IoT-Based Floating Pollutant Extraction System

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Abstract - This eco-friendly boat is seriously cool; it makes getting around rivers better for the planet and cleans up trash from the water at the same time. This boat is amazing with solar power and battery. At the very front, there's a conveyor belt that just scoops up all the junk from the water, whether it's plastic bottles, leaves, or anything else floating around. The conveyor system moves the trash it gathers into a bin on the vehicle for a time. The ESP32 microcontroller is basically the main brain. It spins the motors, keeps the conveyor belt moving, and communicates with the Blynk IoT platform. With the Blynk app, you can easily keep an eye on important things like your boat's battery, how full the trash bin is, and if the motor is good to go, right from your phone. Alright, so there's an ultrasonic sensor, and it's placed just over the trash can. It just checks how full the bin is. Once it's full, a notification pops up on their IoT dashboard, letting them know it's time to empty the trash. This system does double duty: it stops water pollution and gets clean water moving. This thing cleans rivers and gives people an eco-friendly way to move around.

Keywords: Internet of Things (IoT), Sensor Integration, DC Motor Control, Microcontroller (e.g., ESP32), Mobile Application Control.

I.INTRODUCTION

Plastic items, beverages, and other debris found floating in rivers and lakes are one of the largest sources of pollution in our nation's water systems today and will be a long-term environmental issue for many years to come. As more individuals living in urban and rural locations become interested in using alternative methods of transportation, interest in reducing the impact that our mode of transport has on the environment is growing. A key function of a passenger boat is to carry people, while an automatic system removes floating waste from the top surface of the water. This design includes a battery-powered passenger vessel, with solar power as an optional alternative energy source. The boat is equipped with a conveyor belt that runs continuously at its forward end. The conveyor scoops up and collects floating debris while the boat moves on the surface of the water and drops the collected debris into a bin located inside the boat. When the boat is in motion, the cleaning system operates on its own and cleans the surface of the water of floating litter, including plastics. While the boat moves, it gathers floating debris, helping to maintain the overall quality of the water and improving the overall health of the ecosystem within the water body. This design utilizes the ESP32 microcontroller to act as the primary control for all boat operations, including controlling the boat's drive motors and conveyor motor, as well as monitoring the system. The monitoring and operational functions of this boat can both be controlled via the Blynk IoT platform.

II. LITERATURE REVIEW

Recently, we've been really concerned about the amount of trash that ends up in our waterways. It's a major problem for the environment. Scientists and engineers have been working hard to come up with different systems to help clean up pollution from our rivers. Some of these systems are fully automatic, while others require some human help. After looking at a lot of research, it became clear that river cleaning systems, solar-powered boats, and even tools that use the internet of things (IoT) have helped shape the ideas we're exploring now. In 2018, Patil and a team of researchers came up with a system that automatically collects trash from rivers. Their design used a conveyor belt to pick up floating waste. The idea was good, showing how a moving conveyor belt could help keep water clean. However, the system didn't have real-time monitoring, which was a big problem. In 2019, Kumar and Reddy made a robot that runs on solar power to clean up rivers. The robot used solar panels to power DC motors, which drove a belt conveyor to collect debris. The system worked well and was good for the environment, but someone still had to manually handle the trash bins. In 2020, Sharma and

their team created a smart boat that collects trash. The boat used Wi-Fi to send information about what was happening in real time. However, the data wasn't detailed enough, and there was no way to give specific feedback on each bin. In 2021, Jain and Sinha came up with a floating trash collector that uses a conveyor belt controlled by an Arduino Uno. The machine had the conveyor belt at the front, which helped pull out solid waste from the water. Although it made the process faster by automating it, it didn't include IoT integration. That meant people couldn't control the system from a distance or check the data remotely.

III.METHODOLOGY

1. Problem Identification and Requirement Analysis
This project will address the growing problem of floating waste in waterways through a comprehensive analysis of current cleanup technologies, including the identification of their shortcomings, and based on this analysis, develop an automated, remote-controlled system for the collection of floating waste, allowing for such collection to occur at all times by means of "on-demand" operation. The most important functional requirements identified in this project include the ability for the individual units to navigate the water surface, the ability to collect waste efficiently, the ability to be controlled via the Internet of Things (IoT) network, and the ability to detect the amount of floating waste currently on the water surface automatically.

2. System Architecture Design
We built the robot's whole setup with block diagrams. The parts we used are an ESP32 Microcontroller, an L298N Motor Driver, some DC-driven propulsion motors, a conveyor system, a waste detection system, a relay control system, a Wi-Fi module, and a power supply.

3. Mechanical Structure Development
They built the floating platform so it would stay steady on the water. It’s got two motors mounted on the sides, and right up front, there’s this conveyor belt thing that scoops up the trash and drops it into a basket inside. We chose certain materials like acrylic, PVC, or thermocol sheets because they're great for making things float and last a long time.

4. Electronic Component Integration
Getting all the electronics set up has actually been pretty enjoyable. Everything's all hooked up and ready to go. We've got the Relay Module, Ultrasonic Sensor, L298N Motor Driver, and the ESP32, and they're all communicating. We double-checked that all the wires were in the right spots on the circuit boards. After that, we put a special coating on them for waterproofing and hooked them up to the power so things would run nice and smooth.

5.Creating Software and Firmware:
We utilized the Arduino IDE to create the ESP32's firmware and software. The Arduino IDE allows for easy programming to control relays and motors, process sensor data, and send data to Blynk’s cloud platform. We programmed the ESP32 to produce pulse-width-modulated output signals to provide for smoother motor control. The software also has an algorithm to track the amount of waste collected. The final safety feature is an automatic stop of the conveyor belt when the trash bin hits a certain threshold for being full.

6.An IoT Dashboard:
To simplify operations, we developed an individualized dashboard on the Blynk app. Users can use the buttons on the dashboard to control movement left, right, forward, and backward. In addition to controlling the movement of the device, the dashboard contains widgets that provide real-time status updates from the ultrasonic sensors and alerts when the trash bin is full. The system can be monitored and operated from any location via the internet and Blynk-supported wireless connections.

Fig1 : IOT dashboard

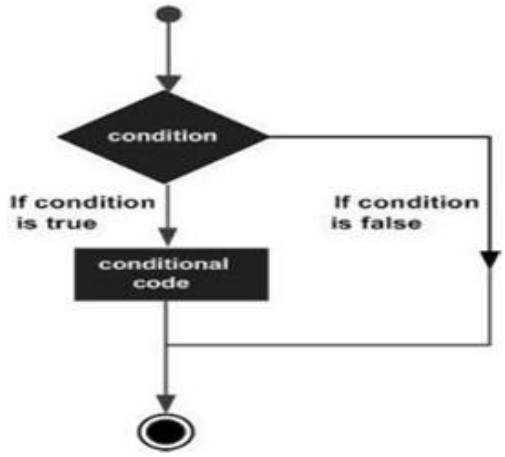


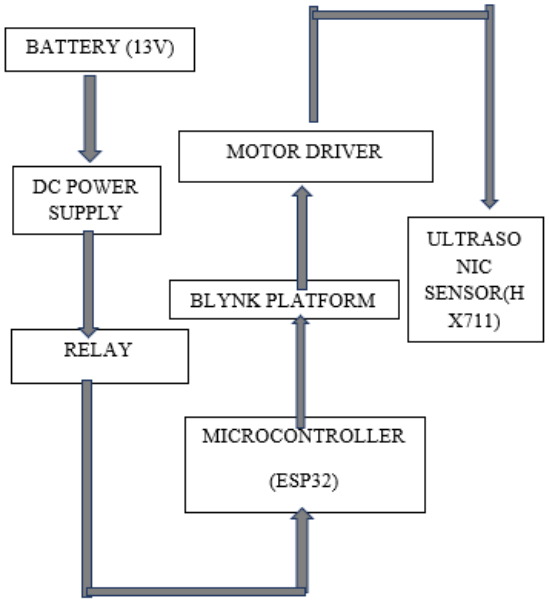
Fig 2: Flowchart

7.Calibration, testing, and repair**:**
In order to check how well the robot can hold still while it is moving around, collecting garbage, and working wirelessly, a series of tests were performed on the robot in water.

8.Final Implementation/Performance Assessment:
A full system was evaluated against the real conditions of a river or pond. This gave us an idea of the ability of the robot to navigate through the water, collect garbage from it, react to IoT commands, and have the capacity for extended battery life (the way we will evaluate overall performance). Information regarding motor speed, conveyor timing, and sensor threshold values will be extracted from the performance assessments for this purpose to improve cleaning performance.

Fig 3: Methodology of Eco passenger boat

BLOCK DIAGRAM



HARDWARE REQUIREMENTS

- Processor: ESP32
- Power supply: +5V
- Sensor: Ultrasonic (HC-SR04)
- Motor Driver: L293D
- DC motor: 12V DC 60 RPM

SOFTWARE REQUIREMENTS

- Software: C programming for Arduino IDE
- IOT Platform: Blynk Setup

IV. RESULTS AND DISCUSSION

This research created a low-impact vessel for transporting passengers that has the capability to collect waste from the waterway being traversed. This type of vessel will transport passengers while also collecting floating debris that would otherwise clutter the riverbanks. This vessel has a conveyor system that collects mixed trash (i.e., plastic bottles, leaves, paper, etc.) and provides for less waste spillage as well as reduced risk of jammed material within it. An ESP32 microcontroller controls this system, and the user can control it using the Blynk app. This system can use an ultrasonic sensor to monitor how full the waste container has become and to provide a notification when the waste container reaches 90% of its capacity to help to

avoid overflow. A dashboard that provides real-time information on the motor status, how full the waste container is, and the current mode of operation of the vessel is displayed on an Internet of Things-enabled electronic device. In our testing of this vessel, we maintained good connectivity to the Wi-Fi network, and our test of the connected vessel using battery power resulted in the total silence of the vessel, as well as no carbon emissions produced at the point of use.

TIME(min)	BIN FULL LEVEL(%)	CONVEYOR LOAD(%)
0	0	0
5	15	40
10	35	60
15	55	70
20	70	75

Table 1: Analysis of bin level & conveyor

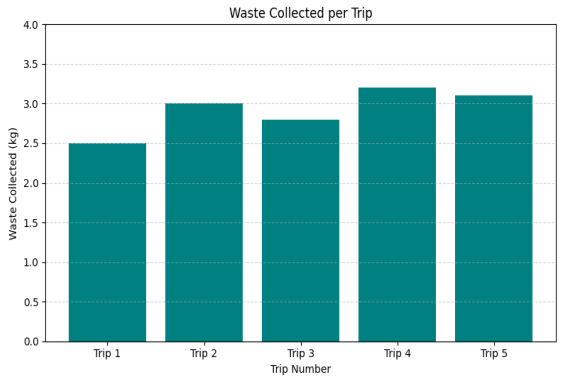


Fig 4: Waste collected by the conveyor

V.CONCLUSION

The Eco Passenger Boat is changing how we travel by cleverly combining smart technology with eco-friendly ways of doing things. So, basically, they're using things like robots and smart gadgets that are all hooked up to the internet to help make our rivers and lakes cleaner. Yeah, that front conveyor really does a solid job of catching all the floating debris. You can keep an eye on things and even control them using the ESP32 and Blynk, no matter where you are. It's all happening in real time. Our ultrasonic sensors mean our bins never overflow, and we're actually helping the planet by running things on renewable power. This system cleans up garbage and gives people an eco-friendly way to get around. Turns out, we can get pretty clever with how we manage our rivers. By bringing in automation, IoT, and green energy, we're finding ways to do it smartly and without breaking the bank. We're hoping to add some neat features later on. Think GPS so we know its whereabouts, maybe even a self-driving mode, and some AI to help it find trash. That would make for a pretty clever cleaning system.

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