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Edge Detection in Image Segmentation

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Abstract
This paper is an attempt in study of different edge detection technique. Understanding images and extracting the information from them such that the information can be used for other tasks is an important task.One of the first steps in direction of understanding images is to segment them and then find out different objects in them. Thus image segmentation plays a vital role towards conveying information that is represented by an image. Edge detectors along with wavelets or other methods can be used in segmentation of an image using MATLAB. Edge detection can be determined by the problem to be studied in image segmentation.

Index Terms- Image segmentation, Image,Edge , DWT, Edge Detection

Introduction

Image Segmentation is the process of partitioning a digital image into multiple regions or sets of pixels. Partitions are different objects in image which have the same texture or color. All of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristics. The critical step in image interpretation is separation of the image into object and background. Segmentation subdivides an image into its constituent regions or objects. Image segmentation can be defined as the partition of an image into a set of non-overlapping regions whose union is the entire image, some rules to be followed for regions resulting from the image segmentation can be as follows:
(i) They should be uniform and homogeneous with respect to some characteristics;
(ii) Adjacent regions should have significantly different values with respect to the characteristic on which they are uniform;
(iii) Boundaries of each segment should be simple, not ragged, and must be spatially accurate.

Image segmentation is usually the first task of any image analysis process. The level to which the subdivision is carried depends on the problem being solved. Color image segmentation techniques can be roughly classified into four types such as
(i) Histogram based approaches ;
(ii) Neighborhood based approaches;
(iii) Clustering based approaches;
(iv) Hybrid based approaches.

Related work

Edge detection is a technique to find out the edges of an image, Edge points are those points in an image which have a different intensity from the neighboring points. Different gradient operators are used like Prewitt, Roberts, Sobel, etc [1]. The Sobel operator is a discrete differentiation operator that computes an approximate gradient of the image intensity function.
A new edge detection method that gives better edge detection accuracy ,based upon simple arithmetic and logic operations, It makes use of no threshold[2]. It can be used for both binary and grey scale images. The grey scale images are first converted into binary images.
The basic mathematical morphological operators are dilation and erosion and the other morphological operations are the synthesisation of the two basic operations. Erosion is a transformation of shrinking, which decreases the grey-scale value of the image, while dilation is a transformation of expanding, which increases the grey-scale value of the image. Erosion filters the inner image while dilation filters the outer image. Opening is erosion followed by dilation and closing is dilation followed by erosion. Therefore, morphological operation is used to detect image edge, and at the same time, denoise the image. Mathematical Morphology is a powerful tool for dealing with various problems in image processing and computer vision [4,5].It was introduced in [5] as a technique for analyzing geometric structure of metallic and geologic samples. It was extended to image analysis in [6, 7]. The basic morphological operations, namely erosion, dilation, opening, closing etc. are used for detecting, modifying the image. Scale space approach can also be used to select the interesting regions using different filters, morphological operations [8], or nonlinear diffusion [9]).

Classical Edge detectors

These are classical operators and uses first directional derivative operation. Sobel (1970), Prewitt (1970), Krisch(1971),Robinson(1977),Frei-Chen(1977).
Detection of edges and their orientation is the main advantage of these types of edge detectors. Main

disadvantage of these types of edge detectors are sensitive to noise and inaccurate.

The Roberts Detection

In Robert cross algorithm the horizontal and vertical edges bring out individually and then they put together for the resulting edge detection.

Sobel Edge Detection

The Sobel edge detection technique is similar to that of the Roberts Cross algorithm. Despite the design of Sobel and Robert are common, the main difference is the kernels that each uses to obtain the image is different. The Sobel edge detection method is introduced by Sobel in 1970. The Sobel method of edge detection for image segmentation finds edges using the Sobel approximation to the derivative. It precedes the edges at those points where the gradient is highest.

Prewitt Edge Detection

The Prewitt edge detection is proposed by Prewitt in 1970 To estimate the magnitude and orientation of an edge Prewitt is a correct way. Even though different gradient edge detection wants a quite time consuming calculation to estimate the direction from the magnitudes in the x and y-directions, the compass edge detection obtains the direction directly from the kernel with the highest response.

Canny Edge Detector

The popular edge detection algorithm Canny first presented in 1986.The problem with this type of traditional edge detection approach is that a low threshold produces false edges, but a high threshold misses important edges. Firstly requires that the image be smoothed with a Gaussian mask, which cuts down significantly on the noise within the image. Then the image is run through the Sobel algorithm, and this process is hardly affected by noise. Lastly, the pixel values are chosen based on the angle of the magnitude of that pixel and its neighboring pixels. Unlike Roberts Cross and much like Sobel, the canny operation is not very susceptible to noise.

Wavelet approach

Wavelet transforms are classified into Discrete Wavelet Transforms (DWTs) and Continuous Wavelet Transforms (CWTs). The Discrete Wavelet Transform (DWT) has been a successful technique used in edge detection.

First,an image is decomposed using an ordinary, isotropic and separable wavelet transform. The DWT separates an image into a lower resolution approximation image (LL) as well as horizontal (HL), vertical (LH) and diagonal (HH) detail components. The low-pass and high-pass filters of the wavelet transform naturally breaks a signal into similar (low-pass) and discontinuous rapidly changing (high-pass) sub-signals, utilizing both basic properties. It is this characteristic that supremely suits the DWT for edge detection**. [10**]

Generally the edge detection approaches have multi–step process such as preprocessing, noise cleaning, thresholding coefficients, smoothing, post processing. Every step may be performed by using DWT with multiple iterations. Therefore the DWT is combined with various other methods for an .optimal solution for the edge detection problem.

Wavelet neural network (WNN) based on the wavelet transform theory,is a novel, multiresolution, hierarchical artificial neural network, which originally combines the good localization characteristics of the wavelet transform theory and the adaptive learning virtue of neural networks.[11].

Morphology

Being based on Set theory of mathematics, it slowly grows up a new theory and innovative method for digital image processing and recognition. The morphological edge detection algorithm is developed from the basic morphological operations. Morphological operators are directly deal with the shape information with the help of a structuring element. It is innovative method for digital image processing and recognition and based on Set theory of mathematics.[12]

The most basic operations are dilation and erosion which may be defined by using union and intersection. Dilation increases the object and erosion shrinks the object. Using the basic operators' dilation and erosion, two more operators are defined. They are Opening and Closing. Opening retains only those parts of the objects that can fit in the structuring element. Closing fills up small holes and gulfs. Thus they both can extract fine shape features that are narrower than the structuring element.[13]

Morphological filters can be simply implemented with AND or OR logic components for binary images, and with maximum and minimum operators for gray scale images.

Drawbacks of morphological filters is that the Morphological gradients are sensitive to noise, do not have edge orientation information, and produce non-uniform edge responses.

Criteria for optimal edge detection

(i) Good detection: The optimal detector must minimize the probability of detecting spurious edges caused by noise, as well as that of missing real edges.
(ii) Good localization: The edges detected must be as close as possible to the true edges.

Proposed Method

The entire process of Image segmentation goes through three phases which are explained as below:
(i)Image Pre-processing.
(ii)Edge Detection
(iii) Image Post-processing

Image is converted to binary if grey image is used. Applied DWT (Discrete Wavelet Transform) to Image , Used the thresholding function. Applied inverse transform. Edge detection of image is done. Finally segmented image is obtained.

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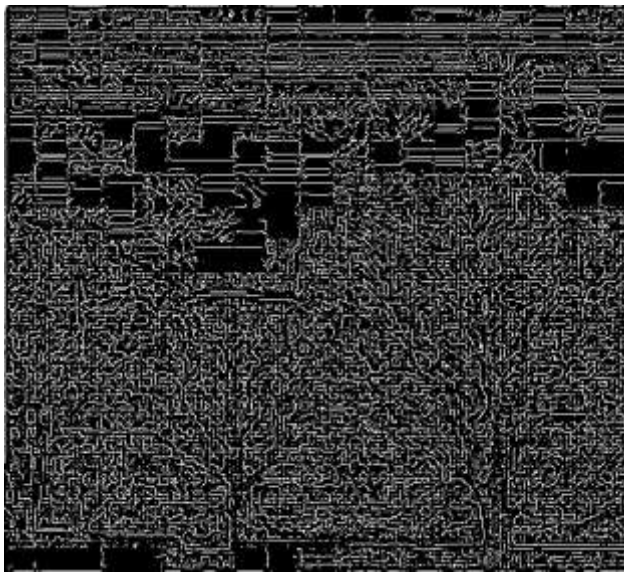
Sobel

Prewitt

Image

Roberts

Wavelets



Canny

Conclusion

Experimental results shows that edge detection is better using wavelets In this paper an attempt is made to review the edge detection techniques. It is observed from the results edge detectors produce almost same edge map.DWT based edge detection is superior one when compared to all for a selected image since different edge detections work better under different conditions. Even though,so many edge detection techniques are available in the literature, since it is a challenging task to the research communities to detect the exact image without noise from the original image

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