

CHEST DISEASE DETECTION IN X-RAY IMAGES USING MULTICLASS CLASSIFICATION WITH NEURAL NETWORKS

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Project Overview Recap

Challenge

- Difficult to differentiate chest diseases such as Pneumonia, Tuberculosis, COVID-19, and Normal (no disease).
- Interpretation can be subjective and prone to errors

Goal

- Using explainability models such as Grad-CAM, develop a highly accurate, interpretable, lightweight model for chest disease detection in X-ray images by applying Convolutional Neural Networks with multi-class classification methodology.

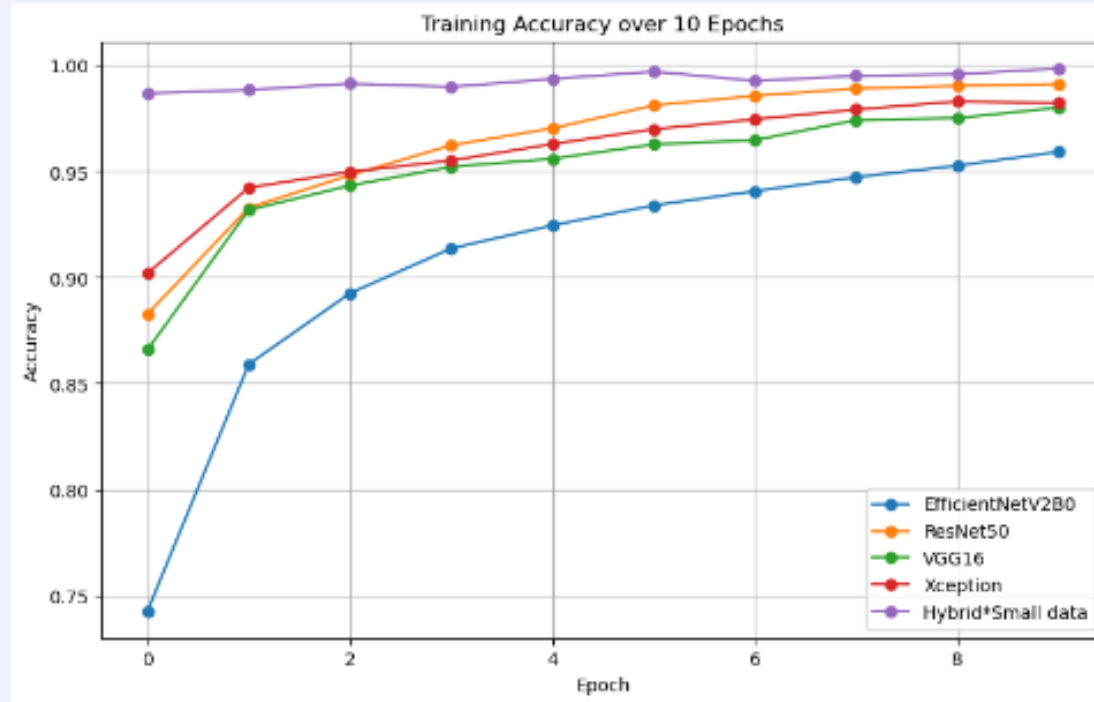


Datasets

- 3 data sources
- 10,000 more TB images added (42 GB zip file)
- Obtained from NIH upon user agreement
- Largest dataset for chest X-ray images among publicly available datasets

Class	Train	Val	Test	Total
COVID-19	4,214	2,397	1,931	8,542
Normal	11,448	3,517	1,215	16,180
Pneumonia	14,589	2,264	1,825	18,678
Tuberculosis	10,968	1,371	1,372	13,711
Total	32,942	8,538	5,257	57,111

Experiment Results – Overall

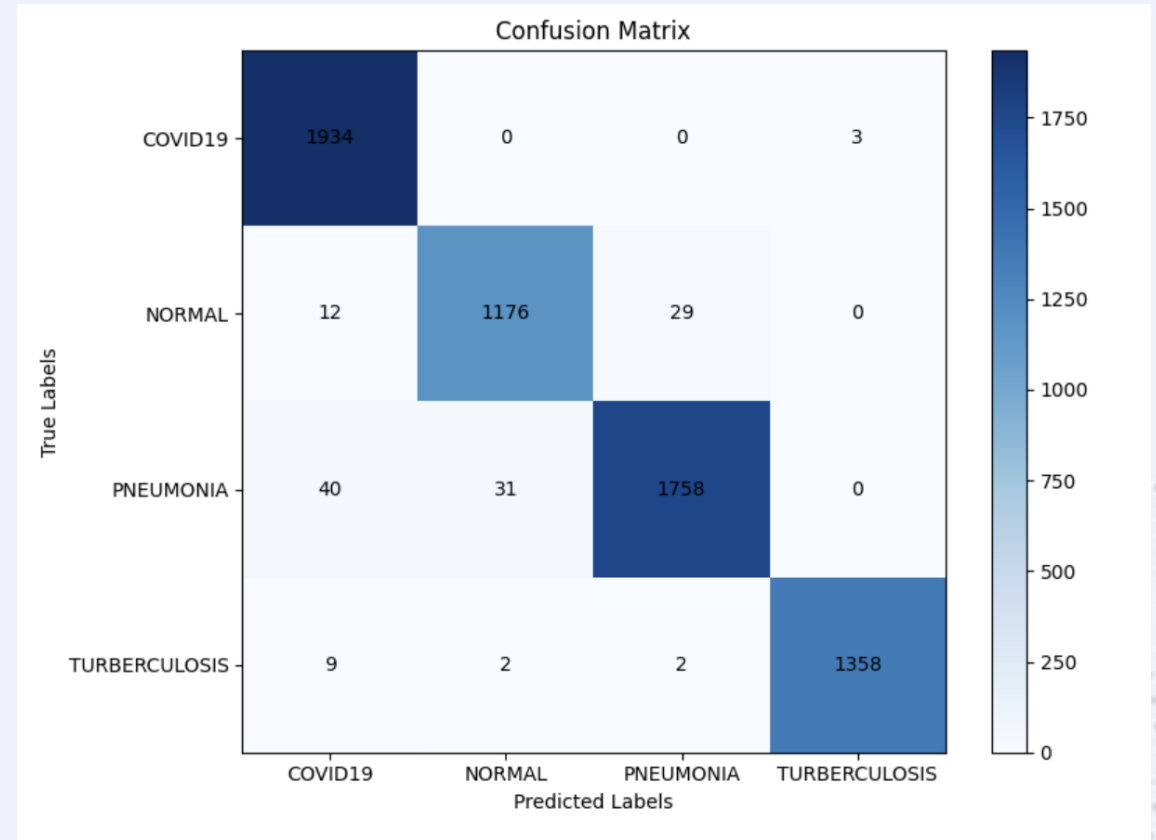


Pre-Trained Model Architecture	Accuracy	Loss	AUC	F1-Score	Recall	Precision
ResNet50	97.99%	0.0718	99.73%	97.98%	97.95%	98.02%
VGG16	96.44%	0.1131	99.57%	96.33%	96.40%	96.47%
Xception	97.12%	0.1198	94.6%	97.02%	99.51%	69.8%
EfficientNetV2B0	98.24%	0.0962	99.73%	98.11%	98.24%	98.24%

Table 2: Test Dataset Results - All Models

Results – ResNet50 (Best Model)

- Architecture
 - Pretrained on ImageNet
 - 50 layers, last 10 were trainable
 - Added flatten layer and two dense layers
- Predictions
 - Normal and Pneumonia hard to distinguish



Results – ResNet50 (Best Model)

Grad-CAM Explainability

- Some unexpected results



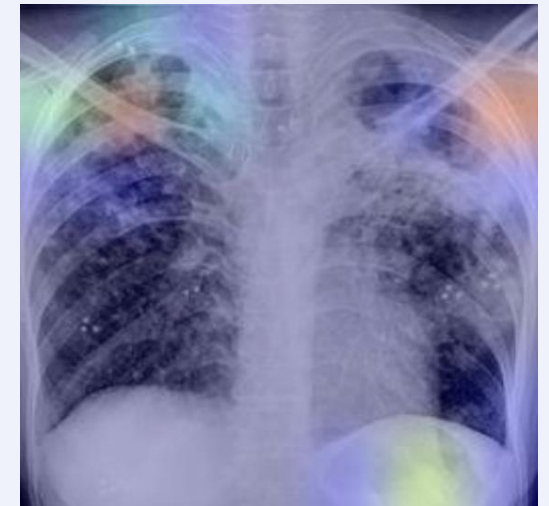
COVID-19



Normal



Pneumonia



Tuberculosis

SME vs Grad-CAM

Dr. Timothy McMullen, PHD reviewed this TB Image

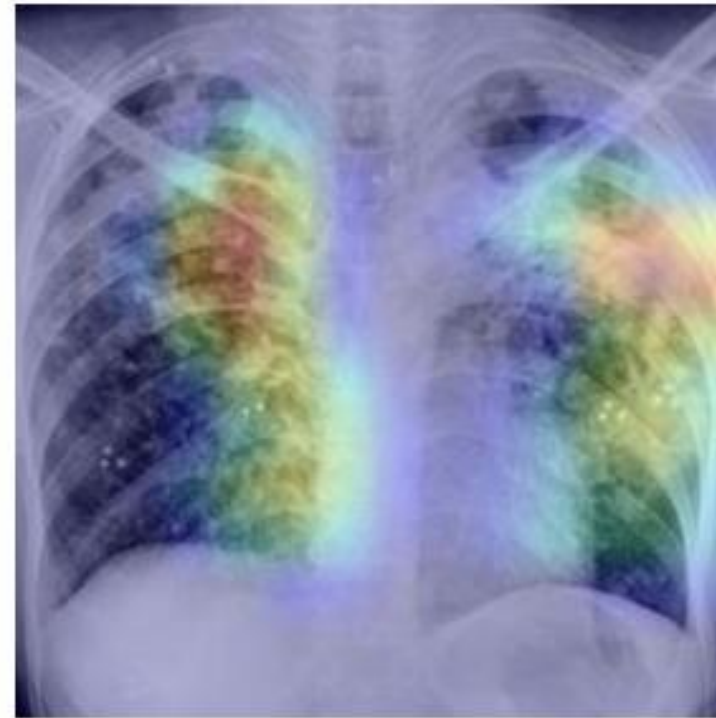


Figure 8: SME Evaluation of TB X-ray (left) vs Grad-CAM with VGG16 (right)