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Classification & Detection of Lung Nodule using Patched Based Context Analysis Method with Support Vector Machine

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ABSTRACT: Lung nodules are small masses in the human lung, small structures thatare roughly spherical. These structures are called pulmonary nodules; however,they can be distorted by surrounding anatomical structures such as vessels and the adjacent pleura. Lung nodules are divided into different types according to their virtual positions. Classification is based upon four types of nodules. Well-circumscribed (w), Vascularized (V), Juxta-pleural (J) and Pleural-tail (P) where the nodules to be classified. Pleural-tail (P) with the nodule near the pleural surface connected by a thin tail. The lung nodule detection and classification method is based on patch based contextual analysis method and it has three main stages: an adaptive patch-based division is used to construct nodule patch, then, a new feature set is designed to identify the intensity, texture, and gradient information, and then a contextual latent semantic analysis-based classifier and the SVM classifier are designed to calculate the probabilistic estimations for the relevant.

KEYWORDS: Lung Nodules, Computed Tomography, Malignant, Benign, Adaptivepatch based, adjacent pleura

I. INTRODUCTION

Lung cancer was uncommon at the beginning of the 20th century, is now aworldwide dilemma, which is more recurrent cancer in the world. Lung cancer is a major cause of cancer-related deaths in humans worldwide. Approximately 20 % of cases with lung nodules represent lung cancers; therefore, the identification of potentially malignant lung nodules is essential for the screening and diagnosis of lung cancer. Lung nodules are small masses in the human lung, and are usually spherical; however, they can be distorted by surrounding anatomical structures, such as vessels and the adjacent pleura. Intra-parenchyma lung nodules are more likely to be malignant than those connected with the surrounding structures, and thus lung nodules are divided into different types according to their relative positions. At present, the classification from Diciottiet is the most popular approach and it divides nodules into four types: well-circumscribed (W) with the nodule located centrally in the lung without any connection to vasculature; vascularized (V) with the nodule located centrally in the lung but closely connected to neighbouring vessels; juxta-pleural (J) with a large portion of the nodule connected to the pleural surface; and pleural-tail (P) with the nodule near the pleural surface connected by a thin tail [1]. Computed tomography (CT) is the most accurate imaging modality to obtain anatomical information about lung nodules and the surrounding structures. In current clinical practice, however, interpretation of CT images is challenging for radiologists due to the large number of cases. This manual reading can be error-prone and the reader may miss nodules and thus a potential cancer. Computer-aided diagnosis (CAD) systems would be helpful for radiologists by offering initial screening or second opinions to classify lung nodules.Figure 1.1 Transaxial CT images with the four types of nodules, shown from left to right, juxta-pleural, pleural-tail,vascularized and vascularized [1].

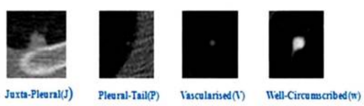

Figure 1.1 Transaxial CT images with the four types of nodules

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II. RELATED WORK

Fan Zhang et.al [1] has proposed a novel classification method for lung nodule.This method consist of three main stages: (1)Clustering patch division, it is used to construct multilevel partition (2) LBP feature set is designed to incorporate texture, information for image patch feature description (3) Multi support vector classifier classifier is designed for the estimation of the relevant images.M.H Hasna et.al [2] has proposed supervised classification method for lung nodule LDCT images. The designed proposed method can overcome the problem of the lung nodule overlapping with the adjacent structures. The proposed system first preprocesses the image and extracts the features. These features were used for classification of lung nodules into four categories: juxta-pleural, well-circumscribed, vascularized and pleural-tail, based on the extracted information. Finally, Decision trees classifier are utilized for classification of lung nodules. P.Thirugnanam et.al [3] has proposed a supervised classification method for lung nodule LDCT images. The four main categories of lung nodules well-circumscribed, vascularized, juxta-Pleural, and pleural-tail were the objects to be differentiated. A novel method to overcome the problem of the lung nodule overlapping adjacent structures. Method had three components: concentric level partition, feature extraction, and context analysis classification. A concentric level partition was constructed by an improved quick shift super pixel formulation. Then, a FS3 feature set including SIFT, MR8+LBP, and multi orientation HOG was generated to describe the image patch from various perspectives. Finally, a supervised classifier was designed through combining level-nodule probability and level context probability.Ravivarman.R et.al [4] has proposed three main procedures which were used by combining the anatomical structures and nodules. The amplification of the input image gives the required process of the segmentation. Adaptive patch-based division is helped for multilevel partition, SVM classifier is used for the classification process. Texture, Intensity and gradient details of the image are derived from a feature set. SIFT(Scale-Invariant Feature Transform) descriptor is used in the feature set for getting the information of the given image. Probabilistic estimation was applied for the classification and analysis procedures. In the classification process texture information was more important for the nodules. Concentric level partition gives the better classification rate than the other methods.

III. SCOPE OF RESEARCH

Medical imaging plays an important role in the early detection and treatment of cancer. It provides physicians with information essential for efficient and effective diagnosis of various diseases. Diagnosis of X-rays can be used as an initial step in nodule detection. The objective of the CAD system developed in this thesis is to help radiologists to improve their accuracy in cancer detection.It is expected that screening can detect lung cancer at an early stage and reducemortality. A number of clinical trials have been performed trying to prove this hypothesis. The screening trials using chest radiography alone or in combination with sputum cytologist examination failed to demonstrate a reduction of mortality due to lack of sensitivity in picking up suspicious lesions.

IV. PROPOSED METHOD

Proposed system configures about a novel image classification and detection method for the four common types of lung nodules. Nodule detection is an image processing problem. The task is to find positions (and shape) of specific pathological structures in the lungs called nodules. A nodule is a small, round lesion in the lungs, or worm-shaped lesion connected to pleura (the lungboundary) with radio density greater than lung parenchyma. Nodules in LDCT images show up relatively low contrast white circular shape and it also overlap with shadows, vessels and ribs.The figure 4.1 below shows the work flow of the system. The system uses LDCT (Low Dose Computed Tomography) image as input. It uses less than a quarter radiations than CT image. The method is based on contextual analysis by combining the lung nodule and surrounding anatomical structures, and has three main stages: an adaptive patch-based division is used to construct concentric multilevel partition; it consist two steps contextual latent semantic analysis based classifier and Support vector machine classifier are designed to calculate the probabilistic estimations for the relevant images. Lung cancer detection test will be carried out depending upon the lung nodule type classification. This projects deals with one of the efficient method to classify four types of lung nodules and detection of lung cancer disease.

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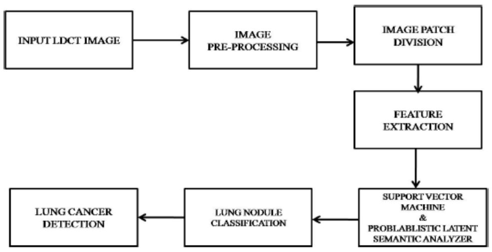
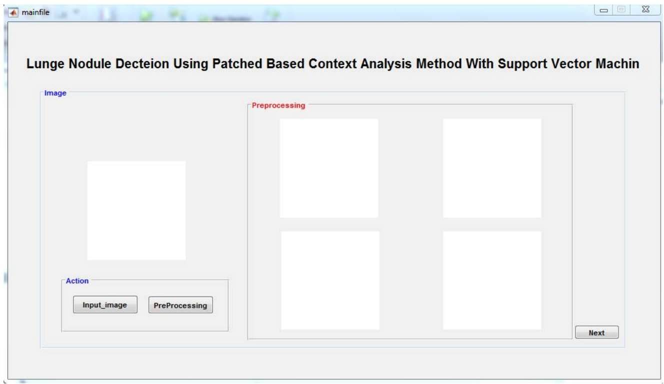


Figure 4.1: Block diagram for lung nodule classification system

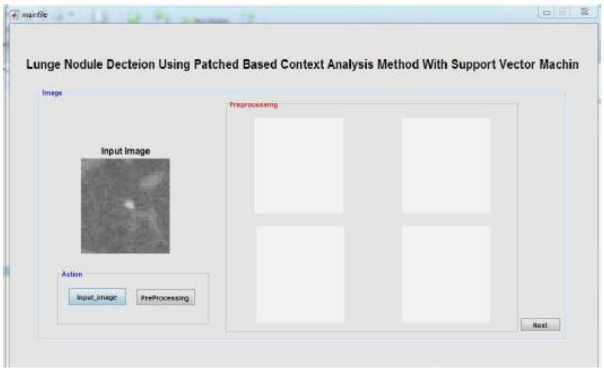
V. SIMULATION RESULTS

GUI of proposed implemented work



Screenshot 5.1: GUI of proposed implemented work

Browse the image by clicking on the button input image. Here click on button Load image to browse image from folder where images are saved. Now click on the button Preprocessing to perform the preprocesing steps.



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Screenshot 5.2:Load input image for Pre-Processing

Preprocessing steps is shown in screenshot 5.2 ,we have to load an input image

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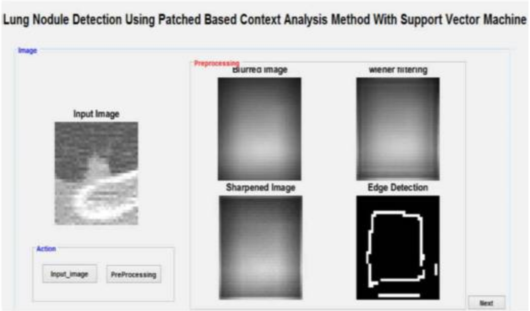
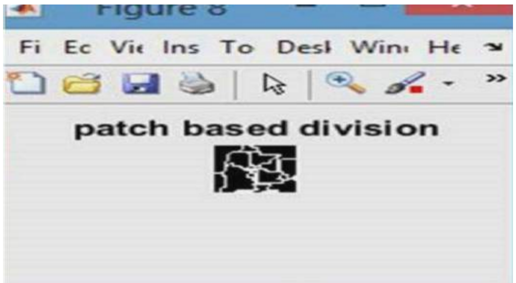
Now Preprocessing steps is perform to get results.

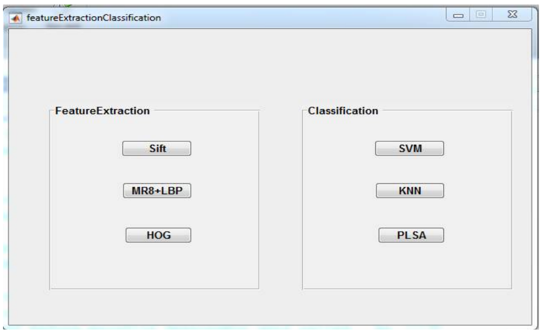


Screenshot 5.3: Image Pre-Processing steps

Now image patch based division is performed.



Screenshot 5.4: Image Patch Based Division



Screenshot 5.5: GUI of Feature Extraction

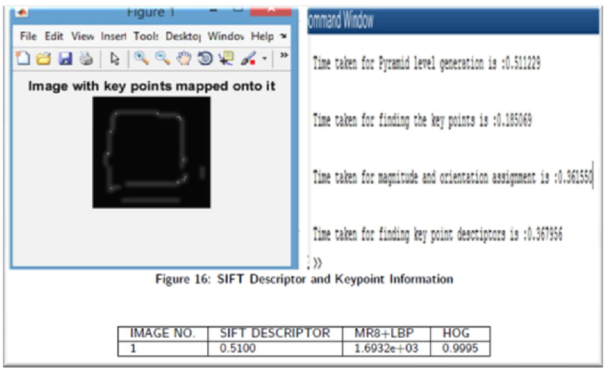


IMAGE NO.	SIFT DESCRIPTOR	MR8+LBP	HOG
1	0.5100	1.6932e+03	0.9995

Screenshot 5.6: FS3 Feature Descriptor table

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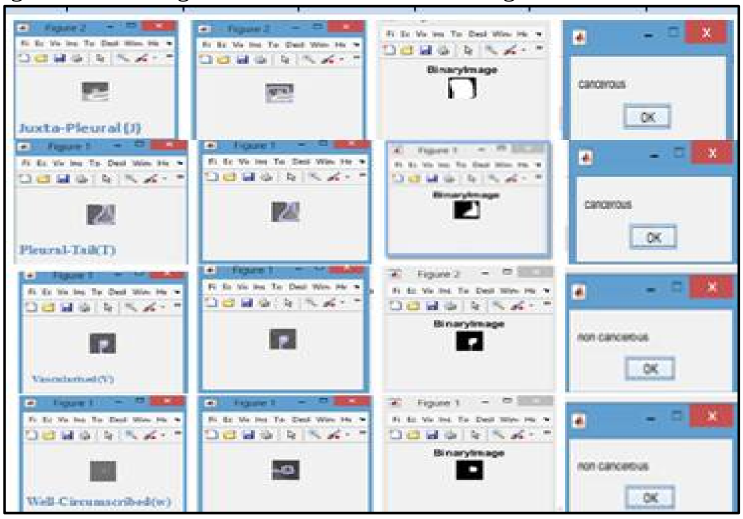
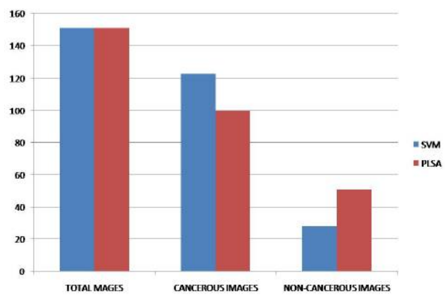
Lung nodule were classified into four categories i.e, Juxta -Pleural (J),Pleural-Tail(P), Well-Circumscribed (W), Vascularized (V). Following shows the lung nodule classification and lung cancer detection images.



Screenshot 5.7: Lung nodule types and lung cancer detection

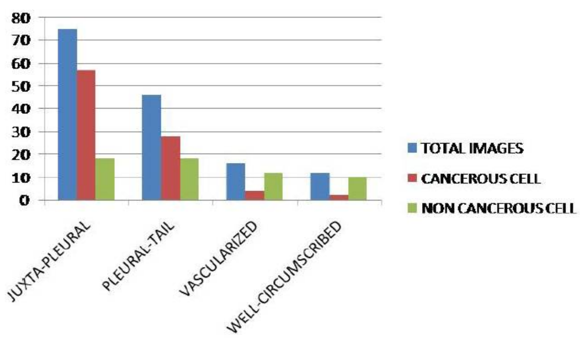
Proposed method is tested on 151 images and it is found that this model is providing the accuracy about 81.45% using support vector machine classifier and accuracy about 66.22% using probabilistic latent semantic analyzer. Results of these images are provided below.Among four types of lung nodules, maximum cancerous cell is found under the juxta-pleural (J) with 76% followed by Pleural-Tail(P) with 60.8% , Vascularized(V) with 25 % and Well-Circumscribed(W) with 16.6%



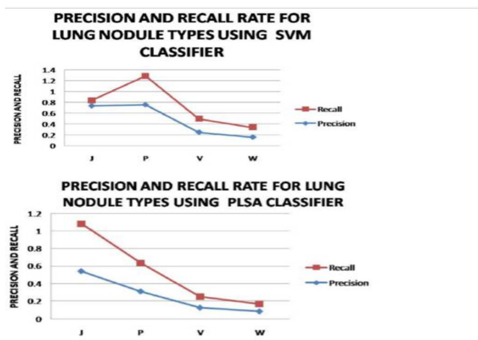
Screenshot 5.8 : Classifier Accuracy Graph

Nodule-Type	Total Images	Cancerous Cell	Non-Cancerous Cell
Juxta-Pleural(J)	75	57	18
Pleural-Tail(P)	46	28	18
Vascularized(V)	16	4	12
Well-Circumscribed(W)	12	2	10

Screenshot 5.9: Maximum Cancerous Cell Found Category



Screenshot 5.10: Maximum Cancerous Cell Found Category Graph



Screenshot 5.11: Precision, Recall Rate For Lung Nodule types Using SVM Classifier and PLSA Classifier

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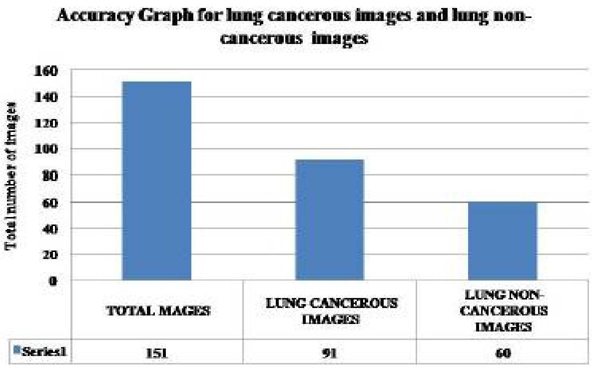

Screenshot 5.12: Accuracy graph for lung cancerous and lung non-cancerous

VI. CONCLUSION

A supervised detection and classification method for lung nodule LDCT images is proposed. The four main categories of lung nodules are well-circumscribed, vascularized, juxta-pleural, and pleural-tail where the objects to be differentiated. Method had three components: concentric level partition, feature extraction, and lung nodule classification. A concentric level partition was constructed by an improved quick shift superpixel formulation. Then, a FS3 feature set includingSIFT, MR8+LBP, and multi orientation HOG was generated to describe the image patch from various perspectives. Support vector machine classifier and Probabilistic latent semantic classifier were designed to classify the lung nodule types.Finally, a Lung cancer detection step is carried out. The results from the experiments on the ELCAP dataset showed promising performance of method.

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