Cancer Cells Detection Using Digital Image Processing Methods

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Abstract- In recent years the image processing mechanisms are used widely in several medical areas for improving earlier detection and treatment stages, in which the time factor is very important to discover the disease in the patient as possible as fast, especially in various cancer tumors such as the lung cancer. Lung cancer has been attracting the attention of medical and sciatic communities in the latest years because of its high prevalence allied with the difficult treatment. Statistics from 2008 indicate that lung cancer, throughout world, is the one that attacks the greatest number of people. Early detection of lung cancer is very important for successful treatment. There are few methods available to detect cancerous cells. Here two methods of segmentation such as thresholding and watershed are used to detect the cancer cell and too find out better approach out of them.

Keywords: Cancer Identification; Enhancement; Segmentation; Feature extraction.

I. Introduction

CANCER is one of the most serious health problems in the world field. The mortality rate of lung cancer is the highest among all other types of cancer. Lung cancer is one of the most serious cancers in the world, with the smallest survival rate after the diagnosis, with a gradual increase in the number of deaths every year. Survival from lung cancer is directly related to its growth at its detection time. The earlier the detection is, the higher the chances of successful treatment are. An estimated 85% of lung Cancer cases in males and 75% in females are caused by cigarette smoking [1].

In 2013 About 1,660,290 new cancer cases are expected to be diagnosed in 2013, and in 2013 about 580,350 Americans are projected to die of cancer, almost 1,600 people a day. Cancer remains the second most common cause of death in the US, accounting for nearly 1 of every 4 deaths. The overall survival rate for all types of cancer is 63%. Although surgery, radiation therapy, and chemotherapy have been used in the treatment of lung cancer, the five year survival rate for all stages combined is only 14%. This has not changed in the past three decades [2].

Lung cancer frequently extends in the direction of the middle of the chest because the usual course of lymph out of the lungs is on the way to the centre of the chest. Metastasis happens when a malignancy cell plants the site where it begins and shifts into a lymph node or to one more part of the body in the course of the blood flow. Tumor that initiates in the lung is called crucial lung cancer. There are a number of dissimilar kinds of lung cancer, and these are separated into two major groups: Small cell lung cancer and non-small cell lung cancer. Non-small cell lung cancer has three subtypes: Carcinoma, Aden carcinoma and Squamous cell carcinomas. [3] The purpose of this paper is to find the cancerous cells present in the CT images of lung and give more accurate result by using various enhancement and segmentation techniques such as thresholding and watershed transform.

II. PROPOSED SYSTEM

2.1 Image Acquisition–

The first stage starts with taking a collection of CT scan images from the Database (ACSC).Images are stored in MATLAB and displayed as a gray scale 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 For the experimental purpose 10 male images are examined his CT scans were stored in database of images in JPEG/PNG image standards.

2.2 *Image pre-processing-*

All the images have been undergoing several preprocessing process such as noise removal and enhancement.

2.2.1Noise Removal

Image denoising algorithms may be the mostly used in image processing. 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 contains noises such as white noise, salt and pepper noise etc White noise is one of the most common problems in image processing. This can be removed by using filter from the extracted lung image. [12]

2.2.2 Image Enhancement

Image enhancement defined as a way to improve the quality of image, so that the resultant image is better than the original one, the process of improving the quality of a digitally stored image by manipulating the image with MATLAB™ software. It is quite easy, for example, to make an image lighter or darker, or to increase or decrease contrast. Unfortunately, there is no general theory for determining what "good" image enhancement is when it comes to human perception. [4]

The aim of image enhancement is to improve the visual appearance of an image, or to provide a "better transform representation for future automated image processing. Many images like medical images, satellite images, aerial images and even real life photographs suffer from poor contrast and noise. It is necessary to enhance the contrast and remove the noise to increase image quality. The enhancement technique differs from one field to another according to its objective. In the image enhancement stage we use Gabor filter enhancement technique. [5]

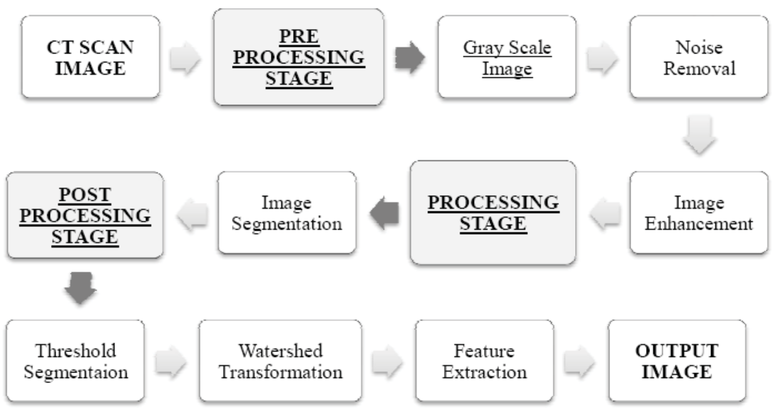


Figure 1. Stages of Lung Cancer Detection

2.3 Processing

This stage involves mainly segmentation which is explained as below

2.3.1 Image Segmentation

In computer vision, segmentation refers to the process of partitioning a digital image into multiple segments (sets of pixels, also known as superpixels).Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) 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 is similar with respect to some characteristic or computed property, such as color, intensity, texture All image processing operations generally aim at a better recognition of objects of interest, i.e., at finding suitable local features that can be distinguished from other objects and from the background. The next step is to check each individual pixel to see whether it belongs to an object of interest or not. This operation is called segmentation and produces a binary image. A pixel has the value one if it belongs to the object otherwise it is zero. After segmentation, it is known that which pixel belongs to which object. [7]

2.4 Post-Processing:

Post processing segmentation is done using following methods.

2.4.1 Thresholding approach

Thresholding is useful in discriminating foreground from the background. By selecting an adequate threshold value T, the gray level image can be converted to binary image. The binary image should contain all of the essential information about the position and shape of the objects of interest (foreground). The advantage of obtaining first a binary image is that it reduces the complexity of the data and simplifies the process of recognition and classification. The most common way to convert a gray-level image to a binary image is to select a single threshold value (T). Then all the gray level values below this T will be classified as black (0), and those above T will be white (1). [8]
Otsu's method using (gray thresh) function Computes global image threshold. Otsu's method is based on threshold selection by statistical criteria. Otsu suggested minimizing the weighted sum of within-class variances of the object and background pixels to establish an optimum threshold. Recall that minimization of within-class variances is equivalent to maximization of between-class variance. This method gives satisfactory results for bimodal histogram images. [9]

2.4.2Marker-Controlled Watershed Segmentation

In Marker-based watershed segmentation markers are used. A marker is a connected component belonging to an image. The markers include the internal markers, associated with objects of interest, and the external markers, associated with the background. Separating touching objects in an image is one of the more difficult image processing operations. The water shed transform is often applied to this problem. The marker based watershed segmentation can segment unique boundaries from an image. The strength of watershed segmentation is that it produces a unique solution for a particular image. The over-segmentation problem is also removed by marker watershed segmentation. [10]
Generally, the watershed transform is computed on the gradient of the original image. It possesses the number of advantages: it is a simple, intuitive method, it is fast and can be parallelized and it produces a complete division of the image in separated regions even if the contrast is poor. An important task was to identify what features must be taken into consideration of a Dicom image for successfully detecting the lung cancer. [11]

2.4.3 Features Extraction

The Image features Extraction stage is very important in our working in image processing techniques which using algorithms and techniques to detect and isolate various desired portions or shapes (features) of an image. 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. In the literature we found among the features used in the diagnostic indicators. [12]
Two approaches to predict the probability of lung cancer presence first approach is Binarization and the second is masking.

2.4.3.1 Binarization Approach

Binarization approach depends on the fact that the number of black pixels is much greater than white pixels in normal lung images, so that the counting starts the black pixels for normal and abnormal images to get an average that can be used later as a threshold, if the number of the black pixels of a new image is greater that the threshold, then it indicates that the image is normal, otherwise, if the number of the black pixels is less than the threshold, it indicates that the image in abnormal. [13]

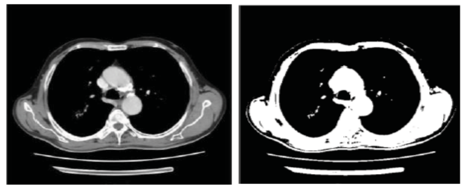
2.4.3.2 Masking Approach

Masking approach depends on the fact that the masses are appeared as white linked areas inside ROI (lungs), as they increase the percent of cancer presence increase. The appearance of solid blue color indicates normal case while appearance of RGB masses indicates the presence of cancer.

III. Experiment and Result

3.1 Thresholding Approach-

Figure 2 (a) shows input image of lung. Threshold segmentation is applied on the image which is shown in the figure 2 (b).This is the area with the intensity values higher than the defined threshold. High intensity areas mostly comprises of cancer cell. So through threshold segmentation we can specify the location of cancer cell.

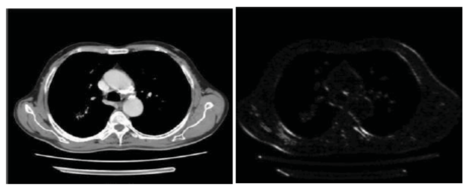


(a) (b)

Figure 2- (a) Original Image (b) Image by Threshold Segmentation

3.2 Evaluation of Gabor filter-

The Gabor filter was originally introduced by Dennis Gabor, we used it for 2D images (CT images). The Gabor function has been recognized as a very useful tool in computer vision and image processing, especially for texture analysis, due to its optimal localization properties in both spatial and frequency domain. Figure 3 shows the result.

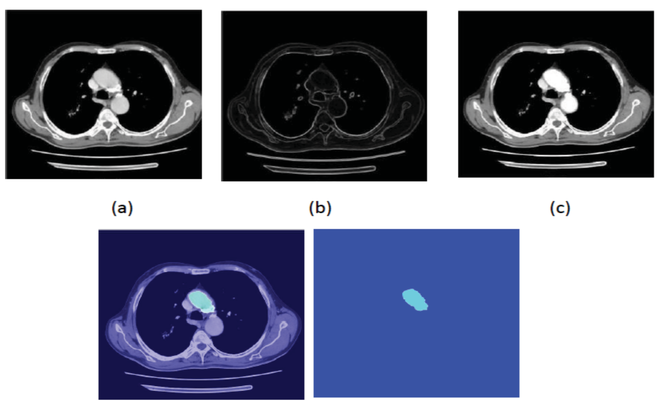


(a) (b)

Figure 3- The result of applying Gabor enhancement technique (a) Original image (b) Enhanced by Gabor

3.3 Approach of Marker Controlled Watershed segmentation-

The marker watershed method is applied to lung image. The result obtained by proposed method shows the clarity and detection of objects marked by image markers. Two types of markers are used. External associated with the background and Internal associated with the objects of interest. Figure 4 shows the output the results.



(a) (b) (c)

(d) (e)

Figure 4- (a) Original image (b) Gradient image (c) Watershed applied to original image (d) Superposition of original image with watershed (e) Segmented image by Marker Watershed.

Table-1 Image Segmentation experimental results

Image	Thresholding Approach	Marker Watershed Method
Image 1	**81.2466**	**83.7769**
Image 2	**80.7752**	**85.2737**
Image 3	**80.0130**	**86.3968**
Image 4	**79.6489**	**84.7092**
Image 5	**79.4329**	**84.5383**
Image 6	**78.7794**	**84.7046**

Image 7	**77.1633**	**83.9142**
Image 8	**76.0059**	**82.7316**
Image 9	**75.9029**	**80.9555**
Image 10	**75.4174**	**81.5094**

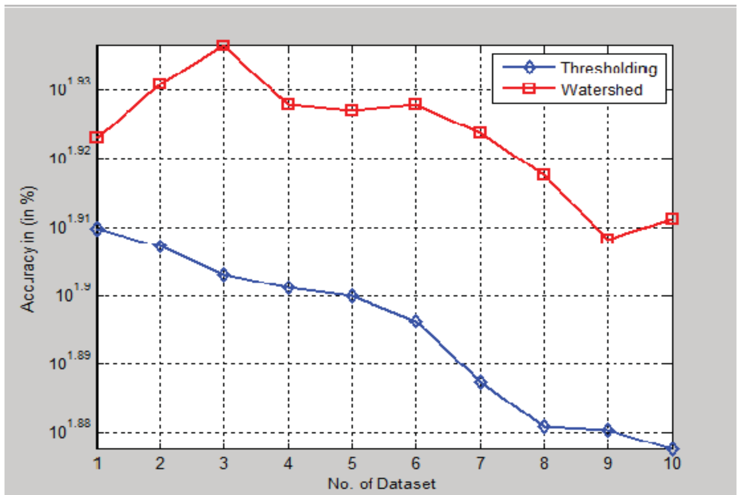


Figure 5- Plot of Accuracy of Threshold vs. Marker Watershed Segmentation

IV. CONCLUSION

Lung cancer is the most dangerous and widespread in the world according to stage the discovery of the cancer cells in the lungs, this gives us the indication that the process of detection this disease plays a very important and essential role to avoid serious stages and to reduce its percentage distribution in the world. To obtain more accurate results three stages used: Image Enhancement stage, Image Segmentation stage and Features Extraction stage. Marker-Controlled Watershed Segmentation approach has more accuracy (85.27%) and quality than Thresholding approach (81.24%).

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