

Team S.S. Minnow

A SeaPerch Becomes Autonomous

Daytona Beach Homeschoolers

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Figure 1 Our Sub 2014

Abstract

This is our second year entering into the Robosub competition. Last year we were the first middle schoolers to enter the competition and finished in 11th place and won a \$500 check. Although this was a great success, we had many technical problems such as issues with our vision

system, compass errors, floatation failures, and fires during testing. This year we are coming back to the competition with many lessons learned and an improved sub that addresses the issues of last year.

Our Old Sub

Last year we developed a submarine based on our previous entry in the SeaPerch competition. At the competition we did much better than we thought we would. We qualified for the semi-finals and finished in 11th place out of all the teams there.

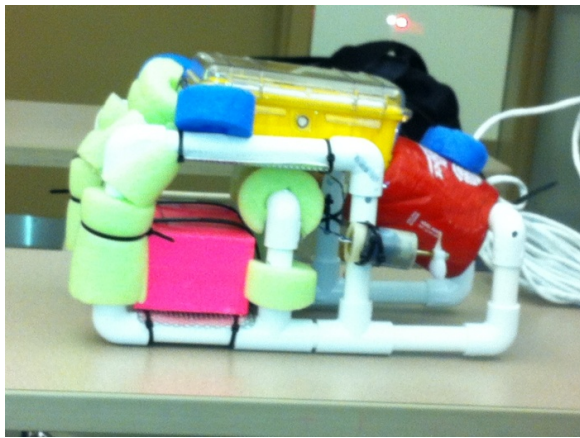


Figure 2 Last Year's Sub

Vision Problems

Our sub's vision stopped working partway through the competition. This unfortunately forced us to rely on our heading hold and compass. We believe we figured out one of the problems we had during the competition last year. Every so often our vision processing board, the BeagleBone Black Board (BBB) would lock up. At the time we thought it was just slow, but during a different project we found it was the USB hub that was slow.



Figure 3 Beaglebone Black Board and Logitech C920 Camera

Compass Problems

The problem with losing our vision during the competition was that we had to rely more on just hoping our compass would work. One problem was that it took a while for the compass to load in a new heading when it started up. Another was the external electrical fields in the pool messed up our readings. During testing at home we found that our sub would occasionally get caught in a spiral. This happened because our compass was affected by tilt

Tilt Problems

When our sub started to turn, it would tilt. As we learned from the SeaPerch competition this year, the thrusters were not correctly located on our vehicle. When the compass indicated a turn was needed, our sub would turn and tilt. This tilt confused the compass and made us turn more, which tilted us more and caused the vehicle to lose heading lock.

No Tethering Capabilities

Having no tether on our sub meant that when our sub needed to be reprogrammed we had to take it out of the water. We also couldn't log our data onto our computers or run our sub through a computer.

No Downward Camera

This meant we didn't get points for following the orange strip at the bottom of the pool even though we could see it.

Fires

We managed to have plenty of fires during our testing hours. Most of these fires were caused by the motor controllers. The good news was that the Beaglebone Black Boards usually survived the fire.

Floatation

Last year we used pool noodles for floatation. These would compress after our sub went down too far in the pool. This caused our sub to go down to the bottom of the competition pool. The good news was that everything still worked and nothing leaked.

The New Sub

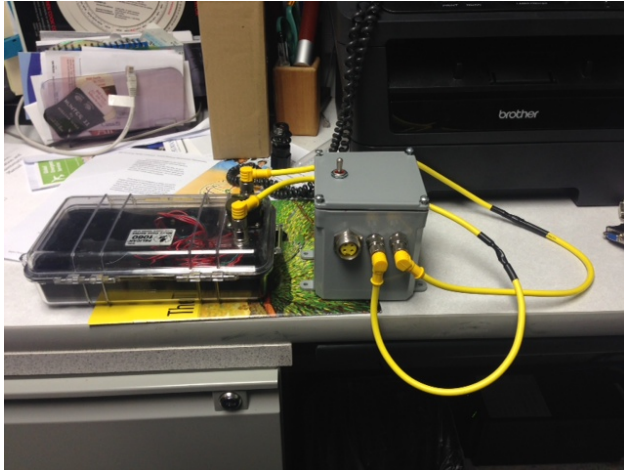


Figure 4 The New Sub Without the Body. Here are the Sub's

Main Box and Battery Supply

SeaPerch

We spent some time at the SeaPerch competition learning about buoyancy, balance, drag, and hydrostatics. Along with learning about those concepts, we won 1st place middle school at our regional competition and 3rd place overall for middle school at the national competition. We will use the knowledge we gained from this competition to build a better balanced and more stable sub.

UDOO Board

We decided to upgrade the processing power. We changed to an UDOO board which is an Arduino and Linux computer all in one. It is faster than our other board we used, the Beagle Bone Black Board. This computer has a faster quad-core processor. The UDOO also comes with a camera you can buy which we are using as our downward facing camera.



Figure 5 UDOO Board and Downward Camera.

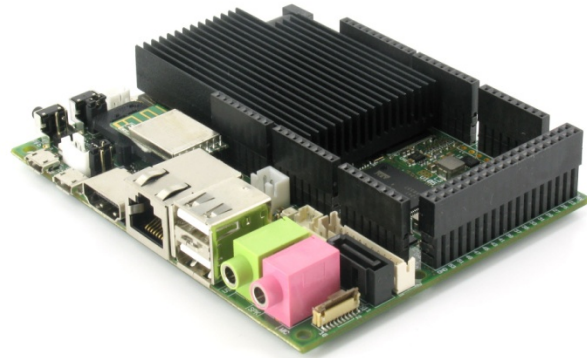


Figure 6 UDOO board

Compass

This year's compass is a YEI (IMU). Hopefully this compass will reduce the electrical field interference we had last year. The tilt problem will also hopefully be gone.

Larger Pelican Case

The UDOO is much bigger than the Beagle Bone Black board, so we bought the largest clear pelican case we could find to hold this processor. We bought motor controllers and moved them to a different box to reduce the amount of interference with the compass.

Waterproof Ethernet Plugs

We fixed the problem of having to take the sub out of the water to reprogram or take pictures off the beagle bone black board. We added a waterproof Ethernet plug to the top of our main box which will connect to the UDOO board. This will allow us to control the sub while it is in the water and reprogram in the water. Because we don't need to open the box to reprogram we won't have as much of a chance to flood the box with water.

Vision

Our sub's vision has improved and we can now see the buoys better than last year. We also don't have the problem where the vision processing stops working for a few seconds and then starts again.

Added Downward Camera

The UDOO camera is going to be our downward facing camera on the sub this year. We added a downward facing camera so we can see the orange strips on the bottom of the pool and follow them to our next task.

Floatation

This year we are using purple foam instead of pool noodles. The purple foam doesn't compress as easily as the pool noodles, and also doesn't hold water inside of itself.

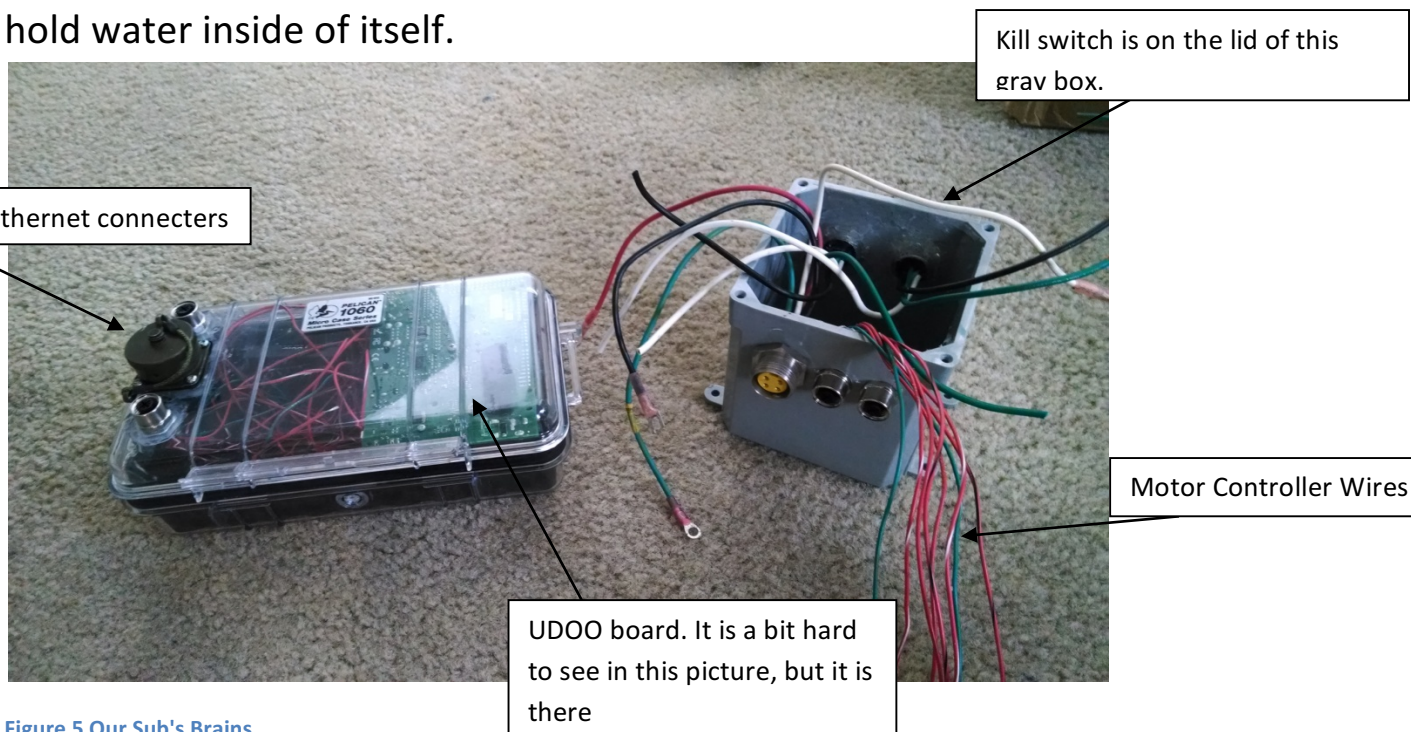


Figure 5 Our Sub's Brains

This Year's New Tasks

This year the maneuvering task is different. There are two ways to complete this task you must either pass over the horizontal section, to the left or right of the center Red riser and inside the outer Green risers, or go around the center Red riser 360 360°

What Tasks We Will Attempt

We are going to go through the qualification gate and then do the control panel. After that we will attempt the maneuvering task.



Figure 6 Our Sub With the PVC Frame Holding the Brains