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Surface Level and Underwater Waste Removal System

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Abstract

This paper introduces a novel approach for surface and underwater waste collection. The impact of water pollution can be devastating, affecting aquatic ecosystems, human health, and economies. Pollutants can harm aquatic plants and animals, disrupt ecosystems, and degrade water quality, making it unsafe for drinking, swimming, and other activities. Waterborne illnesses can also spread because of contaminated water, impacting groups of people who depend on tainted water supplies for hygiene and drinking. However, despite these efforts, water pollution remains a significant global challenge, requiring continued collaboration and innovation to safeguard water resources for future generations. Water pollution caused by plastic debris has become a pressing environmental issue globally There is no efficient method to resolve this issue. So, we introduce this concept of surface and underwater cleaning mechanism to reduce this effect. The strategy combines two distinct yet synergistic technologies: bubble barriers for underwater waste collection and conveyor belts for efficient surface-level waste management. The aim is to create a sustainable, scalable solution that tackles both surface and underwater waste in water bodies, contributing to cleaner and healthier aquatic ecosystems. The underwater waste collection component utilizes a bubble barrier system strategically positioned in water bodies. The system generates a curtain of bubbles using compressed air, creating a barrier that directs underwater waste towards the water surface. Simultaneously, the surface-level waste collection employs conveyor belts positioned on the water's surface. These belts capture floating trash, litter, and other pollutants as they travel continuously over the water thanks to motors. The collected waste is then transferred to designated disposal sites, mitigating the risk of recontamination and streamlining the waste removal process.

Keywords: Bubble barriers technology, conveyor belt

INTRODUCTION

Over the past few years, it is estimated that a bulk of pollutants have accumulated over the water bodies due to the deposition of garbage or debris produced by humans that are threats to marine life. According to a survey in in April 2023 it is estimated that around 1000 rivers account for 80% of all the riverine plastic waste that flows into marine environments which cause harm to aquatic animals and severe health problems [1, 2]. The current waste removal systems face substantial challenges addressing surface and underwater waste accumulation [3, 4]. Surface-level waste, including plastics and debris, poses threats to aquatic ecosystems [5], affecting marine life and water quality [6]. Current waste collecting mechanisms for surface causes harm to aquatic animals and phytoplankton hinder the efficiency of existing systems, leading to incomplete waste removal [7]. Underwater waste accumulation presents additional complexities, with issues such as buoyancy control, limited visibility, and potential environmental disturbances and no effective methods to collect underwater wastes [8]. So, we introduce the concept

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of an innovative and integrated approach to address the critical issue of aquatic pollution by developing a comprehensive waste removal system [9, 10]. The strategy combines two distinct yet synergistic technologies: bubble barriers for underwater waste collection and conveyor belts for efficient surface-level waste management. The aim is to create a sustainable, scalable solution that tackles both surface and underwater waste in water bodies, contributing to cleaner and healthier aquatic ecosystems. The collected waste is then transferred to designated disposal sites, mitigating the risk of recontamination and streamlining the waste removal process. The overall effectiveness of the integrated waste removal system can be validated by conduct implementations in selected water bodies like rivers, lakes, etc. This project envisions a scalable solution with the potential for widespread implementation in various aquatic environments globally.

BUBBLE BARRIER TECHNOLOGY AND ITS EFFECT ON AQUATIC LIFE

The bubble barrier is an economically viable and environmentally friendly solution made up of a catchment system and bubble curtain that work together to trap and collect plastic garbage before it enters the ocean without interfering with fish migration or ship traffic.

By forcing air through a perforated tube on the waterway's bottom, we produce a bubble curtain. Plastic is directed towards the surface by the upward current created by the bubble curtain. The natural flow of the water will force the plastic debris to the side and into the catchment system if the bubble barrier is positioned diagonally across the river.

The catchment system is intended to gather and hold plastics in unison with the bubble curtain.

It will be taken out for processing and reuse after collection. A bubble barrier raises the oxygen content of the water, promoting a healthy ecology and halting the growth of harmful blue algae.

EXISTING SYSTEM

Surface level waste removal systems typically employ nets, skimmers, and boats equipped with specialized equipment to collect floating debris. Nets are used to scoop up large debris, while skimmers utilize barriers and pumps to skim the surface, removing other contaminants. Professional divers and remotely operated vehicles (ROVs) are used in the elimination of waste from underwater environments. ROVs are equipped with cameras and mechanical arms to retrieve debris from the ocean floor, while divers manually remove waste, sometimes utilizing suction devices to assist in the process. These methods are crucial for maintaining the health of marine ecosystems and ensuring the safety of aquatic life.

PROPOSED SYSTEM

This concept relieves the amount of garbage or debris that are deposited over the water bodies by incorporating the conveyor belt system and the bubble barrier technology. The design of the prototype of the proposed system is shown in Figure 1. A vertical conveyor belt is positioned over the water body for the surface level waste collection. The belt is driven by motors continuously over the moving surface. The collected debris is carried over the conveyor belt, and is then transferred into designated disposal mesh to mitigate the risk of contamination of pollutants. Underwater floating debris is collected by using bubble barrier technology by using a pressure pump of 220 psi. The bubble barrier generates a constant flow of bubbles to capture and redirect floating debris towards the conveyor belt. The conveyor belt may also operate continuously or intermittently, depending on the volume of waste being removed and the capacity of the system. Operators of the system typically monitor its performance to ensure effective waste removal by functioning the conveyor belt the bubble barrier system. Overall, the combination of a bubble barrier and conveyor belt technology provides an efficient and environmentally friendly solution for removing surface and underwater waste from water bodies, helping to improve water quality and protect aquatic ecosystems. The overall block diagram of the proposed system is shown in Figure 2.

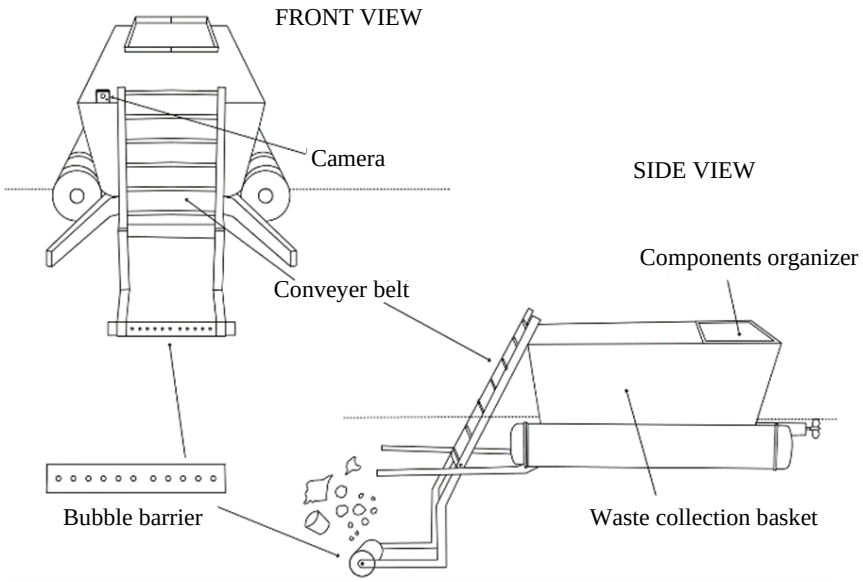

Figure 1. Design of the proposed system.

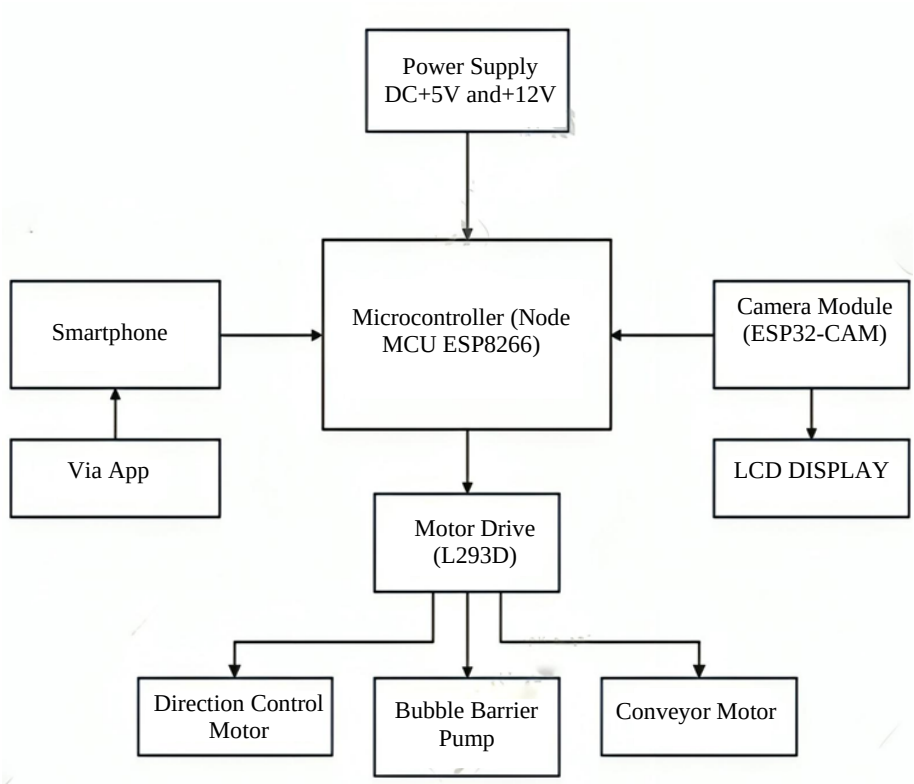

Figure 2. Block diagram of the proposed system.

Surface Level Waste Collection

Surface-level waste collection using movable conveyor belts involves the deployment of conveyor belt systems that can be maneuvered across water bodies to gather floating debris and pollutants. These conveyor belt systems are typically mounted on floating platforms or vessels equipped with propulsion mechanisms to navigate through the water as the conveyor belts move along the water surface, they continuously gather floating debris and pollutants. The conveyor belt system is designed to skim the surface of the water, collecting various types of waste, including plastics, vegetation, and other floating materials. The collected waste is transported along the conveyor belts towards a collection point on the

vessel or platform. Depending on the design of the system, the waste may be deposited into onboard storage compartments or containers for later disposal or recycling. Once the vessel reaches capacity or completes its designated collection route, it returns to shore or to a waste processing facility. The collected waste is then properly disposed of or recycled.

Underwater Waste Collection

Underwater waste collection in a movable system using bubble barrier technology involves the deployment of a curtain of bubbles generated by a perforated tube positioned on the riverbed or at the desired depth. The rising bubbles create a barrier that traps floating debris and guides it towards the water surface, where it can be collected and removed.

Here is how the system works:

1. *Deployment:* The bubble barrier system is deployed underwater at the desired depth using anchoring mechanisms or by securing it to a movable platform.
2. *Bubble Generation:* Compressed air is pumped through a perforated tube positioned along the riverbed or at the desired depth. As the air is released, it forms a continuous curtain of bubbles rising to the water surface.
3. *Barrier Formation:* The rising bubbles create a vertical barrier that spans across the water column. This barrier intercepts floating debris, such as plastics, and other pollutants, redirecting them towards the water surface.
4. *Surface Collection:* At the water surface, a collection mechanism, such as a conveyor belt is deployed to gather the trapped debris. This collection system is typically mounted on a movable platform or vessel, allowing it to navigate across the water surface and collect the accumulated waste.
5. *Transportation and Disposal:* To ensure proper treatment and elimination, the collected garbage is transferred to an authorized disposal site or recycling center. Depending on the system design, the waste may be stored onboard the vessel or transferred to shore for disposal.
6. *Monitoring and Maintenance:* Regular monitoring and maintenance of the bubble barrier system are essential to ensure its proper functioning. This includes inspecting the bubble generating apparatus for obstructions or malfunctions and quickly resolving any problems that are found.

DESIGN INNOVATIONS

The surface-level waste removal system employs conveyor belts strategically positioned in water bodies to automatically collect floating debris, including plastics and organic matter. Meanwhile, underwater waste removal utilizes bubble barrier technology, creating a curtain of bubbles to trap and redirect submerged waste towards the surface. These integrated technologies work in tandem to comprehensively address both surface and underwater pollution, ensuring efficient cleanup efforts and promoting environmental sustainability in aquatic ecosystems.

RESULTS AND DISCUSSION

Surface-level waste removal system using conveyor belts:

- Efficiently collects floating debris and pollutants from the water surface.
- Utilizes conveyor belts mounted on movable platforms or vessels to skim the water surface and gather waste.
- Can be deployed in areas with high waste accumulation, such as urban waterways, harbors, or near pollution hotspots.
- Collected waste is transported along the conveyor belts to onboard storage compartments or containers.
- Provides a systematic and effective method for cleaning water bodies, improving water quality, and protecting aquatic ecosystems.

Underwater waste removal system using bubble barrier technology:

- Forms a vertical barrier of bubbles underwater to trap floating debris and pollutants.
- Trapped waste is redirected towards the water surface where it can be collected and removed.
- Provides a non-intrusive method for removing underwater waste without disrupting aquatic life or habitats.

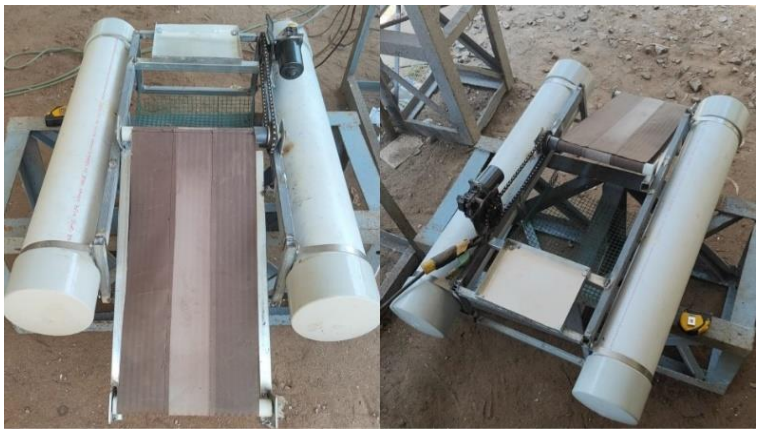

Figure 3. Experimental setup of the proposed system.

The assembled system for experimental setup is shown in Figure 3.

CONCLUSION

Water bodies must be preserved in order to support ecological systems, preserve biodiversity, and guarantee that present and future generations will have access to clean water. Strategies such as implementing strict regulations on pollution, promoting sustainable waste management practices conserving water resources through efficient use and reuse, protecting habitats, and raising public awareness about the importance of water conservation are essential. Additionally, investing in innovative technologies like surface level and underwater waste removal systems can play a significant role in preserving water bodies by effectively removing pollutants and mitigating the impact of human activities on aquatic environments. The surface-level and underwater waste removal system, incorporating conveyor belt and bubble barrier technology, has shown promising results in efficiently removing waste from water bodies Through our project, we demonstrated the effectiveness of combining these technologies to tackle pollution in both surface and underwater environments simultaneously. The conveyor belt efficiently collects floating waste, while the bubble barrier technology directs submerged debris towards the surface for easy removal. Aquatic ecosystems are preserved and a comprehensive remedy to marine pollution is provided by this integrated strategy.

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