Edge Detection Techniques using Character Segmentation and Object Recognition

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Abstract: *Edge is a basic feature of image. The image edges include rich information that is very significant for obtaining the image characteristic by object recognition. Edge detection refers to the process of identifying and locating sharp discontinuities in an image. So, edge detection is a vital step in image analysis and it is the key of solving many complex problems. In this paper, the main aim is to study the theory of edge detection for image segmentation using various computing approaches based on different techniques which have got great fruit. The image is stored in the form of a matrix and the output is displayed in the form of detected images. Experimental Results are carried out in MATLAB.*

Keywords: Edge Detection, License Plate Location, Character segmentation, Character recognition, Image segmentation

1. Introduction

Edge detection is one of the most commonly used operations in image analysis. An edge is defined by a discontinuity in gray level values. In other words, an edge is the boundary between an object and the background. The shape of edges in images depends on many parameters. There are an extremely large number of edge detection operators available, each designed to be sensitive to certain types of edges .The geometrical and optical properties of the object, the illumination conditions, and the noise level in the images.

Operators can be optimized to look for horizontal, vertical, or diagonal edges. Edge detection is difficult in noisy images, since both the noise and the edges contain high- frequency content. Attempts to reduce the noise result in blurred and distorted edges. Operators used on noisy images are typically larger in scope, so they can average enough data to discount localized noisy pixels. Extensive research has been done in creating many different approaches and algorithms for image segmentation, but it is still difficult to assess whether one algorithm produces more accurate segmentations than another, whether it be for a particular image or set of images, or more generally, for a whole class of images. Every year new edge detection algorithms are published. This paper analysis some recent approaches for detecting edges for segmentation.

This paper is organized as follows. Section 2 is for the purpose of providing some information about edge detection for image segmentation. Section 3 is focused on showing the challenges in edge detection and edge classification methods. Section 4 explains different computing approaches to edge detection and sample implementation results. Section 5 concentrates on comparison of various edge detection methods. Section 6 presents the conclusion.

2. Edge Detection for Character Segmentation

The importance of the classification is that it simplifies several problems in Artificial Vision and Image Processing, by associating specific processing rules to each type of edges. There are many ways to perform edge detection. However, the majority of different methods may be grouped into two categories:

Gradient based Edge Detection

The gradient method detects the edges by looking for the maximum and minimum in the first derivative of the image.

Laplacian based Edge Detection

The Laplacian method searches for zero crossings in the second derivative of the image to find edges. An edge has the one-dimensional shape of a ramp and calculating the derivative of the image can highlight its location.

2.1. Classification of Edges and Its Detection Methods for Segmentation of Individual Characters

The Classification that we introduce in this paper is based on the behavioural study of these edges with respect to the following differentiation operators:

- Classical or Gradient based edge detectors (first derivative)
- Zero crossing (second derivative)
- Laplacian of Gaussian (LoG)
- Gaussian edge detectors
- Colored edge detectors

2.1.1. Sobel Operator

It performs 2-D spatial gradient measurement on an image and so emphasizes regions of high spatial frequency that correspond to edges. The convolution mask of Sobel

operator is as shown Figure 1, which are used to obtain the gradient magnitude of the image from the original.

-1	0	+1	+1	+2	+1
-2	0	+2	0	0	0
-1	0	+1	-1	-2	-1
Gx			Gy		

Figure 1. Sobel Mask

2.1.2. Prewitt Operator

The prewitt operator is an approximate way to estimate the magnitude and orientation of the edge. The convolution mask of prewitt operator is shown in figure 2.

+1	+1	+1	-1	0	+1
0	0	0	-1	0	+1
-1	-1	-1	-1	0	+1
Gx			Gy		

Figure 2. Prewitt Mask

2.1.3. Roberts Operator

It performs 2-D spatial gradient measurement on an image. It highlights regions of high spatial frequency which often correspond to edges. The cross convolution mask is shown in figure 3.

+1	0	0	+1
0	-1	-1	0
Gx		Gy	

Figure 3. Roberts Mask

2.1.4. Laplacian of Guassian (LoG) Operator

The Laplacian is a 2-D isotropic measure of the 2nd spatial derivative of an image. The Laplacian of an image highlights regions of rapid intensity change and is therefore often used for edge detection..

1	1	1	-1	2	-1
1	-8	1	2	-4	2
1	1	1	-1	2	-1
Gx			Gy		

Figure 4. Laplacian of Guassian(LoG) Operator

The Laplacian is often applied to an image that has first been smoothed with something approximating a Gaussian Smoothing filter in order to reduce its sensitivity to noise. The operator normally takes a single gray level image as input and produces another gray level image as output

2.1.5. Canny Operator

It is a method to find edges by isolating noise from the image without affecting the features of the edges in the image and then applying the tendency to find the edges and the critical value for threshold are as shown Figure 5.

-1	0	+1	+1	+2	+1
-2	0	+2	0	0	0
-1	0	+1	-1	-2	-1
Gx			Gy		

Figure 5. Canny Operator

The magnitude, or edge strength, of the gradient is then approximated using the formula:

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

3. Challenges in Classification and Detection Methods

Extraction and segmentation has to deal with the following challenges:

(1) The changes in lighting conditions
(2) The background is dynamic
(3) Luminance and geometrical features,
(4) Noise volume has a great impact on shaping the edge.
(5) Missing to detect existing edges
(6) Detecting edges where it does not exist (false edge) and
(7) Position of the detected edge to be shifted from its true location (shifted edge or dislocated edge

4. Implementation and Results

Implementation of the techniques was done on different images. Colored images were converted into gray scale image and then segmentation and recognition methods were applied. A sample grey scale image (figure 6 & 7) is considered for segmentation and object recognition using Sobel, Prewitt, Roberts, Canny, LoG .The segmented image and recognized image using different edge operator's techniques are shown in figure 6 & 7.

Figure 6. Original Image
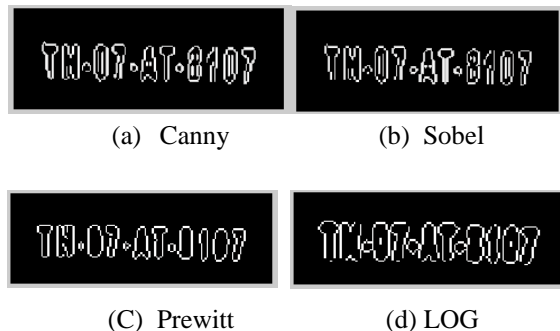
(a) Canny   (b) Sobel

(C) Prewitt   (d) LOG

Figure 6: Result of application of the four different edge detectors

Figure 7: Original Image

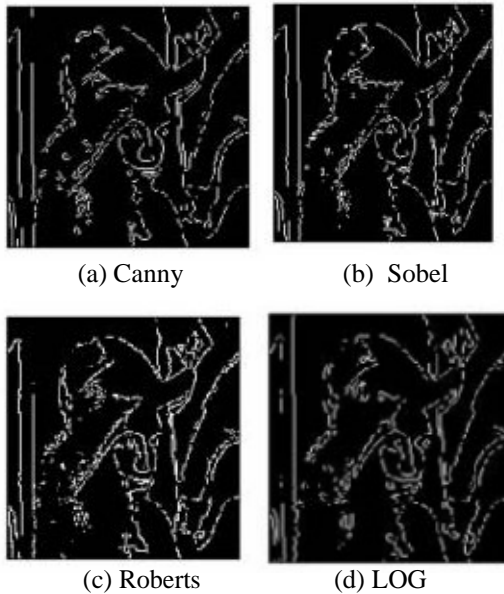(a) Canny   (b) Sobel

(c) Roberts   (d) LOG

Figure 7: Result of application of the four different edge detectors

5. Advantages and Disadvantages of Edge Detector

As edge detection is a fundamental step in computer vision, it is necessary to point out the true edges to get the best results from the matching process. That is why it is important to choose edge detectors that fit best to the application. In this respect, we first present some advantages and disadvantages of Edge Detection Techniques with in the context of our classification in Table 1.

Operator	Advantages	Disadvantages
Classical (Sobel, Prewitt, Kirsch…)	Simplicity, Detection of edges and their orientations	Sensitivity to noise, Inaccurate
Zero Crossing (Laplacian, Second directional derivative)	Detection of edges and their orientations, Having fixed characteristics in all directions	Reresponsing to some of the existing edges, Sensitivity to noise
Laplacian of Gaussian (LoG) (Marr-Hildreth)	Finding the correct places of edges, Testing wider area around the pixel	Malfunctioning at corners, curves and where the gray level intensity function varies, Not finding the orientation of edge because of using the Laplacian filter
Gaussian (Canny, Shen-Castan)	Using probability for finding error rate, Localization and response, Improving signal to noise ratio, Better detection specially in noise conditions	Complex Computations, False zero crossing, Time consuming
Colored Edge Detectors	Accurate, More efficient in object recognition	Complicated, Complex Computations

6. Conclusion

The purpose of this paper is to present a survey and test result of my coding representing various approaches for image segmentation based on edge detection techniques. With the help of presented technique in this thesis, can detect the number of any plate just by giving as input the image of the plate and number gets extracted and recognized. Here present simplest of all and with lesser complexity to detect the numbers. The image is stored in the form of a matrix and the output is displayed in the form of detected numbers. Experimental Results are carried out in MATLAB.

In future, we plan to design a novel approach for Edge Detection, Image Recognition and Character Segmentation with Data Mining Classification Techniques. In which we prove that the data mining technique is more efficient and accurate one compared with other techniques.

References

[1] Raghuraj Singh, C. S. Yadav, Prabhat Verma,

Vibhash Yadav, "Optical Charactern Recognition (OCR) for Printed Devnagari Script Using Artificial Neural Network", International Journal of Computer Science & Communication, January-June 2010

[2] Nadira Muda, Nik Kamariah Nik Ismail, Siti Azami Abu Bakar, Jasni Mohamad ZainFakulti Sistem Komputer & Kejuruteraan Perisian, "Optical Character Recognition By Using Template Matching (Alphabet)".

[3] Kumar Parasuraman, and P.Vasantha Kumar "An Efficient Method for Indian Vehicle License Plate Extraction and Character Segmentation", 2010 IEEE International Conference on Computational Intelligence and Computing Research

[4] H.J. Choi, 1987, "A Study on the Extraction and Recognition of a Car Number Plate by Image Processing," Journal of the Korea Institute of Telematics and Electronics, Vo1.24, pp. 309-3 15,1987.

[5] Hontani, H., and Koga, T., (2001), "Character extraction method without prior knowledge on size and information," Proceedings of the IEEE International Vehicle Electronics Conference (IVEC'01), pp. 67-72.

[6] Dr. P.K.Suri, Dr. Ekta Walia and Er. Amit Verma , "Vehicle Number Plate Detection using Sobel Edge Detection Technique ", IJCST Vol. 1, Issue 2, December 2010.

[7] A. Huertas and G. Medioni, "Detection of intensity changes with sub-pixel accuracy using Laplacian-Gaussianmasks" IEEE Transactions on Pattern Analysis and Machine Intelligence. PAMI-8(5):651-664, 1986.

[8] N. Senthilkumaran1 and R. Rajesh2 "Edge Detection Techniques for Image Segmentation – A Survey of Soft Computing Approaches" International Journal of Recent Trends in Engineering, Vol. 1, No. 2, May 2009

[9] Wen-Xiong Kang, Qing-Qiang Yang, Run-Peng Liang (2009), "The Comparative Research on Image Segmentation Algorithms," First International Workshop on Education Technology and Computer Science.

[10] V. Torre and T. Poggio, "On edge detection," IEEE Trans. Pattern Anal. Machine Intell., Vol. 8, No. 4, pp. 147-163, 1986.

[11] Alina Doringa, Gabriel Mihai, Dan Burdescu, "comparison of two image segmentation algorithms" Second international conference on advances in multimedia, IEEE computer society, pp. 185-190 (2010).

[12] H.S. Kim, et al., 1991, "Recognition of a Car Number Plate by a Neural Network," Proceedings of the Korea Information Science Society Fall Conference, Vol. 18, pp. 259-262, 1991.

[13] S.K. Kim, D.W. Kim, and H.J. Kim, 1996, "A Recognition of Vehicle License Plate Using a Genetic Algorithm Based Segmentation," Proceedings of 3rd IEEE International Conference on Image Processing, V01.2., pp. 661-664, 1996

[14] Park, S. H., Kim, K. I., Jung, K., and Kim, H. J., (1999), "Locating car license plates using neural network," IEE Electronics Letters, vol.35, no. 17, pp. 1475-1477.

[15] Tavsanoglu V, Saatci E. "Feature extraction for character recognition using Gabor-type filters implemented by cellular neural networks," Proceedings of the 2000 6th IEEE International Workshop on Cellular Neural Networks and their Applications, IEEE. 2000, pp.63-8. Piscataway, NJ, USA.

[16] Yoshimura H, Etoh M, Kondo K, Yokoya N."Grayscale character recognition by Gabor jets projection," Proceedings 15th International Conference on Pattern Recognition, ICPR-2000. IEEE Comput. Soc. Part vol.2, 2000, pp.335-8 vol.2, Los Alamitos, CA, USA.

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