IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

IJARSCT
Impact Factor: 6.252

Volume 2, Issue 3, May 2022

Automated Detection of Lung Diseases through Enhancement of Chest X-Ray Images

Abhishek Lonkar[1], Rushabh Munoth[2], Vedant Yadav[3], Vyankatesh Jaju[4], Prof. S. R. Nalamwar[5]

Students, Department of Computer Engineering[1,2,3,4]

Faculty, Department of Computer Engineering[5]

AISSMS College of Engineering, Pune, Maharashtra, India

Abstract: *Covid-19 has brought about a significant disruption in all spheres of life, be it healthcare, lifestyle, work environment, etc. Its prominent effect was seen in healthcare sector where it exposed various vulnerabilities which went unnoticed till now. People around the world were already exploring the applications of AI/ML/DL in healthcare including computer aided diagnosis. Pandemic brought about a phase shift in this and now aided the same. Inspired by the wave of Computer aided Diagnosis and its promising applications we propose a Deep Learning model which can automate and thereby speedup the process of lung disease diagnosis. In this model we use Deep Learning model, this supervised learning technique promise a good accuracy. Dataset balancing techniques such as Image Augmentation and tuning of hyper-parameters was done to improve training and consequently the validation accuracy. The presented model can be used to provide a quick and reliable diagnosis of the diseases stated.*

Keywords: Deep Learning; Computer Aided Diagnosis; Chest X-Ray Images; Convolution Network; Pneumonia; Image Classification; Computer Vision

I. Introduction

Lung diseases kill approximately 900,000 children each year and afflict 8.6% of the world's population. This condition is diagnosed mostly through chest X-rays. In this paper, an effective model for the detection of pneumonia is proposed, which is trained using digital chest X-ray pictures and could speed up the diagnosis process.

Chest X-rays, CT of the lungs, and chest ultrasound are all techniques that can be used to diagnose pneumonia. Chest X-rays are currently one of the most effective ways for detecting pneumonia, because CT imaging takes substantially longer time and resources than X-ray imaging and many impoverished areas may lack sufficient high-quality CT scanners.

COVID-19 is detected using through collecting the samples in the form of nasal swabs from nasal area, such a test poses various threats including the risk of healthcare worker being infected. We hope this model will mitigate such risks and help people access quick, accurate diagnosis of COVID-19 and bacterial pneumonia by providing an alternative method based deep learning and computer vision.

II. Related Work

Much work has been done in this area, and various processes have been described for detection of Pneumonia in chest X-ray samples, especially the models using image classification of Deep Learning. Rajpurkar et al. (Radiologist-Level Pneumonia Detection on Chest X-Rays with Deep Learning) DenseNet-121, a 121-layer CNN model, was proposed as a traditional deep learning network to speed up pneumonia detection [1]. In comparison to experienced professionals/radiologists, the framework produced a higher F1 score. Furthermore, the researchers devised Weighted Binary Cross-Entropy loss, which differed from Binary Cross-Entropy loss in that it assigned different weights to imbalanced classes dependent on their number [1]. However, the loss did not count in the varied training difficulty levels for classes. The problems of poor generalization caused by over-fitting and of spatial sparseness caused by ordinary convolution operation were solved using residual connection network and dilated convolution with the final recall rate being 96.7% and F1 score of their model peaked at 92.7%.

II. Background Study of Deep Learning Methods

Convolutional Neural Network (CNN): A series of convolution and pooling operations are performed on the input image, followed by one or more fully linked layers. The procedures that are being carried out determine the output layer. A

SoftMax layer is used as the multiclass classification output layer. Deeper CNNs also have fundamental problem of shrinking gradients, which can be solved by using residual networks.

Deep Transfer Learning: Transfer learning is a model that has been trained for one task over millions of images which can be used as the basis for another task. However, they are used to solve some tasks, but not help in other.
They help with saving the computer resources and also speed up the process of developing neural networks to solve various problems by training them with such models rather than using randomly initialized weights.

III. Dataset

The dataset is split into two parts, a training and a test set, contributing to a total of 5836 photos. Under the heading "pneumonia infected," both bacterial and viral pneumonia were grouped together. Viral and bacterial co-infection cases were not a part of the dataset. All chest X-ray images were added in the dataset as part of the patients' usual clinical routine.

Table 1: Binary Classification dataset

Category	Train dataset	Test dataset
Normal (Healthy)	1283	300
Pneumonia	3873	400
Total	5156	700
Percentage	88.05%	11.95%

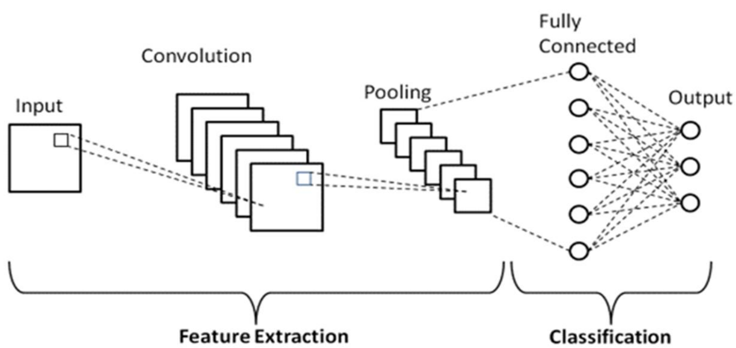
IV. Architecture and Methodology

4.1 Pre-Processing on Image

The image is pre-processed before being sent to the model. Normally, images are in RGB colour, but we transform them to grey scale with a single monochrome channel before sending them to the model to avoid undesired noise. When providing input to the model, the user may give a picture of a different size, so we must transform that image to that size. We've utilised a 100-pixel image here.

4.2 Feature Extraction

This is the procedure for converting input data into a set of features that best represent it. We can minimise the size of a feature if we want to delete it. Various operations including pooling, normalisation, and other operations can be used in this process. We turn the 2D matrix into a flatten array and then transfer it to the dense layer after extracting the feature. CNN models were created using a sequential model from the Keras package, with 2D convolution layers added initially for core processing.



After that pooling layer were used for summarizing the previous layers learning and reducing the dimension of feature map. Thereby reducing the calculations and in a way making it more immune to variation in dataset, i.e., generalizing.

Flattening layers were implemented for single dimension feature map. In the end Dense layers i.e., fully connected layers were used for classifying it in two classes.

IJARSCT

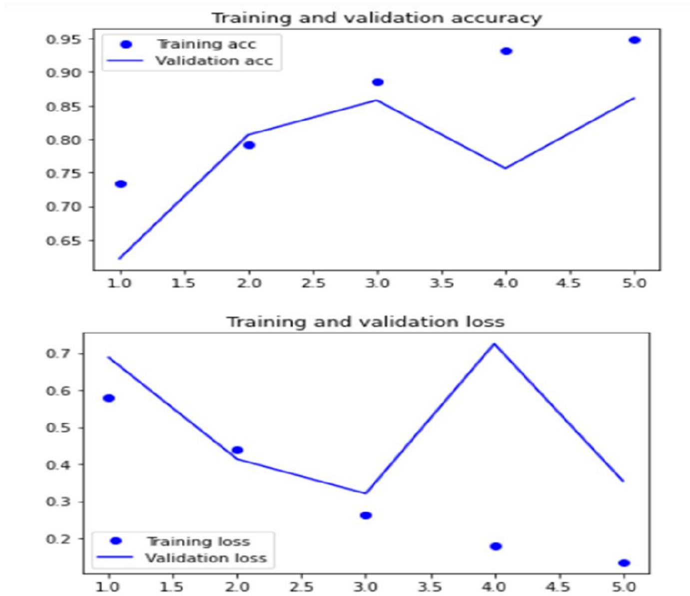
ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

Volume 2, Issue 3, May 2022

Impact Factor: 6.252

V. Result



VI. Future Scope

- Calculating and highlighting the infected area using lung segmentation and masking.
- Differentiate between viral and bacterial pneumonia.
- Going forward we propose to extend the capabilities of detecting lung diseases through two different deep learning classification models, multi-class image classification and multi-label image classification.
    - In Multi-class we consider only one disease for an X-ray image in the dataset thereby classifying the image into one of the pre-determined classes(diseases).
    - With the aim to achieve more accurate predictions overcome the limitations of binary image classification and multi-class image classification by considering the fact that a patient can be diagnosed with more than one disease.
- Calculation the probability of contracting other lung related diseases for already infected patient.

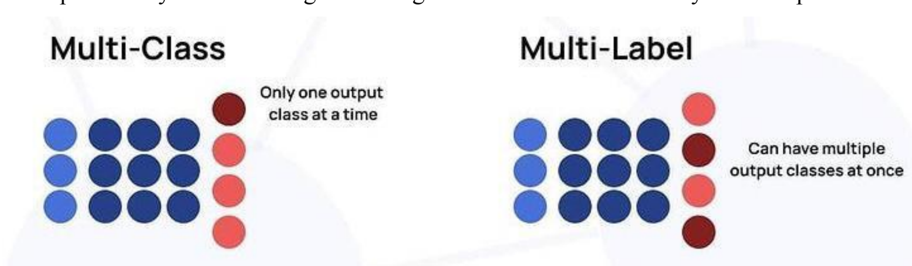


Figure: Multi-class v/s Multi-label classification

VIII. Conclusion

The study of this research is to understand the need to provide better and enhanced lung disease detection using deep learning methods. We were successful in building and implementing a model which detects the lung disease with a promising accuracy and we are of view that with right approach and tools above mentioned features can be added to this project to provide accurate medical diagnostics to under privileged people. Thereby reducing the burden on healthcare professionals.

IX. Acknowledgement

Researchers would like to convey gratefulness to their project mentor, Prof. S. R. Nalamwar for her competent assistance and advice throughout the survey and implementation process of this project and would also like to extend our gratitude to Dr. D.P. Gaikwad (Head, Department of Computer Engineering, AISSMS College of Engineering, Pune)

References

[1]. "Radiologist-Level Pneumonia Detection on Chest X-Rays with Deep Learning".
[2]. J. I. K. Z. B. Y. H. M. T. D. D. D. A. B. C. L. K. S. M. P. L. A. Y. N. Pranav Rajpurkar, "CheXNet: Radiologist-Level Pneumonia Detection on Chest X-Rays with Deep Learning," 2017.
[3]. E. T. Yabsera Erdaw1, "Machine Learning Model Applied on Chest X-Ray Images Enables Automatic Detection of COVID-19 Cases with High Accuracy".
[4]. Y. C., C., R. J. Shangjie Yao, "Pneumonia Detection Using an Improved Algorithm Based on Faster R-CNN".
[5]. T. G. P. Alexandr A. Kalinin, "Deep Learning for Automatic Pneumonia Detection," vol. v1, p. 8, 2020.
[6]. Y. L. Dejun Zhang 1Fuquan Ren "Pneumonia Detection from Chest X-ray Images Based on Convolutional Neural Network," p. 17, 2021.
[7]. S. K. A. G. K.. N. D. B. a. Z. W. G. Mohammad Farukh Hashmi, "Efficient Pneumonia Detection in Chest Xray Images Using Deep Transfer Learning," p. 23, 2020.
[8]. M. Hoon Ko, M. Heewon Chung1*, M. P. Wu Seong Kang2*, M. Kyung Won Kim3, M. Youngbin Shin3 and S. J. Kang4, "COVID-19 Pneumonia Diagnosis Using a Simple 2D Deep Learning Framework With a Single Chest CT Image: Model Development and Validation," vol. v22, p. 13, 2020.
[9]. H. K. e. al, "COVID-19 Pneumonia Diagnosis Using a Simple 2D Deep Learning Framework With a Single Chest CT Image," Journal of Medical Internet Research, vol. v22, 2020.
[10]. J. A. G.-G. L. M.-V. a. J. I. G.-L. D. Arias-Londoño, "Artificial Intelligence Applied to Chest X-Ray Images for the Automatic Detection of COVID-19.," IEEE Access, , vol. vol.8, 2020.