

# Artificial Neural Network-Based Classification System for Lung Nodules on Computed Tomography Scans

Miss. Sheetal V Prabhu<sup>1</sup>, Prof. J.A.Shaikh<sup>2</sup>

<sup>1</sup>M.E. Student, Department of Electronics Engineering, PVPIT, Budhgaon, Maharashtra

<sup>2</sup>Associate Professor, Department of Electronics Engineering, PVPIT, Budhgaon, Maharashtra, India

**Abstract-** The paper describes a neural-network-based system for the computer aided detection of lung nodules in chest radiograms. 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 types such as the lung cancer, breast cancer. Lung cancer is the second most commonly diagnosed cancer in world. Our approach is based on multiscale processing and artificial neural networks (ANNs). The automated Computer Aided Diagnosing (CAD) system is proposed in this paper for detection of lung cancer from the analysis of computed tomography images. In this paper we represent artificial neural network based lung cancer detection system using CT images

**Index Terms-** 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 as round 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 lung cancer than any other cancer. The survival rate of lung cancer patient is only 14% but it could be increased up to 50% if there is an early detection of lung 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 categorize the problem. The lesions are produced with different body parts which cause the cancer. Such lesions are referred to as nodule if they cause cancer, otherwise non-nodule. In the design of a CAD system, the main task is to segment the volume of particular body part, like lung 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-nodule

**II.RELATED WORK**

One of the important contributions of this project is the early detection of lung cancer by identifying small sized lung nodules with the help of SOM method during segmentation.[10]

In our dataset, 31% of nodules are so small (<5mm), and 56% of nodules are medium size. So, the proposed CAD can detect the lung nodules at the early stage. [12]

This study proposes an ANN based CAD system for automatic classification of benign/malign pulmonary nodules at early stages. In this paper, Self-Organizing Maps (SOM) has been used for nodule segmentation to enable the smallest nodules in the lungs. GLCM (gray level co-occurrence matrix) method has been utilized for the feature extraction of benign or malignant nodules. ANN, which is an effective classification technique, has been employed for classification.[10]

This study proposes an automatic CAD system that successfully differentiates the lung nodules as benign or malignant on CT images. The proposed CAD system is an integrated structure since it includes pre-processing, segmentation, feature extraction, feature selection and classification steps.

The objective of this work 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)

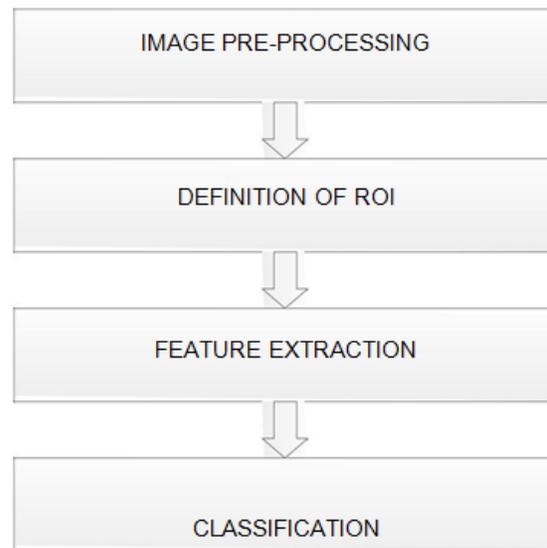
Trained by back propagation. In proposed method back propagation feed forward neural network with Levenberg-Marquardt Algorithm may be use.[9]

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.

**III.SYSTEM BLOCK DIAGRAM**

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 system consists of following steps



A) Image pre-processing:By image pre-processing we improved the quality of data through the application of methods for denoising. Median filter is used for this.

B) Median filter:n 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 neighbourhood window are ranked according to intensity, and the middle value (the median) becomes the output value for the pixel under evaluation.The best known order-statistics filter is the median filter

C) Image pre processing: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.

D) 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.

E) 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.

G) 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.

H) 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 ad hoc. In proposed work different soft computing segmentation methods may be used such as seeded region growing K means clustering, etc. for better improvement.

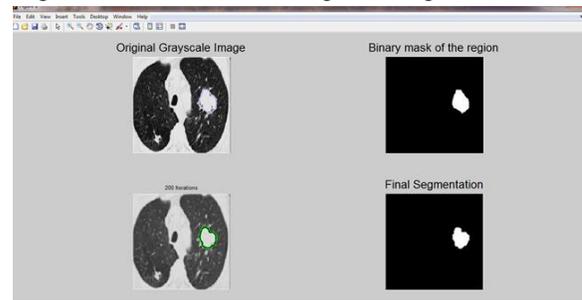
I)K-Means Clustering Algorithm: K-means clustering is a method of cluster analysis which aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean. K-means is one of the simplest unsupervised learning algorithms that solve the well-known clustering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

J) 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 weightsThe 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

#### IV. RESULTS

The proposed technique is used for many images of lungs suffering from cancer. For this method we tested various CT images, the results of pre-processing, ROI, Segmentation is given in this paper. To select the effective size of the ROI surrounding an examined pixel. The texture features and color image segmentation is done for the given image.



Result of segmentation localization radius is: 13 pixels For experimentation of the proposed technique, the CT images are obtained from a internet lungs cancer database This experimentation data consists of 1000 lung images. Those 1000 lung images are passed to the proposed this system. The diagnosis rules are then generated from those images and these rules are passed to the classifier for the learning process. After learning, a lung image is passed to the proposed system. Then the proposed system will process through its processing steps and finally it will detect whether the supplied lung image is with cancer or not. On one hand, user have developed an automatic CAD system for early detection of lung cancer using Lung CT images which a high level of sensitivity has been achieved, with a reasonable amount of false positives per image, (90% sensitivity with 0.05 false positives per image).This prevents the system from hindering the radiologist’s diagnosis. On the other hand, the proposed CAD system is capable of detecting lung nodules with diameter  $\geq 3$  mm, which means that the system is capable of detecting lung nodules when they are in their initial stages. Thus facilitating early diagnosis will improve the patients’ survival rate.Discriminate between cancerous and non-cancerous candidate nodules. On one hand, we

have developed an automatic system for early identification of lung cancer using chest CT images in which a high level of sensitivity has been achieved, with a reasonable amount of false positives per image, (90% sensitivity with 0.05 false positives per image). This prevents the system from hindering the radiologist's diagnosis. On the other hand, the proposed CAD system is capable of detecting lung nodules with diameter  $\geq 3$  mm, which means that the system is capable of detecting lung nodules when they are in their initial stages. Thus facilitating early diagnosis will improve the patients' survival rate.

#### V. CONCLUSION

We developed and tested a new CAD scheme for brain tumor detection & classification of lung 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 presented CAD system gives 2nd opinion to doctors for accurate detection of tumor & its stages.

#### REFERENCES

- [1] Macedo Firmino et al. "Computer-aided detection system for lung cancer in computed tomography scans" Review and future prospects year-2014
- [2] Wook-Jin Choi and Tae-Sun Choi "Automated Pulmonary Nodule Detection System in Computed Tomography Images: A Hierarchical Block Classification Approach" year-2013
- [3] Roland Opfer, Rafael Wiemker "Performance Analysis for Computer Aided Lung Nodule Detection on LIDC Data" Philips Research Europe - Hamburg, Germany
- [4] M. Dolejsi, "Detection of Pulmonary Nodules from CT Scans", Czech Technical University, Faculty of Electrical Engineering, Center of Machine Perception, Prag, 2007.
- [5] Ozekes et al "Nodule detection by calculating density value of each pixel, rule-based lung region segmentation and the Regions of Interest (ROIs) are extracted using 8 directional search" ozekes 2007
- [6] N Engl J Med et al. "The international early lung cancer action program investigators, Survival of patients with stage I lung cancer detected on CT screening", 355, pp. 1763-1771, 2006.
- [7] H. Camdevyren et al. "Use of principal components cores in multiple linear regression models for prediction of Chlorophyll-a in reservoirs", Ecological Modelling, 181, pp. 581-589, 2005.
- [8] P. Campadelli et al. "Lung Segmentation and Nodule Detection in Postero-Anterior Chest Radiographs", 2004.
- [9] K. Suzuki et al. "Massive training artificial neural network (MTANN) for reduction of false positives in computerized detection of lung nodules in low-dose computed tomography", Med. Phys., 30, 1602, 2003
- [10] Self Organizing Maps: Fundamentals, Introduction to Neural Networks : Lecture 16
- [11] © John A. Bullinaria, 2004
- [12] G. Coppini, et al. "Neural Networks for Computer-Aided Diagnosis: Detection of Lung Nodules in Chest Radiograms", IEEE Transactions on Information Technology in Biomedicine, vol. 7(4), pp. 344-357, 2003.
- [13] Y. Lee, T. Hara et al. "Automated Detection of Pulmonary Nodules in Helical CT Images Based on an Improved Template-Matching Technique", IEEE Transactions on Medical Imaging, 20(7), July 2001.
- [14] David A. Clausi et al. "An analysis of co-occurrence texture statistics as a function of grey level quantization" Vol. 28, No. 1, February 2002
- [15] T. Okumura et al. "Variable N-Quoit filter applied for automatic detection of lung cancer by X-ray CT", Proc. CAR'98, Tokyo, Japan, 1998.