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Enhanced CNN for Rice Leaf Disease Classification in Mobile Applications

Authors : Kayne Uriel K. Rodrigo, Jerriane Hillary Heart S. Marcial, Samuel C. Brillo

Abstract : Rice leaf diseases significantly impact yield production in rice-dependent countries, affecting their agricultural sectors. As part of precision agriculture, early and accurate detection of these diseases is crucial for effective mitigation practices and minimizing crop losses. Hence, this study proposes an enhancement to the Convolutional Neural Network (CNN), a widely-used method for Rice Leaf Disease Image Classification, by incorporating MobileViTV2—a recently advanced architecture that combines CNN and Vision Transformer models while maintaining fewer parameters, making it suitable for broader deployment on edge devices. Our methodology utilizes a publicly available rice disease image dataset from Kaggle, which was validated by a university structural biologist following the guidelines provided by the Philippine Rice Institute (PhilRice). Modifications to the dataset include renaming certain disease categories and augmenting the rice leaf image data through rotation, scaling, and flipping. The enhanced dataset was then used to train the MobileViTV2 model using the Timm library. The results of our approach are as follows: the model achieved notable performance, with 98% accuracy in both training and validation, 6% training and validation loss, and a Receiver Operating Characteristic (ROC) curve ranging from 95% to 100% for each label. Additionally, the F1 score was 97%. These metrics demonstrate a significant improvement compared to a conventional CNN-based approach, which, in a previous 2022 study, achieved only 78% accuracy after using 5 convolutional layers and 2 dense layers. Thus, it can be concluded that MobileViTV2, with its fewer parameters, outperforms traditional CNN models, particularly when applied to Rice Leaf Disease Image Identification. For future work, we recommend extending this model to include datasets validated by international rice experts and broadening the scope to accommodate biotic factors such as rice pest classification, as well as abiotic stressors such as climate, soil quality, and geographic information, which could improve the accuracy of disease prediction.

Keywords : convolutional neural network, MobileViTV2, rice leaf disease, precision agriculture, image classification, vision transformer
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