Ceres: A Novel Device Utilizing Raspberry Pi and Neural Networks To Detect Crop Diseases Using Imaging

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Globally food demand is increasing; at the same time, about 10-20% crop is damaged/wasted during production/harvest due to pathogens. This could be reduced with early detection of crop diseases. Current methods rely heavily on time consuming processes of lab testing/expert validation. Ceres, the proposed solution, is an affordable, accurate, scalable device to detect the crop diseases infield/onsite. Early detection helps take preventative measures to stop disease spread. Ceres was trained using the images collected from the growers/universities. These images were validated by the experts. In total, about 13,000 images were collected/validated across 14 crop/fruit/vegetables and 24 diseases. The Ceres model consisted of a total of 12 layers of 6 distinct types for training. A median filter and feature extraction were used so that the model can focus on the contents of the image. For validation, it was fed images which were not seen earlier. The training and validation images were divided in 70%/30%. The validation results suggests that Ceres has accuracy of 89% with F-score of 92.4. The Ceres physical device is easy to use - where the user captures the image, it is analyzed within 2-3 seconds and results are displayed on the screen. Ceres consists of a 3D-printed device, a Raspberry Pi, camera, LCD, and a button to take the image. Overall, Ceres was able to completely fulfill its design criteria. In conclusion, this project shows that a neural network with multiple layers can be developed in conjunction with a physical device for early detection of crop diseases.

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