Scientific Journal of Impact Factor (SJIF): 5.71
e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 08, August -2018

MEDICAL IMAGE SEGMENTATION AND DETECTION OF LUNG TUMOR ON CT SCAN IMAGES

[1]Apurva V. Ital, [2]Dr.Mrs.S.O.Rajankar

[1]Department of Electronics, Sinhgad college of Engineering,Vadgaon(BK),Pune
[2]Department of E&TC, Sinhgad college of Engineering,Vadgaon(BK),Pune

Abstract - *In order to improve the survival rate of lung cancer patient, early detection has a significantly more hopeful prognosis and is the key treatment. CT scanning presents great opportunities for lung cancer diagnosis. In this paper median filter is used for image preprocessing. For image segmentation, thresholding and marker controlled Watershed segmentation approach is used to segment the lung of CT image. In feature extraction step, Gray-level co-occurrence matrix is applied. Depending on the lung feature extraction, decision is made whether the lung has nodule or not. Diagnosis is mostly based on CT (computed tomography) images. CT scanning presents great opportunities for lung cancer diagnosis. The main objective of this paper is to implement lung nodule segmentation and feature extraction using digital image processing for the classification of the disease stages to avoid serious stages early and to reduce lung cancer percentage distribution. These images are more efficient and detailed than X-ray or other conventional methods. MATLAB is one of the most widely used computer program for the examination and study of CT scanned images. This prototype work proposes a convenient and low-cost procedure to detect the cancerous cells accurately from the captured lung CT scanned images.*

Keyword: *Computed Tomography (CT), Image Processing, Lung Cancer; CT scan, GLCM, Matlab2017a.*

I. INTRODUCTION

The lung cancer detection can be done by taking a screening using Computed Tomography (CT) Scan. The CT Scan result then observed on morphological guide of lung cancer as the diagnostic criteria such as the size of the tumor, enhancement, irregular speculated margin, lobulated, water bronchograms, ground glass opacity, and heterogeneous density. The lung cancer diagnosis by using CT Scan image which conducted by a radiologist may lead to an error influenced by the blurring of anatomical structures surrounding the lung area, the small size of lesions, and also the different experiences of the radiologist generate a different interpretation . To avoid the errors and to improve the accuracy and consistency, a computer-based digital image processing is necessary as the second opinion to read the CT scan image result. There are many techniques to diagnose the lung cancer, such as Chest Radiograph (x-ray), Computed Tomography (CT), Magnetic Resonance Imaging (MRI scan) and Sputum Cytology. However, most of these techniques are expensive and time consuming. 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 use of image processing techniques can assist radiologists and doctors in diagnosing diseases and to offer a rapid access to medical information gained importance in a short time.

II. LITERATURE SURVEY

Khin Mya Tun, Aung Soe Khaing [12] in this paper mean filter and median filter is used for image pre-processing. For image segmentation Otsu’s thresholding and marker controlled watershed segmentation approach are used to segment the lung of CT image. In feature extraction step, the physical dimensional, measure and the gray-level co-occurrence matrix (GLCM) method are applied. Depending on the lung feature extraction decision is made whether the lung has nodule or not. Diagnosis is mostly (Computed Tomography) images. CT scanning presents great opportunities for lung cancer diagnosis. The main objective of this paper is to implement lung nodule segmentation and feature extraction using digital image processing for the classification of the disease stage to avoid serious stage early and to reduce lung cancer percentage distribution. Reference -

S Vishukumar K. Patel and Pavan Shrrivastav [13] here proposed gabour filter for enhancement of medical images. It is a very good enhancement tool for medical images. Significant improvement in contrast of masses along with the suppression of background tissues obtained by tuning the parameters of the proposed transformation function in the specified range. The manual analysis of the sputum samples is time consuming, inaccurate and requires intensive trained person to avoid diagnostic errors. The segmentation results will be used as a base for a Computer Aided Diagnosis (CAD) system for early detection of cancer, which improves the chances of survival for the patients. reference -

R. Jayashree and T. Anitha[14] in this paper Region growing algorithm proposed for segmentation of CT scan images of the lung. This algorithm starts with a seed pixel and checks other pixels that surrounds it. It determines most similar one and, if it meets certain criteria, it will meet certain region. In proposed approach for detection of cancer cell from the Ct scan image. The main idea of this is to detect the tumour and decide whether it is cancerous or not. It also finds the lung cancer stage and gives more accurate result by using different enhancement and segmentation technique.

Nihad Mesanovic, Mislav Grgic, Haris Huseinagic, Matija Males [4] in this paper lung segmentation technique i.e. region growing algorithm technique is proposed to accurately segment the lung parenchyma of lung CT images, which can help radiologist in early diagnosing lung disease, but algorithm can also be used to early diagnose other benign or malignant pathologies in other organs, such as liver, brain,spine. Segmentation process of lungs from thorax CT images is shown to be helpful to radiologist, because the focus for the analyzing the images is set only to the lungs, so users can pay attention only on the region of interest.

III. SYSTEM ARCHITECTURE

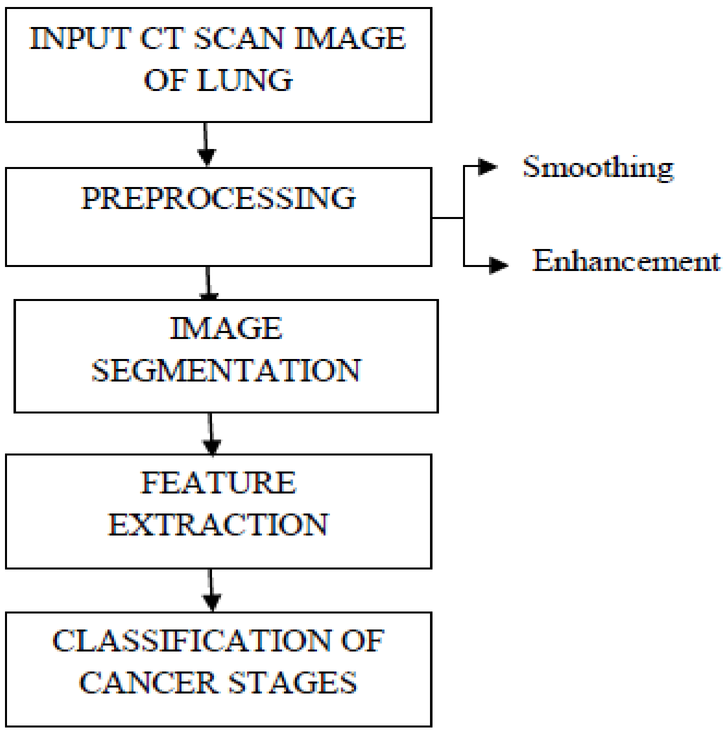

Fig. a. Block Diagram of Proposed System

In this block diagram,

A. Image Acquisition -

The foremost step in the medical image processing is image acquisition. The medical data is usually in DICOM format, which is the standered for storage and transfer of medical image. The lung CT images having low noise when compared to X-Ray scan images and MRI images. Thus CT images are taken for detecting of lungs. The main advantage of computed tomography image has better clarity, low noise and distortion. Lung CT images are given as an input. Input images are taken from LIDC-IDRI database retrieved from http://wiki.cancerimagingarchive.net/. Dimension of images are 256x256 pixels in size. The input CT images contain noises such as white noise, salt and pepper noise etc. So image processing stage is needed to eliminate noises.

B. Pre-Processing

The First Step of process is pre-processing which is divided into two areas i.e.

1. **Smoothing:** The median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The median filter is a nonlinear digital filtering technique, often used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise also having applications in signal processing.

2. **Enhancement:** In enhancement, we are used Gabor filter. It is basically analyses whether there are any specific frequency content in the image in specific directions in a localized region around the point or region of analysis. Frequency and orientation representations of Gabor filters are claimed by many contemporary vision scientists to be similar to those of the human visual system, though there is no empirical evidence and no functional rationale to support the idea. The Gabor function is a very helpful tool in image processing, texture analysis. It is a linear filter and its impulse response is derived from the multiplication of harmonic function and gaussian function. It is a band pass filter. It is used to increase the contrast between the nodule areas and other structure around it. The mathematical expression for the gabor filter is given in equation (1).

$$g\,(x, y) = \exp\left(-\frac{x'^2+\gamma^2 y'^2}{2\sigma^2}\right) \cos\left(2\pi \frac{x'}{\lambda} + \varphi\right) \qquad (1)$$

$$x' = x\cos\theta + y\sin\theta$$
$$y' = -x\cos\theta + y\sin\theta$$

λrepresents the wavelength of the sinusoidal wave.
θ denotes for the orientation of normal to parallel stripes of gabor function.
φ denotes phase offset.
σ denotes standard deviation
γ is spatial aspect ratio

C. Image Segmentation:

Segmentation is used to divide an image into different small regions or objects. It has many applications in the medical field for the segmentation of the 2D medical images. It is an important process for most image analysis following techniques. There are various methods available for image segmentation. In this paper, thresholding and marker controlled watershed segmentation methods are used. Watershed transform is a common technique for image segmentation. It is a classical and effective segmentation method by which one pixel wide continuous edge can be extracted. More importantly it has the advantage of high segmentation precision and accurate positioning. Its drawback includes over-segmentation. Generally watershed transform is computed on gradient image, where the boundaries of the catchment basin are located at high gradient points. To overcome the drawback marker based segmentation is applied on watershed segmented image.

Marker based watershed transform:

Over-segmentation is well known drawback in watershed segmentation. This phenomenon is more serious by applying standers watershed transform on gradient image of pulmonary CT slice.

By using marker based watershed transform proposed in this paper, we can decrease the regional minima and bound them within the region of interest to prevent over-segmentation.

The details of this approach are described in the following steps:

- First read an image and original one is transformed into a gray image.
- Watershed transform is applied on gradient image. The Sobel masking operator is applied on the CT gray image in both horizontal and vertical directions to create the fradient image. Watershed algorithm can be directly tested on it, and then its segmentation result will be a contrast.
- If the over-segmentation is serious, the foreground and background should be marked. Select a circular structuring element and then apply open morphological operation and morphological reconstruction.
- Following, apply morphological clearance operation and reconstruction to obtaine its complement image.
- A local maximum display the maximum areas in original image.
- Again apply an appropriate open and clearance operator to modify local maximum areas.
- The modified image then is changed into binary image.
- Finally, apply watershed transform on the binary image.

D. Feature Extraction:

After the segmentation is performed on lung region, the segmented nodule is used for feature extraction. Feature extraction is one of the most important steps in this system. A feature is a significant piece of information extracted from an image which provides more detailed understanding of an image. All the calculated features from the image carry some information about lung nodules. These contain important information to detect malignant or non-malignant. A feature is defined as a function of one or more measurement, the values of some quantifiable property of an object, computed so that it quantifies some significant characteristics of the object.

The texture feature extraction is performed on the quantized image by using Gray level co-occurrence matrix (GLCM) method, one of the most known texture analysis method. A gray level co-occurrence matrix is a second order statistical measure introduced by Haralick. GLCM is the gray-level co-occurrence matrix (GLCM), also known as the gray level spatial dependence matrix. A statistical method of examining texture that considers the spatial relationship of pixels is the gray-level co-occurrence matrix (GLCM), also known as the gray-level spatial dependence matrix. The GLCM functions characterize the texture of an image by calculating how often pairs of pixel with specific values and in a specified spatial relationship occur in an image, creating a GLCM, and then extracting statistical measures from this matrix. After we create the GLCMs, using graycomatrix, we can derive several statistics from them using graycoprops. These statistics provide information about the texture of an image. The following lists the statistics.
Contrast: Measures the local variations in the gray-level co-occurrence matrix.

Correlation: Measures the joint probability occurrence of the specified pixel pairs.

Energy: Provides the sum of squared elements in the GLCM. Also known as uniformity or the angular second moment

Homogeneity: Measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal.

Along with this some other features such as Autocorrelation, Correlation, Cluster prominence, Cluster shade, Dissimilarity, Entropy, Max Probability, Sum of average, Sum of Variance, Sum of Entropy, Difference Entropy, Information measures of correlation are calculated.

E. Classification: Classification is the final step in image processing to obtain the required information. After feature Extraction process these training features are compared with the testing features and obtaining the difference between two. If difference is related to normal cancer stage category then classification will give result as "no cancer" and if it relate to cancerous category then it will show result as "cancer detected".

RESULTS

1. Simulation result of Pre-processing:

a. Simulation result of Image smoothing:

Image smoothing is a De-noising method for which median filter is used. This filter removes the noise while keeping edged sharper. It is more effective for removing salt and pepper type of noise. It does not degrade the edges as well smoothness white additive noise and also removes impulses. Fig. b. shows median filtered image.

Fig. b. Median filtered image

b. Simulation result of image enhancement:

Image Enhancement is a way to improve the class of an image. For this Gabor filter is used. It is a best tool for enhancement in image processing. It is effectively increased contrast between nodule area and structure around it between nodule area and structure around it. Following Fig. c shows Enhance image.

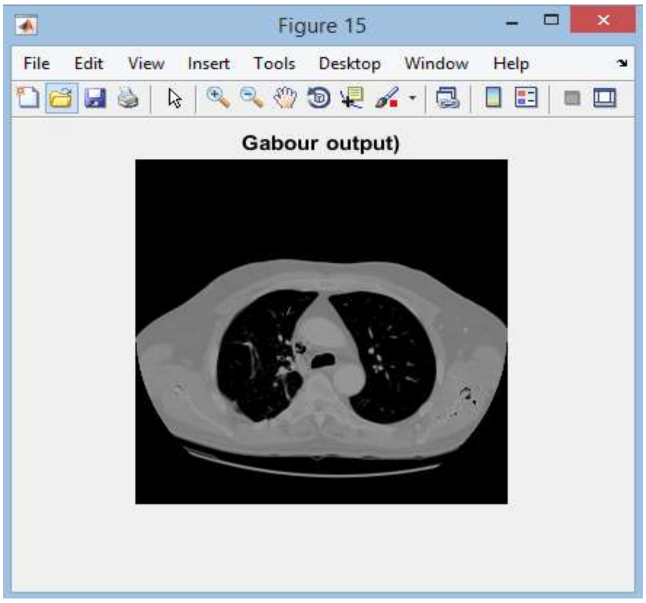

Fig. c. Gabour filtered image

2. Simulation result of finding circular object

Here finds the circles in image whose radii are approximately equal to radius. The output, centers, is a two-column matrix containing the *x*, *y* coordinates of the circles centres in the image shown in Fig. d

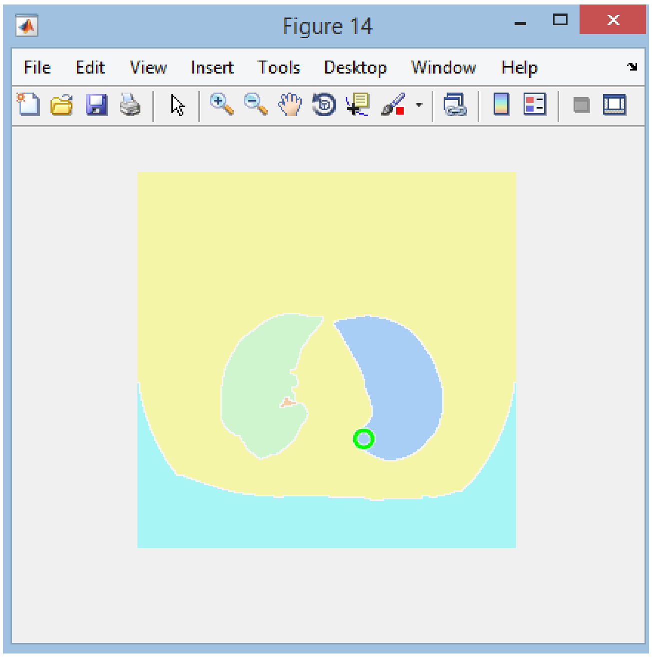

Fig. d. Circular object

3. Final result display on GUI

Visualizing the result on Graphical user interface it allows user to interact with electronic devices through graphical icon and visual indicator shown in Fig. e

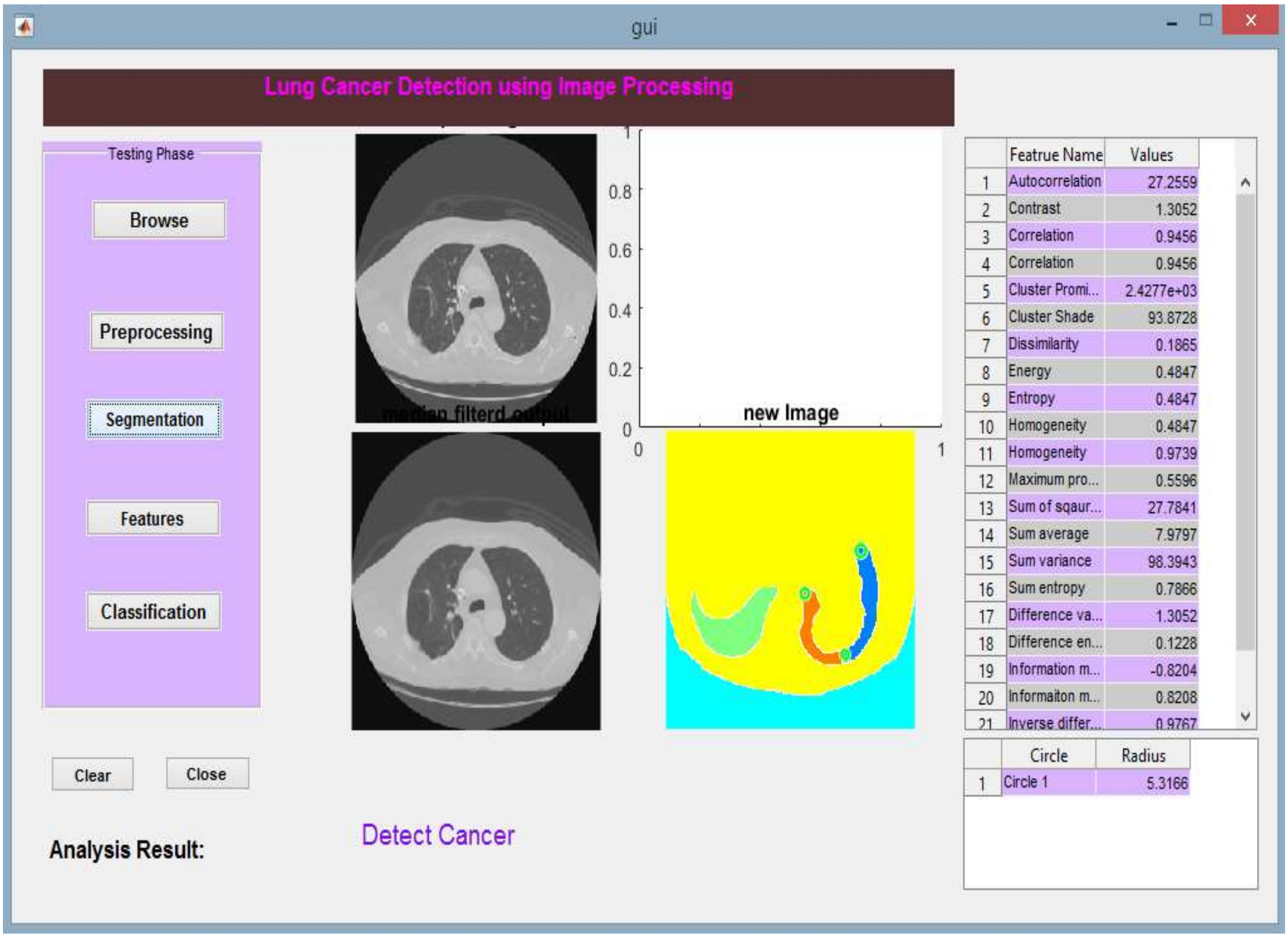

Fig. e. Final result on GUI

4. Simulation result of performance evaluation:

Among the 50 images of lung cancer, with the help of these images the values of TP, FP, FN, TN are calculated. Sensitivity, accuracy, specificity are determined and given in table.

Table 1. Parameter Evaluation

Parameters	**System result**
True Positive	**46**
False negative	**4**
True negative	**48**
False positive	**2**
Accuracy	**94**
Sensitivity	**92**
Specificity	**96**

CONCLUSION

In this system, image pre-processing and image segmentation are implemented to obtain the diagnosis result. By using these steps, the nodules are detected and some features are extracted. The extracted features can be used for classification of disease stages. Determining the nodule features can provide to know more information of the condition of lung cancer at the early stages. This technique helps the radiologists and the doctors by providing more information and taking correct decision for lung cancer patient in short time with accuracy.

REFERNCES

[1] Non-Small Cell Lung Cancer, [online available], http://www.katemacintyrefoundation.org, Adapted from National Cancer Institute (NCI) and Patients Living with Cancer (PLWC), 2007, accessed on 13 July 2013.

[2] Anatomy of lung picture and beginning of cancer, [online available], www.allreferhealth.com, accessed on 4 June 2013.

[3] A.Amutha and R.S.D Wahidabanu, "A Novel Method for Lung Tumor Diagnosis and Segmentation using Level Set-Active Contour Modelling", European Journal of Scientific Research, Vol.90, No.2, November 2012, pp.175-187

[4] Nihad Mesanovic, Mislav Grgic "Automatic CT image Segmentation Of The Lungs With Region Growing Algorithm

[5] Mokhled S. Al-Tarawneh, "Lung Cancer Detection Using Image Processing Techniques", Leonardo Electronic Journal of Practices and Technologies, Issue 20, January-June 2012, p.147-158. ISSN 1583-1078

[6] N.A. Memon et. al, "Segmentation of Lungs from CT Scan Images for Early Diagnosis of Lung Cancer," World Academy of Science, Engineering and Technology. 2006.

[7] Lung Cancer Database Consortium, [online available],www.eddie.via.cornell.edu.com, accessed on 22 July 2013.

[8] Digital Imaging and Communications in Medicine (DICOM) Part 1: Introduction and Overview, National Electrical Manufacturers Association, 2006, pp. 11.

[9] S Jayaraman, S Esakkirajan and T Veerakumar, "Digital Image Processing",3rd edition, Tata McGraw Hill,2010,ISBN(13):978-0-07-014479-8, ISBN (10): 0- 07014479-6.

[10] Gonzalez R.C., Woods R.E., "Digital Image Processing using MATLAB", Upper Saddle River, NJ Prentice Hall, 2008.

[11] Levner I., Zhang H., "Classification-Driven Watershed Segmentation", IEEE Transactions on Image Processing, 2007, 16(5), 1437-45.

[12]Khin Mya Mya Tun, Aung Soe, Khaing "Implementation of lung canver nodule feature extraction using Digital image processing" Vol.03,Issu.09,May-2014, ISSN 2319-8885 pp-1610-1618

[13]S. Vishukumar K. Patel and Pavan Shrivastav "Implementation Of Medical Image Enhancement Technique Using Gabour Filter"International Journal of current Engineering and Technology. ISSN 2277-4106.

[14] R.Jayashree and T.Anitha "Modified Watershed Transform For Lung Cancer Detection" vol. no. 04, issue no.06,October-November-2016,5060-5065.

