Recent Study of Lung Disease Detection Using Deep Learning Techniques

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Abstract. Lung diseases are some of the most common medical conditions in the world. The early detection of this disease is extremely important, since lung diseases can spread from person to person. The field of Radiology plays a vital role in the detection of these diseases. Multimodal imaging techniques can be enhanced through the use of computer-aided detection technology, which is an effective means of improving the efficiency and quality of the doctor's diagnostic process. The purpose of this paper is to provide a review of lung disease detection in a medical image. The objective of this paper is to predict the best classification algorithm for a disease that provides new solutions to the automated processing of medical images and gives a timely and effective diagnosis. In the future, we hope to identify the disease with patterns and severity from medical images to automated processing.

Keywords: Deep Learning · Lung Diseases · Medical Image

1 Introduction

Lung diseases are some of the most common medical conditions in the world. Lung disease is any problem in the lungs that prevents the lungs from working properly. Ten million people have lung disease in the U.S. alone. Smoking, infections, and genes cause most lung diseases. Your lungs are part of the complex system, expanding and relaxing thousands of times each day to bring in oxygen and send out carbon dioxide. Lung disease can happen when there are problems in any part of that system. Lung diseases affected on airways, air sacs, Interstitium, blood vessels, chest wall [1].

2 Objective

- Early detection for early diagnosis.
- Seeking effective solutions to the automated processing of medical images.
- Recent techniques for the detection of lung disease.

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2.1 Following are Some Literature Which We Refer for Our Study

Eman Magdy, Nourhan Zayed et al. "Automatic Classification of Normal and Cancer Lung CT Images Using Multiscale AM-FM Features" In this paper system proposed to analyze and segment lungs to classify them into normal or abnormal (cancer). Wiener filtering is used for pre-processing then histogram analysis with thresholding and morphological operations have been combined to segment the lung region Amplitude-Modulation Frequency-Modulation has been used to extract the feature of ROI. KNN, SVM, Naive Bayes, and linear classifiers have been used for Accuracy, sensitivity, and specificity from which linear classifier is the best one to classify the normal lung and cancer [2].

Yuanyuan Peng et al. "Pulmonary Lobe Segmentation in CT Images Based on Lung Anatomy Knowledge" developed a system using developed in MATLAB and C++. To remedy the problem, they introduce a new framework based on lung anatomy knowledge for lung lobe segmentation. As result, they develop a new lung lobe segmentation scheme that described method has a good performance in pulmonary fissure detection and lung lobe segmentation [3].

Stefanus Tao Hwa Kieu, Abdullah Bade et al. "A Survey of Deep Learning for Lung Disease Detection on Medical Images: State-of-the-Art, Taxonomy, Issues and Future Directions" in this proposed system 98 articles publish from 2016–2020 consider explaining how deep learning is effective on disease detection in medical images and support the identification, quantification and classification of patterns in medical images. It classifies an image into healthy lungs or disease-infected lungs. CNN, DBN, RNN, etc. where used as classification algorithms and also transfer learning and Ensemble (when more than one classifier is used) [4].

Xiaojie Fan, Xiaoyu Zhang et al. "Deep Learning-Based Identification of Spinal Metastasis in Lung Cancer Using Spectral CT Images" The study provides a theoretical basis for the diagnosis of bone metastasis from lung cancer by the spectral CT image. The DC-U-Net model had a lower loss function and higher Dice coefficient versus the CNN, which demonstrated better segmentation effects, with the lung effectively segmented out of the CT image with an accuracy rate of 96.7%, and each scan takes 30 s to detect. In the Conclusion, DC-U-Net model demonstrates better segmentation effects versus the convolutional neural network (CNN) [5].

Suren Makajua, P.W.C. Prasad, et al. "Lung Cancer Detection using CT Scan Images" The proposed system is used to detect the cancerous nodule from the lung CT scan image using watershed segmentation for detection and SVM for classification of a nodule as Malignant or benign using Image Processing Techniques [5].

X. Jin, Y. Zhang and Q. Jin, "Pulmonary Nodule Detection Based on CT Images Using Convolution Neural Network," In this system, a image segmentation and region of interest extraction in pulmonary CT images the method suppresses the linear disturbance and removing a large number of false positive components when ensuring the accuracy of pulmonary nodule extraction [6].

M. B. A. Miah and M. A. Yousuf, "Detection of lung cancer from CT image using image processing and neural network." In their proposed method pursue approaches in which the first step is binary thresholding, and then feature extraction, and then these

features are used to train up the neural network and test the neural network. The proposed system successfully detects lung cancer from CT scan images [7].

Joel Than Chia Ming1, Norliza Mohd Noor et al. "Lung Disease Classification using Different Deep Learning Architectures and Principal Component Analysis" in this proposed system focus on Computer Aided Diagnosis because nowadays early detection and early diagnosis are very important according to study Deep features produced the highest accuracy of 100% as compared to 93.52% produced by using GLCM features. This study also compared the classification of deep features with five different classifiers and the Support Vector Machine (SVM) showed the highest result [8].

Yar Muhammad, Mohammad Dahman Alshehri, et al. "Identification of Pneumonia Disease Applying an Intelligent Computational Framework Based on Deep Learning and Machine Learning Techniques" the proposed system uses 5 deep learning architectures for image processing AlexNet, VGG16, VGG19, Inception-V3, SqueezeNet, and machine learning classification algorithm added KNN, SVM, LR, NB, AB, ANN where use to select the best and generalize prediction model and performance of all the machine learning classifiers checked on X-Ray by transfer learning techniques. After applying various deep learning transfers learning techniques to extract useful features and then the classification algorithms were used to examine the efficiency of the proposed system and it is observed that the Inception-V3 transfer learning technique and ANN give the highest classification accuracy of 97.19% [9].

Anuradha D. Gunasinghe et al. "Early Prediction of Lung Disease" this system work to find lung disease at an early stage. The selection of the classification model was based on the advantages and disadvantages of some common algorithm such as CNN, and Capsule network, Where CNN get additional benefits to predict lung disease with good results [10].

Shubhangi Khobragade et al. "Automatic Detection of Major Lung Diseases Using Chest Radiographs and Classification by Feed-forward Artificial Neural Network" this system proposed an automated system for the detection of lung diseases, where a private dataset is used on which histogram equalization image pre-processing technique is used and to classify the pattern feed-forward artificial neural network technique gives the better result about 92% accurate [11].

Sara A. Althubiti et al. "Ensemble Learning Framework with GLCM Texture Extraction for Early Detection of Lung Cancer on CT Images" this system proposed early detection of lung cancer using CT images where features are extracted using GLCM After applying feature extraction, the accuracy of the ensemble classifier consisting of MLPNN, DT, SVM, and KNN classifiers was computed and confirmed to be highly effective [12].

Comparison shown in Fig. 1 for the classification techniques used in different literature, author uses different classification techniques for their study such as SVM, CNN, ANN, KNN, Linear classification and also Transfer learning and Ensemble for better results. Somehow Neural network techniques shows better results and used by the majority of authors in research.

Image Variations were shown in Fig. 2 for the research by the authors for their respective studies maximum number of authors used computerized tomography for their research where some of them used X-ray as well as both images simultaneously.

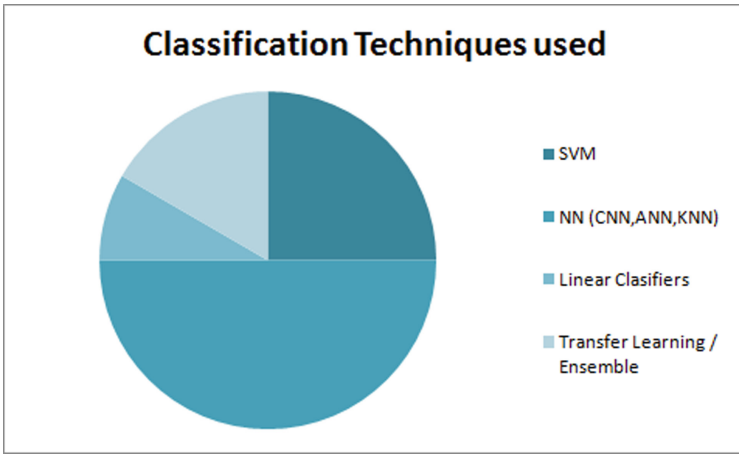

Fig. 1. Classification techniques used in literature referred for the study.

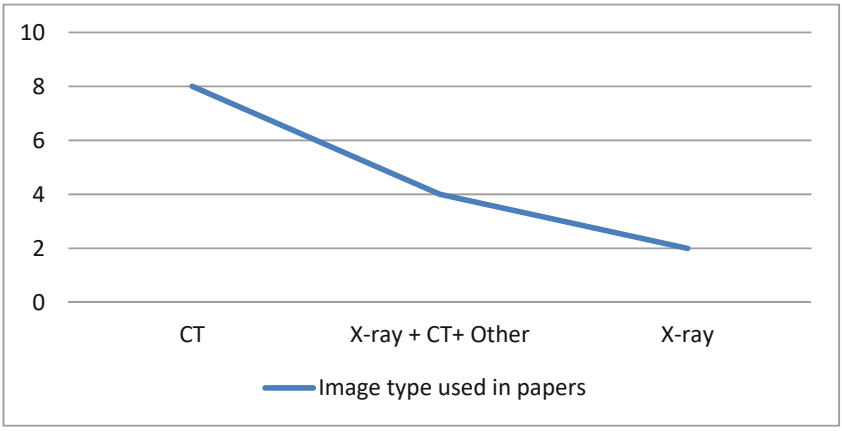

Fig. 2. Image type used by the different authors for their research.

2.2 Available Data Sets

We find the different dataset for different respiratory disease like tuberculosis, Lung cancer, Pneumonia, COVID-19, etc.

- For tuberculosis detection has Montgomery, Shenzhen, Belarus, JSRT Datasets contain X-ray images of tuberculosis
- For pneumonia detection Mooney's Kaggle dataset, NIH, UCI, and JSRT. The NIH-14 dataset contains X-ray images, while the JSRT dataset contains a mix of X-ray and CT images. The rest of the datasets all contain CT images.
- For lung Cancer Kaggle Data Science Bowl 2017 dataset, Lung Nodule Analysis 2016 (LUNA16) dataset. From most of them contain CT images.

- For Covid-19 Kaggle dataset, Github dataset and private dataset. All the datasets contain X-ray and CT images or contain mix images.

3 Result Analysis

Each paper has a distinguished technique for result analysis and sometimes combinations of two or more techniques are used for greater accuracy results. To detect lung cancer and give the accurate result different techniques were used such as Support Vector Machine (SVM), decision tree, Deep Belief Network (DBN), Multilayer Perceptron Neural Network (MPNN), Recurrent Neural Network (RNN), and CNN.

4 Conclusion

Machine learning and deep learning techniques are most commonly used for the Diagnosis of respiratory disease using multimodal images because of their high accuracy and better performance. We have investigated how deep learning working in lung disease detection is highly significant in improving the performance of disease detection systems. Deep learning can also be effective in the Diagnosis of Lung Cancer and Spinal Bone Metastasis.

References

1. (Webmed) Lung Diseases Overview By Matthew Hoffman, MD Access date 11/01/2022
2. Eman Magdy, Nourhan Zayed, Mahmoud Fakhr, "Automatic Classification of Normal and Cancer Lung CT Images Using Multiscale AM-FM Features", International Journal of Biomedical Imaging, vol. 2015, Article ID 230830,2015.
3. Yuanyuan Peng, Hualan Zhong, Zheng Xu, Hongbin Tu, Xiong Li, Lan Peng, "Pulmonary Lobe Segmentation in CT Images Based on Lung Anatomy Knowledge", Mathematical Problems in Engineering, vol. 2021, Article ID 5588629, 2021.
4. Kieu, Stefanus T.H., Abdullah Bade, Mohd H.A. Hijazi, and Hoshang Kolivand. 2020. "A Survey of Deep Learning for Lung Disease Detection on Medical Images: State-of-the-Art, Taxonomy, Issues and Future Directions" Journalof Imaging 6, no.12: 131. https://doi.org/10.3390/jimaging6120131
5. Xiaojie Fan, Xiaoyu Zhang, Zibo Zhang, Yifang Jiang, "Deep Learning- Based Identification of Spinal Metastasis in Lung Cancer Using Spectral CT Images", Scientific Programming, vol. 2021, Article ID 2779390, 2021.
6. Suren Makaju, P.W.C. Prasad, Abeer Alsadoon, A.K. Singh, A. Elchouemi, "Lung Cancer Detection using CT Scan Images" Procedia Computer Science, Volume 125, 2018, Pages 107–114, ISSN 1877-0509, https://doi.org/10.1016/j.procs.2017.12.016
7. X. Jin, Y. Zhang and Q. Jin, "Pulmonary Nodule Detection Based on CT Images Using Convolution Neural Network," 2016 9th International Symposium on Computational Intelligence and Design (ISCID), 2016, pp. 202–204, doi: https://doi.org/10.1109/ISCID.2016.1053.
8. M. B. A. Miah and M. A. Yousuf, "Detection of lung cancer from CT image using image processing and neural network," 2015 International Conference on Electrical Engineering and Information Communication Technology (ICEEICT), 2015, pp. 1-6, doi: https://doi.org/10.1109/ICEEICT.2015.7307530.

9. J. T. C. Ming, N. M. Noor, O. M. Rijal, R. M. Kassim and A. Yunus, "Lung Disease Classification Using Different Deep Learning Architectures and Principal Component Analysis," 2018 2nd International Conference on BioSignal Analysis, Processing and Systems (ICBAPS), 2018, pp. 187–190, doi: https://doi.org/10.1109/ICBAPS.2018.8527385
10. Yar Muhammad, Mohammad Dahman Alshehri, Wael Mohammed Alenazy, Truong Vinh Hoang, Ryan Alturki, "Identification of Pneumonia Disease Applying an Intelligent Computational Framework Based on Deep Learning and Machine Learning Techniques", Mobile Information Systems, vol. 2021, Article ID 9989237, 2021.
11. D. Gunasinghe, A. C. Aponso and H. Thirimanna, "Early Prediction of Lung Diseases," 2019 IEEE 5th International Conference for Convergence in Technology (I2CT), 2019, pp. 1–4, doi: https://doi.org/10.1109/I2CT45611.2019.9033668
12. S. Khobragade, A. Tiwari, C. Y. Patil and V. Narke, "Automatic detection of major lung diseases using Chest Radiographs and classification by feed-forward artificial neural network," 2016 IEEE 1st International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES), 2016, pp. 1–5, doi:https://doi.org/10.1109/ICPEICES.2016.7853683.
13. Sara A. Althubiti, Sanchita Paul, Rajanikanta Mohanty, Sachi Nandan Mohanty, Fayadh Alenezi, Kemal Polat, "Ensemble Learning Framework with GLCM Texture Extraction for Early Detection of Lung Cancer on CT Images", Computational and Mathematical Methods in Medicine, vol. 2022, Article ID 2733965, 2022.