Citrus Huanglongbing Disease Detection
Using Narrow-Band Illumination and Polarizing Filters
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Introduction
Huanglongbing (HLB) or citrus greening is a very destructive citrus disease and has caused massive losses in Florida’s citrus industry.

Image Acquisition and Analysis
The image acquisition system was designed to measure leaf reflections in both parallel and perpendicular directions to the polarization planar of the illuminated light at 591 nm and 400 nm. Our analysis showed that only the images captured with perpendicular polarizing filter at 591 nm contain useful information for HLB detection purpose.

Data Collection and Classification Steps
Two datasets were created:
- Valencia variety: • 20 healthy • 20 HLB + • 20 Zn Def. • 30 Zn Def. HLB + • 6 Zn Def. HLB -
- Hamlin variety: • 32 healthy • 28 HLB + • 15 Zn Def. HLB + • 15 Zn Def. HLB -

A step-by-step classification model was designed for each dataset. The performances of seven classifiers were evaluated and the best one was selected for each step. A K-fold (5-fold) cross validation method was employed to confirm the independence of the results of the training and validation sets.

Questions
HLB symptoms are very similar to some nutrient deficiency symptoms which makes it hard to be detected only by human observation. Is there any unique HLB symptom which can be used to differentiate HLB infection from healthiness and nutrient deficiency?

Discussion
This study investigated the effect of starch accumulation of the HLB-symptomatic citrus leaves on the polarization planar of light. The results showed that image acquisition at 591 nm with perpendicular polarizing filters highlight the HLB symptoms on citrus leaf. Other laboratory or spectroscopy based detection methods may have higher accuracy; however, they are time and labor consuming and relatively expensive.

HLB Detection Results
The main purpose in this study was to detect the HLB infection and not the nutrient deficiency. Therefore, the multi-class classification results were merged into only two classes of HLB positive and HLB negative for each dataset. Considering only the HLB detection, the average classification accuracies of 93.1% and 89.6% were achieved for ‘Hamlin’ and ‘Valencia’ datasets correspondingly.

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