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Summary

Lung diseases have been increasing over the last decades due to population growth, environmental factors, and rising life expectancy. Early detection is crucial because long-term outcomes depend on timely diagnosis and treatment. Chest X-ray imaging remains the most common and accessible tool for initial respiratory assessment.

This study applies a pretrained DenseNet-121 model to the ChestX-ray14 dataset to classify 14 lung diseases, focusing on how data preprocessing and augmentation techniques influence classification accuracy.

Our results show that appropriate augmentation parameters significantly improved performance for Cardiomegaly, Emphysema, and Effusion, each reaching AUC › 0.90.

Methodology

We used the NIH ChestX-ray14 dataset containing 112,120 frontal X-rays from 30,805 patients, labelled for 14 thoracic pathologies. Since the dataset is imbalanced and multilabel, augmentation was essential to enhance generalization.

Data Augmentation Pipeline

- Rescale: 1./255
- Sample-wise normalization
- Rotation: +10°
- Width/height shift: 0.1
- Zoom: 0.2
- Horizontal flip: false
- Brightness variation: 0.8–1.2

These transformations simulate real clinical variability and reduce overfitting.

Model

- DenseNet-121 (~7M parameters)
- A pretrained DenseNet-121 backbone with frozen convolutional layers was combined with a custom Global Average Pooling+GLobal Max Pooling head (BatchNorm → Dense(1024, ReLU) → Dropout(0.4) → sigmoid output).
- Model is optimized using Adam (lr = 1e-3), binary crossentropy loss, and AUC metric for multi-label prediction.

Fig 1. Dataset distribution

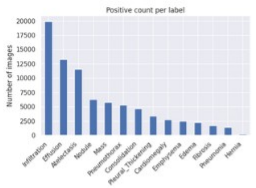


Fig 2. Workflow chart

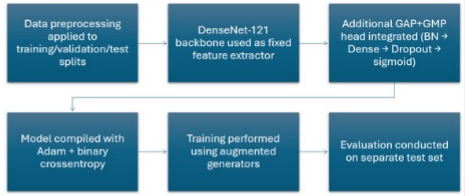
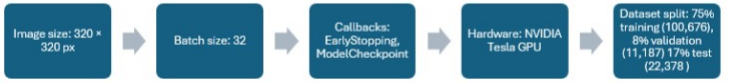


Fig 3. Model training pipeline



Results

Using the defined preprocessing pipeline and the custom DenseNet-121 architecture (GAP+GMP head, BN, Dense 1024, Dropout 0.4), the model demonstrated improved performance across several classes when trained with the applied augmentation strategy.

Table 1. Three thoracic diseases showed AUC values above 0.90

Disease	AUC
Cardiomegaly	0.90195
Emphysema	0.91859
Effusion	0.90028

Conclusion

This work examined how data preprocessing and augmentation influence the performance of a DenseNet-121-