Segmentation of Image using Enhanced Morphological Gradient Hit Method

D. Gladiya Lincy, S. Mary Joans

Abstract - Many biomedical applications require the detection of infected structures in images. In order to get the originality of the image, it needs to undergo several steps of processing. This will vary from image to image depending on the type of image format, initial condition of the image and the information of interest and the composition of the image scene. While several algorithms have been proposed for semiautomatic extraction of these structures, branching points usually need specific treatment. Medical 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 a MGH approach to identify branching points in images. This method is used to change the representation of an image into something that is more meaningful and easier to analyze the interested object. A vector field is calculated using a novel contrast-independent tensor representation based on local phase. Our method extracting image components that are useful in the representation and description of region shape, such as boundaries, infected objects, etc. Non-curvilinear structures, including junctions and end points, are detected using directional statistics of the principal orientation as defined by the tensor. Results on synthetic and real biomedical images show the robustness of the algorithm against changes in contrast, and its ability to detect junctions in highly complex images. This proposed method is based in a model of MGH function which applies the color image to a gray scale image. This method is used to segment the image and selecting the specific image objects, thinning the object to diagnose the region.

Keywords—Detection, MGH, Segmentation.

I. INTRODUCTION

Medical image processing has experienced dramatic expansion, and has became an interdisciplinary research field attracting expertise from applied mathematics, computer sciences, engineering, physics, biology and statistics. Computer-aided diagnostic processing have already became an important part of clinical routine. Since there has been a new development of high technology and use of various imaging modalities, gave rise to challenges. Suppose for example, how to process and analyze a significant volume of images so that high quality information can be produced for disease diagnoses as well as treatment.

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Medical imaging is the technique and process used to form images of the human body for clinical purposes or medical applications. Even though imaging of removed organs and tissues can be performed for medical reasons, those procedures are not usually referred to as medical imaging, but rather are a part of pathology. Segmentation is the process of partitioning a digital image into many segments. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to identify. Image segmentation is typically used to locate objects and boundaries in images.

To be precise, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics. Outcomes of image segmentation are a set of segments that collectively cover the entire image, or a set of contours obtained from the image. Every pixel in a region is similar with respect to some characteristic or calculated property, such as color, intensity, or texture. Nearby regions are significantly different with respect to the same characteristic. While applying to a set of images, typical in medical imaging, the resulting contours after image segmentation can be used to create 3D reconstructions with the help of interpolation algorithms like marching cubes.

The paper proposes an automatic MGH segmentation 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 that are the 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.

II. AUTOMATIC SEGMENTATION

Image segmentation is useful in many applications. It can identify the regions of interest in a scene or annotate the data. We categorize the existing segmentation algorithm into region-based segmentation, data clustering, and also edge-base segmentation. Region-based segmentation includes the seeded and unseeded region growing algorithms, the MGH algorithm.[1] All of them expand each region pixel by pixel based on their pixel value or quantized value so that each cluster has high positional relation.[4] For data clustering, the concept of them is based on the whole image and considers the distance between each data.[6] The characteristic of data clustering is that each pixel of a cluster does not certainly connective. The basis method of data clustering can be divided into hierarchical and partition clustering.

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The last classification of segmentation is edge-based segmentation. This type of the segmentation generally applies edge detection or the concept of edge. Region- based methods mainly rely on the assumption that the neighboring pixels within one region have similar value. The common procedure is to compare one pixel with its neighbors. If a similarity criterion is satisfied, the pixel can be set belong to the cluster as one or more of its neighbors. The selection of the similarity criterion is significant and the results are influenced by noise in all instances. In this chapter, we discuss four algorithms: the Seeded region growing, the unseeded region growing, the Region splitting and merging, and the Fast scanning algorithm.

Morphological operations apply a structuring element or morphological mask to the image. A structuring element that is applied to an image must be two dimensional, having the same number of dimensions as the array to which it is applied.Fig.1A morphological operation passes the structuring element, of an empirically determined shape and size, on an image.

This operation will compare the structuring element to the underlying image and generates an output pixel based upon the function of the morphological processing. The size and shape of the structuring element determines what is extracted or deleted from an image. Generally, smaller structuring elements preserve finer details within an image than larger elements.

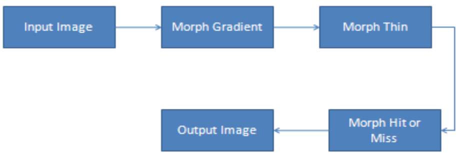

Fig 1 Flow diagram

Morphological operations can be applied to either binary or gray scale images. If applied to a binary image, the operation will return pixels that are either black, with a logical value of 0, or white, with 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 gray scale images, pixel values are determined by taking a neighborhood minimum or maximum value. The structuring element provides the definition of the shape of the neighborhood.

III. A.MORPHOLOGICAL GRADIENT OPERATION

The morphological gradient operator function applies to a gray scale 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 with the highest gradient magnitude intensities (GMIs) correspond to watershed lines, which represent the region boundaries.[8] 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. In mathematical morphology and digital image processing, gradient is the difference between the dilation and the erosion of a given image.[13] The image should be in such a way where each pixel value (typically non-negative) indicates the contrast intensity in the close neighborhood of that pixel. That is useful for edge detection and segmentation applications.

Let $f: E \mapsto R$ be a grayscale image, mapping points from a Euclidean space or discrete grid *E* (such as R^2 or Z^2) into the real line. Let $b(x)$ be a grayscale structuring element. Usually, *b* will be symmetric and has short-support, e.g.,

$$b(x) = \begin{cases} 0, & |x| \leq 1, \\ -\infty, & \text{otherwise} \end{cases}.$$

Then, the morphological gradient of *f* is given by:

$$G(f) = f \oplus b - f \ominus b,$$

Where $\oplus$ and $\ominus$ denote the dilation and the erosion, respectively.

An internal gradient is given by:

$$G_i(f) = f - f \ominus b,$$

and an external gradient is given by:

$$G_e(f) = f \oplus b - f.$$

The internal and external gradients are "thinner" than the gradient, yet gradient peaks are located *on* the edges, as well as the internal and external ones are located at each side of the edges. Notice that $G_i + G_e = G$. If $b(0) \geq 0$, then all the three gradients have non-negative values at all pixels

The image gradient is one that finds edge strength and direction at location (x, y) of image, and defines as the vector.

$$\nabla f \equiv \text{grad}(f) \equiv \begin{bmatrix} g_x \\ g_y \end{bmatrix} = \begin{bmatrix} \frac{\partial f}{\partial x} \\ \frac{\partial f}{\partial y} \end{bmatrix}$$

The magnitude (length) of vector ∇f, denoted as M(x, y)

$$\text{mag}(\nabla f) = \sqrt{g_x + g_y}$$

Gradient vector whose direction is given by the angle

$$\alpha(x, y) = \tan^{-1}\left[\frac{g_y}{g_x}\right]$$

FIG.1.(A)The direction of an edge at an arbitrary point (x,y) is orthogonal to the direction. We are dealing with digital quantities; as a result digital approximation of the partial derivatives over a neighborhood about a point is required.

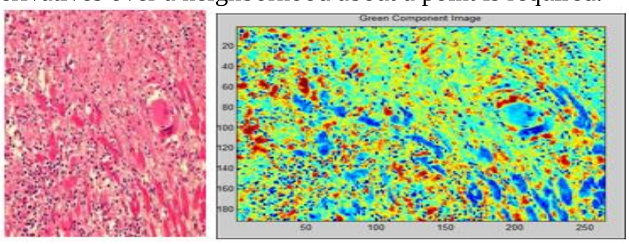

FIG 1: (A) CANCER INFECTED ORIGINAL TISSUE (B) DIAGNOSING USING PROPOSED METHOD

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B. Morphological Structuring Element To An Image

The Morphological operations apply a structuring element or morphological mask to images. The structuring element that is applied to an image must be two dimensional, having the same number of dimensions as the array to which it is applied to the process. A morphological operation passes the structuring element, of an empirically determined shape and size, over an image.[3] The operation compares the structuring element to the underlying image and generates an output pixel based upon the function of the morphological operation. Then the size and shape of the structuring element determines what is defected or deleted from an image. Generally, smaller structuring elements preserve finer details within an image than larger elements.

C.*Multilevel Morphological Segmentation*

The 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.**[5]**Usually image segmentation is an initial and vital step in a series of processes aimed at overall image understanding. The 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.

D. Diagnosing.

Diagnosis is the identification of the nature and cause of anything. Detection and diagnosis is used in many different disciplines with variations in the use of logic, analytic, and experience to determine the cause and effect relationships.[2] In systems engineering and computer science, diagnosis is typically used to identify the causes of problems, mitigation's for problems, and solutions to the issues. Then After segmentation, the abnormal object is diagnosed by analyzing the image shapes and selecting specific image objects by the following ways Dilation is the dual of erosion that is dilating foreground pixels is equivalent to eroding the background pixel. Most implementations of this operator expect the input image to be binary, that is usually with foreground pixels at pixel value 255, and background pixels at pixel 0 value. Such an image can often be produced from a gray scale image using threshold. It is very important to check that the polarity of the input image is set up correctly for the dilation implementation being used. Usually the structuring element may have to be supplied as a small binary image, else in a special matrix format, or it may be hardwired into the implementation, and it does not require specifying .

IV. THINNING IMAGE OBJECTS

The Thinning is a morphological operation that is used to remove selected foreground pixels from binary images, somewhat like erosion . It can be used for several applications, but is particularly useful for skeletonization.FIG.(5) In this mode it is commonly used to tidy up the output of edge detectors by reducing all lines to single pixel thickness. Thinning is a process normally applied to binary images only, and produces output as binary image only. The operation to be done is related to the hit-and-miss transform, so it is helpful to have an understanding of that operator before reading on. Like other morphological operators, the functioning of the thinning operation is determined by a structuring element. Mostly binary structuring elements used for thinning are of the extended type described under the hit-and-miss transform (i.e. they can contain both ones and zeros). Thinning operation is related to the hit-and-miss transform and can be expressed quite simply.

E. Detecting The Abnormal Roots

The morph thin function performs a thinning operation on binary images. After designating "hit" and "miss" structures, the thinning operation will apply the hit-or-miss operator to the original image and then subtracts the result from the original image. The thinning operation is always applied repeatedly, allowing only pixel-wide linear representations of the image objects.[12]The thinning operation stops when no more pixels can be removed from the image. This occurs at the thinning operation (applying the hit and miss structures and subtracting the result) 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.[14] Consider 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).

F. Image Analysis Using Proposed Technique

Input image is analyzed by using our proposed method. First input image is given to the system to detect the boundaries using morphological operation. Then the edges are detected using hit or miss techniques. After detecting the boundary and edge of the input image, shape of the image is extracted using morph top hat technique and finally the infected region is analyzed using region of interest method.

G.Boundary Analysis

Boundary detection constitutes a crucial step in many computer vision tasks. A boundary map of an image can provide valuable information for further image analysis and interpretation tasks such as segmentation, object description etc. It can be noted that the map essentially retains gross but important details in the image. It is therefore sparse yet rich in information from the point of scene understanding. Extracting identical boundary map is of interest in computer vision

H. Erosion

Erosion is one of the two basic operators in the field of mathematical morphology, the other one is dilation. It is typically applied to binary images, since there are versions that work on grayscale images. The fundamental effect of the operator on a binary image is to erode away the boundaries of regions of foreground pixels (i.e. white pixels, typically). Thus areas of foreground pixels shrunk in their size, and holes within those areas become larger. Generally erosion operator takes two pieces of data as inputs.

First one is the image which is to be eroded. The second is a (usually small) set of coordinate points known as a structuring element (also known as a kernel). Structuring element is the one that determines the precise effect of the erosion on the input image

HIT OR MISS

In this section, the region is segmentation is to analyze the image shapes and selecting specific image objects. The hit-and-miss transform is a general binary morphological operation that can be used to look for particular patterns of foreground and background pixels in an image.FIG.(2) It is actually the basic operation of binary morphology since almost all the other binary morphological operators can be derived from it. Like other binary morphological operators it takes as input a binary image and a structuring element, and produces another binary image as output.[9] The structuring element used in the hit-and-miss is a slight extension to the type that has been introduced for dilation and erosion, in that it can contain both background and foreground pixels, rather than just foreground pixels, i.e. both ones and zeros.[11] Note that the simpler type of structuring element used with erosion and dilation is often depicted containing both ones and zeros, but in that case the zeros really stand for `don't care's', and they are just used to fill out the structuring element to a convenient shaped kernel,preferably a square

background of *D* with respect to *W* is defined as the set difference *W* – *D*. The erosion of *A* by *D* is the set of locations of the origin of *D*, such that *D* is completely contained in *A*. The intersection of the erosion of the complement of *A* by the local background set *W-D* and the erosion of *A* by *D* is the set of locations for which *D* exactly fits inside *A*. Denoting by *B* the set consisting of *D* and its background, the match (or matches) of *B* in *A* is

$$AUB = (AUD) \cap [A^c U (W - D)]$$

Generalizing the notation by letting *B* = (*B1*, *B2*), where *B1* is the set formed from the elements of *B* associated with an object and *B2* is the set of elements of *B* associated with the corresponding background.

In our case *B1* = *D* and *B2* = (*W-D*). Therefore:

$$AUB = AUB \cap A^c UB$$

Therefore, the set *AUB* contains all the points (origin) at which simultaneously *B1* found a match ("hit") in *A*; and *B2* found a match in complement of *A* The definition can also be rewritten as follows:

$$AUB = AUB - AU\,B$$

The set *AUB* represents the morphological hit-or-miss.

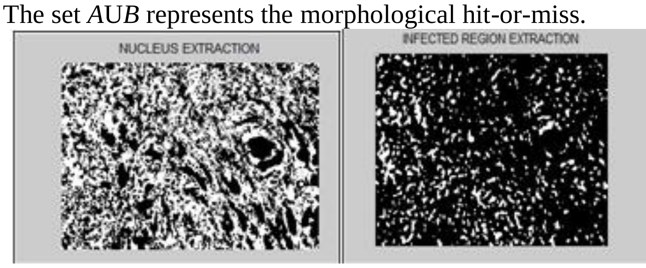

Fig 2. Nucleus Extraction images

A. Analysing Image Shapes

After using a morphological operation to expose the basic elements within an image, it is mostly useful to then extract and analyze specific information about those image elements. 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 In mathematical morphology, hit-or-miss transform is one that detects a given configuration (or pattern) in a binary image, utilizing the morphological erosion operator and a pair of disjoint structuring elements. Usually the result of the hit-or-miss transform is the set of positions, whereas the first structuring element fits in the foreground of the input image, while the second structuring element misses it completely.FIG.(3) In binary morphology, an image is viewed as a subset of an Euclidean space or the integer grid, for some dimension d. Let us denote this space or grid by E.

A structuring element is a pre-defined shape, represented as a binary image, used to probe another binary image, in morphological operations such as erosion, dilation, opening, and closing.

Let C and D be two structuring elements satisfying $C \cap D = \emptyset$. The pair (*C*, *D*) is sometimes called *composite structuring element*.

The hit-or-miss transform of a given image A by B=(C, D) Where is the set complement of A. That is, a point x in E belongs to the hit-or-miss transform output if C translated to x fits in A, and D translated to x misses A .We enclose D by a small window W; the whether the pixel neighbors should be added to the corresponding region. The process is iterated on, in the same manner as general data clustering algorithms.[10] The main goal of segmentation is to partition an image into regions. Few of the segmentation methods such as "Thresholding" achieve this goal by looking for the boundaries between regions based on discontinuities in color properties or gray level. Region-based segmentation is a technique for determining the region directly. In this region growing method was the seeded region growing method. Whereas this method takes a set of seeds as input along with the image. Most of the seeds mark each of the objects to be segmented. Regions are iteratively grown by comparing all unallocated neighboring pixels to the regions. The distinguishable features between a pixel's intensity value and the region's mean, δ, are used as a measure of identity. The pixel with the smallest difference measured this way is allocated to the corresponding region. This process continues until all pixels are allocated to a region.

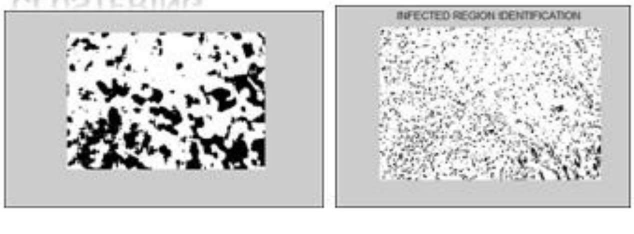

Fig 3. Infected Region Extraction

B. Histogram Analysis

Histogram-based methods are very efficient when compared to other image segmentation methods because they typically require only one pass through the pixels. In this approach, a histogram is computed from all of the pixels in the image, as well as peaks and valleys in the histogram are used to locate the clusters in the image.Intensity or color can be used as the measure.[15] An advancement of this technique is to recursively apply the histogram-seeking method to clusters in the image in order to divide them into smaller clusters.

This is done repeatedly with smaller and smaller clusters until no more clusters are created. Histogram-based approaches can also be quickly adapted to occur over multiple frames and maintain their single pass efficacy. Histogram can be done in multiple fashions when multiple frames are considered.

The same approach that is taken with one frame can be applied to multiple, and when the results are merged, peaks and valleys that were difficult to identify are more likely to be distinguishable. FIG 3.(a)The histogram can also be applied on a per pixel basis where the information results are used to determine the most frequent color for the pixel locations. Histogram modeling techniques (*e.g.* histogram equalization) provide a sophisticated method for modifying the dynamic range and contrast of an image by altering that image such that its intensity histogram has a desired shape. Compared to contrast stretching, histogram modeling operators will employ non-linear and non-monotonic transfer functions to map between pixel intensity values in the input and output images. Equalization of histogram employs a monotonic, non-linear mapping which will re-assigns the intensity values of pixels in the input image such that the output image contains a uniform distribution of intensities (i.e. a flat histogram).fig.(4)we have to compare all the technique. The maximum MGH value is 3.10. We have to reach that approximate using this technique.

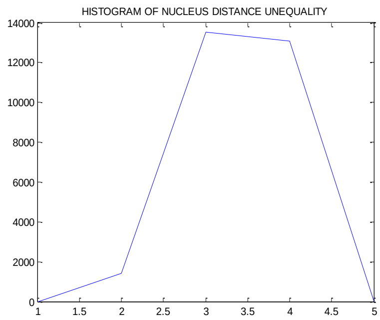

FIG 3. (a)Histogram Analysis

COMPARATIVE ANALYSIS:

RUNTIME PERFORMANCE

METHOD		TIME(S)
• IMAGE		0
• GAUSSIAN	-	0.05
• VESSELNESS	-	0.11
• NEURITENESS	-	2.53
• PCT VESSELNESS	-	2.61
• MGH	-	3.05

FIG .4 comparison table

V. EXPERIENTAL RESULTS

FIG.(5) In this section, our experimental results of applying to different types of infected medical images. Our results shows our method is easy to diagnose the infected region compare to other techniques. we have to use different images and compare all those things and finally find out the exact abnormal areas.

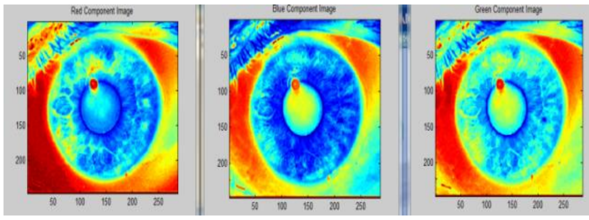

Fig 5. (a) Cataract Infected Image (b) proposed method

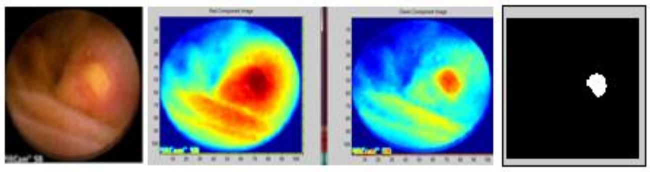

Fig 6. (a) Polyps Infected Image (b) diagnosing using proposed method

VI. CONCLUSION

This paper proposed automatic method of MGH segmentation 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 images. This paper proposes the Accurately analysis the interested objects with Correct position and shape .Easy to adapt better analysis to different types of images .it was perform a low Time consuming, and the good Automatic process.

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