

sdmay18-38: Smart Wireless Ag Sensors for Measurement of Soil Water Contents

Week 3 Report

October 1 - October 11

Team Members

Colin Cox — *Application Design and Microcontroller Integration*

Wage Miller — *Circuit Design*

Jarrold Droll — *Sensor chemical researcher*

Rachel Hoke — *Sensor chemical researcher*

Scott Rowekamp — *Software Lead*

Tyler Thumma — *Circuit Design and Microcontroller Research*

Summary of Progress this Report

During the first part of October we split our team into three groups:

A) Sensors (Jarrod/Rachel)

B) Application/Software (Colin/Scott)

C) Control Box (Tyler/Wage)

A) We learned of the chemicals required for fabrication of the (in soil) sensor, this does not include the (in plant) sensor. The (in soil) sensors consist two electrodes, the reference electrode and the working electrode. The steps for coating the sensors with the correct materials are:

- 1) Once PCB is ready for chemical deposition, convert Ag to AgCl using FeCl₃
- 2) Solder on two wires for connection to sensor box.
- 3) Coat entire PCB in PDMS coating.
- 4) Cut and remove PDMS coating off the sensor side not containing the soldered wires.
- 5) Coat PEDOT.PSS on working electrode
- 6) Coat ISM on working electrode
- 7) Coat PVC.CNT on reference electrode

B) We designed a rough communications protocol for the sensors to store the data. Each sensor will have its own microcontroller and communicate to a central node or coordinator. The coordinator will then be able to upload the data to the internet or store it for retrieval via a smartphone or other mobile device.

C) We researched differential amplifiers which will be used in our sensor circuit. Our current schematics involve four Op-Amps with a variety of voltage inputs. Differential amplifier circuits amplify the difference between two voltages, which allows them to add or subtract the input voltages.

We also looked into the microcontroller (Zigbee S2C) that we are considering using for our sensor networks. It has a communications chip that can be used to talk between all of our sensors that we will have within our sensor network. The link to the datasheet for our microcontroller is listed here:

<https://www.digi.com/resources/documentation/digidocs/pdfs/90002002.pdf>

Pending Issues

A) Pending issues for the sensors are:

- 1) learning how to create all required chemicals for fabrication
- 2) creating a better method for applying all the chemical coating on our sensors
- 3) Design a new electrode layout that will have a better surface area for chemical coating on our sensors
- 4) Design a new PCB for our sensors that will be wafer shaped.

B) Pending issues for the application are:

We are awaiting some requirements for our application from our client.

C) Pending issues for the control box are:

One of our pending issues is that we are using schematics provided to us by Dr. Dong's TA. However, she is not currently available making it difficult to progress our control boxes. We were given old schematics and are attempting to improve them.

Plans for Upcoming Reporting Period

Our plans for the sensors are to learn how to create the chemicals for fabrication.

Our plans for the control box are: Construct the circuits in PSPICE and begin to analyze their behavior.

Our plans for the application are: Create hello world applications for coordinator and node software and demonstrate communication ability.

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Colin Cox	Worked with Scott to start to get requirements for software. Started sample applications. Met with TA's to learn the composition of the chemicals	4	13
Wage Miller	Conducted research on differential amplifiers and Op-Amps that will be used in our circuit design. Began rudimentary analysis of our sensor circuit schematics given to use by Dr Dong's TA. Met with TA's to learn composition of chemicals.	4	13
Jarrold Droll	Worked with Rachel to learn the process of applying chemicals on in soil sensors. Met with TA's to learn the composition of the chemicals.	4	13
Rachel Hoke	Worked with Jarrod to learn the process of applying chemicals on in soil sensors. Met with TA's to learn the composition of the chemicals.	4	14
Scott Rowekamp	Worked with Colin to ideate software requirements. Started sample applications. Met with TA's to learn the composition of the chemicals.	3.5	12.5
Tyler Thumma	Obtained old documentation for previous circuit design of our sensors. Researched into different microcontrollers to incorporate in our sensor network. Met with TA to learn about the composition of chemicals for our sensors.		9.5
