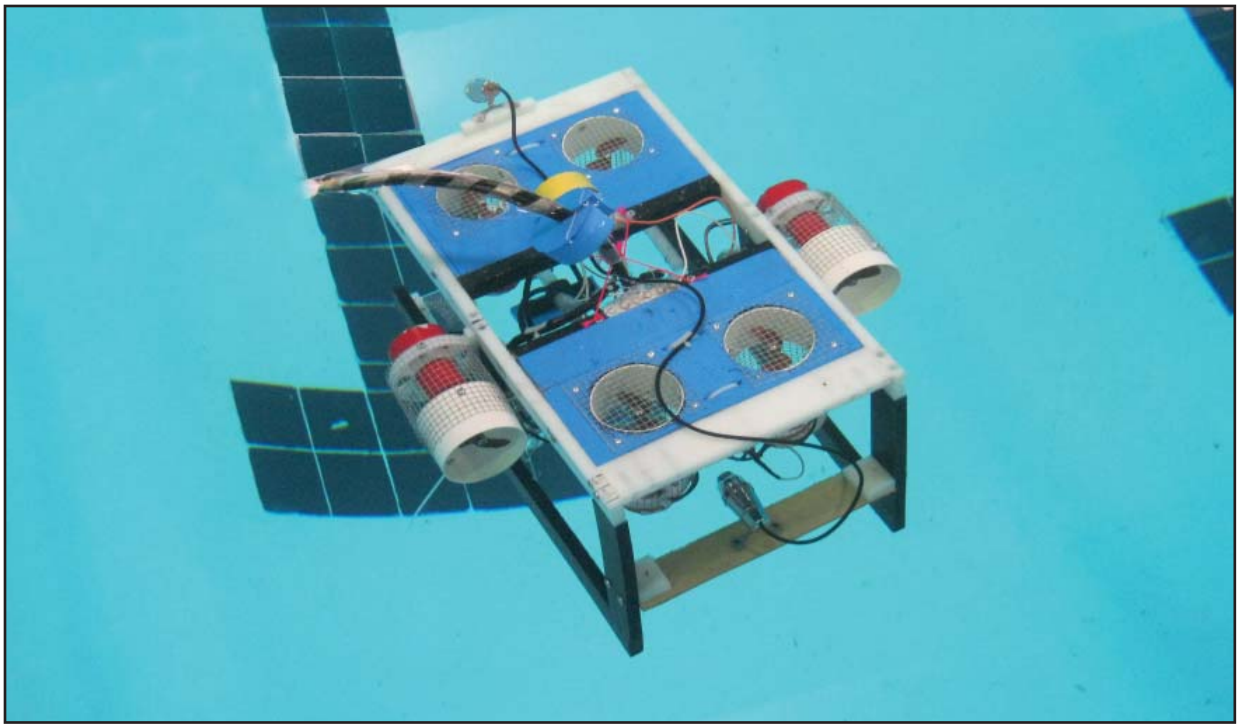
NIMITZ Deep Sea Salvage

Nimitz High School

Houston, Texas



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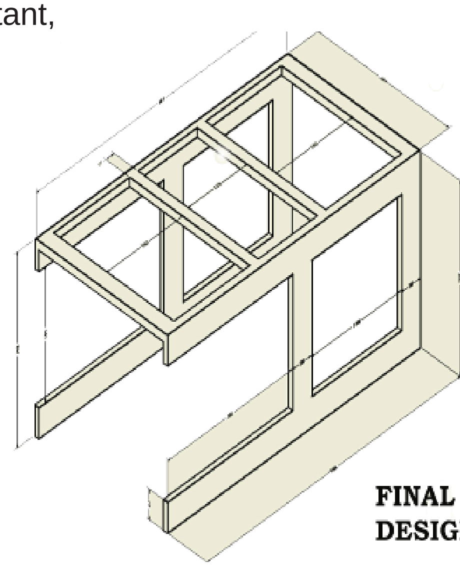
The Deep Sea Angler, a class II ROV, is designed to survey an area, take measurements, extract samples, remove debris, and work quickly and efficiently. Designed and produced by Nimitz Deep Sea Salvage, the Deep Sea Angler has been created from simple ideas and evolved into a top class ROV.

The ROV's compact design allows it to maneuver in tight spaces and its centrally positioned tether allows it to turn 360°. The array of thrusters allows The Deep Sea Angler to make precise movements. The four vertical thrusters are controlled independently allowing us to tilt the ROV forward or backward depending on the task at hand. Two horizontal thrusters control forward, backward, left and right. Several payload tools, such as, the Mosquito, magnet, and claw, are attached to the robot allowing it to complete several tasks. Two joysticks are used to control the robot similar to a Bobcat loader steering, both forward you move forward, if in opposite directions the ROV turns, etc...

Drawn out, calculated, machined and brought to life, the Deep Sea Angler is made to compete with top class ROVs.

Frame

The frame is constructed of UHMW(Ultra-high-molecular-weight polyethylene). This material's density is .95, it's chemical resistant, its coefficient of friction is .005, its highly machinable, strong, and sturdy. Our frame is open and allows water to flow easily through it allowing us to maneuver and not worry about drafts or currents. Our 50.8 cm x 29.845 cm x 27.94 cm size frame is small and allows us to work in tight spaces. Our front struts have been removed to allow our camera a wider more open view. Our payload systems are mounted on a cross member made of Plexiglas which allows us to see through it. Everything is secured by 2 in screws.



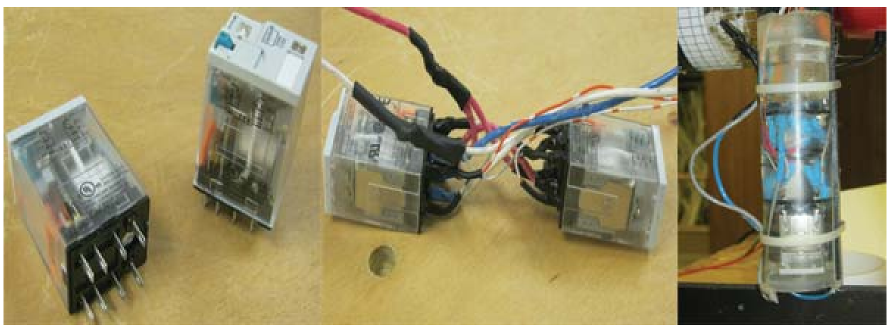
FINAL FRAME DESIGN

Thruster Pods

The thruster pods allow us a forward and reverse direction. Each of our six thruster pods are made up of a bilge pump motor, welding wire fabric, mount, collar, propeller, and adapter. Our mount is designed to be attached to our robot with two screws and the motor fits perfectly inside. A propeller, which is larger than the ones used in the past, is mounted to the motor by means of an adapter. A shroud goes over the propeller to decrease over spill by 50% and focus the thrust. The welded wire fabric holds the shroud in place and protects the motor from foreign object damage and any loose wires or strings. Before mounting any motors, we mounted the to a test stand and used a fish scale to check the thrust. After, we paired up motors that had the same amount of thrust to make sure it wasn't moving out of order.

Relays

Our relays are 10A 12VDC DPDT relays that work in pairs to control our thrusters. Our electrical setup contains a main and a slave relay. The main relay runs the motors clockwise, and the slave relay runs through the main relay to switch the polarity and run our motors counter-clockwise. An Ethernet cable runs to power the relays and allow electricity to flow to our motors. Only on pair of positive and negative cables are used to run the robot. Power runs into our bus and is spread to our relays. We only run one wire per relay to our control because the rest of the circuit is incorporated into the wiring. An important part of our robot is where we have our relays located. Our relays our mounted on the robot and waterproofed to run underwater. This reduces the size of our tether and allows us to maneuver easier. Another advantage is that our ROV can simulate pulse width modulation through the use of joysticks to control our robot very precisely.



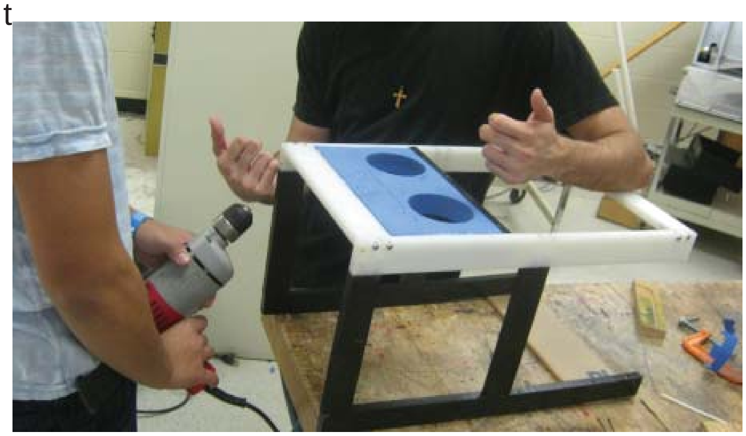
Original Relays   Wired Relays   Waterproof Relays

ROV Control Bus

The ROV has an electrical bus on it which allows it to branch electricity out to the relays. It was designed in our shop and integrated into the ROV's frame. There are two rails one positive and one negative which are separated to ensure there is a lesser chance of a short out in case of a leak from our waterproofed relays. Also our bus is setup to run like a parallel circuit to reduce resistance and run a smaller power source down to our ROV. To water proof it we took a simple approach and hot glued the rails.

Buoyancy

As part of our overall design we decided to build the flotation into the frame. To take a lot of the guesswork out of the process and make a professional looking frame, we tested several different types of foam to select the best for our use. Our criteria was that it needed to have a low density, the ability to recover from pressure, and a closed cell crossed linked structure so that it would not absorb water. Upon concluding the tests, we decided to use boogie board or paddle board the swimming team uses. It met all the criteria. For the next step in the process, we built the ROV frame and attached the flotation to it with screws. We had to measure the length and width of the boogie board and then subtract the volume of the circular cutouts for the motors, which are 8 centimeters in diameter. The volume of the boogie board is equal to 402.665 cc. The final outcome of the ROVs weight is 6.6 kilograms and is neutrally buoyant in the water. These amounts were necessary and sufficient to keep our ROV neutrally buoyant

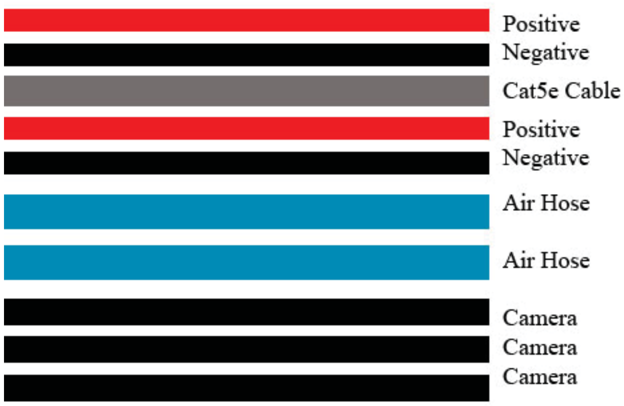


Cameras

There are three CCD Dome cameras model no. CM-DWL60CH. They are water proof and are used to look at our jaw, in front of us, and take sonar images. We used the focal length to determine the length of the frame. The cameras have LED lights to illuminate objects under the water and it has the ability to pickup infrared light. Our cameras run up to a DDR that allows up to 8 camera inputs. Through the DDR we display all of our cameras into our monitor and allow us to see all angles of our ROV.

Tether

The tether is composed of a positive and negative 18 gauge wire which powers our bus, a cat5 cable which switches our relays and ultimately controls our ROV, a molex connector that connects to the Mosquito, two air tubes rated at 150 psi, and the three camera tethers. The tether is wrapped with clear spiral wrap to keep anything loose from getting tangled with the robot itself. Donuts, made of boogie board foam, are secured through out the tether to keep it neutrally buoyant so it doesn't affect the robot.

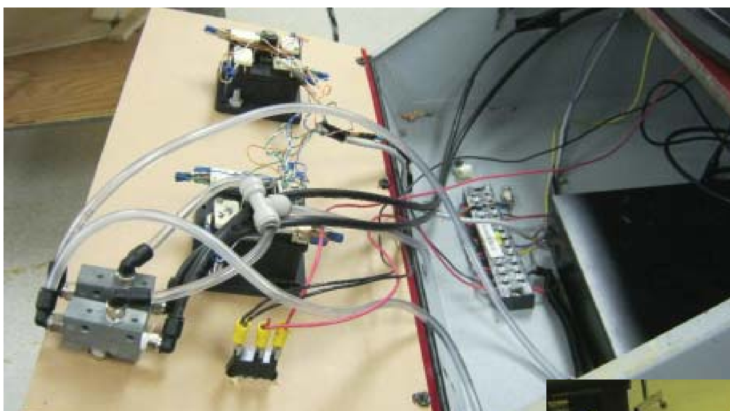


Pneumatics

We are one of the few companies that has adopted pneumatics into our system. Our pneumatic system is simple to configure and work with, also if anything fails we can easily trouble shoot. To run our system, we have a tank, rated for 200 psi, that we fill up to 40psi and run into a pressure regulator and scale it down to only 20 psi. The smaller pressure is enough to run our jaw properly and it lasts longer since we have such a larger reserve. The air runs into toggle switches which run air through air tubes rated at 150psi and into our 4 inch piston rated at 200 psi.

Control Box

Our control box frame is a salvaged CNC machine that was going to be thrown away. The material of the box is metal so its durable and it can be used multiple years. We mounted a piece of corian as a table top for the monitor. We adapted a hinge in order to mount the Plexiglas door that is positioned in the front of the box. The Plexiglas holds our controls: joysticks, electric switch, toggle switches. We have two electric inputs one is positive one is negative it is located on the right of the box and runs through a 25amp safety fuse. Next to the inputs we have our air input that connects to our toggle switches. There is a window one side that is used for the DDR positioned for easy access. On the back face of the box we cut two holes, one the tether and the safely attached to the box through and the second for connecting the DDR, cameras, and monitor.

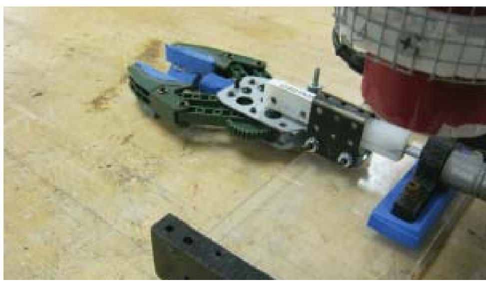
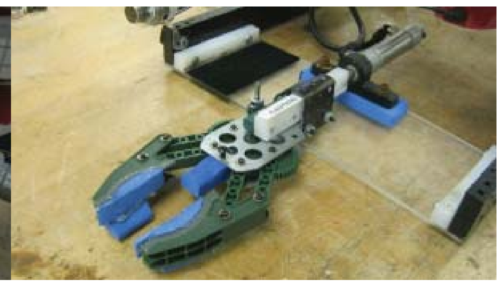


Safety

We incorporated as many safety features as possible to ensure a safe environment for all. First of all, our control box is basically water proof and is sturdy. Our 25 amp fuse ensures no electricity gets into our wires and burn out anything in the control box much less our robot. The joysticks ensure no two switches can be activated and even if they are, the relays are wired so that no shortage can occur. The tether is wrapped to keep our tether as one and make sure no wires can get tangled. Also we have securely attached the tether to the control box and ROV. Everything on the ROV is waterproofed by soldering the connection, hot gluing it, placing heat shrink over it and hot gluing the sides of the heat shrink. The relays are already waterproofed and so is the bus.

Jaw

The jaw is made up of a VEX jaw with our own modifications. Due to our testing, we came to a conclusion that using a VEX jaw would be simple and cost effective. We tested with a VEX motor, but we were unable to run it with our electrical system. We then decided to run it with one of our own motors, but it was not able to open due to the fact that the spring was too strong and the motor was not producing enough torque. We scrapped the idea and decided to back to pneumatics. We came up with a rack and pinion system. To allow our jaw to remain open, we removed the spring. After competition we realized we had made a good decision with using pneumatics. An opposing team used a VEX jaw and a VEX motor; however, their motor was not sealed well enough and the pressure in the water broke through. They were out of the competition and we correctly decided to use pneumatics.

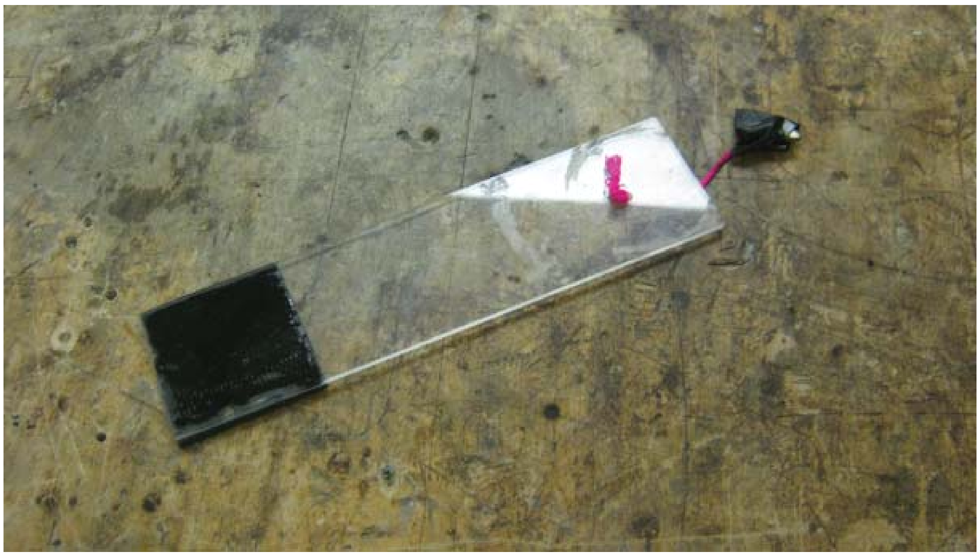



Mosquito

The Mosquito, which is used to take samples, is composed of a 500 gph bilge pump motor, a clear tube, a UHMW plug, a pipe with a fitting for the tube, and an improvised check valve. The pipe is small enough to penetrate the hull and retrieve a sample. To retrieve it and keep it from diluting, the plug works as a separator from the water. The pump then sucks the plug backwards and in return sucks a sample. After competition, we realized the sample had leaked out through front of the pipe so, a check valve was added to the pipe. The best thing about the mosquito is it is one of our removable parts and can be placed on or removed from the robot.

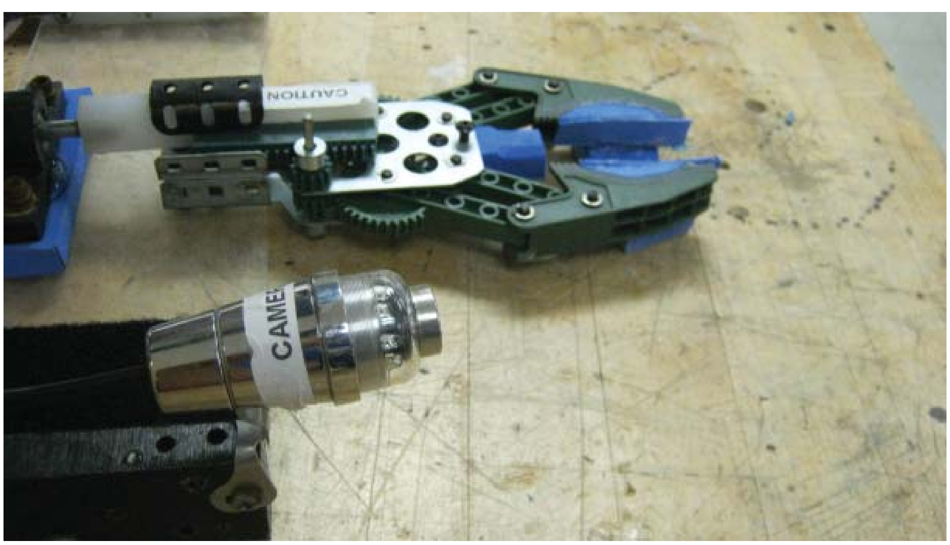

Magnet

One of our tasks is to identify objects and tell if they are metal or non-metal. To test the debris, we added a magnet that would attach to metal debris and indicate wether it is natural sea floor or remains of a metal object. It can be placed where the mosquito mounts and can be viewed through our camera. It is the easiest way to determine if an object is metal or non-metal. The magnet was salvaged from an old hard drive which we took apart.



Simulated Sonar and Back scatter Device

The sonar device is a camera placed on the front of the frame facing forward. We line it up and hold it in place to take sonar images. Our jaw also doubles as a back scatter device. It can be placed on the hull or the calibration tank and take a measurement of the width of steel.



Challenges

Our biggest challenge was time. Most of the crew is composed of seniors and are therefore occupied with other activities. One of our members is enlisted into the Marine Corps and has to participate in physical training on the days that we meet after school, so he can only help the others out during school. Also, the other seniors have college classes which cut into their days at school. Schedule conflictes and it is difficult to have everyone together at the same time. Building the robot went from a couple of months to several months. We were able to manage time and get together to complete the robot.

Troubleshooting

Since our whole system is a large circuit, the first check the battery for full charge, then check for continuity in the pigtails to make sure that electricity is threw to the control box. Next check if the 25 amp safety fuse and test the bus in the control box to check current flow through it. Check continuity and function to the relays by observing the idiot lights on the relays. The final check is motors continuity and rotation.

The pneumatics system is also checked the same way. First check the pressure in the air tank. Then check our regulator the see if there has been any air loss and that enough air is running through. If pressure exists at this point, we move one to check the toggle switch. Once we determine the toggle switches function properly, we examine to see if air reaches the piston to open and close the jaw.

Budget

Item	Quantity	Cost	Total
CCD Camera	3	$250	$750
1000gph Bilge Pump Motor	6	$45	$270
Propellors	6	$5	$30
Clear Tubing	1	$4	$4
500gph Bilge Pump Motor	1	$20	$20
Welded Wire Fabric Roll	1	$20	$20
Total			$1,094

Lesson Learned

We learned to cooperate with people of all backgrounds and manage time. Like we mentioned it was hard to have everyone together at one time, so when we were together we had to get our ROV completed as soon and as fast as possible. After cutting our deadlines close, we got to working efficiently and stopped procrastinating. We learned that having the tether coming from the top gives us an advantage in moving underwater. In the past, we had it coming out of the back of the robot and we experienced drag as we maneuvered through the water and it was troublesome trying to move in tight situations. Having the tether on top of the robot, we learned that the robot pivots better on a fixed point in the center of the robot instead of a point behind the robot.

Future Improvements

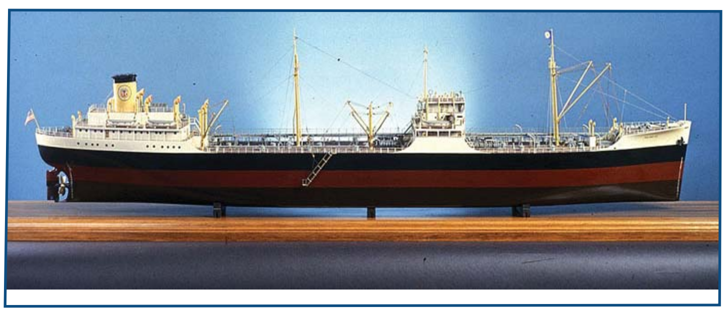
One improvement that we plan on doing in the future is reducing the weight of the ROV. This will decrease the weight of the ROV and allow the motors to move the ROV quicker and easier. We also plan to run our tether with a ball bearing connection that connects in the center of the ROV. The way we have it set up now makes it difficult to rotate the underwater. With a ball bearing we will be able to rotate with ease and allow us to complete the missions faster.

Reflections

Building this ROV has taught our company as a whole about careers in engineering. It also taught us about teamwork and perseverance. As a whole, our team has gotten closer and stronger as teammates and as students to achieve one common goal, to achieve victory and recognition worldwide. As individuals, we learned how to persevere time and work efficiently. We were all brought together and were able to build new relationships.

SS Gardner WWII Tanker

Displacement: 2,270 t.(fl)
Length: 220' 6"
Beam: 37'
Draft: 13' 1"
Speed: 10 kts.
Cargo Capacity: 1,365 DWT
Oil: 12,100 Barrels
Diesel Fuel Capacity: 2,240 Barrels



523 feet long overall
68 foot beam
30 foot draft
10,448 Gross tons
21,880 Loaded displacement tons
6,000 shaft horsepower Turbo-Electric propulsion
Speed 14.5-16 knots
Liquid capacity 141,200 barrels (42 gallons or 162 liters per barrel). [nearly 6 million gallons]

During War World II, the U.S. built many oil tankers to supply oil to war machines overseas. German U-Boats took opportunity and attacked the U.S. tankers at night to stop the the supply of oil from reaching refineries, storage facilites on the east coast of the U.S. and convoy assembly ports bound for Europe. Today there are many sunken tankers along the coast of Florida , the East coast and North Atlantic. The MATE Center released a mission for companies to build an underwater ROV (Remotely Operated Vehicle) to investigate the the SS Gardner and take samples of oil leftovers. The Nimitz Deep Sea Salvage Crew took on the mission to build the least expensive and most efficient underwater ROV possible. For the past seven months, the Nimitz DSS crew has designed and built their robot named the Deep Sea Angler.

U.S. tankers were classified: T1, T2, and T3. T1 tankers were named after major oil fields such as the one near Gardner, Kansas. Their length were between 200 and 250 ft and were built between 1936 to 1942. T2 tankers were named after historical settlements, monuments, forts, battles, trails, and lakes. They comprised most of the tankers built during the war and were 500 to 550 ft in length..The type T3 were even larger tankers and were not built until later in the war. This wreck could not have been a T3.
It is our position that SS Gardner is most likely a type T1 tanker because of its name. we are looking forward to observing the wreck to verify the length of the vessel to verify the type tanker. The primary means of identifying the type of tanker is its length. You can also use the location of the bridge to help in identification. On most of the type T1 tankers the bridge was located on the stern although some were built with it located a midships like the T2 tankers.

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NIMIT-DSS

Acknowledgements

Special thanks for the help and support of these individuals
Greg Hopper - CATE supervisor
Gary Rodgers - Instructor
Sharon Coleman - Counselor
Barbara Brenek - Interpreter

Special appreciation for a great program:
Marine Advanced Technology Education

Appreciation to:
Neutral Buoyancy Laboratory for their great facilities there is no other like it.

Big thanks to:
Greg Gonzolvez for
the donated UHMW
Archer Daniels Midland

Technology Student Association

Thanks to:
University of Houston

Thanks to:
Light Camera Action for having the best cameras we have found.

A Big apprection for letting us have a program at NASA (National Aeronautics and Space Administration)

Thanks to:
Grainger Industrial Supply for helping us fine hard to find supplies