Team Number 19
Client: Professor Que
Advisor: Professor Qiao
Team Members/Roles
Ben Theisen – Team Lead
Michael Rupert – Web Master
Zakk Belloma – Key Concept Holder
Ran Young – Key Concept Holder #2
Ben Engebrecht – Communication Leader
Logan Boas – Communication Leader #2
Ma1719@iastate.eydu
http://may1719.sd.ece.iastate.edu

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Portable Nutrient Data Collection System

Project plan

Contents

1 Introduction

1.1 Project statement

This project deals with a portable system that will be used to analyze water in the field. The purpose of this is to determine whether there are certain nutrients in the water in certain locations. This system has two methods of testing the water. The first is sending a high voltage across a small reservoir of water that essentially vaporizes the water creating a light that goes into a fiber optic cable and into a spectrometer. The second method is shining a strong enough light through the water sample that then goes into a fiber optic cable connected to the spectrometer. After the data is collected by the spectrometer, it will be sent through our system and out to an app for the user to easily view the data.

1.2 purpose

This project could be very beneficial in several capacities, most notably in agriculture and environmental scientists. Agriculture could use this system to ensure that the water they are using is free of any harmful chemicals. This could help farmers gain better yields from crops, use their resources more efficiently (not harming crops with bad water and having to replace them), and ultimately have better financial results from their business.

Environmental studies would be able to use this system to analyze potential pollutions in hard to reach areas with other equipment. With this portable system, they would be able to keep a watch on problem areas. Also, using this system, with the analysis of the spectrometer these scientists would know exactly what is causing problems in the environment. This means that they should be able to find a solution quickly.

Society would benefit greatly from both uses of this project. There would be more food coming from farms and that food would be free of the harmful chemicals that would be detected by the system. Environmentalists finding pollution in water sources and dealing with the issues would lead to a cleaner environment and creating a cleaner place for people to live.

1.3 Goals

As a group, we hope to create a working model by the end of both semesters that will be shown to industry professionals. In doing so, this system could find its way into the hands of people who need it. Before the end product, we will need to have a prototype to perform final testing, our goal is to have this prototype done in March 2017. In addition to the base system, we aim to develop an app that can communicate with the system. Our goal is that we will have a prototype app available at the same time as the prototype system, and a fully functional app by the time we have finished the final system product.

2 Deliverables

To meet our goals, we will need to develop the system that will deal with the data from the spectrometer. We will also need to develop an app meeting the functional requirements.

Documentation

-Project Plan

-List functional and non-functional requirements

-Provide a timeline

-Create a Design Document

System

-Able to communicate with the spectrometer

-Voltage booster

-Wirelessly sends data to the app

-Low power consumption

-Weather resistant

App

-User friendly interface with a tutorial

-Wirelessly receives data from the system

-Able to control the system from the app

-Stores data in a local database

-Communicates with a cloud server

3 Design

Include any possible methods and/or solutions for approaching the project at hand. You may want to include diagrams such as flowcharts to, block diagrams, or other types to visualize these concepts.

3.1 Previous work/literature

As we are continuing the work of another team that began last year, we have the ability to view their progress through the weekly reports, receive a solid project roadmap from the faculty mentor, as well as also being able to contact a member of the previous senior design team.

Detail any similar products or research done on this topic previously. Please cite your sources and include them in your references. All figures must be captioned and referenced in your text.

3.2 Proposed System Block diagram

For most groups you can include a flowchart of how the system will work. In case your project is not about putting together some sort of a system, you may describe the process that you will follow to achieve your deliverables.

3.3 Assessment of Proposed methods

There are two main ways to achieve our end goal, and they both depend on the communication protocol that will be used to receive data from the spectrometer. Initially, we looked at using the USB interface on the spectrometer to send and receive data. However, USB commands are not supported on most inexpensive microcontrollers. On the ones that do support it, it is prohibitively time-consuming and unreasonably complex. The only other alternative is to use a serial connection. This has the benefit of being an easily accessible standard that has wide support while remaining relatively easy to use. The only potential issue is that the documentation that we have discovered does not go into as much detail with serial as it does with USB. This will probably prove irrelevant in the long run, however, so we are moving forward with serial as our main form of communication. This will be sent to a microcontroller, which will perform some data analysis and send the result via bluetooth to a mobile cellular device.

Provide a short discussion about the different approaches available and the approach you want to follow in your work.

3.4 Validation

In order to make sure that our product works,

How will you confirm that your solutions work?

4 Project Requirements/Specifications

4.1 FUNCTIONAL

-Weatherproof/Weather resistant

This system is going to be used in the field around water and potential weather. The system will need to be able to deal with

-Wireless connectivity/Data transfer

The system needs to be able to wirelessly transfer data to the app that we are developing.

-Store data from each sample in a database

Storing data from each sample in a database will allow for the users to compare data from different samples taken in separate locations or the same location over a period.

-Test multiple samples

The system should be able to test multiple samples and should be able to store the data from each sample separately.

-Display data in human readable fashion

The app should display the data from the samples in a way that the user can read.

4.2 NON-FUNCTIONAL

-Interface should be simple and have a tutorial

Tutorial should be able to walk users through the system for them to use it correctly.

-Entire system needs to be portable

Users will need the system in a field and should be able to carry easily.

-System should last for 50 trials on one battery life

Users in the field should be able to perform multiple tests on one battery charge.

-Reasonable wireless range

The user should be able to have their phone with the app

-Runtime of less than 5 seconds

The entire process from start to displaying the data on the app should take less than 5 seconds. This will depend mostly upon how fast the spectrometer performs its function.

-One battery charge should last for a full day in the field

The battery should be able to last for a full day, or until the user performs 50 tests.

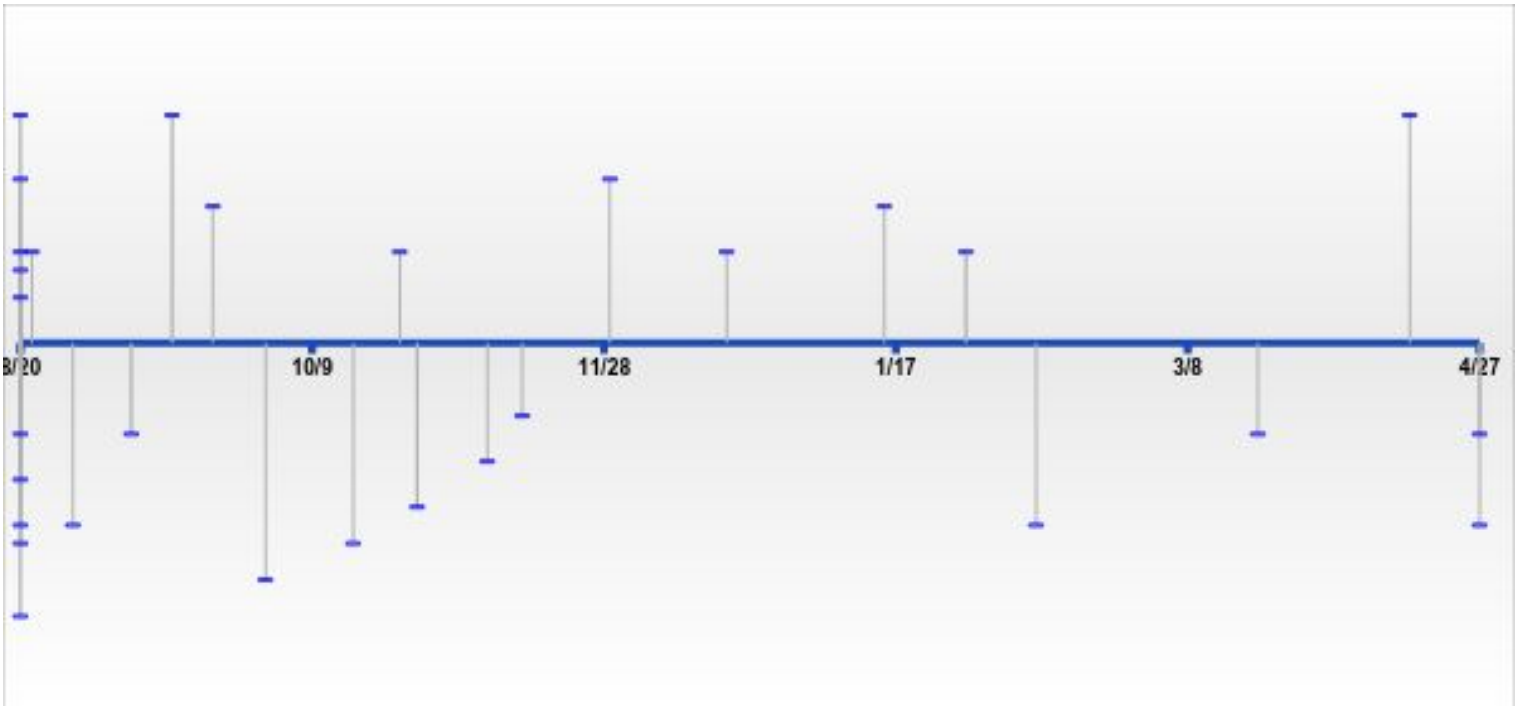
5 Challenges

This project will hinge on having the equipment to perform each function. Currently, we have access to the spectrometer, fiber optics, several raspberry PIs, and a Bluetooth module. To access the GPIO pins of the spectrometer, we need a breakout board. We have ordered one through the senior design class ordering process. Having to wait for parts to get in is a challenge. We cannot speed up the delivery of that part and without that part, we have a huge issue getting data out of the spectrometer.

Challenges will manifest themselves in areas other than just equipment as well. Communication from the spectrometer to the microcontroller could raise an issue. The previous group working on this project was not able to get readable data out of the spectrometer. Until we get the GPIO breakout we will not be able to get data from the spectrometer. However, once we can read data from the spectrometer, we will still likely run into issues with how to format the data. Ocean Optics has their own software for computers that processes the data coming out of the spectrometer, so there may potentially be some issue in interpreting the data received. Some of the members of the team understand serial communication. So, we are attempting to alleviate this issue by having those with experience deal the serial communication.

Communication over Bluetooth could also prove challenging. All members of the group have some experience with Bluetooth programming, either from personal projects or from CprE 288. Because of this, we know that this can be a challenging functionality to setup and get working perfectly. The Bluetooth communication will be used to send data to the app we are developing. Most of the groups experience comes from CprE 288, so learning how to use Bluetooth with an app could hinder the project some. However, this will be a valuable learning experience and group members will learn more about Bluetooth and app creation.

The last major challenge we have identified is the voltage booster. In order to ensure that we are able to correctly gather data, the voltage will need to be sustained for a small amount of time, rather than being instantaneous. This could be challenging and we will need to perform further testing on exactly how long the voltage burst needs to be.



6 Timeline

6.1 First Semester

By the end of the first semester we will have finalized our design of the system, design document, project plan, beginning of the app and serial communication, and a finished presentation on our project.

We have started to divide our team into sub groups that will tackle separate parts of the system.

Ryan Young and Ben Engebrecht – Serial communication

-Able to get use serial communication to receive data from the spectrometer

-Set up communication in a way to send the received data over Bluetooth

-Control the spectrometer over serial communication

Zakk Belloma and Ben Theisen – App and Bluetooth Communication

-Develop prototype app

-App should be capable of receiving data over Bluetooth and displaying that data

-Set up local database

Logan Boas – Voltage booster and wiring

-Find/create a voltage booster capable of producing consistent voltage to perform the micro discharge testing

-Incorporate voltage booster with microcontroller

-Help code the microcontroller to be able to fire the voltage booster

Michael Rupert – Website and start of cloud communication

-Set up website, and post documents from the semester to the website

-Help develop cloud communication with the app

All team members will help with creating documentation, ordering of parts, and planning project strategies.

6.2 Second Semester

During the second semester, testing needs to be performed, a prototype will be created, a final product will be created, and the team will present on the project at the end of the semester.

Ryan Young and Ben Engebrecht – Serial communication

-Code microcontroller to send data over Bluetooth to the smartphone app

-Test communication from spectrometer and also communication over Bluetooth

-Test controlling the spectrometer from the app

Zakk Belloma and Ben Theisen – App and Bluetooth Communication

-Code app to display spectrometer data in a readable fashion

-App should receive the data from the microcontroller over Bluetooth

-Incorporate GPS functionality into the app, store where samples are taken

-Create tutorial for teaching users how to use the app

Logan Boas and Michael Rupert – Powering the system, system case, and cloud communication

-Develop method to power the system for the desired amount of time or sample tests

-Create case for the system that is weather proof/resistant

-Create safety measure for using the voltage booster method of testing

-Incorporate cloud communication into the app in order to store the local data to the cloud

Again, all team members will help with documentation and presentations for the second semester. In both semesters, the sub-groups of the full team will be fluid. Meaning that if one group needs help the team will help that group achieve the goals set for that sub group. This will ensure that our group uses teamwork and communication in order to achieve our goals.

7 Conclusions

This is an interesting project that has beneficial real world applications. Throughout the two semesters, the desired use of the system will be kept in mind and the design will reflect that. Creating a portable system that an industry professional could use in the field is the end goal of this project.

Through both semesters, our group has goals to create a prototype system and app that will lead to final models of both. To reach these prototypes, the system will be created in steps. These steps will be to deal with separate modules of the system, serial communication from the spectrometer to the microcontroller, voltage booster, Bluetooth communication, and the app. Each of these steps will be tested separately before being connected together. Once they are connected together, further testing will be performed and any bugs will be fixed. After the system is connected and bugs are fixed that system will be our prototype. Our prototype will be analyzed and through communication with our advisor and client any desired changes will be made or new functionality created. Going forward from our prototype, we will create a weather proof case that is easily portable for users in the field. At the end of the second semester, we will present the final model to industry professionals.

8 References

List all the sources you used in understanding your project statement, defining your goals and your system design. This report will help you collect all the useful sources together so you can go back and use them when you need them.

9 Appendices

If you have any large graphs, tables, or similar that does not directly pertain to the problem but helps support it, include that here. You may also include your Gantt chart over here.