Precision Agriculture Adoption and Integration Case Study

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Introduction

- Precision agriculture describes a variety of emerging technological systems and tools for use in crop and livestock farming
  - Improve profitability for farmers [1]
  - Potentially reduce negative climatic impacts of farming [2]
- Remote sensing is a tool that has not been widely adopted, despite availability of these systems [3]
  - This is due to high cost and lack of usability
- Sensor Collection And Remote Environment Care Reasoning Operation (SCARECRO) system
  - Modular, extensible, open-source system that uses low-cost hardware to resolve cost and usability issues
  - Consists of a gateway, middle agent, weredog, and sensors
  - Send data collected by sensors to database to be stored, displayed, and used in AI models
  - Already implemented in Laurel Grove Wine Farm in Winchester, VA
- This project aims to test this system's performance in a new application domain: a heritage apple orchard at Sandpoint Organic Agriculture Center (SOAC)
  - Observe performance, compare cost, and evaluate usability

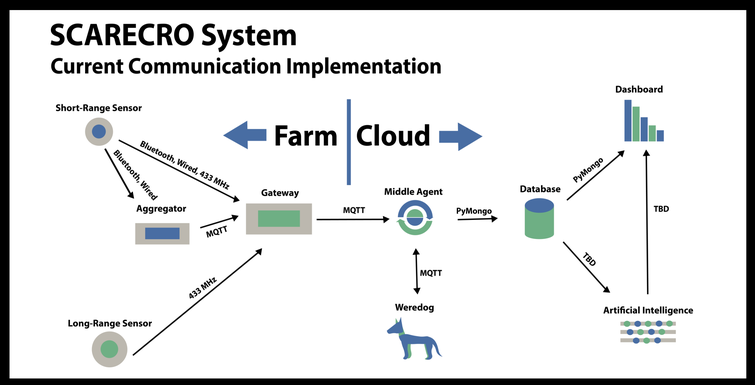

Figure 1: SCARECRO communication diagram

Methods

- Performance
  - Perform routine system maintenance and determine uptime
  - Write automated tools in Python to find system faults
- Cost
  - Calculate labor and component implementation cost
  - Compare to other similar remote sensing systems
- Usability
  - Integrate dashboard to display relevant data
  - Regularly survey farmer regarding system functionality

Figure 2: Left to right: Datagator, Gateway, WeatherRack Station

Progress

- Assembly and installation of all system components is complete (Figure 2)
  - Gateway to eliminate duplicate messages, keep track of sensor connections, and send data to the database
  - Aggregator (Datagator) to collect and transmit readings from sensors located further away from the gateway
  - WeatherRack (both WR2 and WR3 models used) to collect weather data
  - Middle agent to handle data transmission to gateway and/or database on cloud computer
- Integration of a dashboard to view collected data from database (Figure 3)
- System usage and usability surveys
  - Conducted virtually over a 10-week period (will start late summer)
  - Used to discover the usability of the system and dashboard as well as ask for suggestions to improve the system in the future
- Began cost analysis of current structure and comparison to similar systems

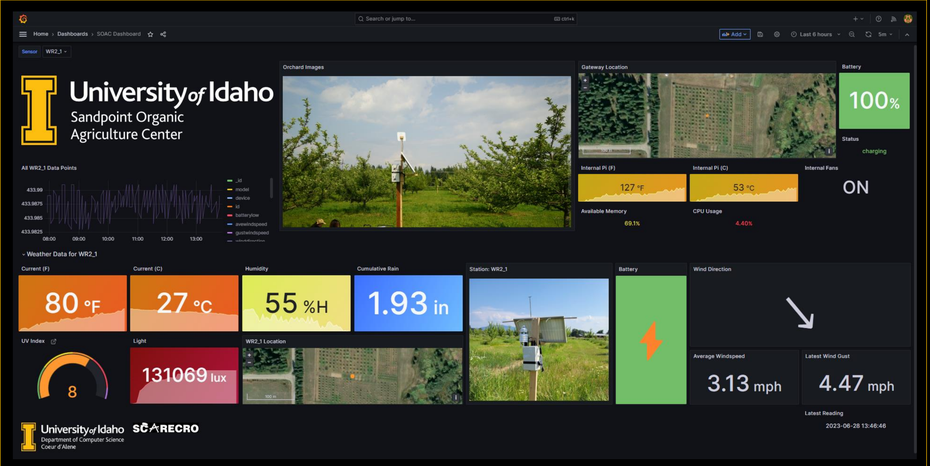

Figure 3: SOAC Dashboard

Results

- Performance
  - System assembly and implementation was successful
  - Consistent data coming in
  - Occasional continuous network connectivity issues
- Preliminary research showed financial advantage to using SCARECRO as compared to other similar systems
- Initial discussions with horticulturalists at SOAC proved this system's usefulness and room for input

Future Work

- Conduct and analyze continued farmer surveys
- Implement SOAC horticulturalist suggestions
  - Light canopy sensors to quantify benefits of pruning
  - Degree day modeling for pest control
- Installation of additional local test unit (Harbor Center)
  - Help test reliability in a new setting
- Troubleshoot connection issues in gateway

References

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[2] P. A. C. T. Force. (2021, November 10) Task Force for Reviewing the Connectivity and Technology Needs of Precision Agriculture in the United States." Available: https://www.fcc.gov/sites/default/files/precision-ag-report-11102021.pdf

[3] Lowenberg-DeBoer, J. and Erickson, B. (2019, July 1). Setting the Record Straight on Precision Agriculture Adoption. Available: https://acsess.onlinelibrary.wiley.com/doi/full/10.2134/agronj2018.12.0779

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