IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Detection and Classification of COVID-19 and Other Lung Diseases using Deep Learning - A Survey

Mayuresh Rajendra Deshmukh
Department of Computer Engineering,
Pimpri Chinchwad College of Engineering, Pune, India.

Ashitosh Balasaheb Dhone
Department of Computer Engineering,
Pimpri Chinchwad College of Engineering, Pune, India.

Utkarsh Santosh Dhavale
Department of Computer Engineering,
Pimpri Chinchwad College of Engineering, Pune, India.

Pratik Vinayak Hegde
Department of Computer Engineering,
Pimpri Chinchwad College of Engineering, Pune, India.

Bodireddy Mahalakshmi
Assistant Professor
Department of Computer Engineering,
Pimpri Chinchwad College of Engineering, Pune, India.

Abstract **- This paper describes different methods used for detection of COVID-19 and other lung diseases like Pneumonia, Tuberculosis. Currently no vaccine is approved for coronavirus disease. So testing the people is of immense importance for detection of COVID-19. There are various techniques used for the detection of Coronavirus. RT-PCR, Chest X-ray, Lung CT scan images are some of those techniques. Here, we describe and compare various techniques that are used for testing of different lung diseases like COVID-19, Pneumonia, Tuberculosis. The time taken for COVID-19 testing is also crucial since the infected people are acting like coronavirus carriers. So now as the cases are increasing, improving the testing speed with more accuracy is very important. Deep Learning techniques are used to automate the testing process and are also helping in increasing the accuracy. In this survey paper, we study and compare various deep learning techniques for detection of Corona virus (COVID-19) and other lung diseases.**

Keywords **-** ***Deep Learning, Transfer Learning, COVID-19, Pneumonia, Tuberculosis, Chest CT images, Computer vision, Convolutional Neural Network.***

I. INTRODUCTION

The coronavirus (COVID-19) is a global pandemic that was discovered by a Chinese physician in Wuhan, a city in China, in December 2019. Currently, COVID-19 propagation is faster when people are in close proximity. Thus, washing hands several times & restriction on movement of people can help to curb the spread. Meanwhile, fever and cough are the most common infection symptoms. Other symptoms may occur, including chest discomfort, sputum development, and a sore throat. COVID 19 may progress to viral pneumonia which has a 5.8% fatality rate. The death rate of COVID-19 is equivalent to 3%. Currently, most of the hospitals are using three ways for diagnosis, namely Reverse Transcription Polymerase Chain Reaction (RT-PCR) uses swab from the nostril or throat of a patient, Chest X-ray and Lung CT scan use images for COVID-19 detection. However, the real-time RT-PCR test using detection of nucleotides has reported low sensitivity and hence it is not an effective tool for coronavirus infection detection owing to lack of stability, quality and viral materials in specimens. The underdeveloped countries do not have much access to sophisticated test kits and hence it creates the need for alternative ways. The potential alternatives to RT-PCR test based COVID-19 detection are Lung CT scan image, Chest X-ray image segmentation. Chest CT is becoming an important diagnostic tool for detection and classification of COVID-19 and other lung diseases. A study conducted by researchers shows that RT-PCR is only 60% sensible while CT is around 90% sensible in detection of Covid-

19. If the patient is symptomatic, CT scan gives results in 15 minutes, while it takes at least 18-24 hours for RT-PCR results [12]. The lung CT images of COVID-19 infected people often show a bilateral patchy shadow. Moreover, Chest CT scan shows the blood vessels of the body in detail, without any discomfort to the patient and it is a fast diagnosis procedure and reported high accuracy for pre-screening of COVID-19 infections. However, with the rise in the number of infections and suspected cases, it is a difficult task for the health experts to manually examine these cases. In these cases, to increase the accuracy and speed, we need an automated technique to detect the Covid-19 disease. So, here we are dealing with deep learning techniques to automate these processes. Further, these cases are quite confusing because of various lung diseases that were in existence before Covid-19. All of these diseases mostly attack the same part of the lungs. So, it may lead to ambiguity between these diseases and hence it may become difficult to get exact treatment. To overcome this problem, we can classify the CT images in various classes according to disease type. To achieve this, we can automate the model that classifies these diseases.

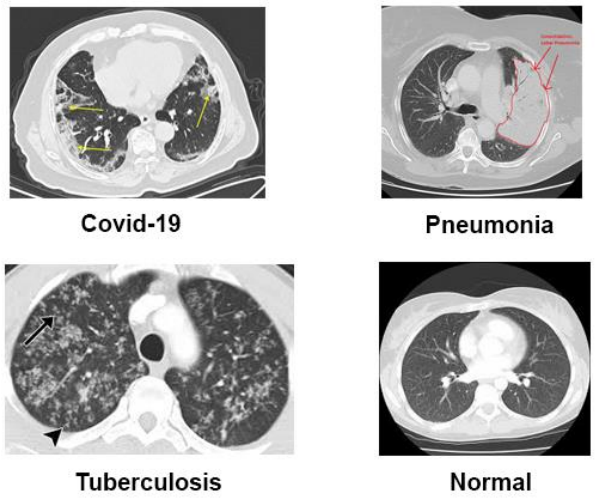

Fig. Chest CT images of different lung Diseases.

II. LITERATURE SURVEY

The Paper [1] uses two techniques a) Transfer learning b) Model Integration technique for detection of COVID-19 from x-ray image of patients. This model uses “Covid-Net” for the diagnosis of Covid-19. They classify the data according to 3 labels: a) Normal b) COVID-19 and c) Viral pneumonia. The flow of the model used in paper is like:

A. Data Loading

B. Transfer Learning

C. Model Integration

For checking the feasibility of the model, here, a representative data set that was open source during the COVID-19 epidemic was used. Two data sets were studied, one is rsna pneumonia dataset and other is chest X-Ray dataset. The model can achieve 96.1% accuracy on the test set.

The Paper [2] uses 3 way classifications for Covid-19, Non-pneumonia (NP) & community acquired pneumonia (CAP). For infection detection and classification to achieve high accurate "Lung Segmentation", open dataset (TCIA dataset) is used to train the deep neural network. They first use different convolution blocks for training different individual classifiers. Then the joint classifier is trained on the aggregated prediction scores. Training and validation sets were created by splitting the datasets and trained with some loss. Performance of the given model was evaluated for each task with 5-fold cross-validation. The different phases of project are summarized in the following five steps:

Step 1: Gather the various chest X-ray images from COVID-19 patients and healthy persons.

Step 2: Generate chest X-ray images using different data augmentation techniques.

Step 3: Represent the images in a feature space to apply deep learning

Step 4: Split the dataset into two sets: a training set and a validation set.

Step 5: Evaluate the performance of the detector on the validation dataset.

Binary classification is also performed on different combinations of two classes for comparative study. because performance of binary classification is usually better than multi-way classification such as NP or COVID-19 and NP or CAP. Model performed better in segregating NP & COVID-19 patients with 96% accuracy.

The paper [3] makes use of “Semi-Supervised Shallow Learning Network” for automatic detection of COVID-19 using lung CT images. The project makes use of publicly available lung CT scan images collected from medRxiv (Brazilian data set) and Zenodo and experiments are performed using the semi-supervised neural network model on both the data sets. It can conclude that the performance of the semi-supervised model on lung CT images is statistically significant, i.e., accuracy is around 93% and offers a potential alternative to the solution of deep learning networks and other features based learning paradigms in upcoming years.

The paper [4] uses optimized CNN for detection of Pneumonia using X-ray images of chest sections of the human body. It uses a dataset available on the Kaggle website which consists of 5863 X-ray images in jpeg extensions and divided into 2 categories, with Pneumonia and without Pneumonia. The actual model is the combination of 2 deep learning models, "ResNet_34 based" and "EfficientNet_B4 based". The model uses Sigmoid Cross Entropy and Dice Loss along with that progressive scaling is added. Author here has put forth a new model that makes use of the compound model. To increase the efficiency features like memory capacity of ResNet, width scaling etc. are added.

	ResNet-34 based U-Net	EfficientNet-B4 based U-Net
Accuracy	82%	94%
Precision	78%	97% (High)
Recall	99% (High)	93%
F1-Score	87%	95%

Table. Result based on Test data

The ensembled model is the combination of both the models with 90% accuracy, in that high recall quality is taken from model-1 and high precision quality is taken from model-2.

The paper [5] makes use of CNN along with X-ray for TB detection. This paper uses the transfer learning models LeNet & AlexNet. Montgomery and Shenzhen dataset are used, which is composed of CXR images. The Montgomery dataset has 138 CXR images and the Shenzhen dataset has 662 images. The proposed system consists of 19 layers out of which 7 are convolutional layers used for extraction of unique features, other 7 of them are ReLu layers used to integrate non-linearity, and another 3 are FC layers and remaining are dropout layers to prevent overfitting. To evaluate the result, data from 2 given datasets are divided into the ratio of 3:1 for training and testing respectively. Different Optimizers were tested against all the aspects from which Adam optimizer performed well with the accuracy of 94.73%. The Nvidia Titan X GPU processor was used during this experimental work along with the tensorflow library.

The paper [6] is all about the use of AlexNet for the ImageNet classification using Deep Convolutional Neural Network. A deep CNN was trained to classify huge amounts of high resolution images into various classes. Using AlexNet, deep CNN can give better accuracy on complex data sets. It uses supervised learning. If a single layer is removed, performance downgrades. . Hence the depth of CNN must be properly set. It can be effective to classify lung diseases using chest CT.

Here approach in paper [7] uses CT images in deep convolutional neural network (CNN) along with various transfer learning models namely VGG16 Architecture, InceptionV3 Architecture, ResNet50 Architecture, DenseNet Architecture and were used to do comparative study of all the models. Fusion of the predicted decision of all the models is done. This also helps to enhance the performance. But it was restricted only towards COVID detection.

Ref.	Dataset Used	Classes	Approach	Performance
[1]	rsna pneumonia dataset and chest X-Ray dataset	3 classes: Normal, COVID-19 and Viral pneumonia.	Transfer Learning and Model Integration	Accuracy : 96.1%
[2]	TCIA dataset containing Covid-19, Non-pneumonia (NP)& community acquired pneumonia images	3 classes: COVID-19, Non-pneumonia and community acquired pneumonia	Weakly Supervised Deep Learning	Accuracy: 96%
[3]	Lung CT scan images collected from medRxiv (Brazilian data set)	2 classes: COVID-19 and Non COVID-19	parallel self-supervised neural network model (PQIS-Net)with Semi-Supervised Shallow Learning Network	Accuracy : 0.931 ± 0.139, i.e., around 93%
[4]	Chest X-Ray Images in jpeg format from Kaggle	2 classes: Pneumonia and No- confirmed	Optimized Convolutional Neural Network (ResNet-34 based U-Net + EfficientNet-B4 based U-Net)	Accuracy : 90%
[5]	CXR images from Montgomery and Shenzhen	2 classes: TB and No- confirmed	Convolutional Neural Network	Accuracy : 94.73%

Table . A Selection Works on Covid-19 and Other lung Diseases Detection

III. CONCLUSION AND FUTURE WORK

To detect COVID-19 among patients many deep learning techniques are used today. These models help to achieve high accuracy while reducing testing time. Some models also classified images between COVID-19 and pneumonia. But to improve it further, we can use a more diversified dataset for model training. Then we can add more lung diseases as labels to classify images. CT images have proved its significance towards detection of COVID-19. Not only for covid, it can be further used for various lung diseases like pneumonia, TB, influenza etc. Hyper tuning & use of non-axial parts may improve performance of model. Fusion of results of various transfer learning models may also increase accuracy.

IV. REFERENCES

[1] Deep Learning for The Detection of COVID-19 Using Transfer Learning and Model Integration IEEE 2020, Ningwei Wang, Hongzhe Liu*, Cheng Xu Beijing Key Laboratory of Information Service Engineering Beijing Union University.

[2] Weakly Supervised Deep Learning for COVID-19 Infection Detection and Classification From CT Images, date of current version July 8, 2020.

[3] Auto-Diagnosis of Covid-19 Using Lung CT Images With Semi-Supervised Shallow Learning Network (Preprint Version of Paper in ResearchSquare), Debanjan Konar, Bijaya Ketan Panigrahi Indian Institute of Technology Delhi New Delhi, India.

[4] Pneumonia Detection: An Efficient Approach Using Deep Learning IEEE-2020. Ayush Pant, Akshat Jain, Kiran C Nayak, Daksh Gandhi, Dr. B. G. Prasad, B.M.S. College of Engineering Bengaluru, Karnataka.

[5] Deep-learning: A Potential Method for Tuberculosis Detection using Chest Radiography, IEEE,2017

[6] ImageNet Classification with Deep Convolutional Neural Networks; Alex Krizhevsky, Ilya Sutskever, Geoffrey E. Hinton; ImageNet Large Scale Visual Recognition Challenge, September 30, 2012.

[7] Identifying COVID19 from Chest CT Images: A Deep Convolutional Neural Networks Based Approach, published on 12 Aug 2020

[8] W.H.O.,"Coronavirus disease (COVID-19) pandemic.", https://www.who.int/emergencies/diseases/novel-coronavirus-2019, 2020.

[9] W.H.O.,"Coronavirus disease 2019 (COVID-19): Situation report – 123",https://www.who.int/docs/default-source/coronavirus/situation-reports/20200522-COVID-19-sitrep-123.pdf?sfvrsn=5ad1bc3_4, Accessed May 22, 2020.

[10] Correlation of Chest CT and RT-PCR Testing for Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases Published Online:Feb 26 2020 Radiology 2020; 296:E32–E40 ,

[11] Chest CT accuracy in diagnosing COVID-19 during the peak of the Italian epidemic: A retrospective correlation with RT-PCR testing and analysis of discordant casesEur J Radiol. 2020 Sep; 130: 109192. Published online 2020 Jul 25. doi: 10.1016/j.ejrad.2020.109192 PMCID: PMC7382359 PMID: 32738464.

[12] Artificial intelligence for the detection of COVID-19 pneumonia on chest CT using multinational datasets, article in NATURE COMMUNICATION.