New artificial intelligence algorithm for more accurate plant disease detection

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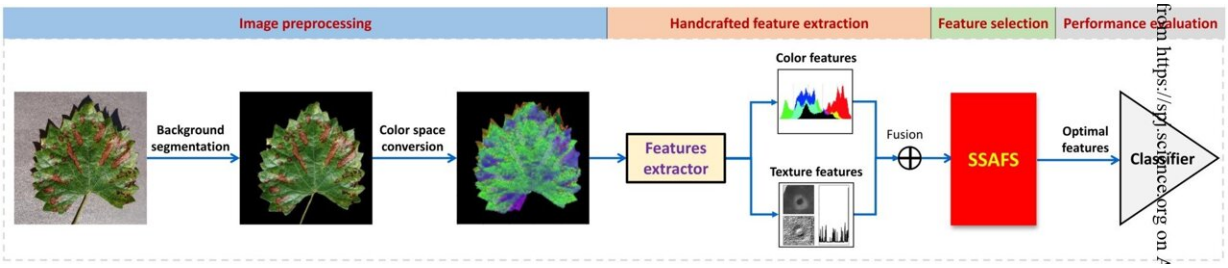

SSAFS uses an "optimal feature subset" of plant images. This subset included only the highest priority features capable of correctly classifying a plant as diseased or healthy and estimating disease severity. Credit: *Plant Phenomics*

Every year, plant diseases caused by bacteria, viruses, and fungi contribute to major economic losses. The prompt detection of these diseases is necessary to curb their spread and mitigate agricultural damage, but represents a major challenge, especially in areas of high-scale production. Smart agriculture systems use camera surveillance equipped with artificial intelligence (AI) models to detect features of plant diseases, which often manifest as changes in leaf morphology and appearance.

However, conventional methods of image classification and pattern recognition extract features indicative of diseased plants from a training set. As a result, they have low interpretability, which means it is

challenging to describe what features were learned.

Further, obtaining large datasets for model training is tedious. Handcrafted features, which are selected based on expert-designed feature detectors, descriptors, and vocabulary, offer a feasible solution to this problem. However, these often result in the adoption of irrelevant features, which reduce algorithm performance.

Fortunately, a solution is now on the horizon. A team of data scientists and plant phenomics experts from China and Singapore have developed a swarm intelligence algorithm for feature selection (SSAFS) that allows efficient image-based plant disease detection. They reported the development and validation of this algorithm in their recent study published in *Plant Phenomics*.

Explaining the benefits of introducing SSAFS, the corresponding author of this study, Prof. Zhiwei Ji, comments, "SSAFS not only significantly reduces the count of features, but also significantly improves the classification accuracy."

The study used a combination of two principles: high-throughput phenomics, through which plant traits like disease severity can be analyzed on a large scale, and computer vision, in which image features representative of a specific condition are extracted. Using SSAFS and a set of plant images, the researchers identified an "optimal feature subset" of plant diseases.

This subset encompassed a list of only the high-priority features that could successfully classify a plant as diseased or healthy, and further estimate the severity of disease. The effectiveness of SSAFS was tested in four UCI datasets and six plant phenomics datasets. These datasets were also used to compare the performance of SSAFS to that of five other similar swarm intelligence algorithms.

The findings demonstrate that SSAFS performs well in both plant disease detection and severity estimation. Indeed, it outperformed the existing state-of-the-art algorithms in identifying the most valuable handcrafted image features. Interestingly, the majority of these disease-related features were local—i.e., they involved distinct patterns or structures, such as points, edges, and patches, which are often observed in diseased plants.

Overall, this algorithm is a valuable tool for obtaining an optimal combination of handcrafted image features indicative of plant diseases. Its adoption could significantly improve plant disease recognition accuracy and reduce the required processing duration.

When asked about the future implications of their study, Prof. Ji comments, "One of the crucial contributions of this work to plant phenomics is the definition of handcrafted features and the precision screen of relevant features through a novel computational approach. We propose to combine comprehensive handcrafted and non-handcrafted features of plant images for accurate and efficient detection in the field of phenomics."

More information: Zhiwei Ji et al, A novel Feature Selection Strategy Based on Salp Swarm Algorithm for Plant Disease Detection, *Plant Phenomics* (2023). DOI: 10.34133/plantphenomics.0039

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