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A Survey on Edge Detection Methods for Image Preprocessing

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Abstract: Edge detection is a technique of image processing used to identify points in a digital image with discontinuities, simply to say, sharp changes in the image brightness. Edge detection algorithm finds numerous applications in image segmentation and data extraction in areas such as image processing, computer vision, and machine vision In This paper, certain important methods on edge detection generally applied in image preprocessing has been presented. A detailed analysis of various edge detection algorithm has been covered with suitable illustration were ever necessary. The paper also serves as aid for researchers working in this direction.

Key Words: Edge, Image Processing, Edge Detection.

INTRODUCTION

Edges are remarkable local changes of intensity in a digital image. An edge can be defined as a set of connected pixels that forms a boundary between two disjoint regions. There are three types of edges viz., Horizontal, Vertical and Diagonal edges. Edge Detection is a method of segmenting an image into regions of discontinuity. It is a widely used technique in digital image processing tasks such as Pattern recognition, Image morphology, Feature extraction, etc. Edge detection allows users to observe the features of an image for a significant change in the gray level. This texture indicates the end of one region in the image and the beginning of another as shown in Fig.1. It reduces the amount of data in an image and preserves the structural properties of an image [1].

There are two types of Edge Detection Operators:

- **Gradient –** based operator which computes first-order derivations in a digital image like, Sobel operator, Prewitt operator, Robert operator.
- **Gaussian –** based operator which computes second-order derivations in a digital image like, Canny edge detector, Laplacian of Gaussian [1][2].

Fig 1. (a) Original image b) Edge detection image

RELATED WORKS

Adaptive Image Edge Detection Algorithm using Canny Operator. The Problem Statement is to Implement a method to combine global and local edge detection to extract edge . In {3], author have developed a new algorithm using canny operator is used for extracting edge. The different Implementation Stages are.1. Canny algorithm uses 2D Gauss function derivative for handling the original image. 2. Amplitude and direction of the gradient are calculated.3. The non-maxima suppression for the gradient magnitude is conducted.4. Double threshold algorithm is used to detect and link edge.5. Adaptive smoothing algorithm is implemented to improve canny edge detection [3].

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The authors have adopted an improved method that combines canny operator smoothing algorithm with local edge detection algorithm to edge detection of an image. The simulation experiments show that the edge detection method that adaptive filtering improved canny operator combines with local weighted k- average method, solving the problems which exist in the traditional Canny edge detection algorithm. As shown in the figure 2, the algorithm can extract fully image edge whose detail is richer, positioning is more accurate, and it is not affected by noise easily [2][3].

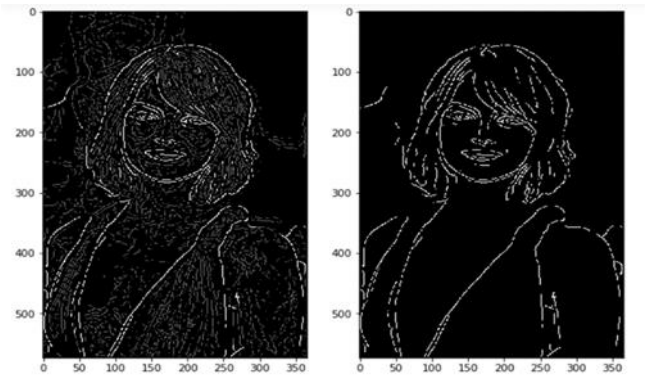

Fig 2. Traditional Canny extracts edge Adoptive Canny extracts edge

Edge Detection Operator for Underwater Target Image.

The Problem Statement is to implement a method to detect edges for underwater images. In [4][5] authors have considered A new feature based on wavelet transform Edge extraction algorithm is used to detect edges for underwater images. The different Implementation Stages are 1. The Multi-scale edge detection is carried out based on the local maximum value of wavelet transform. 2. Input image signal is taken. 3. Supposing the maximum number of decomposition steps given is j, and the image is wavelet decomposed. 4. The decomposed image is reconstructed according to certain rules. 5. By further reconstructing the extracted edges the coarse pixel is owned. 6. The result 0 f is denoised and binarized to obtain a binary image that is the extracted edge image[4][5].

The authors have adopted Edge detection as a classical research with the aim of features of underwater target image, wavelet multi-scale edge detection algorithm is proposed in this paper. The feature extraction based on wavelet transform not only retains the important detail edge information in the image, but also eliminates a large number of remaining edges and false edges. As shown in fig 3 the feature edge of the image is extracted effectively, so it provides reliable information for the subsequent target recognition [4][8].

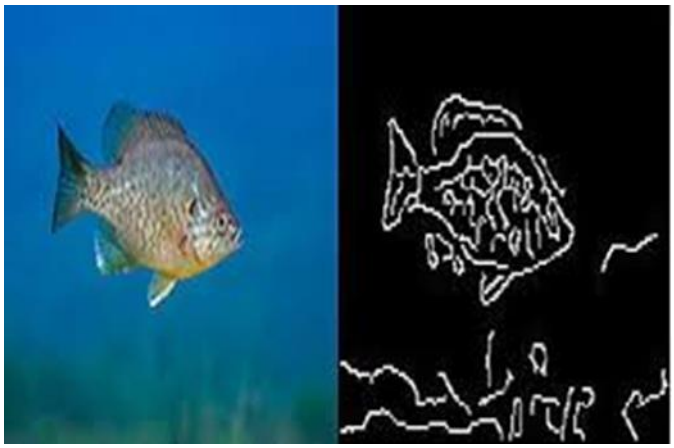

Fig 3. Original image on the left Wavelet transform Edge extraction image right

Mathematical Morphological Edge Detection for Remote Sensing Images:

The Problem Statement is to Analyze and process digital images and implement a technique for Noise Reduction and Edge Detection and compare it with Sobel Edge detector, Prewitt edge detector, Laplacian of Gaussian edge detector and Canny edge detector. In [5], authors have derived Mathematical Morphology is a technique for analysis and processing of geometrical structures, based on set theory. By using this technique, image can be enhanced and edges

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can be detected. The different Implementation Stages are 1. Remote sensing image will be taken. 2.Structuring element of various sizes in different directions will be applied with morphological operators. 3.Edges are found by taking differences between eroded and dilated image in all directions. 4.Average of edges in all directions will be calculated. 5. If there's any line spacing gap in resultant edge, image will be dilated again and if required, intensity of the image will be increased [5].

The authors have adopted line spacing gap in resultant edge, then the intensity of the image will be increased, if required. The results are compared with traditional techniques. From the results, it is concluded that the edge detection using mathematical morphology is more efficient than the traditional methods. The main advantages of mathematical morphology are direct geometric interpretation, simplicity and efficiency in hardware implementation [6][7].

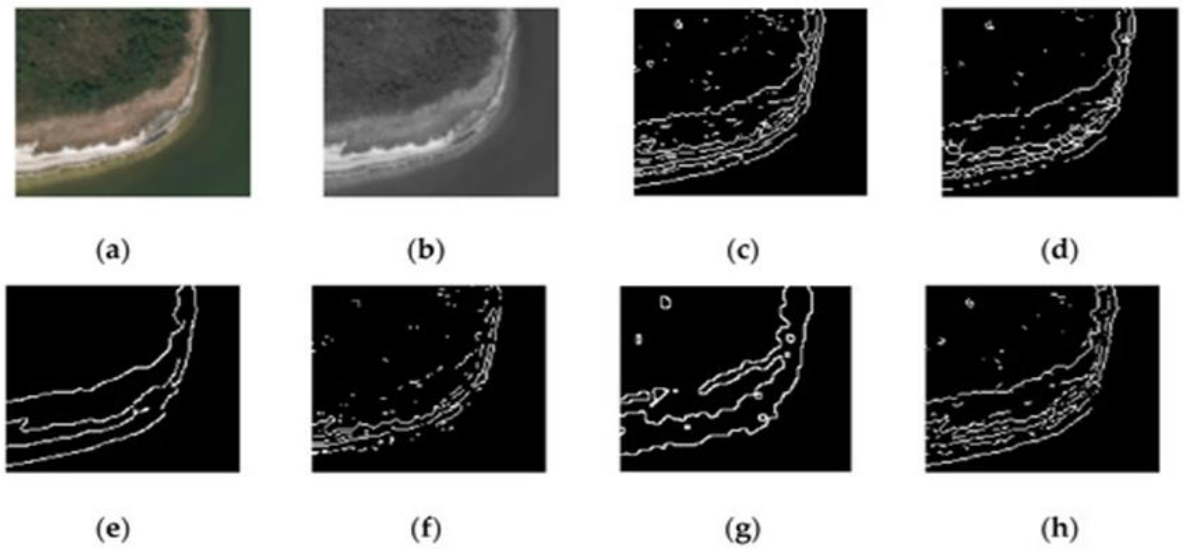

Figure 4. The region of satellite image after edge detection: (a) original color image (Landsat-7 image courtesy of the U.S. Geological Survey); (b) Y component of the original image; (c) Prewitt edge map; (d) Kirsch edge map; (e) Canny edge map; (f) LoG edge map; (g) morphological edge map; (h) SubPixel edge map.

DISCUSSION

Classical edge detectors techniques (Prewitt,Robert,Sobel) are simple to implement but are highly sensitive to image noise and some time it gives inaccurate results. Zero crossing techniques enables detection of edges and its orientation, with fixed characteristics in all the directions, but it shows sensitiveness towards image noise. Laplacian Gaussian identifies exact places of the edges and covers wider area around the pixel but accuracy declines while identifying curve edges. Canny edge detector technique is the most sought-after technique even in noise images, but its implementation complexity is more and it is time consuming.

CONCLUSION:

In this paper, a review of edge detection techniques for image preprocessing is presented. The merits and demerits of various edge detection algorithms have been covered with suitable illustration. The paper provides an insight into edge detection algorithms. Which serves as an aid for researchers working in this direction.

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