Use of UAV Technology and Photogrammetric Practices to Monitor Vine Health and Possible Disease Detection

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SUMMARY

The growing need for precision in vineyard management, particularly for monitoring vine health and detecting diseases, has led to the exploration of advanced technologies. This thesis investigates the use of Unmanned Aerial Vehicles (UAVs) and multispectral imagery to provide a more accurate, efficient assessment of vine health across three vineyards in mainland Portugal. Traditional methods, such as satellite imagery and ground-based inspections, are often hindered by limited spatial and temporal resolution. The study evaluates how vegetation indices derived from UAV-captured multispectral images, including NDVI, MSAVI, and ReNDVI, can offer detailed insights into vine health throughout various growth stages.

Using a DJI Inspire 2 UAV equipped with Zenmuse X7 and Micasense Altum sensors, high-resolution multispectral data was collected at different growth phases. Photogrammetric techniques were applied to generate vegetation index maps and orthomosaics, visualizing spatial variations in vine health. MSAVI was utilized to assess early growth in the Valdoeiro vineyard, ReNDVI for monitoring advanced stages at Quinta de Baixo, and NDVI to evaluate post-harvest conditions in the ESAC vineyard.

The research revealed that UAV-derived multispectral data not only correlates strongly with key vine health indicators but also enhances disease prediction models when integrated with ground-based sensors, offering a more comprehensive approach to vineyard management. The results confirm that UAV-derived vegetation indices are highly effective in identifying areas of vine stress and healthy growth, revealing significant spatial variability within the vineyards. These findings underscore the potential for UAV technology to enhance vineyard management through precise, cost-effective, and timely interventions. This research sets the stage for integrating UAV data with ground-based sensors, paving the way for more comprehensive monitoring and predictive

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models in precision viticulture.

In conclusion, this study demonstrates the transformative potential of UAV-based multispectral imagery in improving vine health assessments, facilitating early stress detection, and optimizing vineyard management practices. Ultimately, the research highlights how UAV technology can revolutionize vineyard management, leading to more sustainable and data-driven practices that can be applied across the broader agricultural industry.