

Lung Nodule Detection using Image Processing Techniques

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Abstract

In areas such as computer vision and image processing, image segmentation has been and still is a relevant research area due to its wide spread usage and application. The objective of the paper is about region based algorithm in medical image processing to segment the lung nodule in CT images. The work includes different image processing tools which successfully achieved the required goals when combined and successively applied. The segmentation system comprises of different stages to finally reach its target which is to segment the lung tumour. Image pre-processing takes place first where some enhancement techniques are used to enhance and reduce noise in images. The next stage is where the images are separated to be able to segment the tumour in later stages. In segmenting the nodule Region based segmentation shows the better result.

Keyword - CT, pre-processing,, Lung Segmentation, Lung Nodules. Region Growing segmentation

I. INTRODUCTION

Computed Tomography (CT) has exceeded conventional radiography in the screening of lungs because it originates a detailed high-resolution images and can show early stage tumors that are too small to be detected by conventional X-ray. CT has been widely used to detect numerous lung diseases, including pneumoconiosis, pneumonia, pulmonary edema, and lung cancer.[1] Early detection is possible only by CT images. The lungs are the parts of our body that we use to breathe. CANCER is one of the most serious health problems in the world field. The mortality rate of lung cancer is the highest among all other types of cancer. Lung cancer is one of the most serious cancers in the world, with the smallest survival rate after the diagnosis, with a gradual increase in the number of deaths every year. Survival from lung cancer is directly related to its growth at its detection time. The

earlier the detection is, the higher the chances of successful treatment are. [2]

Pre-processing is a subcategory of image processing which is used to improve the accuracy and interpretability. Image pre-processing is a powerful and testing factor in the computer-aided diagnostic systems.[3]. In medical image, pre-processing the image is an essential part for segmenting the tumour so that segmentation and classification algorithms work correctly. Accurate detection and segmentation of the tumour leads to exact classification of those tumours. The segmentation is clearly identified only when image is pre-processed as per image size and quality.

Lung segmentation is a necessary step; it has progressed from manual tracing to semi automated to fully automated segmentation. Image segmentation is the process of partitioning a digital image into multiple segments. The goal of segmentation is to simplify or change the representation of an image into something that is more meaningful and easier to analyse. Segmentation divides the image into its constituent regions or objects. The result of image segmentation is a set of segments that collectively cover the entire image or a set of contours extracted from the image [4]. Region based segmentation method 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 seed points. This approach to segmentation examines neighbouring pixels of initial “seed points” and determines whether the pixel neighbours should be added to the region. By using this algorithm early detection of lung nodule or tumour is calculated accurately.

In this paper- section II is about recent survey, section III describes methodology, section IV shows the result and section V conclusion.

A. Literature Survey

The Paper [5] speaks about the three segmentation algorithms namely threshold based, Edge based and region based where concluded that region based segmentation gives better result.

The Paper [6]. propose a comparative study between regions based segmentation techniques. This paper presents an objective comparison of region-based segmentation methods.

The Paper [7]. Describes the pre-processing method consisting of two phases. They applied both the algorithms on different CT and MRI images of Brain, Thorax and Abdomen. Preprocessing remove the unwanted portions from the images thereby significantly reducing the chances of over-segmentation in the process of segmentation of these images.

B. Motivation and justification

As there are various preprocessing filters are available and been introduced, the purpose of using Preprocessing is to enhance some features and to remove unwanted features for segmenting the nodule. Segmentation is an important factor in image processing which helps to detect cancer tissue earlier for treatment.

II. METHODOLOGY

The lung CT images having low noise when compared to scan image and MRI image. The main advantage of the computer tomography image having better clarity, low noise and distortion. So we can take the CT images for processing the lung image. Then segmentation is applied to the lung image. Here, Region based growing algorithm along with rule based filtering gives the best segmented part of liver with region of interest.

The original lung ct image is shown below. (Fig.1)



Fig1.Input lung CT image

The overall model of my paper is given in diagram (Fig.2).

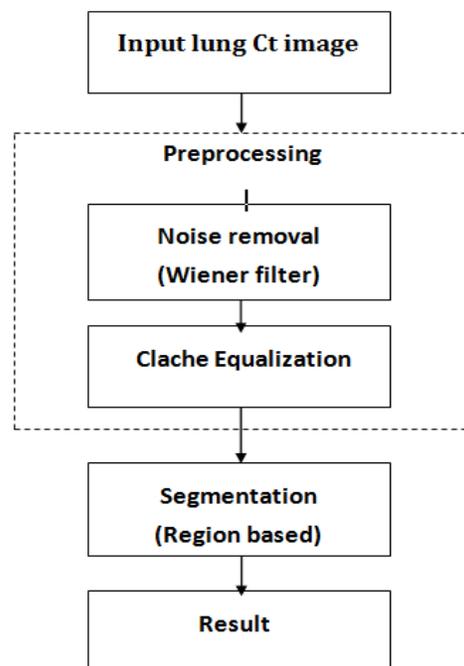


Fig2.Outline of my paper

A. Pre-processing

Preprocessing is a process which is used to increase the accuracy and interpretability. There are several methods in preprocessing techniques. Here only two techniques are used.

They are as:

1. Noise removal (wiener filter)
2. Clache Equalization

These two methods are used in pre-processing for the better results of noise removal in lung CT images

B. Image filtering

Smoothing is an image processing technique used in order to reduce the noise in an image to produce less pixilated and clearer image. Most smoothing techniques are based on low pass linear filters. It is mostly based on the averaging technique of the input image or the middle value technique. To perform a smoothing operation we will apply a filter to our image. The most common type of filters is the linear filters such as wiener filter which is used in our proposed system.[8].

C. Wiener filter

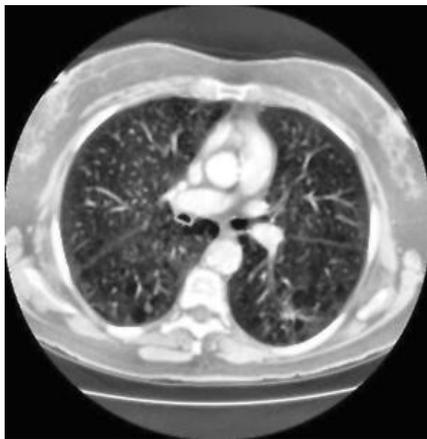
This filter is used to reduce impulsive noise or the salt-and pepper in an image with preserving the useful features and image edges. The goal of the Wiener filter is to filter out noise that has corrupted a signal. It is based on a statistical approach. Typical

filters are designed for a desired frequency response. However, the design of the Wiener filter takes a different approach. One is assumed to have knowledge of the spectral properties of the original signal and the noise, and one seeks the linear time-invariant filter whose output would come as close to the original signal as possible[2].

$$W(f_1, f_2) = \frac{H * (f_1, f_2) S_{xx}(f_1, f_2)}{|H(f_1, f_2)|^2 S_{xx}(f_1, f_2) + S_{\eta\eta}(f_1, f_2)}$$

D Clache Equalization

Contrast-Limited Adaptive Histogram (CLACHE) uses adaptstheq function to performs equalization. It enhances the contrast of the grayscale image by transforming the values using contrast-limited adaptive histogram equalization. Unlike histogram equalization, it operates on small data regions (tiles) rather than the entire image. Each tile's contrast is enhanced so that the histogram of each output region approximately matches the specified histogram (uniform distribution by default). The contrast enhancement can be limited in order to avoid amplifying the noise which might be present in the image. The output of clache equalization as shown below.(Fig3.)[8]



(Fig3. Output of Clache Equalization)

E. Image Segmentation

Image segmentation is an essential process for most image analysis subsequent tasks. In particular, many of the existing techniques for image description and recognition depend highly on the segmentation results[9]. The goal of segmentation is to simplify and/or change the representation of the image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. 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 [9].

The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image (edge detection). All pixels in a given region are similar with respect to some characteristic or computed property, such as colour, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s). Segmentation algorithms are based on one of two basic properties of intensity values: discontinuity and similarity. The first category is to partition the image based on abrupt changes in intensity, such as edges in an image. The second category is based on partitioning the image into regions that are similar according to a predefined criterion. Histogram thresholding approach falls under this category.[11].

F. Region Based Segmentation

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. Region-growing approaches exploit the important fact that pixels which are close together have similar gray values.[5] Region based segmentation is simple as compare to other methods and also noise resilient. It divides an image into different regions based on pre-defined criteria, i.e., color, intensity, or object. Region based segmentation methods are categorized into three main categories, i.e., region growing, region splitting, and region merging [20]. The region based segmentation methods are the methods that segments the image into various regions having similar characteristics.

There are two basic techniques based on this method. They are explained below.

A. Region growing methods:

The region growing based segmentation methods are the methods that segments the image into various regions based on the growing of seeds (initial pixels). These seeds can be selected manually (based on prior knowledge) or automatically (based on particular application). Then the growing of seeds is controlled by connectivity between pixels and with the help of the prior knowledge of problem, this can be stopped. The basic algorithm (based on 8-connectivity) steps for region growing method are lungs.

B.Region splitting and merging methods.

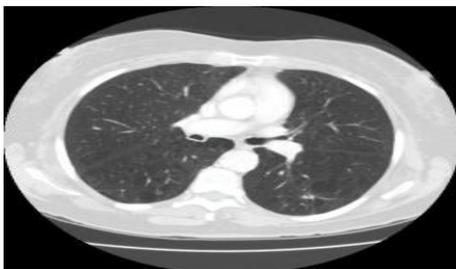
The region splitting and merging based segmentation methods uses two basic techniques.i.e Splitting and merging for segmenting an image into various regions. Splitting stands for iteratively dividing an image into regions having similar characteristics and merging contributes to combining the adjacent similar regions.

III.RESULT

Finally, the result of border correction, detected nodule and segmented area are as presented below.

- (a).lung Ct input image
- (b).Bordered corrected output
- (c).Detected nodule
- (d).segmented nodule

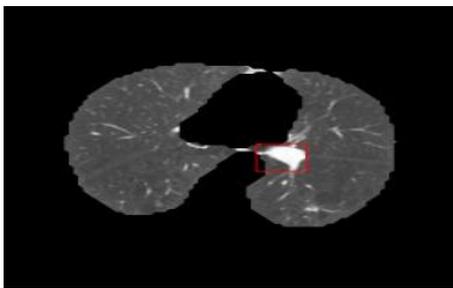
The result are as below:



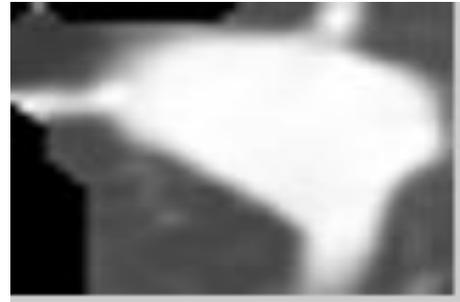
(a).lung Ct input image



(b).Bordered corrected output



(c).Detected nodule



(d).segmented nodule

IV.CONCLUSIONS

Lung cancer is the most dangerous and widespread in the world according to stage the discovery of the cancer cells in the lungs, this gives us the indication that the process of detection this disease plays a very important and essential role to avoid serious stages. In this project initially pre-processing of a CT image is done to remove the noises present in it. Clache equalization enhances the contrast of gray scale image. This paper presents an result of region-based segmentation method to segment a lung nodule in a image. Lung nodule are segmented with the correct region of interest.

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