ROUS SCHLENK

PICKENS HIGH SCHOOL ROV TEAM

Jasper, GA

2007

TEAM MEMBERS

FITRAH HAMID

CODY EUBANKS

EDWARD LILLA

JOSEPH O'DELL

TEAM SPONSER

MEGAN HIGGINS

TEAM MENTOR

JAMES HIGGINS

DEBRA SCHLENKE

HUMAN LIFE AT THE POLES

Antarctica is one of the last pristine areas let on the planet Earth. Thanks to international treaties, human development on the continent has been extremely limited. Military activity, mineral mining, and other forms of human development which could be detrimental to the fragile environment have been banned. Only scientist and researchers with peaceful ambitions inhabit the continent. Antarctica is a land not bound by boundaries or political ideologies. It is a land that is truly free.

CAREERS

For centuries, man has relied heavily upon the ocean for his own survival. As time goes on, man's bond with the ocean goes ever stronger. The many resources collected from the ocean drives the world economy. Millions make their lively hood from it and many more are fed by it. As resources grow scarce, man looks to the ocean supply even more. The job opportunities created by this demand are great. Scientific and industrial opportunities are expanding at a frenetic pace.

The oceans are some of the last frontiers here on planet Earth. Little is none about the great abyssal planes that lay thousands of feet below the oceans surface. These abyssal planes are home to thousands of creatures new to

science. Paving the way for exploring these immense ecosystems are ROVs. ROVs explore the areas of the ocean that man can simply not survive in. These are ROVs have brought back fantastic images of the diversity of life that have managed to thrived in such an inhospitable habitat. As technology advances ROVs dive deeper and deeper and discover more and more.

Science is not the only institution exploring the ocean, but business is as well. As sources of minerals on the surface are exhausted and become less accessible more companies are looking to the ocean to make a profit. Sophisticated technologies such as GPS and ROVs have been employed to map the ocean floor. Many geologists believe there are massive caches of valuable minerals to be exploited from the ocean floor. Oil companies have been drilling for oil in the ocean for years and many other industries hope to follow suite. Leading the way in maintaining these various different business enterprises are ROVs. ROVs can stay in water much longer underwater than any human being. ROVs can also go into much more hazardous situations than any human diver could ever survive in.

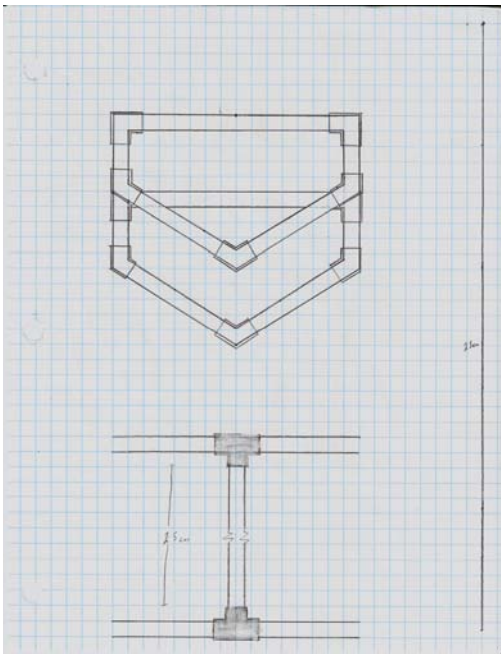
Human development has put enormous stress on the planet. Resources are disappearing faster than nature can replace them. In the future, not even the ocean will be able to support mankind’s needs. The great oceans of our planet offer opportunity, but in mankind must be mindful on how he uses these resources so they will be available to later generations.

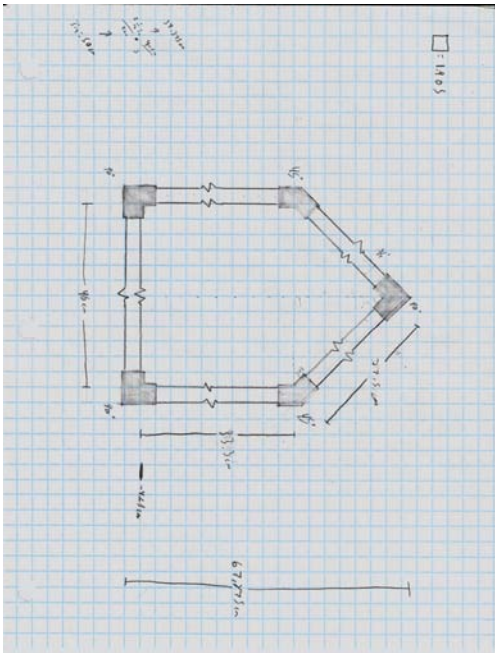
DESIGN

The design of the ROV was the first task we set out completing, hoping that as we got into the project, ideas would start free-flowing for it and other tasks. We were trying to contrive a shape that would be somewhat hydrodynamic and be sturdy enough to hold the weight of all our equipment at the same time. When taking those options into consideration, we chose for the ROV's body to be in the shape of a pentagon, simply a square at the rear and a triangle portion (wedge) connected at the front. With the square frame at the back, most of our equipment could be secured, and with the wedge in the front, we could move easier through the water.

An advantage to choosing a triangle or wedge front is that we could place our pneumatic arm in the center of the supports and allow it access to anything directly in front of the ROV. Also with this wedge front, we had the option of placing two cameras facing in the forward direction for a wider visibility range and two light sources converged on a focal point at the arm. The pneumatic arm was constructed out a modified spring scale connected to a wire in a garbage collecting grabber. For our regional competition, we had constructed two waterproof casings for our cameras out of a Tupperware container and a waterproof floral gel. These cameras did not survive the regional competition due to the heat of the cameras melting the gel over our cameras' circuit board. We decided to purchase two submersible cameras to replace our defected cameras

for the international competition. The design of these cameras fit our need for relocation and reposition during for the first mission.





After we established where the pneumatic arm and the cameras were going, we had to determine where the most advantageous location for our bilge pumps. After much deliberation, we decided that two pumps of equal power would be facing behind the ROV, two of slightly less amperage would be facing left and right, and one with the greatest amperage would be facing down. With the five bilge pumps facing in different directions, we were able to acquire the greatest maneuverability possible; we could now fine tune any movement we made.

Following our establishment of the major component's locations we began to consider what we might need in order to complete each task that our ROV would encounter. In order to make completion of all the missions easier, we have attached two hooks parallel and slightly lower than that of the pneumatic arm.

This enabled us to impale the "jellyfish" in the first mission or to lift the gasket in the third mission. In order to capture a ping pong ball floating underneath a layer of ice, we have constructed a ball catcher that will be located near the stern of the ROV. To better monitor our attempt to capture the ball, we plan to reposition one camera to face the arm while the other is reversed so as to watch the ball catcher.

After each component of the ROV was completed and secured to the frame we began to concern ourselves with the buoyancy of the ROV. Determining the buoyancy of our ROV was a more of a trial and error process, we simply placed the ROV in the water and added foam noodles in the areas of greater weight. Due to the greater pressure and colder water temperatures we will face at the international competition, we are using a foam that is more dense, and therefore, more resistant.

The final designing of the ROUS Schlenk was a long and arduous process that has changed as the construction has advanced. This designing process will always be ever changing while we have the opportunity and the capacity to better our ROV and ourselves.

ELECTRICAL DESCRIPTION

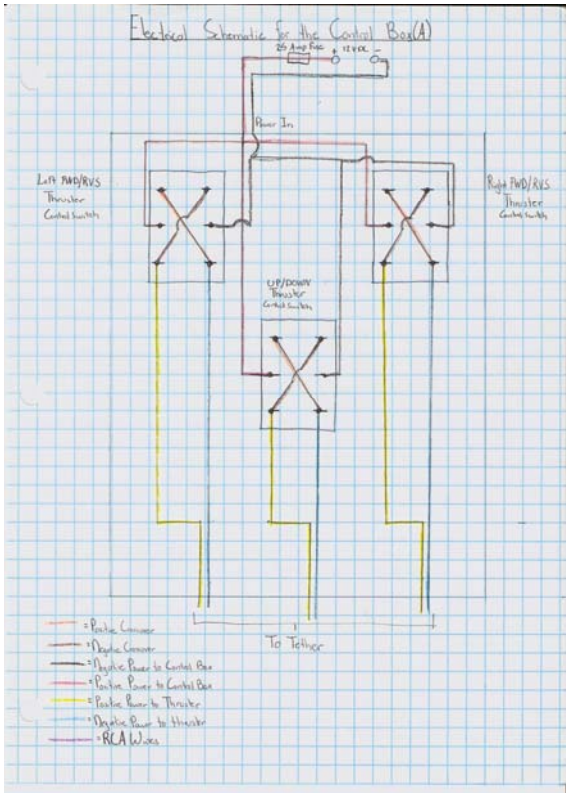
The electrical functions of our robot are quite simple. Our original idea for the robotic arm was to use a servo. To open and close the arm, we planned on hooking the servo up to a DPDT (double pole- double throw) switch and simply reversing the polarity by using crossover wires connecting both poles of the switch. What we did not realize is that for the servos, there is a third wire, other than power, that tells the servo how far and which direction to turn. On top of this, the signal that flows through the third wire is digital, not analog. We learned this after first destroying a forty seven ounce servo priced at fifty dollars ($50) and then a four hundred eleven ounce (411 oz.) servo priced at one hundred fifty dollars ($150). After those major disappointments, we switched to a pneumatic system to operate the arm. As the saying goes, “Keep it Simple”.

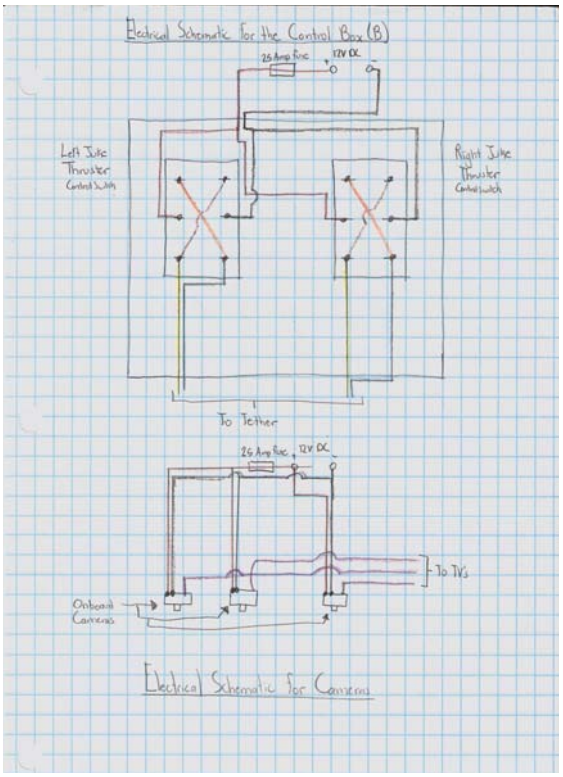
To maneuver our robot underwater, we decided to use bilge pumps. This idea came from seeing previous competition robots use bilge pumps as a means of propelling them. Our main forward/reverse/turning as well as our side to side movement is provided by four (4) five hundred gallons per hour (500 gal/hr) pumps. Our vertical movement is provided by a single one thousand gallons per hour (1000 gal/hr) pump located in the center of the robot. To reverse the direction that the pumps are propelling the robot, we hooked them to double pole-double throw switches with crossover wires connecting the two poles. This

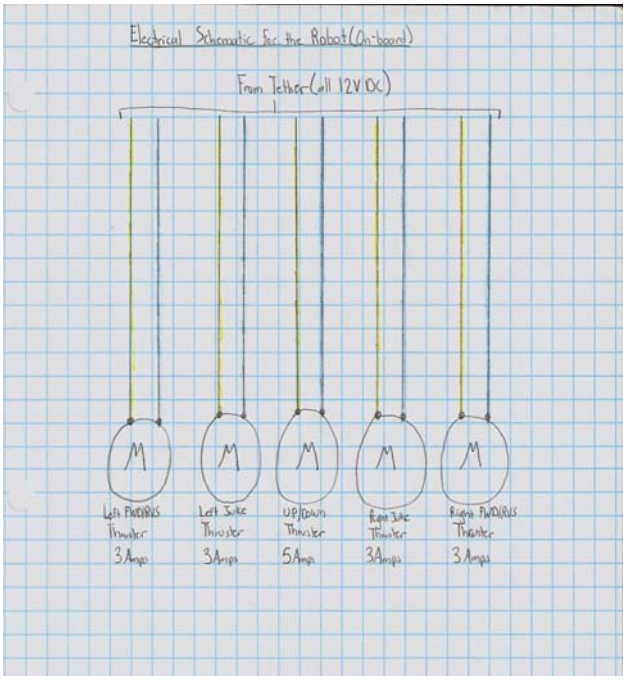
method of reversing the propulsion has been proven to work quite well on other robots as well as on our own.

Another major use of electricity on our robot is for the onboard cameras. The original cameras we used at the regional competition were connected to the extended power line by removing connectors from other power supplies and soldering them together. The newly purchased cameras came fitted with a one hundred foot (100 ft) power cord each. This gave us the opportunity to simply switch out the old cameras and not take apart too much of the established electrical schematics.

The final, and most important, electrical component for the security of the ROV, was the safety fuse. We only had to incorporate one (1) twenty-five amp (25 A) fuse set inline between the power supply and the ROV components. We did learn this should have been the first thing connected in the power schematics and, if done properly the first time, could have saved ourselves the cost of the servos.


Electrical Schematic for the Control Box(A)
25 Amp Fuse
12 VDC
Power In
Left FWD/RVS Thruster Control Switch
Right FWD/RVS Thruster Control Switch
UP/DOWN Thruster Control Switch
To Tether
= Positive Commons
= Negative Commons
= Negative Power to Control Box
= Positive Power to Control Box
= Positive Power to Thruster
= Negative Power to Thruster
= RCA Wires


Electrical Schematic for the Control Box (B)
25 Amp Fuse
12V DC
Left Side Thruster Control Switch
Right Side Thruster Control Switch
To Tether
25 Amp Fuse
12V DC
To TVs
Onboard Cameras
Electrical Schematic for Cameras


Electrical Schematic for the Robot (On-board)
From Tether (all 12V DC)
M
Left FWD/RVS Thruster
3 Amps
Left Side Thruster
3 Amps
UP/Down Thruster
5 Amps
Right Side Thruster
3 Amps
Right FWD/RVS Thruster
3 Amps

CHALLENGES

The most profound problem in designing and building the ROUS Schlenk was the inability of all team members to manage time correctly. All team members were involved in a variety of different activities outside of building the ROV which caused less time to be spent on the critical stages of research and planning. In order to complete the ROV in time for competition, the team had moved forward without a fully developed idea of what they were actually building. This resulted in numerous problems for the ROV team during the building and testing processes. Many of the problems faced by the ROV team could have been avoided simply if more time was spent on the early stages of the development.

The limited number of participants in building the ROV was another major problem faced by the ROV team during assembly of the ROUS Schlenk. The limited number of people actually working on the ROV and the limited experience of the team members involved made working on multiple systems simultaneously impossible. No one person knew enough about any one particular system to be able to work on the system by him or herself and have it working in the given time frame. All team members had to contribute ideas and skills to every part of the ROV in order to make the ROUS Schlenk a reality.

The lack of a person on the ROV team to have any experience in building anything resembling an ROV generated another unforeseen problem: No one

person became leader of the project. The absence of a leader made it difficult for the ROV team members to stay focus and on track. The sheer volume of different ideas on how to build the different systems of the ROV bogged down the team during several critical phases of construction. The team would have to have unanimous support on designs before assembly would take place. The only reason the ROUS Schlenk finished on time was that team members were willing to put aside differences in order to complete the project on time.

Of all the systems, the camera system gave the ROV team the most trouble. In purchasing the cameras, the team opted for less expensive and non-waterproof cameras; it would be a fateful decision. Waterproofing the cameras turned out to be difficult, messy, and unreliable. On several occasions the ROV team had to re-waterproof the cameras because of leakages. Even on the day of competition, both cameras were damaged beyond repair because of water leaking into the “waterproof” container.

All the problems faced were eventually overcome. Through team work and sheer will power and determination, the team managed to successfully complete the ROV on time. The valuable memories and skills gained for this project made building the ROUS Schlenk was worth all the trouble and hardship.

SKILLS

Throughout the construction of the ROUS Schlenk we, as a group and as individuals, have acquired skills that we would not have normally obtained in everyday school activities.

Probably the most important skill we learned was communication and organization. As our ROV construction progressed, we began to encounter many mishaps and unfortunate events that we would have to fix in order to continue with the work on the ROV as a whole. For example, the construction of our arm came to a complete stop two weeks before our regional competition. In order to solve this major dilemma, we sat for hours brain storming any possibilities. Finally, after much deliberation, we developed the design we have on our current ROV. Also, our supplies have lived in Wal-Mart bags through the extent of the entire construction, which were hauled everywhere. On some occasions, not all of our team members knew about practices we were having until we were already having it. And we have a standing offer to practice at the YMCA in Canton, Ohio, even though it is approximately twenty-five hundred kilometers (2500 km) away from our intended YMCA in Canton, Georgia.

We also learned to use several different tools, i.e. the use of a solder gun with the electrical work to simple things like PVC cutters for design of the ROV.

Overall, through the difficult and the very basic, we have obtained a plethora of skills that, in everyday school life, we would have never attained if we had not worked on the ROUS Schlenk.

CONTINUED IMPROVEMENT

After our success at regionals, we all agreed that we needed to schedule more time for practice and have one location secured at which we could use a pool. Previously, regardless of what we planned, we only had two pool practice sessions. Both of which took place during the week of the competition and both with a duration of no more than two hours. Though this was largely due to poor organization and communication, the fact that we did not plan ahead to have one place at which to practice from the beginning also contributed to our lack of practice time. In preparation for the international competition, we definitely needed more practice time at one consistent place.

While every member of our team had a special interest, commitment, and desire to win the regional ROV competition, we found that we fell into procrastinating several times throughout the months leading up to the competition. We knew this could not happen again as we got ready for internationals. With that in mind, our work ethic improved as we paid more attention to the time limits and deadlines. We feel as though if we had assigned each member to specific tasks to complete instead of simply announcing what needed to be done and seeing what members

chose to do, we could have completed our ROV much more efficiently. This type communication was better utilized in preparation for international competition. In fact, overall communication in general improved greatly.

Having gone through this process, one thing we discovered we could have improved was, first and foremost, our organization. From where we stored our equipment to how we spent our time, our organizational skills seemed to be lacking. As we began to see the results of our poor tidiness, not having immediate access to what we need, running out of time while working on projects, etc., we changed our set up. We acquired one large toolbox in which to put all our equipment. We also learned to communicate more clearly with each other so our goals could be met more efficiently. We feel this last minute improvement significantly contributed to our success at the regional competition.

BUDGET

Beginning Balance: $2832.84

Date	Purchase	Quantity	Price (Each)
2/11/07	Bilge pumps	2	15.99
		1	32.99
	LED lights	1	14.99
			84.76
			2748.08
2/3/07	Fuse holder	1	2.49
	Fuse 20A 4 pack	2	1.99
	Banana plug 2 pack	1	2.79
	Spiral wrap	2	3.49
	Project box	1	4.99

	20A DPDT switch	3	4.49
			34.70
			2713.38
2/3/07	50 ft wire	1	12.45
	Switch	3	5.99
	PVC cutter	1	10.79
	10 pack PVC elbows	1	1.90
	12’ cube tap	1	1.97
	Fitting	1	1.44
	Electrical tape 10 pack	1	4.95
	¾ “ tee	8	.28
	¾ “ PVC	10	.59
	¾ PVC	10	1.67
			76.31
			2637.07
2/15/07	Video camera	1	29.95
	12VDC 500mA converter	1	9.95
			51.96
			2585.11
3/8/07	Hacksaw	2	6.49
	PVC cutter	1	10.79
			23.77
			2561.34
2/21/07	PVC elbow	6	1.99
	Male adapters	6	.49
			15.92
			2545.42
3/21/07	Video camera	1	29.95
	12VDC 500mA converter	1	9.95
			59.09
			2486.33
3/21/07	Propellers	3	6.95
			26.88

			2459.45
3/13/07	O Ball	1	7.99
			7.99
			2451.46
3/24/07	Wonder Water	3	6.99
			22.23
			2429.23
3/16/07	Wonder Water	1	6.99
	Epoxy	1	3.99
	Salt/Pepper shakers	2	1.99
			15.86
			2413.37
3/16/07	Illumisticks	4	.99
			4.20
			2409.17
3/16/07	Reaching Tool	1	8.49
			9.00
			2400.17
3/16/07	Aquarium sealant	1	5.39
			5.71
			2394.46
4/9/07	H/C Hangers	1	1.44
	Ziploc containers	1	1.69
			3.35
			2391.11
4/9/07	Fish bobber	1	3.67
	Float	1	1.37
	Underwater light	2	6.92
	Sticky foam	2	.48
	Foamies	1	.33
			21.59

			2369.52
4/9/07	Stopper	1	1.96
			2.10
			2367.42
4/16/07	JB Weld	1	4.44
	Marine battery	1	44.94
			52.84
4/16/07	Swim arms	1	.99
	Wacky noodles	5	2.99
	5” B/W TV	2	24.99
			70.53
			2244.05
4/13/07	T-shirts	8	3.99
	PDB green	1	4.99
	Transfer	3	7.99
			66.51
			2177.54
4/11/07	Prop adapters	3	4.29
			17.42
			2143.19
4/3/07	Battery	2	2.00
	6V Battery	2	3.00
			10.70
			2132.49
3/31/07	Epoxy	1	3.29
			3.49
			2129.00
4/2/07	Super torque	1	47.99
			50.87
			2078.13

4/3/07	Ultra torque	1	149.99
			108.12
			1970.01
4/3/07	#16 copper wire	1	38.53
			41.23
			1928.78
4/18/07	Hotel room	4	49.99
			199.96
			1728.82
4/20/07	Tumbler cup	1	.78
	Camo cord	2	1.54
	AA battery 8 pack	1	4.72
	Litter scooper	1	1.28
			9.86
			1718.96
4/16/07	Battery	2	2.00
	6V Battery	2	3.00
			10.00
			1708.96
4/18/07	Spiral cable wrap	3	3.49
	RCA adapter	1	4.49
			14.96
			1694.00
4/19/07	25’ heavy extension cords	2	8.49
			16.98
			1677.02
4/19/07	Dual phono pg	1	5.99
	Inline manifold	1	2.99
	3 pack 25A blade fuses	2	1.99
			12.96

			1664.06
4/14/07	Splicer	2	1.78
	20’ vinyl	3	3.69
			14.63
			1649.43
4/16/07	Wire connectors	1	1.99
			1.99
			1647.44
3/12/07	10 pack PVC tee	1	2.30
			2.30
			1645.14
4/15/07	6’ cube tap	1	2.30
	JB weld	1	4.19
			5.43
			1645.14
5/21/07	Lorex CVC 6990 B/W Submersible camera		93.90
	Shipping		19.49
			207.29

Ending Balance before trip: $1432.42

ACKNOWLEDGEMENTS

-Mrs. Megan Higgins

-Mr. Steven Banister

-Mr. James Higgins

-Mr. Kent O’Dell.

-Pickens County School Board

-YMCA of Canton, GA

-Ms. Tabitha the Bus Driver

-Royston Industries

-Cory Eubanks

-Mr. Mark Eubanks

-Mrs. Debra Schlenke