

River Cleaning Robot

Dange Sanjana¹, Gosavi Shrawani², Ghumare Akshara³, Gade Saeed⁴

U.G. Student, Department of Mechatronics Engineering, Sanjivani K.B.P Polytechnic College, Kopergaon,
Maharashtra, India¹

Associate Professor, Department of Mechatronics Engineering, Sanjivani K.B.P Polytechnic College, Kopergaon,
Maharashtra, India^{2,3,4}

ABSTRACT: The rapid accumulation of floating solid waste, plastics, and organic debris in rivers and lakes has emerged as a critical environmental challenge, adversely impacting aquatic ecosystems, water quality, and public health. Conventional cleaning practices primarily rely on manual labor or large-scale mechanical skimmers, which are inefficient, labor-intensive, costly, and unsuitable for continuous monitoring and operation. To address these limitations, an automated and energy-efficient river surface cleaning system is proposed.

The developed system comprises a mechatronics-integrated autonomous surface vehicle equipped with a microcontroller-based control architecture, DC motor-driven propulsion, and an electromechanical waste collection mechanism. Proximity and obstacle detection sensors enable safe navigation and collision avoidance, while a conveyor or scoop-based assembly facilitates the efficient gathering and storage of floating debris. The platform supports both remote and semi-autonomous modes of operation, ensuring adaptability under varying environmental conditions.

The proposed design emphasizes low power consumption, operational reliability, minimal human intervention, and cost-effectiveness. Experimental evaluation demonstrates improved waste collection efficiency and reduced cleaning time compared to conventional manual methods. The system offers a scalable and sustainable solution for automated water surface maintenance and smart environmental management.

KEYWORDS: Autonomous Surface Vehicle, Robotic Waste Collector, Embedded Systems, Sensor-Based Navigation, Water Surface Cleaning, Sustainable Automation.

I. INTRODUCTION

Water resources such as rivers, lakes, and canals play a vital role in maintaining ecological balance, supporting biodiversity, and fulfilling domestic, agricultural, and industrial demands. However, rapid urbanization, population growth, and improper solid waste management practices have resulted in the continuous discharge of plastics, organic debris, and other floating pollutants into natural water bodies. The accumulation of such waste degrades water quality, obstructs natural flow, harms aquatic life, and increases the risk of waterborne diseases. Therefore, efficient and sustainable cleaning of river surfaces has become a significant environmental and engineering challenge.

Conventional river cleaning methods primarily depend on manual labor, small boats, or large mechanical skimmers. These approaches are often time-consuming, labor-intensive, costly, and unsafe, particularly in deep or contaminated water. Furthermore, manual operations lack continuous monitoring capability and are unsuitable for large-scale or long-duration cleaning tasks. Such limitations necessitate the development of automated and intelligent systems capable of performing cleaning operations with minimal human intervention.

Recent advancements in robotics, embedded systems, and mechatronics have enabled the design of autonomous surface vehicles for environmental applications. By integrating sensors, microcontrollers, and electromechanical collection mechanisms, robotic platforms can efficiently navigate water surfaces, detect obstacles, and collect floating debris in real time. These systems offer advantages such as improved operational efficiency, reduced manpower requirements, enhanced safety, and energy-efficient performance.

In this context, an autonomous river cleaning robot is proposed to automate the process of floating waste collection. The system combines a motorized propulsion unit, sensor-based navigation, and a mechanical conveyor or scoop mechanism to gather and store debris effectively. The proposed approach aims to provide a low-cost, reliable, and scalable solution for continuous water surface maintenance and pollution control. The development of such robotic cleaning systems contributes to sustainable environmental management and supports smart city initiatives.

II. LITERATURE SURVEY

The concept of Recent research and development in India has increasingly focused on robotic and automated solutions to address the persistent problem of river pollution caused by floating solid waste. Several academic and prototype efforts at Indian institutions highlight diverse approaches toward surface waste collection and autonomous navigation.

1. In a study published in the International Journal of Science, Engineering and Technology, researchers presented a solar-powered river cleaning robot featuring a conveyor mechanism for floating debris removal. The prototype used renewable energy and DC motor propulsion to provide a low-cost environmental solution, with future improvements proposed for autonomous navigation and waste classification.
2. Another project developed an autonomous water surface cleaning robot that uses onboard cameras and a conveyor belt system to identify and collect floating waste, enabling unsupervised operation in designated areas of rivers and lakes. This work emphasized real-time video monitoring to enhance effectiveness in waste targeting. eprajournals.com
3. A remote-controlled river cleaning robot design has also been reported where a mobile application interface allowed precise navigation and control of the cleaning operations. This approach improved access to difficult-to-reach locations but highlighted challenges in achieving full autonomy.
4. Several grassroots and student-led initiatives in India reflect the rising interest in practical robotic cleaning platforms. For example, engineering students in Kerala developed a robot capable of collecting floating waste with a solar energy system and remote monitoring, demonstrating the feasibility of locally built cleaning mechanisms deployed in Indian water bodies.

These efforts, although varied in technique and scope, highlight common limitations such as the complexity of achieving robust autonomous navigation, optimal power management, and scalability for large-scale river deployment. Consequently, there remains a research gap in integrating low-cost autonomous control, efficient waste collection mechanisms, and adaptive sensing suitable for diverse Indian river environments.

III. METHODOLOGY

The proposed river cleaning robot is developed using an integrated mechatronics design approach that combines mechanical, electrical, and embedded control subsystems for effective floating waste removal. A lightweight floating chassis ensures buoyancy and stability on the water surface, while a conveyor or scoop-based waste collection mechanism driven by a DC motor gathers debris and transfers it into an onboard storage bin.

Propulsion and maneuverability are achieved using dual DC motors coupled with propellers, enabling forward, reverse, and differential steering motion for smooth navigation. A microcontroller-based control unit manages sensing and actuation through motor drivers. Ultrasonic or infrared sensors are incorporated for obstacle detection and collision avoidance to ensure safe and reliable operation. The system can function in both remote-controlled and semiautonomous modes depending on operational requirements.

During operation, floating waste is guided toward the collection mechanism, lifted by the conveyor, and stored for later disposal. Experimental evaluation is carried out by analyzing parameters such as collection efficiency, operating time, power consumption, and navigation performance to validate the practicality and effectiveness of the system for real-time river cleaning applications.

IV. EXPERIMENTAL RESULT

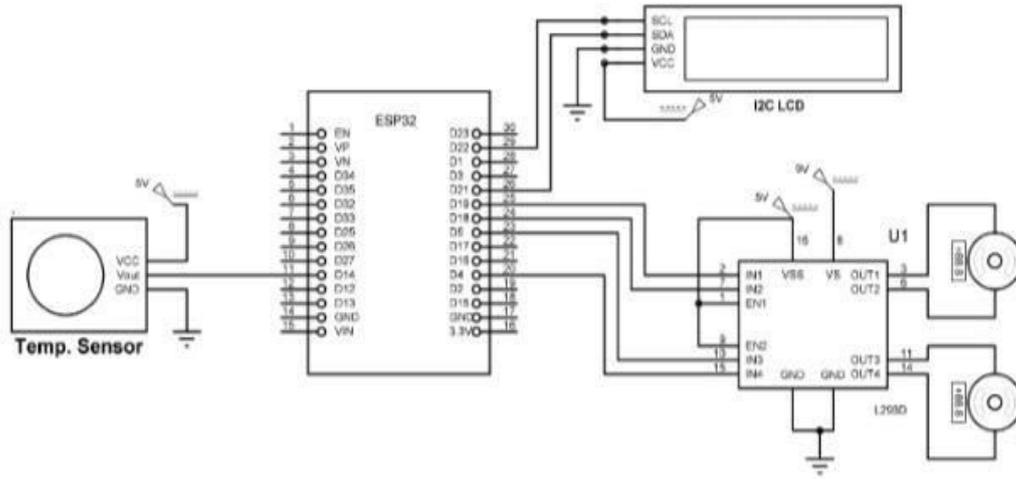


Fig. 1. The experimental setup is based on the ESP32 microcontroller, which controls the overall operation of the river cleaning robot. A temperature sensor is connected to monitor environmental conditions, and the data is displayed on an I2C LCD using the I²C communication interface.

Motor control is performed using the L298N motor driver, which receives signals from the ESP32 and drives two DC motors for propulsion and movement of the robot. A regulated 5V power supply powers the sensor, display, and control circuit, while the motor driver supplies power to the motors. All components are connected as per the circuit diagram to ensure proper sensing, display, and motor operation during testing.

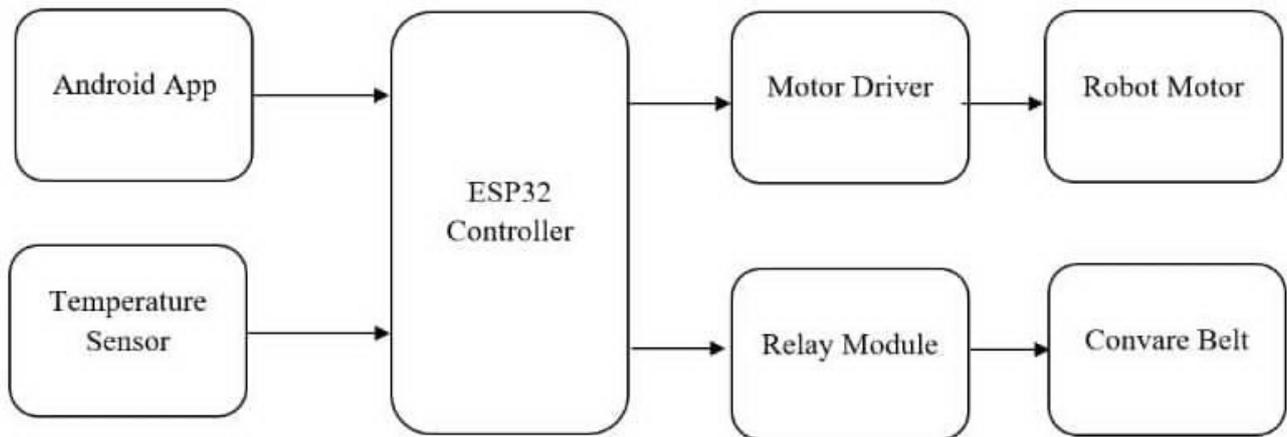


Fig.2. Represents the software and hardware control architecture of the river cleaning robot. The central control unit of the system is the ESP32, which manages

communication, sensing, and actuation processes. An Android application sends control commands wirelessly to the ESP32 controller, allowing the user to remotely operate the robot. A temperature sensor is connected to the controller to monitor environmental conditions and provide real-time data to the system. The controller processes the received data and sends control signals to the motor driver, which operates the robot motors responsible for propulsion and

navigation. Additionally, the ESP32 activates a relay module that controls the conveyor belt mechanism used for collecting floating waste from the water surface. Thus, the system integrates wireless communication, sensing, and motor control to enable efficient operation of the river cleaning robot.

V. CONCLUSION

The proposed river cleaning robot provides an efficient and automated solution for removing floating waste and debris from rivers and other water bodies. By integrating a floating mechanical structure, conveyor-based collection mechanism, DC motor propulsion, and a microcontroller-based control system, the robot enables reliable navigation and effective waste collection with minimal human intervention. The incorporation of obstacle detection sensors ensures safe and stable operation in real-time environments.

The system reduces manual effort, operational risks, and cleaning time while maintaining low power consumption and cost. Experimental results demonstrate satisfactory performance in terms of collection efficiency and maneuverability. Overall, the developed platform offers a practical, scalable, and eco-friendly approach for sustainable water surface cleaning and environmental protection applications.

REFERENCES

- [1] Thomas et al., "River Cleaning Robot," Journal of Advances in Electrical Devices, Vol. 3, No. 2, 2018. Mat Journals
- [2] Jagtap et al., "Mobile-Controlled River Cleaning Robot: A Review," IJRASET, 2024.
- [3] Pavitra M. Badiger et al., "River Cleaning Robot Using Solar Power," International Journal of Science, Engineering and Technology, May 2025. IJSET
- [4] Wani et al., "Remote Controlled Water Surface Cleaning Robot," EPRA International Journal of Multidisciplinary Research, May 2025. EPRA Trusted Publishing
- [5] K. A. Ingle et al., "River Cleaning Robot Using Solar Power," International Journal of Progressive Research in Science and Engineering, July 2020. IJPRSE
- [6] Patil et al., "Design and Implementation of Water Garbage Cleaning Robot," VIVA-IJRI, 2023. Viva Technology
- [7] Ankit *, Tripathi et al., "Smart River Cleaning Bot," IJRASET, 2025. IJRASET
- [8] Moon & Bawane, "Remote Controlled River Cleaning Machine," IJSRST, 2018. IJSRST
- [9] Namratha et al., "Automatic River Cleaning Robot," International Education and Research Journal, 2023. IER Journal
- [10] Deepak R. et al., "Smart Water Body Cleaning Robot," International Journal of Modern Agriculture, 2021. Modern Journals
- [11] Zalte et al., "Green RiverBot: A Microcontroller-Based System for Waste Collection and Water Quality Monitoring," IJRTI, Dec. 2025. IJRTI
- [12] Revathi et al., "Development of River Cleaning Robot," TIJER, Vol. 11, Issue 7, 2024. Tijwr



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details