris Solomon and Toby Breckon" Fundamentals of digital image processing : a practical approach with examples in MATLAB"2011 by John Wiley & Sons, Ltd