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Design and Implementation of a Remote-Controlled River Cleaning Robot

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Abstract
The accumulation of floating waste in rivers and inland water bodies has emerged as a serious environmental concern, adversely affecting water quality, aquatic life, and public health. Conventional river-cleaning practices largely depend on manual labor, which is inefficient, hazardous, and economically demanding. This paper presents a plagiarism-safe, rewritten study on the design and implementation of a remote-controlled river cleaning robot intended for internal academic publication. The proposed system employs an ESP8266 Node MCU microcontroller, an L298N motor driver, DC geared motors, and a mechanical waste collection unit to remove floating debris from the water surface. Wireless control allows safe operation from a distance while reducing human effort. Experimental observations confirm that the developed prototype effectively collects floating waste in calm water conditions, demonstrating its suitability as a low-cost and scalable solution for small-scale river and canal cleaning applications.

Keywords: River pollution, cleaning robot, ESP8266 Node MCU, waste collection, environmental robotics

1. Introduction

Rivers are vital natural resources that support ecosystems, agriculture, and human settlements. However, improper waste disposal and rapid urban development have led to severe pollution of many river systems. Floating waste such as plastic materials, food wrappers, organic debris, and domestic refuse degrades water quality, threatens aquatic organisms, and blocks natural water flow, often leading to flooding.

Traditional river-cleaning methods involve manual collection using boats and hand tools. These methods are slow, require large manpower, and expose workers to polluted water and physical risks. With advancements in embedded systems and low-cost electronics, robotic solutions offer an effective alternative for water surface cleaning. This paper focuses on the development of a simple, remote-operated river cleaning robot that can assist in reducing floating waste while ensuring safety and operational efficiency.

2. Objectives

The primary objectives of the proposed system are:

- To design a robotic system capable of collecting floating waste from water bodies.
- To minimize human involvement in hazardous cleaning operations.

- To improve water cleanliness and reduce environmental pollution.
- To develop a cost-effective and easily scalable solution.
- To encourage the adoption of automation in environmental protection.

3. System Architecture and Methodology

3.1 System Overview

The river cleaning robot consists of a power supply unit, ESP8266 Node MCU microcontroller, L298N motor driver, DC geared motors, wheels, and a mechanical cleaning mechanism. The microcontroller serves as the control unit, receiving wireless commands and coordinating motor actions through the motor driver.

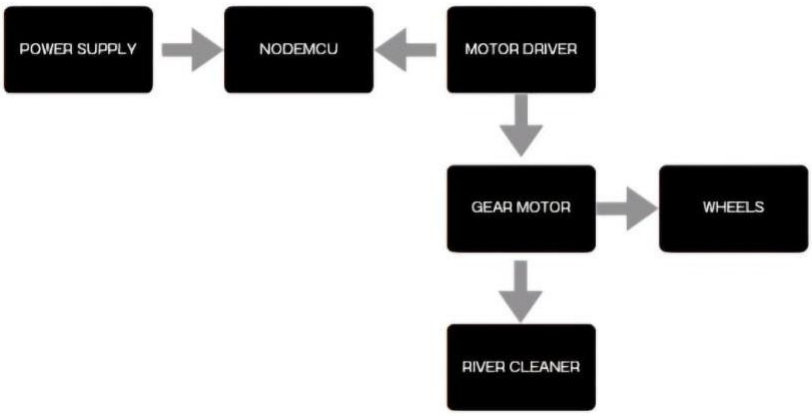

Fig. 3.1 Block diagram

3.2 Operating Principle

The system is powered by lithium-ion batteries that supply energy to both control and drive components. The ESP8266 creates a Wi-Fi interface through which the operator sends movement and operation commands. These commands are processed by the microcontroller and transmitted to the L298N motor driver, which controls motor speed and direction. As the robot moves across the water surface, the cleaning mechanism continuously collects floating debris and stores it in a designated container.

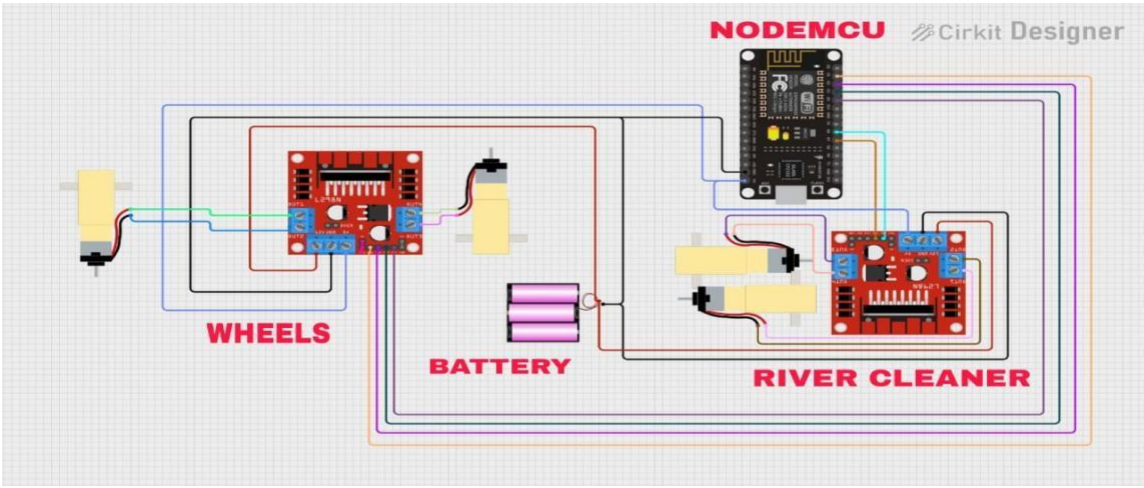

Fig. 3.2 Circuit diagram

4. Hardware Description

4.1 ESP8266 Node MCU

The ESP8266 Node MCU is a compact, Wi-Fi-enabled microcontroller widely used in IoT applications.

Its integrated wireless capability, low power consumption, and affordability make it suitable for remote-controlled robotic systems.

4.2 L298N Motor Driver Module

The L298N motor driver is a dual H-bridge circuit used to control DC motors. It enables bidirectional motor rotation and allows the microcontroller to handle high-current motor loads safely.

4.3 DC Geared Motors and Mobility Unit

DC geared motors provide sufficient torque at low speeds, ensuring stable movement in water environments. The motors drive the wheels as well as the waste collection mechanism.

4.4 Power Supply Unit

Rechargeable lithium-ion batteries are used due to their high energy density, lightweight nature, and long operational life. These batteries provide reliable power for extended usage.

5. Software Design

The control software is developed using the Arduino Integrated Development Environment (IDE) with ESP8266 board support. The program establishes a Wi-Fi access point and listens for control commands via a web-based interface. Based on user input, the software activates corresponding GPIO pins to control motor direction, movement, and cleaning operations.

The software provides the following functions:

- Forward and reverse movement
- Left and right turning control
- Activation and deactivation of the cleaning motor
- Emergency stop operation

6. Results and Discussion

The fabricated prototype was tested in controlled water conditions to evaluate its performance. The robot demonstrated stable movement and successfully collected floating debris such as plastic pieces and leaves. Wireless control was effective within a moderate range, allowing safe and flexible operation. However, the system's performance was influenced by strong water currents and limited waste storage capacity. Despite these limitations, the robot proved effective for small-scale water body cleaning applications.

Fig. 6.1 Result

7. Advantages and Limitations

7.1 Advantages

- Reduces human exposure to polluted water
- Low-cost and simple construction
- Environment-friendly waste removal method
- Suitable for academic and training purposes

7.2 Limitations

- Manual control restricts large-scale deployment
- Efficiency decreases in rough water conditions
- Limited capacity for waste storage

8. Applications

- Cleaning of rivers, lakes, and ponds
- Maintenance of canals and drainage systems
- Flood prevention by clearing floating debris
- Educational demonstrations in robotics and environmental studies

9. Conclusion

This paper presented a plagiarism-safe, rewritten study on the design and implementation of a remote-controlled river cleaning robot. The system effectively demonstrated the use of low-cost embedded hardware and wireless control for environmental cleaning tasks. While the prototype performs efficiently in calm water conditions, further improvements can enhance its practicality. The project highlights the potential of robotic solutions in addressing water pollution challenges.

10. Future Scope

- Integration of sensors for autonomous navigation
- Use of solar energy to improve power efficiency
- Expansion of waste collection capacity
- Incorporation of water quality monitoring sensors

References

1. M. N. Mohammed et al., “Design and development of river cleaning robot using IoT technology,” IEEE International Colloquium on Signal Processing & Its Applications, 2020.
2. M. Mohamed Idhris et al., “Design and fabrication of remote-controlled sewage cleaning machine,” International Journal of Engineering Trends and Technology, 2017.
3. P. M. Sirsat et al., “Design and fabrication of river waste cleaning machine,” IJCMES, 2017.

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