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Edge Detection Technique for Topographic Image of an Urban / Peri-Urban Environment Using Smoothing Functions and Morphological Filter

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***Abstract*— Edge detection from images is one of the most important concerns in digital image and video processing. The extraction of features such as edges and curves from an image is useful for many purposes. Features, such as edges and curves are useful in i) texture analysis ii) 3-D surface restructuring iii) segmentation iv) image matching etc. Edges are important features in an image since they represent significant local intensity changes. They provide important clues to separate regions within an object or to identify changes in illumination. Most topographic image enhancement applications use edge detection as a preprocessing stage for feature extraction. Topographic images can be distorted with point noise. Due to the overlapping of regions, well known edge detection algorithms are not capable to extract all edges. The real problem is how to enhance noisy topographic images and simultaneously extract the edges.**

It consists of the implementation of various image processing algorithms like edge detection using Sobels, Prewitt, Canny and Laplacian and so on. Different technique is reported to increase the performance of the edge detection. The algorithmic computations in real-time may have high level of time based complexity and Image processing system for the implementation Canny's edge detector is proposed here.

It is observed that techniques which follow the stage process of detection of noise and filtering of noisy pixels achieve better performance than others.

***Keywords*— Digital Image Processing, Edge Detection, Canny Edge Detector, Noise, Morphological Filters, Smoothing.**

I. INTRODUCTION

The topographic i.e. aerial image is widely investigated research topic among geoscientist, as well as a very crucial subject for enforcing administrative and legal policies. Edge detection techniques are played vital role in topographic image processing. Edges are boundaries between different textures. Edge also can be defined as discontinuities in image intensity from one pixel to another. The edges for an image are always the important characteristics that offer an indication for a higher frequency. Detection of edges for an image may help for image segmentation, data compression, and also help for well matching, such as image reconstruction and so on [1]. Variables involved in the selection of an edge detection operator include Edge orientation, Noise environment and Edge structure [2]. Many edge detection algorithms have been developed based on computation of the intensity gradient vector, which, in general, is sensitive to noise in the image. In order to suppress the noise, some spatial averaging may be combined with differentiation such as the Laplacian of Gaussian operator and the detection of zero crossing. Canny [3] derived analytically optimal step edge operators and showed that the first derivative of Gaussian filter is a good approximation of such operators.

In this work, the application and performance of sophisticated and automated edge detection techniques is assessed using spectral and spatial information from high resolution images in an urban / peri-urban environment, as a stand-alone methodology and as a combined methodology with other methods for noise removal i.e. morphological filtering and smoothing and techniques for extracting urban features of interest (building boundaries, road segments, etc).

Traditional edge detector methods such as Roberts Cross, the Sobel Operator and Prewitt Operator failed to perform adequately in such application due to the noisy nature of topographic image. They are not able to detect the edges of the object while removing all the noise in the image [4]. Hence for this work Canny edge detectors method is used.

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II. METHODOLOGY

An The methodology for edge detection technique for topographic image of an Urban/Peri-Urban environment using smoothing functions and morphological filter involves four stages as below.

A. Edge detection.
B. Complement image.
C. Morphological Open operator.
D. Morphological Erosion.

Fig.1 a) Original topographic image

b) Canny edge image

A. Edge Detection

Canny finds edges by looking for local maxima of the gradient of f(x, y). The gradient is calculated using the derivative of a Gaussian filter. The method uses two thresholds to detect strong and weak edges, and includes the weak edges in the output only if they are connected to strong edges. Therefore, this method is more likely to detect true weak edges.

The implemented Canny edge detector presented the best performance both visually and quantitatively based on the measures such as mean square distance, error edge map and signal to noise ratio. Using the implemented Canny edge detector as an enhancement tool for remote sensing images, the result was robust and achieved a very high enhancement level [4].

For topographic image edge detection an image of Nanded city in Maharashtra, India is considered (image source www.googlemap.com).

B. Complement Image

This process is to transform an edge image into regions as well as reduce unnecessary noise such as spurs to provide a clean region image [5]. Applying binary invert operator to the binary edge image gives a region image in binary with 1's where a region found a 0's elsewhere is given. In the complement of a binary image, black becomes white and white becomes black. This operation facilitates further morphological filtering and smoothing operations which are carried out in next phases for fine edge detection.

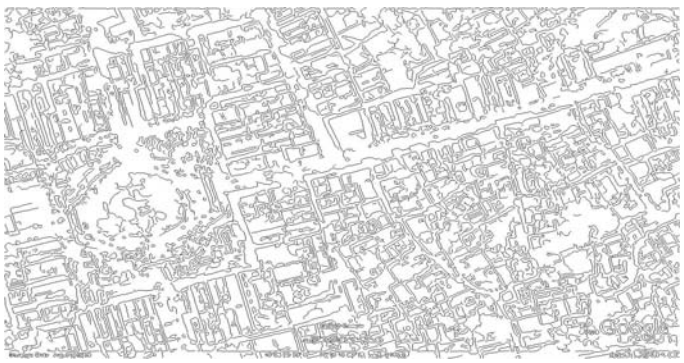

Fig.2 An inverted edge image

C. Morphological Open operator

Morphology relates to structure or form of objects. Morphological filtering simplified segmented images by smoothing out object outlines using filling small holes, eliminating small projections. Primary operations are dilation and erosion. These operations use a structuring element which determines exactly how object will be dilated or eroded. Dilation process expanding image objects by changing pixels with value of "0" to "1". On the other hand the erosion process shrinking binary objects by changing pixels with a value of "1" to "0". There is also a combination of dilation and erosion called opening and closing. Opening is erosion followed by dilation. Closing is a dilation followed by erosion.

Morphological edge detection algorithm selects appropriate structuring element of the processed image makes use of the basic theory of morphology including erosion, dilation, opening and closing operation and synthesization operations of them get clear image edge. The effect of erosion and dilation operations is better for image edge by performing the difference between processed image and original image, but they are worse for noise filtering. As opposed to erosion and dilation, opening and closing operations are better for filtering [6].

Then, in order to remove spike noise regions, opening operator [7] using a 3 x 3 square structuring element is applied to the region image for three times. The result is shown in the figure below.

Fig.3: An edge image obtained by operating three times morphological open operator.

D. Morphological Erosion

The morphological erosion operator is applied for localisation of edges [8] on Fig.3 image that shrinks region pixels in size which make clear image as sown below.

Fig.:4 A Eroded region image.

III. CONCLUSION

The implemented Canny edge detector present the best performance both visually and quantitatively based on the measures such as mean square distance, error edge map and signal to noise ratio. This paper considers the morphological open function with 3 X 3 square structural elements for localisation of the detected edges. Canny edge detector algorithm analyses how the shape of a smoothing function affects the localisation of detected edges. Using the implemented Canny edge detector as an enhancement tool for topographic images, the result was robust and achieved a very enhancement level.

REFERENCES

[1] H. Voorhees and T. Poggio," Detecting textons and texture boundries in natural images" ICCV 87:250-25,1987

[2] 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.

[3] Canny, J., "A Computational Approach to Edge Detector", IEEE Transactions on PAMI, pp679-698, 1986.

[4] Wang Luo, "Comparison for Edge Detection of Colony Images" IJCSNS International Journal of Computer Science and Network Security, VOL.6 No.9A,, pp211-215, September 2006.

[5] N.K.Deshmukh, "Feature Extraction and Recognition of Topographic Object using Primitive Objects.", M.Phil. dissertation, 2009.

[6] Mohamed Roushdy, "Comparative Study of Edge Detection Algorithms Applying on the Grayscale Noisy Image Using Morphological Filter", GVIP special issue on edge detection, pp53-59,2007.

[7] R.Fisher, S.Perkins, A.Walker, E.Wolfart, "Morphological – Erosion", The HIRP2 team, September 2000.

[8] R.Fisher, S.Perkins, A.Walker, E.Wolfart, "Morphological – Opening", The HIRP2 team, September 2000.