Elysium Journal of Engineering Research & Management

P-ISSN: 2347-4408
E-ISSN: 2347-4734

A SURVEY ON LUNG SEGMENTATION TECHNIQUES

R. Shiny Angel[1] and P.Tharcis[2]

[1]PG Scholar, Christian College of Engineering and Technology, Oddanchatram, Dindigul. E-Mail:rshinyangel@gmail.com

[2]Assistant Professor, Christian College of Engineering and Technology, Oddanchatram, Dindigul. E-mail: ptharcis@gmail.com

Abstract--- The cancer in the lung is the common cancer and leads to dead often. The cells which are affected are difficult to analyze in the early stage of cancer because they are overlapped. Many techniques are used for finding the cancer at the early stage is detected. To prevent lung cancer identification of genetic and environmental factors are important. To cure the cancer in the lungs the time factor is very important to discover the abnormality issue in the target images. When the cancer at the lungs has detected and predicted in its starting stages it would reduce many treatment options and also it would reduce the risk of surgery.Therefore early detection and prediction of cancer in the lung could play a vital role in the diagnosis process and also increase the survival rate of patient.

Key terms: Computed Tomography (CT) images, Lungs, Segmentation, detection, image processing, prediction.

1. INTRODUCTION

The usage of computer for finding the affected part of the lungs in CT images is also called segmentation. These are a vital first step in radiologic pulmonary image analysis [1].This techniques have used in various areas such as military, space research, medical and so on.. Based on principal component analysis and Histogram Equalization pre processing technique is used. Classification is very important process in digital image analysis.

Histogram Equalization is used for image preprocessing and feature extraction and in neural network classifier to check the state of a patient in its early stage. After that the survival rate of patient is predicted by the extracted features. Overall, 15% of people were diagnosed with lung cancer survive.

Early detection and prediction system we consider several significant patterns which are Smoking, Environment, Alcohol, Obesity, Chronic lung Disease, Balance Diet, Mental trauma, Radiation Therapy, Tobacco, and Genetic Risk[6,7]. When we use this significant pattern the system will predict lung cancer. Smoking is the important cause of lung cancer. The smoke which is produced by cigarette contains more than 4,000 chemicals. After many experiments, the researchers have found that these chemicals are the cause for cancer. However, other factors, mainly air; excessive alcohol may also be induce Lung Cancer [3]. Lung cancer occurs for out-of-control cell growth and begins in lungs. Lung cancer that spreads to the brain can cause difficulties with vision. It paralyzes one side of the body. Symptoms of lung cancers include cough, coughing up blood, chest pain, and breathe shortness [4].

Early prediction of lung cancer plays a pivotal role in the diagnosis process and for a preventive strategy. Fig1 shows the beginning stage of cancer. The techniques used to diagnosis lung cancer are Chest Radiograph (x-ray), Computed Tomography (CT), Magnetic Resonance Imaging (MRI scan) and Sputum Cytology. These techniques are expensive and time consuming. Even though these techniques expensive and time consuming they are used for detecting the lung cancer in its advanced stages. The patient's chance of survival is very low. Therefore, there is a great need for a technology to diagnose the lung cancer in its early stages. So a computerized diagnosis is essential for detecting the lung disease [4, 6].

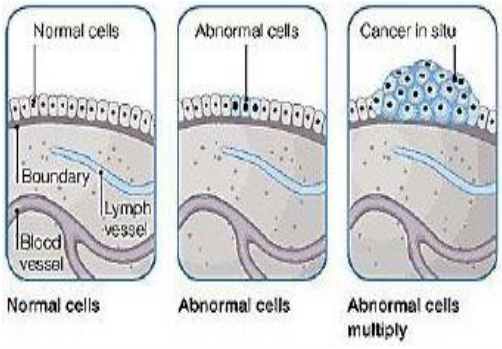


Fig1: The beginning of cancer

If the cancer cells are identified, then entire diagnosis process of Lung cancer detection system as followed by different stages used in this technique.

1.1 Image Capture

In diagnosing of lung cancer, capturing lung image is very essential. Many modern imaging techniques were used to capture such as X-RAY, MRI, SPECT, PET and CT. For this cancer cell identification CT images are used as an input image with pixel size of 512 x 512 stored in a

P-ISSN: 2347-4408
E-ISSN: 2347-4734

JPEG format. Compare to X-ray, CT images are perceptive characteristics of identifying lung tumour size and lymph node regions.

1.2 Image Pre Processing

The image Pre-processing stage in this system begins with image enhancement which aims to improve the interpretability or sensitivity of information included in them to provide better input for other programmed image processing techniques.

Image enhancement techniques can be divided into two wide types: Spatial domain methods and frequency domain methods. When image enhancement techniques are used as pre-processing tools for other image processing techniques, the output will determine which techniques are most suitable. We can use Histogram Equalization in the image enhancement stage [9].The pre-processing of image aims for selective elimination of the redundancy in scanned images without affecting the original image, this play vital role in the diagnosis of lung cancer. Therefore, Histogram-Equalization becomes the crucial step in pre-processing. Hence, each image is pre-processed to enhance its superiority. However pre processing tools are used as image enhancement techniques for other image processing they are most appropriate. FFT, Auto enhancement, wiener and Gabor filtering are the three methods used as image enhancement techniques.

1.3 Image Segmentation

Image segmentation is a crucial process for most image analysis consequent tasks. Especially, most of the existing techniques for image description and recognition are highly depend on the segmentation results. Segmentation splits the image into its constituent regions or objects. Image segmentation can be done by various methods.

Segmentation of medical images in 2D has many beneficial applications for the medical professional such as: visualization and volume estimation of objects of concern, oddities detection, tissue quantification and organization and many more.

The main objective of segmentation is to simplify and change the representation of the image into something that is more significant and easier to examine. Image segmentation can normally use to trace objects and borders such as lines, curves, etc. in the images [10]. More accurately, image segmentation is the process of allocating a label to every pixel in an image such that pixels with the same label share certain pictorial features.

The outcome of image segmentation is a set of segments that collectively cover the entire image, or a set of edges extracted from the image that is edge detection. In a given region all pixels are similar relating to some distinctive or computed property such as texture, intensity or color. With respect to the same characteristics adjacent regions are significantly different.

One of two basic properties of intensity values Segmentation algorithms are based on: discontinuity and similarity. In the first process, we partition the image based on abrupt changes in intensity, such as edges in an image. The next group is based on segregating the image into regions that are alike according to a predefined criterion. Histogram thresholding method comes under this group.

1.4 Feature Extraction

Image features Extraction stage is a crucial stage that uses algorithms and methods to detect and separate various preferred portions or shapes of an inputted image.

2. RELATED WORKS

CT Lung Segmentation Methods are as follows.

2.1 Thresholding-based Methods

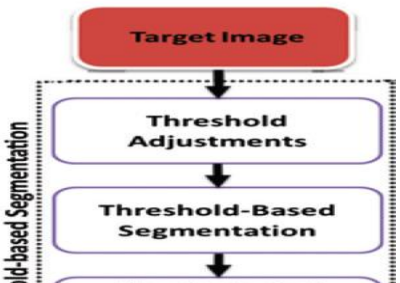
Thresholding methods are very important method for lung segmenation as the threshold value is found the infected part can be easily separated. Thresholding-based methods segment the image by creating binary partitions that are based on image attenuation values, which is determined by the relative attenuation of structures on CT images [7].

A thresholding procedure attempts to determine attenuation values, termed *threshold(s),* which create the partitions by grouping together all image elements with attenuation values that satisfy the thresholding interval.

Thresholding-based methods are simple and effective for obtaining segmentations from images with a well-defined contrast difference among the regions.

Indeed, these methods usually perform better on CT images, compared with images obtained with other imaging modalities, because of the fact that the attenuation values,

measured in Hounsfield units, have well-defined ranges for different tissue components on CT images. The thresholding-based techniques do not typically take into account the spatial characteristics of the target objects (lungs). These techniques are generally sensitive to noise and imaging artifacts.Fig2 shows the flowchart of a thresholding-based method of lung segmentation. The presence of abnormal imaging patterns affects this class of thresholding-based segmentation methods more than other methods because no spatial information and variability are considered during the segmentation process.



P-ISSN: 2347-4408
E-ISSN: 2347-4734

Fig 2: Flowchart of a thresholding-based method of lung segmentation

The appropriate selection of the threshold parameters may be enough for segmenting lungs with minimal or no pathologic conditions because of the stable attenuation values of the air and lung fields. It may be difficult to include pathologic areas within the lung regions with thresholding-based approaches because the thresholding interval is often set to exclude adjacent tissues from lung fields, but pathologic regions may share similar attenuation values to those of soft tissues[12].

2.2 Region-based Methods

For region-based lung segmentation, the seeded scheme is commonly applied. In such cases, a small patch (seed) that is considered to be most representative of the target region (lung) is identified first.

Seed points are the coordinates of a representative set of voxels belonging to the target organ to be segmented.[10].

Once the seed points are identified, a predefined neighborhood criterion is used to extract the desired region. Different methods feature different criteria for determining the lung boundaries.

For instance, one possible criterion could be to grow the region until the lung edge is detected. As another example, region can be used for convergence of the segmentation.

Region-based methods can be used for delineation of airways and pathologic conditions with same content such as cavities. With this ability, a single segmentation algorithm can be used to depict and quantify multiple organ and suborgan structures [8,9].

An example is a single region-based segmentation approach that is applied to multiple structures in pulmonary image analysis: a cavity in the right upper lobe, the airways, and the lung fields In terms of efficiency, region-based segmentation methods can be considered efficient because the timings (a few seconds to a few minutes) and the computational cost reported in the literature are within the bounds of clinical. The repeatability of the region-based segmentation methods depends on the location of the seed points (if seeding-based segmentation);

Hence, different region-based methods have different robustness for repeatability. The fuzzy connectedness method of image segmentation has been shown to be more robust in comparison with the graph-cut, random walk, and region-growing methods. Fig3 shows the region based method of lung segmentation.

2.3 Graph Cut Method

It is a most popular segmentation method to process binary and gray scaled images .Graph cut methods have become popular alternatives to the level set- based approaches for optimizing the location of a contour.

2.4 Random Walk Method:

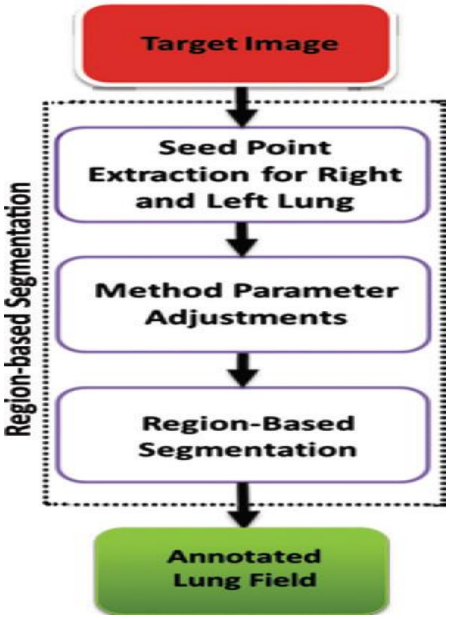
Random walk is used as a initialization tool to solve the segmentation problem. It used to first segment each nodule and then by a model-based shape analysis used to determine anatomical characteristics of all type of nodules.

2.5 Region Growing:

Region growing also classified as a pixel-based image segmentation method since it involves the of initial seed points. It start with a seed pixel, the initial region begins as the exact location of seedpoints. The regions are taken and the seed points are selected to grow these regions.

This is an iteratively grown by keeping examining the adjacent pixels of seed points. The deference between pixels intensity and the regions mean is used to classify the similarity of the image into regions.

There are more recent studies on this algorithm that have extended its approach as main component of their segmentation algorithm.



P-ISSN: 2347-4408
E-ISSN: 2347-4734

Fig3: Flowchart of a Region-based method of lung segmentation.

2.6 Fuzzy Connectedness

A fuzzy method is the method in which the centre point is calculated and by that the defected region is found. This means the concept is difficult in some way, lacking a fixed, precise meaning.

FCM is one of the recently used soft computing methods. In fuzzy clustering, every point belongs to group of clusters and it does not belong to only one point.Thus, points on the edge has slight variations when compared with the points on the centre.

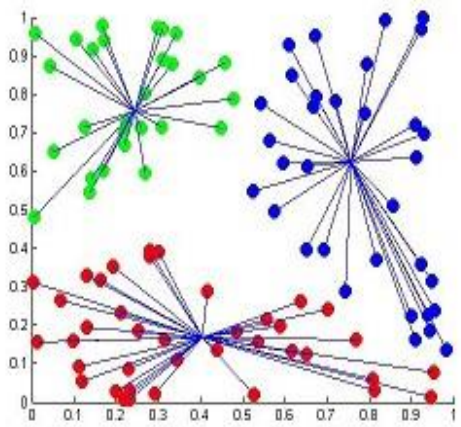


Fig.4 Result of Fuzzy clustering.

2.7 Shape-based Methods

Shape based methods are used to find the affected part in the lungs when the shape of the lungs is bulged. Especially to segment organs with abnormalities that cannot be annotated by using the standard thresholding - based techniques [14].Many algorithms has been introduced but shape based method is used when there are inflammations in the lungsor the lessions are bulged.

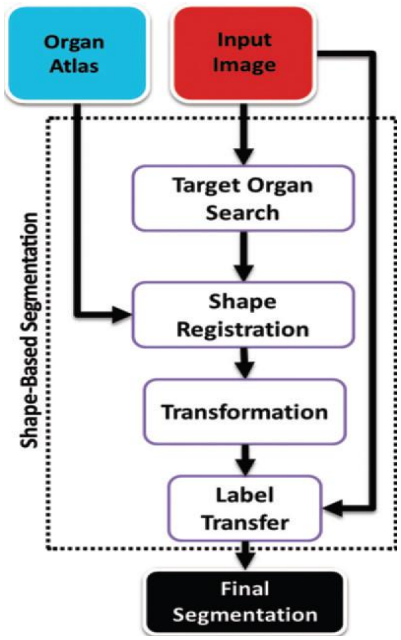


Fig 5: Flowchart of a Shape-based method of lung segmentation.

2.8 Atlas-based Methods

An atlas has a template CT image and the corresponding labels of the thoracic regions. To perform segmentation the affected part is compared with the real part.Once alignment is completed, labels of the atlas are propagated onto the target image. It should be noted that registration (alignment) is a difficult and ill-posed problem, although many registration methods are available with sub millimeter accuracy.

2.9 Neighboring Anatomy–guided Methods

Neighboring anatomy–guided methods use the spatial context of neighboring anatomic objects of the lung (eg, rib cage, heart, and spine) for segmenting lung regions with good accuracy. The main aim is to restrict the search space of the optimal boundary search and remove some of the false-positive findings automatically from the suboptimal segmentations [11]. Once it is known, where the heart and rib cage are, then it is easier for a segmentation algorithm not to leak into those territories. Fig6 shows the flowchart of a neighbouring anatomy–guided method of lung segmentation.

P-ISSN: 2347-4408
E-ISSN: 2347-4734

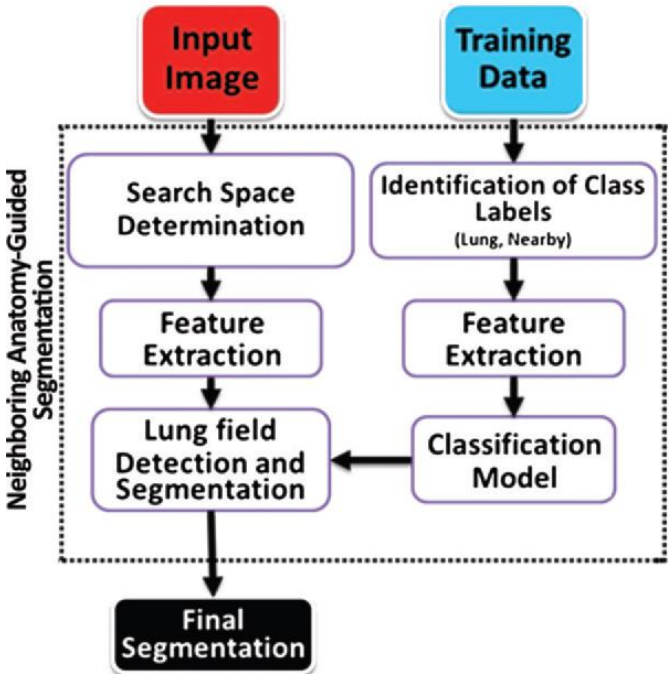


Fig 6: Flowchart of a neighboring anatomy–guided method of lung segmentation.

3. 3. CONCLUSION

The increasing role of software and image processing in the clinical radiology underpins the need for greater awareness among radiologists of how software can identify structures and lesions and yield quantitative characteristics about these objects on the image. Some areas of radiology are using computer-aided detection methods for lesion identification, like in finding of lung and breast nodules. The segmentation algorithms continue to improve the regard to the quality of output and the efficiency of these methods in radiologists work flow for the future potential of com-puter-aided detection in radiology is substantial for the segmentation algorithms. In particular, the contribution to the accurate longitudinal assessment of the disease progression and response to treatment has enable optimal level.

REFERENCE

[1] Wei Hu,Deihui Xiang,Bin Xiang,lirong Wang,Ivica Kopriva and J. H. Macgregor,"Random Walk and Graph Cut for Co-Segmentation of Lung Tumor on PET-CT images," *IEEE Trans. On image. processing.*, vol. 24, no. 12, pp. 5854–5866, Dec 2015.

[2]Q. Wei and Y. Hu, "A Hybrid Approach to Segmentation of Diseased Lung Lobes " ,IEEE JOURNAL OF BIOMEDICAL AND HEALTH INFORMATICS ., vol 18, no. 5,Sep 2014, pp. 1696-1706.

[3]Q.Wei, Y. Hu, G. Gelfand, and J. H. Macgregor,"Segmentation of lung lobes in high-resolution isotropic CT images," *IEEE Trans. Biomed. Eng.*,vol. 56, no. 5, pp. 1383–1393, May 2009.

[4]Ajil MV, Sreeram S. Lung cancer detection from CT images using various image processing techniques. International Journal of Advance Research in Computer Science and Management Studies. 2015 May; 3(5), 249–54.

[5] Chaudhary A, Singh SS. Lung cancer detection on CT images by using image processing. International Conference on Computing Science, Phagwara. 2012. p. 142–6.

[6]Goswami A. For image enhancement and segmentation by using evaluation of gabor filter parameters. International Journal of Advanced Technology and Engineering Research. 2012 Sept; 2(5):46–56.

[7]Ruchika Kalra A. Detection of lung cancer in CT images using mean shift algorithm. International Journal of Advanced Research in Computer Science and Software Engineering. 2015; 5(5):1147–9.

[8]Patela SVK, Shrivastavab P. Implementation of medical image enhancement technique using gabor filter. International Journal of Current Engineering and Technology. 2012 Apr; 2(2):251–5.

[9] Yongjun W, Na W, Hongsheng Z, Lijuan Q, Zhen Y, Yiming W. Application of artificial neural networks in the diagnosis of lung cancer by computed tomography. International Conference on Natural Computation, Shandong. 2010; 1:147–53.

[10] Shah S. Automatic cell images segmentation using a shape-classification model. IEICE Transactions on Information and Systems. 2007; 91(7):1955–62.

[11]Suzuki K, Shiraishi J, Abe H, MacMahon H, Doi K. False positive reduction in computer aided diagnostic scheme for detecting nodules in chest radiographs by means of massive training artificial neural network. Academic Radiology. 2005; 12:191–201.

[12]Al Tarawneh MS. Lung cancer detection using image processing techniques. Leonardo Electronic Journal of Practices and Technologies. 2012; (20):147–58.

[13] Ng HP, Huang S, Ong SH, Foong KWC, Goh PS, Nowinski WL. Medical image segmentation using watershed segmentation with texture merging. IEEE Engineering in medicine and biology Society Conference, Canada. 2008. p. 4039–42.

[14]Nguyen worring HT, Van de Boomgaard R. Watersnakes: Energy-driven watershed segmentation. Pattern Analysis and Machine Intelligence. 2003 Mar; 25(3):330–42.