

Detection of Curly Lettuce Growth and Leaf Conditions Using YOLO and Mask R-CNN

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ABSTRACT

Curly lettuce is a horticultural commodity with high economic value and is widely cultivated using hydroponic systems. However, monitoring plant conditions, such as growth stages, harvest readiness, and leaf damage, is still commonly performed manually, making the process less efficient. This study aims to develop a web-based curly lettuce growth detection system using YOLO for plant condition classification and Mask R-CNN for leaf damage segmentation. The dataset consisted of 460 images, including 405 primary images and 55 secondary images. For Mask R-CNN training, 170 images were used, consisting of 121 damaged leaf images and 49 frog-eye spot disease images. The research stages included data preprocessing, image annotation, data augmentation, model training, performance evaluation, and web-based system implementation using Laravel, React, Inertia.js, Flask, and Docker. The results showed that the best YOLO model was Test 7, achieving an F1-score of 0.92, a recall of 0.921, a precision of 0.862, and an mAP50 of 0.963. Meanwhile, the best Mask R-CNN model was Test 6, with a segmentation Average Precision (AP) of 43.779 and an AP50 of 70.474. Expert validation indicated that the system was able to detect plant conditions in accordance with actual field conditions. Based on the results, the combination of YOLO and Mask R-CNN demonstrated good performance in classifying curly lettuce conditions and segmenting leaf damage areas. The developed system has the potential to assist farmers in monitoring crop conditions more effectively and efficiently.

Key words : Curly Lettuce, YOLO, Mask R-CNN, Object Detection, Instance Segmentation