Smart Water Boat Garbage Collector

Guided by:

Prof. R.K Navandar

Sayali Sathe| Rutuja Kallurkar| Vedant Abhyankar

- **Abstract:** The Smart Water Boat Garbage Collector is an automatic system designed to collect floating waste such as plastic bottles, covers, and other nonbiodegradable materials from rivers, lakes, and ponds. The system uses a floating boat, conveyor mechanism, DC motors, ultrasonic sensors, and a microcontroller based control unit. The system reduces manual effort and helps in maintaining a clean environment. The main objective of this project is to develop a low cost and efficient water cleaning solution using automation
- Water pollution caused by floating waste such as plastics, organic materials, and other debris has become a major environmental concern. Conventional cleaning methods are mostly manual, inefficient, and time-consuming, which limits their effectiveness in maintaining clean water bodies. To address this issue, the Smart Water Boat Garbage Collector is proposed as an automated and efficient solution for collecting floating waste from rivers, lakes, and other water bodies.
- This system is designed using a combination of mechanical and electronic components, including a microcontroller, sensors, and a garbage collection mechanism such as a conveyor belt. The boat is capable of navigating on the water surface and detecting waste using sensors, enabling it to collect garbage with minimal human intervention. In some implementations, the system can also be integrated with IoT technology for remote monitoring and control.
- The proposed model aims to reduce human effort, improve efficiency, and provide a cost-effective and eco-friendly approach to water cleaning. By automating the waste collection process, the system helps in maintaining water quality, protecting aquatic life, and promoting environmental sustainability. The Smart Water Boat Garbage Collector thus presents a promising solution to tackle the growing problem of water pollution.

- **Introduction**
- Water pollution due to floating waste such as plastic bottles, polythene bags, and organic debris has become a serious environmental problem. The increasing amount of waste in rivers, lakes, and ponds not only affects water quality but also harms aquatic life and disrupts ecosystems. Traditional cleaning methods mainly rely on manual labor, which is inefficient, time-consuming, and sometimes unsafe. Therefore, there is a need for an automated and efficient system to remove floating garbage from water bodies.
- The Smart Water Boat Garbage Collector is an innovative solution designed to address this issue. It is an automated or semi-automated floating device that collects waste from the water surface with minimal human intervention. The system uses a combination of mechanical, electrical, and electronic components to perform its operation effectively.
- The main components of the system include a floating boat structure, a microcontroller (such as Arduino), motors, sensors, a conveyor belt mechanism, and a power supply unit. The floating structure ensures stability on water, while DC motors are used for propulsion and movement of the boat. Sensors such as ultrasonic or IR sensors are used to detect obstacles and floating waste. The conveyor belt mechanism is used to collect and store garbage from the water surface into a container. The power supply, which may include batteries or solar panels, provides energy to the entire system.
- The working of the Smart Water Boat Garbage Collector is based on simple automation principles. When the system is activated, the boat moves across the water surface using motor-driven propellers. Sensors continuously monitor the surroundings to detect waste and avoid obstacles. Once garbage is detected, the conveyor mechanism is activated, which collects the floating waste and stores it in a storage bin. The boat can be controlled manually using a remote or automatically programmed for specific paths. In advanced versions, IoT technology can be used to monitor

the system remotely and track garbage collection data.

- This project aims to develop a cost-effective, efficient, and eco-friendly system for cleaning water bodies. By reducing human effort and increasing cleaning efficiency, the Smart Water Boat Garbage Collector contributes to environmental protection and sustainable waste management.\

- **Literature Survey**

- Water pollution due to floating waste has led to increased research in the development of automated and robotic systems for cleaning water bodies. Various researchers have proposed different designs and technologies to improve efficiency, reduce human effort, and enhance environmental sustainability.
- A study on the development of a **water surface mobile garbage collector robot** presented a prototype capable of collecting floating waste using a remotely controlled system. The robot utilized Bluetooth communication for navigation and demonstrated effective garbage collection in small water bodies such as rivers and lakes. However, the system had limited range and required manual control, highlighting the need for full automation.
- Another research work focused on **vision-based autonomous water cleaning robots**, where advanced detection techniques were used to identify floating garbage. The study emphasized the importance of automation, stating that traditional manual cleaning methods are inefficient and hazardous. The proposed system aimed to achieve high efficiency with minimal human intervention using intelligent detection algorithms.
- Research on the **design of surface garbage cleaning robots for small water areas** highlighted the importance of structural design and propulsion systems. The study proposed a detachable robotic structure capable of collecting light floating debris efficiently. It also discussed factors such as draft, resistance, and propulsion selection, which are crucial for improving the performance and stability of the system.
- Another important study analyzed different **garbage collection mechanisms** used in water cleaning robots. It concluded that the efficiency of the system largely depends on the type of collection mechanism, such as conveyor belts, scooping systems, or net- based collectors.
- In addition, research on **ocean surface trash collector robots** introduced a conveyor belt-based collection system combined with a stable floating platform. This design proved to be simple, cost-effective, and capable of collecting a significant amount of waste while maintaining structural stability and durability.
- Recent advancements have also explored **autonomous surface vehicles (ASVs)** and optimized boat designs such as catamarans for water cleaning applications. These systems focus on improving payload capacity, reducing energy consumption, and enhancing operational efficiency.
- Overall, the literature survey indicates that although significant progress has been made in developing water garbage collection systems, several challenges still remain. These include limited automation, navigation issues, energy efficiency, and high implementation costs. Therefore, the proposed Smart Water Boat Garbage Collector aims to overcome these limitations by integrating efficient collection mechanisms, smart sensors, and automation technologies.

- **References (IEEE Format)**

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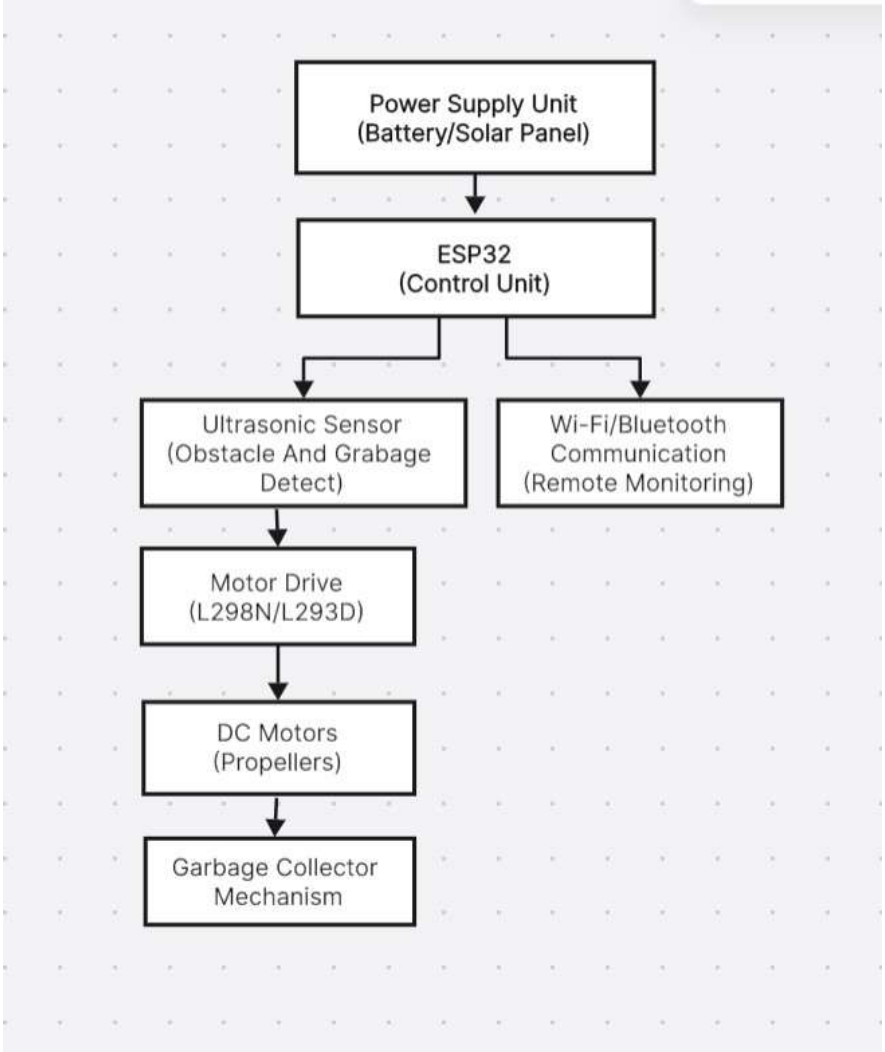
- **Methodology**
- The methodology of the Smart Water Boat Garbage Collector project involves the design, development, and implementation of an automated system capable of collecting floating waste from water bodies. The approach is divided into several stages, including system design, component selection, fabrication, and testing.
- Initially, the overall design of the system is developed by considering factors such as stability, load capacity, and efficiency. A floating boat structure is designed using lightweight and water-resistant materials to ensure proper buoyancy and balance during operation. The design also includes space for mounting mechanical and electronic components.
- The hardware components are then selected and integrated. A microcontroller (such as Arduino) is used as the main control unit to coordinate all operations. DC motors are employed for propulsion and navigation of the boat, while motor drivers are used to control their speed and direction. Sensors such as ultrasonic or infrared sensors are incorporated to detect obstacles and floating waste. A conveyor belt mechanism is installed at the front of the boat to collect garbage and transfer it into a storage container.
- The working of the system is based on automation and control principles. When the system is powered on, the boat moves across the water surface using motor-driven propellers. The sensors continuously scan the surroundings to detect obstacles and waste materials. Upon detecting garbage, the conveyor belt mechanism is activated, which collects the floating debris and stores it in a designated container onboard. The system can be operated either manually through remote control or automatically using pre-programmed instructions.
- In advanced implementations, IoT technology can be integrated to enable remote monitoring and control of the system. Data such as garbage collection status, battery level, and location can be transmitted to a mobile device or computer for real-time monitoring.
- Finally, the developed prototype is tested under different conditions to evaluate its performance, efficiency, and reliability. Parameters such as garbage collection capacity, navigation efficiency, and power consumption are analyzed to validate the effectiveness of the system.
- This methodology ensures the development of a cost-effective, efficient, and eco- friendly solution for cleaning water bodies and reducing pollution.

(With Block Diagram)

- The Smart Water Boat Garbage Collector system is designed using a microcontroller- based control system that integrates sensors, motors, and a garbage collection mechanism. The methodology focuses on automation, efficient waste collection, and ease of operation.
- The system works in three main stages: **input → processing → output**.
- **Input Stage:** Sensors such as ultrasonic or IR sensors detect obstacles and floating garbage.
- **Processing Stage:** A microcontroller (e.g., Arduino) processes the sensor data and gives commands.
- **Output Stage:** Motors and conveyor mechanism perform movement and garbage collection.

Block diagram



Description of proposed work

The diagram represents the working architecture of a smart water garbage collection system using an embedded controller.

Power Supply Unit (Battery / Solar Panel)

- This unit provides electrical energy to the entire system.
- A **battery** ensures continuous operation, while a **solar panel** enables renewable energy usage, making the system eco-friendly.

ESP32 (Control Unit)

- The ESP32 acts as the **brain of the system**.
- It processes inputs from sensors and controls motors and communication modules.
- It also supports **Wi-Fi and Bluetooth connectivity**. **Ultrasonic Sensor (Obstacle and Garbage Detection)**
- Detects obstacles and floating garbage in water.
- Sends distance/data signals to ESP32.
- Helps in navigation and identifying waste.

Wi-Fi / Bluetooth Communication (Remote Monitoring)

- Enables wireless communication.
- Used for:
  - Remote control of the boat
  - Monitoring system status
  - Sending alerts or data to user/mobile app

Motor Driver (L298N / L293D)

- Acts as an interface between ESP32 and motors.
- Controls direction and speed of DC motors based on commands from ESP32.

DC Motors (Propellers)

- Provide propulsion to move the boat forward, backward, and turn.
- Controlled via the motor driver.

Garbage Collector Mechanism

- Mechanical system (e.g., conveyor belt or net).
- Collects floating waste from water and stores it in a container.

The proposed system aims to design and develop an **automated smart boat** capable of collecting floating garbage from water bodies such as lakes, rivers, and ponds.

Objective

- To reduce water pollution using an **automated, eco-friendly, and efficient system**.
- Minimize human effort in cleaning water surfaces.

Working Principle

1. The boat is powered using a battery and optionally supported by solar energy.
2. The ESP32 continuously receives input from ultrasonic sensors.
3. When garbage or obstacles are detected:
4. The system navigates accordingly. Moves toward garbage using motor control.
5. The garbage collection mechanism gathers waste.
6. The collected waste is stored onboard.
7. The system can be: Operated remotely via Wi-Fi/Bluetooth Or made semi/fully autonomous

Conclusion

The Smart Water Boat Garbage Collector project presents an effective and innovative solution to the growing problem of water pollution caused by floating waste. The system successfully demonstrates how automation and modern technology can be utilized to reduce human effort and improve the efficiency of cleaning water bodies such as rivers, lakes, and ponds.

By integrating components such as a microcontroller, sensors, motors, and a conveyor belt mechanism, the proposed system is capable of detecting, collecting, and storing floating garbage with minimal human intervention. The use of an automated approach ensures continuous operation, better coverage, and improved waste management compared to traditional manual methods.

The project emphasizes cost-effectiveness, eco-friendliness, and ease of implementation, making it suitable for real-world applications, especially in small to medium-sized water bodies. Although the current system has some limitations, such as limited storage capacity and dependency on power supply, it provides a strong foundation for further improvements. In future developments, the system can be enhanced by incorporating advanced technologies such as IoT for remote monitoring, GPS for navigation, and solar panels for sustainable energy usage. These improvements can increase efficiency, scalability, and overall performance.

In conclusion, the Smart Water Boat Garbage Collector is a promising step toward cleaner water environments and sustainable waste management, contributing positively to environmental protection and public health.

Aknowledgement

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