

Microcontroller Based Water Trash Collecting and Cleaning Robot

¹Sahil Pawar, ²Mayur Pawar, ³Jaykumar Rajput, ⁴Prathmesh Saraf, ⁵C. Limbadri

^{1,2,3,4}Student, Mechanical Engineering, G H Raisoni College of Engineering, and Management, Wagholi, Pune, Maharashtra, India

⁵Assistant Professor, Mechanical Engineering, G H Raisoni College of Engineering, and Management, Wagholi, Pune, Maharashtra, India

Abstract - India is holey country & during lots of festival like ganesh visarjan, navratri durga puja & mainly kumbhmela there is lots of water pollution of Godavari River at Nashik. The water pollution is very important problem in rivers, ponds and water bodies near Godavari River at Nashik. Due to increase in water pollution in the form to waste debris; it is hampering the life of aquatic animal and make their life in danger. Similarly, sometimes the aquatic animal tends to eats surface waste debris considering it as a food; which ultimately cause the death of animals. Due to pollution water, many skin diseases to human kind are observed. In order to reduce the water pollution, we are going to implement an automated water hyacinth cleaning machine. “An Autonomous Aquatic System for the Removal of Water Hyacinth” is a machine which involves the removing the waste from water surface and safely dispose from the water body. An Autonomous Aquatic System for the Removal of Water Hyacinth works on hydropower to extract waste water debris, plastics & garbage from Godavari River at Nashik.

Keywords: Water pollution in the Godavari River, water hyacinth removal, autonomous aquatic cleaning system, hydropower-based cleaning machine, river waste management, aquatic ecosystem protection, plastic and garbage removal from water bodies.

I. INTRODUCTION

The “Automated Water Hyacinth Cleaning Machine” used in that places where there is waste debris in the water body which are to be removed. This machine is consisting of waterwheel driven conveyer mechanism which collect & remove the wastage, garbage & plastic wastages from water bodies. This also reduce the difficulties which we face when collection of debris take place. A machine will lift the waste surface debris from the water bodies, this will ultimately result in reduction of water pollution and lastly the aquatic animal's death to these problems will be reduced. It consists of Belt drive mechanism which lifts the debris from the water. The use of this project will be made in rivers, ponds, lakes and other water bodies for cleaning upper water waste debris.

From this project we hope to clean the surface water debris from bodies. Similarly, they are lots of problems of water pollution under Godavari River, Nashik which affect the acoustic, human life & beauty of Godavari River. Some photographs are shows the water pollution near Godavari River, Nashik. This invention is about skimmer boats, which are specially designed boats used to clean floating waste from water bodies like rivers, lakes, and harbors. Nowadays, water pollution has become a serious problem due to plastic waste, garbage, and other materials floating on the surface. Skimmer boats help solve this issue by collecting and removing such waste in an efficient and systematic way. These boats are designed to reduce human effort and make the cleaning process faster, safer, and more effective.

Skimmer boats are usually built in two main types of designs: catamaran (twin-hull) and monohull. The catamaran design has two parallel floating sections, which provide better stability and also create space in between for installing cleaning mechanisms like conveyors. The boat moves using propellers or paddle wheels, allowing it to navigate easily even in polluted or narrow water areas. An operator controls the boat and ensures that it moves in the right direction to collect maximum waste.

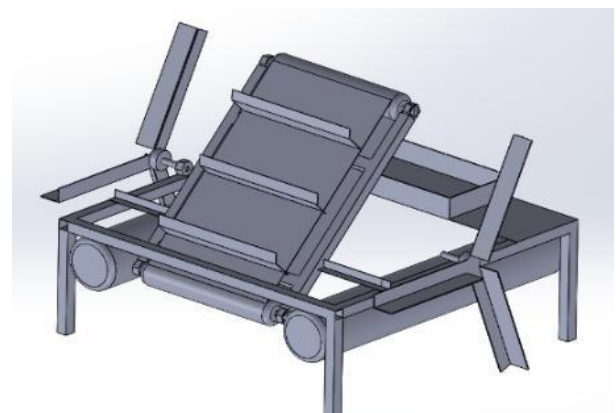


Figure 1: Cad Model

The most important part of the skimmer boat is its conveyor system. A pickup conveyor is placed at the front of the boat and is slightly dipped into the water. As the boat

moves forward, this conveyor collects floating waste like plastic bottles, leaves, and other debris. The waste is then lifted and transferred to a storage area inside the boat using another conveyor. This process continues automatically, making the system very efficient and continuous.

II. OBJECTIVE

The main aim of this project is to develop a robot that can effectively collect floating waste from water bodies like rivers, lakes, and drainage systems. This system is designed to reduce pollution by removing materials such as plastic, leaves, and other debris, while also minimizing the need for manual cleaning and improving safety. Another objective is to build a strong and stable structure that can operate smoothly in water conditions. The project also focuses on checking how well the system works by evaluating its performance and efficiency, so that it can be used as a practical and cost effective solution for real-life applications.

1. To design and develop a water trash collecting and cleaning robot
2. To fabricate the mechanical structure of the system.
3. To test the performance of the developed system.

III. METHODS AND MATERIAL

The system consists of several important components that work together to ensure effective water trash collection. A 12V DC wiper motor with an inbuilt worm gearbox is used as the main driving unit, which provides sufficient torque for smooth operation of the mechanism. Skimming wheels are used to collect floating waste from the water surface and guide it towards the conveyor system. A conveyor mechanism is incorporated to lift the collected waste and transfer it into the storage area efficiently. PVC circular pipes are used to provide buoyancy and help the system float steadily on the water surface. Bearings are used at various points to support rotating parts such as shafts and wheels, ensuring smooth and frictionless movement. The shaft plays a key role in transmitting motion from the motor to the skimming and conveyor mechanisms. A 12V battery is used as the power source to run the entire system. All these components are carefully selected and integrated to achieve efficient performance, stability, and durability of the water trash collecting robot.

3.1 Research Design

1. Basic Information & Literature survey.
2. Design of Machine Components.
3. Selection of Components for Model.
4. Fabrication of Model parts.
5. Assembly, Testing & Documentation of Model

3.1.1 System Requirement

C-BOT developed can be included in the category of rotor mobile robot with navigation system. The System requirement is as given below: The main driver of C-BOT is rotor, so it takes mechanical wheel and wheel driver.

- DC Motor
- Skimming Wheels
- Circular PVC Pipe
- Battery 12 Volts 7 Amp
- Structural steel Angles & Frame
- Microcontroller
- Conveyor belt
- Ultrasonic Sensors
- Arduino

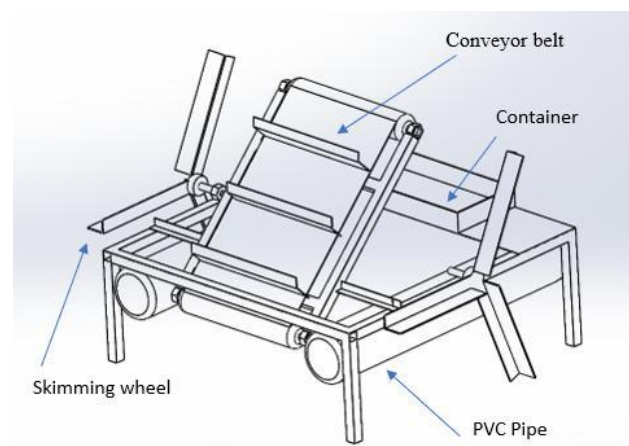


Figure 2: Sketch Model

3.1.2 Mechanical Design

The drive source of our project is an electrical motor operating with a 12V power supply, which is used to drive various mechanisms of the system efficiently. In the proposed Microcontroller Based Water Trash Collection System, motors are employed for movement and waste collection operations. The microcontroller controls the entire system and provides proper coordination between different components. The garbage collection mechanism is designed to collect floating waste from the water surface effectively. Due to water flow and surface tension, collecting trash from water becomes difficult in real-time situations. Therefore, a suitable collection mechanism is implemented to gather waste and transfer it to the storage section. A conveyor or collection arrangement is used to carry the collected trash continuously. The water wheel mechanism is mounted on the frame and helps the system move forward and backward in water. Motors rotate the water wheels using a chain drive mechanism, ensuring smooth movement and efficient operation of the model.

A) D.C. Motor

This drainage-cleaning system has a 1.3Ah, 12V DC motor which actuates the chain driven cleaning mechanism. It works great at low voltage and suitable for solar-charged battery system. It possesses enough torque to lift the floating waste in the drainage duct and disposes it away. The small size and power consumption allow it to run steadily outdoors without looking bulky. Repetition performance ensures the automatic operation at the lowest man power.



Figure 3: DC Motor

Specifications

The torque (T) required:

$$T = F \times r$$

Where,

$F = m \times g$ (Force due to Garbage)

$m = 2\text{kg}$ (Estimated waste load)

$g = 9.81\text{m/s}^2$ (Gravity)

$r = 0.025\text{m}$ (Pulley radius)

$$F = 2\text{kg} \times 9.81\text{m/s}^2 = 19.62\text{N}$$

$$T = 19.62\text{N} \times 0.025\text{m}$$

$$T = 0.49\text{Nm}$$

- Required Torque = 0.49 Nm
- 12V, DC motor with 1Nm torque is selected.
- Type: DC Gear Motor
- Voltage Rating: 12 Volts DC
- Current Capacity: 1.3 Ampere-hour (Ah)
- Speed: Typically, low RPM (e.g., 60 RPM, depending on the gear ratio)
- Torque: Moderate to high (suitable for lifting light to medium drainage waste)
- Direction: Unidirectional (based on wiring)
- Usage: Drives the chain mechanism in the drainage cleaning system

B) L298 Motor Driver

Motor driver is used in the system to control the operation of DC motors efficiently. It is a dual H-bridge motor driver that allows control of both the direction and speed of the motor. The driver receives input signals from the Arduino and accordingly drives the motor in forward or reverse direction. This helps in proper control of mechanisms such as the conveyor and skimming wheel used in the robot. The L298 motor driver is capable of handling moderate current and voltage, making it suitable for small-scale robotic applications. It acts as an interface between the microcontroller and the motor, ensuring smooth and safe operation. By using this driver, the system can achieve better control, flexibility, and performance. Overall, the L298 motor driver plays an important role in controlling the movement and functioning of the water trash collecting robot.



Figure 4: L298 Motor Drive

C) Arduino UNO

Arduino UNO is a widely used microcontroller board that acts as the main control unit of the system. It is based on the ATmega328P microcontroller and is used to control various components such as motors, sensors, and motor drivers in the project. The board receives input signals from sensors and processes them to give appropriate output commands for the operation of the system. Arduino UNO is easy to program and supports multiple digital and analog input/output pins, which makes it suitable for controlling different devices simultaneously. It can be programmed using the Arduino IDE, allowing flexibility in designing and modifying the system according to requirements. The board also provides stable performance and reliable operation, making it ideal for small-scale robotic applications. In this project, Arduino UNO plays a key role in controlling the movement of motors and coordinating the working of different components, ensuring smooth and efficient operation of the water trash collecting robot.



Figure 5: Arduino UNO

D) Relay Module

The relay module is used in the system to control high-power electrical devices using low-power signals from the Arduino. It acts as an electrically operated switch that allows the microcontroller to turn ON or OFF components such as motors or other devices safely. The relay isolates the control circuit from the power circuit, which helps in protecting the system from damage. In this project, a 5V relay module is used, which can be easily controlled using Arduino signals. When a signal is sent from the microcontroller components without directly connecting them to the microcontroller. Overall, the relay module plays an important role in controlling and protecting the electrical system of the water trash collecting robot.

Relay Module Specifications

- Model: SRD-05VDC-SL-C
- Operating Voltage: 5V DC
- Trigger Voltage: 5V (from Arduino)
- Contact Rating: 10A at 250V AC / 10A at 30V DC
- Number of Channels: 1 Channel
- Control Signal: Digital input
- Indicators: Power LED and Status LED

E) Ultrasonic Sensors

Ultrasonic sensor (HC-SR04) is used in the system to detect obstacles and measure the distance between the robot and nearby objects. It works by emitting ultrasonic sound waves from the transmitter and receiving the reflected waves through the receiver. The time taken for the echo to return is used to calculate the distance of the object.

In this project, the ultrasonic sensor helps the robot to avoid obstacles while moving on the water surface. It improves the safety and reliability of the system by preventing collisions with objects present in water. The sensor is connected to the Arduino, which processes the signals and

controls the movement of the robot accordingly. Overall, the ultrasonic sensor plays an important role in enhancing the automation and performance of the water trash collecting robot

3.2 Assembly and Testing

In the final stage of the project, all fabricated and purchased components are carefully assembled to develop a complete working model of the water trash collecting robot. Components such as the steel frame, skimming wheels, conveyor mechanism, PVC pipes, motor, battery, Arduino, and sensors are properly fitted using fasteners and welding wherever required. Special attention is given to the alignment of moving parts like the shaft, conveyor belt, and skimming wheels to ensure smooth and efficient operation without any mechanical issues.

After mechanical assembly, electrical connections are completed by integrating the battery, motor driver, Arduino, relay module, and ultrasonic sensor. Proper wiring is carried out to ensure safe and reliable operation of the system. Once the assembly is complete, the model is tested under practical conditions to evaluate its performance in collecting floating waste from water.

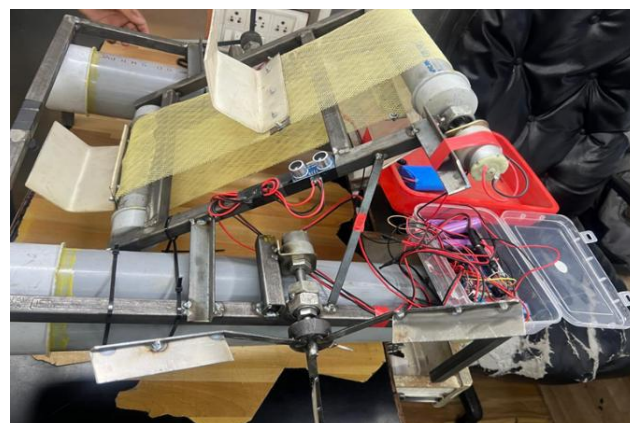


Figure 6: Assembly and Testing

3.3 Working Principle

The water trash collecting robot is designed to remove floating waste from water bodies such as rivers, lakes, and drainage systems in an efficient manner. The system is powered by lithium-ion batteries and controlled by an Arduino UNO, which acts as the main controller for all operations. DC motors are used for robot movement and to operate the skimming wheels and conveyor mechanism. The skimming wheels collect floating waste and guide it toward the conveyor belt. The conveyor then lifts and transfers the collected waste into a storage container. An ultrasonic sensor is used to detect obstacles and ensure safe operation, while a Bluetooth module

enables wireless control through a mobile application. The robot floats on water with the help of PVC pipes that provide buoyancy and maintain stability during operation.



Figure 7: Water Trash Collecting Robot

IV. CONCLUSION

The water trash collecting robot has been successfully designed, fabricated, and tested to provide an effective solution for removing floating waste from water bodies. The system combines mechanical components such as skimming wheels and a conveyor mechanism with electronic control using Arduino, motor driver, and sensors to achieve efficient operation. The robot is capable of collecting different types of floating waste like plastic, leaves, and small debris, thereby helping in maintaining cleaner water surfaces. The use of a battery-powered system ensures smooth functioning of the robot, while the PVC pipes provide sufficient buoyancy and stability during operation. The Bluetooth control system allows easy navigation and handling of the robot, and the ultrasonic sensor enhances safety by detecting obstacles. The overall design is simple, cost effective, and suitable for small-scale applications. The results obtained during testing confirm that the system performs reliably under normal conditions and is capable of collecting a reasonable amount of waste per cycle. Although there are some limitations, the project demonstrates a practical and innovative approach towards reducing water pollution. Overall, the developed system contributes to environmental cleanliness and provides a foundation for further improvements and large-scale applications in the future.

REFERENCES

[1] Ramadevi, Dubala, KalagotlaChenchireddy, Barkam Rekha, Sunkari Prathyusha, Koriginja Shrivani, and Karnati Bhargavi. "River cleaning robot using Arduino microcontroller."

- [2] Janai, Siddhanna, H. N. Supreetha, S. Bhoomika, R. P. Yogithashree, and M. Pallavi. "Swachh Hasth-A Water Cleaning Robot." *International Journal of Engineering Research & Technology (IJERT)* (2020): 839-842.
- [3] Zhu, Y., Zhang, Y., Luo, D., Chong, Z., Li, E. and Kong, X., 2021. A review of municipal solid waste in China: characteristics, compositions, influential factors and treatment technologies: Y. Zhu *et al. Environment, Development and Sustainability*, 23(5), pp.6603-6622.
- [4] Prakash, Chandra, Sarikonda Spoorthi, Kalavadiya Pari, Thotakura Jayanth, Velishala Naveen, C. Lavanya, and Lalit Bhalla. "Design and Prototype Development of Trash Collector Boat." *In MATEC Web of Conferences*, vol. 392, p. 01055. EDP Sciences, 2024.
- [5] Kumar, R. Senthil, A. Sathiskumar, A. Nishanth, S. Seshagiri, and S. Tamilarasu. "Design and Development of an Automated River Cleaning Robot." *International Journal of Engineering & Extended Technologies Research (IJEETR)* 8, no. 2 (2026): 4573-4582.
- [6] Patil, A., et al. "Water Trash Collecting Robot for River Cleaning." *International Journal of Engineering Research and Technology (IJERT)*, vol. 9, no. 6, 2020, pp. 1-4.
- [7] Sharma, Mahima, et al. "Assessment of GO/ZnO nanocomposite for solar-assisted photocatalytic degradation of industrial dye and textile effluent." *Environmental Science and Pollution Research* 27.25 (2020): 32076-32087.
- [8] Reddy, P., et al. "Floating Garbage Collection Robot Using Arduino and Ultrasonic Sensors." *International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET)*, vol. 8, no. 5, 2019, pp. 4560-4565.
- [9] Verma, A. K., Gupta, S. K., Singh, K. K., & Chauhan, H. S. (1998). An analytical solution for design of bi-level drainage systems. *Agricultural water management*, 37(1), 75-92.
- [10] Chen, Y., Pandey, A., Deng, Z., Nguyen, A., Wang, R., Thonapalin, P., ... & Gupta, S. K. (2021, August). A semi-autonomous quadruped robot for performing disinfection in cluttered environments. *In International Design Engineering Technical Conferences and Computers and Information in Engineering Conference* (Vol. 85451, p. V08BT08A024). *American Society of Mechanical Engineers*.

Citation of this Article:

Sahil Pawar, Mayur Pawar, Jaykumar Rajput, Prathmesh Saraf, & C. Limbadri. (2026). Microcontroller Based Water Trash Collecting and Cleaning Robot. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 10(5), 399-404. Article DOI <https://doi.org/10.47001/IRJIET/2026.105054>
