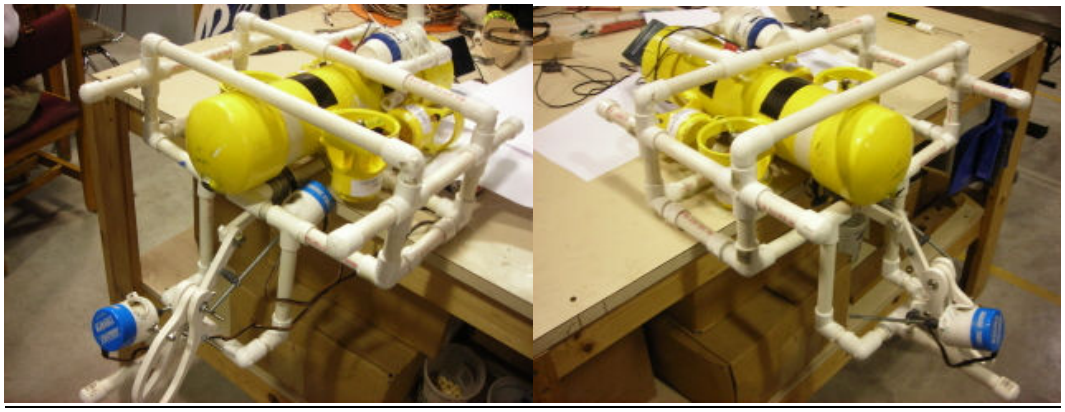
Riviera Beach Maritime Academy ROV Club
Mariners



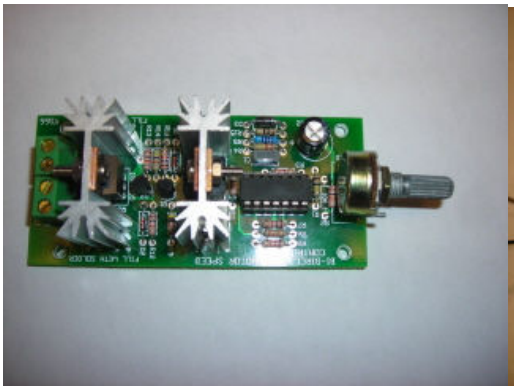
Team members:

John-Marc Diot	Class of 2007
David Maxwell	Class of 2007
Jonnatan Medina	Class of 2007
Katrina Ginocchio	Class of 2008
Jamie Bostrom	Class of 2009
Joey Young	Class of 2009
Cody Muntz	Class of 2010
Micaiah Wells	Class of 2010

Teacher Advisors:
Mr. David Sellepack
Mr. George Bradbury
Captain Gidget Greco

Mentors:
Lockheed Martin

Katrina assembling manipulator



H-bridge

Funneled suction device

Abstract

This year's Riviera Beach Maritime Academy ROV design is based on the last year's body, thruster and control design. It was found to have optimum control, maneuverability and size to complete the missions at hand. Modifications include the removal of last year's tool package and the addition of a new frame mounting system, tether, cameras, and a replacement of the old circuitry. Reusing last years body and control system allows the team a proven platform and to work within a smaller budget constraint. The tool design considerations have led to a simple, robust tool frame which provides a mounting area for tools and cameras. This frame was also designed with the ability for expansion in the future.

Budget/Expense Sheet

Period: 2006-07

School Name: Riviera Beach Maritime Academy

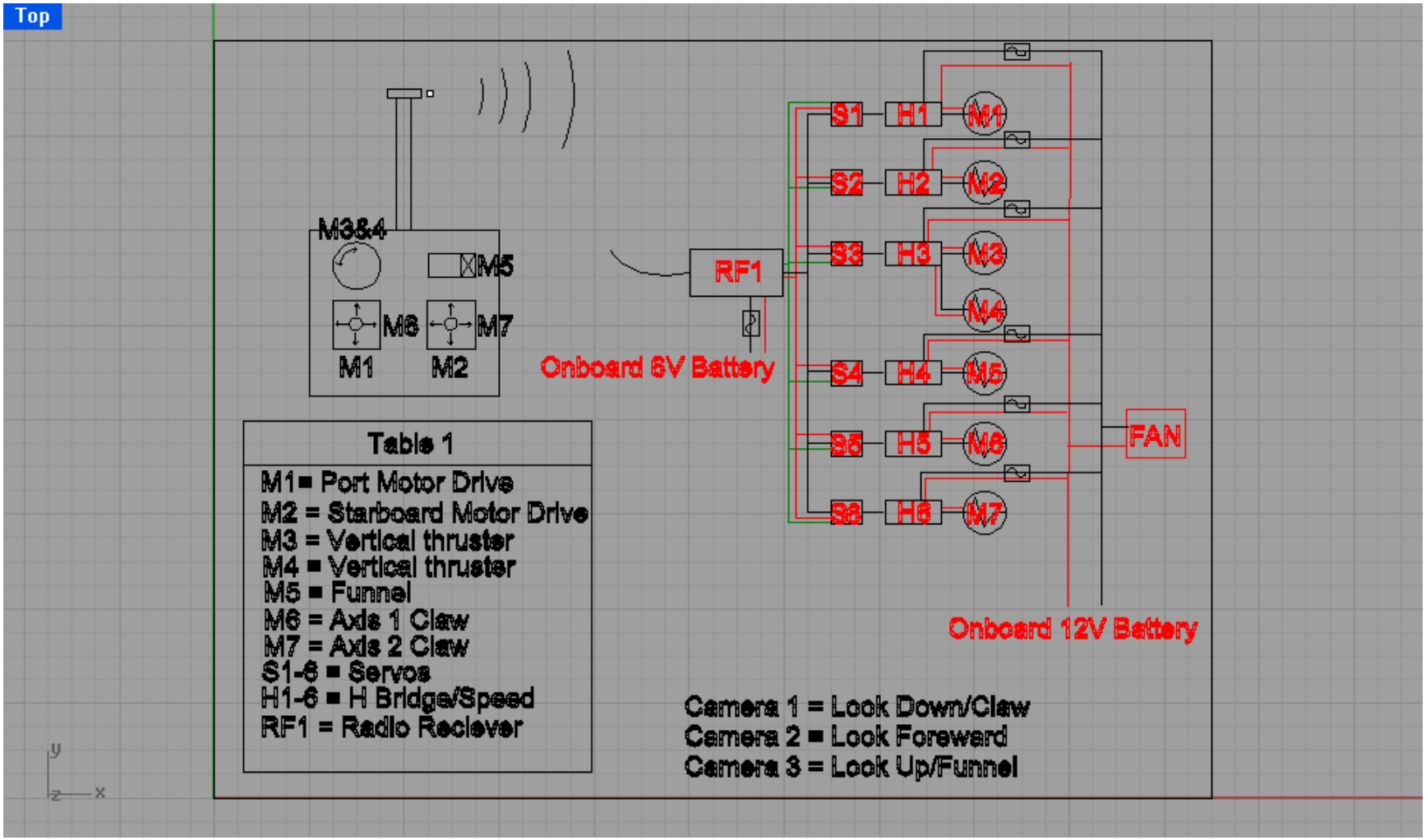
From: 10/1/2006

Instructor/Sponsor: George Bradbury

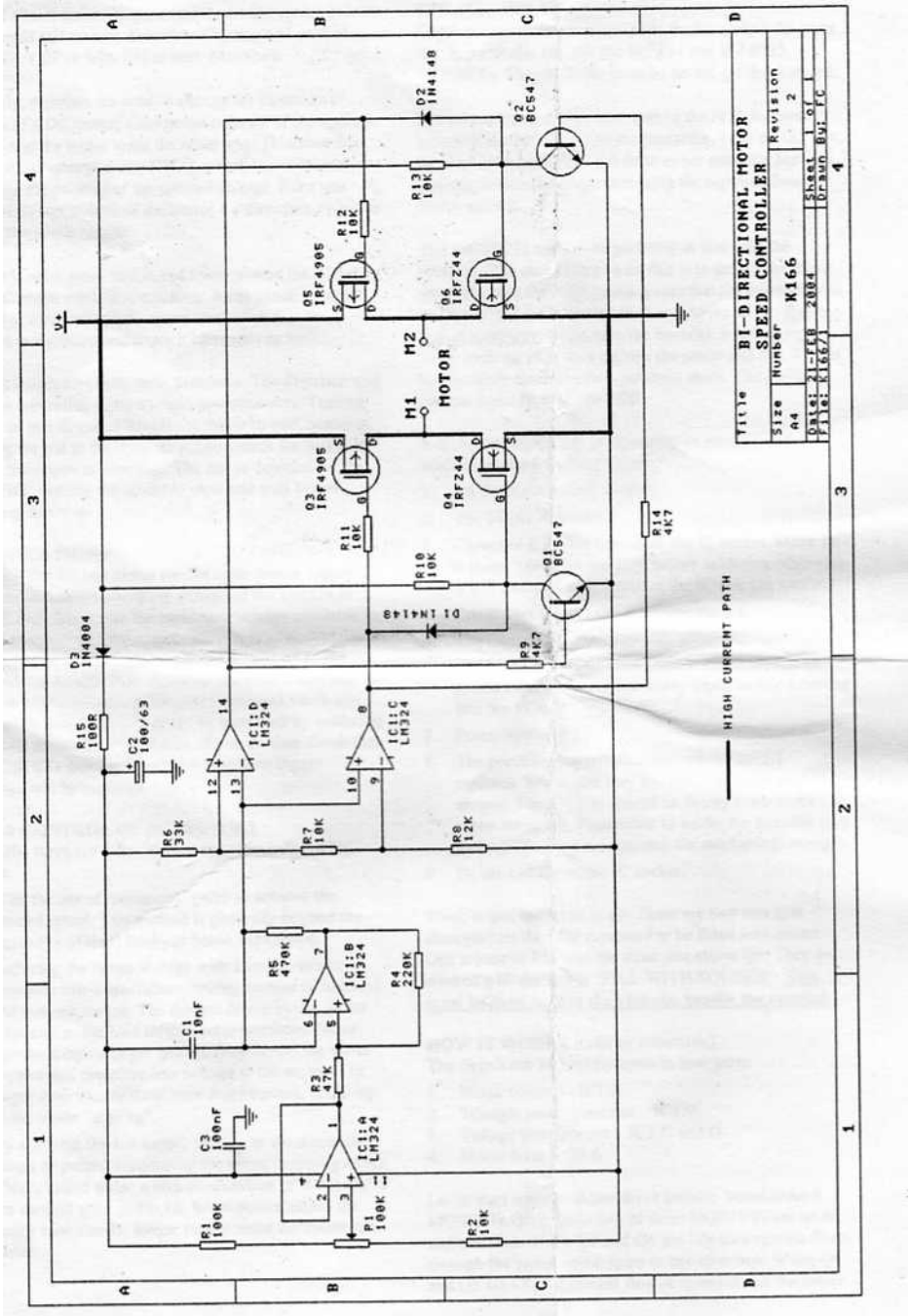
To: 6/31/2007

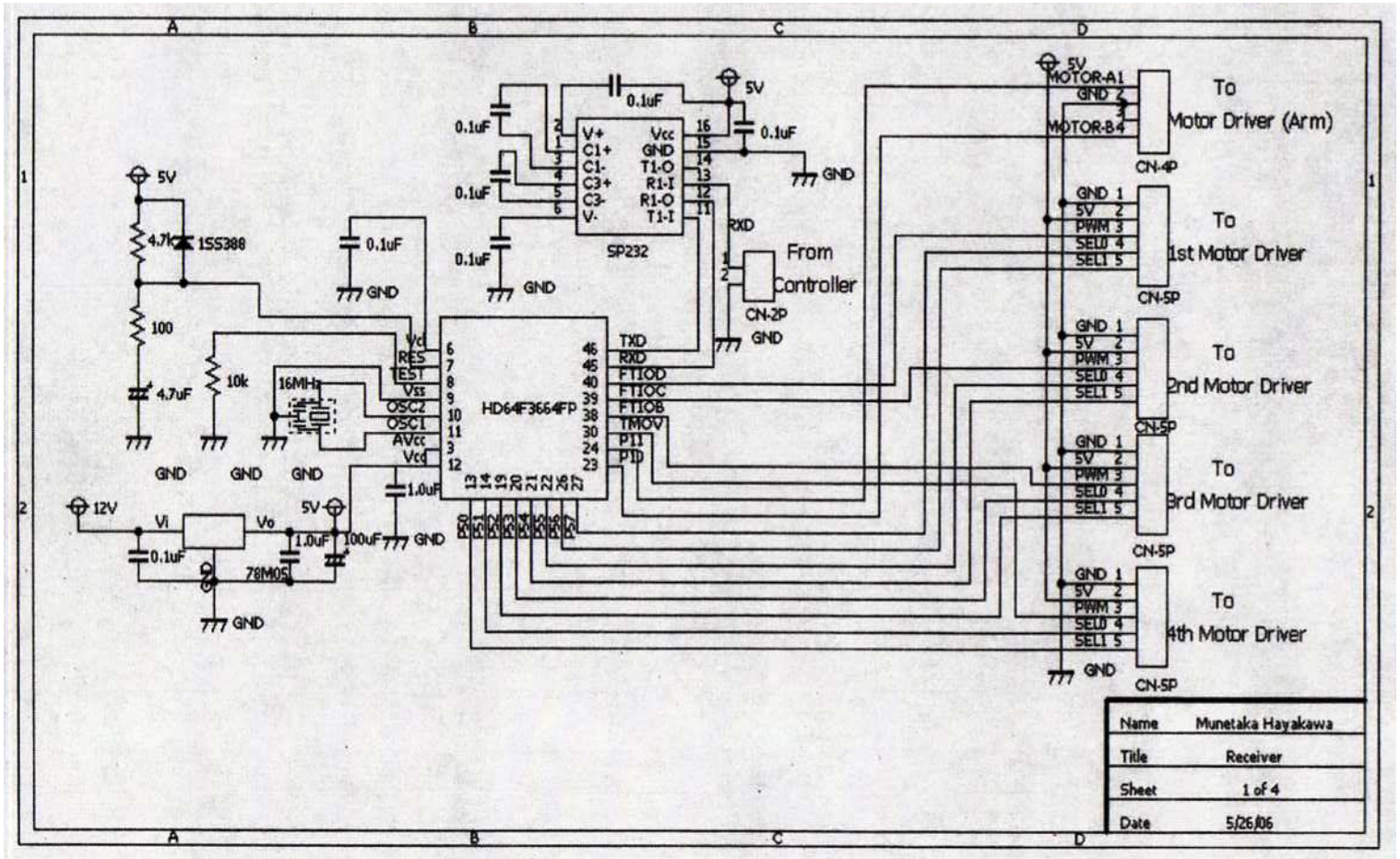
Funds $8000 donation from PB Marine Industries Association

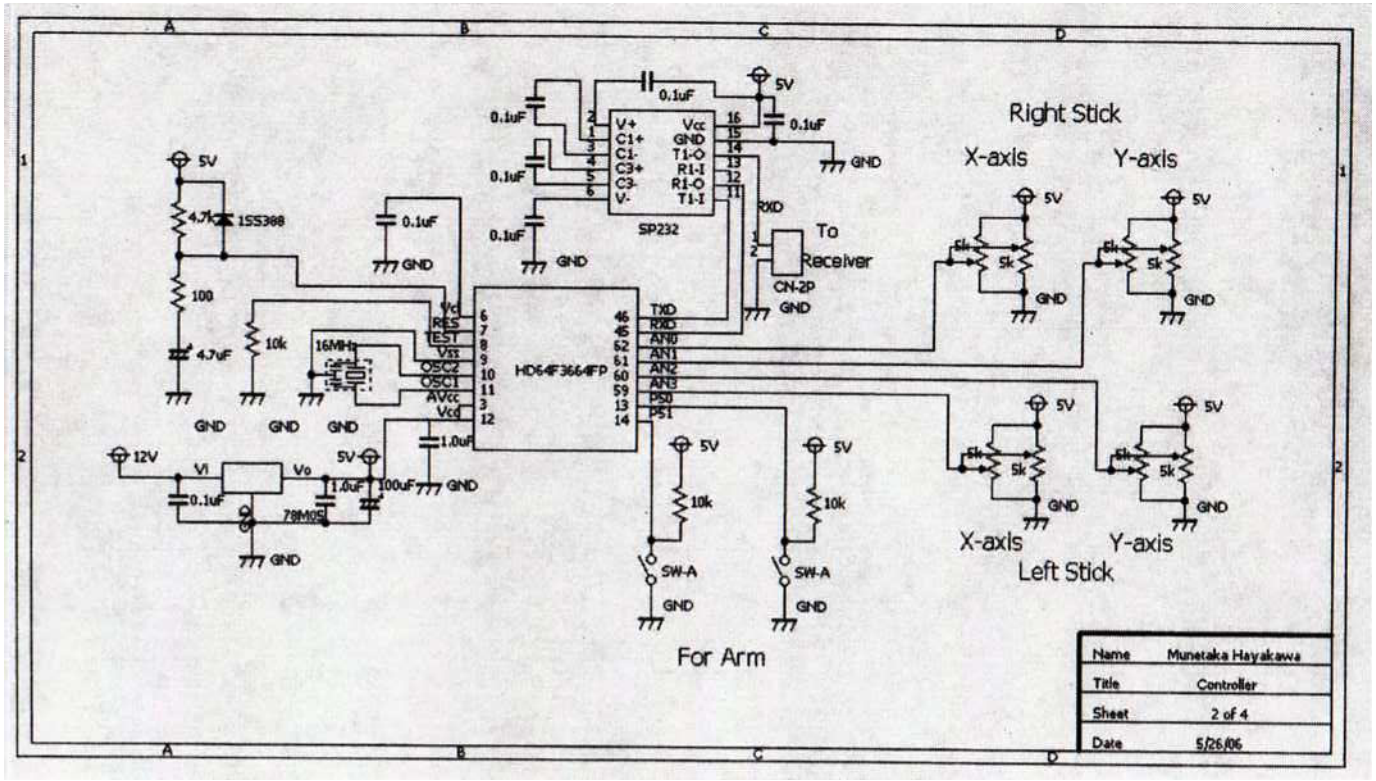
Date	Deposit or Expense	Description	Notes	Amount	Balance
11/7/2006	Expense	H-Bridge Controllers	$8,000.00	$125	$7,875
3/20/2007	Expense	RF Reciever	$ 30.00	$ 30.00	$ 7,845.00
1/30/2007	Expense	Trip Cost	$ 2,940.00	$ 2,940.00	$ 4,905.00
2/16/2007	Expense	Hotel	$ 1,800.00	$ 1,800.00	$ 3,105.00
5/21/2007	Expense	Rental Car	$ 800.00	$ 800.00	$ 2,305.00
11/7/2007	Donated	Scotch Weld 8005			$ 2,305.00
2/16/2007	Donated	PVC Board			$ 2,305.00
1/21/2007	Expense	PVC Tube	$ 30.00	$ 30.00	$ 2,275.00
6/30/2007	Expense	Gas	$ 150.00	$ 150.00	$ 2,125.00
2/16/2007	Donated	Batteries			$ 2,125.00
2/16/2007	Expense	Solder	$ 15.00	$ 15.00	$ 2,110.00
5/21/2007	Expense	Camera	$ 110.00	$ 110.00	$ 2,000.00


Top
M3&4
M5
M6
M7
M1
M2
RF1
Onboard 6V Battery
S1
H1
M1
S2
H2
M2
S3
H3
M3
M4
S4
H4
M5
S5
H5
M6
FAN
S6
H6
M7
Onboard 12V Battery
Table 1
M1■ Port Motor Drive
M2 = Starboard Motor Drive
M3 = Vertical thruster
M4 ■ Vertical thruster
M5 ■ Funnel
M6 = Axis 1 Claw
M7 = Axis 2 Claw
S1-6 ■ Servos
H1-6 ■ H Bridge/Speed
RF1 = Radio Reciever
Camera 1 = Look Down/Claw
Camera 2 ■ Look Foreward
Camera 3 = Look Up/Funnel
y
z
x

Kit 166. Bidirectional DC Motor Speed Controller




5V
4.7k
1SS388
100
4.7uF
10k
16MHz
GND
0.1uF
HD64F3664FP
Vcl
RES
TEST
Vss
OSC2
OSC1
AVcc
Vcc
1.0uF
12V
Vi
Vo
78M05
100uF
SP232
V+
C1+
C1-
C3+
C3-
V-
Vcc
GND
T1-O
R1-I
R1-O
T1-I
RXD
From Controller
CN-2P
TXD
RXD
FTIOD
FTIOC
FTIOB
TMOV
P11
P10
MOTOR-A1
MOTOR-B4
To Motor Driver (Arm)
CN-4P
GND
5V
PWM
SEL0
SEL1
To 1st Motor Driver
To 2nd Motor Driver
To 3rd Motor Driver
To 4th Motor Driver
CN-5P
Name Munetaka Hayakawa
Title Receiver
Sheet 1 of 4
Date 5/26/06


Right Stick
X-axis
Y-axis
Left Stick
X-axis
Y-axis
For Arm
To Receiver
CN-2P
SP232
HD64F3664FP
1SS388
78M05
16MHz
Name Munetaka Hayakawa
Title Controller
Sheet 2 of 4
Date 5/26/06

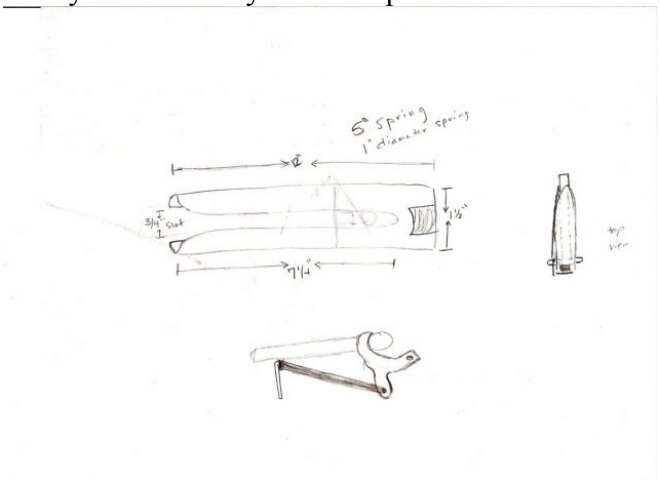
Challenge

It is to be expected that during the course of the build year there will be certain challenges to overcome. This year the main challenge arose with the decision on how to complete the task of inserting a hot stab into a 45 degree angle wellhead. From the start the idea was to use a specific tool to accomplish this task, but as how the tool would work many opinions came to the table. The initial design called for a housing to hold the hot stab which would release it into the wellhead.

To hold the hot stab in the housing it would need a latch mechanism. Many ideas came forward including a pulley rigged latch that would be released with a motor. Also was the thought of having it triggered when the housing tilted over to meet the 45. Then came the matter of projecting the stab into the wellhead, since it was deemed gravity alone could not insert the stab well enough. This was going to be either launched by either a CO2 canister or a spring, with opinions split between the two. It seemed the only agreeable part of this tool was that it would be reeled back into the housing by a small electric motor.

After much deliberation the final design consisted of a housing tapered at the tip. It would be held in by a latch that would be released via push rod which would open the latch upon hitting the opening of the well head. With the latch released a compression spring within the housing would provide the push for insertion. Once the hot stab was inserted for a length of time deemed long enough by the judges it would be recovered by a small electric motor. This entire housing was to be mounted on the ROV on a hinge allowing the housing to tilt to the 45 degree angled wellhead so as not to tilt the entire ROV causing buoyancy shift which could potentially threaten the ROV.

After much debate and time the design for this tool had finally been complete. The next step was simply to build what had been laid out. However, with the parts list finalized it came to the team's realization that with the manipulator the task of inserting and retrieving the hot stab could be completed much simpler. This tool took much time and deliberation and once finalized it was determined unnecessary. Not only was the challenge in determining the design of the tool, but in accepting that much time was lost to designing the tool. It is seen among the team now that it was not a complete loss of time. This tool taught us valuable teamwork skills and the ability to incorporate many ideas and to choose the best to suit the task. Plus we realized once again that a more complex tool is not always a better way to accomplish a task.



Design Rational

To decide and explain which instrumentation we would use on the ROV this year, we set up a flow chart to describe the missions and tasks needed to be accomplished and what tools and other devices could be used. At the end of the chart we summarized the different tools to find what could be used for multiple use and purpose.

Mission #1- threading messenger line	Tool
Attach line to ROV	fixed probe
Locate base	survey camera
Thread through u-bolt	fixed probe
Return line to surface	manipulator with 2 axes

Mission #2- algae, jellyfish, and PAS instrument	
Locate algae	upward facing camera
Collect algae	funneled suction device
Locate jellyfish	survey camera
Collect jellyfish	fixed probe
Carry PAS to bottom	probe and manipulator
Locate designated drop area	survey camera
Place PAS into designated drop area	
Return to surface	upward navigation camera

Mission #3- wellhead gasket and hot stab	
Descend with gasket	fixed probe
Descend with hot stab	manipulator
Locate wellhead	survey camera
Insert hot stab	angle manipulator
Release hot stab	
Remove well cap	manipulator
Insert Gasket	fixed probe
Replace Cap	manipulator
Retrieve hot stab	manipulator

1 survey camera
1 forward tools camera
1 upward tool/navigation camera
1 manipulator with 2 axes
1 funneled suction device
1 fixed forward probe

The main body structure of the ROV is that of last year's design. Its cylindrical shape was chosen because of the shape's ability to resist pressure and ease of waterproofing. Improvements were made to last year's structure to resolve issues with water intrusion. These improvements include better sealing the thruster mounts and using

a water sensing unit inside of the ROV. The sensing unit consists of two wires with one end of each placed on the bottom of the inside body spaced slightly apart. The wires will lead to the surface and be connected to a multimeter to test for any continuity.

This year the ROV will be controlled using a RC sending unit that sends the radio frequency signal down the tether via antenna to a RC receiver to control servos which are linked to the H-bridge potentiometers. These H-bridges control the speed and direction of the motors. The antenna consists of only one tether wire as opposed to the five used last year. Using on board power allows us to eliminate four wires from last year. Those, plus cameras, gives us a tether that has only four cables rather than last years ten. Reducing the size of the tether is a great improvement over the previous year which caused a loss of valuable maneuverability.

Four thrusters are attached to the main vehicle and are housed within PVC couplings with holes cut into the sides to allow the water to flow around the propellers. The motors are oriented with two facing the bottom of the ROV, and two facing toward the back of the ROV. This set up will give the most control of the ROV in its horizontal and vertical axes.

This year, all components of the ROV have their buoyancy calculated before being attached and submerged. The team's goal was slight positive buoyancy. This is to allow for the ROV to reach neutral buoyancy at full depth and to also aide in the ROV's ascension. To accurately measure the buoyancy of each object, the team first measured the volume of each component in a test chamber we created. By measuring the weight of the water displaced by each object and then taking into consideration the force of gravity, we determined the buoyant force of each object. Doing this allowed the team to eliminate the guess and check method used in the past and replaced it with this more accurate measuring technique.

After reviewing the missions needed to be accomplished it was apparent that a manipulator we be an excellent tool for completing a variety of tasks. The manipulator design consists of one elbow joint and one jaw joint. It uses two modified bilge pumps which use threaded rod actuation to raise or low and open and close the jaw. The entire device was designed in Rhino CAD from which a prototype was built out of plywood to test the size, clearances, and actuation. The final product will be built from PVC board which provides ease of fabrication and durability.

The mission involving retrieving an algal sample could not be accomplished with the manipulator already designed. Given the control system and design of the ROV it was determined that a new simple tool could be added to complete this task. A funneled suction device was designed out of components which we had on hand. It consists of a funnel with a membrane stretched across the wide opening and a hole centered in it for which the algae sample will move through but not escape. The funnel will be a suction tool powered by an unmodified bilge pump of which we also had on hand. The membrane was made from resistance bands used for physical therapy. The funnel attached to the bilge pumps with set screw for easy removal with the exhaust vectored around the ROV to be expelled downward, thereby creating an extra push up on the algae for better extraction.

To create adequate mounting space on the ROV for all the new components without having to compromise the hull structure, a PVC frame was fabricated to fit around the vehicle. In order to secure the new frame to the ROV, strong adhesives and set

screws are used. To optimize the effectiveness of the manipulator a probe is fixed facing forward from. This fixed probe will be used in conjunction with the manipulator and on its own to complete tasks in all three missions.

In order to navigate and complete tasks it was determined that the ROV would need three cameras. One camera mounted in the nose of the vehicle is used for observing the manipulator and fixed probe. The second camera, mounted on the forward part of the frame will be used for general navigation, unobstructed by the tool packages. A third and final camera will be placed on the upper aft section of the frame to both navigate under the ice and to position the funnel device.

Troubleshooting

Within the tools designs there laid a few issues to be resolved. Firstly the original manipulator design incorporated a gear actuation that was found to turn too fast for the application. A threaded rod design resolved that problem by slowing the movement of the joints to slower speeds for greater control. With the funnel tool it was extremely hard to find a practical membrane until one of the members broke his leg and came into possession of a resistance band used for physical therapy. After analyzing the material it was determined perfect for our needs and free of charge. After attempting to rebuild last year's control system it was determined that the damaged components could not be salvaged and that a different system was needed. After much research a solution was found and a new control method developed. With all the obstacles we faced as a team it was the look towards the ends which ultimately provided us with the means to accomplish the tasks set before us.

Lessen learned/ Skills gained

Having a team made up of only one returning team member left much to be learned to bridge the gap from last year's accomplishments to our current endeavor. Thanks to the help of our teachers and sponsors, our team was able to learn how to form ideas then make them a reality. Each member came into his or her own learning their individual strong points and how to coordinate them into the team to obtain the best possible results.

Future Improvements

It is always the aim of the club to reach out to more of the student population and gain interest in this unique field. In future years it is hoped that more students will join this team bringing a large base on which to build not only a working machine but a connection between team members only an experience such as this can create. This club is an amazing experience that not only should be known throughout the school, but the community as well.

On the technical side, it was decided at the beginning of the build year that the ROV was to be based on last years design. The main problem with this was that it would have to be modified in order to complete the new missions. A simple solution was adding

a light frame around the main structure that not only accommodated this years tool packages, but would allow for expansion in future years.

The controls for the previous year was based on a RC sending unit which was hard wired to send serial communications to a microcontroller programmed to use pulse width modulation to control the H-bridges. Next year the H-bridges will be controlled with a microcontroller programmed by the team members with Q-BASIC.

Reflection

This was an amazing year for the entire RBMA ROV club. Much was learned and shared between all the members. We are proud to have worked together towards such an outstanding goal. The knowledge gained this year far exceeds anything any member would have expected for him/her self and what any of us would consider their normal interests. It is that thought which has all members realize that this is an experience which will be carried with them the rest of their lives no matter the outcome of the actual competition.

People of the Arctic

In the arctic there can be found indigenous people that inhabit Alaska, Russia, and Canada. In Alaska there can be found three main groups of native, sixteen in Russia and three in Canada. It is believed that the first inhabitants of the North American arctic came over the land bridge, Beringia, which connected Siberia to Alaska about 12000 years ago. These culture relied heavily on what could be hunted consisting of sea mammals and fish. The tools developed were largely made of sharpened stone used to make spears and knives. Once these peoples became established in the regions around the arctic the abundance of food allowed for a permanence and formation of societies. Technology was not only advanced in tools and weapons but in house building. They developed small semi-subterranean structure which efficiently retained heat. Being more permanent also allowed these people to expand the technologies even further. Creating new boats covered in skins, hunting of even larger game, including whales, became a reality.
http://www.arctic.noaa.gov/
http://arcticcircle.uconn.edu/HistoryCulture

Acknowledgements

The RBMA ROV club members would like to thank all those who have helped to make this year's ROV become a reality. Thank you, teacher advisors, Captain Greco, Mr. Bradbury, and Mr. Sellepack for spending a great deal of time with every member to teach valuable skills needed to become productive team members. Also, the RMBA ROV club thanks our mentors from Lockheed Martin for all of their assistance with teaching essential skills and sharing their insight on the professional world of underwater robotics.