Implementation Of Distributed Canny Edge Detection Technique

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Abstract – *Edge detection is basic steps in image processing and computer vision. Edge detection is most common steps in object detection, image segmentation ,object tracking etc. The main purpose of edge detection is to reduce data preserving its structural properties.*
Canny Edge Detection is widely used edge detection technique. It has high intensity as compared to other edge detection technique but with higher latency. So we are going for block level implementation of canny edge detection but directly applying original canny edge detection at block level leads to excessive edges in the image. In this paper we are implementing Distributed Canny edge detection technique that adaptively compute the threshold depending on the block type. This technique uses new algorithm called non uniform gradient magnitude histogram to produce block based hysteresis thresholding. Also this provide low error rate as compared to other edge detection technique. Due to adaptive thresholding it is useful for real time application. 10

Key Words: computer vision, image segmentation, structural properties, canny edge detection, adaptive thresholding.

1. INTRODUCTION

Edge is nothing but the boundary .whenever there is strong contrast in intensity-Differentiating the strong and low intensity. Edge detection filters out the useless information and preserves the useful information. The edge detection should have low error rate and filter out unwanted information. Secondly it should have lower variation between original image and processed image also it should remove multiple response for single edge[2]. Based on these criteria canny edge detection technique smooths out the noise and detect the edges effectively. The canny Edge Detection technique uses computation of high and low thresholding based on the entire statics of the image. This makes the algorithm more complex as compared to other edge detection technique. That results into increase in latency and not adaptable for real time applications.

1.1 Previous Edge detection technique

There are very simple edge detection techniques like sobel ,LOG we have some matlab results for these techniques. **I.Sobel Edge detection** : In this edge detection technique we simply apply mask. When we simply apply mask on prominent vertical and Horizontal edges.it works like first order derivative and calculates the difference in the pixel intensities in the given region. The Results are obtained by using 512x512 image

Fig-1: sobel edge detection

II. LOG edge detection technique: The laplacian of gaussian is nothing but LOG edge detection. The laplacian of image highlights the rapid change of intensity and frequently used for edge detection technique. Laplacian often applied to image which is firstly smoothened out using Gaussian mask. The Results are obtained by using 512x512 image

Fig-2: LOG edge detection

III. Canny edge detection: The original canny edge detection consists of following steps1) Calculating horizontal gradient Gx and vertical gradient Gy by convolving the pixel of image with given mask. 2) Computing gradient Magnitude G and angle Θ for the given pixel. 3) Non maximal Suppression, since arc tangent is very complex function while it also requires floating point number, it is very difficult to implement such for real time application.

The comparison is made between the actual pixel and its neighbor, along the direction of gradient. The pixel is removed if it does not classify as local maxima and interpolation is done to find out the neighboring pixel.

4) Computing the high and low threshold from the histogram of the gradient of entire image. The High threshold computed such that the percentage of pixel P1 classified as strong edge, while the low threshold will be 1-P2. The value of threshold is High threshold 0.7 and low threshold 0.3.

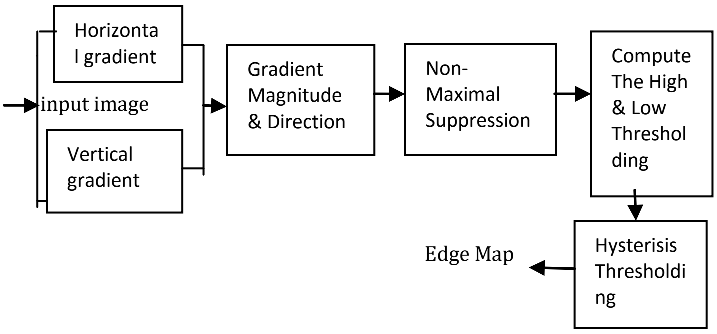

Fig-3: Block Diagram of canny edge detection

5) The next step is hysterisis thresholding to find out the edge map if the gradient value of the pixel is above strong threshold is classified as the strong edge if it is in between the high threshold and low threshold it is classified as weak edge and if it is in below low threshold it is removed. The strong edge is as it is taken in edge map. If the weak edge connected to strong edge will be considered in the edge map otherwise it is removed. The Results are obtained by using 512x512 image

Fig-3: Canny Edge Detection with 9x9 mask and σ=1.4

2. Distributed Canny Edge Detection Technique:

The original canny edge detection technique when applied on smooth block level will results in excessive edge in that block while less number of edges in the block which is classified as strong block. This is because algorithm assumes percentage p1 of total pixel are classified as strong edge and on other hand, for an edge block maximum pixel are edges. Since p1 is less than the actual number of pixel in the blocks. So this results in the missing of edges in that block. The results are obtained by using 512x512 image

Fig-4: Applying original canny algorithm on block Guassian noise of 9x9 with σ=1.4

In order to improve the performance of the canny edge detection on block level ,the new technique is introduced that is nothing but the distributed canny edge detection technique .[1]For the proposed algorithm the image first divided into mxm overlapping blocks. first it is divided into nxn non overlapping block and then with LxL gradient mask it is extended upto (L+1)/2 overlapping block such that m=n+L+1.For performing non maximal suppression the information about the gradient value of adjacent pixel is needed such that for gradient value of pixel (i,j) the gradient value of pixel (i-1,j),(i-1,j-1),(i-1,j),(i,j-1),(i+1,j-1) are needed.

For a given image we first divide the image into nxn non overlapping block and then it is classified as the strong,uniform, texture, medium and strong edge block.This classification is done by local variance using 3x3 window block .For 512X512 lena image there is block size of 64x64. In order to compute the high and low threshold a finally quantized histogram is usually needed.

Step 1:
Pixel classification:

	Uniform	.... var(x,y) ≤ Tu
pixel type =	texture	..... Tu<var(x,y)≤Te
	Edge	... Te<var(x,y)

Step 2:
Block Classification:

Block Type	Number of pixel	
	Nuniform	Nedge
Smooth	≥0.3total pixel	0
Texture	<0.3 total pixel	0
Edge/Texture	<0.65 (total pixel-Nedge)	(>0)&(<0.3total pixel)
Medium Edge	≥0.65(total pixel-Nedge)	(>0)&(<0.3total pixel)
Strong Edge	≤0.7 total pixel	≥0.3 total pixel

Var(x,y):the local (3x3)variance at pixel (x,y);
Tu and Te :two threshold(Tu=100 & Te=900) [4];
Total pixel :Total number of pixel in the block;
Nuniform :the total number of uniform pixels in the block;
Step 3:

Adaptive Thresholding:

Let P1 be the percentage of pixels, in a block, that would be classified as strong edges.

Step I: If smooth block type

P1=0 .....No edges

Else if texture block type

P1=0.03 …….few edges

Else if texture/edge block type

P1=0.1….some edges

Else if medium edge block type

P1=0.2…Medium Edges

Else

P1=0.4…Many edges

Step II: Compute the 8-bin non-uniform gradient magnitude histogram and the corresponding cumulative distribution function F(G).

Step III: Compute High threshold as F(High threshold)=1-P1

Step IV: Compute Low threshold=0.4*High threshold

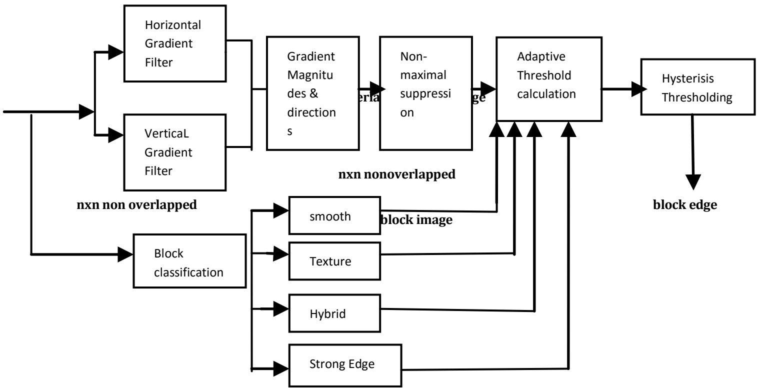

Fig-5: Block Diagram of distributed canny edge detection

I.Parametrical Analysis:

The mask size and block size are parameters that affect performance of algorithm.[3] The Block size should be selected as minimum as possible. When we select lower mask size the edge detector ability is high while noise resilience ability is very low. In contrast with that when we select higher mask size the noise resilience ability is high but edge detector ability of detecting detailed edges and fine edges decreases.

The quality of image was analysed using different block size. The visual quality of edge maps obtained by using different block size. We have evaluated the pearson's correlation coefficient(PCC) for different block size. It defines the how linearly two coefficient are related. The quality was linearly defined according to value of pearson's correlation coefficient. For 64x64 block size the pearsons coefficient has maximum value.

Fig.-6: Dividing Image into nxn non overlapping block

Fig-7: Original Image

Results with distributed canny edge Results with Original canny edge detection
detection

Fig-8:

3. CONCLUSION

The original canny algorithm depends on the frame based statistics to predict the low and high threshold. Thus the algorithm has latency equal to the size of image. In order to reduce latency and for using it in real time application we have implemented distributed canny edge detection. This has benefits -1.Significant reduction in Latency 2.Better edge detection. A low complexity non-uniform quantized histogram is defined in this algorithm which adds another benefits .

REFERENCES

[1] Qian Xu, Srenivas Varadarajan, Chaitali Chakrabarti, and Lina J. Karam, ." A Distributed canny eddge Detector:Algorithm and FPGA implementation".IEEE transaction on image processing,VOL. 23,No.7 July 2014

[2] Q. Xu, C. Chakrabarti, and L. J. Karam, "A distributed Canny edge n detector and its implementation on

FPGA," in M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

[3] "FPGA Implementation of Edge Detection using Canny Algorithm" Online International Conference on Green Engineering and Technologies . 2015 Online International Confernece on Green Engineering and Technologies (IC-GET 2015)

[4] J. K. Su and R. M. Mersereau, "Post-processing for artifact reduction in JPEG-compressed images," in *Proc. IEEE ICASSP*, vol. 3. May 1995, pp. 2363–2366.".