IoT Based trash collecting boat

Radhika Jalli
Department of Electrical and Electronics Engineering,
Vignana Bharathi Institute of Technology
Hyderabad, India
radhikajalli03@gmail.com
Sundeep Siddula
Department of Electrical and Electronics Engineering,
Vignana Bharathi Institute of Technology
Hyderabad, India
sundeep.siddula@gmail.com
Yashwanth Kumar
yashwanth@niua.org

ABSTRACT

Environmental pollution in waterbodies, is caused from numerous industries consists of substantial concentration of heavy metals and dyes which are discharged into the water bodies with nominal or without treatment, and debris so, these poses a significant threat to aquatic ecosystems and human well-being. To clean up the polluted river, this paper aimed at a solution in the form of an IoT-based trash collecting boat designed to autonomously and efficiently remove debris from water surfaces. The proposed system integrates IoT components, including sensors, communication modules, into a robust and agile boat platform. Equipped with computer vision functions, the boat can identify floating debris, ultrasonic sensor to detect obstacles, LM29 motor driver to control the boat and has a dumpster with IR sensor to detect and collect the garbage. The IoT-based trash collecting boat represents a significant step forward in the fight against water pollution, offering an efficient and sustainable solution to help keep our oceans and waterways clean [2].

Key words: **Debris, IoT, Sensors, Communication modules, River cleaning boat.**

INTRODUCTION

In this culture, we did not see rivers as just water bodies. We see them as life-giving gods or goddesses. We never saw rivers as just geographical happenings. Rivers are important to human civilizations as they provide essential services, such as freshwater for drinking, irrigation, and transportation. Rivers are such important as apart from religious celebrations, river banks also host some of the famous art and culture festivals. Such cultural festivals, also promoted as river festivals like Ganges (Ganga), Yamuna, Krishna, Brahmaputra, Godavari are organized to emphasize the importance of rivers in our lives and strengthening of the public-river connect.

Rivers are polluted when harmful substances often chemicals or microorganisms contaminate the body of water, degrading water quality and rendering it toxic to humans or the environment. Pollution of rivers effect on human health, on the

environment, breaks the life of aquatic plants and animals, and as a result, the ecosystem of the whole planet got unbalanced, disturbance in the food chain of animals and plants etc.

Many researchers had found that 100–400 microplastic particles per kg of river sediment were present in samples collected across 7 locations in the lower and estuarine reaches of the Ganges; a majority of the microplastics were composed of polythene.

Sl.NO.	River	Length(km)
1.	Indus	2,900
2.	Brahmaputra	2,900
3.	Ganga	2,510
4.	Godavari	1,450
5.	Narmada	1,290
6.	Krishna	1,290
7.	Mahanadi	890
8.	Kaveri	760

Numerous researchers have developed devices aimed at cleaning rivers. Below are some of these inventions:

"4 Ocean" established a device which used two pumps and a stainless-steel filter, it pulls in the plastic and floating debris. Says it will be emptied by one of the harbor staffers on a regular basis. When the worker cleans the Skimmer, they return organic debris and any fish found in the screen, back into the ocean. The plastic that is collected will be sent to be recycled.

Mr. Trash Wheel is Built and put in place by Clearwater Mills. The fleet of river clean up vessel are powered by waterwheels and the river's current, with solar panels for backup on slower days. Debris is collected by floating barriers and the wheels power a conveyor belt that transfers the rubbish out of the water and into a bin. The previous record for debris removal occurred on May 16, 2014, when the machine removed 11 tons of refuse on that day. At the end of the third quarter in 2016, (which occurred on September 30, 2016), it was noted that Mr. Trash Wheel had collected over 1,000,000 pounds (500 short tons) of trash since its inception.

RanMarine – Waste Shark, A ma rine drone, called the Waste Shark. At over 5 feet long, and almost 4 feet wide, it's small enough to get in tight areas but big enough to gather up to 132 pounds of plastic waste at a time. It can run for up to 10 hours on a charge and has an automated lift to take it out and charge it when needed and many more.

The Great Bubble Barrier is a system installed in an Amsterdam canal in November 2019 which cleans the waterway using just bubbles. Initial tests in the river showed the device collected 82-86 percent of the test material.

The floating boom is called the Tactical Recovery System Hellas, or TRASH, and was manufactured by New Naval. Using technology New Naval developed for responding to oil spills, the mesh barriers collect river plastic and channels it towards a floating cage. This is used to lift the plastic up to the level of the harbor wall so it can be removed.

BLOCK DIAGRAM

The transformer converts the input voltage to the desired output voltage, which is often used for charging purposes. The charging circuit ensures that the voltage provided to the boat's battery is at an appropriate level for charging, preventing overcharging and damage to the battery. This is essential for maintaining the boat's power source.

The LM2596 is a voltage regulator module

that helps regulate and stabilize the voltage supplied to various components in the system. LM2596 Voltage Regulator this component ensures a consistent and controlled voltage supply, preventing fluctuations that could potentially it will damage sensitive components like sensors and microcontrollers.

The LM293D is an H-bridge motor driver that controls the direction and speed of DC motors. LM293D Motor Driver this motor driver allows the boat to control the movement of its motors (likely used for propulsion or steering) with precision, enabling forward, backward, left, and right motion.

Motors are responsible for generating mechanical motion in the boat, allowing it to navigate and collect trash. The motors provide the necessary propulsion to move the boat across the water, enabling it to reach different areas for trash collection.

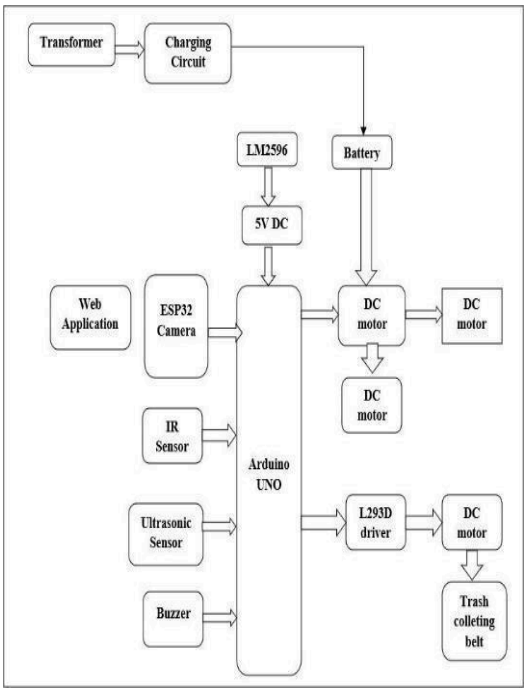
The conveyor belt assists in collecting and transferring trash from the water to the boat. The conveyor belt mechanism helps gather trash from the water's surface and transports it to a storage area on the boat for later disposal.

The buzzer provides audible feedback or alerts based on specific events or conditions. The buzzer might be used to indicate completion of a task (such as when the trash storage area is full) or to notify operators about specific situations or errors.

IR sensors can detect nearby objects or obstacles based on infrared light reflections. IR sensors could help the boat detect obstacles or avoid collisions with other objects in its path, enhancing its navigational capabilities.

Ultrasonic sensors measure distances by sending and receiving ultrasonic sound waves. Ultrasonic sensors could be used to measure the distance between the boat and objects or the water's surface, aiding in trash collection accuracy and navigation.

The Arduino UNO is a microcontroller that acts as the brain of the system, processing data and controlling various components. The Arduino UNO receives inputs from sensors, processes data, controls motors and other devices, and communicates with the IoT network to enable remote monitoring and control of the boat.



The battery serves as the primary power source for the boat and its components. The 12V DC battery supplies the necessary electrical

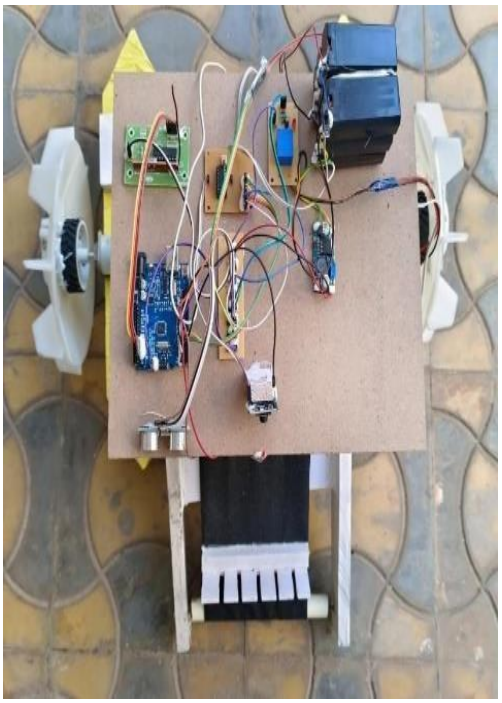
energy to power the boat's motors, sensors, microcontroller, and other components, allowing the system to operate autonomously. The IoT trash collecting boat system utilizes these components in a coordinated manner to navigate waterways, collect trash, and communicate with the IoT network for monitoring and control purposes. Each component plays a crucial role in achieving the overall functionality and effectiveness of the system.

Figure 1 Block diagram of IoT based trash collecting boat [5].

HARDWARE IMPLEMENTATION

- The boat is placed in the water body where trash collection is required.
- The ultrasonic sensor continuously measures the distance to the water surface and ensures the boat maintains an appropriate depth.
- The ESP32 camera captures images or video of the water surface, and image processing algorithms are employed to detect trash in the captured frames.
- The Arduino Uno board processes the data from the ultrasonic sensor and camera, deciding the boat's movement and trash collection actions.
- If trash is detected, the boat maneuvers to the trash location using the propulsion motors, and the conveyor belt motor is activated to collect the trash from the water surface onto the conveyor belt.
- The IR sensor monitors the conveyor belt to ensure trash is correctly picked up and transported to the trash container.
- The boat can collect trash continuously as it navigates the water body, and the trash container stores the collected trash.
- If necessary, the boat can be remotely monitored and controlled through IoT connectivity, allowing users to check its status, location, or even manage its movements.

Overall, the seamless integration of



multiple components, including sensors like the ultrasonic sensor and ESP32 camera, motors, motor driver like the L293d, LM2596 and the Arduino UNO-based controller, enables the

IoT-based trash collecting boat to function autonomously and effectively tackle trash accumulation in water bodies, thereby promoting environmental preservation and sustainable waste management practices [3].

Figure 2 Top view of the hardware

Figure 3 Front view of the hardware

Figure 4 Side view of the hardware.

CONCLUSION

The development and implementation of an IoT-based trash collecting boat represent a significant leap forward in addressing the ever-growing issue of waterway pollution. This innovative system integrates a range of specialized components, including sensors, microcontrollers, motors, and communication modules, to create an efficient and environmentally conscious solution for cleaning up aquatic environments. The real-time data exchange facilitated by the IoT network enables remote monitoring and control, allowing operators to oversee the boat's performance, adjust its course, and receive notifications regarding trash storage levels and system status. As an eco-friendly solution, this IoT-based trash collecting boat not only reduces manual labor and operational costs but also contributes to cleaner water bodies and healthier ecosystems.

APPENDIX

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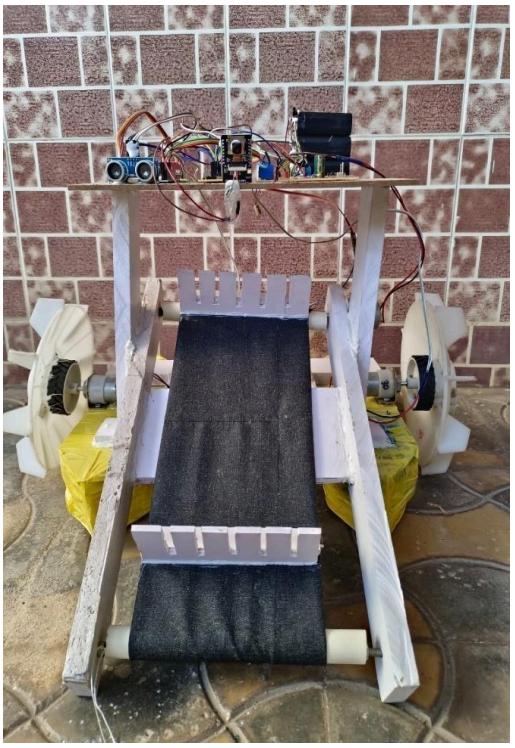

C. Dharani, Final year Student, V. Jananee, Final year Student, S. Logeshwari, Final year Student, N. Megana, Final year Student

[3] Robotic Trash Boat Vaishnavi Bhavsar1, Shradha Barure2, Vaishnavi Chikhale3, Mr. V.B. Raskar4 Student, Dept. of Electronics and Telecommunication Engineering, Imperial College Engineering and Research, Pune, Maharashtra, India.

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