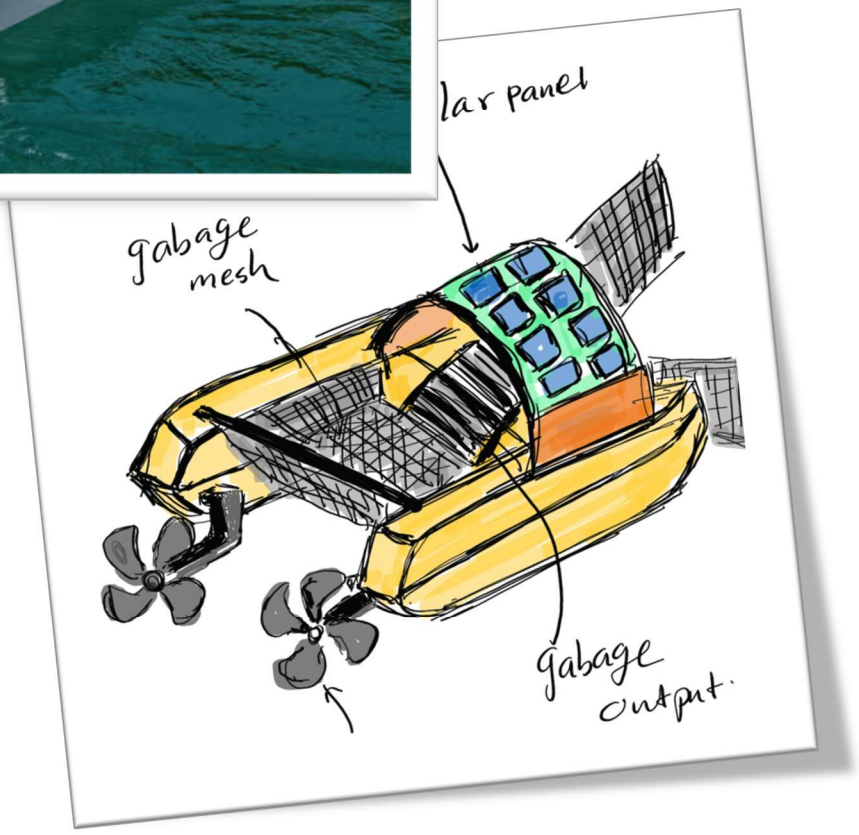
Water Garbage Cleaning Robot



Abstract

This report presents the design of a robot specifically developed for the purpose of cleaning solid waste and floating materials on the water surface. The main objective of the robot is to effectively clean ponds, lakes, and swimming pools. The project focuses on designing a vehicle structure that offers high stability and facilitates easy collection of floating substances. The accumulation of floating particles on the water surface reduces the amount of sunlight passing through the water, leading to a slowdown in photosynthesis and decreased dissolution of oxygen in water bodies. Therefore, it is crucial to remove these floating materials from water bodies. The "Water Garbage Cleaning Robot" project aims to address this issue by efficiently cleaning and removing floating materials from the water surface. The report provides an overview of the project's objectives, the problem it addresses, the system design with parameters, hardware requirements, working mechanism, advantages, limitations, and a conclusion summarizing the project's achievements.

1. Introduction

Traditionally, the collection of floating waste from water bodies has relied on manual methods and the use of boats equipped with trash skimmers. However, these methods are expensive, time-consuming, and pose risks to human workers. To overcome these limitations, the development of a water garbage cleaning robot offers a more efficient and environmentally friendly solution.

The water garbage cleaning robot is designed to efficiently collect solid particles and garbage from the water's surface. It incorporates a cleaner mechanism and a conveyor belt system to facilitate the collection process. By utilizing this robot, the difficulties associated with debris collection can be minimized, leading to more effective and timely clean-up operations.

The robot operates by lifting the surface debris from water bodies, contributing to a reduction in water pollution and decreasing the mortality rate of aquatic animals. It employs a conveyor belt mechanism, equipped with sensors and motors, to enhance its efficiency and effectiveness. The water garbage cleaning robot is designed to be cost-effective, making it suitable for use in rivers, ponds, lakes, and other water bodies.

By implementing this project, the aim is to clean the surface water debris from water bodies in a sustainable and affordable manner. The use of the water garbage cleaning robot will help mitigate the negative environmental impacts of water pollution, reduce the loss of aquatic life, and contribute to the preservation of water resources.

2. Problem Statement

Garbage accumulation in lakes has detrimental effects on the ecosystem. It leads to water contamination, threatens aquatic life, and degrades the overall water quality. Traditional methods of cleaning lakes, such as manual labor or using boats, are time-consuming, expensive, and often insufficient to address the scale of the problem. The garbage cleaning robot project aims to overcome these challenges by developing an autonomous robot that can efficiently collect and remove garbage from lakes. This solution will not only save time and resources but also contribute to the preservation and restoration of the lake's ecosystem.

https://www.reuters.com/business/environment/serbia-starts-clean-up-garbage-filled-lake-2021-01-29/

3. System design with parameters

The system design of the garbage cleaning robot project is crucial for its overall functionality and efficiency. It involves considering various physical aspects, space requirements, component arrangement, man-robot interaction, scope for improvement, weight of the robot, and other important factors. In designing the robot, the following parameters were given special attention:

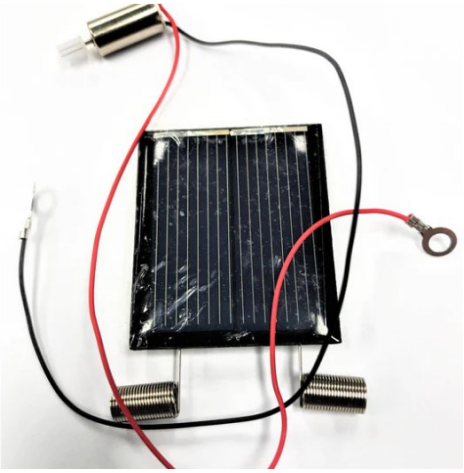
- **System selection based on constraints**
  Considering that the robot is intended for small-area purposes, space becomes a major constraint. Therefore, the system should be designed to be compact, allowing it to fit into small applications easily.
- **Component arrangement**
  Given the space restrictions, all components should be arranged in a way that allows for easy removal and servicing. This ensures that maintenance and repair tasks can be performed efficiently.
- **Man-robot interaction**
  The robot's design should prioritize friendly and intuitive interaction between the robot and the operator. This enhances usability and ensures that the operator can easily control and command the robot.
- **Reliability and failure prevention**
  To minimize losses in the event of any failure, the design should incorporate a high factor of safety. This means that the system should be designed to have fewer chances of failure. Additionally, regular maintenance should be considered to keep the robot in a healthy working condition.
- **Servicing facility**
  The layout of components should facilitate easy servicing. Components that require frequent maintenance or repairs should be easily disassembled to streamline the servicing process.
- **Scope of future improvement**
  The system design should include provisions for future improvements and enhancements to the robot's efficiency. This ensures that the robot can be easily modified or upgraded to incorporate new technologies or features.
- **Weight of the robot**
  The total weight of the robot depends on the materials used for its components and their dimensions. It is important to consider weight reduction to facilitate transportation and ease of movement. A lighter robot is more manageable during transportation and can be easily transported to the workshop when necessary.

By considering these parameters in the system design, the garbage cleaning robot project can ensure optimal performance, reliability, ease of maintenance, and the potential for future enhancements.

4. Hardware Requirements

The successful implementation of the garbage cleaning robot project requires the following hardware components

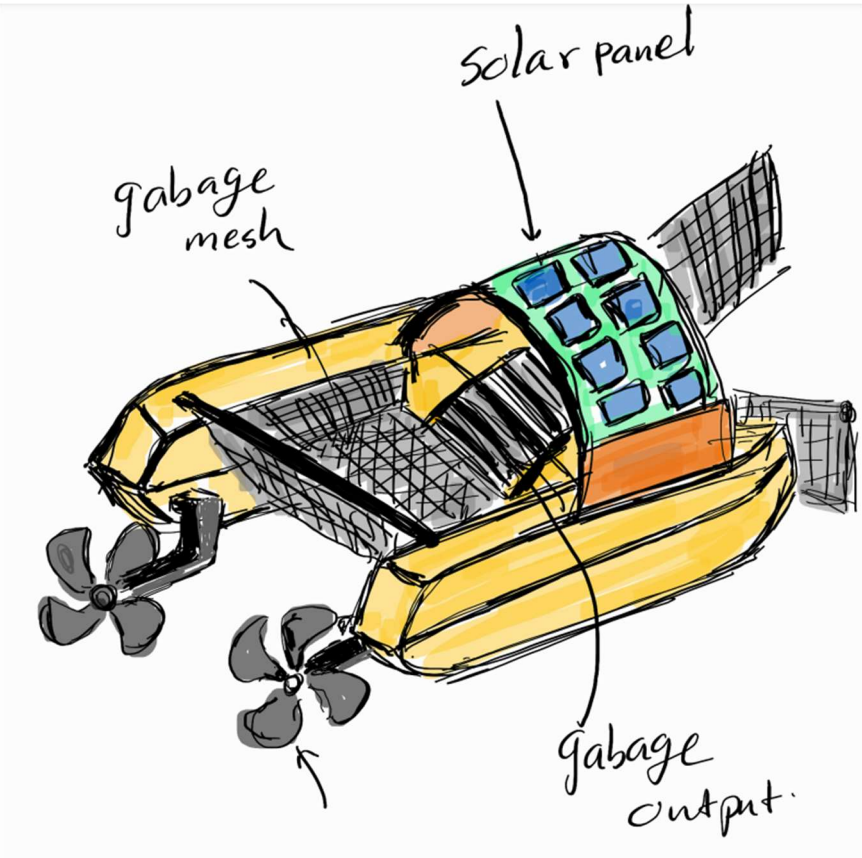
- **Robotic Platform**
  A robust and waterproof base will be essential to support the robot's weight and ensure stability and buoyancy on the water surface.
- **Sensors and Perception Systems**
  The robot will incorporate a GPS module for accurate positioning, obstacle detection sensors to identify and avoid obstacles, cameras for computer vision tasks, and environmental sensors to monitor water quality parameters.
- **Collection Mechanism**
  The robot will be equipped with a suction system comprising a pump and a collection chamber. It will also have mechanical arms capable of grabbing and lifting larger garbage items effectively.
- **Garbage Storage**
  A dedicated storage compartment with sufficient capacity and appropriate sealing mechanisms will be integrated into the robot's design to store the collected garbage securely and prevent any environmental contamination.
- **Power and Energy Management**
  Rechargeable batteries with a high energy density will be employed as the primary power source. Solar panels will be installed on the robot's surface to harness solar energy and recharge the batteries, ensuring sustainable power supply and reducing reliance on external charging sources.



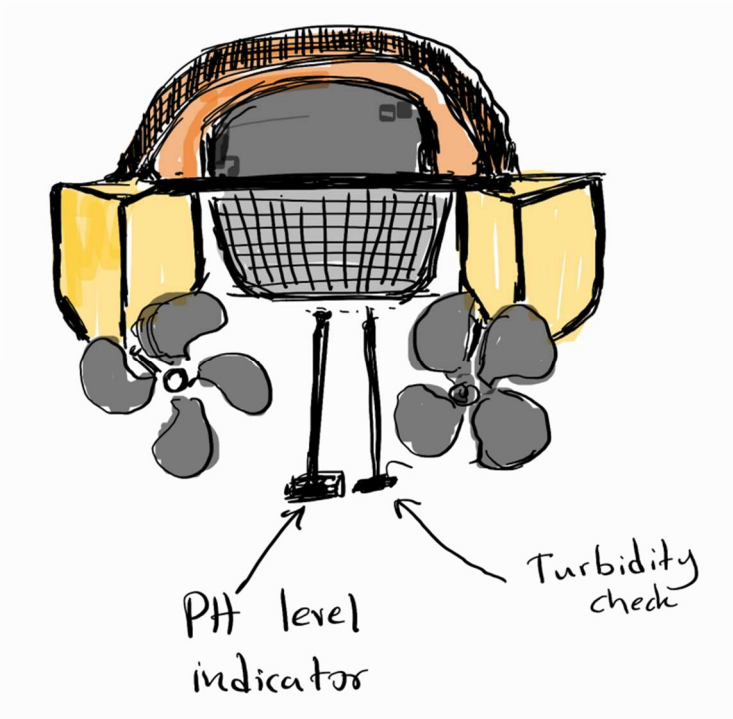
https://www.smartkidsonly.com/products/replacement-solar-panel-advanced-14-in-1-diy-solar-robot-kit

5. Sketches of the enclosure

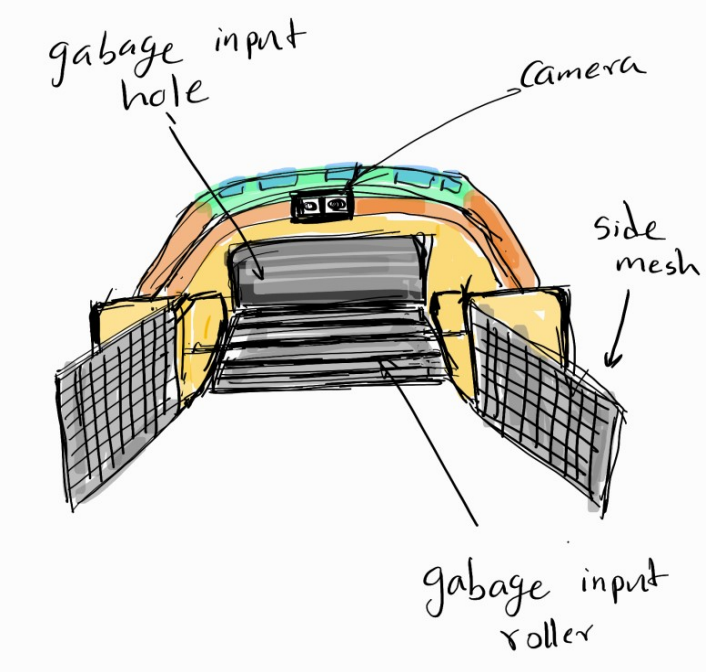
- **Side view 1**



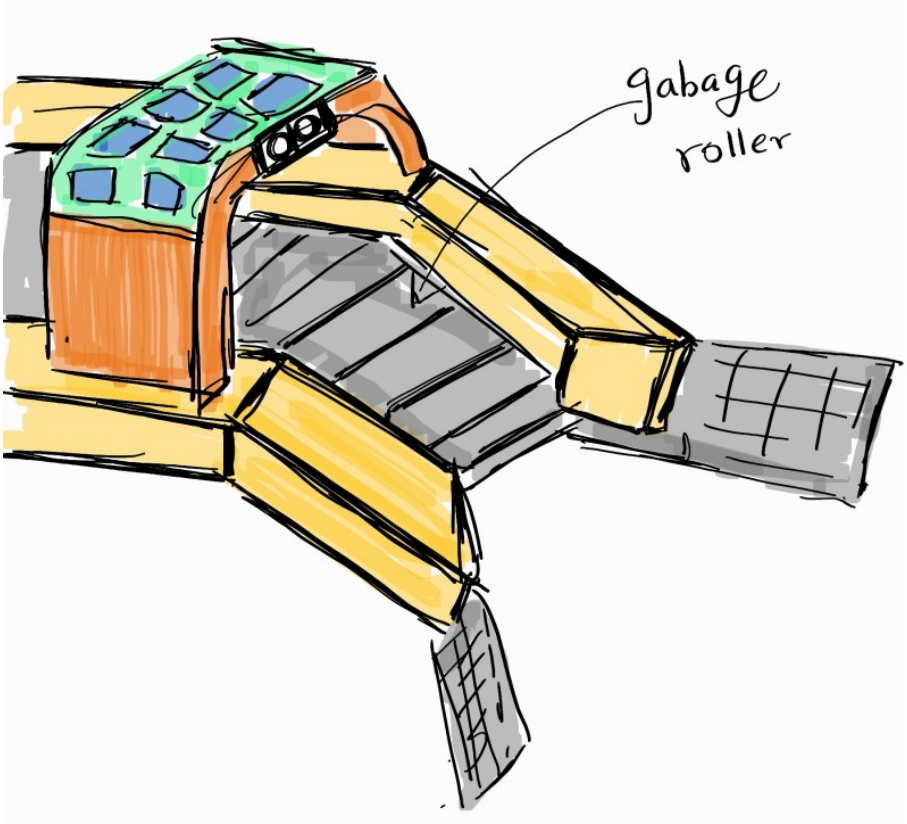
- **Back view**



- **Front view**



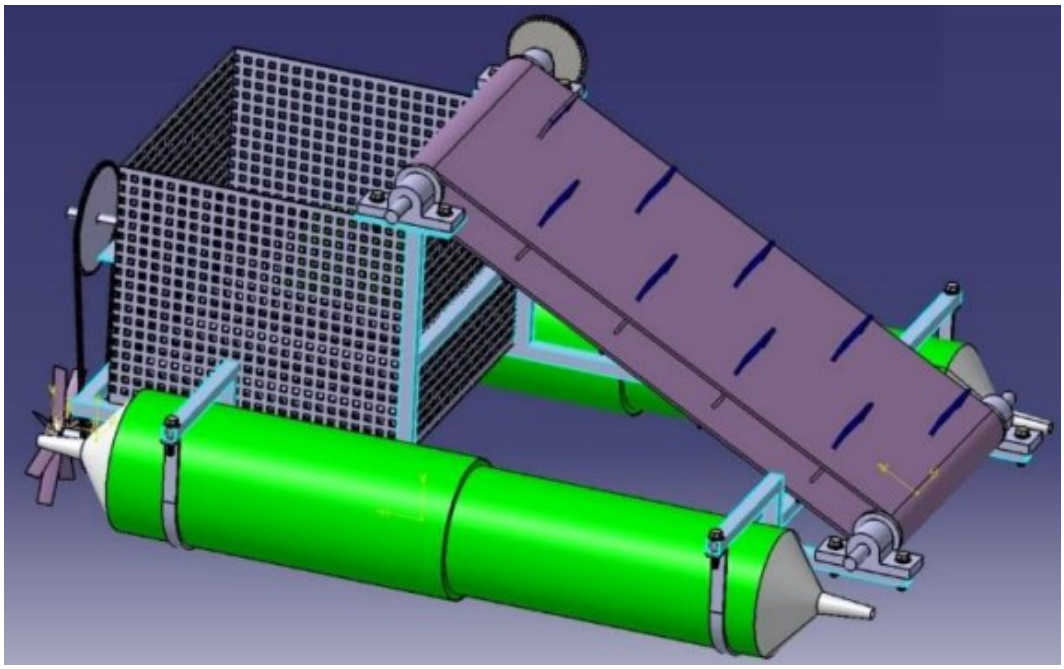
- **Side view 2**



6. Working

The garbage cleaning robot will operate through the following steps

- **Initialization**
  The robot will be deployed onto the lake's surface and initialize its systems, including GPS, obstacle detection sensors, and the garbage detection system.
- **Autonomous Navigation**
  Utilizing the GPS module and obstacle detection sensors, the robot will autonomously navigate across the lake. It will identify the most efficient cleaning path while ensuring safe maneuvering around obstacles and other vessels.
- **Garbage Detection and Collection**
  The robot's computer vision system will analyze the captured images from the onboard cameras, identify garbage items in the water, and classify them. Once detected, the robot will activate its suction system to collect smaller debris and use its mechanical arms to grab and lift larger or submerged garbage items.
- **Garbage Storage**
  The collected garbage will be temporarily stored in the dedicated storage compartment within the robot. The storage compartment will be designed with appropriate sealing mechanisms to prevent any leakage or environmental contamination.
- **Disposal**
  When the storage compartment reaches its capacity or the cleaning operation is complete, the robot will return to a designated location on the lake's shore or a docking station. At this point, the collected garbage can be properly disposed of through recycling or appropriate waste management procedures.
- **Power Management**
  The robot's rechargeable batteries will be periodically recharged using the integrated solar panels. The solar panels will harness solar energy, supplementing the battery power and extending the robot's operational time. This sustainable power management approach will reduce the reliance on non-renewable energy sources and minimize environmental impact.
- **PH sensor**
  The water garbage cleaning robot system is equipped with a pH sensor that plays a crucial role in monitoring and assessing the pH levels of water bodies. The pH sensor enables the robot to collect important pH data of the water during the cleaning process.



https://www.irjet.net/archives/V6/i5/

7. Advantages and Limitations

Advantages

- **Efficient and Autonomous Cleaning**
  The garbage cleaning robot will significantly reduce the need for manual labor, providing an efficient and autonomous solution for garbage collection in lakes. This will save time, resources, and costs associated with traditional lake cleaning methods.
- **Environmental Preservation**
  By removing garbage from lakes, the project will contribute to the preservation and cleanliness of aquatic ecosystems. It will help protect wildlife and maintain water quality, promoting a healthier environment.
- **Sustainable Approach**
  The project's use of rechargeable batteries and solar panels ensures a sustainable power source for the robot. This reduces reliance on non-renewable energy and minimizes the project's carbon footprint.
- **Scalability**
  The modular design of the system allows for scalability, enabling adaptation to clean larger lakes and bodies of water. Multiple robots can be deployed simultaneously to cover larger areas efficiently.

Limitations

- **Adverse Weather Conditions**
  Extreme weather conditions, such as heavy rain or storms, may affect the robot's performance and navigation capabilities. Adequate precautions and robust system design should be considered to ensure reliable operation under such conditions.
- **Limitations in Garbage Classification**
  While the garbage detection system is designed to identify and classify various types of garbage, there may be limitations in accurately detecting and categorizing certain debris items, especially those partially or fully submerged. Ongoing research and development will be necessary to improve the system's accuracy and effectiveness.

Conclusion

The garbage cleaning robot project offers a sustainable solution to the problem of lake pollution caused by garbage accumulation. By developing an autonomous robot equipped with advanced technology, the project aims to efficiently collect and remove garbage from lakes, contributing to the preservation of aquatic ecosystems and the well-being of wildlife. The project's system design, including parameters such as navigation, garbage detection, collection mechanism, and storage, ensures effective and sustainable garbage cleaning capabilities. While the project has certain limitations, such as adverse weather conditions and challenges in debris classification, it offers significant advantages in terms of efficiency, environmental preservation, scalability, and technological innovation. With further improvements and ongoing research, the garbage cleaning robot project can play a crucial role in promoting a cleaner and healthier environment for lakes and their surrounding communities.

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