WADARS

(wreck adaptable discovery and recovery system)

Team:

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Senior Marine Technical Engineer

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Marine Theorist and Media Manager

Mr. Pincy
Remote Operated Vehicle

Mentor:
Mr. Todd Curray

Abstract:

McKinleyville High School will be competing for the second year in a row in the MATE ROV competition in June. Our team consists of two members (Caleb Lesher and Will Benedict) whom have built and tested a small Remote Operated Vehicle (ROV). This ROV has been aptly named Mr. Pinchy due to "his" very maneuverable grabbing claw. This highly evolved trash picker-upper will be performing all of the necessary tasks for the competition. Built completely out of Ace Hardware friendly materials (excluding the camera) and model airplane parts, Mr. Pinchy is a low budget highly engineered ROV. Non-market parts fabricated by the WADARS team include prop extensions, handle, arm mounting plate, and prop guards. Altered Rule bilge pumps provide ample propulsion when combined with four pronged props.

Challenges:

Some of the challenges faced by the WADARS team include: waterproofing servos, finding a 4" plastic dome, achieving neutral buoyancy and balance, and faulty camera wiring.

-To water proof the servos all we had to do was to look up the idea on the web. Somebody had the brilliant idea to use O-RINGS… We tested this theory extensively and concluded that this would work for our purposes. Our servos can last over an hour's time submerged and functioning.

-Finding a 4" plastic dome was very difficult. We never actually found one either, we had to buy 5" domes and cut them down to fit our camera housing tube. This task of cutting was completely with an industrial grinder courtesy of McKinleyville High School's HROP building trades class.

-Finding the amount of weight needed to make our ROV neutrally buoyant was simply a matter of physics. With our 4" camera housing tube completely sealed, there was roughly 8-9 pounds of force making the submarine want to float. After the ROV was completed, it still did not sink, and weights had to be put inside the camera housing and would slide back and forth making our ROV go nose down or up and make the propulsion system function at a lesser level. Making skids out of small PVC piping did not give much weigh to the base of the ROV, but filling the PVC with metal fishing weights helped us reach the desired weight and helped to stabilize and balance the ROV in the water. Once this was completed, the motors were they only aspect moving the ROV in the water.

-Less than a month before the competition we had a catastrophic camera wiring dilemma. The plug and RCA wires used to transmit the video from the ROV to the surface had become separated. A trip to the hardware store got us a new RCA chord and all was supposed to be well. Testing the chord with our camera proved that there was a problem; we had no picture on the monitor. After extensive testing we concluded that the wires were reverse of what they should be as they entered the plug. A moment of horror came over us as we thought that we had shorted out our camera. Fixing the old RCA chord in a makeshift way we found that the camera was not gone. Big relief. We sutured the RCA wires directly to the camera board to make sure we knew how the wires lined up. This worked but brought about the chance of future problems that would take time to fix (re-suturing takes time). At the time this was written we are contemplating buying a new camera or doing higher quality custom wiring. This is the last part of the Sub to be completed.

Skills Learned:

-Suturing and Wire Organization:

The pervious year's team was quite interesting. When wiring their control box they used all the same gauge and color wires. (Not very good when needing to trouble shoot.) We re-wired this control box and added a 25 amp fuse to it as well. The control box was the primary place where being able to suture came in handy. We also sutured some of the wires in our umbilical chord leading up to the surface.

-Metal Lath:

We needed to find a way to attach our props to the axle of our altered Rule bilge pumps as well as extent the axle so that we get less interference in water flow. We designed an extension that used a setscrew to hold it to the axle. With the help of our friend in metal shop we used a metal lath and fabricated our prop extensions. We had to tap the extension so that it could attach to the propeller.

General Communication with Community:

We presented Mr. Pinchy three times to the public. The first time was at the Humboldt State University Education Summit. Here we presented to the local board of education, teachers, and college students. The second time Mr. Pinchy made an appearance at the EAST Conference in Sacramento. Here we had him on display to a large number of students and the general public. Both of these times Mr. Pinchy was simply on display and we answered questions and discussed how he functioned. The third presentation we gave was at Eureka High's EAST gathering. Here we gave a presentation and answered questions, Mr. Pinchy even made it into the local paper. Eureka High was kind enough as to let us use their pool and we gave a demonstration to our fellow EAST students. Giving these presentations and traveling has shown us another side to the world we live in and we have seen how much interest there is in Mr. Pinchy where ever we go.

Design Rationale:

Mr. Pinchy was designed to fit the following:

- -$100 limit on materials
- -Competition Rules
- -Mission Tasks
- -12 watts at 25 amps power limitation
- -Be better than the Sea Horse (last year's team)

Body: The frame of our ROV is build out of high grade aluminum angle iron, steel nuts and bolts, and an aluminum base plate fabricated by Caleb Lesher on a Computer Navigated Cutting (CNC) machine. These components are very durable and highly rust resistant. Everything is attached without the use of any adhesive so that replacement parts can be made quickly and easily. Once the camera housing is attached using hose clamps, we put on a handle fabricated out of aluminum for easy carrying.

Camera Housing: The cameral housing is a 4" black plastic tube. At one end is a modified-to-fit 5" diameter plastic dome. This dome is attached to the tubing using green marine grade two-part epoxy. The opposite end of the tube is sealed with a rubber end cap with a through bolt to allow wires to go through it. Inside the tube brackets are attached with epoxy and support the removable camera components (camera, servos, receiver, and battery). The camera has two servos for vertical and horizontal movement.

Grabbing Claw and Arm: The arm and grabber are composed of an altered trash picker-upper. A hole was drilled near the back (opposite end from the claw) for an axel to go through and enable vertical movement. Cutting the plastic arm and putting a vertical axel through a set of holes created a wrist joint.

Propulsion: four altered Rule bilge pumps propel Our ROV. The vertical movement is taken care of with two 360 GPH bilge pumps. We took off the suction tube and the small turbine to get a simple waterproof spinning axel. The horizontal movement and turning is done with two 500 GPH bilge pumps. The 500's are placed to the sides of the body on limbs to enable lots of leverage for turning. All of the bilge pumps have double pull double throw switches to enable clockwise and counter clockwise revolutions.

Umbilical Chord (tether): Mr. Pinchy's life line consists of CAT5E cable which sends down the radio frequencies on the antenna, aux, and the 12 volt power supply. To connect the umbilical chord to our ROV we used two water resistant boat trailer hitch connecters.

Propulsion Control Box: This is the little black box that all of the wires run through. The main power goes in through this and then out down the umbilical chord to Mr. Pinchy. There is a 25-amp fuse in this control box that will blow if we exceed our limits. Each horizontal bilge pump has its own switch to enable tank-like piloting. The vertical thrusters have one switch that can lock in place to enable turning while ascending or descending. This box also has the video output. The video signal comes up a CAT5E cable from our ROV and into the box, and then goes out to the monitor.

Servo Control Box: Being a not so amateur model airplane pilot, Caleb happened to have a beautiful programmable radio controller. All the servos on our ROV run to a receiver in the camera housing. From there an antenna travels up the umbilical chord until it is in open air and the radio signals can be sent from the servo control box. There are five servos controlled by radio. There are 3 on the arm (grabbing claw, wrist, and vertical) as well as the two inside the camera housing enabling left, right, up, and down movement for our camera.

Future Improvements:

Future improvements could include a number of things, mainly being simply doing higher quality work that could only come with more time to do the work. The basic design of Mr. Pinchy is quite sound. Many hours of theory and brainstorming took place before a final design was decided. Being a team of only two members, there was plenty of work to go around. More team members would be a great improvement for more hands to do work as well as other ideas and theories. Besides a larger team, improvements could include sensors that could attach to a LabPro and Ti calculator. These would not be difficult to add, we would simple have to extend the wire for the sensors. Our base skid/ballast plate gives us lots of room for expansion in the field of chemical testing.

An improvement that could be made on the current Mr. Pinchy without too much difficulty would be an enlarged friction area on the grabbing claw. Foam could be placed along the inside of the "pinchers" to make for a better hold when grabbing objects as well as letting the pilot be a little less accurate and increase overall performance time.

An improvement that could still be made before the competition is the addition of a light system. Like stated before, there is lots of room on the skid/ballast plate for lights to be attached, but then we would have to re-work our neutral buoyancy. The lights should not be mandatory because the pool will be under normal lighting conditions. The lights may come in handy when entering the mock sub, but we don't think they are necessary.

Acknowledgements:

The WADARS team would like to thank the following their support:

-Peter LaFrance: For giving us the opportunity to compete in this competition and letting us use his credit card.

-Marine Advanced Technology Society (MATE) for having such a wonderful annual competition.

-McKinleyville Ace Hardware for having all the supplies we needed.

-Ben Reed for showing us how to use the metal lath.

-Eureka High School for letting us use their pool.

-The Laidlaw family for letting us use their pool.

ROV Today:

ROV are used extensively by many aspects of marine technology industries, such as the Coast Guard, Navy, Universities, and Scientists of all fields. ROV can go anywhere a human can go and more. They can have tools which allow for state of the art sampling and analysis. The great technology that is founding ROV can be seen in the recent Mars Lander, and if Mars was covered in water, we would have sent an ROV. Some recent ROV research can be seen in the form of Hercules and Little Hercules. These ROV have been around for a while now, but have been recently refitted with new deep water gear. They can work alone or together, or with a personal lighting sled. The lighting sled is another ROV built for the soul purpose of giving light to these two ROV. The Hercules brothers are used to study ocean geography and fossils. In a recent mission they were sent down to find fossilized coral at the base of seamounts, and to get samples with custom nets with soft-ball handles.

The Tiburon was doing ocean geography research back in 2001 of the shores of Hawaii. It followed base maps made in 1998 and targeted site specific samples, as well as took images of sea floor features. MBARI's Tiburon helped to find evidence to support the theory of deep sea volcanoes actually exploding. The Tiburon found layers of ash at 1500 meters from a deep sea explosive eruption. The Tiburon's dives ranged anywhere from 150 meters to 3820 meters below sea level. Along the lines of mapping the ROV was looking for areas of volcanic processes, deep flank structure of the islands, drowned shorelines, and submarine canyon processes. This was a busy little ROV.

ROV have been used for all sorts of marine research, but they have also been used to try and find elusive and rare creatures, such as Nessie of Lock Ness, Scotland. In their searches the ROV team got footage of a large decaying animal carcass some 300 feet below the surface. The ROV also found a group of hidden caves that were missed by scanning sonar in previous years. Like in most situations, the ROV out preformed any human that would have been assigned to do the task. ROV will be used as long as there is water on this earth, its research being furthered by scientists and universities such as Florida Tech and MIT. Long live the ROV!!!

Sources:

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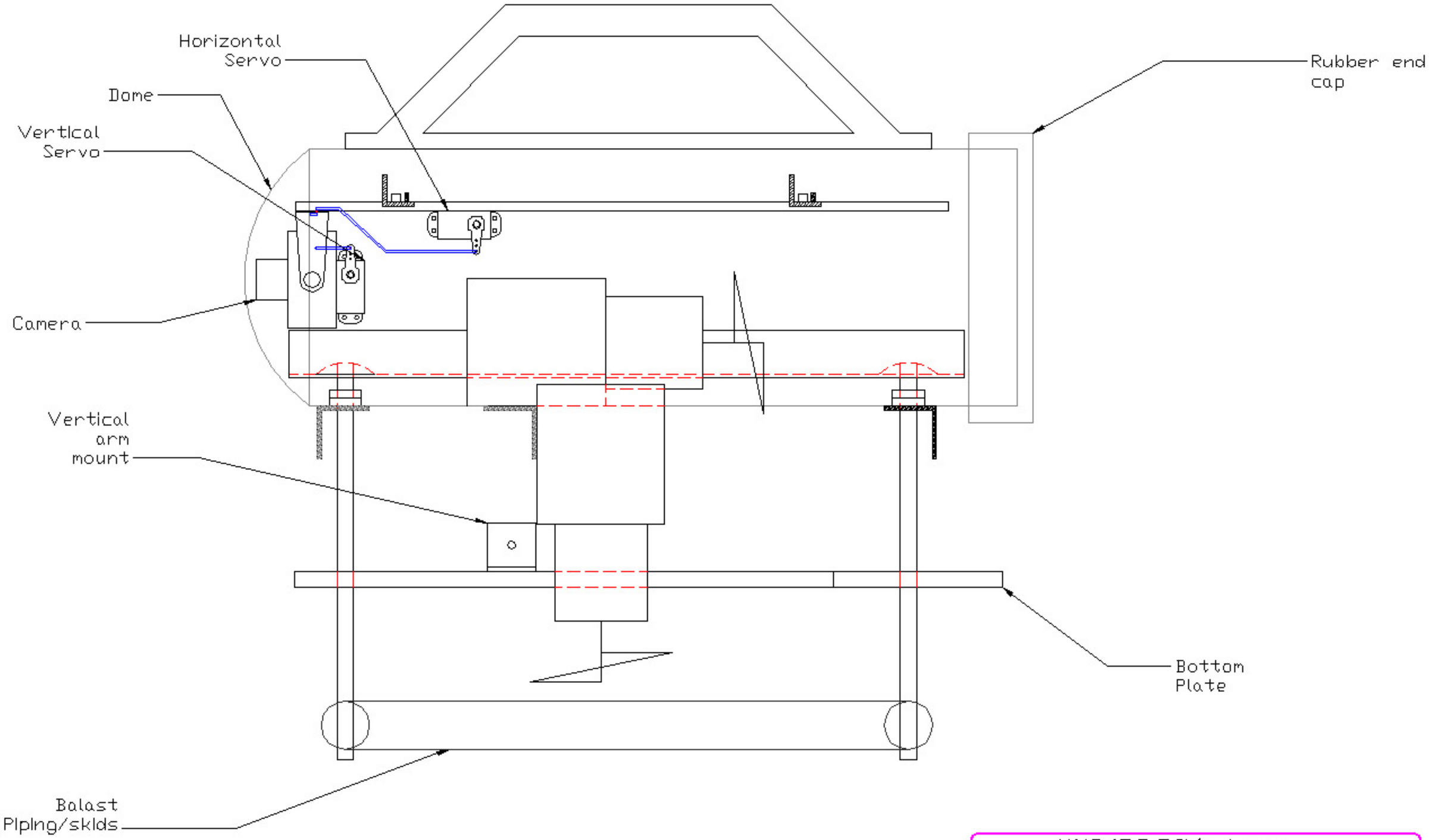


WADARS ROV submarine

Side View

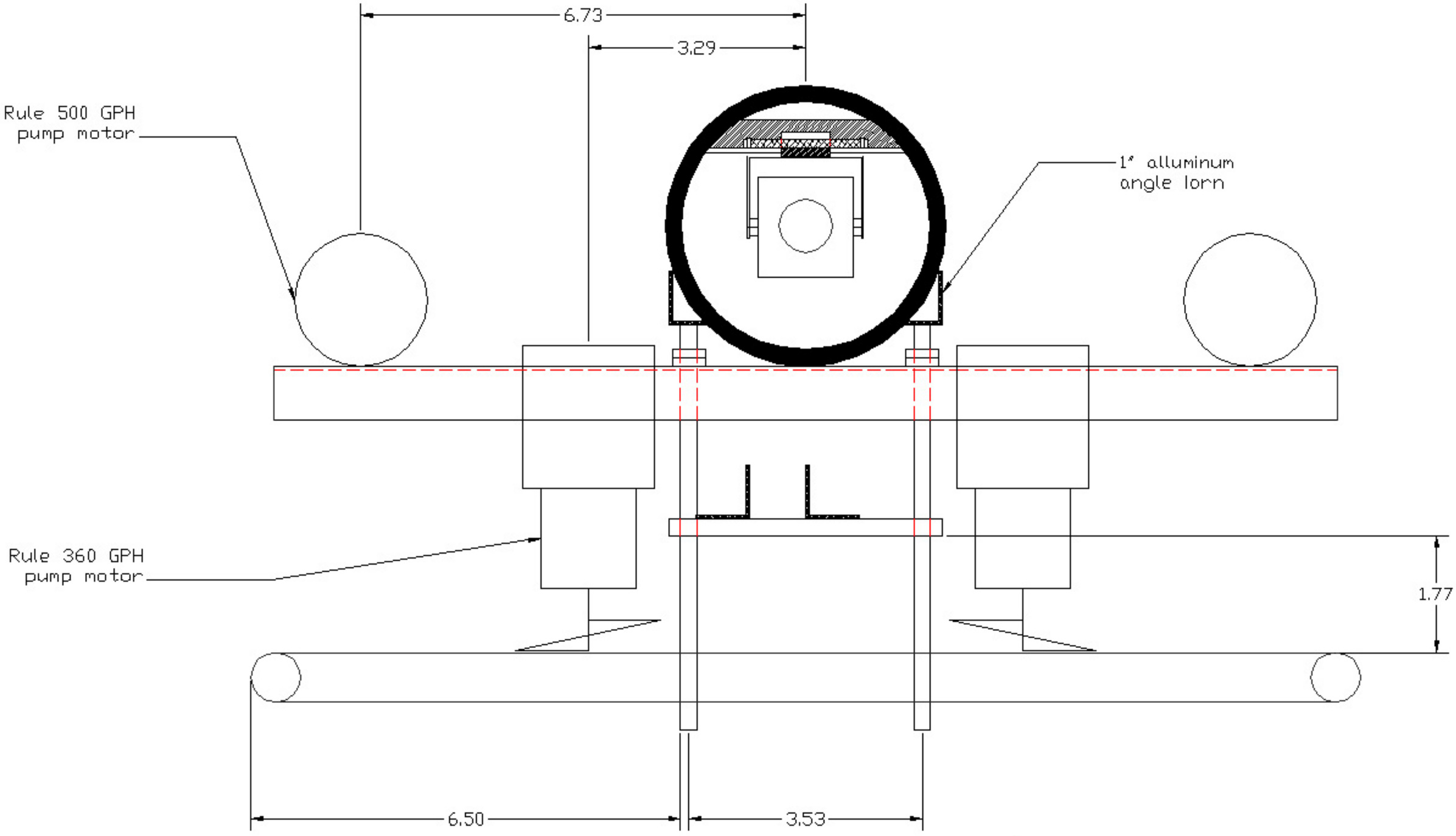
PAGE 1

Drawn By: Caleb Lesher

Full Scale

3-20-04

McKINLEYVILLE HIGH SCHOOL DRAFTING



WADARS ROV submarine

End View

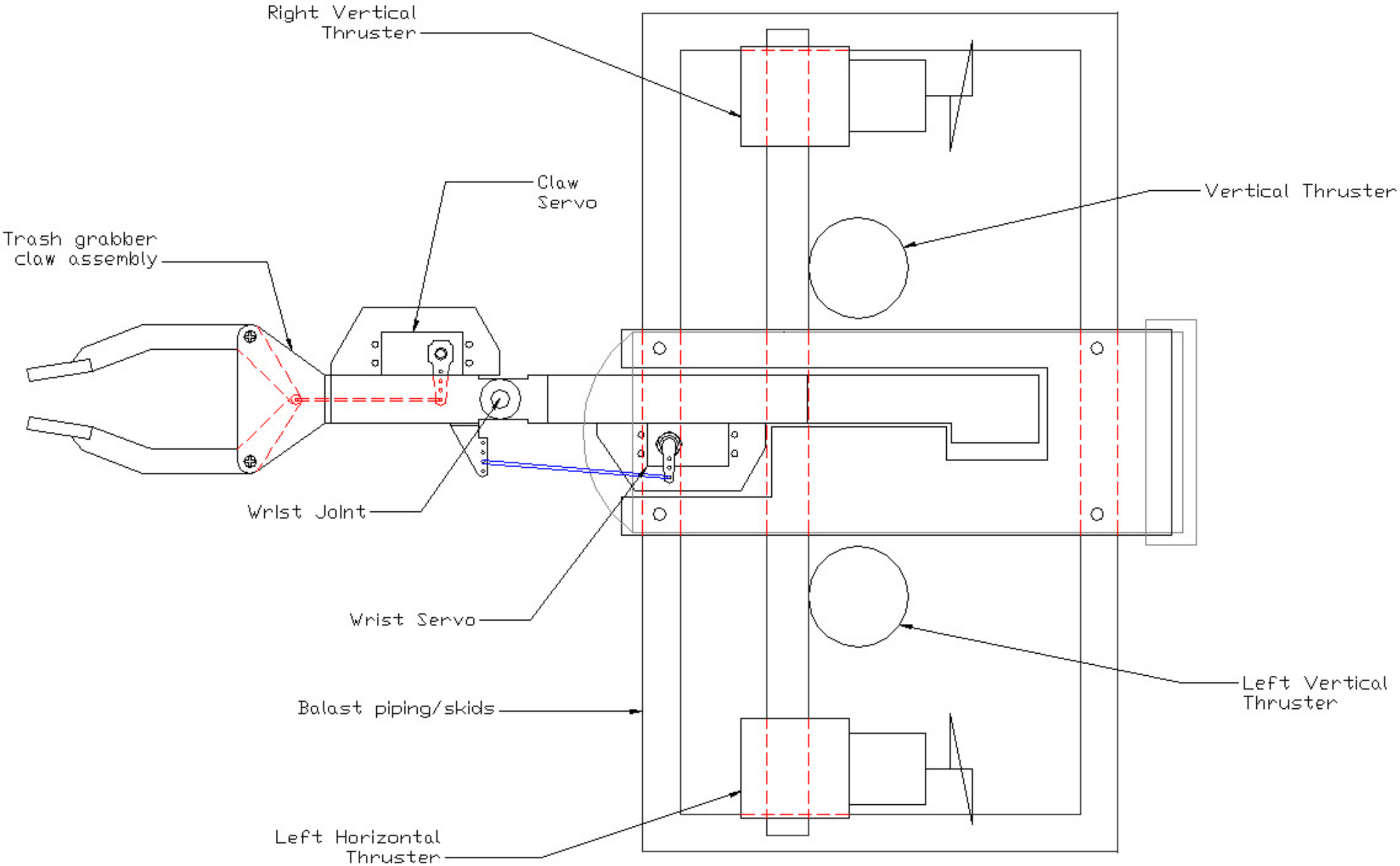
PAGE 2

Drawn By: Caleb Lesher

Full Scale

SCALE

McKINLEYVILLE HIGH SCHOOL DRAFTING



WADARS ROV submarine

Top View

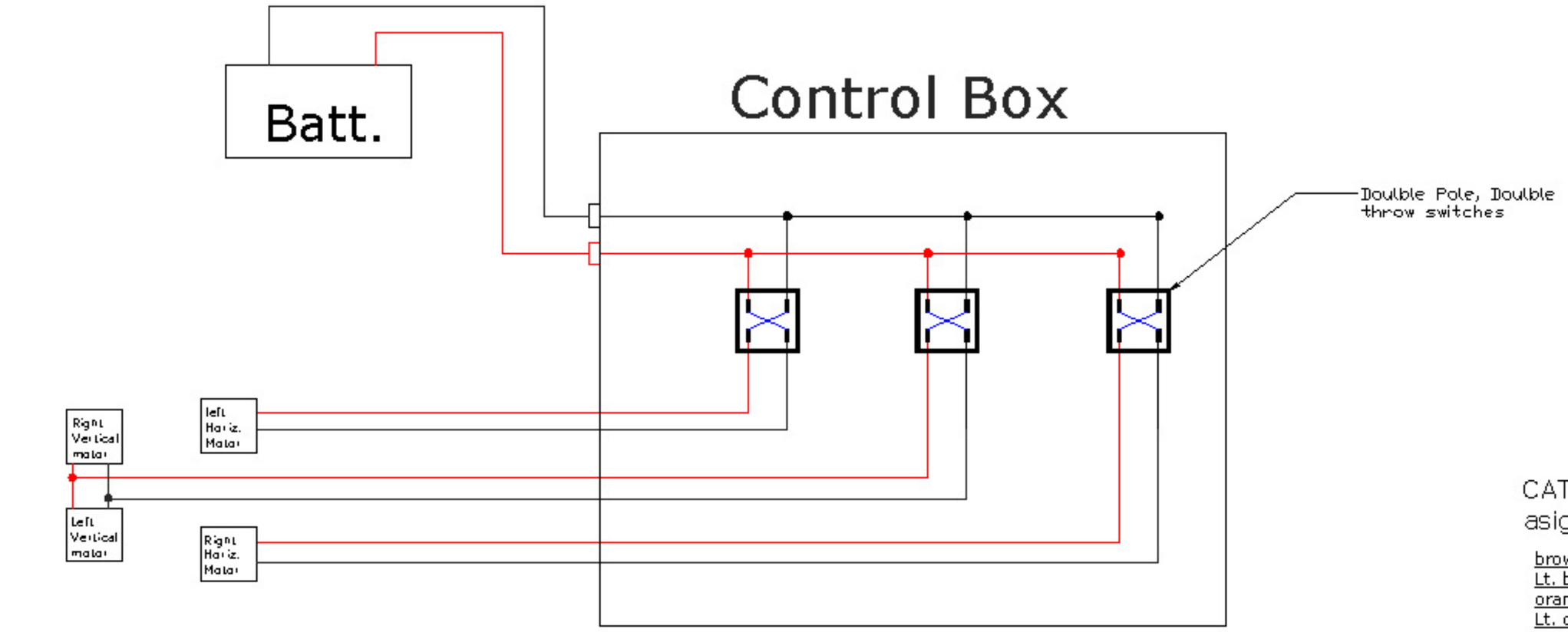
PAGE 3

Drawn By: Caleb Lesher

3/4 Scale

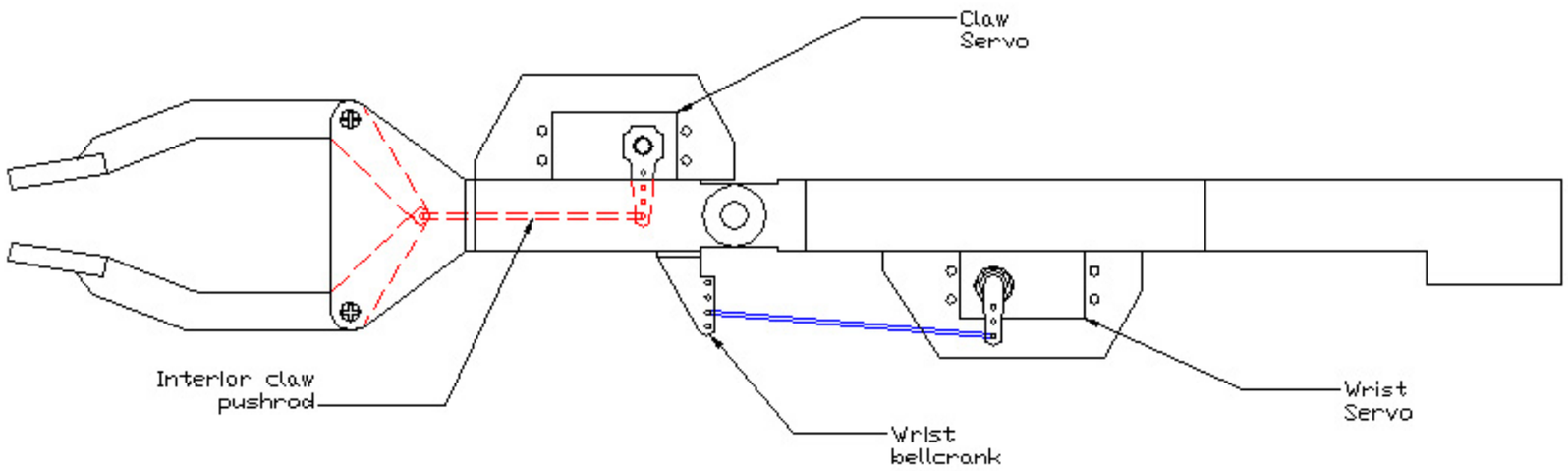
3200

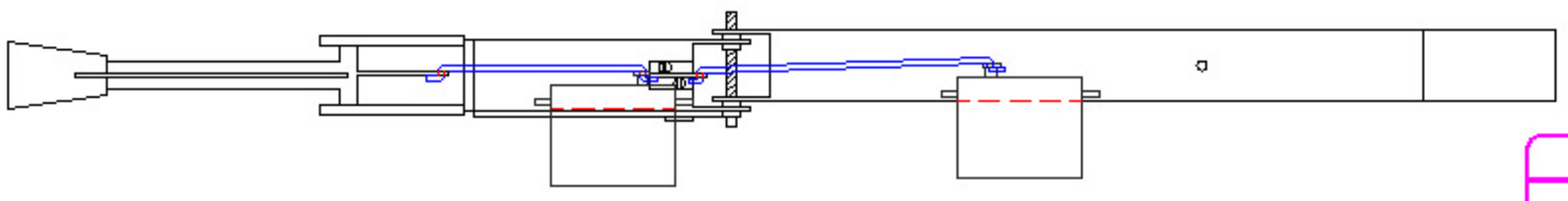
McKINLEYVILLE HIGH SCHOOL DRAFTING



CAT5E Wiring asignments

brown camera signal+
Lt. brown camera signal-
orange aux +
Lt. orange aux-
green antenna
Lt. green
blue +12 volts
Lt. blue -12 volts





WADARS ROV submarine

Arm & Electrical Detail

PAGE 4

Drawn By: Caleb Lesher

3/4 scale

5-20-04

McKINLEYVILLE HIGH SCHOOL DRAFTING