Paradise High School ROV Team's "BENDER" Paradise, California

M.A.T.E. International Competition Houston, Texas 2006 Technical Report

We Be the "Jeniusez"

A step above the clouds; May you find it to be all its name implies.

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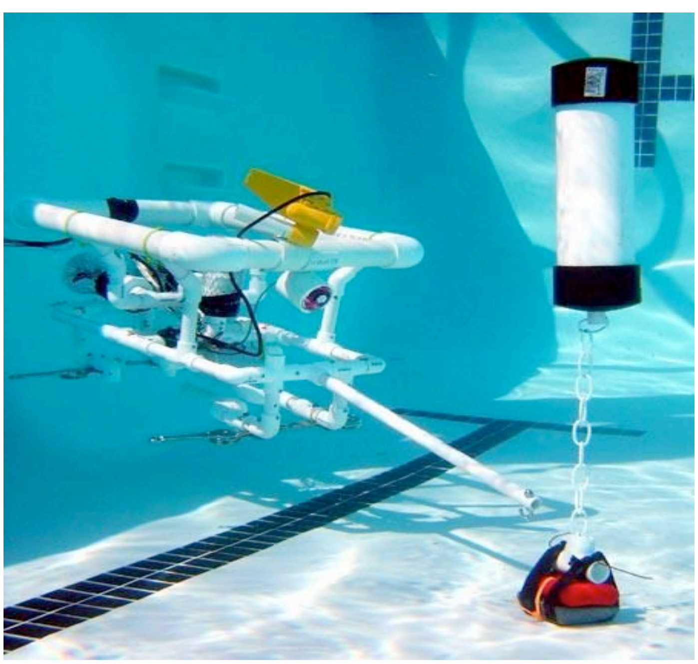
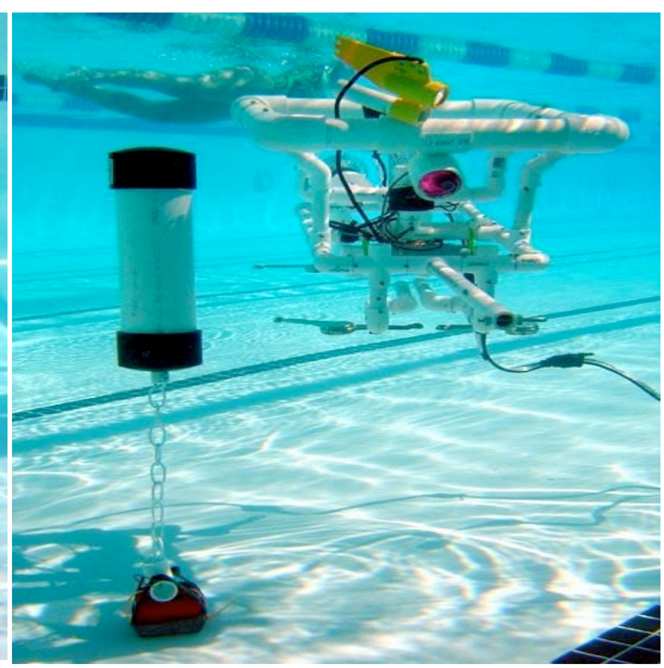
Abstract

This abstract describes the Remotely Operated Vehicle (ROV) Bender. Bender was built by Paradise High School's ROV Team, known as the "Jeniusez." Our ROV was built according to the specifications set forth by MATE to complete all of the mission tasks for the 2006 Regional and International competitions hosted by the Marine Advanced Technology Education Center (MATE). These tasks include: delivering an electronics module to a trawl resistant frame, opening the door of the frame, inserting a power supply probe into the correct port, and releasing a malfunctioned acoustic transponder.

Bender was built out of 3.81 centimeter (1.5 inch) and 1.27 centimeter (.5 inch) PVC pipe and fittings. We also used modified bilge pumps, toggle switches, 18 gauge speaker wire, and two cameras.

This report will give you a better idea of what our team is all about and give you some insight to our ROV Bender. This report will discuss the design rationale for the ROV, final design, skills gained based on our experiences this year, troubleshooting methods, and improvements that we have considered installing to help our ROV be more efficient and effective. There is also information on a career and technology that will give the reader a better understanding of how ROV's are used in real life applications

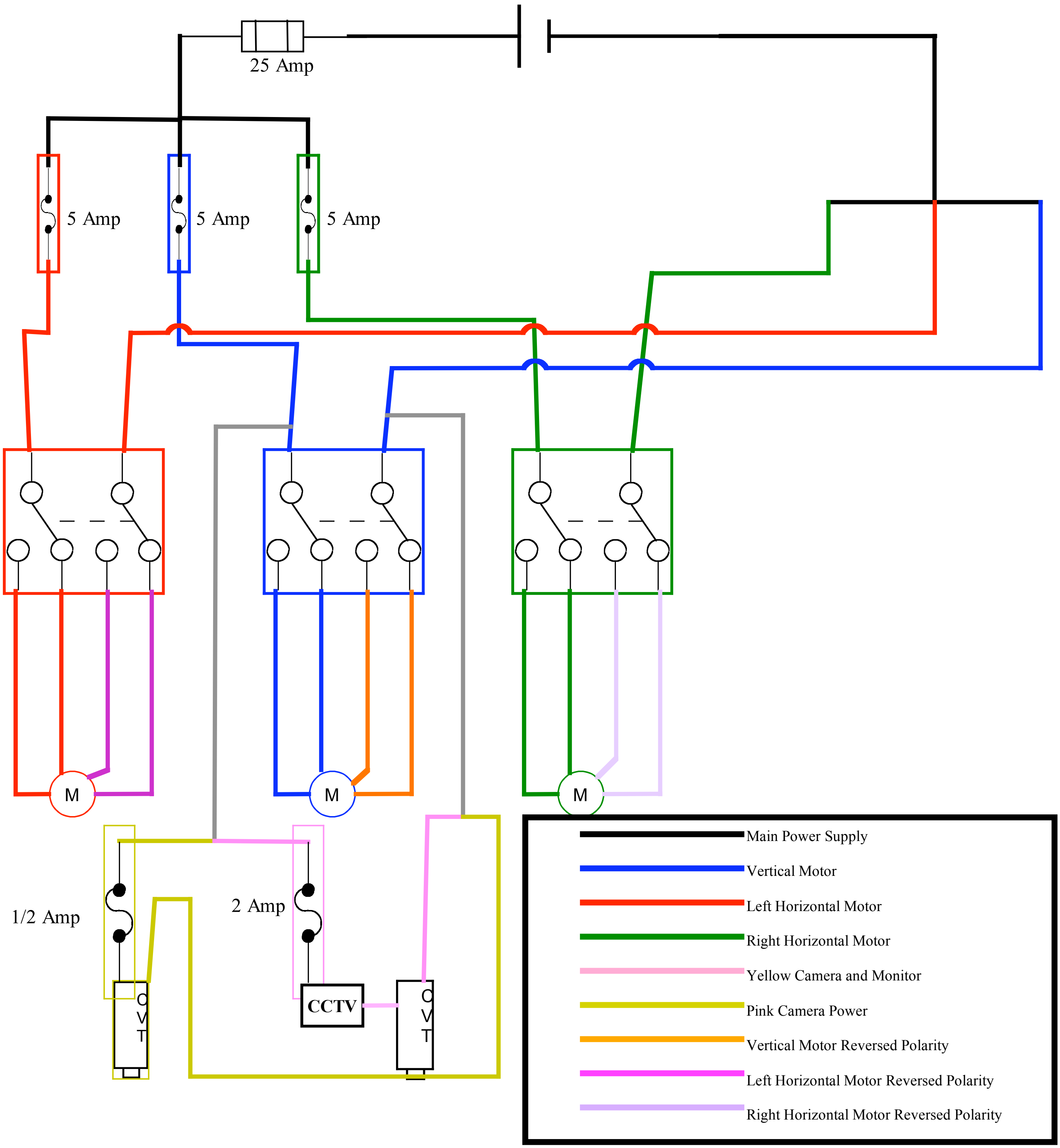




Budget Expense Sheet				
Deposit or Expense	**Quantity**	**Description**	**Unit Price**	**Total**
Hardware				
Expense	3	Gutter Strainer 2"	$2.69	$8.07
Expense	17	1/2" PVC T	$0.14	$2.38
Expense	4	1/2" 45 PVC elbow	$0.23	$0.92
Expense	5.02 ft	1 1/2" PVC pipe	$1.09	$5.47
Expense	150 ft	18 gauge speaker wire	$5.08	$15.24
Expense	1	condelet box	$3.01	$3.01
Expense	8 ft	12 gauge speaker wire	$0.42	$3.36
Expense	10.03 ft	1/2" PVC pipe	$0.23	$2.30
Expense	1	control box	$1.19	$1.19
re-used	3	bilge pump	$15.00	$45.00
Expense	1	Banana Plug	$2.59	$2.59
Expense	1	Terminal Block	$2.89	$2.89
Expense	1	camera wiring	$18.06	$18.06
re-used	3	Toggle switches	donated	$0.00
Expense	1	camera (Harbor Freight)	$113.56	$113.56
re-used	1	camera (MATE)	$45.00	$45.00
donation	4	Ferrari Hinges	donated	$0.00
Expense	16	1/2" PVC elbow (90)	$0.12	$1.92
Expense	2	1/2" PVC coupler	$0.15	$0.30
Expense	3	2" to 1/2" PVC reducer	$1.29	$3.87
Expense	2	3/4" PVS caps	$0.10	$0.20
Expense	4	1 1/2" PVC elbow	$0.45	$1.80
Expense	1 ft	3/4" PVC pipe	$0.17	$0.17
Expense	1 ft	1 1/4" PVC pipe	$0.27	$0.27
Expense		miscellaneous hardware	$9.76	$9.76
Peripheral				
Expense	82	screws	$0.05	$4.10
Expense	1	J-hook	$1.29	$1.29
Expense	7	electrical tape	$0.40	$2.80
Expense	2	solder	$2.29	$4.58
Expense	5	inline fuse	$0.99	$5.94
Expense	4	fuse	$2.29	$9.16
Expense	2	toilet bowl wax ring	$0.70	$1.40
Expense	1	regular PVC glue (8 oz)	$2.26	$2.26
Expense	1	wet/dry PVC glue (4 oz)	$1.82	$1.82
Other (not counted for ROV total)				
Expense	1	poster board	$5.14	$5.14
Expense		excess PVC pipe and Fittings	$36.94	$36.94
	Total Spent		**$320.68**	

Paradise High School

Bender's Electrical Schematic



Design Rationale

This year our team's design process consisted primarily of trial and error. At our first meeting we began to brainstorm practical shapes and designs, which could be constructed to complete the mission tasks. The results of that first meeting were diagrams for "fuzzy blue stars" and "pink hearts" which were innovative, but not feasible. Our team, consisting of ever so practical teenagers, ultimately decided to model our robot after PHS's regional winner, "The Beast", from the 2005 competition. We finally created the robot, which we fondly refer to as "Bender," adhering to a design, which would prove to be both cost effective easily modified. Team members' experience with previous competitions and our background research of the mission tasks drove the design of "Bender" and resulted in an extremely functional ROV.

Design Rationale for Individual Components

1. Frame

The building of the robot began with the frame. We understood that the frame dimensions would need to be comparable to those of the electronic module in order to carry and maneuver the module with efficiency. We again referred to "The Beast" for a design based on stability. It was decided that a rectangular shape would allow the robot to be easily maneuvered and power efficient. Our design proved to be hydrodynamic. The material of choice to build the frame would be 1.27 centimeter (.5 inch) PVC pipe, which was inexpensive (purchased at a discount at Thomas ACE Hardware) and easy to modify. The frame would be screwed together, with 1.5 centimeter Philips head screws, rather than glued, making adjustments simple and less time consuming.

2. Video Camera and monitor

In order to keep track of this year's competition tasks, our team employed the use of two cameras. One was a color camera taken from last year's "The Beast," which was purchased from MATE and pre-sealed. MATE sealed the camera by placing it face down in a clear acrylic jar and then sealing it with silicon around the lens housing. Then, a 2-part epoxy was added to fill the remaining space inside the jar to ensure the entire camera would be waterproofed. We remounted it on a piece of PVC (cut in half) and attached it to the front of the ROV for an adjustable view of the payload. The second camera is black and white and was purchased for $100 from the Harbor Freight Company including a small monitor and 12 volt battery. It is compact and able to reach a depth of sixty feet, a depth we knew our mission tasks would not exceed. The second camera was also mounted on adjustable PVC to guarantee the best view of the electronics module. The monitor from Harbor Freight had hookups for both cameras so that during practice, only one monitor was needed. The cameras were placed in front of the ROV to allow for a clear view of the payload and electronic module simultaneously. The added mass to the front helped to balance the mass of the bilge pumps mounted on the back.

3. Payload Tools

The mission tasks this year required our team to search for innovative methods to install an electronic module in a trawl resistant frame, open a door, correctly insert a data probe into the module, and trigger a malfunctioning acoustic transponder. The simple solution for the opening of the door and inserting of the probe was a 1.27 centimeter (.5 inch) PVC arm. At the end of the arm is a simple metal J-hook, which can be used to pull open the door of the frame. The PVC arm is also capable of opening the door by wedging it in the handle and driving forward with the robot. The hook is a multifunctional tool because it can also be used to insert the power cable and release the transponder. The width of its opening is such that the power cable will remain attached while driving and can be easily removed once the probe is inserted into the appropriate port. The J-hook can also be used to pull the pin from the transponder housing to trigger the transponder.

A payload that would hold and release the electronic module was difficult to conceive. One momentous day, one of our team members opened his new cabinet door and took special note of the hinges, which kept the door from hitting his head. The hinges have adjustable tension and move in both directions. Four of these hinges were later donated to our team by Ferrari America, and we set them to properly hold the electronic module. A payload made from 1.27 cm (.5 inch) PVC was screwed to the bottom of our frame and the hinges were attached to the added portion in positions that would be able to grasp the four rings on the electronic module. The hinges have proven to be ideal for the task because we can adjust their tension based on the propulsion of our vehicle and ensure that the box will not slide off before it reaches the trawl-resistant frame. Once the box is placed in the frame, the driver simply has to drive forward and the hinges collapse and release the box.

4. Tether

We first began calculating the length of the tether using Pythagorean's Theorem ($a^2 + b^2 = c^2$) and figured that 12.192 meters (40 feet) would be sufficient for the tasks based on MATE's parameters, which were approximately 3.96 meters (13 feet) by 11.58 meters (38 feet). Our thrusters were connected to our tether using a terminal block. This terminal block was placed inside of an electrical junction box and sealed with toilet bowl wax. The electrical junction was then centrally located and zip tied to the robot. The wires that were to go directly to the control box were routed to avoid the propellers, and banded together with electrical tape to the back of the ROV. For easy tether management the thruster wires and camera wires were also taped together. To allow the tether to be neutrally buoyant and not alter the balance of the ROV, small pieces of pipe insulation were cut and spaced around 22 centimeters from each other. They were then completely covered with electrical tape to prevent being saturated with water.

5. Thrusters

We salvaged three thrusters from last year's ROV to use on "Bender." They are 1703.44 liters per hour (450 gallons per hour) bilge pumps modified by removing the impellers, adding shafts and adapting propellers. To achieve maximum maneuverability, two motors were placed toward the back of the ROV, evenly spaced, right and left. Our third motor has a vertical orientation and is centrally located in order to surface and submerge our ROV. To ensure the safety of our wires and any divers, we covered the thrusters with shrouds that are usually used as guards for rain gutters.

6. Power and Control System

The robot's power source is a 12-volt battery. The battery is connected using banana plugs to provide power to our robot. The control box consists of three dual-pole dual-throw toggle switches, with auto return to neutral function, which are connected to the motors on the robot. It is designed so that the left and right motor switches are at the top of the control box with the vertical thruster centered directly underneath them. The control box is small and circular, which is easy to handle as the driver can simultaneously access all three controls to the thrusters by grasping it with two hands and employing the use of their thumbs. The set up resembles that of the controls to many RC cars. Each component is individually fused using in-line fuses. The fuses used were 25 amps for the main power, 5 amps for each of the thrusters, 2 amps for the Harbor Freight camera, and a 0.5 amp for the color camera.

7. Ballasts

Although we did calculate the volume of the PVC used on our ROV by water displacement methods, we didn't put these calculations to much use. With Archimedes' principle, which states that the buoyant force a fluid applied to a completely or partially immersed object is equal to the weight of the fluid which the object displaces, we could have figured out the exact measurements of the ballasts which would allow our robot to be slightly positively buoyant. We could have used the equations FB = (ρ_{H2O}) (V_{ROV}) (g) and M_{ROV}= (ρ_{ROV}) (V_{ROV}) (g). [ρ = density, FB= buoyant force, V= volume, M= weight, and g = gravity (9.8m/s).] With these force calculations, we then could have determined the appropriate cylindrical ballast with $V=p\ r^2\ h$. The ballasts were created by trial and error, and we found that 3.81 centimeters (1.5 inch) PVC pipe was needed to get the ROV positively buoyant. We ran into trouble when we didn't take the extra weight of the electronic module into account. We utilize an extra 2.5 centimeter (1 inch) sealed ballast attached to the top of the robot with zip ties for the electronic module task. At the completion of the first task, the robot would resurface and the zip ties would be clipped off to recover neutral buoyancy for the rest of the tasks.

We attempted to make the robot more aesthetic by making the ballast an integral part of the robot using T reducers attached to our frame. We did this by sealing the PVC elbow joints with wax and plugs. Our techniques were unsuccessful as we lost approximately four ballasts. We abandoned the idea and used a sealed ballast attached using zip ties.

Final Design:

"Bender's" Vital Statistics

Dimensions

Components	Length (cm)	Width (cm)	Height (cm)
Ballast	55	46	
Structure	54	28	33
Payload	42	43 (with hinges)	47 (with cameras)

Mass (Kg) and Weight (N)

Dry Mass	6.35 Kg
Wet Mass	1.66 Kg
Dry Weight	62.23 N
Wet Weight	16.27 N

"Bender's" Timed Trials (3 meters)

Trial #	1	2	3	Average	Speed
Time (s)	10.2	9.3	9.1	9.53	.31m/s

Power of "Bender" (Newtons)

Motor	Right	Left	Both
Forward	5 N	5 N	10 N
Reverse	3 N	3 N	6 N
Vertical	2N (up)	2N (down)	

Final Design for Individual Components

1.Frame

The frame is mainly constructed of 1.27cm (.5”) PVC pipe and 1.27cm (.5”) fittings. The fittings are connected using sheet metal screws.

2. Video camera and monitors

We have two cameras operating on our robot. One black and white camera was purchased from Harbor Freight and came with a 12-volt battery and small black and white monitor. This camera is able to reach a depth of 60 feet. The other color camera was purchased from MATE and was pre-potted as described previously.

3. Payload Tools

There are two payload tools used to complete the three mission tasks. One of them is detachable and the other is attached to the bottom of the ROV frame.

#1. This payload tool is an attachable arm made from 1.27cm (.5”) PVC connected to a T fitting in the front of the robot. It has a J-hook attached at the end and fastened with a bolt designed to grab the pin and data probe. The PVC arm is also capable of opening the door to the box.

#2. This payload tool aids in the insertion of the electronics module into its trawl resistant frame. Four cabinet hinges with an adjustable Newton force donated by Ferrari America are attached to our payload. These hinges are notched into the PVC and secured with metal plates and bolts.

4. Tether

Coated 18 gauge copper speaker wire, video camera cables, pipe insulation, and electrical tape comprise our tether. For easy management, we utilize an empty wire spool salvaged from our local hardware store.

5. Thrusters

"Bender" uses three thrusters that are modified 1703L (450 gph) bilge pumps. The pumps were modified by removing the impellers, extending the shafts and adapting propellers onto the extensions. The propellers are 55mm acrylic designed for model boats.

6. Power and Control System

Final design for our power and control did not change from our original design. The robot's runs off a 12-volt battery. Banana plugs connect the battery to the control box. The control box has three dual pole toggle switches connected to the motors on the robot. It is designed so that the left and right motor switches are at the top of the control box and the vertical thruster is controlled by a switch toward the bottom (similar to the controls to many RC cars.) The fuses used were 1-25 amp, 3-5amp for each thruster, 2amp for the Harbor Freight camera, and a.5 amp for the color camera.

7. Ballasts

There are two ballasts, one permanent, and the other removable. The permanent is a 3.2cm (1.5") PVC sealed rectangle connected to our frame using zip ties. The removable ballast is a smaller rectangle made from 1.9 cm (3/4") PVC secured with zip ties so that the ballast can be easily removed.

Design Challenges

In the beginning, we started the design of our ROV on paper. We wanted to design our ROV based on the missions we had to complete. We wanted to design something that was simple yet productive while keeping focus on the mission tasks. While building our robot, we also faced many challenges and obstacles. Each challenge set us back and took time to fix. Even though the obstacles were frustrating, we were always able to get through it.

Our biggest problem was our ballast system. Every time we built a ballast, we ended up making it crooked. Even though the ballast was crooked, we would continue to practice the mission tasks. As we continued practicing in the pool, we started to sink and were unable to bring our robot back up with the propellers. So, not only were the ballast ends crooked, they leaked causing buoyancy problems and prevented us from completing the mission tasks.

Buoyancy was another problem we encountered. Since the ballasts leaked, determining how buoyant our robot should be was difficult. We should have determined the amount of ballast needed to allow our robot to stay buoyant. Instead, we continued with trial and error. When we would practice the mission tasks in the pool, we needed more ballast for the electronics module mission. The module was so heavy that our robot couldn't carry it without sinking. When we made a larger ballast to fix this problem, the robot then became too buoyant to finish the rest of the tasks. The robot was unable to submerge with the larger ballast. To fix this, we ended up having one main ballast and one detachable ballast. This detachable ballast is placed onto the main ballast and then secured by zip ties. The attachable ballast allowed us to carry the module without sinking and comes off quickly so we can finish the other missions in a timely manner.

Another problem was the payload. To help us complete the electronics module mission, we have four hinges that carry the module down into the frame and release it when appropriate. These Ferrari hinges are attached to our payload on the bottom of our ROV. They open and close in such a manner that there is enough tension to keep them from closing and therefore releasing the module prematurely. We attached our ROV to the module, but soon realized that we would either need to loosen or tighten the hinges. The tension of the hinges is adjustable so we continued with trial and error until the appropriate tension was found. Finally, when the ROV was placed in the water with the module, the module had a tendency to shift from side to side preventing us from driving away from the module's u-bolts. To stop the ROV from shifting, we built guide rails on the payload that ran along the center ring of the module so that we could prevent the module from sliding to the left and right.

Every challenge was something that we, as a team, worked out together. While some challenges may have been harder to fix than others, we always got through them. All of the obstacles made a difference in the performance of the ROV. They determined how the robot would operate, how efficient the robot was, and how quickly and effectively we could complete our mission tasks.

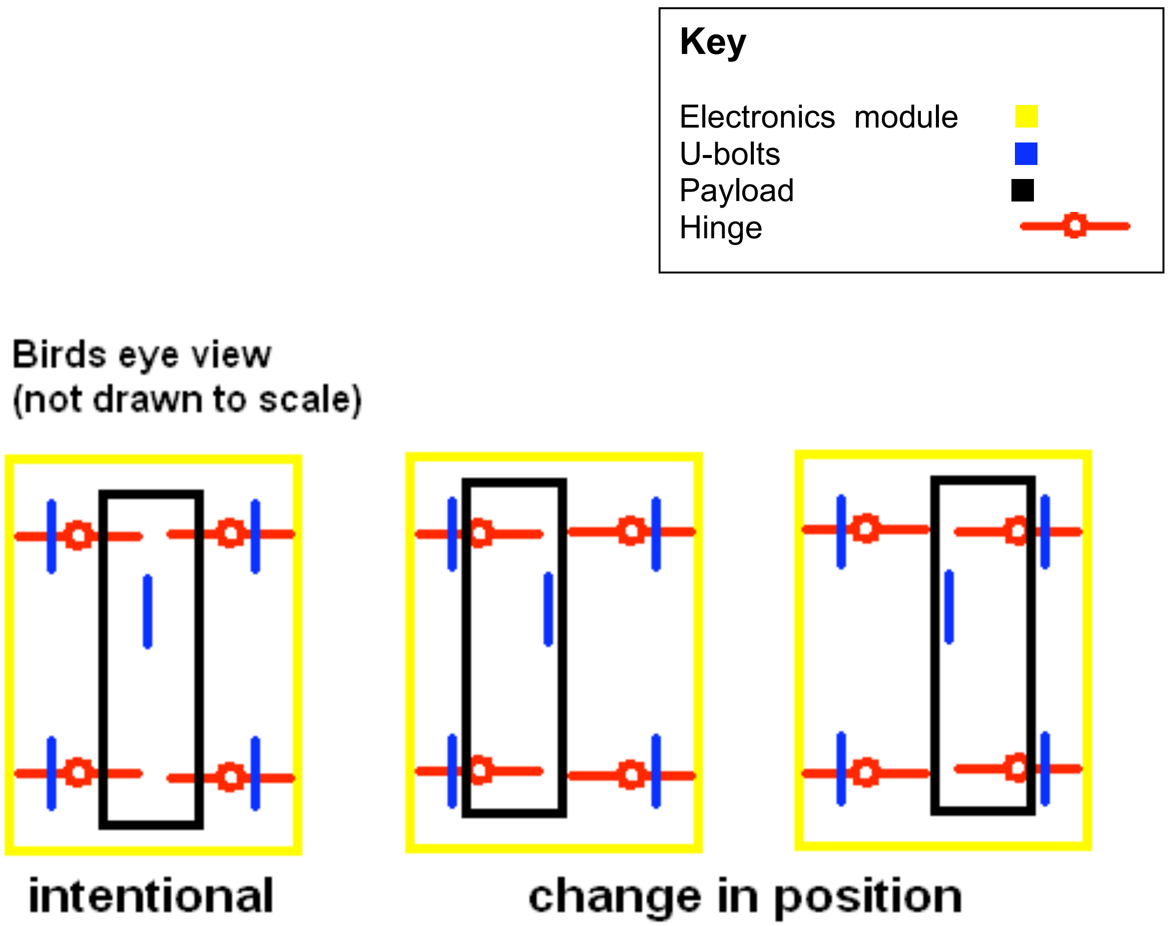
Troubleshooting

Through the course of the year we encountered and overcame many technical difficulties. Some of the problems we encountered were the size of our ROV, the size of our ROV's ballast, and the payload used to carry the electronics module.

When we first built our ROV it was much larger than it is now. We felt we had made the structure too big for our mission tasks. We reduced the size of the structure to gain more maneuverability. We reduced the size of our ROV four times before we felt it was the right size for our missions. After we reached our desired size, our ROV was out of proportion in some areas due to measurement mistakes when reducing the ROV's size. We simply had to replace the incorrectly measured pieces of PVC with new pieces of the correct length.

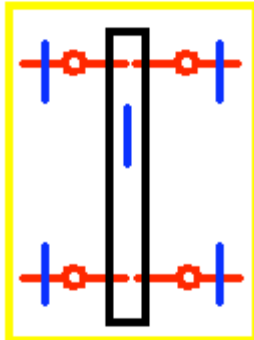
A consistent problem we had up to the night before our regional competition was our ballast. The first ballast we produced acted like a placeholder until we were ready to test our ROV in a pool. When we were ready we removed the ballast and sealed it for the first time. When we reattached the ballast on to our ROV we found that the ballast was crooked. We used the ballast anyway just to get an idea of the size we would need for our ROV. The ballast was too small to keep our ROV afloat with the electronics module attached. We produced a second ballast. This one was too big. Even with the weight of electronics module, it refused to submerge. We produced two more ballasts, neither one provide us with the buoyancy we desired. We then produced one more ballast, this one was just right for our ROV, but not when the electronics module was attached. With this ballast we were satisfied with our buoyancy. We still had to cope with the weight of the electronics module, so we produced another smaller ballast and designed it to be quickly detachable. We use two ballasts for the electronics module mission and then detach the second ballast for the rest of the missions.

Our fist attempt at making the payload for the electronics module contained errors in the design. Our ROV used four hinges to hold the electronics module. We first intended to make this payload detachable, but we changed our minds when we encountered all of the ballast problems. The hinges worked great for holding the electronics module, but we faced difficulties when we tried to release the electronics module. Our first design allowed the electronics module too much free space to move around and allowed it to get caught on the hinges.



We decreased our guide rails (shown below) to stop this movement and that proved successful.

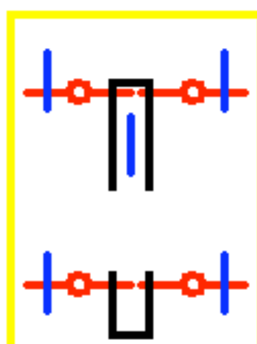
Birds eye view
(not drawn to scale)



Decreased
Guide Rails

When we arrived at our regional competition we arrived to find that the electronic modules provided were smaller than the one we had built for practice. We had to make one final adjustment. We cut part of the guide rails off and moved them toward the back of the ROV. We also had to reshape the front part of the payload to reduce friction so we could easily drive away and release the electronics module.

Birds eye view
(not drawn to scale)



Change at
Regional
Competition

Learning Experience

During the seven months building this robot, everyday was a learning experience. While struggling with daily tasks, such as not having proper ballasts, we all learned from our mistakes. We learned a variety of new skills that go hand in hand with building a remotely operated vehicle.

Electronics was definitely a test this year. Wiring a control box was one of the things we added to our knowledge this year. To wire a control box, we had to solder, connect positive to negative wires and determine which wires should be connected to enable our robot to go vertical, left and right. If the wires were connected incorrectly the flow of current would be reversed. Soldering was a technique used to connect all of our wires from the tether to the control box and back down to the terminal box.

Although waterproofing may seem like a complicated task, it wasn't entirely difficult. Instead of spending unnecessary money on high quality sealant, we used toilet bowl wax ring. This was an inexpensive way to keep the water from interfering with the wire's ability to function.

One of the most challenging aspects of this process was dealing with buoyancy. Buoyancy is an upward force on an object immersed in a fluid, enabling it to float. We built 4 ballasts before we found the right buoyancy. The electronics module added more weight to our ROV and therefore required more buoyant force. When we needed more buoyant force, we had to make a different ballast in a larger size. The size of our ballasts fluctuated often to fit the mission tasks.

Perseverance was a key aspect in succeeding in our regional competition. We encountered difficulties along our journey, and the ability to take those hardships and turn them into success, to actually learn something, is a virtue we all appreciate. Along with perseverance is the ability to work well with others. We encouraged each member's individual strengths and accepted his or her weaknesses. The most rewarding part of this whole experience is our team coming together, not just as a group of students and teachers, but also as a family.

Another rewarding learning experience was getting to know more about real world applications of ROV's today. Part of the initiation to become a member of our team was to do research learn what ROV's are all about. For example in 1865, the S.S Republic set sail for New Orleans. A terrible hurricane attacked and killed around 50 Army officers and businessmen. The Titanic sunk on April 14, 1912 on its way from England to America burying with it more than 2,000 people. Divers were unable to go down in such deep water, but the development of ROV's allowed us to find and recover history.

Future Improvements

Overall, we are satisfied with the structure and the maneuverability of "Bender." Competing at the Regional Competition in Monterey has helped our team focus and understand what could go wrong during the missions and things that could be improved with our design.

One improvement would be to design a way to adjust the buoyancy of our robot without having to detach and reattach our extra ballast. This problem has confronted us when we are placing the electronic module inside the PVC frame. Without the extra ballast, "Bender " plummets to the bottom of the pool and this would be a fatal blow if it happened during the National Competition.

During the Monterey competition the hinges became too loose and caused the electrical module to fall to the bottom of the pool. An improvement we are currently planning is to adapt and add an automotive door lock mechanism to secure the center U-bolt to our payload. This would give us the ability to maneuver without fear of dropping the box if our hinges collapse.

We are also planning to add color and style to our ROV by painting Bender yellow with blue pearl and chrome pinstriping.

Description of a Career

While there are many careers associated with Ocean Technology, perhaps the most fascinating is searching for lost treasures of old. This is the job of Ernie Tapanes, an investor, oceanic engineer, and operations chief of the vessel *Odyssey* at the Odyssey Marine Exploration, an association based in Tampa, Florida. Tapanes, at 35 years old, was employed to find the remains of a civilian steamer from the Civil War called, the *Republic* in the year 2003. The search for the *Republic* had been continued for over 12 years as Odyssey cofounders Greg Stemm and John Morris felt that the recovery of the coins that sunk along with the steamship would be very valuable. As the operations chief of the vessel searching for the Civil War steamship, Tapanes had was responsible for the crew. This responsibility was becoming unbearable for him as all the exact location of the ship, determined from wind speeds, currents, bearings, newspaper reports, and survivor reports, did not seem to be correct. It was finally on July 7, 2003 that the innovative side- scan sonar attached to a lightweight ROV detected a “blocky shape.” The sonar crew thought nothing of the sonar’s detection, as member J.J. Jackson concluded, “It’s just a sailboat” (National 119). However, Tapanes knew that the measurements of the “blocky shape” was not comparable to that of sailboats, as it was much wider. After restocking the ship, the crew and Tapanes returned to the spot of the sighting, this time employing the use of a higher resolution setting on the sonar. Two days were spent attempting to zero in on the shape and create a three-dimensional model in sonar form. The sonar technology was so advanced that sonar team member, J.J. Jackson, remarked that “It’s almost like a photograph. It measures perfectly to what we know of the *Republic*” (National 120).

The wreck was approximately one hundred miles outside southeast of Savannah, Georgia and its image was emailed to Stemm and Morris under the title “Sailboat #1” to ensure secrecy. To prove that the wreck was indeed the *Republic*, on August 2, Tapanes and the team returned with a small tethered ROV with manipulator claws and a video camera. The ROV was simply able to verify that the ship was indeed the Republic, but a larger and more sophisticated ROV would be needed to retrieve the treasured coins. Odyssey purchased a new 250-foot-long vessel, the *Odyssey Explorer*, which would carry the ROV *Zeus. Zeus* would be a “200-horsepower, seven-ton, tank-size robot equipped with powerful manipulator arms that could lift heavy objects as well as small objects gently” (National 121). Top of the line equipment would be needed to merely get to the target and it steady due to the strength of the Gulf Stream.

It was not until September of 2003 that *Zeus* recovered video image of the Republic, which was displayed on the monitor screens in the Odyssey Explorer. Tapanes was not able to find the coins until November 5 when ROV supervisor, Jim Starr, decided to test the new Venturi system. The Venturi system consisted of a six-inch-diameter Venturi tube that functioned mainly as a giant vacuum cleaner. It could clear a site while a precise suction cup called a limpet would pick up artifacts without scratching them. While using the system near the *Republic's* stern, the long lost search for the coins ended as the sand was cleared away.

Tapenes was elated with the discovery of the coins, whose composite value was determined to be near 75 million dollars. The discovery of this Civil War treasure would not have been possible without the hard work of oceanic chief Tapenes whose job made the mission successful. Without such technology as the Venturi system, the coins would never have surfaced either. Due to advanced technologies and Tapenes' career choices, a collection of coins was found that far surpass the value of any of Black Beard's treasures.

Acknowledgments

We would like to thank all of our sponsors for the donations in cash and kind they have given to our team. All of their generosity has helped us reach our goal. Thank you!!

Great White Shark ($500 or more)

MATE and MPC ($1,000 and more!)

Charles Lyon

Rotary Club of Paradise

Killer Whale($350)

The Murray Family

Exchange Club of Paradise

Dolphin ($200)

Hignel Inc.

Sea Star (up to $200 and Gifts in Kind)

Paradise Unified School District

Beyond Fitness

Builders of Paradise

Thomas Ace Hardware

Chico Eye Center

Digital Hearing Aid Centers

Virginia Randar

Juice and Java

Teachers Association of Paradise (TAP)

Jennifer and Barry Warren

Beri Petrovitch

Pine Ridge 4-H Club

Chico Immediate Care Medical Center

Robert and Betty McClenathen

Bernie and Susan Levine

Thomas Eidem and Margaret Wixted

Les Schwab

Papa Murphy's

Charles Kaza

PPPOA-Paradise Pines Property Owners Association

All of our parents and our community

Our marvelous mentors, Chris Jensen and Kim Jones.