An Automatic Approach to Lung Region Segmentation in Chest X-Ray Images Using Adapted U-Net Architecture

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Abstract

Segmentation of the lung field is considered as the first and crucial stage in diagnosis of pulmonary diseases. In clinical practice, computer-aided systems are used to segment the lung region from chest X-ray (CXR) or CT images. The task of segmentation is challenging due to the presence of opacities or consolidation in CXR, which are typically produced by overlaps between the lung region and intense abnormalities caused by pulmonary diseases such as pneumonia, tuberculosis, or COVID-19. Recently, Convolution Neural Networks (CNNs) have been shown promising for segmentation and detection in digital images. We propose a two-stage framework based on adapted U-Net architecture to leverage automatic lung segmentation. In the first stage, we extract CXR-patches and train a modified U-Net architecture to generate an initial segmentation of lung field. The second stage is the post-processing step, where we deploy image processing techniques to obtain a clear final segmentation. The performance of the proposed method is evaluated on a set of 138 CXR images obtained from Montgomery County's Tuberculosis Control Program, producing an average Dice Coefficient (DC) of 94.21%, and an average Intersection-Over-Union (IoU) of 91.37%.

Keywords: lung segmentation; deep learning; CNN; UNET; chest X-ray images.