Automated Spectral Data Acquisition

Automated Spectral Data Acquisition and Analyzer

ELECOMP Capstone Design Project 2019-2020

Sponsoring Company:

TSRgrow
60 Alhambra Rd, Suite 1, Warwick RI, 02886
http://www.tsrgrow.com

Company Overview:

TSRgrow is a USA horticulture lighting manufacturing and solution company partnered with university and industry leaders for advanced LED grow lighting solutions. Horticulture LED lighting solutions are key to every indoor and greenhouse crop quality, production and yield. TSRgrow products, services and solutions offer the best "Totalgrow Solution™" in environmental control, energy savings, recipe management, LED lighting spectrum controls, racking and supporting services to help growers gain the high brand quality production that will give them the competitive edge at the lowest operating cost.

For solutions, visit: https://www.tsrgrow.com/

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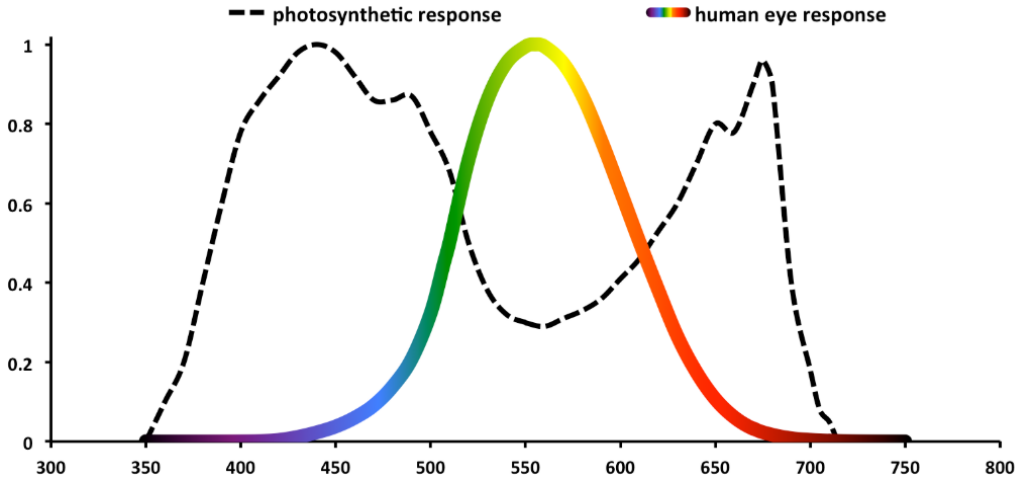
Project Motivation:

Humans and plants see light differently. The human eye is most sensitive to the yellow region of the lighting spectrum. The light perceived by the human eye is measured as Lumens. Plant perceive light as photosynthetic active radiation (PAR). Both are shown on the following graph.



Photosynthetic photon flux (PPF) is the amount of PAR that is produced by a light source. The Sun produces enough PAR for both plants and humans and in quantities that there is enough for each to take what it needs for the task at hand; seeing for humans, growing for plants. Artificial light sources have a fixed amount of energy with which to produce PAR. Therefore, it is important in horticulture lighting, to produce PAR in the spectrum that is the most efficient and effective for the plants. As a leading horticulture lighting solution company, TSRgrow manufactures lighting solutions that deliver the PPF necessary for plants to grow and flourish. This PPF is comprised of a variety of LEDs that deliver specific wavelengths of light that are combined together to deliver light that the plants use for photosynthesis. This is measured in micromoles per second (µmol·s-1).

To determine how effective the lighting fixture is at delivering the PPF to the canopy of the plant, one measures the photosynthetic photon flux density (PPFD) in micromoles per square meter per second (µmol·m-2·s-1). This measurement must be taken at various distances and from the light fixture vertically and horizontally spaced away from the fixture. This information is used to develop a lighting plan and layout for customers to help them determine the number of light fixtures needed and at what positions, to deliver enough photon energy to grow the crops on their farm.

Multiple data points must be taken and combined electronically to generate a report that helps design the configuration for the positioning of the light fixtures. Today, this data must be manually collected and compiled. There is no standard methodology or equipment to perform this testing and data collection. It is time consuming and labor intensive.

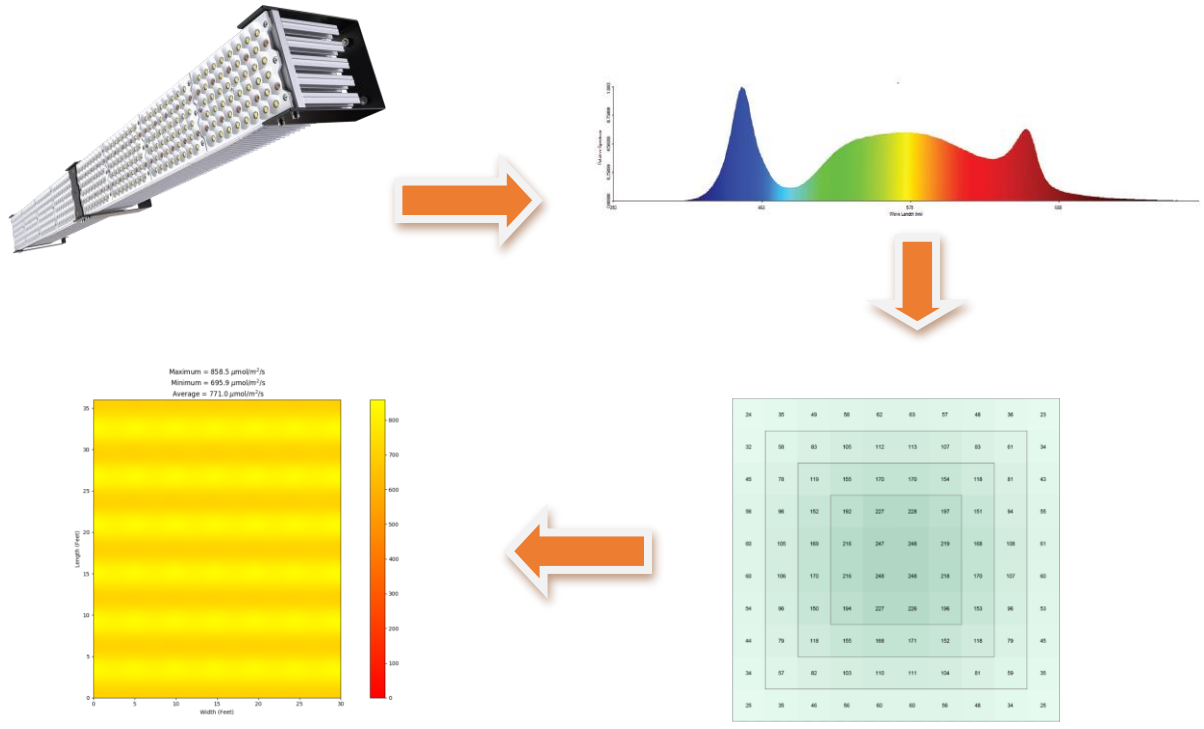
Anticipated Best Outcome:

- Automated data collection of PPF and PPFD from light fixtures
- Frame for accurately mounting fixtures for data collection
- Data collection over a predefined grid area that can vary from 4’x4’ to 16’x16’ at heights from 6” to 72”
- The creation of an application to aggregate, sort and store the information and create reports based on defined queries
- Data entry GUI interface
- Reporting GUI interface

Project Details:

The project will involve a light meter with the capability to measure PPFD in the spectral range of 380nm – 800nm. The meter will need to be manipulated around a pre-defined grid pattern to collect data that represents the distribution output of the light fixture. This measured data will be captured through a data acquisition method and transferred to a computer program. This program will be used to predict the PPFD and spectral uniformity for customers interested in using TSRgrow horticulture lighting fixtures. There will be a need for an adjustable mechanical mounting requirement that will accommodate a variety of fixtures and adjust the height of the fixture up to 6 ft.

Overall System Concept:



Hardware/Electrical Tasks:

- Research and select measurement hardware and sensors
- Identify and implement methodology to position sensors
- Construct/configure interface between sensor and data acquisition program
- Test and implement measurement system

Firmware/Software/Computer Tasks:

- Develop required firmware and software interface to sensors
- Develop program to capture and store data
- Develop interface to existing program to publish the data in reports for desired presentation
- Develop additional firmware/programs as necessary to interface with hardware and software to perform necessary functions

Composition of Team:

1 Electrical Engineer and 1 Computer Engineer

(Preference will be given to engineers with experience in mechanical engineering or interest/experience with motor controllers)

Skills Required:

Electrical Engineering Skills Required:

- Familiarity with Circuit Design
- Familiarity with DYI electronics e.g. Raspberry Pi, Arduino
- Sensors and device level firmware programming

Computer Engineering Skills Required:

- Low-level programming
- Web UI Programming
- Databases
- Data acquisition

Anticipated Best Outcome's Economic Impact on Company's Business:

The best outcome will be to reduce current test time and accuracy and speed of proposal generation to customers. This should result in faster sales cycles and increased revenue.

Broader Implications of the Best Outcome on the Company's Industry:

This test methodology is likely to be adopted across the horticulture lighting industry as more stringent standards are developed around product marketing and sales materials.