

Water Cleaning Aqua Drone

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Innovation project

Abstract

There are bodies of water everywhere, either a swimming pool in your backyard, or a lake, river, maybe even an ocean a couple minutes away from your house. However, whether it's your pool or out in nature, there is always leaves, debris or waste floating on the surface of the water.

My family recently bought a new house with a swimming pool. I was given the job to clean the pool and after a few days of doing it, I was tired of it. Usually, to clean the surface of a swimming pool most people use a net skimmer. Using this can be labor intensive and a lot of work. According to alanjacksonpools.com, the long poles on a net skimmer can be hard to use and sometimes it doesn't do the best job picking up the leaves and debris in a pool. This problem gave me the opportunity to create a prototype that can conveniently clean the surface of a swimming pool without having to pull a muscle. In addition to that, after attending a community beach clean-up lead by my church, I realized how much garbage and litter there was floating on the surface of the water which gave me the idea that my prototype doesn't only have to be used on a swimming pool, but it can also be used to clean rivers and lakes. Litter left out in rivers can potentially choke, suffocate, or disable aquatic life such as ducks, fish, turtles, and birds. Litter also decreases oxygen levels in the water when it decays which puts the aquatic life in danger. Furthermore, when litter left outside starts to decompose, it produces different greenhouse gasses such as carbon dioxide and methane. These gasses contribute to global warming. To decrease the amount of litter on rivers and lakes and to make the job of cleaning a swimming pool easier, this prototype would be a nice machine to use to collect all the leaves, debris, and waste in the water.

Litter's effect on Aquatic Life

Everywhere you go, you see litter, and a lot of it gets carried out into the water. Our oceans and rivers are home to several species, and litter in the water negatively impacts their homes in many ways. According to the United Nations, around 800 species are affected by debris in the water worldwide. Fish, seabirds, sea turtles and other marine mammals have been entangled in or have ingested debris causing suffocation, starvation, and drowning. Humans are part of the problem since it is us who leaves trash out in the open in the first place. While some trash, like plastics, take up to hundreds of years to fully decompose, some of them break down quicker into small particles which end up in the seafood we eat.

Studies have shown that turtles and seabirds worldwide have ingested litter, mostly plastic. Some of them starve after having ingested plastic thinking that they've eaten enough because their stomachs are full. Studies have also shown that after turtles have ingested just 14 pieces of plastic, that increases their risk of death. Millions of seabirds have died each year because of the waste in the water. Many seabirds have been found dead with their stomachs filled with plastics and waste.

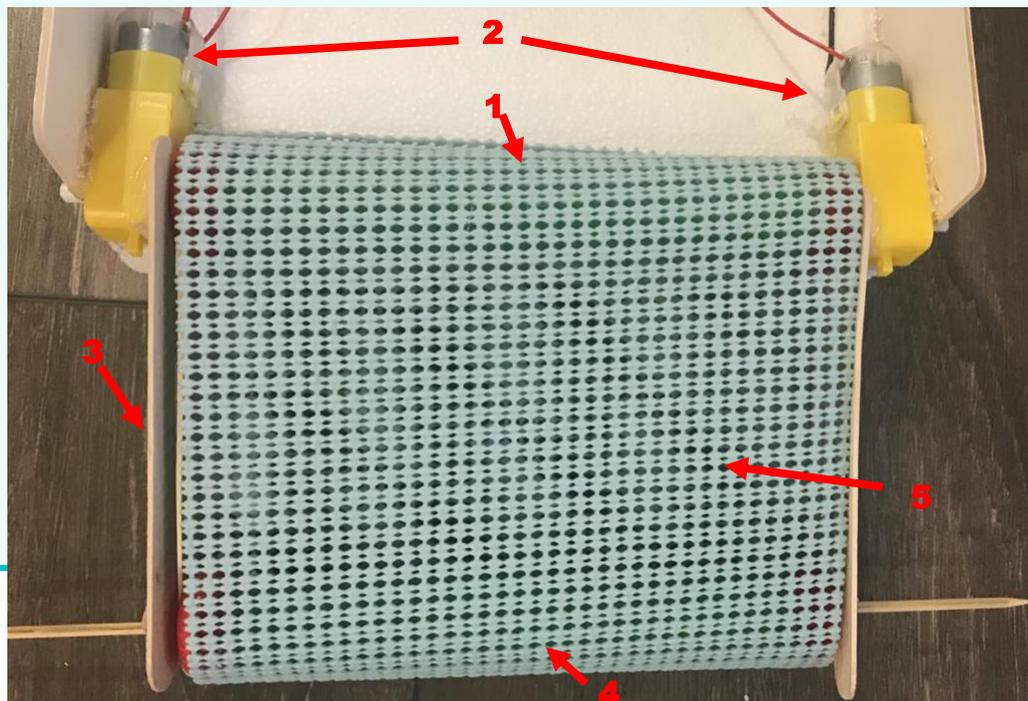
With other aquatic life, they may be intelligent enough to know not to eat the waste, but it can get in their way and interrupt their daily life. When trash starts to decompose in the water, it drops the oxygen levels in the water drastically. This harms the aquatic life by suffocating them. When the oxygen level drops, the water becomes warmer. As the water becomes warmer, fish and other aquatic organisms cannot survive, and some try to swim away and find a better place to live. This can cause a massive decrease in the aquatic life population.

Litter has a very negative impact on aquatic life, and with the water cleaning aqua drone, it can help with cleaning up the waste that's thrown onto the water.

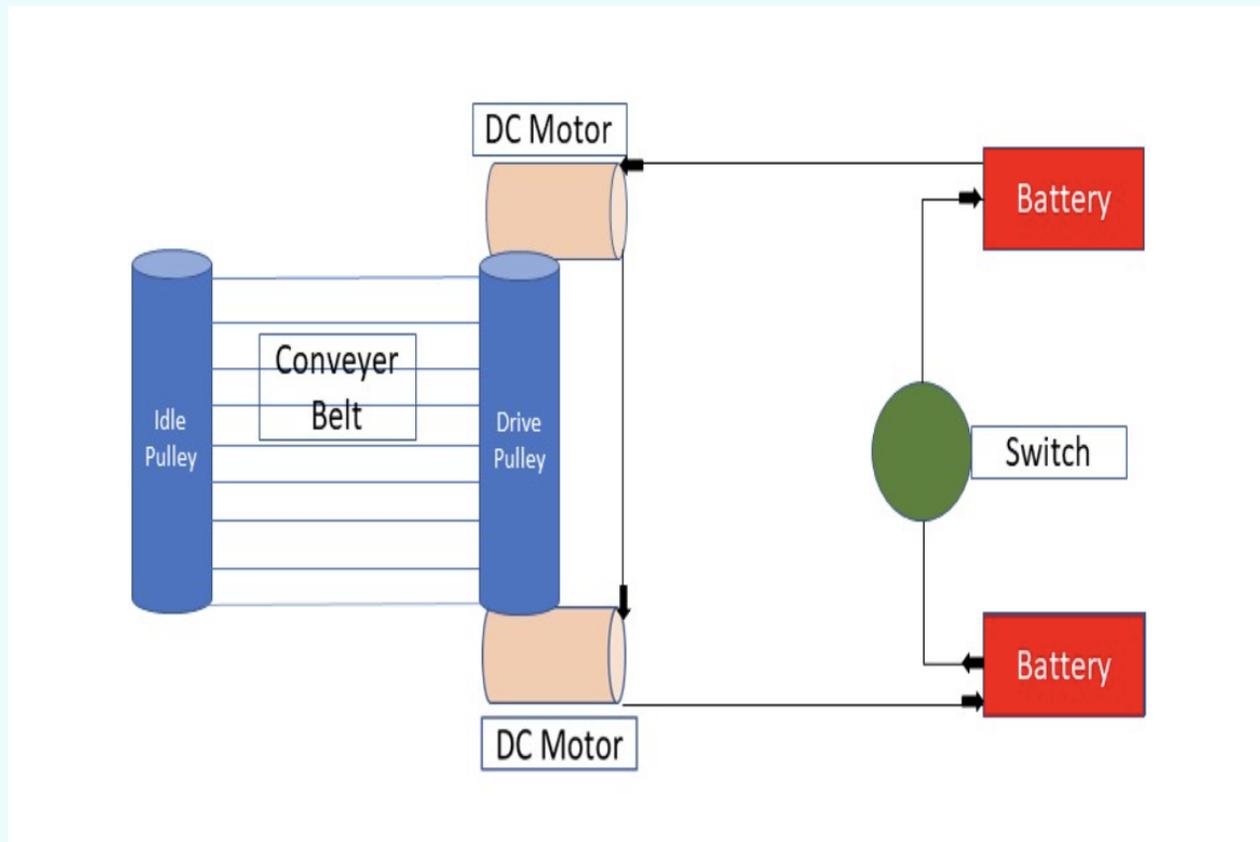
Layout + Background

The aqua drone is divided into three compartments: the front being the waste collector, the middle being the waste storage compartment and the back being the control system.

The front waste collector has a conveyer belt system which spins around and picks up the leaves and debris in the water. It is made from the rod of a plastic shovel cut in half, two DC motors, an anti-slip mat, tongue depressors, bottle caps and wooden skewers. The two pieces from the plastic rod were used to make two pulleys for the conveyer belt system. One rod is put at the end of the boat with a bottle cap glued on to each side (1). With a hole poked into the bottle caps, they are connected to two DC motors that are wired to batteries and an on/off switch which are at the back of the boat (2). When turned on, this rod spins around counterclockwise with the help of the DC motors. This rod is called the drive pulley since it's the pulley that is connected to a power source and spins. Glued to each side of the bottle cap are two tongue depressors fixed in a 45-degree downward angle (3). At the end of the tongue depressors is the other plastic rod with glued bottle caps at each end. With a hole in the caps, a wooden skewer is put through with the ends glued in between the two tongue depressors on each side (4). This pulley is the idle pulley since it's the one that stays still and doesn't spin around. These pulleys are what helps rotate the anti-slip mat. The anti-slip mat is the conveyer belt which helps pick up the leaves and debris in the pool while it's being rotated around (5). This part of the prototype is necessary since it is the part that picks up the trash.



This diagram represents and explains how the conveyer belt system works.



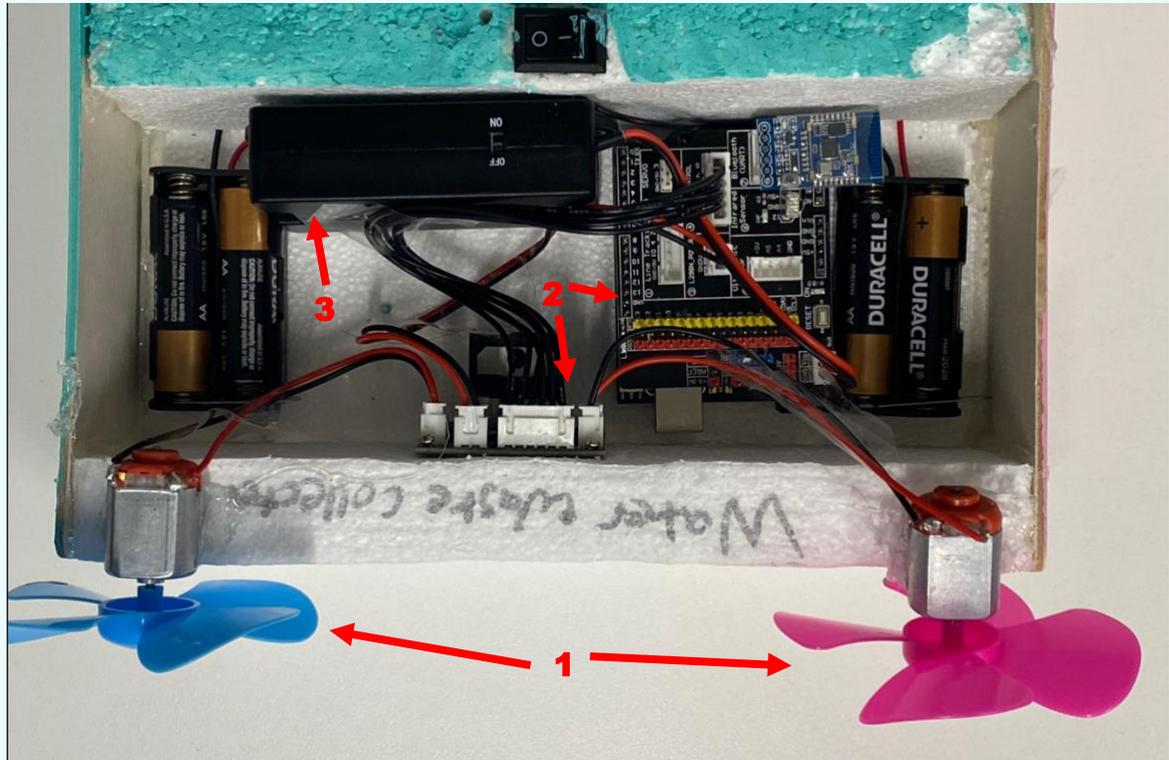
The arrows represent the electric currents sent from the batteries. The batteries are connected to the on/off switch. Once the switch is turned on, it allows the electric currents to travel from the batteries, through the switch and to the two DC motors using wires. Once the motors receive electricity, that causes the drive pulley to rotate.

The middle is the waste storage compartment. The flooring is made of Styrofoam with cardstock paper glued on top of it. While the anti-slip mat rotates around with the help of the drive pulley it picks up the waste and brings it into the waste storage compartment.

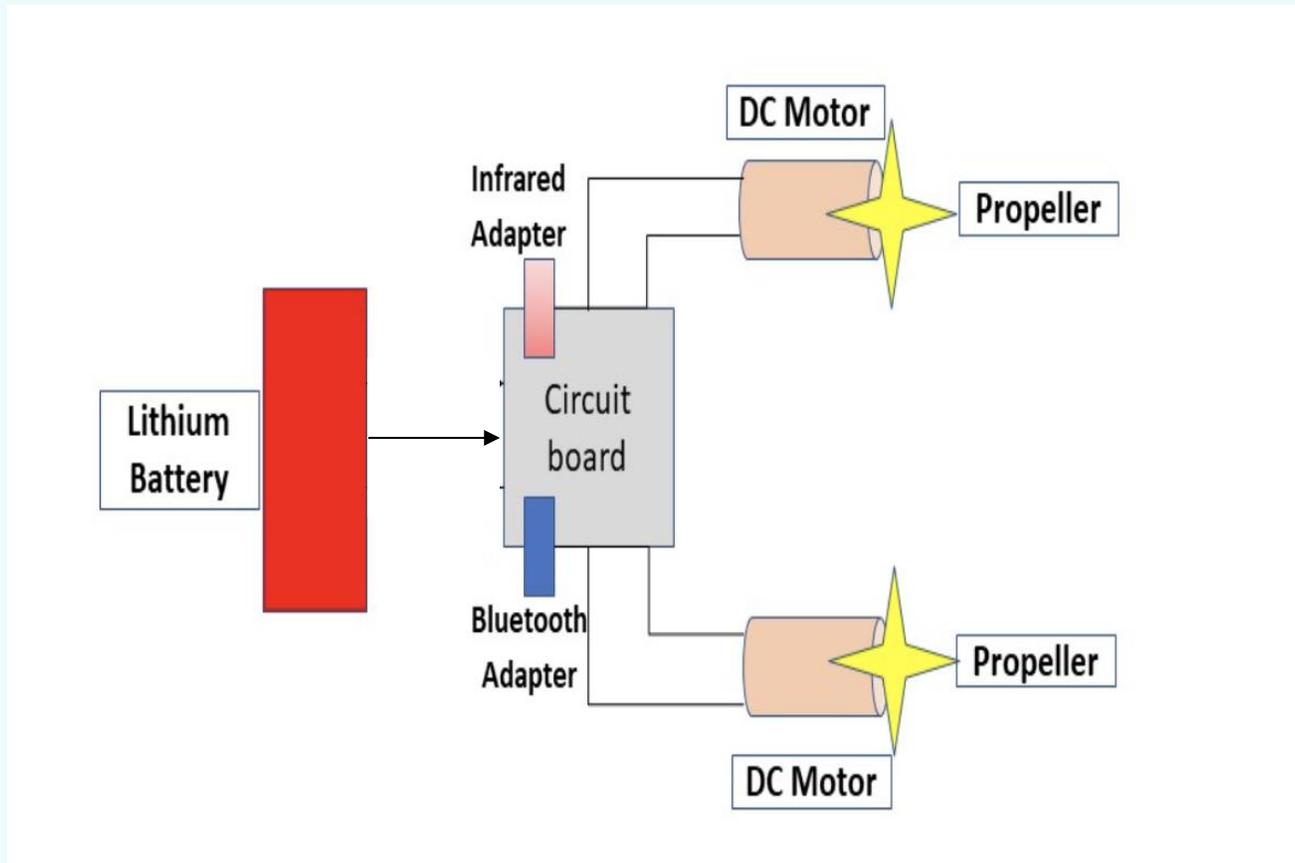


The back is the control system, the important part of the boat which has the batteries, propellers, circuit boards and an on/off switch. There is a propeller on each side at the rear end of the boat, both attached to a DC motor (1). The DC motors are connected to a circuit board (2) which is connected to a lithium battery (3). The circuit boards were programmed by *ELEGOO.com* in a way that they can send electric currents to whatever is connected to them. These circuit boards have an infrared adapter which comes with a simple remote, as well as a Bluetooth adaptor. This means that the DC motors and propellers connected to the circuit boards can be controlled by either using the infrared remote or a Bluetooth device. When the switch on the lithium battery is turned on, it sends electric currents to the circuit boards which therefore sends out infrared waves as well as radio waves so then based on whatever remote is used, it can control the movement of the propellers. The remote is the transmitter, and the circuit board is the receiver. When a certain button is pressed on the transmitter, it completes a specific connection. The circuit board senses that connection, recognizes what button is pressed and sends electric currents through the wires and into the DC motors which causes the propellers to move. The direction of the propellers movement is based on

what button is pressed on the remote. When the propellers spin, it creates a backward airflow which causes the boat to thrust forward. That forward thrust is based on Newton's Third Law of Motion- *for every action in nature there is an equal and opposite reaction*. The action is the propellers spinning around creating wind and the reaction is the boat thrusting forward because of the wind.



This diagram represents and explains how the control system works.



The circuit board is receiving electric currents from the lithium battery which helps it send out infrared waves as well as radio waves. Then, when a button on the remote is pressed, it sends electric currents to the DC motors which powers them up and spins the propellers.

Testing and Results

When I did my first test on the boat, I placed it in a basin filled with water and some leaves, it was floating since the density of the boat was less than that of the water. The idle pulley of the conveyer belt system was under water which made it easier for it to pick up waste from the water's surface. I used the infrared remote to control the movement of the boat. For my second and third tests I tried it on my swimming pool.

I learned from previous research that when I press a button on the remote, it shoots out pulses of IR energy to the IR receiver (the infrared adapter) on the circuit board. The receiver translates the light pulses from the remote to electrical signals that instructs a microprocessor in the circuit board to carry out the programmed command.

When the forward button was pressed on the infrared remote control, the two propellers started rotating clockwise and the boat started moving forward because of the forward thrust the airflow from the propellers created. In the same way, when the back button was pressed on the infrared remote control, the two propellers started rotating counterclockwise and the boat began to move backwards. When the left button was pressed on the infrared remote control, the right propeller started rotating clockwise, while the left propeller was rotating counterclockwise, this caused the boat to turn to the left side. When the right button was pressed, the left propeller was rotating clockwise, and right propeller was rotating counterclockwise. With this, the boat started turning to the right side.

When the conveyer belt system was switched on, the two DC motors started rotating. The power was transmitted to the drive pulley from the four AA batteries. Then, the conveyer belt started moving across both the pulleys.

The remote control was used to move the boat towards the leaves to pick them up. Once the leaves and debris were picked up, they were brought to the waste collecting compartment. The boat was able to pick up the leaves and debris in the pool perfectly.

After testing my prototype, I found out that infrared waves only travel in line of sight. That means the only way I could control the propellers of the boat was by pointing the remote right towards the sensor on the circuit board. However, I solved this problem by using the Bluetooth adapter that was on the circuit board. I connected this to my phone, and it worked perfectly. The reason is because, Bluetooth travels in radio waves, which does not require line of sight.

When I decide to create a bigger model of this prototype, I would be sure to put some type of plastic wrap over the control system since it could get wet and damaged easily without one.

Future Endeavors

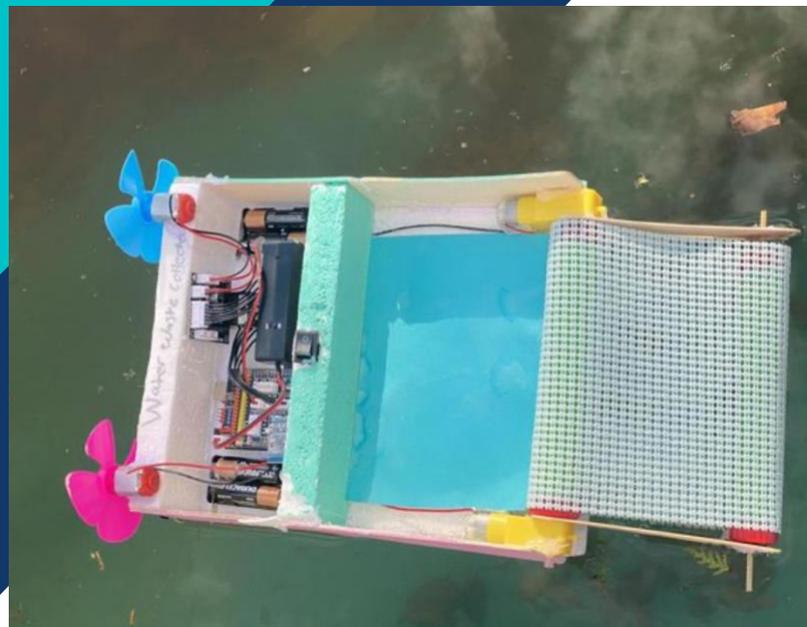
After knowing how great my prototype works, as a future endeavor, I plan to create a larger, modified model of the water cleaning aqua drone to make the job of cleaning the surface of a swimming pool easier and to help clean the surface of any calm body of water.

On my current prototype, I have to manually turn on the switch for the conveyer belt system as well as the control system. To improve this, I plan to integrate those switches to the circuit boards so then I'd be able to turn those parts of the boat on by only using the remote control. I would also like to modify this prototype by making the whole boat waterproof. I could possibly add drone wings as well as a satellite navigation system along with cameras so then I would be able to fly the aqua drone to bodies of water that need to be cleaned up. It would also be helpful if I added a vacuum system so then it would enable the aqua drone to go underwater and suck up the waste down there.

Conclusion

After testing my prototype, I was very proud of what I made. With this prototype, I was able to clean my swimming pool with minimum effort. Knowing that this prototype works efficiently can help me create a larger, and more efficient model of the water cleaning aqua drone to help everyone in the world with cleaning their pools or any calm bodies of water. It would help with the job of cleaning a swimming pool and it would benefit the aquatic life as well as the whole world. Even though it's a small machine that can only pick up a minimum number of things, small things can lead to big changes.

This project has taught me about different electrical systems and how they work, how waste left outside in the water has a negative impact on aquatic life, and how Newton's third law of motion can be applied to help clean our waters.



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