information of the hyperspectral cameras. For instance, the far-range platforms and airborne and spaceborne systems have deficient spatial resolution information compared to the close-ranged systems. The sensors, which have a spatial resolution of 1 m [334], are not suitable for detecting infected/diseased plants. The higher the distance will be, the lower the sensitivity of the sensors will be. Although some studies have attempted to conduct transfer-learning-based studies at different scales, sufficient studies should be conducted to comprehend the scalability issue of close-range, greenhouse, commercial fields, and remote imaging. The camera calibration is also a vital parameter for mapping the spectral information [15], [335]. Therefore, with advanced sensor technologies, platforms, and algorithms for plant disease detection and diagnosis, it is anticipated that hyperspectral imaging could be an essential tool to analyze plant disease, phenotype, and genotypes. This will improve the applications for high-throughput studies.

Accurate detection of the infested pathogen remains unresolved as less attention is paid to biochemical analysis. Therefore, to obtain more insights about the plant pathogen, higher spatial resolution data and soil, climate, and field information could be helpful. Computer analysts must have knowledge of plant diseases, and plant pathologists must have knowledge of computer science, image analysis, machine learning, and so on. In short, a good team of researchers and thorough study can help develop disease detection methods.

Another current issue of the hyperspectral imaging technique is processing a large amount of information. Machine-learning- and deep-learning-based algorithms are used to preprocess the data for disease detection and analysis. Employing parallel processing, batch processing, and hardware acceleration could solve these computational challenges and provide a real-time analysis as a viable solution. Currently, the price of hyperspectral cameras is very high, which limits the application for small-scale farmers. Hyperspectral data analysis can also be improved if optical sensors and 3-D structure measurement techniques can be combined [15]. This will help to obtain 3-D information on the plant organs and pathogens.

To conclude, hyperspectral imaging has advanced plant disease detection in a great way. However, the current challenges need to be addressed to advance in the field significantly. With the advancements in sensor technologies, computational methods, and real-time large-scale/real-world applications, hyperspectral imaging can transform the traditional approach to manage plant health and improve food security and environmental sustainability.

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