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A REVIEW ON DETECTION OF LUNG INFECTION IN CT SCAN IMAGE USING MACHINE LEARNING SYSTEM

[1]Er Dipika N.Gumble, [2]Dr R.D.Ghongade
[1]M.E.Student, [2]H.O.D.of Electronics Department
[1]Department of Electronics and Telecommunications, Amravati University
[1]P.R.Pote (Patil) College of Engineering, Amravati (M.S), India

ABSTRACT

Lung diseases and its infections 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. Identification and grading of disease in a human organ demand expert's opinion and the patients' medications are completely dependent on the results given by that expert. However, there might be situations where experts may not be available or too busy. To tackle the emergencies, which arise due to lack of experts, in this work, we will design an algorithm that inputs an image (MRI or PET or CT one among these) to classify whether the lungs is infectious or non- infectious. If a lung is infectious, we try to identify which disease based on the symptoms and figure out the amount of degradation that the lung has gone through due to that disease. For this purpose, we rely on the image and pattern recognition with machine learning system algorithms. The purpose of the work is to review the work carried out by various researchers for detecting the lung infection in CT scan images.

Keywords: **Lung infection detection, CT Scan, Machine Learning, Respiration**

INTRODUCTION

The term 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. Lung diseases signs and symptoms can differ by the type of the affected disease. Common signs are trouble in breathing, shortness of breath, feeling like you're not getting enough air, decreased ability to exercise, a cough that won't go away, coughing up blood or mucus, pain or discomfort when breathing in or out. 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) [2][3][5].

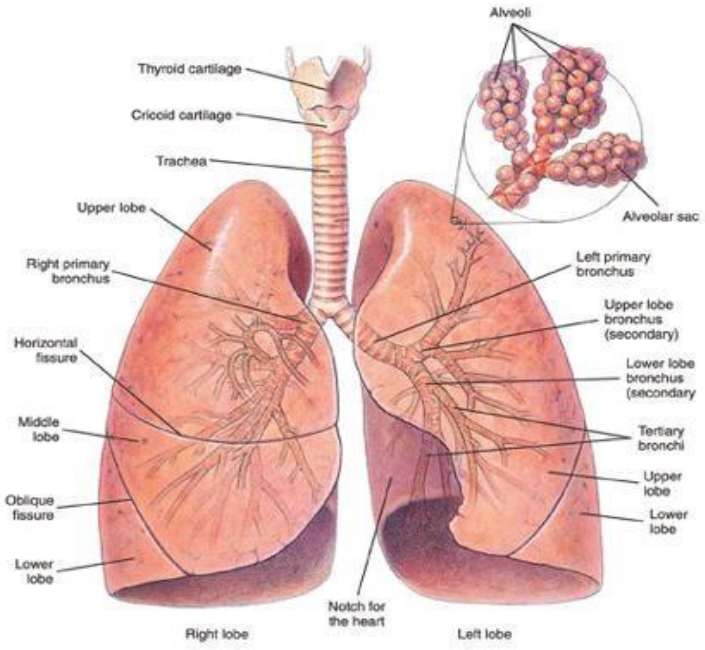

Fig 1: Healthy Lungs of Human

In the recent years, medical CT Images have been applied in clinical diagnosis widely. It assists physicians to detect and locate pathological changes with more accuracy. Computed tomography images can be distinguished for different tissues according to their different grey levels. Lung diseases can be caused by infection, an exposure at the workplace, medications and various disorders. X-ray chest radiography and computer tomography (CT) are two common anatomic imaging modalities that are routinely used in the detection and diagnosis of a variety of lung diseases. Medical images play a vital role in patient diagnosis, therapy, surgical, medical reference, and training. The Digital Imaging and Communications in Medicine (DICOM) standard allows storing textual descriptions, known as metadata, along with the images. It was the most important breakthrough since the discovery of the X-rays, and CT has remained a cornerstone of diagnostic radiology throughout the years [10][12][14]. The respiratory tract infection due to the Coronavirus Disease (COVID-19) is emerged as one of the major threat globally due to its acuteness and the infection rate. It is one of the major communicable infectious diseases caused by Severe Acute Respiratory Syndrome-Corona Virus2 (SARS-CoV-2) and according to a recent report [7][8], it affected a larger human community, irrespective of their race and gender. The infection caused by COVID-19 severely affects the respiratory system by causing the severe pneumonia. Due to its harshness and the spreading rate, the World Health Organization (WHO) recently announced it as pandemic [9]. Even though various controlling and treatment procedures are implemented from December 2019 to till date, the mortality due to COVID-19 infection is rapidly increasing.

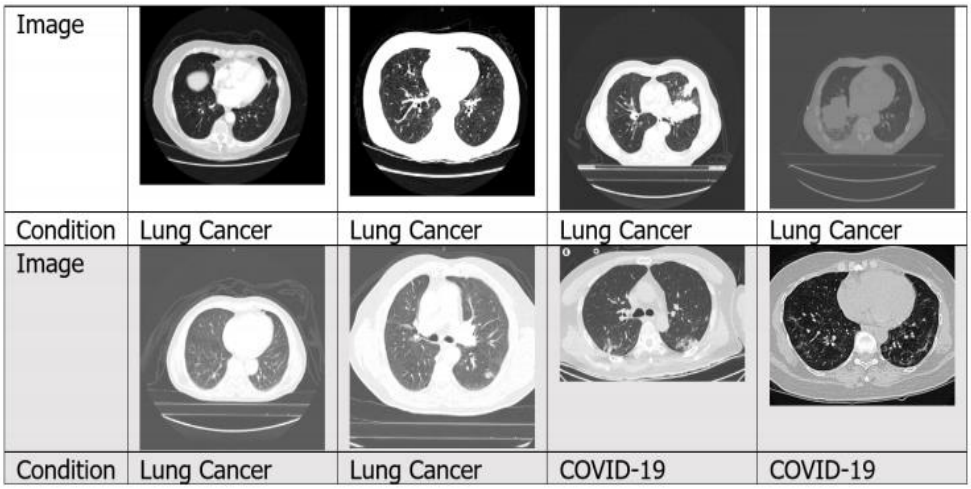

Fig 2: Examples of CT Scan Images

In this article, an automated approach for classification of the lung infections using CT images is reviewed. This review helps researchers as the assistant in detecting the lung diseases in the medical field.

RELATED WORK

Zhao Wang et.al. [1] proposes a novel joint learning framework to perform accurate COVID- 19 identification by effectively learning with heterogeneous datasets with distribution discrepancy. They build a powerful backbone by redesigning the recently proposed COVID-Net in aspects of network architecture and learning strategy to improve the prediction accuracy and learning efficiency. They develop and evaluate our method with two public large-scale COVID-19 diagnosis datasets made up of CT images. Muskan Lawania et.al. [2] proposes a productive strategy to identify the lung malignancy and its stages effectively and furthermore means to have progressively precise outcomes by utilizing KNN and Image Processing systems. Seifedine Kadry et.al. [3] propose a Machine-Learning-System (MLS) to detect the COVID-19 infection using the CT scan Slices (CTS). This MLS implements a sequence of methods, such as multi-thresholding, image separation using threshold filter, feature-extraction, feature-selection, feature-fusion and classification. A two-class classifier system is implemented to categorize the chosen CTS (n=500 with a pixel dimension of 512x512x1) into normal/COVID-19 group. In this work, the classifiers, such as Naive Bayes (NB), k-Nearest Neighbours (KNN), Decision Tree (DT), Random Forest (RF) and Support Vector Machine with linear kernel (SVM) are implemented and the classification task is performed using various feature vectors. Arnab Kumar Mishra et.al. [4] explored various Deep CNN based approaches are explored for detecting the presence of COVID19 from chest CT images. A decision fusion based approach is also proposed, which combines predictions from multiple individual models, to produce a final prediction. Experimental results show that the proposed decision fusion based approach is able to achieve above 86% results across all the performance metrics under consideration, with average AUROC and F1-Score being 0.883 and 0.867, respectively. Ilker Ozsahin et.al. [5] review the diagnosis of COVID-19 by using chest CT toward AI. We searched ArXiv, MedRxiv, and Google Scholar using the terms “deep learning”, “neural networks”, “COVID-19”, and “chest CT”.

Andreas Christe et.al. [6] proposed CAD system for dichotomous classification into the group needing further intervention and the group without the need for further workups was as good as that of the radiologists. The automated system even outperformed the inexperienced radiologist, in terms of the specificity for patient identification requiring subsequent intervention. Preeti Katiyar et.al. [7] proposed survey various segmentation, feature extraction and classification techniques are considered such as Artificial Neural Network, Convolutional Neural Network, SVM, Gray level co-occurrence matrix, Discrete wavelet transform and many more. They observed that the SVM classifier achieved 96% accuracy, ANN achieved 99% accuracy, CNN achieved 94% accuracy and DNN achieved 97% accuracy. Tulin Ozturk et.al. [8] presented new model for automatic COVID-19 detection using raw chest X-ray images is presented. The proposed model is developed to provide accurate diagnostics for binary classification (COVID vs. No-Findings) and multi-class classification (COVID vs. NoFindings vs. Pneumonia). Our model produced a classification accuracy of 98.08% for binary classes and 87.02% for multi-class cases. Varalakshmi Perumal et.al. [9] the transfer learning technique has been applied to clinical images of different types of pulmonary diseases, including COVID-19. It is found that COVID-19 is very much similar to pneumonia lung disease. They propose a transfer learning model to quicken the prediction process and assist the medical professionals. The proposed model outperforms the other existing models. Li et.al. [10] designed and evaluated a three-dimensional deep learning model for detecting coronavirus disease 2019 (COVID-19) from chest CT scans. a 3D deep learning framework was proposed for the detection of COVID-19.

Geraldo Luis Bezerra Ramalho et.al. [11] employ the Adaptive Crisp Active Contour Models (ACACM) for lung structure segmentation. And they propose a novel method for lung disease detection based on feature extraction of ACACM segmented images within the cooccurrence statistics framework. Lal Hussain et.al. [12] employed an automated supervised learning AI classification of texture and morphological- based features on portable CXRs to distinguish COVID-19 lung infections from normal, and other lung infections. Xiaohong Gao et.al. [13] developed an enhanced ResNet deep learning network, depthResNet, to classify the five types of Tuberculosis (TB) lung CT images. Depth-ResNet takes 3D CT images as a whole and processes the volumatic blocks along depth directions. Stephanie A. Harmon et.al. [14] show that a series of deep learning algorithms, trained in a diverse multinational cohort of 1280 patients to localize parietal pleura/lung parenchyma followed by classification of COVID-19 pneumonia, can achieve up to 90.8% accuracy, with 84% sensitivity and 93% specificity, as evaluated in an independent test set (not included in training and validation) of 1337 patients.

PROPOSED METHODOLOGY

The entire working process of the presented method is shown in Fig. 3. As shown in figure, the presented model consists a series of processes which are discussed in the figure.

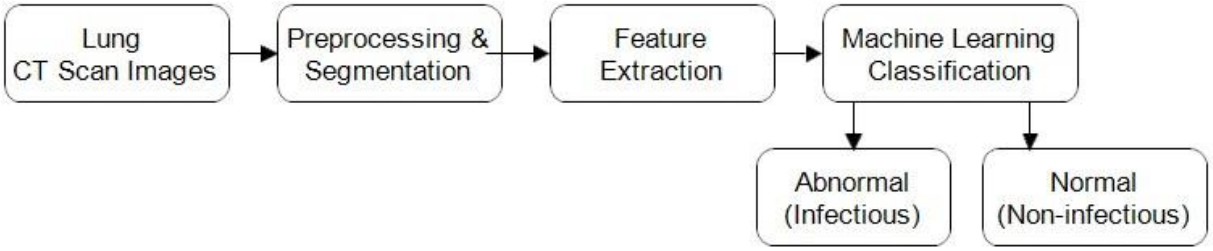

Fig 3: proposed methodology of system

Lung CT Scan Images: We are applying our methodology to standard benchmark image database is applied and observed under several aspects. The dataset has a collection of lung cancer screening CT images that can be employed for the design. The input CT scan lung images are provided as input to the presented model.

Pre-processing and Segmentation: In the initial stage, the pre-processing takes place by the use of median filter and Gaussian filter. Once the input image is pre-processed, the segmentation of images will take place by morphological segmentation algorithm which produces the output as segmented image in the binary form.

Feature Extraction: At the next stage, a collection of important features gets extracted from the segmented image namely centroid, area, perimeter, eccentricity, pixel mean intensity and diameter.

Machine Learning Classification: Then, the classification of images will be carried out using machine learning classification model which finally provides the output as classified image into 'normal' or 'abnormal'. Later if abnormal image is found then only it will show and detect the lung nodule abnormal section. Training and testing of computer aided diagnosis models for detecting and diagnosing lung cancer will be done in proposed approach. The process of extracting features takes place using image processing and classifier operation is carried out utilizing machine learning which helps to develop the trained prediction approaches from the filtered features in an easier way and rapid way.

CONCLUSION

As time goes on, more works on lung infection detection using machine learning have been published. However, there was a lack of systematic survey available on the current state of research and application. This paper is thus produced to offer a survey of lung disease or infection detection using machine learning, specifically on tuberculosis, pneumonia, lung cancer and COVID-19. To conclude, investigating how machine learning or artificial intelligence was employed in lung infection or disease detection is highly significant to ensure future research will concentrate on the right track, thereby improving the performance of disease detection systems. The presented taxonomy could be used by other researchers to plan their research contributions and activities. The potential future direction suggested could further improve the efficiency and increase the number of machine learning aided lung disease detection applications.

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