CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

J0311

Project Title

A Working Submarine with Magnetic Coupling Propulsion System

Abstract

Objectives/Goals

Our goal was to build a working submarine out of materials that we could get easily and that could be built at home. It needed to be able to submerge and rise, propel forward, and take video. In order to accomplish this it required a ballast tank to float or sink the submarine, a propeller to move forward, and an underwater camera to take video.

Methods/Materials

Our final submarine design is approximately two feet long built inside a 5" diameter clear acrylic tube. The tube is sealed with sewer cleanouts that are attached with silicone sealer. The parts are attached to an 1/8" sheet of Plexiglas. A LEGO Mindstorms kit was used for the controller and the motors. The ballast tank is made from a 150ml syringe, which pulls in water to cause the submarine to sink. A Mindstorms motor operates the syringe through two threaded rods. The propeller is made from a computer fan blade. Another Mindstorms motor turns the propeller through a magnetic coupler. The Mindstorms controller is programmed to turn the motors when needed. Diving weights are attached to the outside of the submarine to make it heavy enough to sink when the ballast tank is full of water, but float when the ballast tank is empty. A Hero GoPro camera is attached to the front of the submarine to take video.

Results

There was a great deal of trial and error involved in trying to devise both the propulsion system, ballast tanks and control mechanisms. For propulsion, we went with a magnetic coupling system and if it didn't work, we were going to try a stuffing box design to keep water out of the propeller shaft, but eventually went with a magnetic coupling system. For the Ballast tanks we looked at using CO2 canisters, but a design proved inefficient. Instead we decided to use a syringe that could be operated using power from the Mindstorms kit. Controlling the submarine while underwater proved difficult as well. At first we were hoping to use bluetooth communication with the Mindstorms kit, but discovered that bluetooth does not work underwater. We ended up using a light sensor that could be activated using an underwater flashlight.

Conclusions/Discussion

During the project, we discovered that creating a water tight, self contained submarine is not an easy task. We were able to successfully get our submarine to submerge and rise, move forward and take video.

Summary Statement

Design and build a self contained submarine that can move forward, submerge and rise and can take underwater video.

Help Received

Mr. Labonville taught us how to use the tools needed and helped work through engineering issues that arose. Mrs. Inaba showed us how to use AutoCAD to draw the mechanisms.