



## To Detect Abnormality in Lung Images Using Watershed Segmentation

Poonam Bhayan\*

M.Tech

Computer Science & Engg.

Chandigarh Engg. College, Landran, Mohali,

bhayan29@gmail.com

Gagandeep Jindal

Asst. Professor

Department of Computer Science & Engg.

Chandigarh Engg. College, Landran, Mohali

gaganpec@yahoo.com

**Abstract-** In this paper we are proposing a useful and an effective scheme to detect abnormal formation of cells in the lung image. In this process we have used various methods for the detection of abnormality. The process includes enhancement of image by using different techniques, after that on an enhanced image some filters are applied to remove the unwanted noise and then the resultant image is segmented to segment the required part. In this approach first of all we normalize the input image, after normalization we applied a series of methods initially to enhance the input image, including removal of noise and after that we have used watershed segmentation and morphological operators to get the desired output result.

**Keywords-** Fast Fourier Transform, Histogram Equalization, Median Filter, Morphological operations, Normalization, Thresholding, Watershed Segmentation.

### I. INTRODUCTION

Digital Image Processing means processing of digital images by means of a digital computer. It takes digital image as input applies some processes and produces an output image, which is obtained after the application of series of processes. Lung cancer is the leading cause of cancer-related death worldwide. It starts in the lungs. Tumors can be benign or malignant; when we speak of "cancer," we are referring to those tumors that are malignant. Benign tumors usually can be removed and do not spread to other parts of the body. Lung cancer is the most common cancer which occurs for both men and women. According to the report submitted by the American Cancer Society in 2003, lung cancer would report for about 13% of all cancer diagnoses and 28% for all cancer deaths. The survival rate for lung cancer analyzed in 5 years is just 15%. If the disease is identified while it is still localized, this rate increases to 49%. However, only 15% of diagnosed lung cancers are at this early stage [1].

The human lungs are the organs of respiration in humans. The main function of the lungs is to allow oxygen from the air to enter the bloodstream for delivery to the rest of the body [2]. Lung cancer is caused by uncontrolled cell growth in tissues of the lung. If left untreated, this growth can spread beyond the lung in a process called metastasis into nearby tissue and, eventually, into other parts of the body [10]. Lung cancer is of two types: NSCLC and SCLC. The NSCLC accounts for about 80% of lung cancers. There are different types of NSCLC. And SCLC accounts for about 20% of all lung cancers. Although the cells are small, they multiply quickly and form large tumors that can spread throughout the body. Smoking is almost always the cause of SCLC. It was formerly referred to as "oat-cell" carcinoma [3].

### II. RELATED WORK

Lung cancer was not known before the advent of cigarette smoking. According to the report submitted by the American Cancer Society in 2003, lung cancer would report for about 13% of all cancer diagnoses and 28% for all cancer deaths. The survival rate for lung cancer analyzed in 5 years is just 15%. If the disease is identified while it is still localized, this rate increases to 49%. However, only 15% of diagnosed lung cancers are at this early stage [1]. It was not even recognized as a disease until 1761. Different aspects of lung cancer were described further in 1810. In Germany in 1929, physician Fritz Lickint recognized the link between smoking and lung cancer. Bhadauria and Dewal described that with the advancement in Computed Tomography technology it is widely used in diagnosing different diseases.

The expanding volume of thoracic CT studies along with the increase of image data, supplements the need for CAD schemes to assist the radiologists. Mathematical morphology is a new mathematical theory which can be used to process and analyze the images [4]. Yamamoto *et al.*, described LSCT technique which was mobile-type CT scanner mainly for the purpose of mass screening of lung cancer. With LSCT technique, one main complexity was raise in the image information to around 30 slices per person from 1 X-ray film [5]. Yeny Yim *et al.*, described about Hybrid lung segmentation in chest CT images for computer aided diagnosis.

The author proposed a system which consists of three phases to obtain lung region borders [6]. Zhi-Hua Zhou *et al.* described that Lung cancer is one of the most common and deadly diseases in the world. Detection of lung cancer in its early stage is the key of its cure [7]. Lin *et al.* described the method to diagnose lung cancer nodules on digitized chest radiographs, which was based on a parameterized two-level convolution artificial neural network and on a special multi-label output encoding procedure [8]. Kanazawa, Kubo and N described a system to detect the tumor candidates from helical CT images that

extracted and analyzed features of the lung and pulmonary blood vessel regions and then utilized defined rules to perform diagnosis [9]. Armato *et al.*, described fully automated computerized technique based on two-dimensional and three-dimensional analyses of the image data obtained during diagnostic CT scans for the identification of lung nodules in helical computed tomography scans of the thorax [10]. Penedo *et al.* developed a system that employed an artificial neural network to detect suspicious regions in a low-resolution image and employed another artificial neural network to deal with the curvature peaks of the suspicious regions, which was used in the detection of lung nodules found on digitized chest radiographs.

### III. METHODOLOGY USED

Image processing is one of most growing research area these days and now it is very much integrated with the medical and biotechnology field. It can be used to analyze different medical and MRI images to get the abnormality in the image. This abnormality can be described in terms of tumor or the patch or scare on the human body. We are presenting such an approach to detect the tumor from the lung image. Image processing is one of most growing research area these days. In the following we are proposing an effective scheme to detect abnormal formation of cells in the lungs. Here we present an approach that detects the tumor from the lung image. In this proposed approach we have applied a series of operations, first to enhance the image and then to detect the tumor from the lung image.

First of all we take an image and then take its negative and adjust the contrast automatically. We do so to normalize the contrast of an image by using normalization technique. After normalizing the image, we applied a series of steps to enhance the quality of an image and to remove the noise [10].

In this approach the pre-processing of an image comes first. The aim of image enhancement is to improve the interpretability of information in images for human viewers. Image enhancement techniques can be divided into two broad categories:

Spatial domain methods, which operate directly on pixels, and Frequency domain methods, which operate on the Fourier transform of an image.

When image enhancement techniques are used as pre-processing tools for other image processing techniques, then quantitative measures can determine which techniques are most appropriate. For enhancement first of all we applied Fast Fourier Transform.

We applied Fast Fourier Transform (FFT) to enhance the image quality. Fast Fourier Transform is a method to calculate computations which are large enough. It works on divide and conquers approach; it breaks  $N$  input values into  $N/2$  values, so that it becomes easy to calculate [11].

After the application of FFT, we used another enhancement method named histogram modeling technique; this is the technique that can be used to improve the visual appearance of an image.

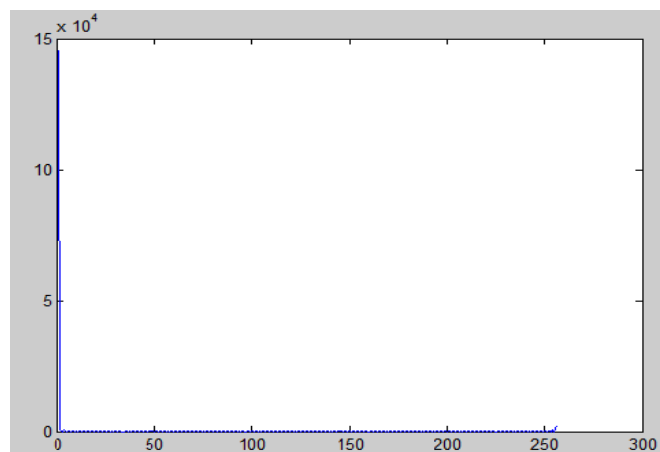
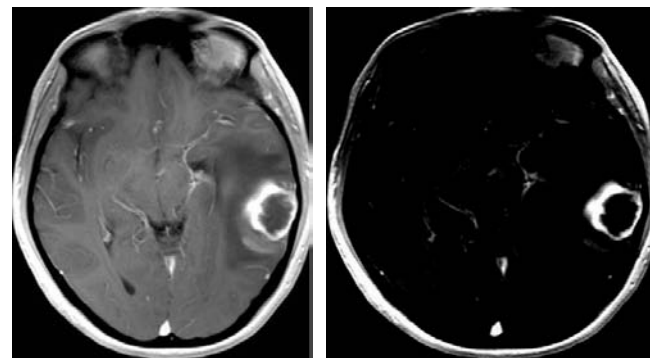


Figure 1. (a) Original image, (b) Image enhanced by FFT, (c) Histogram graph of FFT.

Histogram equalization is a contrast enhancement technique which aims at enhancing the image with an uniform histogram. We applied Histogram Equalization on the FFT enhanced image with an objective to have a uniform intensity throughout the image.

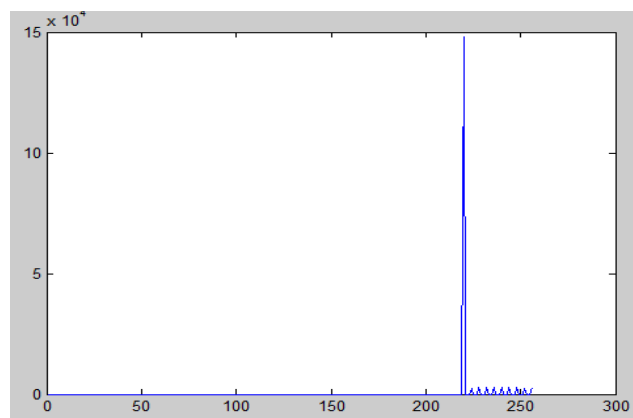
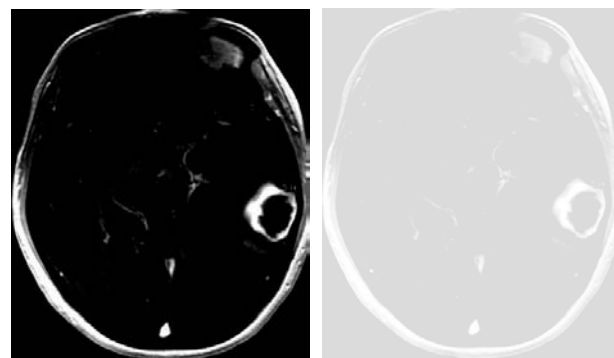


Figure 2. (a) FFT enhanced image, (b) Histogram Equalized image, (c) Histogram graph of Histogram Equalization.

After we get uniform intensity values throughout the image by using histogram equalization technique we applied Gabor transform over the image that helps to determine the changing signal over time.

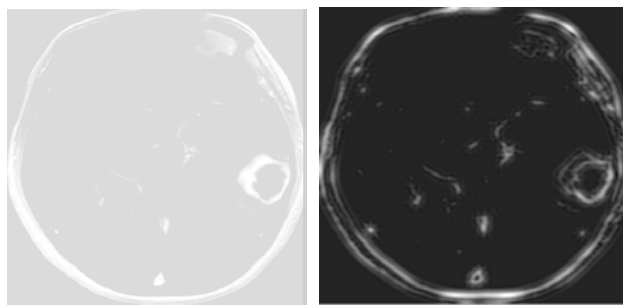


Figure 3. (a) Histogram Equalized image, (b) Gabor Transformed image.

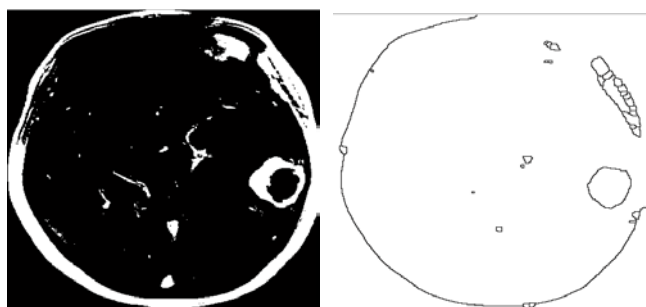


Figure 5. (a) Image after Threshold, (b) Image after the application of Watershed Segmentation.

After enhancing the image by applying a series of techniques. We then filter the image and then threshold it and after that we applied a segmentation algorithm which segment the image's desired part, in this case the tumor which we want to detect.

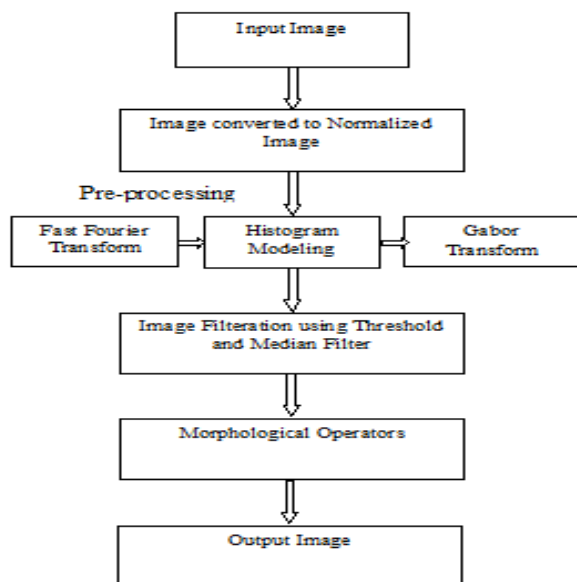


Figure 4. Steps to Detect tumor in lung image.

The figure above explains the complete process which we used to detect the tumor in a lung image.

To segment the image we have used the watershed transformation algorithm. We applied watershed after Thresholding the image. Segmentation is the process of segmenting objects from the background. After segmentation of abnormal region using watershed we then

applied a series of morphological operations [12]. Mathematical morphology is used to process and analyze images. It process images based on shapes. It apply structuring element to an input image and produces the output image of an equivalent size. First of all we applied Erosion and then Dilation, and after the application of these basic operations we apply the operations which are made by the combination of these basic operations such as opening and closing operations.

Erosion erodes away the pixels of the image boundary, and Dilation adds the pixels to the image boundary. The number of pixels added or removed depends upon the size and shape of structuring element [13].

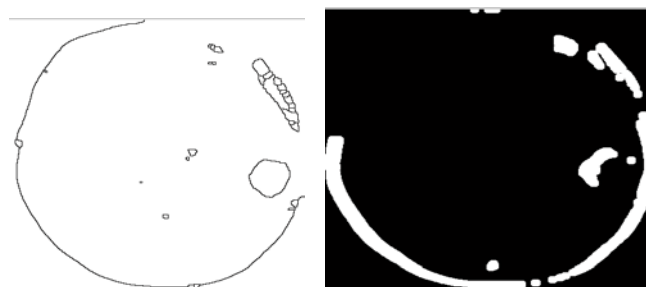


Figure 6. (a) Image after Watershed Segmentation, (b) Image after the application of series of Morphological Operations.

After the application of morphology, we can easily distinguish between the source image which we take as input and the result image which comes as output. The output image clearly shows the tumor part with less blurring and noise and also it tells whether the detected tumor is benign or malignant.

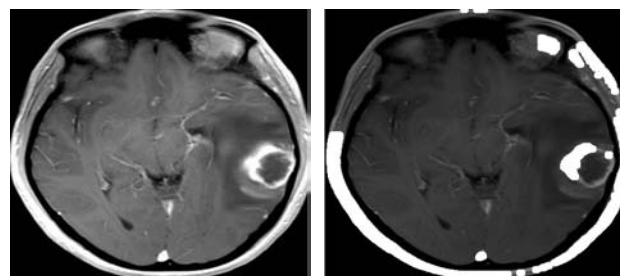
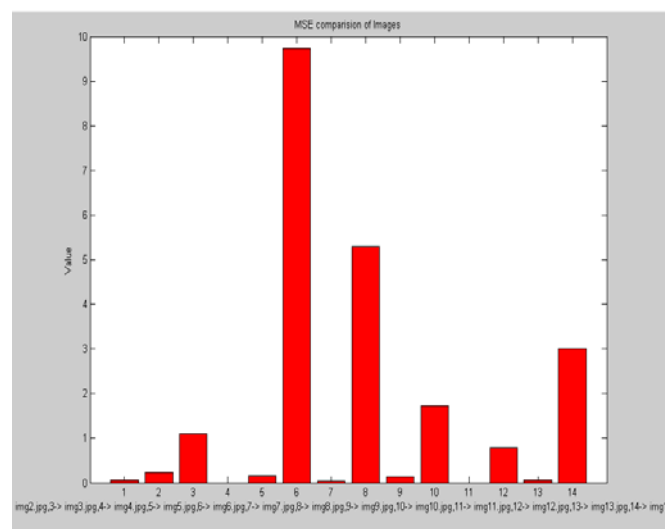
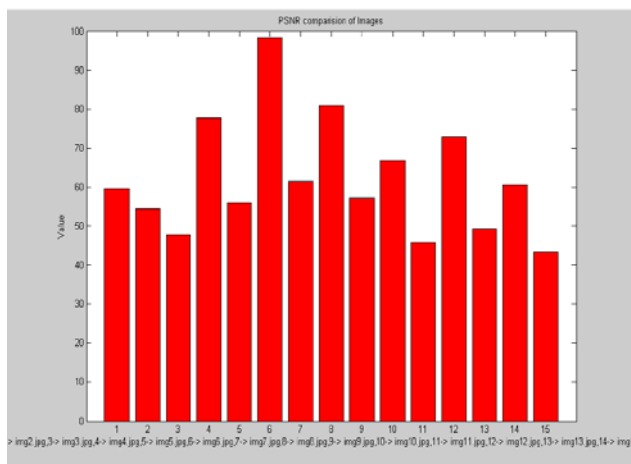


Figure 7. (a) Input image, (b) Output image.

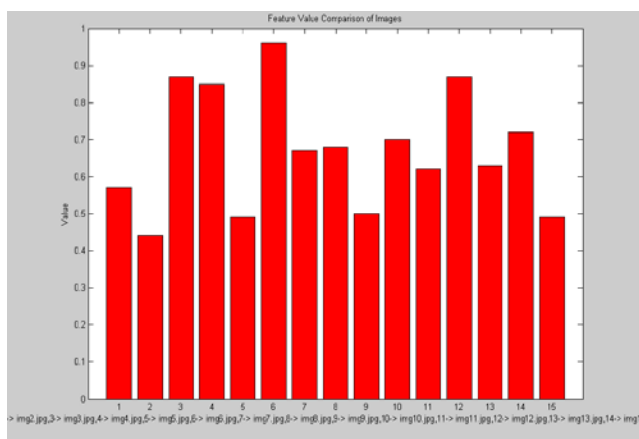
#### IV. IMPLEMENTATION GRAPHS



Graph 1: Shows MSE Comparison of images



Graph 2: PSNR Comparison of images.



Graph 3: Feature Value Comparison of images

## V. CONCLUSION

In this proposed work we acquire the lung image in jpeg format. We then applied a series of methods first to reduce the unwanted noise and then to enhance the image quality. In this approach we first take the negative of an image and then convert the image to normalize image and after that we have used series of methods to enhance it. We used Fast Fourier Transformation first and then applied histogram equalization, and then Gabor filter to enhance the image. Some others like convolution and median filters are also applied to restore the image. After that watershed algorithm and the morphological operators are applied to derive the final result in which tumor is detected. It shows whether the detected tumor is malign or benign. After this the image is compared with actual source image and check the image quality.

## VI. FUTURE WORK

The process can be modified in future to implement on 3-D images and also on bit map images or some other format and to include different modalities by finding suitable thresholds for them as well.

## VII. REFERENCES

[1]. Notter, Robert H,” Lung surfactants: basic science and clinical applications“New York, N.Y: Marcel Dekker.

pp. 120. ISBN 0-8247-0401-0. Retrieved 2008-10-11.

- [2]. WHO (February 2006). "Cancer". World Health Organization, Retrieved 2007-06-25.
- [3]. “Lung cancer - small cell”, Medline Plus. Retrieved 5 February 2010.
- [4]. Bhadauria H S, Dewal M L, “Comparison of Edge Detection Techniques on Noisy abnormal Lung CT Image before and after Using Morphological Filter”, 2010.
- [5]. Yamamoto, S., Jiang, H., Matsumoto, M., Tateno, Y., Iinuma, T. and Matsumoto, “Image Processing for Computer-Aided Diagnosis of Lung Cancer by CT (LSCT)”, IEEE Workshop on Applications of Computer Vision, Pp. 236 –241, 1996.
- [6]. Yeny Yim, Helen Hong and Yeong Gil Shin, “Hybrid Lung Segmentation in Chest CT Images for Computer-Aided Diagnosis”, International Workshop on Enterprise networking and Computing in Healthcare Industry, Pp. 378 – 383, 2005.
- [7]. Zhi-Hua Zhou, et al.,”Lung Cancer Cell Identification Based on Artificial Neural Network Ensembles”, Elsevier Science **24**(1): p. 25-36 (2002).
- [8]. Lin JS, et al., “Reduction of false positives in lung nodule detection using a two-level neural classification”, IEEE Trans. Medical Imaging **15**(2): p. 206-217 (1995).
- [9]. Kanazawa K, Kubo M, and N. N., “ Computer aided diagnosis system for lung cancer based on helical CT images”, in the 13th International Conference on Pattern Recognition (1996).
- [10]. Armato, S.G, Giger, M.L. and MacMahon, H., “Automated Detection of Lung Nodules in CTScans: Preliminary Results”, Medical Physics, Vol. 28, Pp. 1552–1561, 2001.
- [11]. <http://academic.mu.edu/phys/matthysd/web226/Lab01.htm>
- [12]. B. Boashash, editor, "Time–Frequency Signal Analysis and Processing: A Comprehensive Reference", Elsevier Science, Oxford, 2003.
- [13]. S. Beucher, “The watershed transformation applied to image segmentation”.
- [14]. <http://www.mathworks.in/help/toolbox/images/f1812508.html>

## Short Biodata of the Author



First author **Poonam Bhayan** is doing M.Tech in the field of Computer Science & Engg. at Chandigarh Engg. College, Landran, Mohali, and University is Punjab Technical University, Jalandhar, her research interests are in Image Processing and Image Retrieval, and e-mail id- bhayan29@gmail.com.



Second author **Gagandeep Jindal** is currently working as Asst. Professor in the Department of Computer Science & Engg. at Chandigarh Engg. College, Landran, Mohali. He has received his M.E degree in Computer Science and Engineering from PEC University of Technology, Chandigarh in 2005. He is currently doing his Ph.D in the area of CBMIR. His research interests are in Image Processing and Image Retrieval, and e-mail id- gaganpec@yahoo.com