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Segmentation of Abnormal Cancer cells in Lungs using Mathematical Morphology Techniques

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Abstract: *Image can be represented in the area of digital processing, which can be told as another reproduction of an object. Segmentation is the process of partitioning a digital image into multiple regions and extracting meaningful regions for the future image analysis. The prime objective of this research work is to segment the abnormal Cancer cells in lungs. Region growing process is a simple region-based image segmentation method. Finally the boundary region of the Cancer cells is detected using region growing algorithm and various morphological operations.*
Keywords: *cancer cells, segmentation, morphological operation, Region growing process.*

I. INTRODUCTION

Images are imitations of real world substances. The target of image segmentation is to cluster pixels into salient image regions. The excellence of the segmentation depends on the image. Segmentation is mainly used to position object and get the information about that object. The result of image segmentation is a set of segments which wholly covers the object. Region growing process is a simple region-based image segmentation method. Since it involves initial seed points it is also classified as a pixel-based image segmentation method. This advance segmentation examines neighboring pixels of initial "seed points" and examines whether the pixel neighbors should be added to the region. The process is iterated on, in the identical manner as data clustering algorithms. Morphological operation is a broad set of image processing operations that process images based on shapes. In morphological operation a structuring element is applied as an input image and creates an output image of the same size.

II. METHODOLOGY

Image processing is a technique of using algorithms to process an image to get a better feature of image. There are various methods used in the processing of the image. The goal of segmentation is to divide the image into homogeneous regions. Here, the system architecture of our proposed work shown in the fig-1.

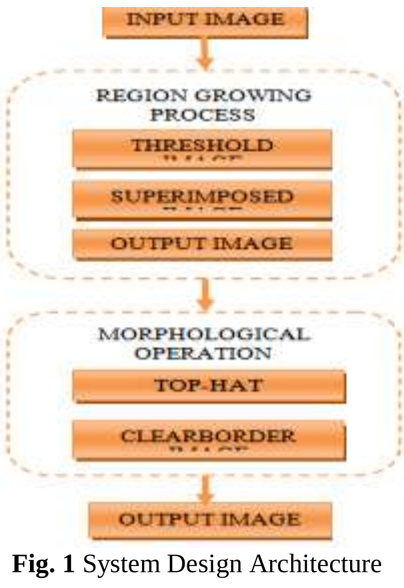


Fig. 1 System Design Architecture

III. SEGMENTATION

Segmentation is the process of partitioning a digital image into multiple regions and extracting meaningful regions known as regions of interest (ROI) for the future image analysis. Image segmentation has emerged as an important phase in image-based applications. Thresholding is a very important technique for image processing. It produces uniform regions based on the threshold criterion T. The thresholding operation can be thought of as an operation, such as

T=T{x, y, A(x, y), f(x, y)}

In which the particular region is detected using this segmentation technique along with the thresholding operation. Edge plays a very important role in image processing application in which they provide an outline of the object. In the physical plane, edges correspond to the discontinuities in depth, surface orientation, changes in material properties, and light variations. When an edge is detected, the unnecessary details are removed, while only important structural information is retained.

IV. REGION GROWING PROCESS

Region growing process is a simple region-based image segmentation method. Since it involves initial seed points it is also classified as a pixel-based image segmentation method. This advance segmentation examines neighboring pixels of initial "seed points" and examines whether the pixel neighbors should be added to the region. The process is iterated on, in the identical manner as data clustering algorithms. Region-Growing segmentation is a technique for examining the region directly. The basic formulation is:

(a) $\cup_{i=1}^{n} R_i = R$
(b) R_i is a connected region, i=1,2,…….,n
(c) $R_i \cap R_j = \emptyset$ for all i=1,2,…….,n
(d) $P(R_i) = TRUE$ for i=1,2,…….,n
(e) $P(R_i \cup R_j)$ = FALSE for any adjacent region R_i *and* R_j
$P(R_i)$ is a logical predicate defined over the points in set R_i and $\emptyset$ is the null set.
(a) Means that the segmentation must be complete; that is, every pixel must be in a region.
(b) Requires that points in a region must be connected in some predefined sense.
(c) Indicates that the regions must be disjoint.
d) Deals with the properties that must be satisfied by the pixels in a segmented region.
(e) Indicates that region R_i and R_j are different in the sense of predicate P.

V. MORPHOLOGICAL PROCESS

Morphological operation is a broad set of image processing operations that process images based on shapes. In morphological operation a structuring element is applied as an input image and creates an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. By choosing the size and shape of the neighborhood the morphological operation can be constructed which is sensitive to specific shapes in the input image. The number of pixels added or removed from the objects in an image depends on the size and shape of the structuring element used to process the image. In the morphological operations the state of any given pixel in the output image is determined by applying a rule to the corresponding pixel and its neighbors in the input image.

A. Top-hat Filtering

Top-hat filtering computes the morphological opening of the image (using imopen) and then subtracts the result from the original image. The top-hat filtering on a grayscale or binary input image I can be computed using the following function,

I2=imtophat(I,SE)
imtophat uses the structuring element SE, where SE is returned by strel. SE must be a single structuring element object, not an array containing multiple structuring element objects.
I2 = imtophat(I,NHOOD)
where NHOOD is an array of 0s and 1s that specifies the size and shape of the structuring element and it is same as the following equation, imptophat(IM,strel(NHOOD)).

The image I can be numeric or logical and must be nonsparse. The output image I2 has the same class as the input image. If the input image is binary (logical) then the structuring element must be flat. Top-hat filtering is used to correct uneven illumination when the background is dark. It is also used to remove the uneven background illumination from an image.

B. Clearborder

The clearborder operation suppresses light structures connected to image border. It suppresses structures that are lighter than their surroundings and that are connected to the image border using the function,

I2 = imclearborder(I)

This function is used to clear the image border. I can be a grayscale or binary image. The output image, I2, is grayscale or binary, respectively. The default connectivity is 8 for two dimensions, 26 for three dimensions, and conndef(ndims(BW),'maximal') for higher dimensions. For grayscale image the overall intensity level is reduced in addition to suppressing border structures by using the function,
Imclearborder

The specified connectivity is described by the function

I2 = imclearborder (I,conn)

where conn can have any of the scalar values. If a nondefault connectivity is specified then a pixel on the edge of the input image might not be considered to be a border pixel. Elements on the first and last row are not considered to be border pixel, if conn = [0 0 0; 1 1 1; 0 0 0], because according to that connectivity definition, they are not connected to the region outside the image. Imclearborder uses morphological reconstruction where

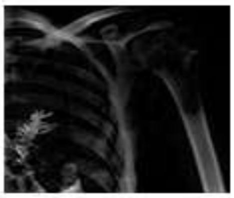
1) Input image is a mask image
2) Marker image is zero everywhere except along the border, where it equals the mask image.


A) Original Image

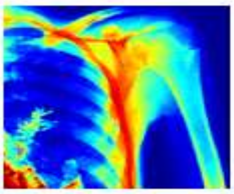

B) Threshold Image


C) Region-Growing Seg


D) Superimposed Image


E) Top-hat Filtering


F) Clearborder Image


G) Segmented Image


H) Abnormal cells

Fig-2 Experimental Results

The experimental results are represented fig-2. In this section various process were implemented and performance measures of Mean Square Error (MSE) and Peak Signal to Noise ratio (PSNR) were measured to enhance the quality of the image.

Mean Square Error (MSE)
The simplest of image quality measurement is Mean Square Error (MSE). The large value of MSE means that image is poor quality. MSE is defined as follow:

$$\text{MSE} = \frac{1}{MN} \sum_{m=1}^{M} \sum_{n=1}^{N} \left(x(m,n) - \hat{x}(m,n) \right)^2$$

Peak Signal to Noise Ratio (PSNR)
The small value of Peak Signal to Noise Ratio (PSNR) means that image is poor quality. PSNR is defined as follow:

$$\text{PSNR} = 10 log \frac{255^2}{MSE}$$

PERFORMANCE METRICS	DATASET 1	DATASET 2	DATASET 3
Mean Square Measure	2.718	2.489	1.745
Peak-Signal-Noise Ratio	3.787	4.169	5.710

Table 1 – Performance Measures

VI. CONCLUSION

In this research work abnormal cancer cells in lungs is segmented. The frontier region of the cancer cells in lungs is segmented using region growing segmentation. Morphological operation is used to process images based on shapes. Finally the boundary region of the cancer cells in lungs is detected using region growing segmentation and various morphological operations.

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