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Lunginsight: Enhanced Detection of Lung Cancer Using Multi-Dataset Integration and Image Optimization

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Abstract: *Lung cancer remains one of the leading causes of cancer-related mortality across the globe, where early and accurate diagnosis significantly improves patient survival rates. The proposed system, LungInsight, focuses on improving lung cancer detection from thoracic CT scan images through the use of advanced deep learning techniques. The approach employs Convolutional Neural Networks (CNNs) to effectively classify lung nodules into benign and malignant categories. To enhance robustness and generalization, multiple publicly available datasets such as LIDC-IDRI, NSCLC, and LUNA16 are combined during model training. Image preprocessing and enhancement methods, particularly Contrast Limited Adaptive Histogram Equalization (CLAHE), are applied to improve image quality and feature visibility. Additionally, optimization techniques including model pruning and knowledge distillation are incorporated to reduce computational complexity and enable real-time clinical deployment. The system is designed to assist radiologists by providing fast and reliable diagnostic support. Furthermore, the framework explores the detection and staging of lung cancer using CT scan images and auxiliary clinical data, ensuring accurate tumor classification and disease progression analysis. By enabling early detection and precise staging, the proposed system aims to support timely medical intervention and improve overall patient outcomes.*

Keywords*:* Lung Cancer Detection, Thoracic CT Scans, Deep Learning, Convolutional Neural Networks (CNN), Medical Image Processing, Lung Nodule Classification, Image Enhancement, CLAHE, Multi-Dataset Learning, Clinical Decision Support System

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