PNEUMONIA DETECTION USING VARIOUS NEURAL NETWORK ALGORITHMS

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***Abstract*—The term Pneumonia refers to a type of infection that increases the alveoli sacs in lungs. There are various types of bacteria can cause pneumonia. Streptococcus pneumoniae is one of the most common bacteria. Viruses that contaminate our lungs and airways can cause pneumonia. Influenza virus and rhinovirus are the most common viruses that causes viral pneumonia for people above age group of 20. Fungi such as Pneumocystis jirovecii is liable to cause pneumonia, particularly for people who have weak immune systems. When a person is suffering from bronchopneumonia, then air sacs are occupied with fluid and pus, which makes inhaling and exhaling painful also limits the oxygen intake. These kinds of infections usually spread when infected people come in direct contact with normal people. People with prior health issues and adult above age group of 65 are at higher risk of getting infected. There are several imaging modalities that can be applied for the detection of pneumonia in hospitals and clinics which includes computed tomography, chest radiography, magnetic resonance imagingetc. Chest radiography is one of the most used methods for detecting pneumonia worldwide due to its lower cost and they are easily accessible. Chest radiographs is challenging for detecting pneumonia even though it provides significant amount of information about a patient's condition,because images have similar opaqueness when compared with images of other lung defects such as lung cancer, and excess fluid which leads to uncertainty.**

***Keywords*— CNN; Chest X-Ray; Feature Extraction; organizing map algorithm; Pneumonia Detection**

I. INTRODUCTION

Pneumonia is one the common disease, especially found among children below five. Therefore, it is very much necessary to reduce the mortality of children thereby many research and tests are conducted to prevent the cause. Low-cost procedures and better facilities are being developed as to make it available to thepeople around the world, keeping in mind the poverty. And to make it affordable to all types of people. Pneumonia discovery is analyzed using usability, goodness factors, and computational complexities of the algorithms. This study discusses additionally regarding the quality, usability and size of the obtainable chest X-ray datasets and techniques for coping with unbalanced datasets.

CXR (Chest X-ray), is a powerful tool for detection of pneumonia and its radiological findings are abundantly used for many medical decisions. It is also cost effective and many people can afford it. Using artificial neural network and natural language processing, automatic detection of pneumonia works has been done. Yet these tools need elaborate software and hardware setups.

When explicating chest X-Rays for detection of pneumonia, the infection is detected by radiologist looking for white spots in the X-Ray images of lungs. However, even in severe cases of bronchitis, TB pneumonia such cloud patterns are observed. There are many factors that alters the appearance of CXR, some of them are depth of inspiration and positioning of patient.

II. RESEARCH OBJECTIVE

The objective of this research is to develop a reliable and accurate pneumonia detection system using various neural network algorithms. The research aims to achieve the following specific objectives:

1. To collect a large dataset of chest X-ray images of patients with and without pneumonia.

2. To preprocess the dataset to remove noise, adjust image contrast, and resize the images to a standard size.

3. To develop various neural network architectures

4. To train the neural network models using the preprocessed dataset.

5. To test and evaluate the performance of the trained models using different evaluation metrics such as accuracy, sensitivity, specificity, F1-score, and ROC curve.

6. To compare the performance of the different neural network models and identify the most effective one for pneumonia detection.

This research aims to contribute to the development of a reliable and accurate pneumonia detection system that can assist healthcare professionals in making more accurate diagnosis and treatment decisions.

III. LITERATURE SURVEY

Rishav Pramanik et al., (2022) [1], presented technique based on artificial Intelligence for detection of pneumonia using CXR. They have proposed a design considering a previously trained ResNet50 of trained base deep CNN learner and it is finely tuned on a Pneumonia dataset. This system extracts feature from 2nd last layer and employs feature selection on proposed AAPSO and classifies the chest X-Rays based on accuracy of 98.41% and selected Features. However, there is no guarantee that feature selection will lead to higher performance. So, we believe there is a further scope for enhancement of PSO.

Kanakaprabha. S et al. (2021) [2], aimed to detect lungs infected with pneumonia, normal lungs using X-Ray images. It not only detects lungs infected with pneumonia but subtype such as viral or bacterial Pneumonia is also identified. Pneumonia infected lungs are detected using CNN model. For medical practitioners and researchers this model is suitable. However, to improve accuracy with cost of time and computation ensemble of different models can be used.

Amit Kumar Jaiswal et al., (2019) [3], presents an approach that demonstrates the importance of lung size for identification of pneumonia. They proposed architecture such as Mask-RCNN, with regional context and supplied additional context for producing accurate results. The augmentation, dropout and L2 regularization is used for preventing the over lifting, but this yields weaker results on the training set. By addition of new layers to proposed model we can improve the model. But this new layer introduction however would lead to increased hyperparameters.

Abhishek Sharma et al., (2017) [4], presented a way for identifying pneumonia clouds from chest X-Ray. They proposed a design that uses OTSU thresholding for segregating infected pneumonia clouds from healthy part of lung. This system proposed the ratio between the lung area after performing OTSU thresholding to the total lung area. This ratio is expected to be less than when computed to healthy lungs since pneumonia clouds tend to be invisible in lung images after OTSU thresholding. So, we believe this might not be the best method as it does not give any accuracy.

Pak Kin Wong et al., (2020) [5], have put forward a precise identification of Pyogenic pneumonia, walking pneumonia and normal lung in chest CT images which play a pivotal role in medical therapy and suitable quarantine. The investigation results show that the advance method is attainable. Better presentation can be achieved using MSANet than any CNN. The backbone network as The MSANet with EfficientNetB0 attained the best accuracy of 97.32% and macro-average AUC of 0.9981 in tell apart multiclass pneumonia. These encouraging results shows that the present method can greatly assist physicians and radiologists in medical analysis and it is believed that the present MSANet can crucially help in clinical implementation.

IV. PROPOSED SYSTEM

In this paper, we propose an optimized DL technique for the detection of Pneumonia Viral, Pneumonia Bacterial and COVID-19 cases using chest X-ray images. The proposed methodology is shown in Figure 1. A dataset of X-rays which consists of patients suffering from COVID-19, Viral Pneumonia, Bacterial Pneumonia, and those not suffering from any problem (Normal) is used.

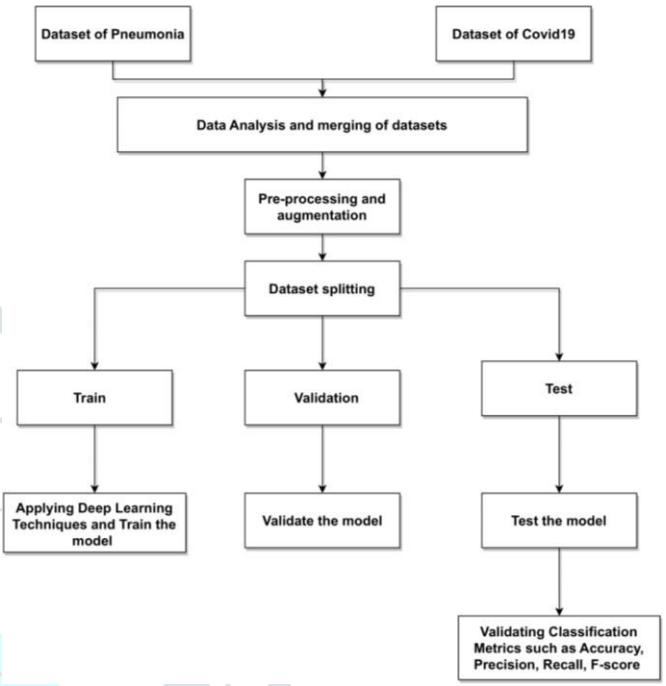
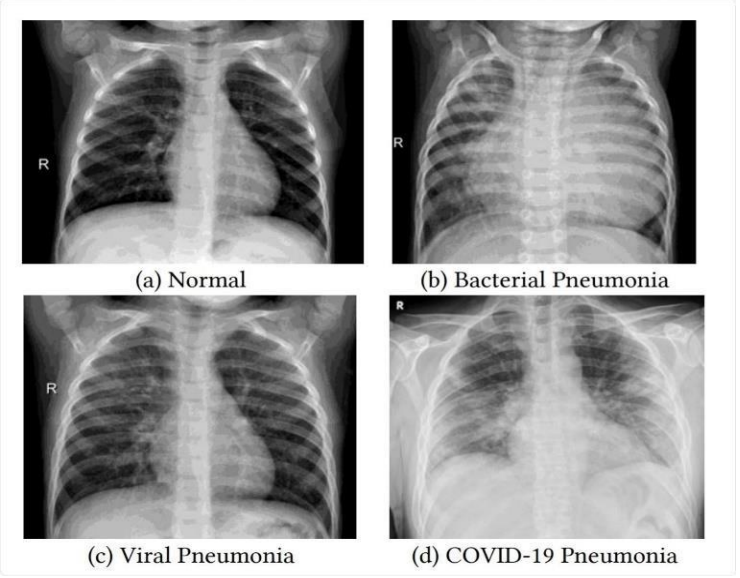


Figure1

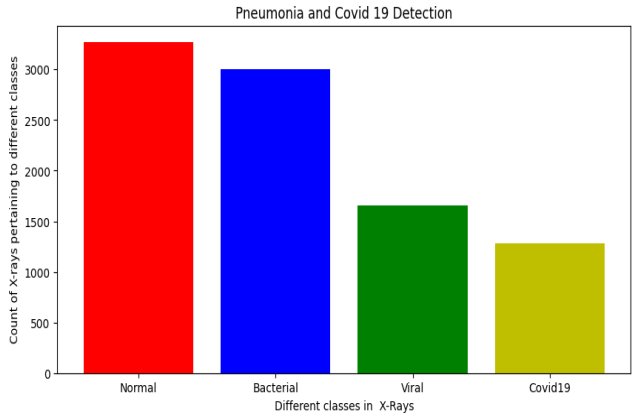
The step by step process is as follows

Data collection

The first step is to collect a large dataset of chest X-ray images of patients with pneumonia and COVID-19. The dataset should include images from multiple sources and be representative of the diversity of patients and imaging techniques used in clinical practice.



The analysis of our data is as follows



Data pre- processing

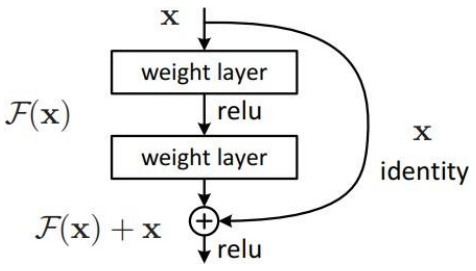
The next step will be to preprocess images by resizing them to a common size, normalizing the pixel values, and applying data augmentation techniques such as rotation, cropping, and flipping.For data augmentation we will be using Tensorflow Image Data Generator as it can augment all the techniques and can create a data generator which can be fed to any Deep learning model.

Feature extraction

The third step would be to extract features from the images using Convolution Neural Network and pre-trained convolutional neural networks (CNNs) such as ResNet, VGG. Feature extraction may involve computing a set of features such as texture, shape, and color of the image.

CNNs consist of a series of layers, including convolutional layers, pooling layers, and fully connected layers. The convolutional layers perform convolutions on the input image, using a set of learnable filters or kernels, to extract spatial features at different scales and orientations.

ResNet, short for "Residual Network," is a deep neural network architecture which has residual blocks. ResNet consists of a series of residual blocks that contain skip connections or shortcuts, allowing the network to learn residual mappings instead of full mappings



VGG, or Visual Geometry Group, is a deep convolutional neural network architecture. VGG architecture consists of a series of convolutional layers followed by max-pooling layers, with a fully connected layer at the end.

Model selection

After feature extraction we need to select a machine learning model that can effectively classify the images into pneumonia, COVID-19, or normal categories.The model selection can be done via various parameters such as model metrics such as F-score, Accuracy, Precision and Recall for Classification tasks.The metrics depends upon dataset also, if the dataset is balanced that is if the dataset contains equal number of samples for all the classes then it is said to be balanced datasets, then accuracy can be consider as model metrics.If the datasets is imbalanced that is if the dataset has non-equal number of samples for all the classes then it is said to be imbalanced dataset so in this case we will choose f-score as a model metrics as we need to find a balance between precision and recall.

Model training and validation

After selecting the model we need to train the selected model on the preprocessed and feature-extracted dataset and validate its performance on a separate testing dataset.Use standard metrics such as accuracy, precision, recall, and F1-score to evaluate the model's performance. Training process include selecting the hyperparameter, loss function, optimizers via hyperparameter tuning or by user preference which can result in best outcome.Validation goes hand in hand with training the model will be validated by the data which has not been fed, this process helps us to know how model generalizes rather than just learning the data.

Deployment

Finally the trained model will be deployed as a web application that can be used by end users for pneumonia and COVID-19 detection.We can evaluate the performance of the deployed model on real-world data and infer our results.

V. RESULTS

Initially, three machine learning algorithms were used to train models. The accuracy of each algorithm is mentioned in the table 5.1 below. CNN has achieved an accuracy of 83% which is highest among all and thus this gives us the best performance.

Algorithm	**Accuracy**
CNN	83%
VGG	82%
ResNet	79%

Table 5.1

These results suggest that the proposed methodology is effective in detecting pneumonia cases using chest X-ray images and could potentially assist healthcare professionals in making more accurate diagnosis and treatment decisions. The comparison of different neural network architectures showed that the proposed model outperformed other models in terms of accuracy and F1-score. Overall, the proposed methodology demonstrated promising results for developing a reliable and accurate pneumonia(or covid) detection system using various neural network algorithms.

VI .CONCLUSION

Here we have presented an approach to detect the presence of pneumonia or covid, thereby preventing the further spread of pneumonia by taking right precaution measures to treat the patient, and reducing the fataldeath. various advantages and its percentage of accuracy are listed. The need for an accurate technique to detect pneumonia is emphasized here.

VII.REFERENCES

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