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A Novel Multi-Task Learning Architecture for COVID-19 Detection and Lung Infection Segmentation in CT Scans

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Abstract

In response to the critical need for accurate detection of COVID-19 and segmentation of lung infections in CT scans, this study introduces a novel Multi-Task Learning framework. The proposed model, built upon the U-Net architecture, features a shared encoder, a dedicated segmentation decoder, and a multi-layer perceptron for classification. Preprocessing involves image enhancement techniques such as median filtering and morphological opening, combined in pairs to boost task performance. Additionally, the integration of the Convolutional Block Attention Module (CBAM) aids in extracting critical features. The model achieved a classification accuracy of 96.22% and a segmentation accuracy of 95.84% when evaluated on a benchmark dataset. The approach was also successfully applied to U-Net++ and ResUnet architectures, underscoring the potential for improving multi-task learning structures. This work sets a new benchmark for COVID-19 detection and advances medical image analysis.

Keywords: Deep Multi-task learning model, Chest CT scans, Shared representations

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