

DESIGN AND FABRICATION OF SOLAR POWERED UNDER WATER WASTE COLLECTOR

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Abstract

Aquatic pollution is a pressing global challenge, with submerged plastics and organic debris posing serious threats to ecosystems and human health. Existing solutions—manual nets, diesel pumps, robotic skimmers, and solar boats—primarily target surface waste, leaving underwater debris untreated. This paper presents the design and fabrication of a solar-powered underwater waste collector that integrates a 12V DC pump, PVC framework, floatation drums, and a perforated basket. Powered by a 100W solar panel and battery backup, the system achieves stable floatation, a suction head of 1.8 m, and waste collection efficiency of 92%. CAD modeling in CATIA V5 validated the design, while fabrication trials confirmed affordability (~₹10,000) and sustainability. The project demonstrates a scalable, community-level solution aligned with UN Sustainable Development Goals (SDGs).

Keywords: Solar energy, aquatic pollution, underwater waste collector, sustainable engineering, CAD modeling.

1. Introduction

Water pollution is a global concern, with UNEP estimating over 8 million tons of plastic entering aquatic ecosystems annually. In India, lakes such as Hussain Sagar (Hyderabad) and Bellandur (Bengaluru) exemplify severe pollution, while reservoirs like Meghadrigedda (Visakhapatnam) suffer seasonal debris accumulation. Existing cleaning methods—manual nets, diesel pumps, robotic skimmers, and solar boats—are either unsafe, costly, or limited to surface cleaning.

This project addresses the gap by designing a solar-powered underwater waste collector that is affordable, modular, and sustainable.

2. Literature Review

Kavitha & Guru (2026): Developed a solar-powered remote-controlled waste collector (Springer ICPERES). Focused on automation but costly and complex.

Kunder et al. (2023): Designed a solar-powered trash boat (IJRES). Affordable and community-friendly but limited to surface waste.

Makode et al. (2023): Reviewed solar conveyor-based collectors (Recent Trends in Fluid Mechanics). Effective for floating debris but unsuitable for submerged waste.

Muhasin et al. (2024): Proposed a solar trash collector prototype (IJCRT). Simple design but lacked underwater capability.

Gap Identified: No existing system balances cost, sustainability, and underwater collection.

3. Methodology

3.1 Design

CAD modeling in CATIA V5 for PVC pipes, basket, pump housing, floats, and solar frame. Floation analysis ensured stability under load.

3.2 Fabrication

PVC pipes cut and assembled with elbows and T-joints.

Basket fabricated from perforated stainless steel mesh.

Pump mounted in waterproof housing.

Solar panel fixed on a tilted frame ($\sim 30^\circ$).

Floation drums attached for buoyancy.



3.3 Electrical Integration

Solar panel \rightarrow Charge controller \rightarrow Battery \rightarrow DC pump.

Fuse protection added for safety.

Waterproof wiring ensured durability.

4. RESULTS & DISCUSSION

Floatation stability margin: 25%

Suction head achieved: 1.8 m

Waste collection efficiency: 92% (medium debris)

Solar panel peak output: 85W at noon

Battery runtime: 2.5 hours continuous operation

Compared to existing systems, the prototype is low-cost, sustainable, and uniquely capable of underwater collection.

5. ADVANTAGES

- Eco-friendly operation
- Reduces manual labor risk
- Low cost system
- Efficient waste collection
- Portable and lightweight design

6. DISADVANTAGES

- Limited depth operation
- Battery dependency
- Cannot capture microplastics
- Limited suction capacity
- Manual monitoring required

7. APPLICATIONS

- Lake and pond cleaning
- River surface & shallow cleaning
- Drainage (nullah) cleaning
- Municipal waste management systems
- Temple tanks & small reservoirs

8. CONCLUSION

The solar-powered underwater waste collector successfully addresses aquatic pollution by combining renewable energy with affordable fabrication. It is scalable for community deployment and aligns with SDGs 6, 7, 11, 13, and 14. Future work includes IoT integration, larger-scale deployment, and municipal adoption.

9. References

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