COMPUTER AIDED DIAGNOSIS SYSTEM FOR THE IDENTIFICATION AND CLASSIFICATION OF LESSIONS IN LUNGS

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Abstract --The Computer Aided Diagnosing (CAD) system is proposed in this project for detection of lung cancer form the analysis of computed tomography (CT) images. To produce a successful Computer Aided Diagnosis system, several problems has to be resolved. Segmentation is the first problem to be considered which helps in generation of candidate region for detecting cancer nodules. The second problem is identification of affected nodules from all the candidate nodules. Initially, the basic image processing techniques such as Erosion, Median Filter, Dilation, Outlining, Lung Border Extraction and Flood-Fill algorithms are applied to the CT scan image in order to detect the lung region. Then the segmentation algorithm is applied in order to detect the cancer nodules from the extracted lung image.After segmentation, rule based technique is applied to classify the cancer nodules. Finally, a set of diagnosis rules are generated from the extracted features. From these rules, the occurrences of cancer nodules are identifiedclearly. The learning is performed with the help of Extreme Learning Machine because of its better classification. For experimentation of the proposed technique, the CT images are collected from reputed hospital. The main objective of the project is to develop a CAD (Computer Aided Diagnosis) system for finding the lung fissures and lesions using the lung CT images and classify the lesions as Benign or Malignant.

Keywords -- computer-aided diagnosis,segmentation,canny method,extraction

I. INTRODUCTION

The most familiar cancer that occurs usually for men and women is lung cancer. According to the report submitted by the American Cancer Society in 2003, lung cancer would report for about 13% of all cancer diagnoses and 28% for all cancer deaths. The survival rate for lung cancer analyzed in 5

years is just 15 %. If the disease is identified while it is still localized, this rate increases to 49%. However, only 15% of diagnosed lung cancers are at this early stage. The survival rate for the cancer patient can be increased by detecting the occurrence of cancer in earlier stages. Early detection can be attained in a population screening; the most common screenings for lung cancer make use of chest projection radiography, or low-radiation dose Computer Tomography (CT) scans. It has been revealed in the Early Lung Cancer Action Project that low dose CT is more valuable than conventional chest X-ray for the detection of pulmonary nodules. The difficulties for detecting lung nodules in radiographs are threefold

- Nodule sizes will vary widely: Commonly a nodule diameter can take any value between a few millimeters up to several centimeters.
- Nodules exhibit a large variation in density – and hence visibility on a radiograph – (some nodules are only slightly denser than the surrounding lung tissue, while the densest ones are calcified).
- As nodules can appear anywhere in the lung field, they can be obscured by ribs, the mediastinum and structures beneath the diaphragm, resulting in a large variation of contrast to the background.

To overcome these problems, the author proposed a Computer Aided Diagnosing (CAD) system for detection of lung nodules. The lung cancer detection system is shown in figure .This paper initially apply the different image processing techniques such as Bit-Plane Slicing, Erosion, Median Filter, Dilation, Outlining, Lung Border Extraction and Flood-Fill algorithms for extraction of lung region. Then for segmentation Fuzzy Possibilistic C Mean (FPCM) algorithm is used and for learning and classification Extreme Learning Machine (ELM) is used.

Related Work

The computer-aided diagnosis (CAD) system is used for early detection of lung cancer by analyzing chest 3D computed tomography (CT) images. The underlying idea of developing a CAD system is not to delegate the diagnosis to a machine, but rather that a machine algorithm acts as a support to the radiologist and points out locations of suspicious objects, so that the overall sensitivity is raised.CAD systems meet four main objectives, which are improving the quality and accuracy of diagnosis, increasing therapy success by early detection of cancer, avoiding unnecessary biopsies and reducing radiologist interpretation time.

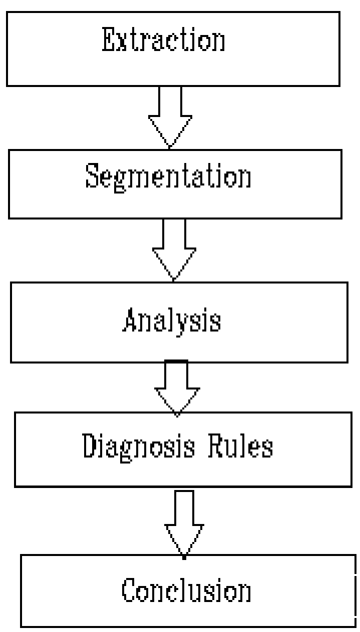

Figure 1. The Lung Cancer Detection System

Lung Ct Images

The CAD system can be developed by using lung CT images.The anatomy of typical human lungs, which have five distinct partitions called lobes.The boundaries of the lobes are lobar fissures. The right lung usually consists of the superior, middle, and inferior lobes separated by the right oblique and horizontal fissures, respectively. The left lung normally has the superior and inferior lobes, separated by the left oblique fissure.

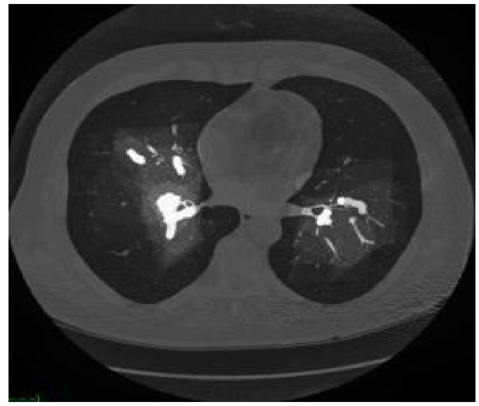

Figure 2. The Lung CT Image.

The lung CT images having low noise when compared to scan image and MRI image. So we can take the CT images for detecting the lungs. The main advantage of the computer tomography image having better clarity, low noise and distortion. The mean and variance can be easily calculated. The calculated value is very closer to the original value.

Input Ct Image

We are going to develop the CAD system by taking lung CT image as input. The input is taken from any hospital and given as an input. The input CT image contains noises such as white noise, salt and pepper noises etc. Lung cancer is the second most common cancer among both men and women.

Lung cancer would account for about 13% of all cancer diagnoses and 28% of all cancer deaths. The combined five-year survival rate of lung cancer for all stages is only 15%. If the disease is detected while it is still localized, this rate increases to 49%. However, only 15% of diagnosed lung cancers are at this early stage.

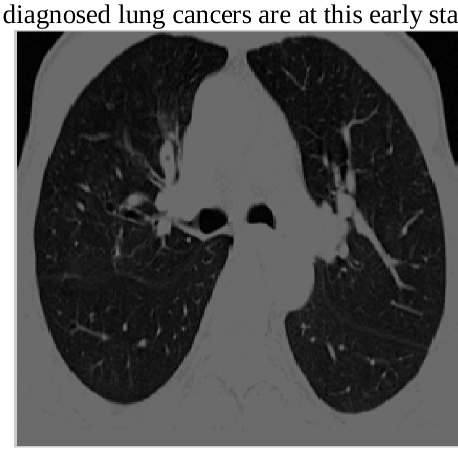

Figure 3. The Original Input CT image

To produce a successful Computer Aided Diagnosis system, several problems has to be resolved. Segmentation is the first problem to be considered which helps in generation of candidate region for detecting cancer nodules. The second problem is identification of affected nodules from all the candidate nodules. Initially, the basic image processing techniques such as Bit-Plane Slicing, Erosion, Median Filter, Dilation, Outlining, Lung Border Extraction and Flood-Fill algorithms are applied to the CT scan image in order to detect the lung region. Then the segmentation algorithm is

II. PREPROCESSING

Preprocessing is the initial step for detecting the lung image.In preprocessing step we are done two steps. They are

1. Denoising
2. Median Filter

Denoising

Image denoising algorithms may be the oldest in image processing. Many methods, regardless of implementation, share the same basic idea noise reduction through image blurring. Blurring can be done locally, as in the Gaussian smoothing model or in anisotropic filtering by calculating the variations of an image.

White noise is one of the most common problems in image processing. Even a high resolution photo is bound to have some noise in it. For a high-resolution photo a simple box blur may be sufficient, because even a tiny features like eyelashes or cloth texture will be represented by a large group of pixels.

However, current DirectX 10 class hardware allows us to implement high quality filters that run at acceptable frame rates. The main idea of any neighborhood filter is to calculate pixel weights depending on how similar their colors are. We describe two such methods: the K Nearest Neighbors and Median filters.

The input image is a normal RGB image. The RGB image is converted into grey scale image because the RGB format is not supported in Matlab. Then the grey scale image contain noises such as white noise ,salt and pepper noise etc. This can be removed by using Median filter from the extracted lung image.

Median Filter

The median filter is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction is a typical pre-processing step to improve edge detection on an image. Median filtering is very widely used in digital image processing under certain conditions.

The sliding median filter of a pre-defined window size *W*x*W* centered at $i=(i_1,i_2)$ moves uniformly over the noisy image, *g*, chooses the median, *μ* of the pixels within the spatial positions Ω_i^W around i to have $g(i)$ replaced by *μ*. For the set of pixels within a square window W_D x W_D, centred at $i=(i_1,i_2)$ and defined spatially by equation (2-2), the median, *μ* of the pixels in Ω_i^W is

$$u(i)=\mu(i) = median\,\{g(j)/j\in\Omega_i^W\}$$

Thus the output of the median filter is that value *θ* which produces the least sum of absolute errors with all the pixels in the local neighborhood defined by the mask. The output of the median filter at spatial position i can also be given as

$$u(i)=\mu(i)=arg\,\min_{\theta}\sum_{r\in\Omega_i^W}\left|g(r)-\theta\right|$$

III. LUNG REGION EXTRACTION

A CT image of chest consists of different regions such as the background, lung, heart, liver and other organs' areas. The goal of lung region extraction step is to separate the lung regions, our regions of interest (ROIs), from the surrounding anatomy structures. The proposed method for the extraction of the lung regions **.**It starts by applying the bit-plane slicing algorithm to each 2D CT image of the raw data. The resulting binary slices are then analyzed to choose among them the best bit-plane image that may help in extracting the lung regions from the raw CT-image data with a certain degree of accuracy and sharpness.

To refine the chosen bit-plane image, other techniques were used for different purposes in a sequence of steps. Erosion, median filter and dilation steps aim to eliminate irrelevant details that may add extra difficulties to the lung border extraction process. The outlining step aims to extract the structure's borders. The lung border extraction step aims at separating lung structure from all other uninteresting structures.

IV. SEGMENTATION

It refers to the process of partitioning digital image into multiple segments or sets of pixels. The goal of segmentation is to simplify or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.

The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region are similar with respect to some characteristic or computed property, such as colour intensity, or texture. Adjacent regions are significantly different with respect to the same characteristics.

Edge Detection

1. Edge is a set of connected pixels that lie on the boundary between two regions.
2. Edges are detected by Prewitt, Robert, Zero-cross or Canny Methods.
3. We choose Canny method because of its accuracy

Canny Method

1. Convolve the image g(r, c) to get smooth image .
2. Apply first difference gradient operator to compute edge strength.
3. Give the upper and lower threshold values to find the edges and the others are discarded. The figure 4.5.a shows the edge detection output image.

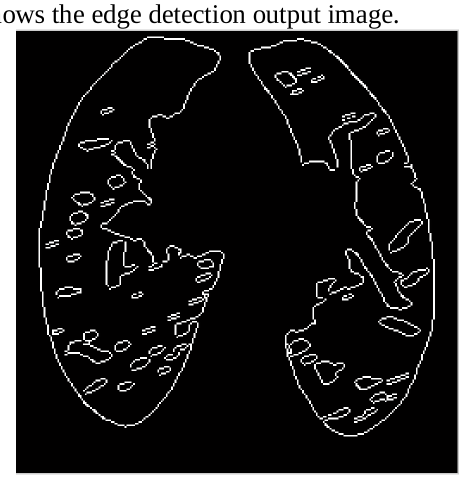

Figure 4. The Edge Detection Output Image

V. FEATURE EXTRACTION

After the segmentation is performed on lung region, the features can be obtained from it and the diagnosis rule can be designed to exactly detect the cancer nodules in the lungs. This diagnosis rules can eliminate the false detection of cancer nodules resulted in segmentation and provides better diagnosis.

VI. DIAGNOSTIC RULES

Initially the threshold value T1 is set for area of region. If the area of candidate region exceeds the threshold value, then it is eliminated for further consideration. This rule will helps in reducing the steps and time necessary for the upcoming steps.

In this rule maximum drawable circle (MDC) is considered. The threshold T2 is defined for value of maximum drawable circle (MDC). If the radius of the drawable circle for the candidate region is less than the threshold T2, then that is region is considered as non cancerous nodule and is eliminated for further consideration.

In this, the rage of value T3 and T4 are set as threshold for the mean intensity value of candidate region. Then the mean intensity values for the candidate regions are calculated. If the mean intensity value of candidate region goes below minimum threshold or goes beyond maximum threshold, then that region is assumed as non cancerous region.

By implementing all the above rules, the maximum of regions which does not considered as cancerous nodules are eliminated. The remaining candidate regions are considered as cancerous regions. This CAD system helps in neglecting all the false positive cancer regions and helps in detecting the cancer regions more accurately. These rules can be passed to the Extreme learning machine (ELM) in order to detect the cancer nodules for the supplied lung image.

VII. RESULTS AND DISCUSSION

The experiments are conducted on the proposed computer-aided diagnosis systems with the help of real time lung images. This experimentation data consists of 1000 lung images. Those 1000 lung images are passed to the proposed CAD system. The diagnosis rules are then generated from those images andbthese rules are passed to the classifier for the learning process. After learning, a lung image is passed to the proposed CAD system. Then the proposed system will process through its processing steps and finally it will detect whether the supplied lung image is with cancer or not.

In view of the results obtained by the proposed CAD system, user has achieved the following. On one hand, user have developed an automatic CAD system for early detection of lung cancer using chest CT images in which a high level of sensitivity has been achieved, with a reasonable amount of false positives per image, (90% sensitivity with 0.05 false positives per image). This prevents the system from hindering the radiologist’s diagnosis. On the other hand, the proposed CAD system is capable of detecting lung nodules with diameter $\geq$ 2 mm, which means that the system is capable of detecting lung nodules when they are in their initial stages. Thus facilitating early diagnosis will improve the patients’ survival rate.

VIII. CONCLUSION

the benefit of the K-mean clustering that its simplicity and speed which allows us to run on large datasets.The automatic segmentation of lung lobe first applied a preprocessing techniques, its remove the noises from the lung image and to segment the lung into right lung and left lung. After that to segment the lung lobe. In this lobe to detect the fissures region, to identify the fissure region and fissure location and curvatures and to get the accurate result. The accuracy of 80% approximate the accuracy indicated by surgeons and radiologists for locating fissure regions during reading clinical CT images in 2.5–7.0 mm.

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