# A Quantitative Approach for Determining Lung Cancer Nodule using Fuzzy Connectedness Technique in CT scan Images

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***Abstract*— In males the most common reason for the death nowadays is lung cancer. From the past few years computed tomography has gained its popularity in detection of lung cancer. The application of image processing has increased day by day. The lungs are a pair of spongy, air filled organs located on either side of the chest. Lung cancer caused by cigarette smoking and passive smoking. This paper proposes a method for segmentation of lung cancer based on lung region, tumour intensity, blood vessels intensity and threshold. This study shows the outcome of applying image processing operation like, pre-processing and segmentation. Proposed work uses the fuzzy connectedness technique. The Lung segmentation method shows the quantitative results such as fast, strong and improves the performance of strong clinical tasks.**

***Index Terms*— Background and Foreground separation Technique, Mask operation, Fuzzy connectedness image method.***

## I.INTRODUCTION

Cancer is a rapid growth of cells in a given region of body. The two important reasons for this rapid growth are mutation and excessive reproduction of cells. Due to this multiplicative growth of cells, there will be uncontrollable growth in organs, these results in formation of tumor. This can happen in any part of the body. If the multiplicative growth of cells takes place in lungs, it is said to be lung cancer. When compared to all other different types of cancers, lung cancer is the only one which leads to death in men. The prediction of lung cancer cannot be done in early stages. At the same time, cause is still not understood. So, detection of the lung cancer in its early stage can be helpful to avoid death rates. So the lung segmentation method shows the quantitative results for the further feature extraction and classification. Many image processing and machine learning technique have come into existence in order to diagnose and segments the lung tumour (nodules) from blood vessels in lung into its different stages. According to the survey made by, cancer caused more than 13,000 annual deaths in the USA, which can be more than 500,000 annual deaths from cancer [1]. This drop in cancer mortality is due to the advance in treatment early and accurate segmentation of lung cancerous nodule or lung tumour from the blood vessels and other particles in the lung. In the present work the segmentation of CT scan images [2] are done based upon mapping of images and threshold.

The proposed method aims to segment the lung region, lung nodules and cancerous lung nodule in lungs of different stages. So there should not be any unwanted information in the image, before prior to segmentation. The proposed work uses fuzzy connectedness technique for the segmentation [4]. László Gin in 2006 created the algorithm for support vector machine [5][6]. In performance analysis, fuzzy connectedness technique for segmentation has proven to be the accurate method in segmentation of a CT scan images when compare to other techniques.

This paper is organized as follows: Section II presents a review on existing technique for lung cancer pre-processing and segmentation. Section III describes about methodology. Section IV gives details regarding results and discussions. Section V describes about conclusion.

## II.LITERATURE SURVEY

A brief survey carried in order to work with the proposed method is discussed in this section. Classification of CT scan images using support vector machine classifier is present in [6]. In this technique, classification of lung cancer is made based on only its three categories namely, normal, benign and malignant. The segmentation techniques for lung cancer detection in CT scan images are presented in [7]. In this paper, the segmentation by registration scheme is applied. The normal lungs are elastically registered with scan for pathology.

In this paper, radiomic analysis performed on the malignant and benign mediastinal lymph node for the complementary features extraction [8]. In this method, mediastinal lymph-hub metastases in non-small cell lung growths explored by the significance of creating effective are progressively stressed. It is because the ideal surgical mediation and treatment for patients with lung malignancy. This paper investigated profound learning, surface highlights and their blends to determine unpretentious distinction among the threatening and kindhearted mediastinal lymph hubs on CT. The radiomics-based outcomes are observed to guarantee for separating threatening from benevolent mediastinal lymph hubs of patients with lung growth.

## III.METHODOLOGY

The whole stream of the proposed work is partitioned into five modules as appeared in Figure.1, the five modules are: Image Acquisition, Image pre-processing, Image segmentation, Extraction of features and Classification. In this paper, CT scan image is taken as input image, which then undergoes image foreground and background separation method, morphological operation, image enhancement [10], and segmentation. Region of interest obtained in segmentation phase.

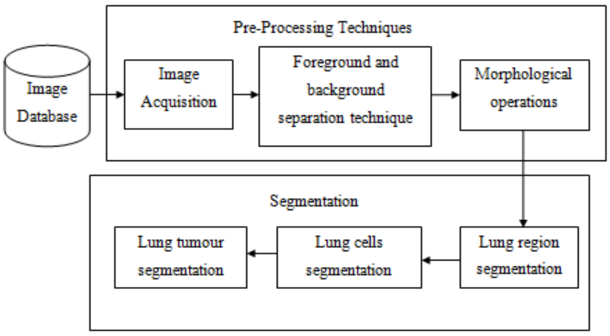



Figure 1: Architecture diagram for the proposed system.

### A. *Image Acquisition*

With the specific end goal to pay out the test examination, the test images are gathered from Image archive. The images are in gray scale. The proposed strategy utilizes smaller than usual Image archive database as it contains finish data about CT scan images [11].

### B. *Image Pre-processing*

The very common unwanted information can be seen in CT scan images [12]. If unwanted information is not removed, then it may lead to wrong classification of disease. This will have strong impact on patient. Pre-processing steps divided into stages namely foreground and background separation method and image enhancement. High intensity labels and unwanted information occurred during image acquisition technique will be removed. Initially do the foreground and background separation method on the CT scan image. In this method, we set threshold value as 604. This value is considered based on mean value of attenuation coefficient value of fat, muscles, blood vessels and tumor intensity. Because to remove the background image without removing foreground information. Resulted image is the threshold image. For the purpose of boundary extraction, disk is used as structuring element. Then perform the mask operation on threshold image to remove the unwanted information left in the threshold image and to convert it as binary image using hole filling function to find the two largest areas (lungs) in the image.

### C. *Image Segmentation*

In our proposed segmentation method, unwanted information free and enhanced image is divided into different partitions [13]. Pixels in each partition will be having similar grey scale of multivariate values. After doing mask operation we get binary image. The CT scan image mapping with this binary image and to select ROI in segmentation stage. Adaptive diffusion active contour model is used for selection of ROI. Then we set the threshold value as I(image)>873, because other region in the lung has low intensity level(less than 873) compared to cancerous tumor and blood vessels, then it removes the low intensity level region in lung and it shows the cancerous tumor and blood vessels in the lungs. Based on intensity range, size, shape and area, cells in lung will be arranged in the decreasing order using the sort and imtool function. Then shows the highest intensity lung tumor or lung cancerous nodule.

Image segmentation is the process of partitioning multiple image segmentation from the digital images. Image segmentation process consists of many segmentation method such as structural segmentation technique, stochastical segmentation technique, hybrid technique, thesholding method, Edge based segmentation method, region based segmentation method, and clustering based segmentation method. But in this paper, fuzzy connectedness technique is used. The main idea of the fuzzy connectedness method as shown in the below figure 2.

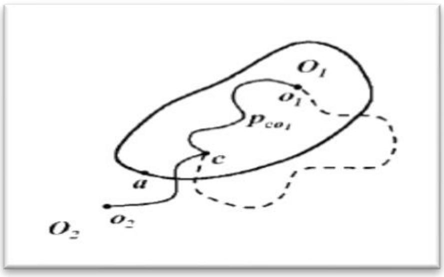


Figure 2: Main idea of fuzzy connectedness method

Figure 2 illustrates the main idea of fuzzy connectedness method. The any spel membership, such as c. Object c is determined based on the c connectedness strength with respect to the reference spel $o_1$ and $o_2$ are specified in the object $O_1$ and $O_2$. c belongs to that object with respect to whose reference spel it has the highest strength of connectedness.

Algorithm of fuzzy connectedness is as shown in below:

Input: C = (C,f), k, spel o, b and η
Output: Fuzzy k-object 0 containing o relative to a background containing b.
Auxiliary data structure: The k-connectivity scene $C_{K_0}$= (C, $f_{K_0}$)
Of o in C; the k-connectivity scene
Begin

0. For x ∈{o,b} do
1. Set $f_k(c) = 0$ for all c ∈ C expect for x set $f_k(c) = 1$
2. Push all spel c ∈ C such that $\mu_k$ (x,c)>0 to Q;
3. While Q is not empty do
4. Remove a spel c from Q;

5. Find

$f_{max} = max_{d \in D}\{\min(f_k(d), \mu_k\ (c,d))\};$

6. If $f_{max} > f_k(c)$ then

7. Set $f_{k(c)} > f_{max};$

8. Push all spel e such that

$\mu_k(c,e) > f_k(e)\ to\ Q;$

End if;

End while;

Endfor;

9. For all c ∈ $C$ do

10. If $f_{k(c)} > f_{k(c)}$ then set $\mu_0(c) = \eta(f(c));$

11. Else set $\mu_0(c) = 0;$

12. Output o;

End

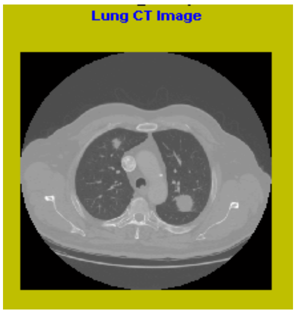
Fuzzy connectedness algorithm is used to segment the lung cancerous nodule accurate from the blood vessels and other particles in the lung region.

## IV.RESULTS AND DISCUSSIONS

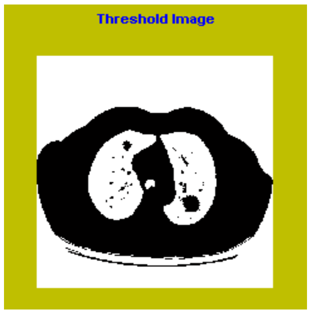
The proposed method is tested with 120 images from image archive database for analysis purpose. Among them, eight images with different shapes, different margin and categories are taken for report generation. Each image will undergo pre-processing steps and segmentation. Figure 2 shows the result of pre-processing steps, three different steps in segmentation.

Initially CT (computed tomography) scan images are collected from the image archive radiofrequency image database as shown in figure 3(a). The data available has to be pre-processed on the image and output is threshold image as shown in figure 3(b). Next function is the morphological operation, i.e, Hole filling operation and mask operation performed on the threshold image to remove the unwanted borders to find the two largest area of lungs (binary image) as shown in figure 3(c). In the lesion segmentation function, the binary image is mapped with the original CT scan image to segments the lungs as shown in figure 3(d). After performance of the mapping, segmented the lung nodules in the lung as shown in figure 3(e) and finally segmented the cancerous no`dules based on the tumour intensity, shape and margins as shown in figure 3(f).

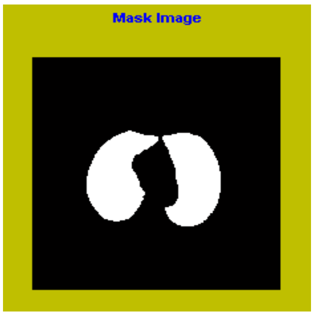
The same operation is performed on few other CT scan images with different abnormalities. The snapshots of the processing stages are depicted in the figure 4, figure 5 and figure 6.




(a) Lung CT image



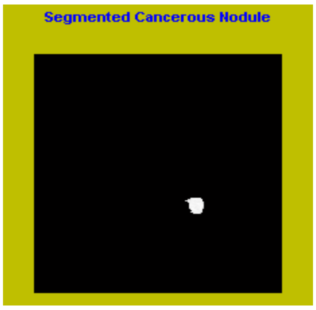

(b) Threshold image




(c) Mask image


(d) Segmented lung region


(e) Segmented lung nodules




(d) Segmented cancerous nodules

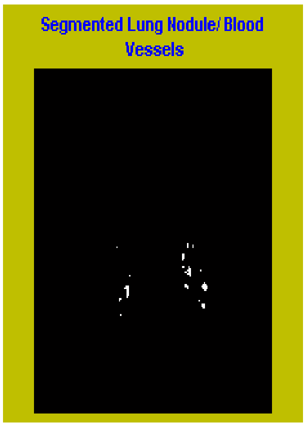
Figure 3: Output result of pre-processing and segmentation phase of lung cancer

(a) Lung CT image

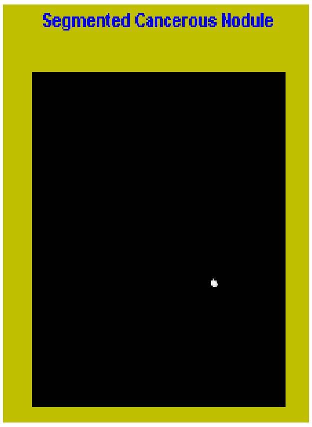
(b) Threshold image


(c) Mask image


(d) Segmented lung region

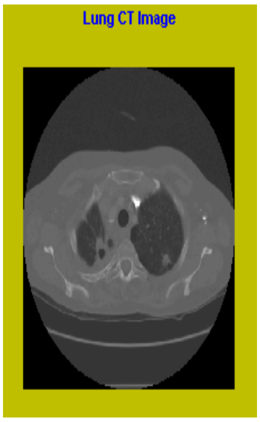



(e) Segmented lung nodules

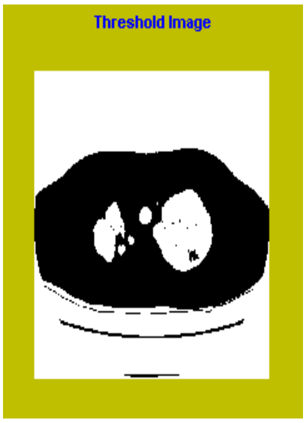



(d) Segmented cancerous nodules

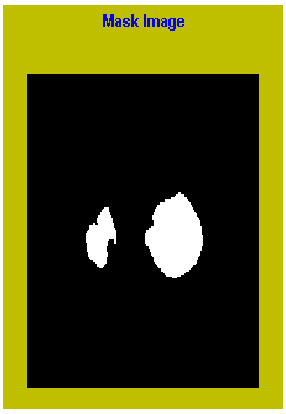
Figure 4: Output result of pre-processing and segmentation phase of lung cancer



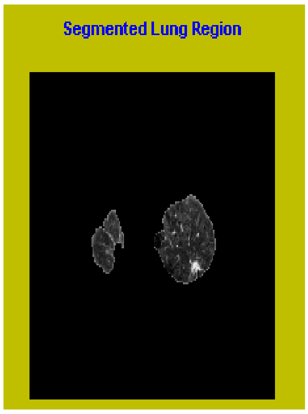

(a) Lung CT scan image



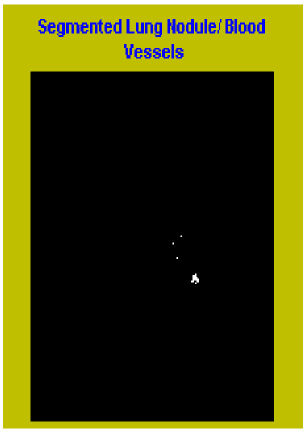

(b) Threshold image



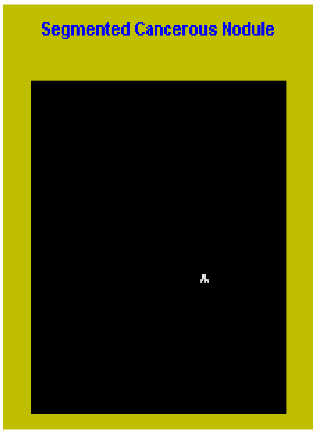

(c) Mask image




(d) Segmented lung region

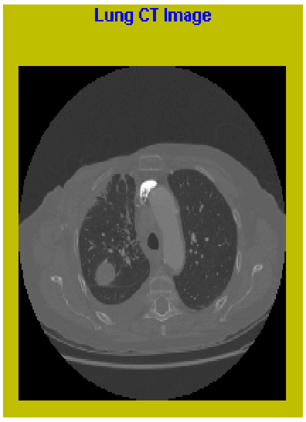



(e) Segmented lung nodules




(d) Segmented cancerous nodules

Figure 5: Output result of pre-processing and segmentation phase of lung cancer




(a) Lung CT image


(b) Threshold image

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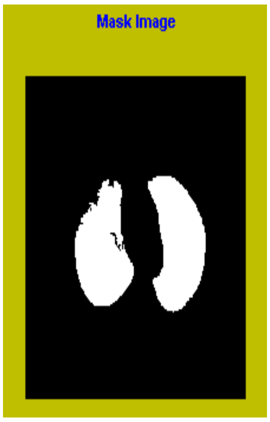
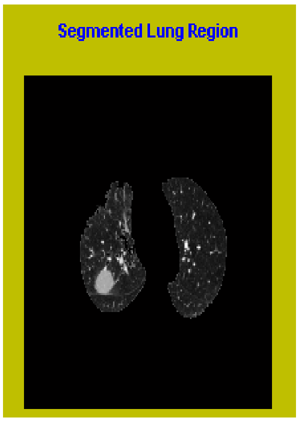
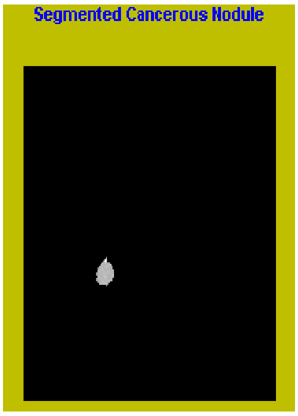



(c) Mask image




(d) Segmented lung region


(e) Segmented lung nodules

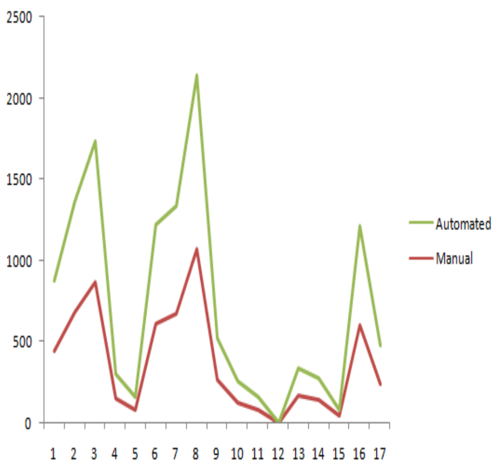



(f) Segmented cancerous nodule

Figure 6: Output result of pre-processing and segmentation phase of lung cancer

A. Comparision graph of lung segmentation analysis system

Number of pixel




Number of datasets

Figure 7: Comparision graph for manual and automat..ed lung segmentation analysis system

Figure 7 illustrates the comparision graph for manual and automated lung segmentation analysis system. In this comparision graph, X-axis indicates the number of data set and Y-axis indicates the number of pixel in images. Green line indicates the automated lung analysis system and red line indicates manual lung analysis system. Compare to manual system, automated lung segmentation analysis system gives better result is shown in the graph. During the segmentation, manual system includes extra information in the lung so its very difficult for the analysis and it may leads wrong prediction but automated lung segmentation process segment the lung cancerous nodule information accurately.

## V.CONCLUSION

Lung cancer is a deadliest disease in men whose symptoms cannot be found in its starting stages. Early and exact determination of lung cancer disease assumes a vital part in keeping away from death rates. The proposed method utilizes computed Tomography method as finding technique for investigation of lung cancer tumor growth using CT scan images. In this paper, Fuzzy connectedness algorithm is used as segmentation technique. The method has been segmented the lung cancerous nodules from the lung region over 120 different kinds of images, and proved that fuzzy connectedness method has achieved high accuracy

## REFERENCES

[1] Awais mansoor, Ziyue Xu, Brent Foster, "A Generic Approach to pathological Lung Segmentation", IEEE transaction medical imaging. VOL 33. NO 12. DECEMBER 2014.
[2] U. Bagci, B.Foster, K. Miller-Jaster, B. Luna, B. Dey, W.R. Bishai, C.B. Jonsson, S. Jain and D.J. Mollura," A Computational pipeline for quantification of pulmonary infections in small animal models using serial PET-CT imaging", Eur.J.Nucl. Med. molecular imag. Res.,vol. 3, no. 5, pp. 1-20, 2013.
**[3]** L. Zhang, E. A. Haffman and J.M. Reinhardt, "Lung lobe segmentation by graph search with 3-D shape constraints", in Proc. SPIE, 2001, vol. 4321, pp. 204-215.
[4] Apoorve mahale, chetan rawool, Dinesh Tolani, Deepesh Bathija Prof. Kajal jewani,"SVM classifier based CAD system for Lung Cancer Detection", ijecs,2017.
[5] Niranjan shukla, Aakash Narayane, Aniket Nigade Krishnakumar Yadav, Mrs Harshada Mhaske, "Lung cancer detection and classification using support vector machine", ijecs, 28-nov-2015.
[6] S. G. Armato, III and W.F. Sensakovic," Automated lung segmentation for thoracic CT: Impact on computer-aided diagnosis", Acad. Radiol., vol. 11, no. 9, pp. 1011-1021, 2004.
[7] I. sluimer, M. Prokop, and B. van Ginneken, "Towards automated segmentation of the pathological lung in CT", IEEE Trans. Medical Image, vol 24, no 8, pp. 1025-1038, Aug 2005.
[8] y. Xu, M. Sonka, G. McLennan, J. Guo. And E.A. Hoffman, "MDCT-based 3-D texture classification of emphysema and early smoking related lung oathologies", IEEE Trans. Med. Imag., vol.25, no.4, pp. 464-475, Apr. 2006.
[9] J.K. Leader, R.M.Rogers, C. R. Fuhrman, F.C. Sciurba, B.Zheng et al," Size and morphology of the trachea before anf after lung volume reduction surgery", Am.J. Roentgenol., vol. 183, no. 2, pp. 315-321, 2004.
[10] G.J. Kemerink, R.J.Lamers, B.J. Pellis, H.H. Kruize and J. Van Engelshoven, "On segmentation of lung parenchyma in quantitative computed tomography of the lung", Med. Phys., vol. 25, p. 2432, 1998.

[11] Shyamala, S. and Dr. Pushparani. M, “Pre-processing and segmentation technique for lubg cancer on CT images”, IEEE Transaction paper on 2016.

[12] K.C. ciesielski and J.K. Udupa, “ Affinity functions in in fuzzy connectedness and objectdefinituon: algorithm image segmentation”, vol.58, no. 3, pp. 246-261, 1996.

[13] A. karthikeyan and M. valliammai,” Lungs segmentation using multi-level thresholding in CT images”, IJECSE, ISSN 2277-1956/VIN 3-1509-1513.