

Design and Construction of an Automated Boat that Removes Debris from the Ocean

Reginald Hart¹ and Tammunoipine Pollyn²

Electrical Electronics Engineering Technology
Federal Polytechnic of Oil and Gas, Bonny, Nigeria^{1,2}

Abstract: *Water bodies have a huge aquatic ecosystem within them. Any high concentration of suspended solids can cause numerous issues for aquatic life by blocking light from reaching submerged vegetation, hence there is a need for a solution to remove this debris from the water bodies. This project design and construction of an automated boat to remove debris from the ocean is focused on developing a robust and efficient prototype solution for autonomously collecting and managing marine Debris, thereby contributing to environment conservation. The two-channel remote control with receiver will enable the boat to navigate predefined routes, identify and collect debris using specialized mechanism and return to a designated collective point. The Two-Channel remote control system allows for precise maneuverability and control over the boat's function. Through a combination of engineering principles, propellers, conveyer belt, tread mill arrangement and shafts. this project aims to address the critical issues of ocean pollution while showcasing the potential for remote controlled boat in maritime environmental management. The anticipated outcomes include a functional prototype, comprehensive operational documentation and preliminary performance assessments, setting the stage for potential scalability and deployment in real-world Ocean clean up initiative.*

Keywords: DC Motors, Conveyor belt, propellers, tread mill arrangement and shafts

I. INTRODUCTION

Our world is facing a severe environmental crisis caused by pollution, and one of the biggest contributors to this problem is the accumulation of plastic waste in our oceans. Ocean pollution poses a threat to marine life by causing habitat destruction, entanglement ingestion and chemical contamination. It also affects coastal communities and industries that depend on clean and healthy oceans for fishing, tourism and recreation. The conventional method requires more human interference. Such a method of cleaning is risky, costly, and highly time-consuming as it may need more human labor. Thus, there comes the need for a sophisticated system that is eco-friendly and works efficiently. The river surface cleaning water boat is one of such system. This systematic method can remove the waste debris from water bodies with comparatively less human interference. The architecture of this prototype consists of a cleaner mechanism for collection and removing waste from water bodies using a belt driver mechanism. The conveyor belt that is powered by a battery continuously rotates in a backward direction by taking water debris into the collector bin. The boat moves in the direction given by the person holding the two-way controller. This machine is controlled remotely.

II. OBJECTIVE

- To construct a boat that uses a two-channel remote control and receiver
- The boat will be controlled by radio control transmitter
- To reduce the amount of manpower and time needed to clean the river.
- To use a debris management boat to remove debris on the ocean

III. LITERATURE REVIEW

MS A. Sujatha Reddy *et al* (May 2023),, "RIVER SURFACE CLEANING WATER BOAT",(1). The researcher proposed system prototype that can float on water and moves in all the possible directions for collecting the solids floating on the water. It is a working prototype of a water cleaning mechanism that collects floating debris and stores it in a

collector's bin on its own. It can be programmed, scaled up to any size and can operate remotely. The movement of the cleaning boat is monitored using the camera installed in the boat. The power supply powers the boat to perform its operation. The motor driver handles motors with directional and speed controls. Motor 1 and Motor 2 are being controlled by the motor driver. These two motors are responsible for moving the propellers of the boat. The motors controlled using the Mobile app named Arduino Bluetooth Controller that is connected to the boat through Bluetooth. The navigation keys on the terminal mode of the mobile app can be F for forward, B for backward, R for Right and L for left. Similarly, Start and Stop keys are for starting and stopping the motion.

Shubham Chikhalkar *et al* (May 2022) "Design and Fabrication of River Water Cleaning System", (2).

The researcher developed a "River cleaning machine" prototype, which is used in the removal of waste debris from water bodies. It is a waterwheel driven mechanism that is used to collect and remove waste, garbage and plastic wastes from water bodies. The collection of debris will also be easier, as a machine will lift the waste materials from the surface of the water. This will reduce water pollution, as well as reducing aquatic animal deaths. The project consists of belt drive mechanisms which lift debris from the water. This will be used to remove surface water debris from rivers, ponds, lakes, and other water bodies.

Drainage pipes are used for this purpose and unfortunately sometimes human life may be lost when cleaning blockages in drainage pipes. This type of problem is solved with the river cleaning machine. In the lower basement, the device is placed across a river and sea so that only river sand can pass through. Any floating waste, such as bottles, plastic cans, covers, etc., is lifted by lifters attached to the chain. The chain moves through the sprocket wheel that is driven by the motor. The energy supplied to the motor is electrical energy. As the motor runs, the chain starts to circle making the lifter lift up. The waste material is lifted by lifter teeth and deposited in the collecting box. Upon filling the collecting box, the waste materials are removed. The bottom of the box has a 45-degree bend plate, which is used to level the riverbed. The material we are going to use is M/S Mid-Grade, which is easily available in the market at a lower price than other materials. As the rollers are allowed to move inside the drainage, the buckets will move inside the drainage and settle on the material inside the drainage block. This is because the rollers rotate. The two rollers are connected to each other through belt drive, on which perforated buckets are mounted. The bucket will pick up waste material and floating material from the drain block. The bucket will allow water to flow out as it is perforated, and only waste material will be collected into the belt-driven storage container.

Walsh Tony Fernandes¹ *et al* (June 2020), "BEACH CLEANING BOT",(3). This research project is designing and fabricating a Wireless Beach Cleaning Robot. The coastlines of Sri Lanka are one of the country's most popular tourist destinations. That is polluted irresponsible human behaviour. Although the Sri Lankan local government institutions have cleaned up the coast, some areas are neglected for various reasons. The main reason is that cleaning is difficult. It requires a considerable amount of time and resources. The debris must be picked up by hand by the workers. Sewage sedimentation caused by coastal breezes has become a significant issue. That makes identifying the contamination challenges. It is difficult for workers to clean up as they dig the beach to collect that waste..

"Design and Fabrication of River Waste Cleaning Machine" by Sirsat, P. M., Khan, I. A., Jadhav, P. V., & Date, M. P. (2017),(4). Design and fabrication of river waste cleaning machine. IJCMES, (1). As discussed in this paper, the focus is on the design and fabrication details of a river waste cleaning machine. The work has been done based on our current situation, in which our national rivers are contaminated with millions of gallons of sewage and loaded with pollutants, toxic materials, debris, and other toxins. With a view to cleaning rivers in India, the Government has invested vast amounts of capital into a number of river cleaning initiatives like "Namami Gange", "Narmada Bachao", and various major and medium projects in cities like Ahmadabad, Varanasi, etc. This machine is designed to clean river water surfaces by taking this into consideration. Conventional methods of collecting floating waste include handpicking or using boats, thrash skimmers, etc., and depositing them near the shores of rivers. We have designed the remote-controlled river cleaning machine that eliminates the drawback of the methods used previously and is efficient, effective, and eco-friendly, by considering all the parameters of river surface cleaning systems and eliminating the drawbacks of the methods used earlier.

With the help of a PMDC motor, the machine is driven by a propeller to drive the machine on the river. The machine consists of a collecting plate together with conveyor belt and chain drives that rotate. The "River waste cleaning machine" is used to clean debris from a water body when there are wastes in it that need to be removed by a RF transmitter and receiver. DC motors, RF transmitters, PVC pipes, chain drive & conveyors will be used to collect wastes, garbage & plastic wastes from water bodies. The "River Waste Cleaning Machine" will be cost-effective, easy to operate, helpful for water cleaning and can be modified to increase the cleaning capacity and efficiency.

IV. RELEVANCE

The Construction of a remote-controlled ocean debris management boat equipped with a two-channel remote control system ensures increased efficiency in the clean-up process. Directed remotely by an operator. This enhanced control enables effective debris collection; reducing human error and increasing the overall clean-up efficiency. As a result, the vast quantities of ocean debris can be removed in a shorter timeframe, facilitating the preservation of marine ecosystem and protecting aquatic life.

V. PROBLEM STATEMENT

The world's oceans are facing a severe pollution crisis caused by plastic waste and other debris. This pollution is not only harmful to marine life but also affects human health and livelihoods. More plastics and debris will continue to enter the ocean than fishes if no action is taken to develop innovative solutions to address this issue.

Marine debris is one of the most pervasive global threats to the health of the world's coastal areas, oceans and waterways. It is an issue of local, regional, national, and international concern. Marine debris can injure or kill marine and coastal wildlife, damage and degrade habitats, interfere with navigational safety; cause economic loss to fishing and maritime industries, degrade the quality of life in coastal communities, and threaten human health and safety.

VI. PROJECT DESIGN

6.1.1 SOFTWARE DESIGN METHOD

A two-channel remote control with a receiver is a common setup used in boats for remote operation. The remote control, held by the boat's operator, consists of two separate channels. Each channel is responsible for controlling a specific function of the boat, such as throttle and steering. The operator uses the transmitter, which sends radio signals wirelessly, to communicate with the receiver installed on the boat. The throttle channel is typically used to control the boat's speed, allowing the operator to increase or decrease the engine's power.

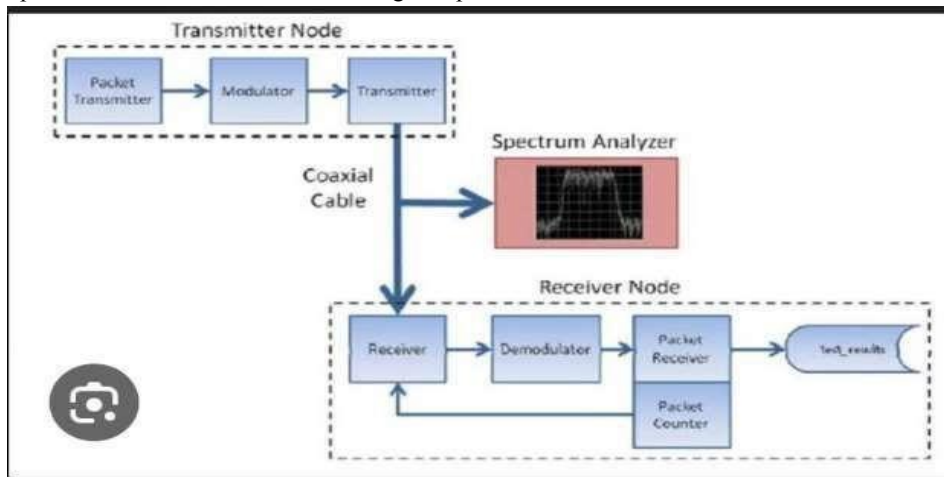


Figure 1 Software Representation of the Radio signal

By pushing the throttle control forward or backward, the transmitter sends corresponding signals to the receiver on the boat. The receiver then relays these signals to adjust the boat's engine throttle accordingly, controlling the speed. The steering channel allows the operator to control the direction of the boat. The transmitter's left and right controls send

signals to the receiver, which is connected to the boat's steering mechanism. These signals instruct the receiver to turn the boat's rudder or adjust any other steering mechanism installed, allowing the operator to navigate the boat left or right. The receiver acts as a mediator between the remote control and the boat's electrical or mechanical components. It receives the signals from the transmitter and translates them into commands that control the boat's throttle and steering mechanisms. In essence, the two-channel remote control with a receiver enables the operator to control the boat's speed and direction remotely. It provides a convenient and efficient way to operate the boat, enhancing the overall boating experience and giving the operator full control over the vessel's movements

TABLE I: List of Material Requirement

Propeller	2
Two channel transmitters with receiver	1
Dc motor	5
Battery	2
Hull	1
Switch	2
Conveyor	1
Shaft	2

6.2 DESCRIPTION OF COMPONENT

6.2.1 Two Channel Remote Control with Receiver

This wireless radio transmitter and receiver, the receiver and transmitter have a two-way working mode, so the user can know the working status of the receiver by the transmitter two-way working mode. When the receiver is successfully triggered by the signal to the transmitter. Radio frequency remotes works in a way whereby they transmit binary code to a receiver via radio wave.

6.2.2 Battery Source

A battery is a source of electric power consisting of one or more electrochemical cells with external connections for powering electrical devices. When a battery is supplying power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox reaction converts high-energy reactants to lower energy products, and the free-energy difference is delivered to the external circuit as electrical energy. current or diverting it from one conductor to another

The most common type of switch is an electromechanical device consisting of one or more sets of movable electrical contacts connected to external circuits. When a pair of contacts is touching current can pass between them, while when the contacts are separated no current can flow. Switch is an electrical component that can disconnect or connect the conducting path in an electrical circuit, interrupting the electric current or diverting it from one conductor to another. The most common type of switch is an electromechanical device consisting of one or more sets of movable electrical contacts connected to external circuits. When a pair of contacts is touching current can pass between them, while when the contacts are separated no current can flow.

6.2.3 Propeller

A propeller is a device commonly used in boats to generate propulsion. It consists of two or more blades that are connected to a hub, forming a rotating assembly.

6.2.4 DC Motor

A DC motor is an electrical motor that uses direct current (DC) to produce mechanical force. The most common types rely on magnetic forces produced by currents in the coils. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

VII. SYSTEM TESTING

7.1 System Operation

In this project the foremost aim of this machine is to lift waste debris from the water surface and dispose of it within the hull. It consists of an arrangement of conveyor which is placed on the shaft of the motor. Due rotation of the motor the conveyor rotates. When the conveyor is moved, it collects water debris, waste garbage and plastics from water bodies, and also the machine is placed within the water. The waste debris in water will get lifted and it moves in an upward direction, when the waste debris reaches the upper extreme position the debris or trash drops into the hull.

Hence this will aid the cleaning of water surfaces and safe collection of waste debris from water. Propeller is used to drive the machine on the ocean and runs with the help of a PMDC motor. The total electrical device is controlled by an RF transmitter and receiver which are used to manage the machine remotely.

Collecting Mechanism is employed in our project to beat real time issues as collection of debris on the ocean is made easier. By using this four-bar mechanism, it rotates at a particular angle intended to gather the rubbish for the model (ocean.) Its two propellers rotate in a way user wishes using remote to rotate the boat. Water wheel is bolted on a shaft which is placed above the frame. The aim of a water wheel (propeller) is to maneuver the machine left or right on water. Motor is used to rotate the water wheel with the assistance of a gear drive mechanism.

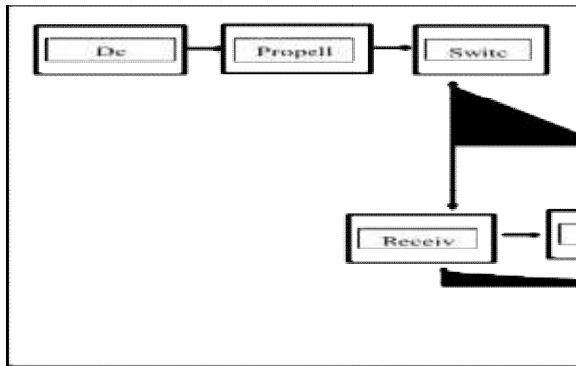


Figure 2 Block Diagram Of Circuit

7.2 Packaging

This is a very important aspect of the design work when constructing, it is the appearance given to the final work. We do not leave the work like that; it has to be cased. The packaging of this boat is designed to ensure safe transportation and storage of the boat and its component, which include features like padding or compartment to secure the boat and prevent any damage when the boat is on motion.



Figure 3: Showing The Completed Work Done

VIII. FUTURE SCOPE

In future this prototype can be improved to sort more types of wastages. In this system we can use more advanced conveyor system and conveyor material for maximizing the efficiency of collection of wastage. We can also use solar panels for supplying more power to the boat instead of battery. To modification in the size of boat with respect to its waste collecting capacity can be increases. This project is made for small lake and by doing some changes in its size and capacity it can be used in big water bodies and rivers.

IX. ACKNOWLEDGEMENT

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X. CONCLUSIONS

During the course of the project, certain conclusions have been made. The efficiency of the conventional water cleaning mechanism is too low thus, we observed that by replacing the existing method with this automated cleaning mechanism could increase the efficiency with minimal expenses. Since the boat has PVC pipes under it, the air tube piping guider mechanism draws all floating garbage from water towards boat. Cleaning of certain amount of waste with the conventional method that took 40 min is performed using the river boat in 11min. Thus, there is an increase in the efficiency by 88.81 percent. The growing problem of waste disposal in fresh water sources can be stopped not only by putting a stop to the mentality of polluting the environment but also cleaning the already polluted fresh water resources in a more sophisticated way

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