Implementation of Transfer Learning with pre-trained Model for Pulmonary Image Classification

1 Introduction

Chest X-ray imaging is crucial for identifying pulmonary nodules, yet the rising prevalence of pulmonary diseases challenges radiologists' capacity. This study employs deep learning, specifically transfer learning with Inception-v3, to develop a computer-aided diagnostic model for thoracic disease diagnosis.

2 Models & Details

Utilizing a dataset of chest X-ray images, we preprocess the data and construct a Sequential model for baseline comparison. Transfer learning is then applied using Inception-v3, alongside other architectures like DenseNet121, VGG16, and ResNet50, involving fine-tuning and feature extraction.

3 Results

Evaluation of the Sequential model yields a test accuracy of 84.62%. Transfer learning with various models shows promising results:

- DenseNet121: Test Accuracy - 84.46%, Train Accuracy - 92.45%

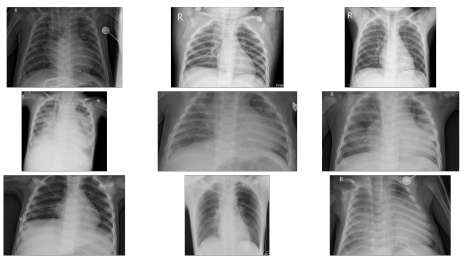

Figure 1: Chest X-Ray Data

Table 1: Model Sequential

Layer (type)	**Output Shape**	**Param #**
conv2d	(None, 178, 178, 32)	896
batch_normalization	(None, 178, 178, 32)	128
conv2d_1	(None, 176, 176, 32)	9248
batch_normalization_1	(None, 176, 176, 32)	128
max_pooling2d	(None, 88, 88, 32)	0
conv2d_2	(None, 86, 86, 64)	18496
batch_normalization_2	(None, 86, 86, 64)	256
conv2d_3	(None, 84, 84, 64)	36928
batch_normalization_3	(None, 84, 84, 64)	256
max_pooling2d_1	(None, 42, 42, 64)	0
conv2d_4	(None, 40, 40, 128)	73856
Output truncated. Total params: 6,203,681. Trainable params: 6,202,785. Non-trainable params: 896.		

Table 2: Accuracy Evaluation Sequential

Dataset	**Loss**	**Accuracy (%)**
Test	0.4296	84.62
Train	0.3312	89.69

- VGG16: Test Accuracy - 65.71%, Train Accuracy - 61.81%
- ResNet50: Test Accuracy - 81.73%, Train Accuracy - 81.96%
- Inception-v3: Test Accuracy - [70.51 %], Train Accuracy - [69.04 %]

4 Discussion

Transfer learning proves effective in enhancing pulmonary image classification. DenseNet121 emerges as a strong contender, while Inception-v3's feature extraction capabilities hold promise. Dataset augmentation and model fine-tuning contribute to improved diagnosis accuracy and efficiency.

5 Conclusion

This study underscores transfer learning's efficacy, particularly with Inception-v3, in developing a computer-aided diagnostic system for pulmonary image classification. By optimizing pre-trained models, we address the diagnostic challenges posed by the increasing incidence of pulmonary diseases, paving the way for further research and clinical implementation.

Table 3: DenseNet Model Summary

Layer (type)	**Output Shape**
input_1 (InputLayer)	(None, 180, 180, 3)
zero_padding2d	(None, 186, 186, 3)
conv1/conv	(None, 90, 90, 64)
conv1/bn	(None, 90, 90, 64)
conv1/relu	(None, 90, 90, 64)
zero_padding2d_1	(None, 92, 92, 64)
pool1	(None, 45, 45, 64)
conv2_block1_0_bn	(None, 45, 45, 64)
conv2_block1_0_relu	(None, 45, 45, 64)
conv2_block1_1_conv	(None, 45, 45, 128)
...	...
Total params:	7,037,504
Trainable params:	6,953,856
Non-trainable params:	83,648

Table 4: VGG16 Model Summary

Layer (type)	**Output Shape**
input_3 (InputLayer)	(None, 180, 180, 3)
block1_conv1 (Conv2D)	(None, 180, 180, 64)
block1_conv2 (Conv2D)	(None, 180, 180, 64)
block1_pool (MaxPooling2D)	(None, 90, 90, 64)
block2_conv1 (Conv2D)	(None, 90, 90, 128)
...	...
Total params:	14,714,688
Trainable params:	14,714,688
Non-trainable params:	0

Table 5: ResNet50 Model Summary

Layer (type)	**Output Shape**
input_4 (InputLayer)	(None, 180, 180, 3)
conv1_pad (ZeroPadding2D)	(None, 186, 186, 3)
conv1_conv (Conv2D)	(None, 90, 90, 64)
conv1_bn (BatchNormalization)	(None, 90, 90, 64)
conv1_relu (Activation)	(None, 90, 90, 64)
pool1_pad (ZeroPadding2D)	(None, 92, 92, 64)
pool1_pool (MaxPooling2D)	(None, 45, 45, 64)
conv2_block1_1_conv	(None, 45, 45, 64)
...	...
Total params:	23,587,712
Trainable params:	23,534,592
Non-trainable params:	53,120

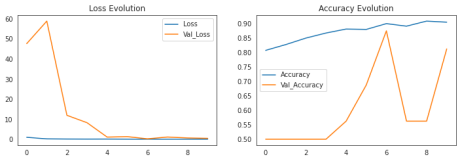

Figure 2: Sequential Model

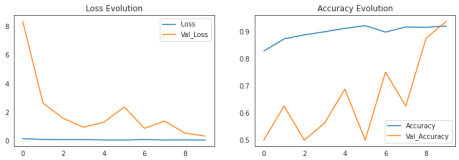

Figure 3: Dense Net Model

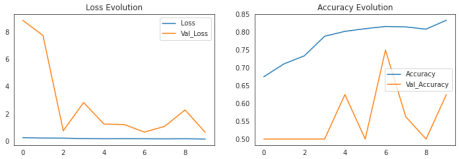

Figure 4: VGG 16 Model

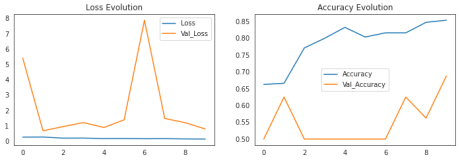

Figure 5: RSSNET Model

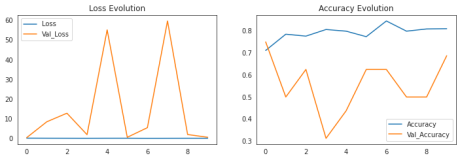

Figure 6: Inception Net Model