Building An Inexpensive Open CDT

Scott Keeney[1], Uriah Nobel[2]and Quinn Severs[2],
Acknowledgements Russell Clark[2] and Adam Soule[2] , Dr. Diane Foster[3]
1 RETE Program, University of New Hampshire. 2 Sanford High School, Sanford, Me
3 Ocean Engineering, University of New Hampshire, Durham, NH

Abstract: The goal of this project is to build a less expensive instrument to measure marine parameters, that is affordable and accurate for use in high school studies. The chosen device will measure the local conductivity, temperature, and water depth.

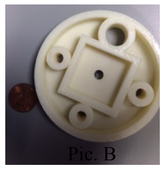
Project Goals:

- The idea behind building the CTD was to bring a instrument back to the classroom that would allow students to do research, including gathering data and interpreting this oceanographic information.
- This information will be incorporated into the lecture on buoyancy, density, waves, and pressure.

The Instrument: A conductivity, temperature, and depth sensor (CTD) is used for quantifying the salinity in a body of water. The selected CTD was also an assemble yourself, open CTD.

- To give an overview of the instrument, it is a 3 inch diameter piece of PVC pipe 15 " in length capped at one end and left open at the other. (pic.A).

Pic. A



Pic. B

- The whole device is submerged with the open end down.
- Halfway in the inside of the pipe is the piece that was 3-D printed, basically a disk with holes in it where the probes extend through. (pic. B)

Instrument Components:

The Open CTD contains several components including a controller, sensors, and data acquisition.

- The Arduino

•Arduino refers to an open-source electronics platform or board and the software used to program it. It is used for controlling the sensors and the data collection system.

Pic. C

- There is a probe for determining conductivity which is related to salinity. (Pic. D)
- The greater the conductivity, the greater the salinity.

Pic. D

- There are 3 probes collecting temperature data. (Pic. E) (Celsius)
- The pressure sensor is used to determine the depth of the water. (Pic. F)
- To calculate the depth of the water, given the pressure, the following equation is used.

$$D = (P(depth) - P(surface) * 100) / (g * 1000)$$

where D is depth in meters

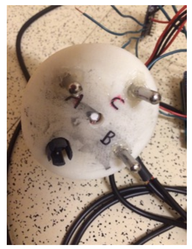
P(depth) is the pressure (in millibars) at depth)

P(surface) is the pressure at the surface in millibars

•g is acceleration due to gravity (9.81 m/s^2)

Pic. E

Pic. F



Pic. G
All probes
in place.

Instrument Assembly:

- When the probes are all in place the disk with the probes protruding will be epoxied, separating the sampling probes that are water bound, from the "dry" area where the electronics reside.
- If the CTD gets into "deep" water mineral oil would be added to the dry area to equalize pressure between water outside and dry area.
- Mineral oil is used because it is not a conductor.

Power Management and Data Acquisition:

- The Qduino mini, is a tiny, Arduino-compatible board with a battery connector and charger as well as a gauge for determining battery life.
- The sensors and controllers are powered by a 3.7 volt lithium ion battery
- An SD card reader (4 MB) is used for storing the data. When the Open CTD is retrieved from the field, data is downloaded with an available card reader. The data format is ascii table.
- An Arduino Shield, which is a device that plugs into the top of an Arduino; giving it more capabilities.

Conclusion:

Even though this device has yet to meet the water, the steps taken so far to make this happen have been numerous.

Much information was learned by the author about these relatively new devices which may become the dominant forces in the computational community.

Even though Open CTD has not been in the water, the sensors for temperature and pressure seem to make sense as to the readings they are producing in the ambient air.

The author and other interested friends plan on finishing the final connections and launching our SQUARE Open CTD. The acronym comes from the first letter of the first name of the people that were involved.

The CTD that was made shall be a new and useful part of the physics curriculum at the author's school.

In perspective, the six weeks spent on this project has been a valuable experience even though at times it was frustrating.

Literature Cited:Andrew Thaler, Kersey Sturdivant, and Russell Niches. Oceanography for Everyone: "Open CTD Introduction and Build Guide".

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