Size Estimation of Lung Cancer Using Image Segmentation and Back Propagation

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Abstract—*Lung Cancer is very leading causes of cancer deaths in both women and men. Therefore detection of lung cancer is not an easy task. In this paper lung images have been segmented using OTSU's thresholding technique and hope shape parameter such as optimal threshold, area, energy, entropy, area etc are calculated. The back propagation network is used to classify the lung cancer on the bases of these parameters. Thus extent of lung tumor is determined with the help of image segmentation and back propagation network.*

Keywords— lung tumour, segmentation, cancer, threshold, Computer Aided Diagnosis, Feed forward neural network.

I. INTRODUCTION

Lung cancer is very leading cause of cancer deaths in both women and men. It is estimated that 1.3 million people are diagnosed with this disease every year (12.6% of the total number of cancer diagnosed), and about 1.3 million people are dying of this disease yearly (17.8% of the total cancer death)[1]. The survival and manage rate is higher if the cancer is detected at early stages. The early detection of lung cancer is not an easy task. About 81% patients are diagnosed correctly at the middle or advanced stage of cancer [2]. In order to detect it at its early stages, regular screening and watching is very important which can reduce the number of deaths due to lung cancer. Lung cancer patients cannot understand any symptoms at initial stages but it can lead to death if not detected and treated on timely [6]. A Computed Tomography (CT) scan is very good medical imaging technique especially in the field of thoracic radiology [16]. A small slice CT scan of the chest is an essential procedure for lung cancer diagnosis. Previous works have concentrated mostly on the analysis of CT-scan images to detect tumors and other anomalies of the lungs. However, minimal work has been done in attempting to classify tumor classes based on these images for which new ground is broken here [16][17].

Fig. 1: CT scan image [17]

Computer-aided diagnosis system is very helpful for radiologist in detection and diagnosing abnormalities earlier stage and faster [3]. The computer aided diagnosis is a second opinion for radiologists before suggesting biopsy test [4]. In recent research literature, it is find thatprinciples of neural networks have been widely used for the detection of lung cancer in medical images [5].For classification of lung cancer, few methods based on neural network have been applied in the literature. Adulate al. [6] proposed a computer aided diagnosis based on artificial neural networks for classification of lung cancer. The features used for classification are area, perimeter and shape. The maximum classification accuracy obtained is 91%.Camarlinghi et al. [7] proposed a computer-aided detection algorithm for automatic lung nodule identification. The sensitivity obtained is 81% with 3 FP/scan. Al-Kadi et al. [8] proposed classification method based on fractal texture features. The classification accuracy get 83.3%. Van Ginneken et al.[9] compared and combined six computer aided detection algorithms for pulmonary nodules. The combination of six algorithms is able to detect 80% of all nodules at the expense of only two false positive detections per scan and 65% of all nodules with only 0.5 false positives. Cascio et al. [10] proposed computer-aided detection (CAD) system for the selection of lung nodules in computer tomography (CT) images. The detection rate of the system is 88.5% with 6.6 FPs/CT on 15 CT scans. A reduction to 2.47 FPs/CT is achieved at 80% efficiency.

II. SEGMENTATION

The systematic overview of the computerized system is, the system takes lung CT image is as an input and applies segmentation on images to remove background noise and extracts the nodules from image. The enhancement phase applies post processing to remove as many false regions as possible. The remaining candidate nodules are classifiedbased on their properties which are extracted in feature extraction phase. Both primary and secondary stage cancer nodules (classified by two radiologists depending on the size of the nodules) with four different kinds of nodules like Well-circumscribed nodules, Vascular zed nodules, Juxta-pleural nodules and Pleural-tail nodules are considered in the work[11]. Fig. 2 shows the CT image of lungs with cancerous region. The lung is segmented from the CT images using morphological operations apply. The gray scale image is first converted into binary image. All the pixels in the input image with a intensity greater than a threshold level is replaced with value '1'and all pixel values with a intensity less than threshold level is replaced with value '0'. The threshold level is calculated by Otsu method [12]. The Otsu method chooses the threshold level to minimize the infraclass variance of the black pixels and white pixels. Fig. 3 gives the greyscale to binary converted image. The morphological opening operation is performed to the binary image with a structuring element. The structuring is a shape, used to probe or interact with a given image, with the purpose of draw conclusions on how this shape fits or misses the shapes in the image. The structuring element used is 'periodic line'. It is a flat structuring element taking $3 \times (A + 1)$ members. The value of 'A'

describes the size of the structuring element. The *A* value is selected as 3. One structuring element is located at the origin. Fig. 4 shows the output after morphological operation. The image is then covered and clear border operation is performed and the clear border operation structures that are lighter than their surroundings and that are connected to the border of the image. The segmentation method uses only morphological operations and an average of 97% of images is segmented correctly. The segmented images are independently connected by two radiologists. Main advantage of morphological operation is their speed and simplicity action implication. Fig.5 shows the final segmented image output [16].

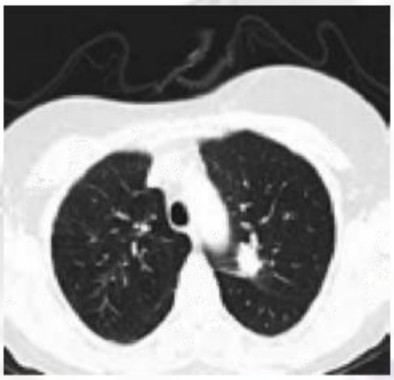

Fig. 2: CT image of lungs with cancer [16].

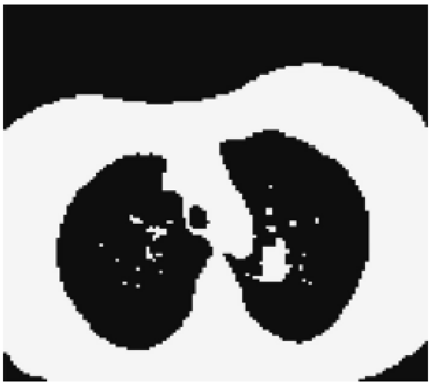

Fig. 3: Binary image

Fig.4:Morphological opening output

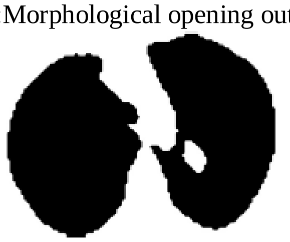

Fig.5:Segmented output [16]

III. Proposed Methodology

The proposed method for lung cancer detection and segmentation follows three basic diagnostic tasks of radiology namely, preprocessing, classification and segmentation. As stated above, the acquired CT images are preprocessed using denoising function in order to reduce the segmentation drawbacks. Moreover, the noise free image is given for feature extraction process that provides exact classification results. If an image results abnormal, level set-active contour based segmentation model comes into effect to severe the cancer part, which highly supports the oncologist in clinical practice.

A. *Feature Extraction*

The image feature extraction phase is very substantial in working with image processing techniques, which using various procedures and techniques to detect and isolate distinctive portions or shapes of an image. In this proposal, some valuable characteristics of images such as contrast, energy, entropy, variance and homogeneity are considered that paves a way for appropriate classification results. The noise free image attained from denoising process is fed up into second order histogram based feature extraction, which represents the relative frequency of incidence of various grey levels in an image. The extracted image features are given for classification to identify the lung image is normal or abnormal.

IV. Classification Of Lung Image

By analyzing the extracted features of various CT images of lungs, classification is done by Multivariate Multinomial Distributed Bayes Classification. The multivariate multinomial distribution is congruous for categorical features. The naïve bayes classifier estimates a separate set of probabilities for the set of extracted feature levels in each class, whereas the naïve classifier is applicable when features are independent to one another within a class. The classification is performed in two steps.

A. *Training Step:* With the training samples, the method computes the metrics of probability distribution with an assumption that features are conditionally independent.

B. *Prediction Step:* For classifying unseen test image, the method estimates posterior probability value of that image belonging to each defined class. Then, the unseen image is classified in accordance with the largest posterior probability value.

The block diagram for classification and segmentation is shown in figure 1. From which the unseen test image is categorized under normal or abnormal classes. Classification performance analysis is for the validation of accuracy rate of obtained diagnosis results. The examination is performed with accuracy parameters such as correct/error rate, last correct/error rate, inconclusive rate, sensitivity, specificity, positive/negative predictive value, positive/negative likelihood and prevalence.

V. Thresholding Method

Otsu's method is aimed in finding the optimal value for the global threshold. An image is a 2D grayscale intensity function, and contains N pixels with gray levels from 1 to L. The number of pixels with gray level i is denoted fi, giving a

probability of gray level i in an image of pi = fi / N.
It is based on the interclass variance maximization. Well thresholded classes have well discriminated intensity values.
M × N image histogram:
L intensity levels, [0, . . . , L − 1];
ni #pixels of intensity i :

$$MN = \sum_{i=0}^{L-1} n_i$$

Normalized histogram:

$$p_i = \frac{n_i}{MN}$$

$$\sum_{i=0}^{L-1} p_i = 1, \quad p_i \geq 0$$

Fig. 6: Thresholding methods such as Otsu's method[3]

VI. Result And Analysis

For experimentation of the proposed segmentation technique, the CT lung images are obtained from dicom dataset. Hence, the aptness of the proposed approach has been assayed through experimentation on real world CT images. The test data consists of 42 lung images. All the computations are implemented using MATLAB. The lung images are consecutively given for denoising process with differentkernel functions and examined with parameters

The following table demonstrates the parameters that are responsible for status identification of a single lung image.

We take two lungs images Figure 4.1: Result Image1 and Figure 4.2: Result Image2 then execute on process. Both the images give different results.

For example, we see that Figure 4.1: Result Image1, we set threshold value is 200 and area is 50.00 then we check the results if threshold value is less than 200 so it's less harmful, if the threshold value is bigger than 200 so tumor is very harmful. Same as we calculate area is the area is less than 50.00 then we find out the tumor area if area is more than 50.00 so tumor size is big.

Fig. 7: Lung image

Table 1:Result Table

Description	Expected Value	Consolidate value
OPTIMAL THRASHOLD	200	212.51160
AREA	50.000	52.611
ENERGY	2.2	2.4170
SOLIDITY	97	96.3184

In this table 4.1,we perform this process not only one images but also another image.

In this Bargraph we easily done comparison between expected value and consolidate value.

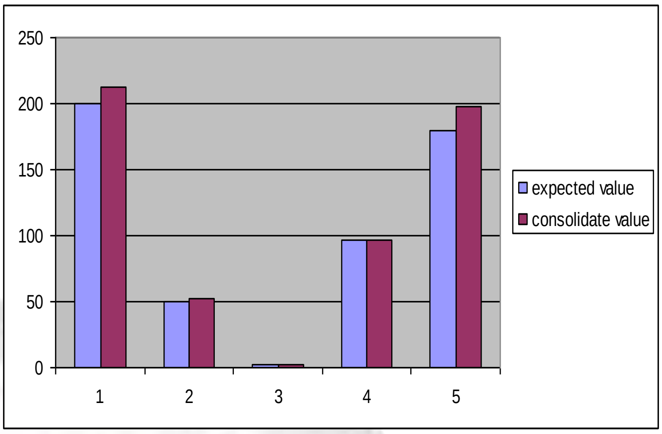

Fig. 8: Bargraph of result image1

According to chart blue colour is expected value and red colour is consolidating value, we clearly see that which value is high and which value is low.

VII. Conclusion

In this paper, lung segmentation is done and lung nodules are detected by using the neuro fuzzy based classifier. The system removes background region from foreground and then extracts possible regions with nodules by applying post processing phase. A detailed feature set containing different properties with hybrid neuro fuzzy classifier has successfully detected. Experimental results have shown that this system is totally accurate and effective which also facilitates the detection of nodules with the developed one which lead to early diagnosis of lung cancer.

The location of mass boundaries is well detected and preserved by our method, independent of gradient. Denoising and classification are the core process involved in the proposed system to grab meticulous results. Besides the attainment of producing accurate classification results, the approach has concern with complex and dynamic tumor shapes of the segmentation of CT lung image well in snagging high segmentation accuracy. The adduced methodhas been processed with 2D image diagnosis and segmentation. As the future work, we plan to expand this methodology for 3D images by developing volume metric depth analysis.

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