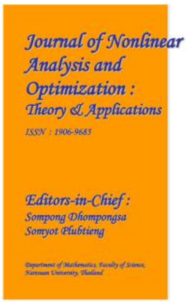
Journal of **N**onlinear **A**nalysis and **O**ptimization
Vol. 15, Issue. 1: 2024
ISSN :**1906-9685**



INTEGRATED CHEST RADIOGRAPHY ANALYSIS FOR MULTIFACETED HEALTH ASSESSMENT: PNEUMONIA, COVID-19, AND TUBERCULOSIS DETECTION

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ABSTRACT: In recent years, CNN models have become important in diagnosing diseases. This approach to treatment reduces delays and also helps doctors make quick and informed decisions. This article presents a transfer learning approach for lung disease prediction using chest X-ray images. To adapt the proposed function to a specific problem, additional CNN layers are used. The five categories that make up the educational materials of this new pre-training model are Bacterial pneumonia, Viral pneumonia, COVID-19, Tuberculosis, and Normal condition. In addition to providing accurate disease predictions, the proposed tool also includes a weighting system designed specifically for COVID-19 cases for severity estimation. Using these studies, doctors can quickly analyze a lung X-ray and reach an accurate diagnosis within seconds. This rapid and accurate assessment is important to help manage the quality and resource allocation of patients, especially during a global pandemic and high demand. In addition, estimating the severity of the disease provides a clinical application opportunity to assist doctors in the care of patients in advance of the disease. Its integration into clinical practice has the potential to revolutionize lung health management, enabling timely interventions and improving patient outcomes.
Keywords:CNN, Deep Learning, Transfer learning, ResNet50 architecture, Feature extraction, Severity assessment.

1. INTRODUCTION

CNN-based deep learning model has changed the diagnostic process in the medical world by using image data to identify various diseases. Our study proposed a transfer learning model using the ResNet50 architecture to classify lung diseases.Timely diagnosis of lung diseases is important for improving treatment strategies and improving patient outcomes. Our learning consists of the base model of ResNet50 and then adds new algorithms on top to perform the classification task. Known for its depth and performance, the ResNet50 architecture provides powerful capabilities for extracting complex patterns from medical images. Thereupon, a new CNN classifier is added to capture prior knowledge.

Since the spread of COVID-19 continues, timely and accurate diagnosis is important. To this end, our tool not only detects the presence of it but also provides a continuous assessment of the severity of COVID-19.

This capability helps doctors assist patients at critical times, share treatment strategies, and improve resource allocation. These studies can also help make quick and accurate diagnostic decisions.By integrating our transformation model (adapted ResNet50 model) into clinical settings, we aim to simplify the diagnosis of lung disease. Physicians benefit from rapid and accurate testing that allows rapid initiation of treatment and improved patient outcomes.

In the next section, we will delve into the architecture and training method. This modified ResNet50 model provides experimental results to prove its performance and discuss its implications for use in a real clinical environment. Our research contributes to the development of information- driven medicine by helping to detect lung diseases and their severity in advance.

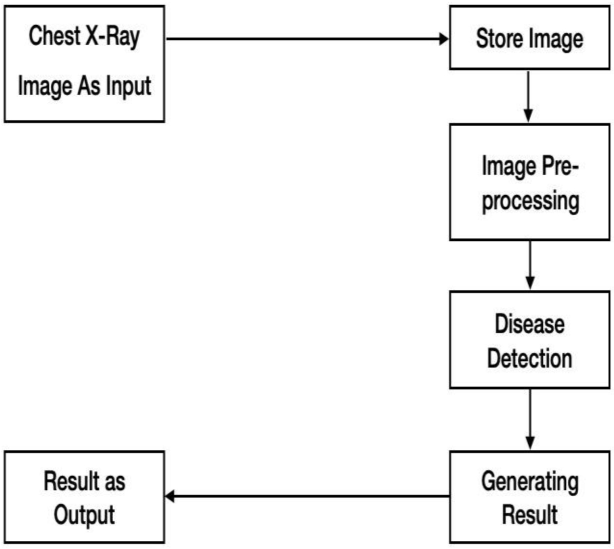

Fig.1. Block Diagram for Disease Classification

2. REVIEW OF LITERATURE

Deep learning has been widely researched and used in clinical diagnosis. Classification of lung lesions in CXR images using edge computing and hybrid InceptionResNet- v2 model) and transfer learning (TL) to classify lung diseases from open data in chest X-ray images [1]. Automatic classification of chest X-ray images according to lung diseases using hybrid deep learning. The paper "Work" builds a framework to identify diseases from chest X-ray images using a hybrid deep learning algorithm (HDLA) [2]. The project, called "Multiple Learning Models for Lung Disease Classification", developed three deep neural networks (InceptionV3, ResNet-50, and VGG16) suitable for lung disease diagnosis after training on the ImageNet dataset [3]. The task of classifying lung diseases using deep convolutional neural networks aims to use CNN-based deep learning algorithms to evaluate the level of accuracy required for the medical industry using publicly available information on chest X-ray images [4].

3. DESIGN AND METHODOLOGY

Dataset Preparation:

From the distribution of the dataset collected from different publicly available resources, that there are inconsistencies in the class labels that may affect the instructional model. Therefore, to overcome the disparity classes and overwork that may result from this, use a technique called data augmentation.

1. **Data Augmentation:** The process of creating new samples from the existing samples by applying certain procedures to the existing samples is known as data augmentation. Here are some of the Data augmentation operations that can be performed on the existing dataset to generate new samples-

a) Rescale

b) Shear Range
c) Zoom Range

2. **Data Preprocessing**: It is a method in which the data is made fit for the model it is chosen to be processed.
3. **Hyper-parameter Tuning:** Hyper-parameter tuning is essential for building effective deep-learning models It enhances the model's functionality and improves its ability to generalize to new data. Some of the hyper-parameters are -

a) Learning rate
b) Activation function (ReLu)

Model Architecture:

In this proposed work, the pre-trained model ResNet50 is used for feature extraction and custom classifier layers are added to the base pre-trained model for our custom classification of five classes of lung diseases: tuberculosis, COVID-19, viral pneumonia, bacterial pneumonia, and normal lung condition.

1. **ResNet50 Architecture:** ResNet50 is a powerful architecture capable of deep neural learning. It solves the missing gradient problem previously seen in many architectures. It can cross-link and match input methods with output methods. It can perform deep learning on big data and varioustypes of images, with up to 50 deep layers.

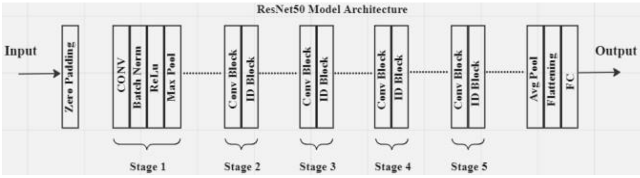

Fig.2: ResNet50 Model Architecture

2. **Custom classifier:** The final classification system of the model will be removed, and custom classifiers will be placed on the ResNet50 architecture. The layers used here are generally dense, dropout, and flatten layers.

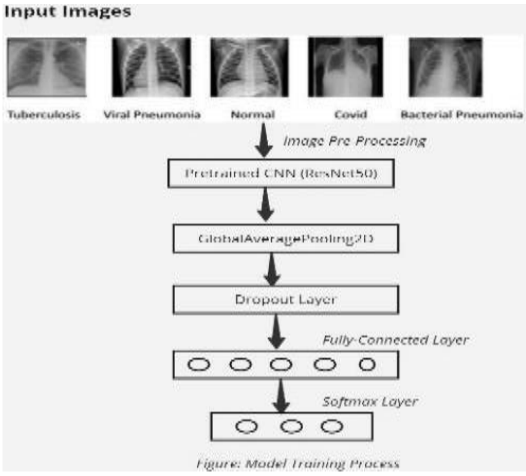

Fig.3: Model Architecture Flow

Methodology for severity level scoring:

1. Lung-diseased images undergo a process of following steps for output-
   - Extraction
   - Masking
   - Segregation
   - Segmentation
   - Estimation of segment scores
   - Finally, severity levels are estimated

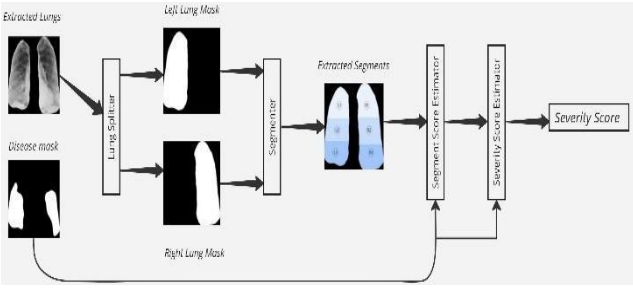

Fig.4: The Covid-19 X-ray's severity scoring procedure

A Comprehensive Synopsis of the Framework:

2. Images are collected from open-source datasets for training.
3. The gathered scans are preprocessed and data augmentation is also performed to avoid class imbalances and provide a more diverse environment.
4. ResNet50 is a base model that is used to extract features.
5. New layers are added to the ResNet50 pre-trained model, especially for classification.
6. These layers obtain the knowledge transferred and are trained specifically for our task.
7. Once the training is done, the predictions of diseases are made by loading the model and by providing the input image.
8. The input is provided from the user interface and it undergoes data preprocessing steps and the predictions are made.
9. If the predicted disease is COVID-19, then a severity score system is designed for the task.
10. Then predictions are dumped in the Non-Relational database MongoDB to display them in the web.

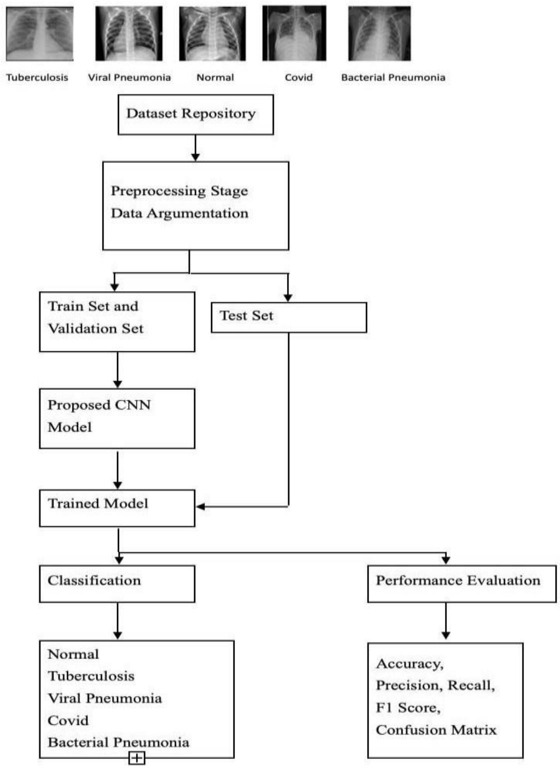

Fig.5: Detailed Overview of the system

Testing and Training:

1. We used 5 different classes for training the model.
2. 75% of data is used for training purpose.
3. We used 5 classes with 25% of random test images for testing purposes.

4. RESULTS AND DISCUSSION

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Test Loss: 0.51412
Test Accuracy: 93.45%
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Fig.6: Model Loss and Accuracy on unseen data

	precision	recall	f1-score	support
BacterialPneumonia	0.92	0.90	0.91	1377
Covid	0.98	0.97	0.98	441
Normal	0.96	0.99	0.98	1151
Tuberculosis	0.98	0.99	0.99	356
ViralPneumonia	0.83	0.83	0.83	743
accuracy			0.93	4068
macro avg	0.94	0.94	0.94	4068
weighted avg	0.93	0.93	0.93	4068

Fig.7: Classification report

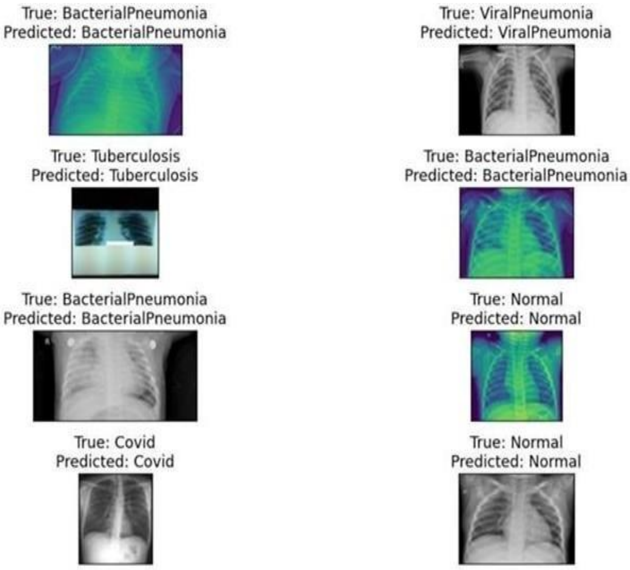

Fig.8: Forecasts (Real Labels against Expected Labels)

Detection For Input Scan Through Web Application:

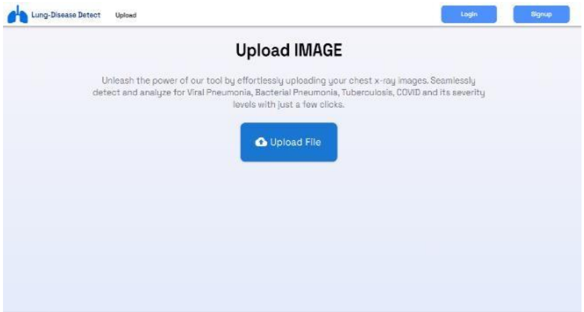

Fig.9: Upload Scan Screen

Fig.10: Image Preview and Prediction Status Display

5. CONCLUSION

Finally, our work presents a neural network learning strategy for distinguishing lung diseases. New classifiers are employed on preceding base model for purpose of categorization, with the latter serving as the basis for feature extraction. Through meticulous design and leveraging learning on a diverse dataset, our model demonstrates high performance in classifying various lung conditions.

Beyond detecting diseases, it provides a nuanced assessment of COVID-19 severity, assisting healthcare professionals in triaging patients effectively. This not only aids in treatment planning but also optimizes resource allocation during critical times. By leveraging the technology into diagnosis for healthcare our tool offers apractical solution for integrating AI into healthcare workflows. Clinicians stand to benefit from its rapid and accurate assessments, facilitating prompt treatment initiation and ultimately improving patient outcomes. The experimental results presented in this study validate the efficacy of the architectural method used paving the way for its potential deployment in real-world clinical settings. A major step forward in AI-driven healthcare is the incorporation of our modified ResNet50 model, which offers scalable solutions for lung pathology's early disease diagnosis and severity evaluation.

REFERENCES:

1. Classification of Lung Diseases Using Deep Learning Models - PMC (nih.gov).
2. Lung Disease Classification using Deep Convolutional Neural Network | IEEE Conference Publication | IEEE Xplore.
3. Detection and classification of lung diseases for pneumonia and COVID-19 using machine and deep learning techniques - PubMed (nih.gov).
4. Multi-class deep learning architecture for classifying lung diseases from chest X-ray and CT images | Scientific Reports (nature.com).
5. Image Classification with Transfer Learning Using a Custom Dataset: Comparative Study – ScienceDirect.