Res-WGAN: Image Classification for Plant Small-scale Datasets

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Abstract

Background: The artificial identification of rare plants is always a challenging problem in plant taxonomy. Although the convolutional neural network (CNN) in the deep learning method can better realize the automatic classification of plant samples through training, the model accuracy is difficult to reach the human eye discrimination due to the quantitative limit of training samples. Thus, effective data enhancement is vital to improve the generalization ability and robustness of deep learning models, especially for plant small-scale data classification task. Different from traditional methods, the Generative adversarial network (GAN) mimics original data distribution and produces new samples with similar features which can help classifiers equip with extraordinary generalization ability. It has not been studied that data enhancement for plant samples' characteristics with GAN since sliced bread.

Result: In this study, we present a novel GAN model named as Residual Wasserstein GAN (Res-WGAN) for data enhancement. To further adapt to plant small-scale datasets, residual blocks were introduced into the classic WGAN-GP as the basic network unit. These blocks enrich the presentation skills and sustained parameters unchanged simultaneously. Moreover, we enforce the idea from SRGAN to take content loss into a final function, which guarantes the similarity between generated samples and original samples in high-dimensional features. Benefiting from these improvements, the proposed Res-WGAN expanded original datasets efficiently. We test it on the ResNet and the experimental results show that new datasets combined transfer learning significantly promoted the accuracy of classification, especially at testing data. To illustrate the generalization of the model, more particular small datasets are applied for expansion and classification in this paper.

Conclusions: Our works report competitive accuracy results than other data enhancement methods, and user study confirms it's an ideal alternative strategy for small-scale plant datasets enhancement. Developing robust and effective small-scale plants classification method to replace expert testimony, is highly relevant for agricultural automation development.

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