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Design and Fabrication of Solar Powered Mobile Operated Lake Cleaning Boat

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Abstract: *Water pollution caused by floating waste such as plastics, bottles, and organic debris has become a serious environmental issue in rivers and lakes. Conventional cleaning methods are labor-intensive, unsafe, and dependent on fossil fuels. This research presents the design and fabrication of a solar powered mobile operated lake cleaning boat that integrates renewable energy, automation, and remote-control operation for efficient waste removal. The system utilizes a solar panel, Arduino UNO microcontroller, DTMF communication module, motor driver, and conveyor mechanism to collect floating waste from water surfaces. Experimental testing demonstrated effective removal of floating debris with reduced human intervention and lower operational costs. The proposed model offers a sustainable and eco-friendly solution for improving water quality and supporting environmental conservation initiativ..*

Keywords: *Water pollution*

I. INTRODUCTION

Water pollution is one of the major environmental challenges affecting rivers, lakes, and reservoirs worldwide. Rapid urbanization, industrial discharge, and improper waste disposal practices have increased the accumulation of floating waste in water bodies. Traditional cleaning methods rely on manual labor or fuel-powered boats, which are costly, inefficient, and hazardous to workers. The integration of renewable energy and automation provides a sustainable alternative for continuous watercleaning operations.

II. PROBLEM STATEMENT

Existing river and lake cleaning systems suffer from limitations such as high operational cost, fuel dependency, low efficiency, and safety risks for workers. Floating waste obstructs water flow, damages aquatic ecosystems, and contributes to waterborne diseases. Therefore, there is a need for an automated and eco-friendly cleaning system powered by renewable energy.

III. OBJECTIVES

- To design a solar powered lake cleaning boat for floating waste collection.
- To reduce human intervention in hazardous cleaning operations.
- To integrate Arduino-based mobile control for remote operation.
- To utilize renewable solar energy for sustainable performance.
- To improve efficiency and reduce operational cost in water cleaning systems.

IV. METHODOLOGY

The proposed system operates using a solar panel connected to a rechargeable battery pack. The stored energy powers the Arduino UNO microcontroller and DC motors. A DTMF decoder receives commands from a mobile phone and transmits signals to the Arduino controller. The controller activates the motor driver to operate propulsion motors and the conveyor belt mechanism. Floating debris is collected through the conveyor system and stored in a detachable waste bin.

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V. SYSTEM COMPONENTS

The major components used in the system include:

- Arduino UNO (ATmega328P)
- Solar Panel (12V, 2A)
- DTMF Decoder Module (MT8870)
- L293D Motor Driver
- DC Motors and Propeller Fans
- Conveyor Belt Mechanism
- Li-ion Rechargeable Battery Pack

VI. WORKING PRINCIPLE

The solar panel converts sunlight into electrical energy, which is stored in the battery pack. The operator controls the boat remotely through a mobile phone interface. Commands are decoded by the DTMF module and processed by the Arduino controller. The motor driver controls propulsion and conveyor motors to navigate the boat and collect floating waste continuously.

VII. RESULTS AND DISCUSSION

Testing of the prototype demonstrated successful removal of floating debris from controlled water bodies. The boat operated efficiently under sunlight conditions and showed reliable remote-control performance. The conveyor mechanism effectively lifted plastics and floating waste into the storage bin. However, efficiency decreased during cloudy weather due to dependence on solar energy.

VIII. ADVANTAGES

- Eco-friendly and powered by renewable energy.
- Reduces manpower and operational costs.
- Minimizes health risks for cleaning workers.
- Provides continuous cleaning operation.
- Suitable for lakes, rivers, ponds, and reservoirs.

IX. LIMITATIONS

- Reduced efficiency during low sunlight conditions.
- Limited waste storage capacity.
- Requires periodic maintenance of solar panels and motors.
- Prototype suitable mainly for small and medium-sized water bodies.

X. FUTURE SCOPE

Future improvements may include GPS-based navigation, IoT-enabled monitoring systems, obstacle detection sensors, and AI-based autonomous navigation. Increasing battery storage capacity and scaling the design for large water bodies can further enhance the practical application of the system.

XI. CONCLUSION

The solar powered mobile operated lake cleaning boat provides an innovative and sustainable solution for water pollution management. By integrating solar energy, automation, and remote-control operation, the system reduces dependence on fossil fuels and minimizes human intervention. The project demonstrates the practical application of renewable energy and mechanical engineering principles in environmental conservation.

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XII. COMPARATIVE ANALYSIS OF CLEANING METHODS

Method	Efficiency	Environmental Impact	Cost
Manual Cleaning	Low	Safe but labor intensive	High labor cost
Fuel-Based Boats	Moderate	High emissions Eco-	High fuel cost
Solar Powered Boat	High	friendly	Low operational cost

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