BROCCOLI FLOWER DETECTION USING DEEP NEURAL NETWORK ON MULTISPECTRAL IMAGERY

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ABSTRACT: Broccoli is one of the most popular vegetables in the world due to its rich nutrition, easy cultivation, storage, and cooking. Therefore, farmers tend to use large-scale farming to pursue more profit. However, the size and the growth stage of the plant are various at the same time. If the farmer decides to harvest at one time, a method to count and estimate the best harvesting time for the best yield is crucial. This study proposed a complete procedure to detect and estimate the size of broccoli flowers using a CNN-based model on multispectral imagery. The concept is to collect the maturity of broccoli for the optimized harvest timing. Besides, this study established a procedure for processing raw multispectral imagery. The process includes distortion rectification, band alignment, irradiance-reflectance conversion, and data normalization. The study adopts the model - EDANet and the modified one that trains with a dataset that comprises 955 training, 284 validation, and 128 test samples. The model modification adds two latent connections from the two dense connection blocks to the cascade upsampling layers, which adds detailed features to enhance object edge segmenting. The preliminary result achieves above 80% f1-score on both models when the imagery contains matured broccoli flowers to harvest. Besides, the modified model has at least 5% performance gains on the unmatured dates compared to the original model. Also, this study adopts the model optimization method - model pruning and model quantization to improve the computation efficiency to achieve real-time detection on the UAV with resource-constraint devices. The inference throughput achieves six fps on the optimized model with integrate-GPU enabled, which speeds up 3.3 times faster than the vanilla model with CPU only. The modified model inferencing with integrate-GPU also achieves 3.3 times faster than the non-optimized version (CPU) and 1.3 times faster than the vanilla model (CPU). The performance of the proposed method proves the applicability of real-time broccoli flower detection and size estimation on single-frame aerial multispectral imagery.

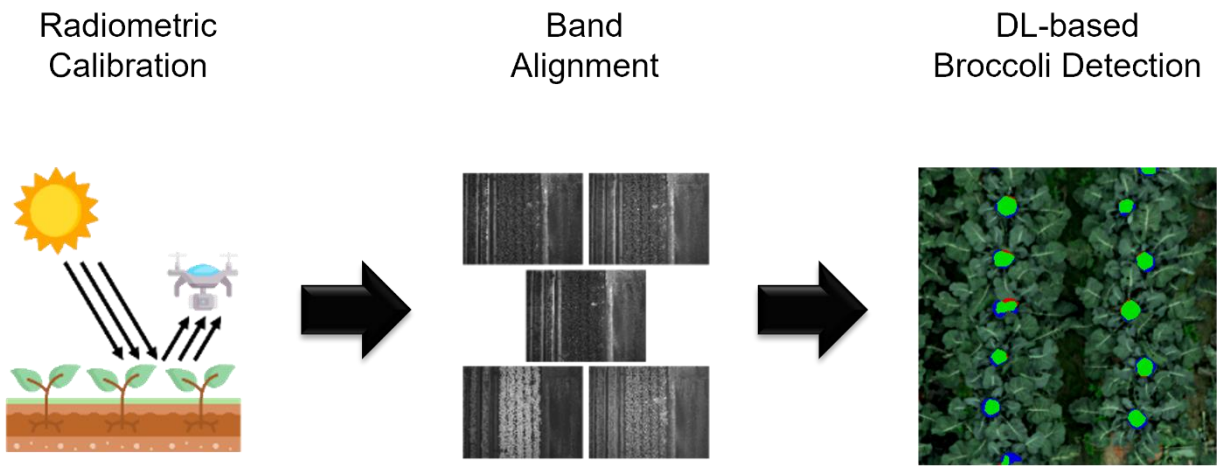

Figure 1. Workflow of the proposed method.