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CAD System for Lung Cancer Detection using ANN

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ABSTRACT : *Lung Cancer is the leading cause of death in both men and women throughout the world. It spreads rapidly after it forms. The survival rate of patient is very less. If the disease is identified while it is still localized the survival rate of the patient can be improved greatly. In this paper, we represent computer aided diagnosis(CAD) system for detection of lung cancer by analyzing CT images of chest. CAD system helps to improve the diagnostic performance of radiologists in their image interpretations. The first stage of CAD system is segmentation of lung region from lung CT image which is nothing but first region of interest(ROI). The first ROI is obtained using region based approach and it gives good segmentation result in short time. To distinguish between true and false candidate nodules we have used Artificial Neural network. The proposed CAD system is capable of detecting lung nodules with diameter ≥ 2mm. the obtained results are good and satisfactory.*

Keywords - *Artificial Neural Network, Computer Aided diagnosis(CAD), Medical Image processing, Region growing, ROI, Segmentation .*

I. INTRODUCTION

The Lung Cancer remains a leading cause of mortality[1]. Its cure rate is very low because it is usually detected at very late stages. The survival rate for lung cancer in five years is just 15%[5]. The survival rate of patient can be increased by detecting the occurrence of cancer in earlier stages. In recent years doctors use wide range of diagnostic procedures to detect cancer . Chest X-ray, Computer tomography(CT) are the standard for pulmonary imaging. In current clinical practice, hundreds of thin-sectional CT images are generated for each patient and are evaluated by radiologist by looking at each image in axial mode. It is very difficult to interpret and very time consuming which cause missing a cancer.

The purpose of this paper is to develop a CAD system which is not used to replace radiologist but to provide them with a tool that may help them to for early detection of lung cancer. Computer Aided diagnosis(CAD) has been revolutionary step in premature detection of lung cancer. The proposed CAD system consist of five main steps : 1) Lung region extraction 2) Segmentation of extracted lung 3) Nodule detection 4) Feature extraction 5) Testing using Neural Network.

1.1 Related work

Zhi-hua Zhou et al.[2002][3], stated that Lung Cancer is one of the most common and deadly diseases in the world. Detection of lung cancer in its early stage is the key of its cure. In general, measures for early stage lung cancer diagnosis mainly includes those utilizing X-ray chest films, CT, MRI, isotope, bronchoscope, etc ., among which a very important measure is the so-called pathological diagnosis that analysis that analyzes the specimens of needle biopsies obtained from the bodies of the subjects to be diagnosed.

JIA Tong et al.[2007][5], in their technical paper "Computer-Aided Lung Nodule Detection Based On CT Images" proposed a computer-aided detection (CAD) scheme that can identify the lung nodule at an early stage from CT images. For this work they have used several steps like segmentation of lung parenchyma, the detection of suspicious nodule candidates, the feature extraction and classification. They have used adaptive threshold segmentation, math morphologic, Gaussian filter, Hessian matrix algorithms.

Sammouda et al.[2005][9], in their paper on "Computer Aided Diagnosis System for Early detection of Lung Cancer Using Chest Computer Tomography Images" used hopfield neural networks(HANN) for segmentation showing good segmentation result in a short time. The images used are chest 3D computed tomography(CT) for analyzing. They have used database of 2668 CT slices from 11 Patients. UP to 90% sensitivity is obtained,with 0.05 false positive per slice.

Gomathi et al.[2010][10]., in his technical paper on "A Computer Aided Diagnosis System for Detection of Lung cancer Nodules Using Extreme Learning Machine" proposed Computer Aided diagnosing (CAD) system which uses fuzzy Possibilistics C Mean (FPMC) algorithm for segmentation to improve the accuracy. After segmentation rule based technique is applied to classify the cancer nodules. The learning is performed with the help of Extreme Learning Machine (ELM) because of its better classification.

Patil et al.[2009][13], in his technical paper on "Geometrical and Texture Feature Estimation of Lung Cancer And TB Image Using Chest X-ray Database" proposed a Active Shape Model (ASM) technique for lung field segmentation . As one of the most important task in medical image analysis is to detect the absence or presence of disease in an image, for this image segmentation is important. Also they have used Gray Level Co-occurrence Matrix(GLCM) technique to estimate texture features. The algorithm is applied on two main types of lung cancer images ,like Small-cell ,Non-small-Cell type and as well as on TB database.

II. METHODALOGY

The projected CAD system involve following steps as shown in the Fig.1.

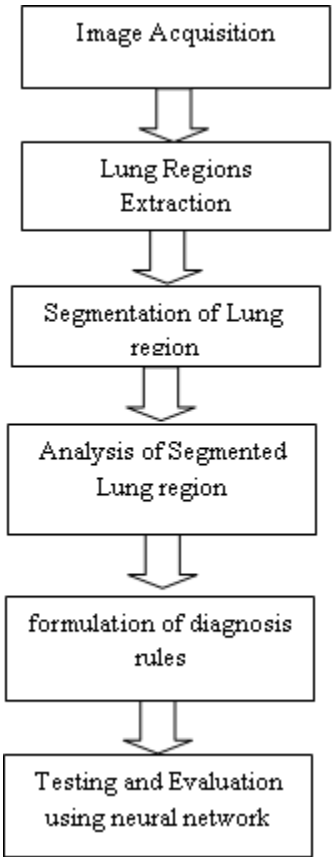


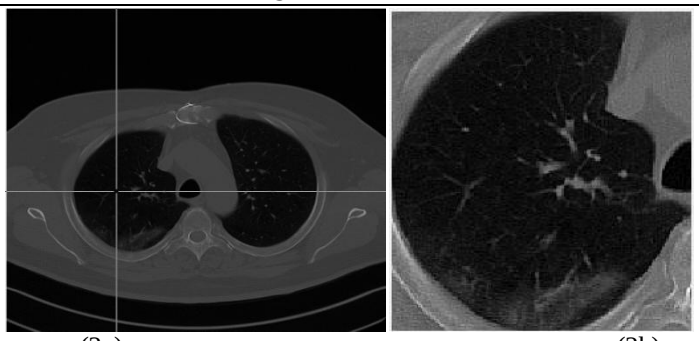
Figure 1: Computer Aided Diagnosis system

The first stage of CAD system is segmentation of lung region from CT images. Second part is to identify candidate nodules from segmented lung region section using rule based approach .Finally ANN is applied in order to classify the cancer.

III. LUNG REGIONS EXTRACTION

The initial segmentation is very important as if entire lung is not segmented properly candidate nodules will be lost which may have important information about cancer into it. The different methods are used for segmentation one of the method is Threshold based segmentation. the problem with this method is selection of suitable threshold value. Another method is based on edge detection but the problem with this system arises when the images are edgeless or very noisy. In this paper we have used region based approach for segmentation. The region based segmentation is a technique for detecting the region directly.

A CT image of chest consist of different regions such as the background, lung parenchyma, heart, liver and other organ area. The goal of lung region extraction is to separate the lung region from other lung anatomy. The region growing algorithm(RGA) is used for segmentation . Growing of region start exactly from location of seed point and go on appending those neighboring pixels that have predefined properties similar to seed. The extraction of lung after application of RGA is shown in the Fig. 2a and 2b.

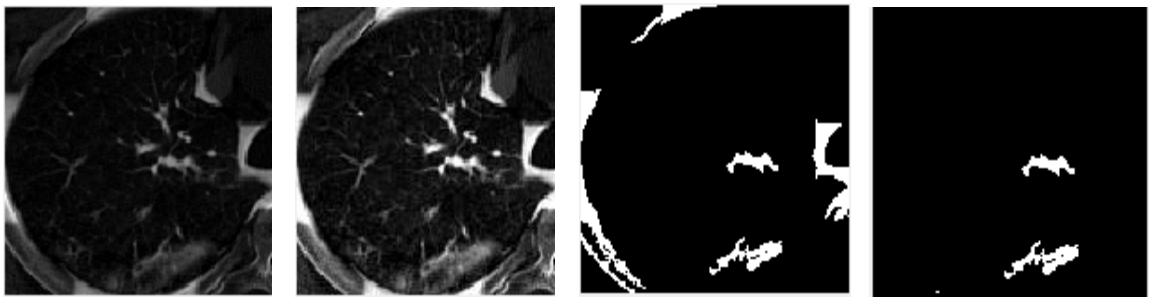


(2a) (2b)

Figure 2: (2a) Original image (2b) Extracted lung

IV. LUNG REGIONS SEGMENTATION

After lung region is detected the next process is segmentation of lung region that aims to search for candidate nodules. This will identify the new region of interest (ROI) which help in detecting the cancer region. Various image processing techniques were used to segment lung region . The result obtained are shown in the Fig. 3. The first image obtained is background image shown in Fig. 3a. the intensities of images are adjusted to highlight the needed information. The final Fig.3d shows candidate nodules obtained by clearing the boundaries.



(3a) (3b) (3c) (3d)

Figure 3: Application of image processing techniques (3a) Background image (3b) Adjusted image intensities (3c) Binary image (3d) Clear boundary image

V. FEATURE EXTRACTION

The extracted features acts as the basis for classification process. This features are used to develop diagnostic rules to detect cancer nodule. The features that are used in this study are Area of candidate region Mean intensity value of candidate region Maximum drawable circle(MDC). The first feature is used to eliminate isolated pixels. the second feature helps in rejecting nodules which do not have chance to form candidate nodules.

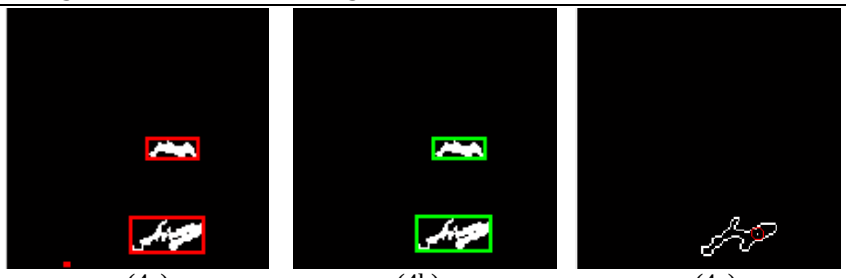
5.1 FORMULATION OF DIAGNOSTIC RULES

After the necessary features are extracted the following diagnostic rules are applied. The diagnostic rules helps in reducing more number of false positive cancer nodules.

Rule 1: Initially the threshold value T1 and T2 are set for area of candidate region. The threshold values are determined by experiments . If the area of candidate region is less than or exceeds the threshold value then it is eliminated for further consideration .

Rule 2: The threshold value T3 is defined for MDC . If the radius of desirable circle is less than threshold value then candidate region is considered as normal cell and is eliminated for further consideration.

By implementing all the above rules the maximum regions which do not exhibit cancer nodule properties are eliminated. The results obtained by applying diagnostic rules are shown in the Fig 4. The Fig 4b shows that the candidate regions reduces to two after the application of first rule.



(4a) (4b) (4c)

Figure 4: Application of diagnostic rule (4a) cancer nodule detected (4b) Application of first rule (4c) Application of second rule.

VI. CLASSIFICATION USING ANN

Artificial Neural Network is developed for diagnosis and classification of candidate nodules obtained from application of diagnostic rules. ANN work by training and testing process applied to it. The ANN network consist of three main layers input layer, hidden layer, output layer. The network is trained using Back propagation(BPA) algorithm. The idea of BPA is to reduce error produced by the difference between actual output and expected result[9].

Initially the best optimized ANN is obtained by varying various parameters of network like hidden nodes , training percentage for training ANN, number of epochs. After the successful network have been developed it is then ready for classification process. The following Table shows the result obtained from classification process of selected candidate nodule.

Table 1: Result of classification of proposed nodule

Result	**Nodule 1**
Cancerous	1 (0.9697)
Noncancerous	0 (0.6924

The performance of CAD system is measured by parameters like Accuracy, Sensitivity and Specificity. The following Table shows the obtained result.

Table 2: Performance of the CAD system

Total cancerous nodule applied	**TP**	**FP**	**TN**	**FP**	**Not classified**	**Sensitivity**	**Specificity**	**Accuracy**
65	24	12	8	7	14	82.14 %	66.6 %	66 %

VII. CONCLUSION

The Computer Aided Diagnosis (CAD) system has been developed successfully. This system was verified by the referred doctors throughout this project. The approach starts by extracting lung region . The RGA was used for extraction of the lung region. The diagnostic rules were used to eliminate false positive candidate nodules. One of the important advantages of Artificial Neural Network is their ability to learn information in data. The best ANN architecture was developed and used for classification of lung cancer nodules in CT images. The CAD system helps the physician and the radiologist to identify the suspicious nodules and thus to increase the sensitivity of the diagnosis.

REFERANCE

[1] Ramnath Takiar , Deenu Nadayil, a Nandakumar," Projection of number of cancer cases in India (2010-2020) by Cancer Groups", *Asian Pacific Journal of Cancer Prevention, Vol 11,2010.*

[2] Rachid Sammouda, Jamal Abu Hassan , Mohamed Sammouda, Abdulridha Al-Zuhairatem abou ElAbbas , "Computer Aided Diagnosis System for Early detection of Lung Cancer Using Chest Computer Tomography Images" ,*GVIP 05 Conference,19-20 December 2005,CICC,Cairo,Egypt.*

[3] JIA Tong, ZHAO Da-Zhe, WEI Ying, ZHU Xin-Hua, WANG Xu, "Computer-Aided Lung Nodule Detection Based On CT Images", *IEEE/ICME International Conference on Complex Medical Engineering, 2007.*

[4] Tetsuya Tozaki, Yoshiki Kawata, Noboru Niki,Hironobu Ohmatsu,Kenji Eguchi, Noriyuki Moriyama,"3D Image Analysis of The Lung Area Using Thin Section CT Images and Its Application To differential diagnosis" , *IEEE 1996.*

[5] S.A.Patil, Dr. V.R. Udupi ,Dr. C.D. Kane , Dr. A.I.Wasif, Dr.J.V.Desai,A.N.Jadhav, " Geometrical and Texture Feature Estimation of Lung Cancer And TB Image Using Chest X-ray Database", *IEEE 2009.*

[6] M.Gomathi , Dr. P. Thangaraj, "A Computer Aided Diagnosis System for Detection of Lung Cancer Nodules Using Extreme Learning Machine" , *International Journal of Engineering Science And Technology Vol.2(10),2010.*

[7] Penedo, M.G., Carreira, M.J., Mosquera, A. and Cabello, D., "Computer-Aided Diagnosis: ANeural-Network-Based Approach to Lung Nodule Detection", *IEEE Transactions on Medical Imaging, Pp: 872 – 880, 1998.*

[8] Fatma Taher ,Rachid Sammouda**, "**Identification of Lung Cancer Based On Shape and Color"- *IEEE 2008.*

[9] Azian azamimi Abdulla, Syamimi Mardiah Shaharum," Lung Cancer Cell Classification Method using Artificial Neural Network", *information Engineering Letters ,Vol. 2 No.1 March 2012.*