LUNG NODULE SEGMENTATION BY WATERSHED ALGORITHM

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ABSTRACT

Lung cancer is one of the most serious health problems in the world field. The death rate of lung cancer is the highest among all other types of cancer. This is one of the major cancers in the world, with the least endurance rate after the diagnosis, with a steady increase in the number of deaths every year. In order to detect to cancer a CADe scheme is developed with improved sensitivity and specificity by use of "virtual dualenergy" with soft tissue image by massive-training artificial neural networks (MTANNs). To reduce rib-induced FPs and detect nodules the VDE technology is incorporated in our CADe scheme. Then the nodule is detected by techniques results in difficult and less sensitivity. Our scheme detected nodule candidates on VDE images by use of watershed algorithm which results in improved sensitivity and specificity.

Keywords: computer-aided diagnosis (CAD), lung cancer, virtual dual energy

1. INTRODUCTION

Cancer is one of the serious problems in the world field .Lung cancer cause the highest death rate among all other types of cancer. Lung cancer is one of the major cancers in the world, with the least endurance rate after the diagnosis, with a steady increase in the number of deaths every year.

The endurance from lung cancer is directly correlated to its growth at its detection time and it is leading to death. Some verification put forward that early detection of lung disease may allow for timely therapeutic intervention which in turn result in a more favorable prognosis of the patients. Correct evaluation in particular accurate apparition and quantification of blood vessels, bronchi and all the tissues in lungs play an significant role in the exposure of interstitial lung disease and other lung disease .But now a days the detection of lung disease is done by radiologist by using their naked eye to visualize the CT scan. But it is very difficult to distinguish the reticular pattern and ILD patterns in the lungs by using the naked eye. In medical practice it is of great importance to be able to differentiate the Vascular tree for the detections of pulmonary emboli, pulmonary hypertension etc .But it has found there to be an impossible task due to the following reason.

(i) It is complicated to conclude boundaries of a vessel consistently, especially thin segments due to the partial volume effects and image noise .

(ii)Volumetric lung scans of the grown-up human consist of more than 500 slices and the vascular tree in a bipodial fashion, rapidly division as one tracks the vessels from their central to peripheral locations, with the full tree formation consisting of more than 23 generations

The earlier detection is, the greater chances of successful lung intervention are. An estimated 85% of lung Cancer cases in males and 75% in females are caused by cigarette smoking. In 2005, just about 1,372,910 new cancer cases are expected and about 570,280 cancer deaths are probable to occur in the United States. It is estimated that there will be 163,509 deaths from lung cancer, which forms 29% of all cancer deaths.

On the whole survival rate for all types of cancer is 63%. Even though surgery, radiation therapy, and chemotherapy have been used in the intervention of lung cancer, the past survival rate for all stages collective is only 14%. This has not altered in the past three decades. The purpose of this paper is to develop a CAD system for early detection of lung cancer based on an automatic diagnosis of the lung regions included in chest CT images. The problems in detecting lung nodules in radiographs are below:
Nodule sizes will differ widely: such as a nodule diameter can obtain any value between a few millimeters up to several centimeters.
Nodules show a large variation in density – and
Hence visibility on a radiograph – some nodules are
Only somewhat denser than the surrounding lung tissue, while the densest ones are calcified.
As nodules can become visible anywhere in the lung field.

The computerized diagnosis is important for detecting the lung disease. Computer aided diagnosis (CAD) scheme for Multi Detector Computer Tomography are commonly used to illustrate, quantify and detect numerous lung abnormalities..The aim of CAD system is to boost radiologist confidence and identify the scope and characterization of the type of present disease pattern. It can be used to detect several lung abnormalities such as focal abnormalities, pulmonary embolism etc.

A major challenge for current CADe schemes is to detect the nodules overlapping, crossings because a majority of FPs is caused by these structures [1], [2]. This leads to lowering the sensitivity as well. To detect such nodules overlapping ribs and clavicles, a CADe scheme developed based on single-exposure dual-energy computed radiography [6], [7].

A dual-energy subtraction technique [8], [9] is a technique for separating soft tissue from bones in CT by use of two X-ray exposures at two different energy levels. Inspite of its great advantages, a limited number of hospitals use a dual-energy radiography system, because specialized equipment is required, and the radiation dose can be double.

To address the issue of the availability of dual-energy systems, an image-processing technique developed called virtual dualenergy (VDE) in CT by means of a multiresolution MTANN .The real dual-energy images were used as the teaching images for training of the multiresolution MTANN. Once trained, real dual-energy images were not necessary any more.

The trained MTANN suppressed ribs and clavicles in standard CT substantially, while the visibility of nodules and lung vessels was maintained. In this scheme for detection of pulmonary nodules by use of the MTANN VDE technology and proposed watershed algorithm to improve the sensitivity.

2. LUNG CT IMAGE

The lung CT images comprise small noise when compared to scan image and MRI image. The MRI takes more cost,time and provide less details compared to CT image.So we can take the CT images for detecting the lungs. In a CT image, overlapping structures are eliminated, building the internal anatomy more apparent. CT images show the surgeons accurately where to operate. Without this information, the success of surgery is greatly compromised.

The risk of radiation exposure from CT is very small compared to the benefits of a well-planned surgery. The major reward of the computer tomography image is that it having improved clarity, Better detail compared with ultrasonography, relatively quick compared with MRI scanning and most systems can be scanned, eg brain to leg. The mean and Variance can be easily calculated. The calculated value is very closer to the original value.

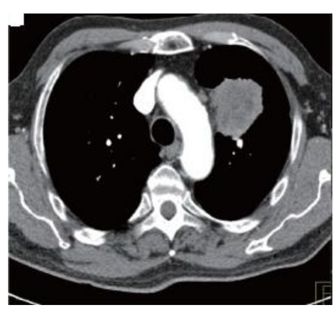

Fig: The Lung CT Image

3. VIRTUAL DUAL ENERGY

Dual-energy imaging is a promising technique for improving the performance of digital radiography (DR) in finding lung lesions by removing bony obstructions, but it requires specialized hardware. In order to overcome this Calling their technique virtual dual-energy DR (or bone suppression imaging), [14] the technology substitutes sophisticated software algorithms for the hardware.

An image-processing technique for suppression of ribs and clavicles in CT has been developed by means of a multiresolution MTANN while soft tissues such as lung nodules and vessels are maintained. The VDE-based CADe scheme detected nodule candidates on VDE images by use of the two stage nodule enhancement technique.

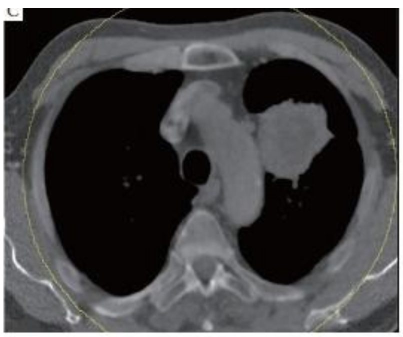

Fig: VDE image

4. SEGMENTATION

Medical Image Segmentation is the process of automatic or semi-automatic detection of limitations within a 2D or 3D image. A chief obscurity of medical image segmentation is the elevated variability in medical images.

First and primary the human anatomy itself shows foremost modes of dissimilarity. In addition many different modalities such as X-ray, computed tomography, microscopy, positron emission tomography (PET), Single-photon emission computed tomography (SPECT), Endoscopy, Optical coherence tomography (OCT), and many more are used to create medical images.

The outcome of the segmentation can then be used to attain further diagnostic insights. Possible applications are automatic measurement of organs, cell counting, or simulations based on the extracted boundary information. There is presently no single segmentation method that yields suitable outcome for every medical image. Methods do survive that are more general and can be applied to a diversity of data. However, methods that are dedicated to particular applications can often achieve better performance by taking into account preceding knowledge. Selection of an suitable approach to a segmentation problem can consequently be a difficult impasse. This provides an general idea of current methods used for the segmentation methods in medical image which includes Preprocessing, Histogram thresholding, Region growing algorithm, Edge Detection

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Histogram thresholding [13] is used for resolving the actual binary masks for the lung area. Binary masks are generated from input gray-level CT data using an iterative thresholding algorithm, a better method than the conventional thresholding algorithm, in which the threshold is simply chosen as the minimum between the two maxima of the gray level histogram.

The image histogram is firstly divided into two parts using a initial threshold value, which can be for example half the maximum of the dynamic range of the current image, or the conventional threshold value just described. Afterwards, the sample mean of the gray values connected with the center pixels and the sample mean of the gray values related with the background pixels are caculated, and a new threshold value is resolute as the average of these two sample means. The process is frequently used until the threshold value does not modify any more.

Region growing algorithm [12] starts with a seed pixel, examines other pixels that background it, determines the mainly comparable one, and, if it meets definite criterion it is built-in in the region.

This process is followed until no extra pixels can be added. The region is iteratively developed by examining all unallocated nearest pixels to the region. The dissimilarity between a pixels intensity assessment and the regions mean is used as a comparison measure.

The pixel with the least difference measured this way is allocated to the iteratively developed region. This process is ended when the intensity difference between region mean and new pixel is higher than a definite threshold. Basically a seed pixel must be preferred from which the region growing may begin [12] .Since the goal of the lung segmentation process is the deletion of the dark areas thatdoes not fit in to the actual lungs, a seed pixel must be preferred from the dark region.

The approach preferred here finds the least pixel from the image on the boundary. This is a dark pixel in most cases. Once the dark pixel coordinates are preferred region growing begins in the form of marking all the pixels which lie in the 4-connected locality of the seed pixel. The process is repeated for each pixel until all the black pixels are marked in the image which adjoin the areas of the lung parenchyma. This will eliminates the dark regions that are joined to the boundary of the whole image. Since the goal of the segmentation process is to segment the lung cavities.

Edge Detection [11] includes each of the pixels in which a region is comparable with high opinion to some characteristic or computed assets such as color, intensity, or texture. Adjacent regions are considerably different with esteem to the same characteristic(s). It have finished this using edge detection and steps for it are:
1. Edge is a set of associated pixels that laze on the boundary between two regions.
2. Edges are detected by Sobel Methods.
3.It prefer Sobel method because of its *Accuracy*

4. WATERSHED ALGORITHM

The watershed algorithm is introduced which results in improved sensitivity and specificity.
Common Algorithmic Steps for Watershed Segmentation:
1. Accept feature map as input and build an image boundary around the borders of the image.
2. Threshold small fluctuations on the low end of the input feature map.
3. Locate and label all single pixel regional minima (pixels those are lower in value than all their 4-neighbors). Pixels are labeled with unique integer value, beginning with 1.
4. Identify all flat regions, give them a distinct label and locate the lowest pixel surrounding the boundary of the region.
5. Trace all pixels that are not members of flat region.
6. Trace all remaining unlabeled flat regions to their respective regional minima (starting with lowest pixel that has already been labeled. By this step all the pixels in the image are labeled with a distinct region label).
7. Mark the flat regions that are regional maxima and mark boundary pixels between region.
8. Depth of each region i.e. Watershed is computed as a difference between the largest and smallest valued pixel in that watershed.
9. Watersheds are threshold according to their depths.
10. Sequentially labeling all individual regions bounded by the marked edges in the binary create a segmented image.image to create a segmented image.

5. RESULT AND DISCUSSION

A major advantage of watershed algorithm is improved sensitivity when compared to all the other segmentation technique. The segmenting result together with the information about which techniques best discriminate among segmentation technique is a good basis for detection.

Our results show the improved sensitivity when compared to other segmentation technique and reduces the false positives by identifying the correct nodules.

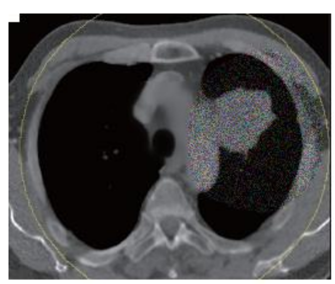

Fig: Watershed segmentation

- Results in improved sensitivity
- Reduced false rate

6. CONCLUSION

The segmentation technique is defined to detect the lung nodules. In addition an efficient Watershed algorithm is proposed for segmenting the lung nodule. Our experimental evaluation demonstrates that the watershed algorithm improves the sensitivity and reduced false positives when compared to all other segmentation techniques. our algorithm is good and scalable in detecting the lung nodules. The proposed method includes stochastic watershed algorithm which improves more sensitivity.

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