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# LUNG PATTERN CLASSIFICATION FOR INTERSTITIAL LUNG DISEASE USING ARTIFICIAL NEURAL NETWORK

B.Buvaneswari (P.G Student)
Dept of Electronics & Communication
Misrimal Navajee Munoth Jain Engineering College
Thoraipakkam, Chennai-600097
mbrgkm@gmail.com

K.Jayabharathi M.E (Associate Professor)
Dept of Electronics & Communication
Misrimal Navajee Munoth Jain Engineering College
Thoraipakkam, Chennai-600097
kjayabharathy2@gmail.com

***Abstract*— Lung disease are the disorders that affect the lungs, the organ allow us to breathe and it is the most common medical conditions worldwide especially in India. The disease such as pleural effusion and normal lung are detected and classified in this work. It presents a computer aided classification in computer tomography images of lungs developed using artificial neural network-back propagation network. The purpose of the work is to detect and classify the lung disease by effective feature extraction through dual tree complex wavelet transform and gray level co-occurrence matrix features. We propose and evaluate the artificial neural network-back propagation network designed for classification of interstitial lung disease pattern. The parameter gives the maximum classification accuracy. Then we propose fuzzy clustering to segment the lesion part from abnormal lung.**

**Keywords:** ***Segment lesion, Fuzzy Clustering, DTCWT, ANN-BPN.***

## I. INTRODUCTION

Lung diseases are the disorders that affect the lungs, the organ allow us to breathe and it is the most common medical conditions worldwide especially in India. The evidence has showed uncontrollable cell growth in tissues of the lung resulting in lung disease. The term interstitial lung disease caused in the interstitium ( a part of the lung).They are also called as diffuse parenchymal lung disease(DPLD).This paper proposes the components of the lung pattern classification for early detection of lung disease. The dual tree complex wavelet transform (DTCWT) is important to generate two filter bands which will generate four sub-bands such as LL, LH, HL, HH frequencies and it is divided further. The DTCWT is important because it provides contrast, shape, texture features. Threshold segmentation is used to segment the lungs. The classifier used is artificial neural network -back propagation network which is used to classify the lung disease such as normal and abnormal. lung disease cause many problems such that disease like pleural effusion. Recent studies have shown that there are two types of cancer these include small cell lung carcinoma (SCLC) and non- small cell lung carcinoma (NSCLC).However lung disease is considered as one of the dangerous in the sense that is harmful and get slowly increased. Lung disease is strongly correlated with cigarette smoking. Researchers think that the disease requires early detection and prevention. First we have to identify the symptoms of the lung disease which will be helpful for further purpose. But it is unpredictable because they vary with different types of cancers. But still it can be diagnosed by taking necessary steps and proper measures.

## II. RELATED WORKS

Wei Zhao et al [10] have proposed a computer aided diagnosis method to classify diffuse lung disease pattern on high resolution computer tomography images (HRCT).The high variety and complexity of diffuse lung disease pattern featured by geometric information is limited. Here by introducing sparse representation based to classify normal tissue and five types of diffuse lung disease including consolidation, ground glass opacity, honey combing.

Heitmann K R et al [4] have proposed neural network and expert rules for the automatic detection of ground glass opacities on high resolution computer tomography. Hybrid network represent a promising tool for an automatic pathology detecting system. They are ready to use as a diagnostic assistant for detection, quantification and follow up of ground glass opacities and further application. But still there is less accuracy.

Gangeh et al [3] have proposed a Textron based classification system based on raw pixel representation along with support vector machine with radial basis function kernel

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is the classification of emphysema in computer tomography of the lung. The proposed approach is tested in 168 annotated region of interest consisting of normal tissue, centrilobular emphysema and parietal emphysema.

## III.SYSTEM DESIGN & IMPLEMENTATION

The early detection and prevention will help us to cure the lung disease. The system architecture shows the following steps to early detection of lung disease. The system architecture shows the following steps for early detection of lung disease. The first stage is the input image is CT scan image taken from reputed hospitals. The second stage is to segment the lung with the help of threshold segmentation. The next stage is feature extraction with the help of gray level co-occurrence matrix features(GLCM) and dual tree complex wavelet transform(DTCWT).In the GLCM features four features are calculated. They are contrast, correlation, energy, homogeneity. And the artificial neural network-back propagation network to classify the lung disease as normal and abnormal. And then fuzzy clustering to detect the abnormal region and segment lesion part from the lung.

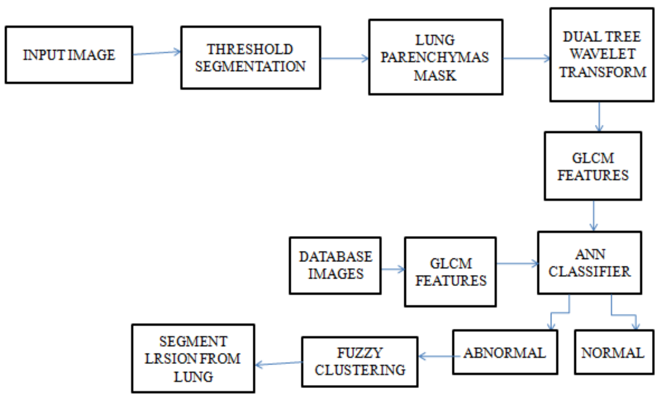


Fig. 1 Proposed System Architecture

## IV.PROPOSED SYSTEM

### *A.INPUT IMAGE*

The input images are lung computer tomography (CT) image in JPEG format. First image selected from the files specified by the string file name. The user has to select the required CT scan image for further processing. Totally 10 samples of lung is given. Then each image is resized to 256*256. CT is non-invasive, safe and well tolerated. It provides high detailed look at different parts of body. Then we are preprocessing the image. The aim of preprocessing, if the image is RGB then it is converted in to gray scale because gray image reduces the processing time and produces fast algorithms.

### *B.THRESHOLD SEGMENTATION*

The segmentation of the lung region from the surrounding anatomical part is performed. For the segmentation thresholding is proposed. And it is applied on the denoised image to separate the lung region and non-body pixels using a iterative process. The design steps for threshold segmentation are

- Set the initial threshold. T=(the maximum value of the image brightness+ minimum value of the image brightness)/2
- Using T segment the image into two sets of pixels B (all the pixel values are less than T) and N(all the pixel value are greater than T)
- Calculate average values of B and N, mean ub and un
- Calculate the new threshold T=(ub+un)/2

Repeat second to fourth steps up to iterative conditions are met and get necessary region from the lung image

### *C.LUNG PARENCHYMA MASK*

By assigning one label matrix and then applying to the original matrix. The resulting matrix is subtracted from the original matrix and to get the lung parenchyma. In the given CT scan image mask is created.

### *D.DUAL TREE COMPLEX WAVELET TRANSFORM*

By applying Dual Tree Complex Wavelet Transform(DTCWT) in the given image it generate low pass(scaling) and high pass (wavelet) filters of one tree generate scaling function and wavelet that are approximate Hilbert Transform of the scaling function and wavelet generated by the low pass and high pass filter of the another tree. It provides better directionality and shift invariance. These filters generate LL, LH, HL, HH sub-bands. These sub-bands are also divided further for processing. In low frequency sub-band include information of contrast features and high frequency sub-band include shape and texture features.

### *E.GRAY LEVEL CO-OCCURANCE MATRIX*

The texture based features are obtained from Gray Level Co-occurrence Matrix (GLCM).GLCM is the matrix that contained all the relative frequencies P(i, j) with intensity value i which occurs in spatial relationship with j. In this process four textural features of all images in the database is calculated using GLCM. The GLCM is a tabulation of how often different combinations of pixel brightness values (grey levels) occur in an image. Then these features are used for classification. At first the co-occurance matrix is constructed based on the orientation and distance between image pixels. The meaningful statistics are extracted from matrix as the texture representation. The GLCM described here is used for a series of "second order" texture calculations. Haralick proposed the following texture features they are

1. Energy
2. Contrast
3. Correlation
4. Homogeneity

**Energy**: It is a gray-scale image texture measure of homogeneity changing, reflecting the distribution of image gray-scale uniformity of weight and texture

$$E=p(x,y)^2 \; p(x,y) \text{ is the GLC M} \quad (1)$$

**Contrast**: Contrast is the main diagonal near the moment of inertia, which measure the value of the matrix is distributed and images of local changes in number, reflecting the image clarity and texture of shadow depth

$$I=(x-y)^2 \, p(x, y) \quad (2)$$

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

$$c = sum\left(sum\left(\frac{(x-\mu_x)(y-\mu_y)p(x,y)}{\sigma_x \, \sigma_y}\right)\right) \quad (3)$$

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

$$H = sum\left(sum\left(\frac{p(x,y)}{1+[x-y]}\right)\right) \quad (4)$$

*F.ARTIFICIALNEURALNETWORK-BACK PROPAGATION NETWORK*

Artificial neural network is the feed forward neural network. It consists of three layers they are input layer, hidden layer which may consists of one or more hidden units, output layer. It helps in training and testing of neural network. It consists of 5 normal and 5 abnormal images in database. In training neural network existing weights never be alternated and new weights are inserted. ANN helps to avoid noisy data. Neural network gives fast and accurate classification and it is a promising tool for classification of lung disease. It can be used in real time. Since the training and running procedure can be implemented by matrix manipulation. The speed of ANN is very fast.

*G.CLASSIFICATION*

The classification is performed by ANN-BPN classifier. The classification performed well with greater accuracy. If the given input image matches with database images then the given image is normal. Then the given features do not match with the database images then the result obtained is abnormal. With the help of GLCM features the result is obtained.

*H.FUZZY CLUSTERING*

Fuzzy clustering (also referred to as soft clustering) is a form of clustering in which each data point can belong to more than one cluster. Fuzzy c-means (FCM) is a method of clustering which allows one piece of data to belong to two or more cluster is frequently used in pattern recognition. It is based on minimization of the following objective function. Where m is any real number greater than 1, uij is the degree of membership of xi in the cluster j, xi is the ith of d-dimensional measured data, cj is the d-dimension center of the cluster, and ||*|| is any norm expressing the similarity between any measured data and the center.

$$J_m = \sum_{i=1}^{N}\sum_{j=1}^{C} u_{ij}^m \left\| x_i - c_j \right\|^2 \qquad 1 \le m < \infty \quad (5)$$

Fuzzy partitioning is carried out through an iterative optimization of the objective function shown above, with the update of membership uij and the cluster centers cj.

This iteration will stop when, where is a termination criterion $\max_{ij} (|u_{ij}^{(k+1)} - u_{ij}^{(k)}|) \le \varepsilon$ between 0 and 1, whereas k is the iteration steps. The algorithm is composed of the following steps. The algorithm for fuzzy clustering is

- Reshape 2D Image to 1D Vector. Initialize U=[uij] matrix, U(0).At k-step: calculate the centers vectors C(k)=[cj] with U(k)

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•Cluster initialization=4

- Update U (k), U (k+1)

- If ǁ U (k+1) – U (k) ǁ< then STOP; otherwise return to step 2.

*I.SEGMENT LESION PART OF LUNG*

To segment lesion part of lung Morphological Filtering Process to locate abnormal lung region for further processing with the help of analysis of cluster output. The disease part of lung is segmented by tracing cancerous areas in the lung.

## V. EXPERIMENTAL RESULTS

The early detection and prevention of lung disease comprised of several stages and is applied in MATLAB R2014a software. The input image is selected from the database it consists of 7 samples of lung CT scan image in JPEG format. In this with the help of given test image threshold segmentation is performed and then the background removal done. Then the regional mask of lung is taken and feature extraction is performed with the help of DTCWT and GLCM features. The result is classified with the help artificial neural network and the abnormal region is detected by fuzzy clustering and segment lesion part of lung is done with greater accuracy.

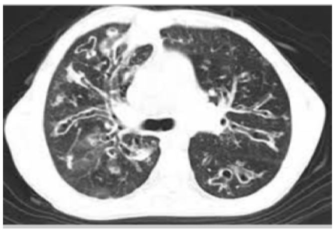

Fig.2 Input image

In fig.2, the image is obtained from the database the given input colour image is converted to gray scale image by using the RGB to gray function command in the Matlab.

Fig.3 Segmented image

In fig.3 the converted image is segmented by using threshold segmentation. The segmentation is performed for further processing in a well-defined manner.

Fig.4 Background removal

In fig.3 the segmentation performed is shown. Background removal is done to remove the distorted and unwanted noise.

Fig.5 Regional mask

In fig.5 Regional mask is performed to show the boundary of lung image. The resulting matrix subtracted from original matrix and to get mask.

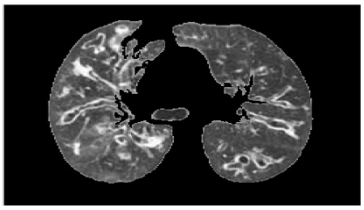

Fig.6 Original information of mask

In fig.6 original information of mask is obtained which is used for classification.

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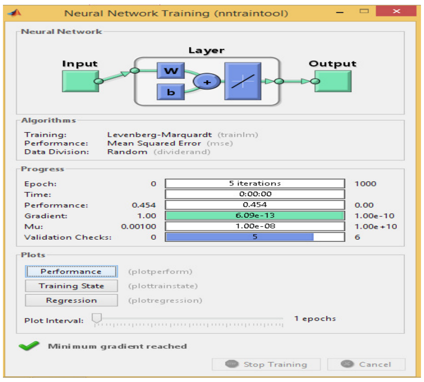


Fig.7 Neural network training tool

In fig 7 Neural network training tool is performed where the input features compared with the database image features to classify it is normal or abnormal.

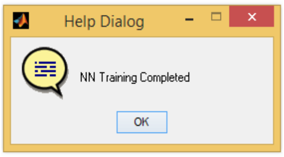


Fig.8 Help dialog

In fig 8 help dialog is shown. It is used for classification of lung disease where the neural network properties are imported in Matlab.

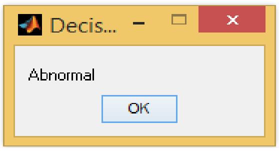


Fig.9 Decision

In fig 9 the given image is abnormal classification by artificial neural network and decision is taken. And the abnormal image is further detected by fuzzy clustering. It can also be applied to detect the normal image.

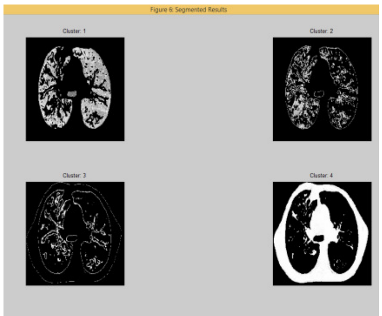

Fig.10 Segmented results

In fig 10 shows the fuzzy cluster output where the cluster initialization is divided into four parts and Find the centroids to each Clusters. Group Pixels to Each Cluster Based on Minimum Distance. That helps to cure disease with greater accuracy. Then update the centroids using update command in Matlab.

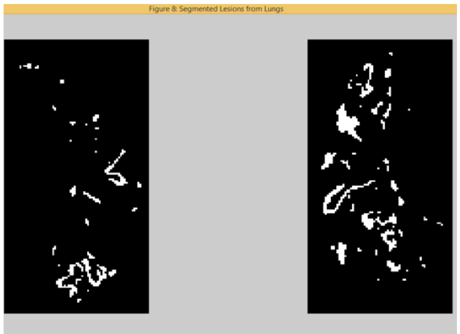

Fig.11 Segment lesion part of lung

In fig 11 segment lesion part of which is used to trace thediseased part of lung with the help of four clustered output and then implementing bit or function in Matlab to trace the cancerous part of lung.

Table.1Parameters calculated for proposed method

| S.NO | PARAMETERS | PERCENTAGE |
|---|---|---|
| 1. | Accuracy | 90% |
| 2. | Sensitivity | 100% |
| 3. | Specificity | 79% |

In table 1 the accuracy, sensitivity, specificity is calculated using the formula

**Sensitivity = (Tp. / (Tp+Fn)).*100;**
**Specificity = (Tn. / (Tn+Fp)).*100;**
**Accuracy = ((Tp+Tn). / (Tp+Tn+Fp+Fn)).*100**

Where

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Tp – Abnormality correctly classified as abnormal
Fn – Abnormality incorrectly classified as normal
Fp – Normal incorrectly classified as abnormal
Tn – Normal correctly classified as normal

Thus accuracy is 90% for proposed system compared to other methods (5% increases from existing method) by using artificial neural network compared to other classifiers. It is calculated after classification and has 10 samples of lung CT images in the database where 5 normal and 5 abnormal images are given.

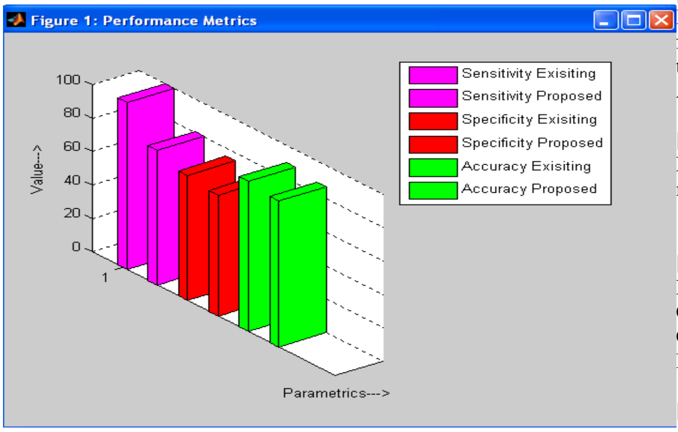


Fig.12 Performance Metrics

In fig.12 shows the performance metrics pink colour represents sensitivity, red colour represents specificity, green colour represents accuracy in the given diagram.

Table.2 Parameters calculated for existing method

| S.NO | PARAMETERS | PERCENTAGE |
|---|---|---|
| 1. | Accuracy | 85% |
| 2. | Sensitivity | 80% |
| 3. | Specificity | 50% |

## VI.CONCLUSION AND FUTURE WORK

The proposed system has an accuracy of 90% compared to existing method by using an Artificial Neural Network classifier. The fuzzy clustering algorithm is utilized effectively for accurate detection of abnormal region and prevention in this paper. The automated proposed system provides better classification accuracy with various stages of test samples and it consumed less time for process. The feature extraction with the help of Dual Tree Wavelet Transform and GLCM features. This can further improved by training it on a larger data set and works effectively.

## REFERENCES

[1] Demedts M and Costabel U"ATS/ERS International Multidisciplinary Consensus Classification of the Idiopathic Interstitial Pneumonias" ,in European respiratory journal 19', 2002,Vol.5 pp.794-796.

[2] Depeursinge A, Van de Ville D, Platon A,Geissbuhler A, Poletti P A and Muller H" Near-Affine-Invariant Texture Learning for Lung Tissue Analysis using Isotropic Wavelet Frames", IEEE Transaction information Technology Bio Medical Imaging,2012,Vol.16,No.8,pp.665-675.

[3] Gangeh, Mehrdad, J, LaugeSorenson, SaherB. Shaker, Mohamed S Kamel, Marleen, De Bruijne and Marco Loog" A Textron-Based Approach for the Classification of Lung Parenchyma in CT images", in Proceedings of the International Conference on Medical Image Computing and Computer-AssistedIntervention-MICCAI,2010,PP.595-602,Springer Berlin Heidelberg.

[4] Heitmann K R, Kauczor H, Mildenburger, Uthmann T,Perl J and Thalen M" Automatic Detection of Ground Glass Opacities on lung HRCT using multiple neural networks", European radiology,1997,Vol.7,No.9,pp.1463-1472.

[5] Korfiatis P D, Karahaliou A N, Kazantzi A D,Kalogeropoulou C , Daoussis and Costaridou L I" Texture Based Identification and Characterization of Interstitial Pneumonia Patterns in Lung Multidetector CT",2010,IEEE Transactions information Technology BioMedical Imaging,Vol.14,No.7,pp.675-680.

[6] Lecun Y,Bottou L,Bengio Y and Haffner P" Gradient Based Learning Applied to Document Recognition", Proc.IEEE,1998,Vol.86,No.11,pp.2278-2323.

[7] Marios Anthimopoulos,Stergios Christodoulidis, Lukas Ebner, Andreas Christe and Stavroula Mougiakakou" Lung Pattern Classification for Interstitial Lung Disease Using a Deep Convolutional Neural Network", IEEE Transactions on medical imaging,2016Vol.35,No.5,pp.1207-1216.

[8] Sluimer I, Schilham A,Prokap M and Van Ginneken B" Computer Analysis of Computer Tomography Scans of Lung: A survey ",IEEE Transactions on medical imaging,2006,Vol.25,No.4,pp.385-405.

[9] Song Y ,Cai.W,Zhou Y and Feng D D" Feature Based Image Patch Approximation For Lung Tissue Classsification",IEEETransactions on medical imaging,2013,Vol.32,No.4,pp.797-808.

[10] Wei Zhao, Rui Xu,Yasushi Hirano,Rie Tachibana and Shoji Kido" Classification of Diffuse Lung Diseases Patterns by a Sparse Representation Based Method on HRCT Images" ,35th Annual International Conference of the IEEE EMBS,2013,pp.5457-5460.