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Exploring Bayesian networks for Lung Cancer Detection

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***Abstract*— Lung cancer is considered to be the leading cause of cancer death throughout the world, and it is difficult to detect in its early stages, because symptoms appear only at advanced stages. Physicians use several techniques to diagnose lung cancer such as chest radiograph and sputum cytological examination where a sputum sample can be analyzed for the presence of cancerous cells. Manual screening for the sputum cells identification involves a labor-intensive task with a high false negative rate.**

Using the Bayesian classification to detect and extract the sputum cells from the sputum color images prepared by the Papanicolaou standard staining method. The segmentation of sputum cells using a HNN to segment the sputum images which is characterized by noisy and cluttered background patterns into three regions, background, cytoplasm and nuclei regions. There are many algorithms which can be used for medical image segmentation, such as histogram analysis, region approach, edge detection and adaptive thresholding.

***Key Words*— Sputum, Bayesian classification, HNN, cytoplasm;**

I. INTRODUCTION

Lung cancer is becoming the prime factor in cancer deaths due to increasing rate of smoking and air pollution in different countries. According to statistics 31% of cancer deaths for males and 26% for females are caused by the lung cancer [1]. There has been a great effort to improve the diagnosis and treatment of the lung cancer. Medical imaging is the main tool for cancer diagnosis and lot of researchers are focused on this area. Computed Tomography (CT) is considered to be the best modality for cancer diagnosis. It provides good details on anatomical features of the tissues. But still there is need for automatic detection of lung nodule in CT scan images. It can eliminate the health risks and complications involved in invasive operations significantly and improve the chances for successful treatment of the patient. Time and cost are two crucial factors in any treatment of a lung cancer. There is need to diagnose the lung nodule of person and will classify whether nodule is cancerous or not by using computer aided diagnosis (CAD). It will help radiologist to improve the diagnosis efficiency by calculating the quantity of nodule growth in each stage accurately.

II. TYPES OF LUNG NODULES

The Lung Nodules majorly classified into two types: Benign and malignant.

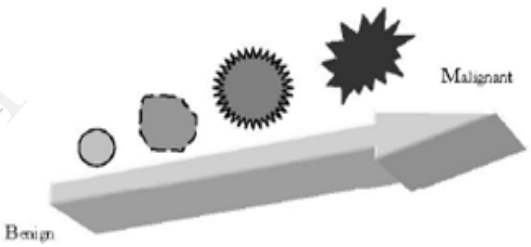

Fig. 1 Nodule growth

The fig. 1 shows the nodule growth from the benign stage to the last malignant stage. Benign is the primary stage of the nodules. It also shows the growth and boundary of each nodule at each stage.

If lung nodule area and density is Minimum then it is normal type of lung nodule. Small lung nodules are not diagnosis with the help of needle biopsy.

A. Benign

Benign nodule is the type of non cancerous lung nodule. If the nodule area is Minimum and density is Maximum then it is called benign nodule. Nodule sizes vary in range of 0.5 to 1. It has regular structure and hardcore boundary without spin.

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B. Malignant

Malignant nodule is the cancerous lung nodule and it spread in affected area. It is most dangerous type of nodule. If the nodule area is Maximum and density is Minimum then it is called malignant nodule. Nodule sizes vary in range of 1 to 1.5. It has irregular structure and nodule boundary with spin. If lung nodule area is Maximum and density is maximum then it is advanced lung cancer nodule

III. METHODOLOGY

There are three main methods were used for the detection of lung nodule type: Pre-processing, feature extraction and nodule classification. CT images were given as input to the CAD system and then perform the operation on it. The system finally gives output as lung nodule is cancerous or not

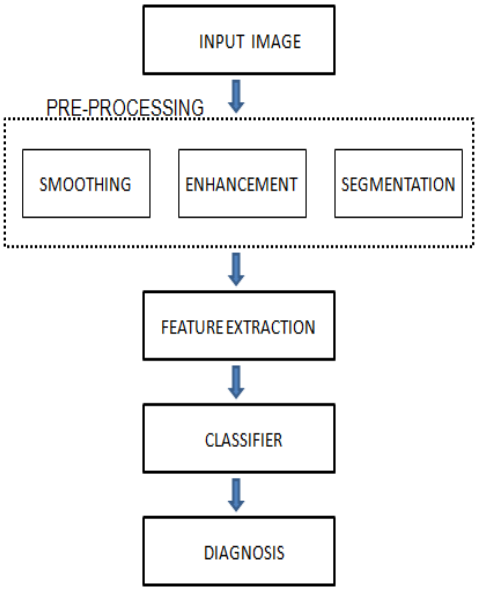

Fig.2. Method use

A. Input Image:

The input images are CT scan images of cancerous and non cancerous patient. The images collected from cancer hospital in the form of **DICOM (Digital Image Communication of Medical)** image format.

Fig 3 Input image

B. Pre-processing: Pre-processing consist of three methods Filtering, enhancement, segmentation.

1) Filtering:

Smoothing is improving the image quality and removes the unwanted noise from images. The smoothing technique is applied to expose the feature of input image.

Fig 4 Improve image

2) Image Enhancement:

Enhancement technique enhances the contrast of images by transforming the values in an intensity image. The contrast enhancement can limit in order to avoid the noise which is present in image.

Zhenghao Shi et al [2] used the Laplacian of Gaussian filter for enhancing nodules in a chest radiograph. It used the high intensity transmission and then applied a LOG filter to calculate the differences in contrast within inside and outside region of interest. The lung nodules have high value at the centre and low vales to its surrounding region. High value means bright portion and low value means dark portion.

Fig. 5(a) Input image Fig. 5(b) Enhance image

Enhancement filter scheme was used by Yang Yu et al [3] in two steps. First step based on volume determination and search of the nodule inside parenchymal volume by using enhancement filter. It was use as a pre-processing step to extract nodular structure based on its morphology and texture feature. In second method nodule search throughout the whole CT scans image. By considered the nodule features like intensity, shape and size.

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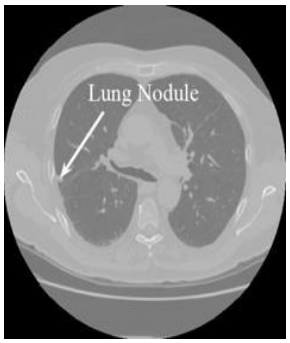


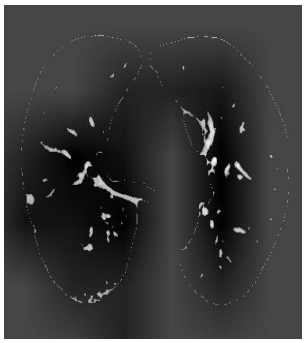


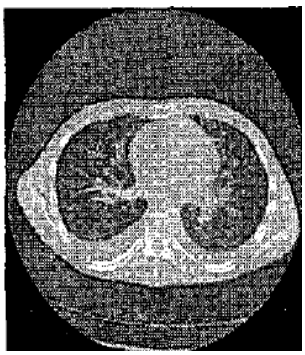
Fig. 6(a) Input image Fig. 6(b) Resulting image

TABLE I.
COMPARISON OF ENHANCEMENT METHOD

References No.	Enhancement		
	Proposed Methodology	***Dataset***	***Result***
Zhenghao Shi et al [2]	Use LOG filter	52 Samples	Differentiate nodules from background
Yang Yu et al [3]	Use enhancement filter in two-dimensional space	23 Samples	Improve sensitivity for the nodule detection process

3) Image Segmentation:

In the image segmentation the CT image subdividing into small regions. Segmentation distinguishes the object from background part of the lung CT images.
Maciej Dajnowiec et al.[4] proposed a method for automatic segmentation of the lung region. In his method optimum threshold value was calculated from the image of the data set. This threshold values were use to differentiate the organ and solid tissue from air region of the lung. After that check the images sequentially from the beginning until found the two objects whose size exceeds 1% of the total pixel. It was consider as base slide. Then remaining region obtained by applying region growing technique. This final result, multiplied with the original CT images to extract the lung portion of each slide.



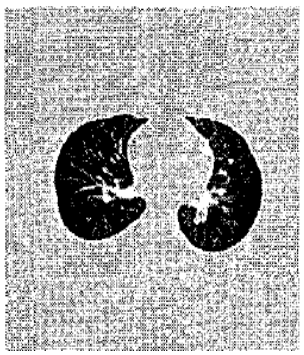


Fig. 7(a) Input image Fig. 7(b) Resulting image

Vivekanandan D et al [5] applied edge based segmentation using snakes on CT images. A snake was used as the energy function in term of internal energy and force that acts on image. In its active snake method the lung contour was detected by using image matrix (i) they initialised the snake from the set of point (p).

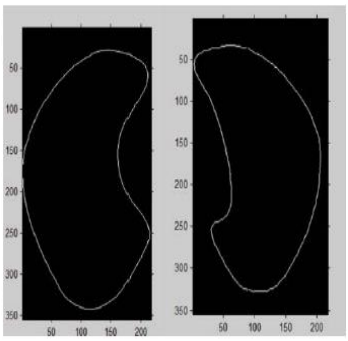


Fig. 8(a) Input image Fig. 8(b) Contour image

Anita chaudhary et al [6] was performed segmentation by using thresholding and watershed segmentation techniques. The thresholding segmented image requires smaller storage space and it have fast processing speed and it is easy in manipulation.

Fig. 9. Thresholding segmentation
Fig. 9(a) Enhance image Fig. 9(b) Resulting image

Watershed segmentation extracts the object from background with the help of seeds.

Fig. 10. Watershed segmentation
Fig. 10(a) Enhance image Fig. 10(b) Resulting image

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TABLE II
COMPARISON OF VARIOUS SEGMENTATION METHOD

References No.	Segmentation		
	Proposed Methodology	***Dataset***	***Result***
Maciej Dajnowiecet al[4]	Automated lung segmentation	100 Samples	Detect 85% of nodules
Vivekanandan D et al [5]	Edge based segmentation using Snakes	132 Samples	Detect the edge of lung and return the contours
Anita chaudhary et al [6]	Thresholding and watershed segmentation techniques	CT images are more efficient than X- ray	Watershed segmentation gives more accuracy than thresholding approach.

C. Feature Extraction:

Feature extraction is essential and very important step to extract region of interest (ROI).
Noriyasu Homma et al [7] used N-quoit filter to find ROI from the CT images. To extract the lung nodule they binaries original image and then calculated mean, variance and entropy of intensity. After that they applied a Gabor filter to find orientation output for new feature. Impulse response was obtained by multiplying the Harmonic and Gabor function. The orientation features were obtained from convolution of image and it involved circle shape information. Finally they used principal component analysis to eliminate the dimensional redundancy.

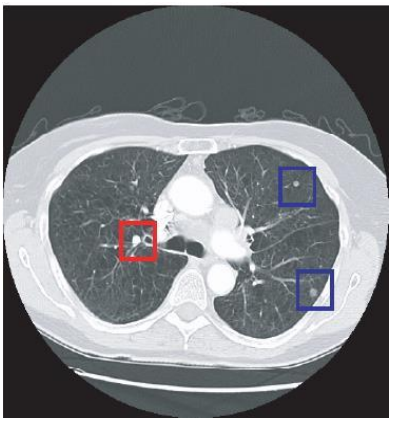

Fig.11(a). Image detect by N-quoit filter

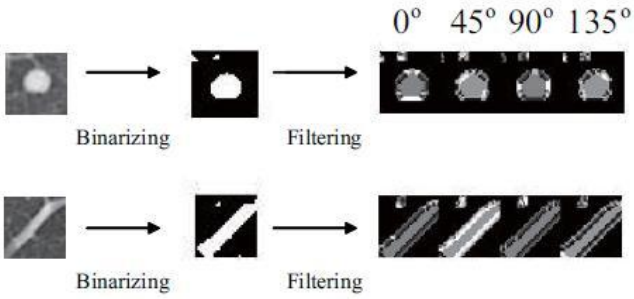

Fig. 11(b). Orientation filter output

Si-yu Xu et al [8] proposed feature extraction algorithm based on 2D PCA. In it they measured the merits of projection space by using the principle function which was calculated from total discrete degrees of projection. They calculated the hybrid mean value instead of distinguish the category of samples in 2D PCA of total divergence matrix. Then all training samples were standardized using this mean value. The feature extracted on the basis of histogram peak value of CT images. They claimed that their algorithm has a better performance on feature extraction than traditional PCA and 2D PCA.

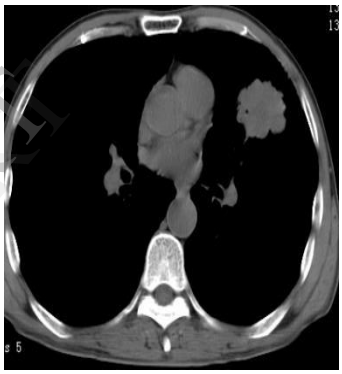

Fig. 12(a). Input image

Fig. 12(b). Extracted nodule

TABLE III
COMPARISON OF VARIOUS FEATURE EXTRACTION METHOD

References No.	Feature Extraction		
	Proposed Methodology	***Dataset***	***Result***
Noriyasu Homma et al [7]	N-qu0it filter to find ROI and Use Gabor filter to extract orientation feature of nodules.	1929 Non-nodule Samples 297 Nodule Samples	True Positivity= 90% False Positivity= 20% .
Si-yu Xu et al [8]	Feature extraction algorithm based on 2DPCA.	100 Samples	Better performance than traditional PCA and 2DPCA

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IV. CONCLUSION

The present paper review and summarizes the existing research performed on computed tomography images i.e. CT scan images for the detection of Lung Nodule is cancerous or not. Existing research work is analyze and each technique have certain advantage and drawbacks but there is need of precision in the Medical diagnosis domain, several classification, Image enhancement technique are used by researches such Neural Network classification approach , Genetic Algorithms but there is a scope of improvement in the existing research.

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