

# Segmentation of Lung Cancer using Image Enhancement Techniques and Region Growing Algorithm

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**Abstract** - Early detection of Lung cancer is the most challenging problem in Medical research. This is due to the abnormal formation of cells which may be sometimes overlapped. Image processing which is a growing research area has been playing a central role in the detection of lung cancer in images which are obtained through imaging modalities such as the Computed Tomography or the Magnetic Resonance Imaging. Here in our paper we use image processing tools and region growing algorithm to detect early lung cancer. In this proposed approach we are using some pre-processing imaging techniques such as the noise removal and contrast stretching. Region growing is used for segmentation. Later we detect the region of interest here the ROI is the cancer cells by boundary detection and pseudo colouring. The algorithm has been tried on different lung images and has given us a desired output.

**Keywords:** Image processing, Region Growing, Lung Cancer, Segmentation, ROI.

## 1. INTRODUCTION

Lung cancer is due to the abnormal formation of cells in the lungs. These abnormal cells grow rapidly and divide to form tumor in the lungs. It is stated that the growth of these abnormal cells can spread beyond the Lungs and spread to other parts of the body. This process is termed as metastasis. As these tumors become larger the effect is numerous. These tumors grow to the extent that they stop the oxygen supply to the bloodstream. The reason behind the abnormal formation of cells in the lungs is due to one of these factors such genetic damage to DNA, smoking, particularly of cigarettes, Asbestos, Air pollution. They are two types of lung cancer which are called as small cell lung carcinoma (SCLC) and non-small cell lung carcinoma (NSCLC). The detection of these cancer cells or tumors is done through imaging such as CT or MRI. Primarily the first step in the investigation of the lung cancer is through chest radiography and later the patients are put under imaging modalities such as the CT, MRI. According to the World Health Organization United States has the highest number of deaths due to lung cancer followed by Denmark and Canada<sup>[10]</sup>.

In our proposed work we are using some of the image enhancement techniques and region growing algorithm to segment the area of the lung cancer. Firstly we apply some

of the image pre-processing techniques such as median filtering which is used in our algorithm to remove noise and later we apply contrast stretching to normalize the pixel values. After we have finished applying the pre-processing steps the resultant image is then further processed using the region growing algorithm. We have applied our proposed algorithm to two axial CT images and the output results have clearly distinguished the tumor. The developing platform for the detection is MatLab, as it is easy to develop and execute.

## 3. METHODOLOGY

The Figure 1 below shows the block diagram of the proposed Methodology:

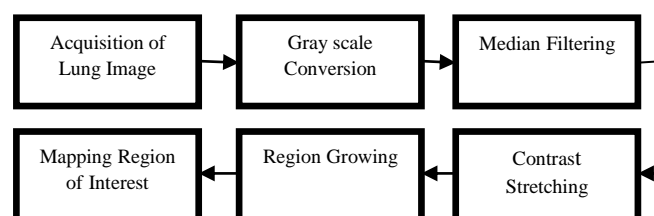


Fig 1: Block Diagram of Proposed Methodology

In our proposed methodology we have taken two axial CT lung images. We apply few pre processing steps and later apply region growing algorithm to the resultant image to segment the region of lung cancer. After we have segmented the cancer cells or the tumor we then map the segmented image with the original image to outline the boundary of region of interest that is, the cancer cells or the tumor. Firstly we have to convert the image into gray scale in the range 0 to 255 where 0 corresponds to white and

Other values correspond to the varying shades of gray. Medical images are in a standard format which is called the Digital Imaging & Communication in Medicine (DICOM) which was first developed by the National Electrical Manufacturers Association. This format in medicine is used for printing, storing and transmission of

medical data. This format is quite different from other imaging formats for example the Portable Graphics Network or the Joint Photographics Expert Group. The most prominent difference between this format and the other format is that DICOM groups all the information into data sets. That is if you take an X-ray image of the chest or an MRI image of the brain these image files contain many attributes such as the patient I.D , patient name , the imaging modality number , time of the scan and many more so that these information can never be separated from image file by mistake. The pixel data in these images can be compressed using JPEG, JPEG Lossless, JPEG 200, Run-Length Coding. Hence, In our proposed methodology we take lung images which are obtained through Axial CT. These images are in the DICOM format as explained above. Therefore to convert these images into gray scale, we apply compression method such as the JPEG on the original image. The resultant output of the compression method is then subjected to gray scale technique, which is conversion of the pixel value in the image in the range of 0 to 255 [7][8].

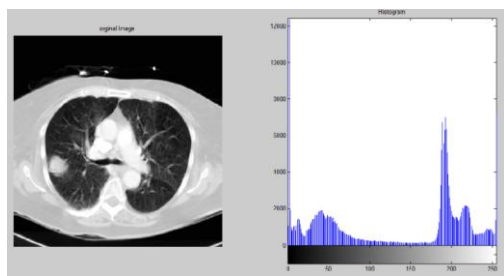


Fig 2: Original Axial CT lung image 1 showing a solitary pulmonary nodule in the peripheral part of the right lung with histogram representation.

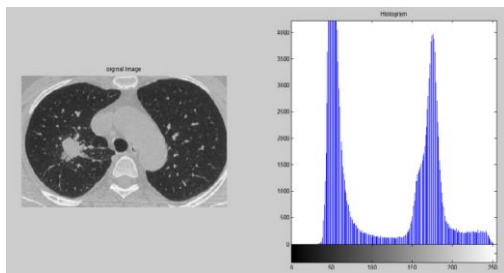


Fig 3: Original Axial CT lung image 2 showing a large tumor formation in the right lung with histogram representation.

The histogram of the two gray scale images are been plotted. From the histogram it is clear that the pixel values in both the gray scale images are in the range from 0 to 255. Histogram is graphical representation of the number of pixels which is present in a specific region. For example in the first gray scale image it is prominent that there are more number of pixels in the range from 180 to 200 and in the second gray scale image the two peaks in the histogram representation represents the number of the pixels with the value from 30 to 80 and pixel values in the range from 150 to 190 are more distributed than other pixel values [7][10].

The next step in our proposed methodology is the image enhancement technique. Image enhancement technique is used to improve the contrast of the image, remove noise present in the image or any artefacts. Many medical images have low contrast and noise present in the images. In order to get an accurate or clearer result we apply the image enhancement techniques. Firstly, we apply median filter to the resultant gray scale image. Median filter is a popular non linear filter which is used to remove the noise and enhance the contrast for further processing. Median filter works by sorting the pixel values in the neighbourhood and taking the median of the pixel values and replacing that value with the original value [8].

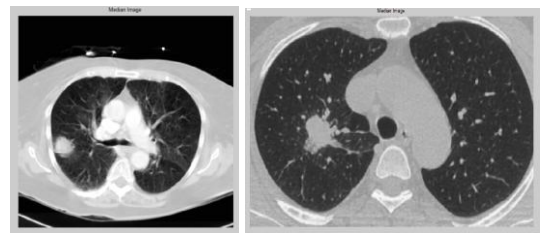


Fig 4 : Median Filtering on both images 1 & 2.

To the resultant Median filtered image we apply contrast stretching technique which is the next step in our image enhancement technique. Here we adjust the contrast of the image using the histogram stretching or histogram shrinking. This helps us to highlight some of the most relevant intensity values in the image. Since an image contains varying intensity values highlighting the most relevant values makes the detection of the tumor easier and also helps in the seed selection for region growing. During contrast stretching the pixel values are been adjusted based on some particular values depending upon the user selection. During the histogram stretching the pixel values are evenly distributed in the range from 0 to 255. But in histogram shrinking the dynamic gray scale range is modified into a narrower gray scale [4][8].

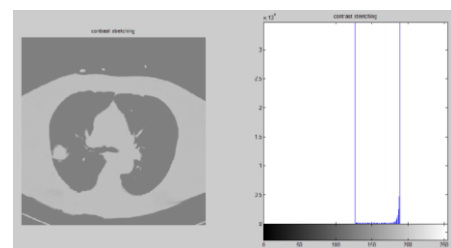


Fig 5: Contrast stretched of image 1 with histogram representation.

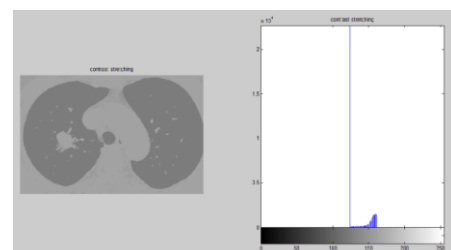


Fig 6: Contrast stretched of image 2 with histogram representation.

The above figure shows the resultant images after applying the contrast stretching Techniques. Histogram of both the images are been plotted for the contrast stretched image. We are now able to clearly observe the differences between the histogram of the original image and the histogram of the contrast stretch image. The prominent difference we observe here is that in the histogram of the original images we observe that the pixel values were distributed in the range from 0 to 255. But in the histogram of the contrast stretched images we observe that the pixels of the both the images are concentrated only in few regions of the image. This is because in contrast stretch technique we choose particular values by observing the histogram of the original image. We then apply these values to the images so that pixel values in the region of interest are more clearly highlighted than other features in the image <sup>[1][3][7]</sup>.

After pre- processing the original images with techniques like median filter and contrast stretching, the next step in our proposed methodology is post processing. For post processing we use region growing technique. Region growing is one of the most widely used image segmentation technique. Region growing is classified as a pixel based region growing method since it involves the selection of the seed point. This process is similar to the clustering methods. This method works by observing the neighbouring pixel values of the initial seed point and determines whether the pixel neighbours should be added to the region <sup>[1][2]</sup>.

The basic concept of region growing is the selection of the seed point. Selection of the seed point depends on a user. For example in our algorithm we select a particular seed point by observing the histogram of the contrast stretched image. We make sure that the seed point selection should segment the tumor or the cancer cells from the other features in the images. The initial region begins as the exact location of these seeds. After the selection of the seed point, the regions are then grown from these seed points to the adjacent pixel points depending on the region membership criterion. Some of these membership criteria are gray level, pixel intensity or it might be the colour. The advantage of using the region growing method in our algorithm is because it can correctly separate the regions that have same properties we define and therefore gives us a good segmentation result <sup>[5][6][11]</sup>.

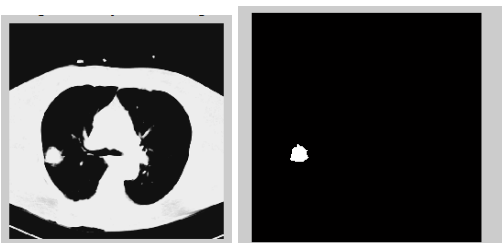


Fig 7: Shows the segmented region after applying region growing.

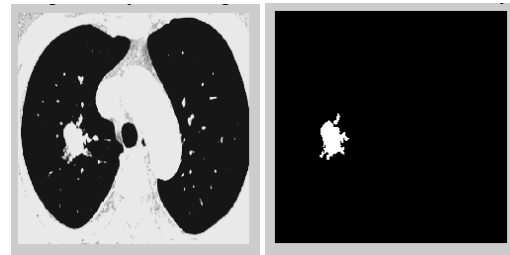


Fig 8: Shows the segmented region after applying region growing.

From the above figures we see that the cancer cells or the tumor are clearly segmented from the original image. This kind of segmentation helps us to clearly understand the shape of the tumor or cancer cells and location of those cells. This helps the clinicians or the doctors to understand the shape of these cancer cells or the tumor more clearly. Hence by using the region growing technique we are able to detect and segment the tumor or the cancer cells <sup>[1][8]</sup>.

Now in order to detect the region of interest in the original image, here in our paper the region of interest (ROI) is the cancer cells or the tumor, we map the segmented image with the original image. In order to do this first we convert the segmented image into a binary image and measure the size of the segmented region in the image using region property methods. After this we outline the boundary using pseudo colouring. We then map the outlined region of the segmented region on the original image using pseudo colouring and boundary detection <sup>[4][8]</sup>.

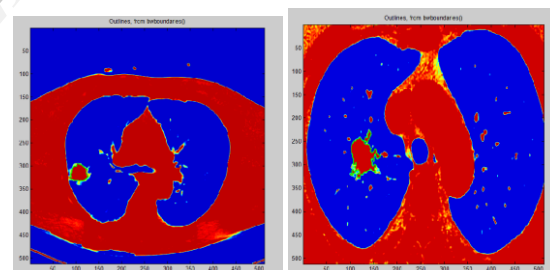


Fig 9: Representation of ROI with pseudo colouring.

From the above two figures we see that the cancer cells or the tumor is clearly outlined with green border. The segmented part of the tumor cells is clearly outlined on the original images. Hence we can clearly distinguish the tumor cells with other features in the image. Hence by this we can clearly locate the tumor cells.

#### 4. CONCLUSION AND FUTURE WORK

In this proposed work two axial CT images of the lung are used and perform a series of operations on the images to detect the region of lung cancer. By using proposed methods it is possible to clearly identify the lesions present in the lung. The segmentation of the cancer cells in turn helps in medical research to clearly outline the shape and the location of the cancer cells. In the future classification of the lesions into benign and malignant to be done and calculation

of the area and the size of the lesions using simpler algorithms will be addressed.

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