Computer Aided Diagnosis System for Lung Nodule Detection using CT Scan Image

Sandeep V¹, Rajeswari²

¹ PG Student, AIT Bangalore, sandeep.reva@gmail.com, 9845108016  
² Professor & HOD, EC Dept, AIT Bangalore, rajeswari@acharya.ac.in

Abstract

Recent years, the image processing techniques widely used in several medical fields for image improvement quality in earlier detection and treatments stages, where the time is very important factor to know and discover the abnormality of issues in targeted image, especially in various cancer tumours such as lung cancer, breast cancer, and many more. The Image quality and accuracy is the core factor for research, image quality as well as improvements are depend on the enhancement of stage where the low pre-processing technique is used a based on the Gabor filter within a Gaussian rule. Following segmentations purpose we are using watershed algorithm and principles, an enhanced image region of the object of interest that used as the basic foundation are information of feature extraction is obtained by using GLCM & SVM. As relying on a general and features, the normality a comparison is made. In this project, the main detecting features for accreted image comparison are pixel percentage and mask-labelling to find out the lung nodules using CT scan images.

Keywords – Lung nodule detection, Image processing techniques, Feature extraction for nodule, Enhancement-techniques, Watershed-algorithm.

1. Introduction

Lung cancer is a disease of the abnormal cells that are multiplying and growing into the tumour. Cancer cells can be a carried away from lungs in blood, or lymph fluid that are surrounds the lung tissue. Lymph flows through a lymphatic vessels, which are drain in- to lymph nodes that located in the lungs and in the centre of a chest. The Lung cancer often spreads in to toward the centre of the chest, because a natural flow of lymph is out of the lungs is towards to the centre of the chest. a Metastasis occurs when the cancer cell leaves a site where it’s began and moves in- to a lymph node or another part of the body through the a blood stream [1].

A Cancer that starts in the lungs is called primary cancer of lung. There are several diff types of lung cancers, and these divided into a two main group: 1. Small cell lung cancer and, 2. non-small cell lung. Cancer has three subtypes: is Carcinoma, Adenocarcinoma & Squamous cell carcinomas.

The rank order of the cancers for the both males and females among Jordanian in the year of 2008 indicates that there were 359 cases of the lung cancer accounting for a (7.7 %) of all diagnosed newly cancer cases in the 2008. The Lung cancer is affected 298 (13.3%) male and 58 (2.4%) of females, with a males to female ratio is 5:1 which Lungs cancer ranked second in the males and 10th among in females [2]. Fig-image 1 shows a general description of lung cancer detections systems that contain four basic stages or steps. The first stage starts with a taking the collections of CT images (normal image and abnormal image) in the available Database from the IMBA Home VIA & ELCAP Public Access, [3]. The second step applied to a several techniques of image enhancements, to get best quality of the image results and clearness. The third step applied to the image segmentation algorithms which play an effective role in image processing stage, and the fourth step to obtains the a general features from enhanced image and segmented image which gives indicators of a normality or abnormality of image.

Figure 1. Lung cancer image processing steps

Lung cancer is most dangerous widespread cancer in the world, according to stages of discovery of cancer cells in the lungs; the process of early detections of the disease plays a very quick and important role and essential role to avoid a serious advance stages to reduce its percentage of distributions.
The aim of this project was to detect a feature for an accurate comparison of images, detection of lung nodule and lung cancer.

2. Material & Methods
In this project, to obtain more and more accurate results, we divided our work into the following three steps:

1. The Image Enhancement stage: to make an image better enhance it from noise, corruption and interference. The following three methods and steps were used for this purpose only: Gabor filter (has best results), the Auto enhancement algorithm is another technique, and one more method FFT Fast Fourier Transform (shows the worst result for image segmentations).

2. The Image Segmentation stage: to divide and segment the enhanced image, used algorithms on the ROI of the images (just two lungs, the methods used are: threshold approach and its Marker-Controlled, Watershed Segmentation (this has a better approach and better results than threshold).

3. Features Extraction step: to get the general features of enhanced by Gabor and watershed image using GLCM and SVM.

To find out the lung nodule size, shape, area of the nodule. Whether it is cancer's lung nodule or not, all these things we are finding in this feature extraction.

2.1 Image Enhancement
The image Pre-processing is a stage starts with the image enhancement; the main aim of image enhancement is to improve interpretability or perception of information included in t image for humans viewers, or to provide a better quality input to other automated image-processing (IP) techniques.

Image enhancement techniques are divided into two broad categories: 1. Spatial domain. 2. Frequency methods. And unfortunately, there is no other general theory for determining what is a "good" image enhancement when it will come to human perception. If it looks good to human eye, it is good. However, when the image enhancement technique is used, pre-processing tools for other image-processing techniques, the quantitative measures can determine which techniques are the most appropriate [4]. In an image enhancement stage, we used the following 2 techniques: for Gabor filter, 1. Auto-enhancement and 2. Fast Fourier transforms technique.

2.1.1 Gabor Filter
Image presentation is based on the Gabor function, constitutes an excellent local multi-scale decompositions in terms of logons that simultaneously (and optimally) localizations in space and frequency domains [5].

The Gabor filter is a linear filter and whose impulse response is as defined by harmonic function multiplied by a Gaussian function. The multiplications & convolution properties and (Convolution-theorems), the Fourier transform of Gabor filter's impulse and its response of the convolutions of a Fourier-transform (FT) and the harmonic function, and Fourier transform of the Gaussian-functions. Figure 2 shows (a) the original image CT image (b) the enhanced Gabor Filter image.

(a) Original Image (b) Enhanced by Gabor

Figure 2. The result of applying Gabor enhancement technique

The Auto enhancement technique is strongly depends on the subjective and observation and a statistical operation such as, 1. mean and 2. variance calculation. The enhancement percentage in this project was equal to 38.025%.

2.2 Image Segmentation
The Image segmentation is an essential process for the most image analysis and subsequent tasks. In the particular many-existing techniques for image description and recognition and depends highly on the segmentation results [7]. Segmentation or divide image into its constituent regions and objects. Segmentation of the medical images in the form of 2D, slice by slice has many useful applications for medical professionals such as: visualizations & volume estimations of objects of interested area, detection of abnormalities (e.g. tumour’s, polyps, etc.), the tissue quantification and they classification, and many more [8]. The goal and aim of segmentation is to simplify or change the representation of image into something that is to the more meaningful and easier analyses. The Image segmentation is typically and mainly we used to locate objects and boundaries of selected image (curves, lines, etc.) with the images. More precise, segmentations of image is the process of the assigning the label to the each and every pixel within the image.
such pixels with the same label shares certain visuals characteristic [9]. Result of segmentation image is the set of segments that are collectively covers the entries image, or the set of contours from extracted the image (detection edge). Of All pixels in a given regions are similar to respect to some characteristics or computed property, such the colour, intensity's, or texture of. Adjacent of regions to different with respect to the characteristic(s) same.

Segmentation algorithms based on one of two basic properties of intensity of values: discontinuity and the similarity. The first (1) category is to partition of the image based on the abrupt changes in the intensity, such as edges in image edges of the image. The second (2) categories is based on the partitioning of the image into its regions that are similar to according to a predefined criterions. The Histogram threshold approach falls to under this category.

2.2.1 Watershed Segmentation Approach
Marker-driven watershed segmentation technique extracts a seeds that indicate a presence of objects or a background at image specific locations. Marker locations are set to be regional minima within topological surface (typically, gradient of original I/p image), the watershed algorithm is applied to [11]. Separating the touching objects in an image is one of most difficult image processing operation, where a watershed transform is often to apply such problem. Marker controlled watershed segmented approach has 2 types: 1.External associated with the background and 2. Internal associated with an object of interest.

![Figure 3. Normal Enhanced image by Gabor filter and its Segmentation using Marker-Controlled Watershed approach](image)

(a) Enhanced image by Gabor (b) Segmented image by Watershed

Image features Extraction stage is an very important stage that uses techniques and algorithms to detect and isolate the various desired portions shapes (features) of a given images. To predict the probability of lung nodule cancer presence, the following two methods are used: (GLCM) & (SVM) and masking, both methods are based the facts that strongly related to the lung anatomy and it information of lung CT imaging.

2.3 Features Extraction

Lung nodule detection is a very difficult step within the CAD systems development. Actually, the CT lung images, the nodules are frequently attached to the blood vessel or to the pleura, further their grey tone is so it is similar to vessels section that traditional intensity-based methods are inappropriate. Instead, The Effective nodule detection algorithm must take both the 1.grey level and 2.the object shape into the account. In our system CAD we adopt a method that uses 3D shapes information to identify of spherical regions within a given grey level. And In this we are use a Gaussian 3D function as smoothing filter.

3. Conclusions

The image improvement techniques are developing for earlier disease detections and the treatment stages, the time factor is taken in account to discover the abnormality issues in the target images. Image accuracy and quality is a core factors of this research project, the quality of image assessment as well as the enhancement stages where were adapted to low pre-processing technique based on the Gabor filter with in the Gaussian rules and function. The proposed technique and method is efficient for image segmentation and principles to be a region of the interest foundations for feature extraction and to obtaining. The proposed technique gives a very promising result’s comparing with other used techniques or old techniques. Relying on the general features, the normality comparison is made on. The main detected features for the accurate images comparison on pixels percentage and mask with high accuracy and robust operations.in the end of results we are finding in this project false positive lung nodule cancer .our research till now we are completed all the enhancement and segmentation, further we are finding area of the nodule and size of the nodule and what stage of the cancer.

4. References


Author Biographies

Mr Sandeep V (B.E.) has completed his Engineering from Reva Institute of Technology, Bangalore. Currently he is pursuing M-Tech in Digital Communication Engineering from Acharya Institute of Technology, Bangalore.