Aegaeon

Distance from competition – 3789 miles

Keith Grammar School

School Road

Keith, Moray

AB55 5GS

Socially Distanced Edited Team Photo – Bent Michielsen

Team Members

Lewis Roger – 18, S6, Chief Executive Officer

Bent Michielsen – 17, S5, Vice Chief Executive Officer

Dylan Taylor – 17, S6, Chief Financial Officer

Jamie Herd – 18, S6, Software/ Electrical Engineer

Peter Grant – 18, S6, Technical Document Manager

Tom Watson – 17, S6, Community Outreach Co-ordinator

Rhea Burgess – 16, S5 Graphic Designer

Gregor Clark – 16, S5 Graphic Designer

Aegaeon – Peter Grant

Our Mentors

Mr Steven Tubbs

Mrs. Ruth Jenkins

Mr. John MacLeod

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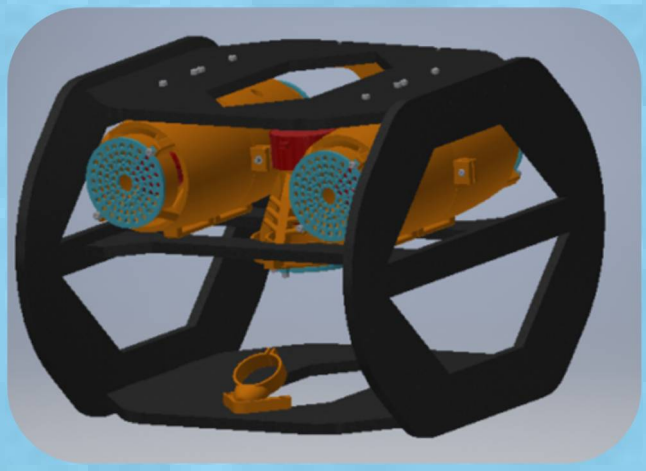
Abstract

This year will be the second year of development for Aegaeon, it has been loosely based on some previous years models but with some tweaks and upgrades with our increased budget. We also had to consider the tasks we'd have to do in a freshwater environment and adapt our design to suit the tasks given to us. 'Ensuring public safety, maintaining healthy waterways and preserving our history', we tried to make sure Aegaeon would be efficient and reliable at securing a better future; this technical document covers our design thoughts and choices as well as the features and safety aspects of our model this year.



Prototype render of Aegaeon on Autodesk Inventor – Peter Grant

Company Evaluation

At impROVise we believe that, despite the difficult circumstances placed upon us this year, we have made great progress and work in developing our skills and our ROV. We were able to accomplish our goals which mainly concerned the fine-tuning of last year's model and the construction of a new testing pool. We all agree that one thing that makes us a reliable and hardworking team is the communication we have with each other, this ties in with the planning as the to do lists we create were regularly updated and changed and team members were notified of when tasks were finished or behind schedule. We are not afraid to give our opinions on others work, aiming to improve things wherever we can. The most fulfilling and rewarding part of the experience for us was the practice of life skills it has developed, by running through and practicing the presentation we grew more confident in public speaking and presenting, the design work on the technical documentation and market display helped hone the talents of our graphic designers and the physical development of Aegaeon has helped those wishing to pursue engineering grasp some more technical concepts and designs. These skills have been trained and worked on throughout the whole year and although there may not be as much physically to show for our work, we know that the skills we gained can lead to greater attainment in the future.

Our Team

Hey, my name is Rhea Jayne Burgess , I am 16 years old and in my 6th year of school. My job roles at ImpROVise are Head of Graphic Designer, the Safety Officer and the Pilot.
This is my second year competing in the MATE ROV competition. Last year I was a Graphic Designer. By competing in this competition it has helped me discover what I enjoy doing, which is why I would like to study Graphic Design at University.

Hey, my name is Gregor Clark, I am 16 years of age and in 6th year at school. I am the graphic designer and tether manager for ImpROVise. This is my first year competing in the MATE ROV competition. The experience that I have gained from taking part in this competition, more specifically the presenting skills that I learnt from doing the presentation, giving me more confidence when speaking to a crowd. This will help me to reach my future carrier of an actor.

Hi, I'm Bent Michelsen , this is my third year competing in the MATE ROV competition and my first time competing in the international. So far I have expanded my electronics skills hugely as well as my team working and communication abilities. As I have taken part in the competition, it has inspired me to go into a career in STEM. The high highs and the even lower lows have taught me resilience and am I am greatly looking forward to competing in the international!

My name is Peter Grant and I'm 18 years old and currently about to start my first year of University studying Chemistry. I am the Technical Document Manager of impROVise which means I deal with the organisation of the Tech Reports and Spec Sheets. This is my fourth year competing in the MATE ROV Competition and third year at RANGER level.The MATE ROV Competition has helped develop some really important skills for life and work, such as communication within a team and working towards deadlines and organising as such.

Hello, I'm Lewis Roger. I am 18 years old and have just finished my 6th year at Keith Grammar School. My Job Role at impROVise is the Chief Executive Officer. This is the 6th Year that I have competed in The MATE ROV competition and the Second time competing in the international finals as I was part of the team when we competed in Long Beach in 2017. Previously my Job Roles have been the Chief Financial Officer, Tooling Manager and General Engineer. In September I will be starting at Robert Gordon University to start my degree in Masters of Mechanical Engineering.

Hello I'm Jamie Herd, I am the electrical engineer for impROVise. I have been taking part in the MATE ROV competition for six years and have learnt a lot from this great experience. For example I now feel comfortable presenting in front of a crowd and learnt a lot about software development. This completion has helped me grow and will definitely help in my future studying computing science at university.

Hi I am Tom Watson, in the impROVise team I am the community outreach coordinator. I have been taking part in the MATE ROV competition for six years. From taking part in the MATE ROV competition my carrier choice has changed from becoming a commercial pilot to a pilot in the navy due to the opportunities of flying an ROV in the navy. Taking part in this competition helped me to become a better team member and grown my confidence as a leader.

Hi, I'm Dylan Taylor. I'm 17 years old and I have now left school. My job role at impROVise is chief financial officer. This is now the third year I have competed in the MATE ROV competition. Last year I was the safety officer. In September I will be starting a masters course in mechanical engineering course at Robert Gordon University.

Client Requirements

The client this year for the competition is everyone. The population of Earth is under pressure to help and prevent the gradually increasing threat of climate change.
Climate change and pollution has affected the planet in many ways. Our client has requested ROV's with the capability of tackling the real-world problems of:

Plastic Pollution in Oceans – Every year millions of metric tonnes of plastic end up in our oceans and, unfortunately, lots of poor innocent sea life gets injured and killed by it. Turtles can end up with plastic wrapped round their necks, fish can ingest and choke on smaller pieces of plastic such as straws or bottle caps and creatures can become trapped in the discarded nets and equipment of fishermen.
There is a growing awareness of this issue and many people are beginning to act on it. Pete Ceglinkski (CEO of the Seabin Project) was concerned about the threats that plastic and other types pollution had on sea creatures and their habitats and sought to make a change.

The Destruction of our Coral Reefs – The reefs in which many creatures call home used to vibrant, colourful and lively are now being destroyed because of climate change. Lots of reefs are ending up being bleached and killed because of the rising water temperatures due

to climate change and pollution. Since these reefs are dying, they can no longer support wildlife living in them.
Some investigations have discovered that a few species of coral reefs are beginning to naturally adapt to warmer conditions.So, scientist in Oahu, Hawaii, are beginning to run tests on bringing the more resilient entities and try to transplant them into other entities and reefs so that the resilience will carry over.

Maintain Healthy Waterways Part II: Delaware River and Bay – Some research teams have been working on how to help creatures in waterways. A research team from the Academy of Natural Sciences at Drexel University have turned their attention to the American eel. To help this creature manoeuvre over the dams the team have created 'eel ways', similar in functionality to a 'fish ladder'. Some traps have been made for the eels so that they can be taken up over the dam and onto the other side.

Teamwork and Development

During the development of Aegaeon every member of the team was involved in meetings and critical discussions. At the start of the year we had several sessions of group brainstorming; coming up with designs and ideas for the ROV. After a few weeks of research as a team, we split up into focussed groups looking at aspects of the ROV we planned to work on.

Teamwork is a vital part of any organisation and at impROVise we strive to work together efficiently and maximise the work we put in. When creating groups to work on things we make sure that those who are assigned with each other have complimenting skills so that they are able to work better and quicker.

At the start of our working year we went through a recruitment process, offering select individuals a form to fill out like an interview. We had to do this rather than actual interviews due to the COVID situation. After a long discussion with the team we decided to offer Gregor a position in the team, so now impROVise has 8 members that all work to their best.

Changes due to COVID

Unfortunately, due to the restrictions put in place because of the coronavirus epidemic there was no MATE competition for us to attend last year. Although this was for the best, as it helped stop the spread of the virus and keep people safe, we couldn't help but wonder what our performance would have been like if we were able to compete.

The situation at our school made working on our project much more difficult but we managed to adapt to the circumstances and have been able to continue working well. We were no longer able to have afterschool meetings so were restricted to 30 minutes during a Tuesday lunchtime where we held our meetings and discussed what had to be done; many of our members had free periods so physical work was able to be done during those times. Respecting and sticking to the physical distancing rules was tricky at first but we spilt into smaller sub-groups for our projects so there were no large crowds together.

Since the theme and tasks for the 2021 Competition are what would have been last year's. We decided rather than creating a new design we would just further our current model of ROV and add features or changes to improve it. With this extra development time we were able to make and design a manipulator that runs on a hydraulics system, make progress towards speed control and create a power distribution board for Aegaeon.

Design Rationale

Propulsion and Motors

In order for ROV's to move, a method of propulsion is required, for Aegaeon we decided to stick with our tried and true system of using modified bilge pumps. Bilge pumps, we've found, are easy to work with while still producing the thrust necessary for our ROV to work. We didn't have to worry about ensuring they were waterproof since already are.

The propellers on Aegaeon are 5 bladed brass propellers. We tested these against many different prototypes and types of propeller and this gave us the amount of thrust we wanted from our motors. We even ran a test against some we had printed ourselves to see if we could replicate the standard.

On Aegaeon we have 5 motors, 4 for horizontal manoeuvres and only 1 for height adjustment, the reason we went for this ratio is due to the frame shape and the orientation we chose for the horizontals, if we wanted a second motor for vertical movement it would have been difficult to find placement where everything was balanced and didn't require reconfiguration of our chassis.

During our design phase, we devised a method that helped us conserve the thrust of our motors and make us more efficient when moving. We have positioned our pairs of horizontal motors back to back in one large shroud. This means that the reverse thrust of one motor will contribute to the forward thrust of the other.

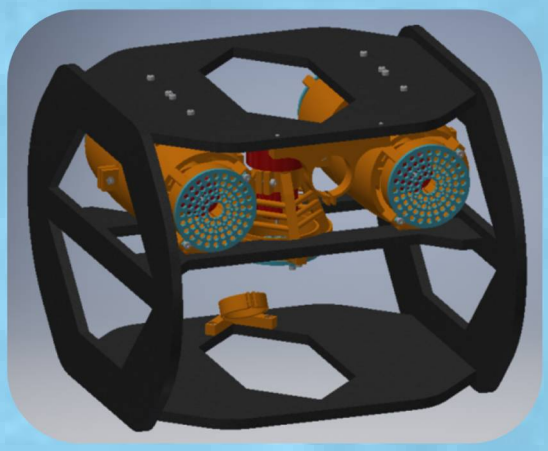
Motor Shrouds on Aegaeon – Peter Grant

Propellers and Blades on Aegaeon – Peter Grant

Frame

The frame and structure of an ROV is very important, the shape an ROV has can determine its functions and capabilities. Reconnaissance ROVs more commonly have smaller compact frames when compared to large industrial work ROVs. Aegaeon's frame is made from 4 high density polyethylene (HDPE) panels with a smaller 'shelf' in the centre. The design of frame we went for is very box-like and has lots of space for equipment while still allowing water-flow. While our model isn't incredibly aqua-dynamic we think it makes up for that with its ease of control and versatility.

Our material of choice was HDPE, after testing with frames made from layered acrylic we came to the conclusion that we needed something stronger, yet still light enough in water. HDPE was the answer we discovered; having a very similar density to water meant that we could use plenty and still only have to worry about the weight of our components. We used 10mm sheets that needed to be cut out of our Computer Numerical Control Router (CNC) with the designs we made on Autodesk Inventor. The thickness of the plates provided us with all the support we needed and it didn't have to be layered with glue.



HDPE frame of Aegaeon – Lewis Roger (The side panel, bottom panel and full assembly respectively.)

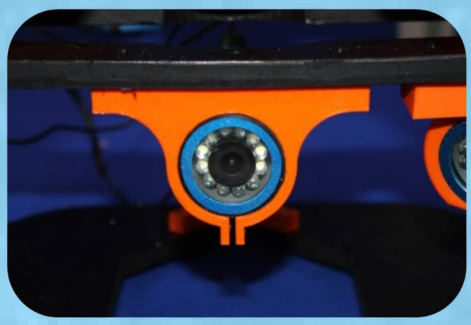
Buoyancy

With the use of HDPE as our ROV's frame our buoyancy was relatively easy to figure out, we aimed for our ROV to be neutrally buoyant in pool water, so that it wouldn't float up or sink when trying to accomplish a task. This was important since many of this year's tasks required precision and stability throughout. When researching methods for achieving neutral buoyancy we came across methods for determining 'Up
Thrust and Buoyancy Forces' we did some calculations relating to our ROV and this is what we discovered.

Our light blue buoyancy blocks either side of the motor. – Peter Grant

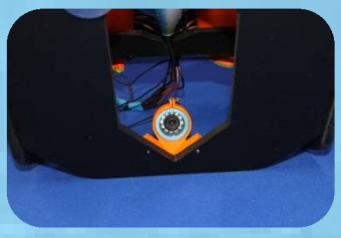
Cameras

There are many things to consider when discussing cameras on ROVs: How many? Where and what angle? What type? On Aegaeon we have 3, 3 cameras all at different angles and positions to give the pilot a range of views. We have two for front views, one at a straight 90° angle to the front and one just off to the side to get a better view of the manipulator. Our third one is aimed at the hole in the bottom plate of Aegaeon so that the pilot can see what is below them.

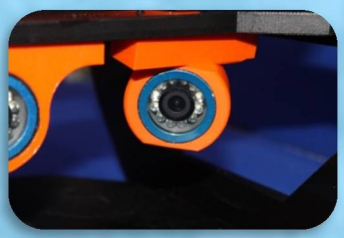


Front facing camera on Aegaeon – Tom Watson

The style of camera we chose is one that we have consistently used every year, the fish-finder. It's incredibly useful since it comes pre-sealed and has a built in light source. We found them to be easy to wire into our designs and simple to maintain and design mounts for.



Underside camera to view what is below the ROV – Tom Watson



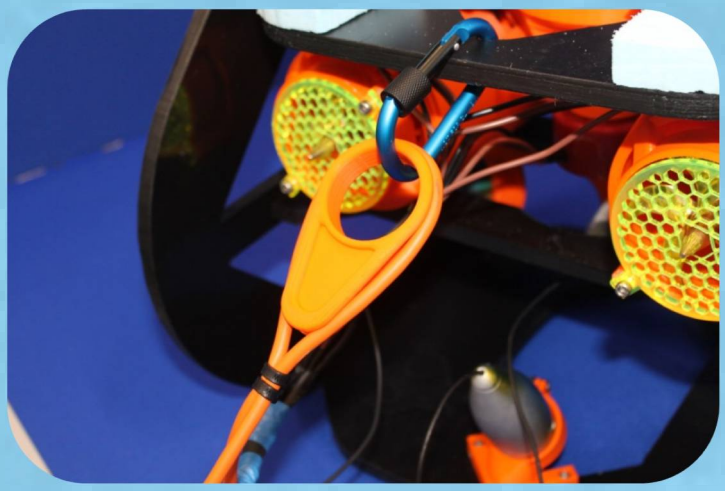
Angled camera for perspective views – Tom Watson

Tether

The tether is one of the most important components of ROVs; they provide power from the surface, saving it from having to be on board. Our tether is made from 6 core wire encased in a vibrant orange rubber sheathe. The rubber of the wire makes it resilient in the water while also being flexible. Not only does the orange of the wire match our company's colour scheme and branding, it also follows our ethos of trying to be safe wherever we can. The brightness of the orange is easily visible underwater so divers can keep track of the ROV and avoid getting tangled in the tether.

The 6 wires in each sheathe connect to each motor, 2 per set (left, right and vertical). The wires from the 3 cameras also have to be weaved into the tether so that they aren't left hanging in the water. Our hydraulic syringe system was also recently incorporated into our tether, it was vital that the tubing remained undamaged as any piercing would cause the entire hydraulic mechanism to stop functioning.

To maximise safety and the prevention of slashes in the tether we covered the whole thing in a large black mesh skim, so it helped to hold the plaited tether together and to help prevent any cuts towards the wires.



The strain relief on Aegaeon which keeps our tether safe – Dylan Taylor

Another aspect we had to consider on our tether is the strain relief. When attempting to re-align the ROV by way of the tether it's important that too much strain and tension is not put on the wires that might cause the wires to become damaged. Our method of strain relief is a hole that we drilled into the back of our ROV where a karabiner is fitted, this attaches to a ring that our tether is looped around, reducing strain when tension is applied. On poolside we have the same system but the karabiner is attached to our control Box.

Tooling

In previous years we have always used a stationary tool and stayed away from manipulators and moving claws, we did this because we weren't sure how long it would take to develop and we prioritised the fundamentals of our ROVs to start with, due to COVID and the extended

time period we have we decided it was finally time to try one out. This turned out to be a very good idea since so far during testing it seems to be much more effective than its static predecessors.

We designed and modelled all the individual parts of the manipulator in school, using a 3D printer to make them, this proved to be very cost effective since we were able to edit and create new versions quickly.

The manipulator design we went for in the end has two retractable claws that are able to grip PVC piping with the help of the hot glue insides we made. To extend and retract the manipulator we have a very small hydraulic system with a single syringe used at both ends and tubing running down alongside our tether. We went for a hydraulic system as we had all the parts in school to design and make it and it wouldn't spend any of our funds to use this method. Hydraulic systems that use water are also very safe since it is at a low pressure and has no contaminants that could harm wildlife were it to leak or break.

Elevated and front view of our 3D printed manipulator claw – Lewis Roger

Control

Usually when creating a control system for our ROVs we just made one box that housed what we needed. This year however, we have decided to make two. One that has standard tank turning controls; this is the one that we aimed to perfect so we knew it would work on the day of the competition. And the other box would be and extra project, it would have variable speed control and we'd consider it a bonus if it were working by the competition day.

The more basic one has three DTDP Switches. Each switch controls a different set of motors, one for the left set, one for the right set and one for the vertical. This is a method we know works since it is what we have run on almost all of our older models of ROV; we made this one a failsafe in case our additional project ended up failing.

The extra project box was designed with the option for variable speed control; we have achieved this by way of potentiometers. We have used systems like this in the past but they haven't always been 100% consistent, this year we planned to try it, see if we could make it work and if not have our backup for the competition.

Testing Process

During our construction and testing phase of Aegaeon we used Autodesk simulation software and CAD CAM testing to test the hydrodynamics of our 3D modelled parts. With the information gathered we could alter and adjust the shape to make it as efficient as possible, evidence of this is shown in the rounded corners of the chassis and the cylindrical shapes of the motor shrouds.

When it came to testing our buoyancy, we used an IBC tank that was sawn in half and filled with water. We would use this to see whether or not Aegaeon would float to the top or sink to the bottom when left idle. If it went to the surface we'd shave some off from the foam blocks, if it sank to the ground then we would add additional foam.

The testing of our motors was relatively simplistic; it involved us determining the rotation of motor when activated. We had to make sure that they all lined up with all the others and that the two sharing a shroud had opposing spins which was crucial to our thrust method. To test the efficiency and power of our propellers we set up a thrust jig and compared which_design yielded the greatest thrust. We settled on the brass propellers for the horizontal motors and a three bladed plastic prop for the vertical as it gave us more strength. As to why we didn't use the plastic design for all motors we felt that the slight reduction in power meant we could have more fine control which we needed for some of the tasks this year.

Safety

Team Safety

At impROVise we strive to be as safe as we can in the workshop and by the pool. We always ensure that our tasks are carried out with the utmost attention to protection and safety, for our team members, the ROV and the equipment that goes with it.

When we are working on our electrics using tools such as a soldering iron or a heat gun, we always make sure that these requirements are fulfilled:

- When using something hot or dangerous, gloves are worn at all times
- Safety glasses are kept on when in proximity to live electrics or dangerous things.
- To preserve work surfaces and to prevent fires, heat retardant mats are using on soldering stations.
- When operating drills, ensure the item to be drilled is secured in a vice and kept stable.

- If possible, carry out tasks in pairs so aid can be given in emergencies.

By following these guidelines we have had no major issues in our workshops and we intend to try and keep it that way.

ROV Safety

ROVs can be dangerous if precautions are not taken when around one being operated. On Aegaeon we have come up with several design features to help reduce the risk factor associated with it. On our side panels we made easy to grip gaps so that transporting it is safer. If the ROV were to be dropped not only would it damage it but it could injure nearby people. As extra safety measures we decided it would be best if we made sure that all our sharp edges or points were filed down and that our wires should be secured to the frame so that nothing is free floating and could cause damage.

On Aegaeon we have large hi-vis shrouds that completely protect our ROV. We also have an acrylic mesh on the front of these shrouds that are cut to the IP20 standard. This means fingers and anything larger than 12mm should not be able to reach our motors and risk damage to it or the ROV.

The parts of Aegaeon that require caution or special attention while being operated have been made in a very visible orange plastic, not only does this greatly contrast with the chassis of ROV but it can also help divers and other creatures locate where the motors or other potentially hazardous parts of Aegaeon are.

Before setting out to fly with Aegaeon we have a pre-flight safety checklist we run through and make sure we fulfil. It helps us maintain our safety standards and ensure the ROV is fully operational.

Pre-flight Safety Checklist for Aegaeon
No loose items or hands are obscuring propellers or are inside the frame.
All Items attached to the ROV are secure.
Fuses are in place, secured and operational.
No exposed connections or propellers on the ROV.
Tether firmly secured at control boxes and at ROV.
Test all cameras to check correct function and correct position.
Test all motors for safe and correct function and correct position.
Ensure tether is not tangled, secured to the ROV and safely coiled.
Test power supply is giving out correct amount of voltage.

The safety precautions taken for Aegaeon before any pool flights - Rhea

Recycling

As the theme of the competition is about preserving wildlife and removing pollutants we started to think of ways we could reflect that in our team. We ended up applying to our school for a 3 stage recycling system that takes old/failed projects from our 3D printer and will allow us to reuse the plastic for new ideas. Graciously, they fully funded it and we were able to get it installed in our Technical Design department.

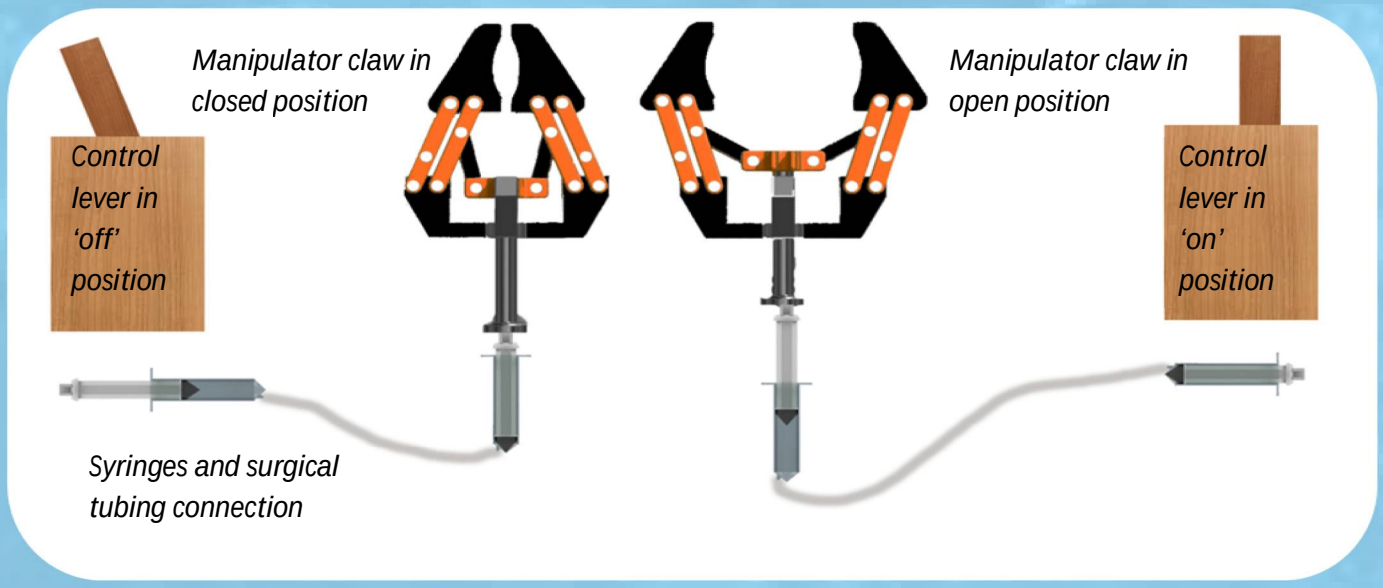
The first stage of the recycling process involves the project being ground up into a dust and ready for use. We didn't anticipate how much of this ground up material we would actually end up with and we have actually ended up with a larger containers worth and still some remaining projects, yet to be destroyed.

Stage 2 involves this dust being dried, all the moisture added to it during the printing process must be removed before it can be used again so it is left to dry for a few hours before its ready for the final stage. This is the extrusion process, which makes the filament required for 3D printing.

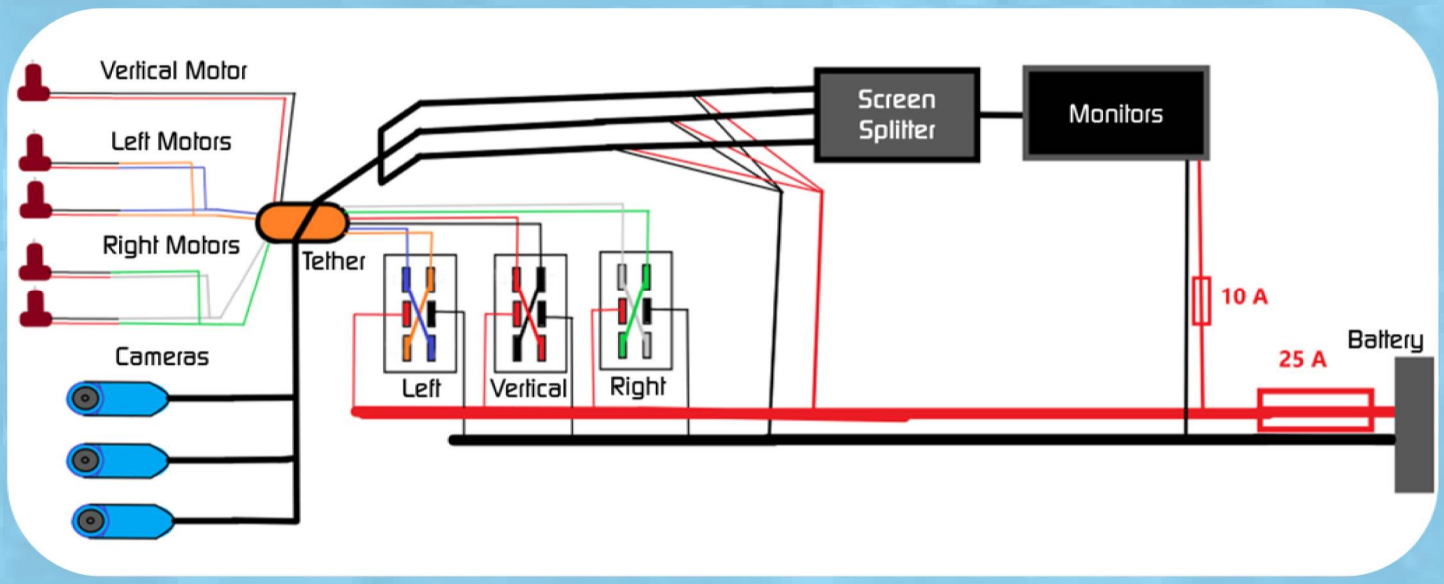
The grinder, drier and extruder respectively – Peter Grant

Systems Integration Diagram (SID)

These are our Systems Integration Diagrams; they show the connections and details of our ROV's electrics and hydraulics.



Systems Integration Diagram of our hydraulic manipulator system – Lewis Roger



Systems Integration Diagram of our electronics linking to our cameras and motors – Lewis Roger

Fuse Calculations

5 Thrusters 3Amps Each

15 Amps x 150% = 22.5 Amps Needed

25 Amp Fuse Fitted

Monitor = 1.5Amps Screen Splitter = 3Amps

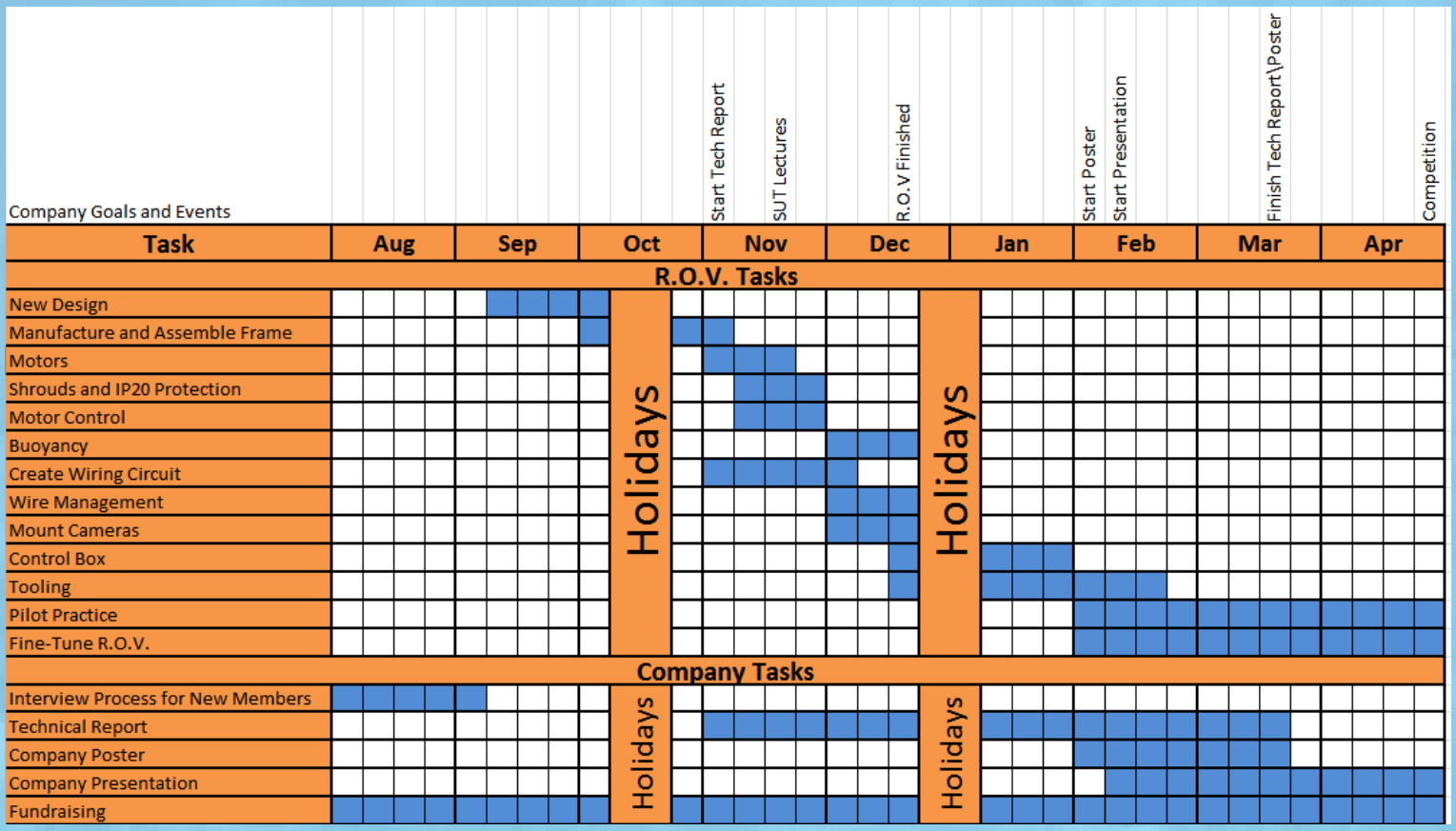
4.5 Amps x 150% = 6.75 Amps Needed

10 Amp Fuse Fitted

Scheduling

At the beginning of the year we made a rough schedule with approximations of completion dates for certain projects. However due to COVID and the impact it created on our access to the school and by extension this project. We have ended up losing a rigid schedule and instead turned to group discussions on what we should all prioritise in the upcoming week. This helped us cope with the unpredictability of the year since we were able to notify others quickly if things fell behind.

We used the format of a Gantt chart to display our original schedule, we chose this because it allowed us to be more flexible with when we finished projects, with due dates ending at the end of the week.



The Scheduled Plan for this year – Rhea Burgess

Financing

This year has been difficult for us since our club primarily runs off of sponsorship and donations and due to many smaller businesses in tight situations financially, we haven't been able to get the same outreach as we have before. Luckily we did have some funds left over from last year so that we could at least make a start on our designs. The recycling machine we were given a grant for was huge for cutting down our current and future running costs since we will not have to buy another reel of 3D printing filament for quite some time.

Budget Planning

We've had to be quite stringent with our money this year, with many of our local and smaller businesses less willing to donate money for sponsorships this year due to really raise was if we got lucky or were able to raise some through the school.

We did receive the unprecedented financial situation, which meant that the only money we could money from the school towards some pieces of technology that would be beneficial to learning or environmental awareness (such as the recycling system)

impROVise's Financial Expenditures

ROV Total Value							
Item	Use	New or Re-used	Attainment	Units	Single Value	Total Value	Total Cost
Fish Finder Cameras	Vision	Re-used	Donated (1) and Purchased (2)	3	£ 108.99	£ 326.97	£ 217.98
Monitor	Vision	Re-used	Purchased	1	£ 78.89	£ 78.89	£ 78.89
HDPE	Frame	New	Purchased	2	£ 40.96	£ 81.92	£ 81.92
Propellers	Propulsion	New	Donated (Ian S. Roger Ltd)	5	£ 37.41	£ 187.05	£ -
PLA Filament Reels	3D Printed Parts	Re-used	Purchased	2	£ 19.95	£ 39.90	£ 39.90
Motor Connecters	To Give Power to Motors	New	Purchased	2	£ 17.34	£ 34.68	£ 34.68
Bilge Pumps	Propulsion	New	Purchased	5	£ 16.59	£ 82.95	£ 82.95
Acrylic	Control Box and Tooling	New	Donated (School)	2	£ 15.00	£ 30.00	£ -
Power Connectors	To Supply Power	New	Purchased	2	£ 10.53	£ 21.06	£ 21.06
Heat Shrink	Sealing Connections	New	Donated (School)	1	£ 6.99	£ 6.99	£ -
DTDP Switches	Horizontal Movement	Re-used	Purchased	2	£ 3.49	£ 6.98	£ 6.98
Adapters	To Connect Motors to Propellers	New	Purchased	5	£ 2.35	£ 11.75	£ 11.75
Rocker Switch	Vertical Movement	New	Purchased	1	£ 2.20	£ 2.20	£ 2.20
6 Core Orange Wire (Priced per Meter)	Tether	Re-used	Donated (John MacLeod)	20	£ 1.20	£ 24.00	£ -
Blade Connectors	To Connect to Controls	New	Purchased	18	£ 0.30	£ 5.40	£ 5.40
Male Cable Connector	To Make Tether Detachable	New	Purchased	1	£ 12.78	£ 12.78	£ 12.78
Female Cable Connector	To Make Tether Detachable	New	Purchased	1	£ 17.03	£ 17.03	£ 17.03
Ciruclar Sealed Connectors	To Make Camera Wires Detachable	New	Purchased	3	£ 21.46	£ 64.38	£ 64.38
Hydralic Tubing (Priced per Meter)	To carry fluid between Syringes	New	Purchased	30	£ 0.26	£ 7.80	£ 7.80
Blue Foam	Buoyancy	Re-used	Repurposed	1	£ 2.13	£ 2.13	£ -
Total Cost of ROV							£ 685.70
Total Value of ROV							£ 1,044.86

The expenditure table for years 2019 to 2021 – Dylan Taylor

Build vs. Buy

In recent years we have had quite a lot of success with our components made ‘in-house’ and we decided to hopefully continue that trend. Especially rather simple and non-technical pieces that easy to print and model on CAD software; things we have made using this method include: our motor shrouds, our camera mounts and our manipulator grip. Creating them ourselves is considerably cheaper since we have our recycling machine that essentially negates failed projects, meaning we can just try again until it suits our needs. Not only does the design and creation of our own parts have a financial benefit to the team it also serves as a learning experience. Meaning we get to go through the process of planning, designing and creating the parts for the ROV and also being able to work with failure and evaluate and adapt to what we did wrong.

New vs. Reused

With the addition to the plastic recycling machine being added to the Technical Department’s arsenal we have been able to reuse most of our old projects by converting them into new spools of filament. We have always favoured reusing components if we can help it, if we know something works and suits our requirements and the competition requirements then there is no real reason not to use it, especially if it saves us money. This year some of the parts we have reused include our bilge pump motors, some of the components of the control box and our cameras. Components we felt was necessary to buy include our brass propellers and the components required to make our variable speed control box.

Troubles and Troubleshooting

Aside from COVID our team luckily hasn’t had many issues during this year’s work. This was mainly due to the lack of actual building and design we had to do this year, most of our work consisted of creating additions to our current ROV. Rather than starting anew.

Throughout most of last year and this year we have been using a sawed off IBC tank as our primary source of water tests, While this allowed us to test and calculate buoyancy as well as simple motor thrust, we were not able to achieve a range of motions and attempt more complex manoeuvres with Aegaeon. Because of this, our mentor Mr Tubbs

constructed a larger pool for us so that we could get used to flying in more open waters.

With the use of our 3D printer were able to create prototypes and ‘tests’ for many of our components. Our motor shrouds actually began as separate units for each motor that then merged into 2 units housing two motors each. The use of Autodesk Inventor 3D meant that we could see things in scale and we also used Inventor to test the aqua-dynamics of the components so we could see how well water would flow past and through it. The printed prototype process was also instrumental for the creation of our manipulator piece, printing each part individually meant we were able to analyse and evaluate its effectiveness and make adjustments if needed.

Community Outreach and PR Events

Unfortunately, this year, we haven’t been able to attend any events or lectures to talk about our team. While our outreach in 2020 was limited, we attended several events in 2019 as a team.

Macduff Aquarium

In June of 2019 we were invited to the Macduff Marine Aquarium to give a small presentation as a part of their Diving and Underwater Technology Weekend. The purpose of this was to teach the visitors to the aquarium about what ROV’s are and how they are used in industry, primarily relating to aiding of aquatic wildlife and the preservation of natural habitats.

SUT Christmas Lectures

We were lucky enough to speak at the SUT’s Christmas Lectures at the end of 2019. The event was held in Aberdeen’s Music Hall. There was estimated to be about 500 primary 7 children attending. We spoke alongside representatives from MATE, speaking about our team and the history of the competition. Especially how it has helped us develop skills individually and as a team. At the end of our presentation we accepted and answered questions from the audience, many were insightful and surprisingly well informed. Our goal for these lectures was to try and encourage and inspire young people to pursue STEM at school and maybe even consider a career in later life.

KGS 2019 Christmas Dance Photography

We volunteered to be the ones to organise and run the photo booth at our school's Junior Christmas Dance. One of our members was taking a photography course at the time so they handled the photos while the others managed the booth and rounded up clients. It was a big success because we were able to get in orders for the photos and turn a profit and it was quick and easy fundraising for the team which we all had fun while doing it.

Moray Maker Space (T-Exchange) Correspondence (2020)

We were approached by the Moray Maker Space (T-Exchange) group who wanted to know more about our team and what we work towards. We obliged and in response sent them a video presentation where we discussed our team and the process behind creating our ROV for the competition. You can find the video on the Keith Grammar Twitter and Facebook pages. T-Exchange were delighted with our reply and followed up by asking us many questions which we happily answered.

@KGS_Engineers

YouTube ***impROVise ROV Team***

Acknowledgements

MATE ROV COMPETITION
ROBERT GORDON UNIVERSITY ABERDEEN
GainTech
Balfour Beatty
IAN S. ROGER Ltd
ADVANCED ELECTRICS
TARBAT
bp
ROVOP

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