Strawberry Advisory System Using Wireless Sensor Networks

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Introduction

- **The AgroClimate.org**

- It is a web/mobile climate information and decision support system developed to help agricultural producers to reduce risks associated with climate variability in the Southeastern United States.

- **Strawberry Advisory System (SAS)**

- The Strawberry Advisory System (SAS), Figure 1, is a tool available on AgroClimate.org that warns growers about the risk of incidence of two main strawberry diseases in Florida: anthracnose and botrytis [1], [2].

- SAS is based on weather information from the Florida Automated Weather Network (FAWN) and other weather stations.

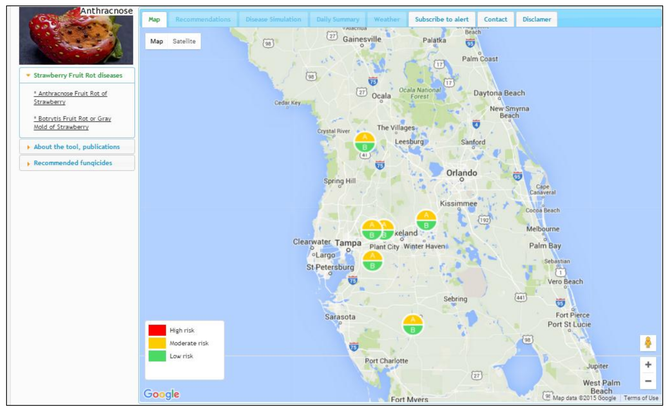

Figure 1 – The Strawberry Advisory System (SAS)

Motivation

- The current system operates with 6 weather stations to cover the main strawberry producing area in Florida and 2 in South Caroline.
- The distance between fields and FAWN weather stations can be a limiting factor for using SAS.
- The closest weather station may not represent the conditions in a grower's field due to spatial variations in climate.
- This spatial variability affects the prediction of the fungal diseases.

Objective

Our objective is to evaluate site specific leaf wetness duration to allow better and more efficient control of diseases using Wireless Sensor Network (WSN) technology.

Development

- **The Wireless Sensor Network technology**

- WSNs are a network of battery-powered sensors interconnected through wireless medium and are typically deployed to server a specific application purpose [3]. These sensors are called Sensor Nodes (SN).
- The WSN are also composed by routers one gateway.
- The routers are used in order to extend the wireless communication range.
- The gateway is the bridge between the WSN and the internet.

- **The site-specific SAS with WSN**

- The first site-specific SAS with WSN will be installed in the University of Florida's Gulf Coast Research Center, Wimauma FL 33598.
- This WSN is composed by:
- One weather station node.
- Two leaf wetness nodes.
- One router to extend the communication range.
- One gateway to provide data to the AgroClimate web server.
- The application is illustrated in Figure 2, where is possible to see all the components at the strawberry field. The yellow line is the wireless connection between the devices.

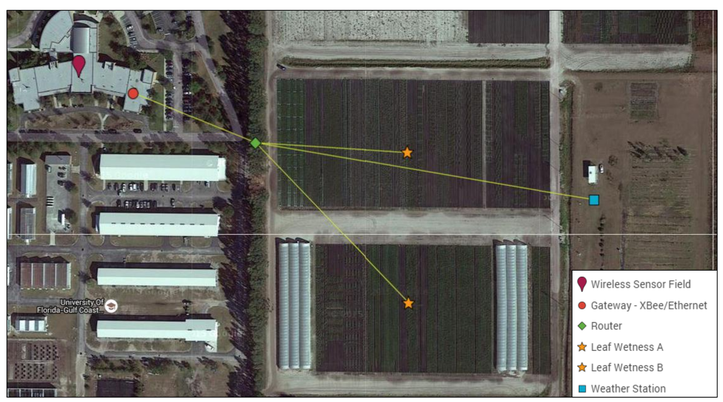

Figure 2 – Site-Specific SAS Solution

Sensor Nodes (SN)

- The SN architecture can be seen in Figure 3. We are using advanced technology for WSN, The microcontroller is the ARM cortex M4 microcontroller. We are using the XBee radio transceiver. We also have a robust power system composed of a Ion-Lithium rechargeable battery, solar panel. Finally, for each type of node, we have specific sensors.

- There are two types of nodes: the Leaf Wetness (LW) and the Weather Station (WS).

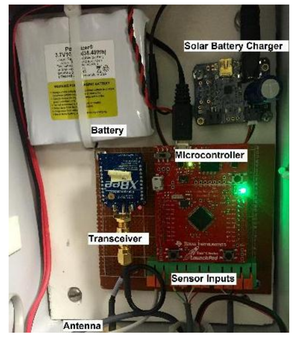

Figure 3 – The Sensor Node architecture

The LW node

- The LW node, presented in Figure 4, will monitor temperature, relative humidity and leaf wetness. Additional units of this node will be deployed later in the project.

- The LW node will evaluate the leaf wetness duration for each strawberry field.

- The estimated cost for each LW node is under US$ 100 dollars.

Figure 4 – Leaf wetness node

The WS node

- The WS, shown in Figure 5, will collect temperature, relative humidity, wind speed, wind direction and precipitation within the strawberry fields.

- The estimated cost depending on the choose of sensors starts at US$ 300 dollars.

Figure 5 – Weather station node

Conclusion

- By creating specific solutions for each farm/field, the WSN approach has a great potential to improve the disease control in a more efficient way.

- The WSN technology also has a vast potential to improve real-time frost protection, the efficiency of water used in irrigation, and farm security systems.

References

1. http://agroclimate.org/tools/strawberry/
2. Pavan, W., **C.W. Fraisse**, N.A. Peres. 2011. Development of a web-based disease forecasting system for strawberries. Computers and Electronics in Agriculture 75(1):169-175.
3. I. Akyildiz, and M. Vuran, Wireless Sensor Networks, New York: John Wiley & Sons, 2010.