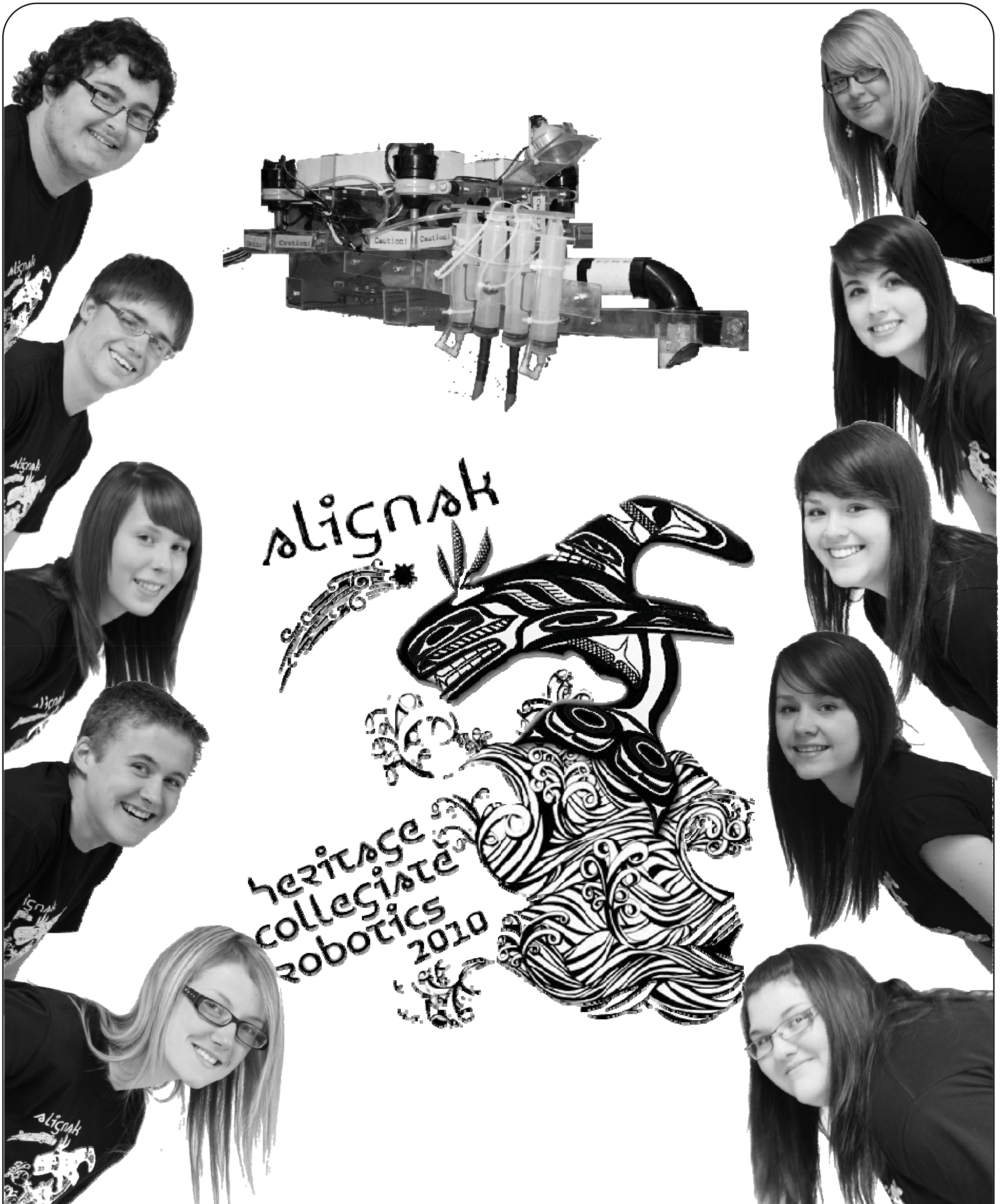


Top left: Jordan Harris, Dillon Harris, Vanessa Skiffington, Jonathon Young, Olivia Brown

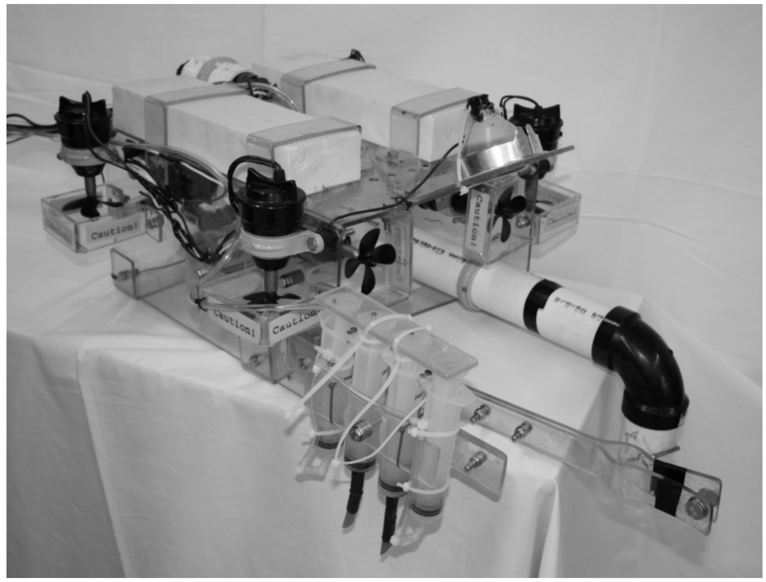
Top right: Andrea Matthews, Deanna Skiffington, Katlin Strong, Jodine Chaulk, Sherell Penney

Mentors (no pics): Michael Coles, Lyndon Williams

TABLE OF CONTENTS

ABSTRACT

The 2010 Marine Advanced Technology Education ROV competition is based on research on the Loihi Seamount, off the Big Island of Hawaii. There are four tasks outlined for the Ranger class, which had to be accomplished quickly and efficiently. To complete the assigned tasks, we created our ROV, Alignak.



Alignak following some last minute modifications at the Newfoundland and Labrador Regional ROV Competition

Heritage Robotics has proved to be very dedicated; we have spent a lot of time and effort ensuring that the ROV is equipped to overcome any obstacles it may encounter. All ideas were openly accepted and the team was enthusiastic while working together to get the job done. We had to be prepared to combat technical problems, and due to the diversity of the tasks, Alignak had to be very specifically designed. This required a sturdy frame, useful end effectors, and a proficient propulsion system. It also needed a stable source of buoyancy, unique sensors, and precise wiring as we had a homemade tether. With a great deal of trial and error and determination, we were able to complete our ROV – which we consider a work of art.

The team is very pleased to present the following technical report which communicates the details of Alignak, a remotely operated vehicle, created by students from Heritage Collegiate, Lethbridge, Newfoundland and Labrador, Canada. This document includes: detailed descriptions and diagrams of Alignak's components; possible future improvements; trouble shooting techniques; the lessons we learned; the challenges we faced; information on the Loihi Seamount; reflections; a thorough budget; and acknowledgments of all those who helped along the way.

VEHICLE SYSTEMS

Throughout the entire process, our team's motto has been simplicity and creativity. We knew that it would be easier to repair any damage done to our ROV if we constructed parts that were simple, yet effective.

Alignak contains novel concepts and distinctive designs such as a box-shaped frame made of polycarbonate resin. It was designed to be more compact to reduce drag and for travel purposes, as it is 9305km from Newfoundland to Hilo, Hawaii. We chose this material as it is sturdier, and is easier to attach subsystems to, than PVC piping.

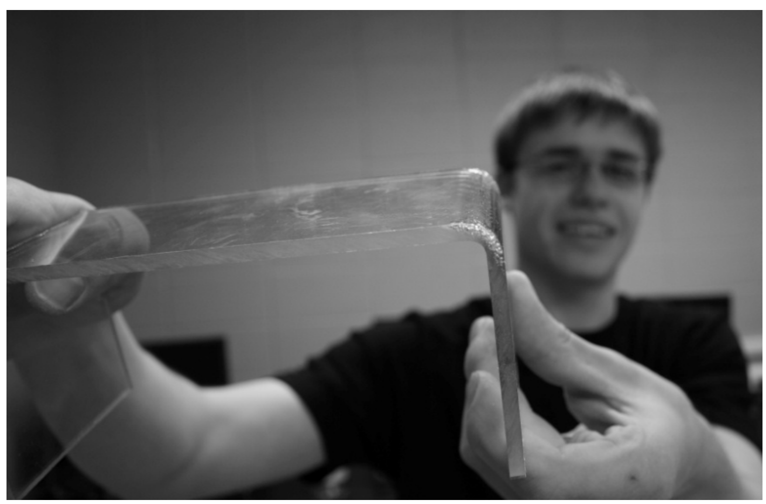
This is the first year that Heritage Robotics has ever made its own tether. We did this to be more cost efficient and so that we could add or replace wires as we desired. The control outlay, which contains double throw, double pole momentary switches, are positioned so that all controls are at the pilot's fingertips. Our controller is constructed of polycarbonate resin and has been spray painted a matte black.

There are three main end effecters on the ROV. These have been created with original ideas and include; the "Grub Vac", made from a 2000L/hr bilge pump and PVC piping, the "Dillon Arm" made from two pieces of molded polycarbonate resin, and four 60mL syringes operated by a pneumatics system.

The team incorporated many other unique designs into Alignak. Our propellers are made from carbon fiber and we maximized our ROV's safety by making square propeller guards out of molded plastics, and added caution stickers. The buoyancy was constructed from high density styrofoam which was cut into two rectangular strips and attached to the top of the ROV to reduce swing. We made our own hydrophone out of a brass plate and a ceramic plate with peizo crystal in between and surrounded it with an o-ring. This allows our pilot to find the area of seismic activity.

DESIGN RATIONALE

A design was required that would allow Alignak to travel and maneuver easily while performing the assigned tasks. With this in mind, we planned six main components in great detail: frame, buoyancy, propulsion, sensors, and the electrical system. Each of these components had to complement the others to produce a functional design.



Team member Dillon Harris holds up a piece of molded polycarbonate resin. Dillon's creative molding techniques were key to this year's success and the secret behind the multipurpose 'Dillon Arm'.

FRAME

For our frame, we chose an open-ended box shape. It may look simple, but it has very little drag and has proven to have high stability in the water. With such an open frame, we had easy access to the ROV's internal components; this was ideal for maintenance and trouble shooting. During forward motion, water passes completely through the hull with virtually uninterrupted flow. In addition, the two vertical sides act as a keel sustaining straight motion while the horizontal top provides stability and maintains level flight.

To make the structure, we used 3/8" polycarbonate resin. Since it has low mass and high durability, with the assistance of heat it can be bent and molded into any shape. We used M6 stainless steel bolts to construct the frame and to attach the end effectors. The frame of Alignak has decreased drastically in size from previous years. It measures 0.40m in length, 0.20m in height, and 0.30m wide. We chose these dimensions as we had to go through a tunnel in one of the missions. These changes have also made the ROV lighter, thus allowing us to move more quickly through the water. Overall, Alignak's frame proves to be sturdy, reliable, and compact.

BUOYANCY

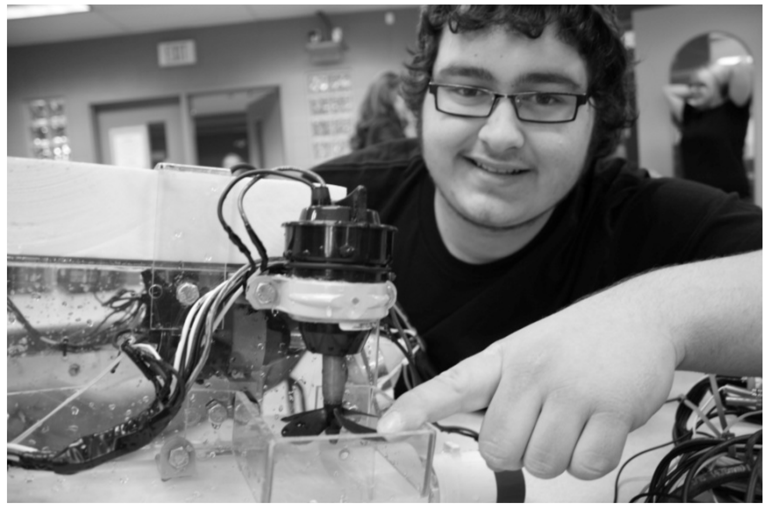
When designing the buoyancy system, our goal was to make Alignak neutrally buoyant, but with a slight positivity in case of mechanical failure. In past years, we have found high density styrofoam to be quite effective, since it compresses very little as the ROV submerges. The size of the styrofoam was determined using the formula of density, multiplied by gravity, multiplied by volume, along with a great deal of trial and error. The foam was cut into two rectangular strips and placed on the top edges of the ROV. They are placed towards the back to even out the weight and so as to make the ROV stable. We used the theory of a punching bag being more stable if it is held by two strings as opposed to one. This keeps Alignak from swinging back and forth in the water. The floatation pieces are held in place using two molded polycarbonate resin strips.

Team member Andrea Matthews holds up two pieces of high density styrofoam. Her 'two string punching bag' analogy allowed us to create a more stable ROV.

PROPULSION

Our motors have been taken from 5000L/hr Johnson bilge pumps. To do this, we extracted the motors from the bilge pump housing and attached a 5mm brass sleeve, tightened with a brass set screw. We chose to use brass so to prevent rust and corrosion. Next, we threaded a 70mm propeller with a 35mm pitch to provide sufficient thrust without drawing too much current. These prop shafts were attached to the motor. The propellers are thin and have a low mass, which is the optimum type for high speed applications, and enables our ROV to complete mission tasks quickly and efficiently. The motors exert a force of approximately 7 Newtons each. To determine this, we conducted a bollard test. This is when you take two motors and attach it to two rails, so it moves like a train on a track. It is then hooked onto a spring, measuring in Newtons, and the motor is turned on. The spring then measures the force. The motors draw 1.3 Amperes of current while out of the water. In the water it draws 2.8 Amperes.

To mount the motors onto the ROV, we began by placing each motor inside a short piece of 2 inch PVC piping. This piping was glued to a plastic bracket and a set screw was installed and tightened to prevent the motor from shifting. Finally, the motor was attached to the ROV by placing a stainless steel bolt through each of the two holes on the bracket. A spacer made of rubber hose was inserted over the bolt to provide ample clearance for the props.



Team member Jordan Harris points out the carbon fiber prop on our propulsion system. Carbon fiber is a very strong durable material, unless you drop your prop, shaft and motor on the concrete floor.

The team decided that it would be best to use four vertical motors to create sufficient lifting force and speed. These were positioned so that there are two motors on either side of the ROV. There are also four motors placed horizontally, but differently from other years. There are two motors on the front and two on the back inside corners, with propellers facing opposite of each other. We control all eight motors by using double pole, double throw momentary switches. The two front motors have reverse polarity, which causes them to pull while the rear motors push. When these switches are pulled backwards the polarity reverses, causing the motors to reverse. There is one switch for vertical movement, one for the starboard side, and another for the port side.

SENSORS

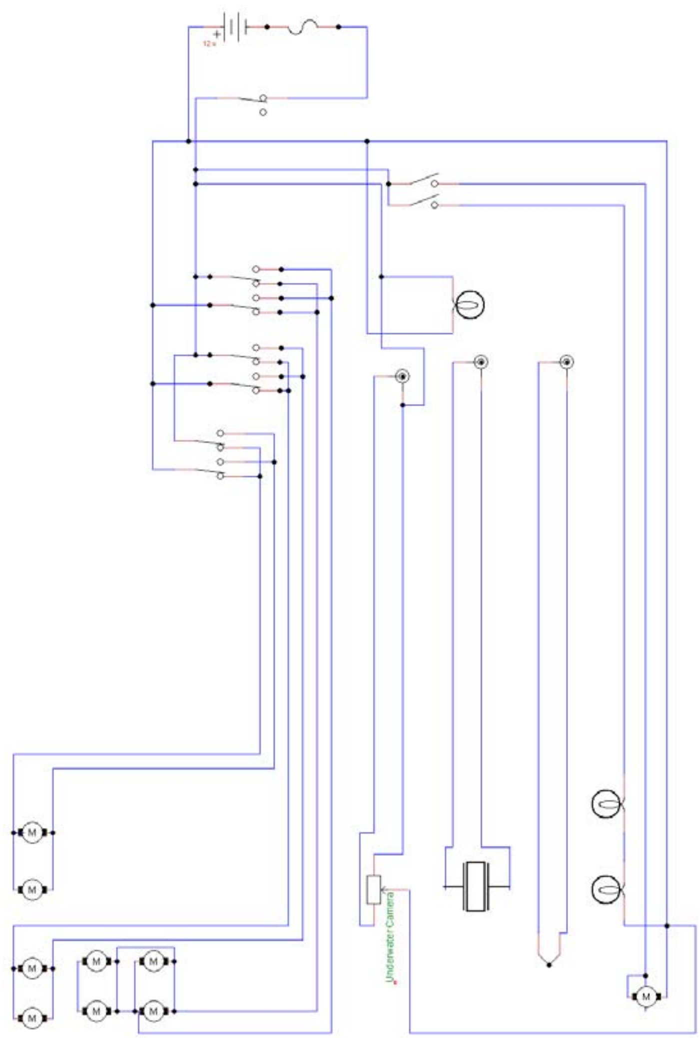
There are three sensors present on our ROV: the camera, the hydrophone, and the thermometer. The first sensor is probably the most important one; the camera. We chose the Lights Camera Action LLC Blu, Vue high resolution color underwater camera. This camera is designed to produce high 560 TVL picture resolution even in low lighting conditions and hazardous environments. The camera has several features which make it ideal for our missions. First of all, it is small and compact, and therefore easily mounted onto our ROV without adding too much mass, or taking up too much space. The camera itself is made up of hard anodized aluminum casing and the cable is composed of heavy duty polyurethane so it is not easily damaged while completing the missions. After choosing the camera, the next task was to determine where to mount it on the ROV. With so many end effecters, it was important that the camera be placed specifically. At first, we planned on using a second camera on Alignak, but decided otherwise when we realized it would only add extra mass and was not a necessity.

The thermometer we use is an indoor/outdoor digital thermometer. It uses the principle of a thermister. When the probe is heated, it emits a small electric current, which is detected by the head unit. It has a 3-line display that shows the time, indoor temperature, and relative humidity. The wire probe sensor is three meters long, but had to have more length attached in order to go up through the tether. It is placed in the grub vac so that the tank's water will not interfere with the temperature readings of the venting fluids. The thermometer records time and – to follow the MATE specifications – measures in degrees Celsius.

Since the first mission involves finding an area of seismic activity, we decided to create our own hydrophone. Essentially, the hydrophone consists of a piezo electric noisemaker (commonly used in things like home smoke detectors and greeting cards), placed between two pieces of polycarbonate resin, with an o-ring that is used to provide a watertight seal and space for wiring. This piezo noisemaker includes a central ceramic disc and an outer brass disc which produces a voltage across the discs when a noise is present. The sound is then carried electrically through the tether and produced through a guitar amp, which is placed by the pilot.

ELECTRICAL SYSTEM

Most modern ROVs use electricity for propulsion, control, and instrumentation. We decided to use electricity due to availability, price of components, and ease of installation. The most common fear with an electrical system is trouble shooting. Due to this, we decided to keep Alignak's electrical system simple and robust.

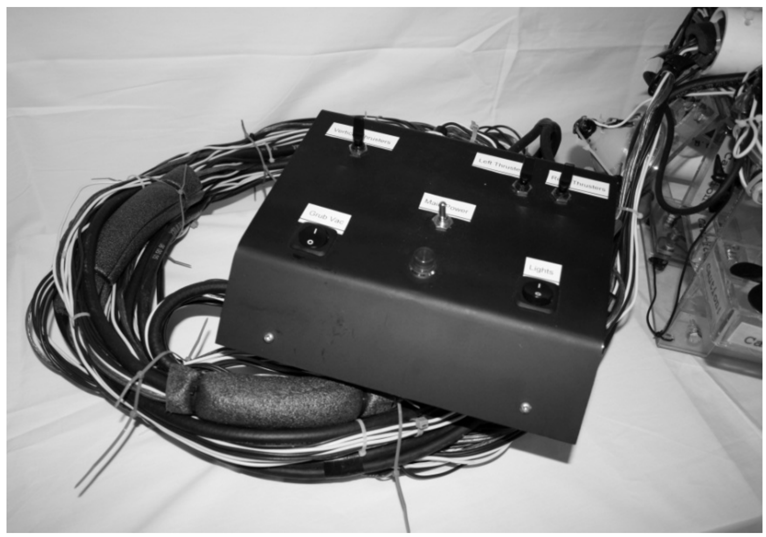


Electrical schematic for Alignak.

Tether

This is the first year that Heritage Robotics has ever made their own tether. Unlike pre-fabricated tethers, we are able to add or remove wires as we please. It is more cost efficient, and can be easily fixed if something is damaged. The tether has six wires for propulsion: two coax cables (one for our camera and one as an auxiliary for a second camera if needed), two low impedance signal wires for our hydrophone, two signal wires for the thermometer, and two wires for the bilge pump. A length of 3/16" braided rubber hose was used for our pneumatics system. Our tether is approximately twelve meters long and is made buoyant using pipe insulation.

Controller



The controller for Alignak.

On our controller there are three thruster switches. These are double throw, double pole momentary switches, wired in an "x" fashion. This means that opposite throws of the switch will reverse the output polarity. Since our thrusters are brushless DC motors, a simple change in polarity will reverse the direction of travel.

Also contained in our controller are two SPST rocker switches. These control the 3.5 Ampere bilge pump (contained in the grub vac), as well as our two six volt spotlights. These lights draw .75 Ampere and are wired in series; this allows them to be fed unregulated from the battery. The last component of our controller is the sensor outputs; these are three RCA jacks that will be used to feed outside instruments. One is an analog feed from our camera. The second connects a thermocouple to our thermometer, allowing the sensitive electronics to stay safe on deck. The third is a feed from our hydrophone.

Fuse

One of our main concerns with our electrical system was safety. If our ROV draws too much amperage, it would cause our wires to heat up and potentially catch fire. Another issue could arise if we had a short between exposed conductors. This would create a plasma arc, which could cause a fire. We have incorporated a 25 Ampere slow-blow inline fuse – as per MATE specifications. The fuse is located on the main positive conductor, close to the power supply.

FEATURES TO ACCOMPLISH THE MISSIONS

The most critical part of our ROV are the end effectors. Without these tools Alignak would be unable to perform any task or requirement other than motion. It is important that these tools are effective, yet simple in design and function. A simpler tool with the same ability of a complex tool is less likely to break.

TASK 1: RESURRECT HUGO

Team member Olivia Brown points out our homemade peizo crystal hydrophone. Did we mention it was homemade?

While HUGO was in operation, HURL's Pieces V was used to insure that the main power/communications cable and junction box were securely placed. Task 1 begins with locating the area of seismic activity. A high-rate hydrophone (HRH) is used to detect volcanic activity in Loihi. The team's ROV must then remove a pin to release the HRH from the elevator and install it near the "rumblings." Next, the ROV must remove the cap from the port on the HUGO junction box and retrieve the HRH power/communications connecter from its holder on the elevator. Finally, the HRH connector is to be placed into the port on the HUGO junction box. After completion, the seismologists back on shore in Loihi would begin to transmit data again.

We created the hydrophone to enable us to detect the area of seismic activity. We produced it ourselves from a brass disk and a central ceramic disk surrounded by an o-ring. The peizo crystal between these disks makes a little spark which causes an electric current. The sound is heard from a guitar amp located on deck. To remove the pin, the cap from the junction box, and to pick up the HRH connecter, we created the "Dillon Arm." It is a multi-purpose flex clamping tool, made from two pieces of polycarbonate resin, heated and molded at the end to allow us to pick up objects effortlessly. We also attached magnets to the end to allow us to pull out the pin with ease. This end effecter proves to be both simple and effective.

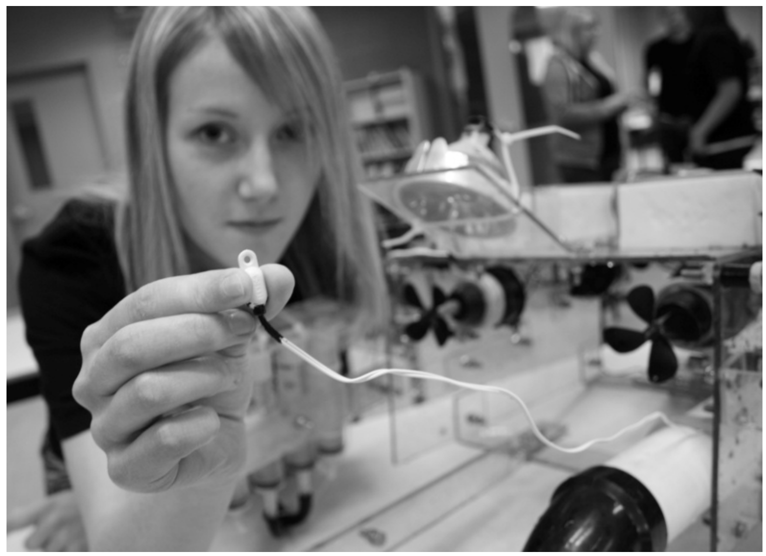
TASK 2: COLLECT SAMPLES OF A NEW SPECIES OF CRUSTACEAN

While the Pieces V was observing Pele's Pit they found an opening to a cave where they saw a tiny, white-bodied creature. They were curious to verify the species. In task 2, the ROV must enter the cave and collect three samples of the crustacean. These samples then need to be brought to the team at the surface.

A grub vac was made to collect these samples. We took the motor from a 2000L/hr Johnson bilge pump and attached it to the end of a 50cm length of 2" PVC piping. We then bent the piping on a 90° angle so we could suck up the grubs from the floor. The vacuum is kept running throughout the entire mission to keep the grubs inside, and to help Alignak move more quickly.

TASK 3: SAMPLE A NEW VENT SITE

Pele's Pit collapsed in 1996 and hydrothermal vent activity on the crater floor and north slope intensified. Before these vents collapsed, they were defined as "low temperature", having temperatures of approximately 30°C. The creation of Pele's Pit changed this and caused high temperature venting. In task 3, the ROV must measure temperatures of venting fluid at three different locations along the chimney. With this information the team must then construct a graph of temperature versus height. Finally, a sample of a vent spire must be collected and brought back to the surface.



Team member Olivia Brown holds up our thermister or temperature sensor.

Our indoor/outdoor digital thermometer is used in this mission. It is placed inside the grub vac to keep pool water from affecting the temperature readings. The pilot places the head of the vac over each area of venting and sucks in the fluid being released. A cord is stretched up through the tether from the thermometer to the pilot which then allows the temperate to be read from the screen on deck.

To collect the sample of venting spire, the "Dillon Arm" is used.

TASK 4: COLLECT A SAMPLE OF A BACTERIA MAT

While the Pisces V was headed toward the Lohiau vent field located on the northwest wall of Pele's pit, they came across an orange, glowing substance. They were planning on taking a sample of the bacterial mat but were unfortunately unable to acquire it that day. In task four, the ROV must obtain a sample of a bacterial mat and return it to the surface.

After testing many ideas, the team came up with a plan to use pneumatics to complete this task. We took four catheter syringes and connected them together with a piece of polycarbonate resin. The two inside syringes have plastic tubing attached to allow a longer reach, while the two outside ones are linked to a compressor with 25 PSI. Tubing is run from the syringes to the compressor. When air is released, the two outside syringes are pushed up, pulling the two inside syringes up as well. With the ROV precisely positioned, the agar will be sucked up into the syringes and brought to shore.

Alignak's 'Ager Sucker' was our school's first attempt at pneumatics.

FUTURE IMPROVEMENTS

Although we are very pleased with our ROV and all we have accomplished, there are still things we wish we could have done differently. We miscalculated the time needed to complete this project, leaving us little time to practice piloting the ROV for the missions. We also would have changed our planning time to building time ratio. We spent a lot of time planning and getting our ideas on paper for this project. However, when it came to actually creating the ideas we envisioned there was limited time.

Next year, we may explore the idea of using computers to control our ROV. We are currently contemplating the use of a USB servo controller, connected to H-bridges, to fully control our propulsion. The addition of a computer allows us to have nearly infinite control of our motors. This will give the pilot a higher degree of precision. The most efficient part of this idea is that it would allow for a smaller tether. Essentially, all we would need is a single control cable and a power supply; this year we have a wire for every aspect of the ROV.

TECHNIQUE

Every team has to be prepared for the challenges they may face. When confronted with a task, we brainstormed ideas until we found the ideal solution. Then, using trial and error, we could expose the flaws in our design so that we could make improvements. This strategy proved to be very effective. For example, we initially intended to manipulate our agar vacuum through a housed cable that came all the way to the surface through our tether. However, our testing revealed that this was not feasible. This led us to explore the use of the pneumatics system and utilize it effectively. Our motto this year was simplicity; we developed basic solutions for complicated tasks. First, the problem had to be identified; the next step was developing and altering a design plan. We then had to conduct more research on our solutions and note other possible improvements. We designed many different prototypes and thoroughly tested each of them so that we could choose the best option. Finally, we put it altogether to form our finished ROV, Alignak.

PROBLEMS AND SOLUTIONS

This year we found that past experience helped minimize the challenges we faced. This did not, however, eliminate all flaws or decrease the many hours that were spent troubleshooting. When Alignak was first placed in the water, we encountered our first major problem. Our buoyancy point was far too positive and would not allow the ROV to submerge. This problem was solved by removing small amounts of flotation at a time. Using trial and error we were able to find the perfect buoyancy for our ROV. We were aiming for neutral buoyancy, however we left it with a slight positivity incase of mechanical failure.

Late at night team members Jodine Chaulk and Jordan Harris tinker with Alignak.

At the MATE Regional Competition in St. John's, Newfoundland and Labrador, we realized that our pneumatics system was going to be problematic. Originally, we had planned to lower the two plastic tubes into the agar and easily suck it up. However, with such an extremely different consistency than what we had expected, we were barely able to collect any of the samples. To solve this, we increased the diameter of the tubes, and added a third syringe to increase the chance of a full sample of collection.

Minutes before our second mission run, we decided to test our camera system. During the test, our camera had intermittent power issues. These are the most difficult to diagnose. The problem was determined to be a soldered splice in the main power circuit. This was easily repaired, waterproofed, and did not cause any more problems. We are now implementing higher quality standards throughout our building process, which will drastically decrease the chance of electrical failure.

LESSONS LEARNED

Many lessons have been learned in both technical and interpersonal fields throughout the journey of creating our ROV. Some things we learned were the importance of safety and precision required for the operation of power tools and the necessity of team work throughout tense and difficult situations.

Our pilot Jonathon Young smiles for the camera. Jonathon is the only member of our team who competed in the MATE ROV Competitions last year.

With nine new members we all had a lot to learn when it came to building Alignak. The challenge of using power tools was difficult in and of itself, for some who had never used them before. We all learned that safety was important, and it quickly became a priority for our team. In addition we realized the importance of planning and designing, followed by building and testing. This was essential in deciding what was good and what needed to be fixed on our ROV. Then after finding our problems we would redesign, re-plan, rebuild and retest until everything was working accordingly.

We also learned that simplicity is the best option when possible. Our homemade tether allowed us to easily add or remove wires when needed for our end effectors. We discovered that keeping our end effectors simple, like our Dillon Arm, eliminated problems such as mechanical failure.

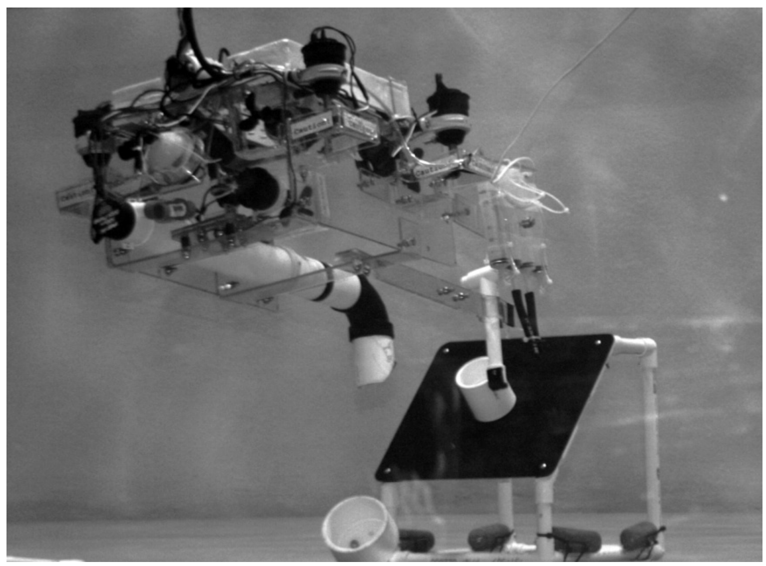
Throughout the entire process, teamwork and dedication are crucial to the success of such a demanding project. Without coming together and working as a team none of this would have been possible. Late nights and countless weekends spent working on our ROV paid off at the regional competition. When we all try our own personal best the team shines. Without everyone's own personal attributes and skills we never would have been able to finish the fully operational Alignak.

During this process we gained an understanding of the importance of ROVs in the real world. Our mission was based on the Loihi Seamount where research is conducted and we repair HUGO. This is much like tasks that occur in real life. Aside from research, ROVs are commonly used for rescue missions and the offshore oil industry. We now realize how many potential career opportunities are available in the ROV field, with something to suit everyone's personality.

So much has been learned in these few short months; it would be impossible to mention everything. Whether we learned how to bend polycarbonate resin; pilot an ROV; operate power tools; or even how a seamount is formed, we will all walk away from this experience with so much more than we ever expected.

CHALLENGES

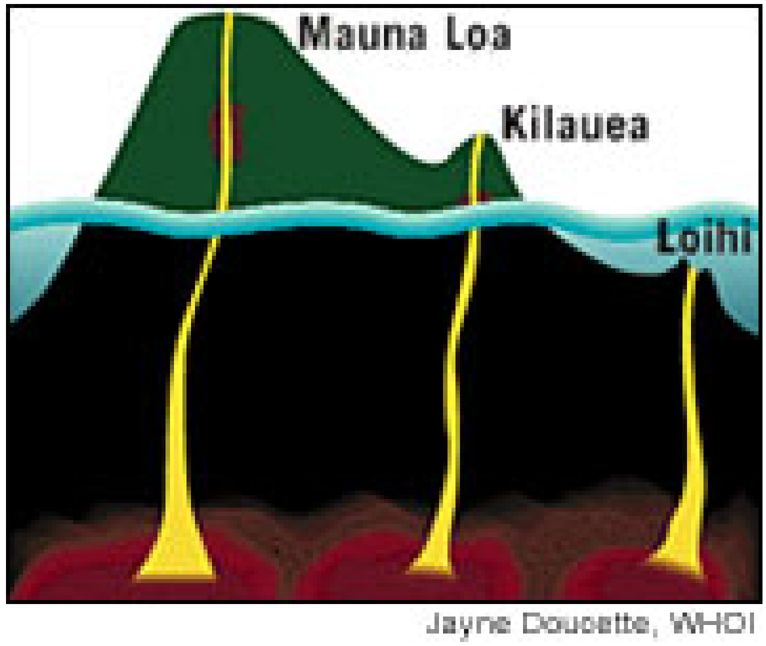
The greatest challenge we faced was prioritizing our time. In prior years, we have noticed that teams spent more time on the building stage as opposed to planning. This year, we decided to take a different route, as we spent more time planning and preparing before entering the building stage. Unfortunately, we underestimated the time that we had. We were left with many great ideas, but not enough time to make them a reality. This resulted in our last week before the regional competition being a very stressful time for the whole team.



Alignak approaches Hugo as seen through the glass of the flume tank at the Regional MATE ROV Competition at the Marine Institute of Newfoundland and Labrador.

Although Heritage Collegiate has built a strong reputation with the MATE ROV competition, we were posed a challenge when we were left with, aside from one member, a completely inexperienced team. Because of this, each member had to contribute a great amount of time learning things that would have come naturally to previous members who had been on the team for multiple years. This team is one that requires a lot of devotion, and Heritage Robotics members are surely up to this standard. Many grueling hours were spent at school in preparation for the competition, but in the end the whole team can surely say that this experience has been worth the effort.

THE LOIHI SEAMOUNT



http://www.fathom.com/feature/122477/index.html

Off the southeast coast of the Big Island of Hawaii lies an active underwater volcano. Loihi was initially believed to be an old, dead seamount like many others around Hawaii. However, in 1970, an expedition studying an earthquake swarm in the area revealed it to be a dynamic volcano with young lava flows and active hydrothermal vents.

A seamount is an undersea mountain of volcanic origin. To be considered a seamount, the mountain must stand at least 1000m above the sea floor. Loihi currently stands over 3000m above the seafloor but is still far below sea level. While seamounts are typically extinct volcanoes, Loihi is currently active and is the newest member of the Hawaiian – Emperor Seamount chain. The entire chain was created as the Pacific tectonic plate passed over a hotspot – a region where a mantle plume reaches the earth's surface.

In 1997, the Hawaiian Undersea Geological Observatory (HUGO) was created to enable scientists to monitor and collect information about the seamount. This automated submarine volcano observatory, with its high-rate hydrophone, and pressure and temperature sensors, were installed near the summit of Loihi and connected to the HUGO shore station by approximately 47km of fibre optic cable.

After HUGO became disabled in 2002, monitoring and research near Loihi was continued by the Hawaiian Undersea Research Laboratory (HURL). This research centre monitors and supports undersea research projects, such as the one at Loihi. Under HURL, the submersibles Pisces IV and Pisces V were developed, along with the remote operated vehicle RCV-150. In addition to repairing HUGO, these machines have been used to study Loihi's geology, volcanism, hydrothermal systems, and micro-bio communities.

MAKING PARALLELS

Our ROV is much like one that would explore the Loihi Seamount. It contains a camera and end effectors to enable us to complete missions that are closely related to real-life tasks. We are able to collect data, including: temperature, sound and visuals just like HUGO did. Also, we are much like Pisces V, as we are repairing HUGO and collecting organism samples.

Team member Sherell Penney puts Alignak in the water for yet another test.

ROVs are used all around the world to research marine activity and underwater geology. Without ROVs this sort of submarine research would be almost impossible. Occupations available in the ROV industry are continuing to grow and courses have become increasingly popular. The Marine Institute in St. John's, Newfoundland offers a program in Remotely Operated Vehicles that is known world-wide. To find out more information about the school, visit: http://www.mi.mun.ca/

REFLECTIONS

Throughout the journey of developing Alignak, practicing the tasks, and competing in the regional MATE ROV competition, we have grown as a team. Only one member walked into this with any previous knowledge of ROVs, making this a totally new learning experience for almost all of us. In a short period of time we learned so many things – like the purpose of end effectors and how to create electrical systems. We learned how to bend and mold polycarbonate resin, how to solder and waterproof our wiring, and how to create a simple pneumatics system. Most of all, we learned how to design and build and test and redesign and rebuild until we arrived at a finished product of which we could all be proud.

Heritage Collegiate is only a little school that takes in around 200 students from 14 small communities on the northeast coast of Newfoundland.

Our school has always done very well placing in the top two at the regional competition over the past five years and placing second internationally last year. This reputation left a lot for us to achieve; so far we feel that we have lived up to and beyond our name. Our success was greatly dependant on the dedication of the members, mentors, and the countless late nights we spent working on the ROV.

This experience has opened our minds to the expanding industry of ROVs. We all had careers in mind for our future; however, after this many of our minds have been changed. Several students are interested in the ROV program at the Marine Institute located in Newfoundland's capital, St. John's, or other fields at the school. We have even inspired children to join the team in the future as they loved every second of watching us in the competition.

We have thoroughly enjoyed this experience and will walk away many great memories. It was life changing in ways we never thought possible.

BUDGET

Although Alignak was designed and constructed completely from scratch, our limited budget forced us to salvage what material we could from around the workshop here at Heritage Collegiate. After four years of MATE competitions, there seems to be no shortage of odds and ends to pick from.

That being said we still had to buy new polycarbonate resin sheets for our frame, some new stainless steel hardware, some new fasteners and epoxy, new wiring, and some new propellers.

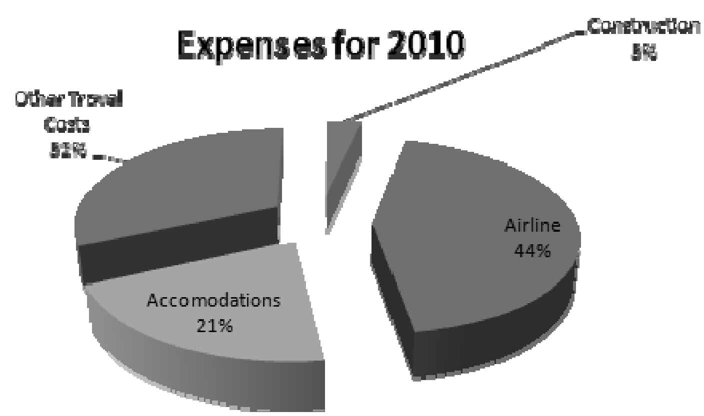
To finance these materials we held a ticket sale lottery on a pickup truck load of firewood. Newfoundland is covered in boreal forest, and wood stoves and furnaces are common means of heating our homes. A pickup load of firewood was not only a popular prize, but something we could acquire at no cost to ourselves. The lottery raised $1160.00 for us – almost enough to cover the materials we needed to build Alignak.

The travel to the International MATE ROV Competitions in Hilo, Hawaii was another matter entirely however. Once again we turned to the local businesses that have been so generous to Heritage Collegiate in the past. Our provincial government and federal governments contributed as well. Dwight Howse of Newfoundland and Labrador's Marine Institute secured us no less than $10,000.00. Another frantic ticket sale lottery, a cold plate sale, and soup supper brought us to within reach of our goal. And last but not least our parents dug deep this year as each student was required to pay $500 out of our own pockets.

In the end our expenses for the construction of Alignak exceeded our budget by $230.52, but we expect that the fundraising that we do for the travel to Hawaii will cover this small deficit.

Construction of Alignak	
Ticket Sales on a Load of Firewood	$1,160.00
Total Income	$1,160.00
Lexan	-$418.01
Hardware	-$203.93
Fasteners	-$208.58
Electrical	-$324.08
Propellers	-$235.92
Total Costs	-$1,390.52
Balance	**-$230.52**

Travel to MATE International ROV Competitions in Hilo, Hawaii	
Donations (Local Businesses and Individuals)	$10,900.00
Parent Contributions	$5,000.00
Government Contributions	$5,000.00
Funding Provided by Marine Institute of NL.	$10,000.00
Fundraising (Ticket sales and Soup Supper etc.)	$8,200.00
Total Projected Income	$39,100.00
Airline Tickets	-$17,770.00
Extra Shipping Cost for ROV	-$200.00
Travel Insurance	-$1,814.00
Hotel Accommodations in Hawaii	-$6,468.00
Hotel Accommodations in St. John's	-$1,746.00
Ground Travel (Taxis & Busses)	-$1,500.00
Rented Vehicles, gas and parking in Hilo, Hawaii	-$2,000.00
Meals	-$7,200.00
Total Projected Costs	-$38,698.00
Balance	**$402.00**



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This has been an amazing experience for all of us.

There are so many businesses and individuals who support the ROV teams here at Heritage Collegiate, we don't know how to properly thank them. They've been a huge part of our success each year. Here are a few that have contributed once again so far this year:

• Barn Loft • Bank Of Nova Scotia • Bayview Farms • Bernice Little • BlueBird Investments • Blagdon Tilley & Co. • Brown's Lumber Co. • CIBC • C B LumberCabot Building Supplies • Castle Building Supplies • Carbiou Ent. Ltd • Ches's Snacks Ltd • Clarenville Drydock • Clarenville Esso • Clarenville Rentals • Coop • Coopers Electrical • Craigs Locksmithing • D & L Dairy • DOF Subsea Canada • Doninni's Pizza and Donair • Eastern Roof Truss • Eastern School District • G B Signs • Greenwood Building Supplies • H & R Excavation • HRCM Consulting Ltd • J-1 Contracting • Juniper Valley Farms Limited • Mercers Marine • Newfoundland Power • Orchids • Over the Edge • Rod Restaurant • Rodways • Sexton's Lumber • Sobey's • Stephenson's Services • Terra Nova Golf Resort • Ven-Rez • W.W. Youngs Home Hardware • Wendel Moores • Wisemans Sales and Services • Young's Industrial, Recreation and Marine Refrigeration •

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