Dissolved Organic Matter Sensor, Spring 2015

Andres Larraza
May 13th, 2015

Abstract

The Fabrication Subteam was created to address problem that arose in the AguaClara plants that are in operation. The Dissolved Organic Matter (DOM) sensor is a project that was created because in the plants in Honduras. DOM is a contaminant in the water that is present naturally due to leaves and other matter in the rivers being decomposed. The DOM in the water was affecting the required amount of coagulant needed to properly flocculate particulates in raw water by requiring more coagulant. The problem was that there was DOM present and we could not measure it properly. This semester, the objectives for the team are to have a working model that can use the RGB(red, green, and blue) values detected by the Arduino board to calculate the concentration of DOM in the water.. This is a first attempt that AguaClara is conducting.

Table of Contents

Task Details

Team: Andres Larraza

Challenges:

1. Understand the challenges with the current DOM sensor.
    - Given the information in the “Challenges Spring 2015” Google Doc, determine whether it would be appropriate to develop our own DOM sensor.
    - .Do research based on the findings for the above decisions and create designs and experiments based on these findings.
    - Set the specific requirements of the sensor, as in cost, portability, accuracy
    - Have research and info done by March 7th
2. Once the information is known, create designs
    - Have at least 3 or 4 possible designs, each with some variation and distinct from each other.
    - Have the rough sketches by March 22nd
3. Review designs with peers, Ethan, and possibly Monroe
    - Review the pros and cons of each design
    - Fine tune the designed according to critiques by March 31st
4. Finalize designs and begin fabrication of the model
    - Write preliminary code for the Arduino Board by March 27th
    - Get the code to have two sensors under manipulation.
        - Both being able to turn off and on.
        - Both outputting data.
    - Have a LabView extension that reads the values and interprets them.

5. Tentatively, the goal is to prove that the concept of this experiment if true.
    - Have the model consisting of the vial, sensor and a black container.
        i. The experiments will be to test the distance where the sensor can accurately measure the color of the water.
        ii. Have it done by May 4th.
6. Given that the designs work and are fabricated, the next step would be to test the sensors
    - Set up experiments and run the tests at different turbidities as well as concentrations of DOM and other particles present in the water plants
    - Design experiments by April 25th
    - Have all data and data analysis by May 6th.

Introduction

Dissolved Organic Matter is present in rivers due to the decomposition of organic material (feces, decaying leaves, etc…) in the water. This decomposition produces a transparent solution that increases the amount of coagulant needed in order to properly flocculate the contaminants in the water. Research has found that the concentration of humic

acid can be found by calculating the proportion of red and blue light that passes through the water when white light is shined through. The sensor will be composed of two white LED lights attached to an RGB color sensor and then hooked up to an Arduino processor. The processor will calculate the proportion of the red and blue wavelengths that pass through the sensor.

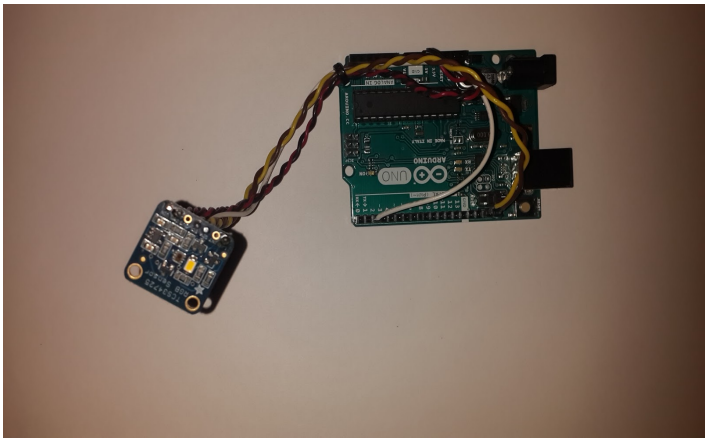

Figure 1: The current Arduino board. Next addition will be another sensor hooked up to the board.

The processor and sensors will be put in an old turbidimeter box so that no outside light can skew the results. **Figure 1** is the current model of the sensor. The Arduino board will have a sensor, the blue square, wired to it. The finalized Arduino board will have an LED wired to it to provide the light required for the sensor to work.

Methods

The sensor was placed in its housing that was fabricated out or a cardboard box. Then the food coloring was added to 30 ml of water and mixed. The vial was mounted on the fitting and the sleeve was placed on the vial with the AdaFruit color sensor. The device was plugged into the computer and 10 cycles were measured with a white LED shined through the opening hole.
Each cycle printed a set of values to the Arduino interface Serial Monitor, these values were recorded. The hex color was then calculated and compared to the color of the solution in the vial.

Analysis

The data from the first trial raised a lot of questions. The values that were being collected did not correlate with the true color of the solution in the vial. One possible explanation for this inaccuracy is that the set up that houses the color sensor and the vial is not static, which causes more variability in the angle that the light shines on the sensor as well as what part of

the sensor gets light. To fix this problem, a more permanent and rigid housing should be made for the system.

Colors detected and color of mixture per trial

Trial #	Color sensed 1	Color sensed 2	Color sensed 3	Color sensed 4	Color sensed 5	Color sensed 6	Color sensed 7	Color sensed 8	Color sensed 9	Color sensed 10	Photo color
1											
2											
3											
4											
5											

This data shows that the color sensor is precise, even though it may not be accurate. This shows promise for the sensor in the future. Furthermore, the method that the “Photo Color” is being captured should be updated. The colors that are being extracted from the photo do not seem to be accurate when compared to the vial in real life.

Literature Review

There already exists many different different kinds of DOM meters. However, they are all prohibitively expensive for AguaClara’s purpose. The goal of this research team was to create an affordable model using the principles already known about how DOM behaves in water. The code that was used for the Arduino was obtained from a company that open sources their code called Adafruit. The code does not do all that is desired, so some of it has to be changed. The code provided the basic structure of the code that was implemented. The code will be modified to purely calculate the red, green and blue photons and return these values. The aim of using an Arduino was that it could run continuously and execute the same program repeatedly or until prompted by a specific function.

Conclusions

The experiment has yielded some results that cause more questions to rise. The sensor was found to return the same values with a consistent showing. However, the variability and inconsistencies in the experiment could be attributed to the lack of a fixed mounting for the vial and sensor. Further experiments with a more stable and static casing would have to be carried out. Thus far, it has been proven, to some extent, that the device is functional and can detect color.

Future Work

The future work of the team will revolve around being able to gather data from the processor and then exporting that data into a computer. The top priority is to get the device functional, then the next step would be to begin calculating and calibrating the sensor. The sensor will be coded using the open sourced software from Adafruit and adding some changes to the implementation.