4th International Conference on
Plant Science and Agriculture
March 09, 2022 | Webinar

FlowerPhenoNet: Deep learning based flower detection using image sequences for 2D and 3D temporal phenotyping analysis

Sruti Das Choudhury
University of Nebraska Lincoln, USA

A phenotype is the composite of an observable expression of a genome for traits in a given environment. The trajectories of phenotypes computed from an image sequence and timing of important events in a plant's life cycle can be viewed as the temporal phenotypes and indicative of the plant's growth pattern and vigor. This research introduces a taxonomy of 2D and 3D temporal flower phenotypes. To achieve this, we introduce a novel method called FlowerPhenoNet which uses deep neural networks for detecting flowers from multiview image sequences for high throughput temporal plant phenotyping analysis. Following flower detection, a set of novel flower-based phenotypes are computed, e.g., the day of emergence of first flower in a plant's life cycle, the total number of flowers present in the plant at a given time, the highest number of flowers bloomed in the plant, growth trajectory of a flower and the blooming trajectory of a plant. Plants are not static but living organisms that change in shape and topology over time. The occlusions of flowers by the leaves, drooping of petals, and change in orientation of flowers in accordance with the incident sunlight pose challenges to the accurate computation of flower size from 2D images. Thus, we compute 3D model of a flowering plant based on voxel-grid reconstruction, and use color and texture properties to segment the flowers from the 3D reconstructed model. The volume of a flower, i.e., flower size, is computed as the total number of voxels constituting the flower. We use the well-known space carving technique for voxel-grid reconstruction and aims to achieve the fully automatic reconstruction of a large number of plants without requiring any manual intervention on an individual plant basis. To develop a new algorithm and facilitate performance evaluation based on experimental analysis, a benchmark dataset is indispensable. Thus, a benchmark dataset called FlowerPheno has been introduced which comprises of image sequences of three flowering plant species, e.g., sunflower, coleus and canna, captured by a visible light camera in a high throughput plant phenotyping platform from multiple view angles. The experimental analyses on the FlowerPheno dataset demonstrate the efficacy of the FlowerPhenoNet..

e: S.D.Choudhury@unl.edu