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Comparison of Linguistic Neuro Fuzzy Algorithm with Precise Fuzzy Modeling for Lung Tumor Detection

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Abstract—A most of the fatal and demotic disease scatter among men and women is Lung Cancer caused by Tobacco Smoking, air pollution, genetics etc. As the manual nodule detection is very time consuming and costly so computerized system can be helpful for this purpose. But sometimes due to issues in the image quality, color of the image, edge detection, image restoration, segmentation and due to enhancement of an image may cause false detection of lung cancer. So our methodology for the detection of tumor is quite concrete to overcome such cases and for more precise results In this paper we proposing a system for the detection of malignant nodule by using two classifiers i.e. Linguistic Fuzzy Modeling (LFM) and Precise Fuzzy Modeling (PFM). Our system consists of two stages i.e. lung segmentation and enhancement, feature extraction and classification. Segmentation will result in separating lung tissue from rest of the image. A feature vector for possible abnormal regions is calculated and regions are classified using the two classifiers LFM and PFM. After that results of both are compared for choosing the more accurate classifier. It is fully automatic system that do not require any human intervention and experimental results shows the validity of our system.

Keywords— lung ,tumor ,linguistic, precise, neuro fuzzy

I. INTRODUCTION

Lung cancer is currently the 2nd most common cancer in both men and women and is the top cause of all cancer deaths. There is a direct association of tobacco smoking and other pollutant and toxic exposures to lung cancer making it the leading preventable cause of death. Since the early 1900's, lung cancer rates have grown until now where it is a national epidemic. Like other cancers lung cancer is capable of spreading to other parts of the body like brain, bones, glands etc. Lung cancer is responsible for more than 25% of all cancer-related deaths every year and lung cancer kills more people than breast, colon and prostate cancers combined.

In recent years the image processing mechanisms are used widely in several medical areas for improving earlier detection and treatment stages, in which the time factor is very important to discover the disease in the patient as possible as fast, especially in various cancer tumors such as the lung cancer, breast cancer. Early detection of lung cancer is very important for successful treatment. Diagnosis is mostly based on CT images. Our current work focuses on finding nodules, early symptoms of the diseases, appearing in patient's lungs. Most of the nodules can be detected if process parameters are carefully selected. We are aiming at computerizing these selections. We passed the available lung cancer images and its database in basic three stages to achieve more quality and accuracy in our experimental results: pre-processing stage, feature Extraction stage and Lung cancer cell identification. For the detection of malignant nodules we fed these features in the ANN(Artificial Neural Network) based classifiers i.e. LFM(Linguistic Fuzzy Modeling) and PFM(Precise Fuzzy Modeling) which are the two advanced versions of Neuro fuzzy classifier.

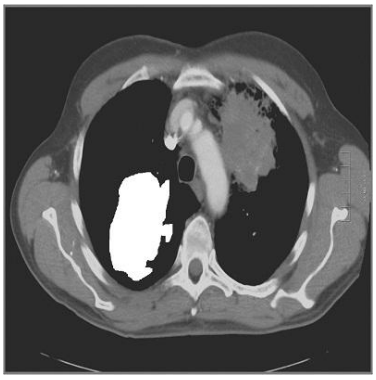


Fig. 1. Lung CT scan image

II. PROPOSED METHOD

The systematic overview of the computerized system is shown in figure 2. The system takes sample lung CT image as an input and applies segmentation techniques on this image to remove background and extracts the nodules from image. Then the postprocessing technique is applied to remove as many false regions as possible. The remaining malignant nodules are classified based on their properties which are extracted in feature extraction phase.

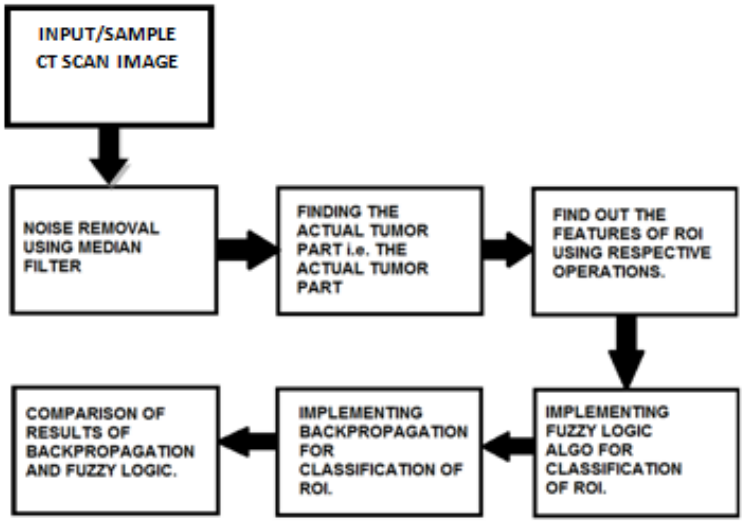


Fig. 2. Flow diagram of proposed system

A. Lung CT Image Segmentation and Postprocessing Enhancement

1. Sample Image:

CT (Computed Tomography) scan is the sample image for this process of determining the tumor in the lungs.

2. Noise removal using Median Filter

The main motive of the median filter is to process each and every pixel one by one, replacing each one with the median of the neighbor entries. The neighbor pattern is known as "window", which slide pixel by pixel over the entire image. Median filtering is a nonlinear procedure generally used in image processing to remove "salt and pepper" noise. A median filter is more beneficial than convolution when the need is to instantaneously reduce noise and preserve edges.

3. Finding the actual Tumor part

In the very first the CT scan is converted to grayscale. The actual tumor part is present in the inner part of lung so the part is focused and rest is not considered. In the CT scan the part is black in color having tumor with light color. The part is focused and is the region of interest.

B. Lung Nodule Feature Extraction and Classification

A portion of image that is to be filtered and on which operations are to be performed is known as region of interest. More than one ROI can be defined in an image. ROI is used to find the area, energy, entropy and intensity of an image. Most difficult step is nodule detection. In CT scan images most of the lung nodules are attached with the blood vessels And the grey scale level of both are almost same. Hence we are considering various other features which is used to find the region of interest. Feature vector which we have made is $Fv = \{F1, F2, F3, F4, F5\}$. These features are:

1) Area (F1): A specific nodule consists pixels within it, total number of that pixels refer to its area. Area is usefull to separate tiny objects.
2) Energy (F2): A property which describes measure of information contained in an image.
3) Entropy (F3): A measurement that represents in the form of statistics standards of randomness that plays a useful role to characterize texture of candidate region.
4) Intensity(F4): A measurement represents the amount of any force, brightness is demotic to intensity.
5) Eccentricity (F5): A calculation in candidate objects which assigns a measure of circularness.

For classification purpose, the feature vector is fed to a classifier based linguistic fuzzy modelling and precise fuzzy modeling . The feature vector is given as input to this classifier. This helps in differentiating between nodule and non-nodule regions. By performing different experiments, we come across to a result that our proposed method is more tolerant to the noisy data related to nodules.

C. Comparison Graph of two Classifiers

In this project we have pointed the main problem regarding the accuracy of tumor detection in lungs via CT scan images through further processes such that we get a clear image of tumor in lungs. Fuzzy Modeling is the process used for further clarification of the CT scan image to get a clear status of tumor. For that we proposed two processes which further accuracy enhancing measures which are named below:

- Linguistic Neuro Fuzzy Modeling
- Precise Neuro Fuzzy Modeling

After simulating both the processes in MATLAB we have concluded their accuracy graphs with which we can come to know their accuracy per rounds.

Both techniques have very good accuracy and the comparison graph for both is shown in figure 3 which clearly shows that the PFM technique is more accurate as compared to LFM technique.

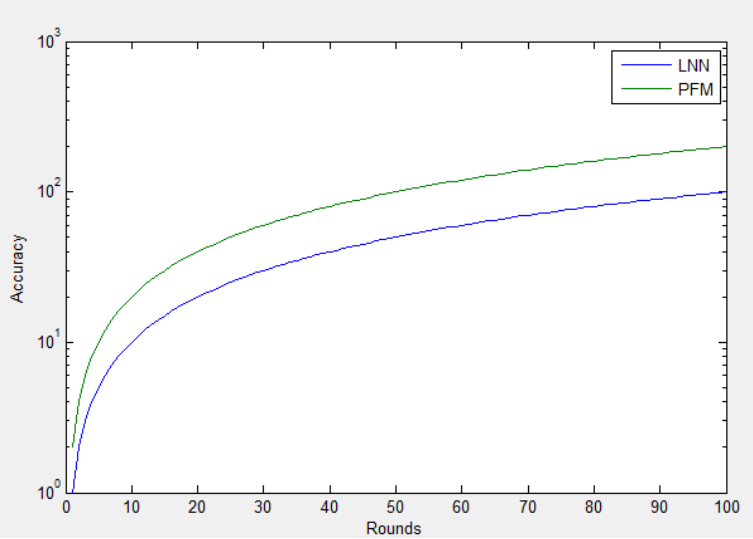


Fig. 3 Comparison graph

III. EXPERIMENTAL RESULTS

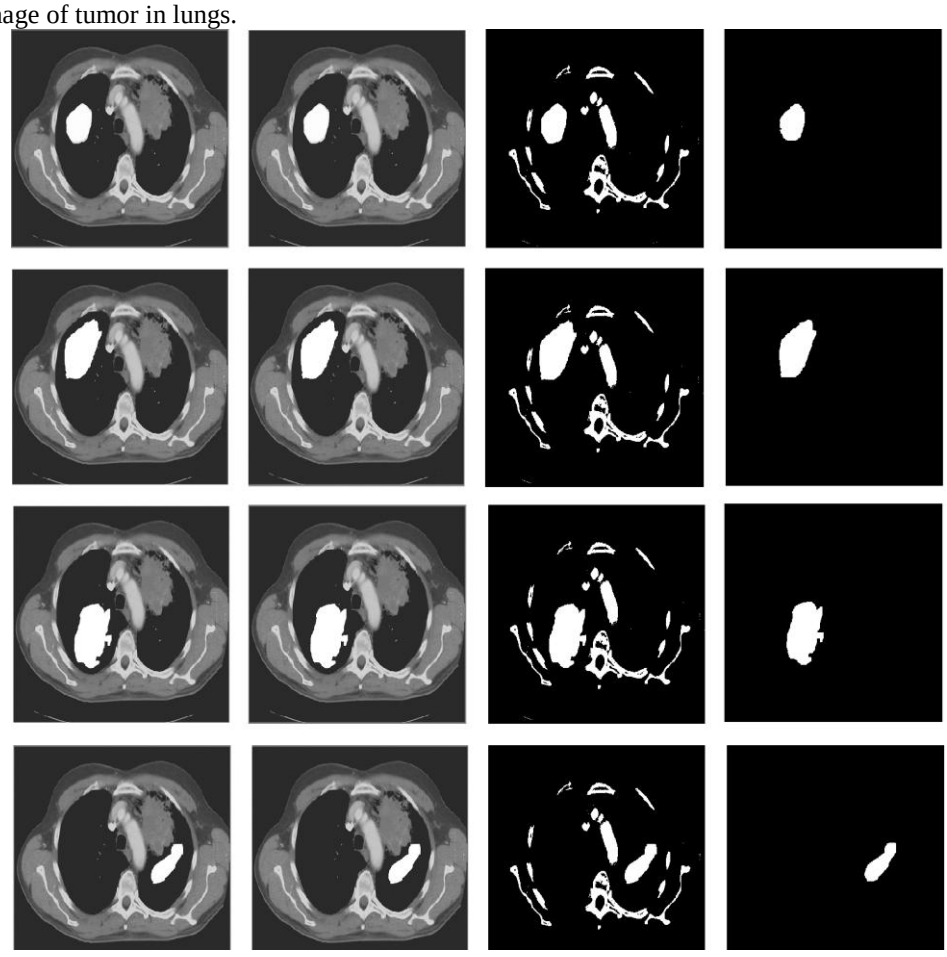
The proposed scheme is thoroughly tested using different lung CT scan images. Figure 4 shows the step by step outputs of different stages for proposed system which shows that proposed method have extracted the lung nodules accurately.

a) Shows the images taken from CT scan.

b) Shows the grey scaled images of the original image.

c) Shows the processed image of the filtered image.

d) Shows the image of tumor in lungs.



a) b) c) d)

Fig. 4 Experimental Results: a) Original Images, b) Greyscale Images, c) Processed Image, d) Nodule detected Images

IV. CONCLUSION

In this paper, we elaborate the accuracy issues and objectives. This paper also gives brief summary of Fuzzy Modeling using different technologies in the literature. The detection through Fuzzy Modeling is further elaborated in two techniques in order to achieve more accurate results regarding tumor in lungs. Both techniques are listed below:

- Linguistic Neuro Fuzzy Modeling
- Precise Neuro Fuzzy Modeling

Both the techniques are compared on the basis of accuracy and the comparison is clearly shown. It is clear from comparison that both techniques are highly accurate and precise.

V. FUTURE SCOPE

In this paper we presented two new techniques to enhance the accuracy in the detection of tumor in lungs from CT scan image by applying Fuzzy modeling over it. In these techniques we are able to detect major tumor in lungs. Our future scope will be detecting multiple tumors available as:

- Two major tumors.
- One major or one minor.

In future we want to prepare technique for detecting multiple tumors.

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