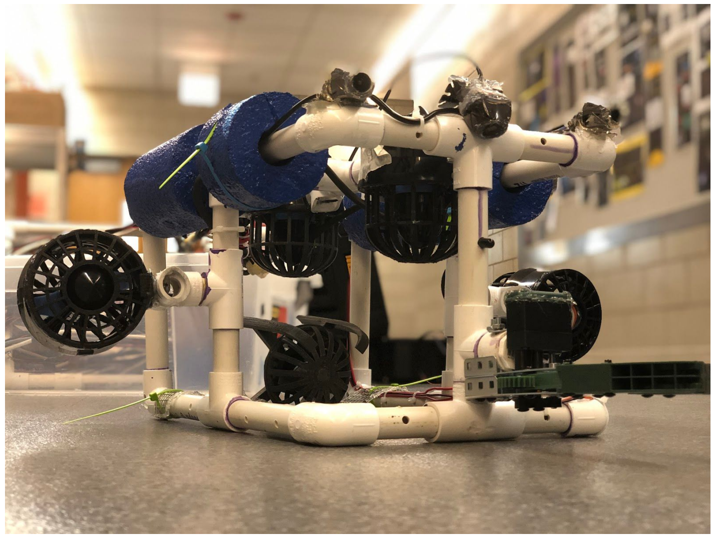

Team Members

Team Heads

Kate Ermentrout	CEO
Thomas Hoos	Head of Marketing
Junbin Huang	Head of Wiring
Jackson Zhang	Head of Engineering

Mentors

Nikolaus Barge

Jacqueline Barge

Frame/Design

Emma Salzman

Chenjia lin

Jacob Livnt

Owen Sims

Franklyn Wu

Jalan Tapper

Marketing

Camila Cancino

Jerrick Tran

Grace Liu

ROV Pilot

Winston Ding

Buoyancy

Gabriel Cerda Menchaca

Mini ROV

Elizabeth Fraser

Francesca Turrinelli

Ezra Danzig

Depth 34 Robotics

Walter Payton College Prep

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Abstract

Depth 34 was a company conceived by a group of 18 scientifically motivated students at Walter Payton College Prep who want to survey, explore, and better understand marine ecology. Our main purpose was to build an ROV, a remotely operated vehicle, capable of performing various tasks underwater. Another purpose is to spread STEM education to both our team members as well as various community members.

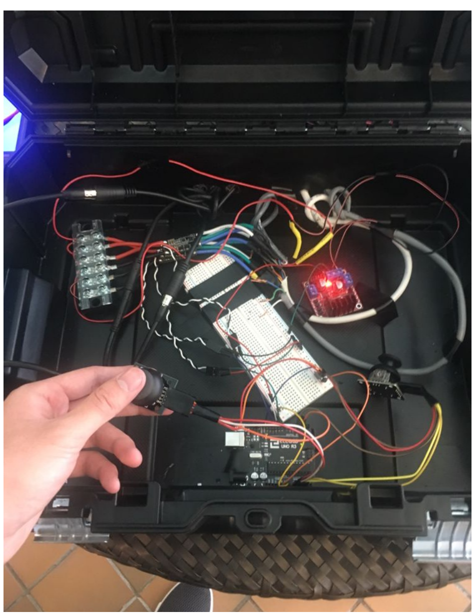
We organized our company into different projects required for Walt-e. Some of these include controls, cameras, marketing, mini-ROV, frame, and claw. In order to design these components, we went through many stages of research and development. We used blueprinting, pros and cons lists, and prototyping in order to narrow down materials or designs of the components. We turned these designs into reality using a variety of techniques such as 3D printing, soldering, and hot glue. Under the leadership of Kate Ermentrout (CEO), we combined these components into one robot that could perform tasks.

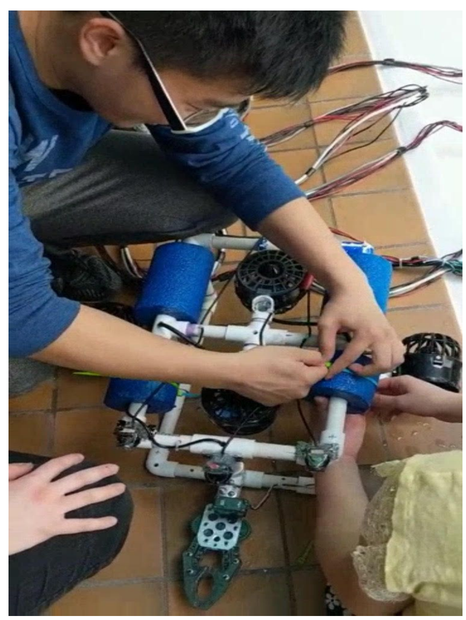
The combination of the claw and cameras allows the robot to pick up a simulated rock and identify species underneath the rock. This models how researchers can use ROVs to determine biodiversity in habitats that are inaccessible to humans. The motors allow the robot to move around and lift heavy props out of the water. One of these props is the simulated cannon, which demonstrates how historians are able to use ROVs to preserve historical artifacts lost underwater.

Project Management

During last year's underwater robotics season, our team experienced some time management challenges that affected how we performed at the regional competition. This year, we constructed a schedule which outlined the stages of the ROV development, Marketing Board, and Marketing Presentation. We used this schedule to guide our progress in order to meet the deadlines we set. In this case, we managed our time much more effectively by accounting for any unexpected developments.

In this schedule, we included meetings that involved our group members to be split up into smaller groups to evaluate and consider many engineering designs for our ROV. We compromised many designs in order to construct an ROV that best fit our image, and we scheduled many more meetings so our departments can collaborate on the integration of wiring, cameras, motors, and the frame. Through this procedure, we established a more efficient method of achieving progress, and the meetings clarified any updates or changes so that our team is on the same page. Overall, we demonstrated our improvement to our time management system when we expanded our team from 8 members to 18 members.


Early control box design and planning


Buoyancy and frame designers adjust balance

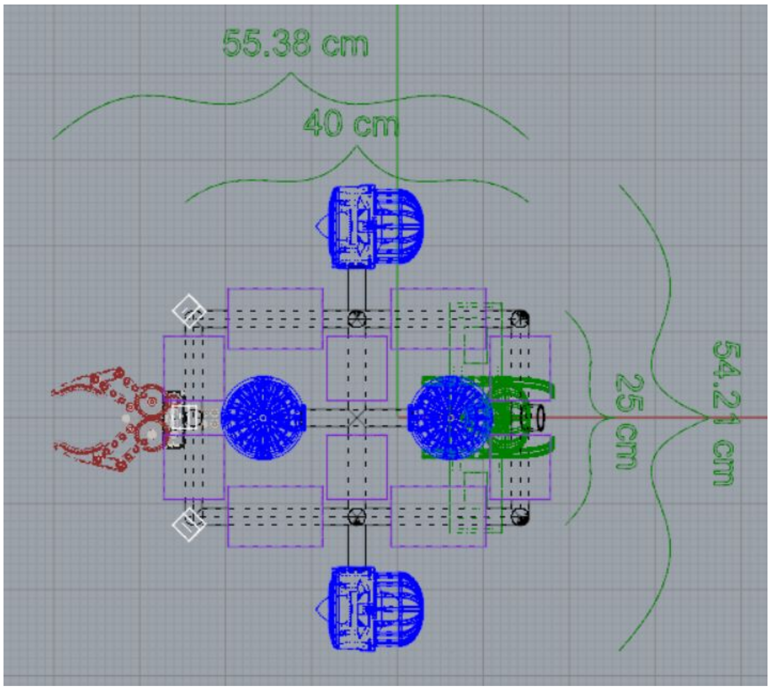
Company Schedule

Week	Mondays (45 min)	Wednesdays (90 min)	Fridays (45 min)
Jan. 7-11	Recruitment Day	Information Session for New members	Information Session Continued
Jan. 14-18	Allocating roles to each member Discuss safety	Design Frame Discuss outreach	Design Frame Make CAD designs
Jan 21-25	1/21/19: MLK Day	Design Frame Make CAD designs	Design Frame Order box for control system
Feb 4-8	Design Frame	3D model workshop	3D model workshop
Feb 11-15	Full-Scale Frame Prototype	Full-Scale Frame Prototype	Full-Scale Frame Prototype
Feb 18-22	2/18/19: President's Day	Order Blue Robotics T100 motors. Research Arduino Mega to Joystick code/syntax.	Order Vex Claw Cutting PVC for the Frame
Feb 25 - Mar 1	Reorganize power wire from the tether to Arduino Cutting PVC for the frame	Secure jumper wires to Arduino Mega. Final test fit for PVC frame parts	Develop code for Arduino joystick, determine specs for voltage and current readings in relation to powering motor. Gluing frame pieces together
Mar 4-8	Order Blue Robotics Electronic Speed Controllers	Troubleshoot the ground, positive, and data connections needed for the brushless DC T100 motors. Start prep for marketing display Prototype mini-ROV	Establish a method to attach the tether to a possible control box, determine effective ways for effective maneuverability of the ROV. Prep for marketing display

Week	Mondays (45 min)	Wednesdays (90 min)	Fridays (45 min)
Mar 11-15	Allocate the wires of the tether to the ground, positive, and data wire of the motor. Order Joysticks	Assign the electronic speed controllers to each motor. Work on the theme for marketing display Prototype mini-ROV	Possible Tether limitation, determine how to have devices take up the least amount of wires. Find pictures for the theme write up for the marketing display
Mar 18-22	Pseudo test code for the joystick to the intermediate electronic speed controller to the T100 thrusters. Work on SID	Placing all control circuitry inside control box. Conduct interviews for design rationale Finish SID Research 3D printed shrouds	Soldering the tether to the connections to the internal of the control box. Work on the design rationale write-up.
Mar 25-29	Solder the electronic speed controllers to the motors, and ensuring these are the final connections made to the poolside vs. underwater electronics.	Attach all three cameras to the front of the Rov. Test the polarities of each motor in ensuring that the motors rotate the correct way when using the 8 directional joystick controls.	Ensure that the power wires to the cameras pass through the regulation of the capacitor to ensure the safety of the system. Work on the marketing assessment and design rationale
Apr 1-5	Waterproof claw servo and attach the claw the ROV. Improve code representation when transferring data via. USB cable.	Work on the marketing assessment Test ROV synchronous to the motors and cameras. Assign roles for marketing presentation 3D print shrouds	4/5/19: School Improvement
Apr 8-12	Finalizing pool deck team and presenter team Collect more photos for the display board	Preparation for marketing presentation Finalizing the display board. Capture images of the control box to ensure any loose connections can be fixed.	Tested ROV at the Pool at Holiday Inn

Week	Mondays (45 min)	Wednesdays (90 min)	Fridays (45 min)
Apr 22-26	Adjusted Buoyancy Create the marketing display board. Re-evaluation of the camera system fixed a disconnected power camera cable discovered through Holiday Inn testing.	Adjusted Buoyancy Create the marketing display board Modified code of the Arduino in order to have the axis reflect the user's movement to become more intuitive.	Full run through of marketing presentation. Run full safety of ROV (making sure that all parts are fully waterproof)
Apr 29 - May 3	Celebrate our win at regionals and discuss next steps	Team meeting on the path to Internationals	Discuss future improvements the ROV
May 6-10	Determine necessary steps to be taken from safety evaluations, product demonstration, and marketing presentation during the regional competition.	Team-wide effort in evaluating the best method to ensure the maximum potential of our product demonstration, identify any more materials needed to improve our performance.	Plan on a more permanent system, this includes fully cementing the ROV as well as soldering the connections to the breadboard instead of using jumper cables.
May 13-17	Order new Blue Robotics Tether Work on tech document	Start work on the technical document (combining all the progress we made in this year); look on MATE website to determine more deadlines to plan accordingly.	Determine roles for the tech document Work on the safety review Remove the old tether Work on JSA
May 20-24	Work on tech document Work on Spec Sheet Work on JSA	Finish tech document Finish Spec Sheet Finish JSA Finish SID(s) Finish Safety Review Document	Establish a more comfortable platform for the joysticks to rest on, improves maneuverability and lessens stress on hands.
May 27-31	5/27/19 : Memorial Day	Solder new tether onto the motors, cameras, and Arduino board	Fully conceal wires and Arduino from the joystick controls.

Design Rationale



CAD Diagram of our ROV with measurements

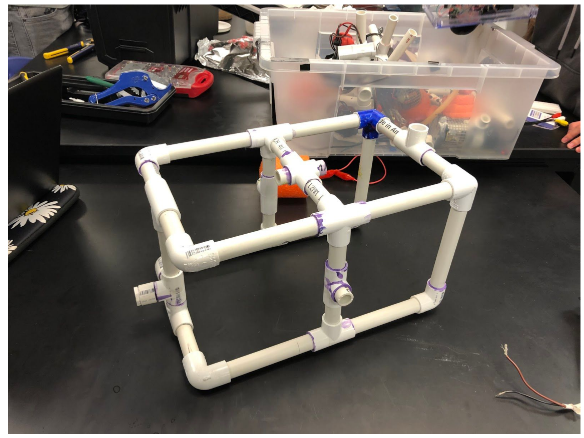
Frame/Buoyancy

In designing the ROV we used an iterative and incremental process. First, we decided to build our own frame instead of purchasing a commercial one because it is more cost-effective and more customizable. Next, we researched materials that we could use to build the frame, such as using acrylic boards and PVC. Using acrylic boards would allow us to easily secure components such as motors and cameras because it is easier to attach them on a flat surface. However, we lacked the proper equipment to cut the acrylic board, and it would make the frame of the ROV too heavy. Although it would be more difficult to attach components to the PVC tubes, PVC pipes would allow us to easily modify and replace frame designs and provide sufficient buoyancy and structural integrity. For instance, during the frame's prototyping phase, we were easily able to remove parts that were too long or too short and consider several different designs. Moreover, PVC is also very lightweight and cost-effective, as our entire frame ended up being 1 kilogram and each foot of PVC costs only $2.25.

After deciding on the best material for the frame, we started prototyping with different frame designs. Several members of the group contributed models using CAD programs and whiteboard sketches.

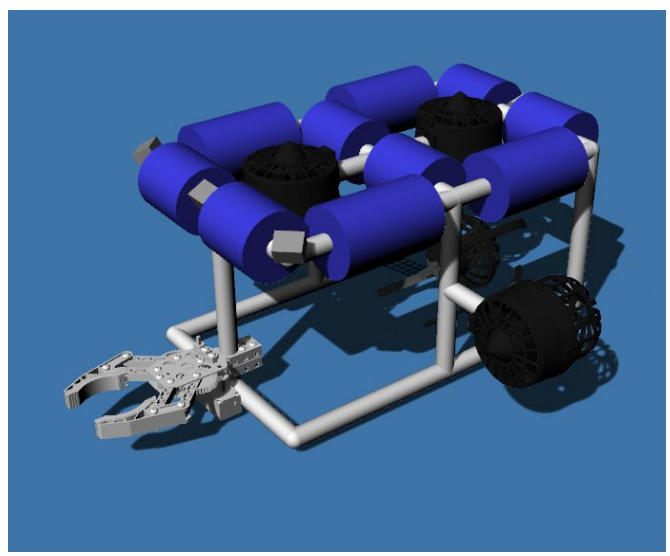
We then attempted to model these ideas with pipe-cleaners. This step allowed us to visualize our ideas from different perspectives and angles.

Our final frame design was selected through discussion with all members of the team, highlighting the pros and cons of each. The frame was modeled after a rectangular prism to maintain balance and maneuverability of the ROV. This maneuverability would allow for easy inspection of a dam for example. A box-like frame would be easy to construct and modify as well. To ensure that the ROV maintains constant buoyancy underwater, we drilled holes along the tubes so that water could enter and stabilize the ROV.



Early design of ROV frame

For buoyancy, we considered many options for having the most effective buoyancy system. We used scientific practices in order to determine which system of buoyancy demonstrated showed the most buoyant potential out of all the options. We set up a tub in which we put each system (foam, pool noodles, and bottles) into the tub and put weights on top of each in order to determine which one held the most weight. We also considered whether we should reuse foam or use fluid power as our system for buoyancy, but since a fluid power system requires a pressurized air tank we decided to reuse our foam buoyancy system.



Initial CAD diagram of frame and placement of components

Claw

VEX claw with servo attached

Our ROV features a VEX claw in the front of the robot, attached to the center of the bottom pipe of the frame. This alignment allows the claw to be in the camera's viewing range and offers the most room to grab onto objects in the product demonstration.

We decided on the VEX claw because it had the strength needed to lift the cannon. With regards to the servo, we considered either buying a waterproofed servo or waterproofing it ourselves. Because VEX does not offer waterproof servos, we waterproofed it ourselves with shaft grease. While incorporating the VEX claw, we evaluated whether its weight would tilt and change the ROV's balance. This concern was resolved by adding buoyancy to the front of the robot.

Shrouds

We decided to 3D print many of the parts (including the shrouds, mini-ROV, and mini-ROV mount). We made this decision because of the natural waterproof quality of the PLA print material, the lightness of the material, and the ability to quickly and easily make modifications and adjustments. It helped to increase the possible level of detail for many of the parts, improving the quality of the final product. It also has made the design feasible for actual use, due to its cheaply reproducible nature and the ease of editing that the CAD program affords. In a real-world scenario, this editability would allow for modifications to optimize the ROV for specific environments and would allow for easy replacement of broken or damaged parts. The shrouds were designed to meet the IP-20 standard in order to ensure safety.

Mini ROV

At the beginning of the year, we prototyped a mini-ROV for the pipe inspection task. However, after testing the motors and examining the effectiveness of the mini-ROV, we decided against incorporating it into our ROV. This is due to the amount of time needed to wire the mini-ROV through our ROV and set up the controls and camera. We decided to repurpose the prototype as a counterbalance on our ROV in order to make it less front heavy.

Motor Placement

During the decision process, we first had one main concern to consider: whether it would be more optimal to place the motors on the outside or inside of the frame. Placing the motors on the inside would reduce the ROV's overall width and reduce damage to the motors, as the sides of the ROV are less likely be caught on obstacles on the bottom of the pool. However, because the motors are closer to the center, less torque ($\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F}$) is generated when the ROV turns, reducing maneuverability.

As a result, we placed the motors on the outside of the ROV, as it would maximize the thrust offered by the motors; the motors would be farther away from the vehicle's center of mass, thereby leading to greater torque. This greater torque allows for faster turns which is helpful in completing the tasks within 15 minutes.

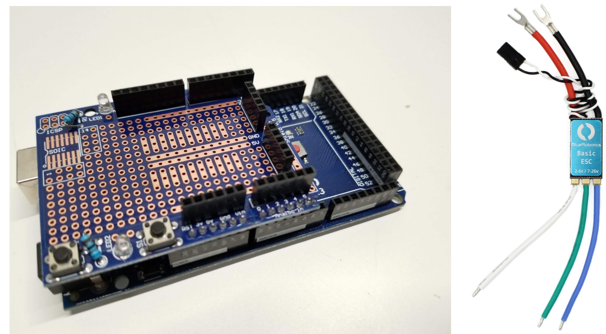
Tether

We ordered our tether from Blue Robotics, as it was neutrally buoyant. This reduces the tether's effect of offset the buoyancy of the entire ROV. We decided to use 3 tethers with 8 wires in it each since we needed a total of 15 wires for the motors and claw, and then another 5 wires for the camera. The tether enters through multiple strain reliefs in order to provide multiple outlets for the stress to be taken off the tether.

Control Box

For our control box, we decided to construct an improved system that allows for better control and maneuverability. Previously, we used switches to turn motors on and off. However, this year, we adopted electronic speed controllers (works with Blue Robotics thrusters) and joysticks, all of which are regulated by an Arduino board. The joysticks offer sensitive movement; it takes input in eight directions along multiple planes.

The Arduino system proved to be inexpensive and easy to integrate and effectively synchronizes the speed controller with joystick inputs, which offers sensitive and accurate movement outputs for the ROV.

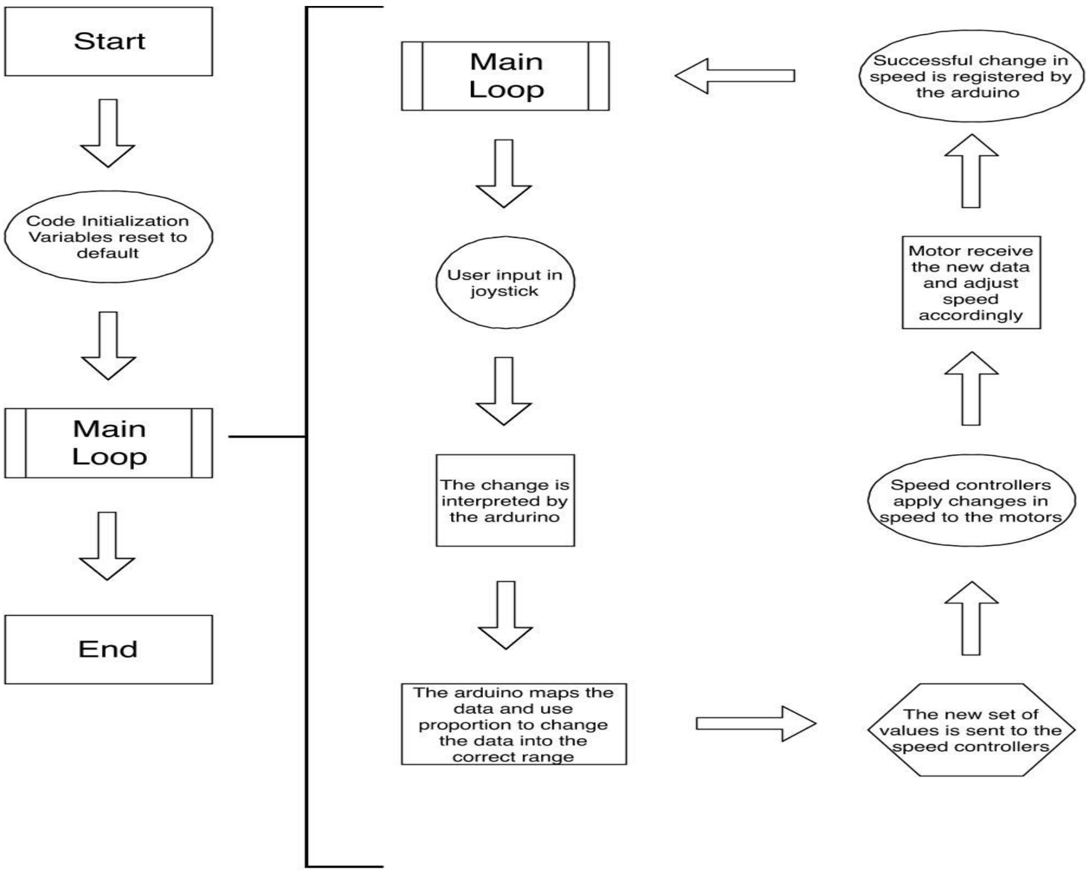


Arduino board (left) and speed controller (right)

Joysticks

Code and Programming

For the control box, we used the Arduino Mega board, which requires knowledge of the C++ programming language, and we integrated Arduino joysticks with our Arduino board in order to effectively control the T100 thrusters. Since the T100 thrusters required electronic speed controllers, we coded the Arduino to convert the values of the joystick using proportions to the necessary values of the T100 thrusters. This allowed our joysticks to have accurate readings in relation to how fast we wanted the motors to spin as well as the polarity of the motors. The ESCs served as the intermediary, which allowed the voltage to be regulated, hence the ability for the motors to spin at varying rates.



Software Block Diagram Of Control Box

Construction Of ROV

When constructing the frame for our ROV, we used PVC cement to bind the corner joints of the 1/2 inch PVC together, and we used a PVC cutter to accurately fit the PVC into the joints. We used Sugru and shaft grease to waterproof the VEX claw. We compensated for the extra weight of the claw by placing more foam in the front end of the ROV than in the rear end. When adding the tether to the ROV, we had 2 strain reliefs on the same lateral plane of the PVC to ensure maximum relief from the tether as we are utilizing more than one tether for our wiring. The strain reliefs are cemented into the PVC, and we made the wiring go outside of the ROV because it is easier to identify any potential issues pertain to the motors. We used screws when attaching the VEX claw to the ROV, and we drilled holes into the PVC to serve as threading components for the screws. Our control box had 2 cables running out of the tether and going into the box, and the Arduino Mega regulated the voltage so the input and output voltages correlated to their respective uses.

Evaluation Of Ideas

Our first step in our iterative planning process was to brainstorm and develop ideas for the frame for our robot in order to be effective for the tasks at hand for the 2019 competition. In this case, our team split into multiple small groups of 3-4 people to draw out the schematics and our groups compared positive and negatives for each proposal. Once we decided on our frame, our team split into multiple departments such as the engineering, frame, wiring, and marketing in order to distribute the workload and organize our system to be as effective as we can with the time we had. We spent our seminar days (a 1 hour and 30 minute period we have every other week) to gather and collaborate on how we will integrate each part together (for example, the wiring group would collaborate with the engineering group to determine how to attach motors to tether, or tether to our control box).

Team leaders initiating discussion of ideas

Team members working on ROV ideas and plans

Industry Mission

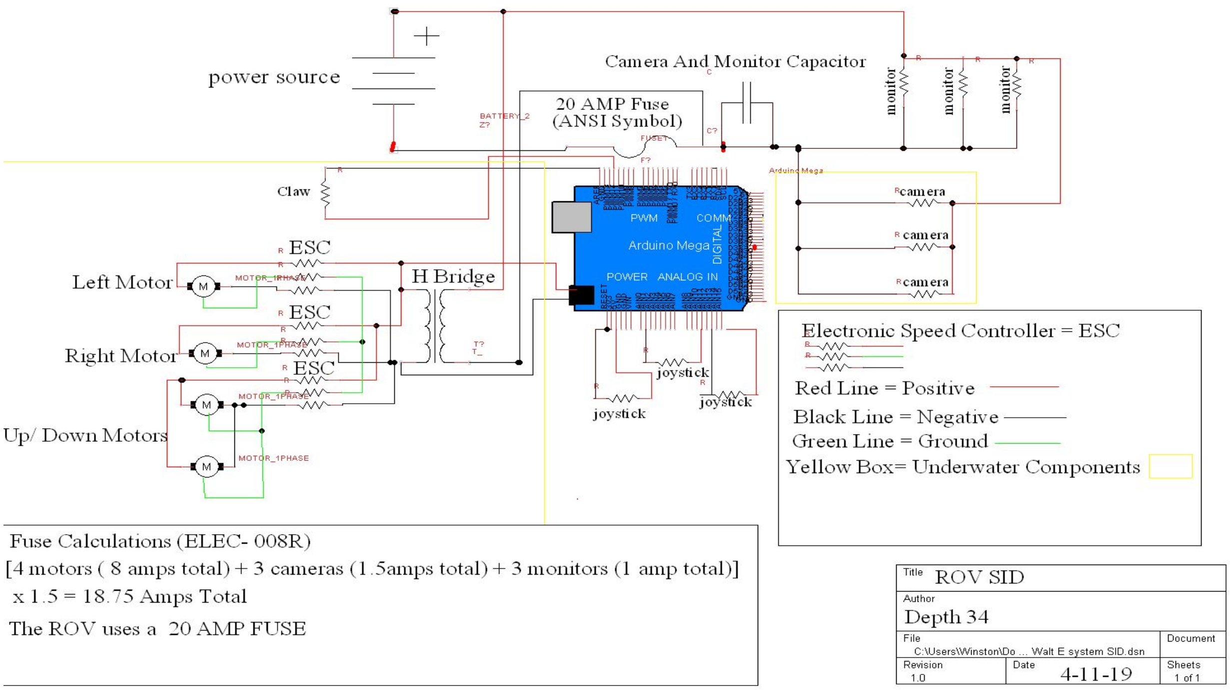
ROVs help to ensure public safety by assisting divers in dam inspections and repairs. ROVs are able to map out a dam and repair it if needed, similar to Task 1 this year. These dam inspections and repairs are extremely important as dam failure can cause flooding and destruction downstream. ROVs can also inspect a boat's hull in order to ensure that it is structurally sound. (Berlijn)

ROVs are able to collect and record data about the physical and chemical properties of water bodies such as dissolved oxygen, pH, temperature, and dissolved metals. This enables environmentalists to track a river's health and determine when chemical contents have reached hazardous levels. ROVs can also access remote areas that human divers cannot reach, allowing for extensive monitoring and restoration of sources of drinking water in disenfranchised areas. In practice, ROVs could monitor water quality from inside a pipe, to determine if there is safe lead level. (Lent)

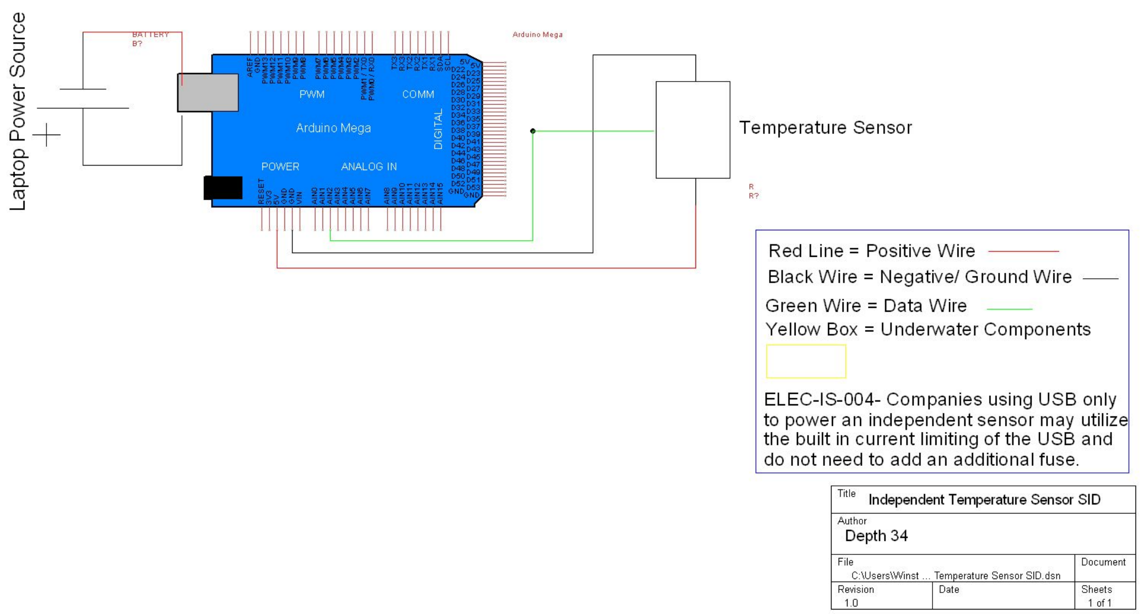
An ROV uses its claw to measure the temperature of a hydrothermal vent in Yellowstone Lake.
Credit: Lovalvo

Biodiversity can also be monitored and measured using ROVs through either a camera system for larger organisms or by sampling water to identify smaller organisms. These methods can determine if outside intervention is needed to restore the biodiversity of species. A solution could be using ROVs to safely transport more organisms and nutrients to maintain a healthy ecosystem. (Vidal)

System Integrated Diagram



ROV SID



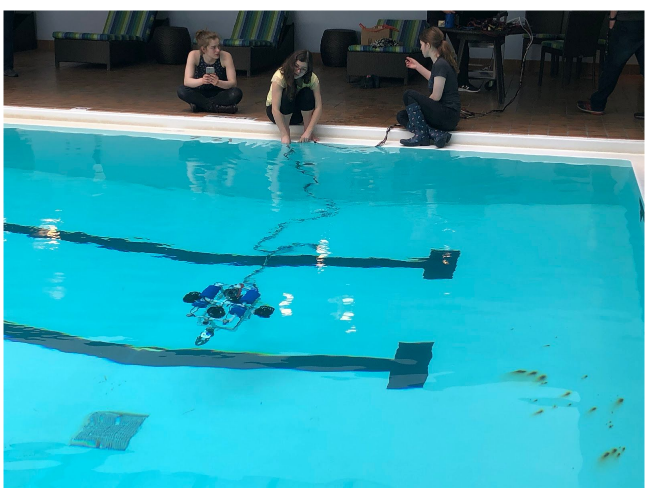
Independent Sensor SID

Safety

In designing our ROV, we wanted to ensure that it would be safe to operate and handle. To prevent a current from passing through the water, we ensured that all wires and connections along the tether would be fully insulated with electrical tape, heat shrink, or hot glue. We applied hot glue to insulate the connections around the claw and cameras. To further ensure that the ROV is safe to operate, sharp edges on our robot were either sanded down or coated with hot glue. Additionally, we also shrouded the motors.

In constructing our ROV, we took special care to make sure that all members are operating tools and equipment safely and taking proper safety repercussions. During our first meeting at the beginning of the year, members from the previous year held presentations and demonstrations for certain tools and procedures (i.e. cutting PVC, drilling materials, using saws, soldering, etc.). In general, members will do their job under the supervision of another member and take protective measures (i.e. putting on goggles, using face masks, proper lifting motion, etc.).

Testing



Testing Walt-e Jr at the Holiday Inn's Pool

Walt-e Jr was successfully tested using the pool facilities at the Holiday Inn. Because of Depth 34's hard work beforehand, few modifications were made after the test. One issue that had to be fixed after the test was buoyancy. Calculations had been done previously to calculate the amount of buoyant foam needed; however, upon testing the vehicle, our team found that the ROV was extremely neutrally buoyant and that there was an excess amount of foam. Because the robot is extremely modular, this issue was easily fixed through cutting the foam and poking small holes through the sealant covering the foam to allow for water to enter. After testing buoyancy again, the robot was neutrally buoyant.

Troubleshooting

Our team encountered multiple technical challenges throughout our design process, especially when integrating new parts such as motors and cameras into the existing infrastructure we had left over from previous years. We employed various methods in order to isolate issues in the robot, particularly in the electrical system. For instance, to test the reliability of the electric connections, we would use a voltmeter to gauge the electric current at various points along the tether and robot. Upon the addition of new parts, all systems were tested and adjusted to make sure they were in working order before moving on, reducing the occurrence of future issues. Parts that were not working in the larger system were removed and run using a separate system to determine if the part itself was broken. In testing the ROV's function underwater, we tested parts individually in smaller, submerged environments before we looked for issues when we tested in a pool. Generally, our troubleshooting strategies focused on isolating problems to specific sources, whether they be problems in the wiring or broken parts. From that point forward addressing such the issue was relatively easy.

Challenges Solved

One challenge we faced was having the joysticks to work effectively, as we had to determine how we can integrate an Arduino control system to control the motors. At first, we had trouble determining how the T100 thrusters could work with the Arduino, but we went online and learned about how electronic speed controllers played a huge role in brushless DC motors. In this case, we had the Arduino board step down the voltage to 5 volts so that the ESC's were able to regulate the voltage applied to the motors. Through this learning experience, we solved a challenge involving how the ESCs acted as the intermediate between the motors and the Arduino board. After multiple tests of our ROV, we were able to overcome the challenge of ensuring constant buoyancy. Our formal buoyancy system used pool noodles, where the pool noodles were not effective in maintaining buoyancy, as they lost their function because the foam takes up water. As part of our solution, we fully covered the pool noodles in a water-resistant solution so the noodles would be protected and the buoyancy of the ROV would be constant.

Another organizational challenge that we faced was the pacing of tasks required for building the ROV. For example, our wiring group had to wait until the frame group was done in order to complete the tether wiring. We solved this issue by increased communication between groups through the leadership of our team. We also made sure everyone was aware of the schedule and their roles on the team. This helped ensure that each group was on schedule and working efficiently.

Lessons Learned

This year, our team experienced a considerable amount of growth and changes in terms of team structure and our product. While designing a completely new product and gaining many new members, the team learned a lot about many different aspects of the process of engineering and engineering itself.

Technical

Building off of the problems with previous models in Depth 34's ROV line, the team focused greatly on improving buoyancy to allow for the best maneuverability. Firstly, new members learned about the concept of Archimedes' principle, which states that upward buoyant force that is exerted on a body in a fluid is equal to the weight of the fluid that the body displaces. The team learned how to conduct tests regarding buoyancy, and how to calculate the buoyant force.

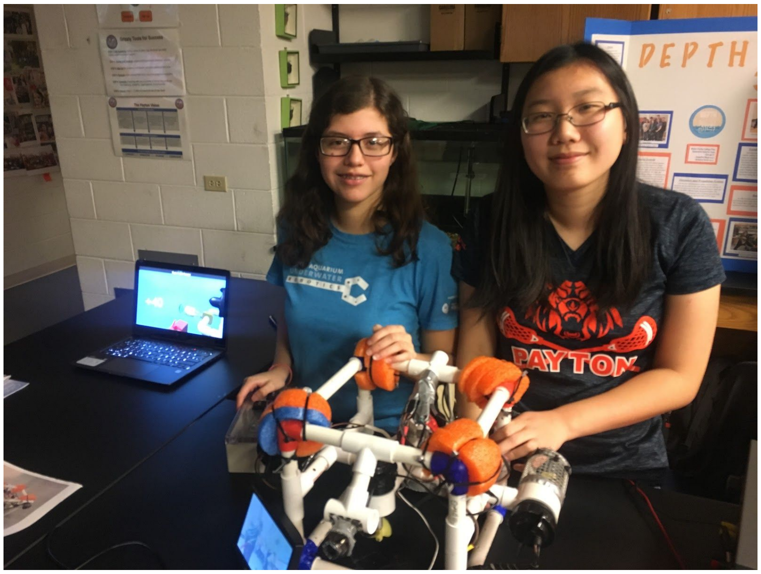
Upon testing various buoyancy methods, members learned that standard foam floating devices trapped in water as they stay in it for extended periods of time. Depth 34 innovated and learned about new methods of stopping this, including utilizing a sealant, and later a specialized buoyancy foam: LAST-A-FOAM R-3312. In addition, the team learned about new forms of lightweight materials, including 3D printing. Overall, the team learned about the technical aspects of buoyancy.

Interpersonal

The members of Depth 34 also learned to engineer in the context of a team. Because of the large size of the team, members were split into different subsections that would focus on different tasks. Each subsection learned to communicate among themselves as well as with other subsections, coming up with effective timelines and schemes for subsequent meetings. This process is how most technological companies work, and by working as a team in high school, members gain valuable experience in effective teamwork.

Development of Skills

All members in Depth 34 learned a lot about engineering and robotics. Because Depth 34 created an entirely new ROV, there were many things that the team learned to make the best product possible. The newer members of the team learned many things including how to safely and effectively solder, how to construct the robot using PVC, and more -- all things that the senior members were able to help and mentor them on. In addition, our team utilized new, innovative technologies that we had to learn together, including 3D printing, new methods for buoyancy, a new claw, and more. Our team also learned how to communicate information about the team effectively through our community outreach.



Team members showcasing our ROV from last year at the Walter Payton Open House

Future Improvements

In the future, we hope to expand on our ROV's design and functionality. We would like to further our Arduino control system, which would allow us to utilize an Xbox controller instead of our switch-based control system. An Xbox controller allows the pilot to make more precise adjustments to positioning. We would also like to add a rear-facing camera so that the pilot is able to see the tether, allowing the pilot to untangle the tether if needed. Finally, we would like to improve our team's communication even more next year by developing a more precise schedule and setting more goals for each sub-group.

Budget

At the start of the year, our team developed an estimate of our projected costs. This figure helped to determine what items the team could afford as well as what amount was needed in our fundraising efforts. Throughout the year, we added more items that we needed to this budget as well as researched alternative items that may be more cost-effective.

We also researched ways we could fundraise the required money through both methods in our school and in the community, which included selling stickers and cookies at school and snacks on Field Day.

Projected Budget	
Item	Total Cost
T-200 Motors	$500.00
X Box Controller	$20.00
Tether	$200.00
Cameras	$100.00
Wiring	$100.00
Tool Box	$25.00
Claw	$100.00
Tether Management System	$30.00
Other Miscellaneous	$100.00
Total Cost	$1,175.00

Projected Budget

Once we found out that we were traveling to internationals, we also made a projected travel expenses figure. The travel expenses figure was based on 14 students and 3 chaperones.

Travel Expenses		
Item Name	Per Student	Total Cost
Coach Bus	$421.00	$5,900.00
Hotel for 4 nights	$412.00	$5,778.00
Food	$200.00	$2,805.00
Total Cost	$1,033.00	$14,483.00

Travel Expenses (International Competition)

Project Cost

ROV Project Cost				
Item Name	Condition	Quantity	Cost Per Unit	Total Cost
T-100 Thrusters	Purchased	2	$125.00	$250.00
T-200 Thrusters	Purchased	2	$175.00	$350.00
ESC Speed Controller	Purchased	3	$25.00	$75.00
Vex Claw	Purchased	1	$19.99	$19.99
Tool Box	Purchased	1	$16.99	$16.99
Backup Camera	Purchased	2	$18.99	$37.98
18 cm Monitor	Re-used	2	$27.99	$55.98
RCA Cord	Purchased	2	$8.95	$17.90
22 Gauge Wire 61 m	Purchased	1	$19.99	$19.99
M-100 Motor	Purchased	1	$70.00	$70.00
Arduino Mega	Re-used	2	$14.99	$29.98
Buoyancy Foam	Re-used	2	$10.00	$20.00
Silicone Gel	Purchased	1	$7.48	$7.48
Tether	Purchased	3	$20.00	$60.00
Joysticks	Purchased	1	$5.00	$5.00
Sugru	Purchased	1	$19.99	$19.99
2-Wire Motor	Re-Used	1	$14.99	$14.99
1.27 cm Strain Relief	Purchased	1	$24.45	$24.45
PVC Pipes	Re-Used	1	$60.00	$60.00
Heat Shrink	Donated	1	$6.98	$6.98
L298N motor shield	Donated	1	$9.98	$9.98
Shaft Grease	Donated	1	$4.00	$4.00
PVC Cement	Re-Used	1	$9.92	$9.92
Hot Glue	Donated	1	$20.00	$20.00
Zip Ties	Donated	1	$5.00	$5.00
Anderson Powerpoles	Donated	1	$16.00	$16.00
Temperature Sensor	Donated	1	$10.00	$10.00
Total Cost				$1,212.61

Revenue for ROV	
Source	Amount
Payton Student Government Grant	$300.00
Field Day Snow Cone Sales	$140.00
Panera Bread Fundraiser	$70.00
Payton Seminar Grant	$600.00
Total Revenue	$1,110.00

Depth 34 Revenues

Acknowledgments

We would like to thank the following individuals or companies for their help, guidance, and support through the process of creating our company and ROV:

Mr. Barge and Mrs. Barge	*For mentoring our team and for providing logistical support*
Mx. Guzzetti	*For lending us tools and supplies*
Our Parents	*For their support and access to networks of individuals and resources*
Blue Robotics	*For providing us with essential parts and components*
Payton Student Government	*For providing us with two $150 grants*
Panera Bread	*For allowing us to gain a portion of their sales from Payton Students*
Six Continents Hotels Inc. Holiday Inn	*For allowing us to test our ROV in their pool*
MATE	*For encouraging students to explore marine technology*

We have been very fortunate to compete in the regional and international competitions, and all our efforts and assistance were not without the help of the aforementioned individuals and organizations.

\- Members of Depth 34

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