Segmentation In Medical Resonance images to extract the cancerous nodule for early diagnosis on cancer

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Abstract:

Image segmentation plays a vital role in several medical imaging programs by assisting the delineation of physiological structures along with other parts. The objective of this research work is to segmentize human lung MRI (Medical resonance Imaging) images for early detection of cancer.' Watershed Transform Technique' is implemented as the 'Segmentation' method in this work. Some comparative experiments using both directly applied watershed algorithm and after marking foreground and computed background segmentation methods show the improved lung segmentation accuracy in some image cases.

Introduction:

A. Segmentation:

Segmentation in medical images is a crucial technique used in image analysis and is very helpful in the diagnosis of various diseases. Segmentation refers to the process of partitioning a digital image into multiple segments that are more meaningful and easier to analyses [1].More precisely, 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 [1]. Magnetic resonance imaging (MRI) provides detailed information of the anatomy of the object that is examined [3]. Over the last two decades, segmentation of brain tissues in magnetic resonance (MR) images has played an indispensable role in medical research and clinical applications including pathology, radiotherapy treatment and planning, surgical planning and simulations, and diagnosis [4]. Image segmentation is basic techniques of the image processing and machine vision. The aim is to extract meaningful features or features need to be applied in image, it is a key technology for successful image analysis, understanding and description [2]. Image Segmentation algorithm can be approximately divided into several categories, including algorithm based on edge detection, region, the combination of edge and region and specific theories. Segmentation algorithm based on graph theory have become one of the hottest research points in image segmentation field. It is the operation at the threshold between low level image processing and image analysis. After Segmentation, it is known that which pixel belongs to which object [4]. MRI, it is the way of obtaining very detailed

images of organs and tissues throughout the body without the need for x-rays or ionizing radiation. MR lung image has a similar and recognizable shape, individual lungs vary in size, features and other characteristics [9]. External difficulties include image sampling artifacts, noise and problems emanating from lung movement during scanning.

A. The Watershed Transform

The watershed transform is a popular segmentation method coming from the field of mathematical morphology [5]. Generally, the watershed transform is computed on the gradient of the original image, so that the catchments basin boundaries are located at

High gradient point. Due to the no. of advantages, watershed transform is widely used in many fields of image processing, including medical image segmentation. It is fastest and can be parallelized and it produces a complete division of the image in separated region even if the contrast is poor, thus avoiding the need for any kind of contours joining [6].

Advantages of watershed transform:

The watershed lines always correspond to the most significant edges between the markers. So this technique is not affected by lower-contrast edges, due to noise, that could produce local minima, and, thus, erroneous results, in energy minimization methods. Even if there are no strong edges between the markers, the watershed transform always detects a contour in the area. This contour will be located on the pixels with higher contrast [6].

Mathematical Representation:

Let $M_1, M_2, \ldots M_R$ be sets denoting the co-ordinates of the points in the regional minima of an image g(x, y).Let $C(M_i)$ be a set de-noising the co-ordinates of the points in the catchments basin associated with regional minima M_i;

Min – Minimum value of image g(x, y)

Max – Maximum value of image g(x, y)

Let T[n] represents the set of co-ordinates (s, t) for which g(s, t) <n

$\therefore$ T[n] = {(s, t)| g(s, t) <n} … (1)

T[n]→set of co-ordinates of points in g(x, y) lying between the plane g(x, y) =n flooded in integer flood increments from

n=min +1 to n =max +1

At any step n of flooding process, the algorithm needs to know the no. of points below the flood depth. Suppose that co- ordinates in T[n] that are below the plane g(x, y) =n are marked "black" and all other

Co-ordinates are marked "white". then ,when we look down on the x-y plane at any increment **n** of flooding, we will see a binary image in which black points correspond to points in the function that are below the plane g(x,y)=n.

Let $C_n(M_i) = C(M_i) \cap T[n]$ … (2)

$C_n(M_i)$ ==1 at location (x, y)

If (x, y) € C (M_i) and (x, y) € T[n]

Otherwise, $C_n(M_i)$ =0

Let $C[n] = \bigcup_{i=1}^{R} C(M_i)$ … (3)

Then C [max+1] is the union of all catchments basin:

$$C\,[max+1] = \bigcup_{i=1}^{n} C(M_i) \; \ldots (4)$$

One problem occurs, $C_n(M_i)$ and T[n] can never be replaced during the execution of the algorithm. The number of elements in these two sets either increases or remains the same as the 'n' increases. It follows that C [n-1] is a subset of c[n].

According to Eq. (2) & (3)

C[n] is subset of T[n].so it follows that C [n-1] is subset of T[n].

It results that each connected component of C [n-1] is contained in exactly one connected component of T[n].

Algorithm is initialized with:

C [min + 1] =T [min+1]

This algorithm proceeds recursively:

Let Q denote that set of connected component in T[n].

For each connected component q € Q[n]. There are three possibilities:

a) q⌒C[n-1] is empty.
b) q⌒C[n-1] contains one connected component of C[n-1].
c) q⌒C[n-1] contains more than one connected component of C[n-1].

Proposed Method:

Marker-Controlled Watershed Segmentation:

The usual way of predetermining the number and approximate location of the regions provided by the watersheds technique consists in the modification of the homotopy of the function to which the algorithm is applied. This modification is carried out via a mathematical morphology operation, geodesic reconstruction [14], by which the function is modified so that the minima can be imposed by an external function (the marker function). All the catchment basins that have not been marked are filled by the morphological reconstruction and so transformed into non minima plateaus, which will not produce distinct regions when the final watersheds are calculated. Segmentation using the watershed transforms works well if you can identify, or "mark," foreground objects and background locations.

Flowchat of proposed work:

Read the color image and converted into gray level

⇩

Preprocessing of original

⇩

Use the gradient magnitude as segmentation function

⇩

Apply directly watershed algorithm to original image Based on threshold, generate an image having particular sized cells (Cancer)

⇩

Due to bad results, mark foreground objects

⇩

Compute the back ground

⇩

Compute the watershed transform of segment

⇩

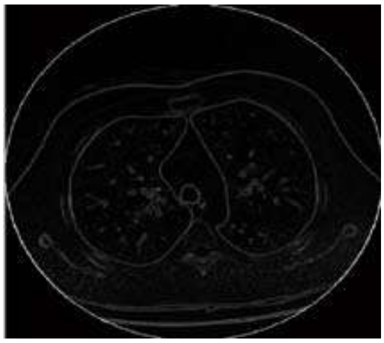
Visualize the results

⇩

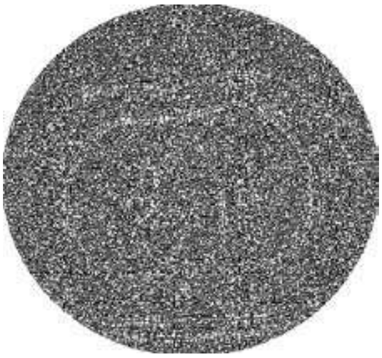
Compare the results.

Results:

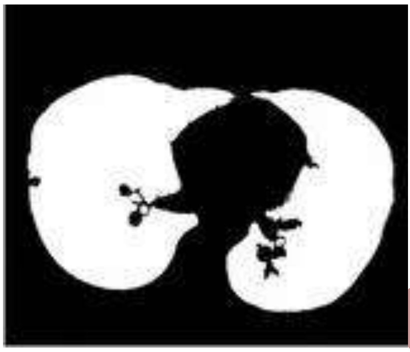
(a) original image



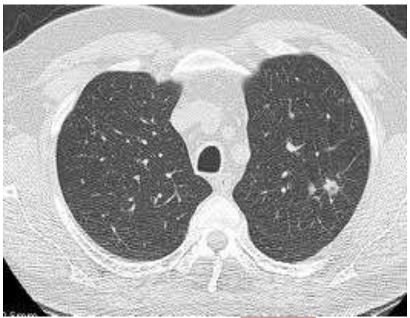
(b) Gradient magnitude



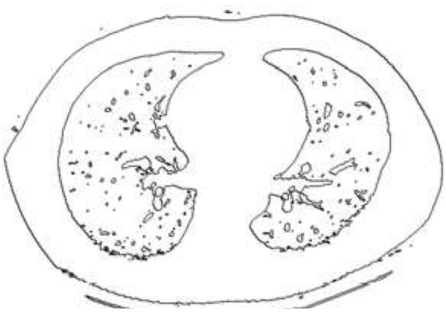
(c) Directly apply watershed



(d) after marking foreground



(e) cancerous nodule



(f) segmented result

Conclusion:

Watershed Segmentation method can be used on a large variety of images and in a wide area of applications. This paper shows an improved and better segmentation algorithm for lung MR images. The results are shown above and the work is done for only lungs MR images. With the help of above algorithm, it is easy to find the cancerous nodule to diagnose the cancer. This technique can be used for various other medical and DICOM images. Hence, this technique is very useful for research for medical fraternity and students.

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