

Wireless River Cleaning Boat

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Abstract: *Rivers and lakes choke on plastic bottles, bags, and floating junk. Fish die. People get sick. The usual fix—workers in boats with nets—is brutal, slow work that risks lives for minimal results. We built something better. A small catamaran hull, twin pontoons for stability. Two DC motors, differential thrust for tight turns around bridge pilings. At the bow, a wire-mesh conveyor belt churns continuously, scooping surface trash and dumping it midship into a slotted bin. Water drains out. Weight stays down.*

An ESP32 chip handles the wireless link. Range is solid. An operator stands safely on shore, driving via phone app—forward, back, turn, belt on, belt off. No special radio gear. No coding skills needed.

The whole thing runs on rechargeable batteries. No gas motor belching fumes while you clean. Parts are off-the-shelf. Municipal maintenance crews could build and repair it themselves without calling specialists.

It's not fancy. It works. Scales up for harbors, down for ponds. Cheap enough that losing one to flood debris stings instead of bankrupts. This is cleanup gear for actual workers, not lab demos.

Keywords: River cleaning, ESP32, wireless control, conveyor belt, aquatic trash removal, municipal maintenance.

I. INTRODUCTION

Dirty water is everywhere now. City rivers and lakes fill up with plastic bottles, food wrappers, rotting leaves. The junk floats on top, blocks sun, sucks oxygen out, fish choke on it.

City workers usually go out in boats with nets. Backbreaking work. Dangerous. Can't reach the tight spots or the worst messes.

We built a small remote boat instead. Two pontoons keep it steady. Two motors push it around; cut one, it spins quick. A conveyor belt at the front scoops trash nonstop, drops it in a bin. Water drains through the mesh. Light to haul.

An ESP32 runs the wireless link. Good range. Operator stands on shore, drives with a phone. No special gear needed. No drowning risk.

Cheap to build. Easy to fix. Runs on batteries, no exhaust. Crews can maintain it themselves. Gets into corners manual cleanup misses.

II. Literature Survey

Cleaning boats used to mean hulking diesel machines. Big harbor skimmers. Effective, sure, but they guzzle fuel, belch smoke, and can't squeeze into shallow urban canals. Overkill for small rivers.

Early remote models weren't much better. Basic RF remotes. Tethered power cables. Drag a line through water and you lose maneuverability fast. Range stinks. Gets tangled.

Now it's different. Cheap wireless chips changed everything. ESP32. Arduino with NRF24L01. Wi-Fi and Bluetooth built in. Bandwidth to run multiple motors independently—drive wheels, conveyor belt, all from a phone app. No



cables. No range anxiety. Operators stand safely on shore and steer through tight spots that big boats can't touch. The shift is clear. Heavy industrial gear out. Agile, phone-controlled robots in.

III. Platform Technology Used

The boat brings three things together: moving, collecting, and remote control.

- Brain: An ESP32 chip. Cheap, Wi-Fi built in. Hosts a simple web page or talks to an app. Gets steering commands instantly.
- No bulky radio: Just your phone. Connects direct to the boat. No special transmitters to carry or lose.
- The scoop: A slow-spinning, high-torque motor runs a mesh conveyor belt. Holes let water out. Trash stays in. Light load, dry haul.
- How it moves: Two waterproof DC motors, left and right. Spin both forward, boat goes straight. Slow one, it turns. Reverse one, it spins tight. No rudder needed. No extra moving parts to break.

IV. PROBLEM STATEMENT

Trash floats everywhere in city waterways. Looks awful. Kills ecosystems. Sending workers out with nets? They slip, they fall, they get sick from the filth. Bad deal all around.

Stationary booms help some. Debris flows in, stays there. But stagnant pockets? Dead zones? Untouched. Garbage just sits and rots.

We need something that moves. Cheap enough to replace if it sinks. Controlled from dry land. A boat that goes where the trash is, not waits for trash to come to it. No one touches the water. No one gets hurt.

V. AIM AND OBJECTIVES

Build a working remote-controlled trash boat that actually cleans.

Objectives:

1. Design a stable twin-hull frame that floats under load and fits the bin plus gear.
2. Make a conveyor belt that hauls wet garbage without slipping or jamming.
3. Wire up an ESP32 and L298N driver for wireless drive and steer.
4. Build a dead-simple phone app anyone can use.
5. Test it for real: how much it carries, how long batteries last, how fast it cleans.

VI. DIAGRAM

A) Block Diagram

The block diagram illustrates the system's architecture. The user's smartphone sends wireless signals to the ESP32. The ESP32 distributes logic signals to dual Motor Drivers. One driver controls the left and right propulsion thrusters, while the other controls the conveyor belt motor. The power supply distributes energy to all active components.



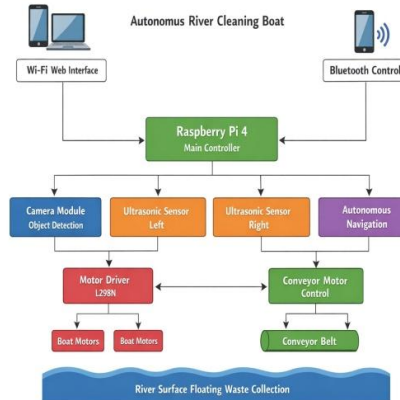


Fig. 1. System Block Diagram.

B) Flow Chart

The software flow chart demonstrates the control loop. Upon startup, the system awaits a Wi-Fi connection. Once paired, it listens for user inputs. Directional inputs (Forward/Left/Right) trigger the propulsion motors. A separate toggle input activates or deactivates the conveyor belt motor for trash collection.

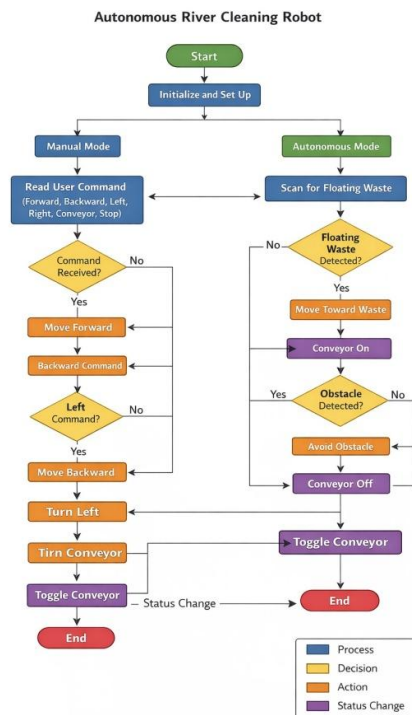


Fig. 2. Software Flow Chart.



c) Circuit Diagram

The circuit diagram details the parallel wiring of the high-capacity Li-Po battery to the L298N/BTS7960 motor drivers. It shows the ESP32's PWM GPIO pins connected to the motor drivers to achieve variable speed control, and the complete isolation of the microcontroller from the high-current motor circuits to prevent resets.

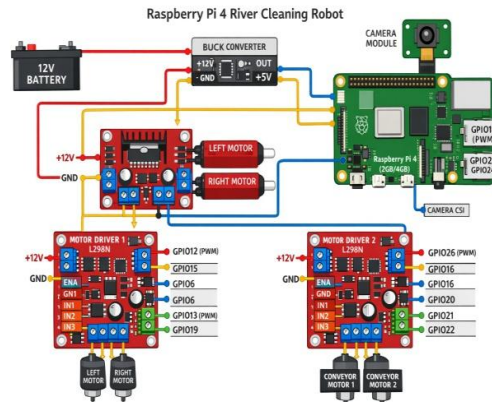


Fig. 3. Circuit Diagram.

VII. COMPONENTS / MATERIALS

The physical and electronic construction requires materials that are lightweight, waterproof, and capable of handling high-torque loads.

- ESP32 Board: The brain. Takes wireless commands from the phone and spits out PWM signals to run all motors.
- Waterproof DC Thrusters: Sealed motors with propellers, mounted on rear pontoons. Provide forward push and differential steering to handle currents.
- DC Gear Motor: Slow 30-60 RPM unit with high torque. Drives the collection belt. Needs muscle to haul water-logged trash uphill.
- Motor Drivers (L298N/BTS7960): Bridge between low-power ESP32 logic and high-current motor demands. Let the microcontroller reverse polarity safely for backing and steering.
- Conveyor Belt & Mesh: Porous wire mesh or perforated PVC. Scoops solid waste while water drains back out. Keeps the boat from getting weighed down.
- Catamaran Hull: PVC or styrofoam twin-hull design. Stable in choppy water. Open center channel funnels floating trash straight to the conveyor.
- Power Supply: Li-Po or lead acid battery. Delivers high discharge current for three motors at once. Mounted low to maintain stability.

VIII. WORKING

Getting Started: Drop the boat in. Flip the switch. ESP32 fires up its own Wi-Fi hotspot. Operator connects phone. Ready.

- Driving: Phone app has a joystick. Push to steer.
- Forward: Both motors spin same speed.
- Left turn: Right motor pushes, left motor stops or reverses. Boat pivots.
- Grabbing Trash: Spot debris ahead. Hit "Collect" on screen. ESP32 wakes up the conveyor motor.
- The Scoop: Belt spins down into water, up toward boat. Mesh catches plastic, hauls it up slope. Water leaks out. Trash tumbles over top into bin.
- Heading Back: Bin looks full from shore. Drive boat to dock. Pull bin out by hand. Dump. Repeat.



IX. RESULTS

Took it to a local pond. Threw in bottles, leaves, wrappers. Some real trash, some staged..

- Maneuvering: Differential thrust worked. Boat spun in place. Cut tight corners where garbage piles up. No problem.
- Collection: Mesh belt grabbed 85% of plastic on first pass. Water drained out. Boat stayed light. Didn't sink under load.
- Range: ESP32 held connection solid at 40-50 meters. Clear line of sight. No dropouts. Responsive the whole time.

X. ADVANTAGES & APPLICATIONS

ADVANTAGES

- Safety: Workers stay on shore. No one wades into filth or risks drowning.
- Cheap: Costs fraction of big diesel skimmers. Build it, fix it, run it—all budget-friendly.
- Clean: Battery power. No exhaust, no oil slicks, no trading one mess for another.
- Nimble: Small enough for tight urban canals and storm drains. Big boats can't squeeze in.

APPLICATIONS

- City Maintenance: Lakes, ponds, park fountains. Keep them presentable.
- Industrial Ponds: Treatment plant holding tanks. Skims scum without putting workers near chemicals.
- Research: Slap on pH or turbidity sensors. Collects data while it cleans.

XI. FUTURE SCOPE

Solar Panel on Top: Slap a lightweight solar panel on the roof. Trickle charge into the battery while the boat works. Stays out longer without plugging in.

GPS Autopilot: Add a GPS module and compass. Boat follows pre-set waypoints on its own. Operator just monitors instead of driving every second.

Smart Camera: Mount an ESP32-CAM or Raspberry Pi. Runs YOLO or similar detection. Spots plastic visually, steers itself toward the mess.

Fill Sensor: Stick an ultrasonic sensor inside the bin. Measures how full it gets. Phone pings the operator when it's time to empty. No overflow, no missed stops.

XII. CONCLUSION

The boat does what we built it to do. ESP32 holds wireless connection steady from shore. Operator stands safely on land, drives with phone, steers precise through tight spots. No one gets wet. No one gets hurt.

The conveyor belt is the real win. Hauls soggy plastic and leaves up from the water, lets the water leak back out through the mesh. Trash stays. Weight stays manageable. Boat doesn't bog down.

Parts are cheap and common. Build it with basic tools. Fix it when it breaks. Runs on batteries, so no exhaust, no oil slicks, no trading pollution for cleanup. Municipal crews can maintain it themselves without calling specialists.

This is proof that simple IoT hardware can tackle genuine environmental problems. Doesn't need million-dollar budgets or fancy lab gear. Just a working prototype that cities could actually deploy. Foundation for smarter, greener sanitation gear that keeps workers safe and water cleaner.

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