



An Imaging Based Lung Tissue and Spread Level Detection for Early Detection of Cancer

B. Thiyaneswaran, K. Anguraj, R. Kandiban, N. S. Yoganathan, J. Jayanthi

Abstract: A tissues in the human organs is mainly due to the disease. The spread of tissue indicates the increase in disease level. The tissues and level of tissue in the organ may require for physician assessment. The proposed work is used to detect the tissue level in lungs. An early detection of tissue may leads to detect the cancer cell. The RGB color input image is converted into gray scale image. The gaussian noise is applied on the gray image. The median filter is applied to project the tissue pixels. The canny edge detection is applied on the filtered image to detect the boundary regions. The gradient magnitude operation is performed to project the edges of tissue. A watershed transform is applied on the gradient image to perform the morphological operation. A morphological area open and area close operation is performed along with reconstruction which highlights the tissue area from the lungs. Super imposing morphology with the regional maximum pixel operation is performed to differentiate tissue pixels. The tissue area is retained and all other area pixels are replaced by logic '0' pixels using Otsu's global thresholding method. The tissue portion is cropped using the OAD regions.

Keywords: Lung Tissue, Median Filter, Watershed, Morphological, cropping.

I. INTRODUCTION

Machine vision techniques are used to find the diseases in the human organs. The diseases are initially in the form of tissue. Cancer is a disease which affects the human life. The cancers cell initially appeared in the form of tissue. Non-cancer cells also appeared in the form of tissue but it dissolve naturally or by the medicine.

The tissue growth needs to be analyzed. If the growth is identified then biopsy procedure is followed for further investigation. The physician needs machine vision based analysis and patient tissue history.

The lung organ is placed an important in breathing system.

The size of the lung is differing with every human. The male lung size is varies in the range of 700 to 750 cubic centimeters. The woman lung size is varies from 250 to 300 cubic centimeters. The male lungs hold more air than the female lung.

The lung diseases are due to bad habits, viruses, improper diet system or genetics. An asthma, lung cancer, chronic obstructive pulmonary disease, and fungal lung infection are various diseases occurred inside the lungs. The analysis of tissue formation in the lungs will help to find out the lung diseases.

II. LITERATURE REVIEW

Computer aided detection algorithm was developed for detecting tissues of lung cancer cells. Thresholding, morphological operations was performed [1]. A wiener filter, AM-FM based modulation techniques are used to find the region of interest in lungs [2]. Clinical based diagnosis was performed in periodic. The growth of tissue is monitored to avoid the cancer cell early [3].

OAD algorithm was applied to detect the exact boundaries of IRIS [4]. Biomarkers are made on the lung tissues. Based on the markers the level of tissue is detected [5]. A clinical based confirmation of lung cancer detection using historical analysis on tissue growth [6].

III. LUNG TISSUE IMAGE CONVERSION

The lung image is captured using computer tomography. The images are in the various pixel ranges. The lung portions are appeared in the color variation (0 to 255) represented by the RGB format as layer-1. The lungs portion is located in the back ground of minimum or zero range of pixels as layer-2. The layer-2 is appeared with the background of maximum range of pixels as layer-3. The image is in RGB format. It is converted in to gray scale format using the equ.1 to 4.

$$G1 = 0.2989 * \text{Red value of the pixel} \quad (1)$$

$$G2 = 0.5870 * \text{Green value of the pixel} \quad (2)$$

$$G3 = 0.1140 * \text{Blue value of the pixel} \quad (3)$$

$$\text{Pixel gray value} = G1 + G2 + G3 \quad (4)$$

IV. GAUSSIAN NOISE

The tissue present in the lung portion is to be highlighted. An intensity of the lung portion is to be increased than the other area. The gaussian noise is mixed with the gray scale image.

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$$P(N) = \frac{1}{\sigma\sqrt{2\pi}} \times e^{-\frac{(n-\mu)^2}{2\sigma^2}} \quad (5)$$

The term 'P' is the probability function. The term 'N' is the gaussian random variable, 'μ' is the mean values, and the 'σ' is the standard deviation.

V. MEDIAN FILTER

A median filter is a non linear filter used to filter the sharp projections. It works based on the masking windows. The windows are in the odd number. It is used to remove the other than tissue portion in the image. In the proposed work [5 5] masking window is used [16]. Totally 25 number of pixels are involved. The pixels are arranged in the ascending order. The target pixel is replaced by the middle pixel.

VI. EDGE DETECTION

The edge detection technique is used to find the boundary pixels. The canny edge detection is having the parameters such as upper threshold, lower threshold (z), and sigma (σ) parameter [17]. In the proposed work, canny edge detection with threshold value of 5 is fixed.

$$Canny_{x,y} = \frac{1}{2\pi\sigma^2} \exp\left(-\frac{(x-(z+1))^2 + (y-(z+1))^2}{2\sigma^2}\right) \quad (6)$$

Where x, y are the pixel positions

VII. WATERSHED TRANSFORMATION

The image is further divided into region. The gradient magnitude is computed for region. The watershed transform is applied on the each region. It converts the pixel regions in to RGB format. It is used for the purpose of projecting lungs regions to get the better visualization.

VIII. WATERSHED TRANSFORMATION

The morphological operation is used to group [1] and process the pixels based on the shapes such as square, rectangle, circular, pentagon, etc. morphological area open, area close, and border clear operations are performed in the proposed work. Image is dilated before the specific morphological operation.

Area Open:

$$A \circ B = (A \oplus B) \ominus B \quad (7)$$

Where 'A' is the input image and 'B' is the structuring element.

Area Close:

$$A \circ B = (A \oplus B) \ominus B \quad (8)$$

The image reconstruction operation is performed with area open and image complement operation.

$$X \oplus B = \left\{ Z \left[\left(B \right)_Z \cap X \right] \subseteq X \right\} \quad (9)$$

Dilation operation is given in the Equ.9. The term B is the rotated image of the original element. 'X' is the reference image and 'B' is the structuring element. 'Z' is the output element. The output element is one of the intersecting elements of 'B' and 'X'.

IX. REGIONAL MAXIMUM PIXEL

The maximum pixel is identified in the each region. The morphological image reconstruction operation is performed on each region. The tissue threshold is computed at this position. The image is converted in to binary format with the obtained tissue threshold value.

X. OBJECT AREA DETECTION (OAD ALGORITHM)

The regions of tissue are to be identified from the whole spread image. The tissue portion is in logic '0' pixel and non-tissue portions are in logic '1' pixel. The OAD is a search algorithm. It performs the search of white pixel from one end to another end. Initially search is performed from left to right end, right end to left end, top to bottom search, and bottom to top search.

A. Algorithm To Find Least Left End White Pixel Value

```
for i = 1: r
    for j = 1: c
        if ( test_z ( i,j ) == 1 )
            if ( r_min > i )
                r_min = i;
            end
        end
    end
end
```

The terms 'i' and 'j' are the initial value of row and column. The 'r' and 'c' are the maximum value of row and column of the image. Result of least left end white pixel is stored in r_min..

B. Algorithm to find least top end white pixel value

```
for i = 1: r
    for j = 1: c
        if ( test_z ( i,j ) == 1 )
            if ( c_min > j )
                c_min = j;
            end
        end
    end
end
```

The result of least top end white pixel is stored in c_min.

C. Algorithm to find the least right end pixel position

```
for i = 1: r
    for j = 1: c
        if ( test_z ( i,j ) == 1 )
            c_max = j;
        end
    end
end
```

The result of least right end pixel position is stored in c_max.

D. Algorithm to find the least bottom white pixel value

```
for i = 1: r
    for j = 1: c
        if ( test_z ( i,j ) == 1 )
            if ( c_max < j )
```

```

c_max = j;
end
end
end
end

```

The result of least bottom most white pixel position is stored in c_max variable.

The results of the search algorithm are applied in the equ. 7 to equ. 10.

$$x_position = x_location \quad (10)$$

$$y_position = y_location \quad (11)$$

$$width = c_max - y_location \quad (12)$$

$$width = c_max - y_location \quad (13)$$

The tissue position located and the image cropping is applied to segment the tissue area from the lungs.

XI. TISSUE SPREAD COMPUTATION

The lung area is calculated using the input image positions. The tissue area is calculated from the cropped image. Finally spread tissue in percentage is computed using the equ. 11.

$$\text{Tissue spread} = \frac{\text{Total lung area}}{\text{Tissue affected area}} \times 100 \quad (14)$$

XII. RESULTS AND DISCUSSION

The CT scanned lung image is obtained from the scan center. The images are with the resolution of either 1360x768, or 1318x 619. A disease affected image shown in the Fig.1. The tissue is appeared in the middle upper middle part of the lung. The image is in 8 bit format and each pixel is represented in RGB values.

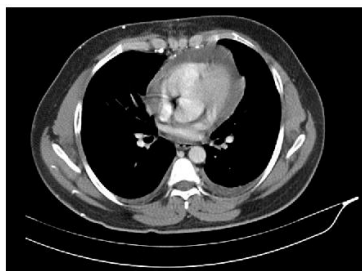


Figure 1 Disease affected input image

The input image is converted in to gray scale image. The corresponding result is shown in the Fig. 2. Now each pixel is replaced by the single gray scale value. The values vary from 0 to 255.

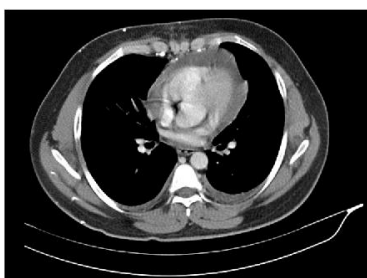


Figure 2 Gray scale image

The gaussian noise with '0' mean and 0.01 variance is applied on the gray scale image. The result is appeared in the Fig.3. The tissue pixels are having more visibility as compared with the gray scale image.

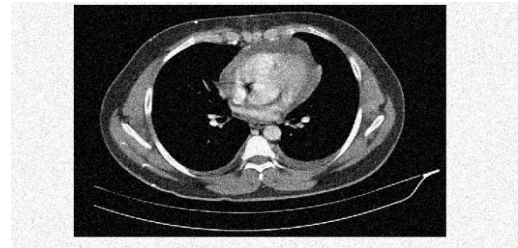


Figure 3 Gaussian noise mixed image

The median filter with the masking window of 5 x 5 is applied on the gaussian image and the corresponding result is shown in the Fig.4. It suppresses effect on layer-3. The sharpening effect of tissue pixels is slightly reduced. Further increasing of masking window will leads to remove the tissue area. The tissue visibility is increased as compared with the gaussian noise mixed image.



Figure 4 Median filtered image



Figure 5 Canny edge detected image

The canny edge detection is performed on the filtered image. It is shown in the Fig.5. The edge of lungs pixels is projected. The gradient magnitude of each is computed from the edge pixels and the corresponding progress is shown in the Fig. 6.

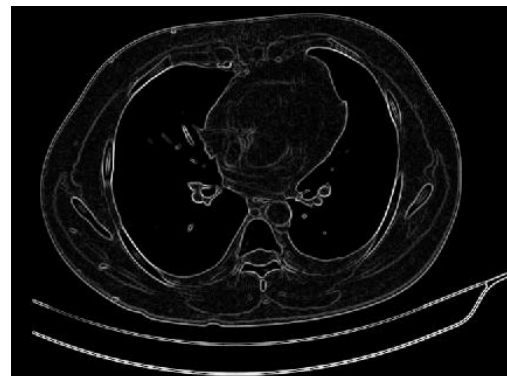


Figure 6 Gradient magnitude image

The water shed transform is applied on the gradient image. It fills the RGB value in the each region and shown in the Fig.7. The non-lung area is appeared in the uniform color spectrum. The lung area is appeared in the distributed color spectrum.

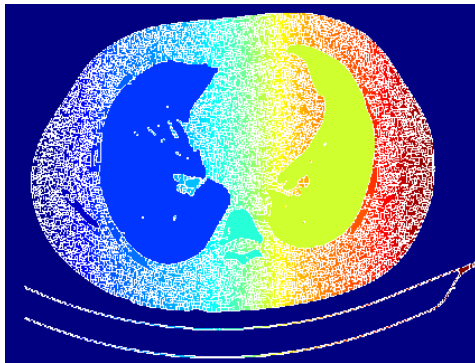


Figure 7 watershed transform

The morphological strel and area open is performed with the disk template. It groups the pixels and the corresponding result is shown in the Fig. 8. The tissue area and few other lung areas in lower lung position are appeared.

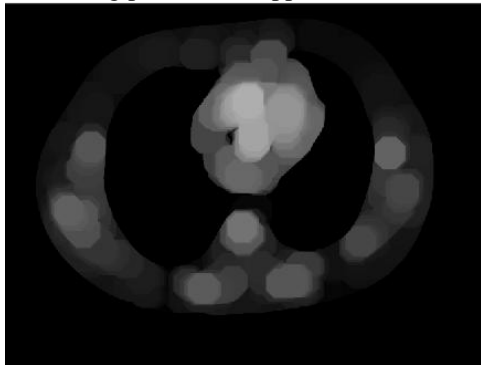


Figure 8 Morphological area open

The area open image is complemented. The image is reconstructed using area open, and complemented image. The corresponding result is shown in the Fig. 9. The tissue pixels are having more visibility than the other lung pixels.



Figure 9 Reconstruction of morphological area open image

The morphological area close and followed by the reconstruction is applied on the area open image. The corresponding results are shown in the Fig.10 and Fig.11.



Figure 10 Morphological area close



Figure 11 Reconstruction of morphological area close

The regional wise maximum pixels are computed on the reconstructed area open and close image. It is appeared in the Fig.12. The image is super imposed and appeared in the Fig. 13.



Figure 12 Regional maxima of area open and close

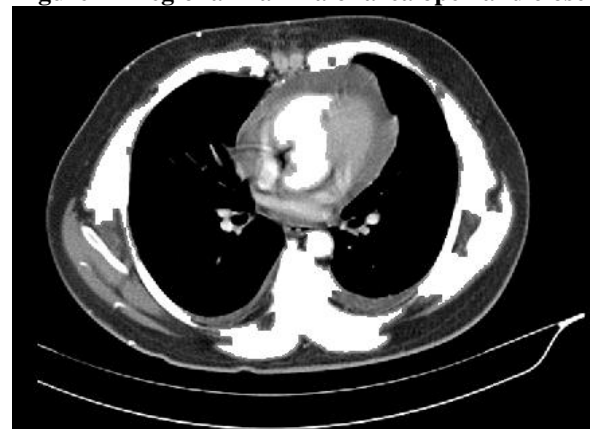


Figure 13 Super Imposed regional maximum image

The global threshold in the tissue area is computed. The Otsu's method is applied using the global threshold. The result is shown in the Fig.14. The tissue portion is clearly appeared in the binary format. All other lung area suppressed.



Figure 14 Global thresholding using Otsu's

Morphological border clear function is applied after the Otsu's method. It clears the 3 layer which is appeared in the logic-1 pixel value. It is shown in the Fig.15.



Figure 15 Disease affected input image

Table I: Results of OAD parameter

Image No	OAD parameters			
	X position	Y position	Width	Length
1	107	578	133	144
2	152	612	136	155
3	141	582	141	160
4	138	520	163	196
5	143	511	295	318
6	149	568	164	169
7	159	606	155	315
8	111	579	136	143
9	124	587	69	116
10	129	507	156	319

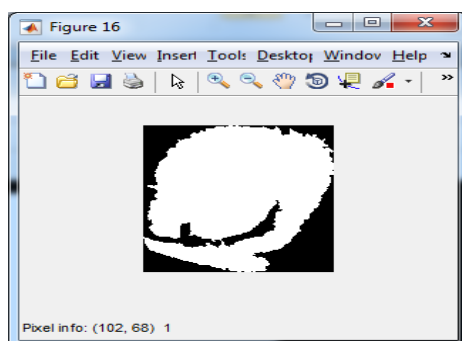


Figure 16 Cropped tissue part using OAD regions

The Table-1 shows the results of OAD parameters. The tissue positions to be cropped are listed in the table. The image cropping operation is performed using the table-1 parameters. The Image no.1 parameter is applied in cropping and the corresponding result is shown in the Fig.16. The appeared image is appeared in the monochrome format.

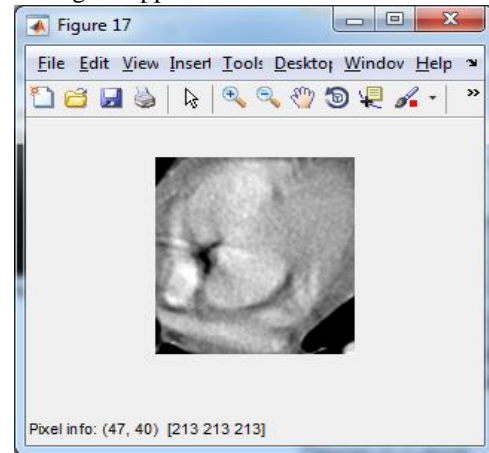


Figure 17 Tissue cropped from the captured input image

The cropped parameters are applied on the original input image and shown in the Fig. 17. The lung portion covered by the tissue is appeared.

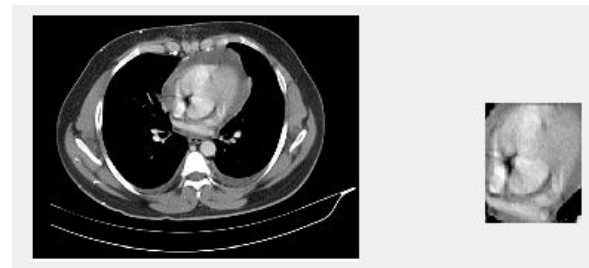


Figure 18 Input and cropped tissue

The input image and cropped output is shown in the Fig.18 for realization. The percentage of tissue spread in the image is further computed. The Table-II shows the various patients with tissue detection and tissue spread in percentage.

Table II: Percentage tissue spread

Image No	Percentage of tissue spread
1	6.1294
2	6.7429
3	7.2120
4	10.1918
5	15.508
6	9.241
7	8.781
8	12.25
9	7.9123

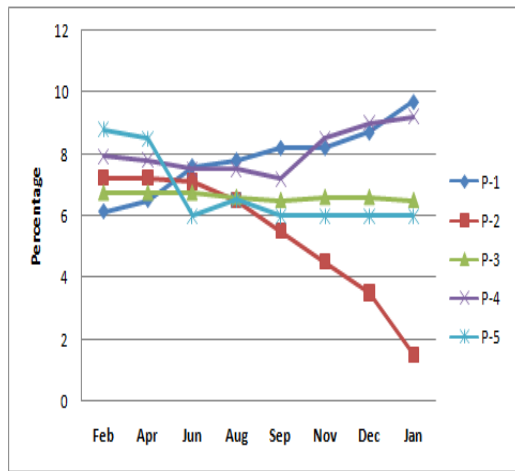


Figure 19 Tissue growth analysis

The five sample of growth history was collected from the 5 patients namely P-1, P-2, P-3, P-4, P-5 respectively. The samples are collected with the periodic intervals. The few data is given the result. It shows the P-1 tissue is increased. The tissue for P-2 is decreased. It shows the tissue was dissolved.

The tissue level of P-3 is decreased but it is not reduced. The tissue growth is happened for P-3 patient. The tissue level of P-4 patient gets increased.

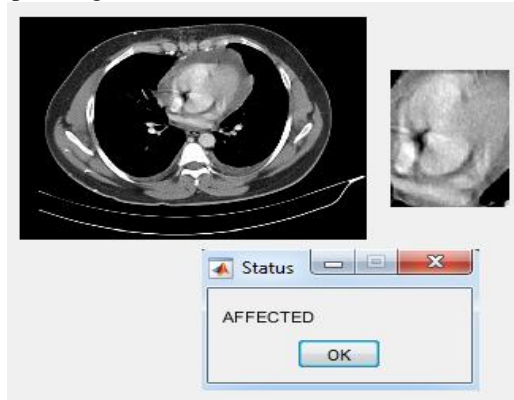


Figure 20 Result of affected image

The CT scanned lung image is obtained from the scan center. The images are with the resolution of either 1360 x768, or 1318x 619. A disease affected image shown in the Fig.21. The tissue is appeared in the middle upper middle part of the lung. The image is in 8 bit format and each pixel is represented in RGB values.

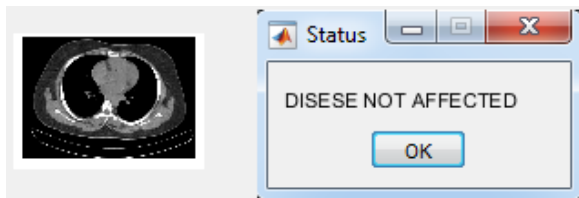


Figure 21 Result of unaffected image

The Fig.20 and Fig.21 shows the sample result given by the proposed work for tissue affected and unaffected images.

XIII. CONCLUSION

The proposed work was tested using 50 samples of affected and 40 unaffected images. The input image was subjected into preprocessing stages. Median filter, global thresholding, watershed transform, Otsu's methods are used in the preprocessing and enhancement stages. The OAD algorithm is applied to detect the exact boundaries of tissue area. The

historical growth of tissue was also analyzed. The percentage of tissue spread in lung area was successfully computed.

REFERENCES

1. Amjed S, Fahoum, Jaber, Jarrah, Automated detection of lung cancer using statistical and morphological image processing techniques, *Journal of biomedical graphics and computing*, vol. 4, No. 2, pp: 33- 42, 2014.
2. Eman, zayed, Faakhr, Automatic classification of normal and cancer lung CT images using multiscale AM-FM features, *Int J Biomed Imaging*, pp: 1 -7, 2015
3. Eggert, Palavanzadeh, Blanton, Screening and early detection of lung cancer, *Oncology nursing*, Elsevier, Vol 33, no. 2, pp: 129-140, 2017
4. Thiyaneswaran B, Saravanakumar A, Kandiban R: Extraction of Mole from Eye Sclera using Object Area Detection Algorithm, *IEEE International Conference on wireless communication signal processing and networking*, pp: 1413-1417 (2016).
5. Shenglin, Wenzhe, bing, Shirong, Multiplexed serum biomarker for the detection of lung cancer, *Ebiomedicine*, Elsevier, pp:210-218, 2016.
6. Amita, Gunjan, Amit, Fahimuddin, Allam, Computational and clinical approach in lung cancer detection and analysis, Vol. 89, pp: 528-533, 2016.
7. Bariqi, Alhadi, Devvi, Image processing based detection of lung cancer on CT scan images, *Journal of physics*, 2017
8. Babarinde, Famlos, Soh, Schreurs, and Beyer, Microwave imaging technique for lung tumor detection, *IEEE Microwave conference*, pp:100-103, 2016.
9. Sangamithraa, and Govindaraju, Lung tumor detection and classification using EK-mean clustering, *International conference on wireless communications, Signal processing and networking*, pp:2201-2206, 2016.
10. Buket, Hasan, Emre, Context-sensitive model learning for lung nodule detection, *International conference on signal processing and communication application*, 1521-1524.
11. Shamala, Kulhalli, CAD system for lung cancer detection using ANN, *IOSR journal of electronics and communication engineering*, pp:11-15, 2015
12. Gaiwad, and Inamdar, Lung cancer detection using image processing on CT scan images, Vol.3, No.4, 2016.
13. Khin, Aung, Implementation of lung cancer nodule feature extraction using digital image processing, *International journal of scientific engineering and technology*, Vol.3, No.9, pp:1610-1618, 2014.
14. Mokhled, Tarwneh, Lung cancer detection using image processing techniques, *Leonardo electronic journal of practices and technologies*, No. 20, pp:147-158, 2012.
15. Rubin, Lung nodule and cancer detection in CT screening, *Journal of thoracic imaging*, Vol.30, No.2, 2015.
16. Sandhiya D, Thiyaneswaran B, Extraction of dorsal palm basilic and cephalic hand vein features for human authentication system, *IEEE International Conference on wireless communication signal processing and networking (WISPNET'17)*, pp: 2260-2264, 2017.
17. Thiyaneswaran B, Kandiban R, Jayakumar K S, Elimination of iris hazards indented for localization using visible features for IRIS region, *Procedia Engineering*, Vol.38, pp: 246-252, 2012.

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Dr.B.Thiyaneswaran is carried out a research on IRIS Biometrics. He completed under graduate program in the year of 2014. He completed post graduate program in the year of 2007. He completed the doctorate in the year of 2014. He He had developed an algorithm for IRIS recognition. Currently he is doing the research on

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