Carrollton High School

Carrollton Ga

2018 Mate international ROV competition

Mentor: Kristie Bradford-Hunt

Malachi Ivey (18) CEO
Kirby Criswell (18) CFO
Laila Floyd (19) Research team
Grant Gordon (19) Safety
Nate Parcels (20)

Leo Ank (19) COO
Thomas (20) Chief Engineer
Amelie Avin (21) Pilot
Kishan Patel (20) Engineer
Elliot Basil (20) Engineer

Eli Nunez (20) Chief Electrician
Peter Ivester (21) Electrician
Taylor Hunt (20) Pilot
Andrew Bell (21) Engineer
Gabriel Smith (19) Engineer

ABSTRACT

InnovOcean, an oceaneering company created in 2007, designs, constructs, and operates Remotely Operated Vehicles (ROVs). ORC.A is InnovOceans newest innovated Remotely-Operated Vehicle, designed to complete three main tasks close to that of the ROVs utilized in the Pacific Northwest region of Washington State. In order to complete these tasks, unique functions were mastered and improved upon by our company. (ROV) has the ability to locate and recover submerged materials/objects, capture photographic information, record and accumulate seismic data as well as the qualities needed to complete installations. In order to execute these functions our ROV is equipped with a moving go pro and a stationary go pro. as well and manipulator with several functions such and a microphone and air hose.

THEME SIGNIFICANCE

The Pacific Northwest area of Washington State is beautiful and unique and yet challenged by the same geography that gives it its edge. These popular sites here are the heart of a wide variety of businesses and ports which happen to be the most active and busiest of which that lie along the west coast. This area is in high concentration of human activity and inhabitants of this area are pushing to restore the environment that was hurt as a result of human industrialization and natural disasters. This restoration accompanied by measures that reduce the footprint of humans in the Pacific Northwest, can only be achieved by the allocation of information from aircraft, earthquakes, and energy from this area by advanced technology. ROVs are the most efficient technology that can complete tasks necessary for accumulating information as well as completing manual tasks, most importantly they can do it underwater.

PROFILE

We had three main staff groups, our programmers who were digidly working on the arduino and the programing behind it. Then we have our engineers who were constantly working to profecrt ORC.A. Then we have our research team who stayed up working late nights to finish the technical documents and poster

SCHEDUALING AND MANAGMENT

Innovocean began meeting on November 16th, 2017, immediately after school on Wednesdays for 1-2 hours. The first month we brainstormed for the Ranger mission and in December every part needed to build was ordered while props were being built. As of January 2018 we began meeting on Mondays, Wednesdays and Thursdays. In January frame assembly, and props were completed. By February majority of the parts were completed Engineering team would work on the ROV three times a week, and once a week the essayists and researching team would work on paper. While the CEO and COO would work on getting tools and parts ordered as well as making sure all members were not only showing up but were given jobs and doing them correctly and the best way possible. On March 8th we began pool practices. On March 14th we determined whom our pilot would be. We practiced until May 4th.

SAFETY

Safety is InnovOcean's greatest priority. This is evident when one inspects InnovOcean's workshop, each of our vehicles, and employee conduct. With appropriate provisions, all accidents are preventable. In the unfortunate situation that an accident does occur, InnovOcean takes initiative to conduct a root cause analysis to fix the issue. All of our employees deserve and require a safe work environment, which InnovOcean strives to guarantee. Overall, our safety procedures can be summed into three key components: Employee Training, Lab Safety, and Vehicle Safety Features.

New and long-time employees both go through a comprehensive training process every year. First, company leaders give a comprehensive presentation in safety practices. They learn or are reminded of what potential danger to look out for, do's and don'ts for the workshop, required dress code and personal protection equipment (PPE). Afterwards, veteran engineers host mini programs in which employees practice workshop techniques for skills such as soldering and drilling. Once in the actual workshop, all members are closely watched and constantly reminded by peers of safe practices. Our training process reinforces that safety is a key component of our company's operations.

SAFETY CHECK LIST

CONSTRUCTION SAFETY CHECKLIST

- Close toed shoes
- Tied back hair
- No loose clothing
- Safety glasses worn at all times
- First aid is visible
- Gloves and dust mask worn while using any chemical
- Proper air ventilation on at all times
- Proper work behavior at all times
- Proper training with all power tools
- All flammables stored in correct containers

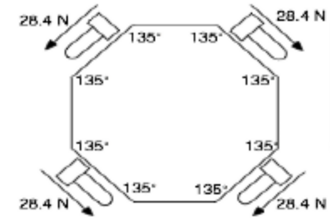
PRE-MISSION SAFETY CHECKLIST

- No exposed wiring or propellers
- All wiring is secured
- Tether is secure to both ROV and control box with proper point of no tension
- Tether is properly uncoiled and untangled
- Deck crew has hair tied back and are wearing wearing closed toed shoes and pants
- Main power is switched off until all electronics are properly connected and checked
- Main power is switched off until all crew members are ready
- Main power is only switched on until words “going hot” is called by pilot

DESIGN RATIONAL

THRUSTERS

We have four electric thrusters for horizontal movement [inside frame] and two for vertical movement. These additional thrusters not only increase movement, but overall speed to complete missions. This increase in movement allows for better precision which is paramount for the ROV. It allows for more accurate measurements in distance which are needed for Task 3 while having to measure the distance from the placement of the turbine. On our first draft we decided to place the thrusters on the top of the robot. We realized that placing them there would cause the ROV to move downwards. To prevent this an additional layer of frame in the center of the robot. This provides a location for the thrusters in an area where center motion can be maintained. Because our previous ESCs had low heat capacity, we attempted to buy the T200 thrusters with a built in ESC's from Blue Robotics but we were disappointed to find out they no longer sold them. Instead we bought two T200 thrusters with an exterior ESC. These two thrusters were placed on the outside of the ROV and mounted on the sides for heat control and vertical movement.



Force Diagram for lateral thrusters

FRAME

In a direct response the change in size the regulations our ROV has increased in size from our previous year's design. Given the opportunity to expand we've chosen a larger frame to make accessibility to innermost parts of ORC.A easier. In previous years, we have had major difficulties removing the water proof box which held the connections to the control system. Fixing potential ROV malfunctions are less cumbersome given the space to make remove and reapply pieces.

In our previous design we located our thrusters on the exterior of the ROV. This caused it to move downward as it moved forward. To prevent this unwanted directionality, an interior frame piece was implemented in the middle of ORC.A for the thrusters.

TETHER

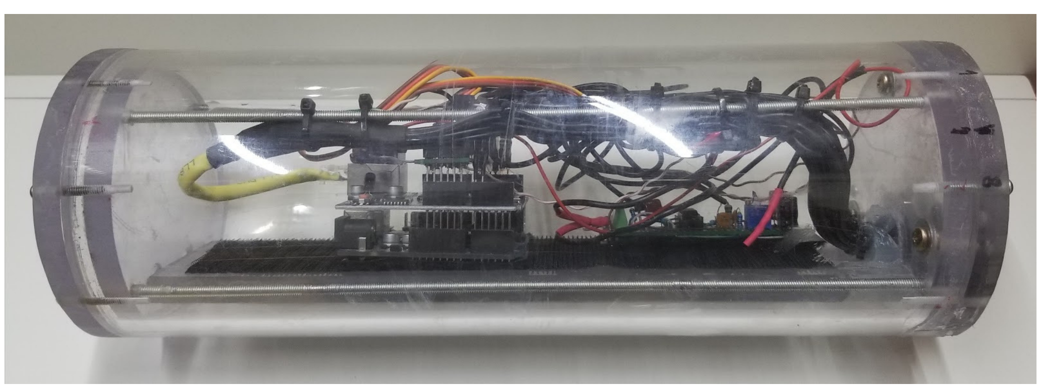
This year we decided to equip ORC.A with a Blue Robotics neutrally buoyant Fathom tether. In previous years we used normal cable and attached pool noodles to the tether. This resulted in a bulky and unbalanced tether. By using a neutrally buoyant tether from Blue Robotics, the overall size of the tether is reduced and balanced.
We also have two power and 16 gauge power leads. The teacher is also functioning as a compartment for a small air tube that fills up ORC.A's lift bags during Task# one.

CAMERAS

ORC.A houses two Go Pro Hero 3's sealed within waterproof cases that allow for a crystal clear view of the ROVs surroundings while functioning. Given its visual ability the manipulator and other payloads can be seen and controlled at will with little difficult and more accuracy. Attached to both cameras are video boards which connect to the control board and allow for the ability to switch between camera views.

WATER PROOF ENCLOSER

This component of our design was thought on most due to issues regarding the waterproof box from our previous year's design. Improper sealing was the number one problem we wanted to prevent. Instead of using a plexiglass cylinder acrylic was chosen due to its ability to resist pressure more efficiently. 0.5" thick interior and exterior plexiglass lids conceal the inside of the water proof box to prevent leaks. The interior lid is permanently fixed to the outer lid with an epoxy seal while the opposite end of the interior lid is fastened to the electronics compartment. This attachment allows for easy removal of all inner electronics which are fastened to an acrylic plate between each of four steel beams when desired. The exterior lid is drilled into the main tube for more water resilience as well.



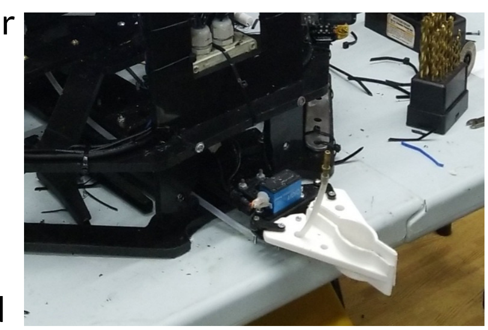
BUOYANCY AND BALLAST

For our ballast we tig welded the weights creating a custom form to correctly fit the sides of the frame. This also allowed us to make our ROV neutrally buoyant. In previous years we have had issues with the ROV not being neutrally buoyant making mission time a little more difficult but by correctly calculating the correct amount of weight needed.

ORC.A features one main buoyancy “tank.” This tank was cut from a sheet of 5 cm Schlüter KERDI BOARD. This highly buoyant material was chosen because of its density, success, and reliability in past vehicles. The foam board is a tile substrate and building panel that is commercially used to create bonded waterproofing assemblies with tile coverings. It consists of an extruded polystyrene foam core, with a special reinforcement material on both sides and fleece webbing for adhesion. The foam is closed cell, meaning that all air pockets inside the foam are trapped, forcing any leaks to remain localized, even with physical penetration. Using precise calculations, the appropriate “cut line” was drawn to enclose the vertical thrusters and shaped the foam using a hacksaw. The sides of the buoyancy tank were further shaped using a saw for maximized hydrodynamics when moving in all directions.
Originally we had planned to utilize a ballast in controlling the balance of the rov upon completion we discovered that it was much lighter than we anticipated so we decided against using it.

MANIPULATOR

The manipulator design is completely based on the missions the we will have to complete. Using the manipulators from previous years we were able to innovate from their designs for this year’s manipulator, giving us the ability to complete missions that are yet to come.We decided to add the circular niche in the manipulator so that during Task 3 we are able to better grab the turbine base with ease. By 3D printing the manipulator we were also able to get exactly what works best for our missions. Something else we strove to improve is the arm of the manipulator. We have noticed after time and over long trips with the ROV the arm was damaged due to improper transportation. This year we tried designing a retractable manipulator for better transportation and this decreases the size of the overall ROV, protecting the manipulator. we added a 3 U-bolt like plastic sheeting we had specifically cut out to insure the the arm is able to slide smoothly in and out. We later added a hole through the arm and the top of this plastic U-bolt so that we can place a pin in and lock it in place.



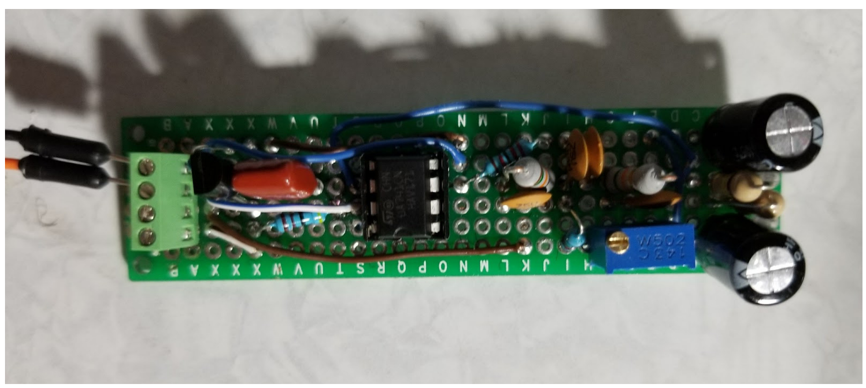
CONTROL BOX

We are using an arduino that sends an Ethernet signal that connects to a router within the box. Three input connectors are also within the box for the cameras. The addition of a third camera is a potential for a new design and the additional input allows for ORC.A to be updated if desired. There is also a connector for output which connects to the monitor this connector sends the live feed to the monitor. The GoPro power leads are found beneath their corresponding live feed input. The main power for the rov also connects on the left of the control box. A latch can also be found near the handle to open the inside the control box if any changes are to be made.and then lock it back closed so that during missions it remains closed.

ACOUSTIC RELEASE

While reading over the manual in the beginning of December we knew we wanted to go for an Acoustic release to release the OBS connector. We just weren't sure how we would do that.

The mechanical side to it was pretty simple and may we say brilliant. it has a piston witch when it receives the pulse it clicks a pen and that is what allows the latch to remain closed and after the pulse remain open. While on the electrical end of it we had a lot more problems then we had hoped. The schematic for our first schematic can be found on page 24. Before competition we realized it wasn't trustworthy it would sometimes open at random times. We believed we had fixed it but after sometime the problem came back so we decided to see if we could make one using an arduino we are currently working on that one.

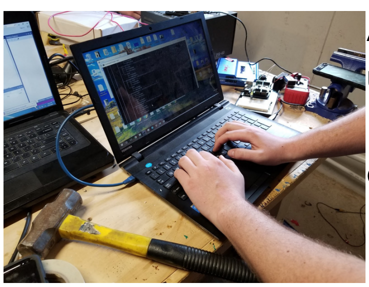


CRITICAL ANALYSIS

TESTING & TROUBLESHOOTING

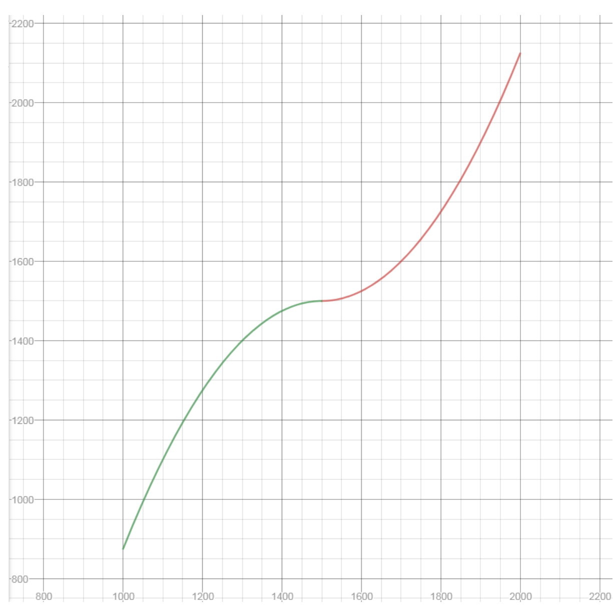
Before we ever put in the water we began dry tests to insure the ORC.A was working correctly. This way any possible safety issues would be handled correctly. After checking and triple checking we were finally ready for the pool.

While outside the pool ORC.A worked perfect When it came to placing it in the pool we realized that after a minute or so ORC.A would decide to restart. At first we believed it was an arduino problem after looking over the Arduino and ethernet shield we saw no problem. With some thinking we decided to check how many amps the thrusters were pulling while moving forward that's when we realized the wire we were using had too small of a gauge to power the thrusters. Now in the teather you will find two fourteen gauge power leads. With the change in wires we haven't seen any malfunctions in the water due to lack of power.



Another problem we encountered the thrusters instead of slightly moving up or down it would jolt up and down so our programmers got to work on providing a system where as the joystick moves up the thrusters exponentially increase speed. This allows us to carefully get to the OBS Microphone without damaging it.

Joystick Power Level(x) vs. Thruster Power Level(y)



CHALLENGES

Like every other year getting the Rov to be neutrally buoyant was a challenge we were constantly placing and removing weights or placing them in different locations of the ROV. by the end we we realized no buoyancy was needed the waterproof box provided enough buoyancy all that was necessary was a ballast on the rear of ORC.A

LESSONS LEARNED

We've learned so much about the arduino and the programing that comes with using an arduino. This was the first year we have ever used an arduino. With the arduino there was a lot of benefits such as being able to change programs just like that. One of the downsides is we had to learn most of the arduino programming in less the a couple months.
During the first month of January we were having some problems regarding certain jobs were not done or if done done incorrectly which lead to conflict. Also during January we had members not showing up and not taking work hours seriously. Later in the year we began to better our communication. By February we really started becoming a family and that's when we noticed a lot more work was being done and most members were showing up.

In future years we plan to begin building the rov in november possibly even earlier and during second semester we would only have to attach payloads this will allow us to have a lot more time to troubleshoot and to practice. We usually feel rushed and with little time. By begging earlier we won't always feel stressed and rushed.

REFLECTIONS

Amelie (21)
As a freshman, I have enjoyed my overall ROV experience with Innocean. Being less experienced than other members, even though I have had two years experience prior to this year, I was not sure how much of help I would be. At first I figured that the freshman would be used a possible side helpers to do the easy task. Simply screwing in screws, building props, handing elder members tools and materials, etc. There was much more than this for the freshman members. We were properly trained on how to use tools, and we helped a lot. We split into different groups to effectively get the ROV completed.

Eli (20)
As a first year member of the ROV team, I was excited to come to a team who was willing to embrace new ideas with which they may not be comfortable. I have enjoyed using my software skills to produce a better control system than the previous years.

Leo (19)
As a junior member of ROV, I have definitely noticed a difference from now to last year. My roles and responsibilities have skyrocketed. I have most definitely lost a couple years of my life due to stress, but I enjoy every second of it.

Malachi (18)
As a senior member and CEO of ROV, I have grown with my company and in my skills as a engineer. In past years, I would spend

Nate (20)
As a first year member of ROV, I have had a great time so far. Being in ROV can bring out the responsibility in everyone, especially when we try to hit deadlines. In ROV, the team is as strong as the weakest link, so I made sure that wasn't me by making sure all my jobs were done on time. Although it can be stressful at times, the end result is well worth it.

ACKNOWLEDGMENTS

InnovOcean would like to recognize several sponsors and individuals for their support and help throughout this year. Carrollton High School has allowed us to use the STEM lab equipment, specifically the 3D printer and CNC router, to create many of ORC.A's components. We thank Advanced Precision Manufacturing for advice on frame design and material choice. We would also like to thank the school for their generous donations and ongoing support. We appreciate the support the Cochran's for permitting us to utilize their pools for practice.
We would also like to thank Ozier Apparel for providing us with custom embroidered polos. Additionally, we would like to give a special thanks to our parents and families for their advice, inspiration, and encouragement as we take on new challenging endeavors. Finally, InnovOcean would like to acknowledge dauphin island sea lab and MATE for giving us the opportunity to participate in such an amazing experience.

INNOVOCEAN
Innovation in Marine Technology

Innovocean

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Expense Report

10/2/2017- 6/20/2018

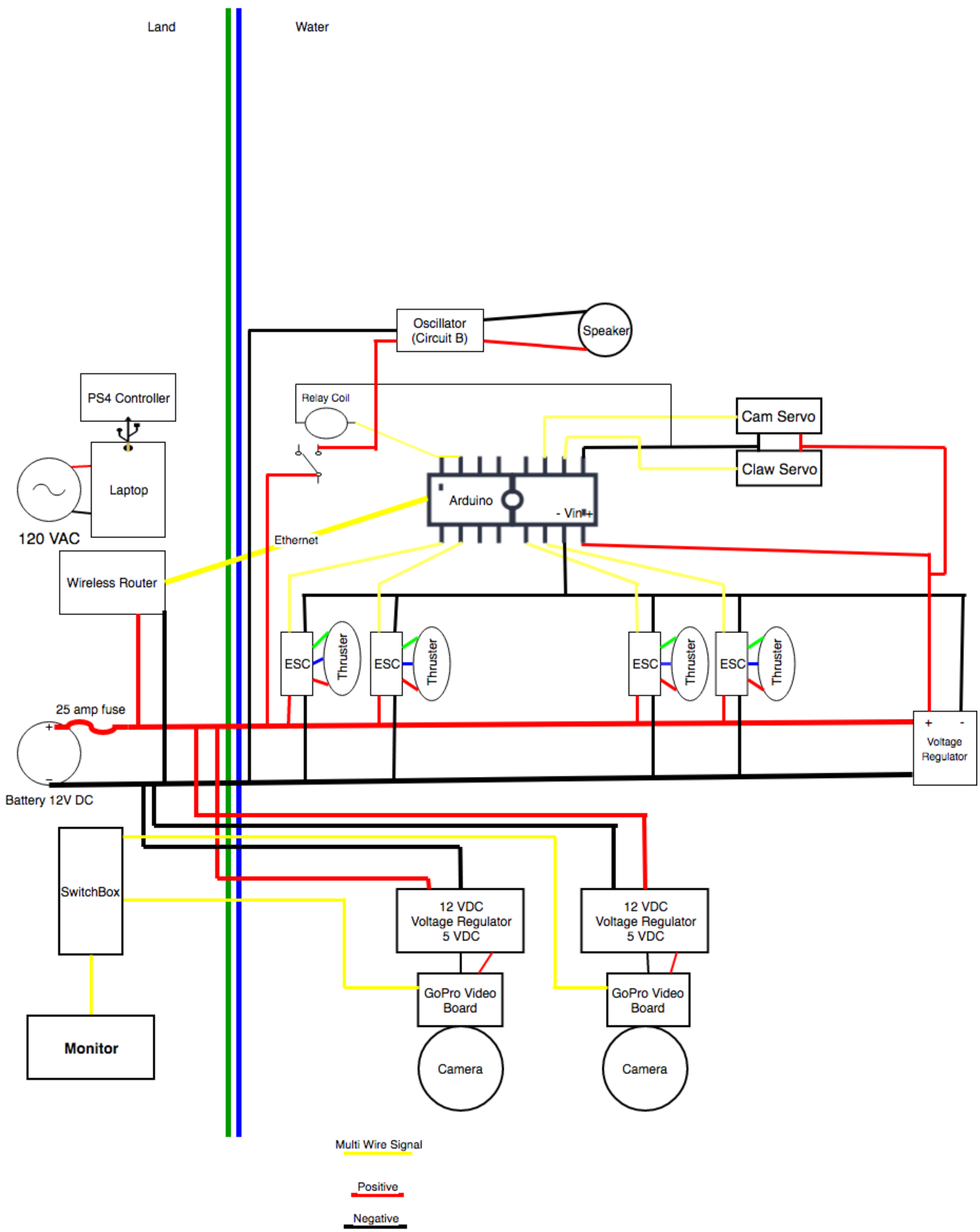
Name	Employee ID	Department
Leonardo Ank	#03292000	COO

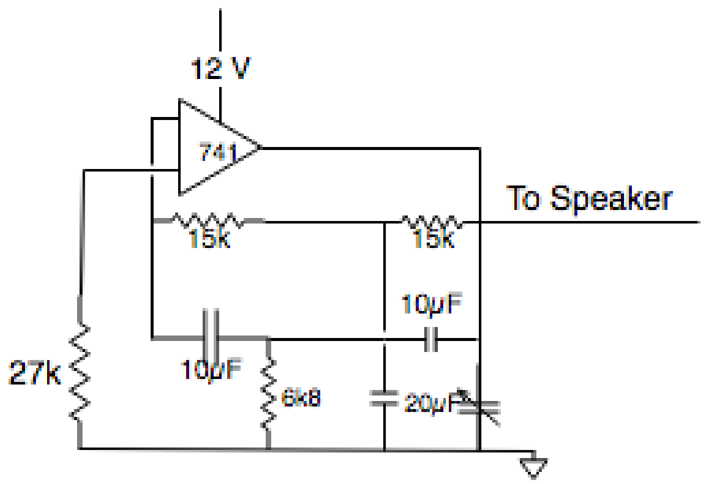
Manager	Purpose
Leonardo Ank	Total Expenses

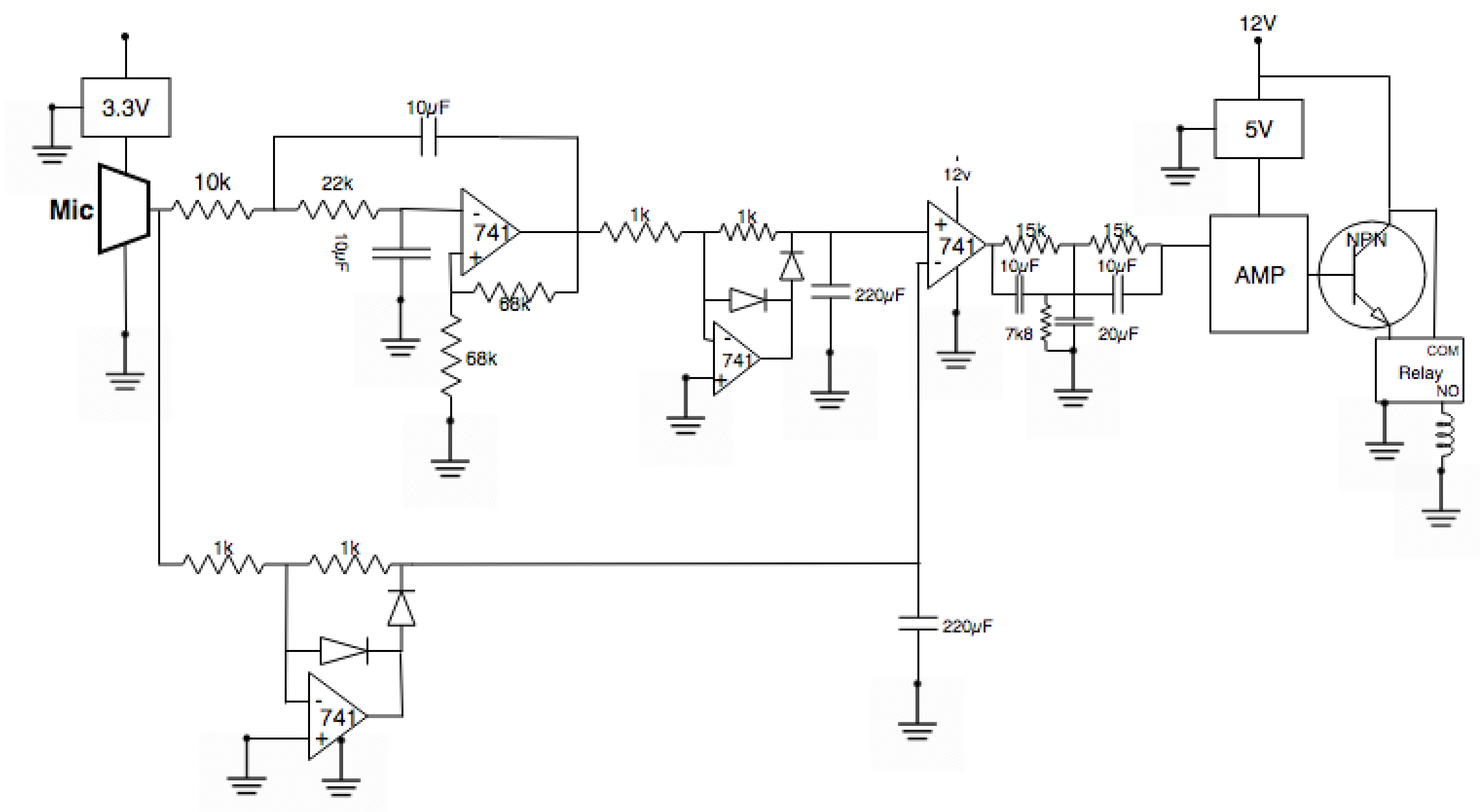
Date	Category	Description	Notes	Amount
11/16	**poinsettias**	$6.5x380 (red)		-$2,470.00
11/17	**Dues**	75x18		$1,350.00
11/29	**poinsettias sells**	$15x352	28(Donated)	$5,280.00
12/12	**Acrylic Tube**	ePlastics		-$56.68
12/12	**HDPE plastic**	ePlastics	x2	-$124.42
12/13	**kerdi-board**	Tile & Stone		-$65.64
12/19	**Home dopot**	Tools & props		-$78.85
12/20	**Home dopot**	Tools & props		-$78.65
12/20	**Home dopot**	props		-$49.38
1/3	**adafruit**	eletronics		-$25.76
1/3	**adafruit**	eletronics		-$19.51
1/3	**Sparkfun**	eletronics		-$20.04
1/3	**Amazon**	props		-$11.99
1/3	**Lift bag**	Amron		-$57.98
12/23	**alleletronics**	eletronics		-$45.65
1/4	**BlueRobotics**	Thrusters	x3	-$521.00
2/1	**Home dopot**	epoxy		-$38.24
2/1	**Home dopot**	screws		-$29.47
2/7	**eplastics**	HDPE		-$75.12
2/7	**Home dopot**	epoxy		-$45.00
2/7	**BlueRobotics**	teather		-$375.00
5/8	**unmarked expences**			-$180.62
5/16				-$627.68

$1,633.32

budget	
category	Amount Spent
payload	$93.02
camara	$560.00
frame	$124.42
teather	$375.00
control box	donated
tools	$157.49
boyancy	$65.64
thrusters	$521.00
eletronics	$110.97
waterproof box	$113.36
total	$2,120.09


Land
Water
Oscillator (Circuit B)
Speaker
PS4 Controller
Relay Coil
Cam Servo
Claw Servo
Laptop
120 VAC
Arduino
- Vin +
Ethernet
Wireless Router
ESC
Thruster
ESC
Thruster
ESC
Thruster
ESC
Thruster
25 amp fuse
Battery 12V DC
+
-
Voltage Regulator
SwitchBox
12 VDC Voltage Regulator 5 VDC
12 VDC Voltage Regulator 5 VDC
GoPro Video Board
GoPro Video Board
Monitor
Camera
Camera
Multi Wire Signal
Positive
Negative


12 V
741
To Speaker
15k
15k
10μF
27k
10μF
6k8
20μF


3.3V
Mic
10k
10μF
22k
10μF
741
68k
68k
1k
1k
741
220μF
12v
741
15k
15k
10μF
10μF
7k8
20μF
12V
5V
AMP
NPN
COM
Relay
NO
1k
1k
741
220μF