Aqua Rover – Shallow Water Explorer & Data Collector

https://www.youtube.com/watch?v=aWk9ANN3eB0

Purpose

The purpose of the Aqua Rover is to design a low-cost, bio-inspired amphibious robot capable of navigating shallow waters and mangrove regions while monitoring water quality. It aims to provide an affordable solution for environmental monitoring, aquatic research, and pollution detection.

Introduction

Water quality is one of the most critical indicators of ecosystem health. Traditional water sampling methods are time-consuming, require manpower, and cover only limited areas. The Aqua Rover offers an innovative solution by combining robotics with environmental sensing. Inspired by amphibious creatures that adapt to both land and water, this robot can move across shallow terrain, float on water, and collect real-time environmental data such as pH, turbidity, temperature, and salinity. The integration of wireless communication allows the Aqua Rover to transmit data for analysis, making it an effective tool for research, education, and sustainable development.

Bill of Materials (BOM)

Component	Quantity	Est. Cost (USD)
Arduino Nano / UNO	1	$3 – $5
DC Gear Motors (Waterproofed)	2–4	$3 each
Motor Driver (L298N Mini)	1	$2
Waterproof Ultrasonic Sensor	1	$4 – $6
pH Sensor Module	1	$8 – $12
Turbidity Sensor	1	$5 – $7
Temperature Sensor (DS18B20)	1	$2
Salinity (Conductivity) Sensor	1	$6 – $8
LoRa / GSM Module	1	$5 – $7
Li-ion Battery Pack (7.4V)	1	$3 – $5
Solar Panel (10W, optional)	1	$10
3D Printed Amphibious Hull	1	~$2
Rubberized Wheels / Paddles	4	$4 total

Component	Quantity	Est. Cost (USD)
Misc (Wires, waterproof casing, epoxy, screws) –		$5

Total Estimated Cost: $55 – $70

Procedure

- **Design & Fabrication**
  - Create the amphibious hull design in CAD software and 3D print the body.
  - Attach pontoons or rubberized wheels/paddles for movement in water.
- **Electronics Assembly**
  - Mount Arduino Nano as the main controller.
  - Connect DC gear motors to the motor driver (L298N).
  - Waterproof all electronics using casing and epoxy.
- **Sensor Integration**
  - Install pH, turbidity, salinity, and temperature sensors in water-contact points.
  - Connect ultrasonic sensor to the front for obstacle avoidance.
- **Power & Communication**
  - Attach Li-ion battery pack as power supply.
  - Optionally connect a solar panel for continuous operation.
  - Connect LoRa/GSM module for real-time data transmission.
- **Programming & Testing**
  - Program Arduino for locomotion, sensor reading, and communication.
  - Test rover in shallow water, collect sensor readings, and transmit data.
  - Refine design for better buoyancy and stability.

Limitations

1. **Waterproofing Complexity** – Protecting electronics in wet environments requires careful sealing, which may still be prone to leaks.
2. **Sensor Accuracy** – Environmental sensors like pH, turbidity, and salinity need frequent calibration, and their readings may drift over time.

3. **Shallow Water Restriction** – The rover is designed for shallow waters and may not perform effectively in deeper or fast-flowing currents.
4. **Communication Range** – Wireless modules (LoRa/GSM) may have limited coverage in remote or signal-blocked regions.
5. **Power Constraints** – Battery life may limit operation time, and balancing buoyancy with battery weight is a challenge.
6. **Maintenance** – Components such as wheels, paddles, and sensor probes may degrade when exposed to muddy or salty water over long periods.
7. **Skill Requirement** – The project demands knowledge in CAD design, 3D printing, electronics, and coding, which may be difficult for beginners to integrate smoothly.

Outcome

The Aqua Rover successfully demonstrates a low-cost, innovative robotic solution for environmental monitoring. It can move in shallow waters, avoid obstacles, and collect key water quality parameters. Data collected can be transmitted wirelessly, enabling real-time monitoring for researchers, educators, and environmental agencies. This project not only showcases the potential of bio-inspired robotics but also contributes to sustainable solutions for aquatic ecosystem preservation.