Μανο Κιηικιηι

Kailua High School

Surfrider Robotics 2005-2006

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Abstract

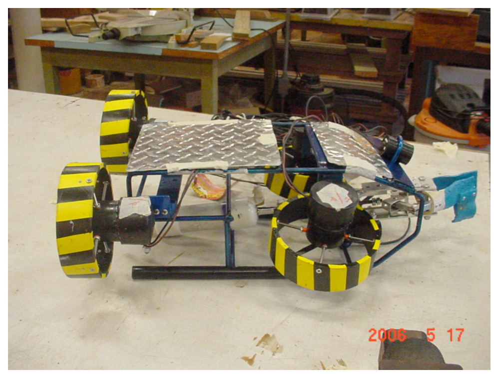
We chose to participate in the International ROV competition held by MATE. An ROV is a Remotely Control Vehicle used for deep sea suverance and missions. When building our ROV we had to accommodate certain design specifications to meet the criteria of MATE ROV competition held on June 23-25, 2006 at Johnson Space Center's Neutral Buoyancy Lab in Houston, Texas. The design decisions of our ROV respectfully named Mano Kihikihi, which is Hawaiian for Hammerhead Shark, had to be feasible, effective, and maneuverable to complete the mission tasks given. We attempted to consider the design of our old ROV in conjunction with new ideas to create the most maneuverable and effective ROV without sacrificing other key features like stability or thrust.

The reason behind naming our ROV "Mano Kihikihi" or "Hammerhead Shark" is for its uncanny resemblance to that sleek and powerful creature of the ocean. A hammerhead shark is similar to our ROV in that, it will sit and patiently wait for the opportune moment from below the surface of the water and when that right moment presents itself, it slices through the glossy barrier of the water striking its prey with accuracy and precision. We plan to share that same quality to strike our missions with the accuracy and precision we envy of the hammerhead shark.

Design Rationale

ROV Dimensions

- Length: 32 centimeters
- Width: 26 centimeters
- Height: 18 centimeters
- Weight: 7,867 grams
- Length of Tether: 15.24 meters



Picture 1: Our stainless steel frame ROV

The shape of our frame was carefully taken into consideration during the initial design and layout of our ROV. The sleek shape of our ROV was designed to be more ergonomic and hydrodynamic. We took steps to apply past knowledge of science and engineering to create our ergonomic frame design that maximizes productivity output and reduces operator strain. To help with this our sleek hydrodynamic design put less drag on the robot increasing thrust. Our double pole double throw switches gave for more accurate and precise robotic movements. Even the placement of the four piranha bilge pump motors added to the overall design and ergonomics. The motor mounts were placed to balance out the weight of the robot and make the center of balance and fulcrum as close to the center of the robot as possible. The mounts of the cameras were placed so that we had the best vantage point for our arm and the best peripheral vision. The arm mount was fabricated so that when we mounted the arm it would be raised exactly 2.5 cm from the floor.

Our frame was out of 10mm stainless steel round bar, 7mm by 38mm flat bar and burnished aluminum checkered plate. Over all, the entire R.O.V. frame measured in at 23cm in width, 47cm in length, and 19cm in height. The frame weighed in at approximately 20.35kg. Considering that the frame was remarkably heavy, we knew that if we achieved neutral buoyancy the weight would not be a factor or problem, but the only problem we faced was reaching neutral buoyancy.

Design Rationale (cont.)

Some reasons why we chose stainless steal were:

- We knew its strength and it wouldn't crack or break as the previous aluminum frame did.
- Welding the frame we learned that was the strongest way to attach metal together.
- We needed a strong frame to endure the powerful force of the pneumatic arm.

Our previous ROV was fabricated from aluminum rod. This material seemed extremely light and acceptably durable; at the time. When we mounted our air powered pneumatic arm, the pressure from the pump split our frame apart. Newton's third law of motion states: Whenever one body exerts force upon a second body, the second body exerts an equal and opposite force upon the first body. So basically our pneumatic arm had a very powerful recoil and that recoil could not be sustained by the aluminum frame.

Our stainless steel frame however is significantly stronger and sturdier. We used 2.5mm 308 stainless steel welding rod to weld the frame. The rod is first cut to length and bent, using a jig, into the shape needed to fulfill the specifications of our design. The jigs were used to obtain a consistency in the bends. We then welded the rods together using a Miller arc welder with a setting of 60 amps. 2.5mm 308 stainless steel welding rods were the size of the welding rods used.

Floatation

The floatation material used on our ROV is called polypropylene. Polypropylene is a very light-weight thermoplastic resin, similar to Styrofoam. One problem with polypropylene is that it takes on water when submerged. To fix this problem we had to rubberize it by putting several coats of "plastic dip" on surface. We positioned the floatation on the top of the ROV because it is the most balanced at that point, i.e. if we put it more towards the bottom of the ROV it will tend to topple or flip.

Another challenge in our floatation was adding just enough "floatie" to follow Archimedes Principle to make our ROV neutrally buoyant. Archimedes Principle states that a body immersed in a fluid is buoyed up by a force equal to the weight of the displaced fluid. We solved this challenge by creating our own buoyancy formula:

$$\mathbf{R + F = W + D}$$

$$100\text{ g} = 1\text{newton (N)}$$

R represents the mass of our ROV in grams. F represents the mass of the floatation in grams. W represents the mass of the water displaced by just the ROV. D represents the mass of the water displaced by the floatation.

So basically, the mass of the ROV and the floatation has to equal the mass of the water that they both displace in order to become neutrally buoyant.

The mass of our ROV was 7,711 grams, or 77.11 N. The mass of the water it displaced was 3,029 grams, or 30.29 N. Then we found the floatation mass to mass ratio was, for 125 square cm. of floatation the floatie's mass is 4 grams and the water displaced was 125 grams. So it was all a matter of algebraic reasoning to figure out that 4,875 square cm of floatation was needed to make our ROV as close to neutrally buoyant as possible. This calculation made the mass of the ROV with the floatation 7,867 grams (78.67 N) and the mass of the displaced water 7,904 grams (79.04 N). This isn't exactly neutral, but from this rough estimate we did a round of test and trial to get the exact amount. Without this formula, finding neutral floatation would have been a tedious procedure.

Propulsion

1) Thrust

–As Newton stated, "actio est reaction": This means a device accelerating air or water in one direction, feels a force in the opposite direction.

-A propeller accelerates incoming air particles, or water molecules, "throwing them towards the rear, and thus feels a force on itself- this force is called thrust."

-The Thrust of a propeller depends on the volume of air (or water) accelerated per time unit, on the amount of the acceleration, and on the density of the medium.

Thrust Formula
T thrust [N]
D propeller diameter [m]
V velocity of incoming flow [m/s]
Additional velocity, acceleration by propeller [m/s]
Density of fluid [kg/m3] (air; = 1.225 kg/m3, water; = 100kg/m3)

Thrust Formula **Thrust=v(a)(ρ)**
F=v(a)(m/v)
F=ma→Newton's second law

2) Pitch
- The linear distance that the propeller would move in one complete revolution through a solid medium not allowing for slip.

Different types of pitch:

1. Constant (fixed) pitch – pitch is equal for each radius.
2. Progressive pitch – pitch decreases along the radial line from leading edge to trailing edge.
3. Regressive pitch- pitch decreases along the radial line from leading edge to trailing edge.
4. Variable pitch – Pitch is different as selected radii.
5. Controllable pitch – blade angle is mechanically varied.

3) Cup:
Small radius or curvature located at the trailing edge of blade.
Cupping helps to reduce or delay cavitations.
Helps to reduce slip, thus increasing actual pitch and usable thrust.

4) Rake:
Propeller blade will slant forward or aft from the Blade Centre Axis (BCA).
Positive rake – blade slants towards aft end of the hub.
Negative rake – blade slants towards forward end or them hub.
Can be specified in inches at the tip or in degrees.

5) Skew:
Blade Centre Line (BCL) in curvilinear
sweeping back from the direction of rotation.
Contour of the blade is not radially symmetrical
about blade centre axis.

Propulsion (Continued)

The 4 two bladed propellers we chose for our ROV are 17.78 cm in width with a constant fixed pitch, and a 45 degree positive rake. They are made from hard plastic, and were intended for aeronautical uses (basically we are using airplane propellers).

The reason we went with aero propellers is for the plain fact that they provide greater thrust. For our testing we calculated that the density of the water might affect the efficiency of the airplane props. Surprisingly they preformed slightly better than our old 7.62 cm brass propellers, for two reasons. First, because of the weight difference, plastic is significantly lighter then brass. Second, because the propellers are longer in width which gives for more surface area and greater water displacement which leads to greater thrust. In addition we put more emphasis on the Kort Nozzle effect. Kort Nozzle basically states the smaller the space or gap between the tip of the propeller and walls of the shrouds, the greater the thrust. Meaning the space between propeller and shroud are inversely proportionate to the thrust. This is accomplished by creating a vacuum effect, furthermore if the vacuum is somehow funneled through a smaller opening, then the propulsion is increased. Somewhat like putting your finger over the tip of a water hose.

We mounted two motors vertical to the frame about 20 cm from the front of the frame, to give the robot ample lift. We mounted the last two motors horizontal to the frame at the end of the ROV to streamline our thrust and balance with the vertical motors.

Pneumatic Arm

Our pneumatic arm uses a very simple application rightfully called a pneumatic pump. This category of pump is more accurately known as a double-acting, piston-type pneumatic pump. The most commonly known of the pneumatic or hydraulic powered pumps is the single-acting hydraulic or pneumatic pump, single-acting meaning that it only moves in one direction. The single- acting piston type cylinder is similar in design and operation to the single-acting ram-type cylinder. The single-acting piston-type cylinder uses fluid pressure to provide force in one direction, and spring tension, gravity, compressed air, or nitrogen is used to provide the force to push the piston in the opposite direction; similar to the figure.

In this cylinder the spring is located on the rod side of the piston in order to have the tension to push the piston back to its previous position.

Normally, a three-way directional control valve is used to control the operation of the cylinder and regulate the fluid or air going in and out of the cylinder. To extend the piston rod, fluid or air under pressure is directed through the fluid port. This pressure acts on the surface area of the blank side of the piston and forces the piston to the right; or left, depending on which direction the cylinder is positioned. This action moves the rod to the right or left, through the end of the cylinder, therefore moving the actuated unit in one direction. During this action of the piston being actuated, the spring is compressed between the rod side of the piston and the end of the cylinder. To retract the piston rod the compressed spring's potential energy is converted to kinetic energy and is exerted on the end of the cylinder and the piston. Since the piston is not in a fixed position, the spring relieves its tension on the piston and according to Newton's third law of motion; for every action there is an equal and opposite reaction, in this case pushing the piston back into start position. The fluid already in the chamber is free to flow from the cylinder through the port, back through the control valve to the return line in hydraulic systems, or into the atmosphere in pneumatic systems.

The fluid or air must be vented out of the cylinder or any trapped air would compress during the extension stroke, creating excess pressure on the rod side of the piston. This in turn would cause a "sluggish" movement of the piston and could eventually cause a complete lock, preventing the fluid or air pressure from moving the piston.

Pneumatic Arm (cont.)

But most piston-type actuating cylinders, like the unit used to power our mechanical arm are double acting. Double-acting cylinders, unlike single-acting cylinders don't rely on a spring for a return force. Double-acting cylinders apply fluid or air under pressure to either side of the piston to apply the force and provide movement.

A common design for a double-acting cylinder contains one piston and piston rod assembly followed by two fluid ports instead on only one. The stroke of the piston and piston rod in either direction is produced by fluid pressure or compressed air (air pressure). The two fluid ports, one near each end of the cylinder, alternate as inlet and outlet ports, depending on the direction of the flow of fluid or air. When fluid or air in injected into one of the two sides of the cylinder the pressure of the opposite chamber has to be less than the pressure of the chamber the fluid or air is being injected into.

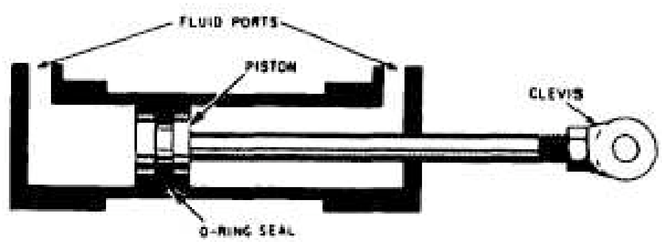


Figure 1: Double acting pneumatic pump

The reason is, if the pressure is equal in both chambers, no motion would occur with the piston rod; and if the opposite chamber had a higher pressure of fluid or air, then the piston rod would move in the opposite direction of which it was intended. So in order for the opposite chamber to acquire a lower pressure, the pressure must be exhausted through the fluid ports from which it was injected.

The double-acting cylinder requires a synchronized system of "inject and exhaust" in order for the piston to actuate properly. When one side of the cylinder is pressurized the excess fluid or air (if any) needs to be exhausted before new pressure can be administered. So when the left chamber is pressurized the pressure in the right chamber has to be decreased.

In our case creating the casing for our double-acting pump was the easiest part of fabricating our mechanical arm. Cutting out the pieces for the pump and attaching them was fairly effortless. We started with the idea conception part, with the conjuring of the pneumatic arm section first. We used the same idea as in our regional competition arm; a shovel connected to a series of pivet points to regulate the opening and closing of the arm. The parts of the arm section were fabricated out of aluminum and PVC piping. The shovel was made from PVC piping and shaped by hand with mapp gas and pliers. The pivet pieces and joints were fabricated from 1.905 cm grooved aluminum and the pins were fabricated by hand out to 0.635 cm aluminum rod. The support handles for the base of the arm were made from 1.27 cm hollow aluminum rod and we drilled 0.9525 cm symmetrical holes in the center of the supports for our piston rod to slide through.

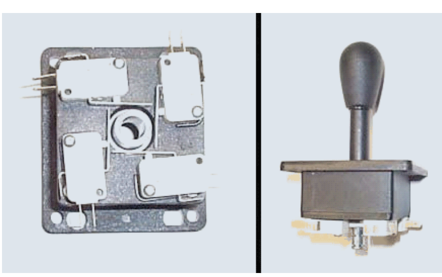
Pneumatic Arm (cont.)

The pneumatic arm casing was fabricated from 3.81 cm PVC tubing and caps. We drilled two 0.9525 cm holes on each cap end for the hose adapters. The hose adapters are used for injecting and exhausting compressed air from our pneumatic pump. The pressure used by our pump ranges from 275 kPa to 415 kPa or 40 psi to 60 psi. To seal the front end of the pump we drilled a 0.9525 cm hole in the middle of the front cap and wedged a 0.9525 cm aluminum tube through it. At the end of the tube we attached a 2.54 cm steel washer followed by a rubber washer. The second piece of this seal is composed of another washer attached to a brass spacer along with another 0.9525 cm aluminum tube and the tube is connected to the pneumatic arm section. O-rings are then placed on the shaft of the piston rod and the two sealant pieces compress the o-rings forming an air tight seal.

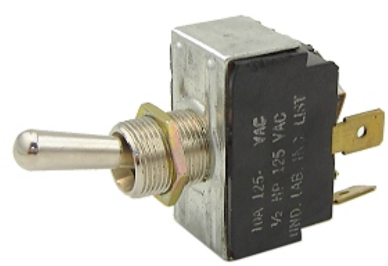
To open our arm we open the valve to let air into the rear end of the pump, so it pushes the rod foreword. To close our arm we exhaust the air from the rear section and inject air into the front section pushing the rod back and in turn closing our arm.

Control Systems

There are several wires that connect to the plug and fuse box. Four sets of these wires connect the switches on our joysticks (controllers) to the positive fuse box and the negative plugs. Connected to the underside of each joystick are four single pole double throw switches. These joysticks aren't like regular joysticks, in that these joysticks don't control the speed of the motors' rotation, they allow vertical and horizontal movements by activating each desired switch. Located on one single pole double throw switch are three brass electrical ports, two of which are connected to the negative and positive power sources, but the third port is connected to the motors. Coming out of a hole drilled on the back side of the box are eight motor wires that have been gathered together in a plastic plug. This makes it so each plug wire will be fused to the opposite wire. According to the multi-meter, the voltage passing through each circuit that powers each of our individual motors is roughly about 12.0 volts. Then there is about 4.5 ohms of resistance between each individual circuit and switch. Also connected to the fuse box inside the control box are the wires that power our infrared camera.



Picture 3: Our joysticks



Picture 4: Double-pole double throw switch

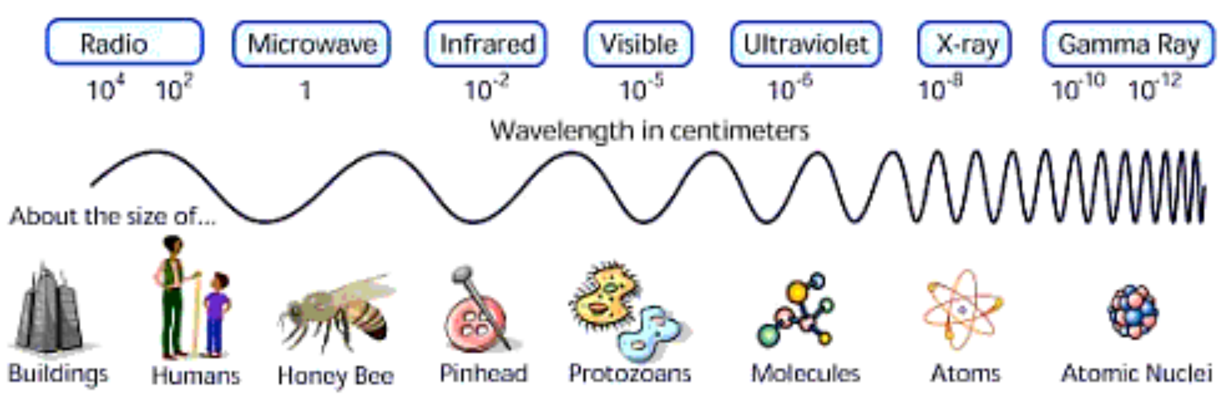
Infra-red Camera System

Our ROV supports two CCI Water Proof cameras. Each camera is equipped with ten infra-red LED lights. A Led is a light emitting diode. These LED emit infra-red light, just below the lowest frequency of visible light. Infrared, IR radiations, electromagnetic radiation of a wavelength longer than visible light, but shorter than microwave radiation. The name means "below red" (from the Latin infra, "below"), red being the lowest color of visible light and the longest wavelength. This basically means with the naked eye is virtually invisible, but with our ROV being tethered to a monitor, it enables us to see the effects of the IR lights. IR radiation spans three orders of magnitude and has wavelengths between 700nm and 1mm.

All reflected light that we *can* see with the naked eye represents a fractional portion of the electromagnetic spectrum, which is infinite. We refer to this section as "visible light". All around us light is reflected which the human retina cannot detect, such as ultraviolet and infra-red radiation.

The visible part of the spectrum falls between the wavelengths of 430nm~690nm. (1nm=10^{-9}m) Infrared rays have much larger wavelengths than this. They are divided into "Near Infrared Rays" (690nm-4,000nm) and "Extreme Infrared Rays" (over 4,000nm).

Unlike ultraviolet and visible rays, infrared rays tend to penetrate any medium rather easily because of their rather large wavelengths. This also means that infrared rays are not refracted significantly when passing from one medium to another. Considering that radio waves are ineffective under water and certain depths, it may seem that the density of water might also affect the wavelengths and spectrum of IR cameras. The only hazard that faced us in the water issue was the electronics, but since the cameras are waterproofed, it saved us time and the hassle of waterproofing a camera system. The manufacture's spec sheet states the waterproofing has a maximum depth of 82.296 meters, yet recommends an operation depth of 15.24 meters. 36.576 meters of waterproof wire provides the signal to be transported up to the monitor, and the power for the system.



The **wavelength** is the distance between repeating units of a wave pattern. It is commonly designated by the Greek letter *lambda* (λ).

Camera Specifications

Dimensions 5.08 cm L x 3.81 cm W x 3.81 cm H
Electronic Shutter: Auto 1/100 – 1/1000,000 sec.
Housing: Brass black in color
Humidity: Within 95% RH
Image Device: .846 cm b/w CCD image sensor
IR Led: 10 IR LED
Lens: 3.6mm, Hor. 72° Vert. 53°
Minimum Illumination: 0 lux
Number of Pixels: 512 horizontal x 492 vertical
Operating Temperature: 265k – 325k
Outputs: Video – RCA with BNC adapter, power –DC Jack
Power Consumption: 100mA
Power Requirements: regulated 12v DC power supply included (UL and CSA listed)
Resolution: 420 lines
Scanning Frequency: horizontal 15.75 kHz vertical 60 Hz
Scanning System: EIA standard 525 TV lines 60 fields/set
Video Output Level: 1.0 Vp.p 75 ohm
Video S?N Ratio: Greater than 46 dB
Weight 209.7 grams

Picture 4: LED infrared camera

Power Clarification

POWER CLARICATION (Taken from Competition Handbook)
Electrical power traveling through the tether meets specifications, 25 amps and 12 volts for Ranger class.

The Following auxiliary DC electrical power is also used:
- Batteries to run topside computers control panels/monitors.

Auxiliary DC systems is fused with 15 amp fuses per circuit.

The following non-electrical sources of power is also used, they meet safety guidelines:
- Pneumatic, such as compressed, inert gases up to 413.685kPa
- Generated from approved, tested and inspected pre-pressurized containers. These containers have a safety relief device.

Troubleshooting Techniques

We had incorporated the "Design Process" into the designing of "*Mano Kihikihi*," our ROV. The design process, in which we learned, consists of seven different steps.

1 Define the Problem (or an existing need or desire)

- We had first drawn out a plan based on what we thought would help us in obtaining optimal speed and maneuverability.

2 Research and Generate Ideas

- Originally the Mano Kihikihi was constructed out of 1.25 cm. aluminum rods Using Mapp gas and Alumaweld. When testing the pneumatic arm it tore the cross support beam off. We then switched to10mm stainless steel round bar. Without a significant loss of speed we were able to make the switch and keep the overall design.

3 Identify Criteria, Specify Constraints, and Select Approach

- The use of formal drawings, rough-sketches, brainstorming for ideas, researching on existing products and various laws, and principles helped us as we compared similarities and came up with a list of alternatives for materials and designs for the structure and propulsion.

4 Make Model or Prototype, Appropriately Using "Tools of the Trade"

- The creation of several proto-types to simulate environment for system, using same criteria, constraints, as the real model. The making of various mock-ups helped in several different ways to test out our design, motors and propulsion. After testing each one and found the current frame design and the six inch airplane propeller offered the fastest trial. Jigs were also made to insure a consistency in the bending of the 10mm stainless steel round bars.

5 Test, Evaluate, and Refine the Design Using Specifications

- By fine tuning our ROV, and running continuous tests on the system searching for errors or areas of improvement we were able to solidify our design plans.

6 Create or Make the Product or System

- We then assembled the ROV according to our specs.

7 Communicate the Processes and Results

- Accurate journals of process were kept to record discoveries, steps, and solutions.

Use of the Design Process helped in solving many of technical and building problems before they occurred. When problems occurred the pre-planning and non-limitations on various parts of the design, such as the material used in the frame, helped in recovering and keeping us on track.

As stated we used various models and sketches and drawings in helping to prevent problems before they occurred. This also included the pneumatic arm. It was first constructed using PVC and other material in order to get a working picture of how it was to operate. This was especially true for the placement of the propulsion. Knowing it had to be balanced on the frame and keep the center of gravity low, proved to be a challenge. Precision was very crucial because the supports and mounting brackets had to be welded to the frame. The exact placement of the motors were calculated by using a PVC model and a lot of trial and error. The placement and weight of the supports and brackets also needed consideration.

Future Improvements

Mr. Izumi was able to show us the importance of using the design process to cut wastes—waste of time, and materials, also to go from designing to fabricating. Although he has a working knowledge of the physical science aspects, we would like to learn more. This project has opened our eyes and made us curious as to being able to discuss our rationale in scientific terminology and various other marine biological explorations.

On future improvements for the ROV, we want to find an alternative frame material; one that isn't heavy, but still durable and strong. The aluminum had the weight we desired but not the strength or durability required for completion of the missions, at least for this competition. Other solutions we had investigated but didn't have the funding for were a graphite or carbon fiber type of material. We had created molds but were unable to actually use them because of some funding that fell short.

Careers/Occupations Careers dealing specifically with the marine aspects—oceanographer, marine technician, communication specialists, and environmental analysts. The second group includes occupations in engineering.

Marine Occupations

Oceanographer

The main job specifications are to explore the surfaces and trends of the earth's environment that will influence the future, such as continental shifts, underwater volcanic activities, and other global issues surrounding the oceans.

Communication Specialists

Communication is one of the main factors to make an efficient team. People with specialty skills in this field are tasked with investigate actions to accomplish specific strategy objectives. This position will focus on planning legislative outreach activities and increasing the team's visibility by coordinating outreach activities.

Marine Technicians

This field requires the person to conduct on-shore and at-sea testing. He or she would be dealing with operation, maintenance, troubleshooting and repair of the standard oceanographic instruments.

Environmental Analysts

This type of career allows the person to manage and protect marine mammals. There are threatened and endangered species that are under the jurisdiction of NOAA Fisheries, which are also under careful observation. The goal of this field is to authorize protection, conservation to the populations of endangered marine wildlife species, They are also there to provide effective protection to detrimental human activities, while allowing humans to proceed in a manner that is sustainable for the species affected.

Occupations in the Engineering Profession Relating to the ROV

Electrical Engineering:

Electrical engineers work side by side with civil engineers to assist them with the electrical part of a project. Their main objective is to test, supervise and manufacture electrical or electronic products. Electrical engineers are also known as designers of new products. They also write performance requirements and develop maintenance schedules. Electrical engineers can be described as a surgeon that works with the inner parts of a body and making it functional.

Occupations (cont.)

In relation to our R.O.V. project, the electrical controls of maneuvering the R.O.V. are done as a simple parallel circuit using joy sticks with double pull-double throw switches. The joy sticks powers the motors and gives the R.O.V. the basic functions to move efficiently underwater.

Mechanical Engineering:

Like the electrical engineers, mechanical engineers work with the testing, supervision, and manufacture of tools, engines, and machines. They work power generators, turbines, air conditioning system, refrigerators, and robots. They also design tools for other engineers to use. Mechanical engineers are the broadest engineering field with many opportunities with the knowledge from civil and some electrical, its integrations make this occupation very flexible. The work between a mechanical engineer and electrical engineer on a ROV (Remotely Operated Vehicle) are very close related. They specialize in the specific functioning of the ROV. The mechanical engineers job is to plan and design a device capable of maneuvering underwater with his/her limited materials. Once the design is complete, the mechanical and electrical engineers work together to connect all necessary circuits to finalize the arm and install it onto the ROV.

Civil Engineering:

Civil engineers deal with the supervision of construction. Their main objective is to see how the project is handled and carried out. Some other civil engineers work entirely in the field or they actually do the projects themselves. Civil engineers' work fields include structural, environmental, transportation, and geotechnical and hydro engineering.

Picture 5: Marine Technician

Hindsights

Written By Zach Fischer

Over the past several months we come to really take pride in our workmanship in the form of our class ROV. The road on our journey to complete our robot was quite tedious and sometimes off-track. After all said and done we kept to our word and finished our ROV to the best of our abilities. The challenges we faced was like something from a cartoon. One thing after another went wrong. At one point I became so frustrated that I literally lost all motivation to proceed with our project, but after a long lecture from Mr. Izumi I realized that my team really needed me and I wasn't about to abandon them. One of the setbacks we faced in particular was the control box, no matter how much time and effort we put into it we still couldn't get it to work. It was only until an anonymous electrical engineer major added his insights and helped us to get it to work. Another major setback was the tragedy of our first frame. Our first frame was constructed from aluminum, a lightweight and somewhat strong material; so we thought. To put it simply, our pneumatic arm ripped it apart. So we had to alter our frame. We sacrificed weight for strength and constructed our current frame from stainless steel. There were many other challenges in our way, but I wouldn't like to go into detail with that because I don't want to have write a book. I don't want to look back at the troubles, but more of looking forward to the future

Written By Jacob Pantastico

Let me start off by saying that this is the coolest thing I have ever done in school. How often do you get to build a ROV and compete with it? Well never for me. Even with all of the hard times and setbacks, this was still the greatest experience for me. One of the challenges in particular was that fact that we were never on schedule, we worked everyday and night for hours on our robot, but only managed to take baby steps on our fabrication. In not saying we were lazy; well maybe a little, but when the time came to work, we worked. Another challenge was figuring out where we were going to mount everything, i.e. the cameras, motors, and mechanical arm. We spent a lot of time just staring at the robot and figuring out what we were going to do. The lesson I learned was to always be prepared. You can't expect ideas to appear magically. You do need a little luck here and there, but luck favors the prepared. Another lesson is that there is no "I" in "Team" and everyone plays a big part in the project. No one person did all the work and no one person did none of the work. Something I would like to improve upon is our procrastination; we are the worst bunch of procrastinators ever. What more can you expect from teenagers? Procrastination is like a disease to teenagers, we acquire it, but this project inspired us to find a cure for that disease and get work done on time.

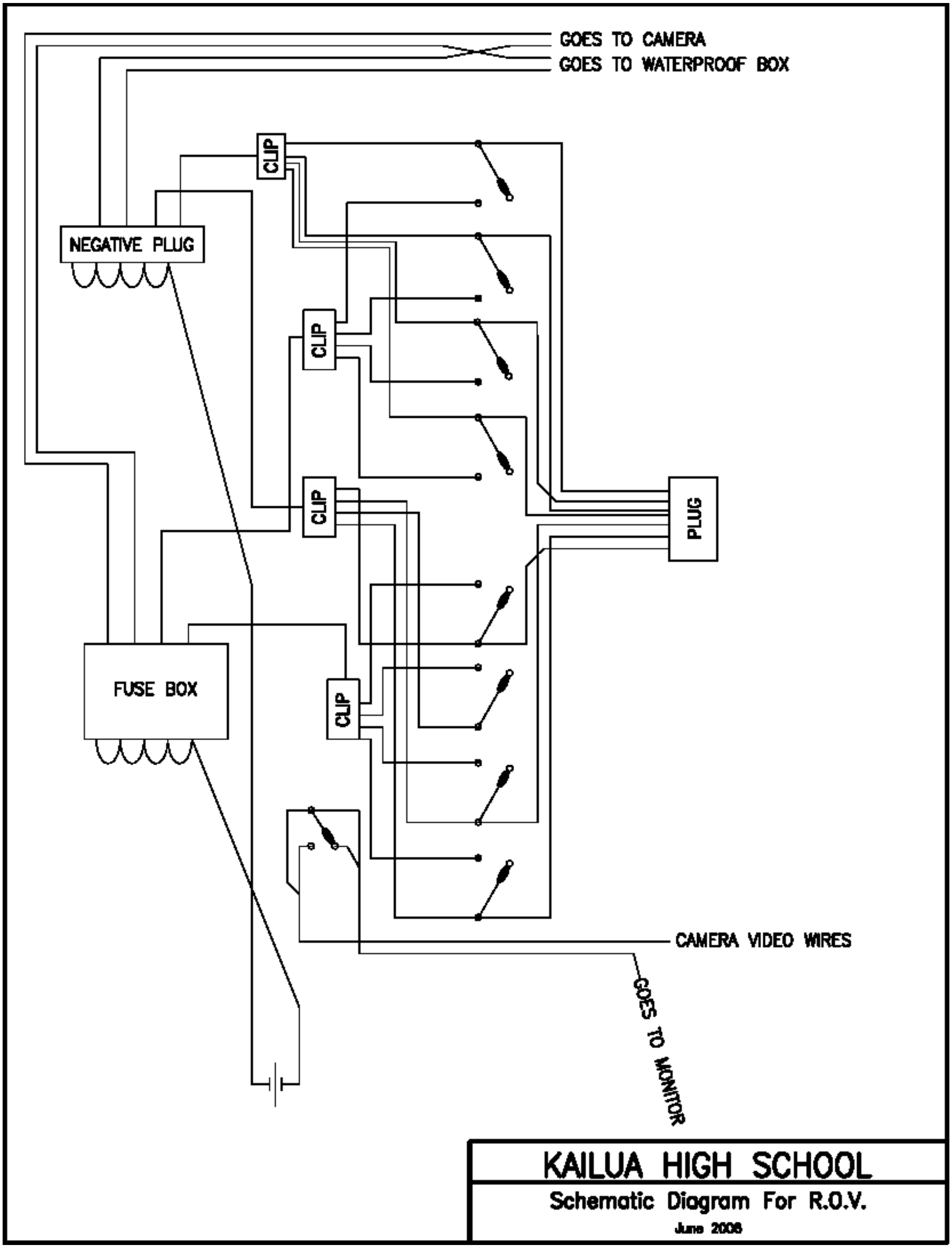
Hindsights (cont)

Written By Keoni Hall

We've had many ups and downs in our path to ROV domination, but none as difficult as the project itself. I mean that we quickly formulated plans and ideas for what we wanted the robot to look like, act like, and perform like. But when it actually came to converting those ideas into a robot, it seemed almost impossible. No matter how well you plan something out, you will always run into problems and new ideas. This makes the project completion time almost impossible to predict. Like for example, the grabbing arm for our robot. We kept changing the mechanics of the arm almost everyday, coming up with new and inventive ways to construct it. From the pneumatics of the arm to how we were going to power it, nothing seemed to be absolute. When we finally settled on an idea we were so far behind schedule that we were practically forced into settling with that idea. This was a very valuable lesson indeed; never count your eggs before they hatch. You always have to be ready for all of life's surprises. Life is like a box of chocolates, you never know what you're going to get. For future references, I would have like to have kept this project easy and simple. Nothing to elaborate, but something that didn't look like elementary students did. This project taught me great leadership skills in that everyone in the team has there own ideas and no one person should be the team's absolute power, i.e. Hitler. You have to follow before you can lead and a great way to follow is the listen to what your teammates have to say and contribute.

Written By Trevor Johnson

This has to be one of the hardest things I have ever had to do. We stay for hours on end, till two o'clock in the morning and we still don't even get paid! It wasn't all torture. I've learned so many things like how a hydraulic pump works and how a ROV works, it's pretty eye-opening. I love to work with my hands and create things. It is the greatest feeling in the world. You women out there should have a slight idea of what this means. When a woman gives birth she brings a person to life. Us on the other hand, we take an idea from our head and bring it to reality. How often can you bring and inanimate object to life; figuratively speaking? I have also learned a great deal as well. DON'T PROCRASTINATE! No matter how many times I tell myself that, I still end up doing it anyways. Maybe I should tell myself *to procrastinate* so I end up not doing it. I can use reverse psychology on myself. But then again I do my best work under pressure. It is that extra push that gives me the boost I need to do my best. If I can get it done by the deadline then there is no harm done. I don't do what's best, I do what's necessary. . The greatest lesson I learned in this ROV project was... "At First You Don't Succeed, Try, Try Again". No matter how prepared and positive in yourself you are, always have a plan B (C, D, E, and F) in your back pocket, because nothing is as it seems. For Future improvements I would like to cut back also on our team procrastination. I would still like to take some of the stress off of my team so being ahead of schedule sometimes would be a little relaxing. Helping out and maybe giving us a false sense of security, was we had made plans and back-ups or alternative plans, just in case.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CAMERA VIDEO WIRES
GOES TO MONITOR
KAILUA HIGH SCHOOL
Schematic Diagram For R.O.V.
June 2006

Budget

Surfrider Robotics	***Instructor:*** David Izumi
Team: Mano Kihikihi	***From:*** Oct. 6, 2005 ***To***: June 14, 2006

Date	Deposit/Expense	Description	Notes	Amount	Balance
	Deposit	Starting Balance	From CTE Funds		10000.00
	Expense	Marine Goop & Sealants		42.07	9957.93
	Expense	Paint on Electrical tape		8.79	9949.14
	Expense	Zip Ties		1.79	9947.35
	Expense	Stainless Steel Nuts, Bolts, Washers		9.30	9938.05
	Expense	Aluminum		29.63	9908.42
	Expense	Cameras	on hand	0	9908.42
	Expense	OSSI Tether Line	donation	0	9908.42
	Expense	Floatation Device	on hand	0	9908.42
	Expense	Fittings for pneumatic pump	on hand	0	9908.42
	Expense	Syringe	on hand	0	9908.42
	Expense	Hose	For pneumatic pump	30.05	9561.41
	Expense	Poster Boards for display	on hand	*0*	9561.41
	Expense	Air Transportation	Tax Included	5110.00	4451.41
	Deposit	Donation From PCL Inc.		500.00	4951.41
	Expense	Hotel	Tax Included	2168.01	2783.40
	Expense	Rental Car	Tax Included	500.00	2283.40
		Total Spent/Balance Remaining		***7716.60***	***2283.40***

The final figure does not account for donation from MATE, and other expenses associated with travel (included are expenses for shipping, meals, gas for vans, and last minute misc. items.

Acknowledgements

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- **Nordic PCL Construction for their monetary donation to Surfrider Robotics**
- **Principal Mrs. Francine Honda**
- **Kailua High School CTE Dept.**
- **Kailua High School faculty and staff**
- **Advisor David Izumi, IET Teacher**