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Aqua Guard: - Guardian For Ocean Oil And Garbage Cleanup

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Abstract— The lives and health of those who depend on marine and coastal habitats are negatively impacted by oil spills, which also severely disrupt these ecosystems. On January 28, 2017, a significant oil leak had considerable effect on Chennai, an Indian coastal metropolis home to nearly 7 million people. Plenty of money is required to get clean from the destructive damages. Skimming is a popular and efficient way to remove oil from water surfaces fast, especially in emergency situations such as oil spills. These devices are made to draw in and gather floating oil while yet permitting water to flow through. Due to density difference, skimming is very reliable. In addition to lowering the risk to human life, it also lowers the cost of physical labor. Our device cleans wastes found, such as plastic wastes, wreaths, bottles, and other wastes found coasting on water. The instruments used for our plan are such that they collect the waste that glides on water bodies and that the collected waste can be efficiently arranged into the container. Plastics have the ability to disintegrate into smaller pieces, releasing potentially hazardous substances. In the study both serious problems were solved with the help of robots which have the capabilities of separating oil and water and collecting in the tank and also garbage collection in the other tank. Motors and electronic circuits have been moved to the platform to be dry and protected from the

elements. Robot is controlled automatically by motor driver, Arduino, sun board, joystick(controller), etc. The robot prototype's ability to gather rubbish and return to the waypoint was demonstrated during testing.

Keyword-Oil spill, skimming, density difference, garbage collector, tank, sun board.

INTRODUCTION

The World Health Organization (WHO) defines polluted water as water whose composition has changed to the extent that it is no longer fit for human use. It's toxic water that is unfit for human consumption or use in critical industries like agriculture. It also harbors the potential to spread illnesses like cholera, dysentery, typhoid, poliomyelitis, and diarrhea. It produces a plethora of problems, including increased dangerous amounts in the water. This toxic concentration has harmful consequences on the food chain, which affects humans. Marine animals can become entangled in or ingest plastic debris, leading to injury or death. This affects a wide range of species, including seabirds, fish, sea turtles, and marine mammals. The production, transportation, and disposal of plastics contribute to greenhouse gas emissions, contributing to climate change.

According to studies, the consumption of oil has increased recently. Oil pollution, usually the most dangerous environmental concern, endangers both ecosystems and economy. Its widespread influence jeopardizes biodiversity and resource sustainability. To address this, governments impose stringent restrictions for cleaning oil-contaminated wastewater, mostly from the petrochemical and industrial sectors. These rules reduce dangers, protect ecosystems, and increase economic resilience.

The most recent and cutting-edge technology should be applied to quickly and effectively contain and clean up oil spills and slicks. As a result, these businesses are required to use oil skimmers in order to remove the oils from the disposal water. The robot is made in such a way that its clean reservoir and developed for replacing labor, cleaning waste on ocean, rivers and also to segregate oil from water. The designed robot framework resembles a boat floating on the water. Contains two tanks built within it to catch waterborne oil and debris. Belt is made with the help of neoprene substance which have capability of absorbing oil. With a joystick, it may be moved in any direction. Connection between robot and joystick has been made using the Wi-Fi module. Controller contains two buttons, one is for moving forward and reverse and second button is used for changing the direction.

LITERATURE REVIEW

1. The design of the canal water purification machine is based on study and writing on different diaries and papers that are readily available, manufactured in accordance with specifications, and may provide flexibility in use. It is anticipated that the paper "Designing of Water Trash Collector by Seabin" will be particularly useful and beneficial to pond and canal cleaning. Modern governments are becoming increasingly fascinated. Modern terminal operations are becoming increasingly unmanned as a result of the growth of programmed terminal administrations. To reduce the amount of effort done by humans, the skimming waste can be gathered by the framework moving along the channel. During the heavier downpours, when there was more rushing water with trash and a higher speed, the cleaner operated successfully.

2. A detailed presentation of the Ocean Bottom Trash Collection Robot's structure is made. Compared to a fan or rotatory mechanism, the two arms' tiny surface wave amplitude is caused by

plastic pipes. Variations in mechanism have a significant impact on the collecting system. The conveyor's designed capacity was satisfactorily assessed. By constructing a central server, the robot may be managed and observed. There are no processing hardware limitations while using the image processing algorithm. In addition, the system might cover a wide range of use scenarios. It is especially useful for collecting radioactive trash in areas where it is dangerous for people to be present. The idea is mainly to create a "smart ocean."

3. This work has focused on the application of the USV element to the development of a water trash collector. When designing the WTC's hull, the catamaran type was chosen for maximum stability and to hold the waste collector between the space hulls. Utilizing Smart Drive Dual and Fly Sky controller, the power system and control system for carrying out the gathering task are developed. The use of WTC can lessen the possibility of drain blockage and water contamination in small lakes. Utilizing cells to supply the electricity system promotes environmental sustainability.

4. An article proposed a water surface robot with wireless connectivity. The study concentrated on the Waste Hunter Surface Robot, which cleaned surfaces, filtered water, and monitored water quality. It was semi-automated, responsive to operator input, and could be turned on and off. The user and robot communicated via a wireless controller and a WI-FI-based protocol, using cell phones running the Blink virtual button keypad software. The Node MCU microcontroller allowed human-robot interaction.

5. Focus on the Analysis and Design of the River Water Purification Device. The study looked at the flow conditions of our country's waterways, which are piled high with hazardous items, debris, and poisons in addition to being emptied of millions of litters of sewage. Considering this, the purpose of this equipment is to clean the surface of a canal. Almost all of the assembly process these days is being atomized in order to provide the goods more quickly. A huge portion of large-scale production is automated. We have currently developed a remote-operated waterway cleaning device. The key idea of the suggested model reducing effort and time spent cleaning the stream is the idea. The mobile apps will have several features, including a virtual keypad for controlling the robot and, when it is linked to a WI-FI module, a propeller control (virtual joystick) for controlling the robot's movement.

METHODOLOGY

This section described the proposed model. The model is made using a sun-board which is a hard sheet.

The proposed model is made from Arduino Nano, 12V battery, two DC motors, nRF24L01 modules, sun-board, pipe neoprene rubber sheet, bearing, jumper wire, etc...

This boat uses cutting edge technology to address the problems caused by oil spills and floating trash in marine areas. The main parts of the system consist of two DC motors for the waste conveyor, one more DC motor for the oil conveyor, and two more DC motors for the boat's left, right, front, and back propulsion. A motor driver is included to control the propeller's DC motor speed precisely, ensuring exact control over the boat's movement. Relays are used to regulate the garbage and oil conveyors, offering an effective way to manage the collection activities. Also, the conveyor belts are made from neoprene rubber which have the ability to absorb oil.



Fig (1) Proposed Model (Side View)

The AquaGuard uses a 12V battery as its power source, which guarantees a dependable and sustainable energy source for prolonged operation. Two nRF24L01 modules enable communication between the transmitter and receiver, which adds to the reliability and effectiveness of the wireless control system. The transmitter interface has two joysticks that provide easy control over the boat's motion and two switches that let the operator regulate the oil and rubbish conveyors separately. This well-thought-out control system guarantees that the AquaGuard can be maneuvered precisely to navigate difficult marine situations and effectively fulfill its dual mission. Modularity and efficiency were given top priority during the project's design phase, which resulted in the use of DC motors for their dependability and accuracy in operating the boat's many systems



Fig (2) Top view

Arduino Nano was the brains of the project since it provided a flexible and adaptable platform for handling the intricate synchronization of several motors and conveyors. The Arduino Nano is designed to decipher signals from the transmitter and convert joystick and switch inputs into commands that can be used to operate the boat's cleaning and propulsion systems. The nRF24L01 modules were used to create the wireless communication system, which was selected for its dependability and range—factors that are critical in maritime conditions where signal integrity is critical.

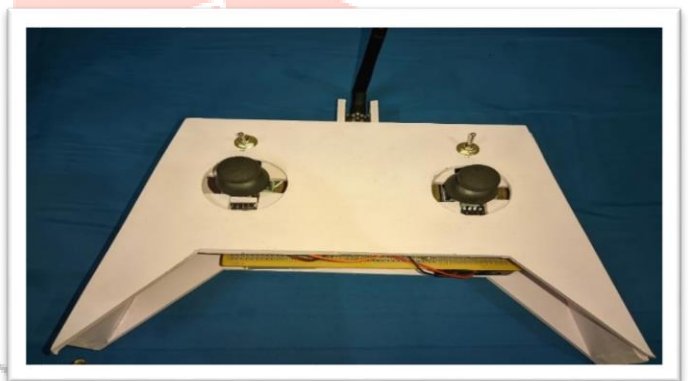
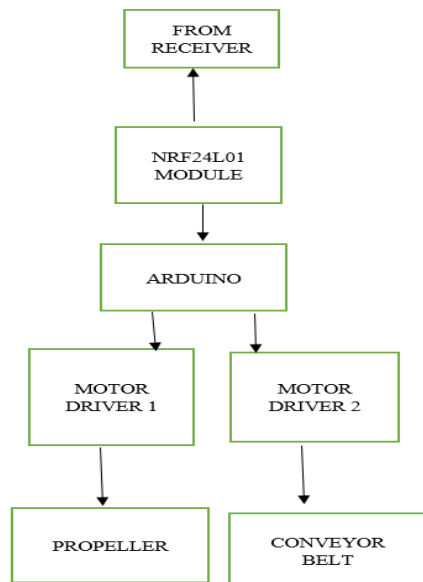


Fig (3) Joystick (Controller)

The Joystick (controller) provided with two buttons i.e. RSB (Right Side Button) and LSB (Left Side Button). The RSB has the function of changing the direction of boat. These can be achieved with the help of motor driver which control the RPM of propeller. So, if the boat requires to move left, then the motor driver reduce the RPM of left propeller and vice-verse.

FLOWCHART



The proposed model work on the shown flowchart.

RESULTS AND DISCUSSION

Proposed model contains two function i.e. collection of garbage from water surface and separation of oil from the water surface. Moving forward, backward and changing the direction of boat is controlled from the Joystick(controller).



Fig (4) Floating test

Testing for floating is conducted in the swimming pool. Two large hollow pipes are provided to float on the water surface. Range is considered with the help of antennas which is installed on the joystick. The whole mass of the boat is approximately about 8kg.

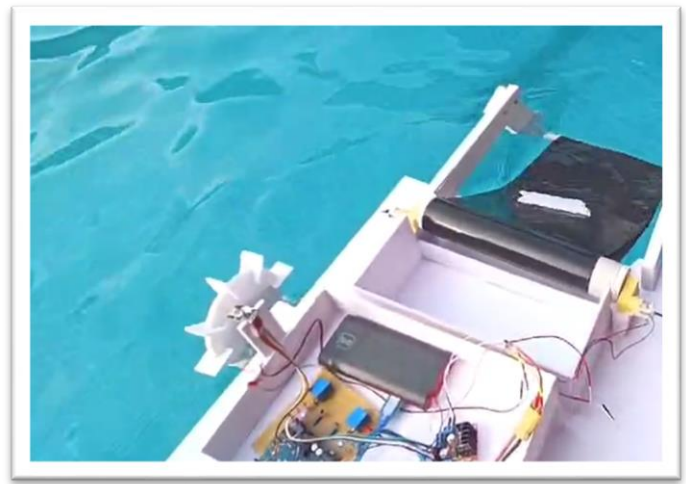


Fig (5) Garbage Collection test

The collection of trash or garbage is collected with the help of conveyor belt. The belt is provided with screw so that the inclination and declination angle can be adjusted according to the condition. Garbage collection test also conducted with the various items plastic bottle, sun board etc.

Oil is also collected with the conveyor belt with the high inclination with respect to the water surface.

CONCLUSION

The implementation of garbage collector boats represents a commendable and innovative solution to address the escalating issue of water pollution in our water bodies. These purpose-built vessels are designed with the primary goal of collecting and removing various forms of debris, waste from rivers, lakes, and oceans. Moreover, garbage collector boats not only contribute to environmental conservation but also raise public awareness about the importance of keeping water bodies clean. the deployment of boat containing oil separator mechanism represents a pivotal advancement in safeguarding our oceans from the detrimental effects of oil spills. By employing cutting-edge technologies such as skimming systems, absorbent materials, these boats can significantly reduce the impact of oil pollution on marine ecosystems.

FUTURE SCOPE

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It is possible to improve the structural design in order to increase its ability to withstand strong waves and maintain functionality in shallow water. Either an ultraviolet (UV) or infrared (IR) sensor can be used to detect debris; the choice depends on how well operating range and cost-effectiveness are balanced. Furthermore, adding antennas and conducting remote operations from the reservoir's banks might further increase the detection range. In order to have a more profound understanding of the effectiveness of oil recovery, a wide range of experiments should be carried out with different oils and different types of belt materials. This would help determine the best combinations for recovering oil. The system should also be able to remove waste that is submerged beneath the water's surface. Moreover, the collection of data concerning the quality of the water, along with the understanding of the sorts of contaminants obtained from the machine learning model, may be utilized to establish local rules. In addition to reducing pollution, these restrictions would raise public awareness of the kinds of materials that eventually end up in the ocean and other major bodies of water. To ensure the system's robustness in extreme conditions, it's crucial to select materials with high endurance to environmental stressors. Thermal regulation is vital, using insulation or cooling systems to prevent damage from temperature extremes. Structural integrity must be analysed to withstand various forces, and simulations alongside physical tests are essential for predicting system behaviour under different scenarios. Design verification against stringent standards, rapid prototyping for real-world testing, and a focus on component reliability are key.

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