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SoLID – An Online Community Database of Leaf Images

Plant leaves exhibit different classifying features such as vein network structures, colors, and chemical concentrations. Analyzing and quantifying such features enables the functional interpretation of leaves. Leaf images are often maintained in curated collections. These collections are not always easily accessible to researchers. However, there is a significant value in the digital analysis of collections, if made available to the larger scientific community. Here, we introduce a novel mechanism to do so via a Social Leaf Image Database (SoLID). SoLID is an online database with a social network mechanism for a community of researchers to contribute, access and share leaf images that also leverages resources of curated collections.

In recent years there has been growing interest in leaf images for a number of reasons. These include: (1) Interest in allometric scaling relationships between foliage structure, chemistry and physiological characteristics. Characteristic correlations between leaf size and climate have been employed to gain insight into adaptive modifications in leaf size (Niinemets et al., 2007). (2) Foliar color is of great interest to resource managers and scientists as a visual indicator of plant health. Digital color analysis is a popular and cost-effective method to evaluate foliar nutrition and health in response to environmental stresses (Murakami et al., 2005). (3) Significance of leaf venation network structure in many areas of plant biology including impact of leaf vein geometry and network on hydraulic conductance. Segmentation and analysis of structure of leaf vein network and areoles (Price et al., 2011). Image processing is a popular and cost-effective method to evaluate leaf color and extract venation networks and areoles, from which we can establish allometric relationships.

SoLID enables researchers around the world to store, annotate, search and share their leaf image collections through a single web interface. The unique features of SoLID can be categorized into two groups: community features and technological features. The community features allow a user to 1) mark an image collection as private or public, 2) share image collections with a trusted user community, 3) post comments on images and its meta-data, 4) flag images for review, etc. The community feature also enables non-scientists with important data to contribute to scientific research, through a trusted user mechanism. From a technology point of view, we have developed a database back-end specifically targeted for leaf images. SoLID allows plant biologists and trusted users to store leaf images online with their meta-data, create collections of images, upload and download images from the collections. An open programming interface allows external image processing software to access marked images from the SoLID. The power of the system comes from different user access privileges on the resources, accessing the database from any image processing platform and one destination for all types for leaf images. Images in the database are linked to other online image databases such as USDA plant database, CalPhotos, Morphbank, Encyclopedia of Life and Google images. We demonstrate the programming interface by using the open source software Leaf GUI (Price et al. 2011, www.leafgui.org) to connect to SoLID, download images, extract leaf venation patterns from images and analyze them.

References

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