International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 4 Issue 12 ǁ December. 2016 ǁ PP.24-29

Automated Lung Nodule Detection Method for Surgical Preplanning

Geethu S Nair, Dr.Sayyad Ajij D
Department of Electronics and Communication,MIT,Aurangabad.

ABSTRACT: *This paper is to develop a segmentation system in order to assist the surgeons for the treatment of certain illness such as lung cancer, and tumours.Lung cancer is one of the most frequently occurring cancer and it has a very low survival .Computer Aided Diagnosis (CAD) helps reducing the burden of radiation and improving the accuracy of abnormality detection during CT image interpretation. The fissures of lung lobes are difficult to see by our naked eyes in low dose CT image because low resolution scanners are used.This is an automatic segmentation system. The lung lobes and nodules in CT image are segmented using adaptive fissure sweep and adaptive thresholding. Firstly noise removal of CT image using filter is done, then the fissure regions are located using adaptive fissure sweep technique.Nodules are present in the fissures region.Oblique fissures are refined by region growing method. Lung Nodules are segmented using thresholding.*

Keywords: *CT image, fissures, lung nodules, segmentation, watershed transform*

I. INTRODUCTION

Human lungs are situated in two cavities on either side of the heart. It is subdivided into distinct pulmonary lobes separated by thin barriers, called fissures. The clinical CT image of the lung is shown in Fig 1.1 and its general anatomy is shown in Fig 1.2. The right lung consists of three lobes - an upper, middle, and lower lobe, whereas the left lung consists of only two - an upper and a lower lobe. Each lobe contains separate supply branches for both vessels and airways. Segmentation of the pulmonary lobes is relevant in many clinical applications. By using watershed transform lung lobes are segmented. The first step for this is lung segmentation. In this method lung regions are extracted by using threshold and left and right lungs are segmented using dynamic programming [6]. Boundary of an object is identified using spline contours and iterative energy minimization formula.

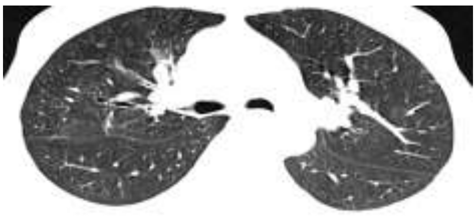

Fig 1.1: CT lung image

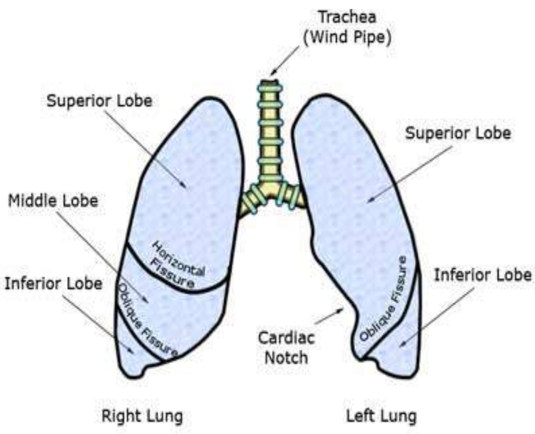

Fig 1.2: Human lung anatomy

II. PROPOSED METHOD

The proposed technique mainly consists of following modules.

1 Pre-processing
2 Vessel Enhancement
3 Lung segmentation
4 Fissure detection
5 Nodule detection

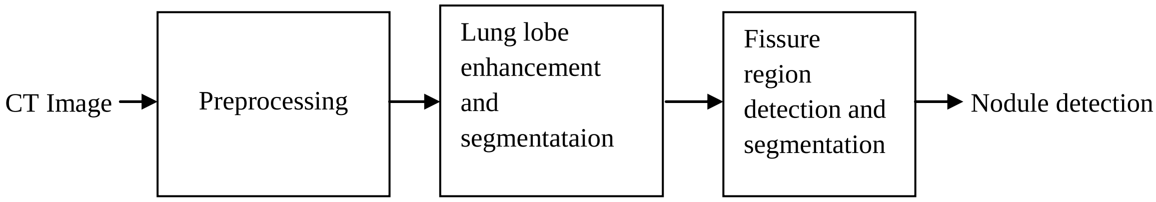

Fig 2.1: Block diagram

Preprocessing: Preprocessing is the method of removal of noise present in an image. The noise present in the image is of Gaussian noise. Gaussian is the natural way of modeling noise. We are using a Wiener filter for removal of noise in CT image. Wiener filer gives an estimate of the original uncorrupted image with minimum mean square error and the estimate is the non linear function of the corrupted image. Wiener filters of size 3*3 are used to remove the noise present in the CT image. After applying wiener filter we obtain the noise removed image.

Vessel Enhancement: This refers to processing an image so that the result is more suitable for a particular application**.** Vascular and Bronchial tress of the lungs are enhanced using the morphological operations. Morphology is a technique of image processing based on shapes[2]. The value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbours..Morphological operations like top hat and bottom hat filters are used. Top-hat filtering is used to correct uneven illumination when the background is dark. Top hat operation contains peaks of object that fit the structuring element. Bottom hat operations are used to fill the gap between the object.

Lung segmentation: Segmentation is the method of separating the required region from the rest of the image[1][3].Here the left and the right lung are segmented using adaptive thresholding. Thresholding is the simplest method of image segmentation. It is used to create a binary image from a grayscale image.For each pixel in the image a threshold has to be calculated .If pixel value is below threshold it is set to the background value otherwise it is set to foreground value. Threshold values are selected based on the mean value of the CT image.

Fissure detection: Fissure regions are identified using the fissure sweeping technique and the fissures are enhanced using region growing method [10]. The fissure sweep technique finds the fissure regions in the preprocessed CT images. The general anatomic structure of the lung is that lobar fissures separate the lung lobes where no major vascular or bronchial trees cross. This signifies that in the pre-processed binary images, fissures are represented by large amounts of air or space extending from the middle to the lateral side of the lungs. The fissure sweep technique uses this knowledge to coarsely define void regions where fissures could be present. The fissure sweep technique first calculates a set of predefined fissure angles. It is defined by angles between the fissures and a flat horizontal line using knowledge from the general lung anatomy

Nodule Detection: Lung Nodules are segmented using adaptive thresholding. Mean of CT image is used as threshold. Initially histogram equalization is used to enhance the contrast of the nodule[5].

III. SEGMENTATION

The purpose of the segmentation of the lung region in the CT image is to achieve a better orientation in the image .For separating the regions of interest or objects of interest from other parts of the image ,a region growing approach is used to distinguish between the specific nodules of lungs and other suspicious region[4]. Region growing is a technique for extracting a region of the image that is connected based on some predefined criteria. This criterion can be based on intensity information and/or edges in the image. In its simplest form, region growing requires a seed point that is manually selected by an operator, and extracts all pixels connected to the initial seed with the same intensity value. The watershed transform is a popular segmentation method from the field of mathematical morphology.The description of this transform is quite simple: if we consider the image as a topographic relief, where the height of each point is directly related to its gray level, and consider rain The description of this transform is quite simple: if we consider the image as a topographic relief, where the height of each point is directly related to its gray level, and consider rain gradually falling on the terrain, then the watersheds are the lines that separate the “lakes” (actually called catchment basins) that form. Generally, the watershed transform is computed on the gradient of the original image, so that the catchment basin boundaries are located at high gradient points.[8] The watershed transform has been widely used in many fields of image processing, including medical image segmentation, due to the number of advantages that it possesses: it is a simple, intuitive method, it is fast and can be parallelized and it produces a complete division of the image in separated regions even if the contrast is poor, thus avoiding the need for any kind of contour joining. Furthermore, several researchers have proposed techniques to embed the watershed transform in a multiscale framework. 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 [7].

3.1 Watershed Segmentation:

The algorithmic steps of watershed transform is as follows

- Accept feature map as input and build an image boundary around the borders of the image.
- Pre-process the Image. Locate and label all single pixel regional minima (pixels those are lower in value than all their 4-neighbors). .
- Based on threshold, generate an image
  having particular sized cells (Cancer)Identify all flat regions, give them a distinct label and locate the lowest pixel surrounding the boundary of the region.
- Segment using Watershed to identify the various regional maximas and minimas.
- Mark the flat regions that are regional maxima and mark boundary pixels between region.
- Depth of each region is computed as a difference between the largest and smallest valued pixel in that watershed [6].Watersheds are thresholded according to their depths.Sequentially labelling all individual regions bounded by the marked edges in the binary image to create a segmented image..

IV. RESULT

CT images from twenty patients have been processed. The resolution of all CT images is 512*512 pixels with a thickness of 5mm to 10mm. The performance of the segmentation algorithm is evaluated using a 1.6Ghz Intel(R) Core(TM) 2Duo CPU with 1GB of RAM running Matlab7.1.0 (R2010a). The Matlab is a Matrix laboratory and it is a high-performance language for technical computing integrates computation, visualization, and programming in an easy-to-use environment. The performance of the segmentation algorithm is evaluated with respect to manual segmentation. Normally for surgeons it takes around 15 to 25 minutes to analyze the clinical CT images whereas the run time of segmentation algorithm is only 3 minutes and this indicates that the automatic segmentation is better suited for busy clinical settings.

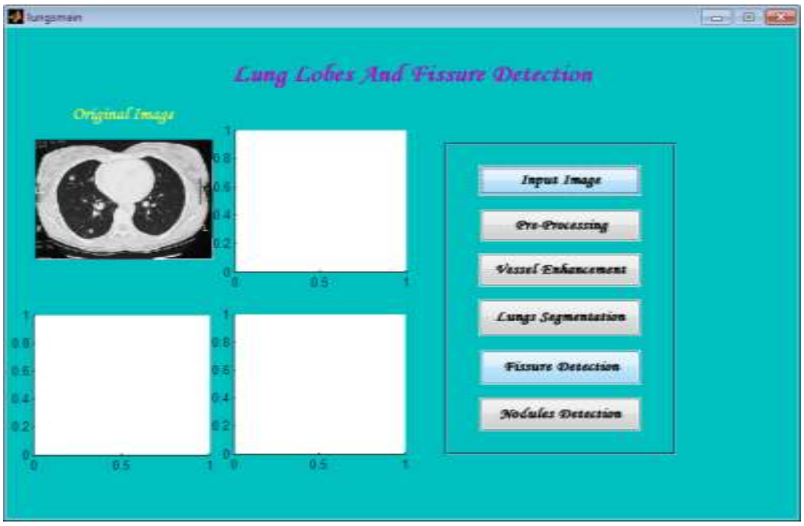

Fig 4.1 Input screen

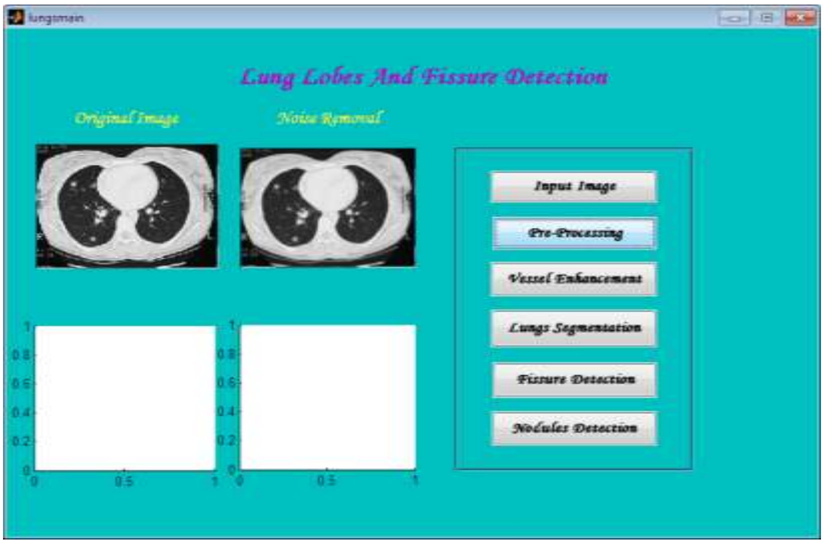

Fig 4.2: Image after Removal of Noise

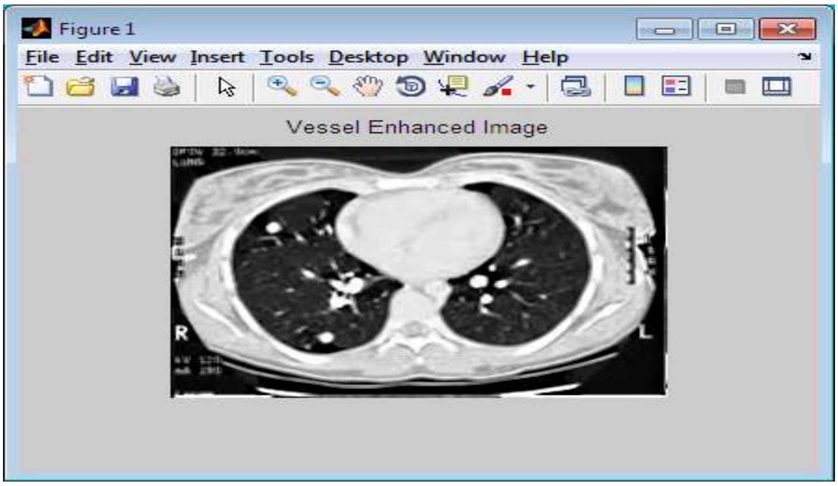

Fig 4.3: Vessel Enhanced Image

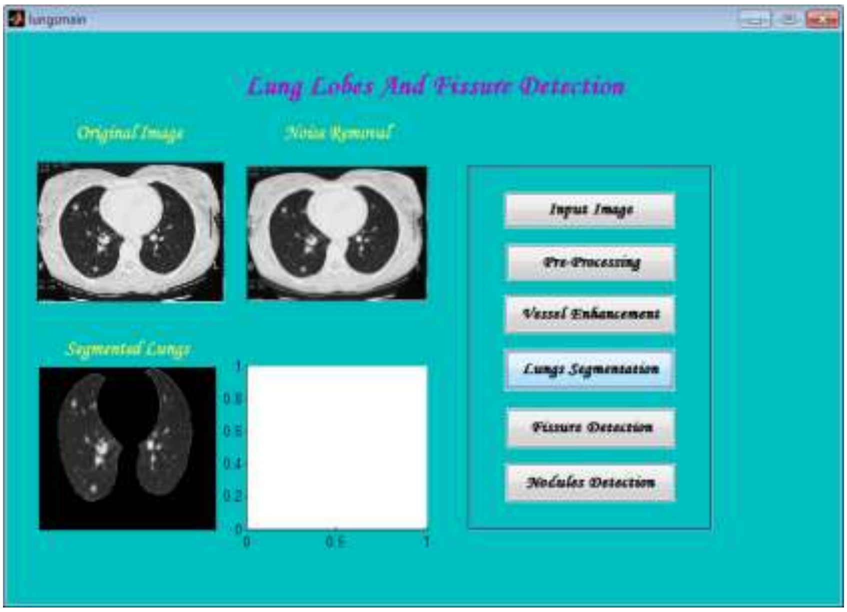

Fig 4.4: Lung Segmented Image

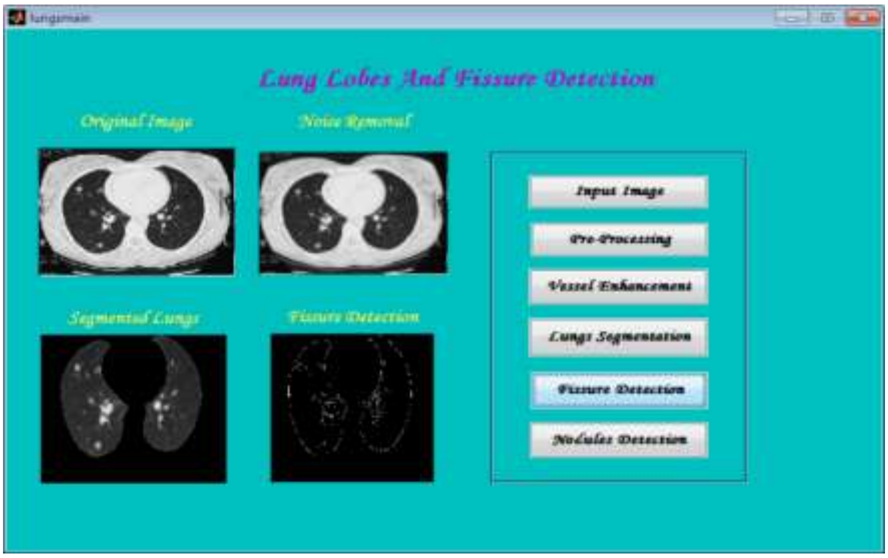

Fig 4.5: Image after Detection of Fissure

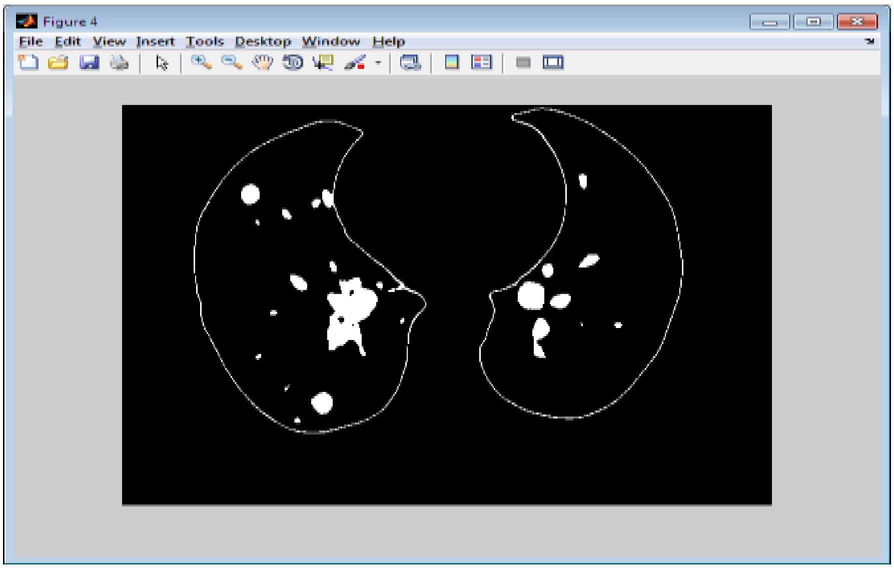

Fig 4.6: Nodules Segmented

V. CONCLUSION

Segmentation and detection of lung lobes and nodules in CT images have been an active research topic. Many algorithms have been utilized to detect the fissures and lobes in lungs. CT scan that is used currently for the detection, characterization and follow-up of lung nodules are of low resolution scanners and as the number of image increases, efforts taken by the medical experts to analyze the image consumes much time. This project proposes a new automatic segmentation algorithm of lung regions which includes four sub-divisions Image Enhancement and Segmentation, Fissure Detection for identifying the fissure regions, Fissure Refinement, Nodule Segmentation using Adaptive .The main advantages are

• Successful enhancement to minutiae for Lung nodules cancer recognition.
• Exceedingly safety measures.
• It takes very short time to find the optimal solution as the apriority knowledge about the image is taken into consideration.
• It controls the output error as it is optimal.
• It is straightforward to design and it is faster.

REFERENCES

[1]. Anitha. and Sridhar."Segmentation of Lung Lobes and Nodules in Ct Images", Signal & Image Processing: An International Journal (SIPIJ) Vol.1, No.1, September 2010

[2]. Jan-Martin Kuhnigk*, Volker Dicken etal "Morphological Segmentation and Partial Volume Analysis for Volumetry of Solid Pulmonary Lesions in Thoracic CT Scans" IEEE Transactions On Medical Imaging, Vol. 25, No. 4, April 2006

[3]. Eva M. van Rikxoort 'Automatic Segmentation of Pulmonary Lobes Robust Against Incomplete Fissures' IEEE Transactions on Medical Imaging, vol. 29, no. 6, june 2010

[4]. E. M. van Rikxoort, B. de Hoop, S. van de Vorst, M etal "Automatic segmentation of pulmonary segments from volumetric chest CT scans," IEEE Trans. Med. Imag., vol. 28, no. 4, pp. 621–630, Apr. 2009.

[5]. K. Okada, D. Comaniciu, and A. Krishnan, "Robust anisotropic Gaussian fitting for volumetric characterization of pulmonary nodules in multislice CT," IEEE Trans. Med. Imag., vol. 24, no. 3, pp. 409–423, Mar.2005.

[6]. Hu S HoffmanE.A and. Reinhardt J.M, (2001), 'Automatic lung segmentation for accurate quantization of volumetric X-ray CT images', IEEE Trans.

[7]. J. B. T. M. Roerdink and A. Meijster, "The watershed transform: Definitions, algorithms and parallelization strategies,"Fundamenta Informaticae, vol. 41, pp. 187–228, 2001.

[8]. V. Grau, A. U. J. Mewes, M. Alcañiz, R. Kikinis and S. K Warfield, "Improved Watershed Transform for Medical Image Segmentation Using Prior Information", IEEE Transactions on Medical Imaging, Vol. 23, No. 4, April 2004

[9]. Kubo M Niki N. Eguchi K,. Kaneko M, and. Kusumoto M. (2000) 'Extraction of pulmonary fissures from thin-section CT images using calculation of surface-curvatures and morphology filters',in Proc. IEEE Int. Conf. Image Process. pp. 637–640

[10]. Jingbin Wang , Margrit Betke , Jane P. Ko , 'Pulmonary fissure segmentation on CT', Medical Image Analysis 10 (2006) 530–547.

[11]. Soumik Ukil and Joseph M. Reinhardt, "Anatomy-guided lung lobe segmentation in X-Ray CT images", IEEE Transactions on Medical Imaging, vol. 28, no. 2, pp. 202-214 , 2009.

[12]. J. Wang, M. Betke, and J. P. Ko, "Pulmonary fissure segmentation on CT," Med. Image Anal., vol. 10, pp. 530–547, 2006