Efficient segmentation and classification of lung cancer Diagnosis Techniques Using Ct Images: A Review

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Abstract: Cancer is an illness caused by uncontrolled division of eccentric cells in any a part of body. Cancer is at the highest of the few places on the list of fatal diseases and is present worldwide, however it continues to rise. Most of the cases associate early detection of lung cancer is cumbersome. This research aims to present an effective and efficient CAD method of computer-aided diagnosis for the classification of lung cancer. Automatic identification and classification of lung infection through computer tomography (CT) images provides an enormous probable to supplement the conventional healthcare approach for tackling the lung cancers. In this research, various research papers are analysed and discussed on the different techniques used for identification and detection of lung disease on CT image. The lung organ scanned output CT image may be affected due to various external noises such as salt and pepper noise, random noise, speckle noise and Gaussian noise. The adaptive 2D filtering algorithms are applied to restore the lung CT image. The low quality CT lung image is enhanced as high quality CT lung image in terms contrast and brightness using various image enhancement techniques. The CT image lung infection disease region is properly segmented using various clustering and threshold techniques for extracting Region of Interest (ROI). The ROI is the disease portion on the image. The feature extraction techniques are used to calculate different features for doing classification further. The Machine Learning (ML), Deep Learning (DL) and Artificial Neural Network (ANN) are applied for classifying different stages of lung CT disease image

Keywords: Computer Assisted Diagnosis (CAD), Computed Tomography (CT), Region of Interest (ROI), Machine Learning (ML), Deep Learning (DL) and Artificial Neural Network (ANN)

1. Introduction

Pulmonary fibrosis is a pathological consequence of acute and chronic interstitial lung diseases. it is characterized by an unsuccessful reconstruction of the damaged alveolar epithelial persistence of fibroblasts and excessive deposition of collagen and other extracellular matrix (ECM) components (e.g., ECM), as well as the destruction of normal lung architecture The progression of pulmonary fibrosis leads to an expansion of the interstitial matrix terminal, compression and destruction of the normal lung parenchyma and thus damage to capillaries leading to and thus damage to capillaries leading to respiratory failure. The etiology of respiratory organ fibrosis is complex and includes age, smoking, infection, drug exposure, and genetic predisposition. A further mechanism is also aerobic stress related to excessive reactive oxygen species (ROS) production. This may be due to improper removal of ROS (aging) or associated with an excessive supply of a high percentage of oxygen, e.g., shortness of breath due to cancer. An increase in cell death of cyst cells related to aerobic stress has been ascertained in idiopathic pulmonary fibrosis (IPF). In medical applications, the quality of ROI is vital wherever sure elements of the image square measure of upper diagnostic significance than others. In such a case, these regions have to be compelled to be encoded at the next quality than the background. The intention of ROI is to extract or view the desired parts from the scanned lung images. ROI makes the image process like segmentation and classification additional straightforward and easy.. If the selected image is greater than or equal to 50 the enriched regions are selected then otherwise remove that region. In the pre-processing stage, the different dimension of the ROI extricated lung image is enhanced by using an innovative strategy i.e. adjust image intensity.

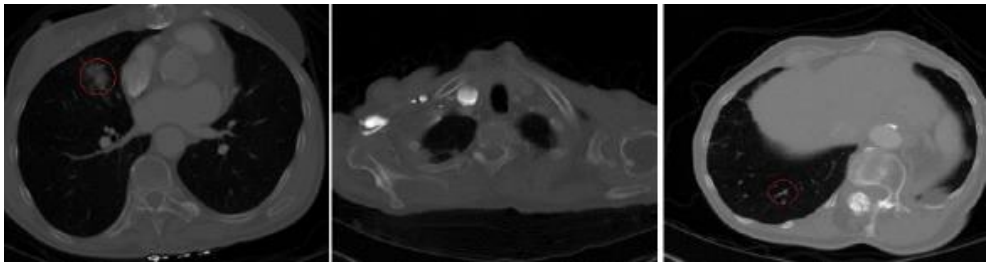

Figure 1: Different angles of lung cancer CT images

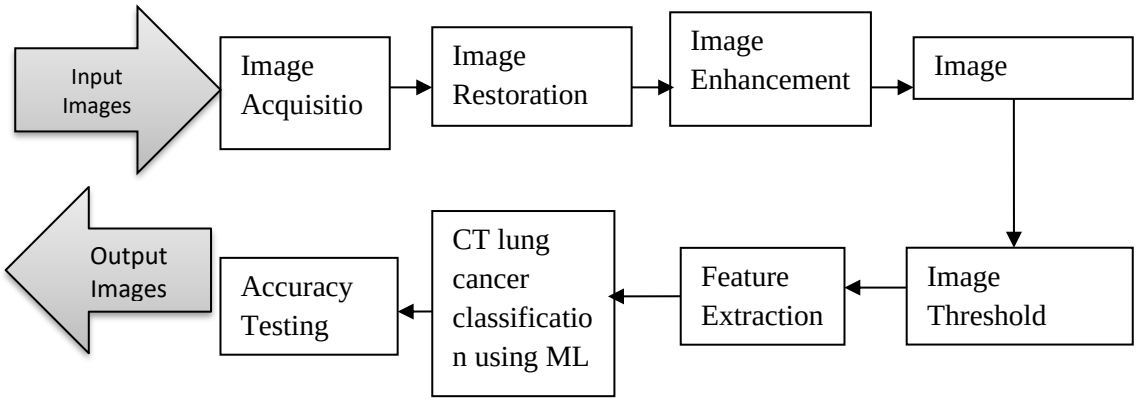

Figure 2: Architecture diagram of identification and classification cancer segmentation and classification on lung CT image

2. Background

Lung disease can be typically stated as the abnormal cell growth in lungs that may cause severe threat to patient health, since lung is a significant organ which comprises associated network of blood veins and lymphatic canals. The earlier detection and classification of lung disease creates a greater impact on increasing the survival rate of patients. For analysis, the CT lung images are generally used, since it provides information regarding the assorted lung regions.The prediction of disease contour, position, and volume plays an imperative role in accurate segmentation and classification of tumour cells. This will aid in successful disease stage detection and treatment phases. Volumetric Analysis Framework for Accurate Segmentation and Classification of lung disease is used for proper diagnosis to treat the patients. The volumetric analysis framework comprises the estimation of length, thickness, and height of the detected disease cell for achieving précised results. Though there are several models for tumour detection from 2nd CT inputs, it is vital to develop a way for lung nodule separation from noisy background. Moreover, morphological processing techniques are incorporated for removing the extra noises and airways. Moreover, morphological processing techniques are incorporated for removing the additional noises and airways. Tumour segmentation has been accomplished by the clustering approach.

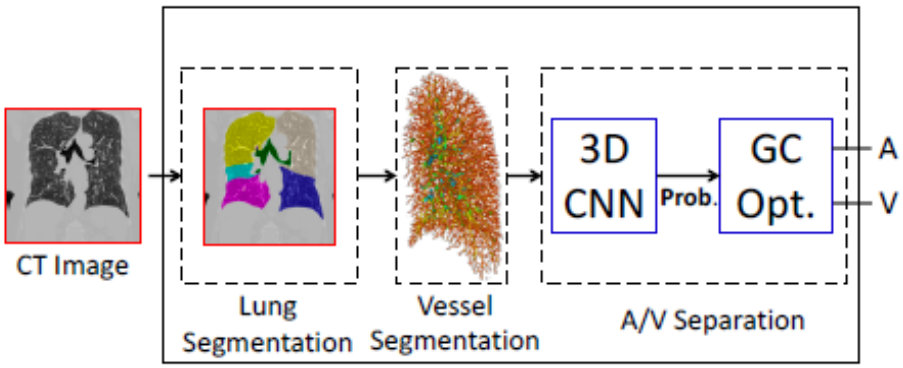

Figure 3: Architecture diagram of the proposed method for classification using CNN classifier

Table 1: Comparison study of different techniques for Lung Cancer Diagnosis

Ref.Paper & Year	**Authors**	**Problem Identification**	**Author's Proposed system**	**Methodology**	**Results**	**Limitations**
"Classification of pulmonary CT Images by using Hybrid 3D Deep CNN Architecture", MDPI, Applied sciences,2019	Huseyin Polat And Humay Danaei	Conventional ML Techniques using Feature Extraction on CT Images are complicated	Deep Learning under ML by using Automatic Feature Extraction minimizes the process	3D-AlexNet 3D-GoogleNet	3D – AlexNet Accuracy-85.79% Sensitivity-83.17% Specificity-88.04% Precision-83.66% 3D-GoogleNet Accuracy-87.95% Sensitivity-82.74% Specificity-91.61% Precision-88.36%	Deep learning based RBF classifier could improve the performance of CNN Architecture in classification of 3D lung CT scanning
"Automatic Detection and Staging of Lung Tumors using Locational Features and double staged Classification ", MDPI, Applied Sciences, June 2019	May Phu Paing And Kazuhiko Hamamoto	Manual staging of cancer remains a challenge due to intensive effort required	CAD for detecting and staging cancer	Back Propagation Neural Network (BPNN)	Avg.Accuracy-92.8% for detection 90.6% for staging	1)Need background knowledge for anatomical lung structure 2)Open issues can be upgraded for N&M staging of lung cancer
"An Appraisal of Lung Nodule's Automatic Classification Algorithm for CT Images", MDPI, Applied Sci.Sensors,2019	Xinqi Wang And Keming Mao	Early Detection and Reliability of Manual CT Images	Modern Computer Vision and ML on CT Images	3D Feature based Method	Difference in accuracies using different Databases	1)To deal with noises and uncertain annotations 2)To deal with anatomical locations of regions

"Lung X-Ray Segmentation using Deep-CNN on Contrast-Enhanced Binarized Images", MDPI, Mathematics, June 2020	Hsin-Jui Chen And Yan-Tsung Peng	Automatic Locating of Lung Regions in CXR Images is important on CAD	Adaptive pre-processing approach for segmenting the lung regions from CXR	Binarized Enhanced Chest X-Ray (BECXR)	Training coverage-20.74% faster Decrease of 90.6% of storage space	Applying other image enhancement and binirization methods for training coverage
"Denoising of Dynamic Sinogram by Image Guided Filtering using Positron Emission Tomography (PET)",IEEE, Medical transactions, 2018	Hashimoto and H.Ohba	Low performance of range distance estimation	De-Noising performance in PET	Sinogram based Dynamic Image Guided Filtering Algorithm	Effects of de-noising Tumour -0.9223 White matter-0.523 Gray matter-0.644	1)Identification of the effect in reversible type Ligands on Dynamic PET images 2)Validation between present data and human clinical data could be provided
"Ultrasound Image De-noising wavelet threshold methods Bilateral Filter", IEEE Latin and America, Nov 2019	C. Rodrigues and Z.Peixoto	Previous methods are not estimating the structural features and contour preservation	New association based on Smedian Thresholding and Fast BF to remove Speckle Noise	Thresholding Methods	PSNR-14.13% increase in structural features contour preservation increase in 4.96% MSSIM -0.70% in β	Principle contribution for better thresholding
"Pipeline for Advanced Contrast Enhancement (PACE)on CXR by using BEMD and CLAHE" , MDPI , Sustainability, May 2020	Giulio Siracusano and Michele Gaeta	Non-Contrast CCT cannot be massively used for both high risk, cost and this tool is not extensively available	To improve the sensitivity of CXR with a non-linear post processing tool	PACE with BEMD and CLAHE	Avg increase of 9% in CII 2.4% increase in ENT and 2% increase in EME	Portability and readability of CXR for monitoring patients in ICU

"Computed Tomography (CT) Image Quality Enhancement via a Uniform Framework Integration" , MDPI Sensors 2019	Jianning Chi and Ying Wang	Noise, Data compression storage& Transmission interrupts Image Quality	To handle de-noising and super-resolution of CT Image at a time	Uniform CNN	Precision-0.86 & 0.955 Recall - 0.96 & 0.84 FI Means – 0.91 & 0.89	1)Image quality enhancement & Noise estimation 2)Convolutional blocks to extract features 3)Multitasking learning strategy
"Automatic Lung Segmentation in low-dose chest CT scans using convolutional deep and wide network (CDWN)", Springer 2018	Akila and Anitha	In need of earlier lung segmentation and performance accuracy	To Segment lung region from chest CT for further medical diagnosis	Convolutional Deep and Wide Network (CDWN)	Dice-coefficient 0.95 Accuracy-98%	1)Segmentation accuracy could be improved even with deep network and GPU 2)Higher dimension in segmentation could be done with 3D lung reconstruction
"Inf-Net Automatic Lung Infection Segmentation from CT Images", IEEE , Dec 31,2020	Deng-Ping Fan and Tao Zhou	Segmenting infected regions from CT Slices faces several challenges	To automatically identify infected regions from chest CT	A novel-Lung Infection Segmentation Deep Network	Dice-0.597 Sensitivity-0.86 Specificity-0.977 Precision-0.515 MAE-0.033	1)A bit drop in accuracy when compared to slice-wise classifier 2)High intensity contrast images could be used
"Automatic Lung Segmentation with Juxta-Pleural Nodule Identification Using ACM & BA", IEEE 2018	Heewon Chung and Hoon Ko	To minimize the Juxta-Pleural Nodule Issue	To predict the lung image based on segmented active contour In previous & neighboring frame	Chan-Vese model and Bayesian approach	Sensitivity-0.9785 Accuracy-0.9964 DSC-0.9809 MHD-0.4806 JPND-96%	1)CV method can be replaced by prior-shape or region based methods 2)Bayesian approach could be provided for more accurate detection
"Hybrid Automatic Lung Segmentation on Chest CT	Tao Peng and Yihuai Wang	Accurate Segmentation in chest CT Scans is challenging due to variations in	To automatically detect the lung boundaries	Pixel based Scan Connected Component Labeling Convex Hull Closed	DSC-98.21 Avg DSC-96.9	Age and gender information during model training and evaluation

Scans", IEEE 2020		lung volume shape		Principle Curve **(PSCCL-CH-CPC)**		could be utilized
"Deep Learning for Lung Cancer Nodule Detection & Classification in CT Scans", MDPI AI ,Dec 2019	Diego Riquelme And Moulay	Detecting malignant nodules from lung CT is hard & time consuming	State-of-the-art deep learning and architecture	CAD with Deep Learning nodule detection and false positive reduction	FP reduction/8 scans Accuracy-87.4 Sensitivity-91.4 FNR-0.24 Specificity-85.2 AUC-0.947	1)Improvement in Convolutional network architecture 2)Data and Imbalanced Nature could be improved by enhancing the convet network
"DCNN For Lung Cancer Stage Detection"	Goran Jakimovski and Danco Davcev	To solve the problem of over-fitting	To detect lung cancer in an early stage for early treatment	Double Convolutional DCNN and Multistage training	Output of the network Single node -0/1 or array Exit layer – Single decimal Values (0.0)-no-cancer (1.0)-cancer	1)Changing DNN to output 2 values for higher certainty classification 2)Modifying DNN to show the location on CT image for cancer detection
"Pulmonary Artery-Vein Classification in CT Images using Deep Learning", IEEE Medical Transactions , 2018	Pietro Nardelli And George R Washko	To detect changes in vascular trees and abnormalities detection is time consuming	To automatically separate arteries and veins in CT Images to accurately diagnose	CNN Graph-cut and Random forest classifier	Accuracy -94%	1)To provide connectivity information and use advanced GC approach to refine segmentation and reduce spatial inconsistency 2)validation on full lung CT images could be generated
"Precision Agriculture for Pest Management on Enhanced Acoustic Signal Using	D. Poornima and G. Arulselvi	Digital filters are proposed to filter noisy signals and enhancement algorithm is proposed to	Improve the quality of signal.	Deep Convolutional Neural network is used to classify the signal.	The accuracy of the signal is around 95%.	The noisy signal is filtered using HNM HMM Wiener filter. The filter signal is

Improved Mel-Frequency Cepstrum Coefficient and Deep Learning", JARDCS , 2020		improve the quality of the signal.				improved in terms of quality. The filtered signal is further segmented and classified using DCNN.

3. Conclusion

Lung Cancer is a serious disease. Rapid development and a significant, constantly growing number of patients are forcing scientists to try new treatment options. This narrative review demonstrates similarity in pulmonary symptoms and the mechanisms of their formation, with previous forms of the lung cancers. In this literature survey, various research papers were analysed to understand the techniques for image restoration, image enhancement, image segmentation, feature extraction and classification. Also many classification procedures are studied to classify the plant leaf disease and from the survey analysis it is found that there were some research gaps in current trend and was discussed.

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