Hartnell College

MESA Rockets and Robotics Club

ROV : Ojo Del Mar

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1. Abstract

The 2008 MATE national ROV competition marks the second appearance for Hartnell College's MESA Rocketry and Robotics club at the MATE competitions. This year's team includes new members making their first attempt at designing an ROV. "Ojo Del Mar" is completely redesigned from last year's project starting from the chassis, and including the control system. The team decided to go with a square tubular frame to keep consistent with working designs, and included a microcontroller for the main processing unit of "Ojo Del Mar". The team faces many problems when it came to construction of the ROV. As a club we can only meat once a week. This was one of the greatest challenges that we meet. Communication was a big issue in order to complete the ROV. "Ojo Del Mar" was constructed under a budget of less than $1,000. This was critical because the capital for "Ojo Del Mar" came out of the members own pockets. As a result some of the parts from last year's ROV were included. The main focus for the team this year was to upgrade the control system which was inspired by our own robotics competition last fall involving the use of the Basic Stamp 2 manufactured by Parallax.

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Luciano Cerritos(left) and Justin Jordan (right)

2. Budget

2008 ROV COMPETITION BUDGET PLAN

Purchases

Category	Item	Quantity	Product Description	Price P/U	Discount	Amount
Electronics						
	BS2P40	1	BS2P40 MODULE-LF	$89.00	$13.35	$75.65
	29150	3	HB-25 MOTOR CONTROLLER	$79.95	$35.98	$203.87
	28130	2	TEMPERATURE PROBE	$15.95	$4.79	$27.11
	604-00001	2	12 BIT A/D CONVERTOR -LF	$10.50	$3.15	$17.85
			SHIPPING			$8.00
			SALES TAX			$23.52
	91309	2	CAMERA-UND	$89.99		$177.98
	11481682YR	1	EXTENDED SERVICE PLAN	$19.99		$19.99
			MONITOR RECYCLING FEE	$6.00		$6.00
		2	Servo	$50.00		$100.00
		250'	SOW Cord	$120.00		$120.00
			miscellaneous	$100.00		$100.00
			SALES TAX	$6.97		$6.97
					TOTAL	$886.94
Plumbing						
	050075MA	8	1/2x3/4 MALE ADAPTER	$0.41		$3.28
	075SOL	8	3/4x1/2 SIDE OUTLET ELL	$1.58		$12.64
			SALES TAX	$1.23		$1.23
	754826200495	2	PVC 40 PEPIPE	$2.32		$4.64
	49081142728	4	PVC SIDE OUTLET	$1.09		$4.36
	49081131685	4	3/4x1/2 MALE ADAPTER	$0.59		$2.36
	49081645281	1	10PK PCV TEE	$2.30		$2.30
	769125010218	2	.093-11X14AC	$2.47		$2.47
	24599050710	1	SCH 40 PVC 10FT	$2.16		$2.16
	2382174	4	SCH 40 PVC NIPPLE/	$0.51		$2.04
					TOTAL	$37.48
Hardware						
	9052838	4	SEA WASHERS PRG N	$0.45		$0.45
	9036724	1	MACHINE SCR NUTS	$0.79		$0.79

9407636	1	MACH/RD/PHIL/ZNC	$2.39	$2.39
			TOTAL	$3.63
			OVERAL TOTAL	$928.05

3. Photographs of Ojo Del Mar

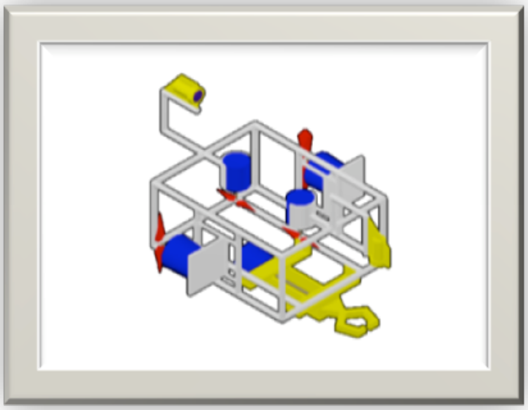


Figure1. Ojo De Mar 3-D AutoCAD

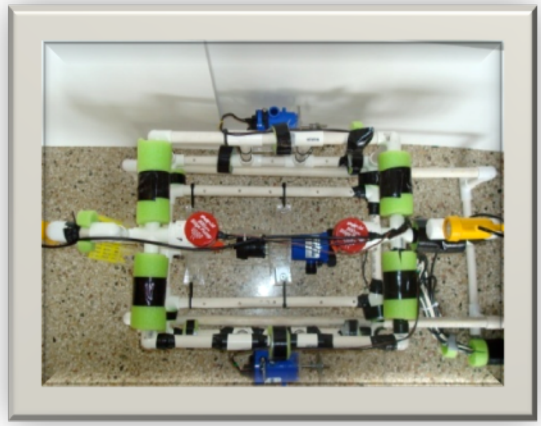


Figure 2. Top View

Figure 3. Left View

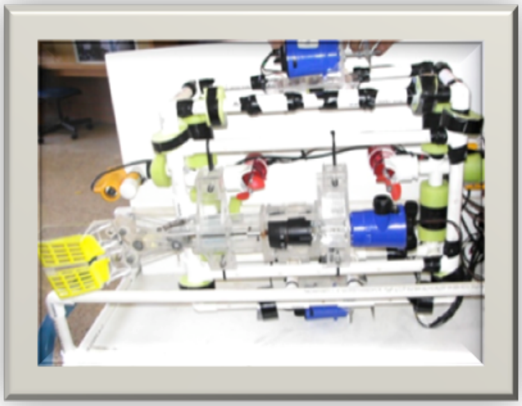
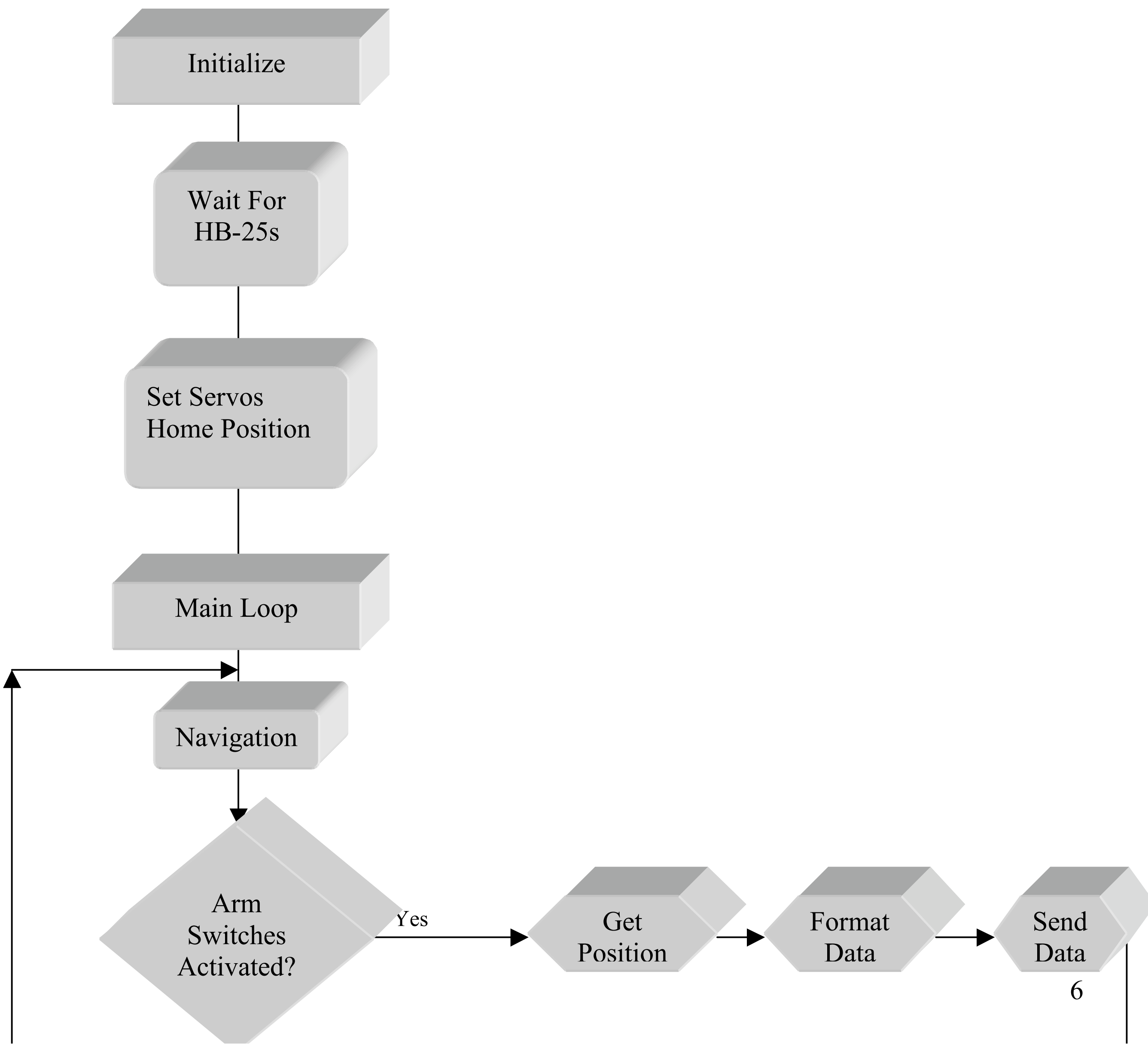
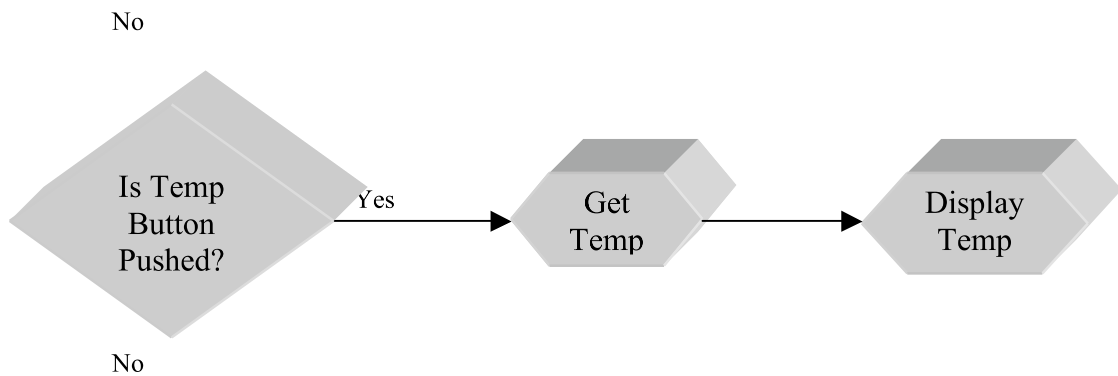


Figure 4. Bottom View

4. F





Initialization: This section of the code causes the Bs2p40 to wait for the HB-25 motor controllers to power up before executing the rest of the code. After the motor controllers are powered up a pulse is sent to each motor controller for a neutral setting. Then serial data is sent to the Pololu servo controller to set each servo arm to the home position.

Main: The main loop of the code reads the variable "joystick" and based on the binary value of "joystick" outputs the appropriate value for each motor controller for that direction. After the pulses have been sent to the motor controllers there are two "IF" "Then" statements that access two different subroutines. After returning from the subroutines, if accessed, the code jumps back to the beginning of Main and executes the loop continuously.

Subroutines:

Get_Temp: If the Get_Temp subroutine is accessed the BS2p40 falls into a "FOR NEXT" loop that activates the LTC 1298 ADC used to convert the analog signal from the temperature sensor, and formats the way data should be received. After the data is received, the data is manipulated and stored in one of three variables used for averageing. This process repeats two more times, and then the average is taken of the three measurements, and sent to a laptop via the "DEBUG" command to be displayed in an application running on the laptop.

Temp_Arm: If the Temp_Arm subroutine is accessed the BS2p40 selects the variable "temparm", and based on the binary value of "temparm" either adds to, or subtracts from the variable that represents the position of either arm that makes up the arm for positioning the temperature sensor. Once the appropriate positioning value is obtained for the appropriate arm Temp_Arm falls into another subroutine that formats the data to be sent to the servo controller for the position of the arm.

GetData: GetData formats the variables used to represent the desired position of either arm1, or arm2, to be sent to the servo controller.

6. Design Rationale

As engineers, working with deadlines, budgets, reports, and meeting the needs of clients are important factors in completing a successful project. By following guideliness troughout this project we understood what was needed to properly construct "Ojo De Mar."

- Reading and undstanding missions specifications.
- Budget under $1,000.00. In this project the need to reuse parts from last years ROV to keep the cost down.
- Finding the neutral buoyancy of the ROV. Due to the design of the ROV, and weight added by the team, used foam to help with restor boyence.
- Construction of two robotic arms. One arms is to collect samples of lava, and the other is the temperature probe.

Team's missions rationale for the construction of "Ojo de Mar".

Mission :

- The first objective was to redesign the control system. Last years control system was a plexi box, and the to control was basic switches.This years control uses motor controls and a joystick to control the movement of the ROV
- Then look for inexpensive cameras that were already water proof.
- The main focus for the team this year was to upgrade the control system which was inspired by our own robotics competition last fall involving the use of the Basic Stamp 2 manufactured by Parallax.
- The experience gained from the competition last fall allowed us to incorporate a microcontroller into our project, the BS2p40. The BS2p40 reads inputs from a joystick through an IC circuit, and based on those inputs it sends pulses to the apropriate motor controller for navigation. The BS2p40 also receives digital information from an analog to digital converter (ADC) for temperature measurement, and sends serial data to a servo

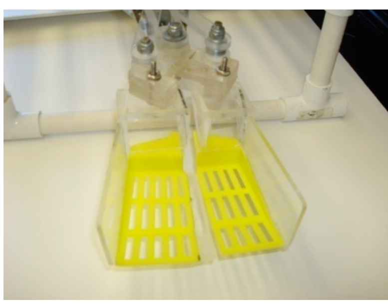
controller for positioning of an arm that the temperature sensor is mounted on. The gripper for has been redesigned to fit the new chassis, and complete this year's missions

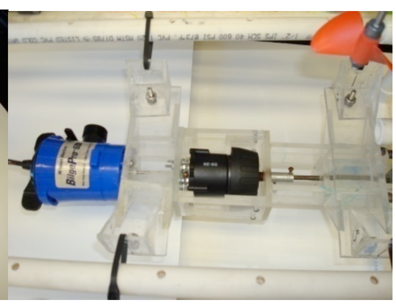
6.1. Design Rationale

Robotics Arms

The robotics arms that we built were unique for this years compitition. The robotic arms were custom made by the team, and each one plays a key roll to success of the missions.

Robotics Arm – The Griper





Materials

- Plexi Glass
- Drill Clutch
- One Popper Scooper

The robotics griper frame is made of plexi glass. This frame was built last year, but there was some modifications made in order to fit it into this years ROV. It is powered by a bilge pump motor that is connected to a drill clucth. This drill clucth, was dismantled from a drill that was donated from a friend, is a high power torque with twelve different levels. We use a popper scooper in order to collect samples as requested by the missions. The robotic arm is controled by one toggle switch,where pushing up makes the claw open and pushing down is to causes the claw to close.

Robotic Arm – Temperature Senser

Materials

- Two Hi-tech servos
- Custome made brakect
- One Temperature Prove

The team custome made to robotic are for sensing temperature from the semulated thermalvent. The robotic are is controlled by two Hitec HS-645MG High-Torque 2BB Metal Gear Servo, and where water proof. The frame of the robotic arm was design from a student, but constructed by a friend. These servos are movable in order to get a better temperature reading. At the tip of the arm rest a temperature prove.

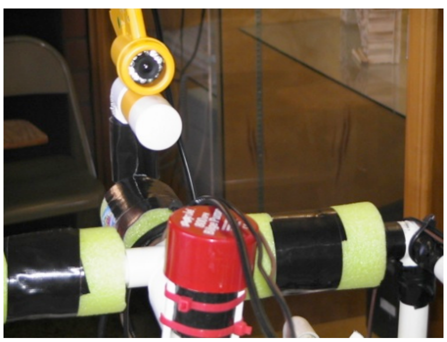
Frame

Matericals

- ¾ PCV pipe

By observing different design the team decided to with the square structure. This square structure gave us a good center to positions all of the equipment, and controls. The material that we use for the ROV was ¾ PCV. This material is good for the fact that is easy to work with and inexpensive. See appendix for AutoCAD Dimensions.

Video system



The camera system that the team use for the ROV this year where cameras water proof with LED lights.

7. Challenges Face

- One of the challenges that we face as a team was time management. The team had a hard time when it came from management. Due to different schedules the solution that we have is to contact each other by via phone, or via email.

- Claw- we made different design for the claw, and each design was great, but each one had a design error. The team wanted to make claw that was not stationary, therefore making a roller that will move the robotic arm forward and backward. Due to time restriction the team made brackets to mount the robotic into the frame.
- An issue that the team had was buoyancy of the ROV. The team cap all of the PVC pipes this will help with the bouynce. The defect of this was that

8. Future Improvements

This is a list of future improvements for next generation of the ROV.

- Sonar- marking the signals wireless and getting rid of some of the tether, there would need to be a transmitter / receiver on the ROV and another one on the controller.
- Claw- the needs to do more than just extend out and open/close, so we plan on giving in three fingers, so it can grab, and also change the screws, on our extending arm so it can turn, not just extend.
- Mount cameras on the top of servos to allow 360 degree movement for a better view.
- Changing frame to fit next year missions specifications.

9. Marine Research: Hydrothermal Vents

Underwater Hydrothermal Vents

Hydrothermal vents are geysers on the ocean seafloor. Theses hydrothermal vents eject very hot water that is very rich in minerals. The mineral rich water aids a diverse community of organisms and allows them to survive and exist. Most of the deep sea has a wide variety of population but these vent sites seem to have an abundance of life. Some of the most common life forms found around hydrothermal vents are tubeworms, huge clams, and eyeless shrimp. The benefits of studying these hydrothermal vents are because they serve as history book in the earth’s biological past. These vents house some of the most primitive biological communities on earth and could serve our understanding how life began on our planet.

NOAA Research

The NOAA currently has a (PMEL) Pacific Marine and Environmental Laboratory Vents Program has developed and deployed innovative instruments to monitor and quantify volcanic and hydrothermal processes. Most of their effort has been focused on the Axial Volcano on the Juan de Fuca Ridge. There have been many instruments placed in the area to monitor the volcanic and hydrothermal activity. The major goal of this research is to understand the extent of the sub-seafloor biosphere and to link the geologic, chemical, and biological processes that have allowed life to thrive in and around submarine volcanoes for billions of years.

11. Reference

http://www.mbari.org/volcanism/Hawaii/HR-Hydrothermal.htm

http://www.oar.noaa.gov/oceans/t_vents.html

http://www.parallax.com/

12. Acknowledgments

We like to thank:

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13. Appendix