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ABSTRACT

The Waltrip High School M.A.T.E. team has built a ROV (Remotely Operated Vehicle) that will function to evaluate a shipwreck of the WWII era and check for potential hazardous materials that it may contain. The hazardous materials, like fuel oil, are a real-life threat to the environment. The ROV was made in a way that embraced the Waltrip High School M.A.T.E. program morals and ethical practices. It is efficient, simple, and low in cost. Any global company will find Waltrip's ROV a good investment.

The ROV is (MEASUREMENTS). It uses four propellers for propulsion. The robot is controlled with a momentary pause switch system.

(DESCRIPTION OF THE ROV)

(PICTURE OF THE COMPLETE ROV)

MEET THE COMPANY

Name: Zach Malcolm
Year: 12th
Company Role: Captain/CEO
Description: Returning for his second year in the MATE competition, 18-years-old Zach is leading this company as the CEO. He is going to study Marine Transportation at Texas A&M Galveston.

Name**:** Ezequiel Abelar
Year**:** 12th
Company Role**:** Creative Director
Description**:** Ezequiel is an 18-years-old senior at Waltrip High School. Although M.A.T.E.'s 2012 competition will be his only one, he has been involved in engineering competitions at Waltrip. He plans to major in chemical engineering at the University of Houston (Downtown).

Name: Sean Russell
Year: 11th
Company Role: Tether Manager
Description:

Name: Allison Buttran
Year: 11th
Company Role: Promotional Manager
Description: Allison is a 17-year-old junior at Waltrip. Although this is her first time doing MATE, she has been involved in robotics through the SPACE city robotics competition.

Name: Jordan Traylor
Year: 11th
Company Role: Assistant of the Creative Manager
Description: Jordan Traylor is a 17-year-old Waltrip junior. Being in robotics has helped him learn about teamwork since he and Ezequiel Abelar had to work together to create the display board and work on the notebook. He hopes that being part of robotics will help him decide his future career.

Name: Crystal Garcia
Year: 11th
Company Role:

Description:

SAFETY

(SAFETY IN THE ROV)

DESIGN RATIONALE: TASKS

Task #1: Survey the Shipwreck Site

These are the tasks the ROV has to perform in order to obtain a total of 120 points for the first task:

- Measuring the length of the wreck.
- Determining the orientation of the ship on the seafloor.
- Creating a map of the wreck site with the following information:
  - *sketch of the shipwreck*
  - *length of the shipwreck*
  - *orientation of the shipwreck*
  - *location of each of the five debris piles*
- Determining if debris piles are metal or non□metal.
- Scanning the shipwreck with sonar.

The ship will measure the length of the shipwreck with_____. And the ROV will determine the orientation by_____. In order to create a map of the wreck site, the robot will_____. To decide if debris piles are metal or non-metal, the ROV will use a sensor. For the last part of the first task, the ROV will use multi□beam sonar to scan the shipwreck.

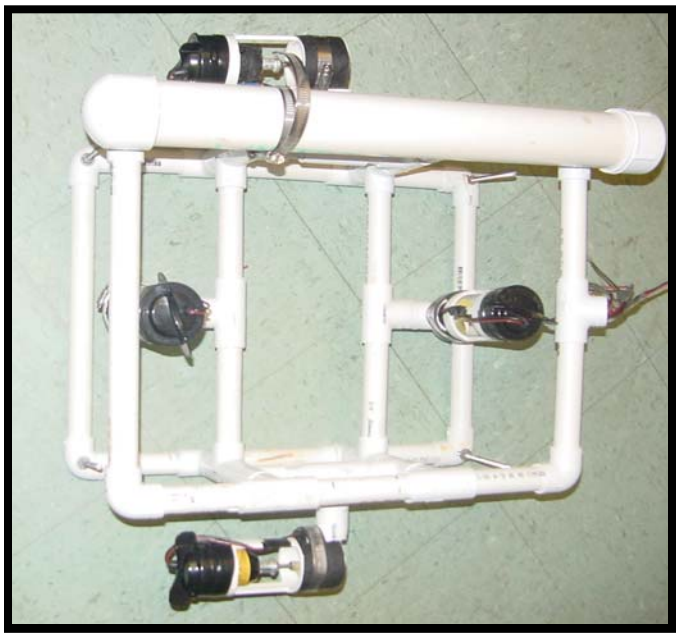
Task #2: Removing Fuel Oil from the Shipwreck

These are the tasks the ROV has to do after the first task that adds up to180 points:

- *Transporting and attaching a lift bag to a fallen mast.*
- *Inflating the lift bag to remove the fallen mast from the worksite.*
- *Removing endangered encrusting coral from the ship's hull.*
- *Transplanting the coral.*
- *Using two simulated sensors, determine if fuel oil remains inside the fuel tank.*
- *Removing a sample of fuel oil from within the tank by drilling a hole into the hull.*
- *Resealing the hole.*
- *Returning the sample to the surface*

DESIGN RATIONALE: ROV COMPONENTS

Propulsion



The ROV has four propellers for thrust. Two propellers make the robot go forward, backwards, left and right. The other two make it go up and down. These propellers allow the driver to control the movement of the ROV in a practical, easy way.

The outer shell of each propeller is made out of PVC. The PVC pieces are 3 inches in diameter and are used to increase thrust and create a safety barrier for the props.

Figure A-11
Testing the ROV's movement in Waltrip's personal pool

Control system

The control system we use consists of double pole – double throw switches that connect to the power supply through our fuse that is in the middle of the positive power supply wire.

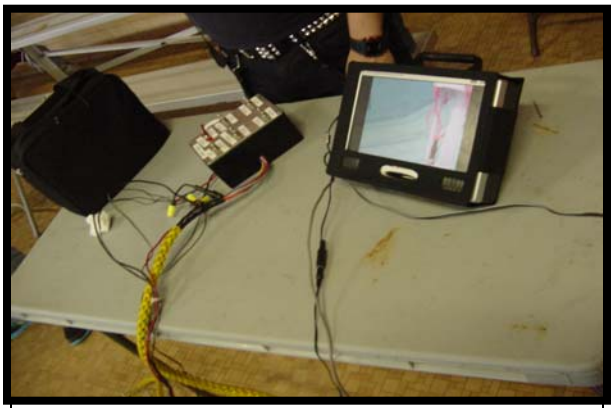


Figure A-12
The momentary pause switches system

Sensors

The ROV uses a sensor to detect metal material on the debris field. The device uses a magnet attached to a rod that pivots on a bolt. We can determine if the object is metal by simply seeing how much the sensor is attracted to the object. There are lines pre-drawn so that we can see the max height the rod reaches.

Figure A-13
Student holding the sensor

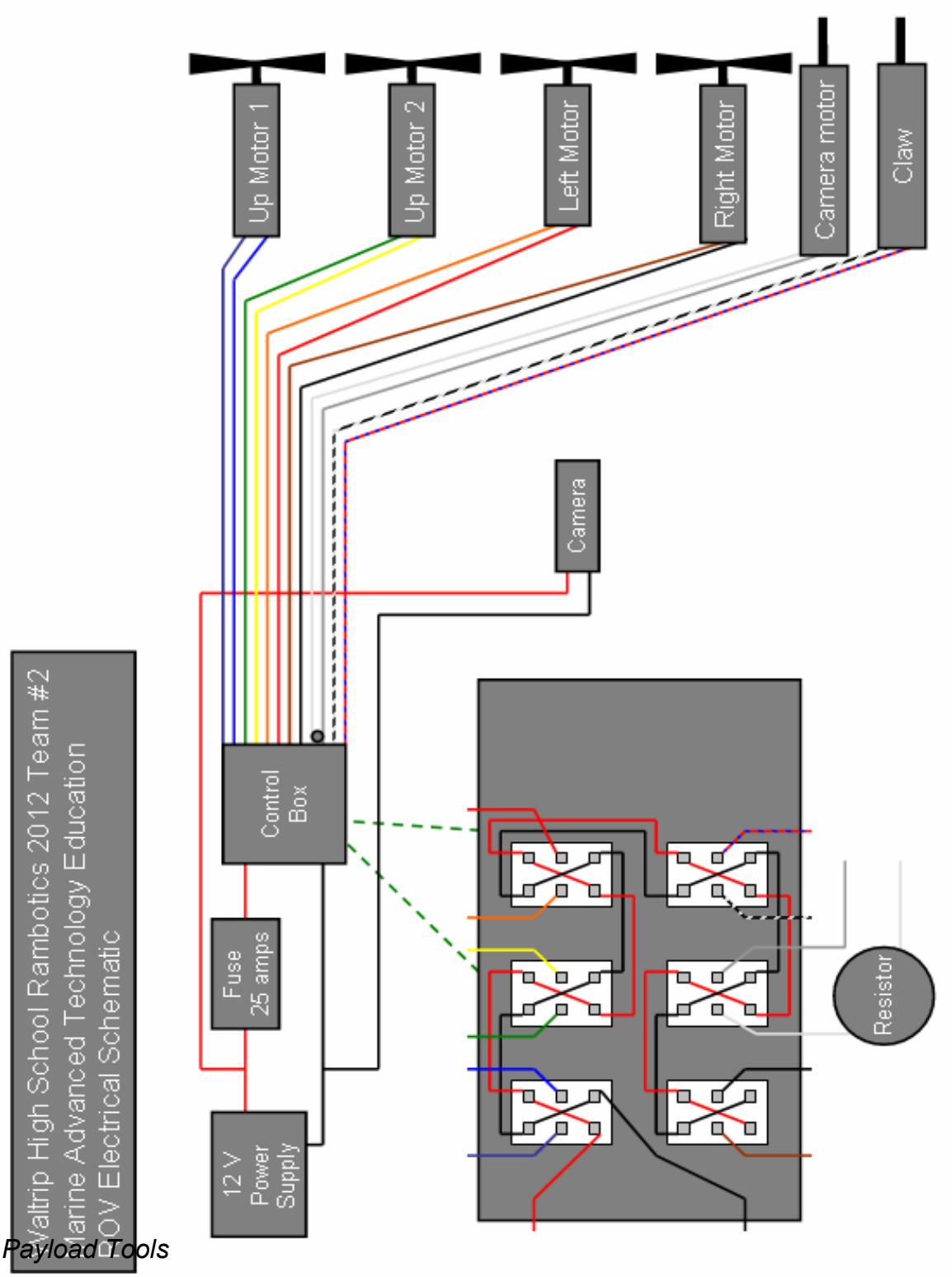
Ballast system

The company attached two sealed 4” PVC tubes that are each 14” long to the top of the robot for flotation. For weight, we added round weights to thread rods on the four bottom corners of the robot and then put a nut over them to keep them from falling off in the water. Having the flotation at the top and the weight at the bottom prevents the robot from rolling over in the water and make it very easy to adjust flotation to make the robot neutrally buoyant.

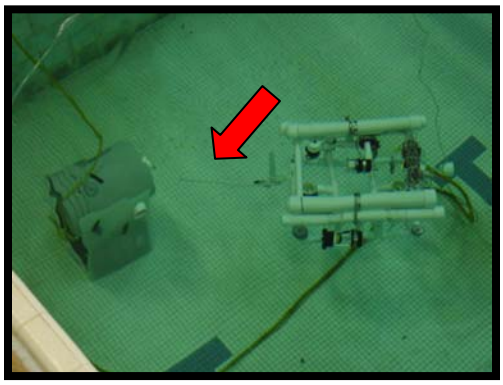
Cameras

We have two cameras, one main camera used for driving around and the other, the secondary camera, is used for hooking and floating the mast and it is also used as an extra forward drive camera. Our primary camera rotates vertically 360° this enables us to see forwards, backwards, up and down, which saves time and saves space on the robot. The motor that enables the main camera to spin is a DC gear driven motor; we included a resistor to slow the speed of the motor at the control box so we have more control of the camera angle.

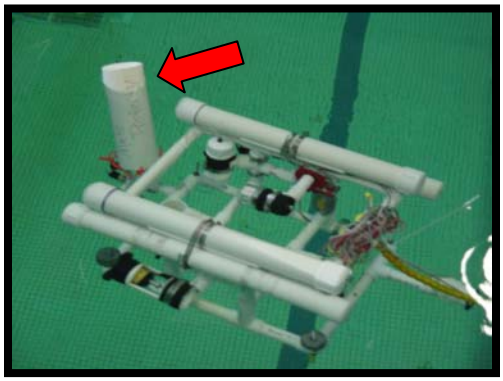
Electrical Schematic



Payload Tools



The Airbag



TROUBLESHOOTING TECHNIQUE(S)

Troubles are bound to come up, especially when ROVs are involved. The following are the problems we encountered as the company was designing the robot for MATE.

Problem:
Solution:

Problem:
Solution:

Problem: The airbag wasn't absorbing enough water to get a sample of the "oil."
Solution:

FUTURE IMPROVEMENTS

As a company, we hope to make improvements on how to go about building an ROV. From last year, we learned that making a smaller ROV is more useful than making a bulk. We will push this belief for future competitions and

place attention to what should be the appropriate size of the ROV. The company will work on teamwork so that the robot and the notebook reflect what Waltrip High School can do. A person will be assigned to their specialized role so that he/she can lead others in the area and help out people that need help. By doing this, deadlines will not be an issue. As for the notebook, we will be more detailed and make a notebook that explains things in a simple way that doesn't distract from the material.

CHALLENGES

Technical

The main technical challenge we met was that the school's pool was going to be drained since Waltrip was going to engage in renovations. We had to work efficiently and swiftly to make the most of the pool. The pool was a great help given that we could test the ROV at 10ft of depth and simulate the conditions met in the competition on our own school. The limited time we had was used to test the robot. On the first run, the ROV didn't receive direction signals as well as we hoped. We had to fix that. We practiced with props the 3rd time we went because the base of the robot was done and ready.

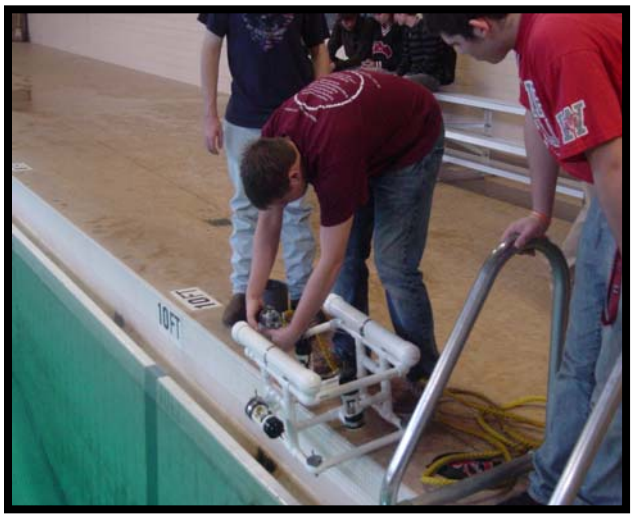


Figure A-15
Testing the ROV in the pool

Teamwork

The biggest challenge for the company was the fact that it was made out of many people. The Waltrip Company had over 15 members. Although the enterprise was divided into two groups-one created the robot while the other worked on the engineering notebook so that there was not a lot of chaos-, it also created a myriad of communication problems. Not everyone was in synch to create such project. Many had different opinions and solutions that made it difficult to listen to each brilliant idea and think about their input. Others had to learn certain things from scratch, which took up some of our time. The sheer size of our company was the biggest obstacle we had to overcome together.

REFLECTIONS & LESSONS LEARNED

Waltrip's MATE team has learned that having a big company creates communication problems. For next year's competition, the team is going to work on communication and have everyone on the same page to make it to the

international competition. Better communication between members will help teamwork in the short and long run. As a high school with many ambitions, the company will use time wisely next time. The hours we have together will be used to practice and come together for a common goal: reach 1st place.

BUDGET

CATEGORY	QUANTITY	ACQUISITION	TOTAL ($)
DOUBLE POLE-DOUBLE THROW SWITCH	6	Reused	419.94
WATERPROOF VIDEO CAMERA	2	Reused	
.0508 M PVC		Reused	

.0190 M PVC		Reused	
BILGE PUMP MOTOR		Reused	146. 58
DREMEL EZ LOCK OUT OFF WH	1	Purchased	20.98
KOBALT 8-32NC/ #29 TAP AN	1	Purchased	4.45
CANDY <A>	1	Purchased	1.08
9V 2PACK BAT <A> 2□6.97	1	Purchased	13.94
SAWZALL <A>	1	Purchased	16.97
SAWZALL <A>	1	Purchased	12.97
5PC JIG BL <A>	1	Purchased	4.97
TUBE CUT <A> TUBE CUTTER-HOSE/PVC	1	Purchased	12.89
YELWRN250 <A> WIRE-NUT, 74B YELLOW, 250/JAR	1	Purchased	13.95
ELEC 10 ROLL <A> CE VINYL ELECTRICAL TATE 10 PACK	1	Purchased	3.94
RISER <A> FCT SUPPLY LINE PEX 3/8 OD x 30 3□1.48	1	Purchased	4.44
PEP PIPE <A> 3/8IN Z 5FT PEX PIPE	1	Purchased	1.98
DIVE COMPASS	1	Donated	35.00
		Donated	
TOTAL COST:			

REFERENCES

http://www.marinetech.org/rov_competition/2011/technical_reports.php

http://www.materover.org/

ACKNOWLEDGEMNETS

We would like to thank the following organizations and people: We would like to give a big shout out to **MATE** for hosting this annual competition and promoting

science. This competition has allowed us, as a company and high school students, to think beyond the realms of our personal life. Thanks you **NASA** for supporting engineering dreams around the nation. As high school juniors and seniors of Waltrip High School, we would like to thank our teacher, **Mr. Lipham**, for being our mentor and encouraging us all the way to the finish line!

MATE

NASA

Waltrip High School