Detection of Lung Cancer Nodule using Artificial Neural Network

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Abstarct **- Lung cancer is the primary cause of tumor deaths for both sexes in most countries. Early diagnosis has an important prognostic value and has a huge impact on treatment planning Our approach is based on multiscale processing and artificial neural networks (ANNs). The problem of nodule detection is faced by using a two-stage architecture including: 1) an attention focusing subsystem that processes whole radiographs to locate possible nodular regions ensuring high sensitivity; 2) a validation subsystem that processes regions of interest to evaluate the likelihood of the presence of a nodule, so as to reduce false alarms and increase detection specificity. The proposed system's aim is to detect & classify lung cancer for early and effective treatment. In this work, we are proposing a computer aided diagnostic (CAD) system for automated classification of cancer stage. The ANN comprised three layers (one input layer, one hidden layer, and one output layer) Trained by back propagation. In proposed method back propagation feed forward neural network with Levenberg-Marquardt Algorithm may be used. Matlab based GUI is implemented. According to the parameters, Accuracy, Sensitivity, Specificity is calculated. According to the Experimental results 98% accuracy.**

Keywords**: Computer-aided diagnosis (CAD) Segmentation, Extraction, Computer aided diagnosis, Region Growing, ROC, Features extraction, CT images(Computer tomography**

I.INTRODUCTION

Lung cancer is the most common type of cancer among various cancers with the highest mortality rate. The fact that nodules that form on the lungs are in different shapes such around or spiral in some cases makes their detection difficult. Early diagnosis facilitates identification of treatment phases and issues success rates in treatment. In this study, a holistic Computer Aided Diagnosis (CAD) system has been developed by using Computed-Tomography (CT) images to ensure early diagnosis of lung cancer and differentiation between benign and malignant tumors. The designed CAD system provides segmentation of nodules on the lobes with neural networks model of Self-Organizing Maps (SOM) and ensures classification between benign and malignant nodules with the help of ANN (Artificial Neural Network)

The human body suffers from different diseases. The cancer is dangerous disease for human life. The generic types of cancer in human body are Bladder, Breast, Colon and Rectal, Endometrial, Kidney, Leukemia, Lung, Melanoma, Non-Hodgkin Lymphoma, Pancreatic, Prostate and Thyroid cancer. The more number of people is suffering and died from lungs cancer than any other cancer. The survival rate of lungs cancer patient is only 14% but it could be increased up to 50% if there is an early detection of lungs cancer .The survival rate is significantly improved but there is need to increase this survival rate more than the current value. This should be done without opening the patient body. The task is performed after having inner view of the human body. The multiple methods are used to take the images from inside the body like X-rays, CT scans, MRI etc. The CT scan is most recommended method which produces the 3D images of the lungs.

The obtained images are of not good quality. There is need of medical expert to give an opinion on the images obtained through the CT scans. The medical experts with same expertise are not available at every place. There is need of certain guidance for such medical experts. Even if medical experts are available, there are chances of human error due to resemblance of tissues, veins and small nodules presenting the image at the initial stage. To achieve this goal, the field of medical imaging introduced CAD (Computer-Aided Diagnostic) systems which help medical specialist to identify and categories the problem. The lesions are produced with different body parts which cause the cancer. Such lesions are referred to as nodule if they causes cancer, otherwise non-nodule. In the design of a CAD system, the main task is to segment the volume of particular body part, like lungs volume should be separated from the complete image so that we can keep our focus on the object of interests. The next task is to separate the objects in lungs volume which are not part of lungs. These objects are unwanted lesions. These unwanted lesions are potential nodules. The next step is to classify the potential nodules into nodules and non-no nodule

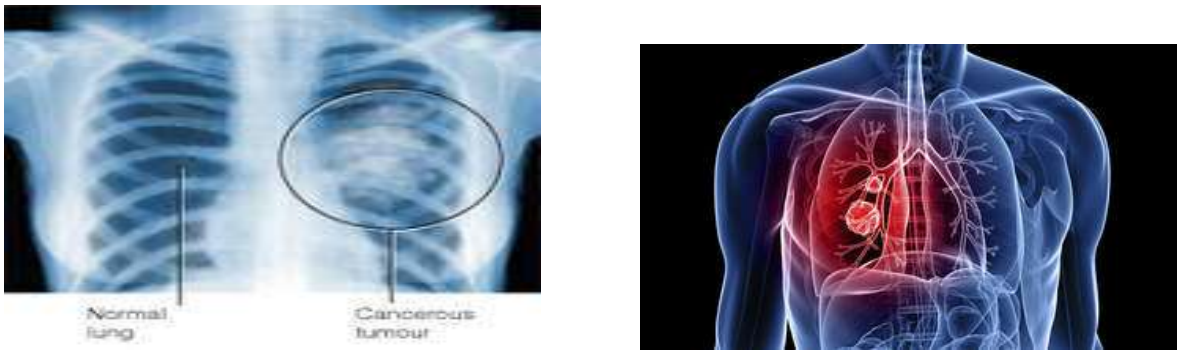

Fig. (a) Samples of cancer affected lungs

This paper is organized as follows: A brief description on Lungs Cancer is given in section II. Section III describes previous work related with detection of lungs cancer sing different types of method. Methodology is presented in section IV. In section V results are discussed. And conclusion are drawn in section VI.

II LUNGS CANCER

Lung cancer, also known as lung carcinoma is a malignant lung tumor characterized by uncontrolled cell growth in tissues of the lung.This growth can spread beyond the lung by the process of metastasis into nearby tissue or other parts of the body. Most cancers that start in the lung, known as primary lung cancers, are carcinomas

As tumors become larger and more numerous, they undermine the lung's ability to provide the bloodstream with oxygen. Tumors that remain in one place and do not appear to spread are known as "benign tumors".

Symptoms of lung cancer

Cancer symptoms are quite varied and depend on where the cancer is located, where it has spread, and how big the tumor is. Lung cancer symptoms may take years before appearing, usually after the disease is in an advanced stage.Many symptoms of lung cancer affect the chest and air passages. These include:Persistent or intense coughing

Pain in the chest shoulder, or back from coughing Changes in color of the mucus that is coughed up from the lower airways (sputum)Difficulty breathing and swallowing Hoarseness of the voice Harsh sounds while breathing (stridor) Chronic bronchitis or pneumonia Coughing up blood, or blood in the sputum If the lung cancer spreads, or metastasizes, additional symptoms can present themselves in the newly affected area. Swollen or enlarged lymph nodes are common and likely to be present early. If cancer spreads to the brain, patients may experience vertigo, headaches, or seizures. In addition, the liver may become enlarged and cause jaundice and bones can become painful, brittle, and broken. It is also possible for the cancer to infect the adrenal glands resulting in hormone level changes.

Stages of Lungs cancer:

Stage I is when the tumor is found only in one lung and in no lymph nodes.

Stage II is when the cancer has spread to the lymph nodes surrounding the infected lung.

Stage IIIa is when the cancer has spread to lymph nodes around the trachea, chest wall, and diaphragm, on the same side as the infected lung.

Stage IIIb is when the cancer has spread to lymph nodes on the other lung or in the neck.

Stage IV is when the cancer has spread throughout the rest of the body and other parts of the lungs.

According to the National Cancer Institute, by the end of 2015 there will have been 221,200 new lung cancer diagnoses and 158,040 lung-cancer related deaths in the USA.

According to the World Health Organization (WHO), 7.6 million deaths globally each year are caused by cancer; cancer represents 13% of all global deaths. As seen below, lung cancer is by far the number one cancer killer.

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IV METHODOLOGY

A prototype CAD system based on the image processing will be developed. This system initially pre-process the image using various pre-processing techniques to condition or enhance the input image and then image segmentation methods are applied to the pre-processed image. Image segmentation method such as K-Means clustering can be used. Feature extraction will be done to detect the disease .To classify the stages ANN can be used.

The proposed system consists of following steps:

- Image pre-processing
- Definition of ROI
- Extraction of features.
- Classification of cancer stage

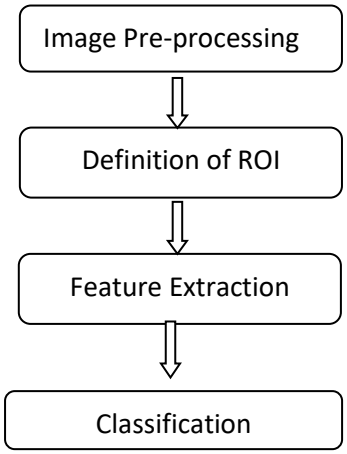


Image preprocessing:
By image pre-processing we will improve the quality of data through the application of methods for denoising. Filters such as Median filter or Laplacian filter or Gaussian filter will be observed & best suited will be used. Image standardization, i.e. gray scale transformation can be used if necessary.

Median filter:
In median filtering, the neighboring pixels are ranked according to brightness (intensity) and the median value becomes the new value for the central pixel. Median filters can do an excellent job of rejecting certain types of noise, in particular,"shot" or impulse noise in which some individual pixels have extreme values. In the median filtering operation the pixel values in the neighborhood window are ranked according to intensity, and the middle value (the median) becomes the output value for the pixel under evaluation.

Laplacian filter:
The Laplacian operator is an example of a second order or second derivative method of enhancement. It is particularly good at finding the fine detail in an image. Any feature with a sharp discontinuity (like noise, unfortunately) will be enhanced by a Laplacian operator. Thus, one application of a Laplacian operator is to restore fine detail to an image which has been smoothed to remove noise.

Gaussian filter:
The Gaussian filters are a class of linear smoothing filters with the weights chosen according to the shape of a Gaussian function. The Gaussian kernel is widely used for smoothing purpose. The smoothing filter is a very good filter for removing noise drawn from a normal distribution.

	Algorithm
Median filter:	filtering operation the pixel values in the neighborhood window are ranked according to intensity
Laplacian filter:	feature with a sharp discontinuity (like noise, unfortunately) will be enhanced by a Laplacian operator.
Gaussian filter:	filters with the weights chosen according to the shape of a Gaussian function

Definition of ROI & Feature extraction:
We will divide the image into regions of similar attributes by using improved segmentation methods. Most of the segmentation methods are adhoc.In proposed work different soft computing segmentation methods may be used such as seeded region growing,K means clustering, etc for better improvement.

K-Means Clustering Algorithm:
K-means clustering is a method of cluster analysis which aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean. K-means is one of the simplest unsupervised learning algorithms that solve the well-known clustering problem.

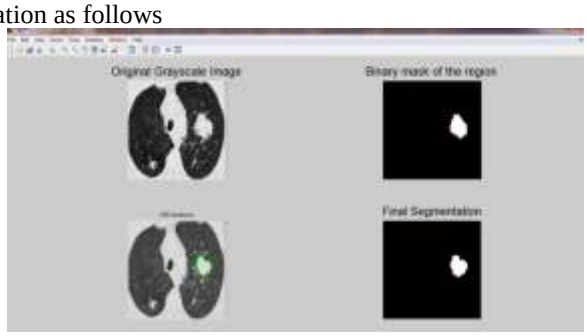
Classification:
For classification of features the back propagation neural network can be used. Training a network by back-propagation involves three stages:
1) The feed-forward of the input training pattern
2) The back-propagation of the associated error
3) The adjustment of the weights.
The ANN comprised three layers (one input layer, one hidden layer, and one output layer) trained by back propagation.
In proposed method back propagation feed forward neural network with Levenberg-Marquardt algorithm may be used.

V EXPERIMENTAL RESULTS AND DISCUSSION

The proposed system gives the detection and classification of lungs cancer using artificial Neural network.

From the database 30 images are tested & accuracy obtained is 97 %. The images are classified and grading is given.

Result of Preprocessing and segmentation as follows



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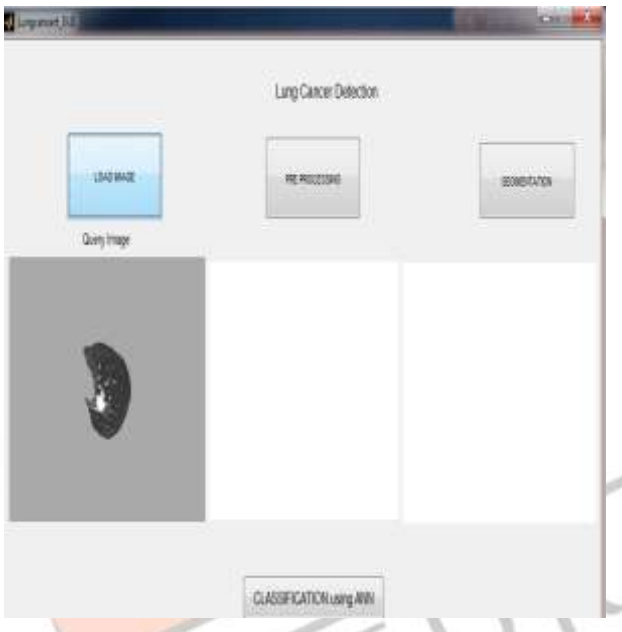

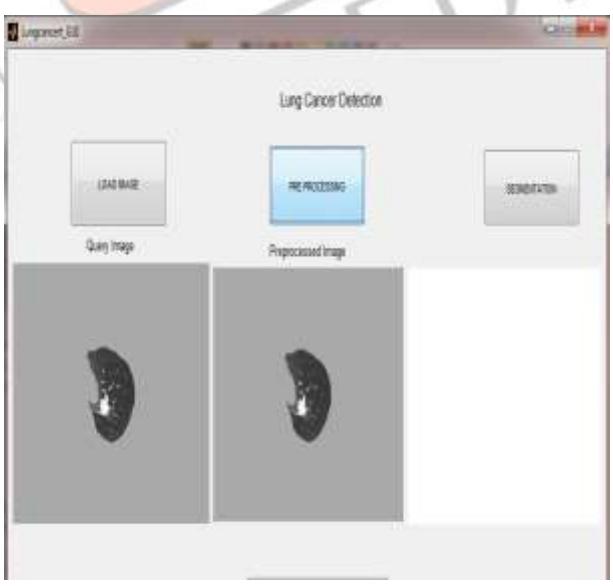

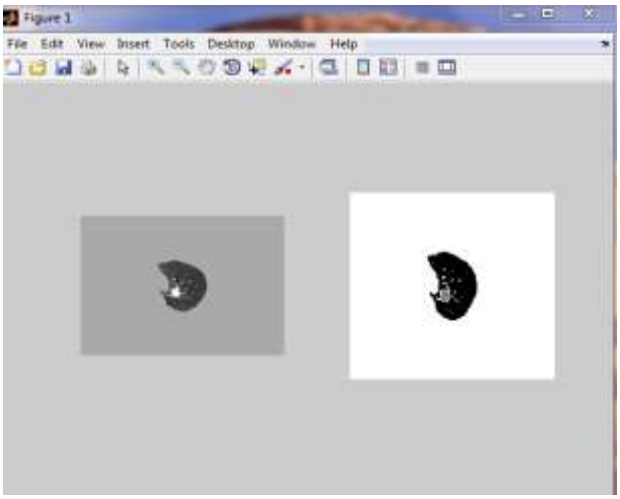
Figure 1
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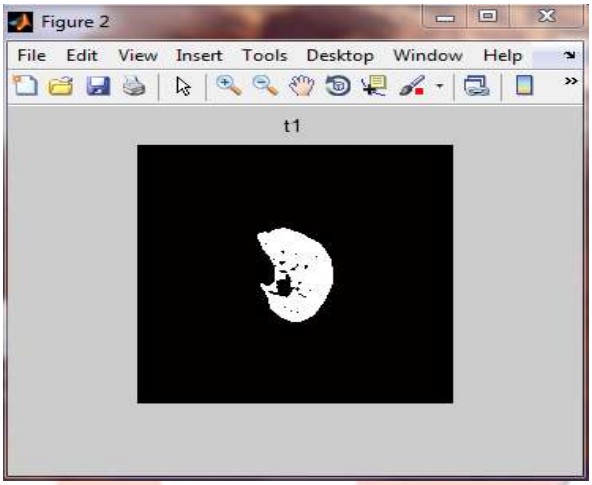
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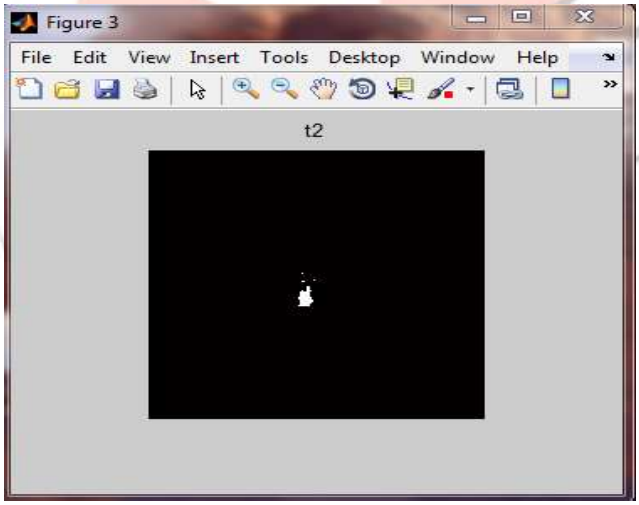
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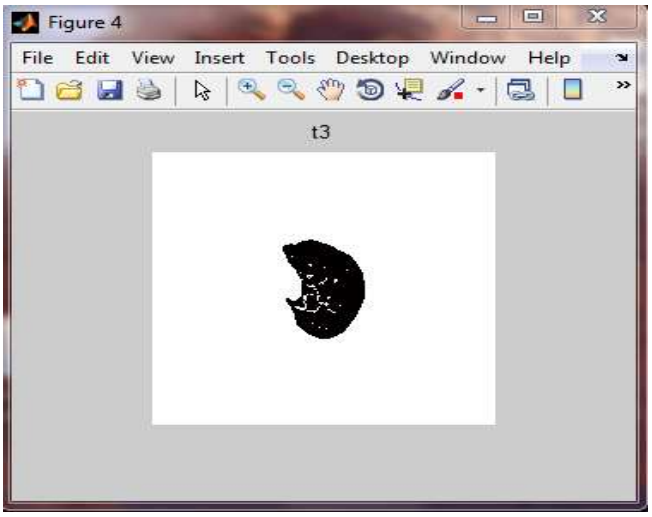

The performance of classification can be examined by sensitivity, specificity, and accuracy. Here TP(true positive), TN(true negative), FP(false positive),& FN(false negative).

$$\text{Sensitivity} = \frac{TP}{TP+FN}$$

$$\text{Specificity} = \frac{TN}{TN+FP}$$

$$\text{Accuracy} = \frac{TP+TN}{TP+FN+TN+FP}$$

Author	Method	Accuracy	Sensitivity
Giuseppe Coppini	multiscale processing and artificial neural networks	**95.7–98.0%**	**60 to 75%**
Emre Dandıl	a holistic Computer Aided Diagnosis (CAD) system has been developed by using Computed-Tomography (CT) images to ensure early diagnosis of lung cancer and	**90.63%**	**92.30%**
Sang Cheol Park	develop a new computer-aided detection (CAD) scheme to detect early interstitial lung disease (ILD) using low-dose computed tomography (CT) examinations.	85.7%	80%
Proposed	computer aided diagnostic (CAD) system for automated classification of cancer stage using K means clustering algorithm	98%	97%

Table. Comparision of our Technique with previous methods.
The proposed technique is compared with existing methods.. The accuracy of proposed system is good.

VI CONCLUSION

We developed and tested a new CAD scheme for brain tumor detection & classification of lungs cancer . To improve the system we tested & examined different CT images. The study showed that the tumor detection & classification can be done effectively with the proposed method. By taking CT images of a patient at regular interval we can also predict the growth rate of tumor which is very difficult to find without CAD system. The proposed syetem using azrtificial Neural Network is 98% accurate and 97% sensitive.The presented CAD system gives 2nd opinion to doctors for accurate detection of tumor & its stages.

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