Various Methods for Edge Detection in Digital Image Processing

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Abstract
In computer and image processing edge detection playing a vital role. It is problems of fundamental importance in image analysis edge characterizes object boundaries and are useful for segmentation, registration and identification of objects in a scene. In this paper we discuss feature extraction. Firstly we apply Gaussian noise removal method for removing the noise from image collected. Secondly some edge detection operator such as Binary Morphology, canny edge detection, log edge detection, differential edge detection are applied and analyzed. According to simulated result the advantages and disadvantages of these edge detection operators are compared. It is shown that the binary morphology operator can obtain better edge detection.

Keywords
Edge Detection, Digital image processing, operator, noise removal, Gaussian noise model.

I. Introduction

The edge is a set of those pixels whose grey have the step change and rooftop change, and it exists between object and background object and object region and region between element and element. When image is acquired the factors as projection, mix, aberrance and noise are produced.

Above mention factors bring on image features blur and distortion, due to this it is difficult to detect edge. In process of noising we use a "Gaussian Noise removal of image on the local feature" after then we apply different operators' e.g Binary Morphology operators, canny operator, log operator, and differential operator for edge detection [1].

The image can be affected by noise inevitably in the process of saving and transmission and noise causes the negative effect on the image processing and analysis.

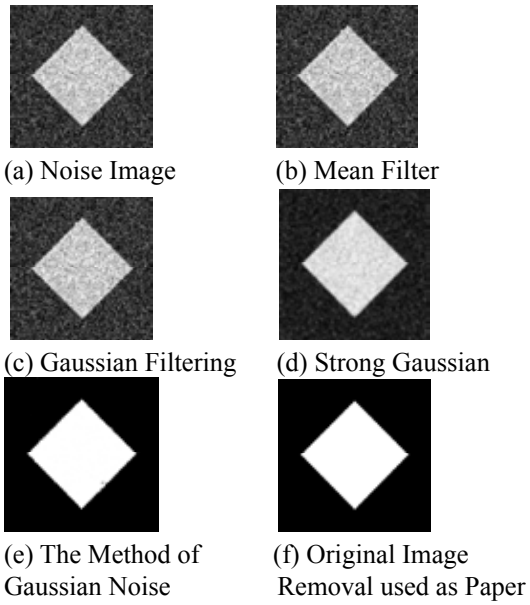
For removing these effects, it is necessary to remove or decrease the noise, at the same time conserve the image information as much as possible, such as edge and the texture

II. Image De-noising

Gaussian noise model has a very significant feature, it does not matter how much the variance and histogram of the original image is it will always follows the Gauss distribution.

In Gaussian method firstly according to the feature that in the image the local neighbourhood pixel in the same object are smooth, we estimate whether the pixel point is on the image edge, the noise point or the edge texture point [4]. Then according to the local continuity of the image edge and the texture feature, using the continuity of the image. And then locate the noise points.

Lastly for the noise which is not on the edge or the texture. Using the mean value of the non-noise points in the adaptive neighbourhood to eliminate the noise, and for the noise on the edge and texture region just using the pixel points of the neighbourhood edge and texture to smooth. With the help of this method we can remove the Gaussian noise in the image well and the number of the residual noise points decreases sharply.



(a) Noise Image (b) Mean Filter
(c) Gaussian Filtering (d) Strong Gaussian
(e) The Method of Gaussian Noise (f) Original Image Removal used as Paper

Fig. 1 :

III. Edge Detection

Edge detection is a problem of fundamental importance in image analysis. In typical images, edges characterize object boundaries and are therefore useful for segmentation, registration and identification of objects in a scene. In other words we can say that an edge is not a physical entity, just like a shadow. It is where the picture ends and the wall starts. It is where the vertical and the horizontal surfaces of an object meet. It has no width because between a bright window and the darken of the right. Basically edge detection contains the following two parts:-

(1) Using edge operators the edge point set extracted.
(2) Some edge points in the edge point set are removed then the obtained edge points are connected to be a line [2].

Commonly we use following operators for edge detection e.g. Binary morphology, Canny, Log and Differential operator.

A. Binary Morphology

Binary image is also known as black and white image. As we know that object can be easily identified in black background. In this method we can apply binary image and mathematical morphology, so it is known as Binary morphology.

The basic idea in this method is that to measure and extract the corresponding shape from image with structural elements having stated form. So that the image analysis and processing can be completed [6].The method as follows:

Suppose that the region is shown in form of the set A. Its border is $\beta(A)$. B is an appropriate structure element, and it is symmetrical around the origin [7]. Firstly we corrupt A with B

Recorded as $A \oplus B = \{x | (B)_x \subseteq A\}$, where $(B)_x$ is a translation

B along the vector. The interior of region is available with $A \oplus B$.

And A-(A⊕B) is the borderline naturally. Then β (A) is obtained. The equation of edge extraction can be said

β (A) = A- (A⊕B).

Structuring element is larger; the edge gained will be wider.

B. Canny operator

This method is not easily disturbed by noise and can keep the good balance between noise and edge detection. It can detect the true weak edge. For two-dimensional image, canny operator can produce two information including the border gradient direction and intensity [3]. Canny operator is actually using templates of different directions to do convolution to the image respectively. Then the mostly direction is taken. From the viewpoint of positioning accuracy, canny operator is better than the other operators. The Canny operator is a sort of new edge detection operator [9]. It has good performance of detecting edge, which has a wide application. The Canny operator edge detection is to search for the partial maximum value of image gradient. The gradient is counted by the derivative of Gauss filter. The Canny operator uses two thresholds to detect strong edge and Weak edge respectively.

C. Log Operator

The Log operator is a linear and time-invariant operator. It detects edge points through searching for spots which two-order differential coefficient is zero in the image grey levels. The Log operator is the process of filtering and counting differential coefficient for the image. It determines the zero overlapping position of filter output using convolution of revolving symmetrical Log template and the image [10]. The Log operator's template is shown in Fig 2.

0	-1	0
-1	4	-1
0	-1	0

-1	-1	-1
-1	8	-1
-1	-1	-1

Fig. 2 : Log Operators Table

In the detection process of the Log operator, we firstly pre-smooth the image with Gauss low-pass filter, and then find the steep edge in the image making use of the Log operator. Finally we carry on Binarization with zero grey level to give birth to closed, connected outline and eliminate all internal spots [8]. But double pixels boundary usually appears using the Log operator to detect edge, and the operator is very sensitive to noise. So the Log operator is often employed to judge that Edge pixels lie in either bright section or dark section of the image.

D. Differential Operator

Differential operator can outstand grey change. There are some points where grey change is bigger. And the value calculated in those points is higher applying derivative operator [5]. So these differential values may be regarded as relevant 'edge intensity' and gather the points set of the edge through setting thresholds for these differential values.

IV. Simulative result analysis

In order to know about the advantages and disadvantages of these edges detection operators, we detect edge using these different operators respectively. The simulation results are shown in Fig. 3.

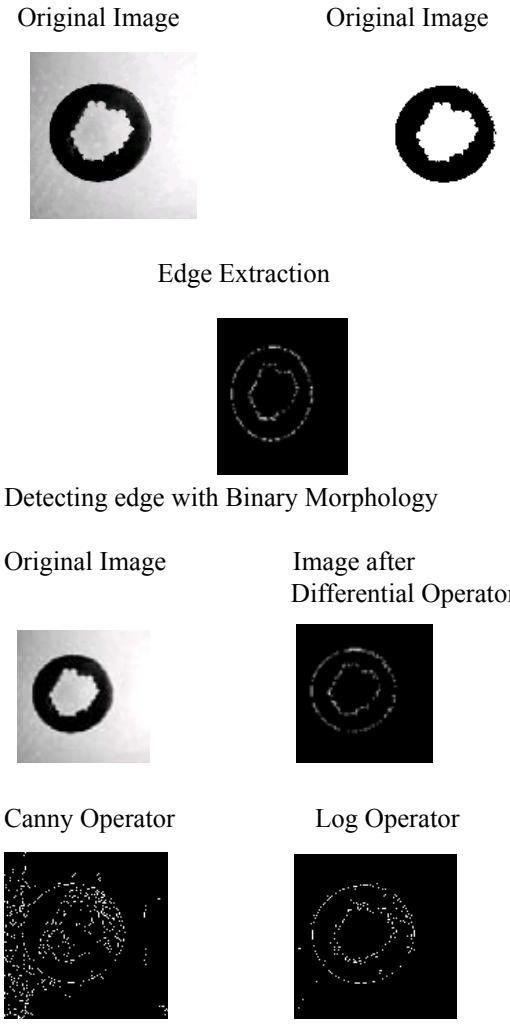


Fig. 3 : Simulation Results

From the simulation results we can conclude that: the effect of detecting edge with Sobel operator after Gaussian de-noising and with Binary morphology directly is better. So these two methods can be used. But finally we choose Binary Morphology method based on specific measurement errors.

V. Conclusion

These edge detection operators can have better edge effect under the circumstances of obvious edge and low noise. But the actual collected image has lots of noises. So many noises may be considered as edge to be detected. In order to Solve the problem; wavelet transformation is used to de noise in the paper. Yet its effect will be better if those simulation images processed above are again processed through edge thinning and tracking. Although there are various edge Detection methods in the domain of image edge detection certain disadvantages always exist. For example, restraining noise and keeping detail can't achieve optimal effect simultaneously. Hence we will acquire satisfactory result if choosing suitable edge detection operator according to specific situation in practice.

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