Automated Machine Vision for Detection of Downy Mildew from Drone Imagery

A PROMISING BREAKTHROUGH IN VINEYARD MANAGEMENT

Detection and management of diseases in grapevines is critical for protecting vineyards from yield losses. A major disease that requires frequent monitoring and control is downy mildew. Early detection is key to minimising the damage caused by this infection. A recent project for the SQNNSW Innovation Hub, funded through an Ag Innovation grant, developed proof-of-concept and low-cost machine vision techniques for a drone to automatically detect early-stage downy mildew in grapevines. It is anticipated that such a technology will enable an automated digital tool for winegrowers to detect downy mildew for targeted spraying in vineyards.

Downy mildew infection spreads rapidly under conducive weather conditions so early detection of the infection is paramount. Initial infection occurs when fungal spores from the ground splash onto foliage during rainfall in periods of warm temperature. The disease appears as small pale yellow spots on leaves, which develop rapidly into larger dark yellow spots and white downy growth on the underside of leaves. The disease subsequently causes browning and dying of young grape bunches. Disease management is conventionally either by an eradicant spray, which relies on manual inspection of grapevines to find diseased leaves, or most commonly by a routine preventative spray of whole vineyard blocks which overcomes the time requirements of manual scouting for diseased leaves.

For the Ag Innovation project, novel machine vision techniques were developed to enable a standard consumer drone to detect downy mildew spots automatically. The approach was novel because the technology targeted early detection of disease symptoms, whilst also being scalable to a whole vineyard block. Notably, the novel techniques extend the capability of other reported systems that either detect later stage damage or otherwise require very high-resolution images of diseased leaves. Four vineyards in south-eastern Queensland were used for the project. Drone images contained diverse types of leaf spots and these included early and dying downy mildew spots, as well as spots caused by factors like sun bleaching and nutrient deficiency. To ensure precise identification, local agronomists provided valuable assistance in diagnosing the presence of downy mildew.

The preliminary findings of the project provide compelling evidence for the viability of employing a consumer drone equipped with innovative machine vision techniques to identify early indicators of downy mildew. The drone's flight parameters were carefully planned to enable scouting of entire vineyard blocks, facilitating efficient disease monitoring. Significantly, the developed machine vision techniques showcased the ability to differentiate spots smaller than 10 mm, a crucial stage that necessitates prompt disease control interventions. The novel machine vision techniques notably enhanced the visibility of leaf spots in the captured imagery, underscoring the effectiveness of the automated analysis approach. These promising results pave the way for further advancements in automated downy mildew detection and management in vineyards.

We are excited for what this project has achieved and the large potential benefit to industry, and we hope to continue the research and test the robustness of the drone-based machine vision across different vineyard environments, varieties and disease severities. Even more excitingly this project has opened avenues for detection of other grapevine conditions. The question could also be asked about whether this research for precise and low-cost leaf spot detection would be of benefit in other agricultural crop production?

Want more information...

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