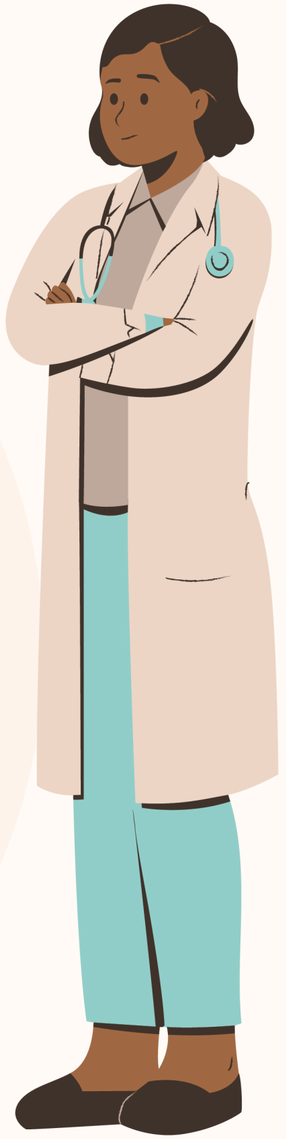
Machine Learning Techinques in Pneumonia Dection

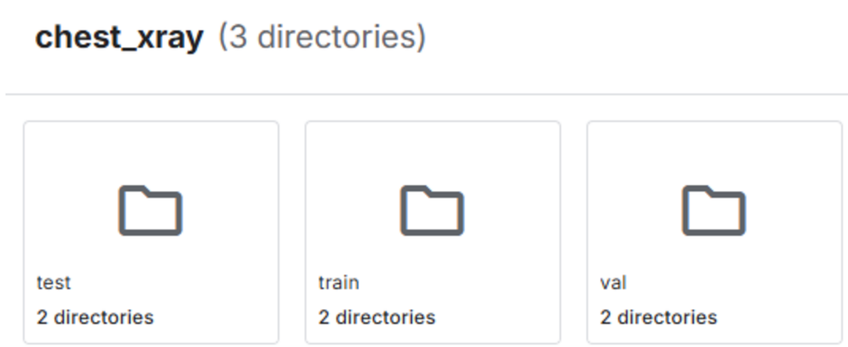
1. Introduction

Pneumonia is a lung infection caused by viruses, bacteria, or fungi, leading to pus and liquid in the air sacs. This research aims to detect Pneumonia in X-ray images using deep learning. Given the rise in cases since the pandemic, the study seeks to improve detection methods in healthcare and identify the most effective model for Pneumonia diagnosis.



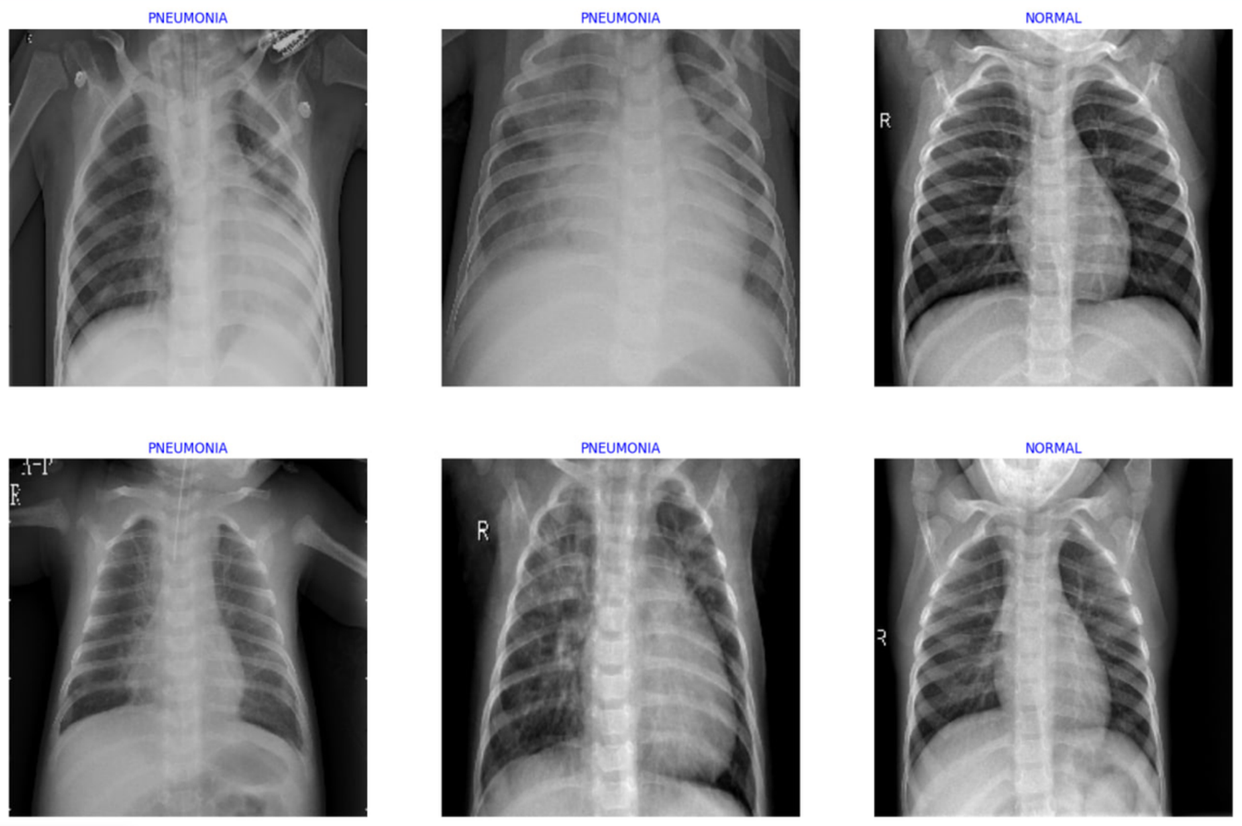
2.Data Structure

The data set is captured from kaggle (Chest X-Ray Images (Pneumonia)) that were selected from Medical Center of GuangZhou (2018)



- Training Set: 5216images with 74.29% Pneumonia, & 25.73% Normal.
- Validation Set: 16 images with 8 images are Pnemonia
- Testing Set: 624 images with 390 images are Pnemonia

3. Visualization



Normal Lungs: Filled with air, which doesn't block X-rays much, making them appear dark.

Pneumonia-Affected Lungs: their lungs fill up with fluid or pus because of the infection. This makes those parts of the lungs look white or cloudy on an X-ray because the fluid blocks the X-rays more than normal air-filled lungs.

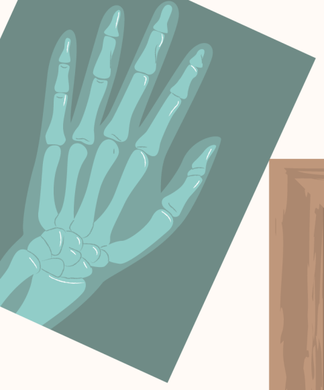
4.Data Augmentation

Data augmentation plays a crucial role in training models for predicting patient outcomes in medical applications because it enhances data diversity and improves the model's generalization capabilities.

Data Transformation (PyTorch)

- Use Scaling Pixel Intensity to (0,1)
- Horizontal Flipping (50%)
- Rotation [-30°, +30°]
- Normalize Pixel Intensity with pre mean and std

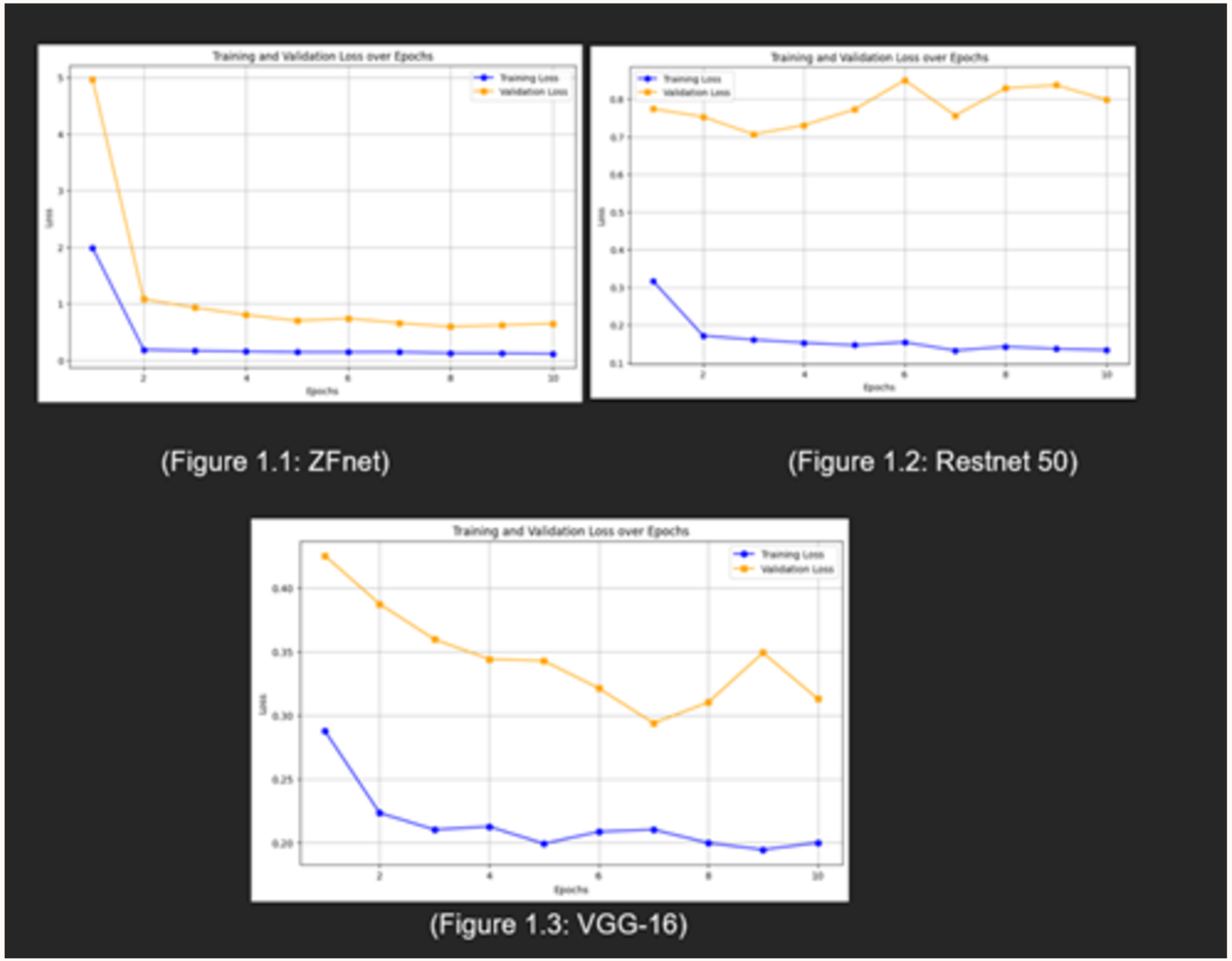
```
from torchvision import transforms
train_transforms = transforms.Compose([
    transforms.ToTensor(),
    transforms.RandomHorizontalFlip(p=0.5),
    transforms.RandomRotation(degrees=30),
    transforms.Normalize([0.485, 0.456, 0.406],
                         [0.229, 0.224, 0.225])
])
val_N_tes_transforms = transforms.Compose([
    transforms.ToTensor(),
    transforms.Normalize([0.485, 0.456, 0.406],
                         [0.229, 0.224, 0.225])
])
```



5.Models

- ZFNet, (2013) contain five convolutional layers and a fully connected layer (Scratch).
- RestNet50, is loaded using transfer learning and consists of 49 convolutional layers and 1 fully connected layer.
- VGG-16 utilizes transfer learning and includes 13 convolutional layers along with 3 fully connected layers ending with a softmax function.

5Learning Behavior



(Figure 1.1: ZFnet)

(Figure 1.2: Restnet 50)

(Figure 1.3: VGG-16)

6.Evaluation Matric

	Accuracy	Precision	Recall	F1-Score
ZFNET	**86.21%**	**84.08%**	**96.15%**	**89.71%**
RESTNET 50	**82.25%**	**78.73%**	**98.71%**	**87.59%**
VGG-16	**88.3%**	**87.82%**	**94.35%**	**90.96%**

Colusion and Discusion

From the results, CNN architectures perform exceptionally well on X-ray image data for pneumonia detection, demonstrating high recall accuracy, which indicates the model's effectiveness in identifying pneumonia patients.

Future work involves addressing dataset imbalance to reduce bias toward pneumonia predictions and improving the model's training process using techniques like Early Stopping and Learning Rate Schedulers.