A Deep Learning Artichoke Plants Identification Approach for Site-specific UAV Spraying

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**Abstract.** Precision Agriculture practices allow input management optimization, environmental impact and production cost reduction, and product quality increase. The new approach derived using Unmanned Aerial Vehicles (UAVs) in combination with Deep Learning techniques is leading to a significant improvement in the management practices of agricultural systems. The aim of the study is the precise identification and the georeferencing of individual artichoke plants as a first step to develop an on-the-fly UAVs aerial spray treatment system. Furthermore, all the gathered information is used to monitor spatial and temporal crop development. During the 2021-2022 season, a large number of images were acquired by an RGB sensor mounted on a DJI Phantom 4 Pro UAV within an artichoke field located in the countryside of Uri (Sardinia, Italy) in different growth stages of the crop. From the data collected in each mission, an orthophoto of the entire field was generated and labeled to train an object detector capable of identifying artichokes inside the field. The trained SSD object detector was developed from a Feature Pyramid Network structure, a type of convolutional neural network that is particularly efficient for dealing with multiscale features and detecting objects at different scales that allows the UAVs to fly at different heights without losing detection performance. The experimental results, computed at the different stages of the study, showed a high detection level with an average F1 score of around 90%. This value, a measure of accuracy, is widely used in the field of object detection. Furthermore, the evolution of the growing index was evaluated, confirming, as expected, that the growing process is stronger during October, reaching the maximum at the beginning of December. The presented results highlight how the proposed approach contributes to designing reliable site-specific UAV prescription maps and can lead to a precise identification of critical zones.