Development of Crop Reflectance Sensor for Precision Agriculture

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Introduction

- According to the World Bank Group report, global **food insecurity has risen due to changing climate patterns.**
- In the Philippines, **climate variability and hazard**s are expected to **substantially impact food insecurity** from the local to the regional level.

Precision Agriculture is one of the emerging technologies that is promising to **solve the problem of food insecurity worldwide**.

- It incorporates various sensors to determine crop and environment parameters effectively.
- In this study, a portable, low-cost reflectance sensor for crop health monitoring was built to assess crop health.

Methodology

List of Materials in the Study

Materials	Specification
Certified Reflectance Standard	Spectralon ® Nominal reflectance - 99%
Photodiode	S1133-01 (Si photodiode) Spectral Range- (320 nm -1100 nm)
White LED	
Connecting Wire	Solid wire (20-AWG)

This study used the RGB color scheme format to quantify the colors being tested in the laboratory. Eight varying green intensities were used, as shown in Figure 1. In the RGB color scheme, the red, green, and blue values range from 0 to 255 per pixel.

Figure 1. Color of different green intensities

- A 3D-printed semi-circular casing was built to enclose the LED and the photodiode.
- Four different detection angle was carried out in the study (90°, 60°, 45°, 30°)

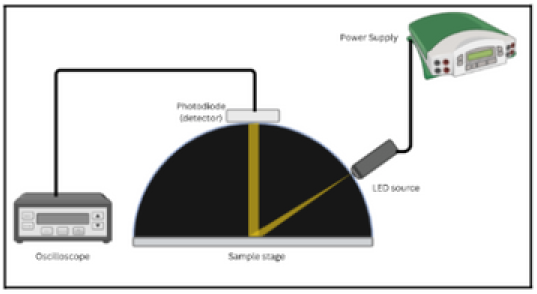

Figure 2: Experimental Setup of Crop Reflectance Sensor

Results and Discussion

- The corresponding R-squared value of the different regression models for different detection angles ranges from 0.795 to 0.958.
- The lowest R-squared values were obtained from the 90° detection angle and the highest R-squared values were obtained from the 45°detection angle.
- This **suggests that in 45° detection angle is better** regarding model fit and detection value.

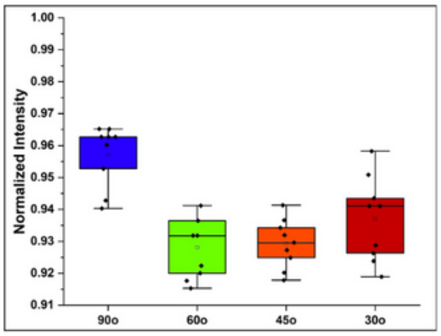

Figure 3. Box plot between detection angle and normalized intensity

- Based on the above box plot, the **45° detection angle shows a better data distribution.**
- The four datasets **show non-outlier points,** suggesting that the S1133 photodiode detector has a good response and consistent behavior to the white LED source within the experiment

Conclusion

- This study used the **RGB color scheme format** to quantify the colors being tested in the laboratory. Eight varying green intensities were used, as shown in Figure 1.
- **Various detection angles** (90°, 60°, 45°, 30°) were carried out in the experiment.
- Results show that **45° was the optimal detection angle** necessary to build a crop reflectance sensor to measure the different green intensities
- **Calibrations** are needed to the **actual plant samples** to further assess the health status of the crop.