K.I.S. Oceaneering

(From left to right): Zack Liddiard, Michael Hanano, Isabelle Tayo, Nikolette Argyris, and Logan Graham

ROV Voyager

Kealakehe Intermediate School

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K.I.S. Oceaneering Corporation Positions:

CEO and Head of R & D Engineer:	***Nikolette Argyris***	**(14 years, 8th grade)**
CFO & Systems Engineer:	***Zack Liddiard***	**(14 years, 8th grade)**
Government & Regulatory Affairs:	***Talen Heinicke***	**(11 years, 6th grade)**
Media Outreach Engineer:	***Isabelle Tayo***	**(11 years, 6th grade)**
Testing & Operations Engineer:	***Logan Graham***	**(12 years, 6th grade)**
Design Integration Engineer:	***Michael Hanano***	**(12 years, 6th grade)**

Teachers & Mentors: Lisa Diaz, Andrew, Ileana, Aricia & Terry Argyris, Captain Chip Conklin and Guinevere Davenport

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ROV Voyager

Total Cost: $4749.64 less $4284.00 in grants, donated & reused items = $515.64 new costs.

KIS Oceaneering is donating R & D and free tech support to MATE for the 2012 *Voyager* prototype

Primary Construction Materials: PVC: (poly vinyl chloride)

Dimensions: 59 cm long, 41 cm wide and 26 cm high Total Weight: 10.0 kilograms

Safety Features: 4 custom motor safety housings prevent entanglement & injury.
A 25 amp fuse & 2 heavy-duty banana plugs wired into a tether safety harness plug into a safety power box with 2 heavy-duty battery contact clamps that connect to a 12 volt marine battery. A current limiter reduces current flow to 20 amps for added safety. Five 3-amp fuses for cameras are wired into the tether's electrical safety harness.

Special Features: designed to carry out 2012 MATE Missions:

KIS Oceaneering designed ROV *Voyager* to explore, survey and monitor shipwrecks, detect metals, salvage artifacts, collect fuel oil for environmental analysis and collect and transplant coral samples.

High Speed Propulsion
4 Johnson1250 GPH motors spin at a rate of 4732 LPH with custom designed, angled, brass propellers for maximum thrust. 1 Johnson 500 GPH motor that spins at a rate of 1,890 LPH with a two blade plastic propeller is used for lateral movement.

Advanced Sensor System:
2 high-resolution, wide-angle cameras provide clear topside views of deep sea shipwrecks, detailed real-time monitoring of wreck structure, and the surrounding benthic environment.
3 additional underwater cameras focus on specialized payload tools for fuel and coral sampling, sonar measurement, and artifact recovery. *Voyager's* advanced sonar, and marine compass provide accurate readings to navigate deep water missions.

Payload Tools:

Tool # 1: Multi-Purpose Claw: collects and transplants coral

Tool # 2: Ferrous Tester: determines if debris pile content is metal or non-metal.

Tool # 3: Lift Bag Cradle: transports lift bag to fallen mast.

Tool # 4: Fuel Oil Collector: collects precise volumes of fuel oil from shipwrecks.

Tool # 5: Metric Line: provides secondary measurements to verify sonar and GPS readings

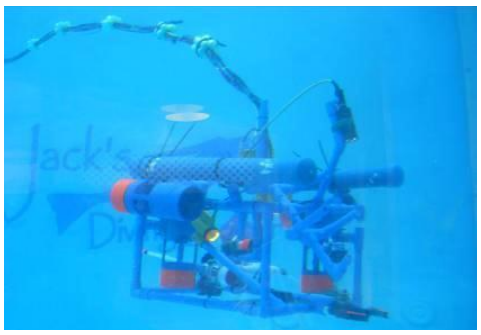
Tool # 6: Marine Compass: assists in navigation for wreck surveys

Tool # 7: Furuno Sonar Sounder: measures distance & aides navigation for ship-wreck surveys

Maximum Amperage draw = 25 amps if all motors, cameras & sonar are on at same time.
A current limiter reduces DC current to 20 amps for added safety.

Tether: 12 conductors, 15 meters (30 feet) **Depth:** *ROV Voyager* dives up to 8 meters

ABSTRACT



Voyager test dive

ROV Voyager was designed by KIS Oceaneering, a team of 6 middle school students ranging from 11-14 years old based at Kealakehe Intermediate School. KIS Oceaneering designed *Voyager* for MATE and NOAA to survey the environmental impacts of deep sea shipwrecks, detect debris, collect fuel oil and artifacts plus also transplant corals.

ROV *Voyager* is a light weight ROV with a PVC frame having the dimensions of 59 cm long, 26 cm high and 41 cm wide, weighing 9 kg and diving up to 8 meters with its 15 meter tether containing 12 conductors. *Voyager* contains 5 thrusters: 4 heavy-duty 4725 LPH Motors for ascent/descent, forward/reverse, and one additional 1890 LPH motor for lateral movement. 5 tools were custom designed to efficiently complete the 2012 MATE missions: 1) Motorized Multi-Purpose Claw, 2) Ferrous Tester, 3) Lift Bag Cradle, 4) Fuel Oil Sampler and 5) Metric Line. 2 precision navigation instruments complete *Voyager's* payload tools: 6) Marine Compass, 7) Sonar. Tool # 1 is operated by 1 SPDT, 1 SPST switch, and a 2 wire VEX Motor. Tool # 4 is operated by 1 SPST switch and an 1890 LPH bilge pump motor. *Voyager* navigates via 5 underwater cameras, protected by individual 3 amp fuses. 2 adjustable PVC pontoons ensure *Voyager's* neutral buoyancy. Maximum amperage draw is 25 amps. A 25 amp main fuse protects all thruster and tool motors. A current limiter reduces current to 20 amps for added safety.

2012 KEALAKEHE INTERMEDIATE /KIS OCEANEERING ROV BUDGET & EXPENSES:

Items:	Category:	Amount:
NEW PARTS: PVC pipe & PVC parts, PVC glue, Paint	**Frame**	**54.38**
Dive Compass, Transducer Extension Cable, hose clamps, VEX gears, aluminum sheet, PVC pipe & parts, screws, zip-ties, Velcro	**Mission Tools**	**161.99**
Switches, wire, cable, solder, shrink wrap, tape, control boxes, banana plugs, 2 Johnson 4732 LPH bilge motors,	**Electrical & Propulsion**	**362.11**
PVC, pool noodles, tie-wraps, weights	**Ballast System**	**15.38**
1 Lights Camera Action High Res. Camera Repair	**Sensors**	**190.00**
PVC, ABS, elbows, couplers, caps, PVC glue, bricks Bolts, screws, zip ties, paint bucket, u-bolt, tubing.	**Mission Prop Supplies**	**137.02**
PVC cutter, pliers, pipe cutter rental, Dremel bits	**Tools & Supplies**	**94.76**
TOTAL '12 NEW ROV PROJECT EXPENSES:		**$1015.64**

DONATED ITEMS:	DONORS /GRANTORS:	
Grant for ROV Equipment	**UpLink School Program**	**500.00**
Mission Tools: 3-1893 LPH (500 GPH) bilge motors	**BIRR Workshop**	**200.00**
Mission Tools & Props: 2 Vapur pouches, Bicycle Pump	**Sports Authority/Alvin Tayo**	**70.00**
Circuit Boards, Conquest Controller, VEX Motor	**Chip's Marine Electronics**	**400.00**
Fish finder, Chart Plotter, Transducer	**Jim Black**	**499.00**
12 DONATIONS & GRANTS TOTAL:	**SUBTOTAL**	**$1669.00**

RE-USED ITEMS FROM '10 -'11 ROV PROJECTS:	Category:	Estimate:
3 Lammensco cameras (BIRR Workshops)	Sensors	400.00
2 Lights Camera Action High U/W cameras	Sensors	900.00
1 Rule 1363 LPH bilge pump motor, VEXplorer Claw	Mission Tools	100.00
PVC pipe	Mission Props	35.00
Two 12 volt Marine Batteries	Power/Electrical	80.00
Custom brass 5 & 7-screw propellers, Two 4732 LPH motors	Propulsion	600.00
Tool box & basic tools	Larry Rice '06 Grant	100.00
TOTAL RE-USED ITEMS	**SUBTOTAL**	**$2215.00**

TOTAL GRANTED & RE-USED PARTS, EQUIPMENT & PROPS: $3884.00

COST TO BUILD '12 ROV: Out of pocket new parts $1015.64 LESS $500.00 grant $515.64

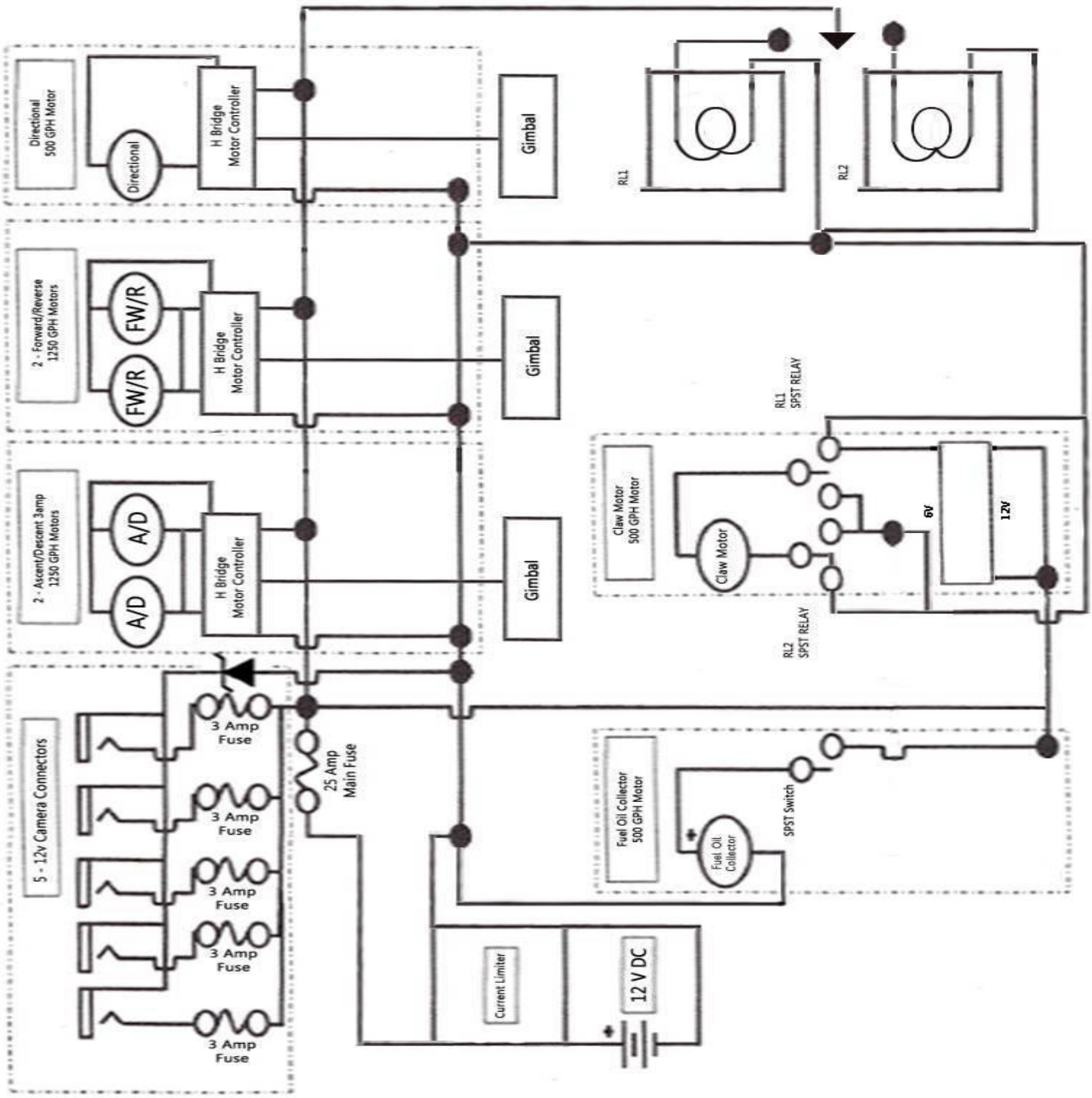
STUDENT HOURS:

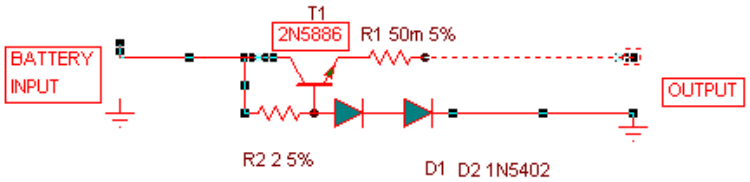
Total estimated student (8 students) ROV design/construction hrs:	**721**
Total estimated student (8 students) research/tech report/display hrs:	**300**
Total estimated student (8 students) pool practice hours:	**400**
TOTAL STUDENT HOURS:	**1421**

ADULT HOURS:

Total Estimated Mentor & parent (4) Safety supervision)	**HOURS:**	**400**
Total Estimated TEACHER (1) (Shopping, supervising)	**HOURS:**	**400**
TOTAL ESTIMATED ADULT HOURS:		**800**

Electrical Schematic:





CURRENT LIMITER

DESIGN RATIONALE

ROV Voyager is designed for efficiency and safety

KIS Oceaneering designed *ROV Voyager* to survey deep sea shipwrecks, assess environmental impacts, detect metal debris, collect fuel oil samples and artifacts, and also transplant corals. We designed an original, safe, efficient, and low maintenance ROV to quickly complete all missions. Striving for efficiency, our ROV frame, camera, motor mountings and payload tools were designed to quickly accomplish the 2012 MATE mission tasks. For time management planning, we used a step by step design process and scheduled tasks by priority, breaking into design and construction teams for the frame, tools, electrical and ballast systems. All of Voyager's systems were tested extensively throughout construction, with mission time trials used to finalize our design.

KIS Oceaneering focused on efficiency and safety. We designed custom motor safety housings to improve water flow, and prevent entanglement. Custom 7-screw propellers aide *Voyager's* ascent & descent motors with 2 additional custom 5-screw propellers attached to forward & reverse motors to achieve better thrust. A lateral motor gives *Voyager* the ability to turn with fine precision. *Voyager* is equipped with a marine compass and sonar plus 2 high-resolution, wide-angle cameras to improve navigation. Our tools & electrical controls are innovative, original designs. Our tether was designed for safety and has minimal drag to increase *Voyager's* maneuverability.

SAFETY:

Safety is our main focus at KIS Oceaneering. We use a 12 point safety checklist to operate *Voyager* to guarantee clear communication between pilots and deck crew. Before connecting power, we ensure every control switch is turned off to avoid damage. Prior to launching *Voyager*, pilots deliver clear orders and require our crew to report that all motors and tools are fully operational. *Voyager's* instrument panels have clear labels and its electrical system is waterproofed with liquid tape and shrink-wraps, to ensure safe, reliable electrical controls. *Voyager's* 25 amp fuse is located in our tether harness. A current limiter, located between the battery and control station, reduces current flow to 20 amps for added safety. Two heavy-duty plugs connect to a power safety box with 2 heavy-duty battery clamps to safely contact a 12 volt marine battery. Five cameras, each with a 3 amp fuse, are wired into the safety harness to safely power the cameras with a 12V marine battery. Plastic sheathing sections keep the tether neat and reduce chances of accidents. Custom motor safety housings surround all propellers to prevent injury and entanglement. Orange caution tape surrounds all motor housings. Focus, safety goggles, closed-toed shoes and hair ties are standard crew requirements.

ROV VEHICLE SYSTEMS:

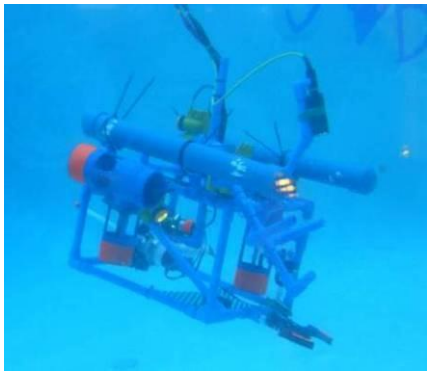
STRUCTURE:

We designed *Voyager's* PVC (polyvinyl chloride) frame around MATE mission tasks and created payload tools to complete shipwreck surveys. PVC is lightweight, low-cost and durable. To ensure even submersion and to assist with buoyancy, holes were drilled into calculated portions of the PVC frame. Our frame measures 59 cm long, 41 cm wide and 26 cm high.

SENSOR SYSTEM:

Voyager has 2 high-resolution Lights Camera Action Model (LCA) 7705-CW-23 cameras, plus 3 Lamensco u/w security cameras. Camera #1 (LCA) is at the front for wide-angle viewing for navigation and locating targets. Camera #2 (LCA) is positioned at the back to view the Fuel Oil Collector and to navigate. LCA Cameras #1 & #2 are depth rated to 66 meters (200 ft.) and use 12 volts DC at a maximum of a .33amp (300 mA) draw and each has a net weight of .49 kg (~1lb). Cameras #1 & #2 transmit 380,000 pixels and have 6 white LED lights. The LCA field of vision is 92 degrees in air- 54 degrees in water. Camera #3 views the claw, lift bag and ferrous tester. Camera #4 views the magnetic strip, and aides in reverse driving. Camera #5 views *Voyager's* on-board instruments (Compass and depth/temperature gauges). Each Lamensco camera (#3, #4, #5) is depth rated to 18 meters and has standard RCA output, 20-meter tethers and white LED lights. Cameras #3, 4, & 5 use 12 volts DC at a maximum of a 1 amp draw and have a net weight of 1.3 kg each. For additional safety, each camera is equipped with a 3 amp fuse and is wired into the tether with a 25 amp main fuse. *Voyager* has 2 on-board, precision navigation instruments: a Furuno sonar sounder with a transducer and a marine compass.

PROPULSION SYSTEM:



Voyager's powerful propulsion system features custom motor safety housings

ROV Voyager utilizes 4 thrusters configured as follows: 2 opposite corner-mounted thrusters for ascent/descent power and 2 side-mounted motors for forward/reverse propulsion, Custom safety housings surround all motors and direct hydrodynamic propulsion. Each motor draws 3 amps under a full load and spins at a rate of 4,732 LPH [liters per hour]. *Voyager* has an additional front mounted directional motor that draws 2.5 amps under a full load and spins at a rate of 1,890 LPH utilizing a two blade propeller. Our heavy-duty bilge cartridge motors are depth rated to 8 meters and outfitted with stainless steel drive dogs and Bonzi Sports brass RC boat propellers. The thrust of the 4,732 LPH Ascent / Descent motors, outfitted with 7-screw propellers, is .80 kg forward and .72 kg reverse. Each of our Left / Right motors, outfitted with a 5-screw propeller, generates .70 kg forward and .62 kg reverse.

We constructed a thrust tester out of a cross of 2 lengths of ½ inch PVC pipe in 30 cm lengths joined in a "+" formation. We zip-tied a 4,732 LPH bilge pump motor with a propeller on a cut PVC "T" and made a custom 16 awg wire harness to ensure safe electrical connection for the test. We attached the thrust test cross to the top of a garden trash container and filled it with water. A digital luggage scale was used and secured to an opposing PVC "T" for the readings. We measured the forward and reverse force in kilograms. We also tested for amperage use of the motor under load with various propeller designs with a multi-meter. The propeller that performed best in both force and amperage use was chosen for the ROV.

ELECTRICAL CONTROL SYSTEM:

2 electrical surface control boxes contain KIS Oceaneering's original control system. Control Box #1 (Conquest Pilot Center) controls propulsion and payload tools: Switch #1 operates forward and reverse motors; Switch #2 operates the claw tool; Switch #3 operates the fuel oil collector; Switch #4 operates the lateral motor and Switch #5 operates the ascent/descent motors. The Fuel oil collector is a SPST (Single-Pull Single Throw) switch and the claw is SPDT (Single-Pull Double Throw) switch. Switch #1 controls the Oil Collector with a 1,893 LPH (500 GPH) motor. Switch #2 operates the claw powered by a 2-wire, VEX motor and a 6 volt regulator. Activating switch #1 causes the ROV to propel forward, and turning on switch #1 and #4 simultaneously causes the ROV to turn. Each 4,732 LPH thruster motor draws 3 amps and our 1,893 LPH motor draws 2 amps. Total amperage for all motors and cameras is 25 amps. A current limiter reduces DC current to 20 amps for extra safety.

Control Box #2 controls 4 bi-directional DC motor speed controllers.

Voyager's Control Boxes # 1 & # 2.

Voyager pilots operate control system.

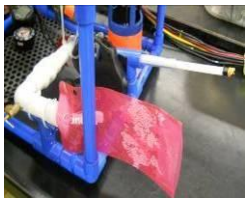
BALLAST SYSTEM

ROV Voyager's adjustable ballast system utilizes 2 pontoon floats positioned on our frame plus tether floats to achieve neutral buoyancy. *Voyager's* frame has drain holes to let air escape and provide stable buoyancy. Prior to launching, our crew conducts a final buoyancy check.

ROV VOYAGER MISSION PAYLOAD TOOLS

We prioritized innovation and simplicity when creating simple, low cost, low maintenance tools for the mission tasks for the 2012 MATE mission tasks.

Tool # 1: Multi-purpose Claw: is a multi-task tool, front positioned, to enable us to transplant coral to a safe location. Tool #1 is a modified VEXplorer claw adapted to efficiently work underwater lift them to the surface. Tool #1 has a maximum 2.0 amp draw. The claw can be used to deploy transponders and lines.



Tool # 2: Fuel Oil Collector: We designed tool #2 by modifying a 1893 LPH (500 GPH) marine bilge pump that enables us to collect a 100ml sample of fuel oil into a .5 liter Vapur sample bag. The Fuel Oil Collector runs on 12 volt DC, pumps 3 liters/minute, and draws a maximum of 3 amps. Tool #2 collects precise fluid volumes to monitor and assess the environmental impacts of shipwreck sites as well as salvage fuel oil from shipwrecks.

Tool # 3: Ferrous Tester: this tool determines metal content of objects in debris piles at shipwreck sites.

Tool #4: Lift Bag Cradle:
Used to transport a lift bag to collect wreck masts and artifacts.

Tool # 5: Metric Line:

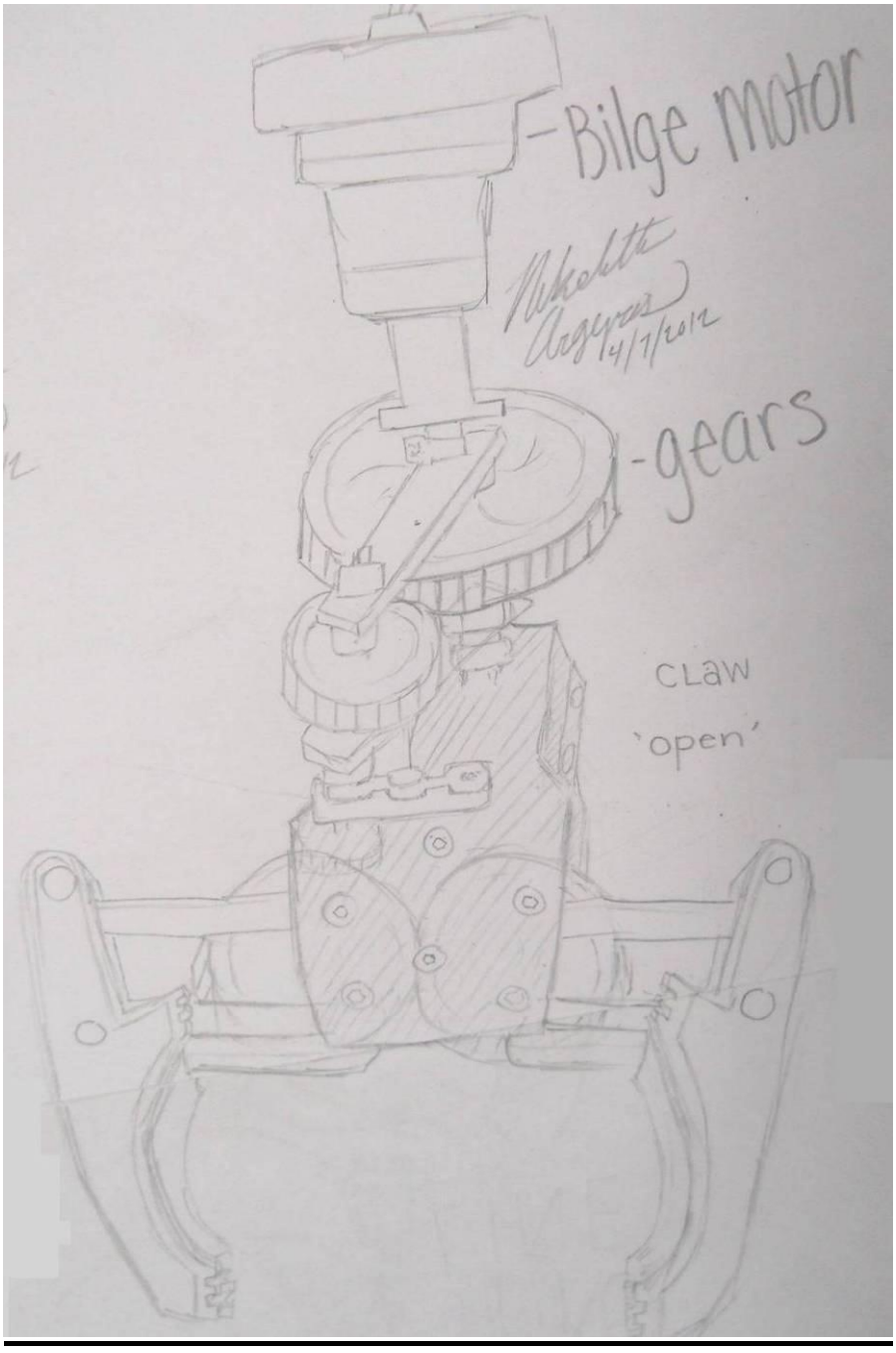
Provides secondary measurements to verify sonar readings.

Tool #6: Marine Compass:

Assists with precision navigation for wreck location and surveys.

Tool #7: Furuno Sonar & Chart Plotter:

Measures distances & aides mission navigation. The sonar is operated by a surface fish finder display in the control shack, which uses an onboard transducer suspended from *Voyager's* frame connected topside via a 15 meter extension cable in our tether using 2.5 amps. *Voyager* deploys sonar targets, to various wreck locations, to obtain sonar readings.



Mechanical sketch of Tool #1: Multi-Purpose Claw

This is our preliminary sketch of the design of Voyager's multi purpose claw. We tested and modified the claw to improve its efficiency by replacing the bilge motor with a direct VEX 2 wire motor, and removed the gears.

CHALLENGES:

Our most difficult technical challenge was developing methods for accurate underwater measurement of ½" PVC poles within an enclosed concrete swimming pool. We researched sonar, GPS and laser technologies and spoke with experts. We found that our 2012 budget would not allow us to purchase underwater laser technology or professional grade GPS equipment. Consumer grade hand-held GPS units are only accurate to a range of 3-9 meters, which would not allow us to accurately complete Mission #1 Task #1, measuring the distance between the ½ inch PVC Deck poles on the shipwreck. We learned that fish finders use sonar to locate fish by detecting their air-filled swim bladders. We developed sonar targets consisting of small air-filled balloons with fishing weights that we could deploy on parts of the shipwreck. We added an extension cable to attach the transducer to *Voyager's* frame and incorporated the cable into our tether to reach the topside Sounder and accurate chart plotter unit. We also included a back up measurement system called Metric Line which allows us to accurately measure linear distances with a retractable line, in case the sonar system malfunctions.

Testing Voyager's sonar system.

TROUBLE SHOOTING TECHNIQUES:

While testing *Voyager,* we encountered many obstacles. At times solutions were easy, for instance, checking switches, using a multi-meter to check current flow, or tightening propeller screws. At other times, the solutions were more difficult. When the thrusters malfunctioned, the team checked the connections in the control box, replaced flooded motors, re-wired and re-soldered when necessary.

One memorable troubleshooting encounter was when we lost power while testing cameras, motors and tools and had to use a multi-meter to find the trouble source. We first turned off all switches and disconnected the banana plugs for safety, then used a multi-meter to locate the power loss in the connection box. We re-soldered the clip to repair the connection. We checked the main and camera fuses for any blown fuses. We examined our tether wiring connections and changed batteries to assure a full charge. We verified that power was on and all tools were fully operational. We had to replace 2 motors that had slowed down due to flooding.

We re-positioned cameras several times after repeatedly testing them during practice missions using our payload tools. We constantly tested motors, tools and instruments and timed pool trial mission simulations to improve *Voyager's* payload tools. We tested and modified the claw to improve its efficiency by replacing the bilge motor with a direct VEX 2 wire motor and removed the gears to simplify operation.

All motors switched off to troubleshoot camera positions during pool testing.

FUTURE IMPROVEMENTS:

For 2013, *Voyager II* will feature a laser scanner for measurement precision and all cameras will be upgraded to high-resolution. Water proof electrical connectors will allow us to upgrade electronics to add onboard circuit boards and micro-controllers, relay switches, and a streamlined SOSI tether.

LESSONS LEARNED:

Voyager's crew offers free technical support

We gained new confidence in ourselves during the MATE Voyager ROV project. We learned the importance of time management, scheduling, clear communications and many technical lessons. We added extra after school workshop sessions to complete construction on-time. We improved our technical skills by learning how to construct bi-directional DC motor speed controllers and assembling circuit boards. Learning to focus and overcome challenges quickly as a team was our most important lesson. Time management was difficult due to the challenging nature of designing waterproof electronics. We learned that we needed to be positive, motivated and dedicated to ensure Voyager would meet our customers' highest

expectations. We have learned a substantial amount about the environmental impacts of wrecks containing oil and toxic waste, and how important it is to create mitigation solutions.

REFLECTIONS:

PERSONAL, ACADEMIC and PROFESSIONAL ACCOMPLISHMENTS:

From participating in the MATE program, we learned to work effectively as a team. We acquired new technical skills such as digital publishing, soldering, trouble-shooting, waterproofing, and piloting ROVs. We learned many new entrepreneurial skills we can use to start our own high tech companies. Team mates gained confidence in presenting and communicating to others clearly. Before participating in Kealakehe Intermediate School's Robotics program and the MATE ROV project, most of us had not thought much about future careers. We learned about new sonar, laser and GPS/GIS technologies and about how ROVs are used to locate, salvage and monitor ship wrecks. After actively participating in the MATE program, our eyes have been opened to many interesting marine tech and engineering career opportunities. The MATE program is very rewarding and will be useful to help us achieve our future academic and career goals.

TEAMWORK:

This year, half of our team is new to ROV. We are a young team of 6th, 7th and 8th graders. To finish our work we had to communicate with each other effectively. We worked nearly everyday after-school on this project, often 10+ hours per week. There was a lot of debate in our groups, which helped us learn how to work as a team in our company. Working with each other brought many new experiences in which we learned the true meaning of teamwork and how to work with people that have different opinions.

ACKNOWLEDGEMENTS:
We thank our Teacher & Mentors:

Science & Robotics Teacher: Lisa Diaz and Mentors: Andrew, Ileana, Aricia & Terry Argyris, Captain Chip Conklin, Guinevere Davenport, for wonderful guidance and their countless hours of supporting us while building and testing *Voyager.*

Sponsors & Donors:

Jack's Diving Locker, Chips Marine Electronics, West Hawaii Electronics, Kealakehe Intermediate School, Diamond Head Sprinkler (PVC Donation), ACE Hardware, HELCO, Kona Marine Supply (motor donation), Doug Perrine, Alvin Tayo: Sports Authority, Radio Shack, Loews, Allan Jose: Harley Davidson, KTA, Marjorie & Dewayne Erway, Service Rentals, John Harp: Wendy's, John Yates: Wal-mart, Lights Camera Action (repair discount), Starbuck's, Target and Panda Express.

Special Mahalos:

Darryl Watanabe, BIRR Coordinator for organizing our regional competition, workshops and giving us equipment. **MATE Center & staff**, especially **Jill Zande, Deidre Sullivan, Erica Moulton, Matt Gardner and Jeremy** for creating the 2012 missions and organizing the competition. **MATE Sponsors (MTS, NSF, NASA, NOAA)** and **MATE judges and volunteers, BIRR judges and volunteers** for supporting students. **Friends of Robotics Hawaii/ROC, KECK Observatory** for supporting ROV competitions in Hawaii. **Kenyan Beals of HELCO** for donating a $2000.00 travel stipend. **Terri & Jeff Leicher of Jack's Diving Locker** for donating their pool for ROV practice. **Jim Black & Bob Harbison** for their marine electronics expertise and donation of sonar equipment and transducers. **Capt. Chip Conklin** for donating his workshop, and marine electronic parts & tools. **Doug Perrine** for donating supplies. **Alvin Tayo of Sports Authority** for donating equipment. **Allan Jose(Harley Davidson Used Cars) and ACE Hardware** for donating car wash space. **Wal-Mart, Starbuck's, Panda Express, Wendy's and McDonalds of Kona** for hosting fundraisers for our team. **LAVA 105 Radio and Kona Underwater Photo Society** for allowing us to do public presentations. **KIS Principal Merwin,** Mrs. Solum, Ms. Hurley, Mrs. Jewell for the Uplink grant support; Ms. Naihe, Ms. Hirotawa for accounting support; Mr. Poff for media support. **KIS teachers, parents and classmates for supporting and believing in us.**

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Interviews:

2007- 2011 Kealakehe Intermediate School ROV Teams, Kona Hawaii

Mr. Bruce O'Bannon, President, JRE International. U/W Sonar expert, Savannah, GA

Mr. Garrett Frost. Electrical Engineer, Independent Contractor for NASA, Honokaa, Hawaii

Captain Rick Gaffney. Pacific Boats & Yachts, Kona, HI.

Mr. Bob Harbison, U/W Sonar and Marine Electronics expert, Kona Hawaii.
Captain Pat Cunningham, Kona Community Cultural & Education Foundation, Kona, Hawaii.