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DETECTION OF SPIDER MITE USING ARTIFICIAL INTELLIGENCE IN DIGITAL VITICULTURE

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Abstract

Aim: Pests have a high impact on yield and grape quality in viticulture. An objective and rapid detection of pests under field conditions is needed. New sensing technologies and artificial intelligence could be used for pests detection in digital viticulture. The aim of this work was to apply computer vision and deep learning techniques for automatic detection of spider mite symptoms in grapevine under field conditions.

Methods and Results: RGB images of grapevine canopy attacked by the spider mite (*Eotetranychus carpini* Oud) were manually taken in commercial vineyard (Etxano, Basque Country, Spain) under natural day light conditions. Leaf segmentation in images was performed based on computer vision techniques, isolating target leaves with spider mite visual symptoms from the vineyard canopy. HSV colour space was used to consider colour variations representing symptoms on the leaves, separating these values from those of saturation and brightness of the image. Spider mite detection was done using Convolutional Neural Networks (CNN) models with an artificially augmented dataset for the classification of leaves with this pest symptoms. An accuracy surpassing 75% was obtained using a hold-out validation.

Conclusions: High accuracy proves the effectiveness of the trained model in the classification of grapevine leaves. Computer vision techniques were useful to image classification on the relevant pixels. Additionally, deep learning techniques provided a robust model to find complex features of spider mite visual symptoms.

Significance and Impact of the Study: Non-invasive technology and artificial intelligence shown promising results in the automatic detection of pests in commercial vineyards.

Keywords: Deep learning, computer vision, pests, grapevine, crop protection

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Introduction

Spider mite is a critical pest in vineyards and other crops. The correct identification and quantification of the causal agent result essential to get a precise diagnosis, in order to manage the pest or disease in vineyard. Nowadays, human experts are needed to perform this task and this process applied to large areas of cultivation is time consuming.

The goal of this work was to use artificial intelligence to identify the leaf symptoms caused by the spider mite (Fig. 1) in commercial vineyards.

Figure 1. Grapevine leaves with spider mite symptoms in a commercial vineyard

Materials & Methods

Images of Hondarribi Zuri grapevine leaves were acquired under field conditions in a vineyard located in Bizkaia (Spain). Images were taken manually under field conditions using a digital RGB camera. Image acquisition was led by an plant pathologist visually identifying healthy and infected leaves.

A combination of different computer vision and deep learning techniques was used to detect leaves with spider mite symptoms among the healthy ones on acquired images following these steps:

- Image segmentation (Fig. 2)
- Image transformation from RGB to HSV color space (Fig. 2)
- Data augmentation
- Leaves classification using CNN (Convolutional Neural Network)

Hold-out method was used for model validation, using 80% of data for training the model and the remaining 20% for testing. All results were evaluated by calculating the training and testing accuracies.

Results

A good detection of spider mite symptoms was obtained on the classification of test data, with an accuracy of 75%. Most of the leaves labelled as healthy or infected with spider mite symptoms have been classified correctly by the deep learning model.

The information obtained from the RGB images seems to be sufficient for the correct identification of the leaves with spider mite symptoms. Furthermore, due to deep learning techniques such as data augmentation, a good result was achieved without the need to collect massive data.

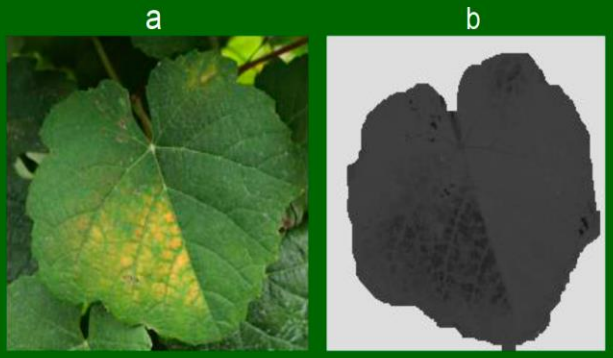

Figure 2. Image preprocessing. a: Image segmentation (ignoring background pixels). b: Transformation of color space from RGB to HSV (separating hue, saturation and brightness values of the image).

Conclusions

Our results show that spider mite pest can be detected in grapevine leaves using computer vision and deep learning techniques. It provided a fast and accurate solution for the detection of this pest, even when considering a large number of grapevine leaves.

This is an important starting point for the automatic detection of pests and/or diseases in grapevine under field conditions.

Televitis DATA-DRIVEN VITICULTURE

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