# Eco-Friendly Robotic Boat Cleanup for Water Waste

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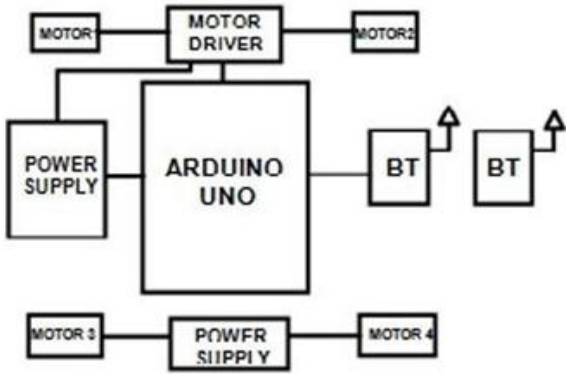
**Abstract: The Internet of Things (IoT), or Internet of objects, is a wireless network of objects. Typically this will be a self- configuring, wireless network of objects, such as appliances. The Internet of Things is the notion that the Internet is not only a global network of people communicating with each other via computers, but also a platform for devices to communicate electronically with their environment. According to the International Telecommunication Union (ITU), the Internet of Things (IOT) is a network of physical objects–devices, vehicles, buildings and other items which are embedded with electronics, software, sensor and network connectivity that enables these objects to collect and exchange data. The Internet of Things connects and controls objects remotely, building on existing network infrastructure, providing us with opportunities for more direct integration of the physical world into computer-based systems and improving efficiencies, accuracy, and economic gain. The project seeks to address the fundamental state of environmental crisis brought about by water pollution, which declines the living standards to all of the ecosystem. It diminishes the sustainability of living aquatic organisms which then in turn, impacts the existence of humanity in a number of indirect ways. Currently, our water supplies are filled with plastic waste, e-waste, and any number of other non-biodegradable waste.**

**Recently, these waste products have integrated into the marine environment. This contamination has become one of the main contributors to one of the global hazards - water pollution. Contaminated waste does not just make the water contaminated, it also contaminates the smallest living organisms in the water body and the entire process eventually harms every organism that is inter-dependent on the water. This is when the harmony is broken and the marine ecosystem is affected and it will harm the existence of mankind. The project is aimed to eventually create a detoxicated environment for anyone reliant on water, including aquatic and marine life as well as humans. In addition, it seeks to enable a better, safer and cleaner environment that we live on.**




## INTRODUCTION

Marine ecosystem plastic pollution is one of the biggest environmental concerns we face in the 21st century. An estimated millions of tons of plastic pollution are entering the oceans including hundreds of thousands of whales, fish, birds, and marine mammals die each year to plastic pollution - not to mention the irreversible direct harm to marine organisms, the disruption of ecosystems in the ocean and the impact on the human food chain. Conventional plastic waste collection methods are typically inefficient, require significant manpower and are costly which drives the need for some novel, lower-cost solutions.

The consequences of plastic pollution are extensive and severe. Marine life often consume plastic debris, not distinctly or knowingly, and can cause death. Additionally, entanglement with plastic bags, fishing nets, and other items can hurt or kill marine life and hamper ecosystems

Micro plastics are small pieces of plastics approximately less than 5 millimeter; can be very dangerous because they can be ingested into the food chain, where they bio-accumulate in marine animals, and may pose a risk to human health when consumed through seafood The boat is fully powered on solar energy, which is free.

The boat will not need an external energy supply so it saves the money. During daytime the boat will store some energy by capturing sun rays on the solar panel and during the night the boat will work and collect the garbage.

The Eco-Friendly Robotic Boat for Water Waste Cleanup embodies a unique concept for addressing water pollution. This autonomous or semi-autonomous boat is constructed to navigate lakes, rivers, harbors, and ocean with ease in retrieving debris as it floats across the surface with little concern flow from outfall (stream and river mouth) to be absorbed. Instead of the standard methods cleanup methods that involve using a fuel-powered boat and manpower, we were able to rationalize an innovative robotic waste removal approach by using clean energy options, smart AI navigation, and environmentally friendly material waste, allowing for a better overall waste management experience.

## RELATED WORKS

Innovative projects like WasteShark by RanMarine Technology and Clearbot by Open Ocean Engineering are advancing eco-friendly robotic boats for water waste cleanup. WasteShark uses AI navigation and electric batteries to collect debris with minimal environmental impact. Clearbot, powered by solar energy and AI vision, efficiently identifies and removes waste from urban waterways. Both solutions highlight the potential of sustainable, autonomous technology in addressing water pollution.

Another important concept is SeaVax, a solar and wind-powered water cleanup vessel that claims to remove ocean plastic waste using filtration and suction, although it is still only a pilot model.

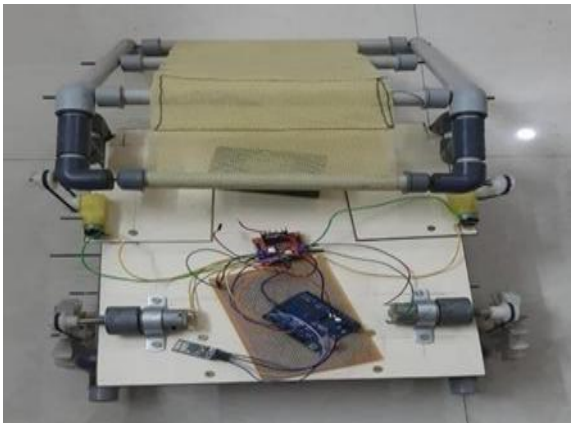
The water Cleanup Interceptor offers a scalable, solar-powered solution for river pollution, using a conveyor belt to autonomously collect plastic waste. Unlike commercial systems, recent research on AI-driven water-cleaning robots focuses on limited computer vision for waste detection, swarm robotics for collaborative cleaning, and energy-efficient designs to extend operational time, highlighting innovation in sustainable aquatic waste management.

This study recommends autonomous underwater rovers with advanced sensing and navigation to locate and collect underwater trash and uneaten fish feed for recycling. By eliminating the need for human divers, this approach offers a more efficient and cost-effective solution for cleaning underwater environments.

This research presents an unmanned surface vehicle for autonomous water quality monitoring and surface cleaning. Equipped with sensors, it collects floating waste and assesses water quality, offering an integrated solution to support and maintain a healthy aquatic ecosystem.

The proposed system is designed to remove waste and plastic debris from flowing and stagnant water. It uses DC motors for movement, controlled by an Arduino Uno and a motor driver. A power supply connects both components, while Bluetooth enables mobile app control. Sensors are integrated via the app, and the system operates through code uploaded to the Arduino, allowing efficient, remote-controlled water cleanup.

SAMPLE IMAGES:



## EXISTING SYSTEM

Amid rising aquatic waste concerns, eco-friendly robotic boats like Clearbot are being deployed globally, including in Hong Kong and India. Clearbot is a solar-powered, AI-driven autonomous boat that uses computer vision to identify and avoid marine life while collecting floating waste. It also maps pollution hotspots, aiding in the development of long-term waste management strategies and promoting sustainable waterway cleanup solutions.

One further important system is Ran Marine's Waste Shark in the Netherlands. This emission free electric boat operates extremely quietly and glides through waterways like drones do, collecting 500 kilograms of waste in a single day, while simultaneously monitoring the water quality using the onboard sensors.

The Urban Rivers Trash Bot in the United States lets people operate a trash-collecting robot from a distance. This community engaged project is run on renewable energy, so it promotes sustainability. It promotes actively getting involved in river cleanup. The Ocean Cleanup-created The Interceptor is a more extensive waste management option. It works in river systems, which account for some of the largest sources of ocean pollution. The Interceptor can work autonomously; it's solar-powered, and has the potential to remove up to 50,000 kilograms of waste daily using a conveyor belt which moves waste onto a barge.

## METHODOLOGY

### Module 1: Locomotion and Navigation Module

The module for locomotion and navigation allows the autonomous robotic boat to move and steer, via DC motors, to either propellers or water thrusters, to allow for the boat to travel forward, travel backward, and steer in various directions. The module defines autonomous navigation through the inclusion of a GPS to track the boat's position and curriculum, ultrasonic sensors to detect obstacles to avoid floating debris, boats, or other unknown items in the water, and possibly IMU (Inertial Measurement Unit) sensors to provide stability and support as the boat traverses forward or backward. The locomotion and navigation module is crucial for the boat to efficiently maneuver through running and still water bodies within the environmental factors. All these components along with the motor control, GPS tracking and navigation, and obstacle avoidance provided by ultrasonic sensors contribute to the autonomous operation of the robotic boat with little human engagement.

### Module 2: Waste Detection and Collection Module

The Waste Detection and Collection Module is a key part of the autonomous robotic boat. This module detects and collects floating debris efficiently. For example, AI-based image processing could be employed in more advanced implementation to differentiate waste from organic material, such as leaves or driftwood to optimize waste collection. Once the waste is detected, the waste detection system would activate a conveyor belt mechanism or rotating paddles to channel the waste into a storage compartment aboard the boat. The conveyor always scoops floating trash, which means that intervention will not be needed as frequently. The modular unit may also include ultrasonic or water quality sensors that would identify waste-dense regions of a body of water, allowing the boat to prioritize heavily polluted areas. The combination of waste detection, automation, and collection capability with storage affordance is complete, which means that the robotic boat will effectively remove floating debris, improve water bodies, and aid in environmental pollution abatement.

### Module 3: Power Management Module

The Power Management Module is the unit within the autonomous robotic boat that supplies and regulates electrical power to everything on the boat. It supplies, distributes, and optimally uses electrical power to motors, sensors, microcontrollers, and communications. For sustainability purposes, additional electrical inputs via solar panels can be included as part of the overall design which enables the boat to enter into a recharge cycle while operating or conducting work, thus relieving dependency on external sources to charge the batteries. The integrated Power Management Module may also have a Battery Management System (BMS) to monitor battery health, prevent overcharging, limit discharging, and promote longer battery life. In addition, it is possible to enhance overall power efficiency by implementing low power modes when the boat is in idle or standby.

### Module 4: Autonomous Navigation and AI Module (Advanced)

The Autonomous Navigation and AI Module is a critical piece that makes the robotic boat capable of autonomous operation with a minimal human role. This module utilizes AI-based image processing to analyze and adapt to water conditions, GPS tracking to manage its location, and advanced path-planning algorithms to guide its navigation in shallow running or standstill water. This module can harness machine learning models to analyze previous encounters with water conditions and potential problematic waste deposition locations. The onboard AI decision making can also allow for prioritization of some highly polluted zones first to make the cleanup an optimized process.

PIR Sensor

Jump Wires

Battery

DC Motor

L298N Motor Device

CONCLUSION

Autonomous robotic vessels came as a world-changing solution to reduce the challenging problem of water pollution. These intelligent systems leverage artificial intelligence, machine learning, GPS navigation, and sensor-based devices to autonomously discover and collect floating debris.

Unlike time-consuming and costly manual cleanup, robotic boats operate continuously with minimal supervision, making water waste removal more efficient. They combine real-time automation and monitoring, autonomously navigating polluted waterways, retrieving waste, and avoiding obstacles, offering a comprehensive and effective cleanup solution.

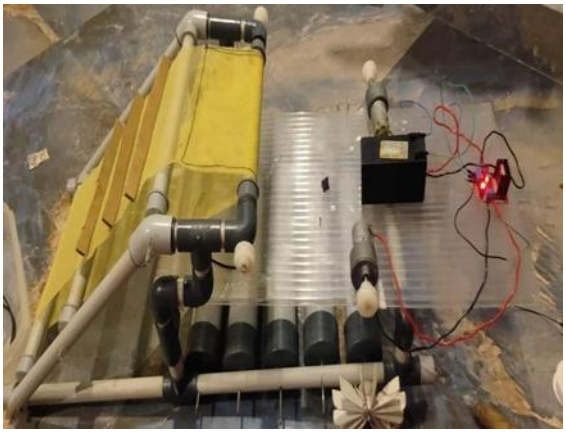
In addition, the boats are adaptable to solar panels for sustainability and energy efficiency. The use of solar panels lowers its environmental impact, enabling continuity.

Additionally, smart data analytics allows authorities to observe pollution patterns to implement form of corrective means. While the benefits are mentioned, costs, maintenance, and regulatory approval would need to be addressed for wider acceptance.

As the field of robotics and advancements in AI continue to grow and develop, so too will autonomous cleanup boats' capabilities and sophistication in terms of many types of waste including plastics, oil spills, and chemical waste. In the end, these robotic boats could revolutionized the way we manage water waste, lessen our environmental damage, and protect aqueous ecosystems.

It is key to incorporate them into current waste management processes and encourage global collaboration through the use and integration of technology to improve waterway clean-up methods and thus create a healthier planet. Utilizing autonomous robotic boat technology will be a milestone toward a healthier waterway and pollution free aquatic environments.

OUTPUT FOLDER:



The use of an autonomous robotic boat for cleaning water waste is an extremely effective and sustainable approach to addressing pollution in lakes, rivers, and oceans. Robotic boats travel continuously across waterways using GPS, path optimization through AI, and can detect and remove all kinds of waste: floating plastics and oil spills, all types of organic matter, and using fine mesh filtration systems, even microplastics. Given sufficient storage, the boats will also return autonomously to docking stations to dump waste and recharge batteries with very little human interaction. Many designs have solar panels with which they operate entirely as autonomous if they used energy from the sun instead of other available energy sources. This technology reduces marine pollution, protects aquatic ecosystems, and improves water quality by

removing harmful waste. Using computer vision and machine learning, the boats distinguish waste from marine life for non-invasive operation. Equipped with LiDAR, sonar, and cameras, they navigate safely and provide real-time data for proactive pollution management.

Autonomous cleanup boats reduce labor costs and create jobs in robotics, AI, and environmental monitoring. Though challenges like battery life and weather remain, solutions like WasteShark, Clearbot, and SeaVax show growing adoption and potential to transform marine conservation efforts.

Eco-friendly robotic boats offer innovative solutions to water pollution, using renewable energy, AI, and real-time tracking for low-impact cleanup. From large interceptors to community robots, they support healthier ecosystems and provide sustainable, accessible tools for long-term waterway management worldwide.

In conclusion, eco-friendly robotic boats represent a significant advancement in sustainable water waste management. They combine technology with environmental stewardship, efficiently removing floating debris across various settings. As awareness of water pollution grows, these systems will play a critical role in protecting aquatic ecosystems and ensuring cleaner, safer waterways globally.

REFERENCE

[1] Harshvardhan Baria, Mackwan Akash, Nirav Makwana, Raj Parmar, Mr. Sharad Chhantbar "Review Paper on Automated Drainage Cleaning System"2018 IJSRSET | Volume 4 | Issue 5 |

[2] Manoj Rathod, Vasant Pund, Rahul Pungle, Jiwan Rathod "Automatic Floating Waste Collector" Vol-3 Issue-3 2017 IJARIIE-ISSN(O)-2395-4396

[3] Mahto Ravishankarkumar Ravindrabhai, Dehadray Vaibhav, Kaka Smit, Prof. Ankur Joshi "Design and Fabrication of River Waste Collector"

[4] Prof. N.G.Jogi, Akash Dambhare, Kundan Golekar, Akshay Giri, Shubham Take "Efficient Lake Garbage Collector by Using Pedal Operated Boat" International Journal of Recent Trends in Engineering &Research (IJRTER), Volume 02, Issue 04; April - 2016 [ISSN: 2455- 1457]

[5] Sheikh Md, Shahid Md Rafique, Dr. Akash Langde "Design and Fabrication of River Cleaning Machine"IJSART - Volume 3 Issue 11 – NOVEMBER 2017 ISSN [ONLINE]: 2395-1052

[6] Madhavi N.Wagh, Kashinath Munde "Design and Analysis of River Water Cleaning Machine"ISSN: 2455- 2631 © July 2018 IJSDR | Volume 3, Issue 7

[7] Ganesh S. Patil, Rahul A. Pawar, Manish D. Borole, Shubham G. Ahire, Ajay L. Krishnani, Amit H. Karwande "Review Paper on Drainage Water Cleaner Machine"International Research Journal of Engineering and Technology (IRJET)Volume: 05 Issue: 01 | Jan-2018

[8] Pranay Agrawal, Bishakh Bhattacharya "Aquatic Multi-Robot System for Lake Cleaning"Conference Paper · August 2013 DOI: 10.1142/9789814525534_0024 Ganesh S. Patil, Rahul A. Pawar, Manish D. Borole, Shubham G. Ahire, Ajay L. Krishnani, Amit H. Karwande"Review Paper on Drainage Water Cleaner Machine