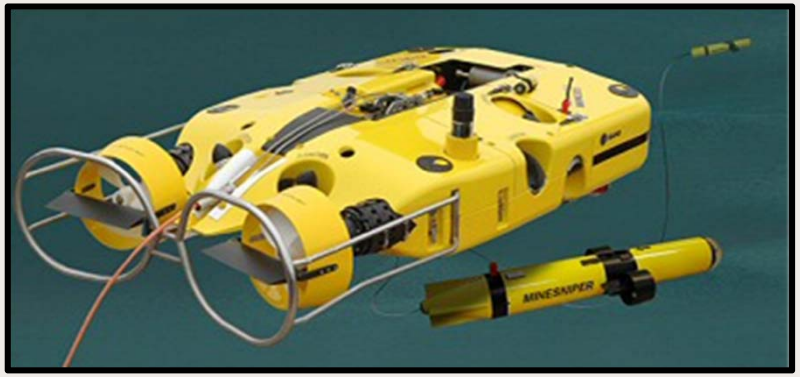
Senior Design
Electrical and Computer Engineering
Howard University
Instructor: Dr. Charles Kim
Website: www.mwftr.com/SD1415.html

SENIOR DESIGN PROJECT



UNDERWATER CURRENT CONNECTOR

Team Members:

Crepin Mahop (Senior EE)

De'Shawnn L. Woods II (Senior EE)

Kerri Chambers (Senior EE)

Joshua Ajayi (Senior CE)

Team Support:

Trey Morris (Graduate EE Student)

Akim Mahadiow (Sophomore CE)

David Nesbeth (Sophomore CE)

Sidney Hall (Sophomore EE)

Industry Advisors: Gregory West and Jim Windgarssen

Faculty Advisor: Dr. Charles Kim

Background

- **Company/Sponsor**:

  Northrop Grumman

- **Customers/Clients**
  - *Navy*
  - *Air Force*
  - *Satellite Company*
  - *Department of Defense*

- **Technology/ Application System**:
  - *Automated Vehicles (Surface & Undersea)*
  - *System Integration*
  - *Advanced Sensors & Sensor Processing*

Background Continued

- ***NOAA (National Oceanic and Atmospheric Administration)*** is a federal agency that often uses autonomous underwater vehicles (AUV), also known as unmanned underwater vehicles (UUV).

- Used for deteching and mapping wrecks, rocks and obstructions that pose a hazard.

- It conducts a survey mission without operator intervention and once completed returns to a pre-programmed location where data collected can be downloaded.

Problem?

Current Unmanned Underwater Vehicles (UUV):

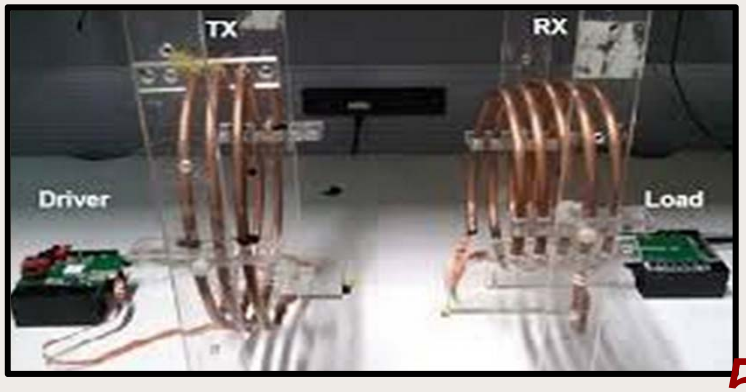
- UUV powered by onboard batteries
- UUV survive underwater for a certain amount of time due to battery life
- No way to keep onboard batteries charged while underwater
- Length of UUV mission lives dependent upon the capacity of the onboard batteries

Is there a way to solve this? Can we create a mechanism to lengthen battery life? Can we create something innovative?

Current State of Art / Technology

Wet Mate Connector & Underwater Power Circulation

- Current wet mate connectors rely on complex sealing and wiping mechanisms (proven unreliable).
- Current Complex Inductive Coupling technology for power circulation has significant loss, large in size and weight (a hassle).



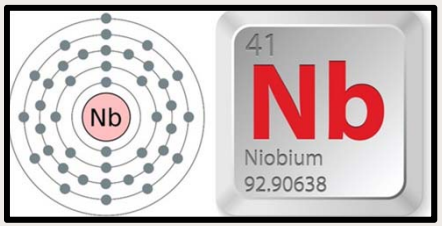
Problem Formulation

Objective

- Develop a two contact wet mate electrical connector
- Utilizing Niobium (or Tantalum) metal as primary contacts between the two platforms.

Benefits of Niobium Metal

- Niobium Self-Insulating Property (no need for seals)
- Pin contacts exposed to water without any potential detriments.



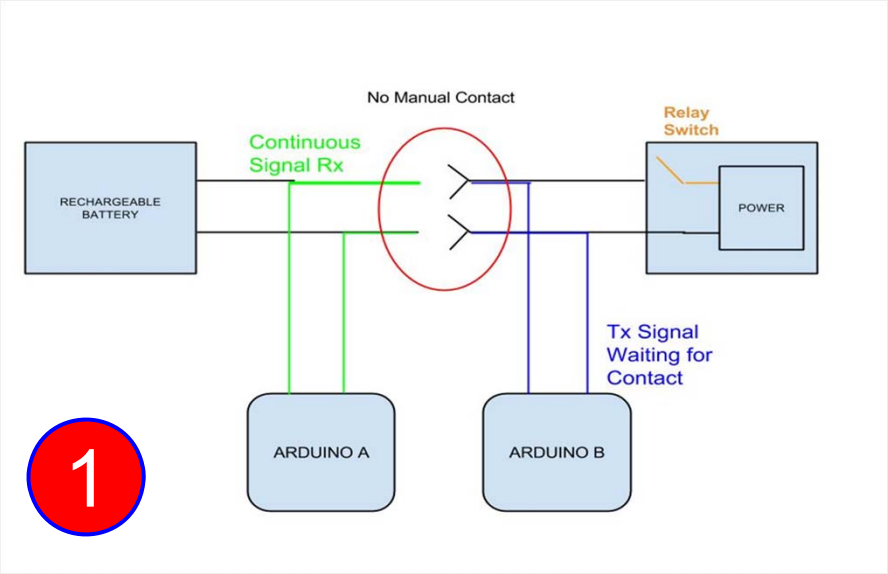
Design Requirements

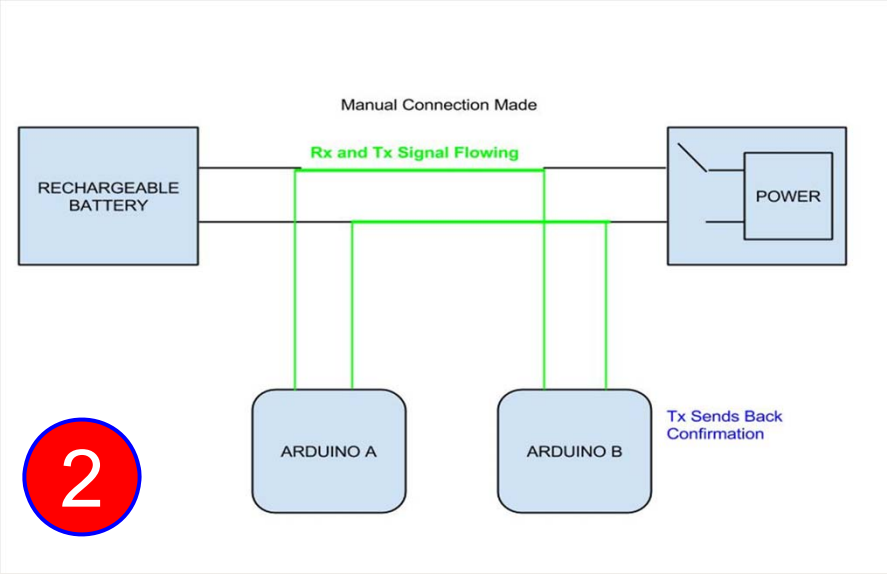
- Input Power: 48 V DC, 25 A
- Capable of functioning in seawater as well as fresh water (>= 100 meters deep)
- Capable of functioning in temperatures between -2℃ and 50℃
- Surviving in temperatures between -40℃ and 70℃
- Capable of spending 25 years submerged in seawater
- Capable of carrying a 2.4 or 5GHz 802.11 signal across the connector

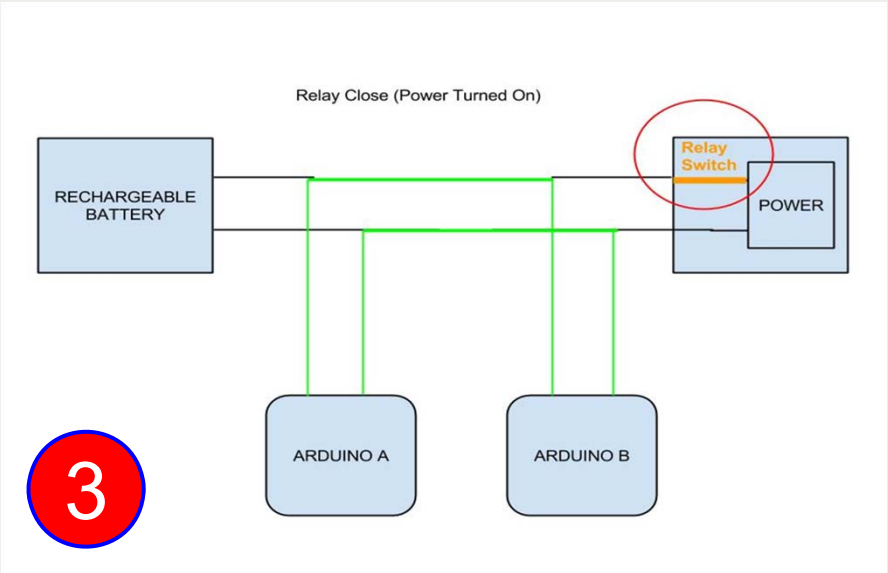
Sending RF Signal Over Niobium Connectors

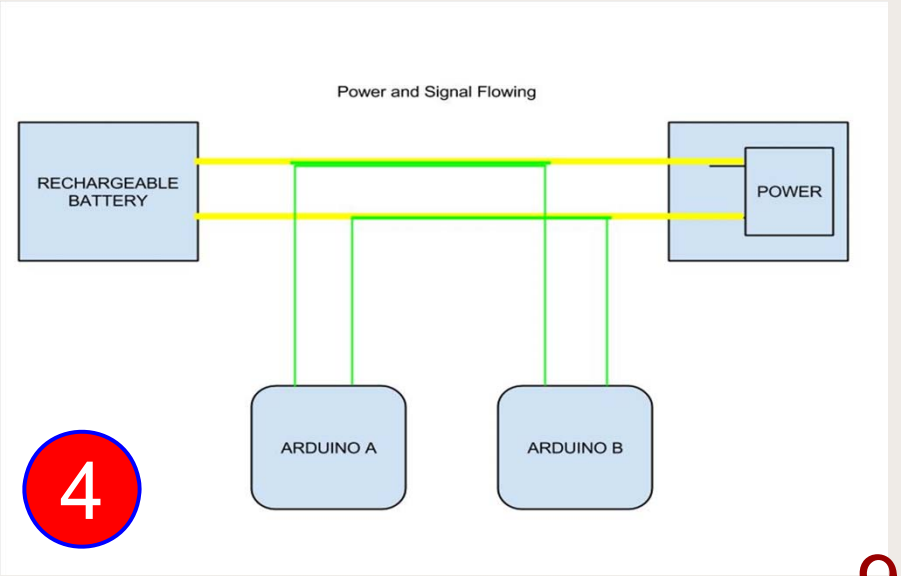
- Sending the RF signal over the connectors allows for less components needed on the design.
- Signal from UUV (Unmanned Underwater Vehicle) will be sent to the charging station, once both Niobium connectors on the UUV are plugged into to the charging station sockets.
- Power will be transmitted from the Charging Station when the signal from the UUV is transmitted.
- With the signal being passed by the connectors data will be streamed seamlessly and efficiently

Conceptual Design

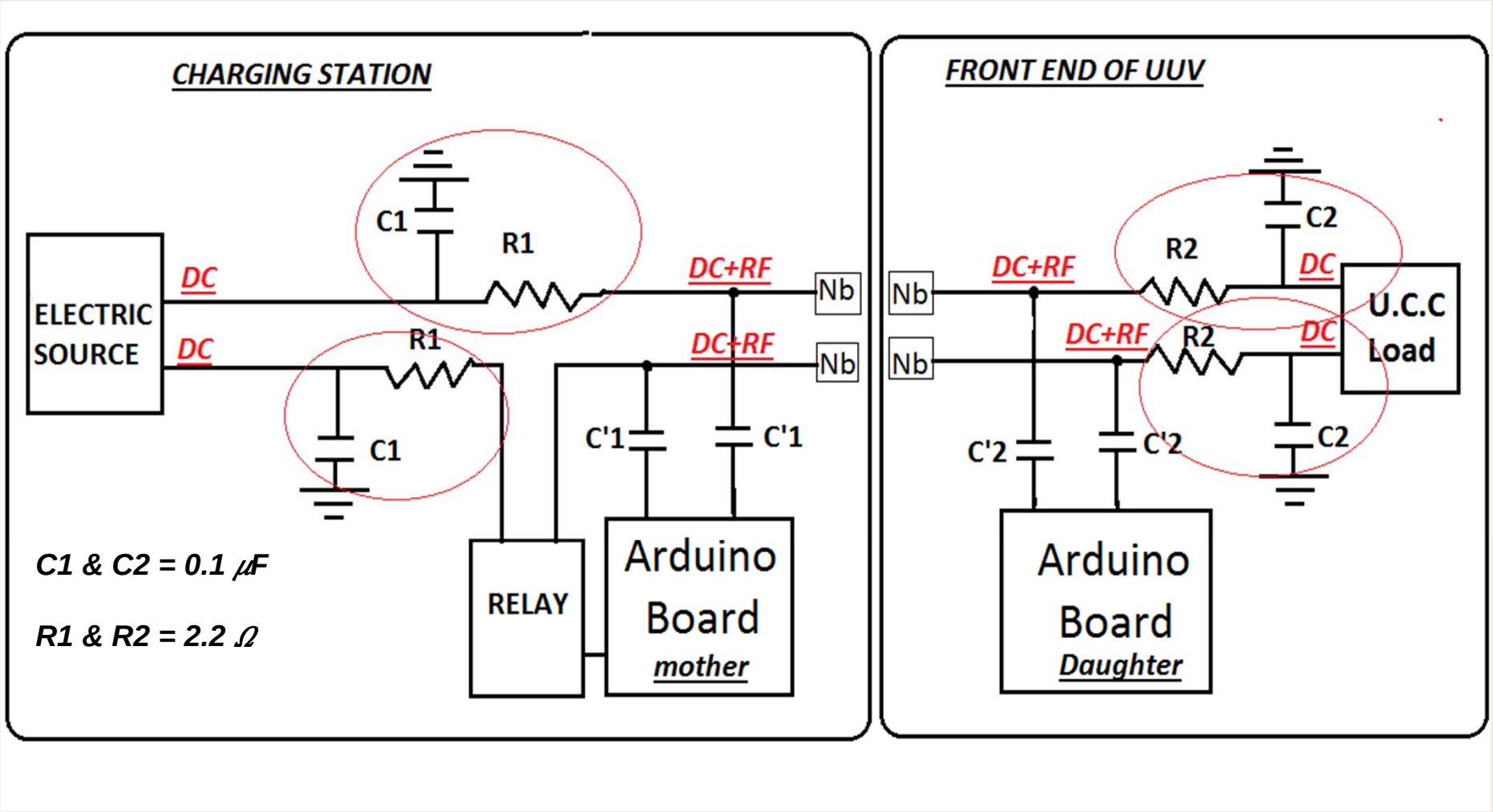




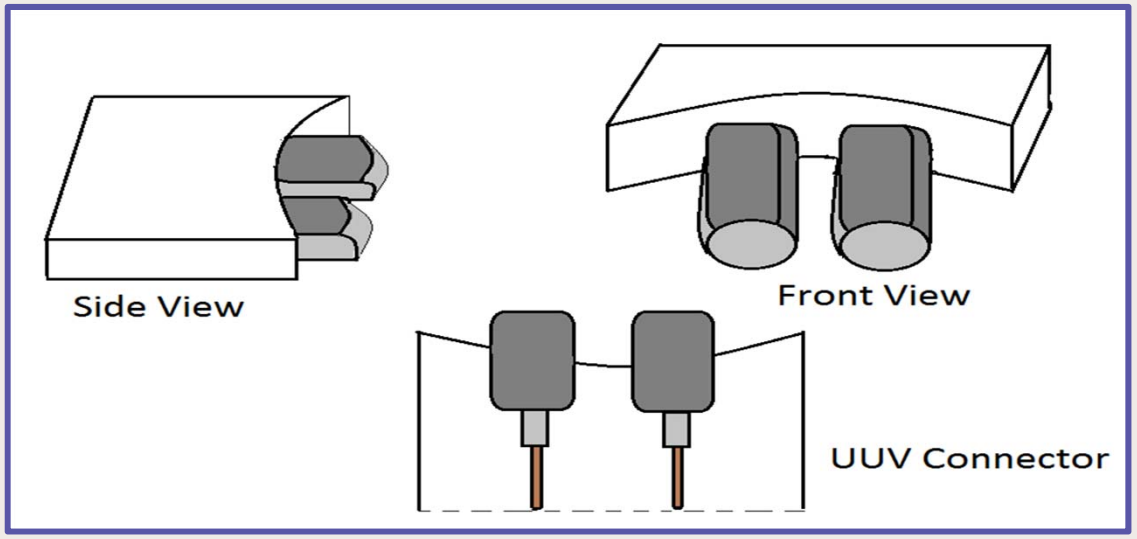


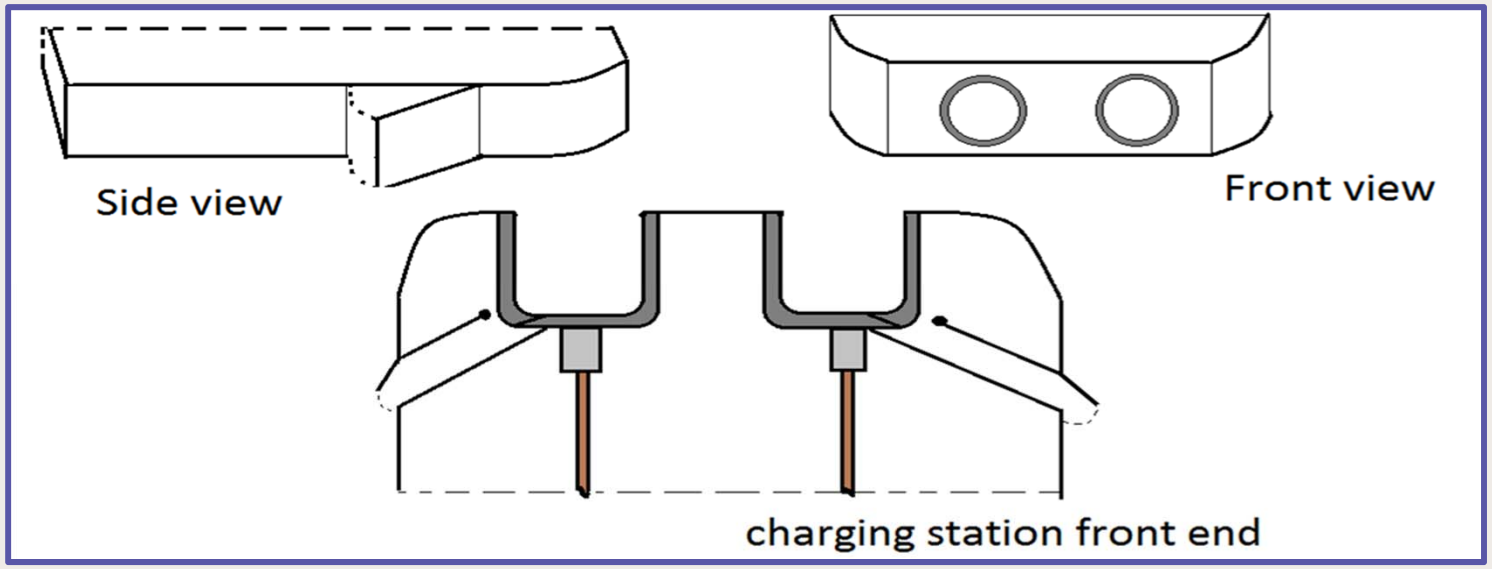


Circuit Schematic For Connection

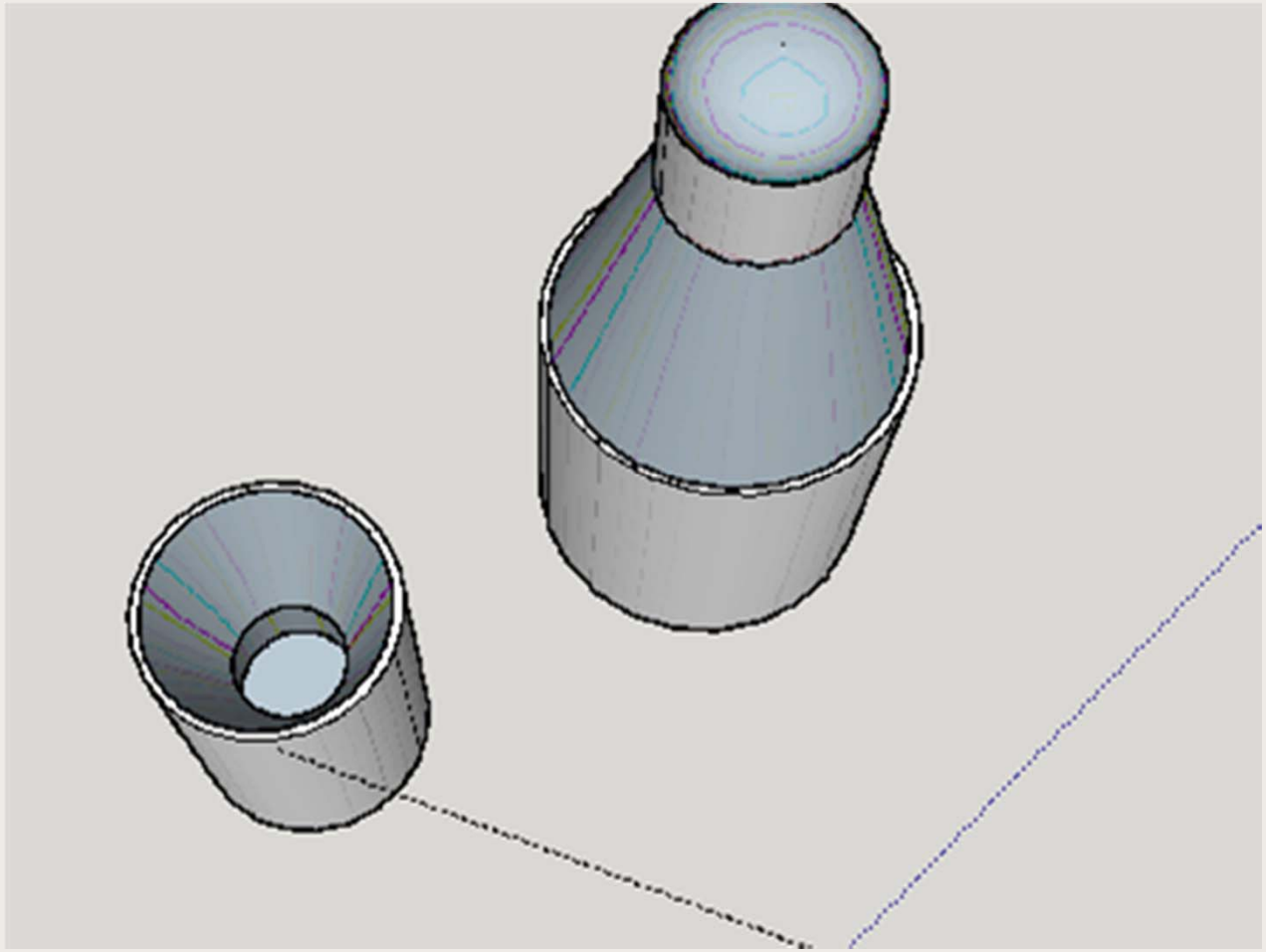


Schematic Diagram

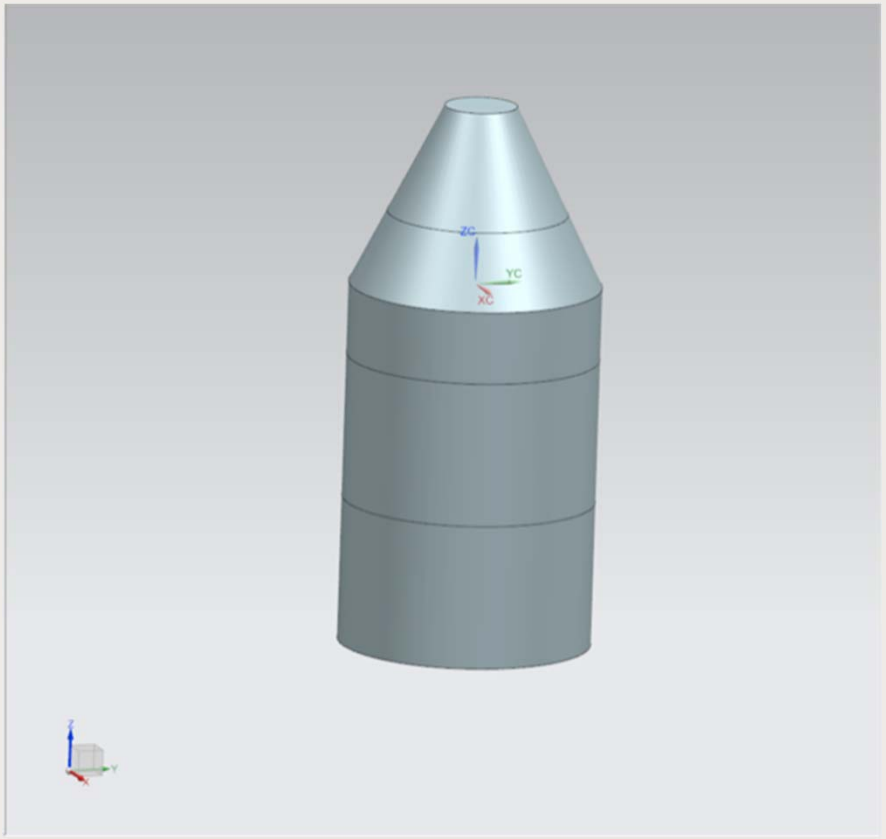




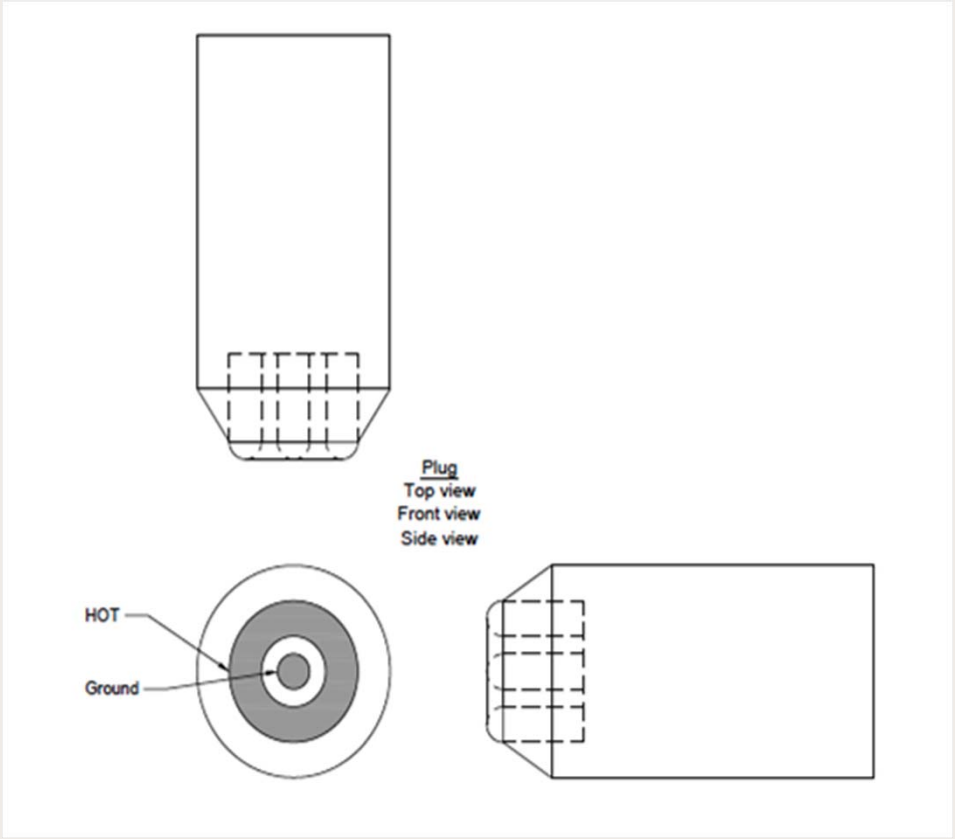
Intial 3D Render for UUV Plug



Final 3D Render for UUV Plug

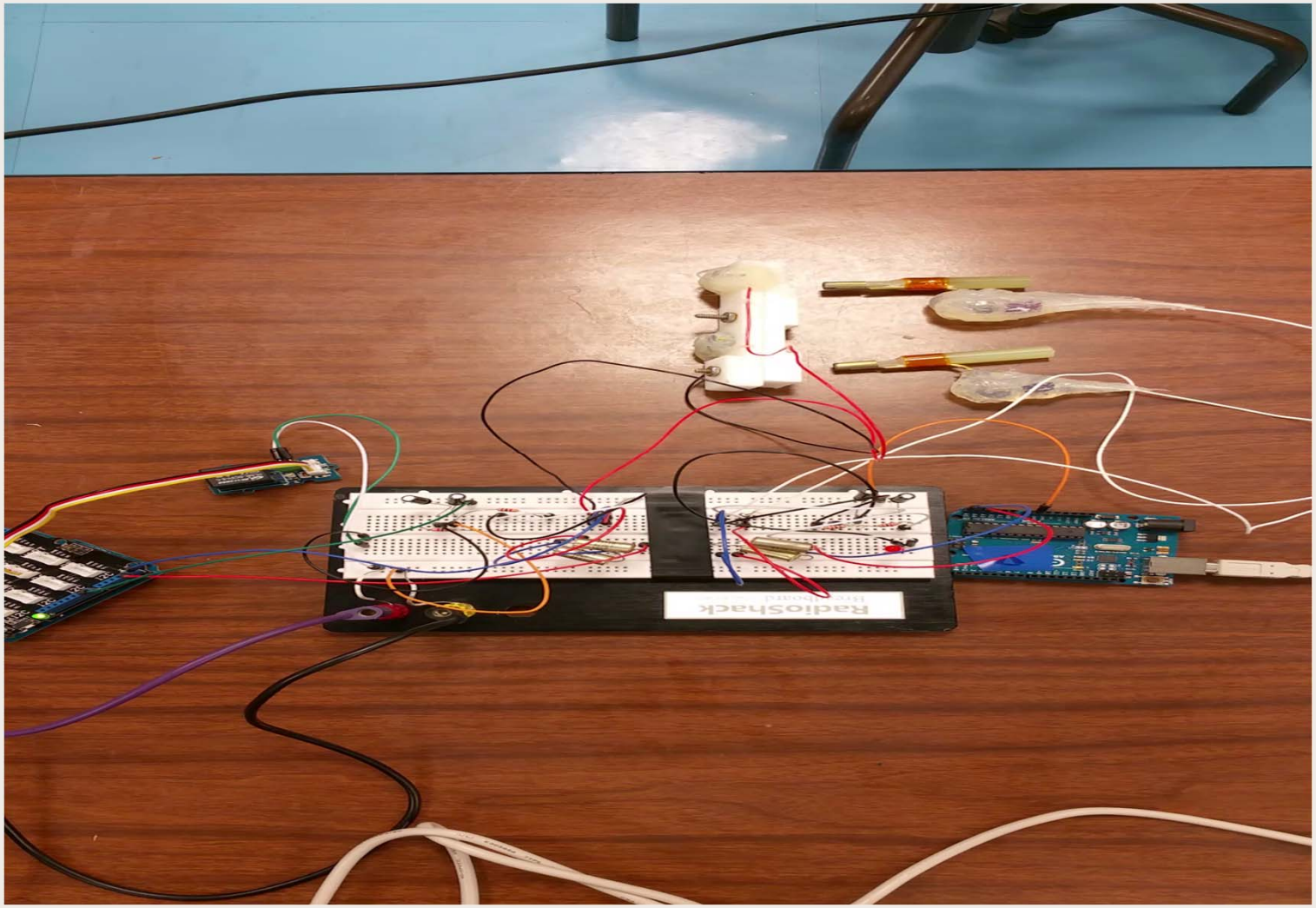


3D Model Render

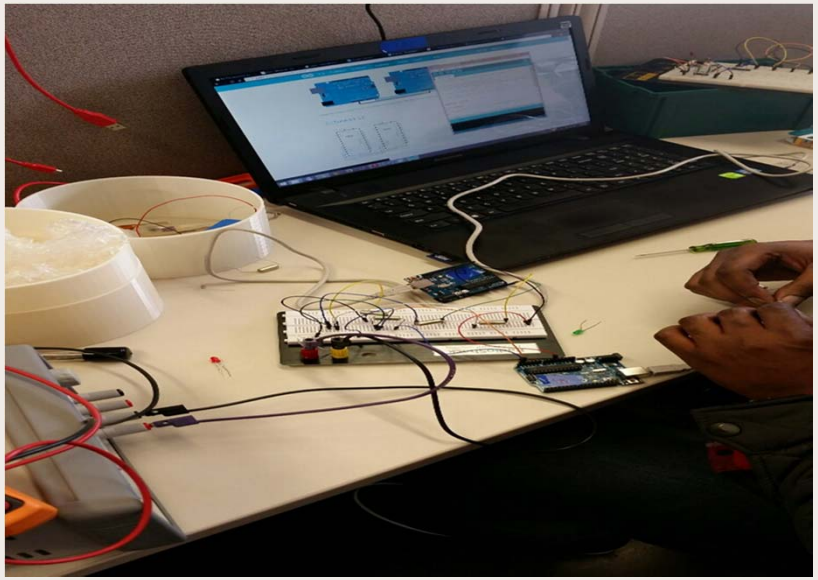


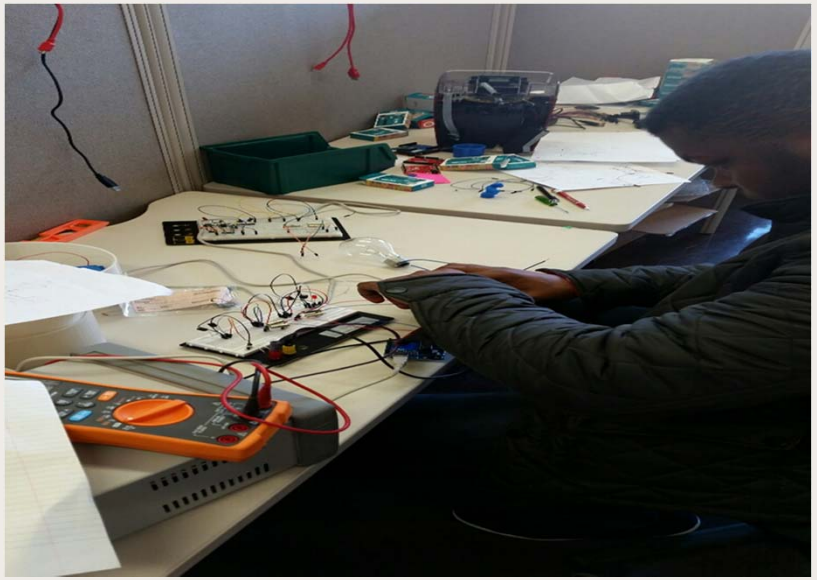
Plug Schematic

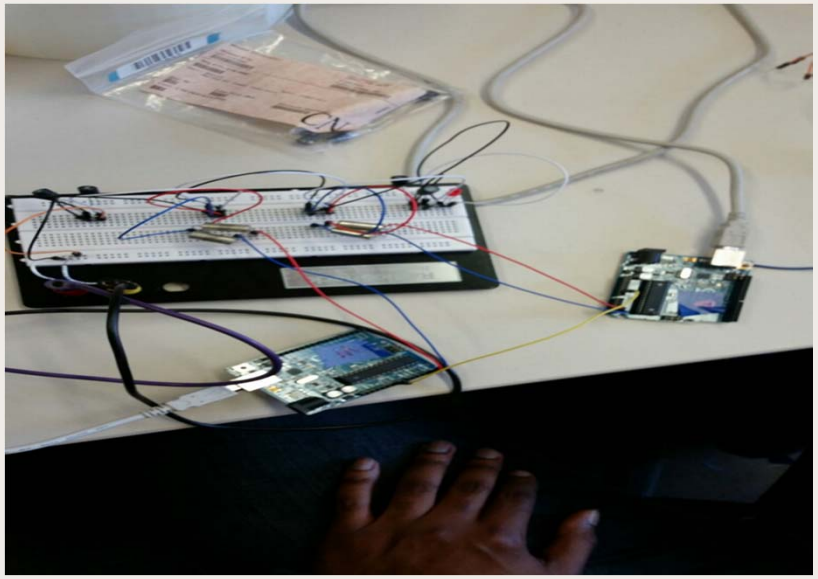
Visual Test Run

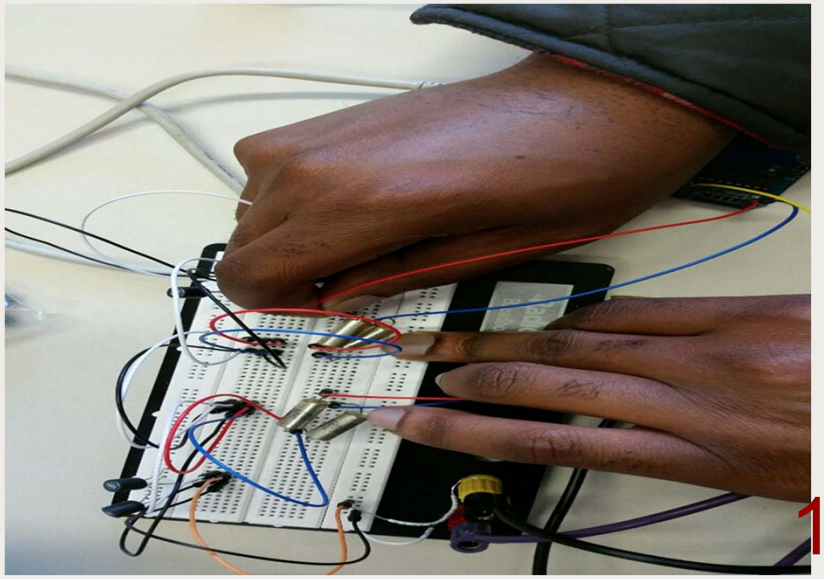


Implementation & Evaluation









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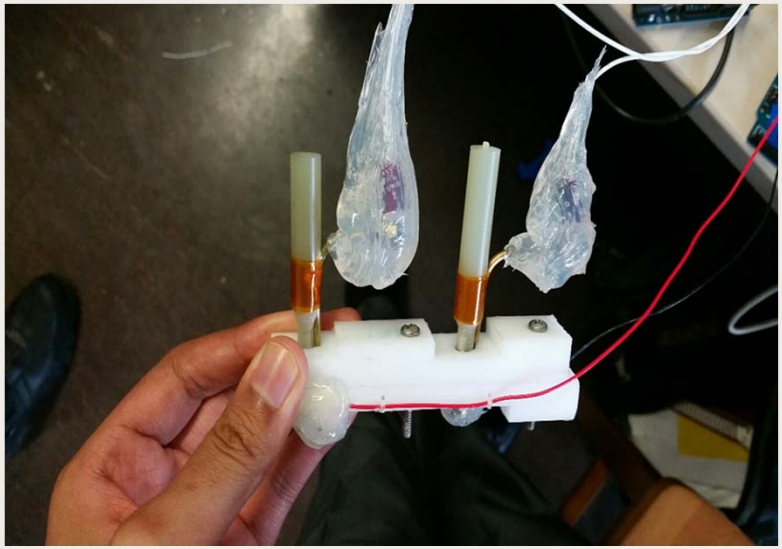

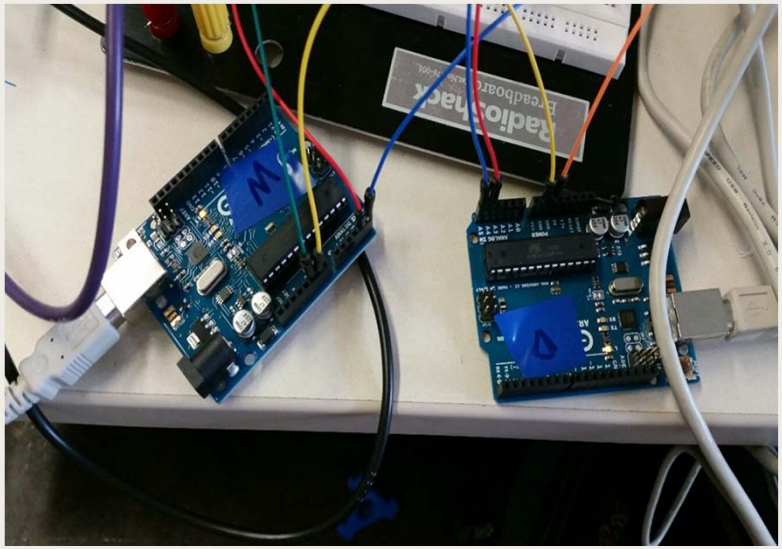

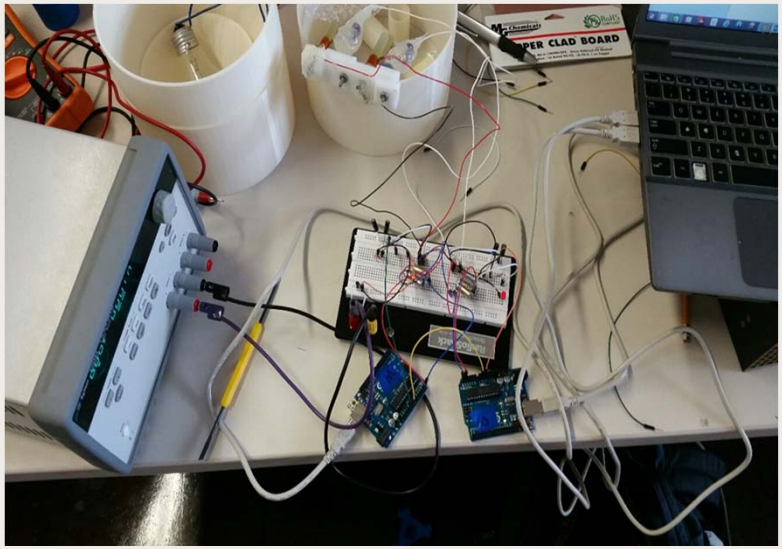

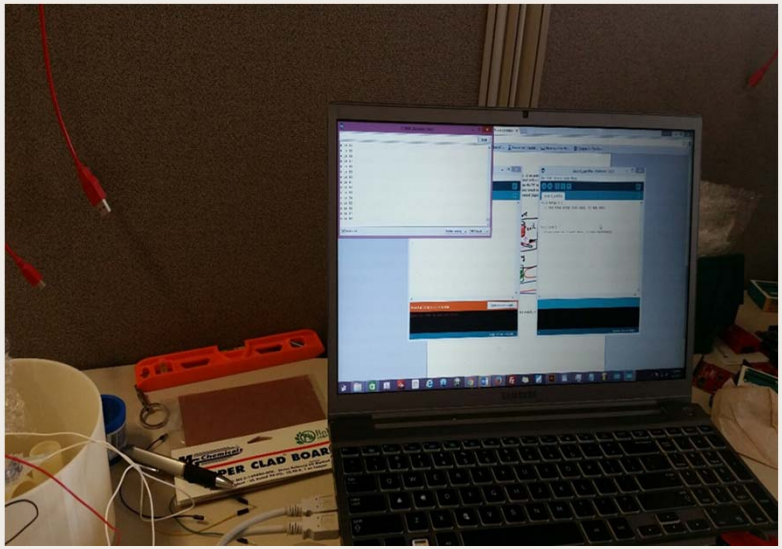

Utility & Resources

Project Utilities:

- *Niobium Bars*
- *LEDs*
- *Circuit Breadboards*
- *Microprocessor*
- *Relay*
- *Ardunio Boards*

Resources:

- *Howard University laboratories & facilities*
- *Northrop Grumman laboratories & facilities*
- *Project Advisors: Dr Kim*
- *Company Sponsor Advisors: James Windgassen & Gregory West*

More Resources

- **<u>Howard University supplied:</u>**
  - *Arduino Boards*
  - *3D Printer*

- **<u>Northrop Grumman supplied</u>**:
  - *Niobium rods for the final implementation*
  - *$10,000 for project expenses*

- Research & testing from our team support: *Akim Mahadiow, David Nesbeth & Sidney Hall*

- Implementation & further knowledge assistance from EE Graduate student: *Trey Morris*

Conclusion

To achieve sucess, we as a team:

- Pulled from existing methods of underwater connection
- Conducted proper research and planning for the materials, tools, and techniques needed.
- Used our design requirements and final design to reach our end goal
- Implemented of the “Direct Connection UUV-to-Charging Station” conceptual design
- Maintained proper “Project Management”, completion of tasks, producing appropriate deliverables

Future Works/What Next?

- Having the wet mate connectors automatically connecting to each other without the use manual labor.
- Adding a process to properly filter out excess water with the help of pressure analyzers.
- Including sensors onto to each connector, to properly align the connectors for mission based purposes.

END...

QUESTIONS???

Please visit our Website: ucchu2015.wix.com/project