Automatic Segmentation of Retinal Images by Using Morphological Watershed and Region Growing Method

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ABSTRACT
Retinal image segmentation is essential for diagnosing various problems occurs in eye. Retinal image segment is one of the critical issues because these images contain very small nerves and some artifacts present in it. This paper proposes an automatic morphological watershed segmentation and region growing method to change the representation of an image into something that is more meaningful and easier to analyze the interested object. There are several methods that intend to perform segmentation, but it is difficult to adapt easily and detect the very small nerves accurately. To resolve this problem, this paper aims to present an adaptable automatic morphological watershed segmentation and region growing method that can be applied to any type of retinal images which is exactly diagnosed even with the small changes that occur in the image. This proposed method is based in a model of morph function which applies the morphological watershed operator to a gray scale image. Morphological segment technique is used to segment the image and selecting the specific image objects, thinning the object to found the root nerves. After using a morphological watershed operation to expose the basic elements within an image, it is often useful to extract and analyze specific information about those image elements. The region growing segmentation performs region growing for a given image region within the array that are connected to neighboring region pixels and that fall within provided constraints[7].

Keyword
Morphological Watershed, Segmentation, Region growing

I. Introduction

Retina is a light sensitive tissue lining the inner surface of the eye. The optics of the eye creates an image of the visual world on the retina, which serves much the same function as the film in a camera. Light striking the retina initiates a cascade of chemical and electrical events that ultimately trigger nerve impulses. These are sent to various visual centers of the brain through the fibers of the optic nerve. A digital image is composed of a grid of pixels and stored as an array. A single pixel represents a value of either light intensity or color. Images are processed to obtain information beyond what is apparent given the image's initial pixel values[6].

This paper proposes an automatic morphological watershed segmentation and region growing method to change the representation of an image into something that is more meaningful and easier to analyze any type of medical images. Segmentation involves separating an image into regions corresponding to objects. 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.

This approach was extended to a fully automatic and complete segmentation method by using the pixels with the smallest gradient length. The not yet segmented image region as a seed point. After segmentation, the infected region is identified by comparing the values of original image with the values of reference image [4]. Then the diagnosed part is enhanced for region growing. Region growing is a simple region-based image segmentation method. It is also classified as a pixel-based image segmentation method, since it involves the selection of initial points. This approach to segmentation examines neighboring pixels of initial "seed points" and determines whether the pixel neighbors should be added to the region.

II. Automatic Segmentation

A. *Morphological Structuring Element to an Image*

Morphological operations apply a structuring element or morphological mask to an image. A structuring element that is applied to an image must be 2 dimensional, having the same number of dimensions as the array to which it is applied. A morphological operation passes the structuring element, of an empirically determined size and shape, over an image. The operation compares the structuring element to the underlying image and generates an output pixel based upon the function of the morphological operation. The size and shape of the structuring element determines what is extracted or deleted from an image. In general, smaller structuring elements preserve finer details within an image than larger elements [2].

Morphological operations can be applied to either binary or grayscale images. When applied to a binary image, the operation returns pixels that are either black, having a logical value of 0, or white, having a logical value of 1. Each image pixel and its neighboring pixels are compared

against the structuring element to determine the pixel's value in the output image. With grayscale images, pixel values are determined by taking a neighborhood minimum or neighborhood maximum value . The structuring element provides the definition of the shape of the neighborhood.

B. Morphological Watershed Segmentation

The morphological gradient operator function applies to a grayscale image. Morphological gradient is the subtraction of an eroded version of the original image from a dilated version of the original image. The watershed transformation considers the gradient magnitude of an image as a topographic surface. Pixels having the highest gradient magnitude intensities (GMIs) correspond to watershed lines, which represent the region boundaries. Water placed on any pixel enclosed by a common watershed line flows downhill to a common local intensity minimum (LIM). Pixels draining to a common minimum form a catch basin, which represents a segment.A grey-level image, may be seen as a topographic relief, where the grey level of a pixel is interpreted as its altitude in the relief [9].

A drop of water falling on a topographic relief flows along a path to finally reach a local minimum. Intuitively, the watershed of a relief   correspond to the limits of the adjacent catchment basins of the drops of water.In image processing, different watershed lines may be computed. In graphs, some may be defined on the nodes, on the edges, or hybrid lines on both nodes and edges. Watersheds may also be defined in the continuous domain. There are also many different algorithms to compute watersheds
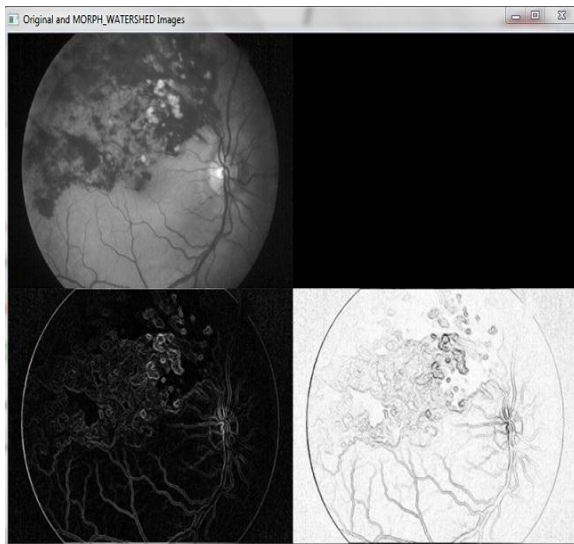

Fig. 1. Original and Morphological watershed Image

The Morphological top hat function applies the top-hat operator to a grayscale image. The top-hat operator is implemented by first applying the opening operator to the original image, then subtracting the result from the original image. Applying the top-hat operator provides a result that shows the bright peaks within the image.

A *watershed region* or *catchment basin* is defined as the region over which all points flow "downhill" to a common point. The idea originates from geology but has been applied to vision as well. In geology, one might want to consider the local region where all rainwater flows to a single lake or river. This might not seem to be applicable to intensitybased regions[3].

C. Watersheds of Gradient Magnitude

In watershed of gradient magnitude edges to be locii of "maximal" gradient magnitude. One way of defining these maximal curves (ridges) is as the boundaries of watershed regions—everything on one side "flows" downhill to one side and everything on the other flows to the other side. Thus, as you cross from one watershed region to another, you've had to cross over some local ridge curve. Unfortunately, this definition of a ridge isn't based on purely local properties but instead requires building the regions first. So, a common technique for segmentation is to use *gradient watershed regions*. First build a gradient magnitude image, then find the watershed regions in this image.One way to find watersheds is to think of filling them from the bottom up and finding where different pools merge[1].

Suppose that the greylevel range is [0,255]. Start first with the 0 pixels. Clearly, nothing can be less than these, so these form the basis for new watersheds. Then add all pixels with intensity 1. If they are next to existing watersheds (0-intensity pixels), add them to these regions. Otherwise, start a new region for each pixel that is not next to an existing region. This process repeats for each intensity k up to the maximum (255 in this example).

Each k-intensity pixel that is next to an already-labeled watershed region is added to that region. Each k-intensity pixel that is *not* next to an already-labeled watershed region starts a new region. One must be careful though: there may be multiple k-intensity pixels together, and if any one of these is adjacent to an already-labeled region, they all should be added.

This basic algorithm can be made faster by maintaining histogram-like data structures that index all pixels by their intensity. This makes it very fast to find all pixels with a particular intensity k.
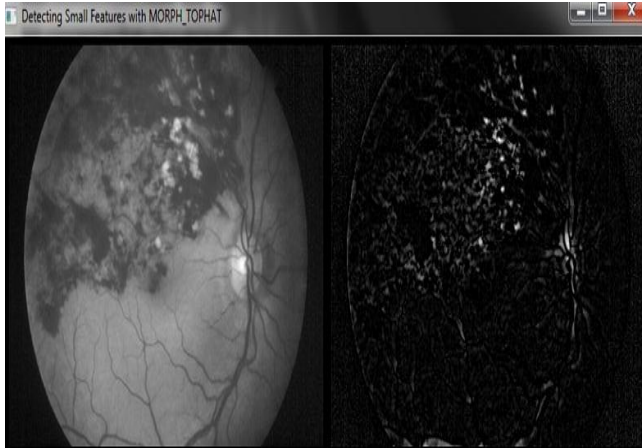
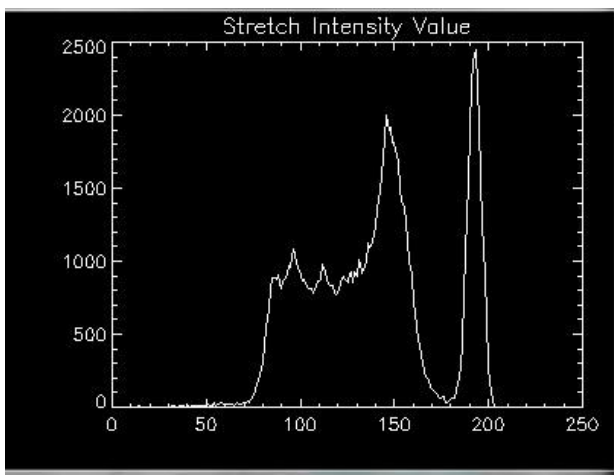Fig. 2. Detecting very small features in retinal image

Fig.3. Histogram for Intensity value

III. Region Growing Segmentation

In this section, the region growing segmentation is to analyze the image shapes and selecting specific image objects.

Region growing is a simple region-based image segmentation method. It is also classified as a pixel-based image segmentation method since it involves the selection of initial points. This approach to segmentation examines neighboring pixels of initial "seed points" and determines whether the pixel neighbors should be added to the region. The process is iterated on, in the same manner as general data clustering algorithms. The main goal of segmentation is to partition an image into regions. Some segmentation methods such as "Thresholding" achieve this goal by looking for the boundaries between regions based on discontinuities in gray levels or color properties.

Region-based segmentation is a technique for determining the region directly. In this region growing method was the seeded region growing method. This method takes a set of seeds as input along with the image. The seeds mark each of the objects to be segmented. The regions are iteratively grown by comparing all unallocated neighboring pixels to the regions. The difference between a pixel's intensity value and the region's mean, δ, is used as a measure of similarity. The pixel with the smallest difference measured this way is allocated to the respective region. This process continues until all pixels are allocated to a region[5].

Seeded region growing requires seeds as additional input. The segmentation results are dependent on the choice of seeds. Noise in the image can cause the seeds to be poorly placed. Unseeded region growing is a modified algorithm that doesn't require explicit seeds. It starts off with a single region A_1 the pixel chosen here does not significantly influence final segmentation. At each iteration, it considers the neighboring pixels in the same way as seeded region growing. It differs from seeded region growing in that if the minimum δ is less than a predefined threshold T then it is added to the respective region A_j. If not, then the pixel is considered significantly different from all current regions A_i and a new region A_{n+1} is created with this pixel. Start with a single pixel (**seed**) and add new pixels slowly. Choose the seed pixel, Check the neighboring pixels and add them to the region if they are similar to the seed, Repeat step 2 for each of the newly added pixels; stop if no more pixels can be added

A. *Analyzing Image Shapes*

After using a morphological operation to expose the basic elements within an image, it is often useful to then extract and analyze specific information about those image elements. The following method uses the label region function and the CONTOUR procedure to identify and extract information about specific image objects.

The Label Region function labels all of the regions within a binary image, giving each region a unique index number. Use this function in conjunction with the Histogram function to view the population of each region[7].

The Label Region function consecutively labels all of the regions, or blobs, of a bi-level image with a unique region index. This process is sometimes called "blob coloring". A region is a set of non-zero pixels within a neighborhood around the pixel under examination.

The argument for Label Region is an n-dimensional bi-level integer type array only zero and non-zero values are considered. Statistics on each of the regions may be easily calculated using the HISTOGRAM function.

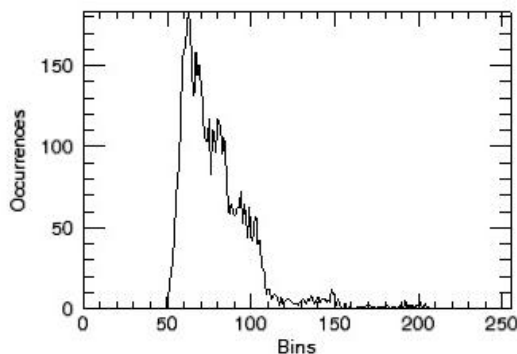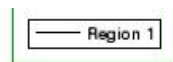Fig. 4. a) Region growing b) Interested object is segmented

Fig. 5. Histogram graph for selected region in retinal image

IV. Conclusion

This paper proposed automatic method of morphological watershed segmentation and region growing to found the small nerves in the retinal image easily and accurately. This method is used to detect the abnormal object from the image very fastly. Our approach detects the centre and boundaries of the objects quickly and reliably to all retinal images.

REFERENCES

[1] M.G. Oghli, A.Fallahi, M.pooyan. "Automatic Region Growing Method Using GSmap and spatial on Ultrasound images,"proceedings of ICEE 2010,978-1-4244-6760-0/10, IEEE,may 2010

[2] F.A.peres,F.R.Oliveira,L.A.Neves,M.F.Godoy,"Automatic Segmentation of Digital Images Applied in Cardiac Medical Image"march 15-19,LIMA,PERU,2010 IEEE

[3] Piotr S. Windyga, "Fast Impulsive Noise Removal," *IEEE Trans Image Processing,* vol. 10, no. 1, pp. 173-179, 2001.

[4] Khanh Vu, Kien A. Hua and Duc A. Tran, "An Efficient Core-Area Detection Algorithm for Fast Noise-Free Image Query Processing," *In Proc. of The 16thACM-SIGAPP Annual Symposium on Applied Computing*, pp. 258-263, Mar. 2001.

[5] Xiaohui Hao, Charles Bruce, Cristina Pislaru and James F. Greenleaf, "A Novel Region Growing Method for Segmenting Ultrasound Images," *IEEE Ultrasonics Symposium*, vol. 2, pp. 1717-1720, 2000.

[6] Jiankang Wang and Xiaobo Li, "A System for Segmenting Ultrasound Images," *Pattern Recognition proceedings 14th international conference*, vol. 1, pp.456-461, 1998.

[7] N. Otsu, "A Threshold Selection Method from Gray Level Histogram," *IEEE Trans. Systems, Man, and Cybernetics*, vol. SMC-8, pp. 62-66, 1979.

[8] Theerapattanakul J,Plodpai J , Pintavirooj C . "An efficient method for segmentation step of automated white blood cell Classifications"IEEE Region 10 Conference, 2004, 11 (4): 191-194.

[9] Anoraganingrum, D."Cell segmentation with median filter and Mathematical morphology operation" . International Conference on Image Analysis and Processing, 1999, 9, 183-188