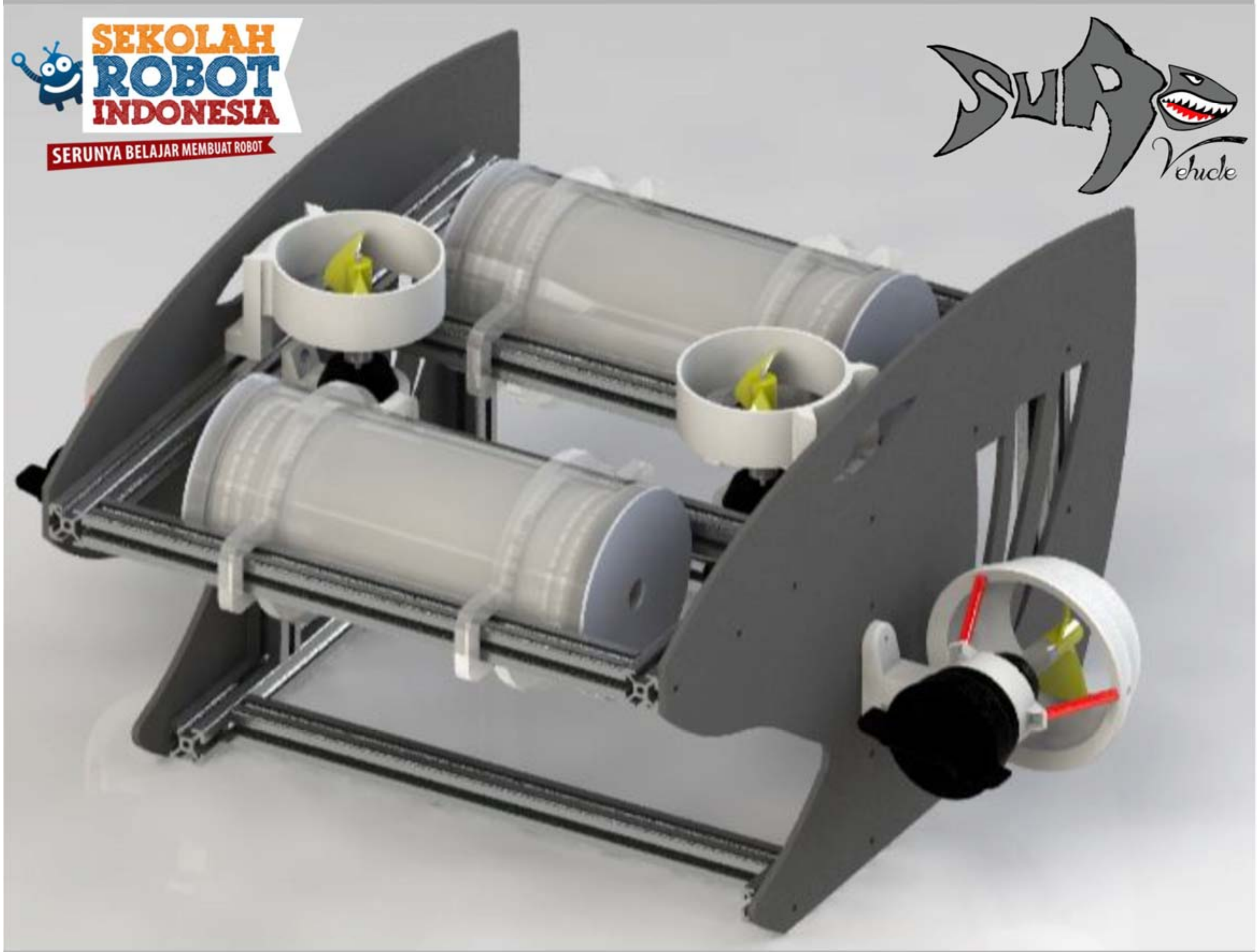
LINTANG SELATAN



Sekolah Robot Indonesia
Technical Report

Team Member

DENTANG SATRIA DALY	(CEO)
ATHFAL SABILAL AHMAD	(Electrical AND Software Engineer)
RAFSI AZZAM HIBATULLAH ALBAR	(Design Engineer)
FIRMAN FATHONI	(CFO and Electrical)
ABHIRAMA RIZKIA TRIADI	(Programmer Team Member)
MUHAMMAD SHIDQI FADIYA	(Programmer Team Member)

TABLE OF CONTENTS

1. Abstract

In Lintang Selatan, advance in science and technology and customer safety are our main priorities. After competing on MATE ROV 2014, we started a research by joining a ROV workshop by Eric Stackpole (from OpenROV), joining some competitions, and one of them is a national competition, and we also made a homemade ROV. Suro, or latest ROV model has been designed specifically to work on extreme terrains, especially below the ice surface such as taking samples of living creatures, inspecting and repairing subsea pipeline, and doing maintenances on an offshore oilfield pipe. Lintang Selatan consist of 6 talented personnels have designed and manufactured Suro to do missions that are given by MATE. Suro makes use of a USB Logitech Extreme 3D Pro Controller operating through an Arduino microcontroller, to put control of the ROV and all of its subsystems in the hands of a single pilot. This speeds up reaction times, increasing the pilot's precision and making fine movements easy because our pilot are used to operate using this kind of controller.

2. Design Rationale and Vehicle Systems

2.1. Frame

Lintang Selatan decided to build a perfection from our previous ROV. This year we made a more hydrodinamic model, more attractive with minimized size to make maneuvers easier.

Our first step on designing ‘SURO’ is we need to consider the utilities that the ROV will hold. We decide the utitlities used based on the missions given by MATE. Suro needs a unit of gripper that can move horizontally and vertically. And we have to consider where to install the thrusters with a total of 4 units (two horizontal, two vertical). And surely, 2 water-tight enclosures to house the electronics and for the buoyancy. And we also need 3 units of camera, 2 cameras for wide view, and 1 camera to focus on objects in front of the ROV.

<u>FRAME MATERIAL</u>

We made the frame from aluminium. We choose aluminium because this material is easy to use, even to build a ROV, and also because we need a sturdy but lightweightmaterial. And it is easy to disassemble if we need to change the design or changing the components immediately because we use screws to connect the frame.

Fig 1. Aluminium Profile type (Lintang, 2014)

Fig 2. Angle Bracket Diecast and T-nut (Lintang, 2014)

Fig 3. design 'suro' with solidwork, by Rafsi (Shidqi, 2015)

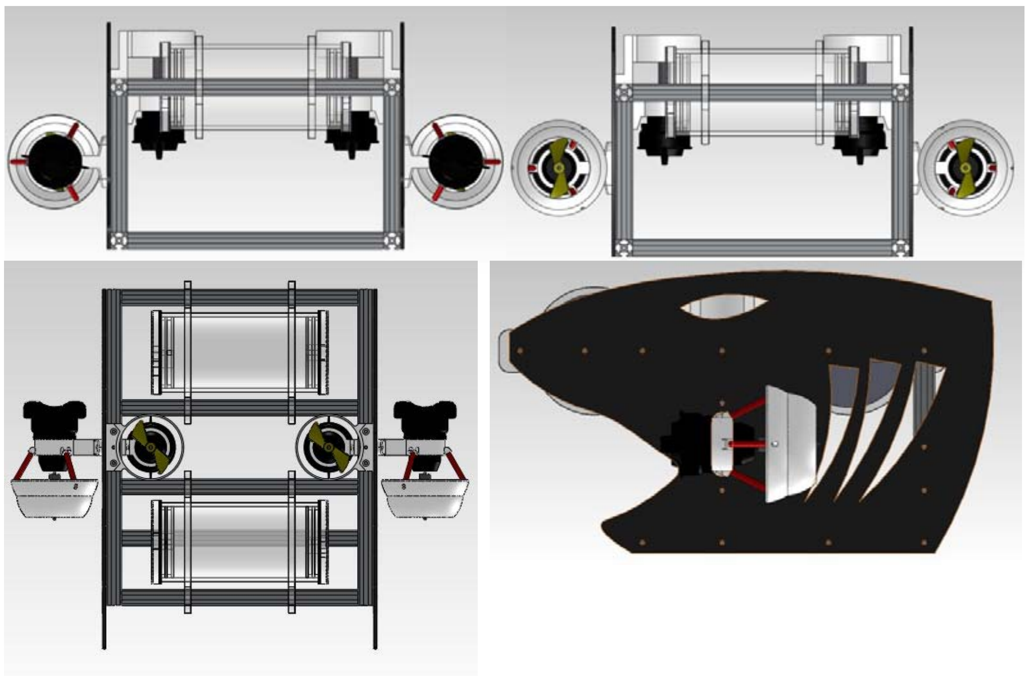


Fig 4. design 'suro' with solidwork (Rafsi, 2015)

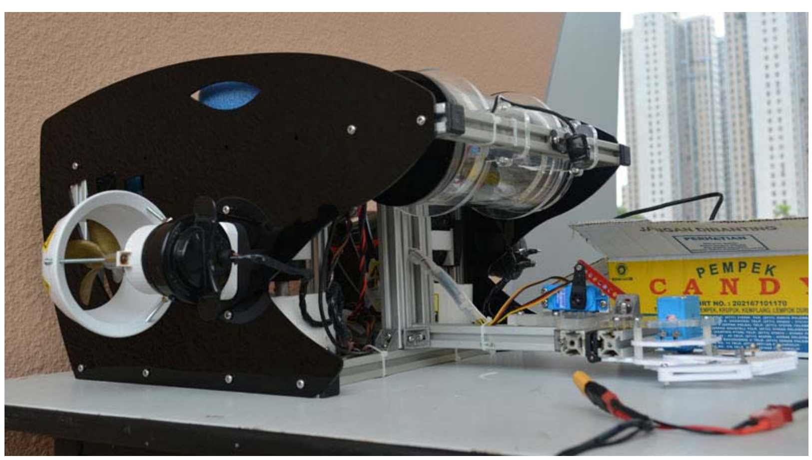


Fig 5. ROV 'Suro' (Rafsi, 2015)

Beside aluminium frame, basic frame use a acrilyc to custum frame. We need cutting laser acrylic to make a some part in our ROV.

Fig 6. make acrilyc frame, by dentang (Sabil, 2015)

2.2. Buoyancy

Buoyancy was a crucial factor in Suro's design process. ROVs require steadiness at varied depths and perform substantially better when their floatation is tuned correctly. We use 2 water-tight enclosures to house the electronics and for the buoyancy. Our engineer made those tubes by cutting an acrylic tube and sealing it using acrylic with an O-ring installed.

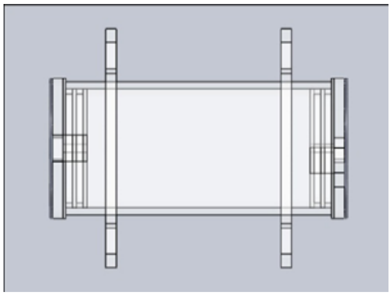


Fig 7. design tube buoyancy with solidwork (Rafsi,2015)

Fig 8. design tube after laser cutting (Rafsi, 2015)

Fig 9. make a tube buoyancy, by sabil (Dentang, 2015)

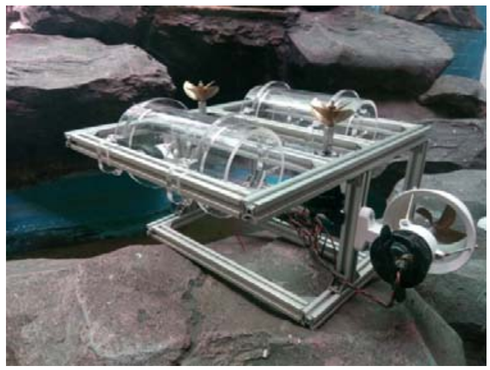


Fig 10. buoyancy placement (Rafsi, 2015)

2.3. Propulsion System

On building the propulsion system of the ROV, we need to consider 4 things :

1. Choosing The Right Motor

   The motors that we will use besides of a waterproof motor, it has to be capable of working nicely on extreme conditions. And for Suro, our engineer uses the same type of motor that we used on the previous ROV, the Johnson Pump Thrust.We choose this type of motor because of its excellent price to performance ratio.. We can get a better thrust for the ROV and it works greatly on our previous ROV.

Fig 11. Johnson Pump Thrust, Designed with solidwork (Rafsi, 2015)

2. Choosing The Perfect Propeller For The ROV

Our engineer decides to install new propeller from our previous ROV, previous ly we use 2 blade propeller (478B Prop.Alu-Alloy) and now we use 4-blade propeller (4 Blades 67mm CNC Alu.Alloy Positive Propeller). Our engineer chooses this type of propeller because it makes the ROV moves smoothly and the motor won’t work heavier.

Fig 12. change Propeller (from left old propeller and new propeller) (Rafsi, 2015)

3. Making a Propeller-to-Motor Connector

To connect the propeller to the motor that wel use, our engineer have to build a connector that fits the hole on the motor and the propeller.

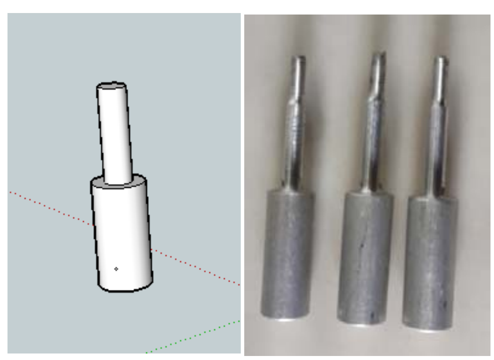


Fig 13. Connector propeller to Motor (Lintang, 2014)

4. Configuring The Thruster’s Position

We will install 4 units of thrusters on our ROV, with the position of 2 units of thrusters installed horizontally (to go forward, backward, turning left and right) and 2 units of thrusters installed vertically (to push the ROV up or pulling it down to the water)

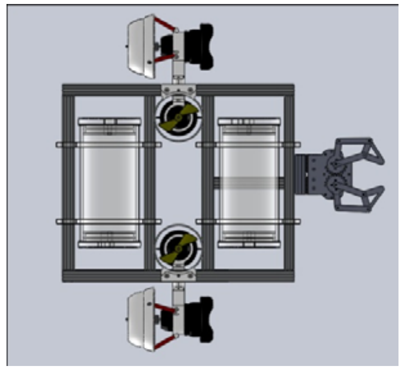


Fig 14. configuring thruster position (Rafsi, 2015)

2.4. Gripper

We use an acrylic-based gripper, which are easy-to design and cutting it with the laser cutting machine.

Fig 15. Gripper Design with solidwork (Rafsi, 2015)

Our personnel uses the paralellogram principle for the gripper to maximize the grippeng force so it helps the ROV to do the task given effectively. This gripper has two joints, and moved bi a waterproof servo motor.

2.5. Camera

Fig 16. Custom cameras (Rafsi, 20: ,

For the camera, we use the same type of camera with our previous ROV that are consisted of 2 units of custom waterproof cameras and a unit of camera that was installed inside an acrylic box. The wirings that goes throgh the acrylic box is sealed o-ring to prevent water from going inside the tube. And we installed a unit of camera to focus on the arm, and 2 units for the wide view.

2.6. Tether

Our tether are designed to be lightweight and flexible to make the ROV easier to do maneuvers. We use a pair of AWM e316944 12 AWG cables for the power supply. We use this type of cable because of its low resistivity. And a AWM e166211 24AWG cable are used for serial communication and camera video. 12 m long tether is responsible for successfully transporting all of the signals that are neccesary for such a complex control system.

Fig 17. Tether (Sabil, 2015)

2.7. Control System

Blok diagram system Electric 'SURO'

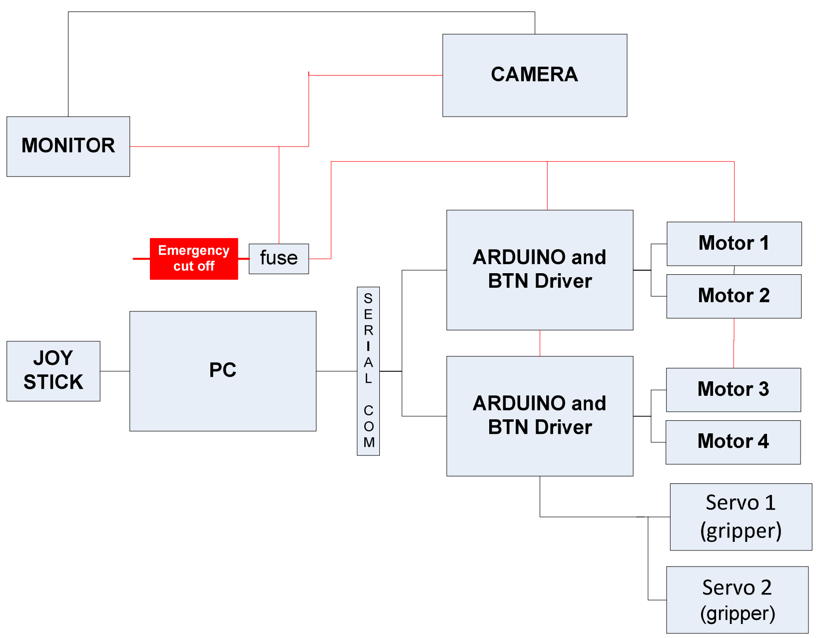


Fig 18. Diagram System (Sabil, 2015)

Control

Our team use a USB Logitech Extreme 3D Pro Controller and connect it to a PC to drive the ROV, with serial RS232 Communication

Fig 19. Joystick (Sabil, 2015)

Electronic

In a ROV the company made driver high current with arduino pro mini. Event 2 chanel driver module we use 1 controller arduino. This decision design part to part was based on simplicity and the possibility of troubleshooting in the event of a failure during competition. BTN7970 High Current PN Half Bridge, for 1 channel driver we need 2 BTN7970. To drive 1 motor we need 1 channel driver. Proccess make a driver ROV thruster first we drawing schematic in eagle software to get a board drawing, and print in transfer paper to PCB, finally soldering component and test drive.

Fig 20. Electronic Controll process (sabil, 2015)

Fig 21. Power Supply monitoring (sabil, 2015)

Voltmeter was placed across the power terminals to read the voltage and Ampere meter was added to monitor the amount of current used by system.

Power supply connections Use standard banana plugs.

.

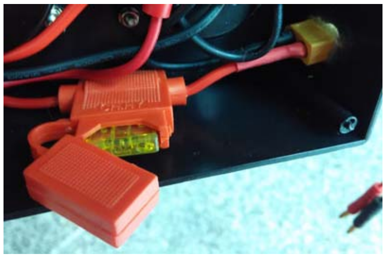


Fig 22. Fuse (sabil, 2015)

The company use 25A fuse or circuit breaker in the positive power supply line within 30 cm of the power supply attachment point.

Add switch was added to shut down power immediately in case of emergency.

3. Vehicle System

All ROV work done in the workshop sekolah robot indonesia, except for 3D printing and laser cuting. Our company must order in some place. firstly we design with solidwork for real ROV. after that we make a real ROV.

Thruster we use bilge pump from ROV last year. we only change a propeler. For safety we use propeller guard from 3d printing.

Buoyancy we use a 10cm Diameter acrilyc tube.

Electric driver and controller we use high curent driver. this a new riset for my company. and controller we use arduino pro mini

4. Safety

In Lintang Selatan, safety is one of our priority. Both at while working at the ROV, and for the ROV itself. So we make sure that or personnel has been trained to operate the electrical and power tools before they are allowed to operate them. When we were at work, we have to wear protection gears including eye goggle, gloves and face masks.

We have three safety regulations when we were working, those are :

COMPANY

- Always wear eye protections and gloves when doing mechanical works
- Always use face masks when doing electrical works

Fig 23. goggle and face mask (sabil, 2015)

THE ROV

- No sharp or pointed edges

Fig 24. ROV Doesn’t sharp edges (Lintang, 2014)

- Caution stickers are placed on any possible hazard (thrusters, grippers, etc.)
- Every propeller contains its own covering to protect the propeller itself and the user

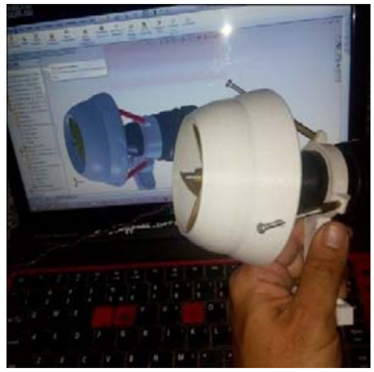


Fig 25. Propeller guard with 3D printing (Rafsi, 2015)

- Tether is properly secured at surface and in ROV

Fig 26. Tether with spiral guard (sabil, 2014)

- All items are connected securely to the ROV and will not fall off

ELECTRICAL

- 25 Amp fuse on the positive side of the main power source
- All electronic parts are placed inside the water-tight enclosure.
- Check all connections before turning on power
- All wiring and electrical parts are properly sealed
- Emergency Cut Off Saklar
- Ampere meter and volt meter display

5. Challenge

When working at Suro,not all things worked as we expected, there are problems we encounter while working. On the technical thing when we were designing and trying to make it real, it didn’t work as expected, the ROV didn’t move nicely in the water. So we have to rethink the design according to the weaknesses that we saw on the first test. And for the non-technical thing, there are so many activities at school that we have to do, so we only have time on afternoon until midnight to work on the ROV and it reduces our sleeping time. And we also didn’t have any pools to test our ROV, so we have to use bath tubs to do the test.

6. Lesson Learned

6.1. Technical

Mastering the programming language for Arduinos was possibly the most helful and useful skill learned by our programmers this year. Even during the development phaase, we already know that we want to use Arduino on the *Suro.*This meant that the software developers and electrical engineers had to get started right away on learning the new language and understanding the new microcontrollers. We have learned many skills, including how to use basic if statements, arrays, serial commands, and the most important skill of all, knowing how to troubleshoot. The many important lessons learned during that process are what allow the *Suro* to dive today.

6.2. Interpersonal

This year Lintang Selatan learned to work efficiently. This happens because of our member’s school activities making them spend their nights on working the ROV and reducing their sleeping time. On example was working on the ROV mechanics. Due to the limited amount of time our member had so we have to work on it on holidays, or even stay up late at night building the acrylic tube and building the frame. Through this opportunity to work, we all learned to appreciate our time, and our fellow member’s time because we want to finish this ROV as expected and efficiently.

7. Future Improvement

In Lintang Selatan, we always looking for new technologies to implement in our products. Even if we thought that Suro is great enough, there will always be rooms for revision and improvements. For the next year we want to develop our ROV by adding depth sensor, an accelerometer, and also installing a gyroscope to our ROV. We’ll make use of the sensor to monitor how deep our ROV goes. An accelerometer will allow us to measure the different accelerations our ROV is producing and experiencing, while a gyroscope will give us information as to how much the ROV is tilting. By adding those materials, we can improve our ROV’s qualities even better. For example, using depth sensors will give us information on what we can see and do in that depth. By combining the depth sensor, the accelerometer, and the gyroscope we can maintain our ROV’s position even better, if we wanted the ROV to remain stationary when there was a slight current, those three sensors will help us. We are also in progress of learning the RaspberryPi and Beaglebone so we can install it to our ROV and make it a better ROV.

8. Reflection

As we reflect on this year, we realized that Lintang Selatan has seen improvements not only in the ROV development, but also in our team personnel's ability and our teamwork when we were working on the ROV. As a team we spent our nights working hard to develop and manufature the *Suro*. Through this project our members have gained more confidence in themselves and as a whole team. This year had challenged us altough we had new members but they have the equal skills and abilities as the old team member did. After what we had been through, we were able to overcome our challenges to become a better team.

Fig 27. Team Lintang Selatan, (Dhadhang, 2015)

From left: Dentang (CEO), Abhirama (Progammer), Shidqi (Progammer), Rafsi (Designer), Firman (CFO), Sabil (Electrical,Programmer,Pilot)

9. Financial Report

Income:

#	From	Income/$	
1	Lintang Selatan team (6 person)		1280
		Total/$	1280

Table 2 Income

Outcome:

Item	Unit price/$		Reused/$	Total Price/$
	MECHANICAL ITEMS			
Motors + Shipping Tax	4	200.00	800	800
Motor Shaft	8	10	-	80
Propellers	6	25	-	100
Aluminum profile	2	20	-	40
Angle Bracket Diecast and T-nut	40	2	-	80
Propeller guard	4	15	-	60
Acrylic Tube	1	100	-	100
Acrylic cutting	1	100	-	100
Servos Waterproof	2	55		110
	EL ECTRICAL ITEMS			
Camera	4	60	-	240
Monitor	3	50	150	150
Tether	1	60	-	60
Joystick	1	60	-	60
Electric Component	1	250	-	250
ROV TOTAL/$			950	2230
TOTAL EXPENSES/$				1280

10. System Integration Diagram

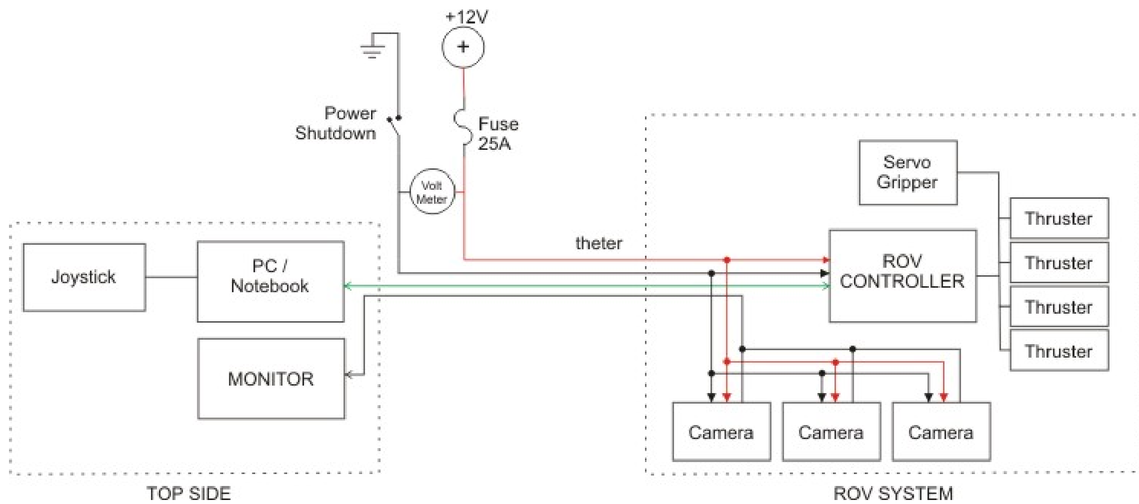


Fig 29. SID (Dentang, 2015)

11. References

1. MATE ROV website, MATE ROV HK website, for scoring information and task information: http://www.rovcontest.hk/ & http://www.marinetech.org/
2. The Arduino Reference Library, which provided software programming details (http://arduino.cc/en/Reference/Libraries)
3. Datasheet BTN7970, http://www.infineon.com/dgdl/Infineon-BTN7970-DS-v01_01-en.pdf?fileId=db3a304316f66ee80117642373746a89&ack=t

12. Acknowledgments

Local team supporers

1. Dhadhang SBW, Team Mentor and Instructor
2. Tri, Solid Instructor
3. REAA (Ali, Sobrun, Mamat, Erik)
4. Team Parents
5. My Teacher in school

13. Gallery

Fig 30. MATE Hong Kong (Dhadhang, 2015)