Evaluating Robust COVID-19 Detection Models Against Gaussian and Salt-and-Pepper Noise in Computed Tomography Images

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Abstract

In this paper, we evaluate the robustness of our previous COVID-19 detection solutions against noisy images. Our approach involves assessing the performance degradation and recovery of three distinct models under varying noise conditions. We utilize the previously developed CNN-based model with image pre-processing, the enhanced Xception transfer learning-based model, and the novel framework incorporating UNet segmentation. The noisy images were generated by adding Gaussian noise to the original CT scans, simulating real-world data imperfections. For the CNN-based model, we maintain the same architecture and hyperparameters, focusing on the effect of noise on its accuracy and robustness. Similarly, the Xception model and the UNet-based framework were tested under the same noise conditions to ensure a comprehensive evaluation. The results indicate that our models exhibit varying degrees of resilience to noise, with the UNet-based framework demonstrating the highest robustness, maintaining significant performance even with high noise levels. This study underscores the importance of robust image processing techniques and model architecture in developing reliable COVID-19 diagnostic tools. Our findings suggest that integrating advanced noise handling techniques can further enhance model performance, making them more suitable for clinical and real-world applications.

Keywords

COVID-19 Diagnosis, Robustness, Computed Tomography Images, Noisy Data, Macro F1 Score, Validation Accuracy.