SEA SWEEPERS

HIGHWAY 68 ROV CLUB

SALINAS, CA

HTTP://SEASWEEPERSROV.COM

5/28/2015

Technical Report

TEAM MEMBERS

JP O'Dell - 6th year - Club President/Chief Executive Officer; ROV Pilot

John Yeager - 6th year - Vice President/Lead Mission Planner; Payload Retriever/ Overall Mission Manager

Tyler Allen - 1st year - Material Researcher/Vehicle Designer; Payload Retriever/ Backup Pilot

Kyle Nishimoto - 6th year - Documenter/Secretary; Tether Manager

Michael Georgariou III - 1st year - Media Representative/Programmer; Mathematician

Douglas Jackson - 2nd year - Chief Financial Officer; Pilot's Assistant

Kaden Agha - 1st year - Electrical Engineer

Mentored by: Kurt Yeager

* Team Position
* Mission Position

Sea Sweepers

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ABSTRACT

The Sea Sweepers ROV Club has been successful in the pool for six years now. We started out with four boys in fifth grade who were inexperienced, yet interested in robotics. Since then, we have achieved first place overall in the Scout, Navigator, and Ranger class in the regional M.A.T.E. competition. Last year, we swept the competition in the Navigator class, so the team decided to move up to Ranger. Over the years, we have learned many types of important life-skills. These include knowledge of electronics, the importance of teamwork, and business interactions.

This year's competition is based on arctic biology. It simulates science under the ice, subsea pipeline inspection/repair, and offshore oilfield production/maintenance. From year one, our team has been building our vehicles as simple as possible. Instead of focusing on complex hydraulics, metal frames, and 3D viewing goggles, we focus on the essentials. We decided from the beginning of this building season that we would keep the basic design of our past ROVs, and would use the NASA engineering design process to add new hardware to this year's vehicle. We decided on Sabertooth controller boards to replace our old K166s. In addition, we installed eight bilge pump motors, four cameras, two electromagnets and a servo, which enable this vehicle to accomplish many more tasks than previous years.

We entered this new division with high hopes. Our team strived for success, and we hope to continue our success in the international competition.

THE BUG 2.0

BIOGRAPHY

Our club, the Highway 68 ROV Club, has existed for six years now. The Sea Sweepers team started in 2010 with four boys in the fifth grade. Three boys have been participating since that first year: JP O'Dell, John Yeager and Kyle Nishimoto. Since 2010, two students participated and dropped out, but we added four who are still with the club. We have been extremely successful in our past competitions, and have had megatons of exciting experiences building our vehicles. While having fun making ROVs, we have learned the concept of teamwork, and how crucial it is to be working together. This enables us to work together and help each other out to complete tasks, or to divvy up the work and get it done as efficiently as possible.

For the first three years, we competed in the Scout Class, where we repeatedly ranked in the top three. Our ROV has always been made a good size so it is large enough to hold everything we need to complete the missions, yet as compact as possible to be very maneuverable. At this desirable size, our vehicle is quite speedy, resulting in low completion times of the missions.

Last year we participated the debut year for Navigator class. We dominated and earned first place in all categories of the division.

Our current team includes JP O'Dell, John Yeager, Kyle Nishimoto, Tyler Allen, Michael Georgariou III, Douglas Jackson, and Kaden Agha. Our vehicle is far more complex than previous years, which required more team members to design, build, and operate. We are optimistic, and hope to perform just as well as we did in the Navigator class.

THE SEA SWEEPERS

TEAM POSITION DESCRIPTIONS

President- Organizes meetings and supervises team members
Vice President- Assists president to make important decisions and execute them
Vehicle Designer- Designs Vehicle and finds parts
Secretary- Writes sponsorship letters and documents vehicle progress
Media Representative- Updates Facebook page and team website
Programmer- Programs any electronics that require programing
Chief Financial Officer- Logs all purchases

Electrical Engineer- Executes the majority of the wiring and soldering work

TEAM SAFETY PHILOSOPHY

Safety is the number one priority for us at the Highway 68 ROV Club. We take many precautionary measures in order to ensure that we are not putting our vehicle or ourselves in any type of danger. We do this by strictly following our critical safety requirements both in our workshop and at the poolside.

Our team makes sure always to keep our work area clean and organized. This is important in order to prevent easily avoidable injuries. When tools and parts are lying on the ground, they become tripping hazards. Electrical cords or the vehicle tether can be accidentally kicked and stepped on, causing breakage of expensive parts and even possible electrocution. Because of this, we make sure to store any unused pieces in tool bags, boxes, and bins and to neatly coil our extension cords. Each individual item has a specific storage location, so it can be easily found. Consequently, all tools and parts are safely stored and can be easily found at any time.

JOHN PRACTICING SAFETY

When powering on our control box, we always follow a certain procedure. First, we give the auxiliary power. After guaranteeing the power source is working correctly by checking for the green indicator light, we then turn on

power to the box with the main power switch. All of our vehicle's power is controlled with the one switch, so we can quickly flip it off if an emergency happens to erupt.

Our team always wears safety glasses whenever cutting, soldering, or using any other potentially harmful tools. Cutting wires always results in flying shrapnel that can easily get into our eyes. Wearing glasses or goggles is a very simple action that prevents any small pieces from being embedded into our eyes.

We have also built the vehicle with safety in mind. The motors are the most potentially harmful parts, because they spin quickly and that the propellers have sharp blades. Because of this, we have covered each one in a prop guard to prevent accidental cuts, scrapes, and breakage to the props themselves. The guards make the bilge pump motors as safe as a rock, without sacrificing performance. Additionally, we make sure that the ROV is safe to touch at all points, without being scratched up. All rough parts are either cut off or sanded to ensure a blood-free robot driving experience.

During poolside practice, we make sure to keep any live un-insulated wires away from water. Electrical components and large bodies of water are usually not a good pair, so we make sure to be extra careful to ensure the safety of both our expensive vehicle and us. All of the electrical components on the ROV itself are carefully waterproofed either from the factory, or by covering it with silicone or hot glue enclosed in heat shrink tube.

PRE-MISSION SAFETY CHECKLIST

- Box Power……ON
- Voltage (12-14 V)…… ……Normal
- Idle Amperage (1-2 A)…….. ……Normal
- Motor Power……On
- Camera Video……Acceptable
- Driving, Servo view, Top, Attachment
- Test Motors……Check
- Align crab motors……If needed
- Test Electromagnets……Check
- Test Servo……Full Range
- Test Bilge Pump……Check
- Test Current Probe……Check
- Spool Up Measuring String……Check
- Test Valve Turner……Check

- Tether……Free of Knots
- Manual attachments aligned……Check
- Necessary mission props……Check
- Sun Shade……Installed
- Deck crew……Ready
- Mathematician……Ready
- Vehicle Mngrs……Ready
- Tether Mngr……Ready
- Pilot Assist……Ready
- Pilot……Ready
- Final Walk Around……Complete

VEHICLE COMPONENTS

FRAME

The frame of the vehicle is constructed of 3/4 inch Polyvinyl Chloride (PVC) pipe. Though PVC is inherently a weaker and less exact material than composites and metals, the cost effectiveness and ease of shaping overshadowed the aforementioned downsides. In addition to constructing the general rectangular box shape frame, PVC was also used to construct the motor mounts that are composed of sawed-off three quarter to two inch PVC connectors. Lengths were measured and then either cut with a hacksaw, reciprocating saw or pipe cutters. It was noted that any method of cutting PVC is inherently inaccurate, but pipe cutters tended to produce the best result. When cutting the pipe, proper personal protective equipment was provided and was used to prevent debris entering the eyes and inhalation of dust or fumes.

ASSEMBLING THE FRAME

TETHER

THE TETHER

The tether on the ROV allows communication between the control box and electrical vehicle components. It consists of two 18x8 motor control wires, one CAT5e for the camera video, one CAT5e to control the servo claw and the electromagnet, a power cable for the camera power, and an extra CAT5 for future needs. The tether in encased in a 19 mm FlexoPet braided sheath. The sheath covers and encases all the wires, as well as increases the visibility of the tether in the water.

BUOYANCY AND BALLAST

Neutral buoyancy is vital for an easily and accurately navigable vehicle. We have achieved neutral buoyancy. To achieve this, the vehicle has two buoyancy tanks composed of two-inch ABS pipe sealed with ABS glue. This ensures an airtight seal that prevents any leaks into the interior of the tanks. These are mounted on the upper lateral sides of the vehicle to insure stability when driving the vehicle. Since these tanks overcompensated for the mass of the vehicle, pieces of rebar were placed in the PVC frame to achieve the long sought after neutral buoyancy.

BUOYANCY TANKS AND REBAR BALLAST

CAMERAS

Four waterproof backup cameras are mounted on our vehicle in order to ensure optimal visibility during vehicle operation. Our four cameras each have a specific purpose for when we are operating the vehicle. These consist of a driving camera, top view camera, internal status/electromagnetic camera, and front payload tool camera.

The cameras are connected to a PVC junction box, which we like to call the "Balun Box." Inside the box, we have a 4-channel balun sealed in a urethane casting resin. The balun takes four analog camera inputs and converts them to a digital signal run through a single CAT5e cable. This decreases tether size. Each of our cameras is hooked up to the three monitors on our box. The top view and internal status share one monitor, while the main driving and front payload cameras each use their own monitor.

MAIN DRIVING AND FRONT PAYLOAD CAMERA

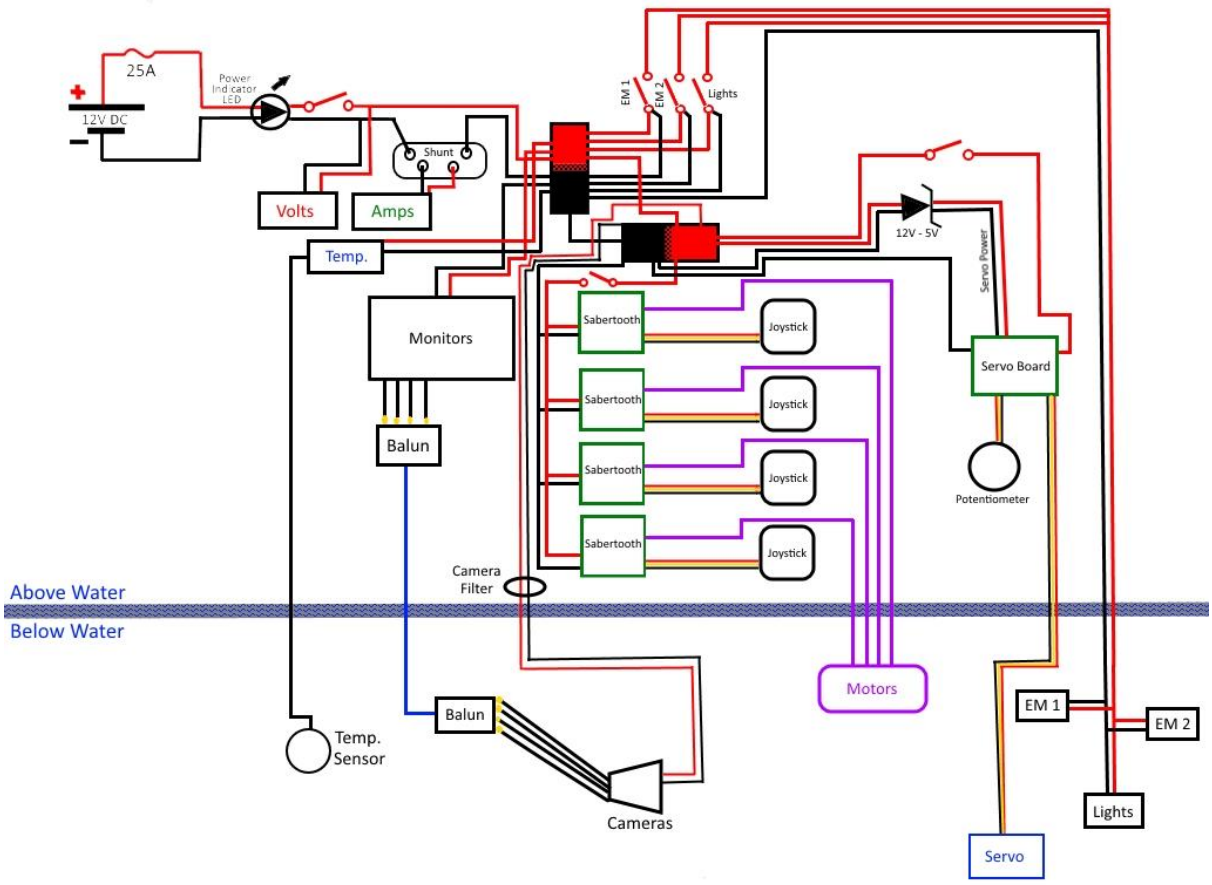
These two cameras are on their own monitors because they were important enough that they needed to be seen by our pilot at all times. We chose the top view and internal status tool to share one monitor because we felt that they were for specific missions or only needed to be checked on occasionally.

THRUSTERS

Our vehicle's thrusters are comprised of eight bilge pump cartridges. Bilge pump motors are made to pump water out of ships and are waterproofed from the manufacturer, making them the ideal thrusters for our vehicle. We mounted four of them vertically, one on each corner of our robot. The other four are mounted horizontally, and are spread out on the frame on the center. After wiring all of them with our joysticks in the control box, the thrusters and their locations allow us to move our vehicle in every axis necessary to perform the demonstrations.

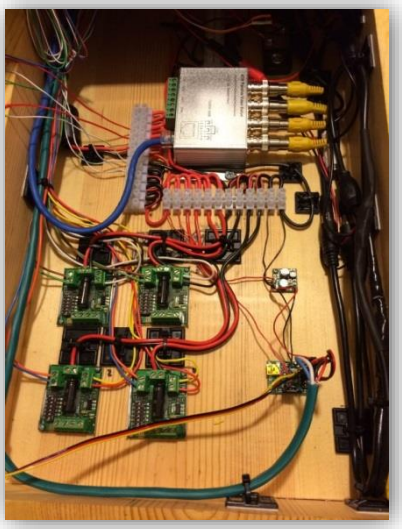
THRUSTER

SYSTEM INTEGRATION DIAGRAM



CENTRAL CONTROL SYSTEM

Our vehicle control system is one of our most unique features this year. The entire box and control system were designed and made from scratch. The box itself was hand crafted from a single 3-meter piece of pine. All of the switches, joysticks, and monitors, are mounted on the external surface of the panels, while the circuits are contained within the box. Our control box is designed with a build-in sunshade frame covered in a blackout cloth to enable the driver to easily see the video feed, without any glare from the sun.



CENTRAL CONTROL SYSTEM

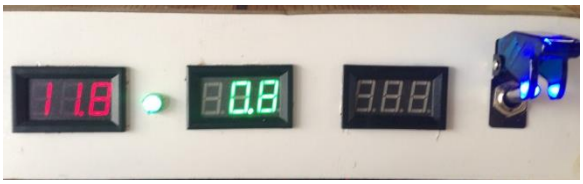
VIDEO MONITORS

Our control box is equipped with three video monitors that display the images from our four cameras. The 23-cm monitor in the center displays the input from the main driving camera. The 18-cm monitor on the left is hooked up to the servo claw camera. The 18-cm monitor on the right displays the video feed from two cameras. Input one is connected to the center electromagnet camera, while switching to input two will put the video from the top view camera on the monitor. Having three monitors on our control box allows us to display multiple video feeds at once and gives us a greater situational awareness around the ROV.

VIDEO MONITORS

STATUS DISPLAYS

We have three status displays mounted on the control box below the monitors. The first of the displays shows the volts (in red) provided to the control box by the power supply. The second display indicates the number of amperes (in green) currently drawn by our system. The last display (in blue) is connected to a tiny temperature probe mounted on the vehicle and displays the water temperature in degrees Celsius.



STATUS DISPLAYS

THRUSTER CONTROL JOYSTICKS

JOYSTICKS

There are four thruster control joysticks mounted on the lower panel of our control consol. Each joystick has a two-potentiometer axes which read variable speed input from the position of the joystick and communicate that information to the Sabertooth controller boards. Each Sabertooth is connected to two motors on

the ROV. The two joysticks mounted in the center of the panel control the primary functions of the vehicle. The joystick on the right controls the four horizontal motors and allows for forward/backward/ movement as well as left/right pivoting turns. The joystick on the left controls the four vertical motors that moves the vehicle straight up and down. Two joysticks are not enough to give us all of the axes that we would like. That is what the "secondary" joysticks are used for. We installed a series of three simple switches that allow us to move about other axes. When we flip a switch, we transfer control from the horizontal motor joystick to its secondary counterpart. This other joystick is configured differently so that after manually adjusting the motors on the ROV, our vehicle is able to crab left and right. The main vertical joystick has a similar setup. Flipping a different switch transfers that control to its counterpart, which allows the vehicle to pitch its nose up and down. This multi-joystick system allows us to precisely control our vehicle during missions.

AUXILIARY SWITCHES

Our control system is decorated with a pantheon of auxiliary switches. The main power switch on the far right of the panel turns the electrical power to the entire system on and off. Both the vertical and horizontal motors each have a power switch. This guarantees that nobody will get his or her finger caught in a propeller when the power is connected to the box. We also have power switches for attachments that are connected to the vehicle. These switches have safety covers and glow red while engaged, and white while dis-engaged. We have a toggle switch with a safety cover for our servo claw. This is an essential part to the safety of the servo because it assures us that the servo will not move without the flip of that switch. A set of three switches in the center of the control panel function to transfer control between joysticks, as mentioned in the previous section. Finally, we have a rocker switch that turns the vehicle lights on and off. Auxiliary switches provide all of the additional function not possible by joysticks alone, thus enabling the ROV to function and complete its missions

SERVO SWITCH, VOLT METER SWITCH, DRIVING LIGHTS, AND ATTACHMENT SWITCHES

TETHER CONNECTOR

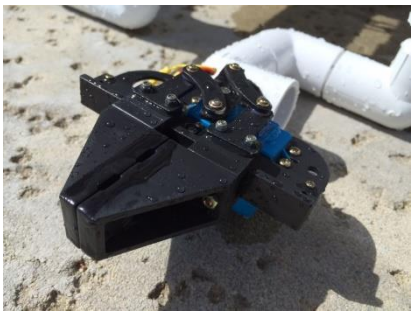
After the hassle of coiling up and storing our tether with our ROV last year, we decided on having a detachable tether for the 2015 season. While, the tether is permanently connected to the ROV, it can be detached from the control box using a heavy-duty military grade Cannon™ connector. These are the same exact type of connectors that the military uses in their fighter jets, meaning that they are unlikely to fail, and are extremely durable. This Cannon™ connector is set up in two pieces: one attached to the tether and one to the box. They have 43 electrical contacts that can be connected or disconnected in a second. This connector makes our vehicle much easier to store, transport, and set up at the mission station.

TETHER CONNECTOR

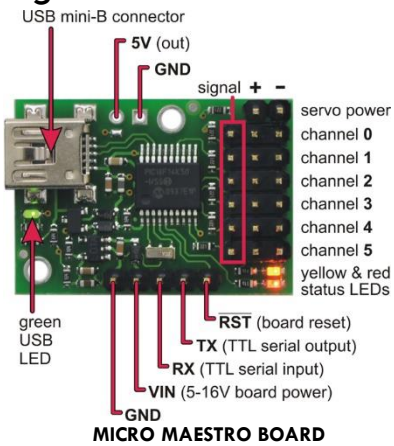
PAYLOAD TOOLS

SERVO CLAW

A servo controls the "claw" payload attachment on the front of our vehicle. A servo is a device that uses electrical power and one signal wire in order to act as an electric arm. The Micro Maestro Scripting Language controls this arm. Using this scripting language, we programmed our servo to mirror what the position of the potentiometer on our board. This board is wired with the potentiometer connected to port 0 and the servo connected to port 1. The position of the potentiometer sends a signal into the Micro Maestro board, which it processes it within the script that we programmed. The board then interprets the position and mirrors it to the servo at the angle we need.



SERVO CLAW



MICRO MAESTRO BOARD DIAGRAM BY POLOLU

LIGHTS

Lights are needed to see at the depths required for the ranger class. Because of this, we invested in an ultra-strong 15 centimeter LED light bar. It was waterproofed and received a IP69k ranking, which means we did not need to waterproof it further. It is mounted on the top front crossbar of our vehicle. Consequently, our cameras can produce clear, bright images, even at deep depths. In our previous vehicle, we used two pond lights that were not waterproof. This led to problems with water intrusion, and altered our buoyancy mid-mission. We decided we needed to better waterproof our lighting system, which is why we settled on a different light setup.

LIGHT BAR

MEASURING DEVICE

Our team had great difficulty designing and perfecting a measuring device in order to complete the mission tasks this season. We attempted a tape measure, a yardstick, a reference pipe, and a rangefinder, but in the end found a much more simple system. We attach a 1.5-meter string via a hook to the object that we need to measure. We then put the vehicle in reverse until the string is taught as to know our exact distance to the object. We have calculated that an object 1 meter in length appears as 8 centimeters in our monitors. We use this ratio to determine the length of any object that we see in the monitor as long as we are at the fixed distance that the string provides.

ALGAE SAMPLE COLLECTOR

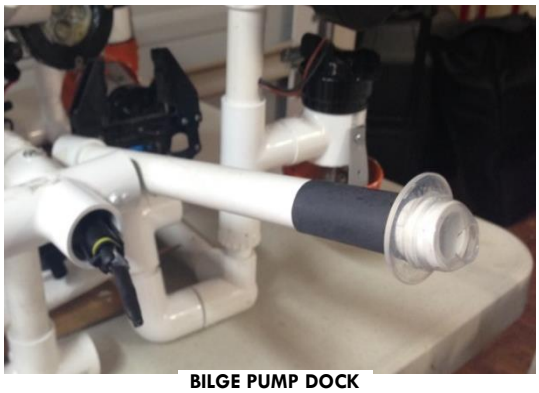
A more recent attachment to our vehicle is our algae sample collector. The idea for this design emerged when one of our team members dropped the bilge pump motor and broke the threaded output connecter. We then decided that we could reverse the direction of the water flow and have the pump suck water instead of push it. Connected to the top of our vehicle, the collector uses a bilge pump in order to suck the algae samples from under the ice sheet. When turned on, the algae sample is immediately sucked onto our vehicle for retrieval in the surface.

ALGAE SAMPLE COLLECTOR

VALVE TURNER

In order to turn the pipeline valves, we use a high torque 30-RPM motor. It is connected to four downward-facing prongs to grip the handle. Connected to a momentary double pull double through switch, we can turn the valves either on or off because we can control our turner in both directions. The key to this design is the high torque. Otherwise, in the water, normal motors would not provide the amount of force needed to turn the valves.

BILGE PUMP DOCK



BILGE PUMP DOCK

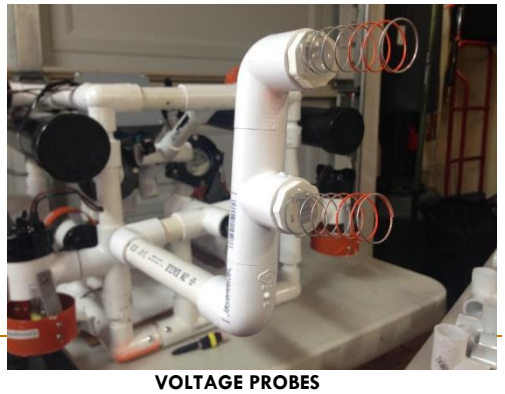
Another bilge pump is being used on our vehicle to pump water through a pipeline. It is a quarter inch bilge pump that can push over five meters. Attached to the pump is a rubber nipple that creates a seal on the pipeline in order to push a constant stream of water through the pipeline.

ELECTROMAGNET

ELECTROMAGNET

Two of the payload tools mounted on our vehicle are electromagnets. The larger electromagnet is located in the center of the vehicle, facing the side. Another is on the front of the vehicle, facing forward. The front magnet is rated to 25 kg, while the main one is rated 60 kg. We will use these in the pipeline repair mission in order to grab and hold U-Bolts while manipulating other things with our servo claw.

VOLTAGE PROBES



VOLTAGE PROBES

In order to test the grounding of anodes, we have an attachment consisting of two springs that are attached to a multimeter through the tether. We chose to use springs to make finding the measurement easier for the pilot. He can

move up or to the sides and would still have leeway in order to not be completely accurate. This allows us to get a more consistent reading on our multimeter.

BASIC ATTACHMENTS

While our vehicle is equipped with more advanced attachments for this new division, we have not forgotten that a simple attachment can often accomplish more than a complex one with a much lower possibility of failure. Our vehicle is equipped with a marshmallow-roaster mounted on the side of the frame that is just as effective at picking up the O-Balls in the "Science Under the Ice" mission as any electronic or pneumatic manipulator is. Our vehicle will also utilize good-old-fashioned PVC pipe in order to turn the valves in "Offshore Oil Field" mission. Our vehicle is designed in a way that will make it easy to add any simple hooks or skewers that we may need in the event of a failure of one of our more advanced payload tools. We have applied our philosophy of very simple attachments to great success in the past and hope that philosophy will help us in succeeding again this year.

MARSHMELLOW SKEWER

CHALLENGES FACED AND FINANCES

CHALLENGES

Throughout the 2015 competition season, our team experienced many challenges with our vehicle's buoyancy and with our electrical servo manipulator. We started off with short 2" PVC buoyancy tanks, which were too small to suspend our robot with all of its heavy motors, lights, and the balun box. We could not fit large enough tanks to the side of the vehicle, which caused us a big challenge. We decided to craft a large buoyancy tank made of 2"ABS that wraps around the entire back of the vehicle. This enables our ROV to have the perfect buoyancy that we need to complete our mission tasks with ease.

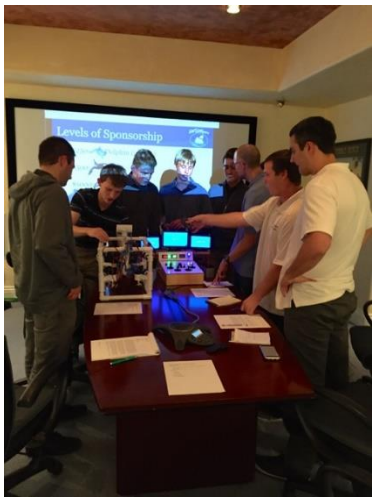
Our second main challenge this season was with our electrical servo manipulator. For some reason, the servo worked perfectly on the poolside, but would immediately fail when submersed into the water. We know that the

servo was not being flooded because it would continue to work immediately when it came out of the water. Additionally, we know that it was not a pressure issue due to the fact that it began malfunctioning even being submersed in two centimeters of water. We are still not sure what the problem was, but we fixed it by hooking up a brand new servo. Before mounting it, we made sure to fully waterproof it by filling the inside with electrical grease and by covering the outer casing with rubber tool dip.

BUDGET/ VEHICLE COSTING

SALES PRESENTATION AT "EXTREME IMPACT"

During the 2015 ROV season, we anticipated our entire system to cost quite a bit more than last year. At the beginning of the year, we set a rough budget of $3500. This estimate covered the cost of the vehicle, control box, all electronic equipment, and team t-shirts. We knew that we would need to get working on securing sponsorships early in the year, and that is exactly what we did. We started with our previous sponsors, asking if they could match or even increase their donation from last season. All of the sponsors asked matched or exceeded their previous donation. We followed a very strict and organized process when it came to asking for sponsorships. We sent out letters in the mail to multiple companies, and then followed up with a phone call a few days later. Then, if the company was interested, we followed up with an interview. We prepared PowerPoint presentations and rehearsed our communicating skills. During the presentations, we talked about our plans for the year, and our current progress on the vehicle. Then we had a Q&A session which often lasted up to forty-five minutes. After surprising our potential sponsors about our accomplishments, we walked out and received a check a few days later. After all of our money was raised, we brought in over $4000 in generous donations from local companies and relatives. This allowed us to purchase and backup components in case something broke at the



"Q&A" WITH EXTREME IMPACT

competition. Without the extremely generous donations of our sponsors, we would not be able to build anything that we did this year. Now that we are heading to Canada for the international competition, we need to raise even more funds. We are reaching out to previous sponsors and searching for new ones at the time this technical report is due. We have raised over $1500 after our regional competition, but we expect to need over $14,000. We have planned local fundraising events and expect a great turnout from them.

SPECIFIC BUDGET

Catagories	Example Items	Estimated Cost
Electronics	Monitors, Cameras, Wires, Switches, Lights..	$1,500.00
Equipment	Bilge Pump Motors, Tether, Power Supply...	$900.00
Frame Material	PVC Pipes, Wood For Box...	$400.00
Payload Tools	Servo, Claw, Bilge Pump Motor...	$400.00
Mission Props	PVC, Cement, Rope, O Balls...	$300.00
		$3,500.00

Post-Competition

	Contributor	Amount
	Tactical Wealth Management	$250.00
	Don Ratcliff	$500.00
	Extreme Impact	$500.00
	MayFest Attendees	$146.00
	Website Donations	$390.00
Total		**$1,786.00**

Pre-Competition

	Contributor	Amount
	Growers Ice	$1,500.00
	Extreme Impact	$500.00
	Salinas Valley Primecare	$500.00
	Patane, Gumberg, Avila LLP	$500.00
	Companion Pet Health, Inc.	$250.00
	Sprenkle & Georgariou, LLP	$250.00
	StreamLife, Inc.	$250.00
	John and Lily Crawley	$250.00
	Jeff and Kim Guidice	$100.00
	John and Sue O'Dell	$300.00
	Jeana Sutton	$250.00
Total		**$4,650.00**

Grand Total To Date $6,436.00

Sea Sweepers International Team Budget

Member	Hotel	Air Fare	Food	Totals
J.P. O'Dell	$ 300.00	$ 1,000.00	$ 300.00	$ 1,600.00
John Yeager	$ 300.00	$ 1,000.00	$ 300.00	$ 1,600.00
Kyle Nishimoto	$ 250.00	$ 1,000.00	$ 300.00	$ 1,550.00
Douglas Jackson	$ 250.00	$ 1,000.00	$ 300.00	$ 1,550.00
Tyler Allen	$ 250.00	$ 1,000.00	$ 300.00	$ 1,550.00
Michael Georgariou	$ 300.00	$ 1,000.00	$ 300.00	$ 1,600.00
Kurt Yeager (Coach)	$ 600.00	$ 1,000.00	$ 300.00	$ 1,900.00
Totals	**$ 2,250.00**	**$ 7,000.00**	**$ 2,100.00**	**$11,350.00**
Others				
Rental Car				$ 600.00
Vehicle Rework				$ 500.00
Shipping Expense				$ 1,500.00
Marketing Expense				$ 150.00
			Total	$ 2,750.00
			Grand Total	**$14,100.00**

Expenditures			
Category	Item		Amount
Electrical	Motor Control Boards		$ 312.00
	Servo Control Board		$ 22.00
	Tether / Wires		$ 419.00
	Monitors		$ 116.00
	Joysticks		$ 55.00
	Camera System		$ 538.00
	Switches, Potentiometers		$ 68.00
	Status Displays		$ 32.00
	Sub-Total		**$ 1,562.00**
Vehicle	PVC Pipe		$ 250.00
	Motors		$ 256.00
	Attachments (inc. Servo)		$ 486.00
	Camera System	(see above)	
	Light		$ 56.00
	Electromagnets		$ 95.00
	Sub-Total		**$ 1,143.00**
Supplies	Sealant		$ 150.00
	Multimeter		$ 3.00
	Mission Props		$ 250.00
	Power Supply		$ 120.00
	Marketing (T-Shirts)		$800
	Misc.		$ 100.00
	Sub-Total		**$ 1,423.00**
		Total	**$ 4,128.00**

LESSONS LEARNED/FUTURE IMPROVEMENTS

Our team learned many lessons this year with regard to the design of our vehicle. We realized that PVC may not have been the best choice for our frame because it is difficult to redo the internal wiring when we need to add an electrical component to the vehicle. We learned that we needed to be more thorough on our waterproofing of every electrical component in order to ensure that these parts do not fail while in the water. We also discovered that adding more thrusters does not always make a more powerful vehicle if it is bigger and heavier. Because of this, we plan on making the vehicle smaller in order to make the vehicle more powerful. We will make sure to learn from our experiences in our first season of ranger in order to be more successful in the future.

REFLECTION

We had a very interesting experience this season of ROV. It was our first time designing a ranger class vehicle to compete in a more competitive division. Last year, we easily swept the navigator division by clinching first place in all categories. This year, we had a much more difficult time because we had to learn about more advanced systems than last year. Our control box is much more complex and our vehicle attachments have had many more problems. As a whole, the team got together and overcame most of these problems. Although not every member made it to every meeting, the majority of the team made it and figured out the problems. Overall, it was a successful year for the Sea Sweepers. Out of the many years that we have done this, our team members have learned the most this year. We have just learned tremendously about electronics and engineering, but also the importance of teamwork. No matter what our outcome in competitions was, our team has come so far to create an outstanding product, and we have learned invaluable life lessons.

VEHICLE CARE

This year, we took multiple steps to ensure that our vehicle is always in top shape and ready to use. One thing we learned in the previous years, is that pool water is very corrosive. By the end of last year, all of our wires were being eaten away, and some actually broke. This year, we made it a necessity to rinse off every centimeter of the vehicle with fresh water after testing it in the pool. This way, all of the corrosive pool water was washed off. So far, all of our wires are clean and in as good of shape as they were six months ago. Also, every time we use the vehicle, we roll up our tether onto a custom made tether roller. We made this tether hold to eliminate kinks or rips in the tether. All of these steps ensure that every time we take out our vehicle, it is set up the same way and ready to use.

CLUB SPONSORS/ CONTRIBUTORS

Our sponsors have helped us at Sea Sweepers ROV tremendously. We have received over $4000 worth of sponsorships and donations.

There were four levels of sponsorship: dolphin, orca, humpback whale, and blue whale. These were categorized by the amount of money donated. They were as follows:

- Dolphin: $100
- Orca: $500
- Humpback Whale: $1000
- Blue Whale: $1500+

Pre-Competition Sponsors:

Growers Ice Company	$1500 Blue Whale
extreme impact inc. Scalable Software Solutions	$500 Orca
Salinas Valley PrimeCare Medical Group, Incorporated	$500 Orca
PA Patane • Gumberg • Avila, LLP Attorneys at Law	$500 Orca
John and Sue O'Dell	$300 Dolphin

streamLife Incorporated	$250+ Miscellaneous Parts Dolphin
Companion Pet Health, Inc.	$250 Dolphin
Parkview Veterinary Hospital	$250 Dolphin
Sprenkle & Georgariou, LLP. Attorneys at Law	$250 Dolphin
John and Lilly Crawley	$250 Dolphin
Jeana Sutton	$250 Dolphin
Jeff and Kim Guidice	$100 Dolphin

Post-Competition Sponsors:

streamLife Incorporated	$500 Orca
Don Ratcliff	$500 Orca

TACTICAL WEALTH MANAGEMENT	$250 Dolphin

Post-Competition Contributions:

May Fest Donations	$146
Website Donations	$390

Total: $6,436.00*

*the amounts given reflect the funds raised and expended as of May 28th.

ACKNOWLEDGEMENTS

We, the Sea Sweepers, would like the gratefully acknowledge the support and dedication of many individuals and their dedication to our competition and the MATE learning philosophy. We would like to thank the MATE organization for hosting this competition that has brought us so many learning opportunities and has taught us so much about an incredible career field in which we have great interest. We would like to thank the Meadows Homeowners Association for allowing for the use of their pool and facilities. We also would like to thank the parents for all their commitment and support. We would like to thank all of the generous sponsors who financially supported us this year and who made competing possible. Lastly, but most important of all, we would like to thank our coach and mentor, Kurt Yeager for his incredible dedication and support of our team this year and throughout the six-year history of our club. He has always been helpful and supportive of our endeavors. We owe him the greatest thanks.

REFERENCES

MATE: *http://www.marinetech.org/*

Sea Sweepers ROV Facebook Page: *https://www.facebook.com/SeaSweepers/*

TIMELINE

May 3, 2014- Swept competition. That evening we decide to go to Ranger.

November 22, 2014- First meeting

December 20, 2014- Decided on first design ROV structure

January 15, 2015- Box structure was built

January 30, 2015- Frame of ROV was built

February 5, 2015- ROV and Box were wired

February 7, 2015- Mounted the cameras

February 10, 2015- Assemble the tether

February 15, 2015- Start Tech. Report

March 1, 2015- First water test

March 10, 2015- Installation Propeller guards

March 25, 2015- Electromagnet and servo claw mounted

March 30, 2015- Buoyancy test

April 4, 2015- Water testing and mission practice

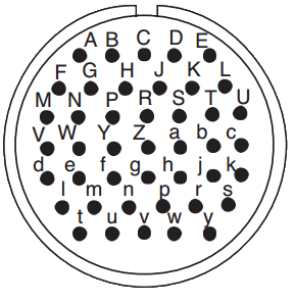
May 9, 2015- Regional competition at Aptos High School

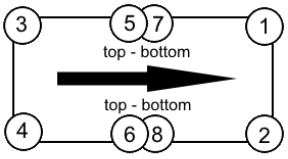
June 18, 2015- Auction and fundraiser event in Monterey

June 23, 2015- Leave for international

June 25-27 , 2015- International Competition

APPENDIX A: TETHER DIAGRAM





Accessory 2 CAT5e (unused)

t - Brown
u - Blue
v - Orange
w - Green
y - Green/White

1 - A Motor - White
B Motor - Black

2 - C Motor - Brown
D Motor - Green

3 - E Motor - Red
F Motor - Yellow

4 - G Motor - Orange
H Motor - Blue

5 - J Motor - White
K Motor - Black

6 - L Motor - Brown
M Motor - Green

7 - N Motor - Red
P Motor - Yellow

8 - R Motor - Orange
S Motor - Blue

T Camera Power +
U Camera Power -

V Servo +
W Servo -
Y Servo Blue
Z Servo White

a Camera CAT5e Brown
b Camera CAT5e Brown/White
c Camera CAT5e Blue
d Camera CAT5e Blue/White
e Camera CAT5e Orange
f Camera CAT5e Orange/White
g Camera CAT5e Green
h Camera CAT5e Green/White

Green CAT5e Accessory

j + Electromagnet 2 Bilge Pump — Brown
k - Electromagnet 2 Bilge Pump — Brown/White
l + Electromagnet 1 Bilge Motor — Blue
m - Electromagnet 1 Bilge Motor — Blue/White
n + Thermometer — Orange
p - Thermometer — Orange/White
r + Lights — Green
s - Lights — Green/White

APPENDIX B: SERVO PROGRAM FLOW CHART