Automatic Morphological Segmentation and Region Growing Method of Diagnosing Medical Images

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Abstract

Diagnosing the abnormal regions in various medical images is one of the critical issues because these images contain different types of random noises and attenuation artifacts. This paper proposes an automatic morphological segmentation and region growing method to change the representation of an image into something that is more meaningful and easier to analyze. There are several methods that intend to perform segmentation, but it is difficult to adapt easily and diagnose accurately. To resolve this problem, this paper aims to present an adaptable automatic morphological segmentation and region growing method that can be applied to any type of medical image 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 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 diagnose the region. After using a morphological 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 grow function performs region growing for a given region within an N-dimensional array by finding all pixels within the array that are connected to neighboring region pixels and that fall within provided constraints. This technique was applied to segment the medical image, diagnosing the interested object from the grown region in all medical images.

Keywords—Morphology, Segmentation, Region growing, Diagnosing

INTRODUCTION

Medical image Processing is a technique to enhance raw images received from cameras placed on medical diagnosing devices or pictures taken from various devices which is processed by the special system. Imaging technology in Medicine made the doctors to see the interior portions of the body for easy diagnosis. Segmentation of medical images allows early diagnosis of disease. Automating this process provides several benefits including accuracy in output, easy way of diagnosing the complex images, minimizing the difficult task. CT scanner, Ultrasound and Magnetic Resonance Image processing techniques developed for analyzing remote sensing data may be modified to analyze the outputs of medical imaging systems to get best advantage to analyze symptoms of the patients with ease.

This paper proposes an automatic morphological 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 is taken as a seed point. After segmentation, the infected region is identified by comparing the values of original image with the values of reference image. 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.

AUTOMATIC MORPHOLOGICAL SEGMENTATION

In this section, first the input medical image is automatically segmented by using morphological technique to diagnose the abnormal region.

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.

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.

Multilevel Morphological Segmentation

Image segmentation is usually the first task of any image analysis process. All subsequent tasks, such as feature extraction and object recognition rely heavily on the quality of the segmentation.Without a good segmentation algorithm an object may never be recognizable. The purpose of image segmentation is to partition an image into meaningful regions with respect to a particular application .The segmentation is based on measurements taken from the image and might be grey level, colour, texture, depth or motion. Usually image segmentation is an initial and vital step in a series of processes aimed at overall image understanding. Segmentations of simple gray-level images can provide useful information about the surfaces in the scene. Segmentation is an essential ingredient in a wide range of image processing tasks and a building block of many visualization environments.

diagnosing

After segmentation, the abnormal object is diagnosed by analyzing the image shapes and selecting specific image objects.

Detecting Edges of Image Objects

Detecting edges of image object by using Morph Gradient function applies the gradient operation to a grayscale image. This operation highlights object edges by subtracting an eroded version of the original image from a dilated version. Repeatedly applying the gradient operator or increasing the size of the structuring element results in wider edges.

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 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.

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.

Selecting Specific Image Objects

To select specific image objects. We use hit or miss morphological operation. The hit-or-miss morphological operation is used primarily for identifying specific shapes within binary images. The Morph Hit or Miss function uses two structuring elements; a "hit" structure and a "miss" structure. The operation first applies an erosion

operation with the hit structure to the original image. The operation then applies an erosion operator with the miss structure to an inverse of the original image. The matching image elements entirely contain the hit structure and are entirely and solely contained by the miss structure.

The hit-or-miss operation is very sensitive to the shape, size and rotation of the two structuring elements. Hit and miss structuring elements must be specifically designed to extract the desired geometric shapes from each individual image. When dealing with complicated images, extracting specific image regions may require multiple applications of hit and miss structures, using a range of sizes or several rotations of the structuring elements.

After specifying distinct hit and miss structures, the elements of the image that meet the hit and miss conditions are identified and overlaid on the original image. We use hit-and-miss operators to find specific points and either add them or remove them from the object by the following equation.
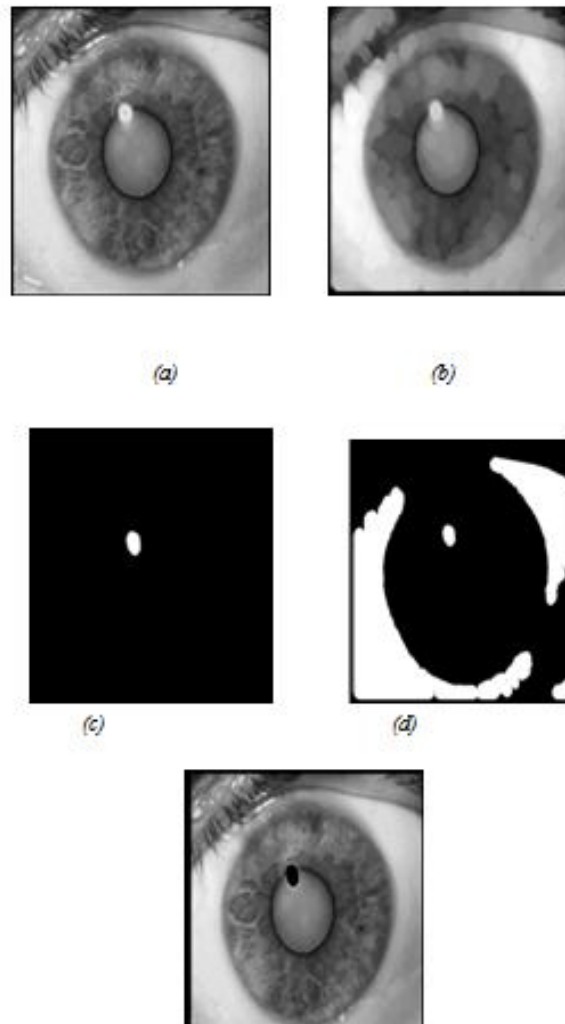

Fig. 3. (a) Original cataract affected Eye image, (b) segmented image, (c) Hit or Miss Image, (d) Selecting specific object, (e) Abnormal region detection

Thinning Image Objects

The morph thin function performs a thinning operation on binary images. After designating "hit" and "miss" structures, the thinning operation applies the hit-or-miss operator to the original image and then subtracts the result from the original image.

The thinning operation is typically applied repeatedly, leaving only pixel-wide linear representations of the image objects. The thinning operation halts when no more pixels can be removed from the image. This occurs when the thinning operation (applying the hit and miss structures and subtracting the result) produces no change in the input image. At this point, the thinned image is identical to the input image.

When repeatedly applying the thinning operation, successive iteration uses hit and miss structures that have had the individual elements of the structures rotated one position clockwise. For example, the following 3-by-3 arrays show the initial structure (left) and the structure after rotating the elements one position clockwise around the central value (right).

$h0 = [[0, 0, 0],$ $h1 = [[0, 0, 0],$
$[0, 1, 0],$ $[1, 1, 0],$
$[1, 1, 1]]$ $[1, 1, 0]]$

The repeated application of the thinning operation results in an image containing only pixel-wide lines indicating the original nerves of an image.
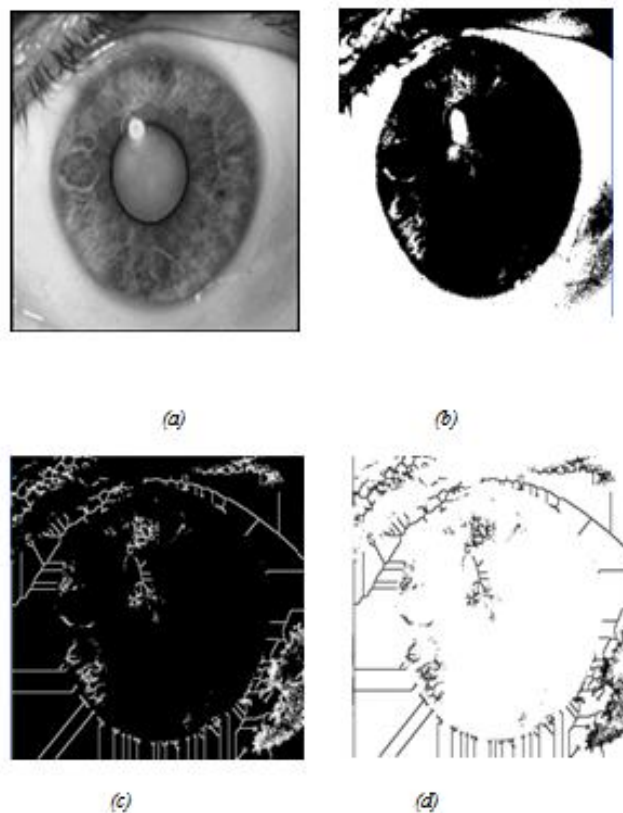

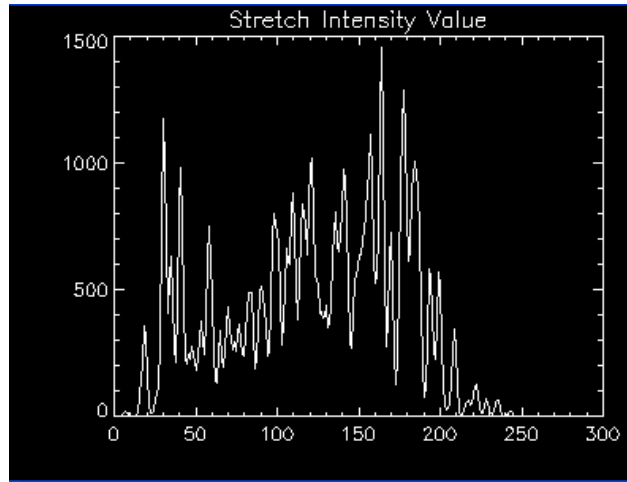Fig 4. (a) Original image, (b) Binary, (c) thinned image, (d) threshold based thinned image as

Fig 5. Statistical Analysis (HISTOGRAM)

REGION GROWING

In this section, the region in which the abnormal object is situated is found exactly and efficiently. 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.

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. 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
1. Choose the seed pixel
2. Check the neighboring pixels and add them to the region if they are similar to the seed
3. Repeat step 2 for each of the newly added pixels; stop if no more pixels can be added.
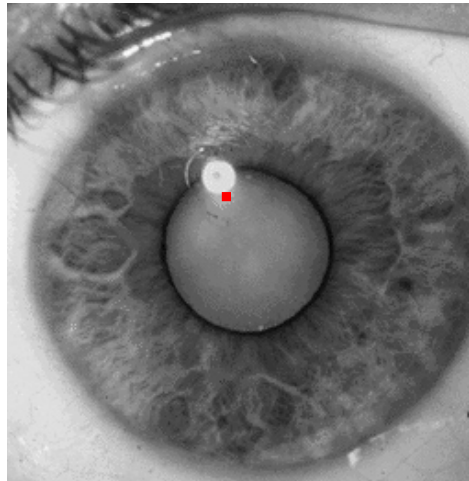

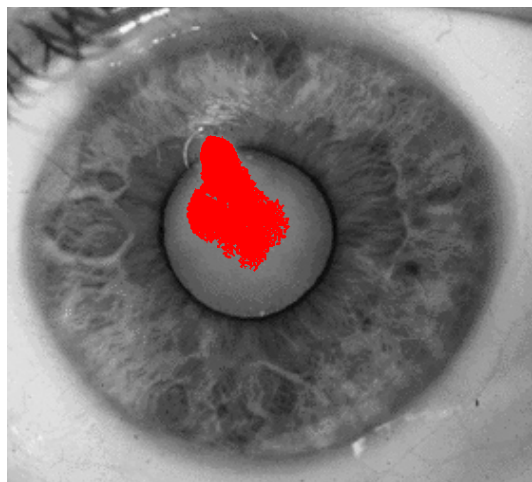Fig. 6. Selection of seed point in the cataract Affected Eye image

Fig. 7. Region growing in infected Object Area

Conclusion

This paper proposes an automatic method of morphological segmentation and region growing to diagnose the medical images easily and accurately. This method diagnose the abnormal object from the image very fastly.Our approach detects the centre and boundaries of the objects quickly and reliably to any type of medical images.

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