River Water Trash Collector

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Abstract—The increasing accumulation of floating waste in rivers and lakes poses a severe threat to aquatic ecosystems and public health. This paper presents the design and implementation of a Smart Floating Garbage Collector system, aimed at automating the process of waste collection from water surfaces. The system utilizes an Arduino microcontroller integrated with a Bluetooth module (HC-05) for remote wireless control. A floating chassis fitted with DC motors and a L298N motor driver module enables navigation across the water surface. The garbage collection mechanism includes a motor-driven net or conveyor system to collect and trap floating debris. Users can control the movement and operations of the device in real-time via a mobile application developed using MIT App Inventor or any Bluetooth terminal app. This low-cost and energy-efficient system offers a scalable solution for manual waste removal in water bodies, with the potential for integration of sensors and automation in future enhancements. The results demonstrate the effectiveness of the proposed prototype in collecting plastic waste and reducing water pollution, making it suitable for deployment in small lakes, ponds, and urban water canals.

Keywords—Water Pollution, Floating Debris, Trash Collector.

I. INTRODUCTION

Water pollution is one of the major environmental issues today. Floating garbage in rivers and lakes leads to ecological damage, affects aquatic life, and disrupts human usage. Manual cleaning is hazardous, inefficient, and labor-intensive. In response to this, we propose a smart and affordable floating system for collecting garbage remotely using a Bluetooth-enabled Arduino-based robotic boat. The system enables efficient collection without physical intervention, improving the cleanliness of water bodies and promoting automation in waste management.

To address these challenges, this paper presents a Smart Floating Garbage Collector—a low-cost, remotely operated system designed to clean floating waste from the surface of water bodies. The system uses an Arduino microcontroller as the central control unit and an HC-05 Bluetooth module to enable wireless communication between the device and a mobile application. With the integration of DC motors and an **L298N motor.

Conventional methods of removing floating garbage typically rely on manual labor or large, expensive machinery that is not always suitable for narrow or shallow water bodies. These approaches are often inefficient, time-consuming, and lack flexibility in real-time operation. To overcome these limitations, the development of a smart, cost-effective, and remotely operable system is necessary.

This paper proposes a Smart Floating Garbage Collector that utilizes an Arduino microcontroller integrated with an HC-05 Bluetooth module for wireless operation. The system is designed to float on the surface of water bodies and collect floating waste using a motorized collection mechanism such as a rotating net or conveyor. The mobility of the device is controlled using DC motors driven by an L298N motor driver module, and the direction and movement can be managed via a Bluetooth-connected mobile application.

The main objective of this system is to provide a scalable and affordable solution to reduce manual effort in garbage collection, enhance cleaning efficiency, and contribute to water pollution control. The proposed model is ideal for small-scale implementation in lakes, ponds, and canals, and can be further enhanced by integrating sensors, automation, and solar power for sustainable operatio.

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II. LITERATURE REVIEW

Various robotic and semi-automatic systems have been proposed in the past for garbage collection. Prior studies focused on IoT-based river cleaners, solar-powered boats, and automated trash skimmers. However, many of these systems are either cost-prohibitive or lack remote manual control for small-scale usage. Our work bridges this gap by offering a Bluetooth-controlled smart garbage collector, offering a balance between automation and manual flexibility.

1. Automated Trash Collectors
Sharma et al. (2019) proposed a solar-powered autonomous robot designed to clean lakes and ponds by collecting floating debris using a mechanical conveyor system. While the system was energy-efficient and environment-friendly, it lacked manual control features, making it less adaptable to dynamic or restricted environments.

2. Bluetooth Connectivity in Environmental Monitoring
Mehta and Kumar (2020) developed an Arduino-based robotic cleaning boat equipped with ultrasonic sensors for obstacle detection and a conveyor belt for trash collection. Their system emphasized automation and avoided collisions effectively. However, it was fully autonomous and did not include any wireless control mechanism, which limited user interaction and flexibility.

3. Software for Smart Waste Management
Singh et al. (2021) presented a Bluetooth-controlled water cleaning robot using an Arduino Uno and the HC-05 Bluetooth module. Their project demonstrated the feasibility of using wireless communication for real-time control via a mobile device. However, their system lacked advanced features such as feedback sensors or GPS tracking for monitoring coverage area.

4. Challenges in Aquatic Waste Management
The challenge of removing floating waste from water bodies has been addressed through various engineering approaches, ranging from manual collection to the use of autonomous robotic systems. Recent advancements in embedded systems, wireless communication, and low-cost microcontrollers have enabled the development of smart and efficient solutions for water surface cleaning.

5. Gaps in Current Research
Most existing systems either focus on automation without user control or offer manual control without smart feedback.
There is a need for a low-cost, manually controllable, and easy-to-deploy system.
The proposed system using Arduino and HC-05 Bluetooth fills this gap by offering real-time control, simplicity, and affordability for cleaning small water bodies.

III. OBJECTIVES

The main objective of this project is to design and implement a low-cost, Bluetooth-controlled floating garbage collector to remove floating waste from water bodies such as rivers, ponds, and lakes. The specific objectives are:

1. To develop a floating system for garbage collection on water surfaces

- The primary goal is to design a device that can float and move across water bodies like ponds, lakes, or rivers. It should be stable and buoyant, capable of navigating areas where floating garbage is commonly found.

2. To use an Arduino microcontroller as the central control unit

- Arduino is chosen for its affordability, flexibility, and ease of programming. It will serve as the brain of the system, controlling the motors, receiving commands from the Bluetooth module, and managing the collection mechanism.

3. To integrate the HC-05 Bluetooth module for wireless control

- The HC-05 Bluetooth module allows for wireless communication between the garbage collector and a smartphone. This makes the system remotely operable, improving safety and convenience during navigation and trash collection.

4. To implement a mechanical system to collect and trap floating waste

- A rotating net or conveyor belt mechanism will be attached to the front of the device. This mechanical setup helps in scooping and storing the trash in an onboard container as the device moves forward.

5. To ensure the system is portable, low-cost, and user-friendly

- The system is designed with affordability in mind, using low-cost electronic and mechanical components. It should be easy to transport, assemble, and operate, making it ideal for use by communities or municipal workers.

6. To reduce the need for manual waste

- Manual garbage collection is labor-intensive and can be unsafe. The proposed system minimizes human effort while increasing the speed and reach of waste removal, especially in difficult-to-access water areas.

IV. METHODOLOGY

The methodology outlines the step-by-step process involved in the design, development, and testing of the smart floating garbage collector system. The approach includes both hardware and software components integrated to achieve a manually controlled, floating waste collection device:

1. System Design:
The floating garbage collector consists of a lightweight chassis that can float on water. Two DC motors are used for propulsion and steering, while a third motor is attached to a rotating net or conveyor system that gathers floating waste into a storage compartment

2. Hardware Components:
Arduino Uno/Nano: Acts as the main controller of the system, receiving signals and controlling motors.
HC-05 Bluetooth Module: Facilitates wireless communication between the Arduino and a smartphone.
L298N Motor Driver: Controls the direction and speed of the two DC motors.
DC Motors: Used for forward, reverse, and turning movements.
Conveyor/Rotating Net Motor: Collects waste from the water surface.
Power Supply (Battery Pack): A 7.4V Li-ion or 12V battery powers the system.

3.Software and Control:

Programming: The Arduino is programmed using the Arduino IDE in C/C++.
Bluetooth Communication: A mobile app (built with MIT App Inventor or Bluetooth Terminal) sends control commands ('F' for forward, 'B' for backward, 'L' for left, 'R' for right, 'S' for stop).
Motor Logic: Based on the received commands, the Arduino activates specific pins on the motor driver to control motor directions.

4. Fabrication and Assembly

The floating platform is created using lightweight, waterproof materials like thermocol or plastic sheets.
Motors are mounted securely on both sides for balanced propulsion.
The conveyor mechanism is placed in front to collect floating waste.
All components are enclosed in waterproof casings to avoid water damage.

5. Testing and Evaluation
Initial dry-run tests are performed on land to check motor control and Bluetooth connectivity.
Final testing is conducted in a small pond or water tank to observe floating behavior, navigation control, and waste collection efficiency.
Adjustments are made based on issues like motor power, balance, or collection speed.

6. Safety and Maintenance Considerations

Waterproofing is ensured for all electrical components.
The system is designed for easy waste bin removal and battery charging.
Regular checks are recommended for motors and floating stability.

Tables

1. Specifications of River Water Trash Collector System

Sr. No.	Component Name	Specifications / Details	Quantity	Purpose
1	Arduino UNO	ATmega328P microcontroller, 5V logic	1	Main control unit
2	Bluetooth Module HC-05	Range ~10m, UART interface	1	Wireless communication with smartphone
3	Motor Driver Module L298D	Dual H-Bridge motor driver	1	Controls direction and speed of motors
4	DC Geared Motors	12V, 100–300 RPM	2	Propulsion for movement on water
5	Propellers / Wheels	Waterproof, suitable for floating base	2	Converts motor rotation into movement
6	12V Rechargeable Battery	Lithium-ion or Lead Acid	1	Power supply for entire system
7	Chassis / Floating Base	Lightweight waterproof plastic	1	Provides buoyancy and support
8	Garbage Collection Net	Basket	1	To collect floating waste
9	Jumper Wires	Male-Male / Male-Female	As needed	Circuit connections
10	Breadboard (Optional)	For prototyping connections	1	Circuit layout (optional for solderless)
11	Android Smartphone	With Bluetooth SPP Manager app installed	1	To control the robot wirelessly
12	On/Off Switch	12V Compatible	1	To control power manually

2. Summary of Trial Results

Parameter	Observation / Result
Location of Trial	controlled outdoor water body (Swimming Pool)
Control Range	Approx. 8–10 meters (Bluetooth via Android phone)
Response to Commands	Accurate and immediate; smooth directional changes
Floatation Stability	Maintained balance; no tipping or water entry
Waste Collection Efficiency	Successfully collected floating waste (leaves, plastics,)
Motor Performance	Good propulsion and maneuverability on calm water surface
Battery Backup	Approx. 40 minutes of continuous operation
Operation Mode	Manual (Bluetooth-based remote control)
Environmental Conditions	Mild wind and small water ripples; device remained stable
Limitations Observed	Limited range due to Bluetooth; lacks automation; not suitable for heavy debris
Overall Outcome	Effective for small water bodies; field performance matched prototype expectations

3. Perfomance Comparison Between Manual Collection and the Bluetooth-based Trash Collector Mechanism

Parameter	Manual Garbage Collection	Bluetooth-Based Trash Collector
Human Effort Required	High (labor-intensive, physical presence needed)	Low (remotely controlled via smartphone)
Safety	Risk of slipping, infections, water contamination	Safer – no direct human contact with polluted water
Time Efficiency	Slower – dependent on human speed and stamina	Faster – continuous motorized movement
Operational Cost	High (wages, equipment, safety gear)	Low (one-time cost for prototype + minimal maintenance)
Accessibility	Difficult in narrow or deep areas	Can access hard-to-reach corners of water bodies
Precision Control	Low – manual tools may miss debris	High – controlled direction and speed via mobile app
Manpower Requirement	Multiple persons needed	Single operator with phone
Environmental Impact	Neutral / Depends on methods used	Positive – clean energy options like solar can be integrated
Operational Duration	Limited by fatigue and daylight	Can operate until battery drains (~45 min or more)
Scalability & Automation	Not scalable; entirely manual	Scalable; automation possible with sensors & AI integration

CONCLUSION

The Smart Floating Garbage Collector presented in this study offers a low-cost, efficient, and remotely operable solution for collecting floating waste from water bodies such as rivers, lakes, ponds, and canals. By integrating an Arduino microcontroller with an HC-05 Bluetooth module, the system enables users to wirelessly control the movement and operations of the device through a smartphone application, improving accessibility and ease of use.

The implementation of a motorized collection mechanism allows the system to gather surface-level waste effectively, reducing the need for manual labor and increasing the safety of the cleaning process. The design also emphasizes simplicity, modularity, and portability, making it suitable for both urban and rural environments.

The prototype successfully demonstrates the feasibility of using embedded systems and wireless control in environmental applications. It serves as a foundational model that can be enhanced in the future with features such as solar power, water quality sensors, GPS tracking, or autonomous navigation to create a more robust and sustainable waste management solution.

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