

# Remotely Operated Water Surface Cleaner

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**Abstract-** Eight million tons of plastic debris is being dumped every year in the ocean, most of them come from beach tourists, urban and storm runoff, sewer overflows and inadequate waste management. Plastic waste encourages the growth of pathogens in the ocean, which is affecting marine life very badly, making many water species endangered and jeopardizing the natural ambience of marine life. Marine debris is disrupting the entire bio-geo cycle giving rise to unwanted problems to the whole marine eco-system. Floating vessel with robust technology is needed to clean our rivers, dams, and lakes. For that purpose, we have developed a vehicle that can collect plastic lying on the surface of the water. It is operated wirelessly and has a long-range wireless connection. A camera is mounted on top of the vehicle to see things around by using concepts of control systems and communication systems. There is a small opening in front of the vehicle to collect plastic from the surface of the water. After collecting plastic or debris, it disposed near the surface. Our proposed cleaner is convenient and can be operated easily by anyone with little hardware knowledge. By using just the flat design of the vehicle, it can float on the surface of the water and a brain to control the vehicle. The integration of all technical things is seamless and intuitive.

**Keywords—** Plastic waste, Remotely operated vehicle, Surface water cleaner, Video monitoring.

## I. INTRODUCTION

Marine litter is a big problem for the whole world. We must go to the depth of this problem, the root cause of where it is originated. Nearly 4 tons of trash is being dumped every day out of which 12.8% is plastic waste in the ocean. Plastic is becoming a big problem for the marine eco-system. As we know more about outside our earth than deep inside our oceans, we must invest more in marine technologies. Suppose we want to explore more about our ocean and to save the marine life which is going endangered due to plastic choking in their stomach eventually causing the death of specie. In that case, we must professionally dispose of this marine litter by using the water surface cleaner [1-3].

Most works are done on ROUV's through supporting mechanism. A big vessel on top of an underwater drone supports the entire mission being carried out. We want the technology to be more accessible we need to innovate in this field because significantly less work has been done in this field. Our main objectives are to build a water surface cleaner which is cost-effective and efficient. It is easily controlled through wireless transmission and lives video transmission with minimum latency. By achieving these objectives, we are sure that we can tackle the growing problem of plastic wastage in the rivers, lakes, and dams.

By cleaning the rivers, we can help to limit marine litter to accumulate on the surface of the ocean. We are going to target the marine industry, which needs more innovation for better technologies to tackle the litter accumulation problem and to provide a natural and pure ambience to marine eco-system [4].

## II. LITERATURE REVIEW

We are spending more on space technology and less on marine sciences. We know more about mars weather less about our oceans. We still do not know how many species are in our oceans. More research is needed for cheap and robust marine technologies [5-7]. Marine resources of Pakistan are still untapped. Oceans have great potential, but we need affordable equipment to explore and see what hiding beneath our ocean. To date, most of water surface vehicles used supporting mechanism to perform their operation. Our purposed system uses wireless transmission and lives video feed, so less human interaction is needed to operate the vehicle [8-10]. You need just remote and give commands to vehicles to collect the floating garbage.

In Pakistan, less innovation has been done to explore our oceans. More research is needed our cheap and robust technologies to explore our oceans [11-15]. As the world is moved for oceans to find their energy needs and tap the hidden resources, we also need technologies for exploration, but first, we need to clean our rivers, lakes, and dams. A handful of universities in Pakistan are offering courses in marine technologies. Our Govt. should be investing more in marine technologies so that more research and innovative ideas can be carried out to clean the river, lakes, and dams [16-20].

If Govt. is investing more in ocean technology, we should be able to increase the research significantly in marine technologies. Engineering departments in different universities should give the student to small projects so they can get more knowledge about marine technology. Students should choose their final year projects in marine sciences to increase the output of research in this field [15].

Universities should have contact with different companies to involve students in real-world problems to increase their experiences. Universities organize seminars, competition, ted talks and other useful activities to include students. By doing all these activities, we can make sure that our knowledge and experience can be helpful to develop new technologies and to live a better life.

Today's most civilian marine technologies are just working on fossils fuels like petrol, kerosene oil and diesel, the technology that have the battery-powered solution we can say our prototype is much more advanced than any technology that has been developed [14]. By giving a hybrid solution to the increasing problem using the battery and solar, it can effectively decrease the growing concern for the fossil's fuels. In a world where most developing countries have their kind of solution to a problem, but we must put them in check to decrease the effect on nature [16-22]. By supplying advance technologies to developing countries, so they can benefit from them. We think there is a greater need for awareness among people by telling them how their small act can be beneficial for all of us.

**Gears:** The motor we are using should give us high performance. The important thing is that if we are going to use the motor as it is, connects the propeller with glue, it is not going to work. Because in our research, the body has a big size, it is in water [14]. If you connect propeller with the shaft of the motor, it going to move freely in the water not pushing the water but just moving freely in the water. A picture of the gear is shown in Fig. 1.



FIGURE 1: Gears

### III. COMPONENTS USED

All the required components are given in Tab. I.

Component Name	Purpose
Gears	Used for vehicle to move with motors
Camera interface	For taking images and videos
Arduino	For controlling the motor
L298 motor driver	To drive the motors
Motors	Used for the propellers to move the vehicle
Propellers	For moving vehicle
Ts5823 video transmitter	Ts5823 transmitter to take video from vehicle camera and transmit to user.
USB, OTG android receiver	To see video directly on the phone
Solar plate	For charging the battery
Hc 12 transceiver	For serial communication

TABLE I: Component table

**Camera interface:** The camera interface of the vehicle should be simple and easy to use. I was using already made components and routing through electrical wires, interfacing with the vehicle and placing carefully on it [11]. The receiver on the other user end can be interface with remote and antenna. At receiver hand, we had to be careful with the weight of the remote because all the components are going to create a bit problem so we should be careful in this matter. It can be noticed that camera interface of the vehicle is going to be at the end of the project we will explain all the phases of the project in the next so you would have a better understanding of the whole project [13].

**Arduino:** We are using Arduino Uno 3 in our project as Controller for the whole system. 13 pins controller place on the top side of the long tunnel. The main objective of placing the Controller on the top side is to avoid water leakage. If water can somehow penetrate through silicon tube, the Controller and other crucial components can be destroyed so

to be on the safe side. We will be making an extra layer of protection top of silicon tube shown in Fig. 2.

We were using Arduino pulse width modulation pin (PWM) to control the speed of motors. PWM pin used to control the speed of motor making vehicle easy to maintain and highly manoeuvrable. We are going to power the Arduino from motor driver 5V pin [5]. No need for extra wires to be attached to Arduino. We were using jumping wire from motor driver to Arduino pin a built-in voltage input pin. We can use Arduino Nano, but it is small and has fewer ports for inputs and outputs connection. Following the project need and demand, we prefer the Arduino Uno 3 have higher ports and the excellent thing support higher current drawn [2].



FIGURE 2: Arduino Board

**L298N Motor driver:** L298n driver use input have 5v to 35V power supply shown in Fig. 3. We used two H-Bridge, one for each motor to control the direction of the motor. L298n driver has good performance. It can support up to 4A current, 2A current for each motor. In our calculation, one motor can draw up to 1.6A of maximum current [15].

The key objective of insertion the driver on the upper side is to duck water outflow if water can somehow infiltrate through silicon tube the driver and other critical components were to be harmless making the additional coating of safety top of silicon tube.

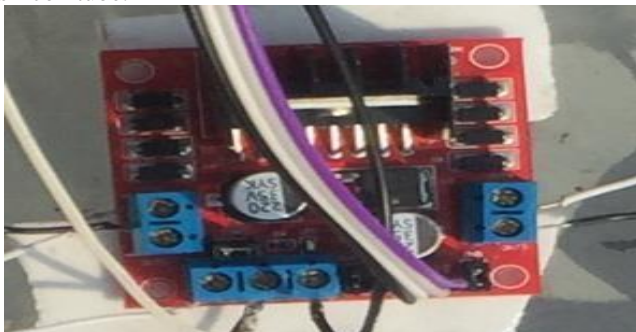


FIGURE 3: Motor Driver

**Motors:** We are using pitman motors with helical gear. 2-motors are used to move the vehicle in two dimensions.

Motors attach to either side to move the vehicle in forward, backward, left, and right directions shown in Fig. 4. The vehicle always has a station-keeping function (the vehicle's ability to maintain the same position and orientation even under disturbances) through Controller. We are using motors with helical gears. The main objective of the helical gear is to transmit large force at propellers of the vehicles, to move the vehicle in the opposite direction.

The main objective of using just two motors is cut down the cost of the overall project. We can use four engines, but it is just going to increase the complexity of the project. Moreover, we must make our project cost-effective, so we are going with only two motors. So, you can imagine just using two motors is a big challenge to complete the project [16]. Motors should be of high performance and can be handle wear and tear. The motor should have a rating of up to 160 rpm, which just enough for our project.

**Propellers:** The actual design of the propeller as you can see in Fig. 4 that propeller is fit on the long rod width up to 6 inches. First, we talk about the rod. Rod is the acrylic material same material as a body made. It is lighter and hardest as metal gets [3]. The durability of the rod is compared with metal. But at the same time, it is lighter than the metal.

The purpose behind using the acrylic rod is due to its thin design, lightweight but at the same time same more robust as metal. Rod had a diameter of 1 inch. With 1-inch diameter we make sure that we are going to fix on it, as good as we want. First, we are testing with different diameters, but 1 inch is the sweet spot for our project [2]. We use lathe machine to make 2 millimetres marks on the rod. 4 marks for four fans and 2 mm marks on the rod are up to 2.5 mm in depth, which is enough to make sure that we do not disturb the durability of the rod. If we increase the depth, then there are chances that we break the rod during running conditions.

WIDTH	2.5 INCH
LENGTH	2 INCHES
DEPTH	4 MM

Table 2: Dimensions



FIGURE 4: Propellers

**TS5823 video transmitter:** TS5823 transmitter to take video from vehicle camera and transmit to user. Work on 5.8 GHz

frequency to transfer the video. Consume up to 400mW of power shown in Fig. 5.



FIGURE 5: Video transmitter

**HC-12 Transceiver:** Hc-12 wireless transmission module using as a receiver to receive command send by the user to move the vehicle shown in Fig. 6. Work on 433MHz frequency to receive the command. It can consume up to 100mW of power. Hc-12 using serial communication, so it is easy to troubleshoot the problem. So, we use HC-12, use serial communication, and have a long range for communication. HC-12 uses 433MHz band for communication [12]. Do not need any library in Arduino IDE. HC-12 uses 3.3V to 5V for communication. We can power it directly from Arduino board which has built-in the pin of 3.3V. HC-12 uses 4 pins for communication. 2 pins for ground and source. Last 2 pin for transmitter and receiver as HC-12 uses serial communication.

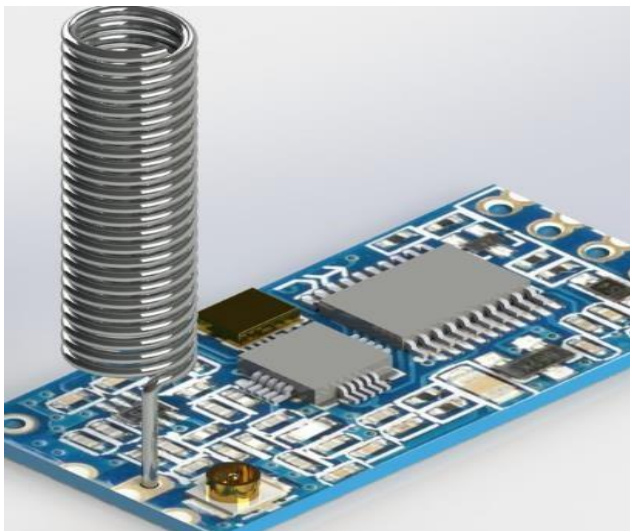


FIGURE 6: HC 12

**Solar plate:** A 12V DC source supplies the vehicle power. It has an onboard rechargeable battery, has a hybrid design can be

charged through solar shown in Fig. 7. A 20W plate solar panel is charging the battery.



FIGURE 7: Solar plate

#### IV. METHODOLOGY

The flow diagram of the vehicles is shown in Fig 8. The user sends the command to the remote. Inside remote command detected by Arduino and send to the transmitter. Transmitter sends the direction command wirelessly to the receiver. At the receiver end command detected by Arduino. Send the signal to motor driver Circuit to move motors.

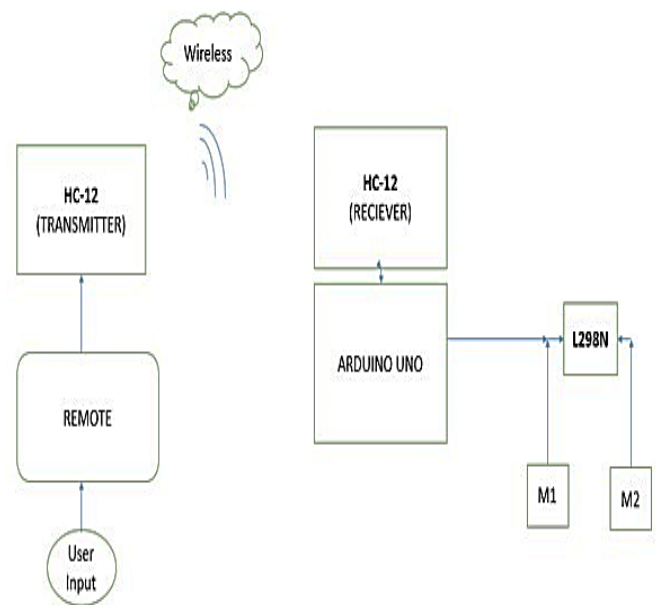


FIGURE 8: Flow diagram of the vehicle and wireless module



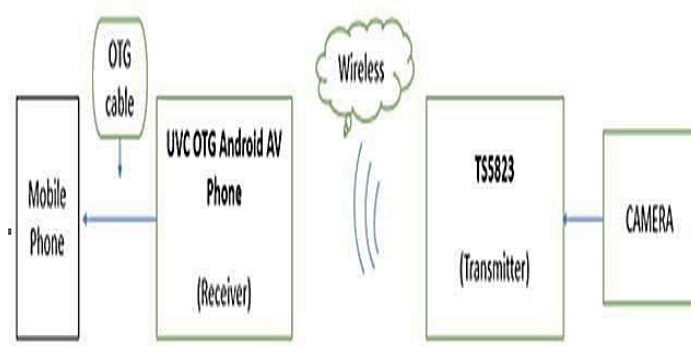


FIGURE 9: Flow diagram of initial live video

The flow diagram of the camera interfaces shown in Fig. 9 as you can see that camera transmit the video to the transmitter (TS5823). The transmitter sends video wirelessly to the receiver. At receiver end a micro USB cable connected to your phone where you can see the live incoming video.

We are designing our vehicle much simple and robust using already available cheap technologies. We are using Acrylic sheets to support the vehicle. Acrylic sheets are lighter cheaper and more durable in the water. Acrylic material is more used nowadays because it is lighter than plastic but in the same way is more durable [14]. It Cuts in different pieces and joint together. We can have the working floating design of the whole body. Sheets are cutting using the laser so that we can have more precision and accuracy. The Acrylic sheet thickness is 4mm. The bottom of the vehicle is a flat surface. The main objective of the flat surface is achieving the more buoyancy force [13]. The flat surface is pushing more on water and in return water applying more buoyancy force on the vehicle helps it float and make the vehicle in the balance position.

There should be a mechanism in the vehicle to collect the garbage. We can put some plate, which can be moved up and down in front of the vehicle; the plate can be controlled with motor [5]. When garbage moves the inside of the vehicle plate come down and garbage stuck inside it. But in the same way, it is going to increase the complexity of the project. By giving the extra command to the vehicle from far away, visibility is good when garbage is inside the vehicle [13].

We can solve that problem by assuming that long tunnel with small holes at the back of the vehicle. By placing enough storage inside the vehicle, we can collect more garbage in the

vehicle [3]. Our design is going to be collecting approximately 2.5kg of garbage. The big challenge is that to move the vehicle on to the garbage and stuck the garbage inside it long enough for the vehicle to move near the surface. So, we design the vehicle carefully keeping in mind the garbage collection problem [4].

**Testing:** The first test we do after the system is to check any leakage of water, check that if there is sufficient silicon layer on every corner and edges of the vehicle [16]. We apply some silicon layer to make sure that no water can penetrate through the corner of the vehicle.



FIGURE 10: Testing in the field trial 1.

It is seen in Fig. 10 that the vehicle is performing according to our need. The vehicle is submerged up to 2 inches in the water, which is good for the propellers to displace the water and push the vehicle in forward and backward direction. 715 Newton of the buoyant force is provided by water [8]. So, we can add more components to the vehicle. The small hole in front of vehicle for garbage to move inside the vehicle and stuck there until vehicle reaches near the surface shown in Fig. 11. Vehicle needed more testing before going final evaluation. Every component needs to check again so it can meet required standard [9].



FIGURE 11: Test trial 2

## V. CONCLUSION

Marine life is greatly affected due to the amount of garbage dumped. To overcome the marine litter issue and to keep the marine eco-system balanced and in perfect ambience our team designed a water surface cleaner that uses cheap and readily available technologies but at the same time more robust than existing systems. Our cleaner can be charged through solar, making the battery to last longer at a single charge. Design of the body is up to standard, flat design making the vehicle to float on the surface without needing other things. More than enough buoyant force is provided by the water to push the vehicle continuously upward. We can add more sensors and components in future without deteriorating the current performance of the vehicle. The control system part of the vehicle is performing good and requires no more testing and ready for final testing. Communication modules have long-range, and commands are sending to vehicles are continuously receiving. No error has been recorded. The decision of choosing acrylic sheet instead of plastic helped immensely in reducing the weight of the vehicle. It also helps the vehicle to float on the surface of the water and maintain the balance.

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