IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023

DOI: 10.17148/IJARCCE.2023.125152

Biomimetic ROV for Underwater Survey

S Jeevan Sai Reddy[1], S Banu Prakash Reddy[2], Suchit C S[3], Hithesh K Naik[4], Dr. Kiran Kumar M V[5]

Student, Mechatronics Engineering, MITE, Moodabidri, India[1-4]

Senior Assistant Professor, Mechatronics Engineering, MITE, Moodabidri, India[5]

Abstract: Lakes and water bodies have a huge impact on the local ecosystem and environment. Unfortunately, water bodies today are in very bad state all over the country. In most cases, they have become dumping place for household and industrial waste. In many places, they are also filled with garbage. The result is that water bodies are dying, and this makes the water crisis faced by the communities worse. Water pollution can be attributed to one of four sources sewage discharges, industrial activities, agricultural activities, and urban runoff including storm waters.

Sources of water pollution are either point sources or non-point sources. Point sources have one identifiable cause, such as a storm drain, dumping of industrial waste, sewage treatment facilities, illegal dumping water treatment plan or an oil spill. Non-point sources are more diffuse, such as agricultural runoff. The first step towards water body revival is to survey for the garbage dumped in waterbodies. So, we have come up with a solution to do a survey of plastic waste in the waterbodies using Biomimetic ROV and IoT i.e., raspberry pi, TDS sensor, Turbidity sensor, Ultra-sonic sensor, GPS sensor. Using camera we will detect the plastic bottle, plastic cup, plastic bag through object detection, the data from the sensors are sent to firebase real-time database and that data will be displayed in the website in real-time. This will help us know the amount of garbage in the waterbodies and that data can be used to clean that garbage, which will reduce the water pollution crisis.

Keywords: Water Pollution Crisis, Biomimetic ROV, IoT, Plastic Garbage, Object Detection.

I. INTRODUCTION

Water covers over 70% of the earth, but only 3% of it is freshwater, and much of it is stored in glaciers, rivers, lakes, and other bodies of water. Rivers and lakes play a crucial role in supporting human life, providing water for irrigation, food, and maintaining ecosystems. However, most of these bodies of water are being contaminated by human activities, endangering aquatic life and making the water unsafe for human consumption. Protecting and cleaning up our rivers is important for our health, the environment, and the survival of endangered species.

The proposed Biomimetic ROV model can help reduce water pollution by collecting data on human and industrial trash and storing it on a cloud platform. The model includes various components such as microcontrollers, sensors, GPS, camera, and motors. Taking care of our rivers is crucial for improving the quality of life and preserving the biodiversity of our planet.

II. LITERATURE REVIEW

[1] Yu Junzhi, Tan M, Wang Long, “Cooperative Control of Multiple Biomimetic Robotic Fish”, The author discussed about the diverse range of processes used by swimming organisms has long served as a source of inspiration for biologists and engineers. Undulation of the axial structure, often known as undulatory swimming, is the most frequent form of aquatic vertebrate locomotion. A fish's core is supported by jointed skeletal components that are powered by muscle motors, and its tail acts as a propeller if you imagine a fish as a hydrodynamic swimming machine. The fish-like gadgets offer a self-contained test environment for developing underwater vehicles that are inspired by biological systems and show tremendous potential for accurate kinematics control and non-biological parameter assessment.

[2] Yu Junzhi, Tan M, Wang Shuo and Chen Erkui, “Development of a Biomimetic Robotic Fish and Its Control Algorithm”, This research aims to use a hybrid control strategy and a PID control system, the project intends to create a biomimetic robotic fish with a flexible posterior body and an oscillating foil as a propeller. The carangiform motion, in which the body undulates and a stiff caudal fin produces push, is the basis for the fish's mobility. By altering the servomotors' oscillation frequency, the speed of the fish can be changed, although interactions with water can lead to resonance and stability problems.

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023
DOI: 10.17148/IJARCCE.2023.125152

[3] Ennasr Osama, Holbrook Christopher, Hondorp Darryl & Krueger Charles, Coleman Demetris, Solanki Pratap, Thon John and Tan Xiaobo, "Characterization of acoustic detection efficiency using a gliding robotic fish as a mobile receiver platform", The author discussed about Autonomous underwater vehicles (AUVs) and animal telemetry are essential tools for comprehending how aquatic species interact with their surroundings. via hydrophones or other acoustic receivers and acoustic transmitters, marked animals can be tracked via acoustic telemetry.

[4] Tan-Hanh Pham, Khanh Nguyen, Hoon Cheol Park, "A robotic fish capable of fast underwater swimming and water leaping with high Froude number", The author discussed about KUFish a robotic fish created by researchers, can leap out of the water and move quickly. Thrust is produced via the robot's tail-beating mechanism, which uses a DC motor, reduction gears, a four-bar linkage, and pulley-string systems. Passive dynamic stability is provided by the robot's symmetric mass distribution, positive buoyancy, and decreased center of gravity. Swimming experiments show that the KUFish can swim 0.68 m and leap out of the water at a speed of 1.35 m/s (6.1 BL/s) at 0.68 s after release.

[5] Chao Zhou, Saeid Nahavandi, Nong Gu, Zhiqiang Cao, Shuo Wang, Min Tan, "Analysis and Implementation of Swimming Backward for Biomimetic Carangiform Robot Fish", The author discussed about the study and implementation of swimming backward for a biomimetic carangiform robot fish are covered in this paper. A multiple-link structure is used to modify the carangiform swimming law in order to allow for backward travel. This modification is based on the European Eel swimming mode.

[6] Cafer Bal, Gonca Ozmen Koca, Deniz Korkmaz, Zuhtu Hakan Akpolat, Mustafa Ay, "CPG-based autonomous swimming control for multi-tasks of a biomimetic robotic fish", The focus of this work is on the artificial intelligence used to control the created biomimetic robotic fish (i-RoF) using a Central Pattern Generator (CPG) approach based on sensory feedback. A novel control mechanism, made up of two subsystems-a biologically based CPG network and a Fuzzy Logic controller-is suggested to achieve rhythmic, reliable, and flexible closed loop control performance.

[7] Morawski Marcin, Słota Adam, Zajac Jerzy, Malec Marcin, "Fish-like shaped robot for underwater surveillance and reconnaissance – Hull design and study of drag and noise", The focus of this work was the design and development of a biomimetic autonomous underwater vehicle (BAUV) for intelligence surveillance and reconnaissance (ISR) in subsea security systems are discussed in this study. The purpose of this paper is to provide research responses to two concerns regarding drag forces operating on the vehicle and how mechanical design affects noise level. Measurements of forces acting on the hull and noise produced by two different types of propulsor drives are also reported, together with quantitative results of the research on vehicle forward velocity, hull drag, increased mass, and created noise.

III. COMPONENTS

- Raspberry Pi 4 - A single-board computer known as the Raspberry Pi 4 Model B with 4GB RAM was introduced in June 2019 as the Raspberry Pi family's fourth version. It is made to offer a cheap platform for computer science education and do-it-yourself projects, as well as a flexible and economical tool for embedded developers and enthusiasts. The quad-core ARM Cortex-A72 Processor included in the Pi 4 Model B operates at 1.5GHz and offers a substantial performance improvement over its forerunners.

- Ultra-Sonic Sensor (JNSR40T) - The JNSR40T is an ultrasonic sensor with applications in liquid level sensing, obstacle identification, and distance measuring. It is accurate to within 1 centimetre and has a detection range of up to 400 cm. The sensor measures the amount of time it takes for ultrasonic sound waves to return after colliding with an item.

- TDS Sensor - The amount of dissolved solids in a solution is measured using an electrical device called a Total Dissolved Solids (TDS) sensor. These sensors are frequently used to check on the quality of the water being treated in water treatment applications. The electrical conductivity of a solution is measured using TDS sensors because it directly relates to the amount of dissolved particles in the solution.

- Turbidity Sensor - Turbidity sensors are tools used to gauge how much water loses clarity from suspended particles. These particles may be organic materials, minerals, or other components that make water cloudy or hazy. The quantity of light scattered by these particles is measured by turbidity sensors, which output a numerical number that corresponds to the level of turbidity.

- GPS Neo6M - GY-NE06MV2 is a module based on the NEO-6M GPS chip, which is widely used for positioning, navigation, and timing applications. The module connects with microcontrollers through a serial interface

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified ⁑ Impact Factor 8.102 ⁑ Peer-reviewed / Refereed journal ⁑ Vol. 12, Issue 5, May 2023
DOI: 10.17148/IJARCCE.2023.125152

and is made to operate with a variety of devices, including Arduino. Also, it has a built-in LED indication that shows the condition of the GPS module and makes troubleshooting problems simple.

- DC Servo Motor (MG996R) - The MG 996R and other DC servo motors are frequently employed in a wide range of applications that demand precise control of angular position and speed. A stator with a number of stationary windings and a permanent magnet rotor makes up these motors. DC voltage is used to activate the stator windings, creating a magnetic field that interacts with the rotor to create torque. It features an 11 kg/cm maximum torque output and a metal gear train. The motor has a maximum speed of 0.17 seconds/60 degrees and runs at a voltage between 4.8 and 7.2 VDC.

- Webcam - A webcam is a compact digital camera used to capture and transmit real-time video over the internet. It can be attached to a computer, laptop, or mobile device and is commonly used for video conferencing, online video chat, and live streaming.

IV. METHODOLOGY

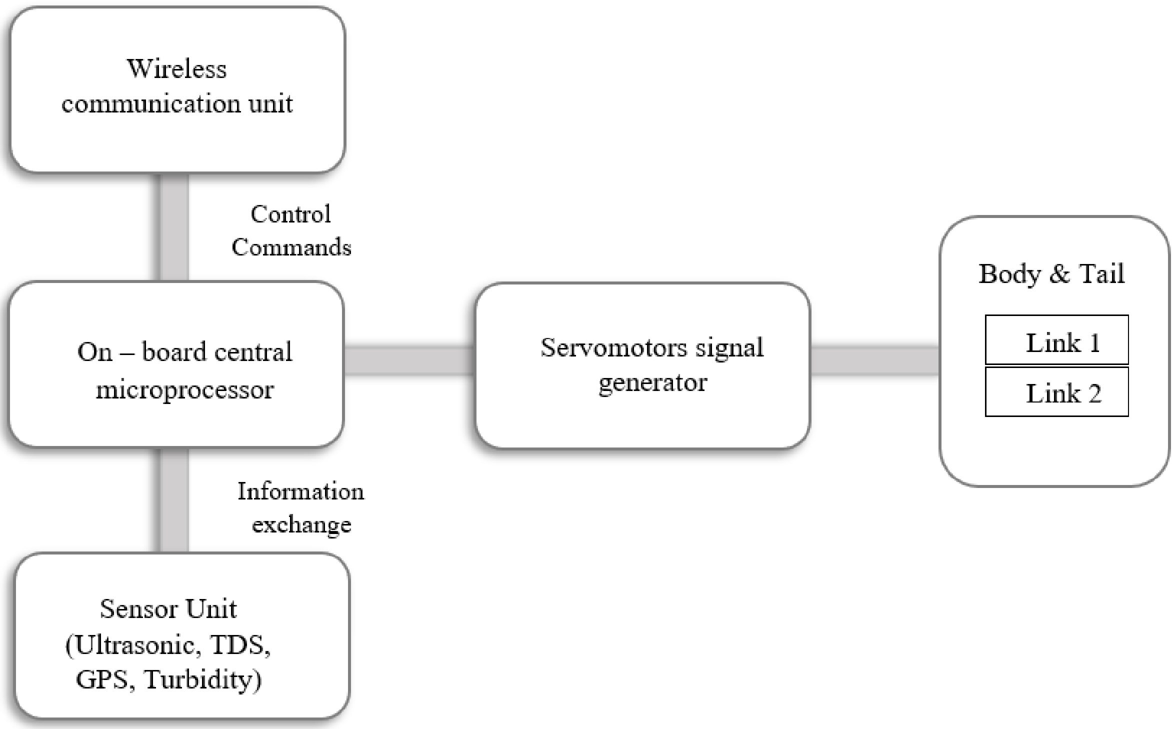

Fig 1: Methodology Flowchart

The robot utilizes wireless communication through RF signals to establish a connection and transmit control commands. This enables the operator to remotely control the robot's actions. At the core of the robot's functionality lies a microprocessor, a small but powerful computer that is integrated within the robot's hardware. The microprocessor serves a crucial role as it processes the incoming commands and the data gathered from various sensors.

The sensors integrated into the robot's design capture valuable information about the surrounding environment. These sensors may include camera, Ultra-sonic sensor, TDS sensor, Turbidity sensor, GPS module. The data collected by these sensors is fed into the microprocessor for analysis and interpretation.

In this particular robot, the servomotors are connected to the tail section through two links. This mechanical linkage allows the servomotors to actuate the tail section, which, in turn, generates motion in the robot's body.

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified ⁘ Impact Factor 8.102 ⁘ Peer-reviewed / Refereed journal ⁘ Vol. 12, Issue 5, May 2023
DOI: 10.17148/IJARCCE.2023.125152

V. CONCLUSION

- In recent years, water pollution has emerged as one of the most significant environmental challenges globally. The dumping of garbage in water bodies has contributed significantly to this problem, posing a severe threat to the health of ecosystems and the environment. In this project, we aimed to develop a solution to this problem by utilizing innovative technology to monitor and detect plastic waste in water bodies.

- Through our project, we have demonstrated that IoT technology, such as Biomimetic ROV and Raspberry Pi, can play a crucial role in addressing this problem. By deploying these technologies in water bodies, we will be able to detect and monitor plastic waste, providing valuable data for identifying problem areas and taking appropriate measures to clean them up.

- By utilizing innovative technologies and data-driven approaches, we can take proactive measures to monitor and tackle water pollution, promoting sustainable living practices and protecting the environment for future generations.

- The product provides social benefits to the laborers involved in lake cleaning while also being economically viable. When used in large quantities and designed on a larger scale, the product serves as an excellent example of technological applications in environmental protection.

REFERENCES

[1]. Yu, Junzhi & Tan, M. & Wang, Long. (2008). "Cooperative Control of Multiple Biomimetic Robotic Fish". 10.5772/5487.
[2]. Yu, Junzhi & Tan, M. & Wang, Shuo & Chen, Erkui. (2004). "Development of a Biomimetic Robotic Fish and Its Control Algorithm". IEEE transactions on systems, man, and cybernetics. Part B, Cybernetics: a publication of the IEEE Systems, Man, and Cybernetics Society. 34. 1798-810. 10.1109/TSMCB.2004.831151.
[3]. Ennasr, Osama & Holbrook, Christopher & Hondorp, Darryl & Krueger, Charles & Coleman, Demetris & Solanki, Pratap & Thon, John & Tan, Xiaobo. (2020). "Characterization of acoustic detection efficiency using a gliding robotic fish as a mobile receiver platform". Animal Biotelemetry. 8. 32. 10.1186/s40317-020-00219-7.
[4]. Tan-Hanh Pham, Khanh Nguyen, Hoon Cheol Park, "A robotic fish capable of fast underwater swimming and water leaping with high Froude number", Ocean Engineering, 2023, ISSN 0029-8018.
[5]. Chao Zhou, Saeid Nahavandi, Nong Gu, Zhiqiang Cao, Shuo Wang, Min Tan, "Analysis and Implementation of Swimming Backward for Biomimetic Carangiform Robot Fish", IFAC Proceedings Volumes, Volume 41, Issue 2, 2008, Pages 3082-3086, ISSN 1474-6670, ISBN 9783902661005.
[6]. Cafer Bal, Gonca Ozmen Koca, Deniz Korkmaz, Zuhtu Hakan Akpolat, Mustafa Ay, "CPG-based autonomous swimming control for multi-tasks of a biomimetic robotic fish", Ocean Engineering, Volume 189, 2019, ISSN 0029-8018.
[7]. Morawski Marcin, Słota Adam, Zając Jerzy, Malec Marcin, "Fish-like shaped robot for underwater surveillance and reconnaissance – Hull design and study of drag and noise", Ocean Engineering, Volume 217, 2020, ISSN 0029-8018.

