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A New Framework for Color Image Segmentation Using Watershed Algorithm

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Abstract

Image segmentation and its performance evaluation are very difficult but important problems in computer vision. A major challenge in segmentation evaluation comes from the fundamental conflict between generality and objectivity. The goal of image segmentation is to cluster pixels into salient image regions, i.e., regions corresponding to individual surfaces, objects, or natural parts of objects. With the improvement of computer processing capabilities and the increased application of color image, researchers are more concerned about color image segmentation. Color image segmentation methods can be seen as an extension of the gray image segmentation method in the color images, but many of the original gray image segmentation methods cannot be directly applied to color images. This requires improving the method of original gray image segmentation method according to the color image which has the feature of rich information or research a new image segmentation method it specially used in color image segmentation.

This paper proposes a color image segmentation method of automatic seed region growing on basis of the region with the combination of the watershed algorithm with seed region growing algorithm which based on the traditional seed region growing algorithm.

Keywords*:* Watershed algorithm, Seed region growing**.**

1 INTRODUCTION

Image segmentation has been as widely applied as in almost every field that is related to image processing and involved in miscellaneous image such as remote sensing image, medical image and traffic image etc. Due to the important role that image segmentation technology has been playing in image processing, researches on image segmentation algorithm have long been in existence ever since the twenties of the last century, of which those really early and classical image segmentation algorithms including threshold-selection-based image segmentation algorithm, area-based image segmentation algorithm and edge-detection-based image segmentation algorithm etc are still popularly in use. While problems with these traditional algorithms are that they are either confronting with feature extraction problem or disagreeing with a featured condition that there're uncertainty and fuzziness with an image (Peck, 2002). In order to solve these problems fundamentally so as to achieve a more extensive applicable scope of the image segmentation algorithms, watershed algorithm is introduced into image segmentation as a hotspot of modern image processing.

II. LITERATURE REVIEW

Because the human eyes have adjustability for brightness, which we can only, identified dozens of Gray-scale at any point of complex image, but can identify thousands of colors. Accordingly, with the rapid improvement of computer processing capabilities, the color image processing is being more and more concerned by people base(Peck, 2002) The color image segmentation is also widely used in many multimedia applications, for example;

in order to effectively scan large numbers of images and video data in digital libraries, they all need to be compiled into a directory, sorting and storage, the color and texture are two most important features of information retrieval based on its content in the images and video. Therefore, the color and texture segmentation is often used for indexing and management of data; another example of multimedia applications is the dissemination of information in the network (Ahmed, et al, 1998) At present, some image segmentation methods have achieved fairly good results in some specific applications, but they always have a lot of limitations. For example, gray level threshold segmentation is not suitable for images with complex objects; edge detecting method is difficult to get the wanted border for the blurred images and the complex edge images.

In many pattern recognition and computer vision applications, the color information can be used to enhance the image analysis process and improve segmentation results compared to gray-scale-based approaches. As a result, great efforts have been made in recent years to investigate segmentation of color images due to demanding needs.

A. The methods for color image segmentation

Specifically applied to the color image segmentation approach is not so much as for the gray-scale images, most of proposed color image segmentation methods are the combination of the existing grayscale image segmentation method on the basis of different color space.

Commonly used for color image segmentation methods are histogram threshold, feature space clustering, region-based approach, based on edge detection methods, fuzzy methods artificial neural network approach, based on physical model methods, etc.

Segmentation algorithms for monochrome images generally are based on one of two basic properties of gray-scale values:

Discontinuity*:* The approach is to partition an image based on abrupt changes in gray-scale levels. The principal areas of interest within this category are detection of isolated points, lines, and edges in an image.

Similarity: The principal approaches in this category are based on thresholding, region growing, and region splitting/merging.

Segmentation of a color image using region growing along with watershed Algorithm.

Here Region growing process is done with automatic seed selection process. Group similar components (such as, pixels in an image, image frames in a video) to obtain a compact representation.

III. Proposed Approach

A. Watershed Method (WS*)*

The watershed transform can be classified as a region-based segmentation approach. The intuitive idea underlying this method comes from geography: it is that of a landscape or topographic relief which is flooded by water, watersheds being the divide lines of the domains of attraction of rain falling over the region. An alternative approach is to imagine the landscape being immersed in a lake, with holes pierced in local minima. Basins (also called `catchment basins') will fill up with water starting at these local minima, and, at points where water coming from different basins would meet, dams are built. When the water level has reached the highest peak in the landscape, the process is stopped. As a result, the landscape is partitioned into regions or basins separated by dams, called watershed lines or simply watersheds

The Watershed method, also called the watershed transform, is an image segmentation approach based on gray-scale mathematical morphology, to the case of color or, more generally speaking, multi component images. Different strategies are presented and a special attention is paid to the “bit mixing approach”. This method objectively maps multi-dimensional data into a mono-dimensional space. In geography, a watershed is the ridge that divides areas drained by different river systems. By viewing an image as a geological landscape, the watershed lines determine the boundaries that separate image regions. In the topographic representation of an image *I*, the numerical value (i.e., the gray tone) of each pixel stands for the evolution at this point. The watershed transform computes the catchments

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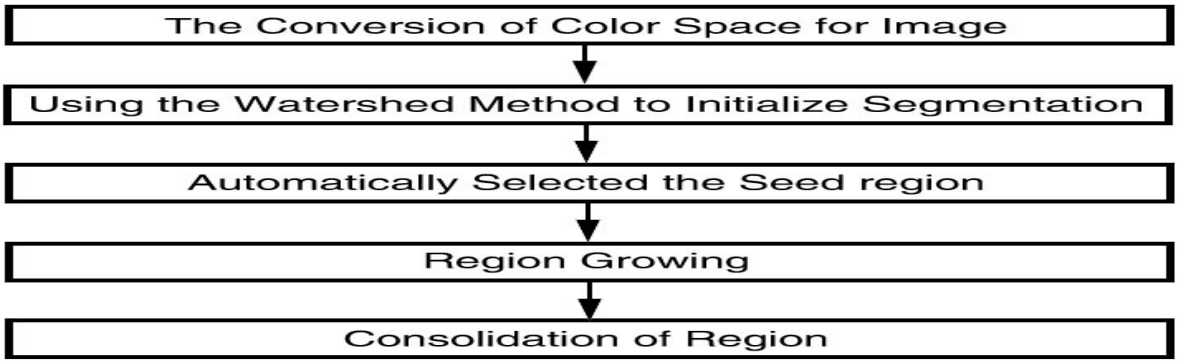
basins and ridge lines, with catchment basins corresponding to image regions and ridge lines relating to region boundaries.

When simulating this process for image segmentation, two approaches may be used: either one first finds basins, then watersheds by taking a set complement; or one computes a complete partition of the image into basins, and subsequently finds the watersheds by boundary detection. To be more explicit, we will use the expression `watershed transform' to denote a labeling of the image, such that all points of a given catchment basin have the same unique label, and a special label, distinct from all the labels of the catchment basins, is assigned to all points of the watersheds. An example of a simple image with its watershed transform is given in Fig. 1(a-b). We note in passing that in practice one often does not apply the watershed transform to the original image, but to its (morphological) gradient. This produces watersheds at the points of grey value discontinuity, as is commonly desired in image segmentation.

The flow chart for the algorithm is as shown



B. Seed Region Growing Algorithm

Principle*:*

The basic idea of region growing method is a collection of pixels with similar properties to form a region. The steps are as follows:

First, we need to find a seed pixel as a starting point for each of needed segmentation. And then merge the same or similar property of pixel (Based on a pre-determined growing or similar formula to determine) with the seed pixel around the seed pixel domain into the domain of seed pixel. These new pixels as a new seed pixel to continue the above process until no more pixels that satisfy the condition can be included.

In the practical application of this method we need to address three questions:

a) Chose or determined a group of seed pixel which can correctly represent the required region;

b) Fixed the formula which can contain the adjacent pixels in the growth;

c) Made rules or conditions to stop the growth process.

The seed region growing algorithm is proposed by Adams and Bischof, Metmert and Jackway further described the dependency relationship between pixels in the seed growth:

a) The first order of dependence occurs when the number of pixels has the same difference ratio as their vicinity.

b) The second order of dependence occurs when a pixels has the same difference ratio as their vicinity

Experiment Results: Original input image

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Figure 1. : Original input image

Description for the above figure :This is original image given as input to start the segmentation process

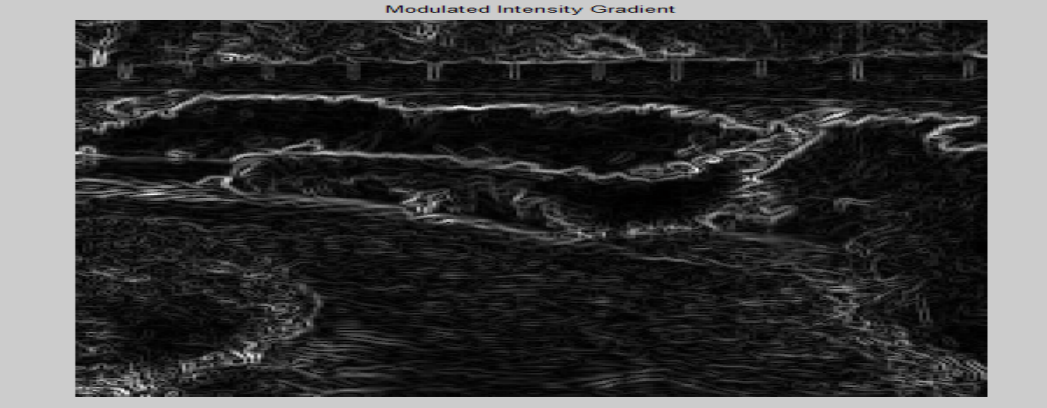

Figure 2. : Modulated Intensity Gradient Image

Description for the above figure : The first output image is the Modulated Intensity Gradient Image.This image is obtained by erosion and dilation operations; this image is used for the boundary extraction.

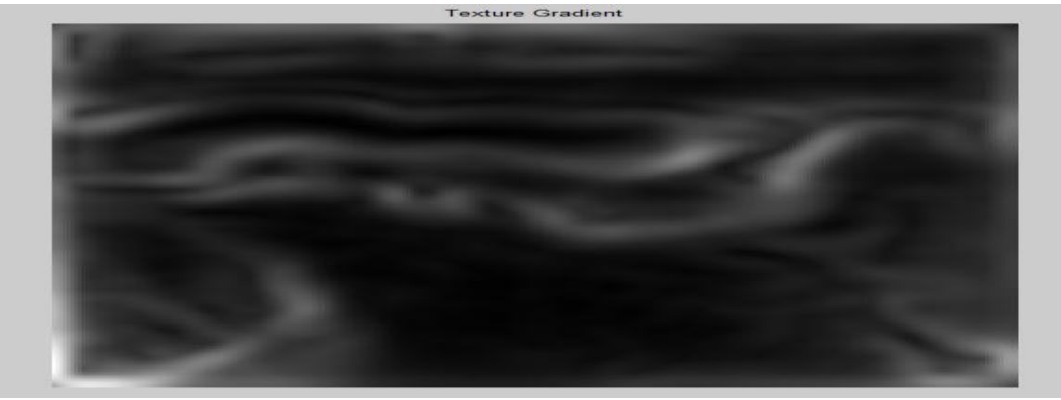

Figure 3. : Texture Gradient Image

Description for the above figure : Second output image is Texture Gradient image. This is used for the extraction of the connected components of the image.

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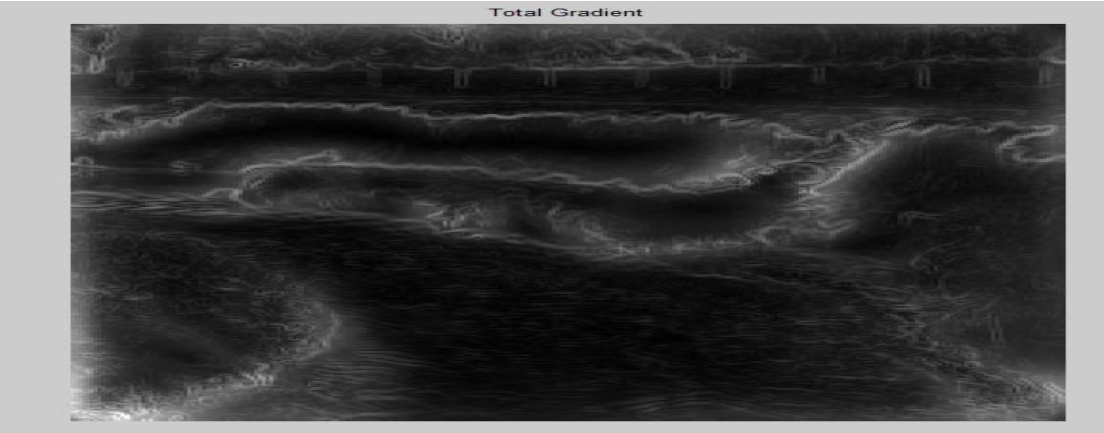

Figure 4. **:** Gradient image

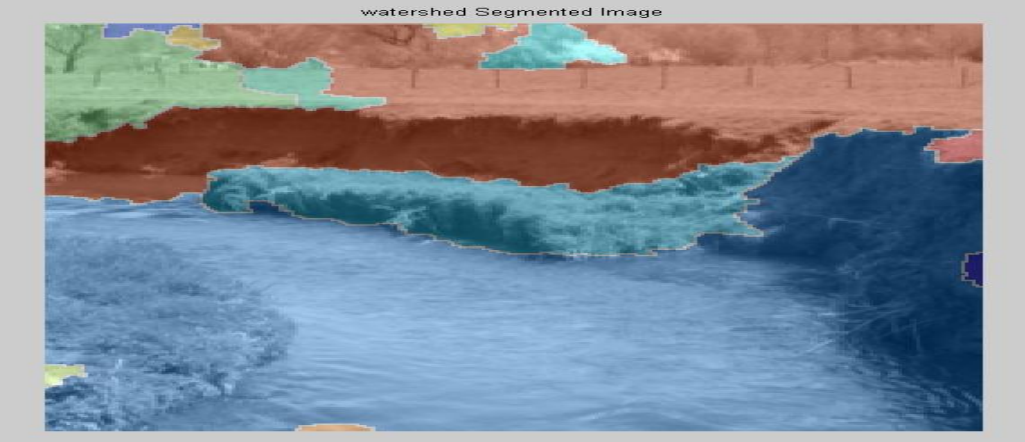

Figure 5. **:T**otal gradient image is input of the watershed algorithm,

Description for the above figure: Now this total gradient image is input of the watershed algorithm, The initial segmented image is as shown

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Figure 6. **:** output from watershed algorithm

Conclusion:

The application of image processing has widely been applied in our life, in which the digital image processing technology is widely used in all aspects of life. Image segmentation is a key step for transition to the image analysis as low-level processing in digital image processing.

For a long time, all kinds of image segmentation methods are dedicated to the study of the gray image, with the improvement of computer processing capabilities and the increased application of color image, the color image segmentation are more and more concerned by the researchers. Color image segmentation methods can be seen as an extension of the gray image segmentation method in the color images, but many of the original gray image segmentation methods can not be directly applied to color images. This requires to improve the method of original gray image segmentation method according to the color image have the feature of rich information or research a new image segmentation methods which specially used in color image segmentation, and thus it is a goal of the researcher to make it have the advantage of universal property and good treatment effect.

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