IJAREEIE

e-ISSN: 2278-8875
p-ISSN: 2320-3765

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

Volume 13, Issue 4, April 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.317

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304071 |

River Cleaning Robot

Tharun D M, Tharun R, Sumith M N, Theja S, Mr. S N PRASAD

UG Students, Dept. of ECE, NIEIT, Mysore, Karnataka, India

Assistant professor, Dept. of ECE, NIEIT, Mysore, Karnataka, India

ABSTRACT: Autonomous robots powered by artificial intelligence (AI) are emerging as a game-changer in the fight against river pollution. These innovative robots navigate rivers, diligently collecting floating debris and particles, contributing to a cleaner and healthier aquatic environment. This technology leverages the power of computer vision to identify and track a wide range of floating waste, from plastic bottles and bags to invasive plants and timber. Paired with this intelligent vision system are robotic arms or conveyor belts designed for efficient collection, ensuring no waste escapes the robot's grasp. The design of these robots prioritizes eco-friendliness, often utilizing solar panels or hydropower for sustainable operation, minimizing their environmental footprint. By automating the river cleaning process, robots offer significant advantages over traditional manual methods. Their tireless operation significantly increases efficiency, while reducing the manpower required for cleaning tasks. Additionally, robots can operate continuously, unfazed by harsh weather conditions or fatigue, ensuring constant progress in the fight against pollution.

Furthermore, the data collected by on-board sensors on these AI-powered robots is a valuable resource. These sensors can provide detailed insights into the types and origins of river pollution, including the identification of hotspots and trends over time. This data can then be used to develop targeted mitigation strategies, allowing authorities to address the root causes of pollution and prevent future contamination. As this technology matures and becomes more widely deployed, AI-powered robots have the potential to become a crucial tool in preserving the health of our rivers, their ecosystems, andthe diverse species that call them home.

KEYWORDS: IOT, filters, sensor, STM microcontroller, Thing speak Cloud platform.

I. INTRODUCTION

Our rivers are under siege by pollution, with floating debris like plastics, paper, wood, and other waste harming aquaticlife and the environment. To combat this growing threat, a new wave of intelligent river cleaning robots is emerging, powered by the versatile ESP32 microcontroller. This powerful and versatile chip allows for the creation of smart robotscapable of navigating rivers and collecting floating debris. Our rivers are under siege by a growing tide of pollution. Plastic bottles, bags, food wrappers, paper products, wood debris, and other waste bob on the surface, harming aquatic life and ecosystems. To combat this escalating threat, a new breed of intelligent river cleaning robots is emerging, powered by the powerful and versatile ESP32 microcontroller. The ESP32 is the brains behind these robots. This low-power, Wi- Fi and Bluetooth-enabled chip allows for sophisticated programming and real-time data processing. It's the key to the robot's autonomous navigation and efficient waste collection.

Sustainability is a priority for these ESP32-powered robots. Often powered by solar panels, they offer an eco-friendly solution compared to traditional fuel-based methods. The ESP32's low power consumption further minimizes the environmental impact. This innovation promises to revolutionize river cleaning, offering a tireless and efficient solution compared to manual methods. Additionally, the data collected by these robots' sensors can be used to track pollution patterns and identify areas that require more attention. This information can be invaluable for environmental agencies and policymakers working to address the root causes of river pollution. In contrast, fine aerosol particles, measuring microns in diameter or smaller, pose a significant risk to human health. They can penetrate deepinto the respiratory system, leading to conditions such as asthma, bronchitis, and even cancer.

Beyond just cleaning, these robots have the potential to become valuable environmental data collectors. The sensor data they gather can be used to track pollution patterns, identify areas with high concentrations of waste, and monitor the effectiveness of cleaning efforts. This information can be invaluable for environmental agencies and policymakers working to address the root causes of river pollution. This innovative solution promises to revolutio nize river cleaning. By offering a tireless, efficient, and eco-friendly approach compared to traditional manual methods, these ESP32-powered robots hold the potential to significantly improve the health of our rivers for generations to come.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304071 |

II. SYSTEM MODEL AND ASSUMPTIONS

Our river cleaning robot utilizes a combination of powerful components to autonomously navigate and collect debris. The core of the system is the ESP32 microcontroller, a versatile chip responsible for processing data and controlling the robot's actions. We've incorporated a GPS module with a compass sensor to provide the robot with precise location awareness and directional heading. This real-time positioning data is crucial for autonomous navigation within the river environment. To translate these commands into movement, the ESP32 interfaces with a motor driver module. This unit acts as a bridge, allowing the microcontroller's low-power signals to control the high-power demands of the DC motors propelling the robot.

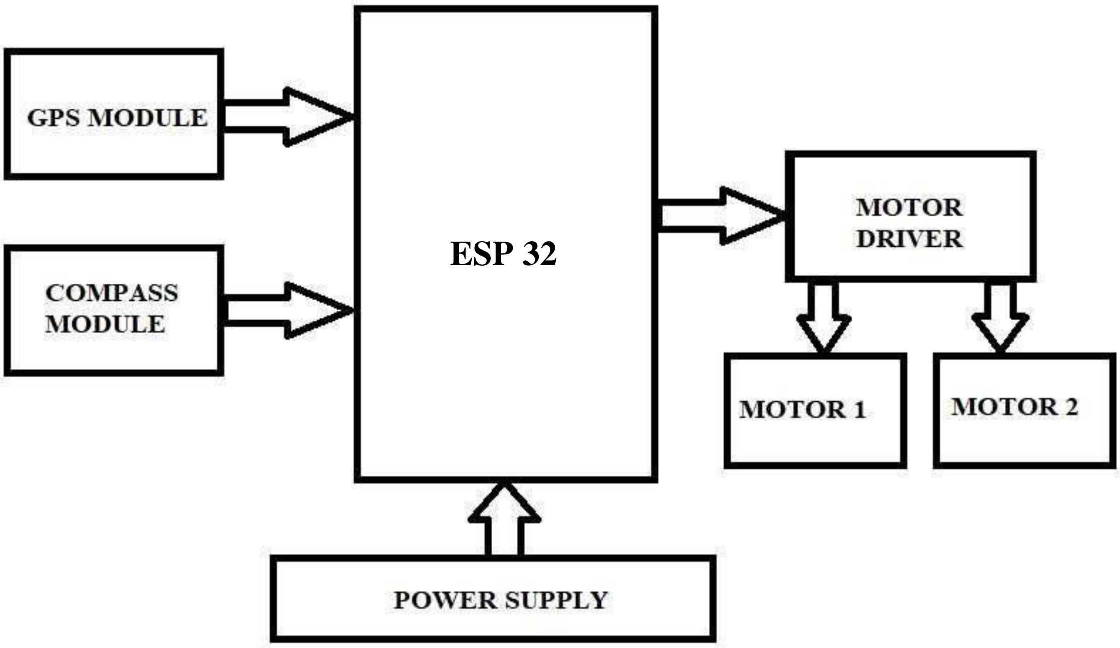


Fig 1: System Model

III. METHODOLOGY

River pollution is a growing menace, with plastic, paper, and other debris choking aquatic life and ecosystems. Traditional methods of river cleaning are often labour-intensive and inefficient. This project proposes a solution: an autonomous river cleaning robot powered by an ESP32 microcontroller, a GPS module with a compass sensor, and DC motors.

The heart of the robot is the ESP32 microcontroller, a versatile chip that acts as the robot's brain. This chip analyses data from the GPS and compass sensor to pinpoint the robot's location and heading within the river environment. Using this information, the ESP32 makes decisions and sends control signals to the motor driver module, which in turn translates them into commands for the DC motors. These commands propel the robot and adjust its movement for efficient cleaning.

The GPS module with a compass sensor provides crucial positioning information. The GPS delivers real-time latitude and longitude data, while the compass sensor offers directional heading. This combined data allows the robot to navigate autonomously, plan and execute movements based on pre-programmed waypoints or avoid obstacles in its path.

Building the robot involves several steps. First, the ESP32 microcontroller is securely mounted on a water-resistant chassis. Next, the GPS module and compass sensor are integrated, ensuring proper antenna placement for clear signal reception. The motor driver module is then installed, connecting it to the ESP32 and DC motors as per the manufacturer's specifications. Appropriate DC motors with sufficient power and torque for efficient river

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304071 |

navigation are selected and mounted, considering water resistance. A collection mechanism (conveyor belt, grabbing arms) is designed and integrated based on the type and size of debris targeted. Finally, a power source, ideally a solar panel system with a battery backup,is included for sustainable and continuous operation.

Software development involves creating code for the ESP32 using a platform like Arduino IDE. Libraries for GPS communication, compass sensor integration, and motor driver control are utilized. Algorithms for autonomous navigation are implemented, including waypoint navigation (following pre-programmed points of interest) and obstacle avoidance (using additional sensors like LiDAR or ultrasonic for real-time detection and path adjustments). Logic for debris collection based on the chosen mechanism is also developed, potentially using additional sensors for precise activation.

Testing and calibration are crucial steps. Initial testing is conducted in a controlled environment (pool, calm water) to verify basic functionality like motor control and GPS positioning. Gradually, real-world testing progresses in a designated river section, starting with short runs and close monitoring. The GPS module and compass sensor are calibrated for accurate location awareness and directional heading. Motor control parameters are fine-tuned for optimal manoeuvrability and power efficiency. Finally, the debris collection mechanism is tested and optimized to ensure it effectively captures targeted waste.

While the robot is designed for relatively calm water conditions, additional features like stabilizers and stronger motors might be needed for strong currents or heavy debris. Dense foliage or built-up environments could potentially disrupt the GPS signal. Mitigating strategies include incorporating alternative positioning systems or relying on pre-programmed waypoints within clear signal areas. Regular maintenance and power management are crucial for optimal motor operation. Battery capacity and solar panel efficiency need to be carefully considered for extended cleaning durations. The debris collection mechanism needs to be designed for the specific type and size of debris targeted. Additional sensors might benecessary for efficient debris identification and collection.

Looking ahead, future considerations include integrating LiDAR or ultrasonic sensors for more precise debris identification and improved collection efficiency. Training the ESP32 with machine learning algorithms could enable therobot to autonomously adapt to different debris types and environmental conditions, further enhancing its effectiveness in combating river pollution.

IV. SURVEY DESCRIPTION

This project tackles the growing issue of river pollution caused by plastic, paper, and other debris harming aquatic ecosystems. Traditional cleaning methods are often labour-intensive and inefficient.

Our proposed solution is an autonomous river cleaning robot powered by an ESP32 microcontroller, a GPS module with a compass sensor, and DC motors. The ESP32 acts as the robot's brain, analysing sensor data to determine its location and heading within the river. This information allows the robot to navigate autonomously and make decisions about movement and debris collection. The GPS module with compass sensor provides crucial positioning data, enabling the robot to track its location and plan its cleaning path.

Building the robot involves mounting the ESP32 on a water-resistant chassis, integrating the GPS and compass sensor, installing the motor driver module, selecting appropriate DC motors, and designing a collection mechanism based on thetargeted debris. A sustainable power source, ideally a solar panel system with a battery backup, is also included.

Software development involves creating code for the ESP32 to control movement, collect sensor data, and activate the collection mechanism. Algorithms for autonomous navigation are implemented, including waypoint following and obstacle avoidance (potentially using additional sensors).

Testing and calibration are crucial. Initial testing is conducted in a controlled environment, followed by gradual progression to real-world testing in a designated river section. Calibration ensures accurate positioning and efficient motor operation. The final step is testing and optimizing the debris collection mechanism.

While designed for calm water, the robot might require additional features for challenging conditions. Strategies exist tomitigate potential GPS signal disruption. Regular maintenance and power management are essential. The

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304071 |

collection mechanism needs to be designed for the specific debris targeted.

Future considerations include integrating additional sensors for more precise debris identification and exploring machine learning to allow the robot to adapt to different debris types and environments. This project offers a promising solution for combating river pollution with an autonomous, efficient, and eco-friendly approach.

V. FUTURE SCOPE AND DISCUSSION

Beyond its current capabilities, this autonomous river cleaning robot holds exciting potential for the future. Integration of LiDAR or ultrasonic sensors could significantly improve debris identification and collection efficiency. Imagine the robot using LiDAR to create detailed 3D maps of the water's surface, allowing it to detect and target even small micro plastics that would otherwise be missed. Machine learning algorithms could be used to train the ESP32 to adapt to various debris types and environmental conditions. For example, the robot could learn to identify and prioritize the collection of specific types of waste, such as plastic bottles or fishing nets, which pose a particular threat to aquatic life. Additionally, exploring communication capabilities could allow for real-time data collection and collaboration between multiple robots. Imagine a fleet of these robots working together, autonomously coordinating their cleaning efforts across a vast stretch of river. This collaborative approach could significantly improve the efficiency and scalability of river cleaning operations. Furthermore, the data collected by the robots' sensors could be invaluable for environmental agencies and policymakers. By analysing this data, they could gain a deeper understanding of pollution patterns and identify areas that require more attention. This information could then be used to develop targeted strategies to prevent pollution at its source, ultimately contributing to a cleaner and healthier future for our rivers.

VI. CONCLUSION

In conclusion, this project presents a compelling solution for combating river pollution with an autonomous robot powered by an ESP32 microcontroller, GPS, and DC motors. This eco-friendly design offers efficient cleaning while minimizing human intervention and the environmental impact associated with traditional methods. Looking ahead, advancements in sensor technology hold the potential to further enhance the robot's capabilities. For instance, integration of LiDAR or ultrasonic sensors could significantly improve debris identification, allowing the robot to target not only large objects like plastic bottles and logs but also smaller micro plastics that pose a significant threat to aquatic life. Furthermore, machine learning algorithms could be used to train the ESP32 to adapt to various debris types and environmental conditions. Imagine the robot using machine learning to identify and prioritize the collection of specific types of waste, such as fishing nets or medical waste, which pose a particular threat to ecosystems. Additionally, exploring communication capabilities could allow for real-time data collection and collaboration between multiple robots. Imagine a fleet of these robots working together, autonomously coordinating their cleaning efforts across a vast stretch of river. This collaborative approach could significantly improve the efficiency and scalability of river cleaning operations. Furthermore, the data collected by the robots' sensors could be invaluable for environmental agencies and policymakers. By analysing this data, they could gain a deeper understanding of pollution patterns, identify areas that require more attention, and develop targeted strategies to prevent pollution at its source, ultimately contributing to a cleaner and healthier future for our rivers.

REFERENCES

1. Guo, S., He, Y., Shi, L., Pan, S., Xiao, R., Tang, K. and Guo, P., 2018. Modeling and experimental evaluation of an improved amphibious robot with compact structure. Robotics and computer-integrated manufacturing, 51, pp.37--52.
2. Ramírez-Macías, J.A., Brongers, P., Rúa, S. and Vásquez, R.E., 2016. Hydrodynamic modelling for the remotely operated vehicle Visor3 using CFD. IFAC-PapersOnLine, 49(23), pp.187—192.
3. Zheng, H., Wang, X. and Xu, Z., 2017, July. Study on hydrodynamic performance and CFD simulation of AUV.
4. In 2017 IEEE International Conference on Information and Automation (ICIA) (pp. 24--29).IEEE.
5. Jagadeesh, P., Murali, K. and Idichandy, V.G., 2009. Experimental investigation of hydrodynamic force
6. coefficients over AUV hull form. Ocean engineering, 36(1), pp.113--118.
7. Chu, C.R., Lin, Y.A., Wu, T.R. and Wang, C.Y., 2018. Hydrodynamic force of a circular cylinder close to thewater surface. Computers & Fluids, 171, pp.154--165.
8. Wang, Z., Liu, Y., Yip, H.W., Peng, B., Qiao, S. and He, S., 2008, July. Design and hydrodynamic modeling

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

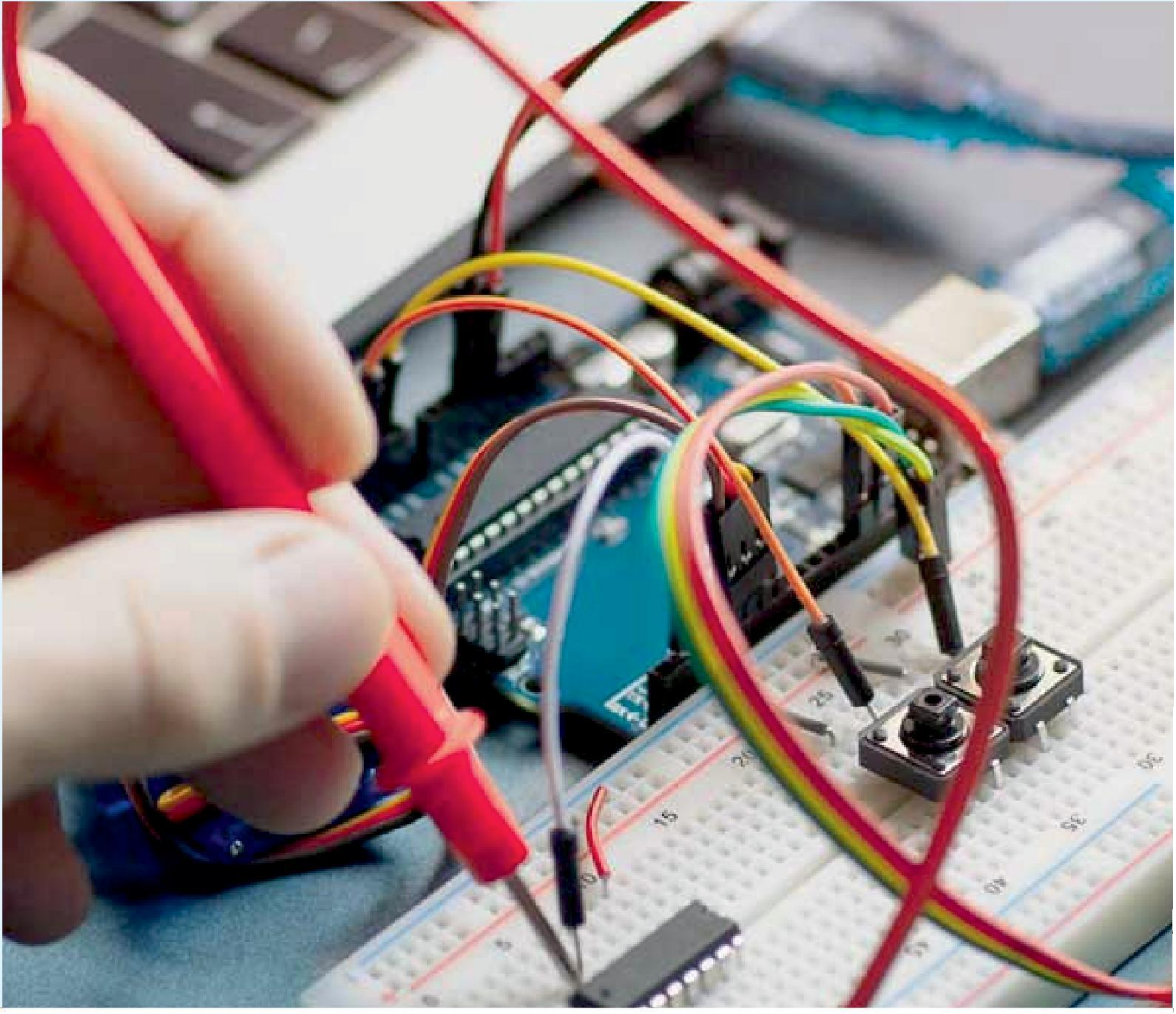
||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304071 |

of a lake surface cleaning robot. In 2008 IEEE/ASME International Conference on Advanced Intelligent Mechatronics(pp. 1343--1348). IEEE.

9. Yue, C., Guo, S. and Li, M., 2013, August. ANSYS FLUENT-based modeling and hydrodynamic analysis for aspherical underwater robot. In 2013 IEEE International Conference on Mechatronics and Automation (pp. 1577--1581). IEEE.
10. Zhou, F., Chen, Z., Zheng, C., Xu, F., Hu, Y., Hou, S. and Qin, Z., 2017. Experimental and numerical buckling failure analysis of acrylic hemispheres for application in neutrino detector. Engineering Failure Analysis, 78, pp.147--160.
11. Allotta, B., Pagliai, M. and Pugi, L., 2016. Design and Modelling of Innovative Propulsion Layouts with Pivoted Thrusters for Underwater Vehicles. IFAC-PapersOnLine, 49(21), pp.454--459.
12. Kadiyam, J. and Mohan, S., 2019. Conceptual design of a hybrid propulsion underwater robotic vehicle with different propulsion systems for ocean observations. Ocean Engineering, 182, pp.112--125.
13. Nath, A., Umamaheswaran, S., Eligar, S.S., Krishnan, K.G. and Sudheer, A.P., 2018, October. Modeling and Analysis of a Five Degrees of Freedom Autonomous Underwater Vehicle. In 2018 International Conference onAutomation and Computational Engineering (ICACE) (pp. 34--39). IEEE.
14. Alam, K., Ray, T. and Anavatti, S.G., 2014. Design and construction of an autonomous underwater vehicle. Neurocomputing, 142, pp.16--29.
15. Clement, B., Rui, Y., Mansour, A. and Ming, L., 2016. A Modeling and Control approach for a cubic AUV.IFAC-PapersOnLine, 49(23), pp.279--284.
16. Park, J. and Kim, N., 2015. Dynamics modeling of a semi-submersible autonomous underwater vehicle with a towfish towed by a cable. International Journal of Naval Architecture and Ocean Engineering, 7(2), pp.409--425.
17. Su, C., Dongxing, W., Tiansong, L., Weichong, R. and Yachao, Z., 2009, October. An autonomous ship for cleaning the garbage floating on a lake. In 2009 Second International Conference on Intelligent Computation Technology and Automation (Vol. 3, pp. 471--474). IEEE.
18. Mascarenhas, W.N., Ahrens, C.H. and Ogliari, A., 2004. Design criteria and safety factors for plastic components design. Materials & design, 25(3), pp.257--261.Fossen, T.I., 1994. Guidance and control of ocean vehicles. John Wiley & Sons Inc.

.



INNO SPACE
SJIF Scientific Journal Impact Factor

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर NISCAIR

International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

9940 572 462 6381 907 438 ijareeie@gmail.com

www.ijareeie.com

Scan to save the contact details