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Research Article

Multi Level Approach for Segmentation of Interstitial Lung Disease (ILD) Patterns Classification Based on Superpixel Processing and Fusion of *K*-Means Clusters: SPFKMC

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During the COVID-19 pandemic, huge interstitial lung disease (ILD) lung images have been captured. It is high time to develop the efficient segmentation techniques utilized to separate the anatomical structures and ILD patterns for disease and infection level identification. The effectiveness of disease classification directly depends on the accuracy of initial stages like preprocessing and segmentation. This paper proposed a hybrid segmentation algorithm designed for ILD images by taking advantage of superpixel and *K*-means clustering approaches. Segmented superpixel images adapt the better irregular local and spatial neighborhoods that are helpful to improving the performance of *K*-means clustering-based ILD image segmentation. To overcome the limitations of multiclass belongings, semiadaptive wavelet-based fusion is applied over selected *K*-means clusters. The performance of the proposed SPFKMC was compared with that of 3-class Fuzzy *C*-Means clustering (FCM) and *K*-Means clustering in terms of accuracy, Jaccard similarity index, and Dice similarity coefficient. The SPFKMC algorithm gives an accuracy of 99.28%, DSC 98.72%, and JSI 97.87%. The proposed Fused Clustering gives better results as compared to traditional K-means clustering segmentation with wavelet-based fused cluster results.

1. Introduction

Segmentation of the image is a critical step for detecting early lung anomalies, diagnosis, and planning of therapy. The purpose of image segmentation is to separate non-connected clusters of the image regions based on feature homogeneity, viz. color intensity, shape, texture, etc. Early diagnosis of disease encourages early treatment, which improves the opportunity for patient endurance. But during the pandemic of COVID-19, resource limitation has significantly delayed the routine diagnosis of lung patients. The nature of lung infections also has a great deal of interest and is highly required to be analyzed. Lung segmentation analysis and classification [1] can significantly help in the early diagnosis of disease patterns. The increasing threat of lung diseases like COVID is the major motivation for designing an efficient segmentation algorithm for higher level analysis or classification. Another motivation behind interstitial lung disease (ILD) research is the low survival time of an average 5 years for ILD patients. This shows the seriousness of designing the early diagnosis algorithm for these images.

ILD is a collection of diseases that induce progressive scarring of lung tissue. It is extremely common in India and worldwide, and it has a higher risk of mortality if not detected at early stages [1–3]. ILD is a case of chronic obstructive pulmonary disease (COPD), and is usually an umbrella term encompassing both chronic bronchitis and emphysema. The diagnosis of ILD diseases is a challenging task at hand. Clustering-based segmentation algorithms [4, 5] are frequently adopted to differentiate clusters belonging to the same classes. A huge number of segmentation