MARINE ENGINEERING RESEARCH CLUB
PINE FOREST-WEST FLORIDA HIGH SCHOOLS
PENSACOLA, FL

Top: Ms. Stradley, Mr. Turner, Courtney Colvin, Lindsay Martin, Jacob Brennan
Bottom: Crystal Redmond, Josh Henson, Eric Singleton

Members not competing: Brandon Howard, Joseph Gammons, Tassy Larkins, Ashley Spears, Austin Williams and Mr. Kevin Rejda (Technical advisor)

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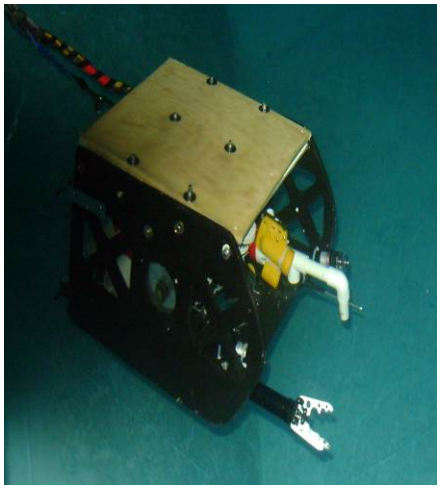
ABSTRACT

Bab's

Bab's Revenge is a remake of our ROV from two years ago, except this time she came with all the stops. In brain storming to build the perfect ROV, we thought of many different ideas to get it accomplished. On the higher side, we didn't expect it to cost near five thousand dollars. In the end, we ended up spending $2,960.80 to complete our ROV. In the original build our overall dimensions were too ample to complete the mission specs that had been assigned to us; we ended up downsizing and exempting one of our motors. In doing so; the interior of the ROV now has two 500 GPH bilge pumps, that are used to move laterally in small increments. Bab's Revenge also have four 1200 GPH water proof motors, two are vertical to move up and down, the other two are at the stern to move forwards and backwards. Referring to the frame, we jumped from idea to idea, and finally decided that it was going to be PVC coated with rubberized black protective spray, and have cross sections cut out of the sides for better lateral water passage. With all of these stipulations we finally found a way to make our ROV neutrally buoyant, and work efficiently with the 13 meters tether. All of the extra sensors and peripherals that are incorporated into Bab's Revenge help to make her unique and one of a kind. This year's ROV is going to be the best we've ever built.



Bab's Revenge

PROJECT GREEN SHORES

Lindsay maneuvering

Bab's Revenge was not just built to work and rove in a pool, but to be used in real world problems and situations that we may encounter each day. Recently there was an oil spill off the coast of Louisiana that has impacted more people than anyone will ever know. Since we are the only group in NW Florida with an ROV designed to do under water navigation, we decided to use our ROV for the best interest of the environment and our coastline. We took *Bab's Revenge* down to a local restoration project called "Project Green Shores". Here we restore sea grass beds, oyster clusters, and many other small invertebrate communities. We used *Bab's Revenge* to extract a cluster of oysters and barnacles from some large barrier rocks we have on the coastline. With these samples we did a rock shake to determine how many invertebrates were alive, and living in a cluster of approximately 2-4kg. In doing the shake we found there were some small fiddler crabs, juvenile stone crabs, and two different species of polychaete worms, essentially we will use the worms as an indicator species. For the simple reason that if the oil ever reaches the shore line, the worms will be the first to die off. As time progresses, We will continue to monitor the organisms in the area, and the amount of living organisms on the oysters and barnacles. We want to use our ROV to really find out if this oil spill is going to affect our ecosystems on the coastline or not. And if so, how much of an impact it will make to our environment.

Josh and Eric piloting

Crystal operating the tether

Bab's Revenge

DESIGN RATIONAL

Frame- With standards set high, the original plan for *Bab's Revenge* was to have a large frame (65cm x 80cm) and use high density polyethylene as material. It was decided that high density plastics would be used because it is known for its durability and it is incredibly sturdy. The original design was much larger than our present design, to accommodate all the components that would be included in the ROV.

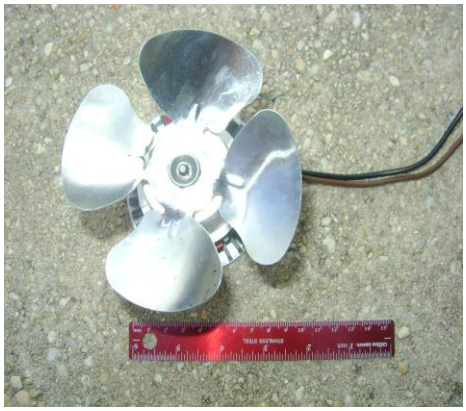
Original frame

However, both of these ideas were modified. When we received the mission specs, the width had to be reduced by at least 10 cm because the ROV was too large to fulfill the necessary tasks to complete the second mission. The measurements are now 37.4 cm in length and 34.3 cm thick. We then decided to use a slightly different and lighter material. We realized that 12mm high density poly-ethylene was just too substantial and heavy. It would result in too much weight and cause us to use more flotation than we could afford, so this materials was scratched. Instead we chose to use regular PVC because it is light and strong so it won't bend and flex underwater. To Support the movement of the ROV we also cut out cross sections on both sides so water could flow through and circulate more easily. As an added addition we also decided to place two PVC bridges to the bow and stern of the ROV. The bow bridge supports one vertical motor, used to move up. And the stern bridge supports to motors used to move forward and backwards.

MOTORS

1200gph bilge pump motor

At first we decided to use three Seabotix motors but the cost of them were too extensive for the funds we had. So we set our eyes on five 1200gph bilge pump motors: port, starboard, lateral and two vertical. However when we tried to put everything together we realized that after downsizing, we didn't have enough room for the lateral thruster and its propeller. The propeller kept hitting objects in the ROV and clearance couldn't be accomplished. With this obstacle at hand, we exchanged two of the 1200gph motors for two smaller 500gph bilge pumps that didn't require propellers to operate. In choosing the propellers, we encountered a bit of a challenge. The propellers we originally decided upon were plastic orange plane propellers that were fairly strong but still flexible. In the end we found the perfect propeller. We went out and bought four little house fans from Wal-Mart and took them apart to get the perfect propeller. They are 10 cm in width all the way around and fit into our design perfectly.



motor blade

Last-a-Foam (top flotation)

FLOTATION

For our flotation we choose a high density foam called Last-a-Foam. It was chosen because the foam is light and is able to float very easily with little trouble. The Last-a-foam floats 1cm to every gram of PVC. Bab's Revenge weighs approximately 8,160 grams so we only need a sheet that is about 6 1/2 cm thick. With these measurements the flotation is strong enough to hold the weight of the ROV without it flexing or bending, and still being able to move freely and precisely to accomplish the missions at hand.

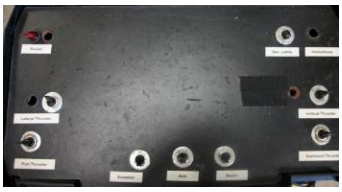
CAMERAS

We started with two 12V DC Neptune Tiburon Underwater Color Cameras. As we were wiring them into the tether, one of the cameras shorted out. We also found that two cameras were not going to give us the field of view we required to complete the missions. In keeping with this thought process, we bought two more of the same type of cameras. One is placed on the stern so we can see the sweeper and be able to maneuver backwards. The other two are on the bow; one is to see the slurpy the other is to see the manipulator arm. They are both set so we can also see in front of us to drive.

bow camera

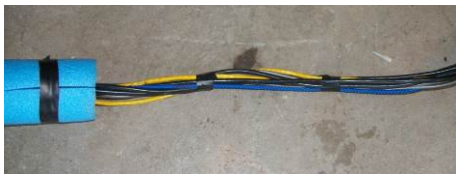
CONTROL BOX

The control box was constructed with the idea of being simplistic and work as efficiently as possible. We have basic momentary switches and on/off switches. The manipulator arm has a momentary switch that is used to open and close the claw. We also used these types of switches on the motors so that they could be reversed to go in the opposite direction. The on/off switches are used for the slurpy, hydrophone, sweeper, and the power switch.



control box

TETHER



Tether

The tether is 13 meters long and has 6 major wires that include two cat 5's and four motor wires. The tether is the only limiting factor in the depth range of the robot. Bab's Revenge could easily reach up to 50ft in the water if the tether was longer.

NAVIGATION LIGHTS

The entire concept of “red right return” is so that marine vassals will not hit buoys and they can tell which direction they are going in the fog or the dark. On a vassal it is the opposite green is starboard and red is port. We thought it would be useful on our ROV because if silt or sand gets stirred up in front of the cameras or even in our visibility from the surface, we will be able to tell which direction our vehicle is going. The navigation lights can also help us guide through curves or areas where sunlight cannot reach. Therefore it may save the vehicle from being lost or helping it return to the surface.

laser

LASERS We learned from the old competition that the depth perception is almost completely gone underwater. So in order to have better aim during the missions we added two lasers that we bought from MBT Divers. These two lasers are attached one above the manipulator arm, so we can have an accurate reading of where the arm is pointing. The other is pointed in line with the temperature prob.

The following are designed and arranged by and for the missions.

Mission # 1

Hydrophone

This specifically designed instrument measures sound waves underwater. Regular microphones use electromagnetic induction and convert sound waves into electrical waves. Hydrophones use pressure changes to pick up sounds underwater. And will be very effective for our first mission to find out which site will be rumbling.

Manipulator arm

Manipulator Arm

The ISL Micromanipulator is an extremely small single function gripper designed to pick up small things that are oblong shaped. It was manufactured from aluminum; the micromanipulator is lightweight and durable. The parallel jaws allow the manipulator to pick up small objects very well. 12DC operated; depth dated to 155M (500ft)

Mission # 2

Sweeper

This mission required us to collect five crustaceans and bring them back to the surface. We designed the sweeper after a vacuum. We attached a metal bar to the back of the ROV and wrapped zip-ties all the way down it, so that when it spins the zip-ties will spin and sweep up the animals. It spins off of a bilge pump motor using two gears and a belt. The belt consists of four rubber bands. We chose rubber bands because they are cheap and if broken, they are easily replaceable. Above the bar is a piece of PVC with twelve holes drilled into the top of it that zip-ties are pushed through. All together it operates as a chamber for us to transport the crustatians to the surface.

Sweeper

Mission # 3

Thermometer

We have three accurate temperature readings within twenty degrees of each other. We chose a Digital Probe Thermometer with a stainless steel probe. The probe is five inches with a fifty nine inch probe cord. It takes a range of -50 degrees to +200 degrees. It also changes from Fare height to Celsius.

Mission # 4

Slurpy

This is the last mission and calls for us to suck up an amount of agar between 25ml and 225 ml and return it to the surface. Our slurpy was constructed of a bilge pump motor and two pieces of PVC. The first piece extends from the motor, out from the ROV. Attached to it is the elbow piece of PVC which has another piece attached that extends downward making an "L" shape. Once we place the PVC into the container we suck up the agar and take it to the surface. Bonuses are added for the amount of augur you collect.

Slurpy

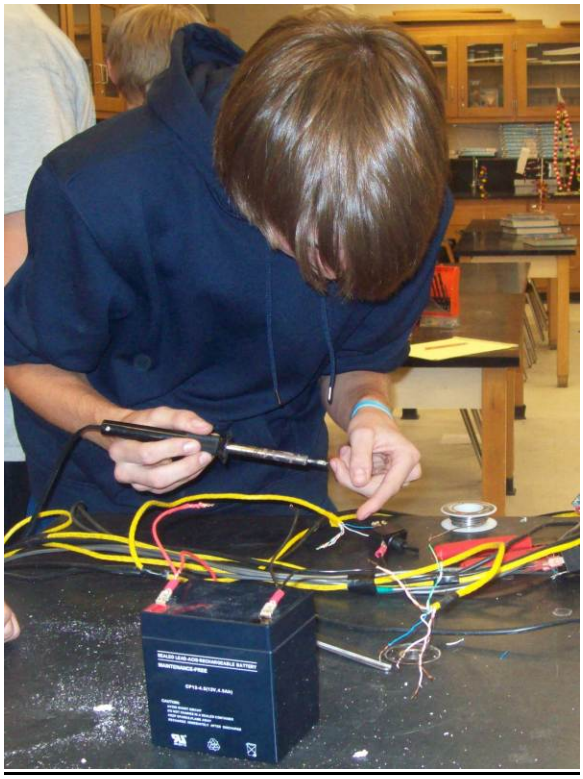
FUTURE IMPROVEMENTS

Many of the future improvements the team needs in the future are better fundraising and organizing. We needed a lot of money at the beginning of the year for the original design however no one was very good at doing it. Next year we will be doing can shakes, bagging, and more fundraisers for money so we aren't as constricted on what we can and cannot do. Another would have to be better organizing. We need to have a better understanding of deadlines, and to learn to abide by those deadlines. It would have been a lot less stressful if we hadn't procrastinated quite so much. So next year the team needs better fundraising and more organization to accomplish the tasks at hand.

TROUBLESHOOTING TECHNIQUES

When the team came back from the last competition in San Diego they had a design drawn up on the plane home. They had dimensions and a shape, however when the mission spec's were released they had no idea how to build the peripherals for the missions. How they decided on it was brainstorming for a month and researching other ROV's to see if they had anything that would give them an idea. They also tried many ideas like the slurpy and realized it wouldn't work for one mission but would work for another. Whenever the team has a problem they brain storm, test many different products, and researched many ROVS for information.

LESSONS LEARNED



Josh working on the tether

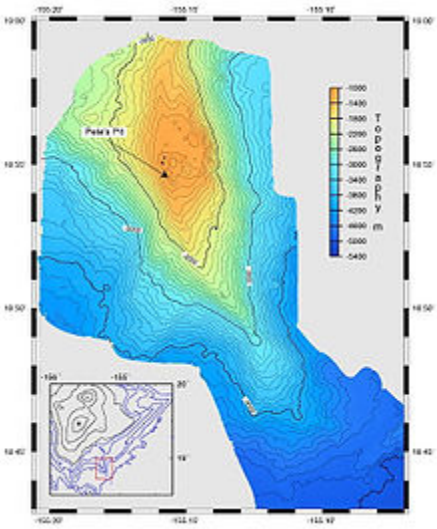
One of the many lessons that our team has learned is that timing is everything, and planning is key if you want to get anything done. When we started to work on *Bab's Revenge*, the team as a whole procrastinated to the very end. We had to work weekends and late into many nights at a team mate's house to get the ROV itself done. Then we started on the paper and the many different other aspects of our work that needed to get accomplished before we could attend this years ROV competition.

Eric piloting the ROV

CHALLENGES FOR THE BUILD

One of the biggest challenges we faced during the construction of our ROV was changing our original design to for the standards of the mission. We started out with a huge design that would not be able to maneuver inside the caves let alone fit into them. So we revised and built a new, much smaller model, so that we could do the missions.

Another challenge we faced during the build was the sweeper on the back of our ROV. We felt that the manipulator arm was entirely too slow to pick up the animals. So we designed basically a long spinning rod with flexible antennas coming off, similar to a vacuum cleaner. This design enabled us to not only quickly suck up the crustaceans, but gain control of them for transfer to the surface.



LOIHI SEAMOUNT

The Loihi Seamount is an active underwater volcano located around 35 km off the southeast coast of the Island of Hawaii. Based on rock samples scientists believe that the Loihi Seamount is somewhere around 400,000 years old. It lies on the flank of Mauna Loa, the largest shield volcano on Earth. Loihi rises more than 3,000 m from the ocean floor, but its peak is still 975 m below the ocean surface.

Loihi is built right on the seafloor with a slope of about five degrees.

http://en.wikipedia.org/wiki/evolution_of_Hawaiian_volcanoes

The Loihi Seamount is the newest volcano in the Hawaiian-Emperor seamount chain, and is following the pattern of development that is a characteristic of all the Hawaiian volcanoes. These are a string of volcanoes that stretch over 5,800 km northwest of Loihi and the Island of Hawaii. Loihi is the only Hawaiian volcano in the deep submarine preshield stage of this development. These are characterized by infrequent, typically low volume eruptions. Also steep sided, usually being defined by caldera with two or more rift zones radiating from the summit. The type of lava erupted in the stage of activity is commonly called alkali basalt. This lava flows into a shallow magma storage reservoir. The only example of a Hawaiian volcano in this stage is the Loihi Seamount, which is thought to be transitioning from the submarine phase of the shield stage. All older volcanoes have had their preshield stage lavas buried by younger lavas, so everything that is known about this stage comes from research done on the Loihi Seamount. The shield stage of this volcano will be divided into three phases: the submarine, explosive, and sub-aerial stages. During this stage of growth, the volcano accumulates about 95% of its mass and it takes on the "shield shape" that shield volcanoes are named for. The largest amount of activity recorded for the Loihi Seamount was a swarm of 4,070 earthquakes between July 16th and August 9th 1996. This series of earthquakes was the largest recorded for any Hawaiian volcano to date in both amount and intensity. Since then, the Loihi Seamount has remained relatively quiet. Hawaii's Volcanoes Revealed ". USGS. http://geopubs.wr.usgs.gov/imap/i2809/i2809.pdf. Retrieved 2009-03-28

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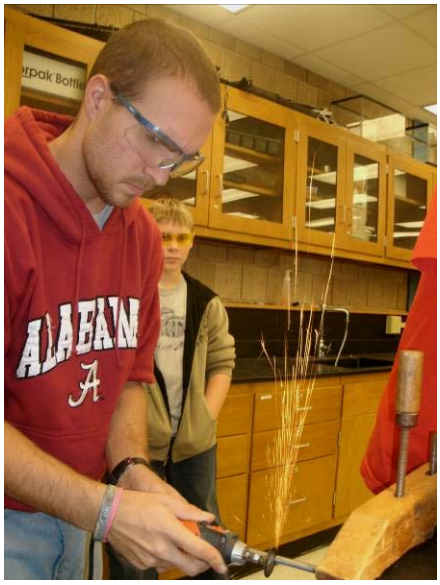


Brandon cutting materials

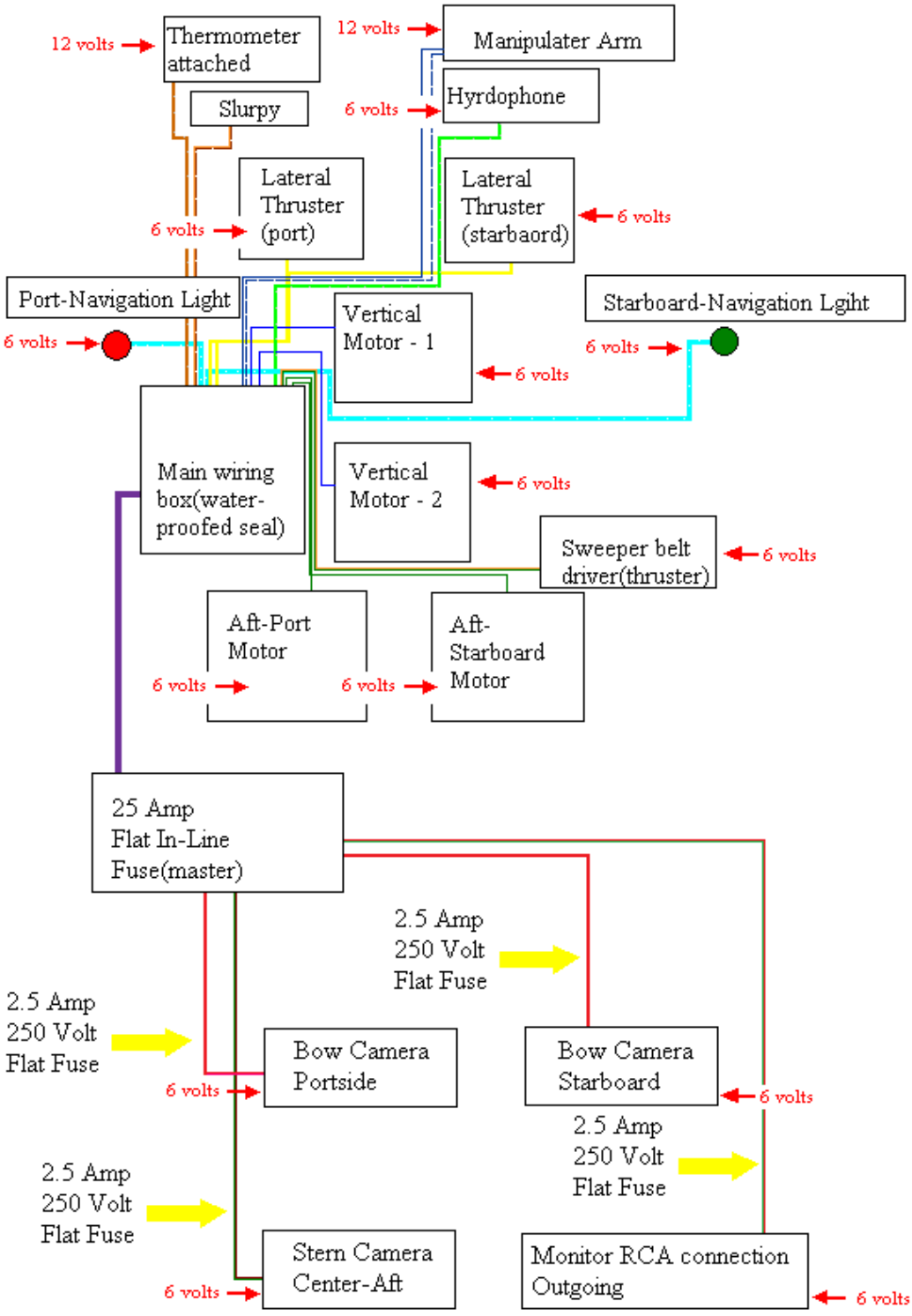
To reflect on everything that we have learned we are reminded of the word teamwork and how much of it we had to persevere through to get to where we are today. When we first got together the team had no idea how anything was going to get done, or how anything would come together. As the week's drug on we began to realize that each person had something unique to bring to the table. In using every ones skills we were able to find out that Josh and Eric were absolute genius's at wiring and soldering things together, were as crystal and Lindsay were good at organizing, Courtney is good at grammatical correctness, while doing this paper she saved our bottoms more than once and helped to correct many of the mistakes we made. On the plus side Jacob is very good at working with his hands and when it came to wiring the control board and trying to fit all the little odds and ends on everything, he was a miracle. So as far as working as a team goes, we've conquered that aspect. Along the way we also each found a little role as a leader. We worked independently and with one another, and in doing so we each had to step up to the plate and take on some responsibilities. Being on this team, we each learned that it's not when things get done but how they get done, and in what manner. We've each learned a life skill that will carry on well into our futures, and help us to adapt to anything that comes our way.

crystal cutting frame

EXPENSE SHEET

Part	Cost per unit ($)	Quantity	Total ($)
3/8 " Last-a-Foam insulation	$50	1	$50
PVC sheeting	donated	1	$0
Tsunami 1200 gph motors	$25	4	$100
Rule 500 gph motors	$15	4	$60
propellers/shrouds	$6	4	$24
18 awg wire - 2 conductor	donated	1 spool	$0
cat-5 cable	donated	1 spool	$0
cameras	$200	3	$600
Seabotics robotic arm	$1,500	1	$1,500
5/16 " all thread	$3	1	$3
toilet seal wax	$1.60	2	$3.20
small project box	$1.50	1	$1.50
large project box	$5	1	$5
8 pin connectors	$2.10	1	$2.10
solder	$3	1	$3
electrical tape	$1	3 rolls	$3
zip ties	$8	1 container	$8
pvc glue	$5	1	$5
3/4 " pvc pipes/connectors	$2	1 each	$4
fiberglass kit	donated	1	$0
jb weld	$5	1	$5
lasers	$35	2	$70
digital temperature probe	$35	1	$35
spray paint	$5	2	$10
hardware	$15	multiple	$15
stanley rolling tool box	$20	1	$20
switches	$3	6	$18
navigation lights	donated	2	$0
monitors	$200	2	$400
fuses	$2	1 pkg	$2
aluminum barstock	donated	1	$0
rubber band	donated	4	$0
caulk	$4	1	$4
liquid electrical tape	$3	1	$3
wire connectors	$7	1 pkg	$7
lead weights	donated	2	$0
1" silicone tubing	donated	1	$0
1/8 " aluminum sheeting	donated	1	$0
fiberboard	donated	1	$0
fun noodle	donated	1	$0
		Total Expenses	$2,960.80

ELECTRICAL SCHEMATIC



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*Family donations
*Our Families
*The Escambia County School Board
*MATE

But mainly our families, without you we would not have had the means to build our robot at all, thank you so much.