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ORIGINAL CONTRIBUTION

CT-GANet: A Fusion of GAN and UNet for CT Image Segmentation of Interstitial Lung Disease Affected Lung

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Abstract Significant advancements in medical imaging have been made over the past two decades, with techniques like computed tomography (CT) scans, magnetic resonance imaging, and fluoroscopy playing a vital role in providing critical diagnostic information. While manual review of these images by radiologists has been instrumental in saving lives, it is limited by subjectivity and the expertise of the specialist, leading to variability in interpretations. Studies have shown that computer-based medical image processing can significantly reduce treatment planning time and improve diagnostic accuracy. Interstitial lung disease, a group of lung disorders that impair gas exchange, is becoming increasingly prevalent due to pollution and lifestyle factors. Accurate diagnosis typically requires chest X-rays or High-Resolution CT scans. Proper segmentation of the lungs is essential for doctors to assess diseased areas more effectively. In this study, we propose a lung segmentation method that is efficient even with limited medical image data, addressing the challenge of data scarcity due to medico-legal constraints. While U-Net and its variants are widely used for image segmentation, they require large datasets and extended training periods. We integrate Generative Adversarial Networks with a U-Net-like generator to enhance segmentation performance by generating synthetic images that improve dataset balance and address underrepresented classes. Our approach customizes the generator to focus on the region of interest. The generator employs encoder-decoder blocks to process input CT scans, extracting features via convolutional layers with skip connections to preserve details. A discriminator distinguishes between real and generated images, guiding the generator towards more accurate outputs. Our model achieved an accuracy of 84.39%, demonstrating significant improvements in lung segmentation despite the limited availability of training data.

Keywords High-resolution computed tomography · Generative adversarial network · Interstitial lung disease · U-net

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Introduction

Recent studies [1] indicate four million global deaths from diverse lung ailments, with a burden reaching 500 million in 2019. Prevalence and mortality surged by 39.8% and 28.5%, respectively, from 1990 to 2019, ranking it as the third leading cause of fatal disease. Substantial lung ailments fall under the umbrella term Infiltrative and Interstitial Lung Disease (ILD).

Advancements in imaging technologies and computational techniques have improved medical image analysis. Deep learning aids in automating diagnosis, while efficient handling of DICOM images remains a challenge. Studies have explored region-based compression for better storage

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