Milestone Report: CyanoStat

Below is a list of milestones there were added to the project website. I placed them in no particular order.

- Continued system and code design troubleshooting.
- Code reevaluation and changes. There may be a bug in the code and needs to be fixed. Furthermore, updated code will allow the system to run more efficiently. As more people test the Cyanostat, more changes to the code can be made.
- Evaluate different microcontroller processors. Arduino is running the system now and it's convenient. BeagleBone Black is in short supply and probably is not a good choice if it is going to be a hassle to obtain. Raspberry Pi is another option but it depends how user-friendly it is. Will consult renowned researcher Eric Lo.
- Reevaluation of circuit board and design through Qualcomm Institute's prototyping lab. We will be starting from the beginning and making several changes that improve the system. For example – as opposed to photoresistor sensors, we will be changing to IR sensors.
- Find another alternative to the solenoid system. This is the biggest expense of the system.
- Currently, the prototype is spread out. I would like to start bringing everything together into a compact case.
- If the microcontroller processor changes, then the code will change to Python.

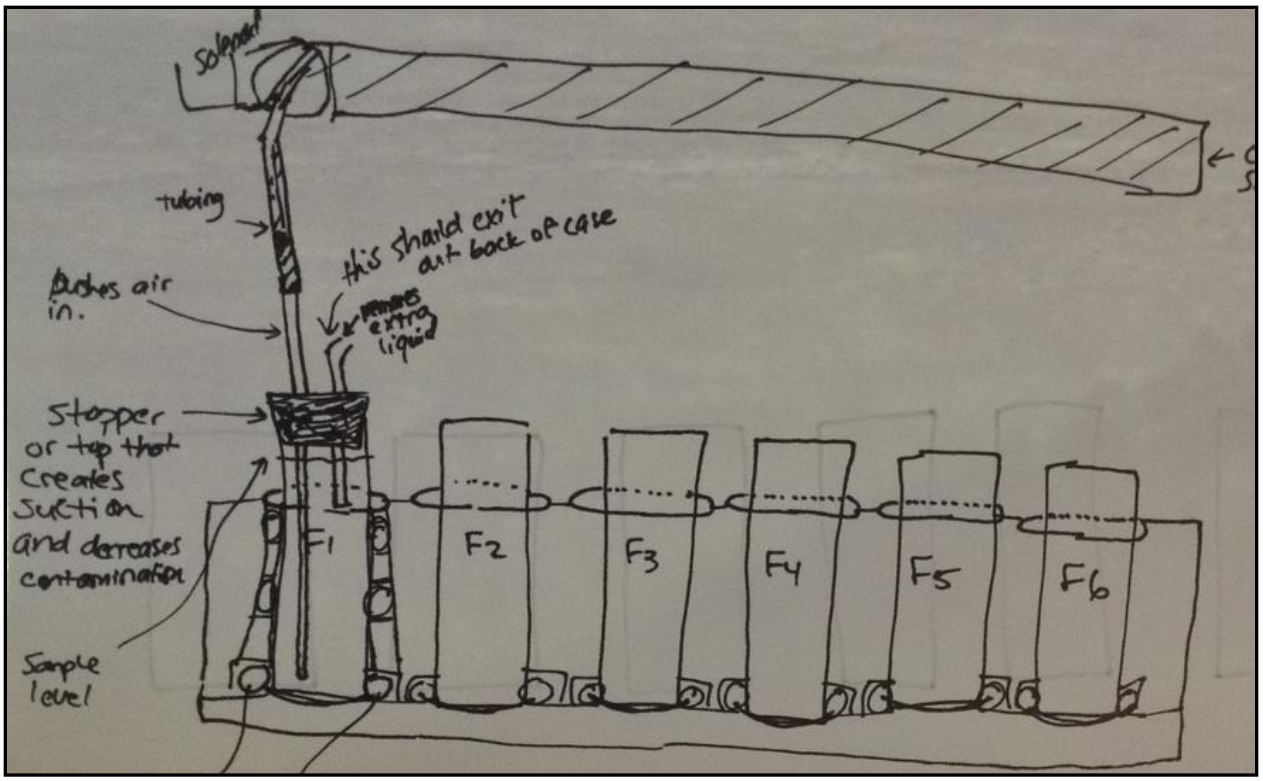
I have been frequenting the prototyping lab in Atkinson Hall since my entry into the class. This is because Altium is used there and one of my goals was to learn Altium. This has since lowered in priority because other tasks mentioned in the milestones above have become more important. One of the milestones was evaluating different microcontroller processors. In the past, I have only used Arduino. Renowned researcher Eric Lo suggested that I look into BeagleBone Black or Raspberry Pi because Arduino may not be the best microcontroller processor for this type of project. BeagleBone Black is not as big of a hassle as I had initially thought. I lucked out and managed to get one from Adafruit as soon as supply was available:

Since I requested cheap shipping, the BeagleBone Black arrived about a week ago. I have been doing tutorials to get an idea of how the BeagleBone Black differs from Arduino. Now that the change from Arduino to BeagleBone Black has been made the code needs to be changed too. Previously, the code on the Arduino was written in C. This code is currently being changed to Python. I chose Python because it can simplify many parts of the C code and thus make it easier to read. For example, this blurb of code is for a single process (data transfer to the Google Doc):

```
if(client.connect(server, 80)) {
  Serial.println("connected");

  client.print("POST /spreadsheet/formResponse?formkey=");
  client.print(formKey);
  client.println("&ifq HTTP/1.1");
  client.println("Host: docs.google.com");
  client.println("Connection: close");
  client.print("Content-Length: ");
  client.println(dataString.length());
  client.println("Content-Type: application/x-www-form-urlencoded");
  client.println();
  client.println(dataString);

  Serial.print("POST /spreadsheet/formResponse?formkey=");
  Serial.print(formKey);
  Serial.println("&ifq HTTP/1.1");
  Serial.println("Host: docs.google.com");
  Serial.println("Connection: close");
  Serial.print("Content-Length: ");
  Serial.println(dataString.length());
  Serial.println("Content-Type: application/x-www-form-urlencoded");
  Serial.println();
  Serial.println(dataString);

  Serial.println("disconnecting");
  delay(1000);
  client.stop();
  client.flush();
}
else{
  Serial.println("failed to connect");
}
```

Python would shorten this to about ¼ its length.

Here is a classy drawing of how the test tube array is set up:



The BeagleBone Black handles six tubes for six conditions. F_1 is the full set-up. On the left side of this tube are three IR sensors placed at the bottom, midpoint, and top. These IR sensors are great because they subtract out background light that the photoresistors in version 1.0 would pick up. The photoresistor sensors are thus hard to calibrate because of this. They are not very reliable for this type of set-up but have worked fairly reasonable leading up to the change. On the right side of the tube are another three circles that represent LED lights. The California Center for Algae Biotechnology says that color of light is not an important factor. Therefore, I am choosing a normal light. The lights will remain on for the entire duration of a day cycle. Again, the user can choose whatever this will be. For now, a 12 hour day and 12 hour night cycle will be used for default testing.

The test tube at the moment has two tubes inside it. A rubber stopper creates suction and eliminates some contamination and allows for liquid to come out. The longer vertical tube is hooked up to an air pump that pushes air in the algae culture – this creates bubbling. Algae need agitation to keep it from aggregating around the sides or bottom of the test tube. The agitation is gentle enough not to shear the algae cells. This would result in the culture dying. A solenoid opens and closes a tube that leads to a container with nutrients and water (i.e. a stock solution). The user can indicate how long (in seconds) they want nutrients to pump in. This will cause an influx of liquid that could potentially be bad if a portion of the culture is not removed. To stop the test tube from breaking or overflowing, another tube takes advantage of the suction of rubber stopper has create and funnels out extra liquid into another container. Since algae regenerates at a fast pace, this outlet serves to take out the algae that are ready for research or production uses. Like the algae, the system is sustainable too.

I will be using the prototyping lab to have a case/stand made. Plexiglass is currently the favorite material at the moment. The solenoid will stay in the design because it is very useful in what it does.

New Milestones

- Python code completion
- BeagleBone Black protoboard soldered and finished. The Arduino PCB has been soldered but I think the layout of how it was soldered can be made better.
- Purchase glassware and other related parts from the stockroom in Urey Hall.
- Completion of the casing/stand that will hold the system.
- Testing of the IR sensors with the IR lights.