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Water Cleaning Robot

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Abstract: *Water is essential to many aspects of our daily life. It is an amazing, essential source of life. Rivers and other bodies of water remain a major source of drinking water for many towns and communities. However, the quantity of trash in these bodies of water is more than just an annoyance; it is a danger to the environment, our lives, and the lives of those we care about. Trash accumulation in our rivers and creeks can be exacerbated by a single piece of garbage left on the ground. Even while the water is purified before it reaches our homes, it cannot be adequately purified to render it unsafe for human consumption if these bodies of water are still contaminated. To make sure maintaining our river systems and keeping them free of pollution is crucial to ensuring that water keeps flowing from our taps. These are what motivate us to work on this project. In an attempt to collect trash that floats in the aforementioned water bodies, we are developing an autonomous water surface cleaning robot that will navigate through them. Our primary objective is to maintain the cleanliness of the water bodies without human oversight. The robot will be given the zone to traverse while gathering the previously described trash and floating across the area. In order to offer real-time views and identify any waste materials in the water body, we also plan to install a camera on the robot. A belt that is attached to the The waste products are to be collected by boat. A conveyor belt transports the waste items to a collection station, where they are gathered and stored until the boat docks once more*

Keywords: Floating waste products; Autonomous; Conveyor belt

I. INTRODUCTION

An environmental issue that persists year after year and still hasn't been fully addressed is waste. We regularly discovered trash from a variety of locations that are emptied into reservoirs, rivers, or other waterways. Trash can obstruct the water's flow, making it soiled and foul-smelling, which leads to frequent overflows and natural disasters like flooding. Cleaning personnel and excavators are two examples of the many resources needed to remove waste from water areas.

The goal of this research is to develop a different approach to the waste issue in water areas.

By creating robotics technology that can function in water environments, this project seeks to offer an alternate approach to the waste issue in water areas. It is anticipated that the suggested applied research will provide a different approach to averting catastrophes, particularly floods. The primary function of the eco-robot, a robotics technology, is waste collection. The robot is made to be manually operated via a remote control. ADDIE is the development method used in this study. This approach entails analyzing the robotic cleaning system, designing and developing the robot, deploying the robot to clean waste in water-limited areas, and assessing the robot's efficacy in picking up trash in a larger area. The design and development are the main topics of this article.

The Ministry of Water Resources' Ganges River Action Plan included a successful test of the Ro-Boat in the Yamuna River in New Delhi. As stated by Fifty of these systems, according to the engineers who designed it, could purify the river in six months.

Fig. 1: Floating wastes

he Massachusetts Institute of Technology (MIT) has named the Ro-Boat technology as one of the top 20 most promising inventions to leave India in 2013. It was also named one of the top five water and drainage-related innovations of 2013 by US-AID.

The goal of the Ro-Boat's on going research and development is to increase its carrying capacity. Its developers are negotiating with the Indian government to increase its use.

Robots have been constructed in the past to clean the water's surface. A few findings that have addressed the creation of such a special purpose robot can be found in the open references. The goal of this project is to use the aqua robot to create a more adaptable and effective system. There's a great chance that this robot's capabilities will grow in the future. Activities like clearing away algae, leaves, and twigs, applying chemical sprays where needed, monitoring the water quality, and deploying payload are all intended to be carried out autonomously.

These features could save a significant amount of human labor and offer a long-term fix for the widespread issue. Numerous well-designed algorithms have already been developed for both single robotic systems and swarms for ground-based navigation and trash removal. These algorithms, however, cannot be applied directly to aquatic surfaces due to the disparity in the dynamic environment, propulsion system, and the challenge of precisely determining the current position based on relative velocity and acceleration. Additionally, the algorithms for navigation evolved. Maritime Traffic subsection

Fig. 2: Maritime Traffic

In the modern world, water pollution is becoming a bigger issue. Trash and chemicals are the two primary forms of pollution that are overflowing our ocean.

Nutrient pollution, also known as chemical contamination, is problematic for economic, environmental, and health reasons. This kind of pollution happens when chemicals from human activities—most notably the application of fertilizer on farms—runoff into rivers and eventually into the ocean. Algal blooms, which can be poisonous to wildlife and dangerous to people, are encouraged by the coastal ocean's higher concentration of chemicals like phosphorus and nitrogen. Local fishing and tourism industries are negatively impacted by algal blooms' detrimental effects on the environment and human health.

All manufactured goods that wind up in the ocean, the majority of which are plastic, are considered water trash. Eighty percent of this debris originates from onshore sources, and its accumulation is facilitated by storm winds, littering, and inadequate waste management. Cigarette butts, bottle caps, food wrappers, fishing gear, and other plastic items like shopping bags and drink bottles are examples of common marine debris. Because plastic waste lasts so long, it is a particularly problematic pollutant. It can take hundreds of years for plastic products to break down.

Animals and people are at risk from this garbage. Some animals mistake things like plastic bags for food and eat them, and fish get tangled and hurt in the debris. Tiny fragments of degraded plastic, known as microplastic, are consumed by small organisms, which then absorb the chemicals from the plastic into their tissues. Microplastics, which have been found in a variety of marine species, including plankton and whales, are less than five millimeters (0.2 inches) in diameter. The harmful substances enter the tissues of larger animals when they eat small organisms that consume microplastics.

In this manner, microplastic pollution moves up the food chain and eventually finds its way into human food. Prevention and cleanup are two ways to address these pollution issues. In today's world, single-use and disposable plastic is widely used in everything from plastic bottles to shipping packaging to shopping bags. It will take time and be financially difficult to change how society views the use of plastic. On the other hand, some items might be impossible to clean. Due to their inability to float, many types of debris—including some plastics—are lost deep within the ocean. When plastics do float, they often gather in big "patches" within ocean gyres.

One example of such a collection is the Pacific Garbage Patch, which spans an area of approximately 1.6 million square kilometers (617,763 square miles) between California and

Hawaii and is made up of plastics and microplastics that float on and below the surface of whirling ocean currents. According to the National Oceanic and Atmospheric Administration, these patches resemble flecks of microplastic pepper swirling around an ocean soup rather than islands of trash. To combat marine pollution, even some promising solutions fall short. Often, so-called "biodegradable" plastics don't decompose until temperatures are higher than what the ocean can ever reach.

Trash in Bodies of Water

Fig. 3: Tangled Trash

When poorly managed trash finds its way into waterways, it can lead to a variety of issues. Aquatic trash contaminates the outdoor areas that we rely on for recreation and tourism, damages water quality, and puts plants and animals in danger. All forms of aquatic waste have the potential to be harmful, but plastic waste is especially problematic due to its widespread production, use, and disposal as well as its propensity to persist in the environment.

Because plastic pollution does not completely biodegrade in the environment, it is especially dangerous. Numerous organisms and environments, including coral reefs, estuaries, beaches, and the deep sea, have been found to be contaminated by plastic. Plastic keeps building up in landfills and the environment because it doesn't break down.

Plastic aquatic debris can directly obstruct navigation, hinder commercial and recreational fishing, endanger health and safety, and decrease tourism, in addition to deteriorating the habitats and ecosystem services that humans depend on. The biggest danger to vessel navigation comes from large debris, like abandoned fishing nets and lines that float at or slightly below the surface. Nets and lines can entangle themselves in motor intakes and wrap around propellers. Additionally, ships may collide with big objects, causing damage to propellers and hulls. More than $5 million is spent annually by coastal communities to combat litter and keep trash from ending up as marine debris. Finding practical ways to lessen the amount of trash that enters our waterways and contributes to marine debris is further justified by the financial burden on the public.

II. LITURATURE SURVEY

During the months of August, September, October November of 2024, a literature review for this project was completed. The literature addressing the advancement of automated water robots received the majority of attention.
References contains the literature sources that are relevant to each input. These information sources came from the following literary journals.

1. Waste Material Detection Through Image Processing and Deep Learning
The purpose of this paper is to design and build a deep learning framework that can be applied to waste segregation with success. Using the idea of a convolutional neural network and an image processing technique that distinguishes waste based on its size, shape, color, and dimension, the image will be identified. This method will automatically assist the system in identifying the relevant features from the trash sample images and subsequently identifying those features in fresh images.

2. UAV and USVs' automatic cooperative water surface coverage and cleaning technique
The foundation of this research is the creative establishment of a system architecture for the collaboration between UAVs and USVs, as well as the design of an autonomous water cleaning method. In order to facilitate autonomous navigation and collaborative cleaning, we must create an autonomous obstacle avoidance path planning technique for our robot.

3. A Review of Deep Learning-Based Object Detection
An outline of deep learning's evolution and the convolutional neural network, which is its paradigm. Next, we focus on common generic object detection designs, along with a number of tweaks and useful advice to improve detection performance even more. Training models with custom training datasets will undoubtedly benefit from this study.

Robot for Cleaning Ponds
The robot in this journal safely disposes of waste materials in the water body after removing them from its surfaces. The Godavari River in Nashik is cleaned of waste, plastics, and trash by the Bluetooth-enabled pond cleaning robot. The fundamental configuration and design that ought to be included when creating such a robot have been highlighted by this literature journal.

GPS and GSM-based tracking system based on Arduino
Tracking System based on Arduino Using GSM and GPS The microcontroller integrates GPS and GSM into a location tracking system. It is used to find cars or anything else that is linked to a GPS tracking device. The proposed system made good use of two commonly used technologies: an Arduino UNO and a smartphone. GPS is a navigation system that provides precise location and data by using satellites. The GSM module is used to send and receive updates from the object location to a database.

SMURF
A Completely Self-Sustained Water Surface Cleaning Robot Using a New Coverage Path Planning Technique: SMURF is a fully autonomous water surface cleaner equipped with state-of-the-art sensors and a unique coverage path planning method. It monitors environmental parameters and gathers and stores trash and pollutants. Operators can remotely control and monitor SMURF, making it a promising technique for maintaining the health and cleanliness of water bodies.

The Yolov3 Detection Method for Vision-Based Water Surface Robots: A Modified Approach
The Yolov3 Detection Method for Vision-Based Water Surface Robots: A Modified Approach A modified Yolov3 object detection technique is presented in this paper for a vision-based water surface garbage capture robot. It uses computer vision and deep learning methods to increase the robot's speed and accuracy in object detection. The accurate data provided by the modified YOLOv3 method helps to maintain ecosystem health and water quality.

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An Android-Based Controller for an Intelligent Autonomous Floor Cleaner

The goal of developing a smart autonomous floor cleaner with an Android-based controller is to produce a cleaning robot that can navigate and clean floors on its own while being managed and observed via an Android device. In order to navigate effectively and stay clear of obstacles while cleaning, it combines mapping, path planning, and obstacle avoidance algorithms. Features like virtual boundaries, cleaning mode selection, and scheduling options might also be included.

III. METHODOLOGY

NEO-6M Module

Compact, low-power, and reasonably priced, the GPS NEO-6M module is widely used in a variety of applications, including asset tracking, robotics, navigation systems, and unmanned aerial vehicles (UAVs). It is based on the industry-leading u-blox.

Fig. 4: NEO-6M

GPS chipset technology, which even in difficult situations with poor signal strength or interference, offers high sensitivity and outstanding performance in acquiring and tracking GPS signals. It is a popular option for GPS applications due to a number of features, including serial communication, low power consumption, NMEA protocol support, and compact size. Because of its low power consumption design, it can be used in battery-powered applications where power efficiency is essential. A dependable, affordable, and user-friendly way to add GPS functionality to a variety of projects and applications is with the NEO-6M module.

Accurate time information, a ceramic patch antenna integrated into the device, multi-GNSS support, configuration and control, and accurate and dependable positioning performance are all features it offers. Under typical circumstances, it can achieve vertical positioning accuracy of about 10 meters and horizontal positioning accuracy of a few meters. Numerous settings can be customized by using AT commands to configure and control it. In order to extract the required GPS information, integration and development entails serially connecting it to the host system and parsing the NMEA sentences that are received from the module. More sophisticated GPS modules are available from U-blox in their product lineup for applications needing more features or greater accuracy.

Module HC-05

One well-liked and frequently utilized module for wireless communication between electronic devices is the HC-05 Bluetooth module. It has a communication range of up to 10 meters and is based on the Bluetooth 2.0+EDR specification. It uses a serial interface, also known as UART, which supports common serial communication protocols like 8-N-1, to communicate with the host system. AT commands can be used to configure and control the module, which can function in either master or slave mode. Depending on the surroundings and any possible obstacles, the range may change.

The HC-05 Bluetooth module is a convenient and reliable solution for establishing wireless communication between electronic devices. Its AT commands allow users to customize settings such as the Bluetooth device name, pairing code. operating mode and communication baud rate. It uses a 3.3V power source and facilitates encrypted and safe communication via the Secure Simple Pairing (SSP) protocol. It has uses in a number of fields, including robotics,

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wireless sensor networks, Internet of Things (IoT) initiatives, home automation, and more. Verifying compatibility and consulting the manufacturer's documentation and resources are crucial when utilizing the HC-05 module.
To make it easier to integrate and use the HC-05 module in various projects, online tutorials and libraries are available.

Fig. 5: HC-05 module

HMC5883L Module

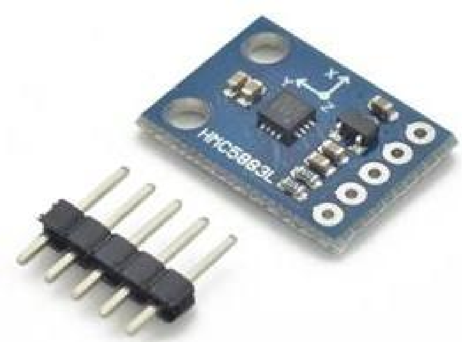

Fig. 6: HMC5883L

A three-axis digital compass module for magnetic field measurement is the HMC5883L. It has a three-axis magnetometer that uses the X, Y, and Z axes to measure the direction and strength of magnetic fields. There is a digital output for the magnetic field measurement data, enabling compatibility with a range of development boards and microcontrollers. With a resolution of up to 0.2 millimeters and an accuracy of 2-3 degrees on average, it provides excellent precision and resolution in magnetic field measurements.
The module offers various operating modes to maximize power consumption and measurement speed, and built-in calibration functionality corrects for external magnetic interference or offsets.
Range, data-adjustable output rate configuration, and automatic gain control are examples of integrated measurement features. It is a well-liked option for projects needing magnetic field sensing and orientation determination because it is extensively supported by a variety of libraries and code samples available for various microcontrollers and development platforms.

A2212/6t 2200kv BLDC Motors

Fig. 7: A2212/6t 2200kv BLDC Motors

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Multirotor drones and remote-controlled (RC) aircraft both use the brushless A2212/6T 2200KV motor. It is distinguished by its particular designations, which include "A2212," "6T," and "2200KV."

It uses brushless technology, which has benefits like increased longevity, lower maintenance needs, and higher efficiency. It can produce a significant amount of power considering its small size, and it is frequently utilized in multirotor drones, RC airplanes, and other related projects. A variety of electronic speed controllers (ESCs) can be used with it.

Electronic Speed Controllers

Fig. 8: Speed controller

A popular tool for managing brushless DC (BLDC) motors is the ESC (Electronic Speed Controller) 30A. By receiving control signals from a compatible controller and modifying the motor's speed and direction appropriately, it acts as a bridge between the BLDC motor and the power source. It uses Pulse Width Modulation (PWM) to regulate the motor's speed and is built to withstand a continuous current of up to 30 Amps. A built-in BEC is a feature of many ESC 30A models that supplies a controlled output voltage to power other system components.

Brushless DC (BLDC) motor speed and direction can be controlled with the ESC 30A, an electronic speed controller. As long as the motor's power needs are within the ESC's current handling capacity, it works with a variety of BLDC motor types. The motor and ESC are protected from harm by safety features like current limitation, low voltage protection, and over-temperature protection. For ESC 30A units to operate as efficiently and safely as possible, initial configuration and calibration are frequently necessary, and correct installation and wiring are crucial. For dependable and secure operation, proper setup, installation, and adherence to safety regulations are crucial.

Objective Location of the Robot

GPS localization is more than just being aware of one's precise location within the Earth's reference frame. Think about a robot interacting with people. Even though this robot must determine its exact location, it is just as crucial to determine its relative location to the target humans. Identifying people with its sensor array and calculating its relative position to them can be part of its localization task. Additionally, a robot will choose a plan of action to accomplish its objectives during the Cognition step. If its goal is to get to a specific place, localization might not be sufficient. To help it plan a route to the objective, the robot might need to create or obtain an environmental model, such as a map. Once more, localization entails creating a map and then figuring out the robot's position in relation to it, rather than just figuring out an absolute pose in space. All of the aforementioned localization techniques obviously rely heavily on the robot's sensors and effectors. Localization presents challenging issues because of the imprecision and incompleteness of these sensors and effectors. Important facets of this sensor and effector suboptimality are highlighted in this section.

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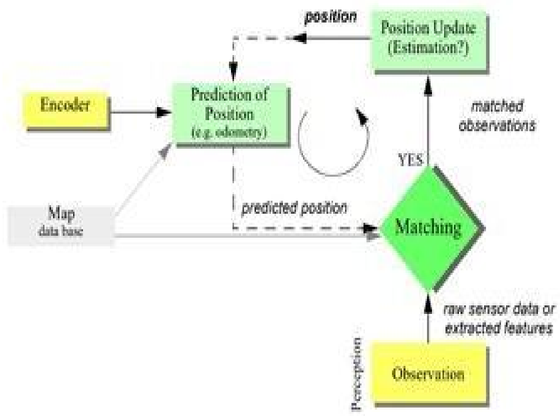

Fig. 9: Block Diagram

Waste Detection System -

Fig. 10: Floating Waste Detection

There are more steps involved in trash classification. Only after image pre-processing do the image flow steps become involved. To improve the segregation training process, pre-processing is applied to the trash dataset images. DNN, SGD, and deep learning were used to extract the classified features from the image pre-processing. Additionally, this approach was used in the trash classification training process.

Deep Convolutional Neural Network

In image processing, deep convolutional neural networks were the most important technological advancement. Deep learning and machine learning were becoming more intelligent at predicting patterns. The DNN algorithm typically consists of two layers or more and has a certain amount of complexity. This technique was used for both image pre-processing and acquisition. We can now easily train computers to recognize, categorize, and detect the various types of objects within an image with high precision and accuracy thanks to the availability of vast amounts of data, high-speed GPUs, and optimized algorithms. By applying filters to inputs, it teaches a computer to recognize and anticipate information. Images, text, or audio can be used to convey observations. Deep learning draws inspiration from the way the human brain processes information. Its aim is to do some real magic by mimicking the way the human brain works.

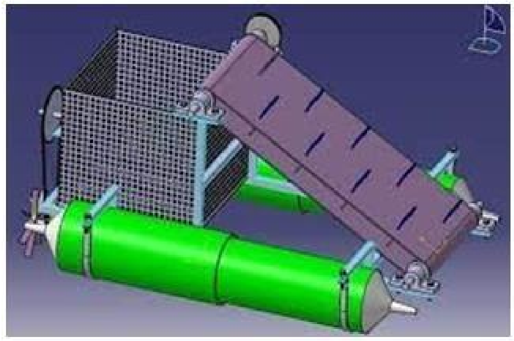

Fig. 11: Robot Model using a Conveyor belt

Waste Collection Methods –

These floating debris can be gathered and brought back to shore using a variety of techniques. Identifying the method by which the floating waste materials can enter the robot is the first issue that needs to be resolved. This can be resolved by creating and putting into use a conveyor belt system that works in our natural environments.

The next problem that comes up is the kind of storage that must be made for the robot in order to hold these waste particles. One solution to this problem is to have the robot pull the plastic mold or storage container behind it as it follows the path.

The other solution is to mount the storage unit on top of the robot, which may change how much space the robot needs.

IV. RESULT

The goal of the Water Cleaning Robot project was to create an autonomous robot that could efficiently clean polluted water sources like ponds, rivers, and lakes. In order to preserve and restore aquatic ecosystems, the robot was made to remove different kinds of debris and pollutants.

The outcomes of the robot's development and testing are shown in this project report.

1. Design and Construction

• To determine the best design for an autonomous water cleaning robot, a great deal of research was done.

• To ensure the robot's suitability for aquatic environments, it was built with sturdy, water-proof materials.

• To efficiently collect and remove pollutants, it was outfitted with a collection mechanism, onboard sensors, and a strong propulsion system.

Design Process-

Fig. 12: Initial framework

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The water cleaning robot body that was created for this project performed and functioned exceptionally well. Its longevity, water resistance, maneuverability, and ease of maintenance were all influenced by the materials used, the waterproof construction, and the ergonomic design. The effective integration of pollutant detection, collection, and filtration mechanisms was made possible by the **body's** compatibility with other systems. These findings demonstrate the successful creation of a water cleaning robot body that can withstand aquatic conditions and support the robot's objective of efficiently cleaning and restoring water bodies.

Material Selection –

- A great deal of thought and investigation went into choosing appropriate materials for the robot body's construction.
- The materials that were selected were strong, light, and impervious to environmental factors and water.
- Great care was taken to choose materials that wouldn't break down or discharge dangerous substances into the water.

Fig. 13: Final Framework

Conveyor Design

Fig. 14: Conveyor design

Conveyor belts made of PVC pipes provide a flexible and affordable way to move materials across a range of industries. PVC pipes offer a lightweight and long-lasting foundation for conveyor system construction.

In order for the conveyor to successfully collect the waste materials from the water, the next step is to choose and incorporate a belt material.

V. CONCLUSION

To sum up, autonomous river cleaning robots are sophisticated robotic vessels made to clean rivers and other bodies of water on their own. Navigation systems, cleaning systems, filtration systems, energy sources, communication systems, and safety features are just a few of the features and technologies they integrate. Using their abilities to navigate

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waterways, gather pollutants and debris, filter water, and send data for monitoring and analysis, these robots work autonomously.

Environmental conservation will greatly benefit from the development of autonomous river cleaning robots. By effectively clearing debris and pollutants from rivers, they contribute to the preservation of water ecosystems and the reduction of pollution. These robots contribute to the preservation of marine life, the prevention of water source contamination, and the general cleanliness of water bodies.

These robots can work continuously, covering vast areas and adjusting to various river conditions thanks to their advanced technologies and autonomous capabilities. By decreasing the need for manual labor and boosting cleaning operations' efficiency, they provide a sustainable and affordable river cleaning solution.

The development of autonomous river cleaning robots has enormous potential for the future, even though there are still obstacles to be solved, such as managing complicated debris or dealing with particular local conditions. We can strive toward healthier and cleaner rivers and help create a more sustainable planet by fusing technological innovation, environmental stewardship, and teamwork.

REFERENCES

[1]. ”Deng T, Xu X, Ding Z, Xiao X, Zhu M, Peng K. “. Automatic collaborative water surface coverage and cleaning strategy of UAV and USVs. Digital Communications and Networks. 2022 Dec 28.

[2]. Zhao, Zhong-Qiu, Peng Zheng, Shou-tao Xu, and Xindong Wu. ” Object detection with deep learning: A review.” IEEE transactions on neural networks and learning systems 30, no. 11 (2019): 3212-3232.

[3]. Soumya, H. M., and Basavaraj Gadgay. ”Pond Cleaning Robot.” International Research Journal of Engineering and Technology (IRJET) 5, no. 10 (2018).

[4]. Mitra, Arghadeep. “”Detection of Waste Materials Using Deep Learn- ing and Image Processing.” PhD diss., California State University San Marcos, 2020.

[5]. Htwe, Thin Thin, and Kyaw Kyaw Hlaing ”Arduino based tracking system using GPS and GSM.” International Journal for Advance Re- search and Development 4, no. 8 (2019): 11-15.

[6]. Li, Xiali, Manjun Tian, Shihan Kong, Licheng Wu, and Junzhi Yu ”A modified YOLOv3 detection method for vision-based water surface garbage capture robot.” International Journal of Advanced Robotic Systems 17, no. 3 (2020):1729881420932715