KEMENTERIAN PENDIDIKAN TINGGI

JOJAPS

eISSN 2504-8457

Journal Online Jaringan Pengajian Seni Bina (JOJAPS)

Underwater Imaging Models with Homomorphic Filtering and Wavelet Decomposition REAL-TIME MONITORING (RTM) DIVING ROBOT

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Abstract

Abstract Fish ethology is a prospective discipline for ocean surveys. In this paper, one ROV-based system is established to perform underwater visual tasks with customized real-time monitoring installed. One image quality enhancement method is presented in the context of creating underwater imaging models combined with homomorphic filtering and wavelet decomposition. The underwater vision system can further detect and track swimming fish from resulting images with the strategies developed using curve evolution and particular filtering, in order to obtain a deeper understanding of fish behaviours. The simulation results have shown the excellent performance of the developed scheme, in regard to both robustness and effectiveness. The fishery sector plays an importance role in the social and economic development in Malaysia. The deep sea and offshore fishery industries are the main contributors to the nation's fisheries. Nonetheless, if compared to the development of fishery sector between Malaysia and other countries such as Japan, Korea, China and Norway and other developed countries, we are still lagging behind.

Key-word: - *ROV, Homomorphic Filtering, Wavelet Decomposition*

1. Introduction

The first reported submarine was designed as early as the year 1620 when a Dutchman named *Cornelius van Drebbel* experimented with a raw boat covered with waterproof leather skin. However, not much information is available regarding his experiment and the vessel that he created could probably be a 'submersible' rather than a 'submarine' when it comes to current terminology. When an object is denser than the surrounding water, it usually sinks while an object that is less dense will float. Similarly, when the object gains similar density to the surrounding water, it has the ability to float. The mechanism used by submarines to sink, float, and surface would be along this same principle.

The submarine body consists of two walls. The outer wall is strong and waterproofed while the inner wall is stronger and could resist immense pressures. The outer and inner walls of the submarines is also referred to as the 'outer' and 'inner' hulls while the much stronger 'inner hull' is also given the name, 'pressure hull'. The space between the two hulls is called the 'ballast tanks' and it is the space which allows the submarine to move around through changing the overall density. When the submarine needs to dive, the ballast tank will be partially filled with water and the air will be kept compressed and kept out from the tank. This mixture of less air and more water makes the submarine denser and therefore allows it to sink. Similarly, when the sub needs to surface, the water will be pumped out, and more air will be filling the ballast tank. The lessening of the density of the sub will allow it to rise. At the time of floating under the sea surface, the water and the air mixture within the tank will equal the density of the surrounding seawater and with the use of propellers; the submarine will be able to move.

The objective of this project is:

i. To design real time monitoring underwater vehicle with Homomorphic Filtering and Wavelet Decomposition.
ii. To develop real time monitoring underwater vehicle with Homomorphic Filtering and Wavelet Decomposition.

2. Selection of System & Components

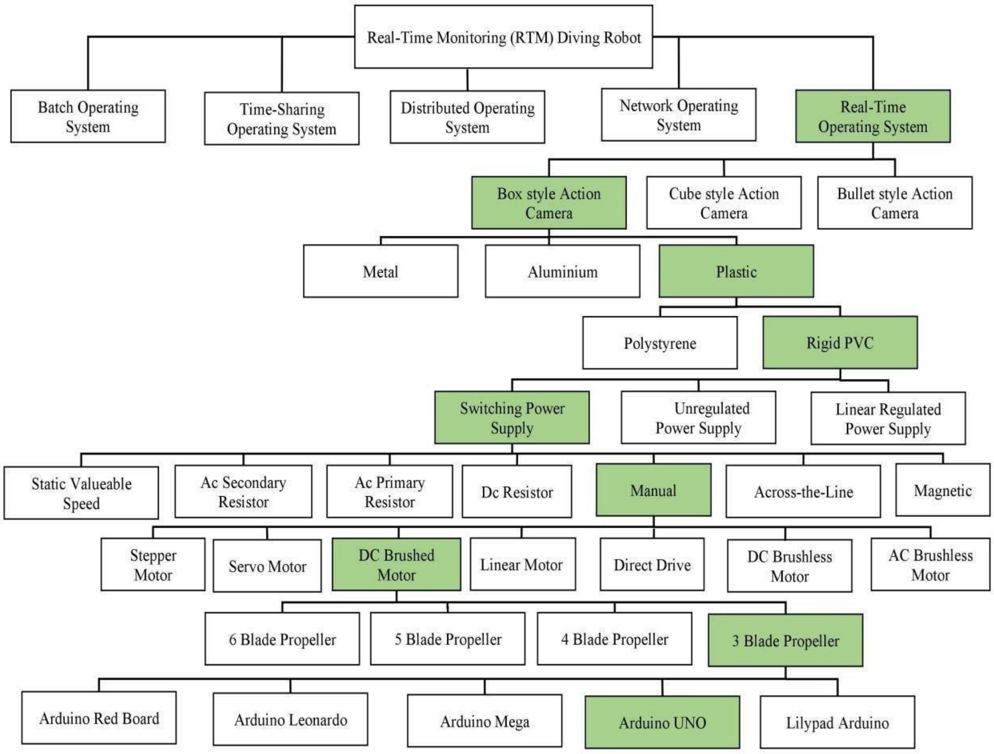


Figure 2.1 Brainstorm K-Chart

3. Methodology

The methodology is focused on how to analyze and study a theory to apply in this innovation. In this chapter, the transmission network development methodology will be explained in more detail. The study methodology is exposition on ways and means of carrying out the study. It is also the approach used in getting information on study and analyse the methods used to achieve data manipulation. There are 4 main parts involved excluding the run test for this project as follows:

3.1 PART A - Main body:
- 3.1.1 Gather the PVC Materials and Cut Them in Appropriate Lengths (4x45cm, 7x25cm, 2x35cm)
- 3.1.2 Drill the Drain Holes
- 3.1.3 Assemble the Vehicle Frame
- 3.1.4 Attach the Payload Net
- 3.1.5 Drill Holes in the Motor Housings

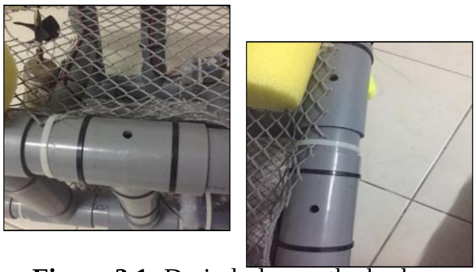


Figure 3.1: Drain holes on the body

Figure 3.2: Parts of PVC pipes

Figure 3.3: Payload net on the top and housings bottom of vehicle frame

Figure 3.4: Drilling holes of motor

3.2 PART B - Motor Controller:

- 3.2.1 Connect the Wires to the Motors
- 3.2.2 Seal Motors
- 3.2.3 Pot (Waterproof) the Motors with Silicone
- 3.2.4 Mount the Propellers onto the Shafts
- 3.2.5 Mount the Motors onto the Vehicle Frame

Figure 3.5: Waterproofing the motors

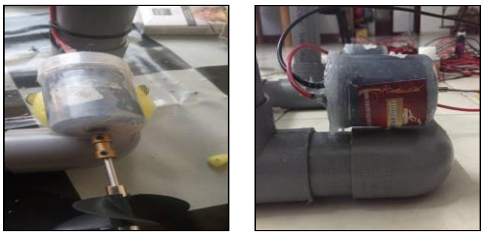


Figure 3.6: Mounting propellers at frame

3.3 PART C - Project Accessories:

- 3.3.1 Mount Camera on the Body
- 3.3.2 Mount Flashlights on the Body
- 3.3.3 Waterproof and Mount the Wires

Figure 3.7: Mounting flashlights on both side and Wrapping the wires using electrical tape

3.4 PART D - Mechatronic section:

3.4.1 Connection of Arduino Board and Motor Driver

3.4.2 Solder the Switches

3.4.3 Controller & Control Box

3.4.4 Coding for Joystick and Motor Driver

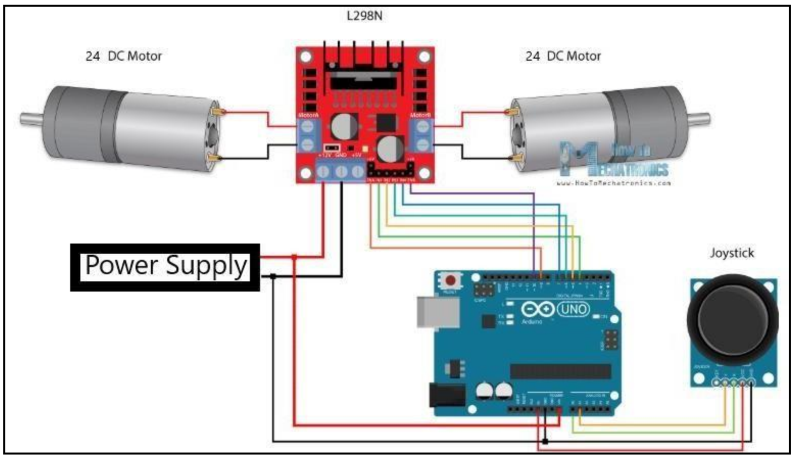


Figure 3.8: Connection of components

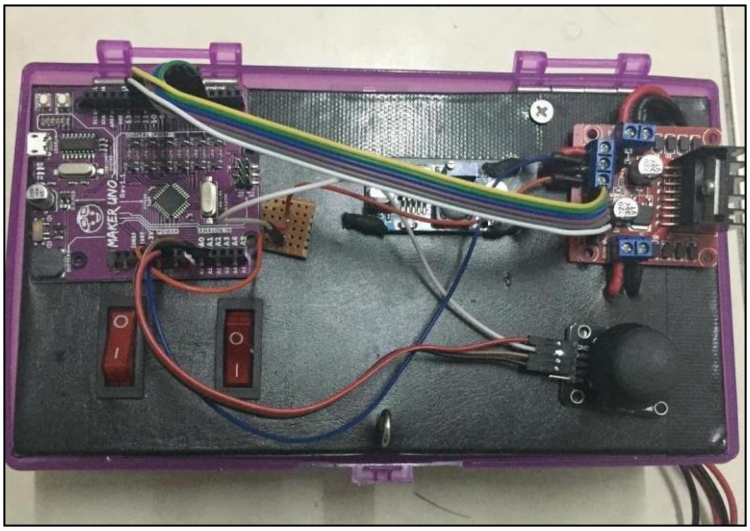
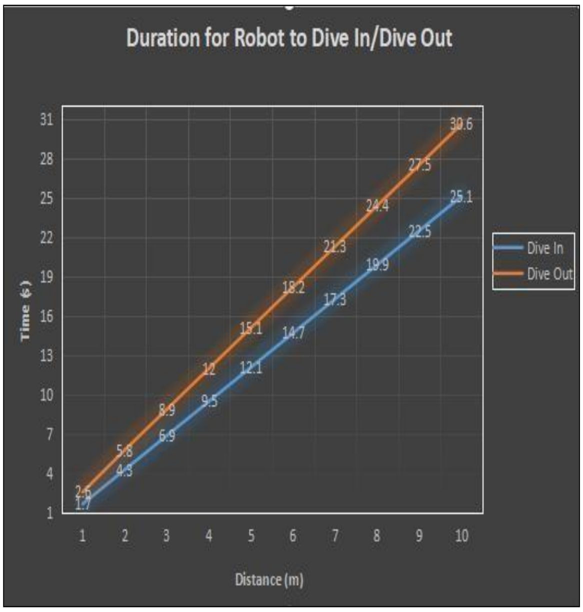


Figure 3.9: Set of control components

4. Result and Analysis

Table 4.1: Time taken for the robot to dive in and dive out per metre



Distance (m)	Time taken for the robot to dive in (s)	Time taken for the taken to dive out (s)
1	1.7	2.6
2	4.3	5.8
3	6.9	8.9
4	9.5	12
5	12.1	15.1
6	14.7	18.2
7	17.3	21.3
8	19.9	24.4
9	22.5	27.5
10	25.1	30.6

The graph and table show the relationship between distance and time taken for the robot to dive in and dive out per metre. If the distance increase, the time taken for the robot to dive in and dive out also increases. As a result, the distance is linearly proportional to the time taken for the robot to dive in and dive out per metre. As shown graph and table above the difference of time taken for the robot to dive in per metre is only 2.7 seconds meanwhile the time taken for the robot to dive out per metre is about 3.1 seconds. This time taken of robot to dive in is influenced by the speed or maybe the torque of the motors. Other than that, this speed also maybe varied due to the current of the river. The time taken for the robot to dive out also have been considered in the matter of buoyancy as this robot follows the concept of submarine. To be explained, a submarine or a ship can float because the weight of water that is displace equal to the weight of the ship. This displacement of water creates an upward force called the buoyant force. A submarine can control its buoyancy, thus allowing it to sink and surface at will. The same principles have been followed by this project. So, this graph and table recorded the value which is really affected by the concept of submarine.

5. Conclusion

Those listed scopes have been achieved by this diving robot. For instance, this underwater vehicle is able to float without any delay. Additionally, this diving robot also can perform well in submerging, rotate left and right and also moving forward and reverse respectively. Furthermore, by planning this diving robot be able to dive in within 5 seconds but then according to the performances of the robot recorded during testing was only 2.7 seconds. We also able to accomplished the main purpose of building this project by merging the display of real time monitoring view. Last but not least, this robot be able to help fisherman to conduct their job easily and it is also be built for safety purpose of the fisherman. In the future, we could build the real autonomous diving robot which can operated without has no connecting cables to the body of project which can send the collecting views or data to the host PC via wireless communication and travel to the designated location automatically.

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