Computer-Aided Diagnosis System for Pulmonary Fibrosis Detection

The proposed project is an automated system for the detection and classification of pulmonary fibrosis from Lung CT Slices, overcoming several significant challenges in medical imaging. Early and accurate diagnosis of pulmonary fibrosis is crucial for effective treatment, but manual diagnosis can be time-consuming and prone to human error. To overcome these limitations, this system utilizes advanced image preprocessing techniques, and an improved deep learning model to ensure robust performance and clinical applicability. During preprocessing, the system has attempted to enhance image quality by eradicating noise. By morphological opening, all the Slices are processed such that noise and small objects are eliminated, making an image much better for diagnosis from Lung CT Slices. Using gamma correction, brightness will be improved in order that all structures are better depicted. In contrast enhancement, CLAHE will bring contrast in localized areas, though with the minimal amplification of noise. Bilateral filtering ensures that edges are maintained despite noise reduction, thus of importance in the retention of lung tissue boundaries' integrity.

The system integrates a DCGAN for data augmentation, the system generates synthetic CT Slices that improves the richness of the training dataset. This can lower the overfitting and underperformance issues commonly associated with the datasets and enhance the generalization capabilities of the system. The core idea behind the proposed classification model is a variant of Compact Convolutional Transformer called CTXNET. An improved model which combines convolutional layers that perform a better feature extraction and transformer-based mechanisms which performs more global contextual understanding, therefore enabling better capturing of both fine-grained local features and long-range dependencies across the entire CT scan-a critical element in catching the subtlest signs of pulmonary fibrosis. These metrics were used to ensure that the model can differentiate between normal and infected Lung CT Slices, thus accurately identifying patients with pulmonary fibrosis and distinguishing them from healthy individuals. The output module categorizes Slices into positive (for pulmonary fibrosis) or negative, forming the basis for further clinical analysis in later stages of the project.