AUTODESK Instructables

Build Your Own Underwater ROV

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Introduction: Build Your Own Underwater ROV

Have you ever been captivated by the idea of exploring the depths of a lake or ocean with your ver y own underwater robot? I sure was, and after stumbling upon a YouTube video of a man using an underwater robot to recover lost treasures, I was determined to make my dream a reality. However, like many of us, I also had a tight budget. So, I embarked on a DIY journey to create my very own u nderwater ROV (Remotely Operated Vehicle). In this Instructable, I'll take you through the steps I fo llowed to build my ROV.

Before diving into building your ROV, let's get acquainted with what an ROV is and how it operates. Unlike a traditional submarine, an ROV is a remotely controlled robot designed to explore underwat er environments. To get a better understanding, check out some resources and videos from experie nced ROV builders who have shared their journeys online. Their insights and experiences can prov ide valuable guidance as you embark on your own ROV-building adventure.

When I began my journey, I discovered that purchasing a ready-made ROV online could cost upwa rds of $1000. However, if you're like me and prefer a budget-friendly approach, the DIY route is the way to go. Many enthusiasts have successfully built their ROVs, and you can too! Let's roll up our s leeves and get started.

Building your own underwater ROV is an exciting and rewarding endeavor. With determination, pati ence, and the guidance of this Instructable, you can create your own underwater explorer. While I c ouldn't provide real images for every step of the process, I've used Fusion 360 to create detailed vi suals that will assist you along the way. So, gear up, embrace your inner explorer, and let's dive int o the world of DIY underwater ROVs!

References

https://www.instructables.com/DIY-Submersible-ROV

https://www.instructables.com/Build-Your-Own-Underwater-ROV-From-Scratch

https://www.instructables.com/Underwater-ROV

http://www.homebuiltrovs.com

https://www.youtube.com/watch?v=0ahCW5KINIc&ab_channel=Drasticg

https://www.youtube.com/watch?v=TfJ0Y3oZTzQ&ab_channel=proto57

https://www.youtube.com/watch?v=WE6ODgQAxvU&ab_channel=LabRatScientific

https://www.youtube.com/watch?v=Lnr5YlBl550&ab_channel=SmithsonianMarineStation

https://www.youtube.com/watch?v=Fltz36ncIs4&ab_channel=NathanBroman

https://www.youtube.com/watch?v=sAY1J2H8yWM&ab_channel=Agermangineer

Have a Fun!

Step 1: Supplies

Electronics(Ebay/Amazon)

- 1 x 8 Channel Relay Module(Ebay/Amazon)
- 1 x FPV Camera(Ebay/Amazon)
- 1 x 12v Battery(Ebay/Amazon)
- 1 x RCA Cable(Ebay/Amazon)
- 1 x Toggle Switch(Ebay/Amazon)
- 1 x On/Off Switch(Ebay/Amazon)
- 2 x Arduino Nano(Ebay/Amazon)
- 2 x 18650 Battery(Ebay/Amazon)
- 2 x 48mm Boat Propeller(Ebay/Amazon)
- 3 x 1100GPH Bilge Pumps(Ebay/Amazon)
- 6 x Momentary Push Buttons(Ebay/Amazon)
- 8 x 1W LED(Ebay/Amazon)
- Twisted Twin TT Cables - 60meters(Ebay/Amazon)

Tools(Ebay/Amazon)

- Soldering iron(Ebay/Amazon)
- Wirecutter(Ebay/Amazon)
- PVC Glue(Ebay/Amazon)
- PVC Saw(Ebay/Amazon)
- Screwdrivers(Ebay/Amazon)
- Glue Gun(Ebay/Amazon)
- Drill(Ebay/Amazon)

PVC(Local Shop)

- 1 x 32mm Endcap
- 2 x 40mm Endcap
- 4 x 50mm Endcap
- 15 x 32mm T Junction
- 20 x 32mm Elbow
- 300mm long 50mm 32mm Pipe

Also Required

- 1 x Water Proof 2-way Connector(Ebay/Amazon)
- 1 x 3-Way Connector(Ebay/Amazon)
- 1 x Air Plane Propeller(Ebay/Amazon)
- 1 x Waterproof 196 x 90 x 60mm Box(LxBxH)(Ebay/Amazon)
- 10cmx10cm Acrylic Piece(Ebay/Amazon)
- 1 x Box For Transmittter.
- Zip-ties
- Bolts
- Screws
- WiresSoler
- Wires
- 10mm Shrinking Tube

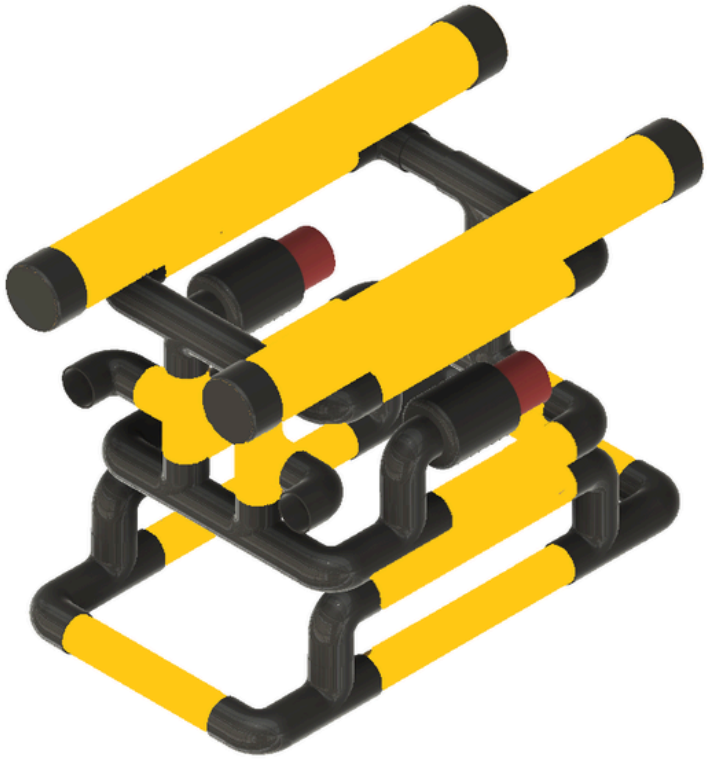
Software(s)

- Arduino IDE
- OBS Studio

Optional(Ebay/Amazon)

- GoPro(Ebay/Amazon)
- 100m Ethernet Cable(Ebay/Amazon).

Step 2: What Is an ROV



Ever dreamed of exploring the hidden mysteries beneath the surface of a lake or ocean? Creating your own Remotely Operated Vehicle (ROV) can turn this dream into a reality. While my DIY ROV may lack advanced features like a manipulator arm, it still offers an incredible underwater adventur e. Let's dive into how this basic ROV works.

How it Works:

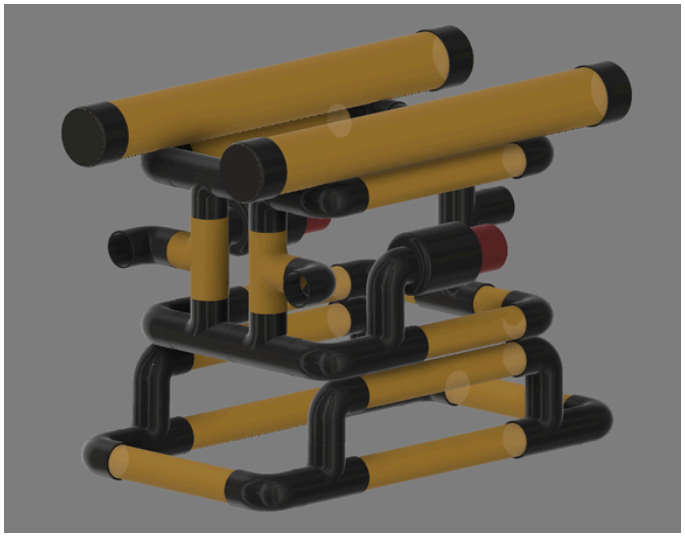
Tethered Control: An ROV is a remotely operated vehicle tethered to a human operator on the surfa ce. This tether allows for direct control and communication with the ROV. While our ROV may lack advanced features, it still relies on this tether for control and data transmission.

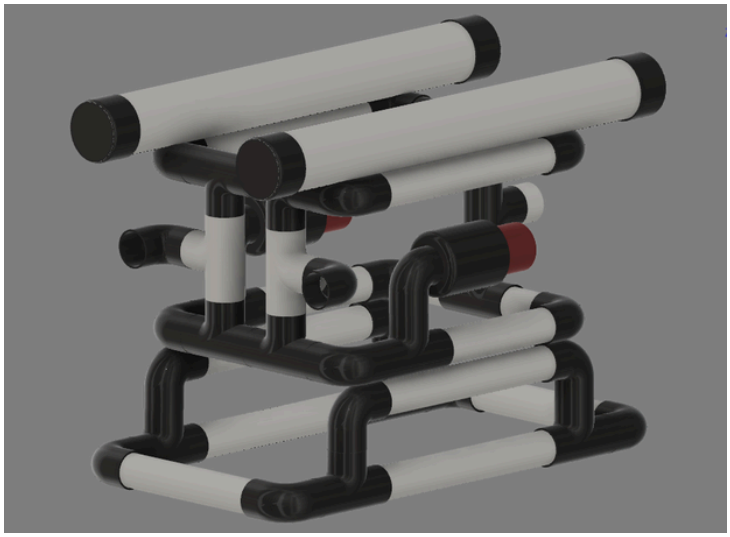
Vertical Thruster: Our DIY ROV is equipped with a vertical thruster, which generates upward thrust. As it pushes water upwards, it follows Newton's Third Law of Motion, causing the ROV to move do wnward. This simple mechanism enables depth control and maneuverability.

Horizontal Thrusters: In addition to the vertical thruster, our ROV features horizontal thrusters. Thes e thrusters create backward thrust, causing the ROV to move forward. The interaction of these hori zontal thrusters with the surrounding water allows for controlled movement in various directions.

While our DIY ROV may not have the capabilities to retrieve objects or water samples, it provides a n excellent platform for exploring and observing underwater environments. It's a cost-effective way to start your underwater adventures and serves as a stepping stone for more advanced ROV proje cts in the future.

Step 3: Selecting a Design for ROV





When it comes to building your own remotely operated vehicle (ROV), there are two popular design choices: the Seafox design and the Seaperch design. After weeks of careful consideration, I settled on the Seafox design for my ROV project. However, for first-time ROV builders, the Seaperch desig n may be the better option due to its simplicity and cost-effectiveness.

Seafox Design Overview:

The Seafox design is known for its robust capabilities and adaptability. In this design, the ROV feat ures two tubes on the top and a bottom section with weights to maintain balance in the water. The t op tubes are sealed, filled with air, and equipped with end caps. Meanwhile, the bottom section is fil led with small glass balls, allowing water to enter. This design ensures buoyancy and stability, maki ng it suitable for various underwater tasks.

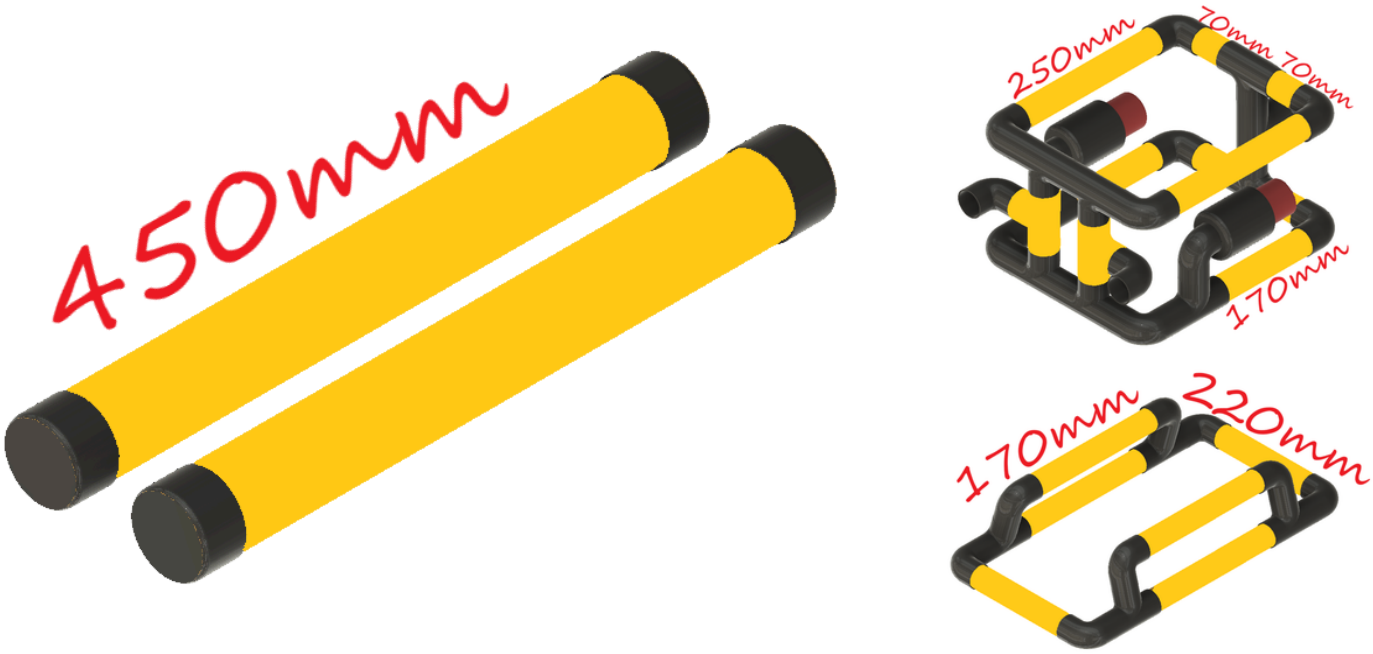
My Modified Seafox Design:

For my ROV project, I decided to make a modification to the Seafox design to accommodate a batt ery. In the original Seafox design, two tubes are located at the bottom of the ROV. I opted to remov e these tubes and instead implemented a custom bottom design. This alteration allows me to carry a battery on my ROV while still benefiting from the Seafox design's underwater capabilities.

Seaperch Design Advantages:

While I chose the Seafox design for my project, I want to emphasize that the Seaperch design has i ts merits, particularly for beginners. The Seaperch ROV requires fewer materials and offers excelle nt maneuverability. It's an excellent starting point for those new to ROV construction.

Step 4: The Frame



Creating your own ROV can be an exciting and fulfilling project, especially when you customize it to meet your specific requirements. In this comprehensive guide, we will take you through the step-by-step process of constructing a custom Seafox-design ROV, complete with your unique dimensions. To aid your understanding, we have provided images that illustrate the dimensions and the assembly process.

Building Process:

Floating Tubes - Image 1

- Begin by cutting two PVC pipes, each measuring 50mm in length. Ensure that both pipes are precisely the same size to maintain the ROV's balance.
- You will need four PVC end caps with a 50mm diameter (two for each tube). Carefully attach these end caps to the ends of the PVC pipes.
- To verify their waterproofing, submerge the tubes in a water tank. Ensuring that they are completely watertight is crucial for achieving the desired buoyancy and stability in your ROV.

Main Frame - Image 2

- Cut 25 pieces of 40mm PVC pipe, each measuring 40mm in length.
- Additionally, cut two PVC pipes, each measuring 250mm in length, and four pieces measuring 70mm each.
- Assemble the main frame by connecting the elbows and 'T' junctions using the 40mm PVC pipe pieces as demonstrated in the accompanying image.
- Secure and bond the PVC components together to create the main structural frame of your ROV.

Battery Carrying Part - Image 3

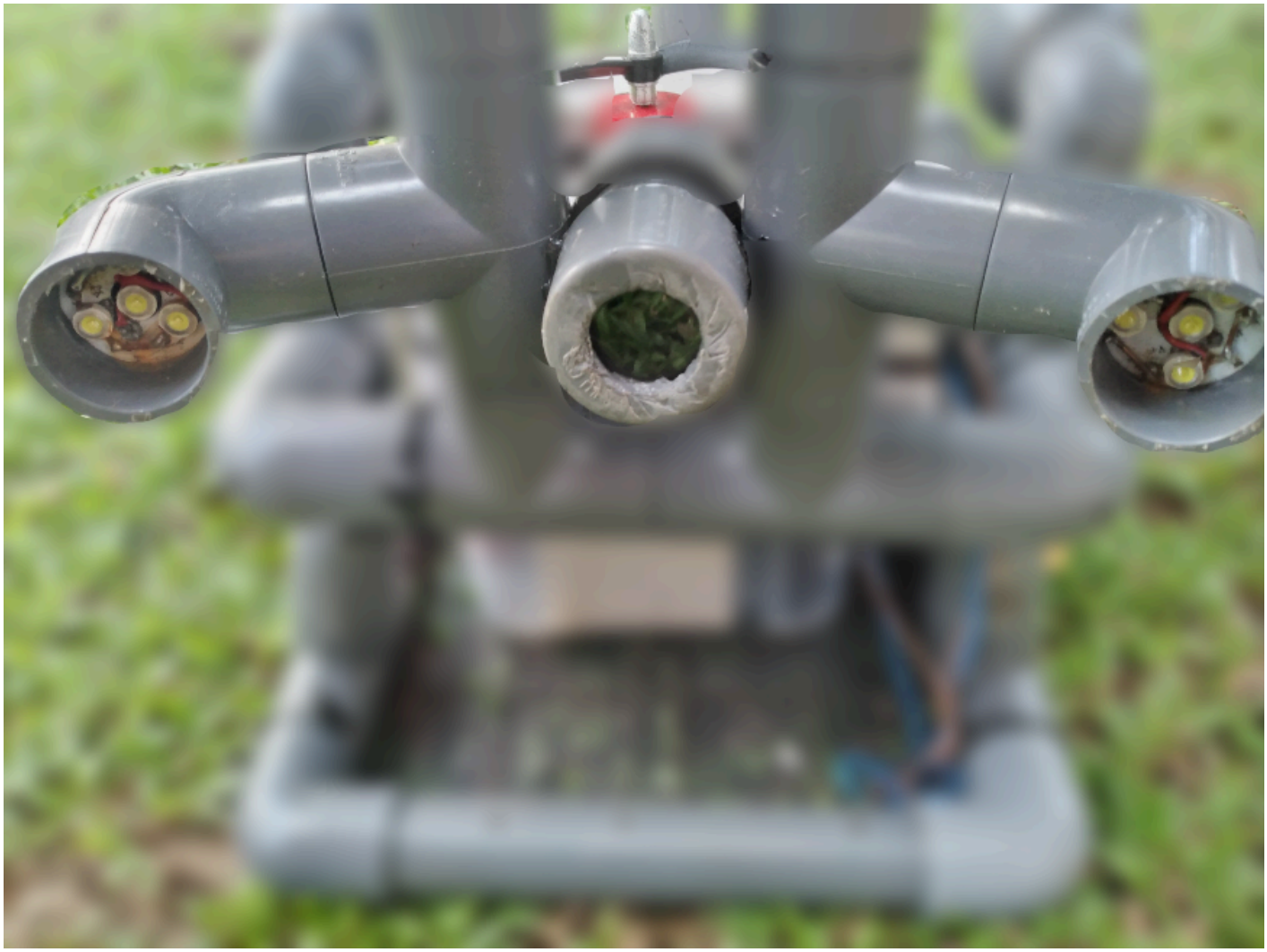
- Cut two PVC pipes, each measuring 220mm in length, and four pieces measuring 170mm each.
- In a manner similar to the main frame, connect the elbows and 'T' junctions using the 40mm PVC pipe pieces to construct the section for carrying the battery of your ROV.
- Assemble and securely fasten the PVC components in accordance with the illustrated image.

By diligently following these detailed instructions and implementing your custom dimensions, you will be well on your way to constructing a personalized Seafox-design ROV. This DIY project not only offers valuable hands-on experience but also the exciting prospect of exploring underwater environments with a ROV designed to meet your specific needs. Enjoy the building process and get ready for thrilling underwater adventures with your customized ROV.

Refer to this Link

http://www.homebuiltrovs.com/seafoxretrofitframe.html

Step 5: The Lights



Effective lighting is crucial for underwater exploration with your custom Seafox-design ROV. In this section, we'll guide you through the process of creating your own LED lighting system using cost-effective and bright 1W LEDs. With these steps, you can illuminate the underwater world and enhance your ROV's capabilities without breaking the bank.

Building the LED Lighting System:

Soldering the LEDs

- Begin by soldering four 1W LEDs that can fit into a 30mm hole. These LEDs are both bright and budget-friendly.

Wiring

- Solder two wires to the ends of the series connection of the LEDs. This will allow you to connect them to your ROV's power source.

Creating the LED Array

- Cut a circular piece of plastic, such as acrylic, with a diameter of 30mm. This will serve as the base for your LED array.
- Securely glue the four LEDs onto the circular plastic piece using hot glue. Ensure that they are evenly spaced and securely attached.

Inserting into Elbows

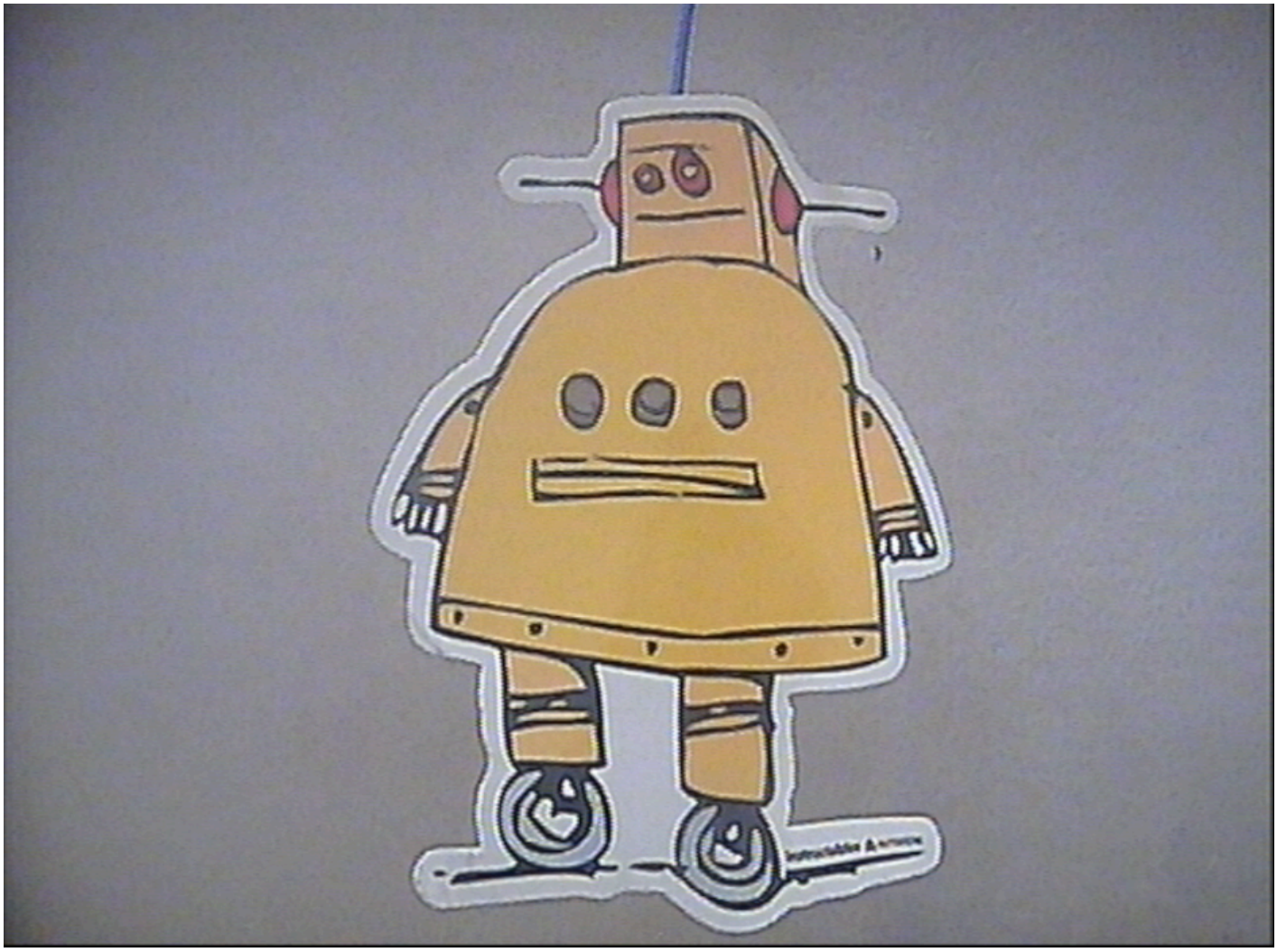
- Insert the completed LED set into a 32mm elbow, ensuring a snug fit.
- Repeat this entire process one more time to create a second LED assembly. Having two light s will provide balanced illumination for your ROV.

By following these steps, you'll have a reliable and cost-effective LED lighting system for your ROV. While you may have concerns about waterproofing, you can take confidence in the fact that LEDs o ften perform well underwater, as you've seen in images online and through your own tests. Illuminat e your underwater adventures and discover the hidden wonders beneath the surface with your cust om-built ROV.

Refer to this Link

http://www.homebuiltrovs.com/seafoxretrofitauxlighting.html

Step 6: The Camera



Achieving high-quality underwater footage is crucial for a fulfilling ROV experience. While action ca meras are a standard choice, their output may not always meet your expectations. In this guide, we recommend using an FPV camera with a waterproof case to enhance your ROV's video capabilitie s. We'll walk you through the process of installing and waterproofing the camera housing for optima l performance.

Installing the Camera:

Camera Wiring

- Your FPV camera will have three wires coming out of it: VCC, GND, and Signal.
- Connect these wires as follows:
- VCC to the positive terminal of your ROV's battery (+).
- GND to both the negative terminal of your ROV's battery (-) and the RCA cable's GND wire.
- Signal to the RCA cable's Signal wire.

Waterproofing the Camera Housing

- Start by drilling or cutting a 30mm section from the 40mm endcap that will house your camer a.
- Cut out a circular piece of acrylic with a 39mm diameter.
- Apply silicon sealant to the binding of the endcap after cutting out the 30mm section.
- Carefully attach the acrylic piece to the endcap, making sure not to blur the acrylic.
- Take another 40mm end cap and drill a hole to allow the three camera wires to pass through.
- Seal the hole and wires with waterproof epoxy to prevent water ingress.
- Securely attach the action camera to the end cap using glue or zip ties, ensuring it is well-pos itioned for clear footage.
- Connect the three camera wires to their corresponding counterparts and solder them togethe r. Be sure to insulate the connections thoroughly to prevent any short circuits.
- Cut a 50mm long pipe from a 40mm PVC pipe to act as a connector.
- Join the two end caps (the one with the camera and the one with the wires) using the 50mm PVC pipe, and secure them in place with glue. This creates a waterproof housing for your FP V camera.

By following these steps, you'll not only enhance the quality of your ROV's video output but also pr otect your FPV camera from underwater conditions. Now, you're ready to capture stunning underw ater footage and explore the depths with confidence.

Step 7: Surface : Controller - Building

To comfortably operate your ROV, a convenient controller is essential. In this guide, we'll show you how to create a user-friendly ROV controller using a compact box and momentary buttons. This str eamlined interface will ensure precise control of your ROV. Let's get started on assembling your cu stom ROV controller.

Building the ROV Controller:

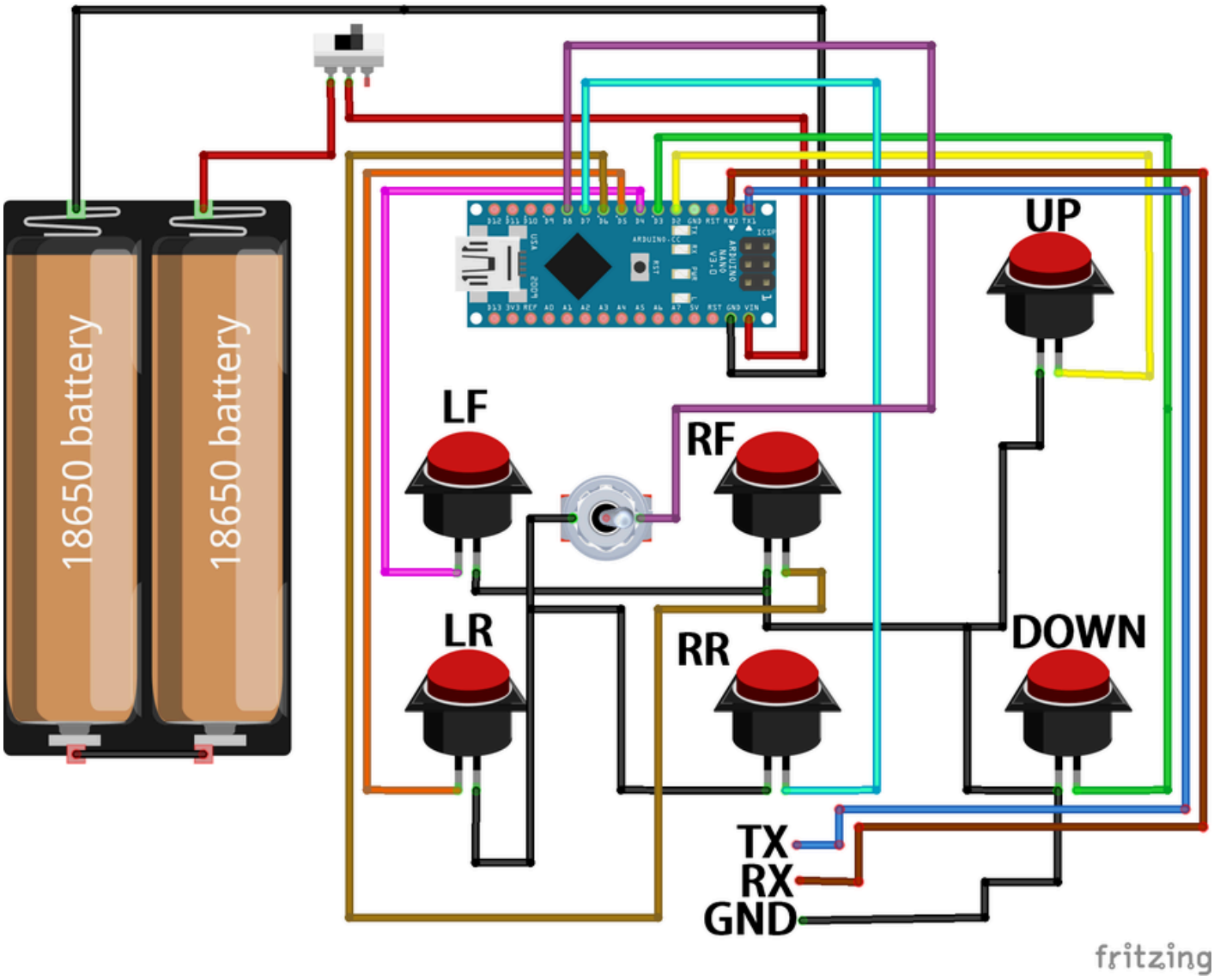
Prepare the Box:

- Begin with a compact box measuring 12x5x9 (LxBxH) that comfortably fits in your hand.
- Drill four holes on the top side of the box with a diameter matching that of your momentary bu ttons (in this case, 16mm).
- Drill two additional holes on the upper side.
- Toggle Switch Placement:
- Drill a hole for the toggle switch, preferably on the top side between the first two buttons.
- Power Switch and Tether Ports:
- Drill two more holes for the main power switch and the wires that come out for the tether (TX, RX, and Ground).
- Wire Connections:
- Connect wires for all electronic components, including the buttons, batteries, and other essen tial elements.

Button Functionality Test:

- Ensure that all buttons are functioning correctly by uploading a basic code to your Arduino. Yo u can find a suitable example in the **Arduino IDE:Arduino IDE >>> File >>> Examples >>> Digital >>> Button**
- By following these steps, you'll create a compact and user-friendly ROV controller that enhan ces your ability to operate the ROV precisely and comfortably. With this controller in hand, yo u'll have full command over your underwater exploration adventures.

Step 8: Surface : Controller - Circuit & Code



Now that you've assembled your ROV controller box with momentary buttons and switches, it's tim e to connect all the electronics and upload the necessary code to make it functional. This guide will walk you through the final steps to bring your ROV controller to life.

Wiring the ROV Controller:

Button Connections:

- Connect the momentary buttons to the Arduino. Refer to the image provided earlier for button placement and connections.

Toggle Switch:

- Wire the toggle switch according to your specific use case. It may be used for functions like p ower and light.

Power Switch and Tether Ports:

- Connect the main power switch to control the overall power supply.
- Ensure that the wires for the tether (TX, RX, and Ground) are securely connected.

Arduino and Power Supply:

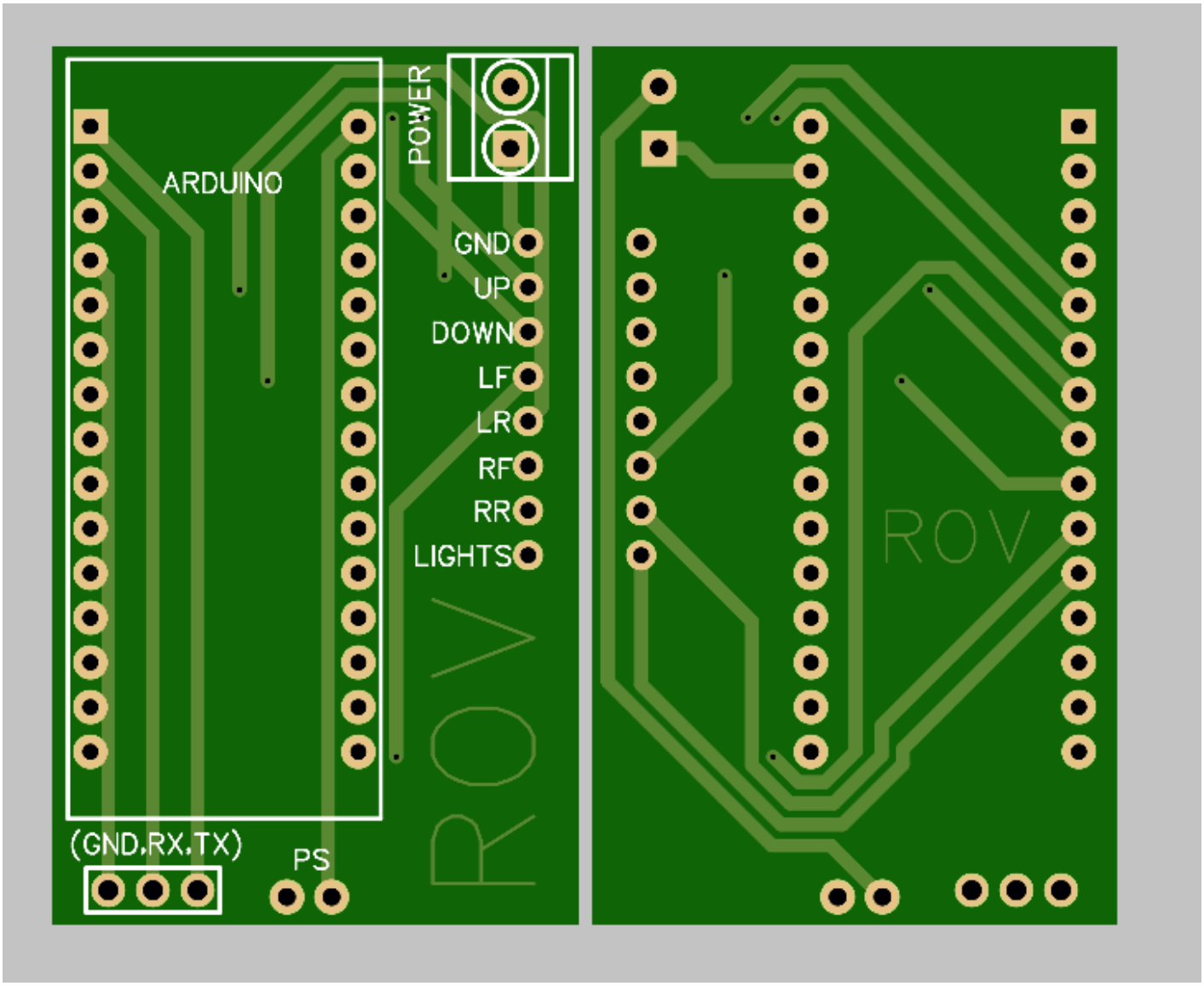
- Connect the Arduino to the appropriate power source (batteries or external power supply) as needed.

Programming the ROV Controller, before closing the box, you'll need to upload the code to the Ard uino. Here's the code you can use:

```
int buttonPin1 = 2;
int buttonPin2 = 3;
int buttonPin3 = 4;
int buttonPin4 = 5;
int buttonPin5 = 6;
int buttonPin6 = 7;
int buttonPin7 = 8;
void setup() {
pinMode(buttonPin1, INPUT_PULLUP);
pinMode(buttonPin2, INPUT_PULLUP);
pinMode(buttonPin3, INPUT_PULLUP);
pinMode(buttonPin4, INPUT_PULLUP);
pinMode(buttonPin5, INPUT_PULLUP);
pinMode(buttonPin6, INPUT_PULLUP);
pinMode(buttonPin7, INPUT_PULLUP);
Serial.begin(9600);
}
void loop() {
int buttonValue1 = digitalRead(buttonPin1);
int buttonValue2 = digitalRead(buttonPin2);
int buttonValue3 = digitalRead(buttonPin3);
int buttonValue4 = digitalRead(buttonPin4);
int buttonValue5 = digitalRead(buttonPin5);
int buttonValue6 = digitalRead(buttonPin6);
int buttonValue7 = digitalRead(buttonPin7);
if (buttonValue5 == LOW && buttonValue6 == LOW && buttonValue4 == HIGH)
{
Serial.write(1);
}
else if (buttonValue5 == LOW && buttonValue6 == LOW && buttonValue4 == LOW)
{
Serial.write(2);
}
else if (buttonValue3 == LOW && buttonValue7 == LOW && buttonValue4 == HIGH)
{
Serial.write(3);
}
else if (buttonValue3 == LOW && buttonValue7 == LOW && buttonValue4 == LOW)
{
Serial.write(4);
}
else if (buttonValue7 == LOW && buttonValue5 == LOW && buttonValue4 == HIGH)
{
Serial.write(5);
}
else if (buttonValue7 == LOW && buttonValue5 == LOW && buttonValue4 == LOW)
{
Serial.write(6);
}
else if (buttonValue6 == LOW && buttonValue3 == LOW && buttonValue4 == HIGH)
{
Serial.write(7);
}
else if (buttonValue6 == LOW && buttonValue3 == LOW && buttonValue4 == LOW)
{
Serial.write(8);
}
else if (buttonValue1 == LOW && buttonValue4 ==HIGH)
```

```
{
Serial.write(9);
}
else if (buttonValue1 == LOW && buttonValue4 ==LOW)
{
Serial.write(10);
}
else if (buttonValue2 == LOW && buttonValue4 ==HIGH)
{
Serial.write(11);
}
else if (buttonValue2 == LOW && buttonValue4 ==LOW)
{
Serial.write(12);
}
else  if (buttonValue5 == LOW && buttonValue4 ==HIGH)
{
Serial.write(13);
}
else  if (buttonValue5 == LOW && buttonValue4 ==LOW)
{
Serial.write(14);
}
else  if (buttonValue6 == LOW && buttonValue4 == HIGH)
{
Serial.write(40);
}
 else  if (buttonValue6 == LOW && buttonValue4 == LOW)
{
Serial.write(50);
}
else  if (buttonValue3 == LOW && buttonValue4 == HIGH)
{
Serial.write(17);
}
else  if (buttonValue3 == LOW && buttonValue4 == LOW)
{
Serial.write(18);
}
else  if (buttonValue7 == LOW && buttonValue4 == HIGH)
{
Serial.write(60);
}
else  if (buttonValue7 == LOW && buttonValue4 == LOW)
{
Serial.write(80);
}
else if (buttonValue4 == LOW)
{
Serial.write(21);
}
else
{
Serial.write(100);
}}<br>
```

Step 9: PCB - 1(Optional)



To further simplify the construction of your ROV remote controller, we've designed a dedicated PCB (Printed Circuit Board) using Easyeda. This PCB not only saves you time but also ensures a clean and efficient layout for your transmitter. You can also find a matching PCB for the onboard controlle r. Here, you'll find the link to download the Gerber file for the PCB.

By utilizing this PCB, you'll streamline the assembly of your ROV remote controller, making your un derwater exploration adventures even more enjoyable and efficient.

Download Link

https://drive.google.com/uc?export=download&id=1JC6nl3tBkYME7euVEcVxX8KFBSy4WGfy

Step 10: Onboard : Controller - Building

Maintaining the waterproof integrity of your ROV's electronics is essential for its functionality and lo ngevity. To house the Arduino Nano and the 8-channel relay module, two waterproof boxes are utili zed. In this guide, we'll detail the steps to ensure that these boxes remain waterproof, protecting yo ur electronics from water damage.

Waterproofing the Electronics Boxes:

Prepare the Relay Module Box:

- Drill a hole in the relay module box to allow wires to pass through.
- Ensure that all necessary wires for the relay module are routed through this hole.

Waterproofing the Hole:

- Apply waterproof epoxy to seal the hole and wires that pass through it. This step ensures that no water can enter the box through this opening.

Repeat for the Arduino Box:

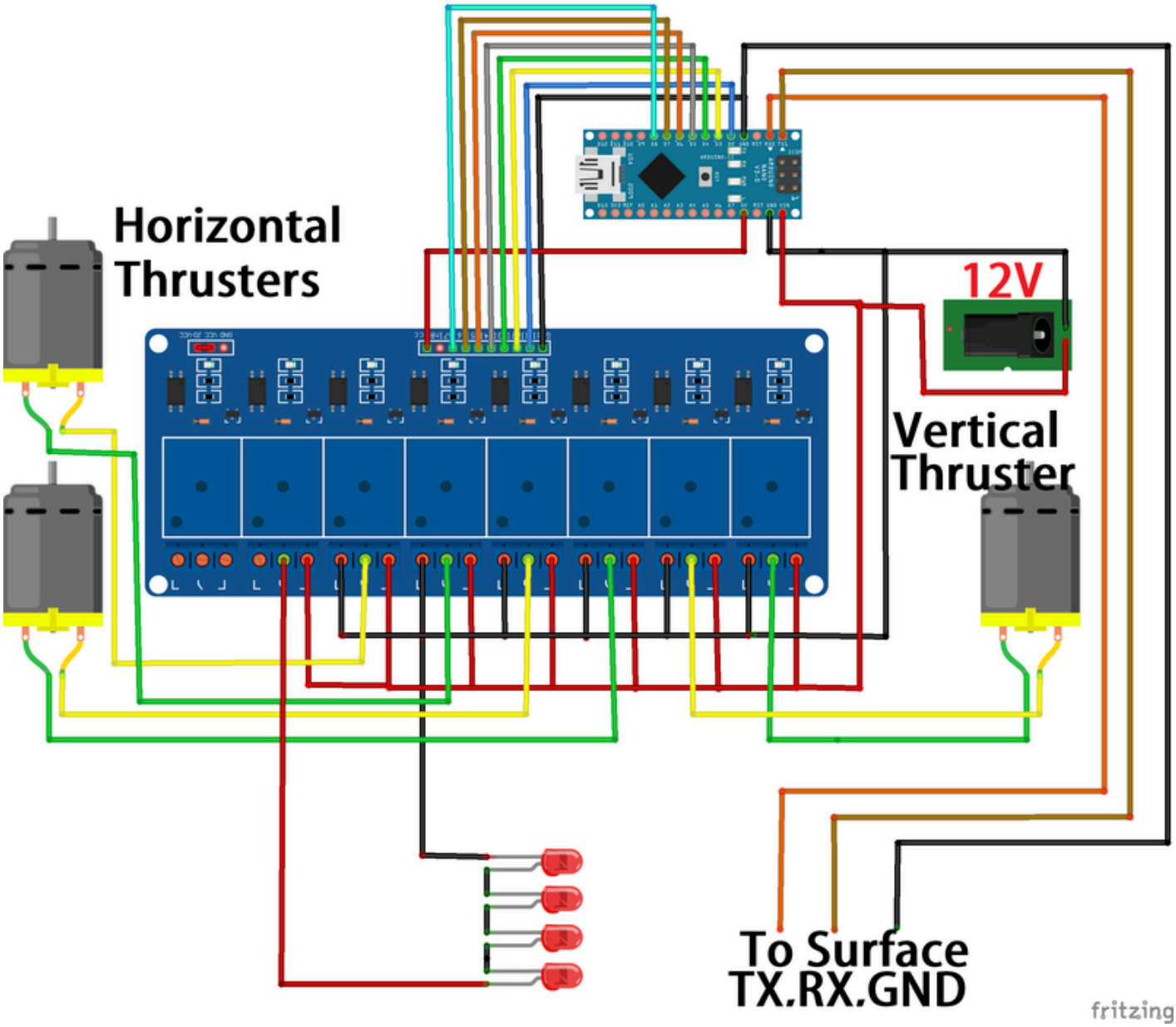
- Follow the same steps for the Arduino box to guarantee that it remains waterproof. Drill a hole for necessary wires, seal the hole with epoxy, and confirm the waterproofing.

Verify Waterproofing:

- Close the lids of both boxes securely, ensuring that the sealing mechanisms are engaged.
- To confirm that the boxes are waterproof, immerse them in a water tank. This test ensures tha t no water penetrates the boxes and jeopardizes the safety of your electronics.

By diligently following these steps, you can safeguard your Arduino Nano and 8-channel relay mod ule from water damage, ensuring the reliable performance of your ROV during underwater mission s. Waterproofing your electronics boxes is a critical step in maintaining the longevity and functionali ty of your ROV's control system.

Step 11: Onboard : Controller - Circuit & Code



The heart of your ROV's control system lies in its circuitry and the code that drives it. In this sectio n, we present the circuit diagram and Arduino code that powers your ROV. Should you have any qu estions or need assistance with any aspect of this project, please don't hesitate to reach out.

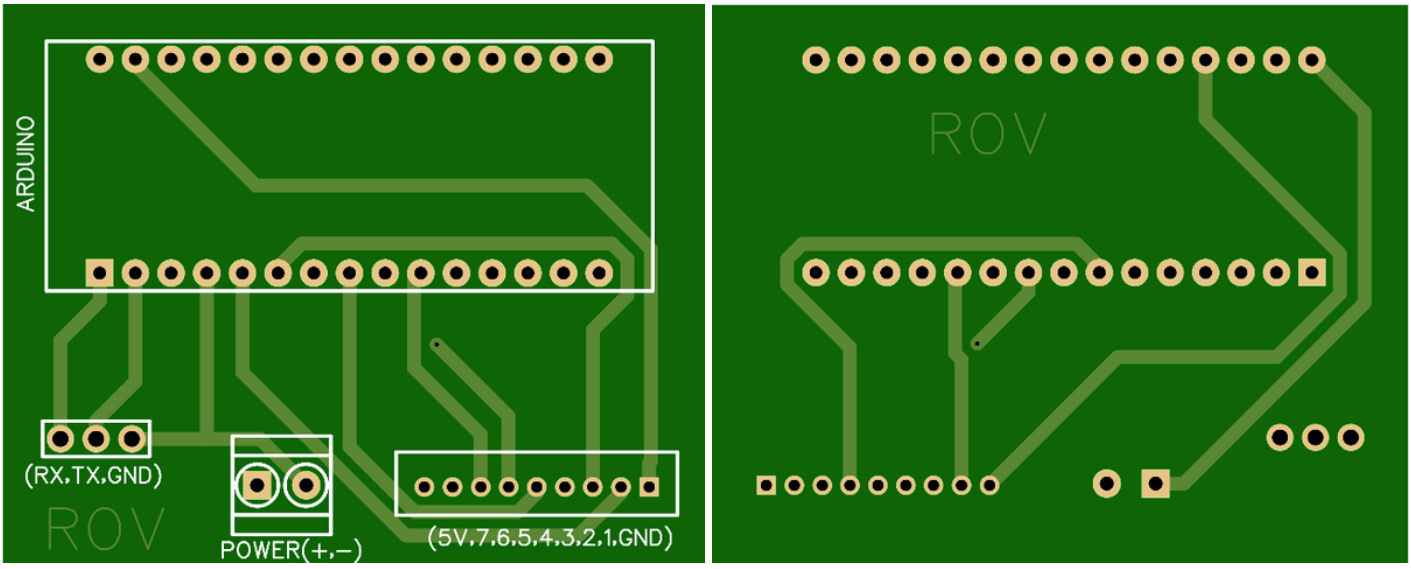
```
int relay1 = 12;
int relay2 = 3;
int relay3 = 7;
int relay4 = 6;
int relay5 = 4;
int relay6 = 5;
int relay7 = 8;
void setup(){
Serial.begin(9600);
pinMode(relay1,OUTPUT);
pinMode(relay2,OUTPUT);
pinMode(relay3,OUTPUT);
pinMode(relay4,OUTPUT);
pinMode(relay5,OUTPUT);
pinMode(relay6,OUTPUT);
pinMode(relay7,OUTPUT);
}
void loop(){
if (Serial.available()) {
```

```
int val = Serial.read();
Serial.println(val);
if(val==(9))
{
digitalWrite(relay1,LOW);
digitalWrite(relay2,HIGH);
}
else if(val==(11))
{
digitalWrite(relay2,LOW);
digitalWrite(relay1,HIGH);
}
else if(val==(10))
{
digitalWrite(relay1,LOW);
digitalWrite(relay2,HIGH);
digitalWrite(relay7,LOW);
}
else if(val==(12))
{
digitalWrite(relay2,LOW);
digitalWrite(relay1,HIGH);
digitalWrite(relay7,LOW);
}
else if(val==(13))
{
digitalWrite(relay3,LOW);
digitalWrite(relay4,HIGH);
}
else if(val==(17))
{
digitalWrite(relay4,LOW);
digitalWrite(relay3,HIGH);
}
else if(val==(14))
{
digitalWrite(relay3,LOW);
digitalWrite(relay4,HIGH);
digitalWrite(relay7,LOW);
}
else if(val==(18))
{
digitalWrite(relay4,LOW);
digitalWrite(relay3,HIGH);
digitalWrite(relay7,LOW);
}
else if(val==(40))
{
digitalWrite(relay5,LOW);
digitalWrite(relay6,HIGH);
}
else if(val==(60))
{
digitalWrite(relay6,LOW);
digitalWrite(relay5,HIGH);
}
else if(val==(50))
{
digitalWrite(relay5,LOW);
digitalWrite(relay6,HIGH);
digitalWrite(relay7,LOW);
}
else if(val==(80))
{
digitalWrite(relay6,LOW);
digitalWrite(relay5,HIGH);
digitalWrite(relay7,LOW);
}
else if(val==(1))
```

```
{
digitalWrite(relay3,LOW);
digitalWrite(relay5,LOW);
digitalWrite(relay6,HIGH);
digitalWrite(relay4,HIGH);
}
else if(val==(2))
{
digitalWrite(relay3,LOW);
digitalWrite(relay5,LOW);
digitalWrite(relay6,HIGH);
digitalWrite(relay4,HIGH);
digitalWrite(relay7,LOW);
}
else if(val==(3))
{
digitalWrite(relay4,LOW);
digitalWrite(relay6,LOW);
digitalWrite(relay3,HIGH);
digitalWrite(relay5,HIGH);
}
else if(val==(4))
{
digitalWrite(relay4,LOW);
digitalWrite(relay6,LOW);
digitalWrite(relay3,HIGH);
digitalWrite(relay5,HIGH);
}
else if(val==(5))
{
digitalWrite(relay3,LOW);
digitalWrite(relay6,LOW);
digitalWrite(relay4,HIGH);
digitalWrite(relay5,HIGH);
}
else if(val==(6))
{
digitalWrite(relay3,LOW);
digitalWrite(relay6,LOW);
digitalWrite(relay4,HIGH);
digitalWrite(relay5,HIGH);
}
else if(val==(7))
{
digitalWrite(relay5,LOW);
digitalWrite(relay4,LOW);
digitalWrite(relay6,HIGH);
digitalWrite(relay3,HIGH);
}
else if(val==(8))
{
digitalWrite(relay5,LOW);
digitalWrite(relay4,LOW);
digitalWrite(relay6,HIGH);
digitalWrite(relay3,HIGH);
}
else if(val==(21))
{
digitalWrite(relay7,LOW);
digitalWrite(relay1,HIGH);
digitalWrite(relay2,HIGH);
digitalWrite(relay3,HIGH);
digitalWrite(relay4,HIGH);
digitalWrite(relay5,HIGH);
digitalWrite(relay6,HIGH);
}
else if(val==(100))
{
digitalWrite(relay1,HIGH);
```

```
digitalWrite(relay2,HIGH);
digitalWrite(relay3,HIGH);
digitalWrite(relay4,HIGH);
digitalWrite(relay5,HIGH);
digitalWrite(relay6,HIGH);
digitalWrite(relay7,HIGH);
}
else
{
digitalWrite(relay1,HIGH);
digitalWrite(relay2,HIGH);
digitalWrite(relay3,HIGH);
digitalWrite(relay4,HIGH);
digitalWrite(relay5,HIGH);
digitalWrite(relay6,HIGH);
digitalWrite(relay7,HIGH);
}}}
```

Step 12: PCB - 2(Optional)

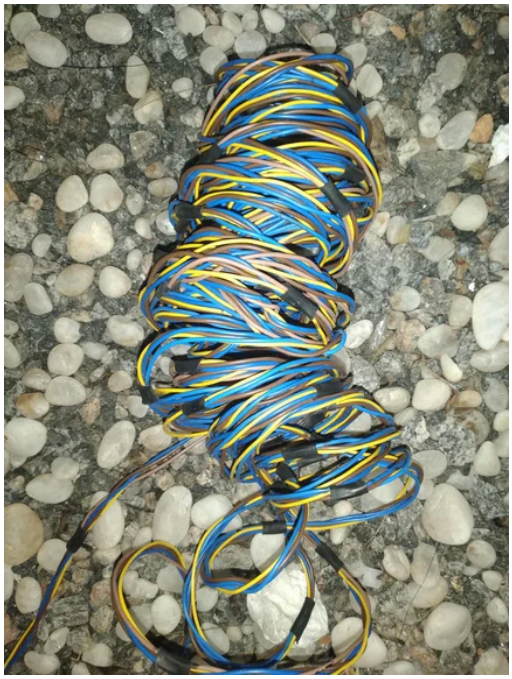


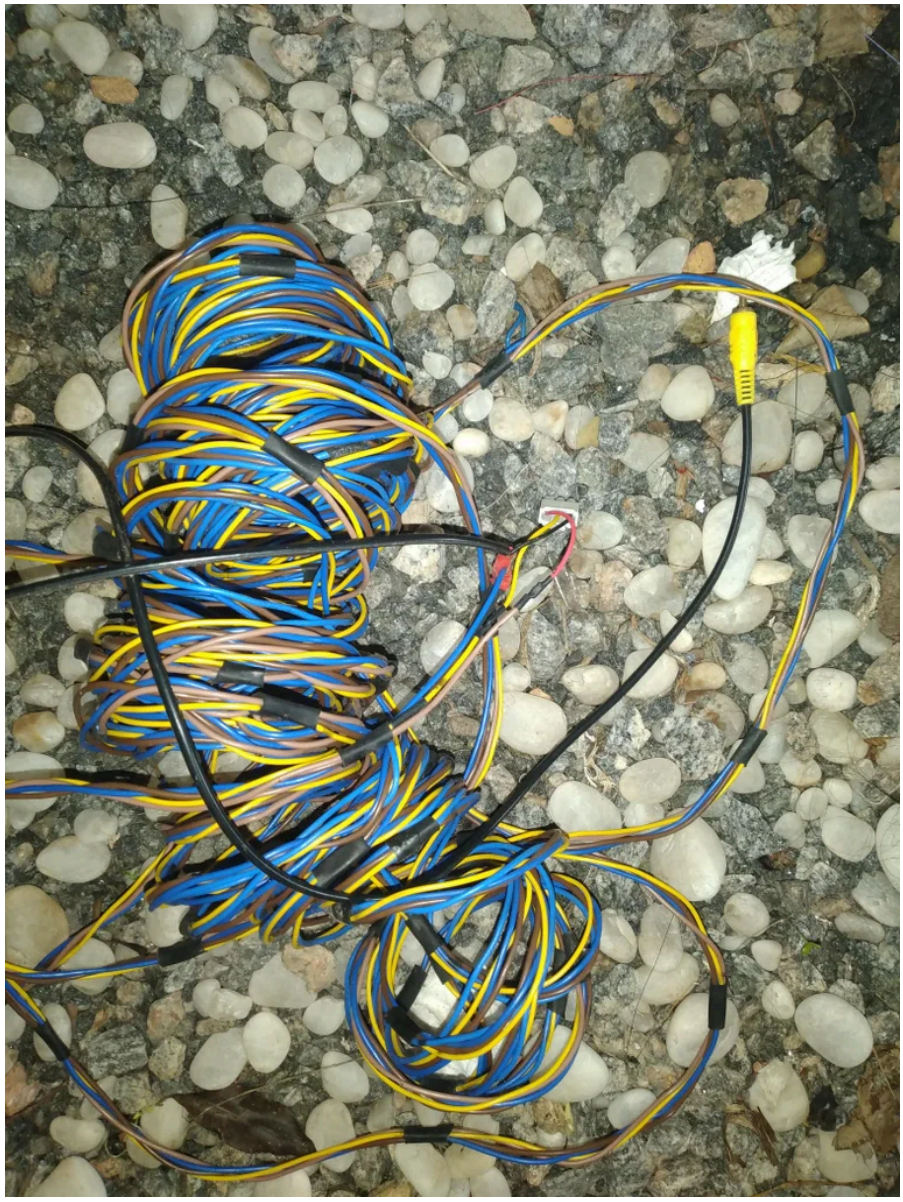
Utilizing this PCB will make assembling your ROV's onboard control system a breeze, ensuring sm ooth operation and enhanced underwater exploration. You can download the Gerber file for the PC B from the provided link below.

Download Link

https://drive.google.com/uc?export=download&id=1xKj76WBfkKuorsD2kDoYERr4zA9ehIZx

Step 13: Tether





Creating a reliable tether for your ROV is essential to maintain communication and power transfer between the surface and your underwater explorer. In this section, we'll share a straightforward method to construct a 30-meter tether using a twin-pair wire. Additionally, we'll discuss how you can extend communication for longer distances if needed.

Constructing the Tether:

Twin-Pair Wire:

- Begin with a 60-meter twin-pair wire and cut it into two equal 30-meter lengths.

Wire Configuration:

- Use one pair of wires for TX (Transmit) and RX (Receive) communication.
- Utilize the other pair of wires for camera signal and Ground.

Securing the Wires:

- To keep the four wires neatly together, employ a 10mm heat-shrink tube.

Heat-Shrink Tube Inserts:

- Cut small 20mm sections from the heat-shrink tube.
- Carefully insert these sections one by one onto the four wires.

Neat and Efficient Tether:

- Take your time to ensure the heat-shrink tube sections are properly placed.
- This meticulous approach will result in a neatly organized and reliable 30-meter tether.

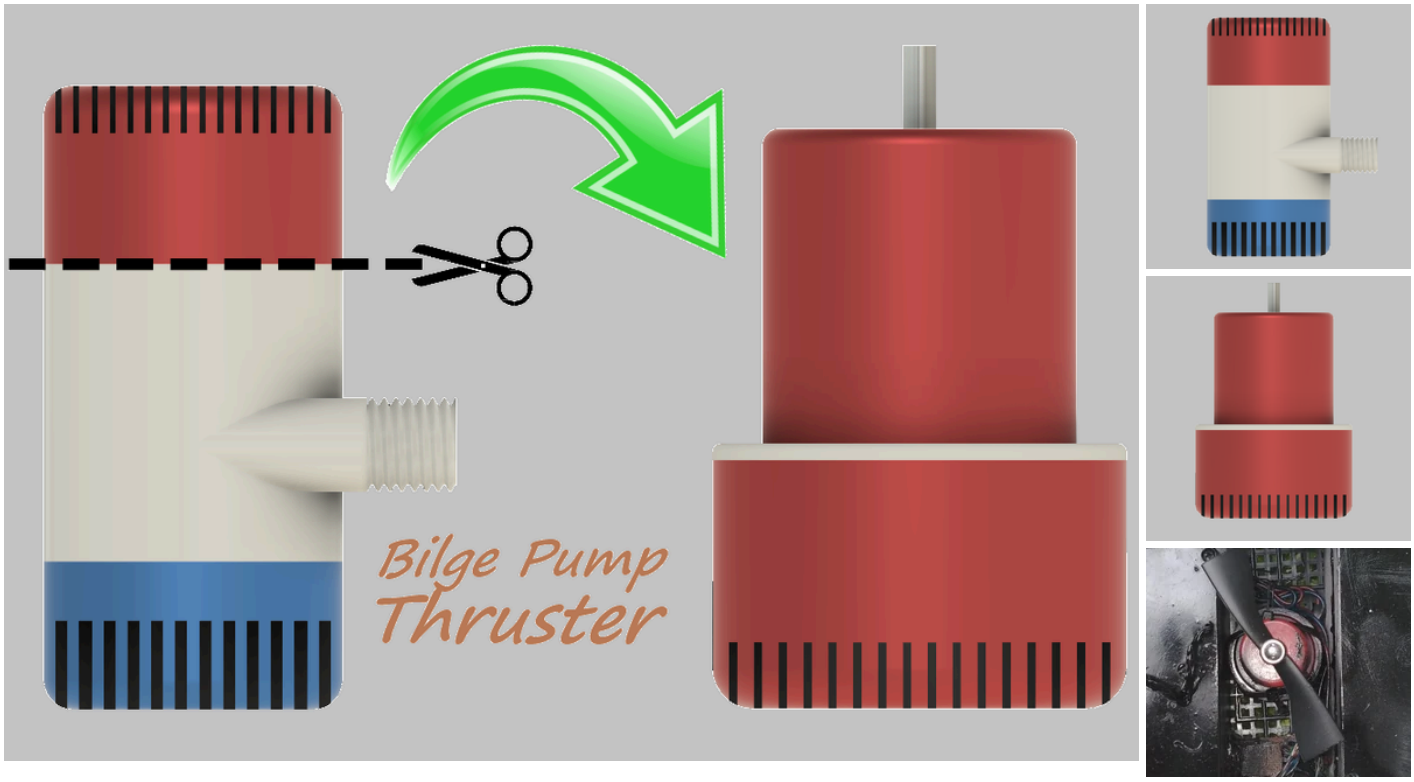
Note - Extending Communication Distance:

The method described above is suitable for tethers up to 40 meters in length. If you plan to commu nicate over longer distances, such as 100 meters or more, consider using a TTL to RS-485 module. This module can extend communication up to 1200 meters (1.2 km).

While you didn't use a TTL to RS-485 module for your basic ROV, it's worth considering for future p rojects with longer tethers. This modular approach ensures robust communication over extended di stances, opening up new possibilities for underwater exploration.

By following these guidelines, you can establish a dependable tether for your ROV, enabling seaml ess communication and power transfer during your underwater expeditions.

Step 14: Converting Bilge Pump Into a Thruster



Thrusters are the driving force behind the movement of an ROV (Remotely Operated Vehicle). In th is section, we'll delve into the significance of thrusters in an ROV and explore a cost-effective and p owerful option for your project. Additionally, we'll guide you through the process of converting bilge pumps into robust thrusters for your underwater explorer.

Understanding Thrusters:

Thrusters are the propulsion system of an ROV, responsible for controlling its movement, speed, an d depth. They generate thrust, allowing the ROV to move forward, backward, ascend, descend, an d change direction. Thrusters play a critical role in the agility and functionality of your ROV.

Selecting the Right Thrusters:

For this project, you can use brushed thrusters, and their performance will impact your ROV's spee d and depth capabilities.

Testing Thrust:

To ensure you have the right thrusters for your ROV, you conducted thrust tests. Here are the result s of my own testings:

- A2212/13T 1000KV brushless motor - 12VDC, 10Amp, 1.2kg thrust (1200g/11.7N).
- Bilge pump - 12VDC, 4.3Amp, 0.8kg thrust (800g/7.8N).

Using Bilge Pumps as Thrusters:

You opted for 1100GPH (gallons per hour) bilge pumps for your thrusters. These pumps are popula r among DIY ROV builders due to their waterproof nature and cost-effectiveness, priced at just $20.

Converting Bilge Pumps into Thrusters:

The process of converting bilge pumps into thrusters is straightforward:

1. Remove the blue housing by pressing two clips on the sides.
2. Carefully cut out the white housing of the bilge pump, ensuring you **do not touch the red par t.**
3. Use a screwdriver to remove the impeller from the motor shaft.
4. Attach the propeller to the motor shaft using a propeller mount.
5. Attach the propeller to the shaft, leaving a small gap.

Attaching Thrusters to the ROV:

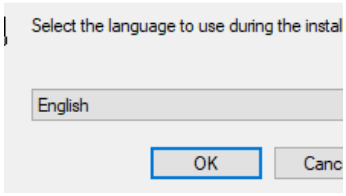
You can secure these thrusters to your ROV using various methods such as zip-ties, ropes, or glue. Ensure the wires from the thrusters are properly connected to the relay box, and double-check your connections before linking them to the relay module.

By following these steps, you'll have cost-effective and efficient thrusters that provide the power yo ur ROV needs for its underwater journeys. Thrusters are the lifeblood of your ROV's movement, an d with these bilge pump conversions, you're well on your way to underwater exploration success.

Refer to this Link

http://www.homebuiltrovs.com/seafoxretrofitthrusters.html

Step 15: Setting Up DVD MAKER 2 [For PC]



To view and record the video output from your ROV's camera, you'll need to connect it to a comput er. In this section, we'll discuss the process of connecting your composite video signal camera to a computer using an RCA to USB converter, such as the DVD Maker 2. Additionally, we'll guide you t hrough the driver installation and setup of OBS Studio, a popular software for capturing and stream ing video.

Driver Installation:

1. Download Drivers for DVD Maker 2:
2. Visit the manufacturer's website or a trusted source to download the necessary drivers for yo ur DVD Maker 2 converter.
3. Extract the ZIP File:
4. After downloading the drivers, extract the contents of the ZIP file to a location on your comput er.
5. Connect Your DVD Maker 2:
6. Plug your DVD MAKER 2 converter into a USB port on your computer.
7. Run the Setup.exe File:
8. Navigate to the extracted driver files and run the setup.exe file.
9. Permissions:
10. Grant necessary permissions when prompted by the installer.
11. Select Your Language:
12. Choose your preferred language and click OK.
13. Installation:
14. Follow the on-screen instructions to complete the driver installation.
15. This process may take some time.
16. Finish:
17. Once the installation is complete, click Finish.

OBS Studio Setup:

1. Download OBS Studio:
2. Visit the OBS Studio website and download the software.
3. Run OBS Studio.exe:
4. Run the OBS Studio installer.
5. Permissions:
6. Provide necessary permissions when prompted during installation.
7. Agreement:
8. Read and agree to the software agreement.
9. Installation:
10. Follow the on-screen instructions for installation. This process may also take some time.
11. Finish:
12. Click Finish when the installation is complete.
13. Open OBS Studio:
14. Launch OBS Studio from your computer.
15. Adding Your ROV Camera:
16. Go to "Sources" within OBS Studio.
17. Double-click on "Video Capture Device."
18. Your DVD Maker 2 converter should now be recognized, indicated by the blue LED on the co nverter.

With these steps completed, your ROV camera's video signal will be accessible on your computer t hrough OBS Studio. You can now view and record your underwater explorations with ease. Enjoy c apturing the wonders of the deep!

Download Drivers For DVD MAKER 2

https://drivers.softpedia.com/get/TV-Tuner-Co/KWorld/KWorld-DVD-Maker-2-BDA-Driver-59721812.shtml

Download OBS Studio

https://obsproject.com/download

Step 16: Power

To overcome earlier challenges and enhance the performance of my ROV, I've decided to integrate an onboard battery. In this section, we'll explore the steps involved in adding a waterproofed lead-a cid battery to your ROV. This modification will provide the power your ROV needs for extended und erwater missions.

Selecting the Battery:

I've chosen a 12V 7Ah lead-acid battery, providing the necessary power to support your ROV's mot ors and electronics.

Installing the Onboard Battery:

1. Prepare Battery Wires:
2. Solder two wires to the positive and negative terminals of the battery, ensuring secure connec tions.
3. Drill a Hole for the Waterproof Connector:
4. Create an entry point for the wire of the waterproof connector on your waterproof box by caref ully drilling a hole.
5. Connect the Battery and Waterproof Connector:
6. Solder the wires from the battery to the appropriate wires of the waterproof connector.
7. Ensure that all connections are properly insulated to prevent water ingress.
8. Seal the Hole with Epoxy:
9. Apply epoxy to seal the hole created for the waterproof connector.
10. Allow the epoxy to cure for approximately one day to ensure a watertight seal.
11. Use No Leak Compound:
12. Enhance the waterproofing by applying a no leak compound around the edge of the lid.
13. Close the lid of the waterproof box and secure it with screws.
14. Wait for about one day to allow the compound to set completely.

Now, you've successfully integrated an onboard battery into your ROV while maintaining its waterpr oof integrity. This addition extends your ROV's operating time, enabling longer and more productive underwater explorations.

Step 17: Controlling the ROV

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Here's the way of controlling the ROV with the controller

A+B >>> Move Forward

C+D >>> Move Backward

A >>> Turn Right(Slow)

B >>> Turn Left(Slow)

A+D >>> Turn Right(Fast)

B+C >>> Turn Left(Fast)

E >>> Up

F >>> Down

G >>> Lights ON

H >> Lights OFF

Step 18: Painting

While entirely optional, adding a coat of paint to your ROV can give it a polished and professional a ppearance. In this section, we'll discuss the process of painting your ROV and offer recommendatio ns for color choices. Please note that this step is purely aesthetic and won't affect the functionality of your ROV.

Selecting the Paint:

Traditionally, ROVs are painted yellow, but you can choose any colour that appeals to you. For this project, I utilized black and white spray paint, resulting in a distinctive appearance.

Painting Your ROV:

Preparation:

- Before you begin painting, **ensure that all unwanted parts**, such as the camera, motors, an d lights, are properly **covered or masked** to prevent any paint from getting on them.

Application:

- Apply the selected paint color evenly across the surface of your ROV.
- Multiple thin coats are preferable to a single heavy coat to achieve a smooth and even finish.

Drying:

- Allow the paint to dry completely between coats as per the instructions on the paint can.
- This process may take a few hours depending on the paint type and environmental condition s.

Final Touches:

- Once you are satisfied with the paint coverage and finish, remove any masking or covering m aterials from the ROV.

While black and white can create a unique appearance, it's recommended to use yellow or a similar ly bright colour for a more professional look. Yellow is a common choice in the ROV industry, makin g it a standard colour.

By following these steps, you can add a personal touch to your ROV and make it stand out in style. While it won't affect the functionality, a painted ROV can add a touch of flair to your underwater exp lorations. The choice of colour is entirely yours, so express your creativity!

Step 19: Fails

Building an ROV is a complex and rewarding endeavor, but it's not without its challenges. In this se ction, we'll discuss some common failures and issues I encountered during my ROV building journe y. Learning from these experiences can help fellow builders avoid similar pitfalls.

Failures and Lessons Learned:

(1) Attempting Wireless Control with NRF24L01:

- After months of work, I attempted wireless control using NRF24L01 modules but encountered communication issues.
- Lesson Learned: NRF24L01 communication may not be reliable underwater due to signal att enuation. Wired communication is often a more robust choice.

(2) Using a Webcam for Video Transmission:

- Initially, I tried using a webcam with USB extension for video transmission but faced limitation s.
- Lesson Learned: USB webcams have distance limitations, making them unsuitable for extend ed underwater exploration. Dedicated FPV cameras designed for underwater use are more re liable.

(3) Tethered Power with Insufficient Ampere:

- My first design utilized an AC to DC 12V power supply for the ROV, but I experienced slow m otor speeds due to ampere drops over the long 30-meter tether.
- Lesson Learned: Tether length and wire thickness are critical factors for power transmission. Ensure your power supply can handle the distance and current requirements.

(4) Weight Balancing Oversights:

- I discovered weight-balancing issues late in the process.
- Lesson Learned: Test ROV balancing early in the project to save time and ensure optimal per formance.

By sharing my experiences and lessons learned, I hope I've provided valuable insights for others e mbarking on their own ROV-building journey. Building an ROV can be a trial-and-error process, but each setback is an opportunity for growth and improvement.

Step 20: Testing

After a year of dedicated effort and overcoming various challenges, the time had come to put my R OV to the test in a real-world setting. In this section, we'll explore your first successful ROV test and the valuable lessons learned along the way.

The First Successful Test:

Testing Beyond the Bathtub:

- While initial testing took place in my bathtub, the real milestone was achieved during a test in a larger body of water.

Overcoming Initial Challenges:

- I've mentioned facing weight and communication issues during your initial tests. These were addressed and resolved, showcasing the adaptability and problem-solving skills essential to a ny DIY project.

Importance of Weight Balancing:

- I've highlighted the significance of weight balancing, emphasizing the need to be prepared wit h additional weights during the first tests.

Note - Weight Balancing:

- It's common for an ROV to require adjustments in weight distribution to achieve optimal buoy ancy and stability. Having extra weights on hand during initial tests can help fine-tune the RO V's balance efficiently.

Step 21: All Done!!!

While my ROV-building journey took over a year, those embarking on this project with all compone nts ready can complete it in just one to two weeks. In this final section, we'll summarize the key asp ects of your ROV project, including cost, timeline, and the importance of sharing your work with the community.

Quick Building Timeline:

- If you have all the components ready, you can build this ROV in just one to two weeks.

Cost Efficiency:

- The project's cost can be around $300 if you follow the detailed instructions.
- By optimizing expenses, you can potentially build the ROV for as little as $200.

Sharing Your Achievements:

- After completing your ROV project, be sure to share it with the community by clicking "I made it."

Questions and Support:

- If you encounter any challenges or have questions during your project, don't hesitate to seek help. Your questions are welcome, and assistance will be provided promptly.

Building this ROV has been an exciting and rewarding journey. As I set out on my own ROV-buildin g adventure, remember that the DIY community is here to support and inspire each other. Thank yo u for being part of this Instructables project, and stay tuned for more exciting DIY projects in the fut ure!

Goodbye and Happy Building!

Second Prize in:

Make it Move Challenge

View Contest