Axios Electronics Projects

Axios is a unique project in many respects, presenting unique challenges and conditions for the electronics to perform in. Reliability and safety are of the utmost importance, and that there is always a ‘fail-safe’ state. **All projects are critical unless otherwise noted. All systems need to be splash resistant to a minimum as well.**

As with Titan (and probably most of our project going forward,) this system will be powered off several LiFePO4 batteries given their proven stability and safety even when failing.

# Control System

There 3 fins positioned around midway on the sub, spaced 120 degrees apart (front view of the sub to the right). These are positioned using linkages to servos. We need to control these servos based on input from the rider, ideally, they use a single joystick to control pitch, roll, and yaw. This system should be isolated from any other system (excluding navigation).

Tasks for this are:

* Writing code for determining fin angles based on a desired rotation rate
* Getting or making a 3-axis flight stick
  + Must be compact enough to fit in the sub
* Writing code to translate the desired fin angles to servo angles

Skills needed/learned:

* C++ coding
* Basic circuitry
* Potential for circuit board design

# Navigation system

To assist the rider in navigation especially in this unconventional configuration let alone environment, there is a need for navigational sensors. These need to display their data in an easy to read and see location, likely using 7-segment displays for numeric values. This is to me developed alongside the control system and likely share hardware if possible. The data required for the rider are:

* Compass heading, using compass sensor – probably as part of a 9DoF module
* Pitch, using an accelerometer – probably as part of a 9DoF module
* Depth, determined using a special depth sensor

Tasks for this are:

* Writing code for collecting this data
* Writing code for / designing the display circuits

Skills needed/learned:

* C++ coding
* Basic circuitry
* Potential for circuit board design

# Oxygen Sensor System

Absolutely critical! This must be an entirely isolated system of its own. Using three oxygen sensors around the hull, it will display the partial pressure of oxygen in the submarine at each point using 7-segment displays. The values will be to three significant figures between 0 and 1, e.g. 0.201 but it will just display ‘201’.

These sensors output analog signals that will require amplification to be processed by our microcontroller which will require the use of operation amplifiers. The 7-segment display also needs to be prepared but will likely be okay if it is a copy of the ones used for the navigational system.

Skills needed/learned:

* Advanced circuit design
* Micro controller (C/C++) implementation and coding
* Breadboard prototyping
* Circuit board design

# Circuit board design

Pretty self explanatory, design the circuits to connect all the hardware in the sub. Note, there will likely be several different boards present in the sub:

* Control
* Oxygen Sensor
* 7-segment display arrays

Skills needed/learned:

* Circuit design
* Using PCB design software
* Circuit assembly
* Circuit debugging

# Pump System

We need a pump to remove water from our leaks during a ride. This will be a basic system that should only consist of a battery, switch, and pump. All connections should be adequately protected from water.

Pump (has to be high pressure to eject water from the submarine): <https://www.banggood.com/FL-3308-130PSI-6LMin-Water-High-Pressure-Diaphragm-Pump-Caravan-Boat-DC12V-p-1071746.html?rmmds=buy&ID=514178&cur_warehouse=USA>

Battery: <https://hobbyking.com/en_us/zippy-compact-4200mah-4s2p-30c-lifepo4-pack.html?___store=en_us>

Skills needed/learned:

* BASIC circuitry
* Basic circuit assembly

# Lights – Optional

In some instances, the sub may need to traverse though darker environments which may need some extra lighting. This is not in the near future however.

Skills needed/learned:

* Circuit design