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Image Edge Detection using Adaptive Filter

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***Abstract*— The canny edge detection technique is a multi-stage algorithm which is an optimal edge detection technique. But it removes noise in an image using Gaussian filter to become insensitive to noise. The Gaussian filter smoothes even the edges in the images so that the through put is decreased. That is some of the true edges may be missed and false edges may appear in the edge detection. We propose the Adaptive smoothing filter for noise reduction which preserves the edges while smoothing the given image. Since Adaptive filter preserves the edges, the rate of detection of true edges will be more and the false edge detection will be less. So, relatively compared to the Gaussian filter by using the Adaptive filter yields better results.**

***Keywords*— Edge detection, Noise, Adaptive filter, Smoothing**

I. INTRODUCTION

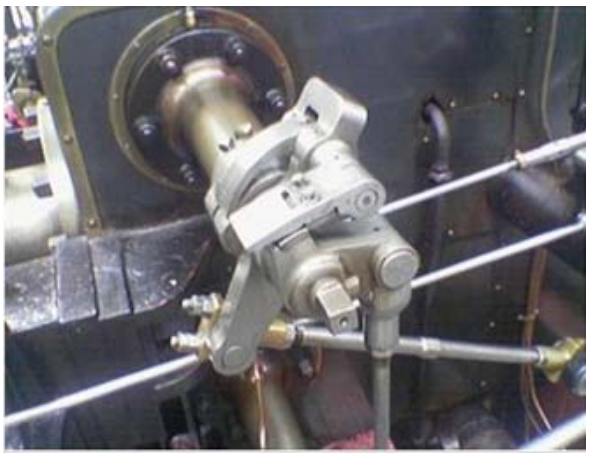
Edge detection is one of the most commonly used technique in the image analysis. It is a critical element in image processing, since the edges contains major information of the image[7]. An edge is a part of an image and can be described as a boundary between two regions separated by distinction in strong intensity values of the pixels. Edge detection can be defined as the process of finding and tracing sharp discontinuities in an image[1]. The discontinuities are unexpected changes in pixel value which characterize boundaries of the objects in an image. It has been widely used in image segmentation, pattern recognition and image analysis [4]. There are several edge detection techniques. They are Sobel, Prewitt, Robert's cross operator and Canny edge detection techniques. Among them the most popular and finest edge detector is canny edge detector[1] which uses Sobel edge detection technique as a part of it's process.

II. PROBLEM STATEMENT

Edge detection is hard if an image contains noise. Removing or minimizing the noise in an image results in blurring of image and distortion of edges. This results in less accurate localization of the detected edges. In the Canny edge detection, the Gaussian smoothing filter is used for eliminating noise in the image. Since the Gaussian filter blurs the whole image which makes the image unclear. In the Fig.1 if the image (a) is smoothened with Gaussian filter to remove noise the resulting image will be as shown in Fig. 1(b). In the Fig. 1(b) the edges are distorted so that, the localization of edges will not be accurate. This reduces the accuracy of edge detection.

II. OBJECTIVE

The objective is that to increase the accuracy of the edge detection. So we propose Adaptive smoothing filter to reduce the noise in the image. Since the Adaptive filter preserves the sharp edges in the image while smoothing, the accuracy in detecting the edges will not be reduced.



(a)

(b)

Fig. 1: (a) Original Image (b) Blurred image using Gaussian filter

III. PROPOSED METHOD

The proposed method is a variant of the Canny edge detection technique. In Canny's method[3] the first step is to smooth the image to eliminate the noise in the image. For this task Gaussian smoothing filter is adopted which does not preserves the edges. So we adopt Adaptive filter which preserves the edges of the objects while smoothing the image. The steps of the Image edge detection using Adaptive filter technique are as follows:

1) Use the Adaptive filter for Smoothing image: The first step is to remove or minimize noise in the original image before trying to locate and detect any edges .The Adaptive smoothing [2] is a class of typical nonlinear smoothing technique. The adaptive filter is based on the neighborhood of each and every pixel for their mean value which preserves the edges in the given image. The algorithm for smoothing the image using Adaptive filter[2] is as follows:

Algorithm:

1) Initialize
   a) Input image
   b) Initialize termination condition, t (number of iterations)
2) Find the images that are equivalent to original image in red, blue and green color Spaces
3) Find the number of rows and columns of the image
4) Find the eight neighborhood pixels of each pixel
5) Compute the difference(d_i) of each pixel with it's neighboring pixels in R,G and B color spaces respectively
6)Normalize the d_i values between 0 and 1
7) Compute $C_i = (1-d_i)^t$
8) Multiply each C_i with corresponding neighborhood pixel in R,G and B color spaces respectively
   repeat steps 4 to 7 for each pixel in the image i.e rows x columns
9) Concatenate the above three images(R,G and B color spaces)
   repeat steps 2 to 8 until t is satisfied.

2) Compute the gradient magnitude and direction of the edges in the image: After removing noise, we have to find the edge strength and direction by taking the gradient of the image[5]. This is done by the Sobel operator by applying on the image. Then, the approximate absolute gradient magnitude at each pixel is found. This can be calculated by using the formula

G = Gx + Gy

Where G is gradiant of pixel
Gx is gradiant of pixel in x-direction
Gy is gradiant of pixel in y-direction
Theta = invtan (Gy / Gx)

Where Theta is the direction of edge to trace.

Sx=

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

Sy=

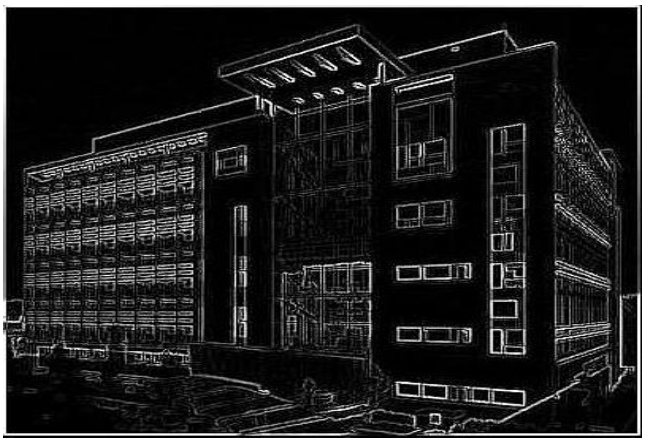
+1	+2	+1
0	0	0
-1	-2	-1

Fig. 2: Sobel gradient operators

3) Generate thin edges: To accomplish this we have to use Non-maximum suppression[1].By using the edge direction which is calculated in the step2 we move along the edge and neglect the pixel that does not belongs to the edge. Obviously this gives a thin line in the output image.
4) Eliminate streaking: After generating the edges we have to eliminate the discontinuities in the edge lines. These discontinuities in the edge lines are known as streaking[6].For this purpose we adopt Dual-threshold algorithm which is used as a means of eliminating streaking.

IV. RESULTS & DISCUSSION

(a)



(b)

(c)

Fig.: 3 (a) Original Image (b) Result of Edge detection using Adaptive Filter (c) Result of Canny edge detection

From the above result it is clear that by comparing the Fig. 3(b) and 3(c) with 3(a) which is the original image, the edges in the Fig. 3(c) are not continuous compared to Fig. 3(b). Similarly in Fig. 3(b), the result of proposed technique the windows edges are in rectangular shape as in original image. But in the Fig 3(c), which is result of canny edge detection technique the shape of windows is not exactly as in original image.

V. CONCLUSION

Hence from the results it is clear that by using the Adaptive filter for edge detection yields better result than the canny edge detection which uses Gaussian filter for smoothing.

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