Project 18: Wireless Microclimate Sensor System for Smart PV Panel Control in Agrivoltaics

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Number of students required: 2 EE students and 1 CS students or more

Agrivoltaics is the dual use of land for both photovoltaic (PV) power generation and agriculture. In agrivoltaics, shading created by PV panels can affect plant growth adversely for light-sensitive crops, as it reduces the light for photosynthesis. On the other hand, PV panels can provide protection for crops in the event of extreme climate conditions such as heatwaves, hail, and heavy rain, all of which are expected to occur ever more often due to the climate change. Excess light exposure in warm-to-hot summer climates is also detrimental to many agricultural products, as it can cause "sunburn" that chemically damages the product and leads to poor quality. To tackle these issues, we propose the use of advanced sensors installed at the site to detect local climate conditions and adjust the solar panel angle to protect crops from potential damage. See Fig. 1 below for the illustration of the proposed PV panel control.

In this project, we will develop the wireless microclimate sensor system that is capable of sensing local climate components such as air temperature, humidity, light intensity, and wind at the agricultural site as well as the soil conditions such as soil temperature and moisture level. These sensing data will be collected remotely on a computer, and used to make automatic decisions on the adjustment of the PV panel angle and other operations. Some extreme weather events such as hails may not be easily detected or predicted from the microclimate sensing. For these events, we will use the public alerts provided by NWS in the XML/CAP 1.2 format to make the necessary decisions.

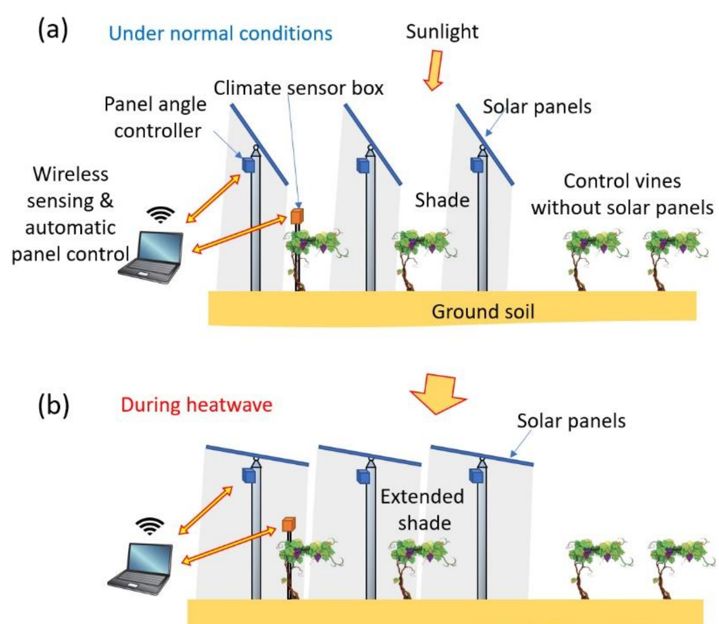

Fig. 1. Illustration of the agrivoltaic system at a small vineyard with smart panel control and climate monitoring system

Major tasks to be carried out in this project:

1) Developing a sensor system consisting of various climate sensors with wireless communication
2) Developing a software program (e.g. LabVIEW or a phone app) that collects sensing data from the sensor system and displays the graphs real-time.
3) Creating a scale model of the PV panel and angle controller that can be operated remotely by the software program.
4) Field-testing the developed system at a local vineyard.