PNEUMONIA DETECTION USING X-RAY IMAGES

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Introduction

- A pneumonia detection system is a computer-based tool that uses AI to identify the presence of Pneumonia in medical images, such as chest X-rays.
- Pneumonia is a serious and potentially life-threatening condition that affects the lungs and can cause inflammation, fluid buildup, and difficulty breathing
- Early detection of pneumonia is crucial for effective treatment as the delayed diagnosis can lead to severe complications.

Motivation

- Developing an automatic system for detecting pneumonia would be beneficial for treating the disease without any delay, particularly in remote areas.
- It is capable of detecting the relevant features without any human supervision.

Literature Review

Paper Type	Title	Author	Inference
Journal [1]	Detecting pneumonia in chest radiographs using convolutional neural networks.	Ureta, Jennifer,Oya, and Joanna	the classifiers were able to accurately identify the presence or absence of pneumonia with an accuracy between 96-97percentage.
Journal [2]	Automatic Multi-Organ Segmentation on Abdominal CT With Dense V-Networks.	Enes Ayan, Halil Murat Ünve	Test results revealed that Vgg16 achieved a higher overall accuracy of 0.87 percent compared to Xception with 0.82 percent.
Journal [3]	Classification of COVID-19 from tuberculosis and pneumonia.	Lokeswri, Venkat Prasad	They evaluated SMOTE's performance on two datasets, observing an accuracy improvement of 10 percent

Table 1: Literature Review

Literature Review

Paper Type	Title	Author	Inference
Journal [4]	Lung Disease Classification Using Deep Learning Models from Chest X-ray Image.	Salma Sultana, Anik Pramanik	Xception exhibited superior performance. This suggests that each network has its own distinct capabilities when applied to the same dataset.
Journal [5]	Visualization of Convolutional Neural Network Predictions in Detecting Pneumonia.	Sivaramakrishna Rajaraman ,Sema Candemir,Incheol Kim,	The customized VGG16 model achieved impressive results, with an accuracy of 96.2percent

Table 2: Literature Review

Gaps Identified

1. Mostly focuses on the binary classification between normal and pneumonia classes, not including other lung conditions.
2. Use of small dataset.
3. Models trained using low-quality and noisy images.

Problem Statement

To develop an automated system using machine learning techniques to accurately and efficiently detect pneumonia and other lung diseases(Tuberculosi and Covid-19) from chest X-ray images, enabling faster and more reliable diagnoses for timely medical intervention.

Objectives

1. To design and implement a CNN model for detecting lung diseases, specifically Pneumonia, Tuberculosis, and Covid19 from chest X-ray images of different image quality, dimension, and color.
2. To evaluate the performance of the developed model by measuring various metrics, such as accuracy, precision, recall, and F1 score.
3. To enable a reliable diagnosis for improved patient outcomes.

Methodology

- Gather lung disease datasets and select the best available dataset for each class.
- The images of the gathered dataset are preprocessed, rescaled, and augmented as a part of preprocessing.
- The system is trained using the newly compiled dataset of labeled chest X-ray images, where each image is annotated into pneumonia, normal, tuberculosis, or COVID-19.
- Adjustments are made to the model based on the analysis post-training
- After training, a CXR image image is fed into the network to generate a prediction indicating the likelihood of lung disease.

Network Architecture

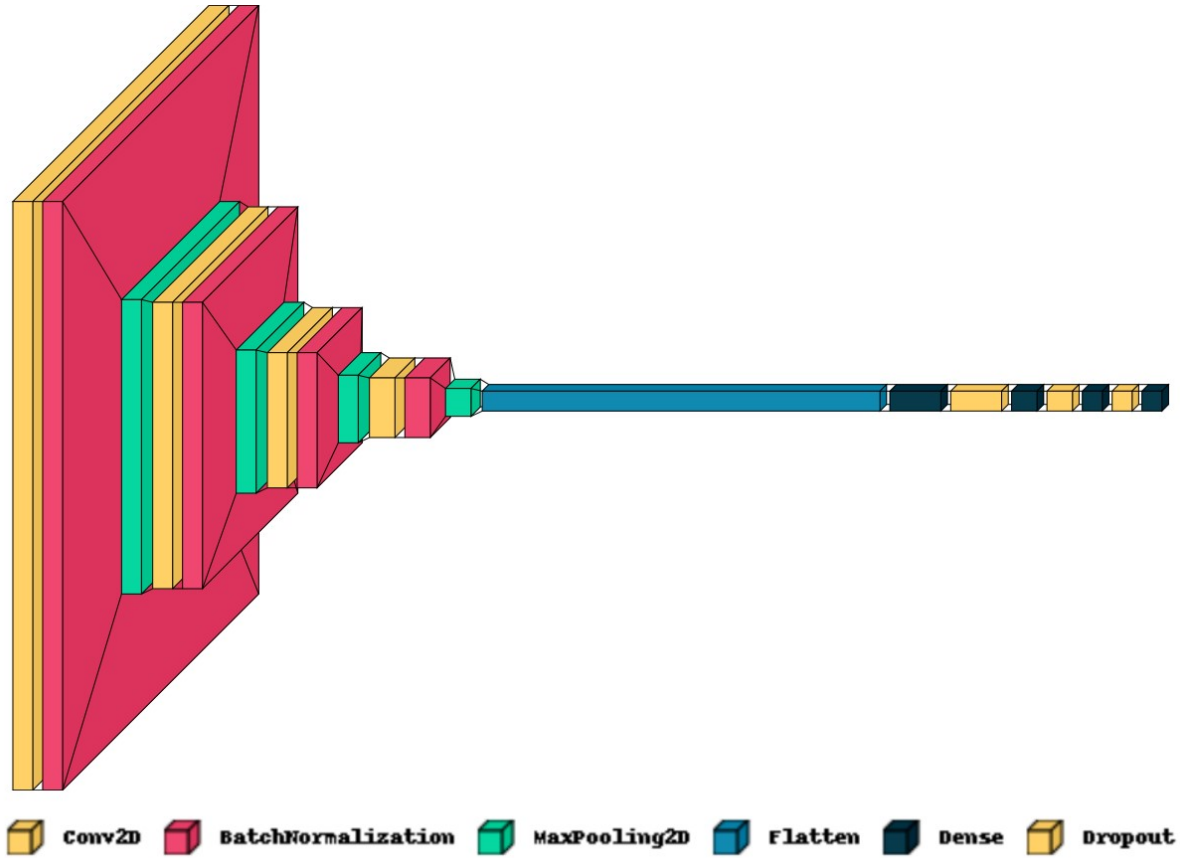


Figure 1: CNN Architecture

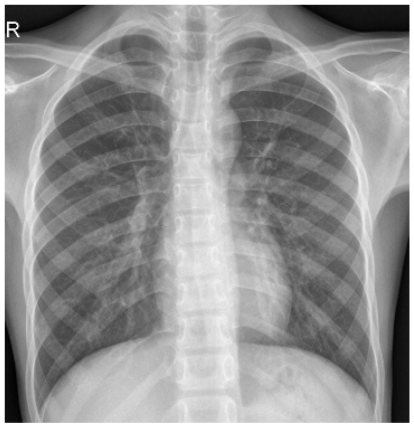
Dataset

All include X-Ray images of the chest region. All the images are in jpg format.

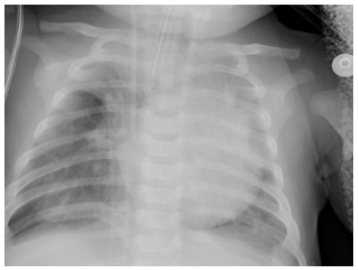
Name	**Image Count**	**Source**
1. Chest X-Ray Images (Pneumonia)v2	5856	[6]
2. 3 kinds of Pneumonia	9208	[7]
3. Chest Xrays(B,V,P,N)	4672	[8]
4. Chest X-ray Images v3	5856	[9]
5. Chest X-Ray(C-19,P,N)	5228	[10]

Table 3: Datset

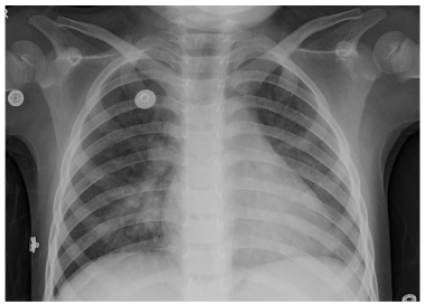
Dataset Sample



Normal



Pneumonia



Tuberculosis

COVID-19

Figure 2: Sample Images

Software Requirements

- Jupyter notebook
- X-ray image dataset
- Python 3.x
- Deep learning libraries(Tensorflow,keras,etc.)
- A relatively powerful system with sufficient RAM and storage and dedicated GPU for optimal performance.

Result and Discussion

- After training the model for 100 epochs, the model achieved a training loss of 0.0641 and a training accuracy of 0.01706 percent.
- The validation loss at the end of the training was 0.1224, with a validation accuracy of 99.517percentage
- After evaluating the model on the test dataset, it achieved a test loss of 0.0241 and test accuracy of 99.356 percentage

Result

Class	Precision	Recall	F1-Score	Support
Pneumonia	1.00	0.99	1.00	427
Normal	0.99	0.99	0.99	350
Tuberculosis	0.99	0.99	0.99	100
Covid19	0.99	1.00	0.99	367

Table 4: Classification report

Result

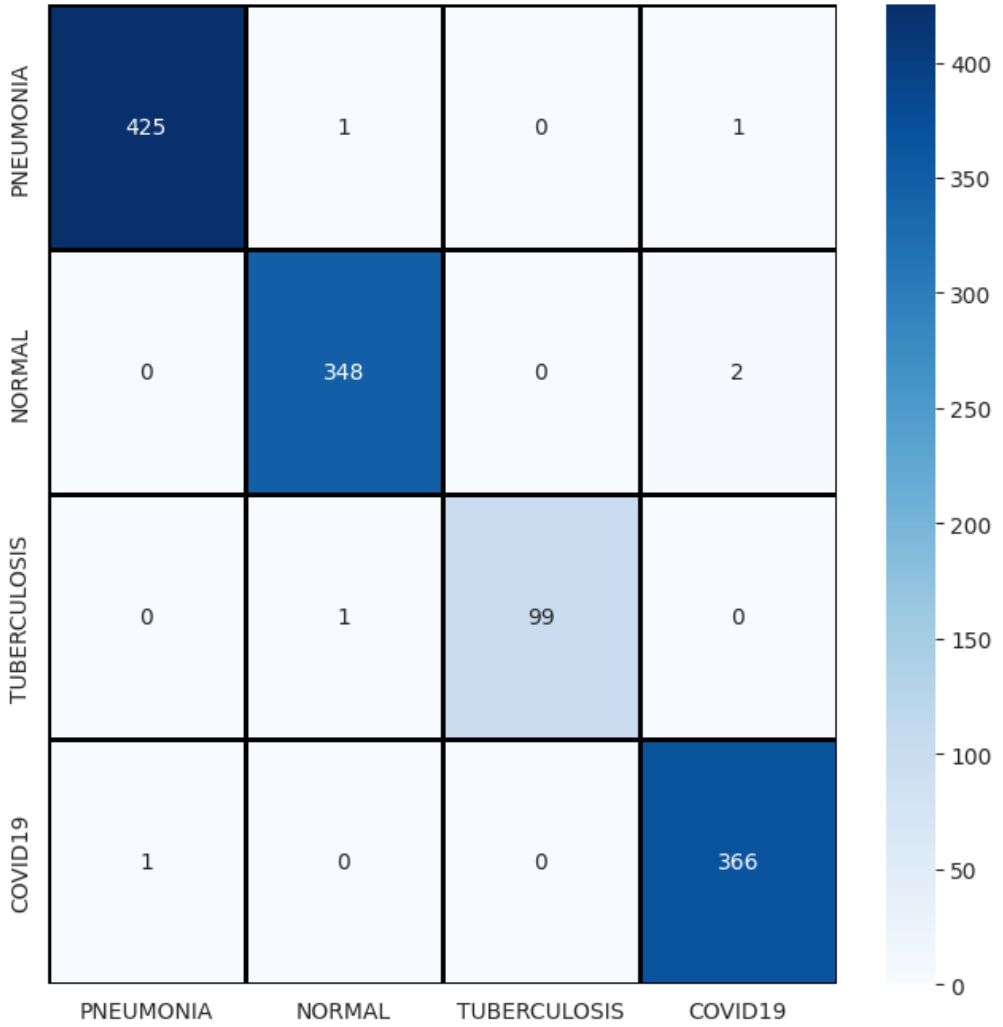


Figure 3: Confusion Matrix

Result

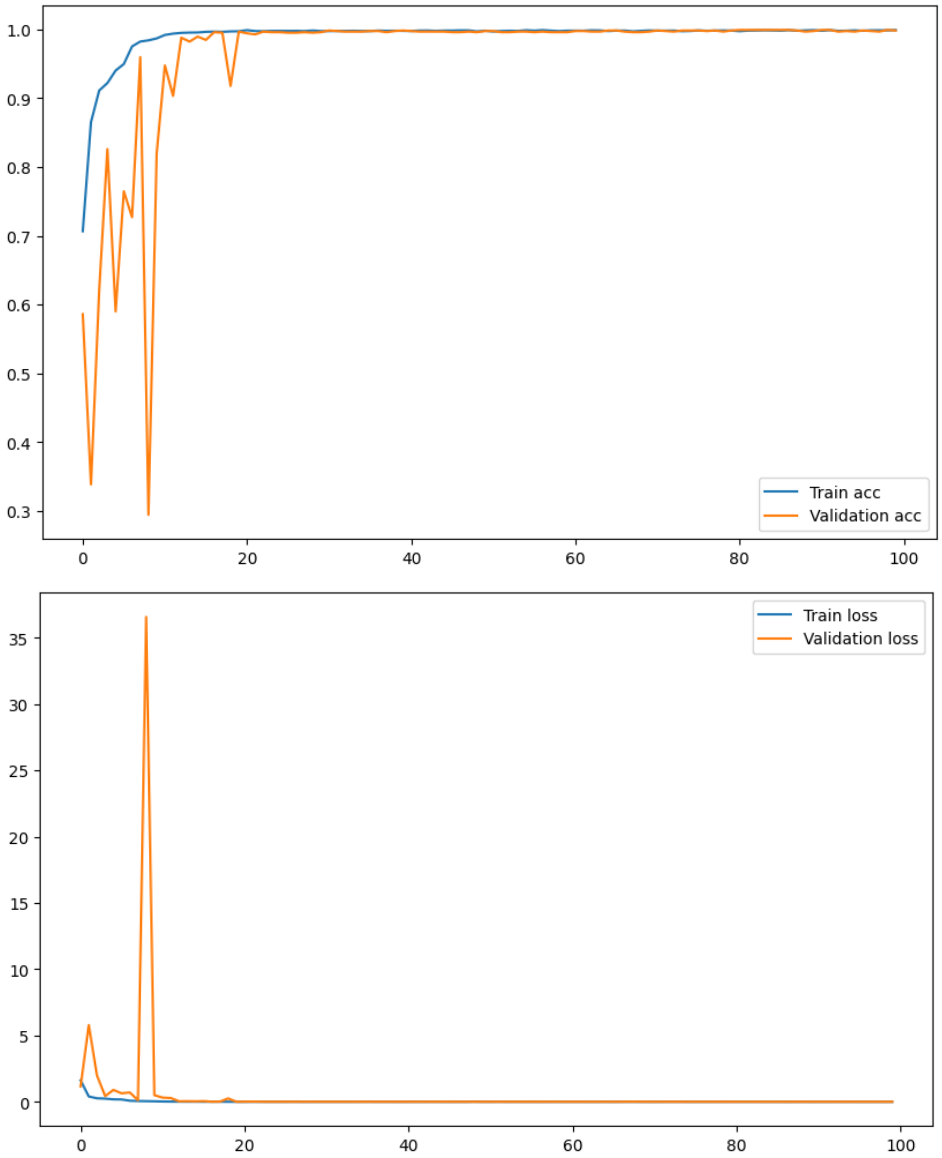


Figure 4: Model Accuracy and Model Loss

Application

- Early Diagnosis and Screening
- Telemedicine and Remote Monitoring
- Research and Public Health Surveillance

Conclusion

- The developed model demonstrated promising accuracy in classifying chest X-ray images of Pneumonia, Normal, Tuberculosis, and Covid using machine learning techniques, indicating its potential for accurate diagnosis of various chest conditions.
- Convolutional neural networks (CNNs) proved effective in extracting relevant features and patterns from the X-ray images, contributing to the model's successful classification performance.
- Accurate classification of chest X-ray images has the potential to significantly assist in early detection and diagnosis, ultimately benefiting patient outcomes. This project highlights the valuable role of machine learning in automating image analysis and aiding decision-making in the medical field. However, certain limitations, such as dataset constraints, and opportunities for further model enhancements should be considered for future research and development.

Future Scope

- Collecting additional data specifically related to Tuberculosis and Covid-19 would be beneficial to improve the model's performance and accuracy in classifying these classes.
- Applying more advanced preprocessing techniques to the existing data can help enhance the quality and relevance of the features extracted, potentially leading to better results and more robust classification.
- Exploring and experimenting with Dense Neural Networks (DNNs) as an alternative or complementary approach to Convolutional Neural Networks (CNNs) may offer valuable insights into their effectiveness for chest X-ray image classification, potentially unlocking improved performance and accuracy.

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[10] "Kaggle." `https://tinyurl.com/3jc873mx`.

THANK YOU