



Archives available at journals.mriindia.com

International Journal of Advanced Electrical and Electronics Engineering

ISSN: 2278-8948

Volume 14 Issue 01, 2025

Design and Fabrication of Wireless Remote- Controlled Trash Collecting and Cleaning Machine

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Peer Review Information	Abstract
<p><i>Submission: 15 Feb 2025</i> <i>Revision: 23 March 2025</i> <i>Acceptance: 27 April 2025</i></p> <p>Keywords</p> <p><i>Remote-Controlled Machine</i> <i>Trash Collection</i> <i>Waterway Waste Management</i></p>	<p>The Wireless Remote-Controlled Floating Trash Collecting and Cleaning machine is an innovative marine device designed to efficiently remove floating debris from various water bodies, including rivers, lakes, and waterways. This environmentally friendly vessel operates on battery power and incorporates advanced navigation and obstacle avoidance technologies, ensuring precise and safe operation. Equipped with a durable waste collection system, such as a conveyor belt and a storage compartment, it can handle large amounts of trash. A camera is integrated to provide a real-time front view for the operator. The machine is remotely controlled through a secure and easy-to-use interface, allowing operators to monitor and navigate from a distance, improving safety and reducing operational costs. This technology has a broad range of potential uses, including municipal waste management, industrial applications, and event cleanup, offering an advanced and efficient solution for waste disposal.</p>

Introduction

Floating trash collection machines, operated by wireless remote control, are crucial in the fight against water pollution. These machines use advanced technologies like conveyor belts, Node MCU, ESP 32 Camera Module and other tools to efficiently remove waste, plastic, and contaminants from rivers and other water sources. By preventing this debris from entering the oceans, they help preserve marine life and enhance the overall environmental quality.

Beyond protecting aquatic habitats, these machines also contribute to human health by

ensuring cleaner water supplies and lowering the risks of waterborne diseases for communities nearby. Their flexible design allows them to reach hard-to-access areas along riverbanks, ensuring that the cleanup process is comprehensive. These machines do more than just clean the water they also support broader environmental goals by preventing pollutants from traveling downstream, which can harm other ecosystems and coastal areas.

The task of collecting and removing trash from rivers is a vital environmental initiative that helps reduce pollutants and maintain water quality. This

effort is essential for protecting aquatic species, ensuring the health of local communities, and sustaining the ecosystem. Although the machines require significant maintenance, their role in

sustainable river management is undeniable. They are vital for preserving river health and supporting biodiversity for the future.

Year	Total Floating Waste (tons)	Plastic Waste (%)	Microplastic Waste (%)	Marine Debris (%)
2020	50,000,000	30%	3%	40%
2021	55,000,000	32%	3.5%	42%
2022	60,000,000	34%	4%	44%
2023	65,000,000	36%	4.5%	46%
2024	70,000,000	38%	5%	48%

Fig 1: Water waste data from 2020 – 2024

Objectives:

1. Efficiently collect and remove trash from waterways, reducing marine pollution and protecting aquatic life.
2. Create a user-friendly remote-controlled system, allowing for easy navigation and control of the boat.

3. Reduce manual labor involved in trash collection, improves workers safety and efficiency.
4. Design and develop cost-effective solution for trash collection, minimizing maintenance and operational cost.

Design Methodology

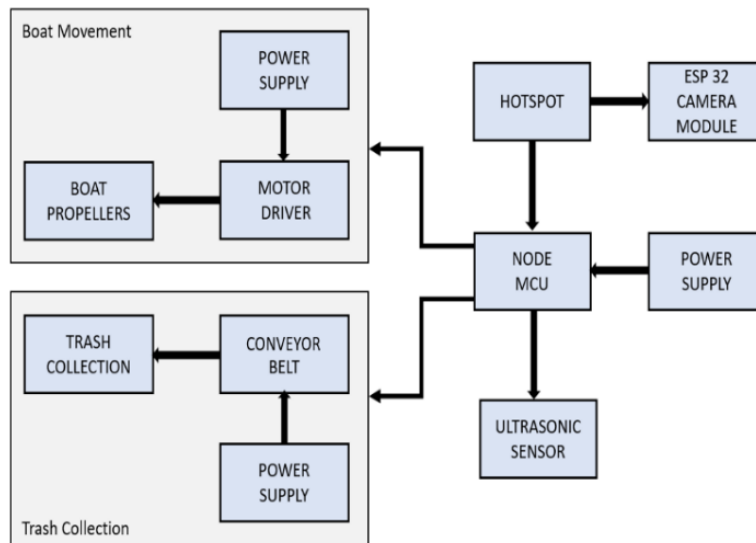


Fig 2: Block diagram of wireless remote-controlled trash collecting and cleaning machine

Hardware Requirements

The hardware requirements for wireless remote-controlled trash collecting and cleaning machine contains the components like Node MCU, Esp 32 cam, Motor driver, Ultrasonic sensor, Conveyor belt and power supply.

Use of each component:

1) Node MCU: (ESP8266)

- Node MCU is the system Microcontroller that Controls entire system.
- It is connected with Wi-Fi to enables remote monitoring and control.

2) ESP32 Cam

- ESP 32 is a Camera module captures video of trash collection area and helps to detect trash and navigate boat.

3) Motor Driver Module (L298N)

- It controls and Regulates motor speed for efficient navigation.
- Drives DC motors for boat propulsion and trash collection.

4) Ultrasonic Sensor (HC-SR04)

- It detects obstacles in trash collecting machines path.
- And it also measures distance to trash and obstacles.

5) Power Supply

- Provides power to entire system. Node MCU manages power supply to components.

Following figure shows the connection of Node MCU 8266 microcontroller with ultrasonic sensor, motor driver, ESP 32 cam module and power supply.

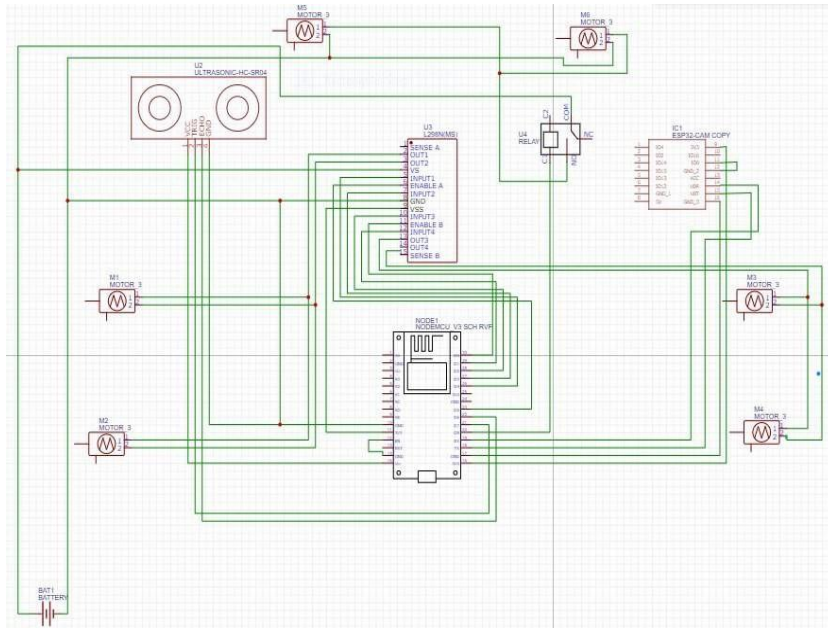


Fig 3: Circuit diagram of wireless remote-controlled trash collecting and cleaning machine

Software Requirements

1) Install the Arduino Software (IDE) on Windows PCs:

Get the foremost later adjustment from the download page. You will be between the Installer (.exe) and the Zip bundles. With the Zip bundle you would like present the drivers manually.

2) Install the Blynk IOT application in mobile:

This application is used to make the controlling dashboard of machine to easily controls the movement of machine.

3) Microcontroller Programming Language:

Write efficient code for the Node MCU to control the boat's movements, trash collection mechanism, and sensor integration. Develop a code for ESP 32 camera module to see the floating trash in water.

Applications

Wireless remote-controlled floating trash collecting and cleaning machine have various

practical applications across different industries and settings. Some of the key uses include:

1. Environmental Conservation:

- **River and Lake Cleanup:** These machine help remove floating debris, plastics, and pollutants from freshwater bodies, ensuring cleaner and healthier aquatic ecosystems.
- **Ocean and Coastal Cleaning:** They are used to collect waste from oceans and coastlines, reducing pollution and protecting marine life.
- **Wetland and Wildlife Reserve Protection:** By removing trash from sensitive wetland areas, these machine help preserve biodiversity and protect natural habitats.
- **Flood and Disaster Response:** After floods or natural disasters, these machines assist in cleaning up debris and waste from affected water bodies and shorelines.

2. Urban Waste Management:

- **Public Park and Beach Maintenance:** They can be deployed in public spaces like parks

and beaches to keep the water clean and trash-free.

- **Airport and Seaport Cleaning:** Floating trash collection machines are also utilized at airports and seaports to maintain cleanliness in bodies of water near transport hubs.

3. Industrial Cleaning:

- **Factory and Warehouse Waste Removal:** In industrial parks, these machine help in cleaning large water bodies polluted by industrial waste or operational byproducts.
- **Chemical Plant Waste Management:** They assist in the removal of hazardous waste and debris from water bodies around chemical plants.

- **Mining Site Reclamation:** This machine is used for clearing out waste and reclaiming water bodies affected by mining operations.

4. Agricultural Applications:

- **Farm and Ranch Cleanup:** They help in clearing waste from ponds, irrigation channels, and other water bodies on farms and ranches.
- **Aquaculture Waste Removal:** This machine is also used to manage waste in fish farms and other aquaculture operations, ensuring clean water for marine life.

Result And Discussion



Fig 4: The prototype of wireless remote-controlled trash collecting and cleaning system

By this prototype is able to remove a significant amount of trash, debris and other floating garbage from the rivers, oceans and other water bodies, making it cleaner and healthier for animals, human beings, birds and all other living organisms as well as for environment too.

Overall, the result of the floating trash collecting and cleaning machine prototype development project would be a tangible step towards addressing the critical issue of marine pollution, demonstrating a potential solution that could have significant environmental benefits if scaled up and deployed effectively.



Fig 5: The garbage collection test in water

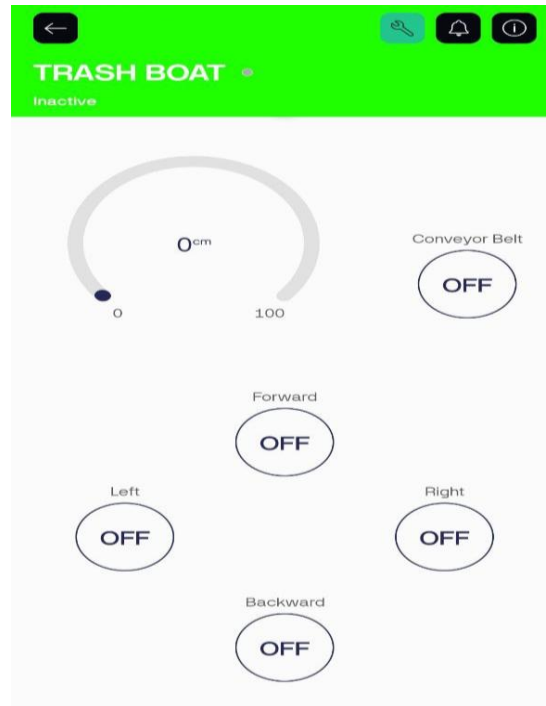


Fig 6: Controlling interface of trash collecting and cleaning machine in Blynk IOT application.

Future Scope:

Future developments will focus on scaling up the design, improving navigation algorithms, and integrating AI-powered trash detection. With its vast potential for global impact, this technology can significantly contribute to maintaining cleaner waterways and mitigating marine pollution.

Conclusion

The Wireless Trash Collecting and Cleaning Machine Project is a great way to keep our oceans and waterways clean. It uses special sensors to detect trash and can be controlled from a distance, making it easy to collect trash from hard-to-reach areas. This project will make cleaning up trash faster, cheaper, and more efficient.

By using this floating trash collecting and cleaning machine, we can keep our water clean and healthy, which is good for animals, plants, and people. This technology also shows how innovation and creativity can help protect the environment.

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