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VARIOUS EDGE DETECTION TECHNIQUES: A COMPARITIVE STUDY

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ABSTRACT: Edge detection is mostly used in computer vision applications now days. Detection process identify the location of edges by sharp discontinuities of image. Edge detection reduces the amount of data and filters out the unwanted information from the image and gives us the most significant information or data about that image. This research paper presents a comparison between various edge detectors to check which method or detector performs better result.

1. INTRODUCTION

EDGES are the basic feature of an image edge detection is introduced in 1959 by julesz later discussed in 1965 by Roberts. After nearly 60 years of research day by day many different edge detection methods are introduced and each of them has its own characteristic and limitations there are many edge detection technique or methods but most of them are facing a problem of poor edge detection

And take long runtime but the canny edge detection is no exception like other has. the first canny operator is implemented by tang and long it is based on gpu+cpu combination.

Edges are present between a target and a background or two regions or primitives. edges carried out most of information about an image. edge detection technique is a low level operation technique and it is used for image processing and in applications like computer vision, image segmentation. With the help of edges, we can make boundaries between different regions of image and these boundaries helps us in identify objects for image segmentation or matching purpose such as face reorganization, finger print unlocking etc. This technique is mostly used for obstacle detection or image compression etc. for

Extraction of the edges we required edge detector.

Types of Edges:

There are four types of edges which we are study in edge detector:

1) Step Edge- The strength of image suddenly varies from one value to one side of the breakage to a different value on other side.

2) Ramp Edge- When the strength change is not spontaneous and appears a limited distance then step edges are changed to ramp edges.

3) Ridge/Line Edge- Thestrength of image suddenly changes values and then returns to the starting point within short distance.

4) Roof Edge- Whenstrength change is not spontaneous and seems over a finite distance usually generated by connectivity of surfaces then line edges becomes roof edges.

II METHODOLOGY

Edge Detector Methods: Thereis different technique of edge detection in which different methods or operator used.Famous of them are prewitt edge detector, sobel edge detector Roberts edge detector and canny edge detector. For detecting the edges from the image there are different steps like filtering the image the Enhancement of that image in the last detection step is carried out.

Now we study the different techniques of edge detector which are described below:

1) The Prewitt Edge Detector:

Edges are measured by using corresponding pixel of an image. In this we use different masks which are known as derivative masks.

Prewitt edge detector give us two masks one for detecting edges in horizontal direction and other is for vertical direction. The prewitt edge detector in an efficient way to detect the magnitude or orientation of an edge. there are 8 possible orientation in prewitt detection.

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

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

Masks use for gradient operation on prewitt operation

The prewitt square root edge is given below:

$$G(x,y)=\{|G_R(x,y)|^2+|Gc(x,y)|^2\}^2$$

With

$$G_R(x,y)=1|(x+2)[(A_2+KA_3+A_4)-A_0+KA_7+A_6]$$

and

$$G_C(x,y)=1|(K+2)[(A2+KA1+A2)-A_0+KA_5+A_4$$

where k=1

The result prewitt operator is either the corresponding gradient vector or normal of this vector.

The main advantage of prewitt edge detector is its cost it is less expensive then compare to other edge detector and faster method for detection. it is best for noiseless or well contrasted image.

2) The Sobel Edge Detection:

The sobel operator measured the gradient of an image intensity at each and every point of an image.

Sobel operator is discrete differential operator. Sobel operator is a kind of orthogonal gradient operator.

It is best to convert the image in grayscale image from RGB scale.it precedes the edge at these

points where the gradient is at maximum point. It performs a 2-Dimentional spatial gradient quality on an image. sobel operator consists of pair of 3*3 complication convolution masks. mask is rotated by 90 degree. there are two direction masks init.

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

Gx Gy

The partial derivatives for sobel operator.

$G_X=(a_2+2a_3+a_4) - (a_0+2a_7+a_6)$

$G_Y=(a_6+2a_5+a_4) - (a_0+2a_1+a_2)$

The gradient magnitude

$|G|= \sqrt[2]{G_{x^2} + G_{y^2}}$

The orientation angle is measured as follows:

$\emptyset$=Arc tan (Gx/Gy)-3π/4

3). The Roberts Edge Detection:

Roberts edge detector was proposed by Lawrence Roberts. This operator consists of pair of 2*2 convolution kernels. This detector helps us to measure the spatial gradient of an image. It takes image as input as gray scale and give us edges involving in that image.It is not symmetric in nature means this detector do not detect the edges which are multiples of 45 degree and that is the main disadvantage of this edge detector.

+1	0
0	-1

Gx

0	+1
-1	0

Gy

Masks used for Roberts edge detection techniques.

The partial derivative of Robert operator

Df/dx=f (I, j)-f (i+1, j+1)

Df/dy=f (i+1, j)-f (i, j+1)

Diagonal edge gradient can be obtained by forming running difference of pairs of pixels.

The Roberts crosses difference operator

$G(x,y)=|G_1(x,y)+G_2(x,y)$

The square root means

$G(x, y) =\{|G_1(x,y)|^2+|G_2(x,y)|^2\}^2$

$G_1(x, y) =f (x+1, y+1)-f (x, y)$

$G_2(x, y) =f (x, y+1)-f (x+1, y)$

The canny edge detection:

It was first created by John Canny for his Master's thesis at MIT in 1983 and still outperforms 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. The solution to this problem was a rather complex exponential function, but Canny found several ways to approximate and optimize the edge-searching problem. There are different algorithms used in canny edge detection which are discussed below:

1) Gaussian Filter Algorithm:

We use the Gaussian filter to eliminate the noise of image. elimination of noise is necessary to present the false detection therefore smoothing the image Gaussian filter kernel is convolved with the image. the equation of Gaussian filter kernel of size(2K+1) *(2K+1) Is given by: -

$$4ij = \frac{1}{2\pi\sigma^2} \exp\left(-\frac{(i-(k+1))2+(j-(k+1))2}{2\sigma 2}\right)i$$

1<=I, j<=(2k+1)

Remember size of Gaussian filter will affect the performance during the detect the detection, if larger size lower sensitivity to eliminate noise.

2) Finding the Intensity Gradient of The Image: -

Calculate the gradient to detect the edge intensity. it is also called music in digital image. in gradient method high gradient pixels are accepted as edges. Edges can be modeled according as edges. edges can be modeled according to theirintensity. we use the gradient because it provides information about the strength of the edge.

Gradient is a vector has magnitude and direction.

Mag $(\nabla f)=\sqrt{(df/dx)^2 + (df/dy)^2}= \sqrt{Mx^2 + My^2}$

dir $(\nabla f)=\tan^{-1}(M_y/M_x)$

die

we can find the gradient smoothened the image and filtered in both horizontal and vertical direction.

3) Non-Maximum Suppression: -

We must perform non-maximum suppression to thin out the edges. A full scan of image is done to remove any unwanted pixels impurity which may not build the edge. for every pixel, pixel is checked if it is a local maximum in its neighbor in the direction of gradient of image which is used to find out the intensity. there are some steps to perform non-maximum suppression.

1)Differentiate the object into four different directions.

2) Check the left and right surrounding gradient values.

3)If the gradient at present pixels value is higher than its left and right surrounding, then it is considered an image, else it is discarded.

For example: -

a) If rounded gradient at angle is 0 degree then gradient magnitude is greater than magnitude at pixel in east ang west direction.

b) If rounded gradient at angle is 90 degree then gradient magnitude is greater than the magnitude at pixel in north and south direction.

c)If rounded gradient angle at 135 degree then gradient magnitude is greater than the magnitude at pixel in north west and south – east direction.

d) If rounded gradient angle at 45 degree then gradient magnitude is greater than the magnitude at pixel in north east and south west direction.

4) Double Threshold: -

Potential edges are determined by * using double threshold. here some external pixels caused by noise or average color variation than desirable gradient values above then threshold value is high, it is considered string value for edge. If the gradient value is not higher and lower in between at then pixel assume weak candidate for edge pixel.

5) Edge Tracking By Hysteresis: -

In final result we need to show strong edge pixel of object , and they are obtained from the original edges in the image , but it is not easy process because sometimes we get the weak edge result therefore , there will be some debate on the weak edge pixels , as these pixels are extracted from the original image.

III FUTURE DIRECTIONS

1) The proposed edge detector can be applying for real time applications.

2) We used these edge detectors to extend three dimensional images.

3) Sometime noise is high in the image that we use edge detector to get proper information about that image.

Applications

1) Finger print: - In mobile phones widely use of finger print as well as in offices, universities for attendance purpose.

2) Satellite images: - By using edge detection generate the edge map which contain more accurate and well localized data.

3) It also removes the noise from the image and generate more realistic edges.

4) Edge detection is also used in cameras.

Time to time due to invention in technologies edge detection is used in all fields.

IV RESULTS AND CONCLUSIONS

After studying the prewitt, the sobel, the Roberts edge detection methods. the result of these methods are not suitable or proper in different circumstances means some time they give errors during detection or do not detect properly therefore canny edge detection method provides algorithms of its own to detect edges in different situations and it also uses all the properties of above another methods which we discussed. Due to their own algorithms it gives us best information about the image. The canny algorithm acceptable in different environment. in canny algorithms have a large spatial

For smoothing if required there should be a low probability of failing to mark true edge point. the point marked as edge points by the operator should approximate to center of real edge as

much possible. an adaptive edge detection algorithm is necessary to provide robust solution that is adaptable to varying noise levels. so canny algorithm is best to use it.

REFERENCES

1) Tzu-Heng Henry Lee "Edge Detection Analysis" Graduate Institute of Communication Engineering, National Taiwan University, Taipei, Taiwan, ROC

2) Radhika Chandwadkar, Saurabh Dhole, Vaibhav Gadewar, Deepika Raut, Prof. S. A. Tiwaskar" Comparison of Edge Detection Techniques" Computer Engineering Department, VishwakarmaInstitute of Information Technology, Pune-48(Conference Paper · August 2013)

3) S. Kaur and I. Singh, "Comparison between Edge Detection Techniques", International Journal of Computer Applications, International Journal of Computer Applications 145(15):15-18 · July 2016

4) Muthukrishnan.R and M. Radha "Edge Detection Techniques for image Segmentation" International Journal of Computer Science & Information Technology (IJCSIT),International Journal of Computer Science & Information Technology (IJCSIT) Vol 3, No 6, Dec 2011

5) Meghana D. More and G.K. Andurkar, "Edge detection techniques: a comparative approach," World Journal of Science and Technology,"International Journal for Science and EmergingTechnologies with Latest Trends" 7(1): 21-25 (2013)

6) Mamta Joshi Ashutosh Vyas "Comparison of Canny edge detector with Sobel and Prewitt edge detector using different image formats" Department of Computer Science & Engineering, International Journal of Engineering Research & Technology (IJERT)

7)WenshuoGao, et.al.; "An improved Sobel edge detection", Computer Science and Information Technology (ICCSIT), 2010 3rd IEEE International Conference, China, Volume: 5, pp. 67 -71, 9-11 July 2010