A New Approches of Lung Segmentation using Neuro-Fuzzy Network

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ABSTRACT-The detection of lung cancer in early stage is a difficult problem, because the cancer cell causesmany dangerous effects due to their overlapped structure. Lung cancer is a disease characterized by uncontrolled cell growth in tissues of the lung. The causes of lung cancer is due to smoking, random gas, air pollution, genetics etc. This paper includes two segmentation methods, Neural fuzzy Network (NFN) and a Fuzzy C-Mean (FCM) clustering algorithm, for segmenting the early stage of lung cancer. The manual segmentation of lung cancer consumes more time, inaccurate and it requires well trained people to avoid diagnostic fault. The segmentation results will be used as a base for a Computer Aided Diagnosis (CAD) system for early detection of lung cancer which will improve the chances of survival for the patient. However, the gray level and the relative contrast results in inaccurate manner, thus we applied a thresholding technique as a Pre-processing step in all images to extract the nuclei regions, because most of the quantitative procedures are based on its nuclei feature. This thresholding algorithm had succeededin extracting the nuclei regions. Moreover, it succeeded in determining the best range of thresholding values. The NFN and FCM methods are designed to classify the image of N pixels among M classes. This paper includes many color images to test both methods, and NFN has shown a better classification result than FCM, the NFN has succeeded in extracting the nuclei regions.

Key words: Fuzzy C-Mean Clustering, Image Segmentation, Lung cancer, Neural fuzzy network, Thresholding Technique

I. INTRODUCTION

Lung cancer is a disease described by unrestrained cell growth in tissues of the lung. If it missed with any treatment, this growth can spread away from the lung in a process called metastasis into nearby tissue or other parts of the body. Most cancers that begin at early stages in lung, known as crucial lung cancers, are carcinomas that obtain from epithelial cells. The major types of lung cancer are small-cell lung carcinoma (SCLC), also called oat cell cancer, and non-small-cell lung carcinoma (NSCLC).

The most common symptoms are coughing , weight loss and shortness of breath. The most common cause of lung cancer is long-term exposure to tobacco smoke, which results 80–90% of lung cancers. Non smokers results in 10–15% of lung cancer cases, and these cases are regularly attributed to a combination of the genetic factors, radon gas, asbestos, and air pollution including second-hand smoke. Lung cancer may be seen on chest radiograph and computed tomography (CT scan).

Manuscript received January 15, 2014.

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The diagnosis is definite with a biopsy which is usually performed by bronchoscopes or CT-guidance. Treatment and long-term outcomes depends upon the type of cancer, the stages, and the person's overall health, calculated by performance status. A common treatment includes surgery, chemotherapy, radiotherapy etc. NSCLC is sometimes also includes treatment with surgery, while SCLC frequently responds better to chemotherapy and radiotherapy. Overall, 15% of people in the United States diagnosed with lung cancer survive five years after the diagnosis. In Worldwide, lung cancer is the most common cause results in cancer-related death in both men and women, and is accountable for 1.38 million deaths per annum, as of 2008. However, these techniques are results in very expensive and time consuming. In other words, most of these techniques are detecting the lung cancer in its advanced stages, where the patient's life time of survival is results in very low. Therefore, there is a great need for new technologies are used to diagnose the lung cancer in its early stages. Image processing techniques provide a good quality tool for improving the manual analysis.

II. THRESHOLDING TECHNIQUE

Thresholding is the process of segmenting scalar images which is done by creating a binary partitioning of the image intensities. A thresholding procedure is used to determine an intensity value, called the threshold, which divides the desired classes. Then the segmentation is achieved by gathering all pixels with higher intensity than the threshold into one class, and all other pixels into another class. Thresholding is a simple often successful means for achieving segmentation in images where various structures have contrasting intensities or other quantifiable features. The separation is usually generated interactively, although automated methods do exist For scalar images, well interactive methods can be based on an operator's visual assessment of the resulting segmentation since the thresholding operation is implementable in real-time. Thresholding is frequently used as an early step in a sequence of image processing operations. Its main restrictions are that in its simplest form only two classes are generated and it cannot be applied to multi-channel images. In count thresholding normally does not take into account the spatial characteristics of an image. This causes it to be sensitive to noise and intensity in homogeneities, which can occur in magnetic significance images. Both these artifacts essentially corrupt the histogram of the image, making separation more difficult. For these reasons, variations on classical thresholding have been proposed for medical image segmentation that incorporate information based on local intensities.

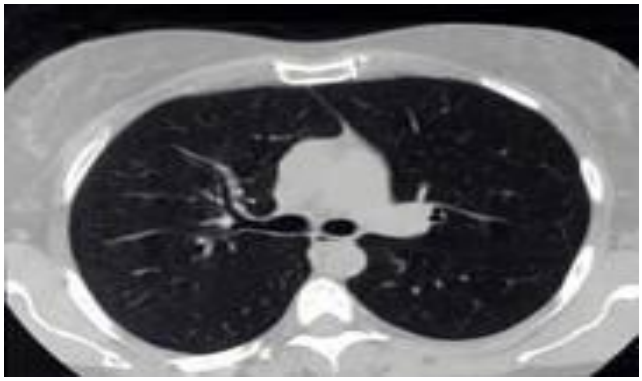

Fig: Original CT image

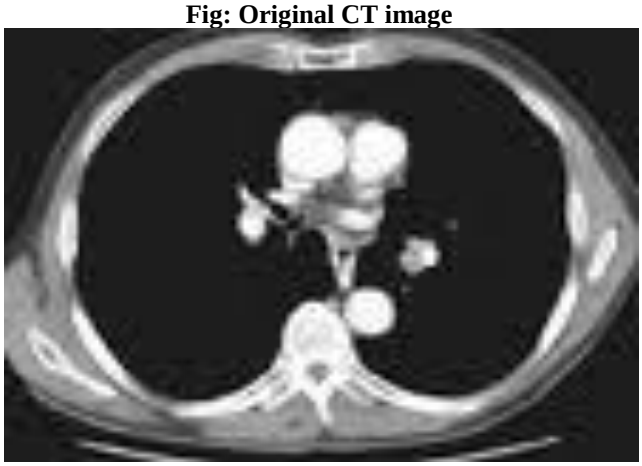

Fig: Threshold image

III. FUZZY CLUSTERING

In fuzzy clustering, each point has a degree of belonging to clusters, as in fuzzy logic, moderately than belonging absolutely to just one cluster. Thus, points on the border of a cluster may be in the cluster to a slighter degree than points in the middle of cluster.

The point x has a set of coefficients providing the degree of being in the kth cluster wk(x). The fuzzy c-means, considers the centroid of a cluster as the mean of all points, which weighted by their degree of belonging to the cluster:

$$c_k = \frac{\sum_x w_k(x)^m x}{\sum_x w_k(x)^m}. \qquad (1)$$

The degree of belonging, $w_k(x)$, is connected inversely to the distance from x to the cluster midpoint as considered on the preceding pass. It also based on a parameter m that controls how a large amount of weight is given to the closest centre. The fuzzy c-means algorithm is very comparable to the k-means algorithm.

- Select a number of clusters.
- Allocate randomly to each point coefficients for individual in the clusters.
- Replicate awaiting the algorithm has to be converged
- Calculate the centroid for every cluster, by the formula above.
- For every point, calculates its coefficients of the starting in the clusters, using the formula above.

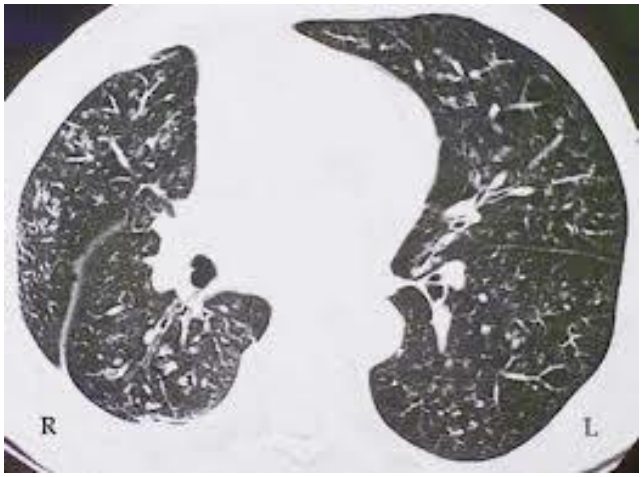

Fig: output of Fuzzy Clustering

IV. NEURO- FUZZY NETWORK

A neuro-fuzzy network is a fuzzyinference system in the body of artificial neural network. Based on the *FIS* type, there are a number of layers that suggest the processes implicated in a fuzzy inference such as fuzzification, inference, aggregation and defuzzification. Embedding an *FIS* in a common formation of an *ANN* has the advantage of using obtainable *ANN* training methods to discover the parameters of a fuzzy system. Neuro-fuzzy refers to collections of artificial neural networks and fuzzy logic.

Neuro-fuzzy hybridization is generally termed as Fuzzy Neural Network (FNN) or Neuro-Fuzzy System (NFS) in the literature. Neuro-fuzzy system (the more popular term is used henceforth) incorporates the human-like interpretation style of fuzzy systems from first to last the use of fuzzy sets and a linguistic model consisting of a set of If-Then fuzzy rules. The major potency of neuro-fuzzy systems is that they are universal approximators with the capability to importune interpretable the rules.The potency of neuro-fuzzy systems involves two conflicting necessities in fuzzy modelling: interpretability versus accuracy.

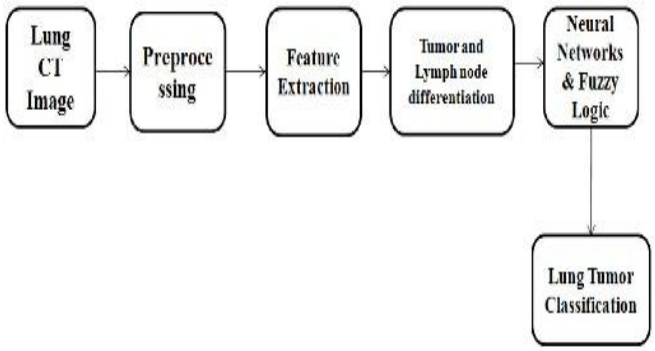

Fig: Detection of lung cancer using neuro-fuzzy networks.

V. CONCLUSION

This paper includes two segmentation processes, the first one is Fuzzy Clustering and the second one is Neuro-Fuzzy Network (NFN). It was found that the NFN segmentation results are more accurate and reliable than Fuzzy clustering in all cases.

The NFN succeeded in detecting and segmenting the nuclei and cytoplasm regions. However Fuzzy Clustering failed in detecting the nuclei, instead it detected only part of it. In addition to that, the Fuzzy clustering is not sensitive to intensity variations as the segmentation error at convergence is larger with Fuzzy Clustering compared to that with NFN. The NFN will be used as a basis for a Computer Aided Diagnosis (CAD) system for early detection of lung cancer.

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