Scientific Journal of Impact Factor (SJIF): 4.72

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 01, January -2018

Study and Realization of Lung cancer identification and detection using Image Processing Techniques

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Abstract — *In Today's world, there are number of deaths recorded causing Lung cancer. The main reason of lung cancer is measured due to consumption of tobacco and its products like cigarettes etc…The ratio of lung cancer by consumption of these products is about 85% or perhaps more than that. The lung cancer can be minimized, if the disease is to detect in initial stage. Although the process of detection of the cancer takes too much time, Hence lung cancer detection system using several image processing techniques to detect whether tumor is present or not in nodes of the lungs in CT-scan(Computed tomography) image. In this study the software MATLAB is used in every step to process. Here, we discussed about techniques and results of that.*

Keywords- *MATLAB, Image pre-processing, Image Enhancement, Image Segmentation, Feature Extraction.*

I. INTRODUCTION

Lung cancer is a very dangerous disease also called lung carcinoma. It is an uncontrolled cell growth tumor in the tissues of the lungs. Basically there are two types of lung cancer: 1.Small Cell Lung cancer (SCLC). 2. Non-Small Cell Lung Cancer (NSCLS). 85 % of cases the reason of the lung cancer is by consumption of tobacco or the smoking. About 10 to 15 % of cases who never smoked[1] [6] [8]. The size of tumor shows the staging of the cancer in the lung nodes. There are total four stages of the lung cancer in which, if the tumor is in the first or in the second stage, it can be recovered. If the tumor is in the third stage of the cancer it is difficult to recover. Very dangerous stage is fourth stage, in which there is no any chances to remove the lung tumor. Lung tumors may be detect in Chest Radiographs and Computed Tomography (CT).This diseases are confirmed by the biopsy report. It is performed by the Bronchoscope and CT guidance. This Processes takes too much time and money also, hence the patient who needs the treatment to recover the tumor, they cannot and hence sometimes patient lost their life. So In this case Image processing techniques are very useful to detect the tumor and hence we can give the best solution to recover the lung tumor immediately. In our work the whole process is shows to detect the lung tumor. In this research, section 2. Shows the methodology used in this work. Section 3. Shows the techniques of the image processing which is used to detect the tumor. Section 4 shows the experimental results and analysis. Section 5. Shows the Conclusion and Future work.

II. METHODOLOGY

There are different stages of lung cancer. In T1 stage, there are two types T1a and T1b, in T1a the diameter of the tumor is less than 2 centimeter, in T1b stage the diameter of the tumor is greater than 2 centimeter and less than 3 centimeter. In T2 stage, there are two types T2a and T2b.In T2a stage, diameter of the tumor is greater than 3 centimeter and less than 5 centimeter. In T2b, diameter of tumor is greater than 5 centimeter and less than 7 centimeter. In T3 stage, diameter of tumor is greater than 7 centimeter.[1-19].

The whole process of lung cancer detection is divided into three parts:

2.1. Image Enhancement:

Image enhancement is basically used to improve the quality of the image. This technique can be performed in both domains, Spatial domain as well as in Frequency domain. The objective of the Image Enhancement is to make Image better, improving the quality of the Image. An Enhancement algorithm is used for the purpose of some particular application, which can be done either increasing or the suppressing the noise or contrast of the image. In Image enhancement we can increase or decrease the brightness of the image as per our application. This technique improves the visual perception of the image. Basically, this technique can be classified into two categories.
1. Spatial domain method. 2. Transform domain method

Spatial domain method are operates directly on the image, while Transform domain method operates on Fourier transform of the image and then again it back into the spatial domain. Enhancement techniques are basically, based on the histograms, because it is very simple and fast. With them acceptable results, we can achieve some application which we want [2] [3] [9] [14].

Image Enhancement is used to make the image sharp. It accentuates and sharp the image features such as edges, boundaries and contrast, hence we can easily visualize the graphical data inside of the image. For Enhancement we used high pass filter and Median filter.

2.2. Image Segmentation:

The main objective of the Image Segmentation is to extract various part of the image.
It is a process of partitioning the image into pixel. Segmentation algorithms are based on area oriented, thus segmentation is used to divide the required region from the image. The main goal of Image Segmentation is to divide the image and change the style to represent it. Image Segmentation is a process of partitioning the image into multiple segments[4] [10][12][15].

Segmentation is basically used to locate boundaries, curves, lines around the object. To make contours' this method is used, hence we can easily detect our object. For Segmentation we used the ROI algorithm.

2.3. Feature Extraction:

It represents the interested part of the image. It describes the information in the extracted region. Features of the image can be extracted by it's content like colors, textures, shape, position, edges and the regions etc... The selected features are the expected information data from the Input data , hence we can perform the desired task[11][13].

The algorithm of lung cancer detection is:

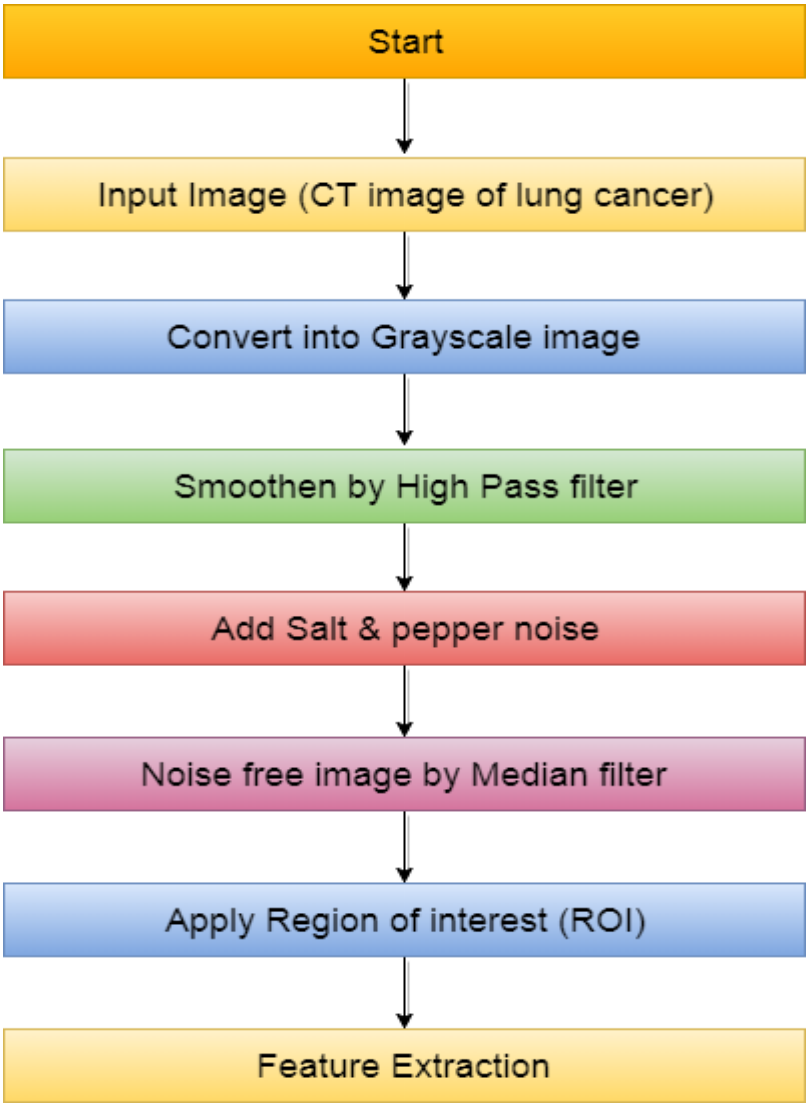

Figure-1: Algorithm of lung cancer detection

III. IMAGE PROCESSING TECHNIQUES

3.1. INPUT IMAGE
The taken input image is the computed tomography (CT) of the lung tumor.

3.2. GRAYSCALE IMAGE
In Gray scale Image, The value of each pixel is single sample, which carries only intensity information of the pixel. Gray scale image is also known as black and white image, where it varying from black (weakest) intensity to white (hardest) intensity. Grayscale image consist exclusive shades of gray. This type of Images are the result of measuring the intensity of light at each pixel in a single band of the light spectrum such as infrared, ultraviolet, visible light etc… We can also covert the RGB and YGB (Colored) image into Grayscale image.

33. HIGH PASS FILTER
To make image sharp and for smoothing purpose, we used High pass filter. High pass filters are passes the high frequency but it attenuates the frequency lower than the cut-off frequency. High pass filter sets the high threshold cut-off, hence to detect the information contain in the image while cutting low frequency. If the intensity is same, nothing happen but if a pixel is brighter than its immediate pixel then it gets boosted. This filters are in the form of matrices, and called it kernel in Image processing. The kernel used for edge detection and there sum of elements is 0. For detecting edges we can use negative or positive both values 0.

3.4. SALT & PEPPER NOISE
Now our second method of filtering the image is done by median filter which will remove all the noise from the image, so to filter the image first we passes the salt & pepper noise on the image. Salt & pepper is the one type of noise which is sometimes occurs in the image also known as impulse noise. It sparsely occurring white(salt) and black(pepper) pixels.

3.5. MEDIAN FILTER
Median filter is a very useful and effective technique to reduce the noise in the image. This detects the edges, first noise should be removed in image and then, edge removal is performed. The main feature of this filter is to remove the noise without removing edges. Average filter is also used for noise remove but, in average filter the mid pixel intensity is replaced by the average of pixels in the window hence, some data will be lose. So here we used the Median filter for noise remove. Median filter is one kind of smoothing technique as linear Gaussian filter. All smoothing techniques are very effective to remove the noise, but adversely affect the edges. So it is very important to remove noise as a time preserves the edges in the image.

The main idea of the median filter is to run, replacing each entry with the median of neighboring pixels intensity entries. This pattern of neighbors is called the "window". For 1D signals, the most obvious window is just the first few preceding and following entries, whereas for 2D (or higher-dimensional) images, more complex window patterns are possible[5] [7].

Odd window sizes are commonly used in median filtering: 3 × 3, 5 × 5, 7 × 7

- Example of median filtering application:

3 ×3 original image:

91	55	90
77	68	95
115	151	210

Median filtering using the full 3 ×3 neighborhood: 91, 55, 90, 77, 68, 95, 115, 151, 210
Now make this series in ascending series: 55 , 68 , 77 , 90 , 91 , 95 , 115 , 151 , 210
Hence, the median value of this image is now 91
Hence, our original image becomes;

91	55	90
77	91	95
115	151	210

Average filter is also used to remove the noise in the image and make image smooth. But using average filter the information will be lost. So we used 3×3 median filter.

3.6. REGION OF INTEREST(ROI)
It is the samples within a dataset. Basically it is used to detect the area. Using ROI we defined the boundaries of the object and we can know the area of the object.

IV. EXPERIMENTAL RESULTS AND ANALYSIS

The CT-scanned image which consist cancer tumor in the lungs node is below. Figure-2[19] shows the nods of lungs in which right node is affected by the cancer tumor

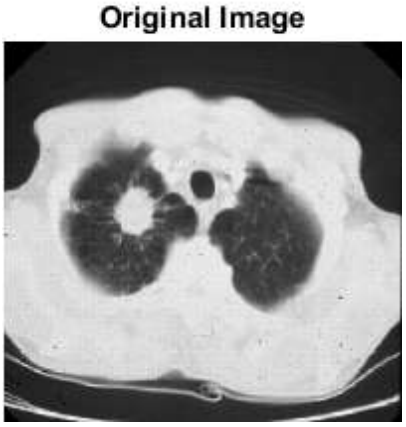

Figure-2: CT-scanned lungs infected by the cancer tumor

Now this CT-scanned image is converted into the Grayscale image, having shades of gray, which is shown in the figure-3

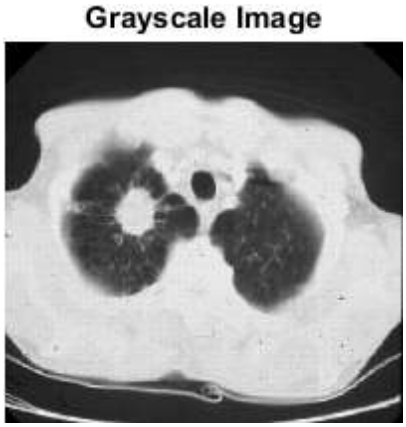

Figure-3: Grayscale Image

Now, this Grayscale image is passes through the High pass filter to make image sharp and smooth, which shows in the figure-4.

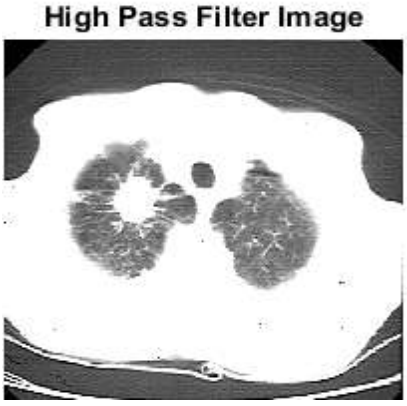

Figure-4: Grayscale image passes through the High pass filter.

In this step we add the salt and pepper noise on the image to make image noise free using median filter. The image of adding Noise and Pepper is shown in figure-5.

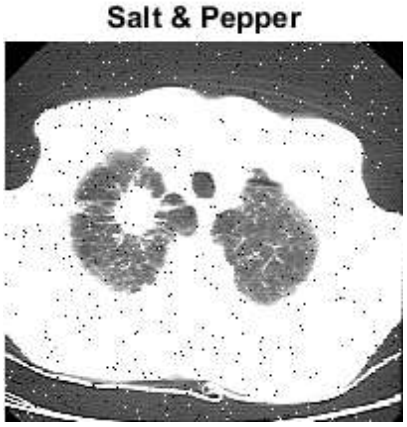

Figure-5: Add Salt and Pepper noise on the high pass filtered image.

The median filter is used to remove the noise from the image without losing the edges in the image, this is shown in figure-6.

We can remove the noise from the image using different window size in the image like 3 × 3, 5 × 5, 7 × 7 window size. Here we use 3*3 window sizes as gives the better result, which shown in figure-6.

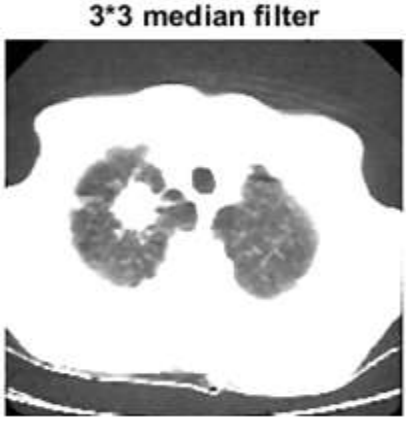

Figure-6: Median filtered image

For Feature Extraction we apply the Region of interest (ROI), using ROI we can know the features of the image, which is shown in the figure-7.

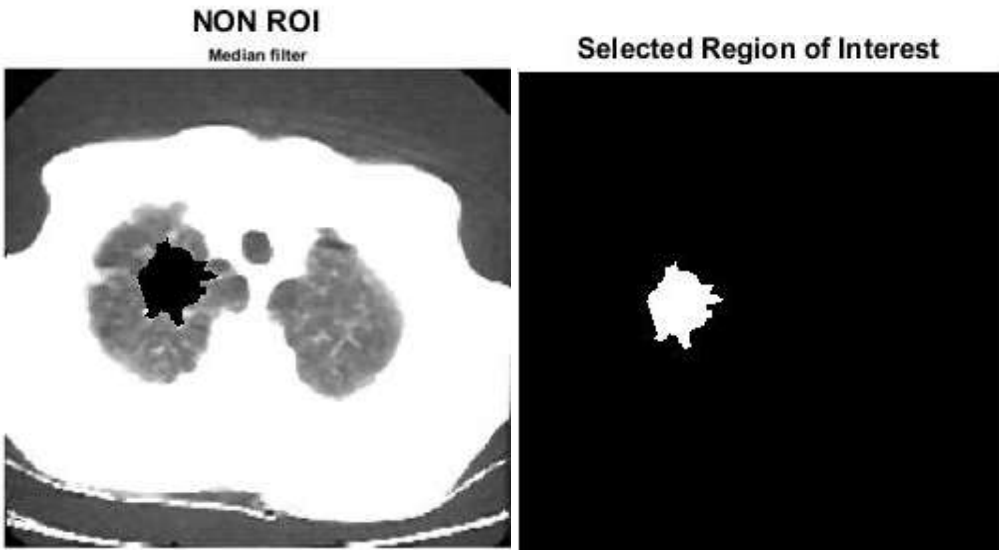

Figure-7: The median filtered image passes through ROI.

V. CONCLUSION AND FUTURE SCOPE

Lung cancer is a very dangerous disease in the world. The expert physicians diagnose the disease by experience. The treatment includes surgery, chemotherapy, radiation, and targeted therapy. These treatments are lengthy, costly, and painful. Hence an attempt is made to atomize this procedure to detect the lung cancer using image processing techniques. High pass filter and Median filter gives the best result for Image enhancement to make image sharp and noise free. The Region of Interest is used for Image Segmentation. For future work, we can also know the size of the tumor in the lungs such as we can find the staging of the cancer and also find the eccentricity, intensity, Average intensity, Perimeter of the tumor. The proposed methods can also be applied to some other cancer types like breast cancer, skin cancer, stomach cancer, brain tumor etc.

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