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Remote controlled Aquawaste collector with Iot Based water pollution monitoring and tracking system

Rahul Patil [1], Ranjeet Ghatage [2], Sagar C Goni [3], Vineet Sharat Torke [4], Soumya Halagatti [5]

[1 2 3 4] Dept. of Electronics and Communication Engineering, S. G. Balekundri Institute of Technology, Belagavi, Karnataka, India.

[5] Assistant Proferssor, Dept. of Electronics and Communication Engineering, S. G. Balekundri Institute of Technology, Belagavi, Karnataka, India.

ABSTRACT

The amount of pollution in water bodies is increasing day. The pollution includes one that is created from the industrial sewage and other one that is dumped directly. The water pollution detection plays a major role in providing clean water for domestic and commercial applications. This project deals with the development of Remote Controlled Aqua waste collector The proposed vehicle involves development of remote controlled water vehicle with sensors embedded on the boat to monitor turbidity, ph Levels, and water temperature. The Sensors present on the boat monitor the levels of the pollution in the water by measurement of the acidic content, basic content, turbidity and water temperature. The data collected is sent to the control station using IOT based panel where in an alert will be triggered if the pollution in particular water zone is detected. The GPS present on the boat gives the controlling authority the accurate location of the polluted water zone along with the sensor data log of different pollution aspects using Internet of things protocol. The system also implements floating Waste collector using the mechanism which will collect all the floating waste in the water bodies.

Keywords—IoT, Aqua waste, turbidity, water pollution.

Introduction

Aquatic waste, also known as aqua waste, refers to any waste material or debris that is found in water bodies such as oceans, rivers, lakes, and ponds. Aquatic waste can come from a variety of sources, including industrial activities, agricultural runoff, municipal waste, and human activities such as fishing and recreational activities. Aquatic waste can have a range of negative impacts on the environment and wildlife. It can harm aquatic animals and their habitats, contribute to the spread of invasive species, and degrade water quality. In addition, aquatic waste can negatively affect human health by contaminating drinking water sources and increasing the risk of waterborne diseases [1].

The Remote Controlled Aqua Waste Collector with IoT based Water Pollution Monitoring and Tracking System is a technological solution aimed at addressing the issue of water pollution in a more effective and efficient manner. The system consists of a remote-controlled aquatic drone, which is capable of collecting waste and debris from water bodies, and an IoT-based monitoring and tracking system that can detect and report the presence of pollutants in real-time.

Efforts to address aquatic waste have included initiatives to reduce waste production, improve waste management practices, and increase awareness about the importance of protecting water resources. Technological solutions such as aquatic waste collection systems and water pollution monitoring systems can also play a crucial role in addressing the problem of aquatic waste and promoting cleaner and healthier water bodies.The aquatic drone is equipped with a range of sensors and cameras that enable it to navigate through water bodies, identify waste and debris, and collect them using a collection mechanism. The drone can be remotely controlled from a base station, which allows for greater flexibility and efficiency in collecting waste.

Fig 1. Aqua waste in water bodies

The IoT-based monitoring and tracking system is designed to detect and report the presence of pollutants in water bodies. The system consists of sensors that are placed in different locations in the water body, which measure parameters such as water quality, temperature, pH levels, and dissolved oxygen levels[2] . The data from these sensors is collected and transmitted to a central server, where it is analyzed using machine learning algorithms to identify the presence of pollutants.

Traditional methods of collecting aquatic waste are often labor-intensive, time-consuming, and inefficient, and may not address the problem of pollution comprehensively. In addition, monitoring and detecting pollutants in water bodies can be challenging, especially in large bodies of water.The advent of technology such as IoT and robotics has opened up new opportunities for addressing the problem of aquatic waste and water pollution. The use of remote-controlled aquatic drones equipped with sensors and cameras allows for more efficient and targeted collection of waste and debris. IoT-based water pollution monitoring systems enable real-time detection and reporting of pollutants, allowing for more timely and effective action to be taken.

The technology also has a tracking element that enables authorities to keep tabs on the underwater drone's motion and real-time development. This increases overall effectiveness by ensuring that the drone collects garbage and debris from the entire water body rather than just a particular area.
Overall, the Remote Controlled Aqua Waste Collector offers a complete answer to the problem of water pollution when used in conjunction with an IoT-based Water Pollution Monitoring and Tracking System. The technology guarantees cleaner and healthier water bodies by having the capacity to efficiently collect garbage and debris and track the progress of the collection operation.

LITERATURE REVIEW

The current study builds upon a significant body of research that has investigated the effects of topic of the study on relevant outcome variables. In this literature review, we will summarize and analyze the key findings from previous studies in this area, highlighting the most important and relevant findings to inform the present study.

In study [3], As we approach a time when technological advancement is accelerating exponentially, we may see a possible future in which a cybernetic world coexists peacefully with the natural world. This offers a wide range of prospects that grow in many different directions, with a focus on fusing nature with digitization. This paper's goal is to present a thorough assessment of the literature that establishes the theoretical framework for how various Smart Earth Technologies might be utilised to track and address the deterioration of air and water resources. A centralised research repository would be a useful tool for both seasoned scholars and those who are just entering the area. The study includes a wide range of research literature, enhancing the current monitoring systems with real-time models, case studies, and empirical studies. The main goal of this research is to further theoretical, practical, and empirical research on how intelligent technologies might contribute to the creation of an environment free from pollution. It also intends to offer a thorough analysis of Smart Environmental Pollution Monitoring Systems, which presents a plethora of prospects for upgrading environmental management expertise using contemporary global technology. Technology enthusiasts can contribute to the creation of numerous "smart" solutions by researching historical patterns and working with environmental pollution researchers. This will pave the way for a future that is Smarter, Greener, and Brighter for research and development in Sustainable Technologies that support a pollution-free environment.

In study [4], Whenever a person hears about pollution, more often than not, the first thought that comes to their mind is air pollution. One of the most under-mentioned and under-discussed pollution globally is that caused by the non-biodegradable waste in our water bodies. In the case of India, there is a lot of plastic waste on the surface of rivers and lakes. The Ganga river is one of the 10 rivers which account for 90 percent of the plastic that ends up in the sea and there are major cases of local nalaas and lakes being contaminated due to this waste. This limits the source of clean water which leads to major depletion in water sources. From 2001 to 2012, in the city of Hyderabad, 3245 hectares of lakes dissipated. The water recedes by nine feet a year on average in southern New Delhi. Thus, cleaning of these local water bodies and rivers is of utmost importance. Our aim is to develop a water surface cleaning bot that is deployed across the shore. The bot will detect garbage patches on its way and collect the garbage thus making the water bodies clean. This solution employs a surveillance mechanism in order to alert the authorities in case anyone is found polluting the water bodies. A more sustainable system by using solar energy to power the system has been developed. Computer vision algorithms are used for detecting trash on the surface of the water. This trash is collected by the bot and is disposed of at a designated location. In addition to cleaning the water bodies, preventive measures have been also implemented with the help of a virtual fencing algorithm that alerts the authorities if anyone tries to pollute the water premises. A web application and a mobile app is deployed to keep a check on the movement of the bot and shore surveillance respectively. This complete solution involves both preventive and curative measures that are required for water care.

In study [5], Agriculture-based industries generate significant amounts and varieties of agro-industrial wastes (AIW). AIW, if not treated properly, may cause environmental pollution and pose a harmful effect on human and animal health. Although AIW consist of organic compounds that can pose a risk to the environment, however, if used in the right way can potentially produce bioenergy, biofertilizer, and biofuels. Energy generation using agro-wastes not only fulfill the energy demand locally but also contribute to a significant reduction in greenhouse gas emissions. Bioenergy a possible substitute for fossil-fuels can be generated from AIW residues like rice straw, sweet potato, sugarcane bagasse, sawdust, etc. Nutrient-rich and bioactive compounds obtained from AIW can be recycled as raw materials in the agro-based industries, which can reduce the total production costs. Moreover, agricultural wastes, such as animal manures, agricultural effluents, biosolids, etc., can be used as organic fertilizers. This will help to mitigate the scarcity of organic fertilizers and increase the crop yield and productivity. However, the sorption of heavy metals in fertilizers needs to be considered. AIW can be converted to biodegradable plastic or can be used as a feed-in aquaculture industry. Overall, AIW seems to be a potent source of alternative energy and organic fertilizers.

In study [6], The adoption of "Zero Waste" and Industry 4.0 has increased the usage of artificial intelligence in trash management, generating enormous amounts of image data and advancing analysis methods in the process. Convolutional neural networks (CNNs) have become essential tools for spotting hidden patterns in visual characteristics among the more sophisticated analysis techniques. CNNs are still relatively new to environmental researchers, despite being increasingly used for intelligent waste identification and recycling (IWIR) activities in recent years. Furthermore, it is difficult to distil the results of current IWIR investigations due to the absence of standards and benchmarks for datasets and models. In order to better understand the CNN methodologies utilised in IWIR, this review will cover fundamental CNN information, open-source datasets, and cutting-edge CNN models. The report also summarises the applications of CNNs in three important areas of IWIR: recyclable material identification, trash pollution detection, and solid waste classification. These three main areas of IWIR are classification, object detection, and segmentation. In order to provide insight into the future prospects of CNNs in this field, the paper concludes by discussing the difficulties and limitations of the present CNN applications in IWIR.

In study [7], Waste or trash management is receiving increased attention for intelligent and sustainable development, particularly in developed and developing countries. The waste or trash management system comprises several related processes that carry out various complex functions. Recently, interest in deep learning (DL) has increased in providing alternative computational techniques for determining the solution to various waste or trash management problems. Researchers have concentrated on this domain, and as a result, significant research has been published, particularly in recent years. According to the literature, a few comprehensive surveys have been done on waste detection and classification. However, no study has investigated the application of DL to solve waste or trash management problems in various domains and highlight the available datasets for waste detection and classification in different domains. To this end, this survey contributes by reviewing various image classification and object detection models, and their applications in waste detection and classification problems, providing an analysis of waste detection and classification techniques with precise and organized representation and compiling over twenty benchmarked trash datasets. Also, we backed up the study with the challenges of existing methods and the future potential in this field. This will give researchers in this area a solid background and knowledge of the state-of-the-art deep learning models and insight into the research areas that can still be explored.

METHODOLOGY

Our goal is to develop a remote controlled Aqua bin waste collector. The Remote Controlled Aquawaste Collector with IoT based Water Pollution Monitoring and Tracking System is motivated by the need to address the problem of water pollution in a more effective and efficient manner. Water pollution is a global issue that affects not only the environment and wildlife but also human health and the economy.

The Remote Controlled Aqua Waste Collector with IoT based Water Pollution Monitoring and Tracking System is therefore motivated by the need to leverage technology to address the problem of water pollution in a more comprehensive and effective manner. By providing a more efficient and targeted approach to waste collection and pollution monitoring, the system can help to promote cleaner and healthier water bodies and mitigate the negative impacts of water pollution on the environment, wildlife, and human health.

The main objective of this project is to develop an aquatic floating bin which can collect all the single use plastic waste floating in the seas, oceans and other water bodies and to implement water pollution monitoring system which will use the turbidity sensor to detect the water pollution. It helps to implement GPS and GSM based notification system which will inform the same to the concerned authorities over SMS and to make the system user friendly to operate.

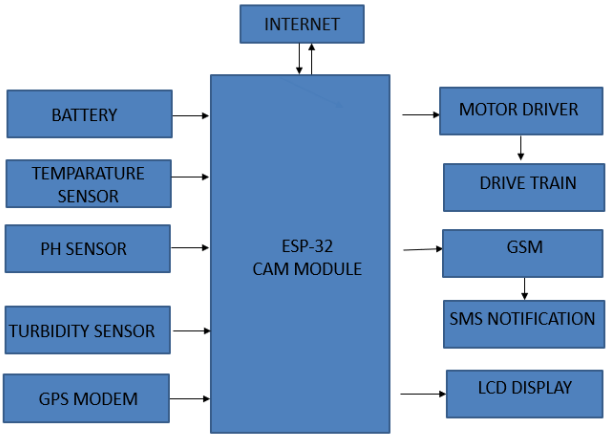

Fig 2. Block Diagram of Aquabin

Ultrasonic sensors can be used in floating water waste collection systems to detect the presence and location of floating debris in waterways. Ultrasonic sensors work by emitting high-frequency sound waves and measuring the time it takes for the waves to reflect off of an object. By analyzing the time delay between the emission and reception of the sound waves, the sensor can determine the distance to the object and its location.

In a floating water waste collection system, ultrasonic sensors can be mounted on a floating platform or vessel and used to scan the surrounding water for the presence of floating debris. The sensors can be programmed to trigger an automatic response, such as activating a motor or other mechanism to move the platform or vessel towards the debris, or to alert a human operator to the location of the debris.

Using ultrasonic sensors in floating water waste collection systems can help to improve the efficiency and effectiveness of the collection process by allowing the system to detect and track debris in real-time, and to respond quickly to changing conditions in the water. However, it is important to note that ultrasonic sensors may not be able to detect all types of floating debris, and they may be affected by factors such as water temperature and turbidity. As such, it may be necessary to use multiple sensors or other types of sensors in order to ensure comprehensive coverage and accurate detection.

pH sensors are devices that measure the acidity or basicity (alkalinity) of a solution. These sensors can be used in floating water waste collection systems to monitor the pH of the water in which the system is operating. In a floating water waste collection system, pH sensors can be used to ensure that the system is operating within an optimal pH range for the specific type of water being treated. For example, pH sensors could be used to ensure that the system is not releasing any chemicals or other substances into the water that could alter the pH balance and harm aquatic life.

pH sensors can also be used to monitor the pH of water being treated by the system, in order to ensure that the system is effectively removing contaminants or other substances that could affect the pH balance. For example, if the system is designed to remove oil or other hydrocarbons from the water, pH sensors could be used to ensure that the oil is being effectively neutralized or removed, and that the water is not being acidified or otherwise affected. Overall, pH sensors can play a useful role in ensuring that floating water waste collection systems are operating effectively and in a way that minimizes any negative impacts on the environment.

Turbidity sensors are devices that measure the number of suspended particles in a liquid, such as water. These sensors can be used in floating water waste collection systems to monitor the clarity or purity of the water being treated.
In a floating water waste collection system, turbidity sensors can be used to ensure that the system is operating within an optimal range for the specific type of water being treated. For example, turbidity sensors could be used to ensure that the water being treated by the system is not excessively cloudy or contaminated, which could indicate the presence of harmful substances or pollutants.
Turbidity sensors can also be used to monitor the effectiveness of the floating water waste collection system in removing contaminants or other substances from the water. For example, if the system is designed to remove oil or other hydrocarbons from the water, turbidity sensors could be used to measure the amount of oil or hydrocarbons remaining in the water after treatment, in order to ensure that the system is effectively removing these substances.
Overall, turbidity sensors can play a useful role in ensuring that floating water waste collection systems are operating effectively and in a way that minimizes any negative impacts on the environment.

Working of Aquabin

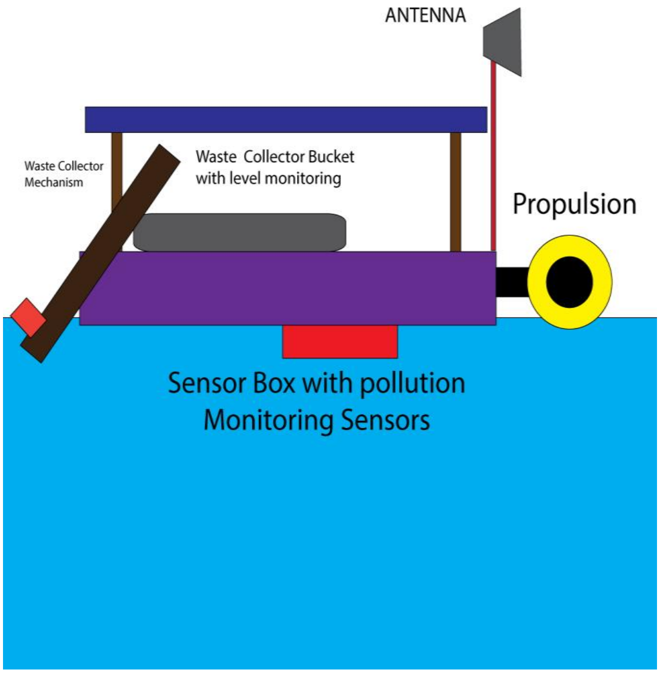

Fig 3. Working of Aquabin

The Remote Controlled Aqua waste Collector with IoT based Water Pollution Monitoring and Tracking System involves with:
Design and Development of the Aquatic Drone: The aquatic drone is designed and developed with the necessary sensors and cameras for efficient navigation and waste collection. The drone is equipped with a collection mechanism, which can be remotely controlled to collect waste and debris.
Installation of IoT-based Water Pollution Monitoring System: The IoT-based water pollution monitoring system is installed, which includes sensors that measure parameters such as water quality, temperature, pH levels, and dissolved oxygen levels. The data from these sensors is collected and transmitted to a central server for analysis.

Data Analysis and Reporting: The data collected from the sensors is analyzed using machine learning algorithms to identify the presence of pollutants in real-time. The results are reported to the relevant authorities, enabling timely action to be taken.
Remote Control and Tracking: The aquatic drone is remotely controlled from a base station, allowing for greater flexibility and efficiency in collecting waste. The tracking component of the system enables the authorities to monitor the movement of the drone and track its progress in real-time.
Waste Disposal: The collected waste and debris are disposed of appropriately, using methods such as recycling or landfill.
Overall, the methodology involves the integration of technological solutions such as aquatic drones and IoT-based monitoring systems to provide a more efficient and effective approach to addressing the problem of aquatic waste and water pollution. By leveraging technology, the system can help to promote cleaner and healthier water bodies, mitigating the negative impacts of water pollution on the environment, wildlife, and human health.

RESULT AND DISCUSSION

Floating water waste, such as plastic bottles and bags, is a significant environmental issue in waterways around the world. This type of waste can harm aquatic ecosystems and impact human health, as it can entangle and suffocate marine life and leach toxic chemicals into the water. In addition, floating water waste can be unsightly and negatively affect the aesthetic value of waterways.
Current approaches to collecting and removing floating water waste from waterways are often inefficient and costly. Traditional methods, such as manual clean-up efforts and boom barriers, can be labor-intensive and require frequent maintenance. These approaches also tend to be reactive rather than proactive, meaning that they are often unable to prevent floating waste from entering waterways in the first place. Floating water waste collection projects aim to address these issues by developing and evaluating technologies that can capture and remove floating water waste from waterways in an efficient and cost-effective manner, while minimizing any negative impacts on the environment. These projects can potentially improve water quality, enhance environmental protection, and enhance the aesthetic value of waterways, while providing cost savings and increased efficiency compared to traditional approaches.

Fig 4. Aquabin

The Remote Controlled Aqua waste Collector with IoT based Water Pollution Monitoring and Tracking System can provide several benefits and results, including:

Efficient and Targeted Waste Collection: The system enables efficient and targeted waste collection, reducing the time and labor required for manual collection. The remote-controlled aquatic drone can navigate to specific areas and collect waste and debris, including those that are hard to reach.
Real-time Detection and Reporting of Pollutants: The IoT-based water pollution monitoring system enables real-time detection and reporting of pollutants, allowing for more timely and effective action to be taken. This can help to prevent the spread of pollutants and minimize the negative impact on the environment and wildlife.

Enhanced Tracking and Monitoring: The tracking component of the system enables the authorities to monitor the movement of the drone and track its progress in real-time. This can help to ensure that the drone is operating efficiently and effectively and can provide data for future analysis and optimization.

Promotion of Clean and Healthy Water Bodies: By providing a more efficient and effective approach to addressing the problem of aquatic waste and water pollution, the system can help to promote cleaner and healthier water bodies. This can have positive impacts on the environment, wildlife, and human health, as well as the economy.

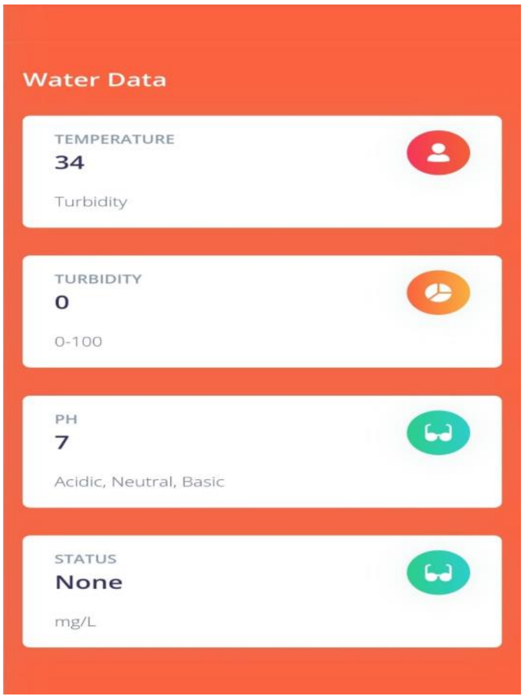

Fig 5. Figure showing Temperature, Turbidity and pH

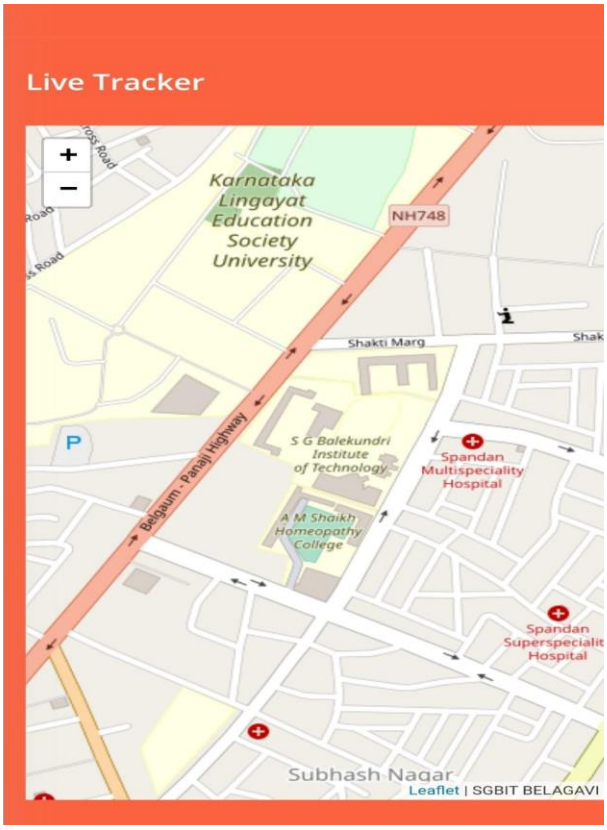

Fig 6. Aquabin locating and collecting waste

Overall, the Remote Controlled Aqua waste Collector with IoT based Water Pollution Monitoring and Tracking System can provide significant benefits and results in addressing the problem of water pollution. By leveraging technology and providing a more efficient and targeted approach to waste collection and pollution monitoring, the system can help to mitigate the negative impacts of water pollution and promote cleaner and healthier water bodies.

CONCLUSION

To achieve this goal, the proposed system utilizes a combination of sensors to detect the presence of humans in the area. These sensors may include PIR sensors to detect human heat, microwave sensors to detect human motion, ultrasonic sensors to detect the presence and distance of objects, and infrared cameras to detect the presence of humans based on body heat. The proposed system will also include a physical robot that can navigate through debris and hazardous environments to assist with rescue and recovery efforts. This robot will be equipped with various tools and capabilities to perform tasks such as lifting and moving objects, communicating with rescue workers, and potentially providing medical assistance.
Additionally, the proposed system will utilize live coverage technologies such as drones and wearable cameras to transmit real-time footage of the disaster area back to an android app, allowing users to stay informed and potentially aid in rescue efforts. Satellite imagery and mapping technologies will also be utilized to provide a comprehensive overview of the disaster area.

FUTURE SCOPE

There are many potential future scopes for floating water waste collection projects, depending on the specific goals and objectives of the project. Some potential areas of focus could include:
Development and testing of new or improved floating water waste collection technologies: There is ongoing research and development in this area, with the aim of finding more effective and efficient ways to capture and remove floating water waste from waterways.

Expansion of the scale and scope of floating water waste collection projects: Once a technology or approach has been developed and demonstrated to be effective, there may be opportunities to expand the project to cover larger areas or to address different types of floating water waste.

Integration of floating water waste collection with other environmental initiatives: Floating water waste collection projects could be integrated with other efforts to protect and restore aquatic ecosystems, such as habitat restoration or water quality improvement projects.

Exploration of potential economic and social impacts: Research could be conducted to examine the potential economic benefits of floating water waste collection projects, such as cost savings or revenue generation, as well as any social impacts, such as community engagement or education.

Investigation of potential unintended consequences: As with any environmental intervention, it is important to consider the potential unintended consequences of floating water waste collection projects. Future research could focus on identifying and mitigating any negative impacts of the technology or approach being used.

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