Chapter 23
Segmentation of Lung Nodules in CT Scan Data: A Review

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ABSTRACT

Developing an effective computer-aided diagnosis (CAD) system for lung cancer is of great clinical importance and can increase the patient's chance of survival. For this reason, CAD systems for lung cancer have been investigated in a huge number of research studies. Several studies have shown the feasibility and robustness of automated matching of corresponding nodule pairs between follow up examinations. Different image pre-processing and segmentation techniques are used in various research sides to segment different tumors or ulcers from different images. This paper aims to make a review on the existing segmentation algorithms used for CT images of pulmonary nodules and presents a study of the existing methods on automated lung nodule detection. It provides a comparison of the performance of the existing approaches in regards to effective domain results.

1. INTRODUCTION

Computed Tomography (CT) scan is an established method for non-invasive lung imaging and detection of nodules in the lung. CT scan is widely used as a diagnostic tool for pulmonary region analysis and for the detection of lung cancer nodules (Aliloub, KOvalev & Snezhko, 2014) and (Teramoto & Fujita 2013). Computer assisted detection of lung nodules offers a more accurate method of nodule detection which leads to reliable diagnosis of lung cancer. The CAD scheme is efficient for the better diagnosis for large volume of CT image data. Several studies have shown the feasibility and robustness of automated matching of corresponding nodule pairs between follow up examinations. A typical CT scan contains multiple 2D images of a lung referred to as a slice in which each slice contains lung tissue data. Nodules

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detected in one slice may not represent complete information pertaining to the location of an abnormality and hence, detections from multiple slices must be combined to provide a holistic representation for the medical expert. The first step towards nodule detection is lung segmentation. It is a most crucial step as it leads to increased sensitivity and specificity and also improves the speed of detection. Different image pre-processing and segmentation techniques are used in various research sides to segment different tumors or ulcers from different images. In some research, segmentation was carried out by using thresholding and watershed techniques which are the most used methods in processing the microscopic images.

This study analyses and compares the algorithms for segmenting various lung structures in computed tomography (CT) images, namely the lungs, airway trees and vessel trees. These algorithms can facilitate a better platform for detection of nodules from the lung region. A fully automated lung segmentation algorithm is based on region growing and the assumption that the lungs are of lower intensities than surrounding structures in CT. Furthermore, we have also compared a post processing step that sharpens the boundaries and removes noise from the image by using region growing process which improves the reliability of the lung segmentation algorithm.

Nodules' effects and its detection in the pulmonary region hold an important regard in Medical Image Processing. Lots of research has been carried out in this area to decrease the increasing death rate now a days. Different methods have been presented and experienced in different research which employs different structures. Each structure involves a number of algorithmic components as well as their specific inter-relationships. This paper formulated a generic structure for lung nodule detection that can be used to categorize and represent majority of the existing approaches. Several existing nodule detection systems include all these components, whilst others employ only a subset of the components. When a system does not include a certain component, the presented generic structure could be reduced by bypassing the particular component and creating a smaller structure for the system. Presentation of the existing systems based on the devised structure helps the reader to better establish an understanding of the operation principles of the systems, and also compare the characteristics of the methods that employ similar frameworks.

2. BACKGROUND

The process of acquiring medical images from imaging modalities is the Image Acquisition process. There exist several common methods for lung imaging. CT enables visualization of small volume or low-contrast nodules by decreasing the thickness of slices and the interval between consecutive slices. CT is preferable for the preliminary analysis of lung nodules screening comparing to other lung imaging methods as they produce more accurate results. Lung CT images can be found in public and private databases. In Image pre-processing, the process of improving both the quality and interpretability of the acquired lung images which reduces noise and artifacts in the lung image slices and hence detecting the position and size of the nodule.

The existing research literature on lung segmentation includes region filling techniques that employ thresholding. (Aliloub, KOvalev & Snezhko, 2014) discusses the process for nodules' identification using an approach based on multiple thresholds followed by morphological opening and 3D region growing algorithm followed by a combination of rule-based procedure and support vector machine classifier