Draft Analysis ROV *(Remotely Operated Vehicle)* Exploration For Underwater

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1. Introduction

1.1Background

Indonesia is one country that has greatest.Sea waters is an ecosystem rich with natural resources that can be utilized for prosperity and well-being person.As it is known that 70% of the earth's surface covered olehwaters / sea and more than 90% of the biomass of life on the planet live in the sea. There for the ocean is an important part of human survival. (Sudrajad, 2006). Most of the territory of the Republic of Indonesia consists of ocean waters is located very strategically. Indonesian marine waters other than utilized as local and international communications facilities, also has a very rich marine resources and other resources important among fisheries, coral reefs, mangroves, minerals, and its coastal area can be used as a tourist attraction which is underwater has interesting.Robot became one of the effective means to support human beings in terms of underwater exploration. Because humans have limitations to be able to withstand the pressure underwater so great. Underwater robots have become one of the effective means to replace humans in exploring underwater. Exploration in this case has a broad meaning, ranging from the simple exploration of the underwater ecosystem sort of observation, to discover such high risk seabed sampling to detect metal mine at a depth of more than 1000m. Such exploration can still be done without the need for direct human intervention in exploring. By using underwater robots, humans are just waiting on the mainland for the next task is done by venturing underwater robot. (Princess, 2012).Humans have limitations to be able to withstand the pressure that so great. In addition, along with the natural conditions such that the temperature factor as well as the lack of lighting on the seabed causing visibility is reduced and the topography of the seabed that is not reachable by manusiaseperti small caves, crevices in the shipwreck.

ROV*(remoteoperating vehicle)* is one type of underwater robot electric water powered with thrusters*(thruster)*have some hydraulic or electrical components such as Arduino microcontroller Atmega 328p, camera, propeller, DC motors, power supply, and cables used tether.ROV object foreksplorasi under the sea like an underwater shooting, military operations, repair undersea pipelines sea.ROV used for activities in the area of human reachable don't like a small cave under water. NavyAmerika ROV fund the creation of the first year made has 1960.ROV sea rescue operation ability in and improvement of the surface of the seafloor objects.ROV developments in the world is growing rapidly, science and technology as the development progresses ROV.Although still many flaws in the ROV which has been developed as an artificial Police Science Faculty of Computer Science University of Bandar Lampung. On PTIK ROV pilot phase have been made ROV PTIK already can make some movement and acceleration both in the water, but unfortunately it has some weaknesses that must be corrected to meet the standards of the ROV in general.Based on the above description, the author is interested to create / write scientific writing with the title "Analysis of ROV Design (Remotly Operated Vehicle) To Exploration Under Water".

2. Basic Theory

2.1 Literature

1. Research by Tirzah Dian H. Naidoo, Kawilarang WAMasengi, Patrice NI Kalangi, Masamitsu Iwata and Ixchek F. Mandagi of Fisheries Resource Utilization Studies Program, Faculty of Fisheries and Marine Sciences, University of Sam Ratulangi, Manado Aquamarine Fukushima, Iwaki, Fukushima - Japan, entitled "Applications *remotely operated vehicle (ROV)* in the study of marine and fisheries in the waters around North Sulawesi and Biak Papua"the condition of the sea waters at certain depths not easily understood thoroughly if only rely on the human ability without

the support of other ancillary facilities such as the availability of adequate equipment and technology. There are several factors that cause human limitations to dive into the deep sea of which is pressure every additional sea depth of 10 m will lead to increased pressure of 1 atmosphere, so the deeper the water, the higher the pressure that is incompatible with the human environment. In addition to the natural conditions such as the temperature factors as well as the lack of lighting on the seabed causing visibility is reduced, therefore the need for technology that can explore the potential of fisheries and marine resources. One of the tools that have been developed to overcome these obstacles is the Remotely Operated Vehicle (ROV). Research using the ROV, is one way to overcome the limitations of human beings in the water without having to dive. ROV is an underwater technology that is controlled by someone who is already a professional at the time of the operation. Research on the ROV is also very helpful, especially in the field of marine and fisheries to determine the extent of the ROV role in helping the human limitations in the water when researching an object that is in the sea.

2. Research by Made Santo Gitakarma, Ariawan, Udy Ketut, Nyoman Arya Wigraha Electrical Engineering Department, Education Department of Mechanical Engineering, Faculty of Engineering and vocationalUndiksha, Singaraja, entitled Tool *Survey* "DownUsing Amoba water, ROV-Based Robot".Computer technology, especially robotics in today has become an important part of human life. Robots are Eletro-mechanical equipment or bio-mechanical, or a combination of equipment that generates the autonomy movement and the movement based on movement ordered (Halim, 2007).Robot in some cases can replace the role of man, as seen on the robots are applied in various fields such as industry, health (health), defense (defense), agriculture (agriculture), research (research), ploy (game), and others. In modern industry, robots have taken over the position of workers in factories. For example, in the automotive industry, electronic equipment, computer devices, robots have become a major driver of this industry. The main reason is because the use of robots, robots under certain conditions (the minimum requirement is met surgery) could be the ideal worker, the robot has a high degree of accuracy and high efficiency, and more important is the low operating costs with higher output produced.There are several types of robots, which can generally be divided into two groups, namely robots and mobile robot manipulator *(mobile* robot). Robot manipulator is characterized by having an arm*arm),* (robotic and are widely used for industrial robots. While the mobile robot is a robot that can move on the move, although the robot will also be installed manipulator. Robot cars can be categorized into three namely land robot (ground robot), robot water (underwater robots), and the robot flying (aerial robot). The third type of robot is very much developed at the present time because of its very fungsional.Pada see this research will be developed underwater robot monitor*(integratedunderwater*vehicle)with a system based ROV*(remotelyoperated*vehicle).In simple terms the employment of ROV-based robot is operated using a system controlled by the user via the device controller. Underwater video camera system is also active will be installed the unmanned vehicle is controlled remotely. Robots and robot control system itself linked to a data transmission medium such as cable or radio waves (RF = Radio Frequency) .Some research on ROV systems have been discussed in foreign countries like (E. Kelner, 2012) who developed the data sampling system ROV sea in depth and research (Enfang S 2005) implementation sonar for underwater detection by the ROV. The reason why in this study the authors monitor the theme of underwater robot, is because the robot is not much developed and probably less attention, particularly in Indonesia. It is very ironic and contrary to the geographical condition of Indonesia, of which Indonesia is a country that have waters very wide and contains the value of a very large economic potential. Limitations of man's ability to identify potential underwater Indonesia especially for marine areas in unspoiled. To explore this potential and maintain the necessary support device that is able to help the exploration process and one of them is to use the ROV robot. Most underwater exploration activities conducted solely by humans without the aid of a robot, such as underwater observation. Underwater observations carried out by the human being has some risks, namely the areas that are difficult to reach humans and the threat of attack

dangerous water animals. Therefore, to maximize the process of underwater exploration was needed tools that are able to move freely in the water, safe and efficient in helping the human task.

3. Thesis by Ilham Rizki Program Marine Sciences and Technology Faculty of Fisheries and Marine Science, Bogor Agricultural University with the title "Development of *Prototype Remotely Operated Vehicle* (ROV): Mechanical Aspects" The situation and conditions of the seabed environment is not easy to know for sure without the support of the availability of equipment and adequate technology. This research aims to develop a vehicle that can assist in exploring human limitations sea. In the form of mini-submarine rides are driven by the motor. The mechanical aspect to be one important factor that will determine performance in water. All the basic material of manufacture should be non-corrosive (stainless). The design of this instrument consists of: frame, four motor*(thrusters),body*,floodlights, electronic components and the *charge-coupled device* (CCD) video camera. Motor drive serves as a prime mover. CCD video camera is a visualization tool that serves as a camera and a video that will take pictures underwater environment. Spotlights serves as additional lighting deeper waters where the light intensity decreases. All instruments supporting components mounted on a frame made of *stainless*steel. The end result is a prototype development vehicle in the form of mini-submarines. The trial results prove that this instrument is able to withstand pressures of up to a depth of 50 meters.*Remotely Operated Vehicle* (ROV) is driven by two motors driving two motors pendorong forward and upward. Each couple the motor moves in the opposite*(counterstrike).*Motor driver has three divider vane motor while advancing only two.source *power*ROV mainis a generator of 220 V, 900 Watt connected by cable to the ROV. BuoyancyROV assisted by buoys placed at the top of the ROV. The instrument is operated by the operator from the top using *a*joystick.
4. Research by Shahrieel Mohd Aras and Fadilah Abdul Azis *Department of Mechatronics, Faculty of Electrical*Engineering,University of Technical Malaysia Melaka Hang Tuah Jaya, Melaka Malaysia with the title *"ROVTrainer Kit for Education* Purposes"In 2011, the National Oceanography Directorate (NOD) under the Ministry of Science, Technology and Innovation (MOSTI) introduced the first competition for underwater competition for primary schools in PutraJaya Maritime Center called *Underwater Remotely* Operate *Vehicle* (UROVeC). NOD was established in November 2000 to serve as the National Focal Point for the coordination of research, development and commercialization and all activities related to oceanography and marine science in Malaysia. In 2012 and 2013, this competition under water is introduced to regular secondary schools and secondary schools to technical majors, respectively. In 2013 the competition was held in *WorldOcean Week* 2013 (WOW 13) All the user to design simple ROV with Four Degrees of Freedom (DOF 4) provided by the technical committee of MOSTI. The competition is supported by many in the field of underwater industry involves such as the Royal Institute of Naval Architects (RINA), Institute of Marine Engineering, Science and Technology (IMarEST) and MTC Engineering.In 2013, *the Underwater Technology Research Group* (UTeRG) one of the research groups at RIA of the Faculty of Electrical Engineering, University of Technical Malaysia Melaka (UTeM) was invited to become a member of the committee as a technical committee and the jury for the competition held in June 2013. after a technical briefing before the competition was held at the Faculty of Electrical Engineering, UTeM. The main problem faced by all students to come to this technical guidance, including their teachers is fundamental ROV is weak and no idea how to design the ROV. Based on the simple guidelines given to students and YouTube did not give enough to understand how to design faster ROV.How make ROV for this competition? It challenged for these students will be discussed. Most of them only use the standard design ROV based on the instructions given. Thruster is a motor and propeller are the same for all participants. That means thespeed *thruster* and the amount of thrust will be the same. But, the difference is the design of the ROV. The size of the ROV is one of the most participants understand the effect sizes. Based on a small scale thruster, ROV size should not be too big and heavy. There is nothing to wonder the rest of the factors to make the ROV faster,

even their teachers also leak this knowledge. For this reason, the ROV trainer kit is designed to provide a clear and basic knowledge to students or young researchers.

3. Analysis of Results and Discussion

3.1 Discussion

A. ROV General

3.1.1 Classification ROV

ROVclassified by size, weight and power, which are divided as follows:

1. The Micro-ROV-type micro size and weight are very small. Now can weigh less than 3 kg.ROV is commonly used to help divers, specifically for the access point can not reach such a small cave and pipelines.
2. Mini-ROV-type mini weighs approximately 15 kg.ROV types of mini can be ridden by one person like a small boat. General - this type has the power under 5 HP. Usually equipped until used for sonar and underwater survey. This type can reach depths below 1000 meters and there is also made to reach a depth of 7000 meters.
3. Light workclass- this type has a strength of approximately 50 HP. Usually have 3 usefulness. Made with -polyethylene material, stainless steelor alumunium.Tipe mixture is capable of reaching depths below 2000 meters.
4. Heavy workclass- this type has a strength about - about 220 HP and has two uses. Can reach depths of up to 3500 meters.
5. Trenching / burial- this type has a strength of more than 200 HP and can reach depths of up to 6000 meters (Remotely Operated Vehicle, 2006)

3.2 Construction ROV

ConstructionROV usually have a large buoyancy at the top are made of steel or a mixture thereof, to support synthetic float.Foam power is used to power float.Alat other support placed at the bottom of the system. Lighting is usually placed in the front and heavy components at the bottom, cover system framework is between buoyancy and gravity, it supports the stability and strength for underwater works (Remotely Operated Vehicle, 2006).Electrical wiring must be protected from water corrosion laut.Sistem movers usually placed in three positions to generate maximum control. The camera and light with supporting components are in the front of the ROV which sometimes helps to maneuver (Remotely Operated Vehicle 2006). ROV components in general according to the journal in 2014, include:

a) Relay
b) Battery
c) Voltage Regulator
d) Pressure Sensor
e) Thruster
f) PIC16F877
g) Air Regulator
h) SK40C
i) 1.5 metersPool
j) Control board
k) Cover
l) Pressure Hull

Components the explanation above is as follows:

3.2.1 Relay

Relay is the Relay Switches (Switch) are operated electrically and is an Electromechanical components (Electromechanical), which consists of two main parts namely electromagnets (Coil) and Mechanical (set Contacts Switches / Switch). Principle of Electromagnetic Relays use to move the contact switch so that the electric current is small (low power) can deliver a higher voltage electricity. For example, with the use of Electromagnetic Relay 5V and 50 mA are moving armature Relay (which

functions as the switch) to conduct electricity 220V 2A.Some of the Relay function that has been commonly applied into electronics equipment are:

1. Relay is used to perform logic functions (Logic Function)
2. Relay is used to provide a time delay function (Time Delay Function)
3. Relay is used to control high voltage circuit with the help of a low voltage signal.
4. There is also a relay that serves to protect the motor or other components from excess voltage or short circuit (Short).

3.2.2 Battery

Battery or battery, or it could be accu is a power cell where it takes place in a reversible electrochemical process (back can) with a high efficiency. What is meant by an electrochemical process is reversible, is in the battery can last the process of converting the chemical into electrical power (the discharge), and instead of electrical power into the power of chemistry, charging again by regeneration of the electrodes used, namely by passing electric current in the direction (polarity) opposite in the cell.

a. Function

Batteriesor batteryon the car serves to store electrical energy in the form of chemical energy, which will be used to supply (supply) system to the electric starter, ignition system, lights and other electrical components.

3.2.3 Voltage Regulator

Voltage Regulator is a device voltage regulator voltage regulator has the main function is to create a voltage in accordance with our wishes while the voltage stabilizer main function is to make the voltage stable.Normally a voltage regulator has a slide that we can set how much the output voltage we want. Voltage regulator also has the same capacity as the voltage stabilizer nothing 1kVA, 2kVA, there are dozens of 3kVA even kVA.

3.2.4 Pressure Sensor

Pressure Sensor (Pressure Sensor) is a sensor to measure the pressure of a substance. Pressure (p) is aunit of physics to declare force (F) per unit area (A). Pressure unit is often used to measure the strength of a liquid or gas.

$$P = F / A$$

Unit of pressure (Pa = Pascal) can be connected to the unit volume (content) and temperature. The higher pressure in a place with the same content, then the temperature will be higher. It can be used to explain why the lower temperatures in the mountains than in the lowlands, because in lowland higher pressure.However, this statement is not always true or exception to moisture, water vapor if the pressure is increased there will be a change of the gas back into a liquid. (quoted from wikipedia: condensation). The formula of pressure can also be used to explain why a knife is sharpened and thinned to a sharp surface. The smaller the surface area, the same style will get a higher pressure.The working principle of the pressure sensor is converting mechanical stress into an electrical signal. Voltage size is based on the principle that prisoners introduction changed the length and cross-sectional area.

a. Working Principle *Pressure Sensor*

Sac pressure changes cause changes in the position of the coil core, resulting in a change in the magnetic induction coil. The coil used is a coil CT (center tap), thereby shifting the core when the inductance at one coil inductance on the coil increases while the other decreases. Then the signal converter is used to change the magnetic inductance arising in the coil into a proportional voltage.

Environmental factors that affect the performance of the sensor:

a. The state of erratic weather
b. situation temperature in an environment of
c. pressure around the sensor
d. Age from components such sensors
e. Application *Pressure Sensor*

The pressure sensor can be applied to:

a. Motor gasoline
b. Aircraft
c. gauges tire pressure
d. gauges the height of a liquid
e. heights, airplanes, rockets, satellites, blimps etc.

3.2.5 Thruster

Azimuth thruster or use to make it easier to maneuver the ship, but eating the actuator with the position of being at the top so as to give a more eight to place its main propulsion, either a diesel engine or electric motor.

3.2.6. PIC16F877

PIC16F877 ormicrocontroller is one of a family of PICmicro microcontrollers are popular in use today, ranging from beginners to professionals. This is because the PIC16F877 is very practical and use technology FLASH memory so it can be in the program-remove up to a thousand times. These types of RISC microcontroller superiority compared to other 8-bit microcontrollers in its class mainly lies in the speed and compression code. In addition, PIC116F877A also quite practical and compact because it has a 40 pin package with 33 channels of I / O. Microchip PICmicro family members artificial Inc. pretty much. Some use the FLASH memory and some types of OTP (One Time Programmable). Microcontroller of the popular PICmicro family, among others PIC2C08, PIC16C54, PIC16F84. To be more familiar with PIC16F877A, here given the important features found in PIC16F877A.

a. FeaturesPIC16F877,

Actually PIC16F877 microcontroller is not special in PICmicro family. Nevertheless, the PIC16F877 is quite easy to learn and can be said has a powerful ability as a microcontroller that has 40 pins.

The features in the PIC16F877 include:

1. RISC CPU which has high performance
2. Only 35 types of instructions that need to be learned
3. All instruisi have a single cycle except for instruction branching.
4. Free Instruction: DC - 20 MHz clock input DC - 200 ns instruction cycle
5. 8K x 14 words of FLASH Program Memory, 368 x 8 bytes of Data Memory (RAM), 256 x 8 bytes of EEPROM Data Memory
6. Pinout compatible with PIC16C73B / 74b /76/77
7. interrupt(14 interrupt sources)
8. Eight-level hardware stack
9. Direct, indirect and relative addressing modes
10. Power-on Reset (POR)
11. Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
12. Watchdog Timer (WDT) with on -Chip RC oscillator
13. Programmable code protection
14. Power saving SLEEP mode
15. Selectable oscillator options
16. Low power, high speed CMOS FLASH / EEPROM technology
17. Fully static design
18. in-Circuit Serial Programming (ICSP) with only two pins
19. Single 5V in-Circuit Serial Programming capability
20. Processor read / write access to the program memory
21. Wide operating voltage range: 2.0V to 5.5V
22. High Sink / Source Current: 25 mA
23. Commercial, Industrial and Extended temperature ranges

b. *Peripheral Features:*

1. Timer0: 8-bit timer / counter with 8-bit press caller

2. timer 1: 16- bit t Imer / counter with press caller, can be increments during the SLEEP with an external crystal / clock
3. Timer2: 8-bit timer / counter with 8-bit period register, press caller and postcaller
4. Two Capture, Compare, PWM modules (Capture is 16-bit, max. resolution is 12.5 ns, Compare is 16-bit, max. resolution is 200 ns, the PWM max. resolution is 10-bit)
5. 10-bit multi-channel Analog-to-Digital converter (ADC)
6. Synchronous Serial Port (SSP) with SPI (Master mode) and I2C (Master / Slave)
7. Universal Synchronous Asynchronous Receiver Transmitter (USART / SCI) with 9-bit address detection
8. Parallel Slave Port (PSP) 8-bits wide, with external RD, WR and CS controls (40/44-pin only)
9. Brown-out detection circuitry for Brown-out Reset (BOR)

3.2.7 Air Regulator

Air Regulator namely working air pressure regulator.

3.2.8 SK40C

SK40C is another enhanced version of the 40 pin PIC microcontrollers start up kit. It is designed to offer an easy start board for PIC MCU users. However, all interfaces and programs must be developed by the user. Board comes with the basic elements for users to start development projects. It offers plug and use features.

a. Pool 1.5 meters (1.5 meters from the floor of the pool / water)
b. Control Board is a tool used to control the ROV The
c. Cover ie outside the framework of the ROV
d. Pressure Hull is a tool to regulate the pressure hull.

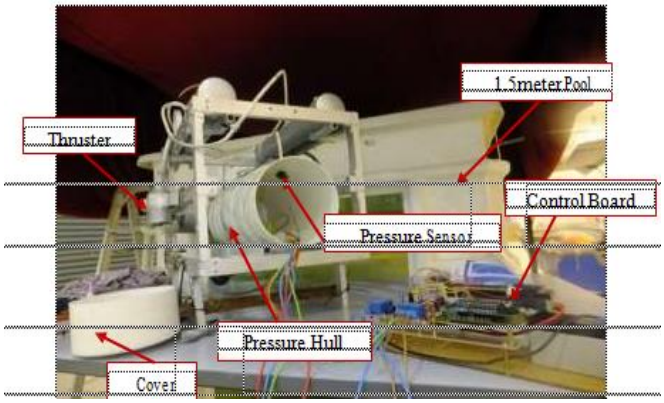

Figure 1. Experimental set-up.

Figure 2. Testing the pressure sensor

Figure 3. shows the ROV tested in a test tank Lab.

Performance pressure sensitivity and MPX5700GP MPX4250GP pressure sensor is shown by plotting pressure versus output voltage, only the similarity graph form, but slightly different value than the results of the analysis of the datasheet. In addition, more sensitive than MPX5700GP MPX4250GP maximum 2.5 bar. Thus, the pressure sensor can be used by ROV MPX4250GP for automatic depth control system [14]. Based on the Aras et al. [14], MPX 4250 GP pressure sensor has a lower

percentage of error compared with other sensors used in depth, and this is another reason why this sensor is suitable for a range of the depth of this project. Another image lab tank trial example of the journal in 2015:

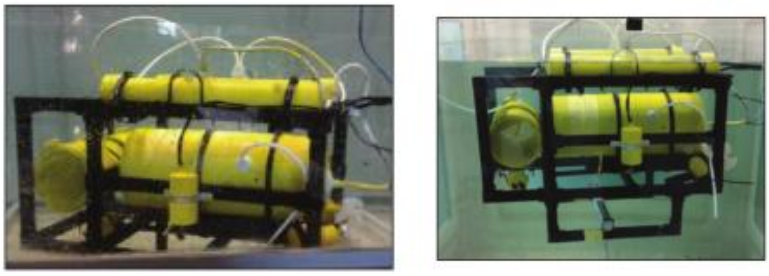

Figure 4 Testing Lab Tank ROV

3.3 Rov Pptik Ubl

3.3.1 Research Took

Study was conducted at the University of Bandar Lampung. Tests performed in Swimming Pool Primary in a flamboyant way highway Suropati profit, Labuhan in, Bandar Lampung, to test the performance of the ROV. Several tests were conducted buoyancy, watertightness, motor power, durability and functionality of video / camera.Research take place on June 20 -21 February 2017. PPTIK ROV is one type of development Rov which is currently being developed by students of Computer Science University Fakultas BandarLampung. From results of research conducted, it can be seen there is a lack of components and support tools in the PPTIK ROV.

As for the shortcomings of the components contained in the ROV Nikken UBL is as follows:

1. Spotlight 12volt
2. motor drivers
3. Remote control / joy stick
4. Clamps

3.4 Results Analysis

In this research will be testing to see the performance of the technical components ROV PPTIK Nikken UBL which include:

3.4.1 Testing Input Control

Input control comes from laptops that have been made or designed so that it can carry out commands according to the instructions from user.Command used in this test is only able to move Forward Backward, Left and Right, and Up and Down.

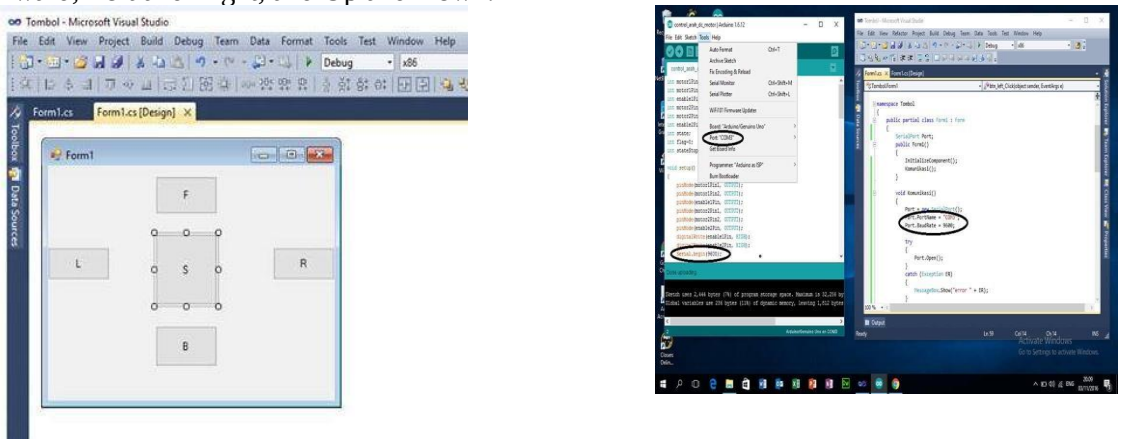

Figure 5. Testing input control

3.4.2 Testing Motion Propeller

Testing motion the propeller will be undertaken only be maneuvered when the ROV is moved like a forward motion the propeller on the right and left *body* ROV will rotate to the right, if ROV backward so the blades will be spinning the opposite, namely to left.

3.4.3 TestingVisualization Camera

Testing visualization2MP IP CCTV cameras can display images *stream* to a laptop with a goodduring the day but if done in the dark state, the camera displays the image stream is not good and obviously due to the reflection of light from the CCTV.

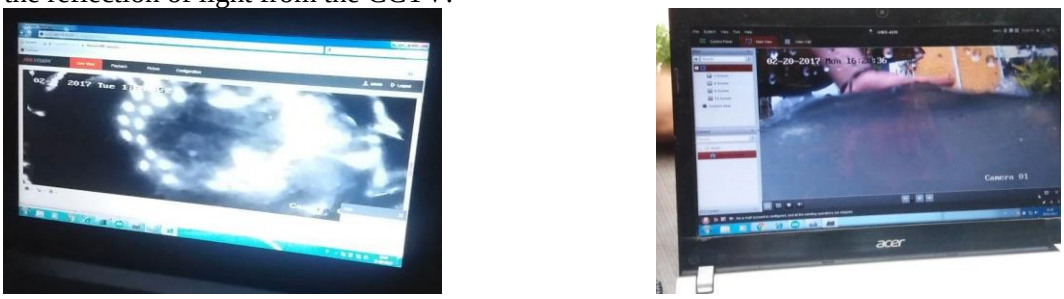

Figure 5. Testing The Camera Image Visualization

3.5 TestingOverall

Weight balance between the front and back on the tube or body ROV is important in order to be stable position both in a position above the water surface, under water or when hovering. But what happens when the field tests, the position of the ROV is still too heavy to back.All positions have been adjusted to their respective portions but the position of the ROV is still geared more weight to the rear. Then that happened in camera should be able to function properly, but because at night or in dark conditions too bright lights that make reflections on the camera, causing not maximal image captured by the camera. Additionally, use of cover on aluminum tube that contains the main components of the ROV and the camera is not tight so that there are small cracks that cause water ingress into the*body* ROV. Meanwhile, in the ROV in general or meet the standards in terms of balance between the weight of the back and front of the ROV in the water is stable, the camera works well in order to produce a video that is clear and obvious, cover tightly so it can not be penetrated water, floodlights or lighting both of which do not cause too reflected light cameras

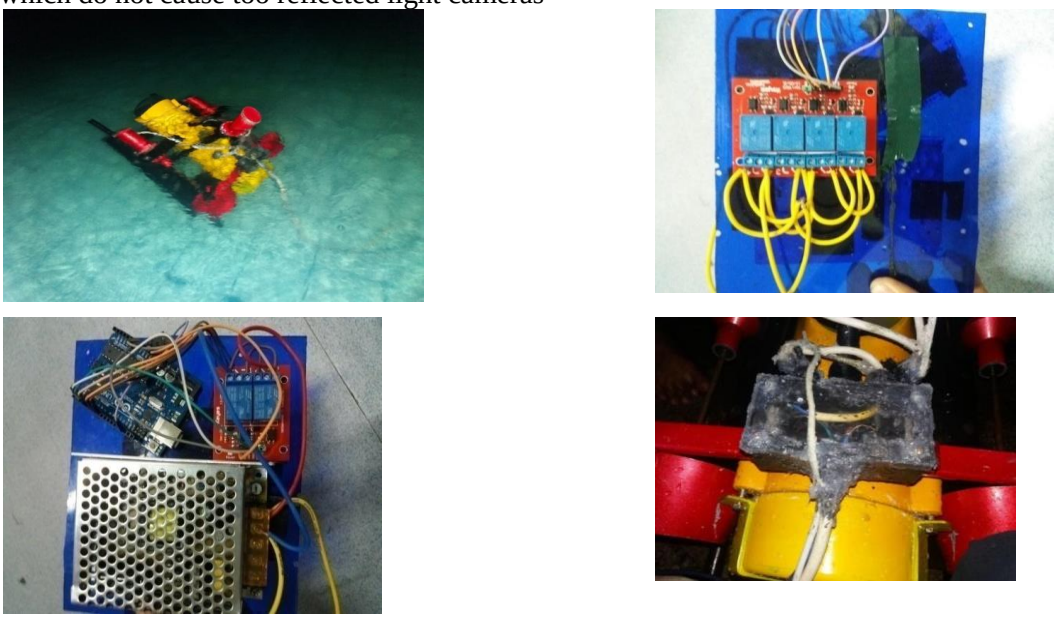

Figure 6. Testing Overall Figure

4. Conclusions And Recommendations

4.1 Conclusion

Based on the analysis it is concluded that there are still many shortcomings in Nikken PPTIK ROV ROV UBL compared with the general who has been described in the foregoing discussion, after testing the like, Testing input control, testing vane motion, visualization testing and testing of the

overall camera then generated that UBL Nikken PPTIK ROV can not be said to meet the standards ROV in general.

4.2 Suggestion

Of the writer to the reader is expected with this research can increase knowledge and insight on the ROV. As well as for further research are expected to develop ROV PPTIK Nikken UBLbecause still many inadequacies, then there must be further development in a variety of ways, including:

a. Heavy loads ROV in the water so it does not reduce the performance of the motor.
b. The cooling system to reduce condensation that occurs in the dome camera, so the camera is not impaired vision.
c. Packingevery system better part for prevention of water ingress.
d. Good buoys in order to maintain buoyancy and ROV good aesthetic appearance.
e. Additional lighting is better.
f. The addition of a compass and tool positioning ROV.
g. The addition of marine parameter measurement sensors will make ROV more useful. Some of the above are important factors that must be considered in the development of the next ROV, especially regarding the movement of ROV and camera. The use of the main ingredient of making ROV is stronger and lighter can be a high-weight alternative ROV.

References

[1] FA Ali, MSM Aras, FA Azis, MF Sulaima and I. Jaaffar,2014. "*Design and Development of Auto Depth Control of Remotely Operated Vehicle Using Thruster System*", Jurnal ISSN (Print):2289-4659.

[2] Made SG, Ketut UA & Nyoman AW, 2014. *"Alat Bantu Survey Bawah Air Menggunakan Amoba, Robot Berbasis Rov"*, Journal ISSN: 2303-3142 **Vol. 3**, No. 2.

[3] Mohd Shahrieel Mohd Aras & Fadilah Abdul Azis,(2012). "*ROV Trainer Kit for Education Purposes" ,International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Impact Factor.*

[4] Rizki, Ilham,2008.*"Pengembangan Prototipe Remotely Operated Vehicle (Rov) : Aspek Mekanis*", SKRIPSI.