Healthy Hydroponics: Creating a Plant Health Monitoring System in Hydroponics Using Photogrammetry and a Convoluntional Neural Network

Nguyen, Brandon (School: Bangor High School)
Nguyen, Brayon (School: Bangor High School)

Hydroponics aims to reduce water consumption and facilitate optimal nutrient absorption while increasing crop cultivation. However, pests and harmful bacteria can enter these hydroponic structures and negatively impact the productive yield of crops. Moreover, there is a considerable demand for electricity that puts a large toll on energy consumption when compared to traditional agricultural systems. As such, a crop health monitoring system was developed using a deep convolutional neural network (CNN) and programmed red, green, blue (RGB) value splitting to classify plant health. The proposed system consists of a standard NFT setup, including nutrient solutions flowing through the setup. A micro hydro power framework sits in place as the water flows into the reservoir. Raspberry Pi cameras attached to the setup take images of growing crops where plant health classification will be determined. Specifically, the CNN was developed and pre-processed in MATLAB which takes the augmented training data and separates them into two classes, healthy and unhealthy. The training process divides the randomly selected images into two sets; 70% training and 30% testing. The model can consistently obtain a training accuracy of 83.33% with an average identification percentage of 70%-80%. Moreover, RGB values from the identified plant images are then quantified through average RGB pixel values and signify statistical correlation between the health of the plants and the average concentration of green vs. red pixel values. This proposed system provides many insights to determining the health of plants rather than using other common methods such as near-infrared applications and can verify crop health as a sustainable and cost friendly way for higher yields and productivity.