

River Bin for Surface Water Waste Using Low-Cost Materials

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Abstract

The rapid increase in floating solid waste, plastics, and oil traces in rivers, lakes, and urban water bodies has emerged as a serious environmental and public health concern. Conventional cleaning methods depend heavily on manual labor, large equipment, and continuous supervision, making them costly, inefficient, and impractical for small and medium-scale water bodies. This project presents the design and development of a low-cost, efficient “River Bin” model intended to collect floating debris and absorb oil content from the surface of water using locally available materials.

The River Bin operates on a simple filtration and suction principle. A motor-driven pump creates a flow that draws in floating waste and surface water into a catch bag system. The catch bag, made of steel mesh, is layered with sponge and jute materials. The mesh traps solid debris such as plastics and floating waste, the sponge layer aids in absorbing oil traces present on the water surface, and the jute covering acts as a fine filter to capture microplastic particles. The filtered water is then discharged back into the water body, ensuring continuous circulation without disturbing the natural flow.

The structural framework of the model is fabricated using steel square pipes, bolts, and a plastic collection bin that firmly supports the catch bag assembly. The prototype is designed using AutoCAD and implemented as a physical model to evaluate its performance under controlled experimental conditions. The system is lightweight, durable, easy to install, and can be operated and maintained by a single person. The use of biodegradable and recyclable materials such as jute further enhances the environmental sustainability of the design.

Experimental testing in a recirculated water sump demonstrated that the River Bin can collect approximately 1–1.5 kg of floating waste within 10–15 minutes of operation. The model proves effective in trapping suspended debris, plastics, and oil films from the water surface. The cost analysis of the prototype confirms that the system is economically feasible and suitable for deployment in small rivers, irrigation canals, ponds, lakes, and urban drainage channels where waste accumulation is common.

This project highlights a practical, affordable, and eco-friendly solution for surface water waste management. By reducing manual effort and promoting continuous passive cleaning, the River Bin contributes to cleaner water bodies, improved environmental health, and potential social benefits through local maintenance opportunities. The scope for future enhancement includes the integration of solar power and increased storage capacity, making the system more sustainable and scalable for real-world applications.

Introduction

Across the world, waste management is a major problem for cities. The amount of garbage Produced is rising along with the rise of city or growth in population, creating serious societal, ecological, and economic problems. In the face of this growing challenge, conventional waste administration methods, which depend on combustion and garbage dumps, are proving to be insufficient and unaffordable. Novel techniques are being investigated as a reaction to the rising need for efficient trash disposal solutions.

One among the global issues that keeps coming up every year and cannot be resolved is waste. It was common practice to dump trash from various areas into lakes, streams, and other bodies of water. Every river, channel, sea etc., in the planet is contaminated with plastic trash. Birds and aquatic organisms frequently consume it, which concentrates harmful substances in their organs and fills their digestive systems to the point of starvation. Waste plastic in the water is an emergency that goes well beyond aesthetics.

Whilst hooks and nets can become tangled in cylinder openings and wrap around propellers that spin vessels may crash

with large items, shattering their hulls and propellers. To solve this issue, various governments worldwide are working on various initiatives. Most of these projects use energy and engine systems, which require continuous effort from people.

The vast majority of these projects have been conducted in open ocean or deep seas, with little focus on coastal waterways. Trash may block water flow, making it foul-smelling and dirty, which raises the risk of excess and the ensuing emergencies such as floods. Large supplies, such tractors and cleaning staff, are required for eliminating of waste out of water zones. environments like a watershed's edge. Because it is shielded from powerful flow and Atlantic gales, it can lessen hazardous waste in areas that are obviously highly populated.

The Trash collector bin Concept is one such creative idea that is gaining popularity. It is a comprehensive strategy that rethinks trash management techniques in metropolitan environments. In order to develop a sustainable and effective waste management model, this idea incorporates a number of different factors, such as garbage pickup, reuse and recycling, producing electricity, and community participation. This essay will explore the concept of the Trash collector bin Concept, looking at its tenets, elements, advantages, and obstacles as well as the chance to completely transform methods for handling waste everywhere. The trash collector bin is a device that resembles a bin as well as is equipped with an electrically driven water pump. It is fixed to a watershed border. The fluid's movement of the pump attracts all floating debris and waste into the system, forming an organic container. The fluid is then replenished in the water source. Rarely, depending on the quality. The water movement of the impeller attracts all floating waste and trash into the circulatory system, generating an organic container. The water is then replenished in the form of a water stream. Depending on the caliber of the catch bag, Trash collector bin may occasionally be able to separate oil from water as well.

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Literature Review

Arjun Yadav et.al,2022

"SEABIN" is a floating bin with several clever features, as the name suggests. The major goal of this effort is to remove floating garbage from all of the country's waterbodies and make them litter-free. The Seabin is a trash can that floats on the water and can be found at marinas, docks, yacht clubs, and commercial ports. The following three key components are used to clean the ocean: a pumping unit, a catch bag made of jute material, and steel pipes. The Seabin follows the flow of the tide, gathering any floating trash. Water is drawn in from the surface and passes through the Seabin's catch bag. After that, the water is pumped back into the marine.

Nitin Agarwala* et.al,2020

The marine environment has deteriorated to the extent that it has begun to impact human health and the planet itself. The primary causes of this deterioration are an increasing population, the Industrial Revolution, and the increased use of fossil fuels. While the damage done to the environment cannot be undone, the impact can be lessened with a better understanding of the ocean and with monitoring future pollution using technology. Such an effort will help achieve sustainability, as laid out by the Sustainable Development Goals 2030 of the United Nations. Though efforts have been made to monitor the ocean for pollutants, both physically and remotely, interpreting the data collected is a humungous task due to the high volume of data. In reply, technology again provides a solution. One such technology, namely 'Artificial Intelligence' ('AI'), can be used to understand and monitor marine pollution, and is the topic of discussion in this article. In doing so, the article will discuss the emerging opportunities and risks associated with the use of AI in managing marine environmental pollution through sustainability. To strengthen the argument, use-cases of AI in the

marine environment and their scalability are discussed. However, these cases are considered merely a stimulus for a better and a larger variety of solutions to follow in the ever-evolving domain of AI.

Shrikant Somal et al.,2020

This paper describes the design of a robot for collecting waste floating on the water surface. Three important issues for designing the aquatic robots are a cost-effective solution along with robustness and durability. Due to the nature of the cleaning work, we designed the robot structure with car like mechanism that can provide high stability, good ability in maneuver and can easily collect all the waste flowing on the water. The plastic pipe container works best for this case and fulfils all structural stability criteria. For collection of waste, a motor-driven conveyor belt has been designed for collecting the wastes and deploy it into a plastic box connected to the platform. This design provides simple and effective waste removal and accommodates large amounts of waste within a little space. This light-weight and tough structure support the total weight of the collected waste, conveyor as well as the hardware components used. The rotating arms system based a differential drive mechanism has been designed, which allows the robots to require a 360 turn on the spot and provides high thrust. Electronic circuit and motors have been placed on the platform, in order to protect them from water. The robot is automatically controlled by Arduino, sensors, motor driver, GPS and GSM modules. The testing of the robot prototype proved to be effective in waste collecting and getting back to the way-point. The maximum trash loads that robot can bear is up 5 kg. The main aim of the project is to optimize time, energy and overall process speed.

Krishna Kulkarni *et al.,2021

One of the largest problems in our world today is the extreme pollution of our oceans and waterways. Each day, thousands of tons of trash and plastic debris are dumped into our oceans. Since plastic is a non-biodegradable substance, like most natural substances, it is left floating in our waters. Unfortunately, these floating debris sometimes consumed by many of the aquatic lifeforms in our oceans. As we know that plastic is a toxic substance it gets accumulated in the tissue of animals and ultimately leads to the death of animals. This problem of pollution in oceans can be solved with the help of seabins, Which helps in extraction and elimination of the waste material floating on the surface of water The Seabin is a water cleaning device which is installed near to the ports, docks, harbors and in every other waterbodies where we can see the floating debris such that it helps in avoiding the entering of this pollutants or debris into the ocean .As the principle of working of Seabin is very simple i, e it acts as an water filtration system . In simple words the floating debris is attracted towards the floating bin and waste material gets collected in the mesh and the water again enters into the ocean.

Materials and Methods

Materials: Collection bin

Collection bin is manually designed using a plastic bucket with the following dimension of height – 38cm, Top dia – 30cm, Bottom dia of 26cm. Collection bin acts as the protection for the catch bag, which is built quality of the materials that are durable and strong enough to hold the catch bag firmly, it is the fundamental component of the trash collector bin design. Collection is as shown in figure 3.1.



Fig 3.1: Collection bin



Fig 3.2: Jute Bag



Fig 3.3: Sponge

Steel Square Plate, Bolt and zinc plated MS plate round washer:

The steel square pipe is used to hold the main body part of trash collector bin firmly which as the dimension of 40X40 mm and 30X30 mm welded in fillet type. The main purpose of this is to hold the catch bag firmly. With the help of bolts and Zinc plated MS plate round washer of dia – 10mm, it connects the steel square pipe. Fig 3.5 and 3.6 shows the process making the holding device and apparatus used in the process.

Fig 3.4: Steel Square Pipe



Fig 3.5: Bolts and zinc plated MS plate



Motors:

The motor is important apparatus which helps in suction of waste particles that have collected in the water sources tanks. One horsepower is the motor capacity is used in the experimental process.

Fig 3.6: Motor

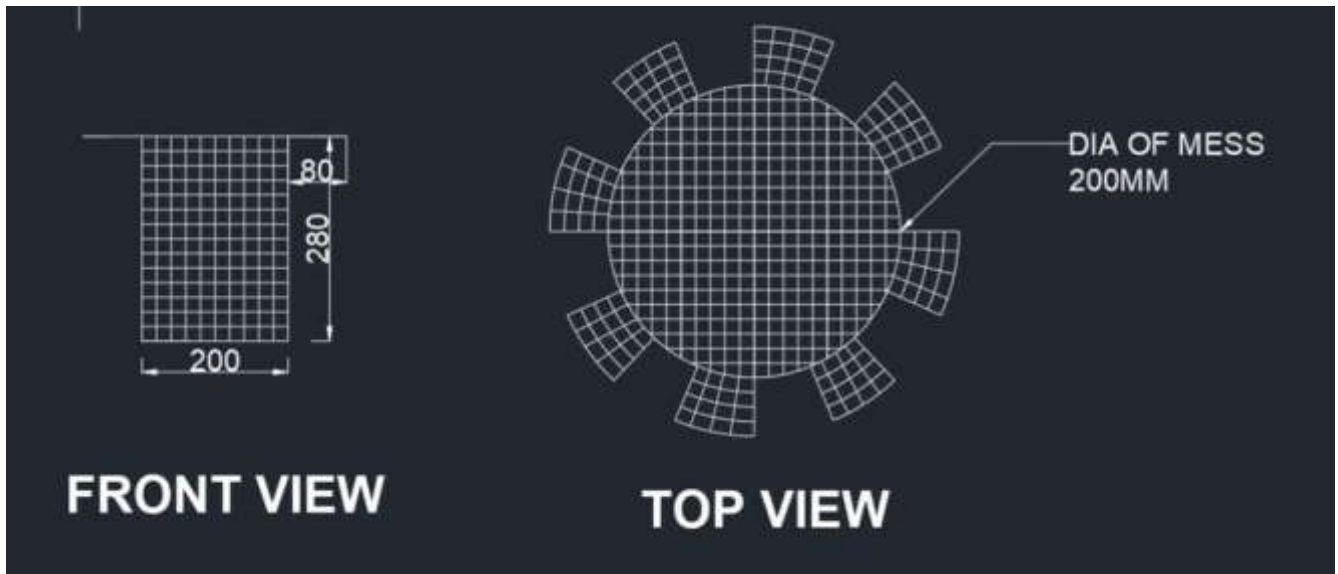


Fig3.7: AutoCADD Front and Top view of Catch Bag

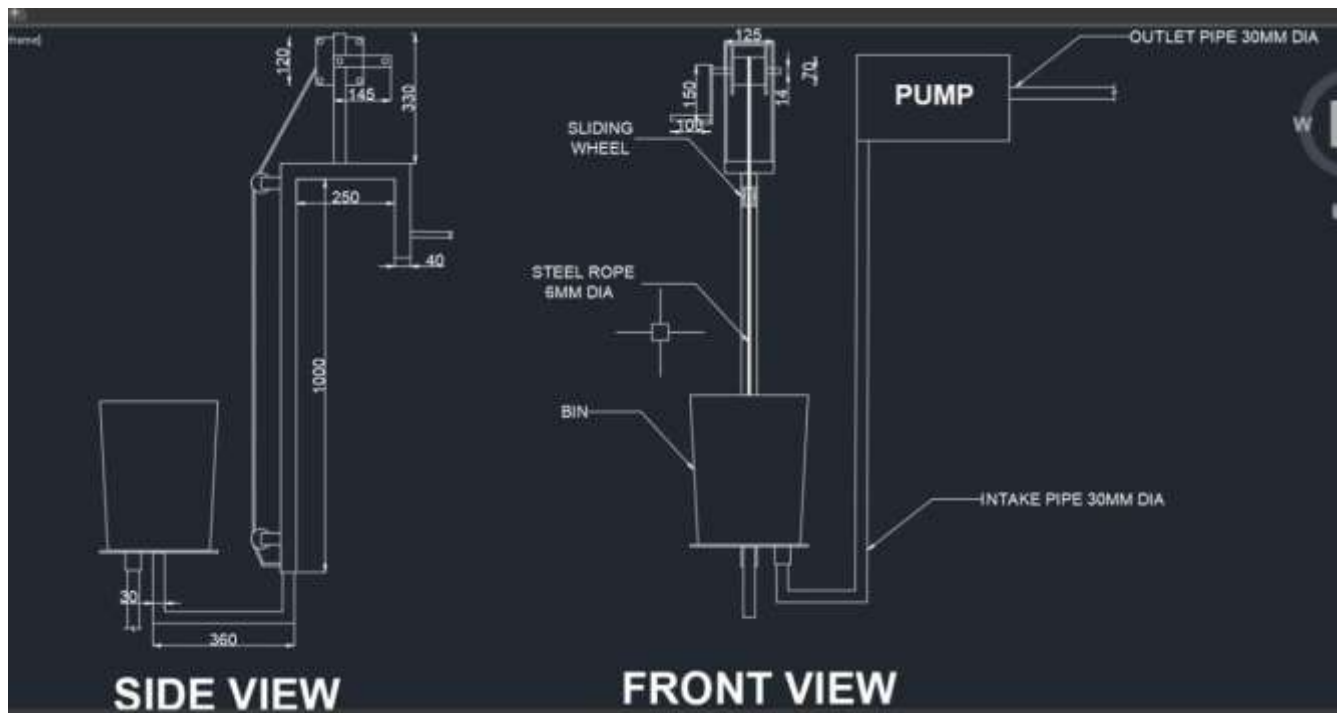


Fig3.8: AutoCADD Longitudinal section of experimental setup

METHODOLOGY

- Water will be filled in the sump which is recirculated to conduct the experiment.
- Simulated waste debris is created inside the sump.
- Catch bin with the help of the frame and slider connected with rope is inserted to the sump.
- Motor is turned on to collect the debris inside the catch bag.
- Filtered water will be reverted back to the sump through outlet of the catch bag.
- Collected debris in the catch bag is manually removed and disposed safely at the disposal site.

EVALUATION OF MATERIAL AND WEIGHT

Table 3.1: Materials and Specifications

<i>Sino.</i>	<i>Item</i>	<i>Material</i>	<i>Weight</i>
1	collector bin	Plastic	1kg
2	Catch bag	Steel	0.5kg
3	Framework	Steel Square pipe	12kg
4	Bolts And Zine Plated MS plate Round Washer	Steel	0.25kg
5	Motor	-	15kg
		Total	28.75kg

Result and Discussion

The idea of using trash collector bins to gather trash is executed well in a prototype model. The floating waste debris are collected in the catch bag of 1-1.5 kg with the duration of 10- 15 min the same can be implemented in a any type of surface water with a sophisticated setup.



Fig 4.1: Collecting the Waste Debris.



Fig 4.2: Collection of Waste

Relevance to social benefit:

The waste collecting trash collector bin are a great step forward in combat-ting pollution, the major cause of water scarcity. However, it could also be a method of improving the lives of individuals in developing countries like India. The most direct effect of decreased pollution is improved health as a result of increased availability of clean water, but the proliferation of trash collector bins could lead to economic oppurtunities as well. In order to deploy waste collecting trash collector bin across the planet, people are going to be needed to take care of them and take away the waste they collected.

COST ANALYSIS

A detailed cost analysis for a prototype trash collector bin is as shown in table 4.1.

Table 4.1: Cost Analysis of Prototype Trash collector bin

<i>Materials</i>	<i>Cost</i>
Steel Frame	3500 Rs
Labor	1500 Rs
Pump	3500 Rs
Catch bag	300 Rs
Bolts connection	100 Rs
Steel Rope	600 Rs
Transportation	500 Rs
<i>Total cost</i>	<i>10000 Rs</i>

CONCLUSION

The following conclusions are drawn from the research work

- A prototype trash collector bin is developed which actually traps the debris, which is constructed of jute and is one of the key components. This isn't an issue because jute is completely biodegradable, recyclable, and compostable.
- When a catch bag is about to break or at the end of its life cycle, just clean it well to get rid of any plastics or contaminants, then compost it to grow your own veggies.
- Introducing trash collector bin, reduces the effort needed on the part of people to remove debris from the water bodies and doesn't need any extra assistance or supervision to function.
- An Economical and simple to build technology has been designed and developed to Clears out floating and suspended debris, from water bodies.
- The trash collector bin project is a smaller-scale method, but it still has great goals. This eco -friendly Garbage container can be installed in smaller scale water bodies such Irrigation channels, Recreational ponds etc for sucking up waste and even removing oil from the water bodies.

SCOPE OF THE WORK

- Further the project may be Additionally Implemented by using solar energy.
- Further, the project may be expanded by adding a suppression motor to reduce the amount of dust in the storage collection bin and increase storage.
- Further, the project may also be expanded by adding a suppression motor to reduce the amount of dust particles in the storage collector bin and by enlarging the storage tank to hold additional water-collected particles.

REFERENCE

- [1] Arjun Yadav, Amit Sharma, Aditya Dalvi, "Seabin", JETIR April, Issues 4 Volume 9. B. H. Yuan, X. H. Gao, B. Zhang and H. Y. Lin, "The Design and Realization of Small.
- [2] Size Water-surface Garbage Cleaning Boat, "Journal of Long Dong University, Vol.28.no.1,2017, pp.24-2. D. Geer, Propeller Handbook: The Complete Reference for Choosing and Installing.
- [3] Understanding Boat Propellers, International Marine, Maine, USA, 1989, pp:152. Explorato Technoments, "Automated Garbage Collector", Instructables. [Online]. Available: <https://www.instructables.com/id/Automated-Garbage-collector/> [Accessed April 10,2019]. S. Khandare, S.Badak, Y.Sawant and S. Solkar, "Object Detection Based Garbage Collection Robot", International Research Journal of Engineering and Technology (IRJET), vol.5, no.3, March 2018.
- [4] E. Rahmawati, I. Sucahyo, A. Asnawi, M. A. Taqwim and D. Mahendra, "A Water Surface Cleaning Robot", Journal of Physics: Conference Series, Vol,1417, No.1, p.012006. Do: <https://doi.org/10.1088/1742-6596/147/1/012006>.
- [5] Krishna Kulkarani, Anand, Prof. Veerbhadrappa Prabhushetty, "Seabin", Issue: 8, August-2021, Volume 3.
- [6] L. J. Chien, M. Drieberg, P. Sebastian and L. H. Hiung. "A simple solar energy harvester for wireless sensor networks", In 2016 6th International conference on Intelligent and Advanced Systems (ICIAS), 2016, pp, 1-6, IEEE 2016.
- [7] Muhammad Abbas Khan, Dr. Muhammad Zubair Khan V, Hammad Khan, Muhammad Hanzla, Muhammad Jamal, Taimoor Khalid, Naqeeb Ullah, "Garbage collector robot", Received: 09-04-2020, Accepted: 29-04-2020, Published: 19-06-2020.
- [8] Sagar Gavade, Ghanashyam Phadke, Shrikant Somal, Praful Gaikwad, Praful Gaikwad, "Autonomous Ocean Garbage Collector", Issue 4, July-Aug-2020, ISSN (online): 2395-566X, Volume 6.
- [9] Shrikant Somal, Ghanashyam Phadke, Praful Gaikwad, Sagar Gavade, Mahesh Mane "Ocean Surface Trash Collector", Issue 1, August 2020, Volume 4.
- [10] Soumya, H. M. Preeti and B. Gadgay, "Pond Cleaning Robot", International Research Journal of Engineering and Technology (IRJET), Vol.5 No.10, Oct 2018, pp. 1136-1139.
- [11] "Saving the world's water", Borgen magazine, July 10, 2018. [Online]. Available: <https://www.borgenmagazine.com/trashrobots/> [Accessed: Jan 20]