Severity Prediction for Pulmonary Fibrosis

Pulmonary fibrosis is a chronic and progressive interstitial lung disease characterized by irreversible scarring of lung tissue, ultimately leading to respiratory failure. Timely detection and accurate severity assessment are essential for effective clinical management and improved patient outcomes. This study proposes a comprehensive Computer-Aided Diagnosis (CAD) system that leverages deep learning and interpretable artificial intelligence to automate the recognition and evaluation of pulmonary fibrosis from lung computed tomography (CT) scans. The approach begins with precise segmentation of lung parenchyma and fibrotic regions using SegNet and U-Net++ architectures. Features are then extracted from the segmented slices using the InceptionV3 network, capturing image characteristics such as texture complexity, structural irregularities, ground-glass opacities (GGO), honeycombing patterns, and spatial hierarchies. A Multi-Instance Learning (MIL) framework is employed to identify diagnostically relevant slices, enhancing the focus and reliability of subsequent analysis. To model disease progression and temporal dependencies across selected slices, a Long Short-Term Memory (LSTM) network is utilized for sequence-level classification. The system concludes with a softmax-based severity prediction and an AI-generated, interpretable report to support clinical decision-making. By integrating advanced segmentation, deep feature learning,

and temporal modeling, the proposed system offers a robust, accurate, and clinically relevant solution for pulmonary fibrosis assessment.