High-throughput Phenotyping of Tan Spot Disease on Wheat using IoT and Deep Learning: A proposal workflow

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Abstract

Several leaf diseases affect the potential of wheat production, limiting plant development and many times causing severe yield losses. In this context, early detection methods of plant diseases are of great importance, preventing disease spread with the minimum damage to crop production and reducing costs to the farmer due to fewer chemical applications. Based on our previous positive results [1], using Transfer Learning technics on top of an Inception-v3 [2] convolution neural network (CNN), we draw a proposal workflow to collect, process and analyze the Tan Spot development on wheat leaf under controlled conditions (greenhouse environment). All the sensor data and digital images collection will take place automatically based on the Internet of Things (IoT) framework using a Raspberry Pi that sends the information periodically to a server using the message queuing telemetry transport (MQTT) protocol. The information collected through the disease development will be used as input of a mathematical model and combined with a neural image classification for earlier detection. The proposal workflow will study the minimal periodicity necessary for collecting data to further use in classification and detection. This IoT component will be attached to each plant container, to follow the Tan Spot development on a top three wheat leaf. At the validation phase, the attached IoT device will be responsible for classifying the disease symptoms, as soon as possible, and report an alert on the monitoring system. The final network classifier will be embedded inside a smartphone application to be used in both greenhouse and field conditions. In addition, the final network classifier, the mathematical model output and the sensor data from greenhouse sensors will be used to compose information to be displayed on an augmented reality (AR) application for a smart-glasses prototype, to provide necessary information on the decision for chemical spread applications.

References

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