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Performance Comparison of Deep Convolutional Neural Networks for Binary Classification of Fine-Grained Leaf Images

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Abstract : Intra-plant disease classification based on leaf images is a challenging computer vision task due to similarities in texture, color, and shape of leaves with a slight variation of leaf spot; and external environmental changes such as lighting and background noises. Deep convolutional neural network (DCNN) has proven to be an effective tool for binary classification. In this paper, two methods for binary classification of diseased plant leaves using DCNN are presented; model created from scratch and transfer learning. Our main contribution is a thorough evaluation of 4 networks created from scratch and transfer learning of 5 pre-trained models. Training and testing of these models were performed on a plant leaf images dataset belonging to 16 distinct classes, containing a total of 22,265 images from 8 different plants, consisting of a pair of healthy and diseased leaves. We introduce a deep CNN model, Optimized MobileNet. This model with depthwise separable CNN as a building block attained an average test accuracy of 99.77%. We also present a fine-tuning method by introducing the concept of a convolutional block, which is a collection of different deep neural layers. Fine-tuned models proved to be efficient in terms of accuracy and computational cost. Fine-tuned MobileNet achieved an average test accuracy of 99.89% on 8 pairs of [healthy, diseased] leaf ImageSet.

Keywords : deep convolution neural network, depthwise separable convolution, fine-grained classification, MobileNet, plant disease, transfer learning
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