Intelligent Deep Learning Architecture for Automated Pulmonary Atelectasis Identification in Radiographic Images through Hybrid U-net and VGG-16 Integration

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Abstract

Pulmonary atelectasis occurs when part or the entire lung collapses because of alveolar compression, fluid accumulation, or blockage of the airways, resulting in reduced gas exchange. The clinical challenge in timely diagnosis due to subtle radiographic manifestations and overlapping clinical presentations with other respiratory pathologies. This study introduces an innovative, AI-driven diagnostic system that utilizes advanced deep learning methodologies to achieve precise detection of atelectasis in chest radiographs. Our method integrates Contrast Limited Adaptive Histogram Equalization (CLAHE) during preprocessing to significantly improve contrast and strength feature visibility. This methodology incorporates U-Net for detailed pulmonary segmentation followed by feature extraction with VGG-16 and subsequent classification via a Deep Convolutional Neural Network. Comprehensive evaluation against established baselines including Artificial Neural Networks (ANN), standard Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM) networks, and ResNet-50 demonstrate superior performance, achieving remarkable diagnostic accuracy of 98% with enhanced clinical reliability.

Keyword: Artificial intelligence, pulmonary atelectasis detection, deep convolutional networks, U-Net segmentation, diagnostic accuracy.