Lung Nodule Detection using Patched based Context Analysis Method with Support Vector Machine

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ABSTRACT
Image processing is a technique to improve the quality of unprocessed images obtained from cameras. These images were placed on satellites, aircrafts or pictures taken in day to day life for various applications as well as for different purpose. In recent years, image processing techniques were widely used in many medical areas for improving earlier diagnosis and stages for detecting any type of diseases. Due to high extensiveness allied with the inconvenient treatment, lung cancer has being pulling the attention of the medical communities in the latest years. Lung nodule classification and detection can be developed with the help of image processing techniques. This paper deals with the well organized method for classification of four categories of lung nodules, which includes: Well-Circumscribed (W), Juxta Pleural (J), Pleural-Tail (P) and Vascularized (V).

Keywords
Lung cancer, Computerized tomography, Classification, Detection

1. INTRODUCTION
Cancer causes the death in human worldwide. Lung cancer is one of the most regular cancers in now days. There is a moderate increase in lung cancer patient, due to different way of living of people. Weight loss, pain, breathing problems is the common symptoms of cancer. Survival rate decreases, if the detection is not done at early stages. So it is essential to detect this disease at early stages. [1]

Lung is a main organ that carries out multiple functions every second. Lung nodules are tiny mass having small structure present in the lungs of human. These small structures known as pulmonary nodules. Lung nodules are categorized into four different types according to the position and are spherical in shape; however, they can be pulled by surrounding anatomical structures, such as vessels and adjacent pleura. The most leading approach includes well circumscribed (W), Juxta-Pleural (J), Pleural-Tail (P) and Vasculature (V). In radiology, Computer aided diagnosis, are the methods in the medicine that help out the doctor for interpretation of medical images to endorse the possible regions for nodules. The subtlety for identifying lung nodules in X-ray pictures are below:

1. Sizes of nodule carry widely: Nodule diameter having the value ranges from few mm to several cms.
2. In the lung tract, nodule can appear anywhere.
3. Nodules possess a large change in density and therefore perceptibility on radiograph.

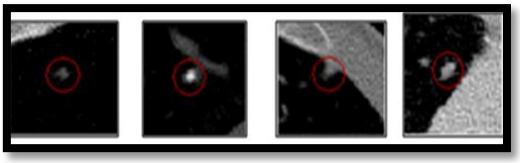


Fig 1: Four types of nodule followed by well circumscribed, Vascularized, Juxta-Pleural, Pleural-Tail.

Fig 1 depicts the four types of lung nodule types. They are Well-circumscribed (w), Vascularized (V) Juxta-Pleural (J), Pleural-Tail(P).

1. Well-Circumscribed (W): Nodule is towards the lung with the absence of connection to vasculature. It is captive to limited area.
2. Vascularised (V): Nodule is towards the lung and nearly associated to neighbouring vessels.
3. Juxta-Pleural (J): Nodule having large portion associated to pleural surface.
4. Pleural-Tail (P): Nodule close to the pleural surface associated by thin tail.

The paper is organized into four sections. Section 2 covers Background study. Section 3 covers Procedure Overview. Section 4 covers the conclusion.

2. BACKGROUND STUDY
Image processing play a very essential function in the healthcare industry. Image Processing play very important role in detection of cancer when the input is in the form of images. Image processing uses the techniques such as image pre-processing, removal of noise, morphological operations etc. These techniques are used in various medical fields for image betterment in detection stages, where the time element play an essential role in order to come across abnormality present in the target images. Computerized Tomography images having the broad amount of data. Dataset used for CT images can produce a huge amount of data, a typical CT dataset that is used for pulmonary identification having 500 plus more slices where volume ranges in the order of 1mm. Earlier study mainly focuses on use for classifiers for classifying the lung nodule. Using K-Nearest Neighbors (KNN) classifier it is found that it is error prone due to the lapping feature spaces of nodule. Decision tree classifier provided confined modeling of data.

3. PROCEDURE OVERVIEW
3.1 Proposed Methodology
In this research work, author proposes image classification method for the lung patches depending upon

support vector machine classifier and latent semantic analyzer. Fig 2 depicts the block diagram for lung nodule system.

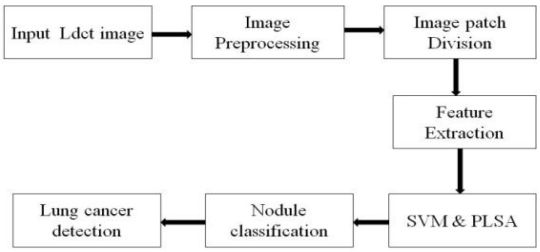


Fig 2: Block diagram for Lung Nodule system

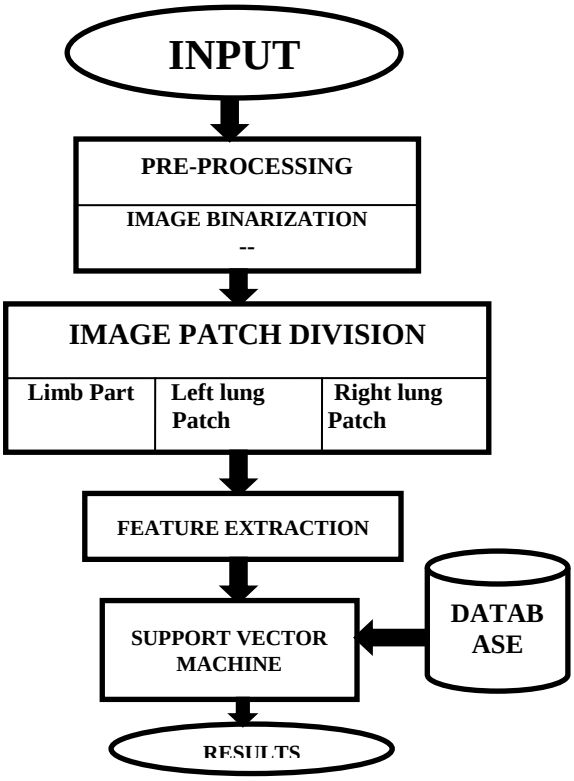


Fig 3: Flow Diagram for Proposed System

3.1.1 Lung Ldct Image

Here LIDC Lung Image Dataset Constronium is taken as input image Dataset having computerized tomography examine over the lung image. LIDC Dataset is openly accessed through internet. Collect the low dose computed tomography images from Lung Image Dataset Constronium (LIDC). Following depicts the features of using LDCT Images.

1. Help to spot tiny lung nodules.
2. Help to identify the cancer in early stage.
3. Identify the overlapping Nodule.
4. Cancerous tumors were easily detected.

Fig 4 shows the snapshot for taking the input image for testing.

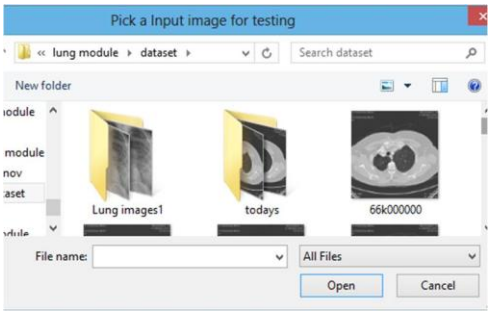


Fig. 4: Pick an input image for testing

3.1.2 Image Pre-Processing

For reducing the noise and for contrast enhancement, image Pre-processing technique is used. Weiner Filter: It is a class of optimal linear division. The performance criterion is having minimum mean square error. Design of the wiener filter is distinctive.

Syntax: J=Weiner2 (I, [M, N], NOISE]

Where weiner2: filters the gray scale image.

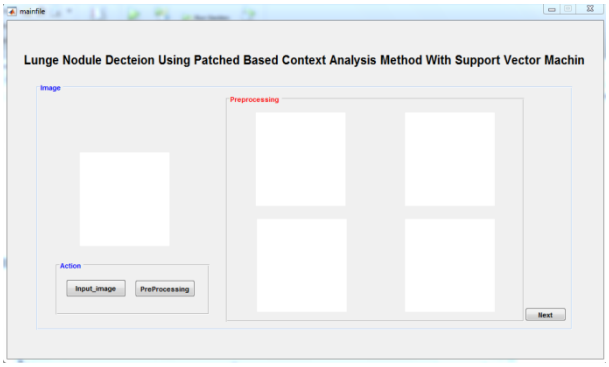


Fig 5: GUI of proposed implemented work

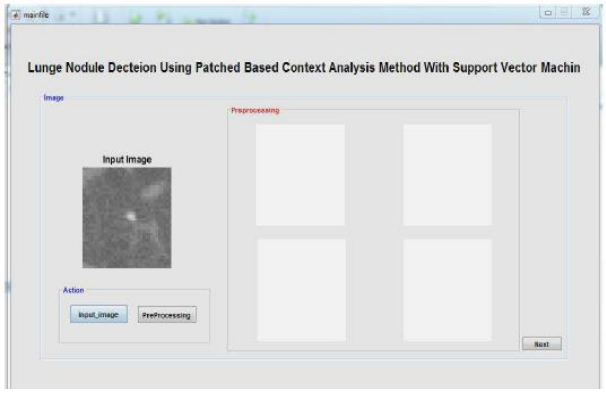
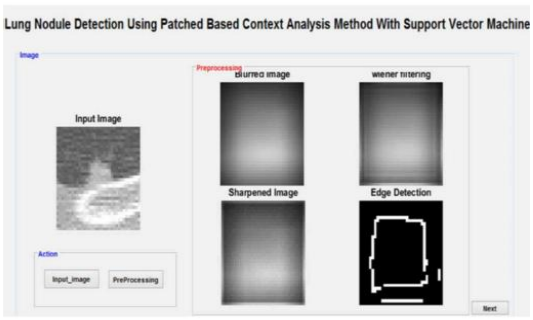


Fig. 6 : Load input image for Pre-Processing



Fig, 7 : Image Pre-Processing steps

3.1.3 Image Patch Division

For image patch division, start with edge detection techniques applied upon LDCT images. Firstly, canny Edge detection technique is applied on filtered image. Secondly, Sobel edge detection technique is applied upon filtered image. Compare the both results; it is found that canny results are better. The following are the steps for canny Edge Detection Methods.

1. Convolute the image to obtain smoother image.
2. Put the image in frequency domain by using convolution.
3. Apply upper and lower threshold value to obtain the edges and remaining are discarded.

Fig 8: Image Patch Based Division

3.1.4 Feature Extraction

The effectiveness of image feature description depends on: distinctionand invariance, which means that, the descriptor needs to capture thedistinctive characteristics and be robust to adapt to the various imaging conditions. Based on our visual analysis the lung nodules, we suggest that intensity, texture, and gradient can characterize the various nodules and the diverse contextual structures. We thus designed the feature set of the combination of SIFT for overall description, MR8+LBP for texture, and multi orientation HOG for gradient. For convenience, we refer to this feature set as the FS3 feature. Formally, denote an image as I comprising of O

patches PA = [pao|o =1,...,O].

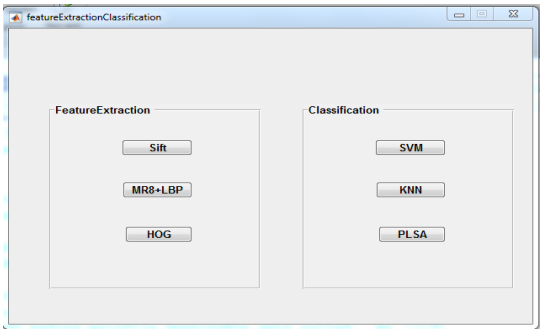


Fig 9: GUI of Feature Extraction

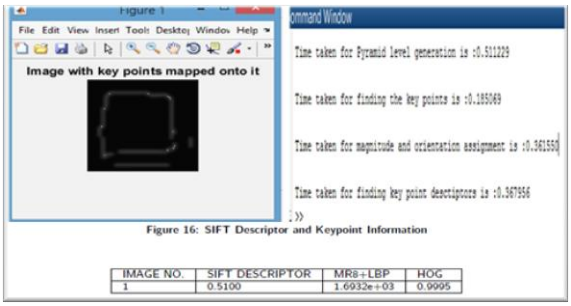


Fig 10: FS3 Feature Descriptor table

3.1.5 Support Vector Machine

Support vector machine will be used for lung nodule classification purpose. The following points show the characteristics of the support vector machine.

1. Speed of learning is good.
2. Speed of class is excellent.
3. Tolerance to missing value is good.
4. Irrelevant to attribute is excellent.

4. CONCLUSION

In this paper, author discussed about how the image processing technique were used in the medical field for betterment in the detection and diagnosis stages.

Four types of lung nodule include Well-Circumscribed (W), Juxta-Pleural (J), Pleural-Tail (P) and Vasculature (V) was discussed. The approach begins with collecting the lung LDCT images. For image enhancement, image pre-processing techniques were used. For obtaining the patches from the input image, image patch division is performed. Three patches were formed by separating the images into multiple patches based upon radiate segmentation with predefined amount of pixels. The features were extracted from the obtained images. The lung nodule type can be classified using the support vector machine classifier and latent semantic analyser classifier respectively. The outcome of this research work will be to alert patient and doctor about lung cancer which automatically save life of human being.

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