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Design and Fabrication of Remote-Controlled Trash Collector Boat by using Bluetooth Module

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ABSTRACT
The Remote-controlled Trash Collector Boat is an innovative solution designed to tackle water pollution by efficiently removing floating debris from water bodies. The designed eco-friendly boat is equipped with a lightweight, durable hull, electric propulsion system, and an advanced remote-control unit. The primary feature of fabricated boat is a front-mounted conveyor belt that collects trash and deposits it into a large storage compartment. It has been powered by an Li-ion battery of 9v battery pack, the boat operates sustainably with minimal environmental impact. This technology offers precise navigation and efficient debris collection, making it ideal for use in various aquatic environments, from small ponds to large lakes. By automating the trash collection process, the boat significantly reduces labour and time, contributing to cleaner and healthier water ecosystems.
Keywords: Remote control, Water bodies, Floating debris, Conveyor belt, Environment.

INTRODUCTION

Rivers are crucial for our lives, but many people don't realize their importance. The evidence is clear: our rivers and creeks are full of trash, making them look and smell like dumpsites. This garbage isn't just ugly—it can contaminate our drinking water and harm nature, ourselves, and our loved ones. Even one piece of litter on the street can end up in our rivers. Rivers are very important and need to be cleaned. There are species unique to the Philippines that could be saved if we clean our rivers. Clean rivers mean better health for people and a better quality of life. Less trash also means more fun activities like walking and running along safe, clean river trails [1].

The trash collector boat is a small, automated boat designed to collect floating trash from the water's surface and store it temporarily. At the end of its operation, the collected trash will be removed manually. The design process used engineering methods to create a practical and portable trash collector boat based on existing designs. Using Autodesk Inventor 2009, a 3D model of the boat was created to show all the details. The boat will be built with suitable materials to ensure it works efficiently [2].

The "Trash Boat" is a machine designed to clean up waste and debris from water bodies like rivers, ponds, and lakes. It works with a waterwheel-powered conveyor belt that collects and removes garbage, including plastic waste, from the water. This helps reduce water pollution and saves aquatic animals from harm. The conveyor

belt lifts the debris out of the water, making it easier to collect and dispose of the waste. This machine helps keep water bodies cleaner and healthier [3].

Water running through a water drainage system mostly carries along waste materials most which are non-biodegradable which not only cause flooding but also climate change. Our project help to reduce water pollution and clean the water, which can be very useful for the living things. In India there is need of automated machine which can clean trash and collect this solid waste. The “River cleanup machine” used in that places where there is waste debris in the water body which are to be removed. This machine is consists of waterwheel driven conveyer mechanism which collect & remove the wastage, garbage & plastic wastages from water bodies [4,5,6].

The impurities present in water can cause hazardous and disease. As long as the draining system is considered the function of the main drainage system is to collect, transport and dispose of the water through an outfall or outlet. Impurities in drainage water can be only like empty bottles, polythene bags, papers, etc. It’s an Industrial Working Prototype of Entirely Solar Powered Water Cleaning Mechanism which can auto collect floating garbage and solid waste from the water surface and collect it into its floating bin. It can be programmed, scaled up to any size and can operate remotely. The system is indigenous and efficient to tack river cleaning cause [20].

Author explained the present condition of the National sacred rivers which are infected by large amount of waste and loaded with pollutants, toxic chemicals, debris, etc. due to such situation and also because of the multiplying water pollution in the form of waste debris the aquatic life is in danger. The machine has been designed that will be collecting all the waste debris from the water. This will be resulting into reduction of water pollution and also reduce the rate of aquatic animals’ death. The use of this project will be made in rivers, ponds, lakes and other water bodies for to clean the surface water debris from bodies.[9]

The model features a cage that is partially submerged in water to collect floating garbage. The debris is trapped by moving the cage around it. Researchers added level sensors to manage the amount of garbage in the cage, as well as pH and turbidity sensors to measure water pollution. An odor sensor detects harmful smells in the water.

This project addresses the severe problem of rising water pollution, which endangers aquatic life and can cause skin diseases in humans. Aquatic animals sometimes eat the debris, mistaking it for food, which can lead to their death. To tackle these issues, the "River Cleanup Machine" has been proposed. This machine efficiently removes waste debris, plastic, and garbage from the water surface.

Powered by hydropower, the machine uses waterwheels to convert kinetic energy into mechanical energy to drive a conveyor system that collects and disposes of the waste. This design aims to clean the Godavari River effectively [21].

The Over two thirds of Earth's surface is covered by water; less than a third is taken up by land. As Earth's population continues to grow, people are putting ever-increasing pressure on the planet's water resources. In a sense, our oceans, rivers, and other inland waters are being "squeezed" by human activities so their quality is reduced. Poorer water quality means water pollution. It relates to skimmer boats, i.e., work boats for collecting and disposing of floating solid waste materials in harbors and waterways [20].

Today, pollution, especially water pollution, is a major problem for humans and living organisms. Water pollution harms living creatures in various ways, putting many aquatic species in danger. Fish and other aquatic animals, as well as plants, are facing hazardous conditions. Polluted water often leads to excessive algae growth, which reduces oxygen levels and causes the death of fish and other organisms. Over the past twenty years, aquatic life has decreased by about 40%. Algae also give water an unpleasant taste and smell and can cause illnesses like gastroenteritis. There are many recorded cases of marine life being destroyed by polluted water [5].

Among the various sources of pollution, floating debris such as plastic bottles, bags, and other waste materials pose a particularly visible and pervasive problem in water bodies worldwide. To address this challenge, innovative solutions are needed to efficiently collect and remove debris from the water surface. One such solution is the development of remote- controlled trash collector boats.

Remote-controlled trash collector boats represent a promising technological advancement in the field of waterway cleanup. These specialized vessels are designed to navigate water bodies autonomously or under remote control, equipped with mechanisms to detect, collect, and store floating debris. By harnessing remote control technology, these boats can access hard-to-reach areas and effectively remove trash from rivers, lakes, harbors, and coastal regions.

METHODOLOGY

1. Motor

A torque motor is a specialized type of electric motor designed to provide high torque at low speeds, or even at standstill, without requiring gear reduction. They are commonly used in applications where precise control of rotational force is needed.

Key Characteristics:

High Torque at Low Speeds: Designed to deliver significant torque even when the motor's speed is low or zero.

Direct Drive: Typically used in direct drive applications, eliminating the need for mechanical gearboxes.

Precision Control: Offers precise control over torque and positioning, making them suitable for applications requiring fine adjustments.

Types of Torque Motors:

Permanent Magnet Torque Motors: Utilize permanent magnets to generate torque, known for their high efficiency and reliability.

Induction Torque Motors: Rely on electromagnetic induction, typically used in applications requiring robust and maintenance-free operation.

2. Battery

A 12-volt lithium battery is a compact, high-energy-density power source commonly used to power small electronic devices and motors, including torque motors. These batteries offer several advantages over traditional battery types, making them suitable for applications requiring consistent and reliable power.

Voltage: Provides a stable 12-volt output, which is suitable for various low-power applications.

Energy Density: High energy density allows for longer operational times compared to other battery chemistries.
Lightweight: Lithium batteries are lighter than their alkaline counterparts, making them ideal for portable applications.
Capacity: -volt lithium batteries typically have capacities ranging from 500 to 1200 mAh, which determines how long they can power a device.
Rechargeability: Rechargeable variants offer long-term cost benefits but require an appropriate charger.
Compatibility: Ensure the battery meets the voltage and current requirements of the torque motor to prevent underperformance or damage.
using a 12-volt lithium battery to drive a torque motor.
Power Requirements: Verify the torque motor's voltage and current requirements align with the battery's output.
Current Draw: Ensure the battery can supply sufficient current for the motor's operation, especially under load.
Battery Life: Assess the expected runtime based on the motor's power consumption and the battery's capacity.

3. Conveyor belt

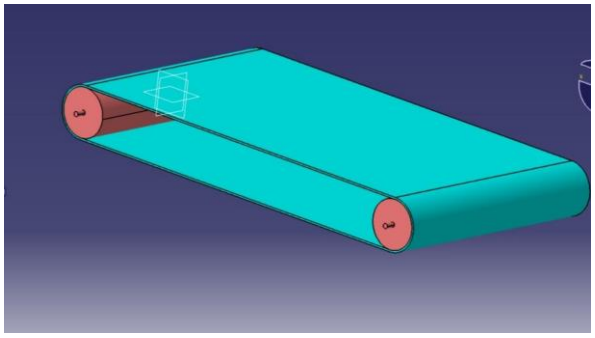


Fig. 1. Conveyor belt

A conveyor belt on a trash collector boat is a crucial component designed to collect and transport floating debris from the water's surface into a storage compartment on the boat. This system enables efficient and automated cleaning of water bodies, contributing to environmental conservation.

Key Characteristics:
Material: Typically made from durable, corrosion-resistant materials like rubber, to withstand water exposure and harsh environmental conditions.
Design: Features a series of belts or chains with attached scoops or paddles that move debris from the water onto the boat.
Power Source: Operated by an electric motor, often powered by the boat's battery or solar panels, ensuring continuous and reliable operation.
Components:
Belt: The main component that moves continuously to transport collected debris.
Rollers: Cylindrical components that support and guide the belt, ensuring smooth operation.

Frame: The structure that holds the conveyor system in place, typically mounted at the front or side of the boat.

Motor: Provides the necessary power to drive the belt, often a low-voltage motor suitable for battery operation.

Scoops/Paddles: Attached to the belt to help lift debris out of the water and onto the belt.

The conveyor belt on a trash collector boat is an essential system for efficient and automated debris collection from water bodies. Made from durable materials and powered by reliable motors, these conveyor belts ensure continuous operation and effective cleaning. Their use in various aquatic environments helps maintain cleaner water, contributing to environmental conservation and sustainability.

4. Arduino uno and Bluetooth model.

Integrating an Arduino microcontroller and a Bluetooth module into a trash collector boat enhances its functionality by enabling remote control and automation. This setup allows for wireless
communication between the boat and a remote controller ,
facilitating precise maneuvering and efficient debris collection.

Components

Arduino Board: The central microcontroller that processes input signals and controls the boat's motors and other components.

Bluetooth Module (e.g., HC-05): Enables wireless communication between the Arduino and a smartphone or remote controller.

Motor Driver (e.g., L298N): Controls the motors based on commands received from the Arduino.

Motors: Propel the boat and operate the conveyor belt.

Battery: Provides power to the Arduino, Bluetooth module, and motors.

Conveyor Belt System: Mechanically collects and transports debris from the water surface to the storage compartment.

Arduino pin connection with Motor Drive and Bluetooth Module

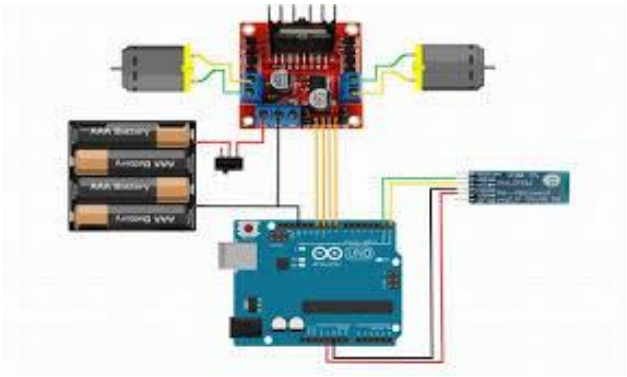


Table: 1 Arduino connection

Arduino Uno	Motor Driver	Bluetooth Module
TX	RX (pin 0)	RX
RX	TX (pin 1)	TX
5V	VCC	VCC
GND	GND	GND
3	Motor 1 Positive	-

6	Motor 1 Negative	-
9	Motor 2 Positive	-
10	Motor 2 Negative	-

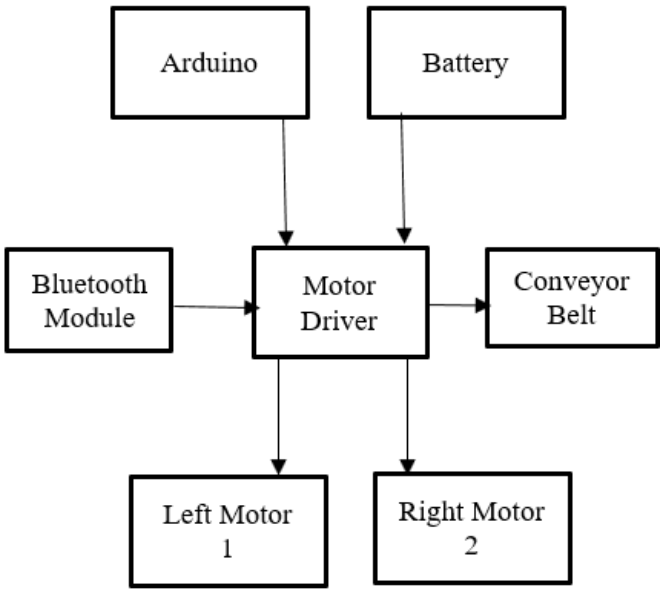


Fig. 2 Block Diagram of Arduino and Bluetooth module connection

Using Arduino code for controlling a trash collector boat using Bluetooth communication. It utilizes two motor driver pins for controlling the movement of two motors responsible for propulsion. The Bluetooth module, connected to pins 0 and 1, receives commands from an external device. Commands 'F' and 'B' initiate forward and backward movement, respectively, while 'L' and 'R' command the boat to turn left and right. The 'S' command halts all motor activity. Each command triggers a corresponding function that sets the appropriate motor pins to achieve the desired movement. This setup allows remote control of the boat's navigation, making it suitable for collecting trash from water bodies.

Using an Arduino and Bluetooth module to control a trash collector boat allows for efficient and precise remote operation. This setup enables real-time maneuvering and debris collection, enhancing the boat's functionality and ease of use. By integrating these technologies, the trash collector boat becomes a more effective tool in maintaining clean and healthy water bodies.

5. Floating Platform

The floating platform of the trash collector boat consists of five hollow PVC pipes, each measuring 60 cm in length and 3 inches in diameter, attached to a sturdy wooden board. This design choice offers several advantages for the functionality and efficiency of the boat. Firstly, the hollow PVC pipes provide buoyancy, enabling the boat to float effectively on water while carrying out trash collection tasks. Additionally, their lightweight nature ensures that the overall weight of the boat remains manageable, facilitating easy maneuverability and transportation. The use of PVC pipes also contributes to the platform's durability, as PVC is resistant to corrosion and degradation when exposed to water and environmental elements. By securely

affixing these pipes to a wooden board, the platform gains stability and rigidity, allowing it to support the weight of the boat and any collected debris efficiently. This design configuration optimizes the performance and functionality of the trash collector boat, making it well-suited for addressing water pollution challenges in various aquatic environments.

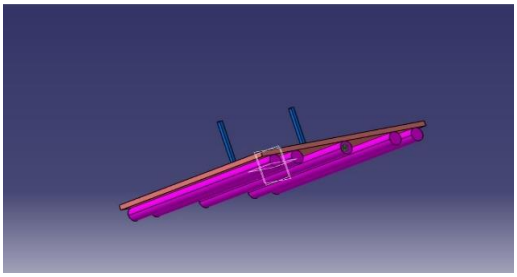


Fig. 3 Floating Platform

Calculations for floating Platform:-

Total volume of hollow pipe = max. water displaced
Length = 60cm,
Radius = 3.8cm
Volume of 1 pipe = length × π× radius^2
Total Volume of pipes = 60 ×π ×3.8^2×5
Total Volume of Pipes = 13609cm^3
Total Water Displaced =Volume of pipes×Water Density
Density of Water = 1g/cm^3
Total Water Displaced= 13609×1
Total Water Displaced = 13609 gram
In Kg 13.60Kg
Self weight of Hull is 3.5 Kg

II. RESULT

The Remote-Controlled Trash Collector Boat represents a significant advancement in addressing water pollution. By leveraging automated technology this boat efficiently removes floating debris from water bodies, ensuring cleaner and healthier aquatic environments. Its design, featuring a durable hull, precise navigation via remote control, and an effective conveyor belt system, makes it a practical solution for various applications, including lakes, rivers, and coastal areas.

Enhanced Automation

Sensor Networks: Utilizing advanced sensors to monitor water quality and debris levels, optimizing the boat's routes and collection efficiency.

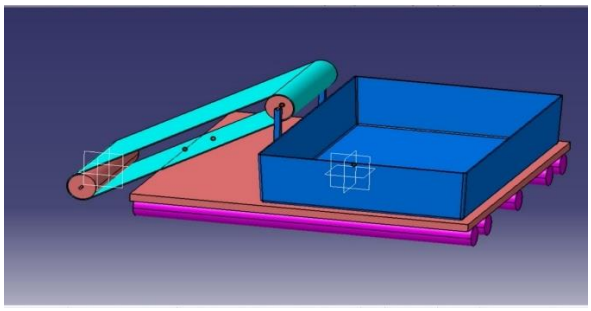
Increased Efficiency Advanced Materials: Using lightweight, durable materials to enhance the boat's performance and longevity.

Expanded Applications

Larger Scale Operations: Designing bigger models for larger bodies of water, capable of handling greater volumes of debris.

Specialized Designs: Creating specialized versions for different types of debris, such as oil spills or microplastics.

Design



CONCLUSION

To achieve this goal, the proposed system utilizes a conveyor belt for collecting Debris in the water bodies. Conveyor belt rotates and lift the floating debries from water surface into the basket. The proposed system will also include a Bluetooth module with Arduino that can navigate boat for collecting debris and hazardous environments to assist with rescue and recovery efforts. The boat's ability to reduce manual labour and enhance the efficiency of trash collection highlights its potential as a vital tool in environmental conservation efforts.

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