

Study on Automated Real-time Crop Health Monitoring and Management

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Abstract

Crop health monitoring and management involve tracking and managing crop conditions throughout their growth cycle using advanced technologies such as remote sensing devices, drones, satellite imagery, soil moisture sensors, and data analytics platforms. These tools provide real-time insights into crop health, enabling the detection of diseases, pests, water stress, and nutrient deficiencies. Proactive responses to these issues help prevent significant yield losses, enhance productivity, and optimize resource use. By enabling precise application of inputs like pesticides and fertilizers only when necessary, crop health monitoring minimizes environmental impact and reduces production costs for farmers. This review paper explores the application of automated, real-time crop health monitoring and management systems, emphasizing technologies such as IoT, UAVs, multispectral and hyperspectral imaging, and artificial intelligence in precision agriculture. It highlights recent advances in machine learning for disease detection and crop health assessment, focusing on the integration of sensor data, cloud computing, and imaging techniques to enable early problem detection and efficient resource management. While these technologies have demonstrated improved accuracy and efficiency, challenges remain in affordability, rural connectivity, and data integration. This review identifies critical gaps in the literature, including the need for low-cost solutions, improved AI model generalization, and standardized data processing frameworks. It also addresses regulatory and operational limitations, particularly in UAV usage and associated environmental concerns. To overcome these barriers, the study emphasizes developing scalable, cost-effective systems, enhancing connectivity, and providing farmer training on adopting such technologies. By addressing these challenges, this research contributes to the development of sustainable and accessible crop health management systems, fostering the growth of precision agriculture and supporting global food security in a changing climate.

Keywords: *Automated crop health monitoring, IoT in agriculture, Smart farming, Agricultural technology, Artificial intelligence in farming*