Spicy Otters ROV

Abstract

The SeaPerch competition provides an opportunity to be creative with developing solutions to real-world problems. While there are many great designs already out there, our goal this season was to come up with a unique and creative design that performs better than the classic Remote Operated Vehicle (ROV). Our ROV is designed to perform the competition tasks but in a new innovative way. We have implemented rotating thrust motors onto our ROV, inspired by an aircraft that utilizes a proproter. Collectively, this ROV has four working motors: two for the rotating propellers, one for the gearbox, and one that is stationary in the middle for lift. The motors are protected by custom hydrodynamic motor covers reducing drag. Attaching the motor covers to the frame with a 3D printed axle, the gearbox is the mechanism that performs the rotation. Inside, the gears are arranged to produce torque to counteract the resistance force of the water, as well as the gears rotate at a slower, more controllable speed for the competition. On the top of the frame, we included two hooks on the sides to assist with removing the beacon, as well as pushing the floating objects. These special parts all assist in the game tasks. They regulate the movement of the ROV closely and produce thrust in any direction. Our design is a new, creative solution to the SeaPerch competition.

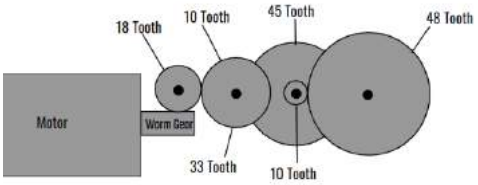
Task Overview

In the beginning, we defined the tasks together as a team of what the ROV will be required to perform, then formed our design to fit the requirements and constraints. For Regionals, we participated in the obstacle course, recovery challenge, and the speed test (which we set a school record of 16.3 seconds and won gold). For Internationals, we will participate in the recovery challenge with a time limit. Our ROV is designed to effortlessly transport objects quickly and smoothly over long distances. To complete these tasks, our ROV's design utilizes mechanisms, shape, and size to our advantage. Undoubtedly, the most essential part of our design is the rotating motors. They are versatile and function in all of the tasks. The gear ratio of the motors is calculated to provide torque so the motors will have the strength to lift, sink, and maneuver objects. Although they are not designed specifically for speed, the configuration of having three motors that can propel in the same direction, compared to other designs where there are usually only two in one direction, will help with speed. The small size of the ROV was intentional to be able to maneuver quickly and sharply around obstacles and through the water. Also, the shape is wide and sturdy enough to turn the vault gate. For the recovery challenge where the ROV interacts with objects, our design has individualized parts for each task. The claw on the bottom functions to hold objects in place securely while traveling and distributes the weight across three prongs. The purpose of the hooks on the top of the ROV is used to move the beacon parts off while also being small enough to not hinder the movement of the ROV. They also aid in the floating garbage patch to drag items under or poke items over the ring. We took the risk in trying to create an ROV with rotating motors to help us move items to meet the objective of navigating a large course while transporting items efficiently.

Design Approach

Our ROV's design began the minute last season ended. Last season, the ROV struggled to lift items in the recovery challenge and it would nosedive where the object was being held. It also lacked control and strength. This year, we did extensive research into many fields to find a catalyst for our new design. We decided to base our ROV off of the V-22 Osprey plane. The osprey plane is a tilt-rotor aircraft with a unique capability of rotating the propellers (Boeing). It is also known as a "proproter" since it combines two different propellor types (Airforce Technology, 2021, March 25). This inspired our solution to address the lift and pitch problems identified from the previous season. Along with our past weaknesses, our ROV was very slow: the ROV's speed time was only 45 seconds. Using our prior knowledge, this year we planned our design around that issue since it impacted all aspects of our functionality. We agreed as a team that Yale's idea, inspired by the V-22 Osprey, was the best for our goals this season. The purpose of the rotating motors is it gives a new function to the ROV; it can now counter its own actions. It is no longer one ROV with stationary parts. The pivoting motors give an innovative way to change the direction while still providing a steady amount of effort force in said direction. It is a unique idea that challenged us, as this idea has never been accomplished in our school's history.

The main dilemma was finding a way to rotate the arms like the Osprey plane. After plenty of research, we decided on the worm gear as the solution because "it changes the rotational movement by 90 degrees, and the axis of movement also changes due to the position of the worm on the worm wheel" (Machinery Lubrication). This will allow a gear ratio to produce torque to handle the weight of the motor and the force needed to carry the ROV. This is possible with a gearbox that utilizes a torque gear ratio. We 3D-printed many prototypes of the gearbox, all 3D-designed by Tracie. After printing out the first model of the gearbox, we discovered that the holes in the prototype were misaligned, therefore the gears would not fit as planned. To get the alignment correct, we used a caliper to remeasure and reprint another gearbox. The new gearbox contained four gears: the worm gear connected to the motor shaft also connects to the first gear. The second gear connected to that has a ratio of 18:1. The second gear contains 18 teeth that are connected with a larger gear that has 33 teeth. The third gear slows down the gears by almost half, 6/11 to be exact, and has a smaller 10 toothed gear next to it that is aligned to the fourth gear. The fourth gear has two gears on it as well. The 45 toothed one is driven from the 10 toothed gear from the third gear. When we tried using it, however, it spun too fast to control. To remedy this, we added a gear that had 45 teeth, which spun once every 6 turns from the previous gear. We printed a smaller version of a prototype to ensure the spacing was correct for the last two gears. This was a separate model to test the placement without printing another gearbox which resolved the issue successfully. This decreased the gear ratio to



890:1, which had a more controlled speed. Another issue with the gearbox was the second gear and the worm gear were bending and twisting due to heat. This was easily solved when we ran the gearbox in the water which effectively cooled them down. After, we agreed to incorporate the gearbox into the frame instead of separate pieces to accurately align the steel rods with holes in the frames for the motor cover attachments. We designed this gear ratio to rotate slowly, but also for torque so the ROV can withstand resistance force from the water. The gearbox was designed to be shaped like a bullet. Its shape is hydrodynamic which helps to decrease the drag of our ROV. The difference between just an axle driving a motor versus our gearbox design is that our gearbox increase the output force using the same input force, therefore, it can spin two motors and function the way we intend it to.

After the gearbox was finalized, we worked on the frame of the ROV. Our goal was to ensure that a water bottle could fit inside the frame along with the other components. We chose to make our ROV 4 inches by 8 ½ inches in order to hold a water bottle because a water bottle is around 3.5 inches in diameter and the height is 8.25 inches. We added a rear motor that is stationary and is used for thrust across the Z-axis. This motor is going to be printed directly into the frame. The rectangular prism shape of the frame gives stability and is easy to balance. After completing the frame, we decided to work on the side motors that were going to be attached to the fifth gear. Custom motor guards were created using Autodesk Inventor to minimize drag and to protect the propeller from game pieces. The guards are shaped like bullets in order to travel in the water smoothly. We printed the motor guard connecting rods at three inches and sanded them down to two inches after finding that three inches was too long and made the ROV roll. The custom motor covers are supposed to give protection and alignment to the thrusters, which is why we put effort into balancing the motor covers. We incorporated the hook for interacting with game parts by forming an attachment to fit around the frame. The design is a simple, straight pole designed to be hydrodynamic but perform well. We have found in the past that hooks with an angled end are hard to maneuver and get underneath the parts which is why we chose to go for a classic hook that snaps onto the ROV.

We proceeded to brainstorm how to retrieve the sunken water bottles. We did this by creating a cradle that holds the water bottles in four different corners to lift it up to the desired location. We used the application Autodesk Inventor and created an L-shaped piece that will be printed four times that will be positioned to create a basket. We later found out that the C-clamp that connected the L-shaped pieces to the ROV were weak and would come off with a slight bump. To tailor the C-clamp to the ROV, we created a pin by drilling a hole and using a paperclip to ensure that the C-clamp did not move the L-shaped pieces. Later, we found out that the water bottles would slip through to the backside of the ROV and concluded we needed a stopping point for the water bottle. We removed the lower half of the L-shaped pieces from the design so only two of them curved them in. Yale had the idea to form paperclips into a rainbow shape to form to the water bottle. This will create the cradle to stop the water bottles from falling out. This will coincide with our

small frame, folding the pieces into the ROV to keep the smaller size which will help maneuver through the obstacle course, recovery, and speed test.

After Regionals, we found lots of issues with our design in the pool we had not been able to find in our small tank at school. We revised our ROV to allow us to maneuver with more control. We used our gearbox, however, this time it is placed in the back so that we can fix the issue with lifting and sinking. At Regionals, our ROV struggled with moving to any desired location. When the motors were facing up, they would move the back over the front in a circle instead of upwards. We fixed this by placing our two front motors in the back and changed the location of the rear motor to the middle while changing its orientation to function as a lift motor. The layout of the placement of the motors was similar to a standard ROV, however, we can move our rear motors in the upward position to aid in lifting or in a front-facing position to move forwards. We also changed the hook design when ours struggled to keep the items on. We designed a new claw with three prongs, like a trident, that went underneath the ROV, and two singular hooks on the top for floating items. The body shape had to change to fit the new placement of the motors and gearbox, so we took the opportunity to redesign from a trapezoidal shape to a square back with a triangle front, which makes it easier to interact with the vault gate. We believe strongly that our design is innovative and will perform better than in past years. The concept of the osprey was new to us, but throughout the design process we have come up with more creative ways to improve our design.

Experimental Results

Our tests involved a variety of concerns from ensuring that the gearbox was working to testing the rotation of the side motors to checking to fixing the floatation. The main issue we found was we needed to find a way to permanently attach the last gear to the steel rod. Our first worm gear was attached with super glue, however, due to the high strength of the gears, the gears could not be held with super glue. We tried super gluing the gear to the steel rod three separate times, all of which came apart. We then tried solving this issue by soldering a piece of metal into the plastic gear itself to connect to the steel rod. This worked for about a week before the solder gave up on the steel rod. Finally, we did some research into types of bondings and found epoxy to be the best for bonding (Loctite). It can form a bond with plastic and metal, which was a struggle for us to connect the two well. We used epoxy glue while adding a spacer to also help grip the steel rod with more surface area. After the epoxy was cured for 48 hours, we discovered that the epoxy worked extremely well. Unfortunately, we did not sand the area where the motor covers connect to the ROV enough and while the epoxy held, it was difficult to rotate because of the friction. Using a hairdryer, we warmed the 3D material to be malleable and pulled the motor covers out to make the hole larger, reducing friction and successfully attaching the motor covers to the gearbox.

We attached the motor covers and tested them in the water. We discovered that the ROV was rolling from left to right a tremendous amount. To counter this, we decreased the length of the arms so there is a closer center of mass. This solved the rolling problem so we continued to add flotation to the bottom. We found out the ROV naturally turned itself over because the weight of the gearbox and the rear motor fell to the bottom. Instead of trying to change this, we flipped the ROV design over, as this would allow us to place flotation on the top of the frame of the ROV design. This helped prevent rolling which was an issue before. We added weights to the bottom of the ROV and added flotation to the top to ensure that the bottom of the ROV had a lower center of mass and an upward pull on the top. At first, we decided to try to use styrofoam for flotation since it could be easily shaped but we found out that the ROV would roll again if the belly was covered in flotation. We solved this issue by replacing the styrofoam cutouts with pool noodles on the sides and no flotation on the belly to decrease the rolling. On top of that, we found that the rear of the ROV was sinking. We added flotation to the rear with styrofoam that fit perfectly in the frame of the ROV.

During Regionals, we learned how our ROV acted in the water. This was the first time we were able to drive the ROV further than three feet and it was drastically different. We learned that we needed a better way for the ROV to lift with the added resistance of the water. Also, we learned about how the two motors act in the front. All the turning happened at the front which made the rear harder to turn and control. We redesigned the ROV motor configuration from the two turning in the front to the back, and the back stationary motor to the middle which now works as a lift motor. The hook and basket did not work as well as we hoped, so we changed the hook into a three-prong trident hook underneath the ROV and added two single hooks to the top. When testing the new claw it worked great, but the objects kept slipping further back and it was hard to get them off the hook. From there, we added zip ties to the back corners to keep the objects on the front, making it easier to slip them off. This new redesign worked amazingly well compared to the previous ROV. Throughout all the trial and error, we ended with a design better than the last. These tests were important to fix before testing fully in the water, and without these new additions, we would not have a functional ROV. All of the shortcomings inspired us to come up with something completely different.

Reflection & Next Steps

From this season, we learned many things about how a new design would perform. The gearbox, custom motor frames, and floatation all provided significant obstacles. The silver lining is we now have learned lessons to evaluate before designing and developing next year's ROV. One of the most challenging issues this year was making a mechanism to rotate the arms with the two side motors. Creating this mechanism was challenging, as it seemed that once one issue was solved, there always seemed to be two more. We faced this the most with the gearbox. We first had issues with the spacing, then it was moving too fast and not the right hole size for the steel rods. After we resolved these issues, we had another issue in permanently attaching the last gear to the steel rod when the superglue and soldering did not hold. Then we found out that the space between the side motor arms and the slots they went into were too small.

The rotating motors were the star of the design, but there was a lot of trial and error since they were unique. This is because it is the first ROVs of its design in our school's history, which left us susceptible to more issues. We did not have past teams who have tried this type of design to learn from, so we had to learn for ourselves. We learned that the center of mass is affected by more than just floatation when the two motors on the side being off-kilter rolled the ROV uncontrollably. We can also learn from this year that epoxy is a permanent bond that works best in water compared to other forms of attachment. These issues continuously popped up. We went into the design with basic ideas and relied on prototypes for decisions in the design process. We should have taken more care in planning the design, in the beginning, to have avoided many of these problems and use prototypes for testing rather than designing. After competing in Regionals, we learned how the ROV works in a larger body of water and with game pieces. It served as a valuable learning experience in how the mass was distributed on the ROV, and how the center of mass changed when interacting with objects and the resistance of the water. It was extremely rewarding to see the hard work pay off in the end during the filming for Internationals and how all of the improvements and slight changes made a huge difference in our performance. All these lessons learned will be implemented in the next season, much like how our design this year was based on last season's failures. That is why every season gets better and better. We will take these mistakes and learn from them to create more in-depth designs in the future.

Acknowledgments

Our advisor, Greg Quast, supported our team in many ways this season. He provided our team with resources that were necessary to build the ROV and valuable advice to solve our many failures. The 3D printer was the most important tool that we had access to as it makes up the whole ROV. Mr. Quast also gave us game-changing suggestions to improve our ROV; we got assistance on a suggestion about flipping our ROV over and placing the flotations on the sides of the ROV. While he provided information, he let us solve the problems ourselves with a nudge in the right direction.

Our team also received suggestions from Kevin Surber (a Construction Tech teacher). He helped ensure that we had a permanent bond between the last gear and the steel rod which was an ongoing issue. We received suggestions from him about using epoxy as well as adding a spacer next to it to create more surface area for the epoxy to bite. We were provided epoxy from Mr. Surber from his classroom that solved this big issue we were stuck on for too long. Without the success of the epoxy, we would have never found a way to attach the last gear to the steel rod.

References

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Appendix A: Budget

Gear Pack (gears, spacers)	Amazon	5 gears, 2 spacers used in the gearbox	$0.88
Steel Axles Pack	Amazon	4 axles used in the gearbox	$2.80
Fish Weight Pack	Amazon	6 weights used to sink the ROV	$0.68
Styrofoam	Amazon	1.5"x1.5"x.5" piece used to test floatation	$0.05
2"x6"x6" Cedar Wood	Lowes	1 piece made into the controller	$1.76
Floaties	School	4 pieces used to test floatation	$0
Paper Clips	Amazon	5 paper clips used as pins/to hold items	$0.04
New Rov (3D)	School	Frame of ROV with gearbox	$2.75
New Side motors (3D)	School	Holds the side motors	$1.60
Side extenders	School	Holds the steel rod	$0.20
Up down motor cover(3D)	School	Covers up/down motor	$0.60
Side Motor covers(3D)	School	Covers side motors	$1.20
Ramps (3D)	School	Helps move floating items	$0.45
Stoppers(3D)	School	Allows us to push floating	$0.20
Hook (3D)	School	Picks up sunken items	$0.45
		Total Cost of SeaPerch Components	$13.66

Fact Sheet

Spicy Otters

Patriot High School SeaPerch, Nokesville, Virginia, USA

High School

3 Years participating in SeaPerch

0 Times at the International SeaPerch Challenge

Our SeaPerch is unique because: (100 words MAX)

We are implementing a new type of mechanism into the competition; rotational side-arm motors. We have created a gearbox in the middle of our ROV to place our fourth motor. The fourth motor, in conjunction with the gears, works to rotate an axle connected to the side motors. Thus, allowing our side-arm motors to rotate 360 degrees and provide thrust in any direction. This allows us to use all three driving motors in the same direction at the same time quickly. This mechanism has not been done in our school's history, until now.

SeaPerch Design Overview: (100 words MAX)

Our ROV design is inspired by the V-22 Osprey. Plane. We incorporated the tiltrotors into our ROV design with a gearbox using a fourth motor. We wanted to design a fast, lightweight ROV to shorten our run time and still have the ability to perform retrieval tasks. We incorporated a cradle and hook to maneuver objects in the water. To achieve our goal of speed, we created hydrodynamic motor guards onto our rotating motors to reduce drag. We also downsized the diameter of the 3D printed frame for a smaller ROV.

Our biggest takeaway this season is: (100 words MAX)

At the beginning of the school year with COVID-19, it was a challenge to design our ROV because we could not communicate like we were used to. This slowed down our progress and made the interactive design process hard to achieve. To help make the process smoother, we split the roles into a builder, 3D designer, and technical writer. The three roles worked to each of our strengths. While developing our ROV, we learned a lot about how to incorporate real-world sources into Seaperch and how to apply what we learned by working together to our strengths.

Engineering Notebook

School or club name: Patriot Sea Perch

City, State: Nokesville, VA

Team name: Spicy Otters

ROV name: Lobster

Spicy Otters
Engineering Notebook
2020-2021

seaperch
TEACH • BUILD • BECOME

Contents

Contents

Page	Project/Activity	Date

Youngwoo (Yale) Kim
11th grade Junior
Role: builder

Hello my name is Youngwoo Kim, however I go by Yale. This is my second year in sea perch with 2 years in VEX robotics. During my freshman year, I was aware of vex and when I found out about sea perch, it was too late to join. In my 10th grade year I decided to try both even though I heard it was very challenging. When I experienced these challenges, I knew that I would need to only choose one for my junior year. Therefore this year, I decided to do sea perch over VEX as I found it more intresting. This year I hope to execute one of our team designs that is quite intresting and unique including a 4th motor. I would also love to maintain a neat and organized notebook with the nebessary information. As a hobby, I enjoy woodworking and love to make about anything (such as our controller).

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Yale Kim	11/21/20	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
C V	11/21/20	

Entries

TRACIE TRANG
JUNIOR

Hello, my name is Tracie Trang. I am a junior and my role on this Seaperch team is to 3D design. I have been in Seaperch for 3 years now, I was captain in 9th, 10th and now 11th grade. I 3D designed and sparked the idea for our ROV design, and contributed to the engineering notebook. Some of my interests outside of Seaperch are soccer, football, hiking, traveling, and spending time with my friends and family. This year, my team and I hope to make it to internationals. My personal goal is to 3D design a decent ROV. My favorite food is a Vietnamese food, but my most favorite has got to be a Vietnamese dessert called Chè Ba Màu, in English it is Three color dessert.

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Tracie Trang	11/21/2020	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Cam Vinh	11/21/20	

CARLY VIRAG
JUNIOR

HELLO, MY NAME IS CARLY VIRAG. I HAVE DONE ROBOTICS FOR 8 YEARS NOW. I STARTED FLL IN 4TH & 5TH GRADE, THEN GRADUATED TO VEX FOR MIDDLE AND HIGH SCHOOL. I STARTED SEADERCH IN FRESHMAN YEAR AS A CLASS. I HAVE RETURNED THIS YEAR TO FOCUS ON THE DOCUMENTATION PROCESS. I ENJOY WRITING, CODING, AND MY JOB AT LOGAN'S ROADHOUSE.

MY MAIN GOAL IS TO CREATE A COMPREHENSIVE DETAILED NOTEBOOK THAT CAPTURES THE FULL DESIGN PROCESS IN A CONCISE MANOR.

MY FAVORITE FOOD IS BROWNIES!

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Carly V	11/21/20	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Tracie Truong	11/21/2020	

Entries

LOGO DESIGN BRAINSTORM

OUR FIRST STEP IN EVERY DESIGN PROCESS IS TO COMPILE A LIST OF REQUIREMENTS

- TEAM NAME
- SCHOOL COLOURS
- SCHOOL
- ROV
- YEAR(S)
- GAME PIECES
- UNIQUE DESIGN

WE WANTED AN AQUATIC ANIMAL TO REPRESENT US. WE AGREED ON AN OTTER, BUT IT WAS TOO CUTE. TO MAKE IT MORE INTIMIDATING, WE EXPERIMENTED WITH FANGS AND SCARS.

WE ENDED WITH CROSSED ARMS AND NARROWED EYES TO GLARE.

WE USED REFERENCES FOR DIFFERENT PARTS OF THE OTTER TO MAKE IT MORE CHARACTER-LIKE.

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
[signature]	11/22/20	
WITNESS / TEACHER: Tracee Tracy	DATE: 11/22/20	PROPRIETARY INFORMATION

TO INCLUDE OUR SCHOOL COLORS, WE MADE THE OTTER RED, INSPIRING THE NAME 'SPICY.'

- WE HAD A LOT OF DEBATE AROUND INCORPORATING OUR NAME, SCHOOL, & YEAR WITHOUT LOOKING OUT OF PLACE.
  - ↳ TO SOLVE THIS WE ZOOMED AND USED GOOGLE SLIDES TO ROUGHLY MAP OUT OUR DESIGN, THEN ADDED BANNERS OR USED NEWFONTS TO INCLUDE THE INFORMATION.

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Cano Vino	11/22/20	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Tracie Strang	11/22/2020	

Entries

OUR FINAL ROUGH DRAFTS INCLUDED THE GAME PIECES & THE ROV ON OPPOSITE SIDES OF THE OTTER

THIS IS OUR FINAL DESIGN. WE DECIDED ON A RED BORDER WITH THE SPLASH COMING OUT. THE BORDER ALSO HAS THE INFORMATION.

WE ARE REALLY HAPPY WITH THE DESIGN AND OUR TEAMWORK. WE WERE ABLE TO DEBATE RESPECTFULLY AND cv ~~SR~~ SPROUT IDEAS OFF ANOTHER.

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
WITNESS / TEACHER	DATE 11/24/20.	PROPRIETARY INFORMATION

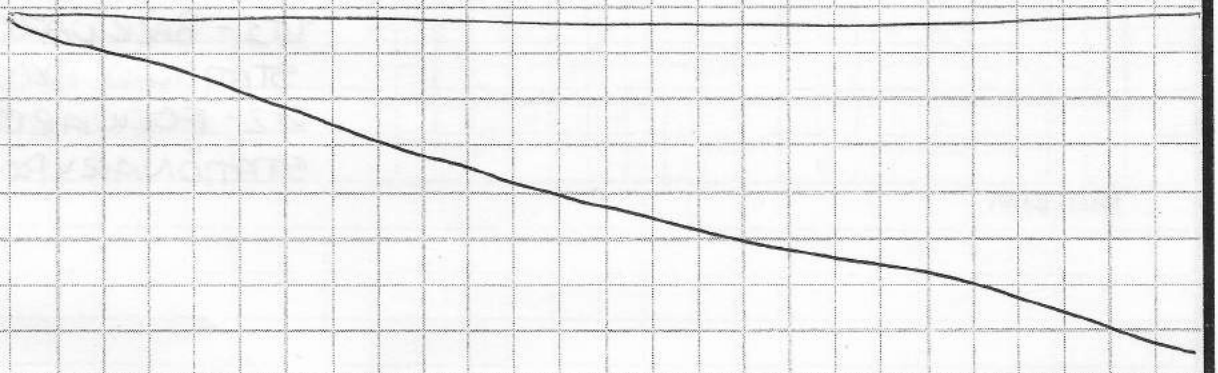
GOALS & IDEAS FOR THE SEASON

- OUR MAIN GOAL IS TO TRY SOMETHING NEW AND SUCCEED. WE HAVE DONE THE BASIC DESIGNS BEFORE, BUT WE WANTED TO INCORPORATE OUTSIDE ASPECTS TO INNOVATE THE BASIC DESIGN

* LAST SEASON, OUR ROV STRUGGLED TO LIFT ITEMS IN THE RECOVERY CHALLENGE, HAD LITTLE CONTROL, & LACKED TORQUE.
  - ↳ TO REMEDY THIS WE ARE PLANNING TO DO EXTENSIVE ~~RESAI~~ CV RESEARCH IN DIFFERENT TYPES OF VEHICLES.

OUR TEAM GOAL IS TO WORK TOGETHER TO PERFORM WELL AT REGIONALS AND HOPEFULLY GO BEYOND THAT.

WE WANT TO CREATE AN ORIGINAL ROV TO SUCCEED.

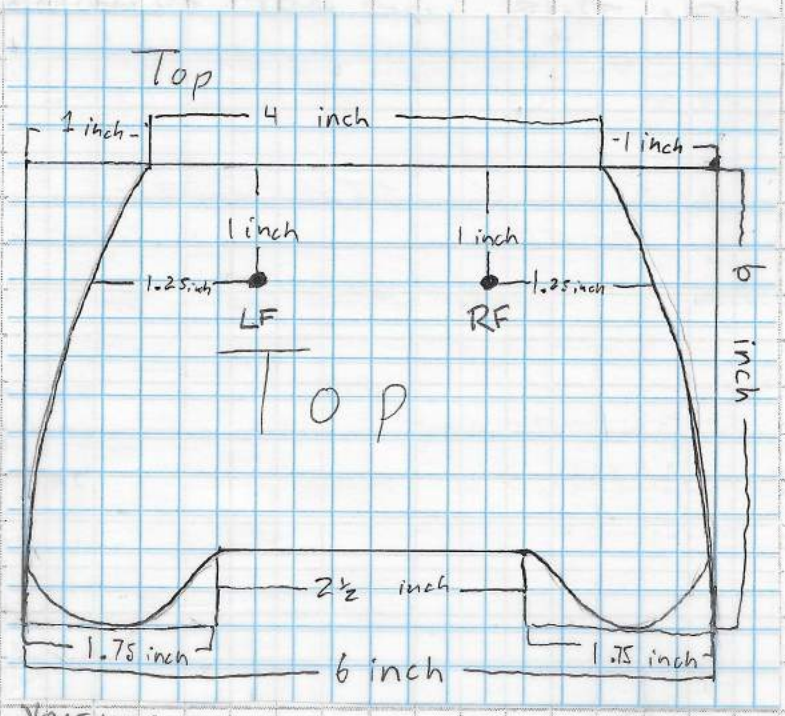


OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
[signature]	11/27/20	
WITNESS / TEACHER: Tracie Tramp	DATE: 11/27/2020	PROPRIETARY INFORMATION

CONTROLLER DESIGN

IN HIS FREE TIME, YALE DOES WOODWORK. AFTER USING THE BOXY DEFAULT CONTROLLER HE DECIDED TO CREATE HIS OWN THAT BETTER SUITS HIM. TO IMPROVE FUNCTIONALITY

INSPIRED BY GAMING CONTROLLERS, IT IS A MORE ORGANIC SHAPE TO BETTER FIT THE HAND. IT MAKES IT EASIER TO MANEUVER THE SWITCHES AND BUTTONS THAT ARE IMPLEMENTED INTO THE HOLLOWED WOOD.



YALE KIM

THE CONTROLLER HAS TWO JOY-STICKS AND FOUR SWITCHES

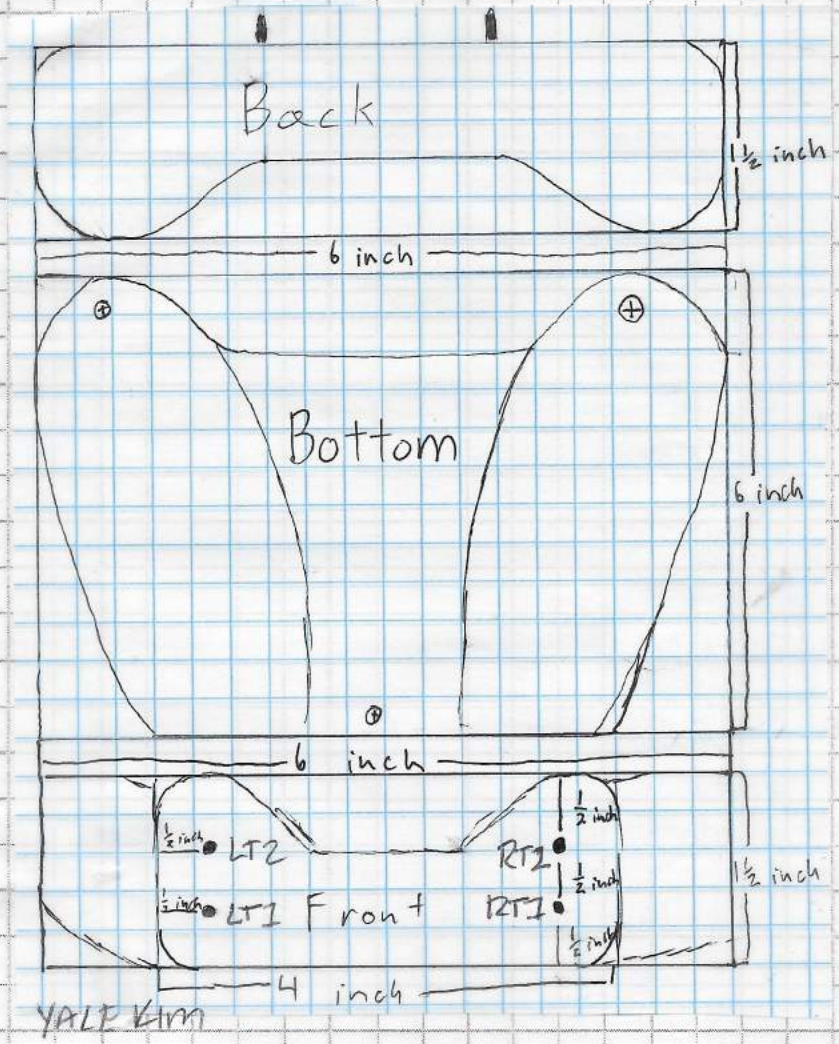
LF - LEFT PROPELLOR
RF - RIGHT PROPELLOR

LT1 - GEARBOX UP
LT2 - GEARBOX DOWN

RT1 - BACKWARDS STATIONARY PROPELLOR
RT2 - FORWARDS STATIONARY PROPELLOR

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Yale Kim	11/29/20	
WITNESS / TEACHER: Tracie Truong	DATE: 11/29/2020	PROPRIETARY INFORMATION

CONTROLLER FINAL SKETCH & PICS



YALE KIM

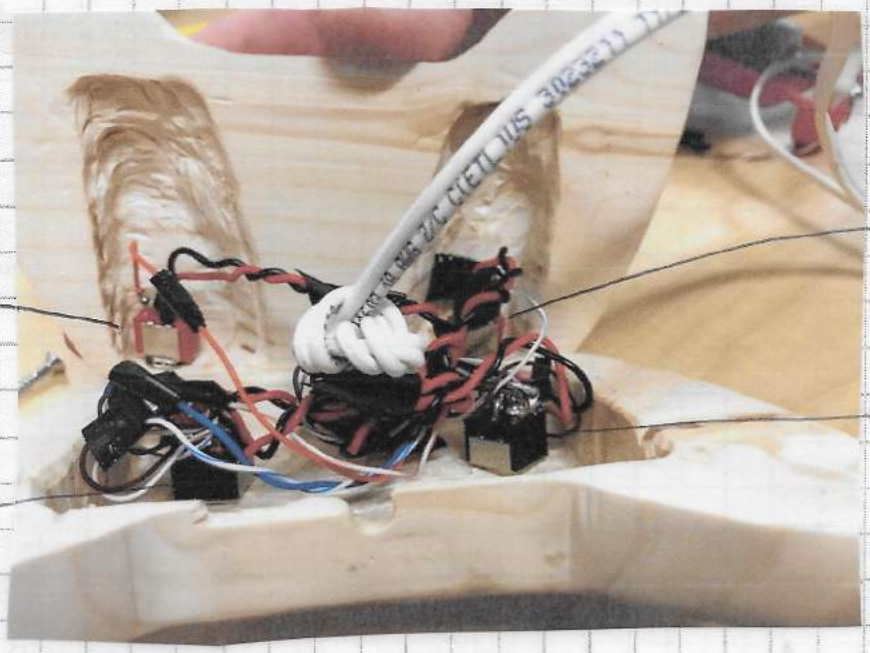
YALE KIM

THE BACK IS SCREWED ON IN A TRIANGLE FORMAT.

THERE WILL BE A HOLE DRILLED IN THE TOP FOR THE WIRE TO COME OUT AND THE INSIDE WILL BE CARVED OUT FOR THE REST OF THE WIRES TO SIT IN NEATLY.

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Cam Vu	11/29/20	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Tracie Travis	11/29/2020	

Entries



INSIDE OF CONTROLLER FINAL

FRONT

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Carlos Vargas	11/20/20	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
	11/20/20	

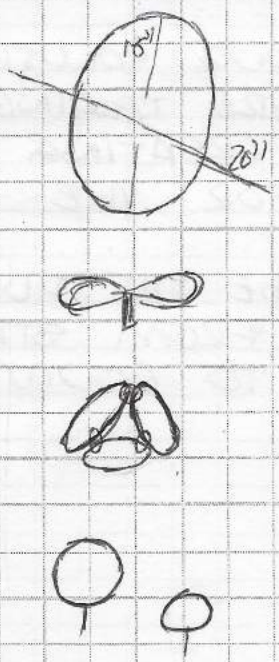
DESIGN BRAINSTORMING

AFTER LAST SEASON, WE ALREADY HAD AN IDEA OF WHAT WE WANTED TO DO. OUR BRAINSTORMING WAS NOT OF THE REGULAR DESIGNS, BUT OF IMPROVEMENTS

FIRST WE MADE A LIST OF CONSTRAINTS, THEN OF ADDITIONAL ASPECTS.

REQUIREMENTS

- LESS THAN 18" DIAMETER & NO LONGER THAN 20"
- ONLY 3 THRUST MOTORS
- MUST BE ABLE TO MANEUVER OBJECTS IN WATER
- MUST PERFORM SPEEDILY & AGILE



ADDITIONAL ASPECTS

- UNIQUE DESIGN THAT HAS NOT BEEN SEEN BEFORE
- MUST FIX LAST SEASON'S MANY ERRORS
- NEW COST LIMIT OF 25$
- LEARN TO COMMUNICATE

WE READ THROUGH THE RULES TO GET PROPER DEFINITIONS AND EXPLANATIONS FOR THIS SEASON'S IRREGULAR COMPETITION.

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
C V	12/1/20	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
	12/1/20	

Entries

DESIGN BRAINSTORM & RESEARCH

OVER THE SUMMER, YALE DID RESEARCH INTO DIFFERENT VEHICLES AND THEIR MECHANISMS. HE FOUND THE V22 OSPREY PLANE.

A THE V22 OSPREY PLANE
- ↳ A TILT-ROTOR AIRCRAFT WITH A UNIQUE CAPABILITY OF ROTATING PROPELLORS. IT IS ALSO KNOWN AS A "PROPROTER" SINCE IT COMBINES TWO PROPELLOR TYPES.

THIS INSPIRED OUR SOLUTION TO PREVIOUS SEASONS. WE ARE TAKING A SIMILAR APPROACH OF CREATING A ROTATING MECHANISM FOR THE THRUST MOTORS.

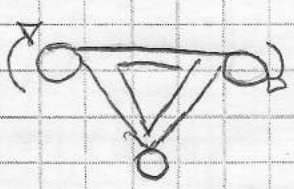
IT WILL CHANGE THE FUNCTIONALITY OF THE MOTORS FROM STATIONARY TO BEING ABLE TO COUNTER IT'S ACTIONS.

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Cam V	12/1/20	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Traci Dang	12/1/2020	

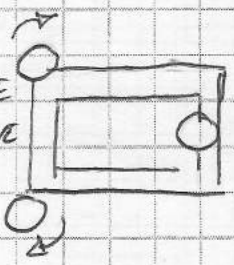
DESIGN BRAINSTORM

OUR DESIGN IDEA OF ROTATING MOTORS BRINGS A COMPLEX CHALLENGE OF HOW TO CREATE IT. WE STARTED WITH THIS ISSUE BEFORE CREATING A DESIGN AROUND.

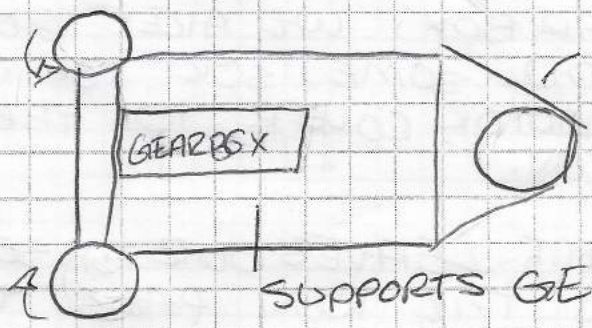
- TO ROTATE THE ARMS WE HAVE TO USE A GEARBOX. FOR THIS IDEA, THE GEARBOX WILL SIT IN THE MIDDLE AND CONNECT TO AN AXLE ON THE ROTATING ARM.
- FROM THERE WE MAPPED OUT SOME FRAME DESIGNS & THE OTHER THRUST MOTOR IDEAS.



TRIAGLE VS RECTANGLE
- HYDRODYNAMIC
- HARD TO BALANCE
- SUPPORTIVE
- CHUNKY



FOR THE FRAME, WE COMPROMISED ON A SHARE BY COMBINING BOTH A RECTANGLE AND A TRAPEZOID.



OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
[signature]	12/6/20	
WITNESS / TEACHER: Tracie Tracy	DATE: 12/6/2020	PROPRIETARY INFORMATION

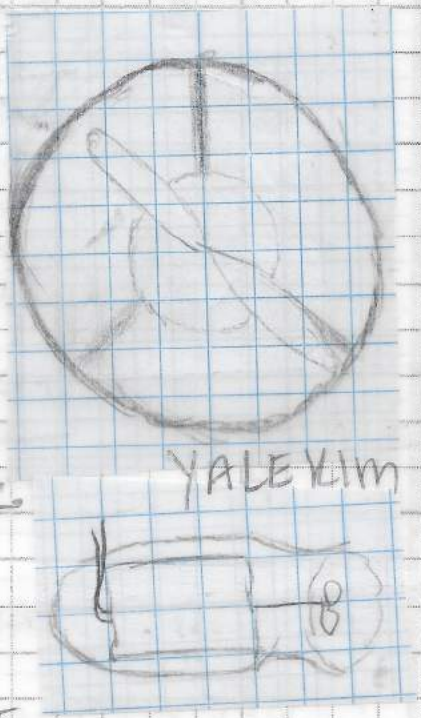
DESIGN BRAINSTORM

THE PROPELLORS ALSO NEED TO BE PROTECTED FROM OBSTACLES.

↳ WE ARE USING THE WELL KNOWN DESIGNS AS A BASE, BUT WE HAVE TO CONNECT OUR ROTATING MOTORS TO AN AXLE.

THESE ARE THE BASIC SKETCHES OF THE REGULAR MOTOR COVERS.

THE RING PROTECTS THE PROPELLOR & THE BULLET-LIKE BODY IS DESIGNED TO HOLD THE MOTOR & BE HYDRODYNAMIC.

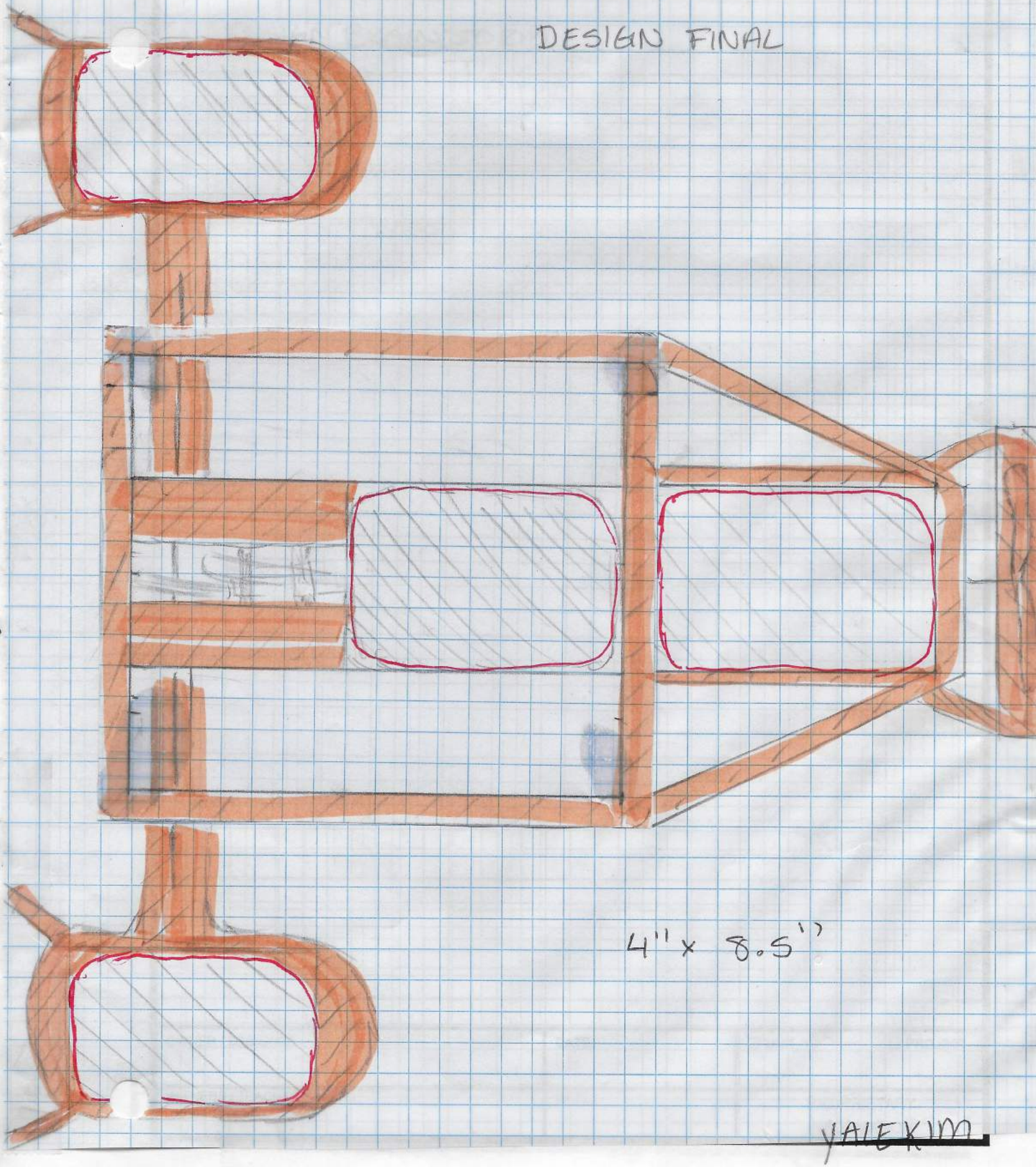


TO CONNECT TO AN AXLE IN THE GEARBOX, WE ARE GOING TO HAVE TO ADD SOME SORT OF CONNECTOR INTO THE MOTOR COVER TO THE FRAME OF THE ROV.

TOGETHER THIS LEAVES OUR BASE FINAL DESIGN ON THE NEXT PAGE. →

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Carlos V	12/6/20	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
yale lim	12/6/20	

DESIGN FINAL



4" x 8.5"

YALE KIM

DESIGN FINAL REASONING

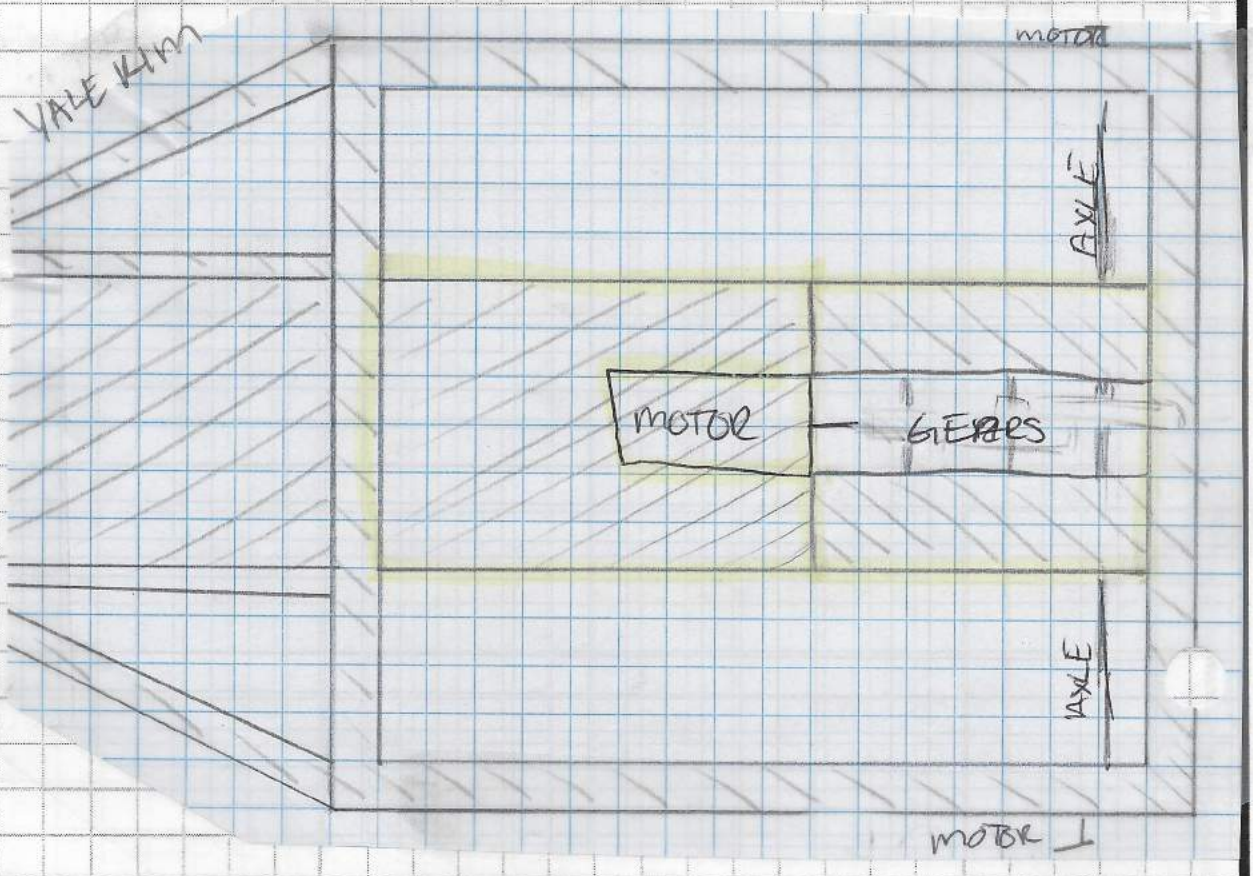
- WE AGREED AS A TEAM, YALE'S DESIGN WAS THE BEST FIT FOR OUR GOALS THIS SEASON.
  - ↳ THE PIVOTING MOTORS GIVE AN INNOVATIVE WAY TO CHANGE DIRECTION WHILE MAINTAINING POWER AND SPEED.
  - ↳ THE CUSTOM MOTOR COVERS WILL PROVIDE ALIGNMENT & PROTECTION
  - ↳ THE SHAPE WILL STABILIZE THE MOTORS WHILE ALSO BEING HYDRODYNMIC.
- WE ALSO AGREE OUR BIGGEST CHALLENGE IS THE ARMS.
  - ↳ WE MUST WORK OUT A WAY TO ROTATE THE ARMS IN THE GEARBOX
  - ↳ SINCE THIS IS SO NEW TO US, IT WILL INVOLVE MORE TESTING THAN PLANNING
  - ↳ WE NEED TO ADD PARTS THAT WILL INTERACT WITH THE GAME PIECES.

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
C V	12/8/20	
WITNESS / TEACHER: Laurie Leung	DATE: 12/8/2020	PROPRIETARY INFORMATION

GEARBOX DESIGN

- WE WANT TO ROTATE THE MOTORS, BUT ONE AXLE ALONE CANNOT PROVIDE THE STRENGTH NEEDED
  - THIS IS WHERE THE GEAR BOX COMES IN.
- FOR THE MAIN DESIGN, A CLASSIC GEAR BOX THAT WILL SNUGGLY FIT THE MOTOR IN THE MIDDLE OF THE ROV.

IN SIMPLER TERMS, A HOLLOW RECTANGULAR PRISM



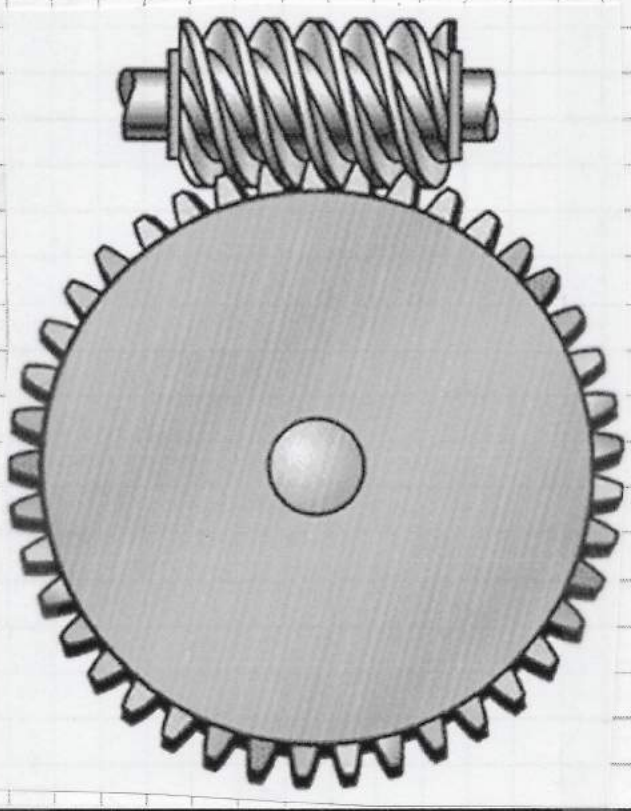
OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Connor Vu	12/12/20	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Tracie Truong	12/12/2020	

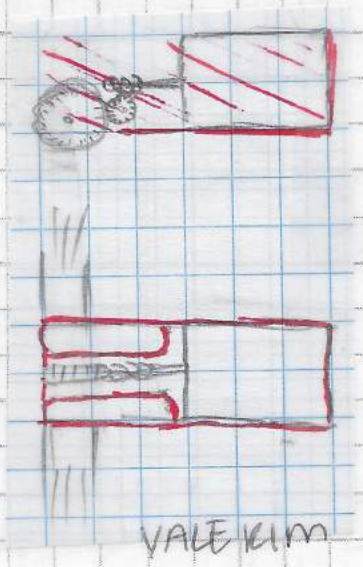
GEARBOX DESIGN AND RESEARCH

- OUR MAIN ISSUE IS THE ROTATION.
  - AFTER DOING SOME RESEARCH WE FOUND DIFFERENT MECHAISMS THAT COULD PERFORM THE INTENDED FUNCTION.

WE DECIDED ON THE WORM GEAR.

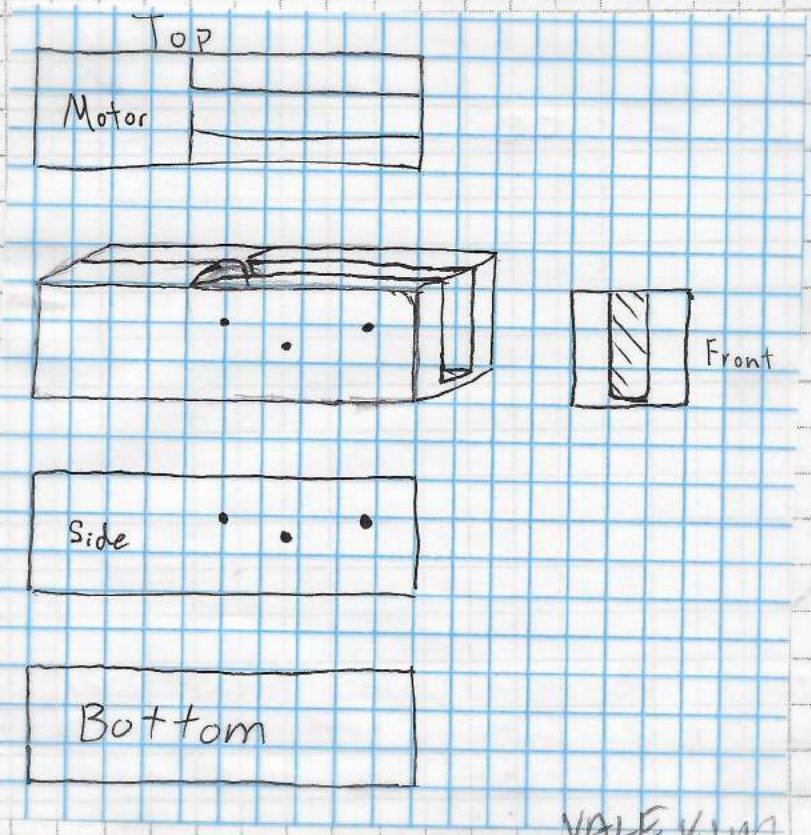
"IT CHANGES ROTATIONAL MOVEMENT BY 90 DEGREES, AND THE PLANE OF MOVEMENT ALSO CHANGES DUE TO THE POSITION OF THE WORM ON THE WORM WHEEL" - MachineryLubrication





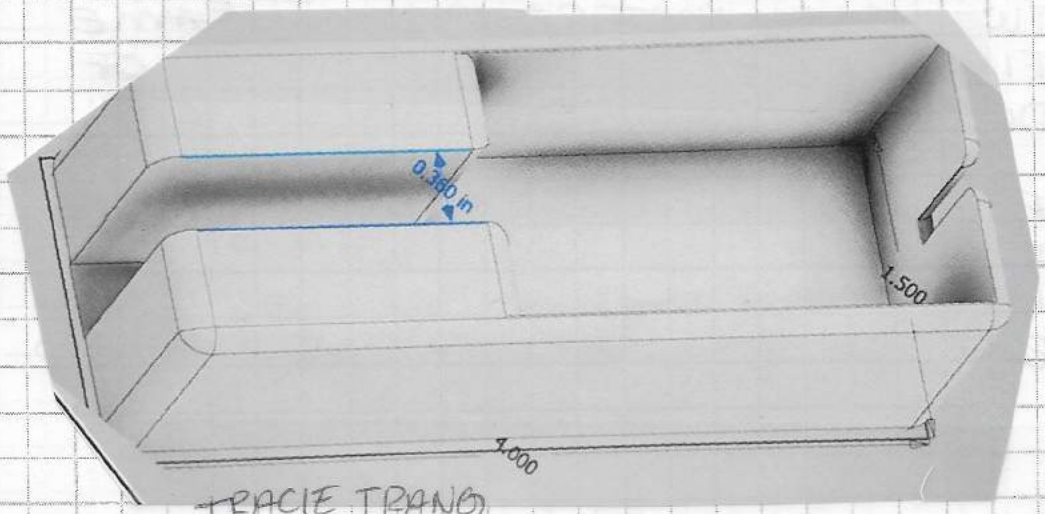
OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
C V	12/12/20	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
	12/12/20	

GEARBOX DESIGN AND CAD



VALE VIN

- THIS WAS OUR FIRST GENERAL DESIGN IDEA.
- THE ~~GEAR~~ GV GEARS WILL SIT INSIDE ON AXLES THAT GO THROUGH THE HOLES.
- WE THEN MADE A CAD DESIGN AND PRINTED IT

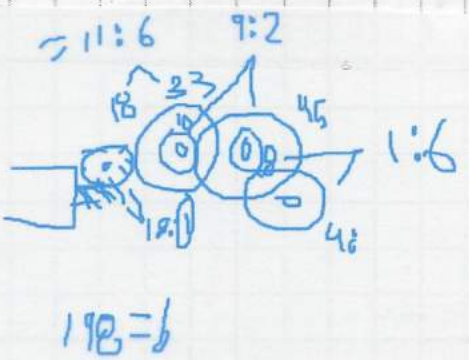


TRACIE TRANG

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Carlo Vino	12/14/20	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Tracie Trang	12/14/2020	

GEARBOX PROTOTYPE 1 & RATIO

- WE THEN IMPLEMENTED OUR GEARS BASED ON THE CALCULATED GEAR RATIO BELOW - 890:1



- WE KNOW THE GEAR RATIO FOR TORQUE IS A SMALLER GEAR AS THE INPUT & A LARGER GEARS AS THE OUTPUT
  - WE NEED THE TORQUE TO ROTATE TWO HEAVY MOTORS AT THE SAME TIME WITH THE RESISTANCE OF DRAG IN THE WATER

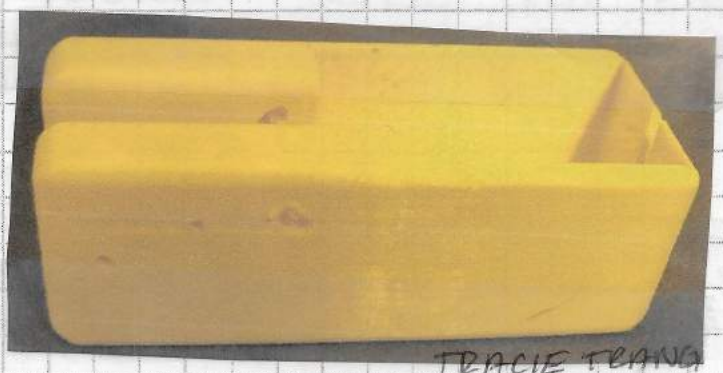
- THE PROTOTYPE, HOWEVER, SPUN TOO FAST TO CONTROL. WE THEN ADDED ANOTHER GEAR ONTO THE END TO REDUCE OUTPUT SPEED

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
[signature]	12/14/20	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
[signature]	12/14/2020	

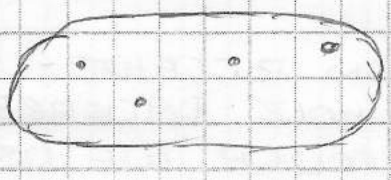
GEARBOX PROTOTYPES

IN ALL THERE WERE 2.5 PROTOTYPES

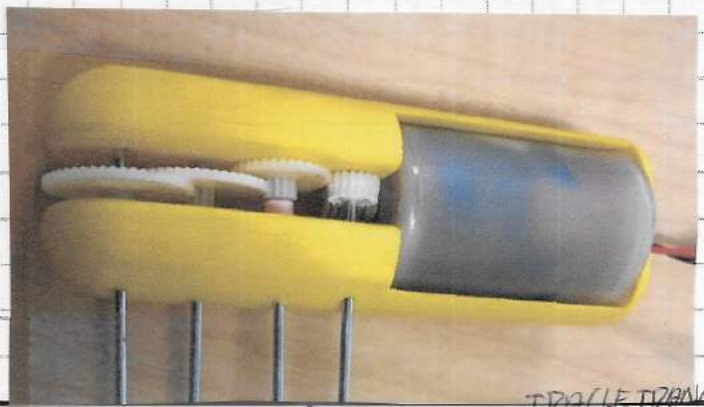
1.0 AS SEEN ON THE PREVIOUS PAGE
↳ TOO FAST, GEARS TOO LOOSE



1.5 A SMALL VERSION OF JUST THE HOLES TO FIX THE ALIGNMENT



2.0 A MORE ROUNDED, HYDRODYNAMIC VERSION
↳ WORKED WELL WITH THE NEW ALIGNMENT



OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Carlos Vivas	1/12/21	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Tracie Trang	1/12/2021	

GEARBOX COST

- THE GEARS & SPACERS CAME IN A SET FROM AMAZON
- THE PROTOTYPES WERE ALL 3D PRINTED LY WE PAY THE SCHOOL IN FULL BUT OUR FINAL ROV COST IS GOING TO BE LESS THAN 25$ REGARDLESS

NAME	WEIGHT	AMOUNT	COST x	TOTAL
PROTOTYPE 1.0	27	1	.05	1.35
PROTOTYPE 2.0	27	1	.05	1.35
PROTOTYPE 1.5	4	1	.05	.2

WE WANTED TO WAIT FOR A HIGHER TOTAL TO PAY THE SCHOOL.

AMAZON RECEIPT - THIS IS THE COST OF THE WHOLE PACKAGE AND WE CALCULATE HOW MUCH WE USED TO MONEY

Items:	$6.69
Shipping & Handling:	$0.00
Total Before Tax:	$6.69
Estimated Tax Collected:	$0.64
Order Total	**$7.33**

.875 $ used of 7.33$

OWNER / DESIGNER [signature]	DATE 1/12/21	☐ UNIT ☐ PROJECT
WITNESS / TEACHER Tracie Tracy	DATE 1/12/21	PROPRIETARY INFORMATION

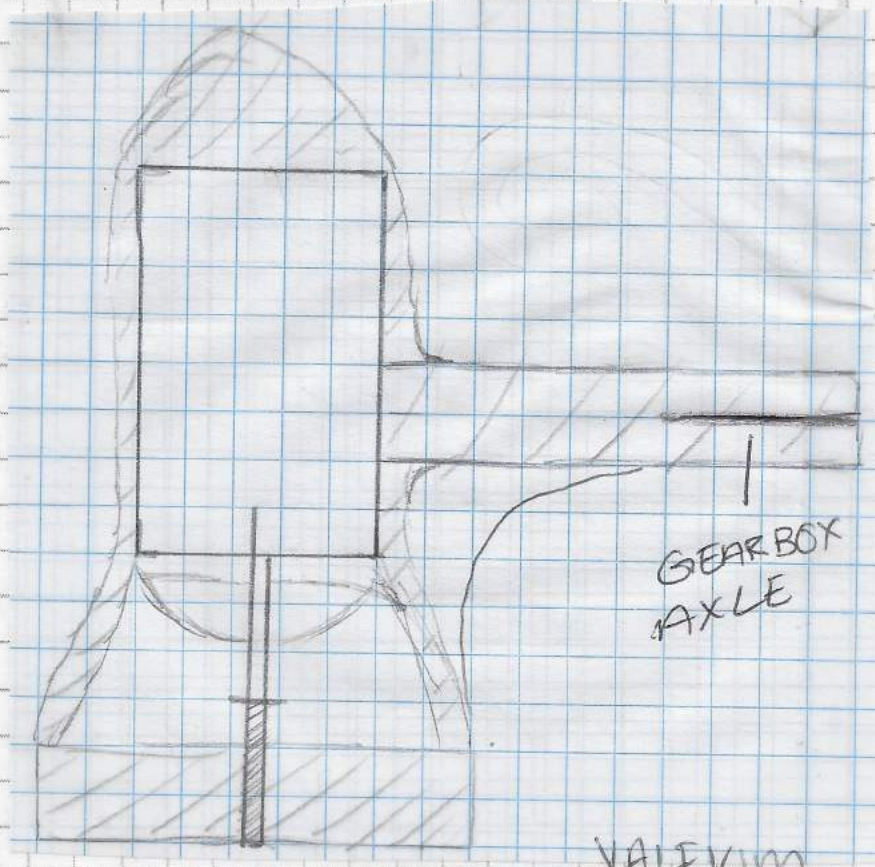
MOTOR COVER DESIGN

THE RULE STATE:

"ONLY THREE THRUSTERS WITH NO CHANGE TO THE PROPELLOR OR MOTOR"

FOR OUR THRUST MOTORS WE NEED CUSTOM DESIGNS.

↳ THE WING MOTORS NEED AN AXLE CONNECTOR. WE AGREED ON A 3-D PRINTED AXLE THAT WILL GO THROUGH THE FRAME



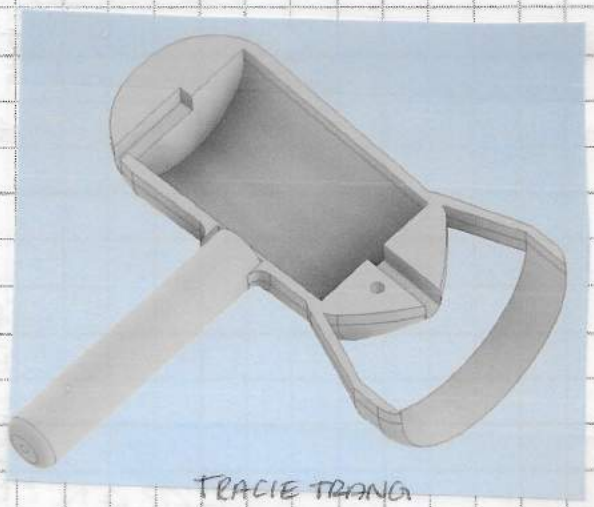
- THE LENGH FROM THE BODY NEED TO BE SHORT FOR BALANCE AND CONTROL
- THE AXLE FROM THE GEARBOX WILL SIT IN THE 3D PRINTED AXLE WITH SUPERGLUE.
- 2 PARTS IN 1/2

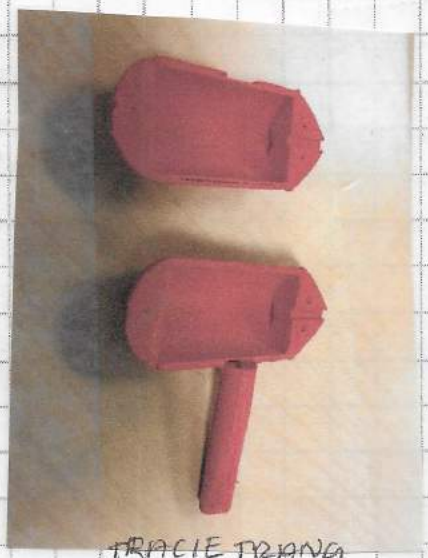
OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
[signature]	1/17/21	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Tracie Truong	1/17/2021	

MOTOR COVER PROTOTYPES

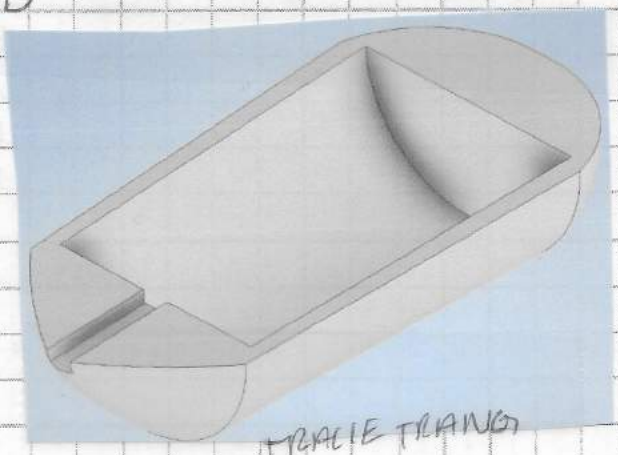
WE ALSO MADE MULTIPLE VERSIONS OF THE MOTOR COVERS

1.0 DID NOT CLOSE PROPERLY WITH THE TOP AND BOTTOM, ROD WARPED FROM MECHANICAL ERROR, TOO TIGHT, GUARDS BROKE





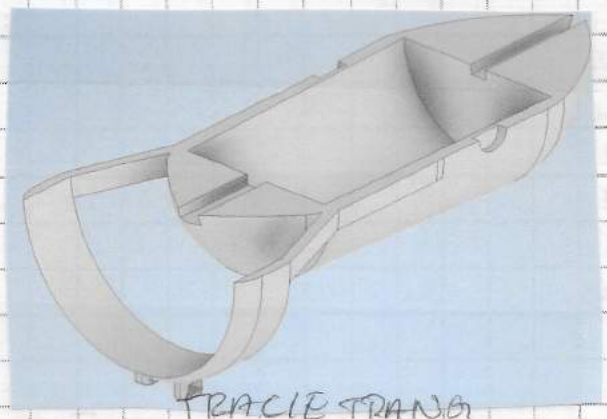
FIXED BY - SANDING INSIDE OF THE HOLE WHERE THE ROD GOES & ADJUSTED SIZE IN CAD



OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Cong Vinh	1/20/21	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Tracie Trang	1/20/2021	

MOTOR COVER PROTOTYPES

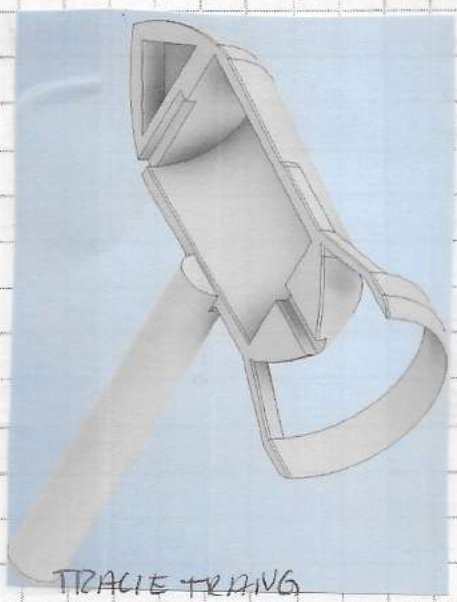
2.0 SIZE WAS NOW TOO BIG, ADJUSTED THE BULLET SHAPE TO BE HYDRODYNAMIC, MADE GUARDS THICKER



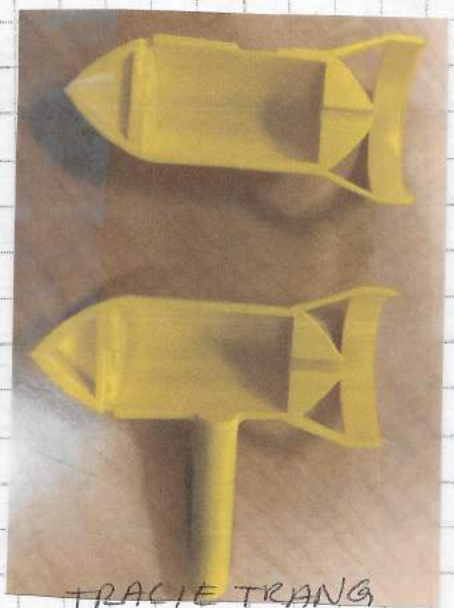
TRACIE TRANG

TRACIE TRANG

3.0 THE GUARD WAS STILL WEAK SO TRACIE EXTEND THE CONNECTING PART DOWN TO BRACE ALONG THE BODY



TRACIE TRANG



TRACIE TRANG

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Cora Vino	1/20/21	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Tracie Trang	1/20/2021	

MOTOR COVER COST

- THE PROTOTYPES ALL CAME IN SETS OF 2 FOR THE 2 PARTS EXCEPT 2.0 WHICH WAS TO TEST FOR FITTING THE MOTOR

NAME	WEIGHT	AMOUNT	COST x	TOTAL
PROTOTYPE 1.0	10	2	.05	1
PROTOTYPE 1.0 W/ROD	13	2	.05	1.3
PROTOTYPE 2.0	13	2	.05	1.3
PROTOTYPE 3.0	12	2	.03	1.2
PROTOTYPE 3.0 W/ROD	16	2	.05	1.6
BACK MOTOR	12	1	.05	.6

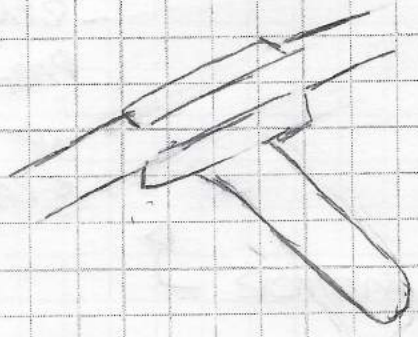
- THE BACK MOTOR WAS A TEST TO FIT IN THE FRAME WE DISCARDED AFTER DECIDING, INSTEAD TO PRINT IT INTO THE FRAME.

- WE USED SUPERGLUE TO ATTACH THESE TO THE GEARBOX AXLE
  - USED ON ANY SURFACE
  - CONSISTANTLY HOLDS
  - WATER & HYDROXYL REACT TO FORM A STRONGER BOND TO KEEP THEM TOGETHER.

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
C V	1/26/20	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
	1/26/21	

HOOK DESIGN & CLAWS DESIGN

- TO INCORPORATE INTERACTIVE PIECES, WE HAD TWO IDEAS; A HOOK & A BASKET CLAW
- THE HOOK IS SIMPLE AND HAS BEEN USED BEFORE SUCCESSFULLY.
  - A STRAIGHT, ROUNDED POLE THAT C-CLAMPS ONTO THE ROV



TRACIE TRANG

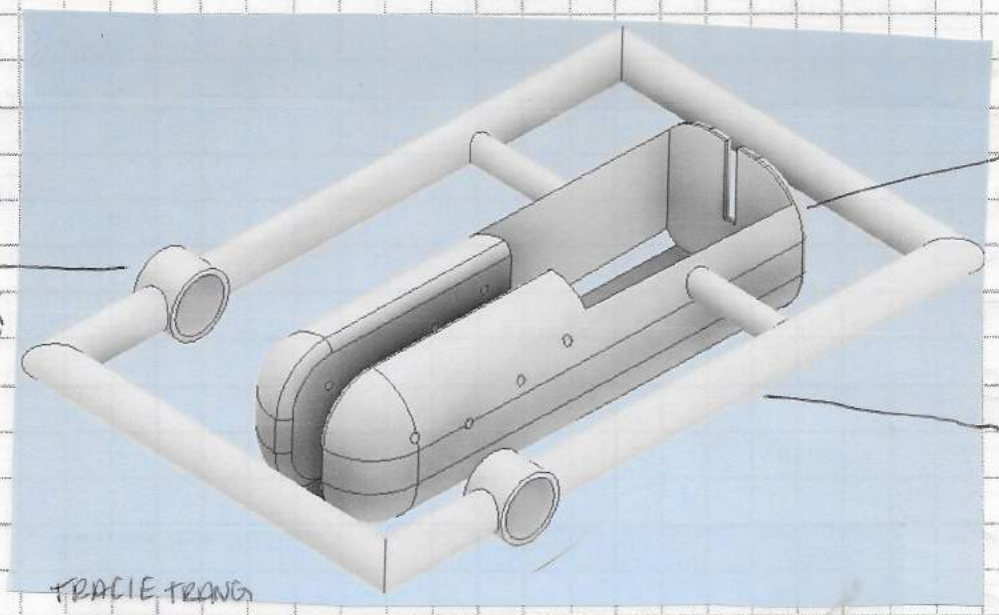
- THE BASKET CLAW IS A COMBO OF 3D PRINT AND BENT PAPERCLIPS
  - WE MADE L-SHAPED CLAWS THAT WILL ALSO C-CLAMP TO THE FRAME ALONG WITH BENT PAPERCLIPS TO BRACE A BASKET THE SIZE OF A 8.25" x 3.5" BOTTLE

TRACIE TRANG

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Carlos Vargas	2/4/21	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Tracie Trang	2/4/2021	

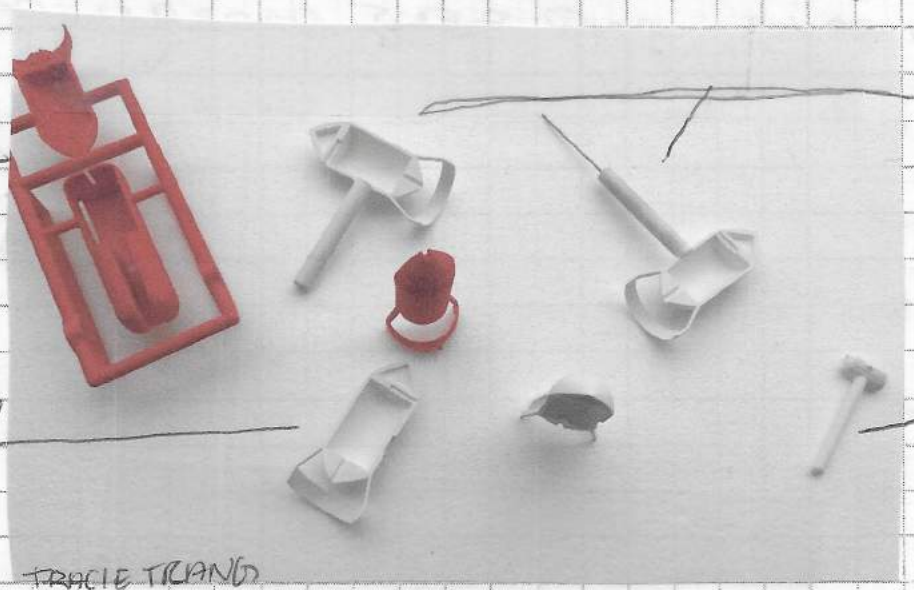
Entries

FINAL ROV CAD & PRINT



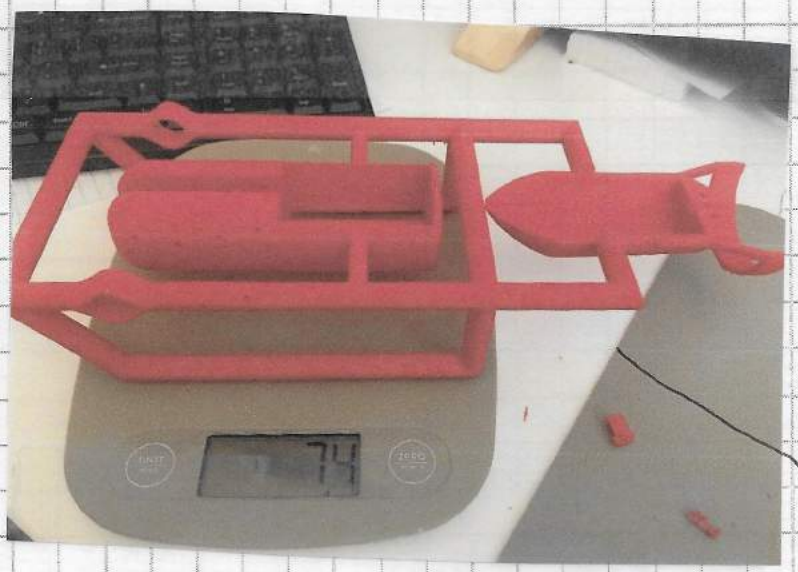
CAD BODY WITHOUT BACK MOTOR

FINAL MAIN COMPONENTS



OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
[signature]	2/16/21	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Tracie Trang	2/16/2021	

FINAL ROV CAD & PRINT

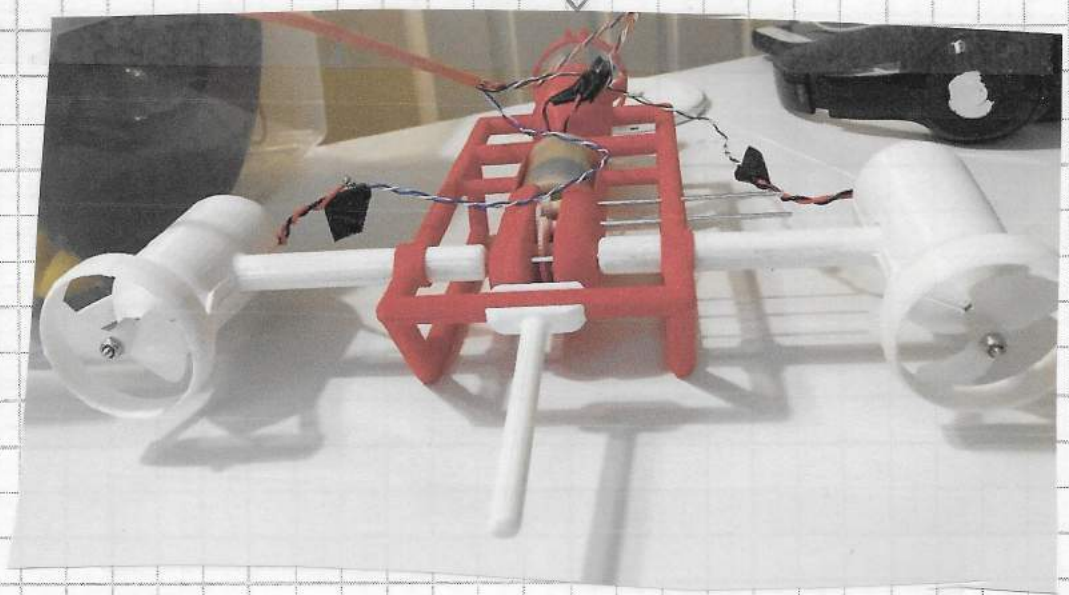


← FULL BODY W/ BACK MOTOR

* WE REMOVED THE TRAPEZOID FOR A SIMPLE RECTANGLE FOR STABILITY

ONCE PUT TOGETHER WE NOTICED THE ROV RESEMBLED A LOBTER, NOW HE'S NAMED LOBSTER.

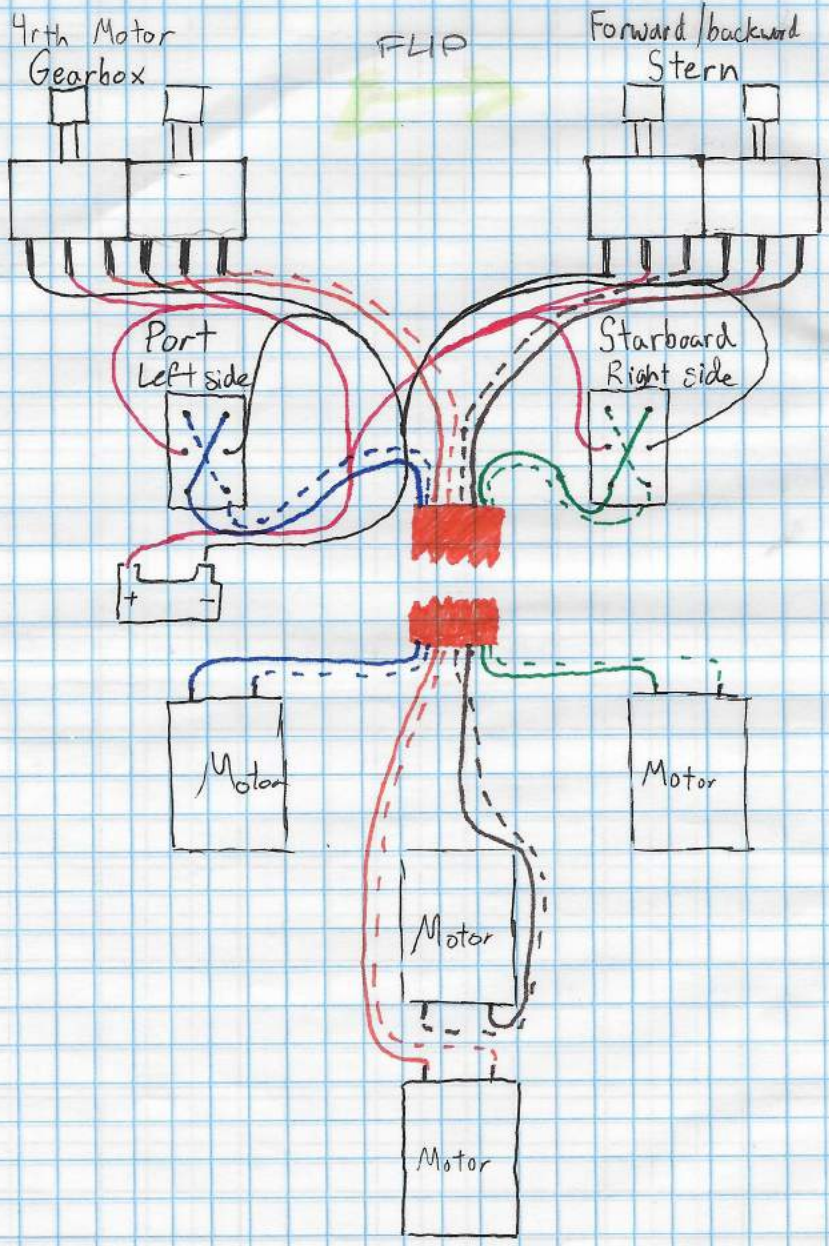
COMPLETE ROV ↓



OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Cam Vin	2/16/21	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
	2/16/21	

Entries

FINAL WIRING DIAGRAM (FLIPPED)



YALE KIM

OWNER / DESIGNER	DATE 2/23/21	☐ UNIT ☐ PROJECT
WITNESS / TEACHER Dracie Dracy	DATE 2/23/2021	PROPRIETARY INFORMATION

FINAL COSTS

- IN TOTAL TO THE SCHOOL OUR COST ARE

Part Name	Weight in Gr	Number of Parts	xCost per gram	Total Cost
GearboxPrototype One	27	1	0.05	1.35
GearboxPrototype Two	27	1	0.05	1.35
AlignmentPrototype	4	1	0.05	0.2
SideMotorPrototype One	10	2	0.05	1
SideMotorPrototype One w/ Rod	13	2	0.05	1.3
SideMotorPrototype Two	13	2	0.05	1.3
SideMotorPrototype Three	12	2	0.05	1.2
SideMotorPrototype Three w/ Rod	16	2	0.05	1.6
BackMotor	12	1	0.05	0.6
Hook	3	1	0.05	0.15
Body	150	1	0.05	7.5
Total	351			17.55

- THIS IS FOR 3D PRINT COSTS WE PAY TO THE SCHOOL. THIS IS NOT THE COST OF OUR FINAL ROV

RECEIPT **№ 2704**

Date 3/3, 2021

Received from Spicey otters

Seventeen and 55/100 Dollars $ 17.55

For 3D Printed Parts

Amt of Acct.		Paid Cash	✓
Amount Paid		Check	
Balance Due		Money Order	

By Quast

THANK YOU

OWNER / DESIGNER Cam V	DATE 3/28/21	☐ UNIT ☐ PROJECT
WITNESS / TEACHER Tracie Tracy	DATE 3/28/2021	PROPRIETARY INFORMATION

FINAL COSTS

• OUR FINAL ROV COSTS ARE

Component	Vendor	Component Used?	Cost
Gear Pack (gears, spacers)	Amazon	5 gears, 2 spacers used in the gearbox	0.875
Steel Axles Pack	Amazon	4 axles used in the gearbox	2.8
Fish Weight Pack	Amazon	4 weights used to sink the ROV	0.54
Styrofoam	Amazon	1.5"x1.5"x.5" piece used to test floatation	0.05
2"x6"x6" Cedar Wood	Lowes	1 piece made into controller	1.76
Floaties	School	4 pieces used to test floatation	0
Paper Clips	Amazon	5 paper clips used as pins/to hold items	0.04
SideMotorCover w/ Rod (3D)	School	Motor covers that rotate	1.6
BackMotor (3D)	School	Motor cover for the back	0.6
Hook (3D)	School	Hook for objects	0.15
Body (including gearbox) (3D)	School	Frame of ROV with gearbox	7.5
		Total Cost of SeaPerch Components	15.92

IN TOTAL, $15.92 IS OUR TOTAL ROV COST.

RECEIPTS:

Items:	$7.98
Shipping & Handling:	$0.00
Total Before Tax:	$7.98
Estimated Tax Collected:	$0.76
Order Total	**$8.74**

Items:	$14.99
Shipping & Handling:	$0.00
Total Before Tax:	$14.99
Estimated Tax Collected:	$1.42
Gift Certificate/Card:	-$6.30
Order Total	**$10.11**

View order details

[redacted]
Order #
111-2685106-4017021
Order total
$8.74 (1 item)

Cancel items

Shipment details

Change shipping speed

Not yet shipped

[redacted]

Officemate Giant Paper Clips, Pack of 10 Boxes of 100 Clips Each...
Qty: 1
Sold By: Amazon.com Services LLC
$7.98

[redacted]
Order #
111-6152426-4132239
Order total
$10.11 (1 item)

Cancel items

Shipment details

Change shipping speed

Not yet shipped

[redacted]

Silverlake Craft Foam Block - 4 Pack of 11x17x1 EPS Polystyrene...
Qty: 1
Sold By: SilverlakeLLC
$14.99

[redacted]
Order #
111-8829726-7348242
Order total
$7.33 (1 item)

Cancel items

Shipment details

Standard Shipping

Not yet shipped

[redacted]

LUSHAZER Fishing Weights Sinkers Kit, 100pcs Round Split Shot Sinker,...
Qty: 1
Sold By: Indoor Outdoor Furniture The Best Choice
$6.69

ALTHOUGH THE COSTS SEEM HIGH, WE ONLY UTILIZED A SMALL PORTION OF EACH PURCHASE.

WE CALCULATED THE EXACT COSTS OF EACH PART THEN ADDED OUR COSTS OFF OF THAT.

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
[signature]	3/28/21	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
[signature]	3/28/2021	

BIGGEST ISSUES

★ THE BIGGEST CHALLENGE WAS CONNECTING THE FINAL GEAR TO THE AXLE THE MOTORS ARE ON

1 WE USED SUPERGLUE AT FIRST TO BOND THE PLASTIC GEAR TO THE STEAL AXLE. IT ENDED UP SLIPPING & BREAKING.

2 THEN WE SANDED & REGLUED THINKING IT WASNOT SCORED ENOUGH. THAT ALSO SLIPPED.

3 WE GLUED ONE FINAL TIME WITH A LONGER WAIT TO DRY... THAT ALSO SLIPPED

4 NEXT, YALE SOLDERED THE AXLE & SCREW CAPS WHICH ENDED UP MELTING THE GEAR IT DID LAST LONGER, BUT EVENTUALLY BROKE

OUR INSTRUCTOR, Mr. QUAST, ADVISED US TO LOOK INTO EPOXY GLUES. WE FOUND JB WELDS & GORRILLA EPOXY

5 WE LET THE EPOXY CURE AND FINALLY IT STAYED!

FOR NOW AT LEAST, IT HOLDS WELL ON THE PLASTIC AND STEEL.

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Carlos Vinas	3/31/21	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Tracie Truong	3/31/2021	

FLOATATION

- SURPRISINGLY, OUR ROV WAS BALANCED ON IT'S WEIGHT, BUT IT HAD A HABIT OF FLIPPING WHEN WE USED STYROFOAM TO FLOAT IT.

↳ AFTER TESTING WE FOUND IT ROLLED BECAUSE THE FLOATATION WAS UNDER AND THE WEIGHT OF THE MOTOR WAS ON BOTTOM.

WE DECIDED TO COMPLETELY RID OUR DESIGN TO KEEP A LOWER CENTER OF MASS.

↳ THIS FLIPPED OUR WIRING WHICH I MARKED ON THE PAGE

INSTEAD OF STYROFOAM WE SWITCHED TO QUARTERED POOL NOODLES ATTACHED WITH ZIPTIES, AND ADDED 4 SYMMETRIC WEIGHTS.

WE ZIPTIED THESE TO THE FRAME OF ~~THIS ROV~~ CV THE ROV AND TESTED IT IN THE WATER. IT FLOATED WELL BUT DID NOT PULL TOO HARD WHEN SUBMERGED IN THE WATER TANKS WE PRACTICE WITH AT OUR SCHOOL.

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
Cam Vang	3/31/21	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
Tracie Truong	3/31/2021	

COMPLETE ROV

WE HAD TO REMOVE THE BASKET CAGE TO PHOTOGRAPH THIS BUT OUR COMPLETE ROV IS ABOVE.

WE ARE EXTREMELY PROUD AS TO HOW IT TURNED OUT AFTER SO MUCH TRIAL AND ERROR.

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
	4/3/21	
WITNESS / TEACHER	DATE	PROPRIETARY INFORMATION
	4/3/21	

REGIONALS

THIS YEAR REGIONALS WENT GREAT!

SPEED:

↳ WE HAD A PERSONAL BEST OF 16.3 SECONDS

↳ LAST YEAR WAS 45 SECONDS

RECOVERY:

↳ DID NOT GO AS WELL AS HOPED. WE FOUND ISSUES WITH THE DRIVING AS IT WAS OUR FIRST TIME IN A LARGE BODY OF WATER

OBSTACLE COURSE

↳ WENT WELL BUT THE MOTOR COVERS KEPT GETTING STUCK IN THE HOOP DESPITE BEING MUCH SMALLER.

OVERALL IT WAS A GREAT EXPERIENCE!

OWNER / DESIGNER	DATE 4/7/21	☐ UNIT ☐ PROJECT
WITNESS / TEACHER	DATE 4/7/21	PROPRIETARY INFORMATION

REDESIGN

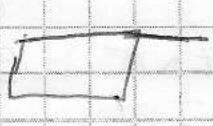
MOTOR PLACEMENT

↳ WE MOVED THE ROTATING MOTORS FROM THE ~~FRONT~~ FRONT TO THE BACK AND THE CV STATIONARY MOTOR TO THE MIDDLE

↳ WE ALSO CHANGED THE STATIONARY MOTOR TO A LIFT MOTOR 

CLAW

↳ THE BASKET DID NOT WORK WELL, NOR THE CLAW. SO WE REDESIGNED INTO A TRIDENT-LIKE CLAW 

↳ WE ALSO ADDED TWO HOOKS ON THE TOP 

SHAPE

↳ WE HAD TO CHANGE THE SHAPE FOR THE NEW MOTORS

↳ MADE A SQUARE & TRIANGLE SHAPE 

OWNER / DESIGNER	DATE	☐ UNIT ☐ PROJECT
[signature]	4/28/21	
WITNESS / TEACHER [signature]	DATE 4/29/21	PROPRIETARY INFORMATION