A real-time approach system for vineyards intra-row weed detection

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Summary

With the incorporation of autonomous robotic platforms in various areas (Industry, Agriculture, etc.), numerous mundane operations have been assisted by fully automated. From the dawn of humanity, in Agriculture, the high demanding working environment let the development of techniques and machineries that could cope with each case. To further explore, new technologies (from high performance motors to optimization algorithms) have been implemented and tested in this field. Every cultivation season, there are several operations that contribute to the crop development and had to occur at least once. One of the above-mentioned operations is the weeding. In every cultivated crop, there are crops that developed which are not part of the cultivation. These crops, in most cases, have a negative impact to the crop and had to be removed. With traditional methods, weeding was taken place either by hand (smaller cultivations) or with the use of herbicides (larger cultivation). In the second case, the dosage and the time are pre-defined, and they are not taking into consideration the growth percentage and the weed allocation within the field.

In this work, a novel approach for intra-row (between the vine plants) weeding in real vineyard fields is developed and presented. All the experiments both for data aggregation and the algorithm testing were took place in a high value vineyard which produce numerous types of wine. The focus of this work was to implement an accurate real-time the weed detection and segmentation model using a deep learning algorithm in order to optimize the weed detection procedure at the intra-row of the vineyard. This approach consists of two essential sub-systems. The first one is the robotic platform that embeds all the necessary sensors (GPS, LiDAR, IMU, RGB camera) and the required computational power for the detection algorithm. The second one is the developed algorithm for weed detection. The developed algorithms were tested in many datasets from vineyards with different levels of weed development. In order to proper validate the algorithm, the unknown data ware acquired in different time periods with variations in both camera angle and wine varieties. The results show that the proposed technique gives promising results in various field conditions.

Keywords

Weed detection, RGB camera, vineyard, UGV, deep learning, masked RCNN

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