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Artificial Neural Network-Based Classification System for Lung Nodules onComputed Tomography Scans

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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 form the analysis of computed tomography images. In this paper we represent artifial neural network-based lungs cancer detection system using CT images.

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. Inthis 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 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 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 nodules

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II. RELATED WORK

The following techniques have been developed for diagnosis of lungs cancer detection using artificial neural network: MacedoFirmino1etal.[1]presentedacriticalreviewofmajor Computer-Aided Detection systems (CADe) for lung cancer in order to identify challenges for future research. CADe systems must meet the following requirements: improve the performance of radiologists providing high sensitivity in the diagnosis, a low number of false positives (FP), have high processing speed, present high level of automation, low cost (of implementation, training, support and maintenance), the ability to detect different types and shapes of nodules, and software securityassurance.

Wook-Jin Choi et al.[2] proposed a novel pulmonary nodule detection method based on hierarchical block classification. The proposed CAD system consists of three steps.Inthefirststep,inputcomputedtomographyimagesare split into three-dimensional block images, and we apply entropy analysis on the block images to select informative blocks. In the second step, the selected block images are segmented and adjusted for detecting nodule candidates. In the last step, we classify the nodule candidate images into nodules andnon-nodules.

Roland Opferet al.[3] explained CAD algorithm with a validation study on these data sets. The CAD performance was analyzed by virtue of multiple Free Response Receiver Operator Characteristic (FROC) curves for different lower thresholds of the nodule diameter.

M. Dolejsiet al.[4] presented a computer-aided diagnosis (CAD) system to detect small-size (from 2mm to around 10mm) pulmonary nodules from helical CT scans. A pulmonary nodule is a small, round (parenchymal nodule) or worm shaped lesion in the lungs.

Ozekeset al.[5] developed a new method for automated lung nodule detection in serial section CT images with using the characteristics of the 3D appearance of the nodules that distinguish themselves from the vessels.

NEnglJMed[6]JournalpaperbyTheNewEngland Journal of Medicine estimated the 10-year lung-cancer– specific survival rate among participants with clinical stage I lung cancer thatwas detected on CT screening and diagnosed by biopsy, regardless of the type of treatment received, and among those who underwent surgical resection of clinical stage I cancer within 1month.

H. Camdevyrenet al.[7] used of principal components cores in multiple linear regression models for prediction of lung cancer. he proposed a theory based on principle component analysis. The result shown that this classification method using principle component has outstanding performance with respect to previous methods.

P. Campadelliet al.[8] described a method for processing Postero Anterior chest radiographs which segments the lung field and extracts a set of nodule candidate regionscharacterizedbylowcardinalityandahighsensitivity ratio.

K. Suzuki et al.[9] developed artificial neural network (MTANN) performance or reduction of false positives in computerized detection of lung nodules in low- dose computed tomography Developing an effective CAD system which will provide training and testing database, validation method is the goal of the work.

G. Coppiniet al.[10] studied a neural-network- basedsystemforthecomputeraideddetectionoflungnodules in chest radiograms. This paper is based on multiscale processing and artificial neural networks(ANNs).

Y. Lee et al.[11] proposed a novel template- matching technique based on a genetic algorithm (GA) template matching (GATM) for detecting nodules existing within the lung area; the GA was used to determine thetarget position in the observed image efficiently and to select an adequate template image from several reference patterns for quick templatematching.

David A. Clausiet al.[12] studied the effect of grey level quantization on the ability of co-occurrence probability statistics to classify natural textures. Correlation analysis is used to rationalize a preferred subset of statistics.

L. H. Chen, et al. [13] proposed anadaptive learning algorithm (ALA) for PCAis
proposed. By adaptively selecting the learning rate parameters, we show that the 7n weight vectors in the ALA converge to the first m principle component vectors with almost the same rates.

R. M. Haralick, et al.[15] described some easily computable texture features based on gray scale tone dependencies and illustrated the applications related to the scale dependency

III. METHODOLOGY

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 outputlayer)Trained by back propagation. In proposed method back propagation feed forward neural network with Levenberg- Marquardt

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Algorithm may be used.

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 segmentationmethodsareappliedtothepre-processedimage. Image segmentation method such as K-Means clustering can be used. Feature extraction will be done to detect thedisease

To classify the stages ANN can be used

The proposed system consists of following steps:

- Image pre-processing
- Definition ofROI
- Extraction offeatures.
- Classification of cancerstage

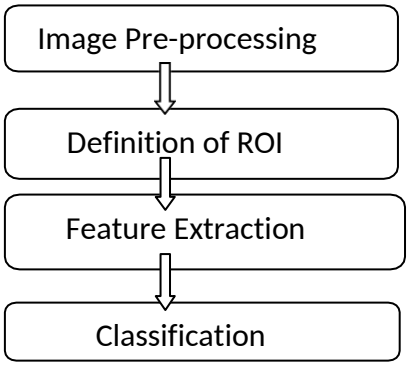

Image preprocessing:

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.

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.

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

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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 threestages:
1) The feed-forward of the input trainingpattern
2) The back-propagation of the associatederror
3) The adjustment of theweights
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.

IV. CONCLUSION

This paper discusses, classification of blood group using Support Vector Machine. SVM is capable of predicting an unknown sample with good degree of accuracy.Itisrobustwithnoisydata.SVMperformswell in higher dimensional spaces. Lack of training data is often not a severe problem in case of this classifier. It is computationallymuchlessintensiveandhasfastlearning speed.
Such classification system eradicates human errors, minimizes transfusion reaction risks. In emergency situations, appropriate diagnosis of blood type within short interval of time is possible with this system

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