A Water Surface and Floor Cleaning Robot

Prof. Ketki Shirbavikar, Dharmraj Dange, Kunal Dalvi, Ishwari Chothave

Department of Mechanical Engineering.

Vishwakarma Institute of Technology, Pune – 411037, Maharashtra, India

Abstract *— **Water is fundamental life source for all the living species. The way that life started with water and tidiness of it is an exceptionally fundamental part of life to make do on the planet. However, the results of science and innovation laid their huge strides as toxins. The greater part of these toxins is poisonous in nature, and they are influencing the water assets (wells, lakes, waterways, and ocean), living things in the water, and all reliant creatures antagonistically. Likewise, because of the remissness of people and upkeep of water bodies, a huge number of plastics and other drifting squanders are unloaded into the water consistently. Mostly, when required, the water bodies are cleaned physically with human work which requires a much of time and cost moreover. To address this, the proposed work in this article focuses on the plan and advancement of a water surface junk cleaning semi-independent bot controlled by Arduino-Uno. The most interesting thing about this robot is that it not only cleans the water surface but also the ground floor. Hence, it is very effective to clean things like farm ponds, lakes, beaches, public places like hospitals, roads, and railway stations. This robot has two front working parts namely- Robotic arm and Loading Bucket. These two things can be replaced with one another very easily according to requirement and condition. This product work is reproduced and planned to utilize the open-source recreation instrument TINKERCAD. All these simulation results about this product plainly shows that the proposed work would be an option for water surface garbage assortment and floor waste assortment. This will help in upkeeping neatness of the water and places around us with minimal expense and least human exertion.***

Keywords *— (byproducts, cleanliness, pollutants, simulation, trash)*

I. INTRODUCTION

Water is essential everyday routine hotspot for all the experiencing species and it is a significant asset to get by on the earth, it covers around 70% of the world's surface, out of that, just 3% is drinkable water. Water is otherwise called general dissolvable which can break down the greater part of the substances including harmful materials from production lines, sewage, synthetic compounds, and so forth Accordingly, water is totally dirtied by human exercises. The serious issue that living beings are confronting now a days is water contamination. Generally, the water contamination is brought about by sewage removal, trash, and fluid misuse of families and compound enterprises. Dispersion of these synthetics into water bodies is hurting the existences of the oceanic biological system. Therefore, that water becomes non drinkable [1]. Indian streams like Ganga contribute around 40% of water for the Indian populace across 11 states, serving around 500 million of the populaces. This sum is extremely high contrasted with some other waterways in India, however the most perilous thing about it will be, it was positioned second most contaminated stream on the planet in 2017 [2]. The public authority is finding various ways to clean the waterways yet it costs exceptionally high. Essentially, there are a large number of issues in regards to water contamination under the Godavari River moreover. Subsequently, it influences the human existence and magnificence of the Godavari River. Many ventures have been attempted by the public authority to control water contamination in various waterways of India. The amazing truth is, water contamination is brought about by people and it hurts to people itself. It causes numerous serious water-borne illnesses like the trachoma, hepatitis, and so on, to people. Taking a gander at the measurements, 22% of all transferable sicknesses are water-borne illnesses as per WHO [3]. The most extreme effect of this multitude of things is on marine creatures in light of the fact that their endurance is totally subject to water. The answer for this multitude of issues is to clean the water bodies and encompassing region by various ways. Likewise, because of the bountiful development of green growth on the outer layer of water, the oxygen content in the water diminishes, which prompts the passing of fishes and other marine creatures. By breaking down this issue, we have planned this robot so that, it is equipped for gathering the green growth as well. Henceforth, the task proposed in this article expects to foster a water boat with a mechanical arm too as stacking can, that can distinguish, pick, and gather trash from water-bodies and along these lines improve the approach to cleaning.

II. LITERATURE REVIEW

A few scientists all over the planet had worked on the water cleaning boats in view of various advances. This section describes how the project proposed in this article is unique as compared to others. In [4] introduced designing of an industrial underwater cleaning boat. It is possible to work under water with this boat. It is capable of scanning the particular surface, and recording biological reactions under water. The system design is limited to clean bio fouled in water bodies. In [5] the Robot named “Swachh hasth” was

designed by Siddhanna janai. The proposed project is capable of picking up the debris as it has the robotic arm. But the major drawback observed was, it could not clean the algae from surface of water and also does not describe the actual structure of robot and its working. Chen Su, et al. [6] contains the robot for cleaning the trash drifting on water. System of the robot has been portrayed in this article. The boat was customized to work physically just as run naturally founded on ultrasonic distance estimation. The significant disadvantage noticed was, development of the boat was not valuable and zero influence over the assortment of trash. The proposed work depended on human accelerating, and that implies that the working was completely manual. Since no hardware or programming innovation associated with the plan, there is no programmed command over the trash assortment. 'Water Surface Cleaning Robot' was created and planned by Raghavi et al [7]. The principal points of the venture proposed was to plan a surface vehicle. The robot was organized with water quality checking sensors. The significant limit saw with this technique is, it isn't cost effective and the most common way of assembling is very perplexing in nature. Soumya et al. [8] proposed "Lake Cleaning Robot", the machine is worked utilizing a cell phone to gather the junk from the lake. The framework had no sensors for programmed recognition of trash and for working of the robot.

III. METHODOLOGY

This paper depicts the framework "A water surface and floor cleaning system". The most important feature of the proposed robot is, it works on the water surface as well as on the ground. The robot is built in such a way that the sufficient force is generated to suspend/ float and run the robot in water. The rubber wheels help to run the robot on ground and the special type of fans attached to the wheels helps to run the robot on the water surface. The pontoons help it to prevent from sinking and maintaining the weight. As a result, it can be used to clean the water surface as well as ground. This system employs different sensors to record parameters like obstacle detection & its distance from the robot, and recognizable proof of living or non-living organic entities. In view of the readings of these sensors, the boat and automated arm or loading bucket are controlled with the assistance of cell phone or IR remote for getting the drifting junks in the water. The system is semi-autonomous in nature which increases the flexibility while using it. The framework plan idea is portrayed in two phases; the principal stage includes the robot with sensors employment and the subsequent stage includes the automated arm as well as loading bucket. There are two types of loading system- the first one is robotic arm and second is loading bucket. These two loading systems can be easily replaced and employed on the boat. The most interesting fact about the project proposed in this paper is that, user gets the flexibility to choose the loading system according to the use of it and conditions. For example, if the user wants to collect algae or semi-liquid type of things from surface of water, then the robotic arm will not work for it and hence loading bucket is to be used for collecting algae or semi-liquid type of things from water surface. Likewise automated arm is utilized to get the trash like plastic bottles from surface of water. Both the type of loading systems employed on the boat are shown in figure 5 and 6 respectively.

Hardware Requirements:

Physical equipment of the framework is basically founded on the Arduino Uno platform. There are two boards of Arduino Uno on the boat as displayed in 3D design of robot below. One is utilized for controlling wheels of the robot and taking contribution from the sensors; another is utilized for controlling the loading framework (automated arm or loading bucket). Everything related to hardware part and their utilization is described in the coming section.

1. **Arduino UNO R3:** We have used ATmega328 as a microcontroller. It takes input from the cell phone or IR remote and sensors and handle the robot and loading system according to the need.
2. **PIR Sensor:** The Passive Infrared Sensor (PIR) is used for knowing if the obstacle is non-living thing or living organism. If the obstacle is living organism, then buzzer employed on the boat starts ringing.
3. **IR(Infrared) sensor:** It is used to connect the IR remote with the boat to control movement of boat and loading system manually.
4. **Ultrasonic Sensor:** If there is any obstacle in front of it, then this sensor will identify it and also it will measure the distance. When the obstacle is found, then, at that point, the LED on robot turns on.
5. **Bluetooth Module hc05:** HC-05 module here is used to connect the smartphone with the boat to control the robotic arm or loading system and also to control movement of the wheels of the boat through smartphone.
6. **DC Motors:** There are 4 DC motors taken in use attached with wheels. There is special type of fans attached with wheels to actually move the boat forward by pushing water backside.
7. **L293D Motor Driver:** This motor driver is used to control the DC motors for movement in different directions.
8. **Robotic Arm:** It is structured with servo motors. Different types of parts of the arm like elbow, wrist, and base has servo motors for movement. Depending on the given instructions through IR remote or smartphone, the arm adjusts in particular directions as per the requirement, picks up the trash, and dumps it in trash bin employed on the robot or any other dumping space. Its use is to pick up the trash like plastic bottles, plastic bags, papers or any other garbage floating on water or from the floor or ground too.
9. **Loading Bucket:** It is structured with servo motors attached to different parts of it. It is used to collect the trash floating on water or trash thrown by people on the ground. It is used to collect the algae from water surface too.

10. **Battery:** 12V battery is used to power up all the above components.
11. **Smartphone or IR remote:** These two components are used for the same purpose. User has the flexibility to choose any one of it as per the availability. Their utilization in this system is to control the movement of the servos and robot.

Software Requirements:

This whole system is made and developed by using Arduino IDE software and the app named Blynk. All the tools are playing very essential role in software part of the project.

1. **Arduino IDE:** It is a notable open-source integrated development platform (IDE); it permits clients to program and order the viable boards according to the necessities. All the Arduino boards are customized utilizing Arduino IDE to peruse the sensor inputs and control wheels and also the arm by carefully guiding actuators. All of its features are more intriguing on the grounds that it is viable with the Blynk application too for controlling components.
2. **Blynk App:** It is a computerized platform permitting client to fabricate a graphical user interface (GUI) by using widgets in the cell phone. It is utilized for controlling of movement of robots and loading system.

IV. IMPLEMENTATION

The physical development of the project is still in the process of completion; therefore, the work has been implemented virtually. All the virtual work like simulation and 3D design of the project is completed. As an option in contrast to the actual execution, the functionalities and instrument of the framework were properly simulated and planned utilizing an open-source reproduction apparatus TINKERCAD. Both phases of simulation are modified precisely to work the robot and loading system as indicated by the accessible condition. Whole simulation is completed in two stages, the primary stage includes the IR remote controlled DC engines gathering with sensors to envision and investigate the water boat working and mechanism as displayed in figure 1, and the subsequent stage is the working of robotic arm or loading bucket controlled by servo motors using IR remote illustrating the functionality of the loading system as shown in figure 3.

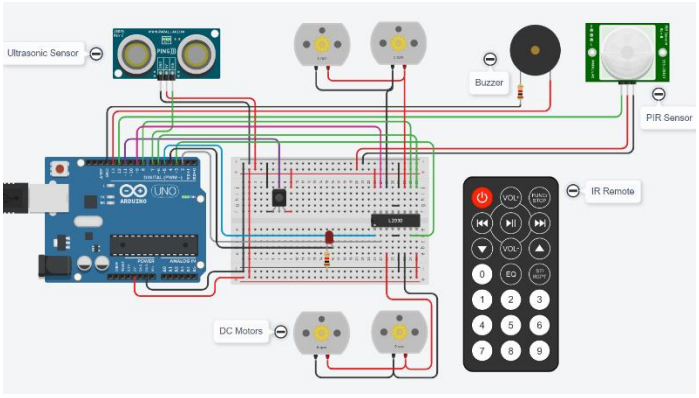

Figure 1: Circuit diagram of robot and sensors assembly

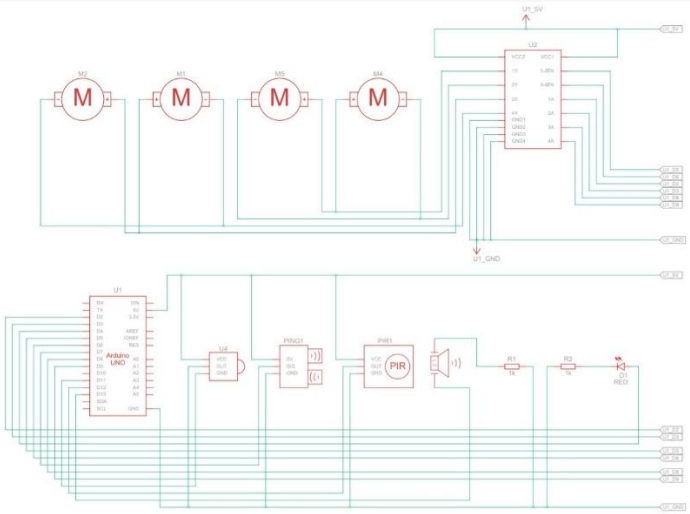

Figure 2: Schematic view of robot and sensors assembly

Above figure 2 is the schematic view of robot and sensor assembly i.e., main robotic body. This schematic view is generated using TINKERCAD. All the connections about the project are clearly described in this figure.

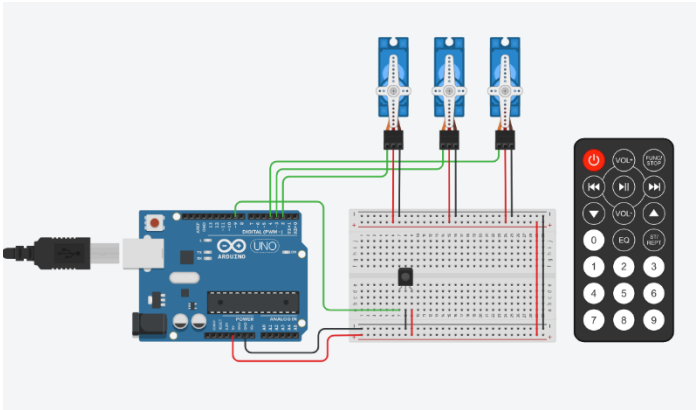

Figure 3: Circuit diagram of loading system/ Robotic arm/ Loading bucket assembly

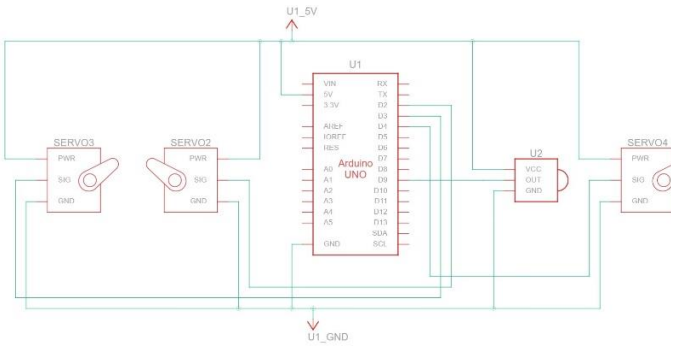

Figure 4: Schematic view of loading system/ Robotic arm/ Loading bucket assembly

Above figure 4 is the schematic view of loading system of the robot. This schematic view is generated using TINKERCAD. All the connections about this system are clearly described in this figure.

3D Design:

3D model of the robot attached with both the types of loading systems is very accurately designed to get the real and actual feeling of the proposed project. All the components of the project are very clearly designed and correctly assembled in the 3D design as shown below. Figure 5 shows the robot with robotic arm type of loading system and Figure 6 shows the robot with loading bucket type of loading system.

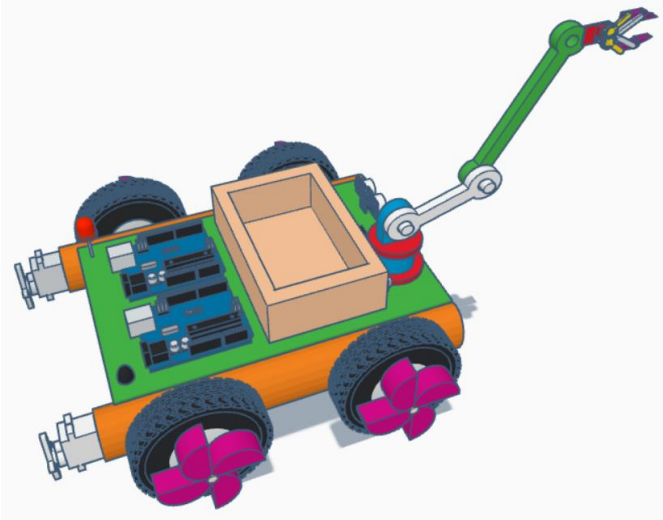

Figure 5: 3D model of robot with robotic arm

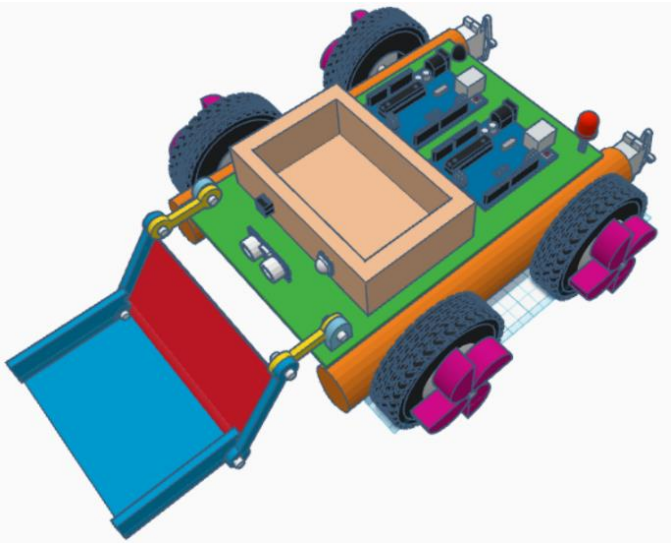

Figure 6: 3D model of robot with loading bucket

Process Flow:

Illustrating the operation of the robot with loading system, an algorithm has been developed. Flowchart of robot and sensor assembly operation is described in figure 7 and flowchart of loading system working is clearly illustrated in the figure 8.

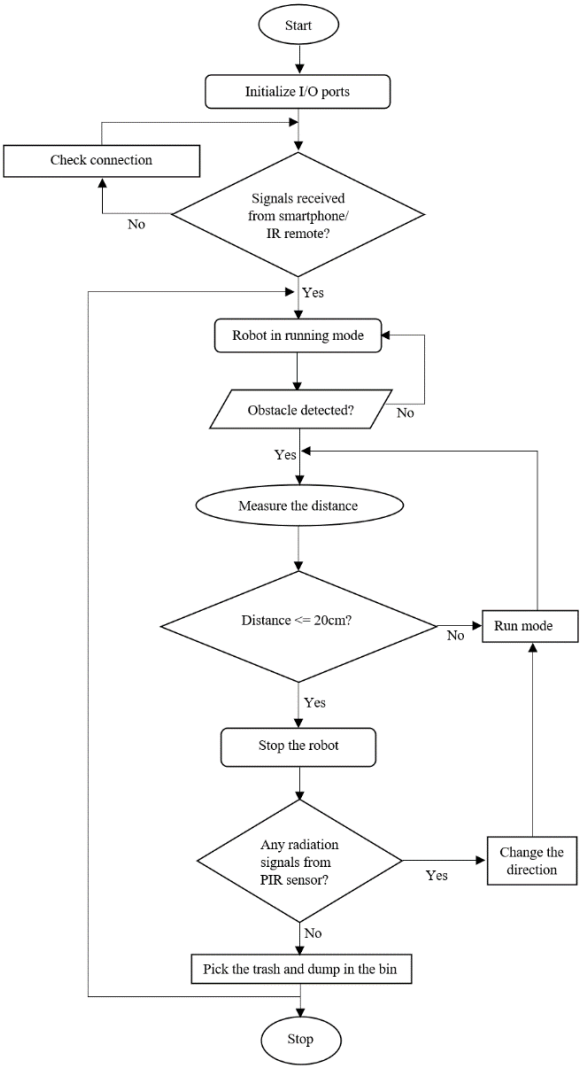

Figure 7: Robotic movement flowchart

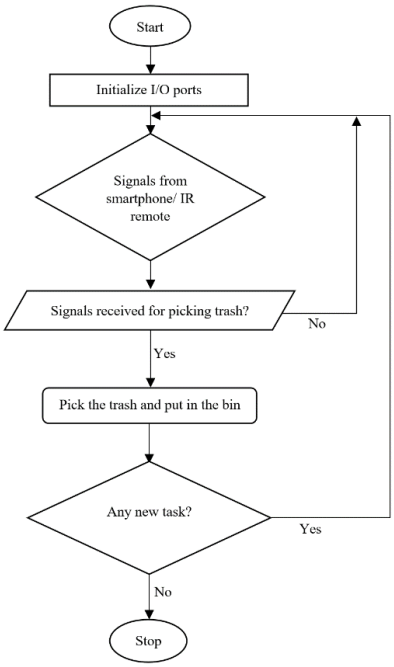

Figure 8: Flowchart describing loading system

V. RESULTS

The most efficient thing about any project is its successful output. This project is really output efficient and effective. The simulation results are shown as shown below. Figure 9 describes the simulation results. In this figure, the upper motors are shown with positive rpm (revolutions per minute) and lower motors are shown with zero rpm meaning that the robot is turning left as there is living organism detected by PIR sensor. Also, the detection of the organism and ringing of buzzer is shown in this figure. The circuit is programmed to perform all these functions.

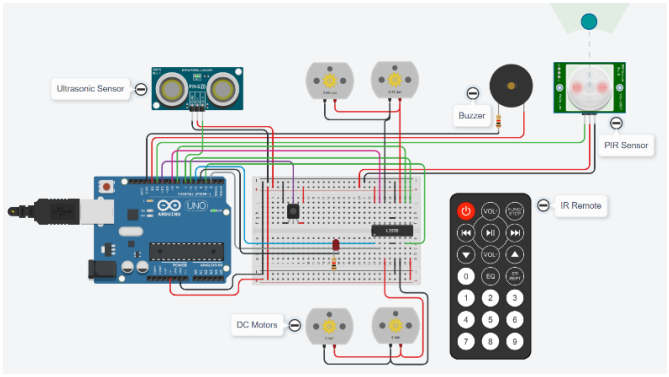

Figure 9: Circuit diagram of simulation results of the robot

Similarly, the Figure 10 (a) is showing that, all four motors are running in positive rpm meaning that robot is moving forward. Figure 10 (b) is showing that, the obstacle is detected in front direction of the ultrasonic sensor and also the distance of that obstacle from the robot is shown in centimeters as well as in inches.

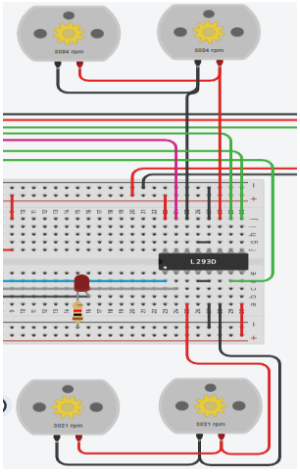

Figure 10 (a): Motors assembly

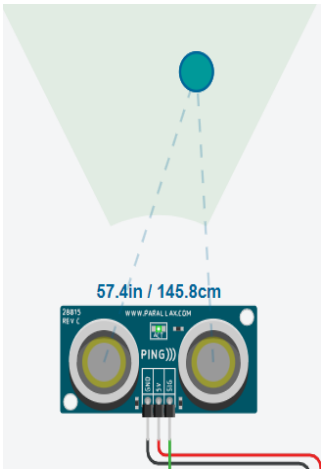

Figure 10 (b): Obstacle

The functionality of the loading system i.e., robotic arm or loading bucket is described in following figures. Figure 11 contains the three servo motors fixed at three joints of the loading system respectively. The working of robotic arm and bucket is successfully tested in the simulation performed in TINKERCAD. The simulation is programmed to perform the particular function. Movement of these servo motors can be performed using IR remote to collect the trash.

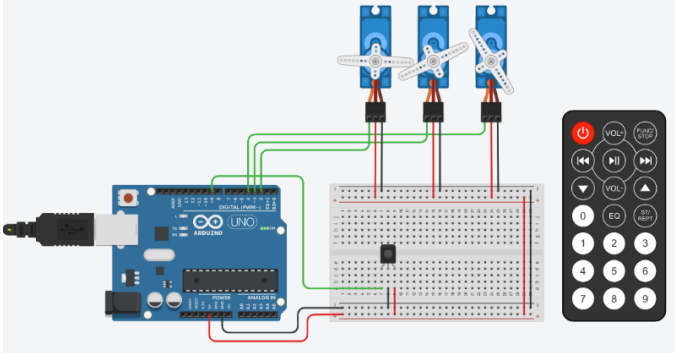

Figure 11: Simulation result of loading system

Figure 12 shows the robot in working stage which is collecting the plastic things like plastic bottles and cups.

Figure 12: 3D design of robot on duty

VI. CONCLUSION

We have observed many problems due to lack of cleanliness. The proposed project in this paper "A water surface and floor cleaning robot" is the solution to all these problems. The mechanism of the project is that, it is programmed to work according to the signals of sensors and signals from remote. Microcontroller employed on Arduino UNO read the inputs from the ultrasonic sensor, IR sensor and PIR sensor and according to the sensed information, perform suitable move by sending signals to actuators. Its unique feature is that, it works on water as well as on the ground. Hence can also be called as amphibian robot. This project neither reduces the quality of water nor disturbs or harms the aquatic life. As a result, the project is proven very innovative and effective to promote the cleanliness drives like "Swachh Bharat" mission in our nation.

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