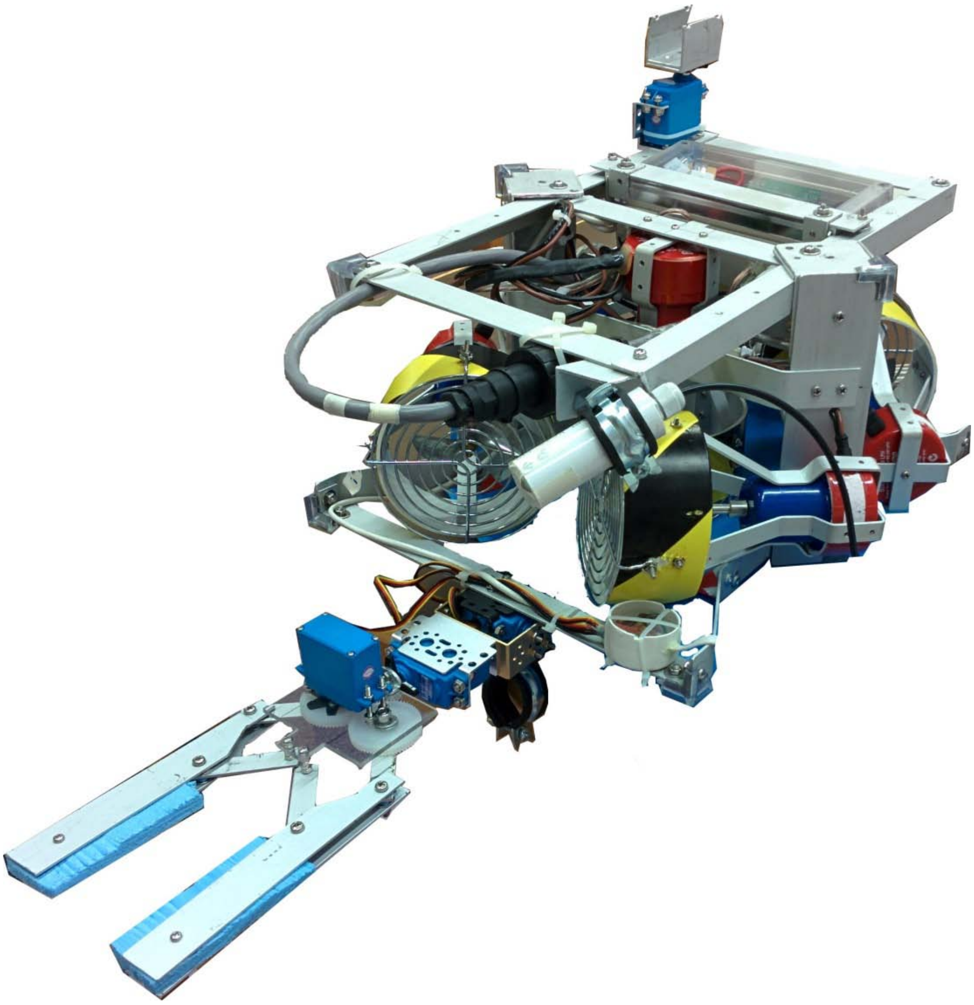
NEWTYPE
INDUSTRIES

Po Leung Kuk Ngan Po Ling College, Hong Kong, China

The IET/Marine Advanced Technology Education (MATE) Hong Kong Underwater Robot Challenge 2014
Ranger Class



Po Leung Kuk Ngan Po Ling College ROV team:	
Team instructor	**Mr. Boby Chan**
Mentor	**Jacky Leung**
CEO, Lead Electrical Engineer	**Donald Chai**
Lead Mechanical Engineer, Pilot	**Jonathan Wong**
Research and Development Head, Co-Pilot	**Kaneko Shoyu**
R&D, Poolside Operator	**Stitch He**
R&D, Chief Financial Officer	**Kaiser Fan**

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Abstract

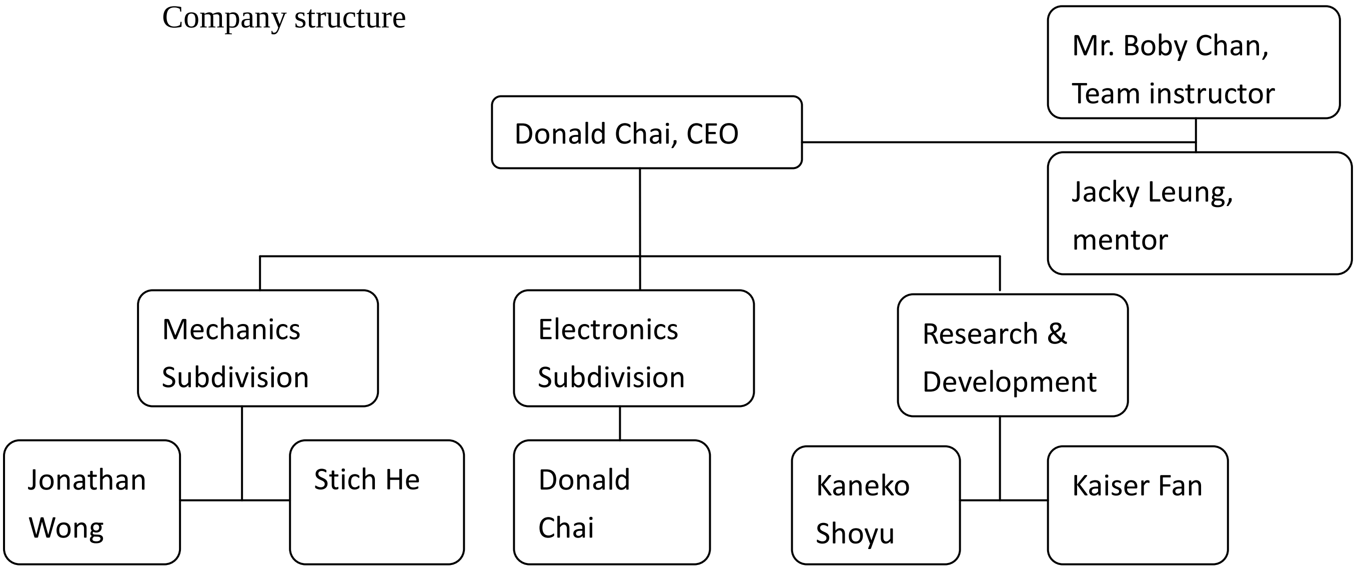
The 2014 Marine Advanced Technology Education (MATE) ROV competition revolves from shipwreck investigation, sinkhole observation and conservation in Thunder Bay National Marine Sanctuary. The National Oceanic and Atmospheric Administration's (NOAA) Office of National Marine Sanctuaries (ONMS) is interested in the capability of ROVs in the works mentioned above.

In order to meet the requirements of the above working conditions, the Newtype Industries has designed Type-II. Type-II is a remotely operated vehicle (ROV) which is capable of exploring, documenting and identifying deep-sea ship wrecks, conducting ocean floor observations, collecting samples as well as removing trash and debris from ocean floor.

Newtype Industries is not an ordinary company that aims to produce functional units for commercial purposes. We aim to incorporate innovative materials into our products' designs, and ultimately, bring revolutions to the ROV industries.

This report describes and illustrates the main components, the production processes, possible future improvements of Type-II. It also includes information on the Thunder Bay National Marine Sanctuary (TBNMS). Acknowledgement, information on themes, references and appendices are included at the end of the report.

Company structure



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Po Leung Kuk Ngan Po Ling College

The IET/MATE Hong Kong Underwater Robot Challenge

Type-II

Budget Sheet

Category	Item	Unit Cost (HKD)	Quantitiy	Acquisition	Total Cost (HKD)
Frame and Manipulator	Aluminium Strip (Width: 24mm)	150.00	N/A	Purchased	150.00
	Aluminium Strip (Width: 12mm)	150.00	N/A	Purchased	150.00
	Aluminium Strip - L shape (Width: 50mm)	80.00	N/A	Purchased	80.00
Propulsion	500 GPH bilge pump	172.00	4	Reused	688.00
	550 GPH bilge pump	220.00	4	Reused	880.00
	Extention tube + Propellor	80.00	8	Purchased	640.00
	Water Pipe (Diameter 110mm)	100.00	N/A	Purchased	100.00
Control System	Arduino Mega2560	280.00	2	Reused	560.00
	Pololu VNH2 & VNH3 Motor Driver	420.00	3	Reused	1260.00
	Kitsrus DIY Kit K68 - Voltage Regulator	75.00	1	Reused	75.00
	Speaker Wire	300.00	1	Purchased	300.00
	Fuse Box	10.00	10	Purchased	100.00
	Banana jack	4.00	10	Purchased	40.00
	Water-proof Box (165x85x55)	65.00	2	Purchased	130.00
Camera	Door-eye camera	300.00	3	Purchased	900.00
	Material for making the water-proof housing of camera	100.00	3	Purchased	300.00
	Video Cables	200.00	1	Purchased	200.00
	Video Signal Wires	10.00	5	Purchased	50.00
	Sunpo SP-460A Color Duplex 4 Pictures Processor	270.00	1	Reused	270.00
Mission Tools	SANWA YX-361TR	480.00	1	Purchased	480.00
	Wires	50.00	1	Purchased	50.00
	12V DC motor	30.00	2	Purchased	60.00
	Waterproofed Servo Motors	350.00	4	Purchased	1400.00
Miscellanous	Epoxy	25.00	4	Purchased	100.00
	Clear Epoxy	240.00	1	Purchased	240.00
	Shock Absorber	20.00	1	Purchased	20.00
	Heat Shrink Tube	50.00	N/A	Purchased	100.00
	Screws	100.00	N/A	Purchased	100.00
	IMU gyroscope				
				Total Cost:	9423.00
				Total Expenditure:	5690.00

Design rationale: ROV

Overall vehicle systems

This year, Newtype Industries has taken a new approach to our ROV, Type-II. After series of brainstorming and discussions, we have decided versatility, agility, stability and user friendliness in performing maintenance works are the overall rationale in designing Type-II.

Moreover, functional requirements, such as manipulation of objects and collection of data for the tasks mentioned by MATE Centre, are included. Precise movement is crucial to complete these tasks. Thus, manoeuvrability is one of our main concerns when designing the vehicle system.

After drawing up our rationale, we have divided our engineers into 2 groups. One is responsible for designing the core structure while the other group is responsible for researching and designing specific components for the required tasks. When manufacturing the parts, designs may be alternated so as to adapt to the limitations of the tasks such as inadequate strength, availability of space and other feasible operating conditions.

To manufacture our product, separate components are bought, modified and assembled onto our ROV. Although this is time consuming, we were able to assemble our ROV with flexibility and originality at a low cost. Waterproofed motors, waterproofed servos, propellers, wires and circuit boards are the only commercially available items which are used in our ROV system. Newtype Industries currently do not manufacture such components. As bending aluminium strips accurately requires more experience in craftsmanship, our mentors have provided us with assistances during the manufacture of the frame.

Although Type-II is a successor to prototype Type-I from last year, we have only a few reused parts in our ROV due to their versatility and stability. The reused parts include circuit boards and propulsion unit cores. Re-using these parts help us to cut cost and promote environmental friendliness. It also retains optimal functionality of the ROV as it is a revolutionized design.

Frame

The ROV frame is a cubic design. It is made of aluminium alloy which provides a rigid and corrosion resistant framework at a low cost while maintaining certain degree of extension possibilities. Our frame consists of different modules, which includes the top, the bottom platform and the core. They can be detached from the extensions so as to users performing maintenance at ease. Weights or ballasts can also be mounted on designated areas to achieve neutral buoyancy conveniently. Furthermore, as the frame is a skeleton frame, contact surface area with water is reduced and water resistance will be relatively lower. Originally, the team was intended to use a plastic frame which is light and flexible. However, the material is not stiff enough to hold the extensions. Also, aluminium frames are less bulky than plastic frames. Therefore, aluminium frame is employed.

Manoeuvrability

Type-II is designed to perform precise movements with agility. The propulsion system of Type-II is made up of eight motors adapted from 12-volt 500GPH bilge pumps. Propellers with extension shafts are installed onto the pumps. As a revolution of our ROV production line, the Type-II adopts the "4-vector" motor mounting configuration for optimal manoeuvrability. In addition to simple translational movements, such configuration allows the ROV to perform rotation along its centre of gravity with great torque. All four motors in the horizontal plane work at the same time, so no motors will be redundant during operation. Four motors are placed at four different top corners of the frame as vertical motors. The power of the front and rear vertical motors can be fine-tuned independently. These layouts facilitate stability of the ROV during vertical movements. Thus, agility and efficiency are both incorporated into the manoeuvrability of Type-II.

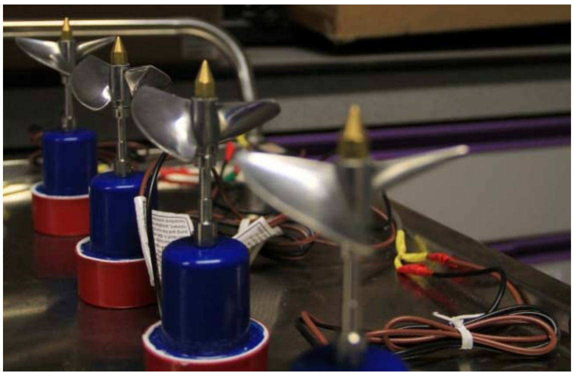


Fig.1 Our modified bilge pumps as propeller driver

Control system

Like previous models of Newtype, the operation of Type-II requires 2 pilots, one for controlling the ROV and the other for controlling the manipulator. This allows each pilot to focus on one task at a time. Type-II inherits the digital control system of its predecessor from Type-I which uses programmable Arduino boards for the controls. Potentiometers and joysticks are used for signal input in this system. Arduino boards are used as processors and programmes are written to interpret signals issued by pilots.

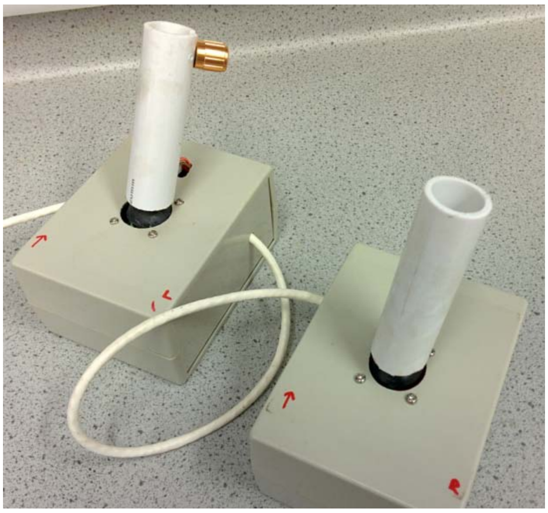


Fig. 2 Main ROV control

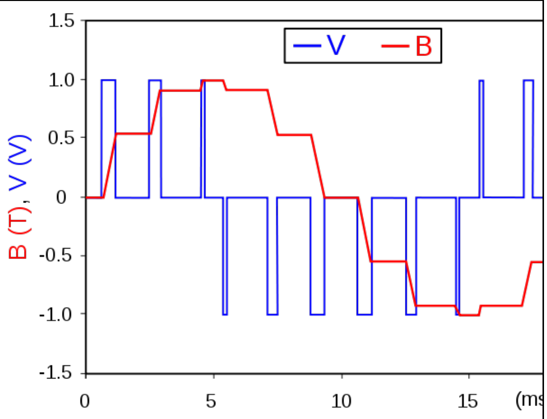


Fig. 3 PWM control example
V: voltage, B:magnetic field strength in motor

The controls and programmes are tailor-made to suit the needs of our pilots in different operating conditions.

Regarding to the ROV control mechanism, when the pilot moves the joysticks, the joysticks send signals to the Arduino. It then interprets the signals and sends PWM (pulse width modulation) signals to motor drivers on the board of the ROV. The motor drivers then power the motors. As for the manipulator control mechanism, it is in a similar fashion with ROV control mechanism, but the Arduino sends digital signals to the manipulator.

One of the advantages of using Arduino boards, PWM signalling and motor drivers is that the output of the propulsion unit is linear while operating at a constant 12V power input. Compared to mechanical switches which can only offer on/off output, our software control facilitates agiler manoeuvrability of the ROV. Also, maximum output power of the motor could be set in the Arduino to maximize efficiency and/or to act as a power limiter. These facilitate precise movement of Type-II. Adopting software control sacrifices the stability and low cost offered by mechanical control. However, software control is less stable and costs more compared to mechanical control.

Electronics layout

Fig. 4 Quick fit poolside electronics box

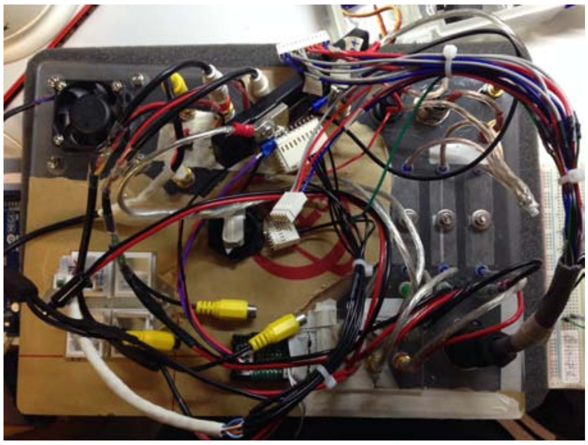


Fig. 5 Wirings under plate

Electronic components are placed in two containers. One is placed at the poolside while the other is mounted onto the ROV. The poolside box contains most of the components, including Arduino boards, voltage regulators for Arduino and cameras, video splitter, power connections and tether connections. This layout keeps most of the electronic components away from water, which also significantly increases the stability of each electronic component. For user-friendliness, wirings and chips are hidden under an acrylic plate. This arrangement prevents wirings from exposing from water to provide a tidy connection interface. Connections are mounted on the plate for set-ups with efficiency and ease. As for the container mounted on the ROV, it contains 3 Polulu motor drivers and a Mini IMU gyroscope. The motor drivers must be placed onto the ROV to allow the use of only 1 power cord and split independently supply power to different motors. The sensors also have to be placed onto the ROV to measure its orientation. So, a waterproofed box is installed so as to house the motor drivers and gyroscope of the ROV.

Fig. 6 ROV electronics box

Fig.7 polulu motor driver

Arduino

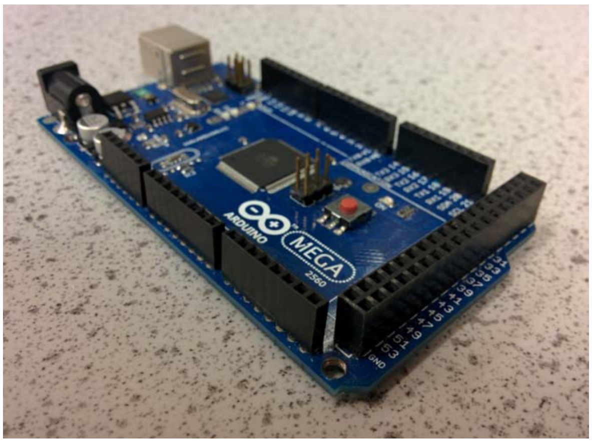


Fig. 8 Arduino mega 2560 board

The Arduino boards are signal processors of the ROV. We chose Arduino boards for processing since they are highly programmable and they have sufficient slots to attach motor drivers and sensors. We have written programmes for controlling the ROV and manipulator. Programmes for interpreting signals from sensors are tailored as well. In total, we have used 1 Arduino Mega board and 1 Arduino Uno board. Compared to Type-II's predecessor, we have cut down from 3 Arduino boards to 2. Programme variables, such as speed of propeller and sensitivity of potentiometers, can be changed easily to adjust for mission requirements.

Tether and wiring

Fig. 5 25-pin cable connector

Fig. 6 Tether

The tether consists of 8 cables (one 25-pin signal cable, four video cables, two 4-pin cables, and one power cable). The 25-pin signal cable is employed since it is flexible and able to provide right amount of signal wires for our main controls and sensors. The flexible 4-pin cables are used for servo controls for the same reason. Digital control allows power to be split by motor drivers inside the electronics box on the ROV, so only 1 power cord is needed. When compared with analogue models that require at least 13 cables (including 6 sets of thick power cords) for the same setup, our tether is much more compact and effective. Furthermore, the tether outlet will be positioned at the centre of Type-II to minimize movement restrictions caused by the tether.

Except those for motor drivers, all wirings are inside the electronics box, the electronics box and on-board motor driver box are centralized on the ROV. This configuration allows users to trouble shoot electronic failures easily.

Cameras

3 waterproof door-eye cameras and a wide-angle camera have been installed onto our ROV. The door-eye cameras and wide-angle camera provide fields of views from 50° to 170° respectively. They provide clear image with adequate range of field of view. The cameras are waterproofed by our engineers to cut cost and they are highly adaptable underwater.

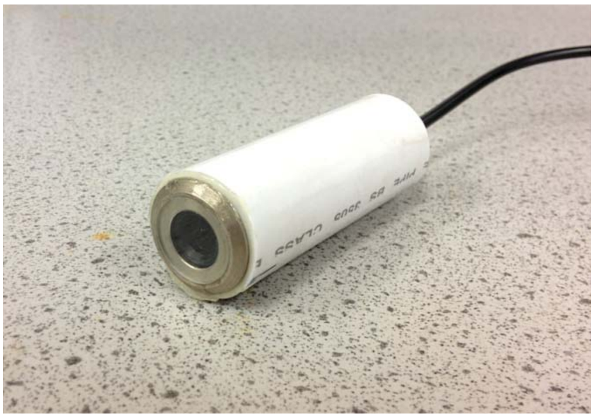


Fig. 7 Waterproofed camera

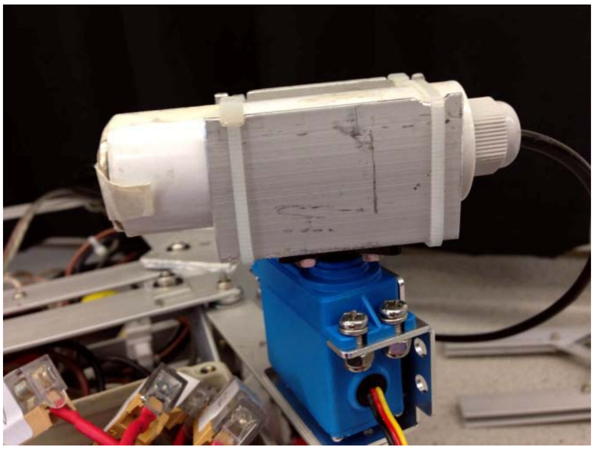


Fig. 8 Camera on servo

The waterproofing process is inspired by a demonstration from a MATE advanced workshop. We solder the essential connections of the cameras and keep them in PVC water pipes. Next, clear epoxy is filled into the pipe. Clear epoxy seeps into the wires and blocks water from penetrating into the wires. In addition, this technology allows us to make the smallest camera ever produced by Newtype Industries.

The cameras work perfectly even though they are immersed in water of 2 meter depth for 160 hours. This shows that our cameras are ready for underwater missions. The cameras are mounted by pipe holders on the frame. Refer to Page 15 of the report for the camera configurations. 2 cameras are mounted on waterproofed servos. These cameras can be rotated by the servos to change the viewing angle. These give a larger field of view to the pilots.

Safety

Safety philosophy

Safety is one of our major concerns in designing and constructing our ROV. Possible safety hazards are eliminated or reduced at all costs. Potential hazardous parts of our ROV include electronics, propellers, manipulator and sharp edges of the frame. For electronics, electronic parts are prone to problems caused by water penetration. Salty water and water with ions are conductive to electricity so short circuit of electric components will occur and create electric hazards. For the latter three, they may cause physical injury. For example, propeller rotating at high speed can hurt fish or any other objects in water seriously.

Apart from safety concern while the ROV is in action, Newtype Industries is also aware of safety issues during production of the Type-II. According to the injuries record, it is reported that cuts due to sawing and drilling happened quite frequently. Therefore, we have introduced safety measures like, when entering the Physics Lab, engineers must follow all safety precautions in laboratories such as wearing safety spectacles. Engineers who are working with dangerous tools or machineries must go through the instruction manuals so that they know how to operate them properly and safely. They must put on protective gear as well.

Safety features

Waterproofed connections

Various wire connections are outside of the electronics boxes. They should be waterproofed so as to prevent electricity leakage. From past experiences, we have learnt that just a layer of epoxy is not enough for waterproofing. Wire connections are now coated with a layer of epoxy, and wrapped with heat shrink method. To protect vulnerable parts, such as the 25-pin signal wire connections and camera connections, we have used silicone gel and clear epoxy to seal off wire connections. They can also seep into the small gaps between wires and then harden to seal as many gaps as possible.

Fig. 10 On-board fuse

Electronics

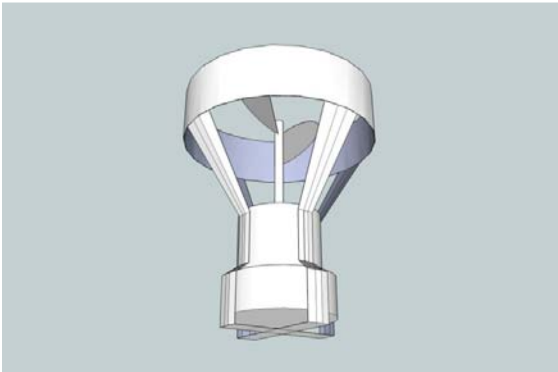
Fuses with suitable ratings, a voltmeter and an ammeter are installed in the electronics box. With independent fuses installed for each motor to the motor driver box for safety lest there are short circuit or other electrical problems. The fuses cut the power when the current is too strong; meanwhile, the voltmeter and ammeter alert the pilot of abnormal power consumption.

Propellers, edges and manipulator

As propellers and sharp metal edges may cause injuries when they collide, safety measures are employed to avoid hazards.

To prevent collision of propellers from happening, Newtype Industries have developed a new integrated motor mount. When mounting the propulsion units onto the ROV, the mount also help to block foreign objects. All propellers are installed inside the ROV frame, so they will not protrude and hit living things. Besides, the propeller casings are painted with bright warning colours so that foreign living creatures may notice its presence. Sharp edges are also filed and polished smoothly to prevent injuries if collision occurs.

Fig. 11, 12 Integrated motor mount



Sensors

Sensors are installed on board the Type-II to measure the movement of the ROV. They include a Mini IMU integrated sensor and a depth sensor. The Mini IMU sensor is an integration of gyroscope which shows rolling angles, a compass which indicates directions, and accelerometer which measure the acceleration speed. The Mini IMU is used since it is small but it provides us with the functions we need. Data provided by the sensors are interpreted by the Arduino board to show the orientation and movement of Type-II. This allows the pilots to control the ROV with more reference points.

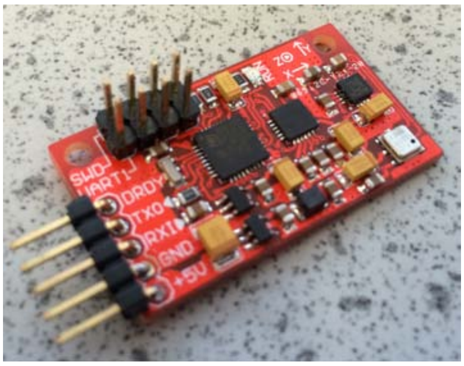


Fig. 13, Mini IMU integrated sensor

The accelerometer and depth sensor can also measure the dimensions of the shipwreck or other kinds of surrounding. By moving the ROV along the sides of the shipwreck, data from accelerometer can be used to plot a velocity-time graph. The distance travelled is the area under curve (By velocity x time = displacement). By moving the ROV from the bottom to the top of the shipwreck, different depths can be recorded and measured. The difference of depth is the height of the shipwreck.

Design rationale: Task

Manipulator

We have been changing our design of our manipulator to suit MATE's tasks. Our current design of the manipulator (Paros arm) facilitates 3 high torque waterproofed servos for pitching, rotating and grabbing. High torque servos are installed to facilitate solid grips underwater. The servos are controlled by a user-friendly software programme. Flutter boards are sandwiched between the manipulator plates to reduce load on servo motors (only when underwater). Anti-slip tapes adhered onto foam boards are attached to the inner side of the manipulator to increase both kinetic and static friction of the manipulator to facilitate solid grabbing. As missions mainly require picking up and transferring matters, the manipulator is able to grab hold of things tightly so as to complete the tasks.

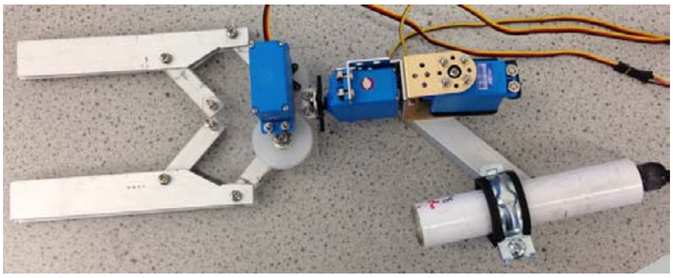


Fig. 14 Manipulator with camera mounted

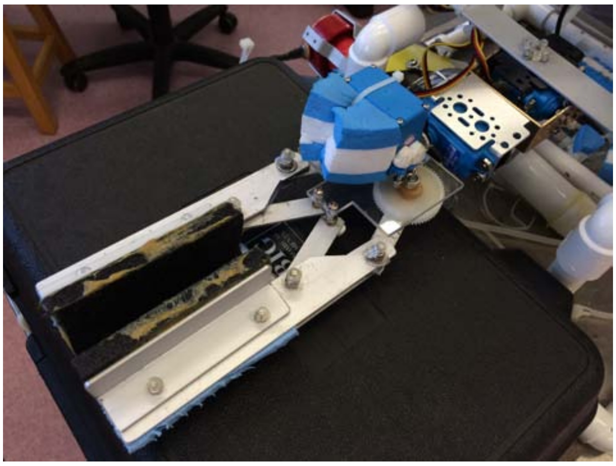


Fig. 15 Manipulator with anti-slip tape and foam board

Submersible LED illuminator

To light up the dark environment of the ocean bed and interior of the shipwreck, our engineers has adopted the LED lamp design from the MATE advanced workshop. It is a 5V LED lamp connected with a 10W100ΩV ceramic resistor in series. Therefore, it can be powered by the 12V mains. It is waterproofed in a similar way we waterproof our cameras. This helps to cut cost as we do not have to buy commercial waterproofed

12V lamps. The LED lamps are used due to its brightness and energy efficiency. Most important of all, they are durable.

Conductivity probe

While Newtype Industries aim for revolutionary design, we also believe simplicity is the best. To complete the task of comparing conductivity of solutions in a sealed-sinkhole underwater, we use an analogue multi-meter to estimate and measure the resistances of the solutions. The lower the resistance is, the higher the conductivity of a material it is. Thus, conductivity can be compared. A simple design of attaching two shaped-probes to the arm of ROV is sufficient enough to penetrate the sealed-sinkhole containing the solution. A simple multi-meter is adapted and fine-toned to compare the conductivity of solutions underwater as well. Due to the simplicity of this task, there is also no need to use digital sensors as well. This also saves the cost for purchasing digital sensors and saves time cost for writing programmes to process the collected data.

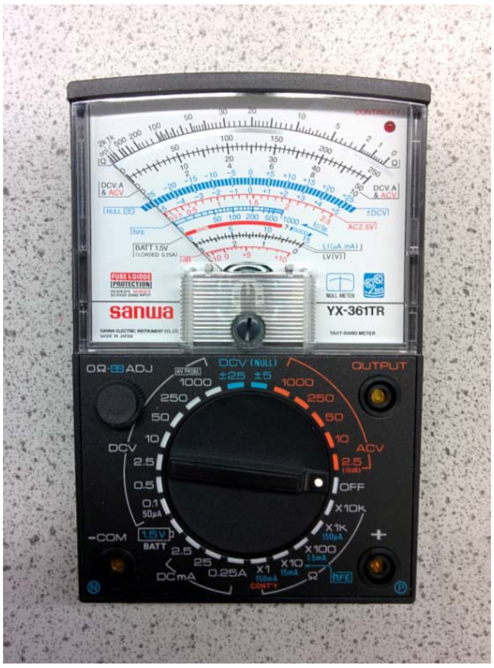


Fig. 16 Sanwa YX361TR adapted for conductivity sensor

Extractor

In order to extract samples of microbial mat from waterbed, our research and development team has developed a quick-fit extraction tool. A pipe with an enclosed blade connected to a DC motor is fitted to the bottom of the ROV. During an extraction, the motor rotates the pipe together with the blade to penetrate into the microbial mat. At the same time, the down force of the propellers help the blades "cut" the microbial mat slice by slice. The pipe also acts as the sample holder to store the samples from the "cut" before retrieval at poolside.

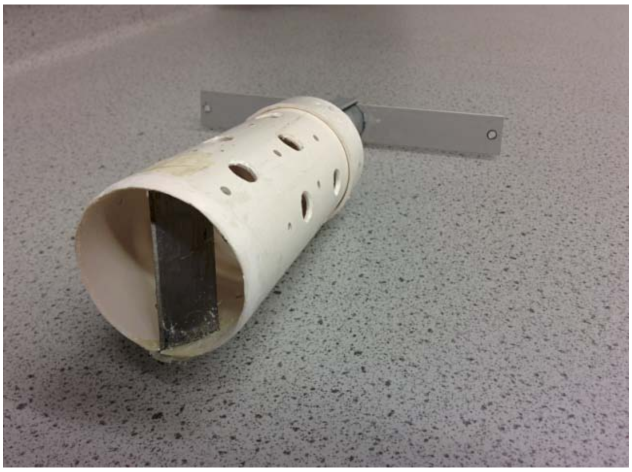


Fig. 17 Extractor with blade shown

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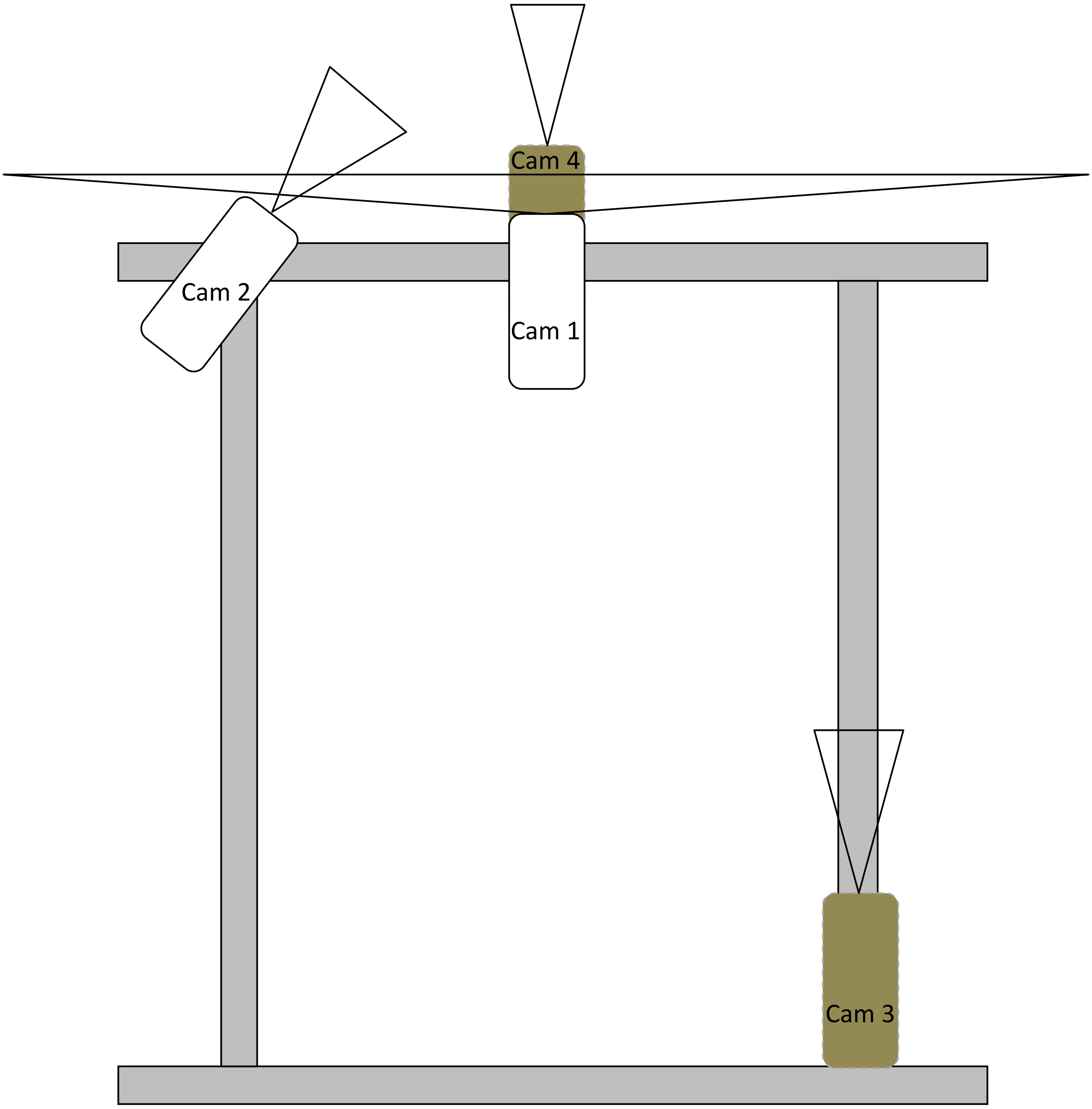
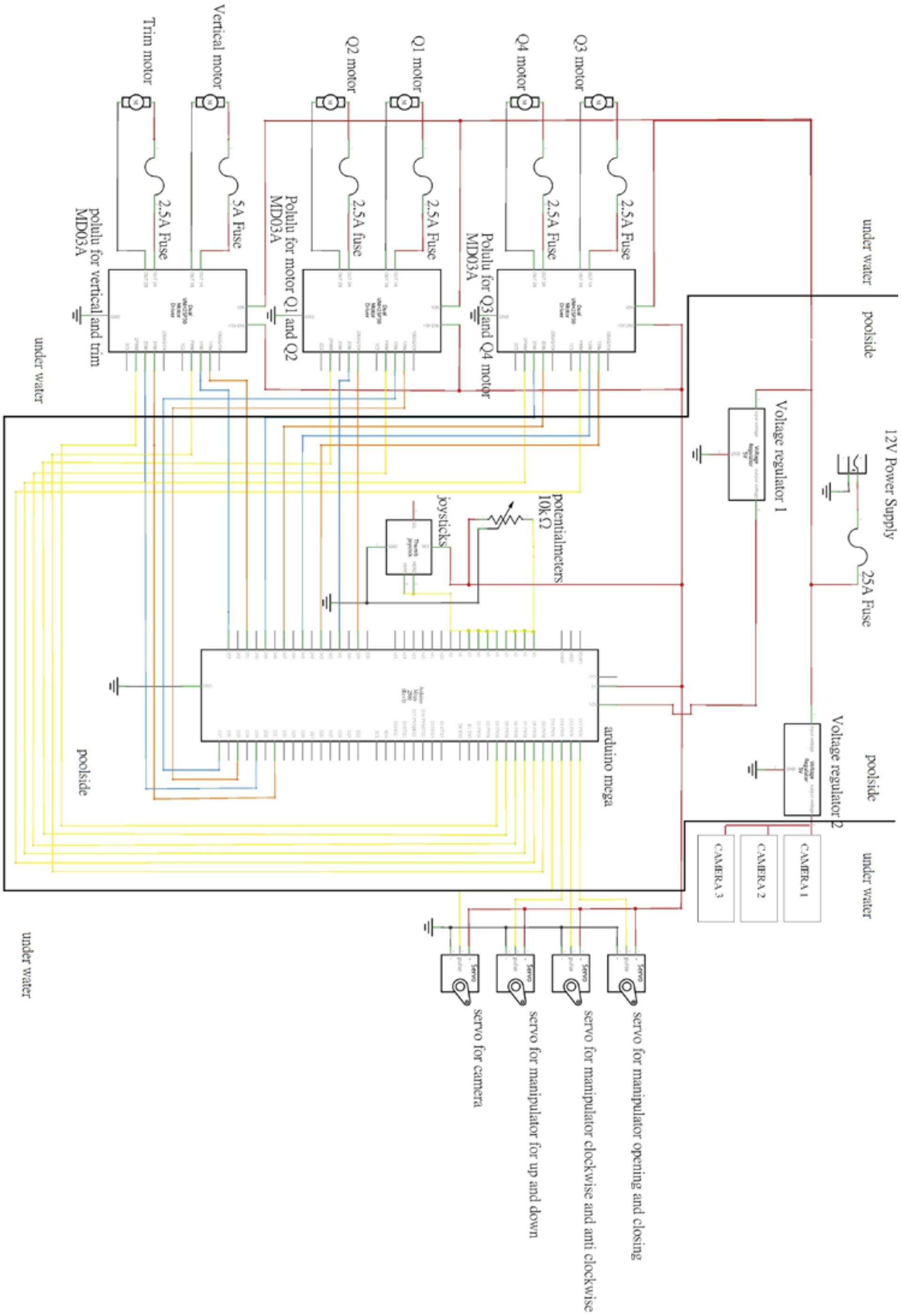
Configuration of Cameras



Camera	Angle of view	Servo installed	Ability of Motion
Cam 1	170^o	No	NA
Cam 2	50^o	Yes	Up-Down in vertical plan
Cam 3	50^o	Yes	180^o along the forward direction
Cam 4	50^o	Yes	Move together with manipulator

Electrical Schematic



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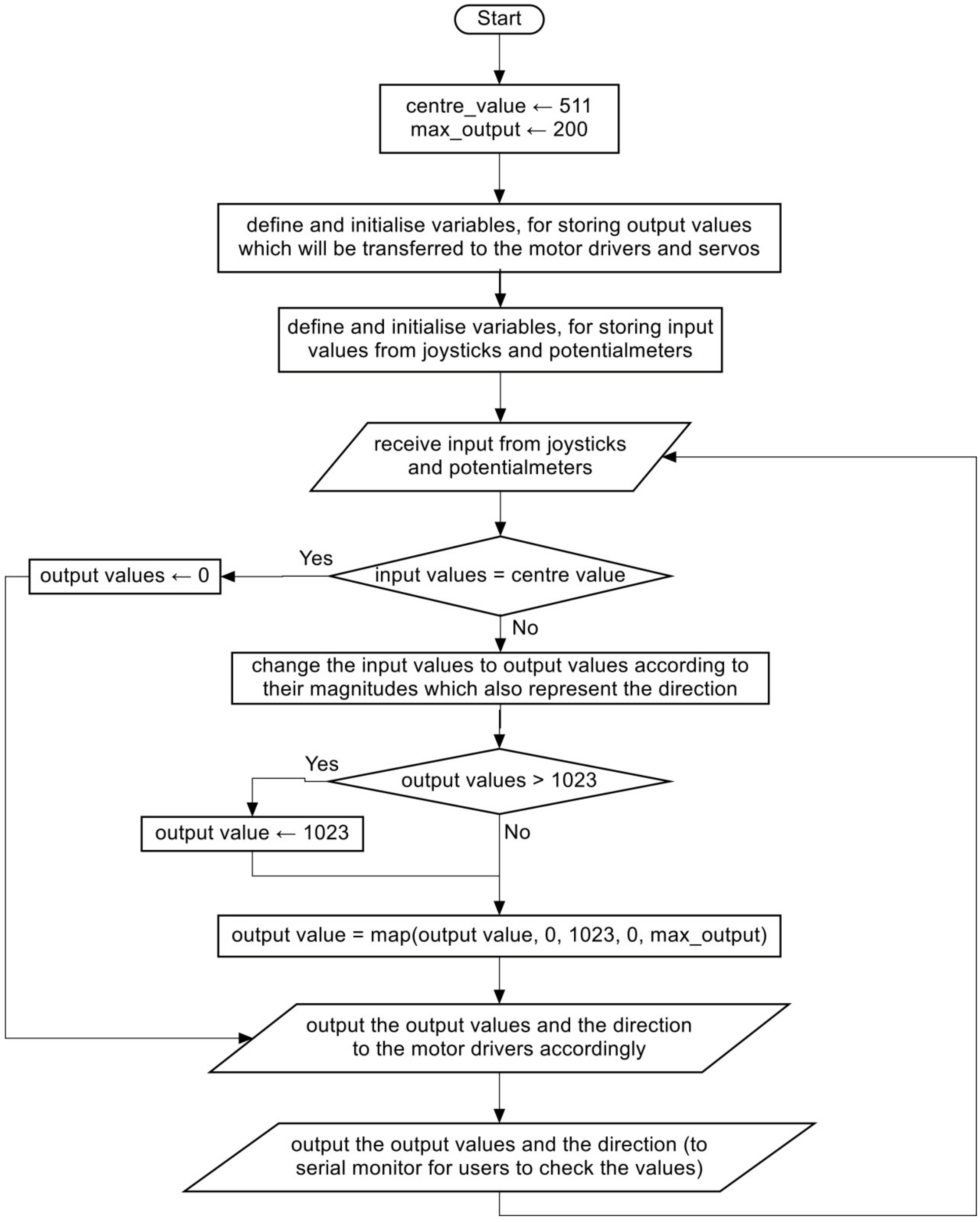
Programme flowchart



Challenges and Lessons learned

Having learnt the lesson of waterproofing and the experience of programming last year, engineers of Newtype Industries are now more confident in making ROVs. The planning and target setting skills learnt are also applied from last year.

Nevertheless, we have encountered a new challenge this year—electronics. Owing to the various types of signal wire and chipsets, especially the 25-pin signal cable, soldering the wires is not an easy task. The colour codes of the signal wires are so similar that they are hard to identify; such as “black with blue strips”, “blue with black strips”, “white with black and red strip” and “red with white and black strip”. They are independent but similar looking wires. Our electrical engineers were confused when connecting this cable and found that soldering this cable is one of the most difficult tasks. Conquering this challenge, our electrical engineers have improved their skills in handling electric components

The new 4-vector control system has also brought challenges to our programmers. With the new configuration of motors and joysticks, our programmers have to write a complicated controlling programme from nothing. The planning and flows of the main control programmes are the most challenging tasks for our programmers.

Lack of spare time also drags our progress. Having promoted to Form 5, our engineers have more work to do at school. This cuts the time we can devote for Newtype Industries and Type-II. We have worked until late at school, but progress is so slow that we were unable to complete the whole ROV before our first deadline -- which was after the Chinese New Year. To keep up with the progress, we have rearranged our priorities in our working schedule, redistributed our work and discarded ideas that were too difficult to accomplish within limited time. The challenge was not to crack tasks properly, but to assign tasks to the suitable person and decide on what to sacrifice.

From this experience, we have learnt more about setting priorities when planning and distribution of work within our team.

Trouble-shooting

As a company, we always tackle problems as a team. After an identification of a bug, we report to our CEO and run tests for identifying possible causes. We only change our subject of interest and keep other factors constant during tests. After identifying the cause, we hold meetings to discuss possible solutions and make improvements.

This way, we have gathered opinions from our members, allowing us to have clear picture and make wise decisions.

Troubleshooting routines and related indicators are also developed for easy identification of bugs and quick troubleshooting in electronics. For example, we have a 2-man motor testing routine. 1 man is responsible for checking the propellers and motor drivers while the other is responsible for inputting signals according to the routine. The electronics box has lamps on the user interface to indicate current flow to signal whether the circuit is closed or not.

Test case forms are used to test for syntax error, run time error and logical error. Different tests like the validity tests were put into action, and a number of detailed diagrams are drawn for reference.

After the completion of Type-II, we have conducted full vehicle testing. Tests include basic manoeuvres, response of interface and manipulation of objects. Then, the power of the motors underwater is measured. This helps us to identify the differences in power of the motors. Then, the output values of the motors can be adjusted to suit our needs.

Teamwork

Compared to previous years, the structure of Newtype Industries is now more clearly defined. The CEO now assigns tasks and deadlines to the head of department (including mechanical engineering, electrical engineering and research & development). The head subsequently has their freedom to design and build as long as it meets the requirements. Posts under the head will receive jobs from the department head to assist the completion of the task. This provides more flexibility to departments. After receiving jobs, teammates will set up a work schedule among themselves, and finish their work according to the schedule. The schedules and status of tasks will be frequently checked by the CEO to ensure that everything goes according to the plan. At the same time, teammates can receive help after the CEO take notice of an issue.

Future Improvements

Advanced balance system

This year, we have introduced manually operated trimming. To enhance the efficiency of the buoyancy and balance system, we may incorporate advanced ballasts system in the upcoming products. The system consists of four ballast blocks located on four sides of the ROV. The hydraulics system may be used to pump in water or air to alter the buoyancy of each block, shifting the balance of the ROV. The system will offer automatic balance when used with the gyroscope.

Manipulator with flexibility and smaller size

This year, the manipulator of our company designed has a small flaw which is its large size. This hampers the flexibility of the ROV in performing tasks. Our future manipulator will come in smaller sizes, with more axis of movement for better flexibility. Designs should include servos stacked together, adopting smaller servos and feature carbon fibre manipulator to achieve better weight to strength ratio.

Reflection

Below are reflections from participants

Reflection from CEO Donald Chai

I learnt how to build a ROV and how to work out a program for controlling the ROV starting from zero. These experiences are irreplaceable, and I really enjoyed working in Newtype Industries.

But that is not the most important. It is the leadership skills and teamwork of my group mates that have impressed me. An individual competition is always easy. But, when it comes to a group project, it is never a simple task. What is more important is how to lead a team, to achieve our dreams. The difficult part is how to get teammates to cooperate and finish tasks according to schedule.

In the first year, I have learnt about how ROVs and the competition work. The second year, I have learnt how to cooperate with teammates to build an ROV. This year, I have learnt to be fully prepared for the big event. During the process, I really hope that we can achieve what we have been longing for, and do our best with all our effort.

Reflection from Lead mechanical engineer Jonathan Wong

As the mechanical engineer of Newtype Industries for two consecutive years, I have gained much craftsmanship skills in handling tools such as saws, drills, files and more to assemble ROV components. This has given me chances to learn important skills in daily life when I have to repair appliances at home. Besides, this opportunity that allows me to apply my physics knowledge in real life situation is nowhere to be found in other societies.

Completing the ROV while managing form 5 studies is no easy task, my work in Newtype Industries has greatly improved my planning and deadline-consciousness, lifting my working efficiency.

Reflection from head of research and development Kaneko Shoyu

What I have gained from building ROVs from the previous years is something which most students in Hong Kong are not familiar with. I had to come up with the most genuine designs for the every task, I had to assemble and disassemble parts when I found errors, I also had to cope with the horrible smell of the melting plastics whenever I had to solder the electronics.

Back in time, I did not actively participate in the competition during the first year. I had no idea on how the different switches controlled the ROV, and I did not really care about that. I was literally not putting in my efforts, until the day I saw my mentors feeling frustrated by our poor design of ROV. I felt deeply ashamed about that, so I went back to the starting point. I tried to do some researches on what ROV is and what it is really for. I figured out the importance of this device, and I was ignited by it. I tried to squeeze my fully packed schedule and burning mid-night oil soon became my bad routine. However I still enjoyed that. I reckoned what drove me to the lunacy towards ROVs is the wholehearted attitude.

It is sad to realize that my opportunity to get along with the ROVs is shortening these years. I really enjoyed the precious time with my teammates, including the ups and downs of our atmosphere. I loved participating in this competition, regardless of the result. I think we all did our best for this. I wish I can work in similar industry as my future career, because I found my passion in building Robots.

Reflection from research and development member Stitch He

Newtype Industries is my second society to join that is not related to public exam. Compare to last time, now I have already become a form five student and there are large amounts of assignments and tests. In the production of the ROV, I found that it was really hard to strike a balance between my study and the ROV. At the beginning, I could hardly achieve a win-win situation. Sometimes, I was too concentrated on my study that I neglected the ROV. However, I spent too much time on ROV and left much homework behind. After making a plan on what we should do and setting deadlines with members of Newtype Industries, our efficiency increased significantly and I could handle my study and ROV project. I have learned that it is very important to make a plan before you act. Joining the Newtype Industries cannot help to improve my public exam results. There were specializations and cooperation during the process of making the underwater robot which can educate us on how to deal with some real life problems. I can not only gain happiness, but also experience applications of physics knowledge. It is really exciting to join in Newtype Industries.

Information on theme

The Thunder Bay National Marine Sanctuary (TBNMS), located in north western Lake Huron, has many special features. It is home to shipwrecks from 19thcentury and sinkholes resulting from erosion of limestone sediments. ROVs are needed in particular to investigate and protect the waters of TBNMS. The shipwrecks from across the years as well as the microbes in the mineral rich sinkhole environments are points of interest of investigation. Debris produced by human waste and invasive species also need monitoring and they should be removed by ROVs.

Acknowledgement

First of all, we would like to thank MATE and other organizers for organizing this meaningful event. We would also like to thank our school principal, Dr. Hong Lo Chi Chun for providing us with financial support and training facilities. Besides, our mentor Mr Boby Chan and Mr Jacky Leung have given us a lot of ideas and encouragement during the construction process. In addition, we would like to thank Bob Chim for inspiring us when constructing the innovative integrated motor mount. We would also like to say thank you to Ms Wong, our Physics Lab technician, for teaching us how to use tools, and machinery. She has been accompanying us until late evening during our work.

Reference

[1] BOHM, Harry, JENSEN, Vickie and MOORE, Steven W., Zolo, "*Underwater Robotics – Science, Design & Fabrication*", Marine Technology Education (MATE) Center.

Safety Check List

1.	Check main fuse and the 3 other fuses which are for the 12V output	Pilots	
2.	Clear the tether	Poolside operator	
3.	Clear all the things surrounding the rov	Poolside operator	
4.	The box (attached to the robot) must be closed firmly	Poolside operator	
5.	Connect all wires to the quick-fit electronic box	Pilots	
6.	Check on the computer to see whether the output value for the motor driver is 0	Electronics engineer	
7.	Start the ROV	Pilots	
1.	Turn off the ROV	Pilots	
2.	Disconnect the quick-fit electronic box with the power supply	Pilots	
3.	Place the rov on the pool side	Poolside operator and Electronics engineer	
4.	Disconnect other wires	Pilots	
5.	Leave	N/A	