Design and Prototype Development of Trash Collector Boat

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Abstract: Every year, millions of tons of trash find their way into the rivers and streams around our country, contaminating the water and endangering the all those whose lives depend on it. A significant portion of the rubbish is floating, insoluble material, which is more hazardous since it creates a barrier between air and water. The design of an ocean cleaner is suggested in order to remove garbage from the sea or to create a cleaner atmosphere. This floating rubbish can be taken out of the water's surface by this system. The system uses a conveyor belt-style arrangement that is powered by an electric motor. The conveyor belt continuously goes upward, collecting trash along the way thanks to spike arrangements. After that, a trash collection tank is supplied, where the same are momentarily stored. An advantage of this type of device is that it may be made to float, allowing it to move on the water's surface and continuously gather floating rubbish. On the roof, we can also employ solar power cells to supply electricity. The river cleaning system may eventually include a rubbish level indicator assembly.

1. Introduction

River garbage cleaning machines play a pivotal role in addressing water pollution by employing innovative technologies such as floating booms, trash skimmers, and amphibious devices. Equipped with conveyor belts, nets, and suction systems, these machines effectively collect, sort, and remove debris, plastics, and contaminants from rivers and water bodies. Their diverse mechanisms enable them to navigate challenging riverbank areas and ensure comprehensive cleanup.

By preventing debris from reaching the oceans, these machines safeguard marine life and contribute to environmental health. Beyond protecting aquatic ecosystems, they also

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benefit human health by providing cleaner drinking water sources and reducing the risk of waterborne diseases for nearby communities. Despite challenges such as high maintenance costs, these machines are indispensable components of sustainable river management, vital for preserving the vitality of rivers and promoting biodiversity. The deployment of a River Cleaning Boat not only serves the immediate purpose of purifying water but also contributes to broader environmental goals. By preventing the downstream transport of pollutants, the boat mitigates the adverse impact on downstream ecosystems and coastal areas. Moreover, the collected waste can be appropriately treated, recycled, or disposed of, further reducing the overall environmental footprint.River garbage cleaning is a crucial environmental initiative aimed at removing pollutants and debris from rivers and water bodies. This practice is essential for maintaining water quality, protecting aquatic ecosystems, and ensuring the well-being of surrounding communities.

1.1 Problem Statement:

India is a country that is encircled by water on three sides.There are 14,500 km of navigable water, of which motorized ships can use 5,150 km of the river and 4,030 km of canals. India has a serious environmental problem with water contamination.We release 29 crore gallons of sewage junk into the Ganga waterway, agreeing to an yearly report. Plastic, strong squander, rubbish, and waste entering closed stream water bodies has ended up reasonably common in later a long time due to a need of extra waste expulsion facilities.This hone has long-term negative impacts on the region's biodiversity as well as the nearby environment.The world's streams and seas can carry trash.It can be found coasting at best, floating in the water column, or at the bottom of almost any body of water. It is as often as possible eaten by angle and winged creatures, which concentrates harmful compounds in their tissues and causes them to starve.Plastic squander has the foremost potential to hurt the environment, natural life, and individuals of all sorts of waste. India is a sacred nation, and there is significant water pollution of adjacent water bodies during holidays like Ganesh Visarjan, Navratri, Durga Puja, and daily rubbish disposal, among others. The risk posed by this issue extends beyond aquatic creatures to include people. We as people should not drink this water because it is used for irrigation and drinking purposes. If ingested, it can result in respiratory problems, skin conditions, and disorders brought on by water, such as jaundice.

Fig. 1. Disposal of solid waste into water bodies

2 Literature survey

Historically, rivers were often used for waste disposal, leading to pollution. Early efforts to clean rivers involved manual removal of garbage and pollutants. During the industrial revolution, rivers became heavily polluted due to industrial waste. This prompted increased awareness about the need for river cleanup. In today's world, the quick speed of production in many nations results in an increase in undesired trash, providing considerable problems to waste management, particularly in metropolitan areas. Manual garbage disposal, while common, is beset with problems such as excessive pollution and manpower shortages. To solve these issues, we created an autonomous robot capable of detecting and tracing lines on surfaces, as well as monitoring waste levels in containers. Inspired by the constraints of current manual techniques, this self-sufficient solution promises to reduce the monotony of manual work, solve security problems, and improve waste management efficiency, providing a realistic option for cleaner and healthier settings.Autonomous robots are a viable approach for increasing waste management efficiency and environmental purity. These robots expedite garbage collection procedures, increase reach, and reduce pollution by eliminating the need for physical labor. With their capacity to function autonomously, autonomous robots promise a game-changing approach to trash management, assuring a healthier and more sustainable future for cities and beyond.

Prior to thoroughly outlining our own answer and comprehending the need for a more compact, affordable, and adaptable framework, it is necessary for us to have a thorough understanding of the prior studies and research in the area. As a result, a wide range of research articles were examined in this area in order to gather pertinent data regarding the project.Using wireless connections Sirichai Watanasophon and Sarinee Ouitrakul [1] developed a waste pickup robot for use on beaches. Mobile robot system is made up of a Bluetooth module for wireless connection and IP cameras to provide the user with a live feed. The autonomous trash collector bot created by Shobhit Khandare et al. [2] is based on a Raspberry Pi. The Raspberry Pi's pre-programmed instructions cause the motors to rotate when the ultrasonic sensors identify obstructions. All that the image processing method does here is determine whether or not the thing is an animal. A wirelessly powered garbage pickup robot was proposed by Kamal et al [3]. A web application can be used to construct a program that allows the user to operate a robot. The robot was only ever tested using Proteus simulations; actual ground testing was never done.

Because no attempts were made to replicate real-world situations or obstacles, it might not be trustworthy for someone wishing to test. Robotodumpster, an autonomous garbage collector, was created by Rama Prabha et al. [4]. The robot has a wirelessly controllable arm with seven degrees of freedom. The only characteristic employed in this trash sorting process is the object's width, hence there is no accuracy. Due to the human fabrication process, the 7DoF arm is an expensive technology that is not cost-effective.The Autonomous Garbage Collector Robot, created by Apoorva et al. [5], is an excellent and efficient waste-scooping mechanism that collects rubbish by use of a shaft with rotating blades.As a result, this device will collect anything it sees in its field of vision and deposit it into a mounted bin. The amount of trash in the container is always being observed. Twinkle et al [6] created the smart dustbin, that alerts users when trash has reached a specific level in the dustbin and that they should be cleaned or emptied right away. Alshafi and Almaleky [7] created a metallic waste collection robot with the primary goal of lowering the pollution that metallic waste causes to the environment.

Furthermore, Nurlansa and colleagues [8] have created an Automatic Garbage Collector to gather waste from the waterways.

The garbage collector was designed utilizing engineering methods, and the robot's main motor is a rotor. They also employ sensors for autonomous navigation. Anukriti Jha et al. [9] proposed developing an autonomous garbage collector. Robot made of aluminum. When it identifies an impediment, it executes the code and lifts the rubbish using the defined technique. Ketan H. Pakhmode et al. [10] demonstrated a solar-powered water surface garbage collection boat. The boat collects the garbage floating on the water surface. The project works automatically and saves man power. The solar powered boat does not require any external power supply.

The bins are connected to an Advanced RISC Machines microcontroller outfitted with seven infrared (IR) sensors and a central system that displays the top level of full rubbish on a mobile device via a Wi-Fi connection [13]. As a result, the HTML page updates the layer's state but does not display the containers' current positions. In another piece, the bins are linked to an ARM7 CPU with ultrasonic sensors, and the system sends an alarm text using Short Message Service (SMS) and Global System for Mobile Communications (GSM) technology. This notification is designed to advise truck drivers of the availability of packed containers for rubbish collection [12]. The following research uses a similar machine interfaced with a LinkItONE Arduino board to deliver a warning text message based on the volume of garbage loaded using Ubidots [11]. In the following study, an attached machine connected to a Peripheral Interface Controller (PIC) microcontroller is used to transmit an alert text message about a full garbage can via Zigbee technology [14].

In the last paper of the first section, a similar machine is connected to an Arduino UNO board to send an alert text message about the level of trash loaded by GSM technology. This machine additionally suggests stuffed up-tiers thru shadeation Light Emitting Diodes (LED) [15]. Most of the current works contain only ideas and models. Many documents were proposed without even testing real conditions or difficulties, and in this way it may not be reliable for artificial intelligence (AI) calculations, causing costs to rise. So we expect to do our best by offering accurate results without the use of sophisticated CPUs and GPUs. With our suggested framework, we hope to cut prices and so open the market for the diverse development of self-driving cleaning robots. The trash cans are linked to an Advanced RISC Machines (ARM) microcontroller equipped with 7 infrared (IR) sensors and a central system that displays the top level of filled trash on a mobile browser on an html page over Wi-Fi [16].

3 . Methodology:

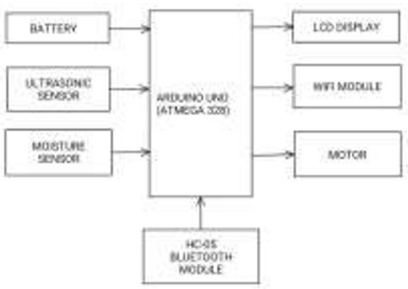

Fig.2. Block diagram of Trash Collector and Monitoring Boat

Figure 2 displays the proposed system's block diagram.When the system is powered on, all of the proposed system's sensors begin to function continuously. Here, the ATmega328p microcontroller serves as the robot's brain. In addition to these sensors, we also have a motors, motor drivers, Liquid Crystal Displays (LCDs), Wi-Fi modules, batteries, Bluetooth modules (HC-05), and toggle switches. Here, the moisture content and trash level in the bin are displayed via an LCD. One part of the suggested system is the L293D motor driver, which acts as an interface between the motors and Arduino. The robot that is connected via a Bluetooth module can be controlled to move in manual mode with the help of the mobile application.

3.1 Hardware description of the proposed system :

Turbidity Sensor: The Turbidity sensor module includes a waterproof lead, a driver circuit, and a connecting wire. The testing probe includes a transmitter and a receiver. A JST XH connector with three pins (VCC, ground, and output) is used to connect to the sensor. It runs at 5VDC with a maximum current of 30mA and can withstand temperatures ranging from -30 to 80°C.

DS18B20 Temperature Sensor: The DS18B20 digital temperature sensor uses a single-wire protocol and can measure temperatures from -67oF to +257oF (-55oC to +125oC) with ±5% accuracy. It supports data resolutions ranging from 9 to 12 bits and uses a 64-bit serial code to operate many sensors from a single microcontroller pin. A command triggers temperature conversion, and the resulting data is stored in a 2-byte register.

HC-05 Bluetooth Module: HC-05 could be a module designed for distant communication. This module can be used in either an ace or slave setup.Bluetooth serial modules allow all serial-enabled devices to interact with each other via Bluetooth. It can travel up to <100m, depending on transmitter and collector, air, geography, and urban environment.

16 * 2 Alphanumeric LCD : It offers tall adaptability to client as he can display the desired data on it. Liquid crystal display (LCD) is a flat electronic visual display that utilizes the light-changing capabilities of liquid crystals. LCs do not emit light specifically. LCDs subsequently require a light source and are classified as "detached" shows. LCD module has 61 x 15.8 mm seeing range Can show 224 diverse images.

L293D Motor Driver : The L293D Motor Driver IC contains sixteen pins. As the name suggests, it is mostly used to power engines. A single L293D integrated circuit may power two DC motors at the same time and regulate their routes independently.Every ground pin should be grounded. This IC has two control pins: one is the Vss (Vcc1), which supplies the voltage necessary for the IC to work; set this to +5V. The other is Vs (Vcc2), which supplies power for the engines to function; depending on your engine, you will connect this stick to anywhere from 4.5V to 36V.

Arduino Uno : The Arduino Uno board could be based on the 8-bit ATmega328P microprocessor.The Arduino Uno includes 14 digital input/output pins (of which 6 can be used for PWM outputs), 6 analog input pins, a USB connection, a Control barrel connector, an ICSP header, and a reset button.Arduino sheets may study analog or digital input inputs from various sensors and convert them into a result, such as starting an

engine, turning Driven on/off, connecting to the cloud, and performing a variety of other tasks.

3.2 Software description of the proposed system :

Install the Arduino Software (IDE) on Windows PCs: Get the foremost later adjustment from the download page. You will be between the Installer (.exe) and the Zip bundles. With the Zip bundle you would like present the drivers manually.When the download wraps up, proceed with the foundation and allow the driver foundation plan once you get a caution from the working framework.

Linking a Battery:
The board is powered by a battery while it is operating independently, as opposed to a USB connection to a computer. Although the external power source can be anywhere between 6 and 24, a common 9 V battery is more practical.

MC Programming Language-Embedded C:
This is the foremost broadly utilized programming language for implanted processors/controllers. Gathering is additionally utilized but basically to execute those parcels of the code where exceptionally tall timing exactness, code estimate efficiency, etc. are prime prerequisites. Implanted C is maybe the foremost prevalent dialects among Implanted Software engineers for programming Inserted Frameworks. There are numerous prevalent programming dialects like Gathering, Essential, C++ etc. that are frequently utilized for creating Implanted Frameworks but Implanted C remains prevalent due to its productivity, less advancement time and transportability.

Results :

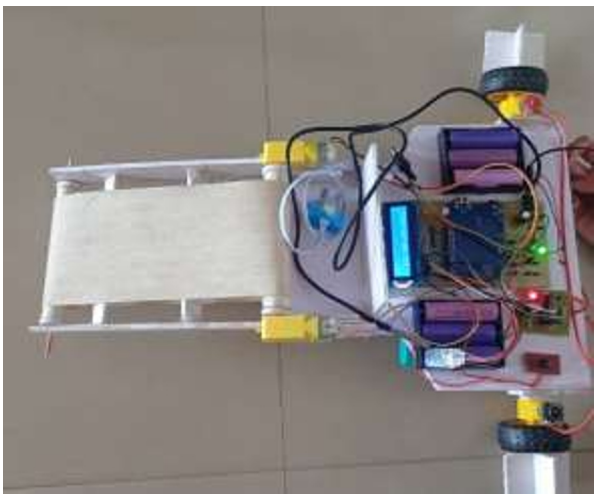

Fig 3: Model of Trash Collector Boat

By this prototype is able to remove a significant amount of trash, debris and other floating garbage from the rivers, oceans and other water bodies, making it cleaner and healthier for animals ,human beings, birds and all other living organisms as well as for environment too. Ultimately, the trash collector boat prototype stands as a tangible testament to the commitment to preserving our oceans and waterways, offering a tangible pathway towards a cleaner and healthier marine environment. Throughout the development process, considerations for the environmental impact of the trash collector boat would be essential. This would include assessing factors such as energy efficiency, emissions, and the potential for unintended harm to marine life.Overall, the result of the trash collector boat prototype development project would be a tangible step towards addressing the critical issue of marine pollution, demonstrating a potential solution that could have significant environmental benefits if scaled up and deployed effectively.

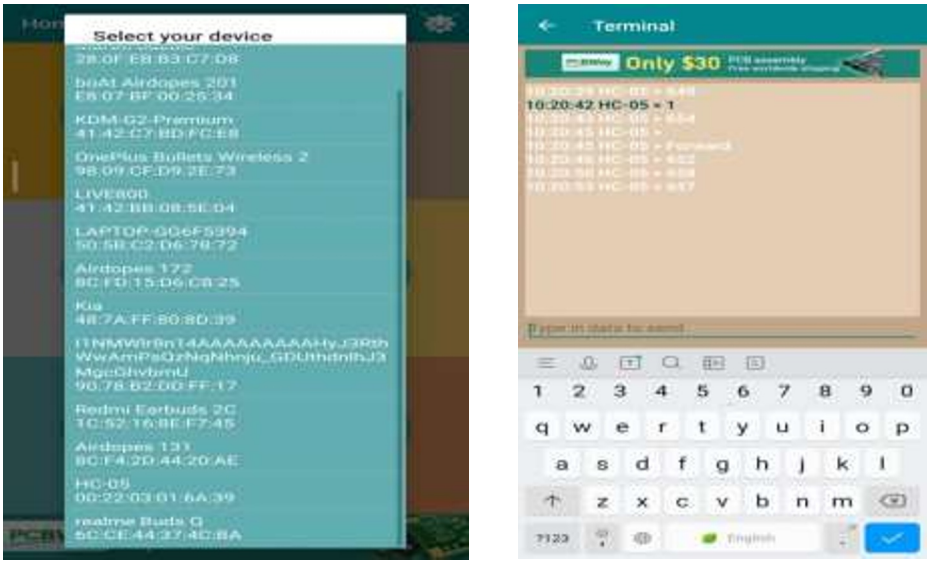

Fig 4: Controlling Boat using Commands on Mobile App

Conclusion :

A wide range of benefits are available for sustainable water management and environmental preservation when river cleaning boats are deployed. By safeguarding aquatic life, eliminating garbage and plastic waste, and preserving the natural balance of river ecosystems, these vessels effectively combat water pollution. The prevention of ecological damage and the financial impact that polluted rivers have on nearby towns demonstrate their long-term cost-effectiveness, even with the initial outlay. In addition, the interaction of river cleaning boats with nearby communities promotes consciousness and cooperation, which amplifies the efficiency of cleanup operations and cultivates a feeling of accountability among inhabitants. The dedication to enhancing the capabilities of these boats is further demonstrated by continuing technology developments such automated trash collection systems and environmentally friendly disposal

techniques.Moreover, river cleaning boats help governments and environmental organizations satisfy water quality standards, which is a crucial part of regulatory compliance. Consistent upkeep and sanitation guarantee compliance with environmental policies, bolstering ecosystems' general health. Essentially, the numerous advantages of river cleaning boats place them in a position where they are considered essential resources in the joint endeavor to protect our natural water resources and encourage a sustainable coexistence of technology and the environment.

To sum up, the use of river cleaning boats is a proactive and long-term solution to the problem of water pollution in rivers. These boats are going to be more and more important in maintaining and improving the condition of our waterways as awareness and technology develop.

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