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Study of various effective optimization techniques for lung classification

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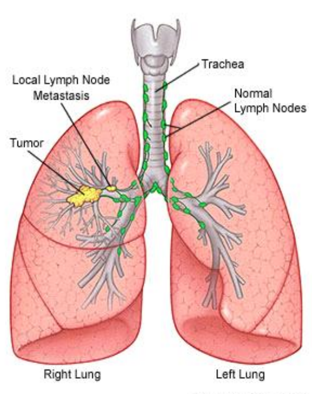
Abstract- **Lung diseases are the disorders that affect the lungs, the organs that allow us to breathe and it is the most common medical conditions worldwide especially in India .Diseases in lung can be classified using various techniques. In this paper new method for classification of lung diseases is given and comparison of various techniques is covered.**

Keyword- ct images, classification, genetic algorithm, CAD, classifier

I. Introduction

Lung diseases are some of the most common medical conditions in the world. Tens of millions of people suffer from lung disease in the U.S. Smoking, infections, and genetics are responsible for most lung diseases. Lung disease refers to many disorders affecting the lungs such as asthma, chronic obstructive pulmonary (COPD) disease, infections such as tuberculosis, influenza, lung cancer, pneumonia and other breathing problems [3]. Lung diseases signs and symptoms can differ by the type of the affected disease. Medical image analysis and process requires an environment for data access, data



analysis, processing, revelation and algorithm development. Medical imaging is the technique and process used to create images of the human body for clinical purposes for diagnosis and analysis or medical science (including the study of disease of normal anatomy and physiology) Image fusion has turned into a common term used within medical diagnostics and treatment. The word is employed when multiple images of an individual are registered and overlaid or merged to provide additional information. Fused images may be created from multiple images from the same imaging modality, or by combining information from multiple modalities such as for instance magnetic resonance image (MRI), computed tomography (CT), positron emission tomography (PET), and single photon emission computed tomography (SPECT). In radiology and radiation oncology, these images serve different purposes. For example, CT images are utilized more often to ascertain differences in tissue density while MRI images are generally used to diagnose brain tumors. In this paper various techniques for classification of lung diseases is compared and their advantages and disadvantages are discussed.

II. Techniques used

Various techniques have been used for classification of lung diseases that are discussed below:

a) Neural Network and SVM model for early detection of lung cancer:

The model consists of an input layer, a hidden layer and an output layer. The network was trained with one hidden layer and one output layer by giving twelve inputs. One of the most common forms of medical malpractices globally was an error in diagnosis[11]. By using the fusion of SVM and BPNN they achieved the accuracy of 98%. The performance simulation has taken place in MATLAB 7.10 environment. The MATLAB has inbuilt Neural Network toolbox and SVM has been implemented using two steps training and testing phases.

b) Vessel segmentation in Computed Tomography scans of lung :

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Vessel segmentation in the lung challenge objectively compares the performance of different algorithm to identify the vessels in thoracic computed tomography (CT) scans. Vessel segmentation is fundamental in computer aided processing of data generated by 3D imaging modalities [7]. As manual vessel segmentation is prohibitively time consuming, any real world application requires some form of automation. Several approaches exist for automated vessel segmentation but judging their relative merits is different due to lack of standardized evolution.

c) Classification of Lung Tumour using SVM :

Computer Aided Diagnosis System (CAD) for early detection of lung cancer nodules from the Chest Computer Tomography (CT) images. There were five main phases involved in the proposed CAD system. They were image pre-processing, extraction of lung region from chest computer tomography images, segmentation of lung region, feature extraction from the segmented region, classification of lung cancer as benign or malignant. Initially total variation based de noising was used for image de noising, and then segmentation has been performed using optimal thresholding and morphological operations [2]. Textural features extracted from the lung nodules using gray level co-occurrence matrix (GLCM). For classification, SVM classifier was used. The main aim of the method was to develop a CAD (Computer Aided Diagnosis) system for finding the lung tumour using the lung CT images and classify the tumour as Benign or Malignant.

d) Image Dissimilarity-Based Quantification of Lung Disease from CT :

The images were mapped into a dissimilarity space using an image dissimilarity measure, and a standard vector space-based classifier was applied in that space. The classification output of the approach was used in computer aided-diagnosis problems where the goal was to detect the presence of abnormal regions or to quantify the extent or severity of abnormalities in the regions. The proposed approach was applied to quantify chronic obstructive pulmonary disease in computed tomography (CT) images, achieving an area under the receiver operating characteristic curve of 0.817. This was significantly better compared to combining individual region classifications into an overall image classification, and compared to common computerized quantitative measures in pulmonary CT.

e) Fusion of Support Vector Machines and Back Propagation Neural Network :

Neural Network and SVM model for early detection of lung cancer has been used [5]. The model consists of an input layer, a hidden layer and an output layer. The network was trained with one hidden layer and one output layer by giving twelve inputs. One of the most common forms of medical malpractices globally was an error in diagnosis. By using the fusion of SVM and BPNN they achieved the accuracy of 98%. The performance simulation has taken place in MATLAB 7.10 environment. The MATLAB has inbuilt Neural Network toolbox and SVM has been implemented using two steps training and testing phases.

f) Diagnostic aid system for interstitial lung diseases:

The proposed system comprises three stages. In the first stage, the parenchyma region in HRCT lung images was separated using a set of thresholding, filtering and morphological operators. In the second stage, two sets of over complete wavelet filters are utilized to extract features from defined regions of interest (ROIs) within parenchyma. Then, in the third stage, the fuzzy k-nearest algorithm was employed to perform the pattern classification. The proposed method has tested for classifying four different lung tissue patterns (ground glass, honeycombing, reticular and normal) selected from a database of 339 images from 17 subjects. After applying there technique to classify these patterns in isolated ROIs, they extend the classification scheme to the whole lung in order to produce quantitative scores of abnormalities in lung parenchyma of patients.

g) Genetic Algorithm with kNN and SVM for Feature Selection in Tumour Classification:

Genetic Algorithm (GA) was used for effective feature selection. Informative genes were identified based on the T-Statistics, Signal-to-Noise Ratio (SNR) and F-Test values. The initial candidate solutions of GA were obtained from top-m informative genes. The classification accuracy of k-Nearest Neighbour (kNN) method was used as the fitness function for GA. In this work, kNN and Support Vector Machine (SVM) was used as the classifiers. The experimental results show that the proposed work was suitable for effective feature selection. With the help of the selected genes, GA-kNN method achieves 100% accuracy in 4 datasets and GA-SVM method achieves in 5 out of 10 datasets. The GA with kNN and SVM methods are demonstrated to be an accurate method for microarray based tumour classification.

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III. Literature survey

In 2009 [1], Lu Meng and Hong Zhao introduced a new lung segmentation algorithm which was based on anatomical knowledge and Snake model. This algorithm totally overcomes the disadvantage of traditional lung segmentation algorithms, which was mainly based on edge extraction, mathematical morphology, region growing, threshold, etc, and can't get satisfied results when segmenting pathological clinical CT images with traditional algorithms. Experiments showed that no matter whether the CT images are pathological or not, this segmentation algorithm has good results, high speed, and total automation.

In September 2012 [2], Ms.Swati P. Tidke, Prof. Vrishali A. Chakkarwar provided a Computer Aided Diagnosis System (CAD) for early detection of lung cancer nodules from the Chest Computer Tomography (CT) images. There were five main phases involved in the proposed CAD system. They were image pre-processing, extraction of lung region from chest computer tomography images, segmentation of lung region, feature extraction from the segmented region, classification of lung cancer as benign or malignant. Initially total variation based de noising was used for image de noising, and then segmentation has been performed using optimal thresholding and morphological operations. Textural features extracted from the lung nodules using gray level co-occurrence matrix (GLCM). For classification, SVM classifier was used. The main aim of the method was to develop a CAD (Computer Aided Diagnosis) system for finding the lung tumor using the lung CT images and classify the tumour as Benign or Malignant.

In March 2014 [3], C.Bhuvaneswari, P.Aruna and D.Loganathan proposed a feature extraction and feature selection to detect and classify the lung diseases by effective feature extraction through moment invariants, feature selection through genetic algorithm and the results were classified by the Naïve bayes and decision tree classifiers. The pre-processing techniques removed the noises and the feature extraction were done to extract the useful features in the image and the feature selection technique optimized the top ranking features that were relevant for the image and the classifiers were employed to classify the images and the performance measures were found for the same. The result shows that the Decision tree classifier shows more promising results than the naïve bayes classifier.

In 2013 [4], Gurpreet kaur and Harpreet singh proposed a Neural Network and SVM model for early detection of lung cancer. The model consists of an input layer, a hidden layer and an output layer. The network was trained with one hidden layer and one output layer by giving twelve inputs. One of the most common forms of medical malpractices globally was an error in diagnosis. By using the fusion of SVM and BPNN they achieved the accuracy of 98%. The performance simulation has taken place in MATLAB 7.10 environment. The MATLAB has inbuilt Neural Network toolbox and SVM has been implemented using two steps training and testing phases.

In 2010 [5], Lauge Sorensen, Marco Loog, Pechin Lo and et al. proposed to classify medical images using dissimilarities computed between collections of regions of interest. The images were mapped into a dissimilarity space using an image dissimilarity measure, and a standard vector space-based classifier was applied in that space. The classification output of the approach was used in computer aided-diagnosis problems where the goal was to detect the presence of abnormal regions or to quantify the extent or severity of abnormalities in the regions. The proposed approach was applied to quantify chronic obstructive pulmonary disease in computed tomography (CT) images, achieving an area under the receiver operating characteristic curve of 0.817. This was significantly better compared to combining individual region classifications into an overall image classification, and compared to common computerized quantitative measures in pulmonary CT.

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IV. Comparison Table

Ref. No	Authors	Year	Technique Used	Features	Limitations
10	Choa-Lung,R.J. Kuo	2015	Non-dominated sorting genetic algorithm	Improves clustering quality on categorical data	GA algorithm does not guarantee the global optimization solution
8	Lu Meng, Hong Zhao	2009	Anatomical knowledge and Snake model	Overcomes disadvantages of traditional lung segmentation	PSO suffers from initial particle selection
7	Shengjun Zhou,Yuanzhi Cheng	2014	Weighted averaging and adaptive culture threshold	Ensure the smoothness of lung boundary	Hybridization of GA and PSO is ignored
6	Ms. Swati P.Tidke	2012	SWM Classifier	Classifies the tumour as benign or Malignant	Computational time is high
9	C.Bhuvaneshwari, P.Aruna	2014	Genetic algorithm	Optimises the top ranking features	Non-reliable and less effective
11	Gurpreet Kaur and Harpreet Singh	2013	Neural Network and SVM model	Accuracy of 98% is achieved	Non effective for image matching
14	Lauge Sorensen, Marco Loog	2010	Image Dissimilarity Based Quantification	Achieves an area under the receiver operating characteristic curve of 0.817	GA algorithm does not guarantee the global optimization solution
12	C. Gunavathi, K. Premlatha	2014	Genetic Algorithm with KNN and SVM	Acheives 100 % accuracy with GA-KNN in 4 data cells and GA-SVM achieves in 5 out of 10 database	PSO suffers from initial particle selection

V. Conclusion and Future Scope

In this paper, a survey on various optimization techniques has been done. From the survey, it has been concluded that the hybridization of genetic algorithm and Particle Swarm Optimization has been ignored in the literature. Genetic Algorithm does not guarantee global optimization solutions. Particle Swarm Optimization guarantees global optimization solution but suffer from initial particle selection. So, the future work suggests hybridization of Genetic Algorithm and Particle Swarm Optimization which has the ability to address the above problems.

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