Aquatic Surveillance Robot

Dr B. Ramakrishna[1], Dr. D. Kameswara Rao[2], Dr. K. Sudhakar Reddy[3]

[1,2]*Assistant Professor, Department of Mechanical Engineering, Mahatma Gandhi Institute of Technology, Hyderabad-500075.*

[3]*Professor, Department of Mechanical Engineering, Mahatma Gandhi Institute of Technology, Hyderabad-500075.*

doi.org/10.64643/IJIRTV13I1-205054-459

***Abstract*—Aquatic Surveillance Robot is an underwater Remotely Operated Vehicle (ROV) controlled by an operator from a ground station. The need for surveillance and monitoring under water is gradually increasing every day, due to an increase in advancements and intrusions under water. This robot is superlatively useful for monitoring the systems that are being established under water and operated for surveillance purposes. The main objective of this project is to create an aquatic robot, using the knowledge of Marine technology and the fundamentals of Archimedes' Principle. By referring to the depth control unit of submarines, we have chosen to design a Buoyancy Control Unit (BCU) for controlling the depth of the robot. For the rotation and movement of the robot in the XY plane, durable hydraulic pumps are used, which produce a higher magnitude of thrust. These components will be administered by a programmable microcontroller and operated with the help of a transmitter and the receiver installed inside the robot. A wireless camera will also be placed inside the robot in order to monitor how the robot is performing its activities in its designated viscous milieu.**

***Index Terms*—Aquatic Robot; Underwater ROV; Unmanned vehicle; Submarine.**

I. INTRODUCTION

There is a lot of research and development going on the autonomous systems and robots, which move on a surface or which fly, but not much on the robots which submerge in dense fluids, comparatively. An Aquatic Surveillance Robot (ASR) is a submersible Remotely Operated Vehicle (ROV) used for monitoring a specific region for various purposes under water. The first tethered ROV, named POODLE, was developed by Dimitri Rebikoff in 1953. ROVs are now used in all manner of exploration and commercial applications, from dam and water-tank inspections to evidence recovery, pipeline maintenance, aquaculture, and drowning-victim recovery. After a series of experiments during research and development of underwater robots, we decided to build a robot capable of monitoring specific regions underwater from ground stations.

II. METHODOLOGY

This project uses a microcontroller and a system on chip-based controller called ESP32 for the administration of all the electronic components. The Buoyancy Control Units (BCU) in the depth control system use syringes with lead actuation driven by two N20 micro gear motors. These motors are controlled using an H-bridge motor driver (L298N). The Brushless DC (BLDC) Hydraulic Pumps are used for the translation and rotation of the robot. The robot is operated by connecting to the WiFi network of the ESP32 in coordination with the microcontroller (Arduino UNO ATmega328P). A clear acrylic pipe (Outer diameter: 82 mm) is utilized to embody the entire mechatronics system and protect it from water, air-locked via epoxy-resin and rubber O-Rings.

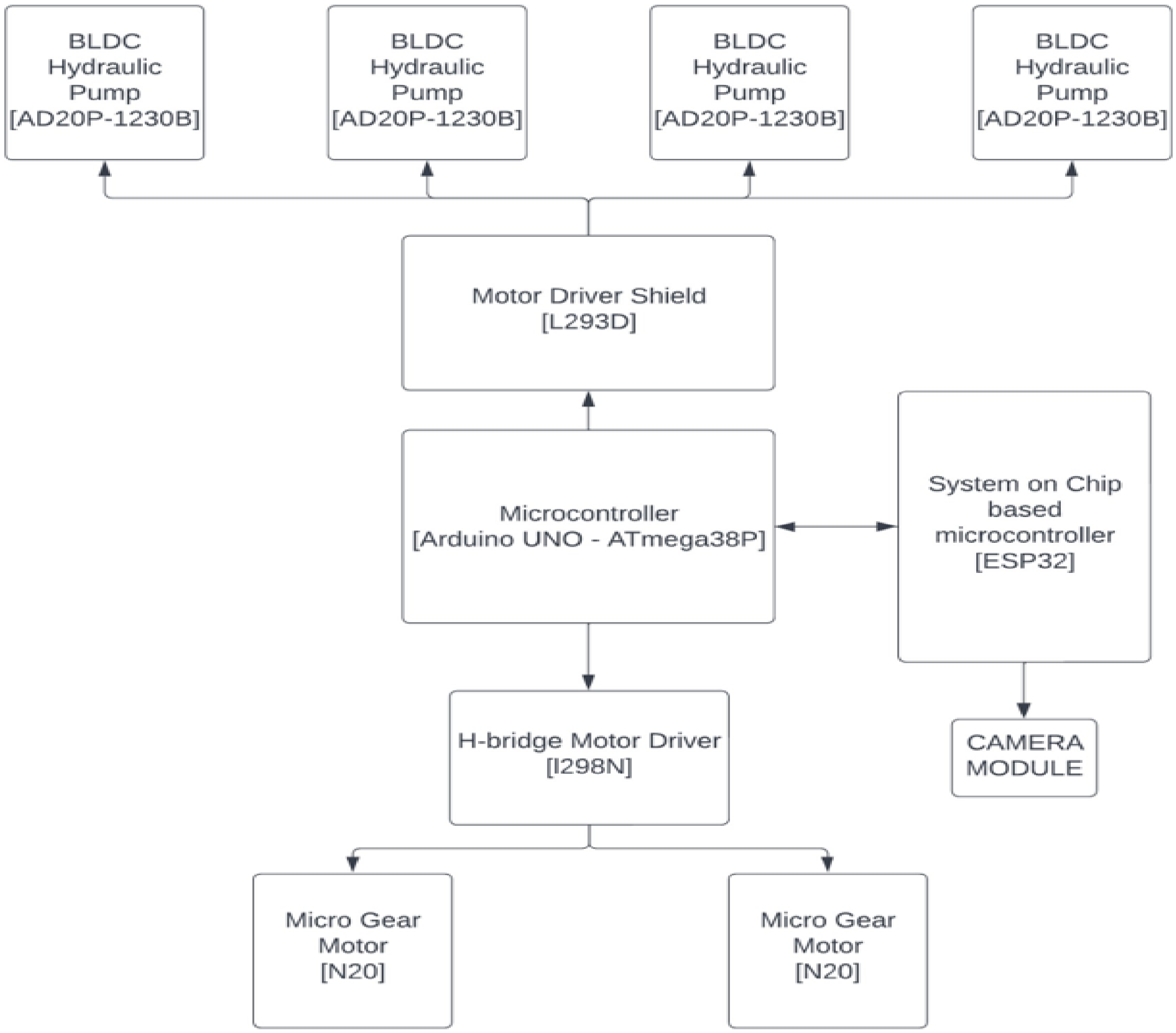

Figure No:1 Block Diagram of Aquatic Surveillance Robot

Table 1. Core Component Specifications

Parameter	Specification
Microcontroller	ATmega38P (Arduino UNO)
Operating Voltage	5V
Hydraulic Pump	BLDC AD20P-1230B
Pump Operating Voltage	12V
Camera Module	ESP32-CAM
Depth Control	BCU (Syringe + N20 Motor)

III. RESULS AND DISCUSSION

The Aquatic Surveillance Robot was successfully designed, fabricated, and completely leak-proofed by air-locking it with epoxy resin and rubber-o-rings at the faces. The Buoyancy control units (BCUs) and thrusters are working in the desired manner. Live feed of video footage is obtained from the robot to the control station on the ground via the ESP32 WiFi network. Whenever the water is consumed into the BCU, we observed a change in the depth of the robot; similarly, it floats when the consumed water is drained out. The BCU works efficiently as a single acting hydraulic cylinder. The entire frame proved to be robust enough to sustain high stresses under water, and the latency of the robot acting upon a control signal is quite trivial.


Figure No 2:Top view of ASR


Figure No 3: Top View of BCU

IV. CONCLUSION

The desired functionalities of the robot were successfully achieved by placing all the units precisely at their corresponding locations with care. The rotation of the robot in the XY plane is achieved by the actuation of thrusters in rotation mode, whereas the translation is achieved by the actuation of the thrusters in propulsion mode. To control the robot, a remote controller application was used successfully. Proper actuation of the Brushless DC Hydraulic Pumps was achieved by interfacing them with an L293D Motor driver shield using Arduino. The N20 micro gear motor successfully controls the suction and drain of water from its volume to alter the buoyancy. The ESP32 based camera effectively shares the live feed of the underwater footage with reasonable clarity.

REFERENCES

[1] Charles Eriksen C, James Osse T, Andrew Chiodi M. Sea glider: A long-range autonomous underwater vehicle for oceanographic research. IEEE J Ocean Eng. 2009;26(4).

[2] Nana L, Singhoff F, Legrand J, Marce L. Embedded intelligent supervision and piloting for oceanographic autonomous underwater vehicles. 2010.

[3] Wang WH, Chen XQ, Marburg A. Design of autonomous underwater vehicle. Japan Agency for Marine-Earth Science and Technology. 2013;13(2).

[4] Sharma PB, Sinha RK. Design and development of the autonomous underwater vehicle "ZYRA." Robosub Competition Journal Paper. 2010. p. 143–150.

[5] Wang Y, Tan R, Xing G, Wang J, Tan X. Profiling aquatic diffusion process using robotic sensor networks. IEEE Trans Mob Comput. 2014;13(4).

[6] Yu X, Dickey T, Bellingham J, Manov D, Streitlien K. The application of autonomous underwater vehicles for interdisciplinary measurements in Massachusetts and Cape Cod Bays. Cont Shelf Res. 2012;22.

[7] Maurelli F, Cartwright J, Johnson N, Petillot Y. Nessie IV autonomous underwater vehicle wins the SAUC-E competition. In: Proceedings of the 10th International Conference on Mobile Robots and Competitions (ROBOTICA 2010); 2010 Mar; Leiria, Portugal.

[8] Hidaka S, Kawashima S, Nam S, et al. System design and hardware development of autonomous underwater robot "Daryabird." In: Proceedings of the AUVSI & ONR 18th Annual RoboSub Competition; 2015 Jul; San Diego, CA, USA.