World Academy of Science, Engineering and Technology
International Journal of Biomedical and Biological Engineering
Vol:17, No:01, 2023

A Multi-Output Network with U-Net Enhanced Class Activation Map and Robust Classification Performance for Medical Imaging Analysis

Authors : Jaiden Xuan Schraut, Leon Liu, Yiqiao Yin

Abstract : Computer vision in medical diagnosis has achieved a high level of success in diagnosing diseases with high accuracy. However, conventional classifiers that produce an image to-label result provides insufficient information for medical professionals to judge and raise concerns over the trust and reliability of a model with results that cannot be explained. In order to gain local insight into cancerous regions, separate tasks such as imaging segmentation need to be implemented to aid the doctors in treating patients, which doubles the training time and costs which renders the diagnosis system inefficient and difficult to be accepted by the public. To tackle this issue and drive AI-first medical solutions further, this paper proposes a multi-output network that follows a U-Net architecture for image segmentation output and features an additional convolutional neural networks (CNN) module for auxiliary classification output. Class activation maps are a method of providing insight into a convolutional neural network's feature maps that leads to its classification but in the case of lung diseases, the region of interest is enhanced by U-net-assisted Class Activation Map (CAM) visualization. Therefore, our proposed model combines image segmentation models and classifiers to crop out only the lung region of a chest X-ray's class activation map to provide a visualization that improves the explainability and is able to generate classification results simultaneously which builds trust for AI-led diagnosis systems. The proposed U-Net model achieves 97.61% accuracy and a dice coefficient of 0.97 on testing data from the COVID-QU-Ex Dataset which includes both diseased and healthy lungs.

Keywords : multi-output network model, U-net, class activation map, image classification, medical imaging analysis
Conference Title : ICBIIP 2023 : International Conference on Biomedical Imaging and Image Processing
Conference Location : New York, United States
Conference Dates : January 30-31, 2023