Plant Growth through Webcam Surveillance

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Introduction:

Context

Growing basil and lettuce plants under different lightings for chemical compounds analysis

Problematic

We required a growth monitoring system at low cost that required less human intervention

Goal

Develop a system of cameras to measure the increase in leaf surface over time

Methodology:

Installation of Webcams in the Experimental Platform

Webcamimg, an existing program created by our research group, is used to take pictures of the plants with 8 D-Link webcams. These webcams were positioned to capture the top of the plant as well as it's side.

Analysis of the Images

We adapted and added modules to the *Readimg* program created by our research group. This program classifies which part of the JPG image is a leaf and which part is a stem. By comparing the color of the pixels of the JPG with reference colors for the leaves and stems, it sorts the pixel into the category with which it has the smallest color distance.

$$\sqrt{(R_{JPG} - R_{REF})^2 + (B_{JPG} - B_{REF})^2 + (G_{JPG} - G_{REF})^2} = Color\ distance$$

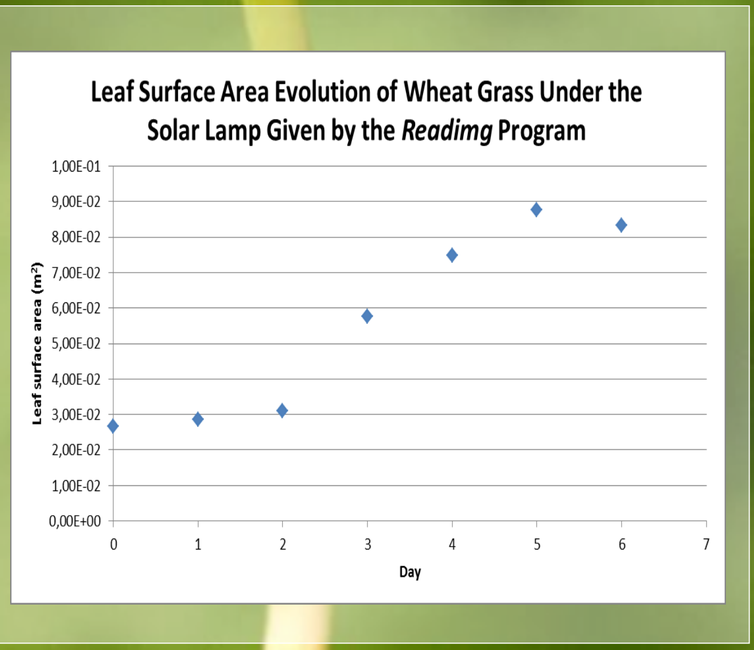
Each category is attributed a arbitrary color to create a PGM picture. The category red was added to also observe evolution of pigmentation in red leaf lettuce and the category other for pixels that are not a part of the plants. The PGM picture allows us to observe if the pixels were sorted into the right category.

Nature of the Results

We get a numerical value of leaf surface area perceived by each camera and recognized by the program. We also get the number of pixels for each category. Pictures were taken twice a day to ensure a good follow up on plant growth.

JPG

PGM



Discussion:

We can clearly identify the position of plants on the PGM images with the color attributed to leaves. However, a lot of leaf surface area was mistaken for stems or other. The surface mistaken for other corresponds to light reflection on the leaves due to their wax. The leaves are normally darker than the stems, but the lighting can make the leaves look brighter. This has an impact on the numerical values of leaf surface given by the program. The leaf surface area is therefore underestimated and the stem and other categories overestimated. To improve our results, we project to merge the leaves' and stems' categories. We expect that it will give us a more accurate numerical value of leaf surface area because the stem surface is smaller then the one of the leaves that were mistaken for stems.

Conclusion:

The analysis that we made of the leaf surface area was not on a sufficient time lapse to have solid conclusion on the validity of our method in addition to a lack of a solid comparison method. The experiment should be redone over a longer time period with human measurements of total leaf surface to have comparison results. The recognition of the different surfaces categories was generally correct, but we have slight issues differentiating stems from leaves. The merging of these two categories is envisaged.

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