Chapter 9

Weed Estimation on Lettuce Crops Using Histograms of Oriented Gradients and Multispectral Images

Andres Esteban Puerto Lara

https://orcid.org/0000-0002-3818-5667
Fundacion Universitaria Panamericana, Colombia

Cesar Pedraza
Universidad Nacional de Colombia, Colombia

David A. Jamaica-Tenjo
Universidad Nacional de Colombia, Colombia

ABSTRACT

Each crop has its own weed problems. Therefore, to understand each problem, agronomists and weed scientists must be able to determine the weed abundance with the most precise method. There are several techniques to scouting, including visual counting for density or estimations for coverage of weeds. However, this technique depends by the evaluator subjectivity, performance, and training, causing errors and bias when estimating weeds abundance. This chapter introduces a methodology to process multispectral images, based on histograms of oriented gradients and support vector machines to detect weeds in lettuce crops. The method was validated by experts on weed science, and the statistical differences were calculated. There were no significant differences between expert analysis and the proposed method. Therefore, this method offers a way to analyze large areas of crops in less time and with greater precision.

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INTRODUCTION

The interest in precision agriculture has increased since it facilitates the agronomical, economical and environmental management of a crop. Currently, the agriculture in Colombia has not appropriately developed (Serrato & Castillo, 2018), considering 70% of the country is not even technified yet (Junguito, Perfetti, & Becerra, 2014; Rodríguez, Plaza, & Gil, 2008). The competition between crops and weeds over nutrients – in addition to the spatial interference caused by weed – represents a huge problem within agriculture, as global estimates of crop losses due to weeds are approximately 34% (Oerke, 2006), and in certain crops, the losses could reach 100% (Zimdahl, 2007). Therefore, it is crucial to quantify, characterize and identify accurately the weeds abundance, floristic composition, biodiversity, functional components and the spatial distribution, in order to suggest improved management plans with the least possible impact, or having more accurate research data (Westwood et al., 2018). There are conventional assessment techniques (Rew & Cousens, 2001) to estimate the coverage (area covered by plants per unit area, expressed as percentage) and density (number of plants per unit area) of these plants, but it entails a subjectivity problem that depends on the evaluator’s abilities and training.

Nowadays, there are multiple advances in many areas that allows to improve many agricultural processes (Kim, Kim, & Chung, 2019). Even including modern artificial intelligence techniques such as convolutional neural networks (dos Santos, Freitas, Silva, Pistori, & Folhes, 2017) despite of their extra hardware requirement (Umamaheswari, Arjun, & Meganathan, 2018). Some of these tools can be used in order to estimate weed in crops.

Despite some works apply machine learning techniques in weed detection, there are a lack of tools to estimate weeds in crops (Murawwat, Qureshi, Ahmad, & Shahid, 2018), for example vegetables like lettuce. In consequence, it would be appropriate to design and develop software tools based in artificial intelligence, to measure the amount of weed present in a crop with more precision (Sujaritha, Annadurai, Satheeshkumar, Sharan, & Mahesh, 2017).

The main objective of this chapter is related to introduce a method to estimate weed in vegetables crops. The method is based on the implementation of multi-spectral images, built upon techniques to extract features using histogram of oriented gradients (HOG) and conduct further processing using support vector machines in order to implement a learning model that enables the proper detection of weed in a specific crop.

This chapter is organized as follows: a background section with a brief compilation about conventional sampling, in addition to a brief summary emphasizing on some studies on precision agriculture that use digital image processing techniques. Also the problem addressed is explained. Then, the method proposed to detect weed using multi-spectral images in a lettuce crop is explained in main focus section taking into account that this method is more accurate that human visual assessment, an experiments section is included in order to test the methodology proposed. Finally, issues, results and conclusions of the method proposed are exposed.