Kailua High School
451 Ulumanu Drive
Kailua, HI 96734

Surfrider

Marine Recovery Systems

C-LION

Photo: Jian Madiam - Team minus wahine

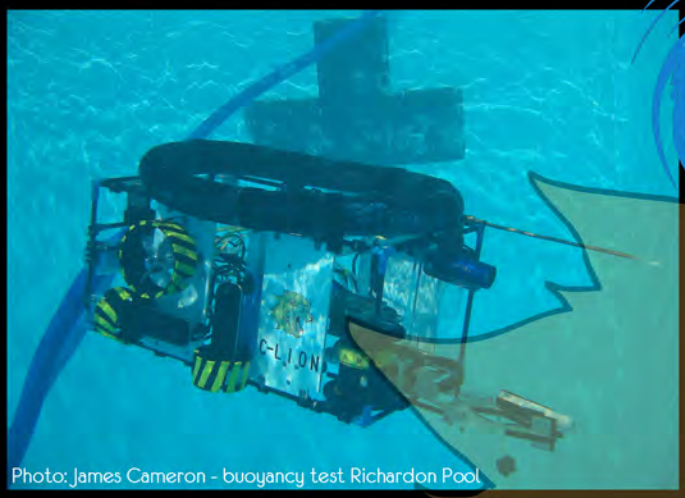


Photo: James Cameron - buoyancy test Richardon Pool


Photo: James Cameron - buoyancy test Richardson Pool


Photo: Len Poleshaj - Romnick Vamolja MIG welding the frame

Any Time.
Any Place.
Any Challenge.

- **Austin Vegas – CEO** (Junior, 2013)
- **Chris Campos – Pilot & CFO** (Junior, 2013)
- **Jacob Valencia – External Wiring Coordinator** (Junior, 2013)
- **Michael Sabate – Electrical Engineer** (Junior, 2013)
- **Samuel Rasay Jr. – Human Resources** (Junior, 2013)
- **Hannah McConnaughey – Director of Marketing** (Freshman, 2015)
- **Samuel Walters Jr. – Safety Manager** (Junior, 2013)
- **Romnick Vamolja – Machinist** (Junior, 2013)
- **Ipo Silva – Machinist** (Junior, 2013)
- **Ted Cabana – Independent Studies** (Junior, 2013)

Leonid Poleshaj – Mentor/Advisor

SURFRIDER RECOVERY SYSTEMS

TECHNICAL REPORT

Surfrider Marine Recovery Systems

Abstract

Surfrider Marine Recovery Systems (SMRS) can be described in six words: Any time, any place, any challenge. Our company designs and fabricates remote operated vehicles (ROVs) that are high quality, low cost, and ready for any situation.

Our shipwreck-specific ROV, C-LION, is efficient and reliable, easily capable of evaluating the SS Gardner. The C-LION was created specifically with the MATE Center as a client; however, because SMRS's company philosophy centers on adaptability, this ROV is relevant and equipped for a wide variety of shipwreck situations.

C-LION is capable of: measuring the ship, identifying debris as metal or non-metal, collecting an oil sample, etc. Due to the time frame of 15 minutes, it was a priority to design C-LION to be flexible in terms of completing multiple tasks within a short window of time. The frame of C-LION was designed in order to house our main tools (the multiuse claw, suction system and compass) while simultaneously being able to provide an exceptional amount of maneuverability and adjustability. The strategic camera placement on the C-LION is planned out to obtain the maximum amount of information out of each individual camera. The overall design and concept of C-LION has been inspired by other industrial and commercial ROVs.

FIGURE 1 - CEO, AUSTIN VEGAS (LEFT), AND CFO/PILOT, CHRIS CAMPOS (RIGHT), LEADING A BOARD MEETING DISCUSSING THE VARIOUS JOBS AND DUTIES OF EACH CREW MEMBER.

Design Rationale

The underwater remotely operated vehicle constructed by Surfrider Marine Recovery Systems has been designed to complete the mission of surveying a shipwreck site successfully. To effectively combat the tasks involved in the mission we contemplated and created specific payload tools to get the jobs done in the most efficient way possible. After the brainstorming and construction of the tools, we proceeded to build a simple box frame out of carbon fiber rods that would allow full customization and adjustability of placement of parts. Ocean currents have been anticipated and our lateral motors were developed accordingly. The positioning of all of our motors has been finalized in order to keep balance between maneuverability and control. Safety is a big concern at Surfrider Marine Recovery Systems, so to ensure that all crew members know what is dangerous, we have marked all objects capable of causing injury with danger tape. The buoyancy of the ROV is neutral which allows the pilot to grab and move objects with ease and complete tasks in a timely manner. A pneumatic flotation tube was attached to the top of the ROV to add or release air to correct and adjust our buoyancy underwater. The claw has been developed and customized to snatch objects with precision and ease. Two aluminum panels have been attached to each side of the claw to create a greater surface area to grab objects with and make more accurate grabs. We focused on using a pneumatics system to operate our tools because it offered a more reliable system than an electrical one as well as reducing the amount of electrical load, and to create a system that was easy to learn. All materials chosen for the construction of C-LION has been chosen for their durability, strength, corrosion resistance and light weight.

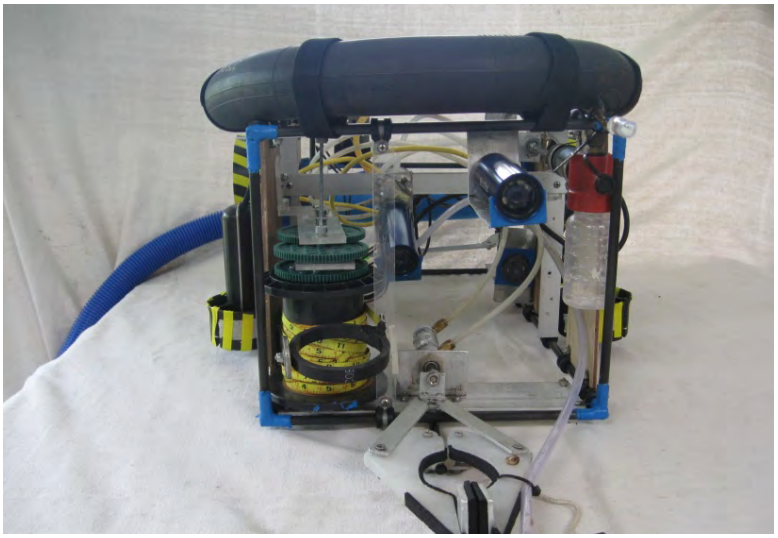
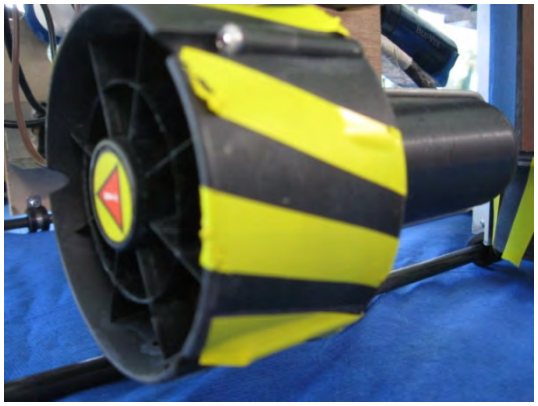


FIGURE 2 - FRONT VIEW OF CARBON LION (C-LION)

FIGURE 3 – AUSTIN ADDING THE FINISHING TOUCHES ON THE FRAME.

Frame

The frame of C-LION fully customizable, accessible, and is easily adapted for any challenge. The frame is constructed of carbon fiber rods joined by custom made stainless steel joints, which we then coated with liquid rubber. This is a measure to prevent C-LION from potentially damaging the shipwreck environment. The frame is 64.5cm in length, 33.5cm in width, and 28.75cm in height. Fully assembled, C-LION measures 92.5cm in length, 52.5cm in width, and 35cm in height. We chose to implement carbon fiber rods in our frame because of their strength, light weight, corrosion resistance, and durability. PVC panels are strapped on to the carbon fiber frame using fasteners, and provide mounts for the cameras, motors, double actuated pump, and measuring spool. The fasteners granted us the ability to slide the panels along the carbon fiber rods to adjust tools as we see fit, which saved us a large amount of time in terms of correcting small errors and mistakes. Holes were drilled through the panels to let water flow through and grant us the ability to move laterally faster. Placement of the tools, motors and cameras were extremely important for the design of the ROV. The double action actuated claw and pump were placed in front center and front top right, respectively, for efficiency and easy access. Vertical thrusters were placed on the sides and centered as much as possible to maintain balance as it ascends and descends. Our lateral propellers were placed at the rear of C-LION to combat tether skewing the bot off course. Forward/backward thrusters are placed parallel to one another. This provides optimal thrust power. Our cameras are mounted on the PVC panels to give us clear views of the claw, pump, measuring spool and compass.



FIGURES 4 & 5- THE RIGHT BTD 150 HORIZONTAL THRUSTER (TOP) AND THE 380/500 BILGE PUMP LATERAL MOTOR (BOTTOM).

Propulsion

C-LION is propelled by six motors. The two vertical and horizontal thrusters are SeaBotix BTD150 motors. Each thruster has a peak thrust of 2.9 kgf and a cruising thrust of 2.2 kgf as well as max continuous amperage of 4.25 amps. The vertical thrusters are securely mounted on cross-bars, parallel to one another to create a balanced ascent and descent. The horizontal thrusters have been mounted on the PVC panels to optimize forward and rear maneuverability. While the position of our propellers allows us a relatively large turn radius, their placement, most of all, allows for optimized forward speed.

The two lateral thrusters are 380/500 Bilge Cartridges. These motors can draw 1.7 to 1.8 amps. Each motor measures at 10.8 cm in height, 6.9 cm in

width and length. Our thrusters' positions provide stable lateral movement while evaluating the SS Gardner.

Cameras

C-LION navigates and evaluates with the assistance of four cameras. We use two Blu-Vue underwater cameras to provide us with clear views of our claw, measuring spool and siphon. Each camera provides us with a 160° range of vision and each is equipped with a 3.6mm lens. The cameras each weigh 705 grams on the surface, and reduce to 360 grams when placed in freshwater.

The ROV is also equipped with a Blu-Vue VD7D camera with a 3.6mm lens. During our rigorous pool testing, we discovered a leaking issue, resulting in lens fogging. We addressed and overcame this problem by taking apart the camera and fixing the lining, then sealing it with an 'O'ring.

The camera trained on the compass is a salvage item. SRMS is a company dedicated to high quality, but also low cost. We economize without compromising craftsmanship. This is our only infrared camera, and provides black and white video.

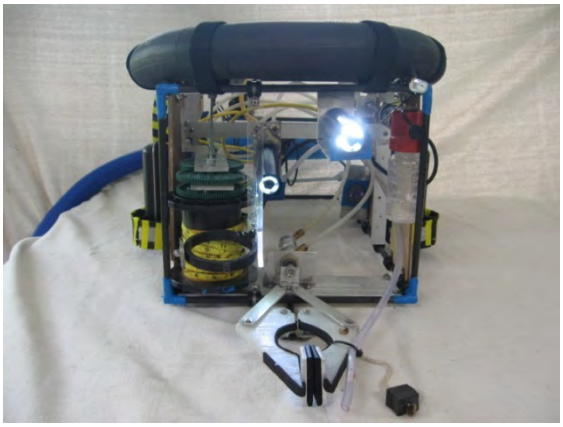


FIGURE 6 - FRONT VIEW OF C-LION WITH TWIN BLU-VUE CAMERAS ON.

Buoyancy

The C-LION is neutrally buoyant to optimize maneuverability. Our adaptable ballast system constantly regulates buoyancy. A pneumatic line feeds into an inner tube 66.04 centimeters in diameter. It is securely fastened to the top of the C-LION with Velcro straps. This pneumatic flotation tube is operated by a single valve. We use a 'T' needle to adjust the speed and volume of air being sent to the bag. The tube allows us to make small corrections whenever we become positive, and swiftly reach the surface if needs be.

We added the flotation bag to C-LION to address an issue of unequal weight. C-LION was front-heavy, and to assuage this problem we shifted ballast forward to compensate. We also added some additional floatation on the rear of the bot to secure and center our tether. Its adjustable buoyancy allows the C-LION to handle any underwater conditions efficiently and effectively.

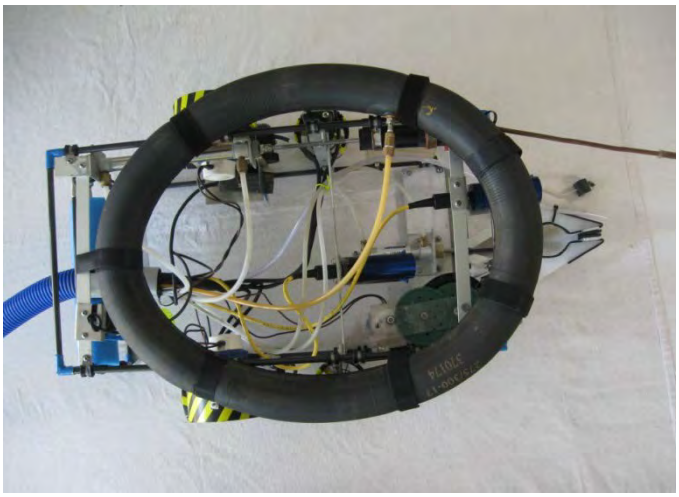


FIGURE 7 - FLOTATION BAG MOUNTED ON TOP OF C-LION

Tether

The tether measures 15.24 meters and weighs approximately 12.7 kg. The tether consists of six pneumatic lines: three 1/4-inch polyethylene lines, rated 120 psi, two 5/16-inch polyethylene lines, rated 130 psi, and one 1/4-inch vinyl line, rated 55 psi.

There are also additional four video cables, four thruster cables, and three 18-gauge insulated wires. The entire bundle is encased by a 1 1/2-inch, flat-ribbed, commercial vacuum hose to protect both the ROV and shipwreck against abrasion and potential entanglement.

Pneumatics System

FIGURE 8 - PNEUMATICS MANIFOLD WITH DIVE TANK.

Our custom-designed pneumatics manifold incorporates three-way ball valves to increase efficiency and ease of use. It is both time efficient and energy efficient. The pneumatics system is powered by our certified dive tank that expels an input pressure of 1496.96 kPa, pre-regulated by our adjustable pressure regulator to our operation pressure of 137.9 kPa.

The pneumatics system contains six lines which operate our claw, siphoning system, flotation bag, and supplies air to the flotation bag. The first two lines lead to our siphoning system and control the drawing of fluids. It takes three cycles of three seconds to completely fill our collecting container. The next two lines are directed towards the claw and control whether the claw opens or shuts. The line after that heads towards an open end tube attached to the side of our claw. This line supplies air to the flotation bag to lift the mast of the ship to remove it from the wreck. The last line is in charge of regulating the flotation bag system attached to the top of our ROV. A 'T' needle valve is used to limit the speed of volume at which air is added or released to or from the flotation bag.

Control Box

The control box was designed to be heavy duty and variable. All wires within our control box are rated at 12 AWG and are color coded for safety *(See Fig. 9)*. As a safety precaution we installed a main resettable 25 amp circuit breaker, emergency kill switch, and a "power-in" light which alerts us when is power flowing into the box. An amperage gauge is another feature we installed to monitor the C-LION's amp draw. Our electrical draw is 16 amps.

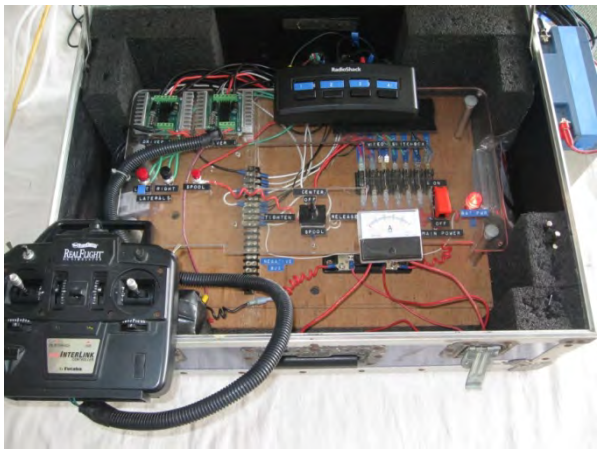


FIGURE 9 - TOP VIEW OF CONTROL BOX ALONG WITH CONTROLLER.

In our positive bus there are seven circuits each protected by its own fuse. Two circuits protect the cameras (each protected by a 0.5 amp fuse), two 3 amp circuits protect each of our lateral motors, and one circuit protects the measuring spool which is protected by a 3 amp fuse which leads to the double-pull, double-throw toggle switch, which grants us the ability to reverse the polarity allowing for extraction and retraction of the spool to measure the overall length of the ship.

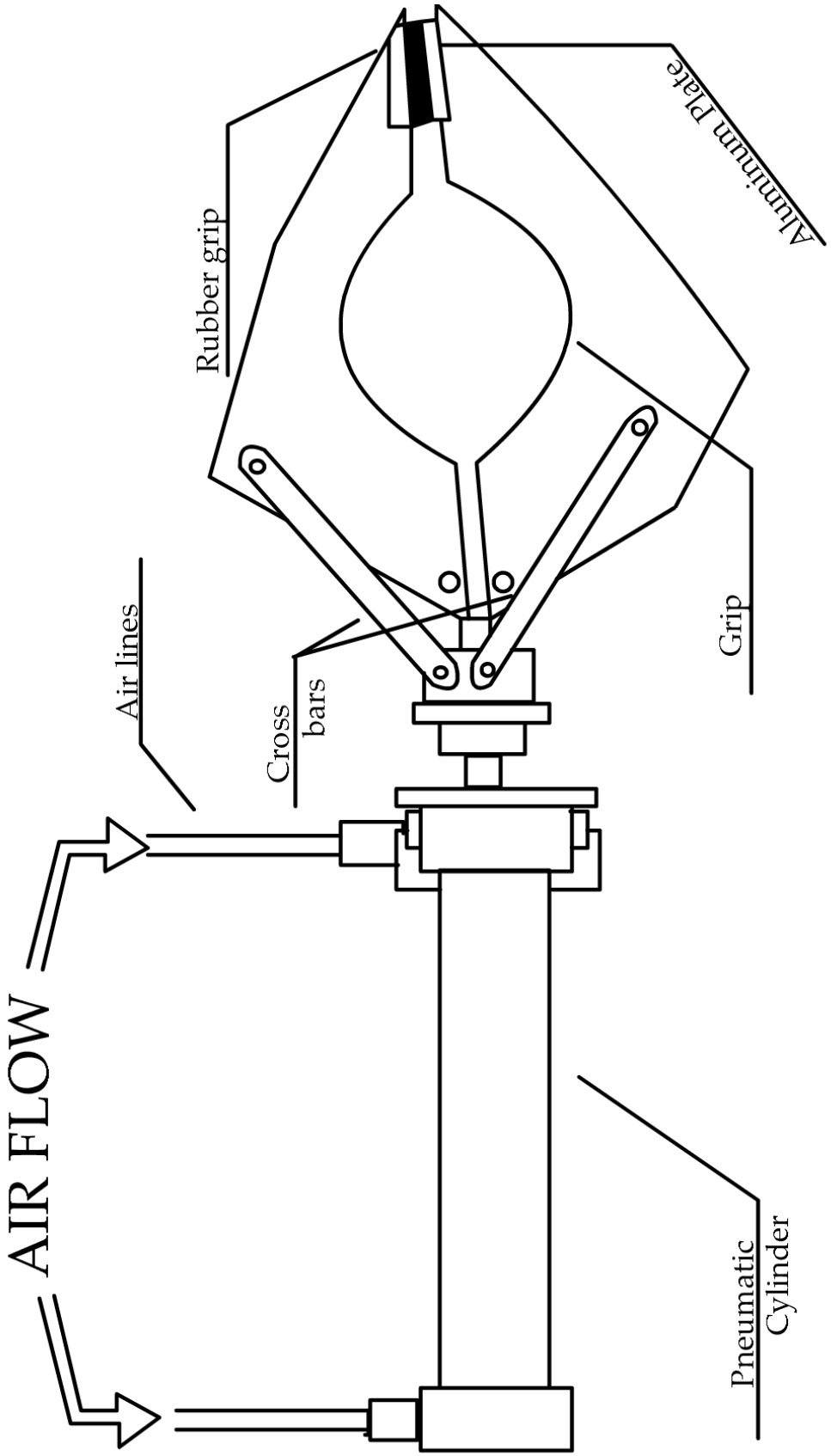
There are two additional circuits controlling drivers, each protected by a 5 amp fuse. One circuit controls the vertical thrusters while the other controls the horizontal thruster, each motor driver supplies 11.6 volts to each thruster. Our camera box has a video switch and allows us to utilize four different camera video inputs. This switch allows us to alternate views between individual camera feeds on the monitor.

The controller for C-LION is a flight simulator controller rewired to provide C-LION with precision steering. The joysticks are pressure sensitive and the dials adapt the maximum throttle for our thrusters as situation dictates.

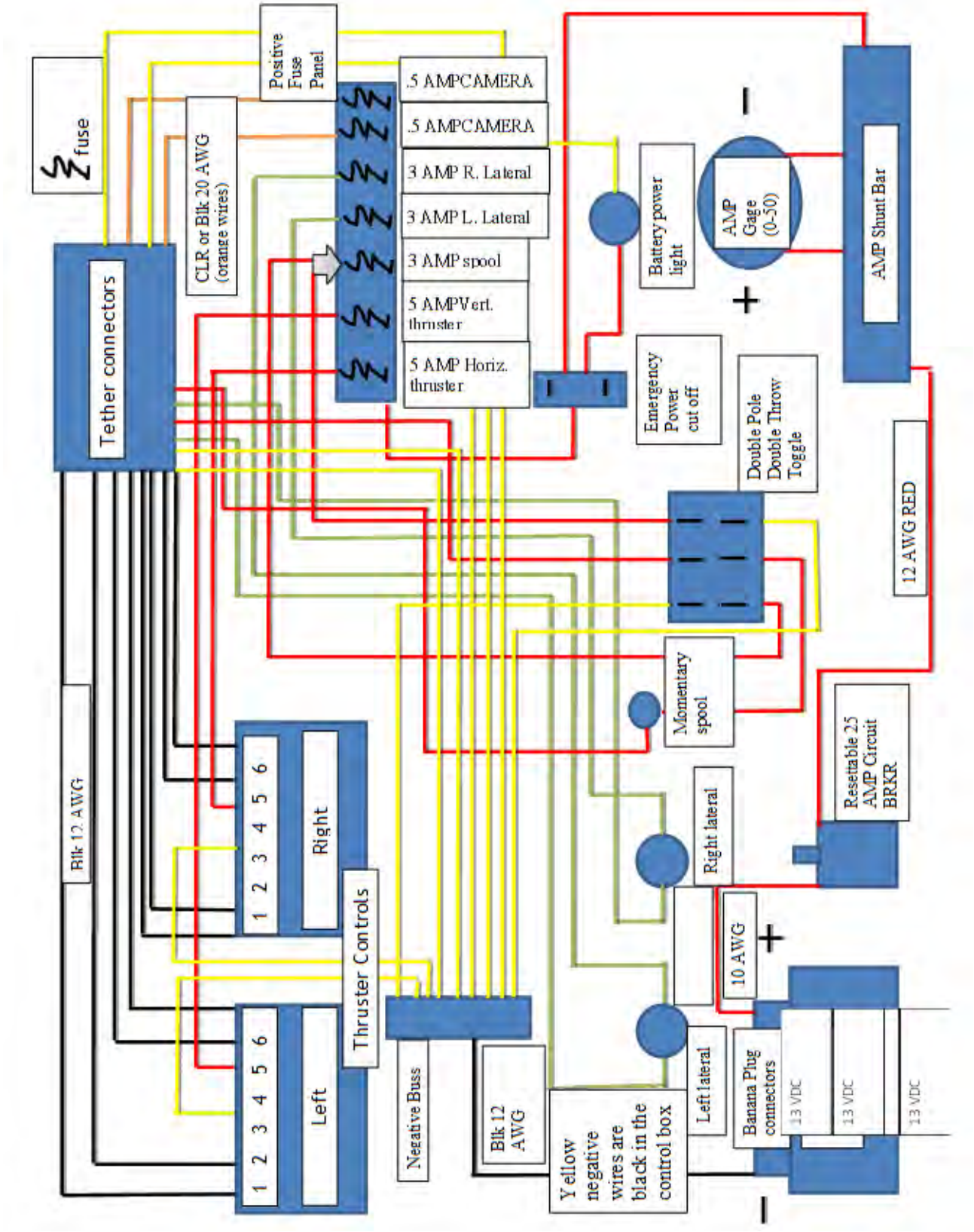
Design & Construction Schedule

Week #	Dates	Accomplishments
One	1/16-1/20	Elected offices and create company name
Two	1/23-1/27	Clean work area and list necessary tools, safety briefing
Three	1/30-2/3	Look over missions and start construction of props
Four	2/6-2/10	Finish construction of props and start assembly
Five	2/13-2/17	Begin designing ROV Frame
Six	2/20-2/24	Order parts for ROV, welding work shops
Seven	2/27-3/2	Begin construction of frame
Eight	3/5-3/9	Finish frame and design payloads
Nine	3/12-3/16	Construct and attach pay loads to ROV
Ten	3/19-3/23	Assemble tether and wrap tether in pool house
Eleven	3/26-3/30	Start designing the control box and purchase necessary parts
Twelve	4/2-4/6	Start wiring the control box and soldering work shops
Thirteen	4/9-4/13	Finish control box and connect it to tether, start tech report
Fourteen	4/16-4/20	Test ROV in pool and trouble shoot, work on tech report
Fifteen	4/23-/27	Run missions, finish tech report start speech practice
Sixteen	4/30-5/4	Tech report due 5/5, continue mission practice and speeches
Seventeen	5/7-5/10	Practice speeches Have parent night demonstration
Eighteen	5/14-5/18	Competition 5/19, asses how we did in competition
Nineteen	5/21-5/25	Fine tune ROV, gather funding to go to internationals

Mechanical drawing of Claw System – Figure 10



Control Box Schematic – Figure 11



Missions

The C-LION was custom-designed and custom-built to efficiently and accurately evaluate the SS *Gardner*, an oil tanker that was sunk on December 25, 1942, loaded with approximately 5 million gallons of bunker oil. The C-LION is fully equipped to perform an assessment of the SS *Gardner*. To survey the shipwreck site, C-LION has faculties to: measure the overall length of the shipwreck, determine the orientation of the ship, create a map of the wreck site, determine debris piles as ferrous or non-ferrous, and scan the shipwreck with sonar.

To measure the length of the shipwreck, we created customized measuring spool. The C-LION quickly and accurately evaluates the orientation of the ship via camera feed of an onboard compass. The debris piles will be determined as ferrous or non-ferrous using our custom-fabricated magnet. The C-LION's steadiness, neutral buoyancy, and onboard cameras allows it to accurately scan the shipwreck with sonar.

The C-LION is also equipped for the oil sample removal and coral removal the SS Gardner requires. With its custom multipurpose manipulator, the C-LION safely transports and attaches the lift bag, removes and transplants the coral, and reseals holes in the oil barrel. Inflation of the lift bag is actuated by a pneumatic line zip on the outside of the manipulator.

C-LION's siphoning system easily handles the removal of an oil sample. To address potential environmental hazards of oil leakage, a Vaseline-filled nylon tube is attached to the tip of C-LION's siphon. C-LION can adapt and handle any size fluid sample by changing the size of the screw on its collection tank.

SMRS has also installed two sensors on C-LION: an ultrasonic thickness gauge and neutron backscatter device to determine the thickness of the oil barrel and to confirm its contents.

Payload

Claw

C-LION's claw is capable of precise, pinpoint retrieval on a variety of sizes, shapes, and textures. It is highly adaptable, and cost efficient.

The two sides of the claw are created from plastic composite and are lined with rubber to optimize grip while retrieving objects. They are joined by a carbon fiber rod and attached to an aluminum flat bar. The claw design is a result of rigorous testing, prototypal experimentation, and proven excellence.

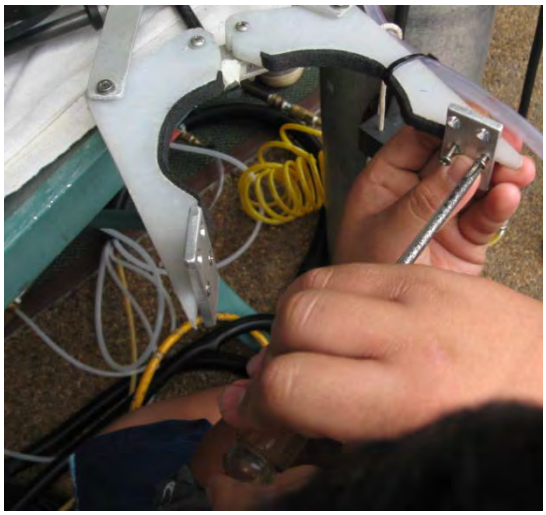


FIGURE 12 - INSTALLATION OF THE ALUMINUM METAL PANELS.

Magnet

C-LION's sensor to detect ferrous debris piles is comprised of four seperate magnets. Nylon thread connects all magnets to the left of the manipulator. The sensor is viewed on camera so detection of the ferrous debris piles can be observed and recorded on deck.

FIGURE 13 - FINISHED CLAW WITH MAGNET ATTACHED.

Siphoning System

To retrieve an oil sample from the SS Gardner, the C-LION utilizes a double actuated pneumatic cylinder. This maximizes the amount of sample we draw out with each pump, as the suction only works one way. It takes only three cycles of three seconds to fill our oil collection tank.

The siphoning system features a copper rod, with nylon tubing attached to a 90° corner as a needle. The nylon tubing at the end is a safety measure to prevent any bodily harm which could have previously resulted from the exposed rod.

FIGURE 14 - DOUBLE ACTUATED PNEUMATICS PUMP.

Measuring Spool

To accurately measure the overall length of the ship C-LION is equipped with a custom-built measuring 7.62 meters of measuring tape onto a recycled wire spool at one end. On the other, a PVC ring is attached, functioning as a hooking device to latch onto one end of the shipwreck. The measuring spool functions through a gear system that reduces rotations and applies torque. It incorporates an axle to create a steadier system. The gear system also releases and winds the spool. The gear system is powered by single modified pump motor and a double pull double throw toggle switch allowing us to reverse polarities and give us an unwind and rewind feature.

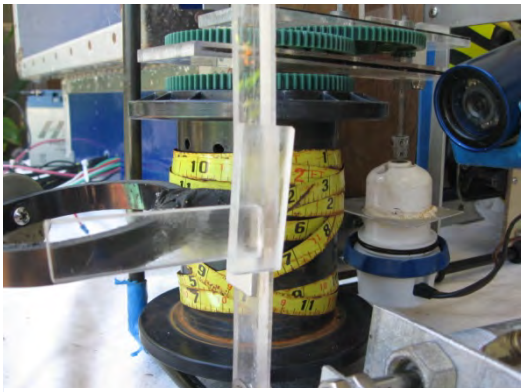


FIGURE 15 - FULL VIEW OF THE MEASURING SPOOL'S GEAR SYSTEM.

Future Improvements

There are many things with C-LION that SRMS as a company wishes we could have implemented. We plan to incorporate these improvements to assist us with our future endeavors.

Cameras

First, we want upgrade the C-LION to include higher-quality cameras and motorized swivel camera capable of providing the pilot with greater range of view. This wider range of view would be of great assistance with surveying the surrounding area and gaining more information of our environment. A split screen view is another feature we are researching because it would allow us the ability to multi-task to some extent and position the ROV better.

Pneumatics System

In the future, SMRS will downsize the size of the pneumatics manifold, reducing its bulk and weight for mobility reasons. Additionally, the pneumatics manifold will be protected by a casing.

We also wanted to redesign and reconstruct our claw out of a harder, more durable material in order to increase the pressure used by the entire system. We lowered ourselves down to 137.9 kPa because anything above it caused the claw to slip when closing. We need to better match the throw cycle of our actuators to match the travel needed at the tool (i.e. the claw and siphon).

Miscellaneous

In addition to downsizing the pneumatics manifold, we will also downsize our tether. Fusing the lines will make it more convenient in terms of space and maneuverability.

Reflections

While working on the robot in our building phase, all members were exposed to every aspect of constructing the robot. These aspects included the teaching of: wood working, welding, wiring, gear systems, grinding, hand tools, pneumatics systems, video controls, piloting, and budgeting. Acquiring these skills will definitely help us throughout our entire life, even if it our future does not involve a career in engineering or construction.

Designing and constructing C-LION together as a company has also taught each member a sense of responsibility and respect for one another. Time management, teamwork and team building skills, applying math to real life situations, and public speaking are all skills we learned from building the C-LION, and will help us innumerable times throughout our lives. Building an ROV has given us insight as to what we can do to contribute each day as an individual.

Troubleshooting Techniques

Define the Problem, Need, or Desire.

- Specifically address the problem, need, or desire.
- Accurately record of any processes, solutions, discoveries, and steps.

Research and Generate Ideas

- In what ways can the problem, need, or desire be solved, built or satisfied?
- Draw rough drafts, brainstorm for ideas, research existing products for similarities or environmental similarities.
- Accurately record of any processes, solutions, discoveries, and steps.

Identify Criteria, Specify Constrains, and Select Approach

- Identify the laws, safety issues, and limitations on materials, supplies or environment.
- Make a formal drawing for the product or system.
- Accurately record of any processes, solutions, discoveries, and steps.

Make a Model or Prototype Appropriately Using "Tools of the Trade"

- Create a model, prototype or simulate an environment for the system using the same criteria and constraints as the real model.
- Accurately record of any processes, solutions, discoveries, and steps.

Test, Evaluate, and Refine the Design Using Specifications

- Fine tune the product or test the system for errors or areas of improvement.
- Accurately record of any processes, solutions, discoveries, and steps.
-

Create or Make the Product or System

- Complete the model or system using the processes, solutions, discoveries and steps that were recorded.
- Communicate the processes and results

Safety Check List

- All personnel on deck must wear eye protection and covered shoes at all times.
- Check fuses to ensure power flow (check power light)
- Check or reset circuit breaker.
- Check wired connections including camera wires.
- Have all pneumatic valves closed before they are pressurized.
- Secure lines and make sure all connections are air-tight.
- Spray air line connectors with soap-water to check for leaks.
- Fix leaks (if there are any).
- Keep the air pressure below the MATE standard of 35 PSI (we only use 20 PSI).
- Double check all connections from tether to control box.
- All dangerous tools/items shall be designated and labeled.
- Read the voltage and amperage to ensure safety at all levels.
- Point regulator, tank, and gauge on manifold towards the operator.
- Straighten/relax the tether to reduce cable memory and kinks in the line.
- Keep hands away from motors and or thruster when in use.

Acknowledgements

Surfrider Marine Recovery Systems has several heartfelt thanks to send out to all of our supporters. First and foremost to the MATE Center for giving us the opportunity to compete, learn, and grow from this experience. Our mentor, Leonid Poleshaj, deserves our utmost thanks and our eternal gratitude and respect. None of the things we accomplished could have been made possible without your help. We deeply appreciate the time and effort you have put in to help us become successful not only as a company, but on a personal level as well.

Surfrider Marine Recovery Systems would also like to recognize the following people for their motivation, support, advice, donations, and compassion. Without these individuals, we as a company would not be where we are today.

- Ms. Francine Honda (Principal) – Words cannot express how grateful we are to have you as our principal. Providing us with an empty classroom to work with and showing interest and support in our program means the world to us. We cannot thank you enough.
- Mr. JJ Feurer (Science Department Head) – Thanks for keeping up with us and showing love and support from the science department!
- Mrs. Jill Laboy – Thank you for showing us a huge amount of support and helping all of us with our public speaking skills. Your efforts will definitely carry on with us throughout our pursuits.
- Jill Zande (MATE Associate Director, Competition Coordinator) – Allowing us to pursue our dreams and fanning the fire that fuels our dreams with this experience is unreal. Thank you.
- Mark Rognstad (HURC Director) – Thank you for organizing the competition and allowing us to put our skills to the test.
- Aunty Patti – Thank you for keeping such good care of us while we used your pool to practice in. Most of us would have died from starvation if you had not fed us during our test runs.
- Mr. Ronald Campos – Thank you for the generous donation of PVC pipe. We couldn't have completed the props without it.
- Mr. Rodney Tabiolo – Thanks for allowing us to use your tools and shop, as well as giving us advice to better improve our robot.
- Aaron's Dive Shop – Thanks for the dive tank! It works great!
- Hydra-Air Pacific – Thank you for supplying us with parts at your cost.
- Genuine Auto Shop – Thank you for helping us drill the whole for our spool axle.
- Hardware Hawaii – Thank you for the generous donation of miscellaneous wiring, it was very helpful.
- Amaron CMD – Thank you for the parts scholarship donation.
- Pearl Harbor – We appreciate the use of the Richardson Recreational Center Pool as the site of the competition.
- Parents – Your morale and undying support for our pursuit of happiness will never fade from our hearts. Thank you for tolerating us and showing understanding and appreciation for our endeavors. We promise to do our best every day and to make you proud in any way possible. Remember, we love you.

All Photos contained in this report were taken by Samuel Rasay, Jr.

Budget List

Category

Pneumatics/ Manifold

Object	Units	Cost	Tax	Total
-Bushing	2	$7.94	$0.37	$8.31
-Pump w/ Probe	1	$39	$1.83	$40.83
-Brass - R Nipple	5	$42.45	$2.01	$44.96
-Brass - Y Nipple	5	$18.45	$0.86	$63.77
-Male Connector	1	$28.20	$0.33	$29.53
-3 Way brass ball valv	1	$146.32	$6.90	$182.74
-3 way brass ball valv	1	$36.58	$1.72	$38.30
-Tee	1	$20.59	$0.97	$37.55
-90 Female Elbow	1	$4.11	$0.19	$4.30
-Male Connector	1	$9.43	$0.44	$9.87

Frame

Object	Units	Cost	Tax	Total
-Screws	12	$1.92	$0.09	$2.01
-Washers	24	$2.88	$0.14	$3.02
-Nuts	12	$3.00	$0.14	$3.14
-Aluminum Bar	2	$11.98	$0.56	$12.54
-SS S	2	$0.40	$0.02	$0.42
-SS N	2	$0.94	$0.04	$13.95
-Carbon Rod	5	$130.00	$6.13	$136.13
-Shipping Handling	1	$57.95	$2.73	$60.68
-Cushion Clamp	11	$14.41	$0.68	$15.09
-SS Cushion Clamp	16	$17.92	$0.84	$18.76

Props

Object	Units	Cost	Tax	Total
-PVC Pipe	1	$5.13	$0.29	$5.37
-PVC Cap Slip	1	$0.35	$0.01	$0.36
-PVC Pipe	3	$5.52	$0.26	$5.78
-White Polypropylne	1	$8.00	$0.38	$8.38
-Yellow Polypropylne	1	$4.10	$0.19	$4.19
-PVC Bushing	1	$0.90	$0.94	$0.94
-PVC Coupling	1	$0.72	$0.03	$1.70

-Grey Brick	10	$5.30	$0.25	$5.55	
-White PVC Pipe	25	$15.75	$0.73	$16.48	
-Galv. Nipple	5	$12.45	$0.59	$13.04	
-Cement PVC Clear	1	$5.49	$0.26	$5.75	
-FG U-Bolt	1	$3.29	$0.16	$3.45	
-White PVC Pipe	1	$2.79	$0.13	$2.92	
-Nylon Braid Rope	8	$1.12	$0.05	$1.17	
-Test Cap Knock Out	2	$1.80	$0.09	$1.89	
-PVC Cap Slip	2	$1.80	$0.09	$1.89	
-Pipe ABS DWV	1	$2.17	$0.10	$2.27	
-PVC Cross Slip	1	$2.29	$0.11	$2.40	
-PVC Elbow	1	$2.29	$0.11	$2.40	
-Velcro	1	$2.72	$0.13	$2.85	
-PVC Bushing	1	$0.63	$0.03	$0.66	
-PVC Coupling	1	$0.81	$0.04	$0.85	
-PVC Cap Slip	1	$0.35	$0.02	$0.37	
-PVC Tee	50	$22.50	$1.06	$23.56	
-PVC Elbow	12	$4.20	$0.20	$4.40	
-PVC Cap Slip	1	$0.35	$0.02	$0.37	
-PVC Elbow	10	$3.50	$0.16	$3.66	
					$121.81

Tether

Object	Units	Cost	Tax	Total	
-Poly Tubing	1	$9.50	$0.44	$9.94	**$25.26**
-Gray 18G/4C STRD UNSHLD	1	$15.00	$0.71	$15.71	

Actuator

Object	Units	Cost	Tax	Total	
-Air Cylinder	1	$22.57	$1.06	$23.63	
-Shipping	1	$2.79	$1.19		
					$26.55

Control Box

Object	Units	Cost	Tax	Total	
-PK2 SPST Push SW	1	$4.39	$0.21	$4.50	
-Female Connector	1	$4.50	$0.21	$4.71	
					$9.10

Payload

Object	Units	Cost	Tax	Total	
-Classic Compass	1	$19.99	$0.94	$20.93	
-Rection M/Rawr					
-5K Pump w/					
-Propeller	1	$39.00	$2	$40.84	
					$61.76

ROV Total	$816.08
Props Total	$121.81
Overall Total	$937.89

LOAN CONTRACT

On January 15, 2012, Len Poleshaj (Mentor) is loaning Surfrider Marine Research Services one-thousand dollars ($1,000) interest free to paid in full by June 30, 2012.

In, addition, up to 50% of the original loan may be loaned to Surfrider Marine Research Services at a later date should they require additional funds.

The undersigned are authorized representatives of Surfrider Marine Research Services:

_____ _____

Chief Executive Officer Date

_____ _____

Designer Engineer Date

_____ _____

Lender, Len Poleshaj (Mentor) Date

Note: This contract is non-legal non-binding and is for the purpose of sample and demonstration only.