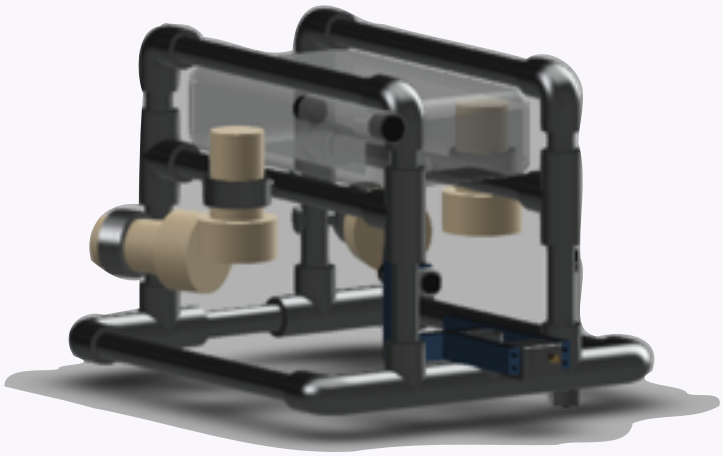
AQUILA INTEGRADED SOLUTIONS

american international school

hong kong . hong kong

The Aquila



Billy Chan, Class of 2016
Chief Executive Officer & Founder

Justin Bae, Class of 2016
Chief of Mechanical Engineering , Project Manger

Thomas Low, Class of 2016
Chief of Electrical Engineering

Jeffery Kam, Class of 2017
Electrical Engineering

Ronald Ng, Class of 2017
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Megan So, Class of 2019
Communications Director

Jamie Fox, Class of 2019
Head of Technical Writing

Michael Chan, Class of 2019
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Engineer

Justin Lee, Class of 2019
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Justin Cheung, Class of 2019
Engineer

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ABSTRACT

Aquila Integrated Systems (AIS) is proud to present its flagship remotely operated vehicle (ROV) product, Aquila. Previously known as Eagles, with new recruits and experience to base our work off of, it was only fitting that the company underwent a name change. From the ashes of The Fried Eagle rises the versatile Aquila. The talented individuals at Aquila Integrated Systems have devised a ROV that is adaptable to the situation presented, adjusting individual modules of the ROV according environmental challenges. Aquila will be equipped with four bilge pump motors (each with propellor shielding), four waterproof cameras, a temperature sensor, a water pressure sensor, and a rotatable mechanical arm. Thanks to the modular design, the company is able to have several mission-critical components created at the same time. With the team coordination from team leader Justin Bae, each module of Aquila does not interfere with another. With its affordability, fixability, and most importantly–adaptivity, Aquila is the ideal ROV for astronautical customers with intent on exploring the depths of oceans in far away worlds.

COMPANY MISSION

Aquila Integrated Systems offers practical options through application of different fields of science. This year's product embodies these fields with our specialized members in mechanical engineering, electrical engineering computer science, and even astronomy (specialized members are enthusiastic or have planned to study in these respective fields when they enter college). AIS seeks innovative solutions to produce awe-inspiring systems with state-of-the-art functionality for our clients.

THEME

For a company that emerged out of the American International School, it seemed only fitting that the competing ROV team's name matched the school-wide Eagle theme. The Aquila has an astro-marine focus with the features for effective marine exploration and accessibility and flexibility for the various challenges in space.

DESIGN RATIONALE & VEHICLE SYSTEMS

CHASSIS

The objective design of the chassis was to reduce the amount of material used so that it is easier to control in terms of buoyancy. We decided to use PVC pipes to construct the fundamental shape of the ROV, as we are able to manipulate it very easily and it is strong enough to hold the components of the ROV, but soft enough for us to cut. This gives us a lot of flexibility in terms of changing the dimensions of the ROV. We also drilled holes into the ROV, as it allows the entire chassis to sink. This also makes the buoyancy easier to control and would increase the manoeuvrability of the ROV. We decided to make the Chassis shaped like an upside down pi so that we can input storage space for the ROV's non-waterproof components. Our design is very minimalistic, as it helps us find any mistakes or broken parts on the ROV very easily. We used PVC pipe glue to secure the parts, as it prevents unnecessary imbalances to how much water is in the chassis. This method is to also add minimum amount of weight to the ROV, making it easier for us to control.

MANIPULATOR

Aquila's manipulator uses two servo motors; one for opening and closing the jaw, and one for rotation the grip. Since the servos are attached directly to the rotating part, the grip is very durable and free of minor mechanical faults.

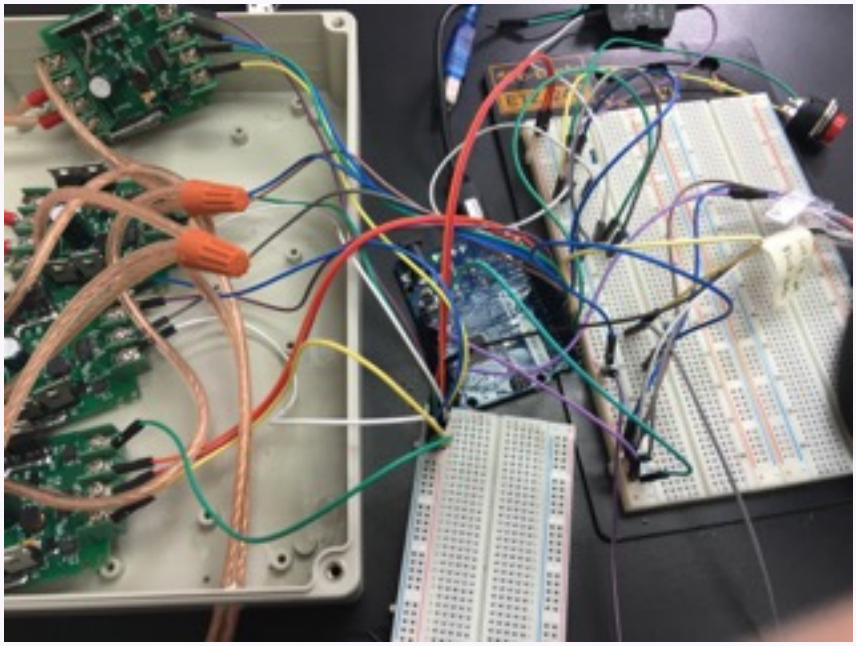
Another noteworthy feature of Aquila's manipulator is that its body is built out of individual aluminium blocks. Hence, we did not have to rely on certain predetermined configuration but were able to easily design and construct the manipulator frame that suits our purposes: First, by using the blocks, we were able to create and attach a platform for the camera on Aquila's manipulator body. In fact, versatile nature of the blocks allowed us to attach the platform at the ideal location we want. Also, by attaching a PVC pipe joint of the main frame to the manipulator body, we ensured that the manipulator be attached rigidly and naturally to the frame.

CONTROL AND PROPULSION SYSTEM

The control system has a dramatic change from last year's PS2 design. The control input system includes a Thrustmaster joystick, 2 buttons for up and down movement, and 4 buttons for metallic grip movement; The brain of the control system is 3 arduinos (2 uno and 1 nano); The control output system includes 4 pwm controlling 4 separate motors. The fundamental concept of how the joystick controls the ROV is that the system's code convert the analog values retrieved from the joystick to x and y values based on the joystick's center location. Since the analog values received from the joystick are too unstable due to the joystick's sensitivity, the system accounts for the constant varying data first by limiting the maximum and minimum values and then by dividing the each joystick axis into 21 sections, 10 above and to the left of the midpoint section, 10 below and to the right, and one for the equilibrium point. Our team achieve this by mapping the analog value in the constrained range (around 120 to 940) from -10 to 10, and setting 0 as the equilibrium point.

Unlike last year, the xy value is not combining to create a cartesian plane, instead, it separates x as the rotation factor, and y as the linear propulsion factor. For the rotation factor, the system will rotate the ROV in the relative direction of the center of joystick with a speed proportional to the magnitude of the joystick movement. For linear propulsion factor, the ROV will propulse in the y direction of the joystick; simply put, if the joystick location is above half, then it moves forward with magnitude respective to the difference from center, and vice versa for backward. To make the transition from linear propulsion state to rotation state, our team have installed a button that when it is pushed, the system will change to the rotation state and when released, it will return back to linear propulsion state as default. For the z motion (up and down motion), there will be 2 seperate button exclusively for that control as the joystick only provides 2 variables. Our system does not take speed into account for the up and down motion, because usually up and down motion is not a continuous task and does not require as much precisions compared to x and y motion.

The hardware design of the system separates mainly into 2 groups, one for controlling movement, which will be an isolated system that process all the computation above water, and the other for receiving sensors' data underwater and controlling the arm movement, which transfer data back and forth between an arduino above water and one underwater. There will be 2 different programs in the system, one for reading the joystick analog input and 2 buttons input to control the main ROV movement, and the other for transfer data such as temperature and pressure from the one underwater to the one above water and transfer arm movement input to the one underwater to perform arm motion. The arm itself has 2 servos, one for opening and closing the metallic grip, the other for rotating the whole grip. The second servo is installed due to specific mission. Each servo will have 2 respectives button for controlling, one for each direction for the servo to move. The system also has a safety mechanism that will keep track of the position of the servo so it wouldn't reach the maximum of the degree it can turn and break the servo internally.



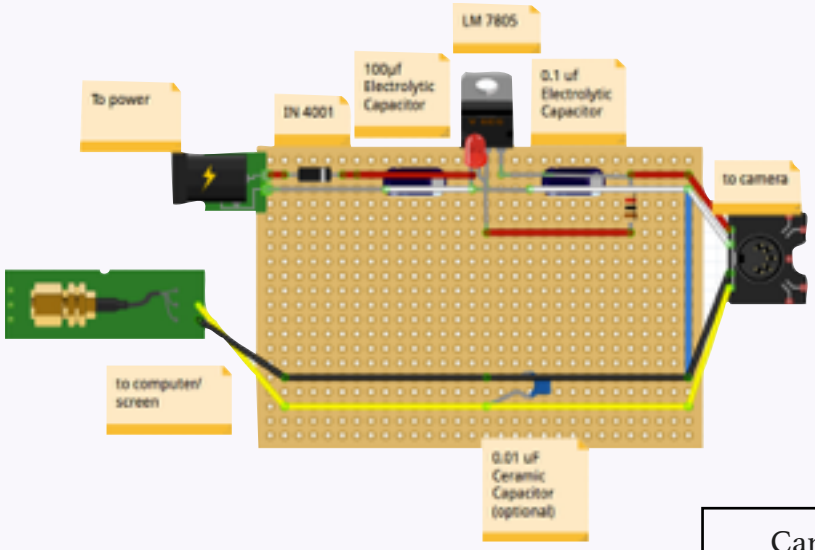
Control System Prototype

CAMERA SYSTEM

The Aquila is equipped with four cameras, frontal camera, down camera, and full view camera. The frontal camera is used during missions in inspection missions, and allowing. It also gives use an idea of where we are going. The camera on the arm provides a precise view on the action of the arm, allowing the action to be more precise and making it easier to complete the objective. The down camera is used to help us in locating the object underneath in order to complete the missions, and to locate things that are underneath the ROV. This would help us in obtaining the objects from below. The full view camera is used to provide a birds eye view to the whole pool which allows us to know where everything is in order to plan how to go to each places.

All our cameras are made with Spy-Hole B/W Camera K701. We chose this camera mainly because it is small and easier to be customized. Each camera is put inside a11 cm long clear acrylic tube, linked to 15 meter long cable which is directed to a CCTV module into a computer. We used a 2 part epoxy to seal the camera inside. The reason we chose to use acrylic tube is because it is strong enough to withstand the water pressure, rather than a plastic bottle. Epoxy has the ability to leave no gaps for water to go through into the camera.

The camera systems's power are connected to 4 Underwater Camera Interface circuits. These circuits are capable of transforming 20-9 volts of electricity to 5volts, which the cameras runs on. The circuits consist of one 50v 100µF capacitor, 35v 0.1µF capacitor and a LM7805 voltage regulator. The capacitors are used to prevent damages from the short circuit while the voltage regulator is used to decrease the voltage to 5 volts in order for the camera to use. The circuit is based on a perfboard as it is a lot more flexible during maintenance and debugging. All of the power circuits are enclosed inside a waterproof enclosure with several outlet so that it is completely detachable from the ROV.



Camera circuit design

PRESSURE SENSOR

The pressure sensor is a relatively small and delicate device, and thus, during the soldering process, it requires definite precision. The pressure sensors after soldering is then waterproofed so that it can used underwater with full exposure. Our system uses I2C bus communication to interact with the pressure sensors and the data retrieved from the sensors is in mBar, in other words, 0.1 kilopascal. The main usage of the pressure sensor is to measure the depth of the ROV underwater. Our team has devised an equation (int)((pressure*100*1000)-101325)/(0.993*9.8) for calculating depth based on the equation pgh in fluid mechanics. The design of the system is that the pressure sensor will send data to the arduino underwater, then the data is processed into depth through the equation above and then send to the arduino above water through ethernet wire and softwareSerial protocol. The data will then display on the computer's monitor through an application we wrote in Processing, which reads the serial output of the data and display in an organized form on the screen.

TEMPERATURE SENSOR

The temperature sensor we have chosen for our ROV is model DS18B20. We deliberately chose DS18B20 as our thermometer as it's waterproof and it uses a Unique 1-Wire interface which requires only one port pin for communication. Our temperature sensor can accurately measures temperatures from –55°C to +125°C (–67°F to +257°F) with only ±0.5°C error.

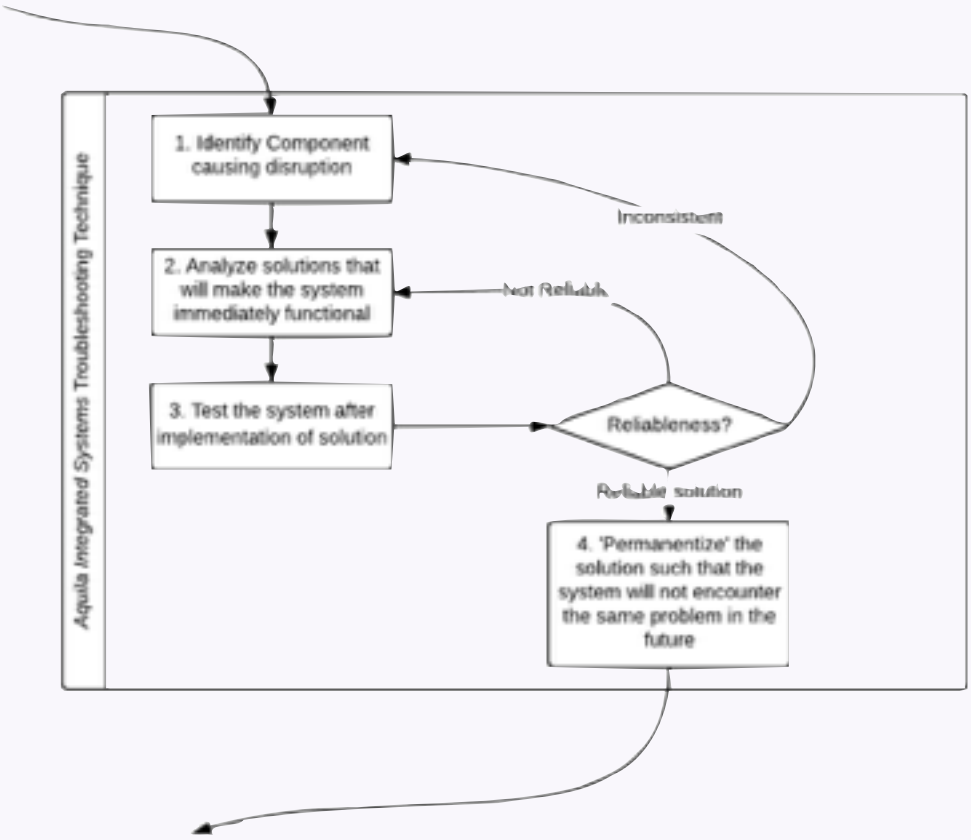
Diagram of sensor

RE-USE OF MATERIALS

Aquila Integrated Systems salvages and re-uses previous products (The Fried Eagle) solely for tests. With the upbringing of new and sometimes unconventional ideas, it is a certainty that members will have failed to account for errors, even after validation of the new system's and calculations. Prioritizing safety of the members, re-used materials such as motors, floats, and PWM have been worn-out, experienced leakage, and overheated to the point of flame ignition (respectively). This use of the obsolete items ensures complete development of our solutions, having tested and accounted for all factors (particularly any extraneous aspects that may affect operational performance), as well as test reliability of the system.

All materials that make the Aquila were never of The Fried Eagle. Parts with improved specifications are required for our company's progressing advancement of our solutions, thus our annual acquisition of brand-new materials is a testament to the company's growth.

TROUBLESHOOTING TECHNIQUES AND TESTING



SAFETY

Safety Philosophy

Safety in using the ROV is one of our primary concern when we were designing the ROV. The Aquila has been designed to meet the competition's safety requirements. No safety issue is too small for us. We employ this philosophy to our design and working habit. After multiple check and test, we have determined that our product meets all the safety standards of IET.

Safety Practices

The team follows strict safety procedures when the ROV is being constructed. We ensured that all electric parts cannot not have any gap for water to leak in and cause a short circuit. During our construction of the ROV, the crew must follow safety procedures. We ensured that the proper safety equipments are worn when using specific tools including saws and drill. Each engineer has received training on the correct use of the tool that were used during construction and every one followed a

Safety Check

Safety Checklist at Work	Check
Long Hair is tied back	
Gloves are worn when handling eproxy	
Hearing protection and safety goggles are worn when operating power tools and motor circuits	
Clear workstation completely after work	
Unplug soldering iron after use	
Never touch the metal section of the soldering iron, regardless circumstances	

Safety Checklist before Operating the Aquila	Check
All wires are securely connected to ROV	
Both ends of the tether are properly lugged in.	
Run system check (include motors, cameras sensors)	
ROV is securely connected to 12V DC battery.	

Safety Checklist when Operating the Aquila	Check
All staff around the pool are aware of the deployment off the ROV	
Only one member can act as pilot	
No member is allowed to touch the water pool when ROV is in operation.	

The Aquila's Safety Features

- Motor Shields has been used to prevent people from accidents caused by the blade of the propellers.
- The tether is tightly secured
- All sharp edges smoothened.
- 25A fuse on main power source.
- Each motor is fitted with a 5A fuse.
- The ROV is also designed to be light which would reduce the force and momentum during a collusion.
- Labels are tagged on wires to prevent users to connect device in the wrong polarity.
- yellow and black safety warning color indicators on motors and other hazardous items
- One camera is tied to the tether for full view of the ROV and its surroundings.

Incidents

Despite the fact that we have taken every single safety, there were still several incident during the development of our ROV. One of notable incident during the development of the ROV took place during the production of the motor control. The PWM circuit for our motor caught on fire during use. We have replaced the PWM circuits with a different model and we included wearing safety protection as one of the protocols when operating the motor circuits just in case. There was another incident when one of our member's hand was injured by a hot soldering iron. After this incident, we especially designed to items on the checklist concerning soldering irons to decrease the possibility of similar accident.

CHALLENGES

NON-TECHNICAL CHALLENGES

As a novice team, the main problems of the team stemmed from the fact that majority of the teammates were new to the team. Our progress was therefore often heavily reliant to few senior members and resulted in inefficient teamwork

Failing to sufficiently familiarize new members to our project also led to overall lack of motivation. Since many of the members were not fully aware of the necessary concepts or skills, their participation was often very limited.

Lack of organization was also a huge problem that emerged in this context. At the beginning, our team divided ourselves to several sub groups and assigned different tasks to each group. However, as each groups began to encounter more and more problems, the independent nature of each groups resulted in inefficient troubleshooting process that had to be coped only within the group.

TECHNICAL CHALLENGES

One of the main sources of our technical problems came from the Arduino. Failing to accurately wiring the PWM boards and the motors often burnt the Arduino, and members had to make unplanned expenditure in purchasing new sets of Arduino. After several trial and errors, we were finally able to solidify the connections.

Using a joystick to control the motors entailed several problems as well. First, the Arduino code didn't receive any signal from the joystick if the joystick lever was not tilted perfectly toward 90 degrees angle. This problem prevented us from manipulating the vehicle swiftly and smoothly, since it was it was impossible for us to tilt the lever toward precise right angles continuously.

Unwanted penetration of liquid was another major hindrance. First of all, careless waterproofing often led to fault in our cameras, buoyancy, and especially the robotic arm (the Arduino and other electric boards for the arm are enclosed in the watertight case that submerges underwater with the vehicle).

FINANCIAL REPORT

Budget and Expense Sheet

* signifies a donation

TYPE	ITEM	UNITS PURCHASED	UNIT PRICE (HKD)	UNIT PRICE (USD)	AMOUNT PRICE (USD)
Frame Section	PVC Pipe (2 metres)	One	$89 .00	$11.47	$11.47
Frame Section	Buoyancy Toilet Float	Two	$5.00	$0.64	$1.28
Frame Section	Watertight Electronics Enclosure	One	$299.00	$38.54	$38.54
Frame Section	PVC Glue	One	$5.00	$0.64	$0.64
Propulsion	Blige Pump Motors	Four	$150.00	$19.34	$77.36
Propulsion	Propeller	Four	$40.00	$5.16	$20.64
Propulsion	Propeller Adapter	Four	$80.00	$10.31	$41.24
Propulsion	Propeller Shield*	One	$49.50	$6.38	$6.38
Control System	Arduino Nano	Two	$89.00	$11.47	$22.94
Control System	Arduino Uno	One	$125.00	$16.11	$16.11
Control System	Joystick	One	$265.00	$34.16	$34.16
Camera	Rear View Camera (Automobile)*	Four	$206.00	$26.55	$79.65
Camera	Power Supply Circuit	Four	$35.00	$4.51	$18.04
Camera	Camera Circuit Enclosure	One	$110.00	$14.18	$14.18
Camera	Underwater Cable for Camera System	One	$158.00	$20.37	$20.37
Camera	Analog to Digital Video Signal Converter	One	$200.00	$25.78	$25.78
Camera	Four Channel CCTV Splitter	One	$497.00	$64.07	$64.07
Sensor	Digital Temperature Sensor	One	$35.00	$4.51	$4.51
Sensor	Pressure Sensor	One	$235.00	$30.29	$30.29
Sensor	Underwater Cable for Sensor System	One	$200.00	$25.78	$25.78
Arm	Servos	One	$241.00	$31.07	$31.07
Arm	Mechanical Claw	One	$123.00	$15.86	$15.86
Tools & Equipment	Drenal Drill	One	$1099.00	$141.67	$141.67
Tools & Equipment	Water Tank	One	$200.00	$25.78	$25.78
Tools & Equipment	Tool Box	Two	$150.00	$19.34	$38.68

FINANCIAL REPORT

Expense	Amount in HKD	Amount in USD
Frame Section	$402.70	$51.93
Propulsion	$1129.20	$145.62
Control System	$567.70	$73.21
Camera	$1722.10	$222.10
Sensor	$469.80	$60.58
Arm	$363.90	$46.93
Tools and Equipment	$1598.4	$206.13
Travel Expenses	$300.00	$38.69

Total Cost: $6,553.80 HKD $845.19 USD

LESSONS LEARNED

TECHNICAL LESSONS

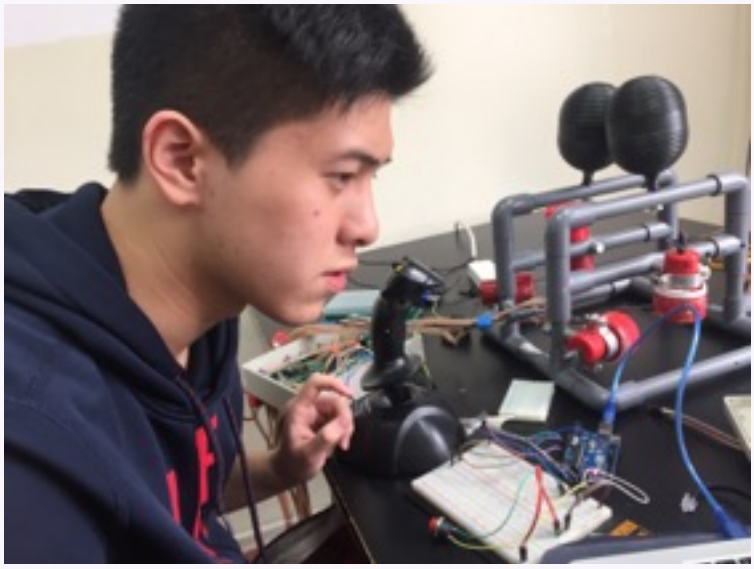
Learning from our challenges and mistakes while building the Aquila, we have learnt to always have extra arduino boards incase of incidents where the arduino is burnt or is failing to work. Junior members have learnt our team leaders how to code, work the sensors, and developing the design. We have also developed a stronger, more efficient design that been developed by learning from our mistakes in the previous year's design.

Mr. Kang and Billy Chan working on concept of ROV

LESSONS LEARNED

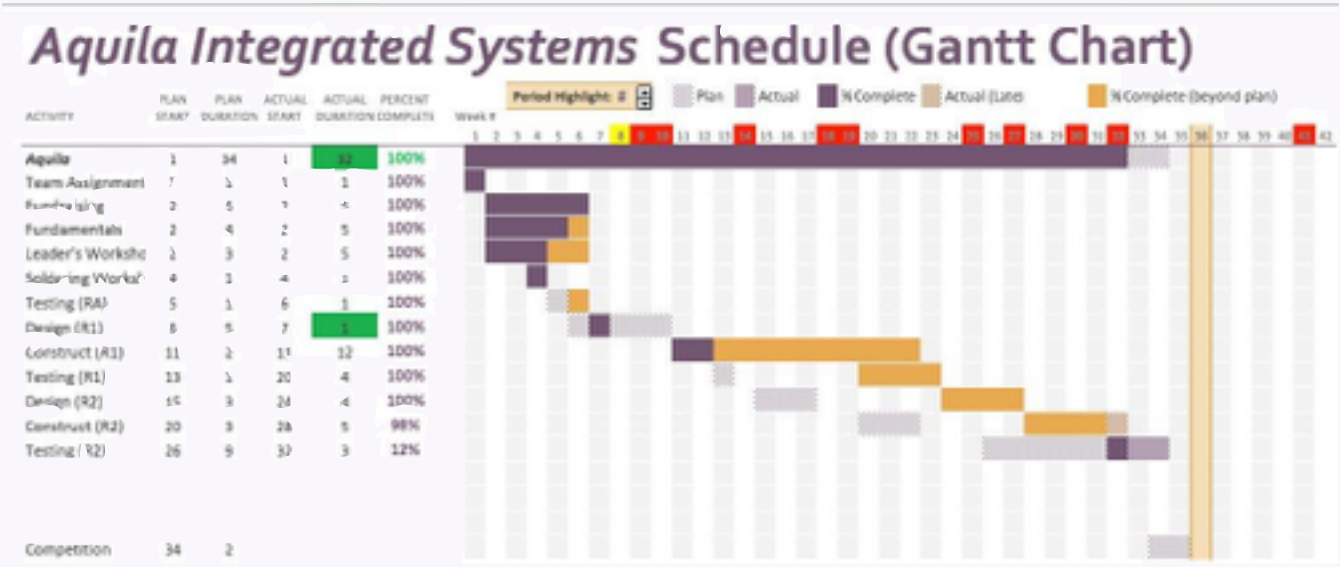
SOCIAL LESSONS

Learning from personal challenges that our team has faced, we have learnt to always keep our heads high and remind ourselves there is another way to overcome and fix any problems. We have learnt to always have a second plan and in some cases a third. Working in a supportive and friendly atmosphere allowed us to learn to be more patient and understanding whenever any technical and personal challenges are faced.



Ronald Ng working on fixing the Joystick

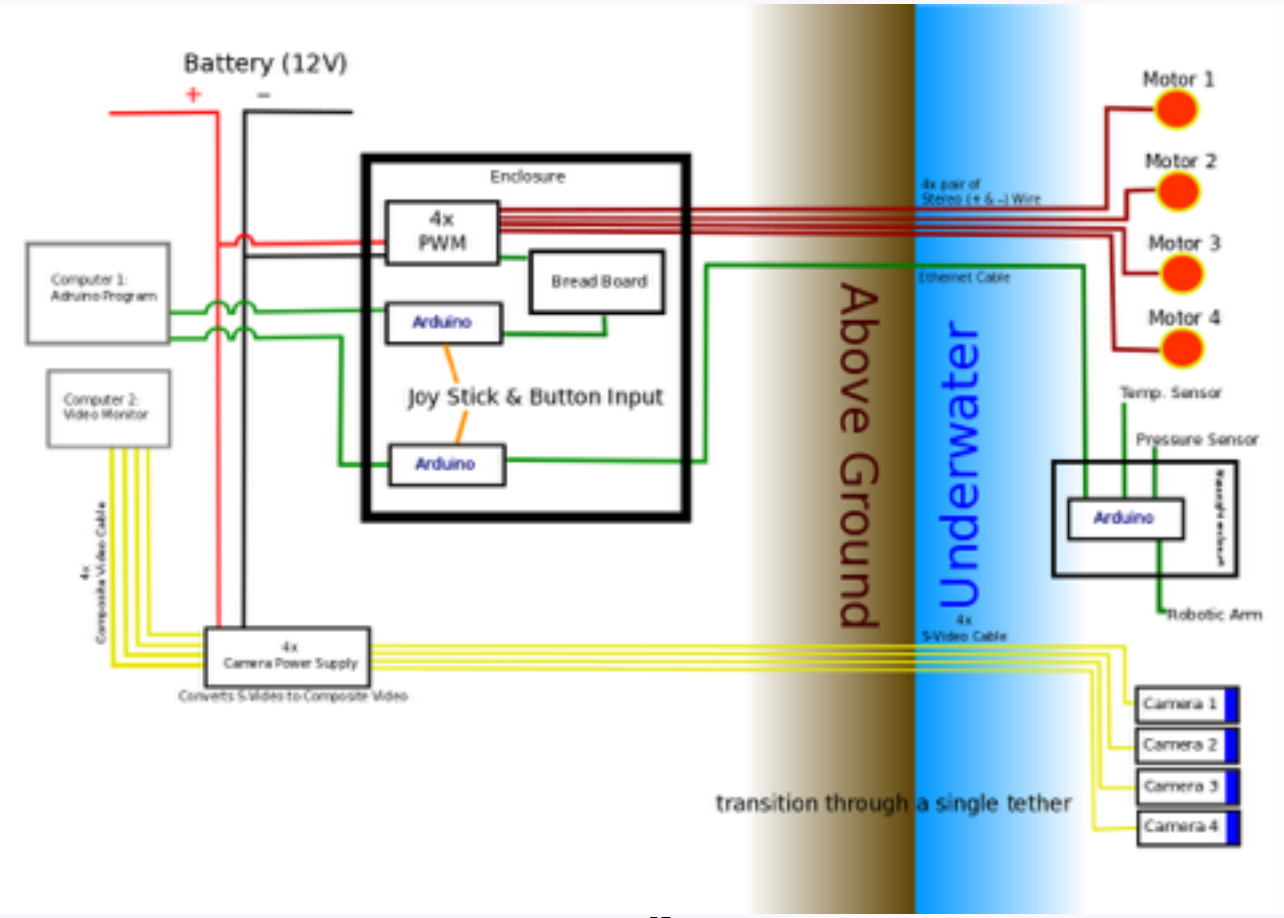
PROJECT MANAGEMENT AND SCHEDULE



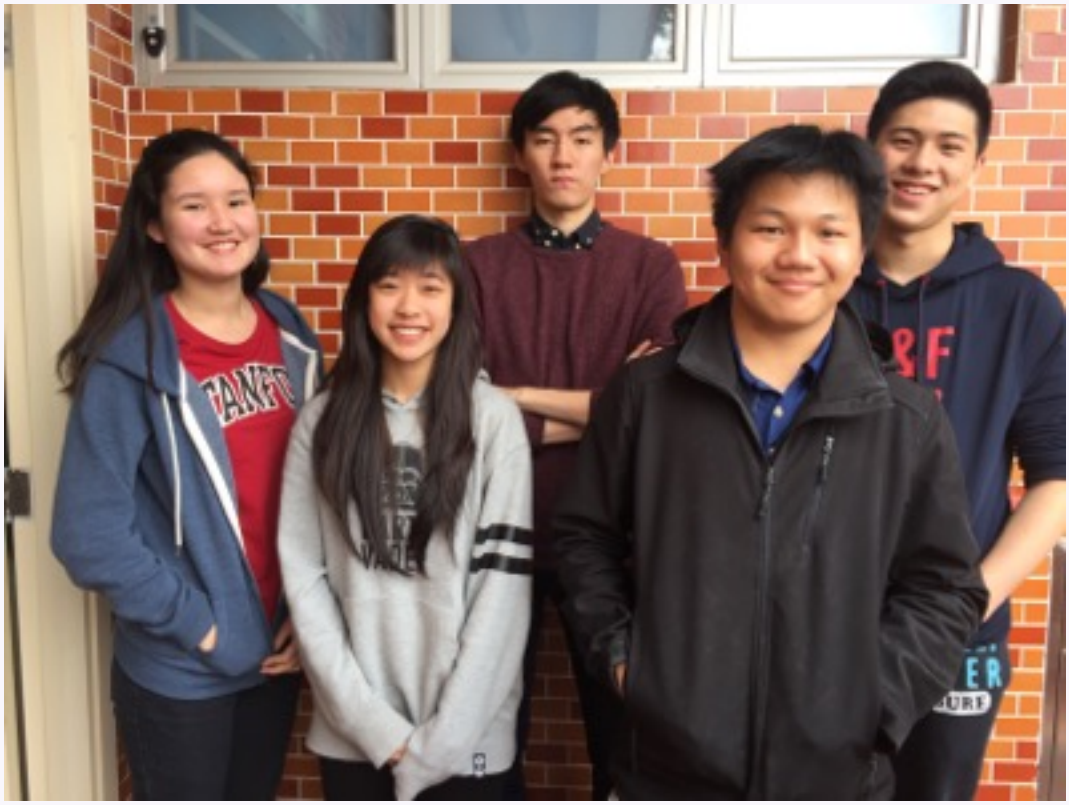
FUTURE IMPROVEMENTS

Two major areas that need improvements for our team are the following: Lack of passion and Lack of sessions. First of all, due to general incompetence of the members, our teammates frequently experienced limitation to their participation, which eventually led to low motivation. This unpleasant cycle went on and on and lingered as a main source of general inefficiency and low productivity. Starting next year, with more passion and enthusiasm, we believe that our members will be able to participate to their full potential and reach fruitful outcome with our Aquila. In regards to this fact, it is imperative that our members first become competent engineers and gain sufficient knowledge and skill to participate. The problem of this year was that lack of available sessions hindered the progress of our learning. Hence, in order to boost up the passion of the members in the future and expect improvements, Aquila's crews must first acquire sufficient time to hone their skills and contribute to their full potential.

SYSTEM INTEGERATION DIAGRAM



REFLECTIONS



Members of ROV Team
Back Row (left to right): Jamie Fox, Justin Bae, Ronald Ng
Front Row (left to right): Megan So, Thomas Low
Missing Members: Tony Kovari, Justin Lee, Justin Cheung, Tim Chen, Jeffery Kam

Justin Bae, Class of 2016

Although our team gathered and prepared for this competition as members of mere school extracurricular club, for me, it was a great opportunity to participate in an activity that I genuinely enjoyed. This competition gave me other several benefits. First of all, my experiences served as an excellent opportunity for me to apply the academic concepts, especially in Physics and Computer Science. By applying into tangible situations and objects, I was able to understand the concepts more clearly and easily, by which I even found chance to achieve pleasant outcomes for my academic endeavors as well. Also, as a team leader, my efforts in the club even allowed me to find opportunity to strengthen my capacity as a leader, through teamwork, resolving conflicts, and organizing the community. In the end, I regard my experiences preparing for this competition as a huge boon throughout my high school years and hope my fellow teammates to find pleasant benefits from this experience as well.

REFLECTIONS

Thomas Low, Class of 2016

This year is the second year I participate in the project. It is a great pleasure work with some old teammates. It is also great to see some new members participating in this project. As I am already familiar with the project I have helped my teammates to start training the new members in advance. I am currently leading the team of freshmen to build the camera system. I particularly enjoy the process of debugging the circuits. I am glad that I am able to use my knowledge from physics and maths to this project. By doing actual application, I am able to understand the subject more. Leading a team of freshmen also helped me on my communication and leadership skills. My experience working in this project has been a great part of my high school life, and I hope my teammates are benefit by this project the same way as I did.

Jeffrey Kam, Class of 2017

The two core values of engineering for me are exploration and problem solving. During the course of the ROV making process, I have enriched myself in those 2 values. I always try to explore new and more efficient solutions to the existing system, trying to improve it with better code and higher efficiency design. For example, from researching online, I realized that ethernet wire at CAT6 has really low resistance, and thus useful for our design for transferring data between underwater and on ground arduinos. This year, I also have to teach some of the freshmen how to integrate hardware into arduino and write a program that works perfectly uninspected. This new experience allows me to be a better communicator as i always keeps the idea and thinking process to myself and often explain concepts in an overcomplicated way. As one of the main programmer and electronics engineer in the club, I wish train some of the members on the team to have individual problem solving abilities and the heart to explore so in the future after i left, those will be able to make the team thrive with their ability to problem solve and guide the team to explore for new solutions.

Tony Kovari, Class of 2019

This is the first year I worked on any ROV and I learned a lot from the experience juniors and seniors in our team. We are very fortunate to have a great team leader that can motivate people to work and allow time for new members to get a look and feel of the work process. The designs and code made by our senior members benefited the team greatly, without them perhaps we would be behind schedule more than last year.

REFLECTIONS

Justin Lee, Class of 2019

After almost a year of being in engineering club, I have learnt a lot about engineering in general. This club was my first approach to learn about engineering. Throughout this year, I have learned how a ROV works and the safety precautions we have to take while engineering. My contribution to this ROV is working on the temperature sensor. With the help of a very advanced programmer and a teacher, I have successfully made a working temperature sensor with another freshman who also had no experience in programming programming. I look forward to seeing what I will able to accomplish next year with the knowledge I have.

Tim Chen , Class of 2019

This is my first year in high school and the ROV team, so there were and still are a lot of things I don't know. But throughout this year, I have learnt more and more on engineering in general from the seniors and juniors in the team. I am currently working on the pressure sensor with a fellow freshman; it isn't an easy job for us since we had no experience with engineering or arduino coding. But with the help from our teacher Mr Kang and other seniors/juniors, we had successfully made a working underwater pressure sensor. During this experience, I had enhanced my problem solving skills as well as my cooperation skills. I look forward to learn more and do more to help our ROV team in the future.

Michael Chan, Class of 2019

During the course of this club, i have learnt a lot about engineering. This was my exposure to engineering, so I had no knowledge that I can apply to this club. I have learnt a lot about arduino and also where to get tools to use. One major contribution I gave was the temperature sensor. First, we had to make sure the sensor was waterproofed. Then, we had to overcome a lot of bugs that prevented the code from working. After successfully running the code, it still did not show the temperature. With the help of seniors, juniors and the teacher, I have successfully made my first working physical product along with a working code.

REFLECTIONS

Jamie Fox, Class of 2019

As a freshman in High School this year, I had set a goal to myself this year to learn and experience a range of clubs and teams that would help broaden my learning experience. I decided to join the ROV team as it seemed every different and interesting to learn about. Although I was a newcomer and did not know much about how to build an ROV, the senior members were very welcoming and patient. I have learnt so much from being apart of this amazing journey from attending workshops, making the cameras waterproof, and also designing this report. This has truly been a wonderful experience and I am very excited to continue this project.

Megan So, Class of 2019

As a student attending AIS, the engineering club is one of the only non-athletic clubs that stood out to me. This being my first year at the AIS engineering club, I thought it was a very enlightening experience and experiences are the best teachers for everything. I had no knowledge joining the club and through the club, I learned new skills, for example assisting and waterproofing the cameras. Not only was I able to learn new things, but I was also able to meet great new people. Our club was charmed to have an amazing teacher, Mr.Kang, who guided us through our difficulties alongside Bill, our club's senior president.

Ronald Ng, Class of 2017

In these two years working on this project, I've encountered various challenges, learned different variety of things and met different people. The first year we join this competition, our team was compact, and had similar idea; it was really smooth working with them. This year, our team grew exponentially, many new members joined coming up from middle school, each and every excited for learning new things about engineering. As a senior member of this club, I was lucky to be able to teach the new members of the club about experiences that I've learned last year. Joining this competition inspired me a lot, I was surprised that we don't even know majority of the world we live in because there's still so much that we still haven't discovered in the ocean yet. Also, I was greatly enriched with the problem solving skills I learned by joining this competition, the critical thinking and the team communication was something that I really enjoyed while working on the ROV. I hope to spread the knowledge and the fun of engineering to more students in the future.

ACKNOWLEDGEMENTS

Aquila Integrated Solutions would like to thank and appreciate all the donations and sponsorships we have received. We couldn't have accomplished the Aquila without our wonderful sponsors. Thank to MATE/IET for providing us the chance to compete and develop our critical thinking skills along the way. We also appreciate the American International School for providing us the space and sponsorship for the Aquila. Also, we would like to thank the donations that were donated from the inspiration night our company hosted to raise money for our projects that need funding. The inspiration night helped fundraise over $3000 HKD / $386.88USD. Lastly I would like to thank our teacher and team supporter Mr. Eunsup Kang. He has spent mass amounts of time helping and guiding us to where we are now.