Performance Analysis of Lung Disease Detection and Classification

Deivanai S[1], Jagadeeshwari S[2], Kaviya G[3], Ganesh K R[4]

[1,2,3]*Student, Department of EIE, Valliammai Engineering College, SRM Nagar, Kattankulathur, Tamilnadu, India*

[4]*Assistant Professor, Department of EIE, Valliammai Engineering College, SRM Nagar, Kattangulathur, Tamilnadu, India*

---***---

Abstract: Lung disease, a heterogeneous group of parenchymal lung disorder is a great menace to human health. Segmentation is a major step in the estimation of lung disease using Computer Aided Diagnosis (CAD) system. An automatic segmentation of lung field is presented which separates the exact lung region from the background CT slice. After that Thresholding and Morphological method is used for identify or detection of Lung Disease in extracted lung region. Finally the segmented images are applied with feature extraction that helps us to select the relevant attributes for classifying and detecting the injected areas. By enforcing K-Nearest Neighbour approach, the images are classified. Performance indices such as Accuracy, Precision, Sensitivity and Specificity will be studied.

Keywords: Thresholding and Morphological method, KNN approach

I. INTRODUCTION

A large number of diseases that affect the worldwide population are lung-related. Therefore, research in the field of Pulmonology has great importance in public health studies and focuses mainly on asthma, bronchiectasis and Chronic Obstructive Pulmonary Disease (COPD) (Holanda et al., 2010; Winkeler, 2006).

The World Health Organization (WHO) estimates that there are 300 million people who suffer from asthma, and that this disease causes around 250 thousand deaths per year worldwide (Campos and Lemos, 2009). In addition, WHO estimates that 210 million people have COPD. This disease caused the death of over 300 thousand people in 2005 (Gold Copd, 2008). Recent studies reveal that COPD is present in the 20 to 45 year-old age bracket, although it is characterized as an over-50-year-old disease. Accordingly, WHO estimates that the number of deaths due to COPD will increase 30% by 2015, and by 2030 COPD will be the third cause of mortalities worldwide (World…, 2014).

For the public health system, the early and correct diagnosis of any pulmonary disease is mandatory for timely treatment and prevents further death. From a clinical standpoint, diagnosis aid tools and systems are of great importance for the specialist and hence for the people's health.

CT images of lungs represent a slice of the ribcage, where a large number of structures are located, such as blood vessels, arteries, respiratory vessels, pulmonary pleura and parenchyma, each with its own specific information. Thus, for pulmonary disease analysis and diagnosis, it is necessary to segment lung structures. It is worth noting that segmentation is an essential step in image systems for the accurate lung disease diagnosis, since it delimits lung structures in CT images. Indeed, image processing techniques can help computer diagnosis if lung region is accurately obtained

II .BLOCK DIAGRAM
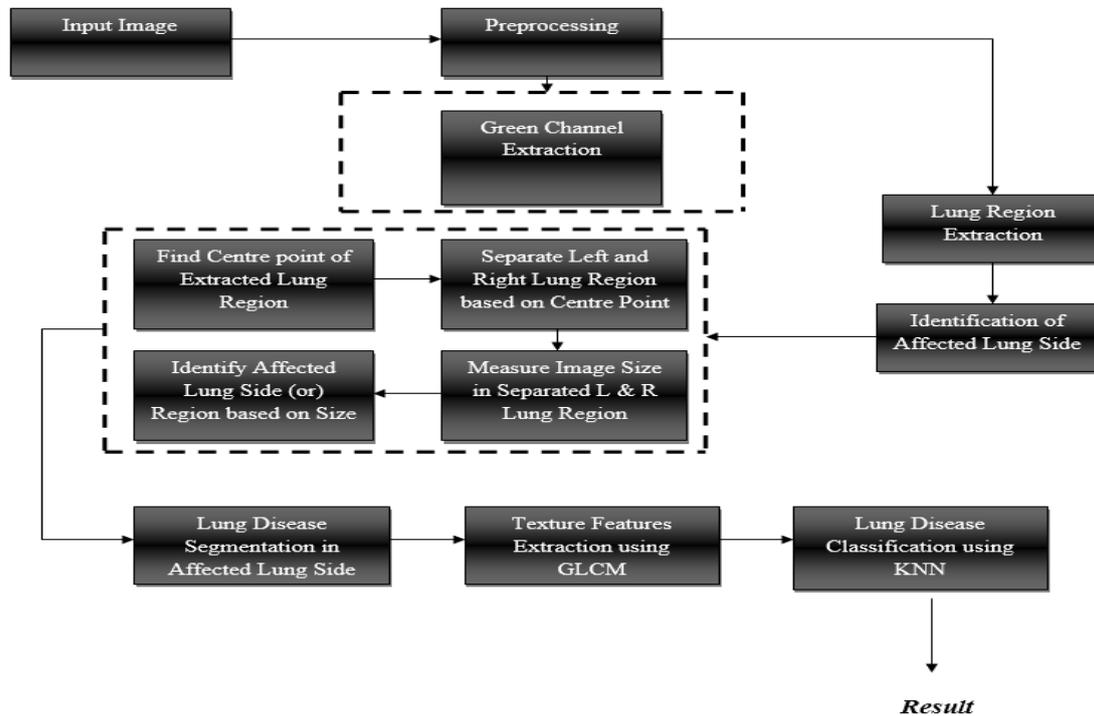
BLOCK DIAGRAM DESCRIPTION:

1. Image Acquisition:

Images are acquired from Gallery.

2. Preprocessing:

- The objective of the preprocessing phase is to apply possible image enhancement process to obtain the required visual quality of the CT lung image.
- The CT image is in RGB type which is an additive color of red, green, and blue. In preprocessing step, green channel extraction is performed from the RGB image.

3. Lung Region Extraction:

- In this step, lung regions extracted from the background CT slice image by using multilevel thresholding method.
- In order to, we get left and right lung region for further lung disease detection.

4. Identification of Affected Lung Side:

- In this step, affected lung side was identified by using size of lung region.
- First centre point was calculated for extracted both lungs.
- Based on the centre point, each lung region was separated.
- Next each separated lung size was measured.
- Finally based on size affected lung side was identified.

5. Lung Disease Segmentation:

i. Thresholding Method:

- Grayscale thresholding is employed to segment the nodule in the CT image. Binary image is called as thresholding image.

- Thresholding makes it possible to highlight pixels in an image. Thresholding can be applied to gray scale images or color images. In this discussion gray scale images are used. In Thresholding a pixel intensity value is adjusted, by taking the given value as reference the low intensity pixels will become zero and rest of the pixels will become 1. The result of the Thresholding is a binary image containing black and white pixels.

6. Feature Extraction:

i. Texture Feature:

- In statistical texture analysis, texture features are computed from the statistical distribution of observed combinations of intensities at specified positions relative to each other in the image. According to the number of intensity points (pixels) in each combination, statistics are classified into first-order, second-order and higher-order statistics.
- The Gray Level Co-occurrence Matrix (GLCM) method is a way of extracting second order statistical texture features. The approach has been used in a number of applications, Third and higher order textures consider the relationships among three or more pixels.
- Gray Level Co-Occurrence Matrix (GLCM) has proved to be a popular statistical method of extracting textural feature from images.

7. Classification:

- The classification process is done over the segmented images. The main novelty here is the adoption of K-nearest neighbour. KNN classifier is applied over the segmented images and the classification is done.

III. LITERATURE REVIEW

"Medical image segmentation by combining graph cuts and oriented active appearance models,"

X. Chen, J. K. Udupa, U. Bagci, Y. Zhuge, and J. Yao, IEEE Transactions on Image Processing, vol. 21, no. 4, pp. 2035-2046, 2012.

The proposed method consists of three main parts: model building, object recognition, and delineation. In the model building part, we construct the AAM and train the LW cost function and GC parameters. In the recognition part, a novel algorithm is proposed for improving the conventional AAM matching method, which effectively combines the AAM and LW methods, resulting in the oriented AAM (OAAM). A multiobject strategy is utilized to help in object initialization. We employ a pseudo-3-D initialization strategy and segment the organs slice by slice via a multiobject OAAM method. For the object delineation part, a 3-D shape-constrained GC method is proposed.

"Computer-aided diagnosis (CAD) of subsolid nodules: Evaluation of a commercial CAD system,"

J. Benzakoun, S. Bommart, J. Coste, G. Chassagnon, M. Lederlin, S. Boussouar, and M.-P. Revel, European Journal of Radiology, vol. 85, no. 10, pp. 1728-1734, 2016.

To evaluate the performance of a commercially available CAD system for automated detection and measurement of subsolid nodules. Materials and methods: The CAD system was tested on 50 pure ground-glass and 50 part-solid nodules (median diameter: 17mm) previously found on standard-dose CT scans in 100 different patients. True nodule detection and the total number of CAD marks were evaluated at different sensitivity settings. The influence of nodule and CT acquisition characteristics was analyzed with logistic regression. Software and manually measured diameters were compared with Spearman and Bland-Altman methods.

"Ground-glass opacity nodules detection and segmentation using the snake model,"

C. Bong, C. Liew, and H. Lam Bio-Inspired Computation and Applications in Image Processing, pp. 87-104: Elsevier, 2017.

A ground-glass opacity (GGO) is a pulmonary shadow comprised of hazy increased attenuation with preservation of the bronchial and vascular margins in a high-resolution computed tomography (CT) image. The appearances of GGO nodules on CT images are very different from solid nodules. The current nodules segmentation method does not work well for segmenting tiny nodules and GGO nonsolid or part-solid nodules. The objective of this study is to detect and segment the GGO nonsolid or part-solid nodules.

Selection of parameters in active contours for the phenotypic analysis of plants.

J. P. Chopin, S. J. Miklavcic, and H. Laga, "in 20th International Congress on Modelling and Simulation, 2013, pp. 510-516.

In this paper we attempt to establish relationships between the parameter values of active contour models and the geometry of the objects/shapes that they are segmenting. Our goal is for users to be able to utilize some basic a-priori knowledge about the geometry of the object in order to automatically select a range of suitable parameter values. We analyse the accuracy of active contour models over multiple series of shapes that exhibit some pattern, such as decreasing number of sides or increasing concavity. We present a novel normalization technique so that the parameter values are of a similar scale. We also carefully design an experimental setup that ensures no bias between different shapes or parameter values.

IV.SYSTEM DESIGN

DATA FLOW DIAGRAM:

1. The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of input data to the system, various processing carried out on this data, and the output data is generated by this system.

2. The data flow diagram (DFD) is one of the most important modeling tools. It is used to model the system components. These components are the system process, the data used by the process, an external entity that interacts with the system and the information flows in the system.

3. DFD shows how the information moves through the system and how it is modified by a series of transformations. It is a graphical technique that depicts information flow and the transformations that are applied as data moves from input to output.

4. DFD is also known as bubble chart. A DFD may be used to represent a system at any level of abstraction. DFD may be partitioned into levels that represent increasing information flow and functional detail.
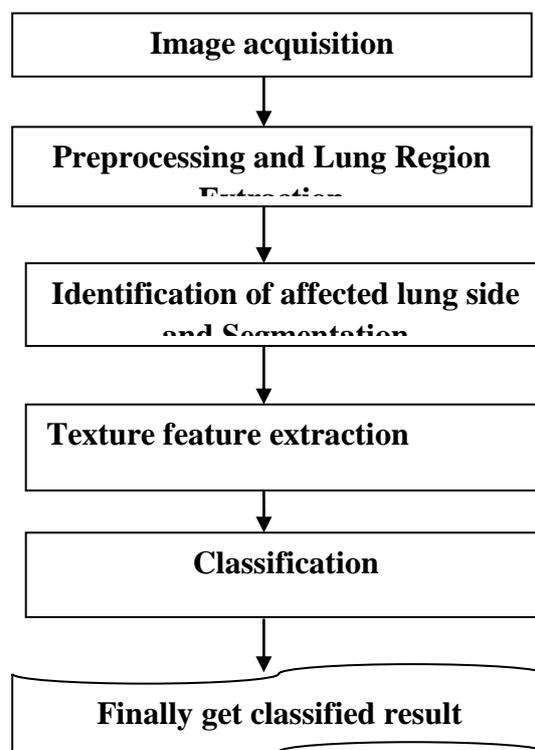
V. PERFORMANCE ANALYSIS
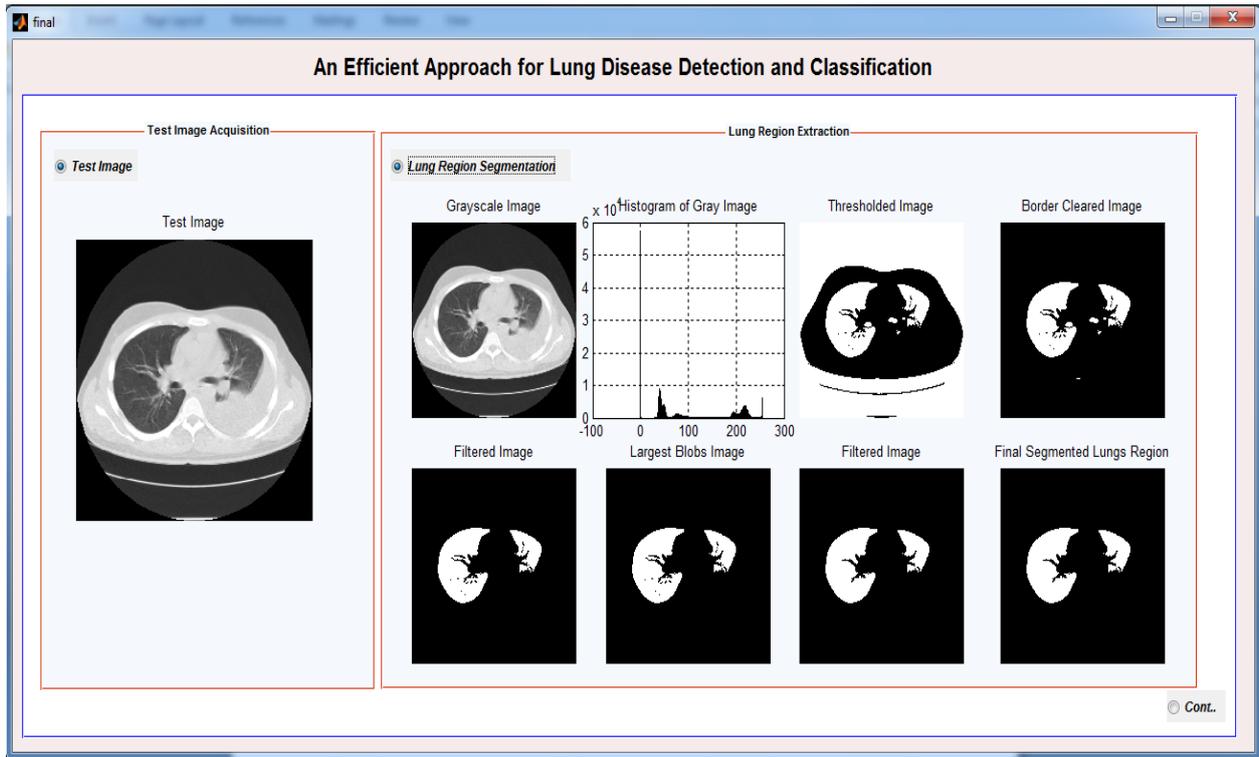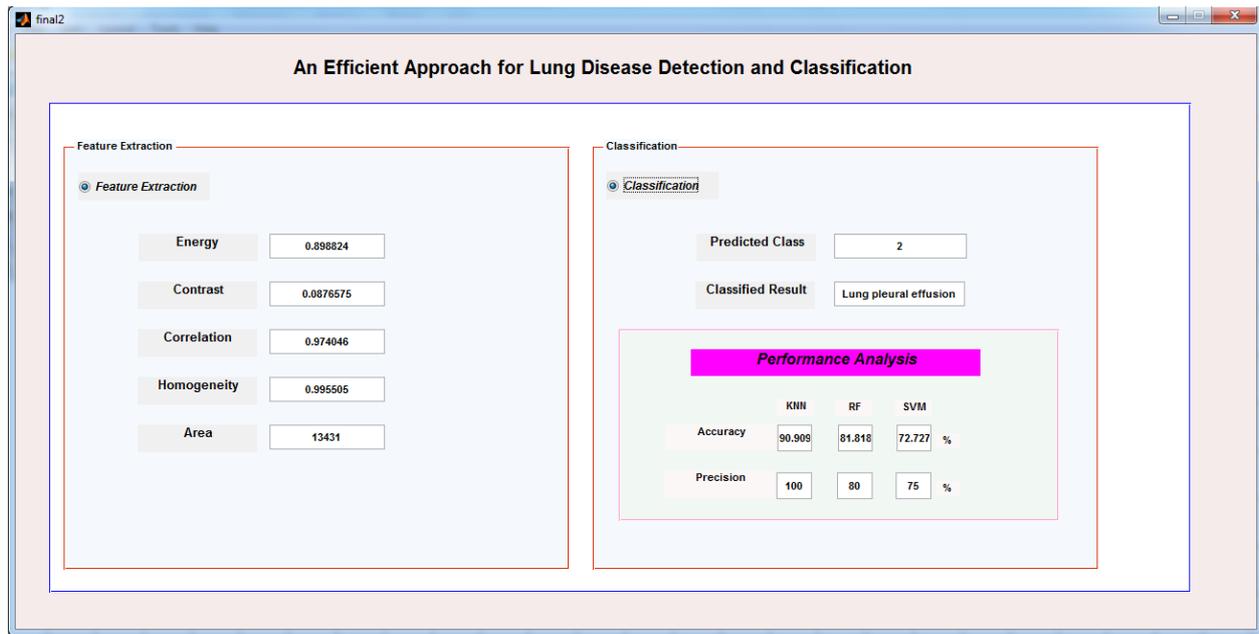
VI. CONCLUSION

An automatic system for segmentation and classification of lung disease in CT images is proposed. The image is acquired from the database and preprocessing operations like green channel extraction is proposed. The preprocessed output image is then segmented using the thresholding and morphological operation which is fast and yields good results. Finally classification is used for classified of segmented lung disease. Our Classification method achieved more accuracy than existing work.

REFERENCES

[1] Uppaluri R., Mitsa T., Sonka M., Hoffman E., and McLennan G., "Quantification of pulmonary emphysema from lung computed tomography images," Am. J. Respir. Crit. Care Med. 156, 248–254 (1997).

[2] Xu Y., Sonka M., McLennan G., Guo J., and Hoffman E., "MDCT-based 3-D texture classification of emphysema and early smoking related lung pathologies," IEEE Trans. Med. Imaging 25, 464–475 (2006).10.1109/TMI.2006.870889.

[3] Armato S., Giger M., and MacMahon H., "Automated detection of lung nodules in CT scans: Preliminary result," Med. Phys. 28, 1552–1561 (2001).10.1118/1.1387272.

[4] Li Q., Li F., and Doi K., "Computerized detection of lung nodules in thin-section CT images by use of selective enhancement filters and an automated rule-based classifier," Acad. Radiol. 15, 165–175 (2008).10.1016/j.acra.2007.09.018.

[5] Uppaluri R., Hoffman E., Sonka M., Hartley P., Hunninghake G., and Mclennan G., "Computer recognition of regional lung disease patterns," Am. J. Respir. Crit. Care Med. 160, 648–654 (1999).

[6] Uchiyama Y., Katsuragawa S., Abe H., Shiraishi J., Li F., Li Q., Zhang C., Suzuki K., and Doi K., "Quantitative computerized analysis of diffuse lung disease in high-resolution computed tomography," Med. Phys. 30, 2440–2454 (2003).10.1118/1.1597431.

[7] Sluimer I., Waes P., Viergever M., and Ginneken B., "Computer-aided diagnosis in high resolution CT of the lungs," Med. Phys. 30, 3081–3090 (2003).10.1118/1.1624771.

[8] Denison D., Morgan M., and Miller A., "Estimation of regional gas and tissue volumes of the lung in supine man using computed tomography," Thorax 41, 620–628 (1986).10.1136/thx.41.8.620.

[9] Kalender W., Fichte H., Bautz W., and Skalej M., "Semiautomatic evaluation procedures for quantitative CT of the lung," J. Comput. Assist. Tomogr. 15, 248–255 (1991).

[10] Zagers R., Vrooman H., Aarts N., Stolk J., Schultze Kool L., Voorthuisen E., and Reiber J., "Quantitative analysis of computed tomography scans of the lungs for the diagnosis of pulmonary emphysema: A validation study of a semiautomated contour detection technique," Invest. Radiol. 30, 552–562 (1995).10.1097/00004424-199509000-00008.