# LUNG CANCER DETECTION USING CIRCULAR HOUGH TRANSFORM TECHNIQUE

**V. Banupriya[1], J. Bagyamani[2]**

*[1]Research Scholar, [2]Associate professor,*
*Department of Computer Science, Government Arts College, (India).*

## ABSTRACT

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. There are two main types of lung cancer, small-cell lung cancer and non small-cell lung cancer. Small-cell lung cancer typically responds well to chemotherapy and radiotherapy and non-small lung cancer is more commonly treated with surgical removal of lung tumor. Medical image processing techniques are used for timely detection of lung cancer in high resolution medical images. In this work, Lung cancer image has been preprocessed, segmented, and circular Hough transform technique is used to detect cancerous cells.

***Keywords: Computed Tomography, Image Enhancement, Watershed, Circular Hough Transform Technique.***

## I. INTRODUCTION

Lung cancer is a disease of abnormal cells multiplying and growing into a tumor. Lung cancer is the second most common cancer and the leading cause of cancer death for men and women. Cancer cells can be carried away from the lungs in blood, or lymph fluid that surrounds lung tissue. Metastasis occurs when a cancer cell leaves the site where it began and moves into a lymph node or to another part of the body through the blood stream. Cancer that starts in the lung is called primary lung cancer. There are several types and these are divided into two main groups namely i) Small cell-lung cancer ii) Non small-cell lung cancer. Non small cell lung cancer has three types: Carcinoma, Aden carcinoma, Squamous cell carcinoma. The earlier detection is, the highest the chances of successful treatment are.

The most recent estimates according to the latest statistics provided by World Health Organization indicate around 7.6 million deaths worldwide each year because of lung cancer. Lung cancer is one of the commonest malignancies among men and one of the leading causes of death globally. Despite improvement in diagnostics, staging and treatment modalities, the prognosis remains poor. Age adjusted incidence rate of lung cancer in India ranges from 7.4 to 13.1 per 100,000 among males and 3.9 to 5.8 per 100,000 among females. Five year survival of 12-14 percent has been reported for non small-cell lung cancer and 2-3 percent for small-cell lung cancer. This year, an estimated 224,210 adults (116,000 men and 108,210 women) will be diagnosed with lung cancer. Furthermore, mortality from cancer are expected to continue rising, to become around 17 million worldwide in 2030.

There are many techniques to acquire lung cancer image such as Chest Radiograph (x-ray), Computed Tomography (CT), Magnetic Resonance Imaging (MRI scan) and Sputum Cytology. A number of medical researchers utilized the analysis of sputum cells for early detection of lung cancer. However, most of these techniques are expensive and time consuming. In other words, most of these techniques are detecting the lung cancer in its advanced stages, where the patient's chance of survival is very low. Therefore, there is a great need for a new technology to diagnose the lung cancer in its early stages. Image processing techniques provide a good quality tool for improving the manual analysis. The proposed work detects cancerous cells present in the CT images of lung cancer and gives more accurate result.

The rest of this paper is organized as follows: a comprehensive Literature Survey is provide in Section 2, proposed system with block diagram is discussed in Section 3, which is followed by test results and discussions in Section 4, and the conclusion in Section 5.

## II. LITERATURE SURVEY

Nikita Pandey, Sayani Nandy [1] proposed, "A novel approach for detection of cancerous cells from Lung CT scan images". This is used to detect the cancerous cells effectively from the CT scan images by reducing the detection error made by the physicians naked eye for medical study based on Sobel edge detection and label matrix. Sobel operator helps to find the edges in an image and it finds the image gradient. Image gradient is the change in intensity of the image. The gradient will be greater where the intensity value is very large. The Sobel method finds edges using the Sobel approximation to the derivative. Prof. Samir Kumar Bandyopadhyay [2] proposed a method using Computer Aided Diagnosis System (CAD) to detect edges from CT images of lung for the detection of diseases.

Fatm Taher, Naoufel Werghi and et.al [3] deals with filtering thresholding algorithm for extracting the sputum cell from the raw sputum image for lung cancer early detection. Malik et.al[4] has proposed modified algorithm for segmentation of 2-D images to evaluate whether the tumor is benign or malignant. Anam Mustaqeem[5] has proposed, Brain tumor detection using combination of watershed and thresholding technique. Main problem with thresholding is to deciding threshold value. Kothavari [6] has proposed Image segmentation techniques on CT Lung images. N.G.Yadav [7] has proposed content based medical image retrieval to detection of Lung nodule used to find early stage of lung cancer. Anitha and Sridhar [8] used have signal and image processing techniques in segmentation of Lung lobes and nodule in CT images used to gives the better segmented result. Ayyadurai et.al [9] has proposed sobel edge detection method for analysis Lung cancer used to find the edges in an image.

One of the major challenges in computer vision is determining the shape, location or quantity of instances of a particular object. An example is to find circular objects from an input image. While numerous feature extraction techniques are openly available for circle detection, one of the most robust and commonly used methods is the Circular Hough Transform (CHT)[10][11]. The gradient based Circular Hough Transformation is used in many applications after simple pre-processing and gain considerable improvement in performance against the traditional Circular Hough Transformation method [12]. To determine diameter of a bloom, gradient based Circular Hough Transformation method is used in which gradient of image pixels is calculated and depending upon magnitude of these gradient pixels circle detection and diameter estimation is done. The diameter value returned at the end is in terms of pixels. To convert pixel count into millimeter (mm) a standard known diameter bloom is kept inimage and considered as reference to obtain diameter values for remaining circles.

## III. PROPOSPED METHOD

This work aims to apply an image processing technique which is an effective scheme to detect the abnormal cell in the lungs. Present approach that detects the tumor from the lung image. In this proposed method contains three stages. In the first stage CT scan lung images arecollected in available data base. In the second stage image processing techniques such as preprocessing, enhancement such as contrast or brightness is applied to enhance the image.

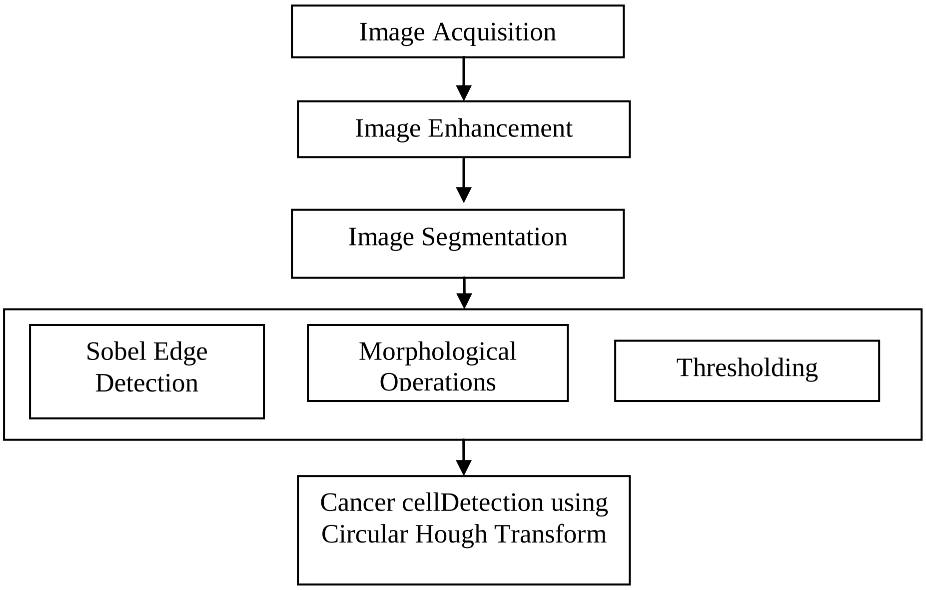



**Fig. 3.1 Block Diagram**

In the third stage image segmentation algorithm is applied to extract affected cells region from the images. In this watershed and thresholding algorithm are used, which plays an effective role in detecting cancerous cells. Finally to apply Circular Hough Transform gives a clear location of cancer by the highest peak. since cancer density will be more than the normal tissue. Fig 3.1 depicts the block diagram of the proposed work.

### 3.1 Image Acquisition

The first stage starts with collection of CT scan images from the Database (ACSC). The lung CT images avoiding low noise when compared to scan image and MRI image. The main advantage of CT image having better clarity, low noise and distortion. Fig.3.2 shows the CT scan lung image.

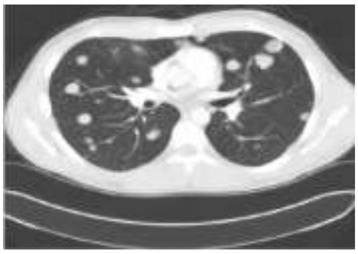


**Fig. 3.2 Lung CT Scan Image**

### 3.2 Image pre-processing

Image pre-processing stage starts with image enhancement. The aim of image enhancement is to improve interpretability or perception of information in images for human viewer, or to provide better input for other automated image processing techniques. All the images have been undergoing several preprocessing process such as noise removal and image enhancement.

#### 3.2.1 Noise Removal

The gray scale image contains noise 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. Wiener filter is used for removing the noise present in the lung CT image. The CT image normally contains artifacts, noise which will not be suitable for further processing and hence it has to be pre-processed to reduce the noise using Wiener filter.

#### 3.2.2 Image Enhancement

Image enhancement is to improve the visual appearance of an image, and 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. 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.

The propose work, to change the contrast or brightness of an image, the Adjust Contrast tool performs contrast stretching. This technique used to improve the visual appearance of an image. Fig. 3.3 shows the Contrast Stretching after applied on lung image. In the proposed work, Adjust contrast tool is used to change the contrast or brightness of lung image.

**Fig. 3.3 Image Enhancement using Contrast Stretching**

### 3.3 Image Segmentation

The next stage deals with image segmentation. Segmentation is the process of segmenting object from the background. It is an essential process for most image analysis subsequent tasks. The goal of segmentation is to simplify and change the representation of the image and easier to analyze. The result of image segmentation is a set of segments that collectively cover the entire image, or aset of contours extracted from the image (edge detection). All pixels in a given region are similar with respect to some characteristic or computed property, such as colour, intensity, or texture. Image segmentation is typically used to locate objects and boundaries in images. In this proposed work, Sobel edge detection, Watershed segmentation and Thresholding techniques are used.

### 3.3.1 Sobel Edge Detection

The sobel method helps to discover the edges in an image; it does so by seeing the image gradient. Image gradient is the change in the intensity of the image. The intensity of the image will be of maximum value where there is a separation of two dissimilar regions thus an edge must exist there. The gradient will be greater where the intensity value is very large. The sobel operator uses this greatest value to detect edges in an image. Fig. 3.4 shows the edges of lung image using Sobel edge detection technique.

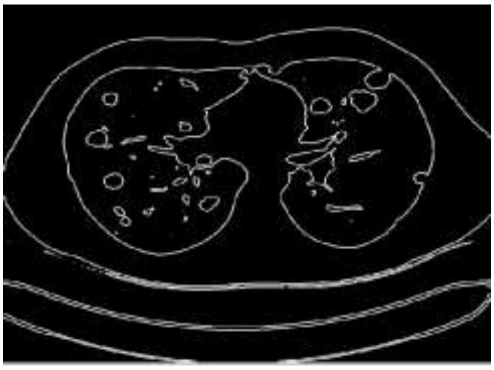


**Fig. 3.4Sobel Edge Detection**

### 3.3.2 Watershed Segmentation

The watershed transformation has been widely used in many fields of image processing including medical image segmentation due to the number of advantages that it possesses: it is a simple, intuitive method and it is fast. Segmentation using the watershed transforms works well if the foreground objects and background locations are identified or marked. The strength of watershed segmentation is that it produces a unique solution for a particular image, and it can be easily adapted to any kind of digital grid.

### 3.3.3 Morphological operations

The next step of image segmentation is morphological operations. The data should be represented as a boundary or as a complete region. It refers to certain operations where an object is hit with a structuring element and thereby reduced to more revealing shape. To create a structuring element specified by a shape structures like disk, disk-shaped approximation are suitable for computing cells. Disk-Shaped structuring element is approximated by specified radius from the origin of cells. Morphological operation includes erosion, dilation, filtering, and granulometry. In this proposed work morphological erosion and dilation has been applied to the enhance image to eliminate small unwanted pixel and image smoothing.

The erosion operation uniformly reduces the size of objects in relation to their background and dilation expands the size of objects. Besides dilation and erosion secondary operations like opening (erosion followed by dilation) and closing (dilation followed by erosion) can be applied on the image. Opening is used to smooth the contours of cells and parasites; and closing used is to fill the holes and gaps.

Fig. 3.6 and Fig. 3.8, shows the results obtained after a series of morphological operations namely erosion and dilation. It is eliminate small unwanted pixel and for image smoothening. Perform the morphological area closing on the lower pixel image to fill the hole and the unwanted small pixels are eliminated. The dilation and area closing have been applied on higher pixel image.

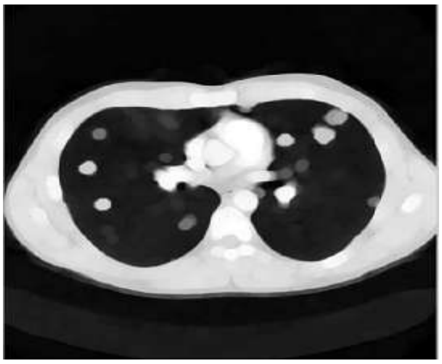


**Fig.3.5 Opening**

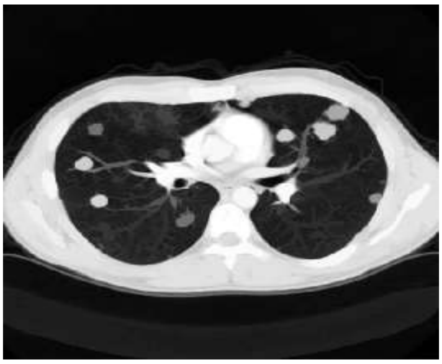


**Fig.3.6 Erosion**

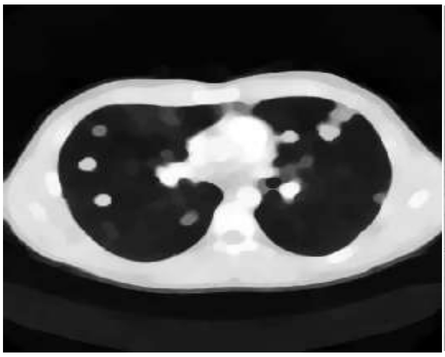


**Fig. 3.7 Closing**

**Fig.3.8 Dilation**

Fig 3.5 and Fig. 3.7 shows the area closing on the lower pixel image and higher pixel image using morphological operation involving erosion and dilation, the cancerous cell can be viewed accordingly.

### 3.3.4 Thresholding Approach

Thresholding is useful in discriminating foreground from the background. Otsu's method is based on threshold selection by statistical criteria. Otsu suggested minimizing the weighted sum of within-class variances is and background pixels to establish an optimum threshold. Also minimization of within variances is equivalent to maximization of between-class variance. This method gives satisfactory results to bimodal histogram images. By selecting an adequate threshold value, the gray level image can be converted to binary image.

Fig. 3.9 shows the binary image contain all of the essential information about the position and shape of the objects of interest. The advantage of obtaining 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. Then all the gray level values classified as black and white. In this proposed work binary image obtained based on Otsu's method in which the using threshold is global.

**Fig. 3.9 Applied Otsu's method**

## IV. RESULTS AND DISCUSSIONS

The proposed method was finally tested on 10 images of lung cancer image set obtained ACSC dataset. The Fig.3.2 shows the input image. Fig.3.3 shows the result of image enhancement technique. This technique is used to improve the visual appearance of an image. The edges are detected by Sobel edge detection method. After applying the sobel method the edges are clearly visible as in Fig. 3.3. The result obtain after using morphological operations namely opening and closing is eliminate small unwanted pixel and image smoothing is shown in Fig.3.5 and Fig. 3.7.

Fig. 3.8 shows binary image using Otsu's method. This method gives satisfactory results to bimodal histogram images. After the conversion of the binary image, Circular Hough Transform is applied to detect the cancer shape. Fig.4.1 shows the result after performing Circular Hough Transform.

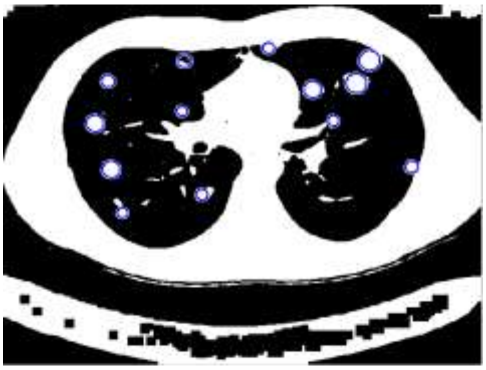
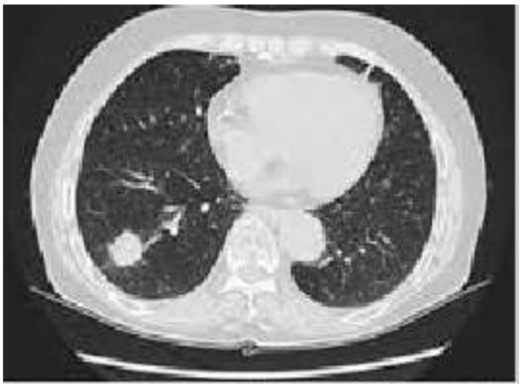
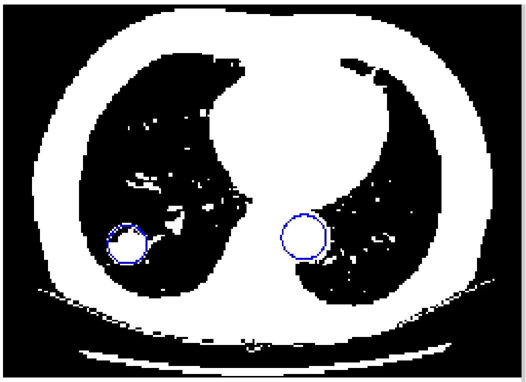


**Fig.4.1Cancer detection using Circular Hough Transform**

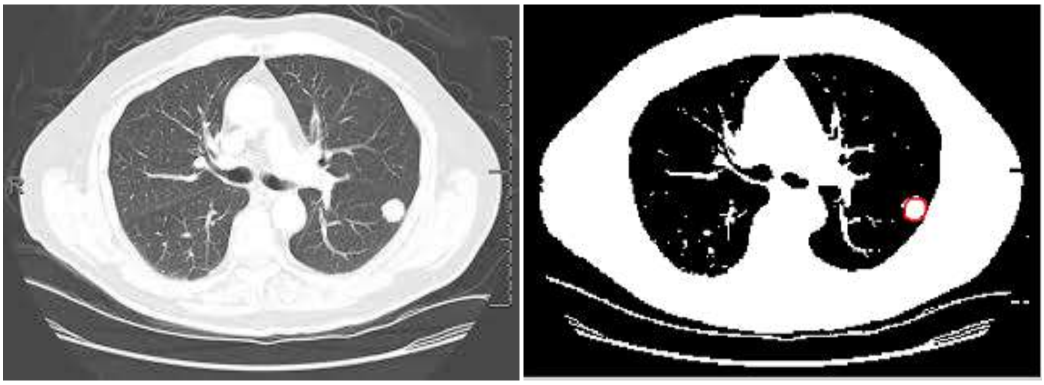
The average accuracy is measured based on final results produced by the algorithm to refer the manual analysis.

**Orginal image 1** **Cancer cell detected image1**





**Original image 2** **Cancer cell detected image 2**



**Original image 3Cancer cell detected image 3**

## V. CONCLUSION

Lung cancer is a major cause of cancer-related deaths; it can be detected early by detecting the lung nodules. Early detection can improve the survival rate of lung cancer patients. The proposed method is efficient in terms of cost and time consuming compared to existing techniques. Day-by-day research work is increasing in this field and various image processing techniques are implemented in order to get more accurate result. The main aim of this paper detects the cancerous nodule from the lung CT images using Circular Hough Transform Technique. The proposed work helps to identify abnormality detection.

## VI. ACKNOWLEDEGMENT

I thank Lord Almighty for the wisdom and perseverance that he has been bestowed upon us throughout our life. A special thanks goes to my friends who helped me in completing the work and exchanged interesting ideas. Last but not least, I wish to thank my parent for their undivided support and interest who inspired me and encouraged to prepare this paper.

## REFERENCES

[1] Nikita Pandey, Sayani Nandy "A Novel Approach of Cancerous Cells Detection from Lungs CT Scan Images'' International Journal of Advanced Research in Computer Science and Software Engineering Volume 2, Issue 8, August 2012.

[2] Prof. Samir Kumar Bandyopadhyay "Edge Detection From CT Images of Lung"" International Journal of Engineering Science & Advanced Technology Volume - 2, Issue - 1, 34 – 37.

[3] FatmTaher, NaoufelWerghi and Hussain Al-Ahmad "Extraction of Sputum Cells using Thresholding Techniques for Lung Cancer Detection" 2012 International Conference on Innovations in Information Technology.

[4] Malik Sikandar Hayat Khiyal, Aihab Khan, and Amna Bibi, Modified Watershed Algorithm for Segmentation of 2D Images, Informing Science and Information Technology Volume 6, 2009.

[5] Anam Mustaqeem ,Ali Javed ,Tehseen Fatima, An Efficient Brain Tumor Detection Algorithm Using Watershed & Thresholding Based Segmentation, I.J. Image, Graphics and Signal Processing, 2012, 10, 34-39.

[6]K. Kothavari and S.N. Deepa, "A study of image segmentation techniques on CT lung images", International Journal of Emerging trends in Electrical and Electronics, Volume 2, Issue-4, April-2013.

[7] N.G.Yadav , "Detection of Lung Nodule using content based Medical Image Retrieval",International Journal of Electrical, Electronics and Data Communication, ISSN (p): 2320-2084, Volume-1, Issue-2, April- 2013.

[8] Anitha. S, Sridhar.S, "Segmentation of Lung Lobes and Nodules in CT Images", Signal & Image Processing: An International Journal(SIPIJ) Vol.1, No.1, September 2010.

[9] P. Ayyadurai, P. Kiruthiga, S.Valarmathi, S. Amritha, "A Study of Lung Cancer Analysis and Identification Using Sobel Edge Detection Method and WEKA Tool", Vol. 3, Issue 3, pp. 2706-2712, 2013.

[10] Richard O. Duda and Peter E. Hart "Use of the Hough Transformation to detect lines and curves in pictures" graphics and image processing Communication of the ACM, Volume 15, Number 1, pp 11-15, January 1972.

[11] Fatoumata Dembele "Object Detection using Circular Hough Transform" ECE –Design team 3 documentation

[12]Ali Ajdari Rad1, Karim Faez, and Navid Qaragozlou1 "Fast Circle Detection Using Gradient Pair Vectors" Proc. VIIth Digital Image Computing:Techniques and Applications, Sydney, 10-12 Dec. 2003, pp -879-887.

[13] Ayman El-Baz, Aly A. Farag, Robert Falk, Renato La Rocca, "Detection, Visualization and identification of Lung Abnormalities in Chest Spiral CT Scan: Phase-I", International Conference on Biomedical Engineering, Cairo, Egypt, 12-01-2002.

[14] Anita chaudhary, SonitSukhraj Singh"Lung Cancer Detection on CT Images by Using Image Processing"2012 International Conference on Computing Sciences.

[15] R.Kiruthikaa, S.Govindaraju, An Implementation Of Markers Based Watershed Segmentation Using Fpga Processor, pdf online.

[16]Shilpa Kamdi, R.K.Krishna, "Image Segmentation and Region Growing Algorithm", International Journal of Computer Technology and Electronics Engineering (IJCTEE) Volume 2, Issue 1.

[17] S. G. Armato, M. L. Giger, C. J. Moran, J. T. Blackburn, K. Doi, H. MacMahon, "Computerized detection of pulmonary nodules on CT scans", RadioGraphics, Vol. 19, pp. 1303-1311, 1999.

[18] Shiying Hu, Eric A. Huffman, and Joseph M. Reinhardt," Automatic lung segmentation for accurate quantification of volumetric X-Ray CT images", IEEE Transactions on Medical Imaging, vol. 20, no. 6 ,pp. 490-498, June 2001

[19] Joao Rodrigo Ferreira da Silva Sousa, ristofanes Cor-rea Silva, Anselmo Cardoso de Paiva, Rodolfo Acatau-assu Nunes "Methodology for automatic detection of lung nodules in computerized tomography images", Computer Methods and Programs in Biomedicine, Vol. 98, pp. 1-14, 2010.

[20] Gonzalez R.C., Woods R.E., Digital Image Processing, Upper Saddle River, NJ Prentice Hall, 2008.

[21] Huang Q., Gao W., Cai W.,Thresholding technique with adaptive window selection for uneven lighting image, Pattern Recognition Letters, Elsevier, 2004, 26, p. 801-808.

**BIOGRAPHY**

Authorwasborn in Dharmapuri,Tamil Nadu(TN), India, in 1991. She received the Bachelor of Computer Application (B.C.A) degree from the Periyar University (PU), Salem,TN, India, in 2011 and the Master of Computer Application (M.C.A) degree from the Anna University, Chennai, TN, in 2014. She is currently pursuing the M.phil degree with the Department of Computer Science, PU. Her research interests include Image Processing.