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Survey: Lung Nodule Detection

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Abstract: Early identification of lung cancer includes detection of uncertain nodules and classifying them into different condition of disease. The identification stage includes pattern matching and confirmation to increase accuracy, performed by fuzzy logic, support vector machine, statistical classifiers. The categorization stage involves matching characters (texture, shape and density) of the detected nodules to characters of normal cells (texture, shape and density) of nodules with known condition of disease (confirmed by sample extraction techniques). The nodule detection is mainly considered as it plays an important role in cancer detection nodules extracted are classified using neural network classifiers to differentiate between normal and abnormal lung cancer.

Keywords: LungNodule, Image Acquisition, Pre-Processing, Segmentation, Feature Extraction.

I. I. INTRODUCTION

The term cancer is a technical term refers to uncontrolled cell growth in tissues leading to malfunctioning of body organs at extreme state of influence cause major suffering and even death. Cancer leads to excessive multiplication of abnormal cells without control and are able to affect other tissues. Cancer cells infect neighbouring part of human body through connective tissue. Most of the cancers are named for the organ where cancer starts – rapid growth of abnormal cancer cells in the colon is called colon cancer; that of skin is called basal carcinoma.
Cancer types are grouped into following categories:

- Carcinoma – is a cancer in which cells of Skin isaffected.
- Sarcoma - is a cancer in which cells of cartilage, fat, muscle, bone, blood vessels, supportive or connective tissue is affected.
- Leukemia is a cancer in which cells of blood generation tissue like bone marrow is affected.
- Lymphoma and myeloma - is a cancer in which cells of the immunity of human is affected. Central nervous system cancers - is a cancer in which tissues of the brain and spinal cord is affected.

WHAT IS LUNG NODULE?
A nodule is a "spot on the lung," seen on an X-ray or computed tomography (CT) scan. In fact, a nodule shows up on about one in every 500 chest X-rays. Normal lung tissue surrounds this small round or oval solid overgrowth of tissue. It may be a single or solitary pulmonary nodule. Or, you may have multiple nodules.

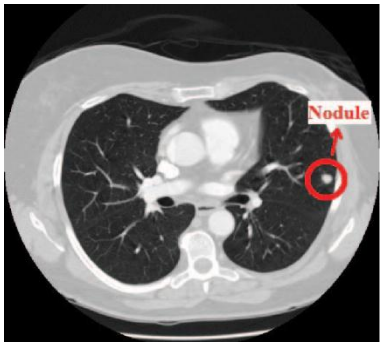

Figure: Lung CT scans Image.

The lungs are a couple of wipe like, cone-formed organs. The right lung has three projections, and is bigger than the left lung, which has two flaps. Life structures of lung area appeared in Fig.1. The sorts of lung disease are isolated into four phases. In stage I, the growth is restricted to the lung. In stages II and III, the malignancy is kept to the mid-section (with bigger and more intrusive tumour's named stage III). Stage IV disease has spread from the mid-section to different parts of the body. Of a wide range of growth, lung disease is the most well-known reason for passing, representing 1.3 million passing every year. An expected 159,260 individuals are required to end up from lung malignancy in 2014, representing roughly 27 present of all tumour. Early recognition of lung disease can build the shot

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of survival among individuals. There are numerous systems to analyse the lung malignancy, for example, Chest Radiograph(x-beam), Computed Tomography (CT), Magnetic Resonance Imaging (MRI sweep) and Sputum Cytology. Be that as it may, the greater part of these procedures is costly and tedious. In this way, there is an extraordinary requirement for another innovation to analyse the lung malignancy in its initial stages.

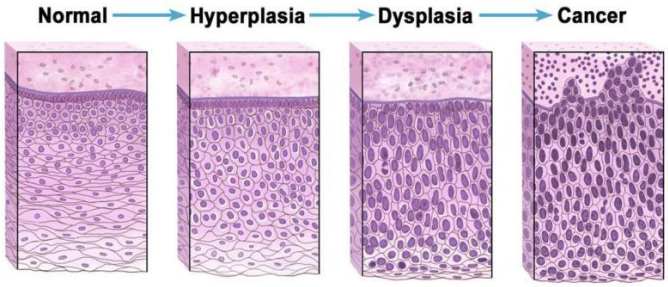

Figure2: The beginning of cancer.

Picture handling procedures give a decent quality device to enhancing the manual investigation. The utilization of picture handling strategies can help radiologists and specialists in diagnosing illnesses and to offer a fast access to restorative data picked up significance in a brief timeframe. In this paper, MATLAB has been utilized through each techniques made.

II. BACKGROUND METHODOLOGY

A general description of lung cancer nodules segmentation and feature extraction system that contains five basic steps. The first step starts with taking a collection of CT images (normal and abnormal) from the available database. The second step applies image preprocessing, to get best level of quality and clearness. The third step is image Segmentation which plays an effective role in image processing steps, and the fourth step contains feature extraction. The final step gives image diagnosis result of the indicators of normality or abnormality of lung images.

III. LITERATURE REVIEW

"D. J. Brenner" et al proposed Computed tomography-an increasing source of radiation exposure" This paper is focus on an automatic segmentation approach of sub-pleural lung nodules from Computed Tomography (CT) scans based on morphological operations. Because the extraction of sub-pleural nodules is challenging and a computer-aided diagnosis system is, hence, indispensable. The proposed system is divided into three steps: pre-processing, initial detection of sub-pleural lung nodule and post-processing.

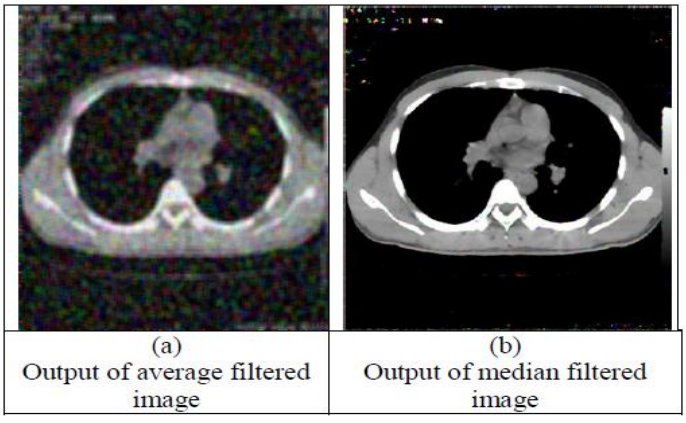

Figure: Outputs of image preprocessing.

"J. G. Fletcher", et al proposed Perspective on radiation risk in CT imaging" The aim of proposed system is to develop an efficient Computer Aided Diagnosis (CAD) for detection of lung nodules from parenchyma region of lung and classify the nodule into either cancerous (Malignant) or non-cancerous (Benign). The proposed system consists of following steps: i) the image taken is enhanced initially and then the region of interest is cropped, where the user can select the area to be cropped. ii) Morphological operation is performed to suppress the blood vessels and enhance the

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nodules. iii) Nodules are identified by labeling. iv) Features Extraction. v) Neural networks are implemented for features classification. The proposed work was able to detect the lung nodule that falls in close proximity to the lung wall. The system is able to achieve an overall accuracy of 92.2%.

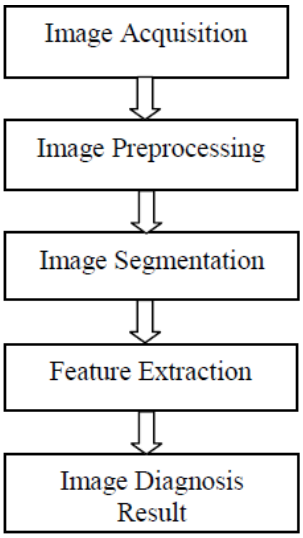

Figure: Block diagram of Lung Cancer Nodule Segmentation and Feature Extraction System.

"A. J. Einstein", et al Estimating risk of cancer associated with radiate exposure from 64-slice computed tomography coronary angiography "The proposed system implements a Computer-Aided Detection (CAD) system that detects small size nodules (larger 3 mm) in High Resolution CT (HRCT) images. It used a cylindrical filter for filtering nodule cases from other objects in images. They use a lung LIDC image database.

CLAHE and Fuzzy Clustering Method

K. Punithavathy et al. presented a methodology for automatic lung cancer detection in PET/CT images. Along with Wiener filtering, for pre-processing **contrast level, adaptive histogram equalization (CLAHE)** technique is also used. Morphological operations like closing and opening are performed for accurate extraction of lung ROI. Feature classification is done using a fuzzy clustering method. FCM is unsupervised, simpler and soft cblustering method that retains more information of the image as compared to hard clustering method.

Advantage:

The Morphological operations enable accurate lung ROI extraction and reduce the search space.

"Yihuan Lu" et al investigation of Sub Centimeter Lung Nodule Quantification for Low-Dose PET " In this paper, we thoroughly investigated the combined impact of respiratory motion, size of nodule, reconstruction voxel size, nodule contrast, and noise level on lung nodule quantification. In addition, most of the studies cited above evaluated nodules larger than 10 mm in diameter, whereas we are focusing on sub-centimeter lung nodules. A Mini-Derenzo phantom study was also performed to investigate the impact of voxel size. In addition, interpolation methods were also compared when up sampling of the reconstruction to a finer voxel size was performed. Our goal was to evaluate the feasibility of imaging sub-centimeter nodules under different low-dose protocols, to determine the upper-bound performance for quantification of such nodules, and to provide a guideline for future patient studies.

Image Smoothing using Median Filtering

Kulkarni et al. [2] proposed a system for lung nodule cancer detection using CT images in DCOM format. Image smoothing was done by the Median filter to reduce the blurring of edges. The advantage of using a median filter is that it is not affected by individual noise spike, to eliminate impulsive noise quite well and it does not blur edges much and can be applied iteratively.

Gabor filter is used for enhancement as it gives a better result compared to Fast Fourier Transform and auto enhancement. The Gabor function represents an excellent local and multi-scale decomposition, used here for the presentation of the image which is based on that is simultaneous localization in space and frequency domain. Marker controlled Watershed algorithm is used for segmentation purpose. Area and parameter were extracted feature based on which classification was done.

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Advantage:
The median filter gives more accurate results compared to Gaussian, mean and Wiener filters.

"Jue Jiang", et al proposed Multiple Resolution Residually Connected Feature Streams For Automatic Lung TumorSegmentation From CT Images " Our work extends the FRRN by residually combining features computed at multiple image resolutions, whereby, a dense feature representation is computed by simultaneously combining feature maps at multiple image resolutions and feature levels. Such a dense feature representation increases the network capacity and ultimately enables the network to recover the input image spatial resolution better than the existing methods.

Marker-Controlled Watershed Algorithm
S. Kanitkar et al. introduced a novel approach to detect lung cancer using an image processing technique. The Gaussian filter is used to smooth the image in the preprocessing stage so that it can remove high-frequency components from the image. The **Marker-Controlled Watershed** transform is used for the segmentation purpose. The features such as average intensity, perimeter, and area are extracted from the detected tumor. To extract the region minimum value from image watershed segmentation is used. It determines to the divide a line with the least value. The dividing line in a form of the image can give the rapid change of boundary. It behaves the image as a plane, where light pixels are high and dark pixels are low.

Advantages:
1) The marker-controlled watershed segmentation technique separates the touching objects in the image.
2) It provides the best identification of the main edge of the image and also avoids over-segmentation.

IV. PROPOSED SYSTEM

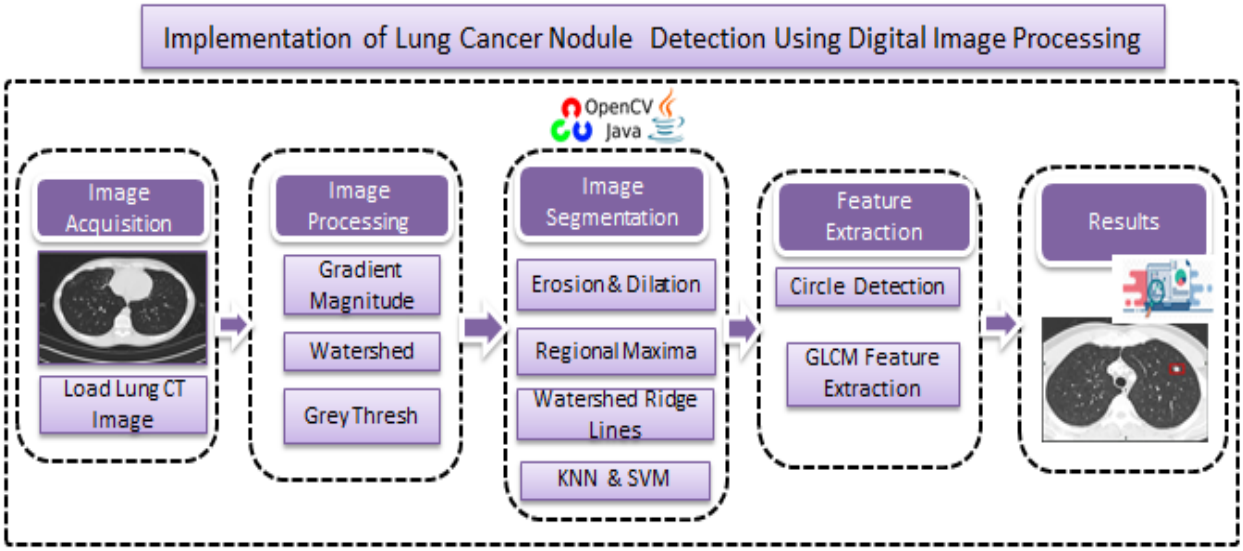

Figure: - System Architecture.

In the proposed work an attempt will be done to uses Gradient Magnitude, Watershed techniques in image preprocessing. For image segmentation, Gray thresh, Erosion & Dilation, regional Maxima and Watershed ridge lines approach will be used to segment the lung of CT image. In the feature extraction step, the physical dimensional measure will be applied. Depending on the lung feature extraction, the K-Nearest Neighbors Algorithm and SVM will be applied for cancer detection.

V. CONCLUSION

In this paper an attempt is made to study the literature survey of the different researchers made on lung nodule detection till now. The researchers used different techniques for lung nodule detection that mainly includes Marker-Controlled Watershed Algorithm, CLAHE and Fuzzy Clustering Method, Image Smoothing using Median Filtering and so on. Listing the advantages and disadvantages of the existing system the proposed system is developed using the techniques like image pre-processing and image segmentation are implemented to obtain the diagnosis result. By using these steps, the nodules are detected and some features are extracted respectively.

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