Download kit

Free documentation & blueprints for Aquapioneers Kit
Part III - Electrical & Monitoring system - The Nervous System

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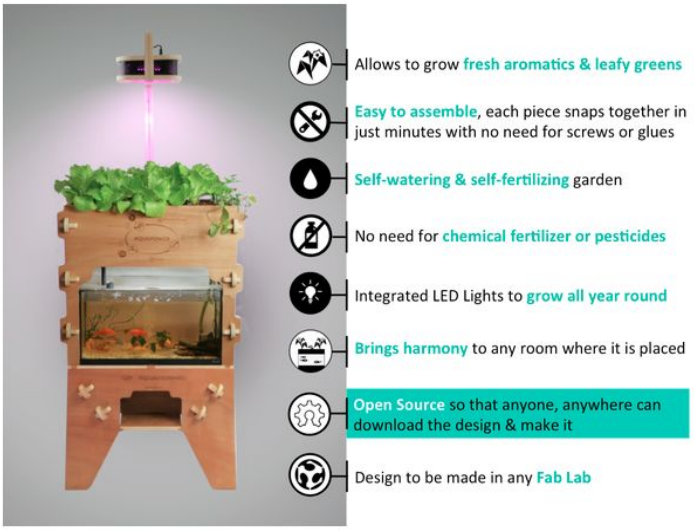
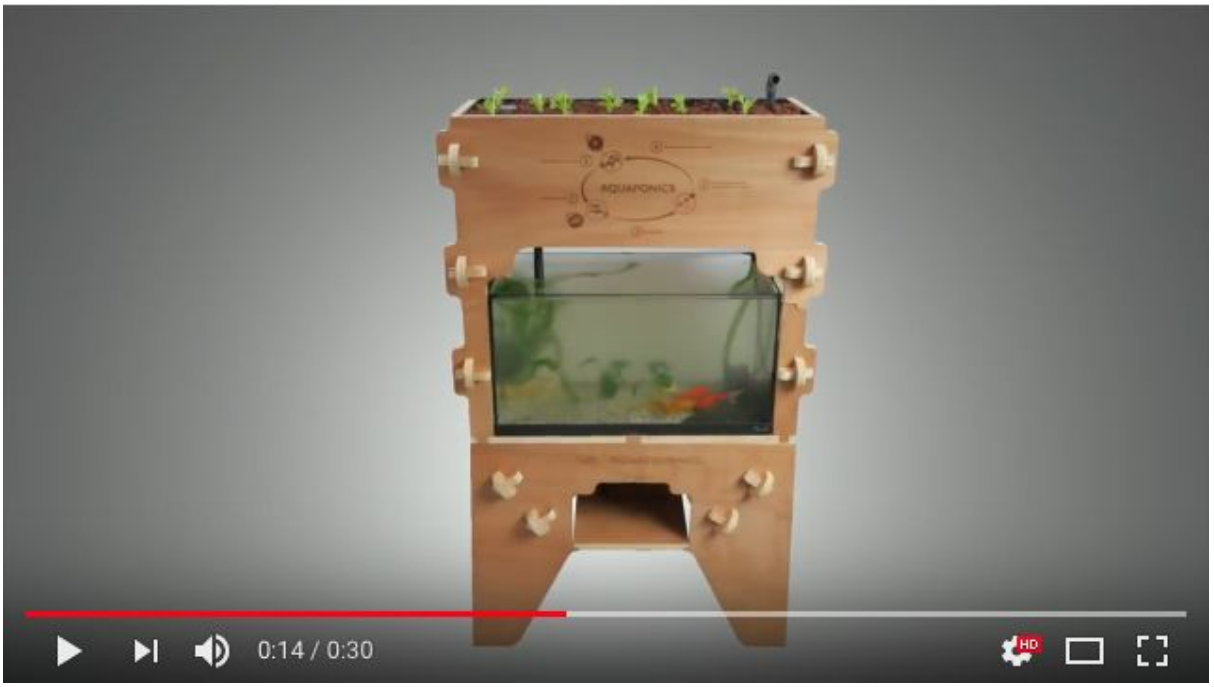
AQUAPIONEERS KIT MAIN FEATURES

The Aquapioneers Ecosystem is a thoughtfully crafted fun, educational, and rewarding experience.

At the intersection of hardware and ecology, it allows you to grow fresh and tasty food all year round. This little piece of nature, will engage and inspire you, your family and your friends.



You can watch the following 30s timelapse Youtube video that sum up the overall assembly process and show a one month growing period with lettuces.



*Please note that the blueprints for Aquapioneers Kit v1.6 and v2 have been designed for a **specific aquarium dimension (60x30x30cm) which is the most common in Europe**. Please make sure you can find these dimensions in your area before you proceed. If you can not source an aquarium with these dimensions, you will have to modify the structure design to be compatible.*

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SOME HERBS & LEAFY GREENS YOU CAN GROW

LETTUCE

STRAWBERRY

PARSLEY

MINT

BASIL

SHIZO

SOME SPECIES OF FISH THAT CAN INHABIT YOUR ECOSYSTEM

GOLD FISH

GUPPY

HEMICHROMIS

TETRA NEON

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Project Overview

AQUAPIONEERS - What is this ?

AQUAPIONEERS is a Barcelona based social enterprise that aims to combine the unbeatable advantages of Aquaponics as a sustainable method of urban agriculture and the power of Digital Fabrication to unlock social innovation. Locally we develop creative services around aquaponics for schools, businesses and individuals and globally spread the word using open source tools.

The Aquapioneers Ecosystem is our first open source product. Its design and user manual documentation release has been possible thanks to our 248 backers that supported our crowdfunding on ULULE closed on July 2017.

This document contains the information you will need to download, fabricate, assemble and use the Aquapioneers ecosystem v1.6 and v2 with confidence and grow aromatics all year round.

Open Source Non Commercial - Why ?

The CC-BY-NC license we have chosen gives anyone the right to download, edit and remix their own versions of the AQUAPIONEERS ECOSYSTEM designs. We think participation in design is something to be actively encouraged. By adapting, improving and creating new variations of the ecosystem we hope to encourage research, innovation and a spirit of collaboration. Because empowering people is one of the fundamental pillars of our project, we believe that everybody should have free access to this documentation to explore aquaponics and digital fabrication. Unfortunately in 2017 it is not yet possible to make a living out of free work.. this is why we have decided to limit the free use of our work to individuals. While we hope to inspire sustainable innovation with our work, we believe that economic value created from inventions should also benefit the inventors. This is why commercial use of this documentation will only be permitted through formal collaboration agreements. If you are interested in making commercial use of this work, please get in touch with us and we'll do our best to find a way to work together!

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Project toolkit

Download-kit

Free documentation & blueprints

Starting an aquaponic system can be tricky, because quality information is rare and scattered all over the web. By open sourcing our design and its user guide, we want to break down the barriers of entry by ensuring that you work with the same system as the entire community and benefit from our collective experience.

We use Github to host our designs and file repositories. It allows anyone access to download files, make changes, "fork" new versions and work in a distributed and networked fashion. If you'd like to contribute to the project, Github is the place to make comments and add your work: https://github.com/aquapioneers/Aquapioneers-Kit-Barcelona-Design

Forum

A place to meet & help each other

If we don't share what we know, how can we learn from each other? We would like to encourage all participants to contribute what they can to improve the project. This might be peer review, debugging existing designs, creating entirely new design, sharing tips to grow amazing vegs, and collectively study the mystery of aquaponics.

This forum is a place to share pictures, skills, knowledge and interests through ongoing conversation: http://aquapioneers.io/community-forum/

Local Manufacturing

+1200 maker spaces to build your kit

Check out these links to locate one in your city: www.themakermap.com. The Fablabs network: www.fablabs.io and also www.fabhub.io

Tutorials

Video tutorials to grow with confidence

Youtube channel : https://bit.ly/2IElaDe

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Project Goals

1 **Developing open source aquaponics designs that are suitable for local and digital manufacturing and that can be optimised for locality.**

- Developing a number of aquaponics designs that are used as a base for adaptation.

2 **Creating a public library of aquaponic recipes through innovative forms of citizen science.**

- Imagine a public library of aquaponic recipes, where each recipe is associated to a particular plant and tells you how to set your ecosystem (i.e. fish density, lighting and environmental conditions, etc) to suit this plant's needs. Just like a cooking book!
- Together we are smarter! This library will be collaborative, meaning that each user will be encouraged to share his cultivation experience with the community. This way we can use our collective intelligence to figure out the best aquaponic recipes for each plant. The more the community participates, the better the recipes will be!
- Develop protocols and pathways for ‘Citizen Science’.

3 **Bridging the information gap between aquaponics enthusiasts and maker communities**

- Encouraging information sharing between people with differing backgrounds and expertise.
- Developing a range of communication tools (forum, tutorials, download kit, tutorials) to facilitate innovation in local aquaponic farming.

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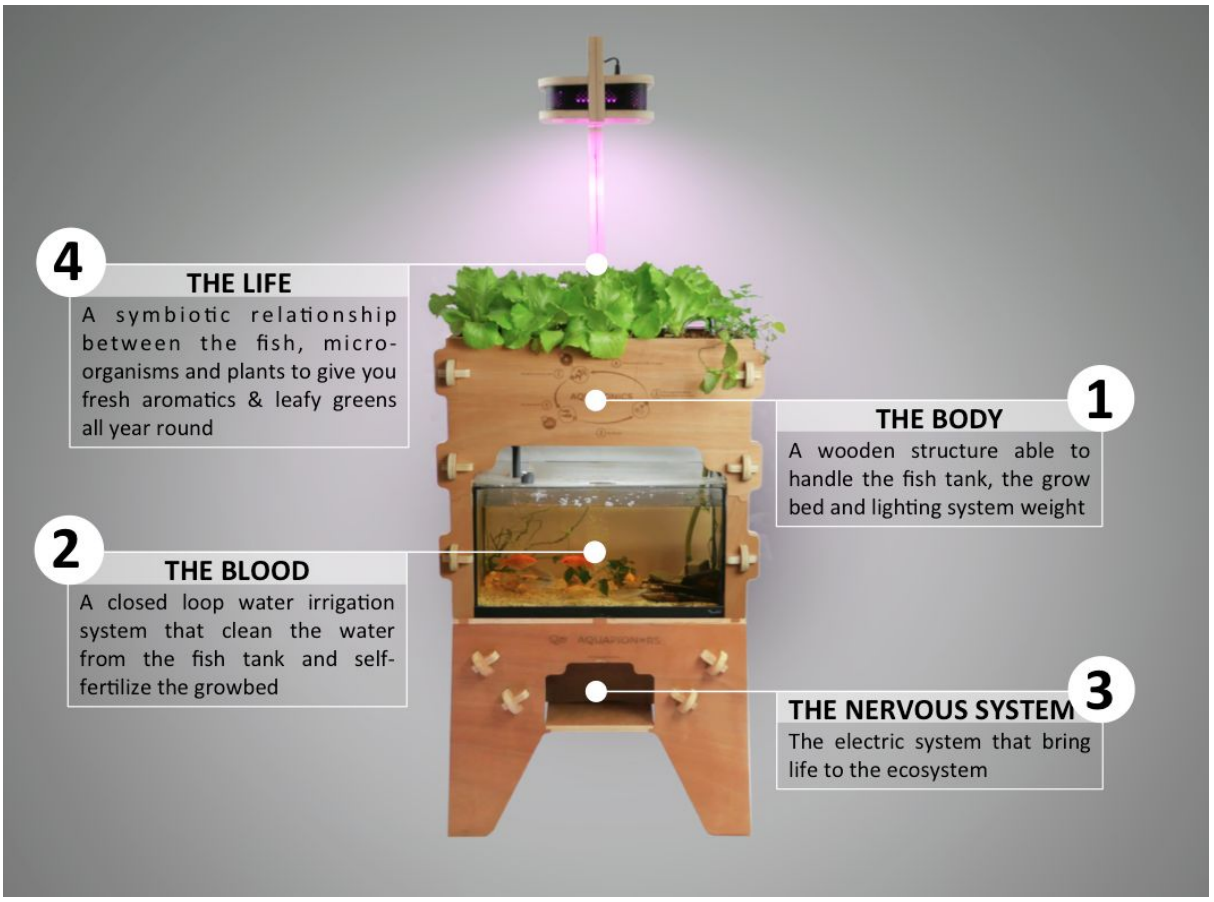
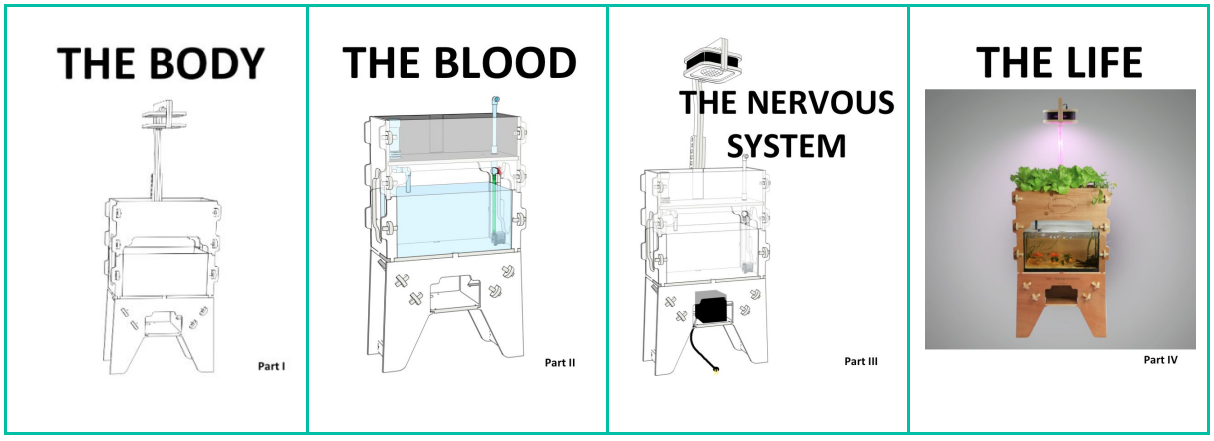
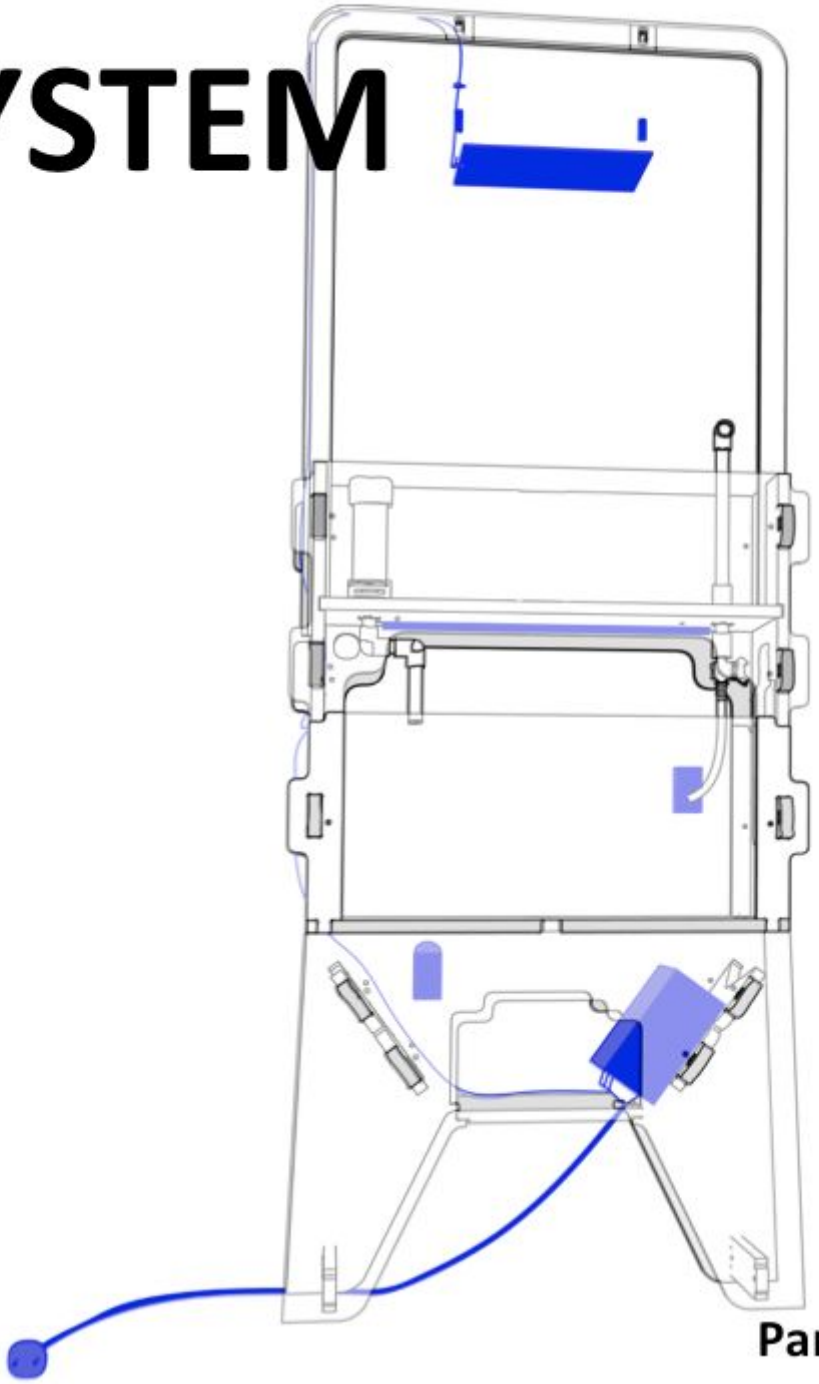
AQUAPIONEERS ECOSYSTEM ANATOMY



The user manual has been divided into four blocks following the Aquapioneers Ecosystem anatomy to ease its construction, assembly and use.



THE NERVOUS SYSTEM



Part III

+

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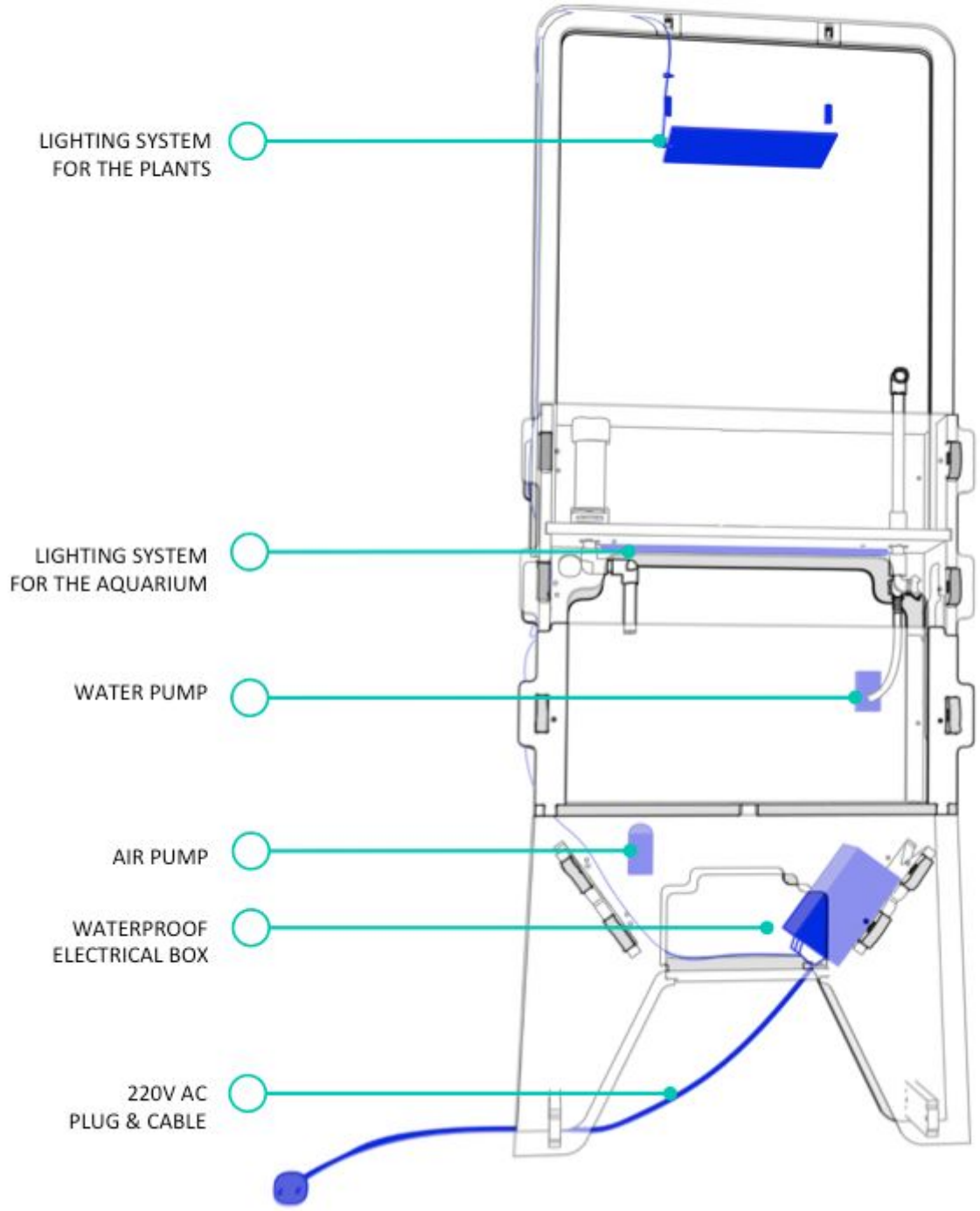
THE ELECTRICAL SYSTEM



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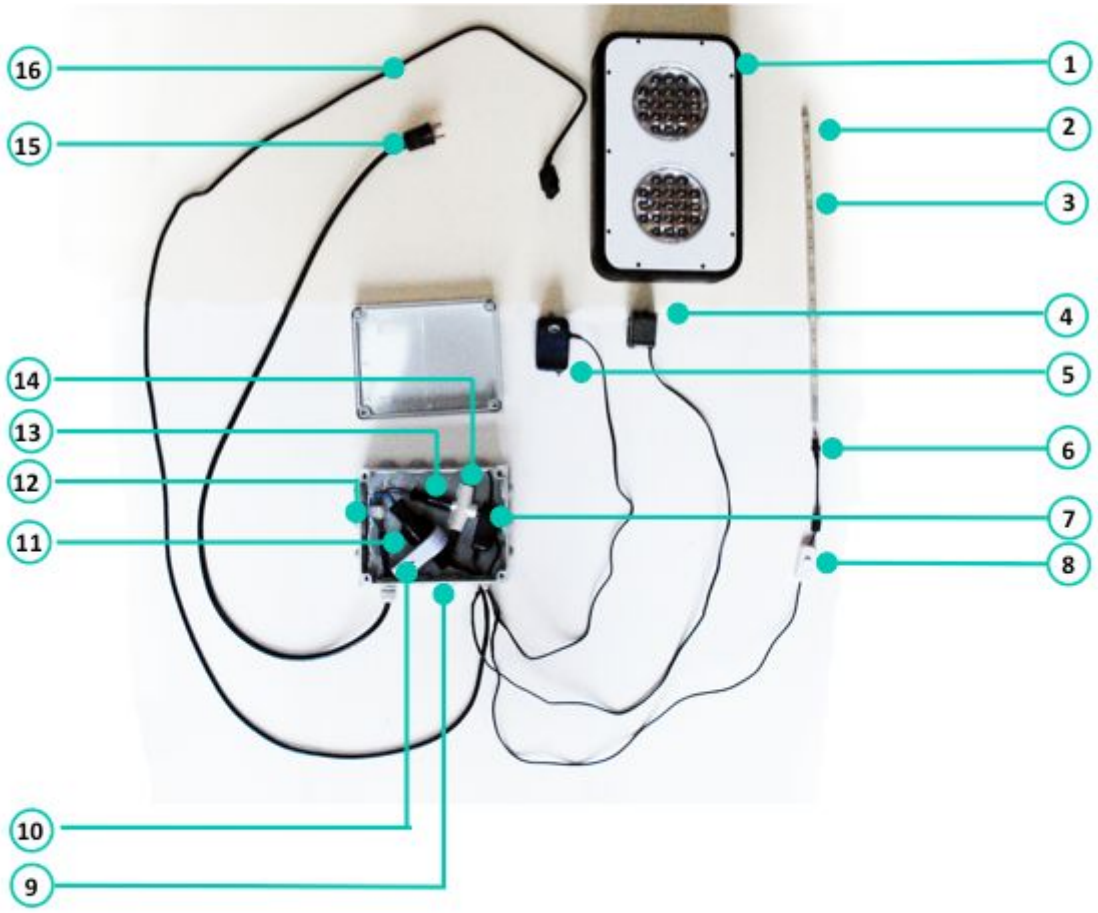
BILL OF MATERIALS



COMPONENTS					
1	120 W GROWING LED	x1	9	24cm x 19cm x 10cm Waterproof electrical box	
2	50cm x 1cm x 1cm Aluminium profile	x1	10	Aquarium light timer	
3	50 cm x 12 V White LED strip	x1	11	220 V Male plug	
4	600 L / h water pump	x1	12	Male rewireable 2 Pin grounded Plug	
5	140 L / h air pump	x1	13	Male rewireable 2 Pin Plug	
6	Connector Jack DC 12v		14	Multiple socket - 3 inputs	
7	220V AC/ 12V 1A DC adapter for LED strip		15	220V AC Plug & 1.3m grounded cable	
8	12v switch		16	120 W LED Growlight	

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SAFETY NOTE: THE FOLLOWING ELECTRICAL ASSEMBLY PART SHOULD BE PERFORMED ONLY BY USERS EXPERIENCED WITH ELECTRICAL SETUPS. IF YOU ARE NOT FAMILIAR WITH ELECTRICITY WORK, ASK FOR PROFESSIONAL HELP. ELECTRICITY WORK IS DANGEROUS AND CAN BE FATAL IF DONE INCORRECTLY. AQUAPIONEERS DECLINES ALL RESPONSIBILITY IN CASE OF DAMAGES OR INJURIES.

STEP 1: MAKING THE AQUARIUM LED LIGHT STRIP

Time expected	Expected cost
30 min	6€

For this you will need the following:

7 mm diameter Heat shrink tube	50cmx1cmx1cm Square aluminium profile	30W-60W soldering iron	50 cm white 12V 9.5 W/m waterproof LED strip	12 Volt Female & Male connectors
Price: 0.02€	Price: 1€	-	Price: 1,5€	Price: 1 €

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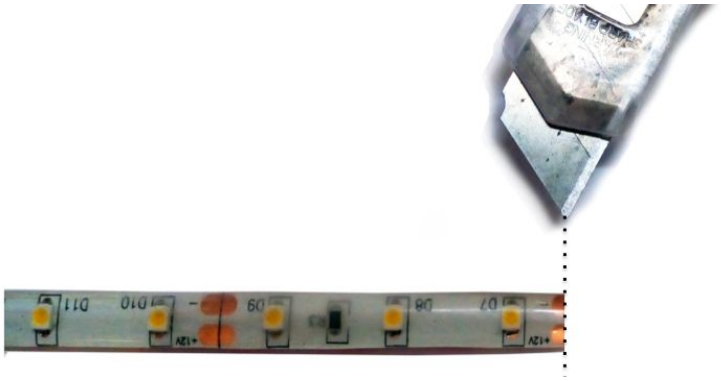
Step by step, please follow the next steps:

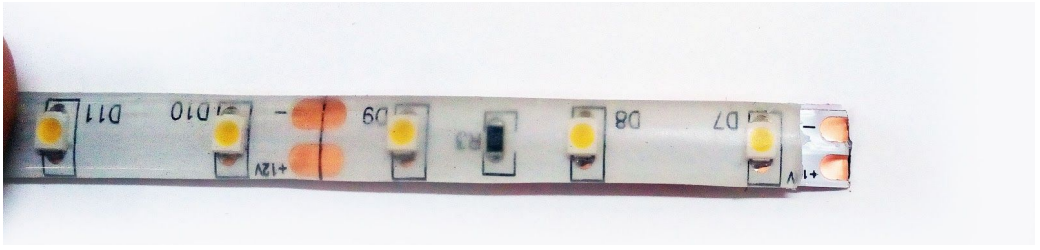
PREPARING THE LED STRIP BEFORE SOLDERING

1



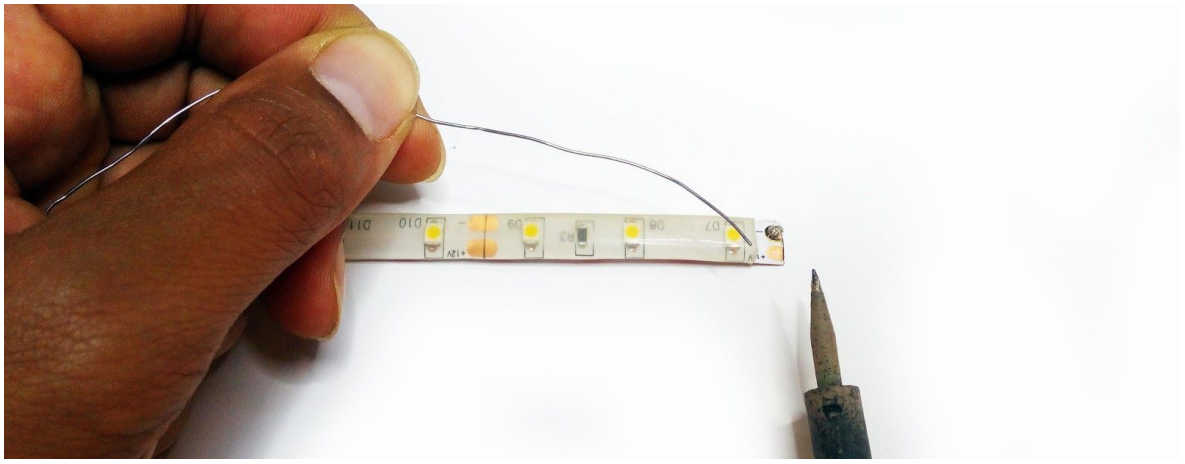
Since the LED strip can only be cut every third LED, you may have to go slightly under the 50cm desired specification. To cut your waterproof LED Strip Light it is first of all important to have a sharp pair of scissors or cutter. Each waterproof strip light will have a cut mark between the two pairs of copper connection pads. Once you have located this cut line you can then cut your LED Strip Light to the desired length. Be certain to make a clean straight cut without putting any additional stress on the PC Board, doing so can break the board making that 3 LED Section un-usable. Cut exactly along the black line to leave sufficient exposed copper for soldering.

2



In order to solder wire to your waterproof LED strip light you must first cut back the TPU coating to expose the copper connection pads on your LED strip light. Use a sharp blade to cut back the TPU coating, be very careful not to cut through the PC Board on the LED Strip light. We recommend only cutting off the top half of the TPU coating and leaving the bottom half for support of the PC board like you see in the picture to the right.

3



The next step is to tin the copper dots on your LED Strip Light by melting a small amount of solder directly onto the copper dots.

MAKING THE LED STRIP FEMALE CONNECTOR

4

Prepare a 2-wire cable for soldering on your female jack connector. The positive lead (red) should be slightly longer as it will be soldered to the cup-like terminal at the center of the connector, while the negative lead (black) will be soldered to the thin section connected to the outer casing, via the hole provided for this purpose.

5

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As you solderboth leads, make sure you don’t accidentally connect the positive with the negative ports which would short-circuit your LED. As both terminals are very close together, this can easily happen if you are not careful.

6

Cover up your solder joint with heat shrinking material. Use a heat gun or a lighter to shrink your heat shrink to protect your solder joints and then test one more time to be certain of a proper connection. Before moving on, test your positive and negative connector parts for continuity with the free ends of the wires to ensure the soldering was successful.

7

8

Screw on the insulating plastic casing of the connector, carefully without damaging the fragile soldered connections.

Once you have tinned both the wire and the copper dots on your LED Strip Light you can now mate the two together. Be careful to match your positive and negative wires to the (+) and (-) signs printed next to the corresponding soldering dots. Once again, make sure there is no connection between the + and - dots. Individually place the wire to the copper dots and then place the soldering iron over both in order to heat up each solder enough to melt and become one. Be sure to hold long enough to not create a "cold solder." Once dry, connect your freshly soldered LED Strip to a proper power source and test your connection.

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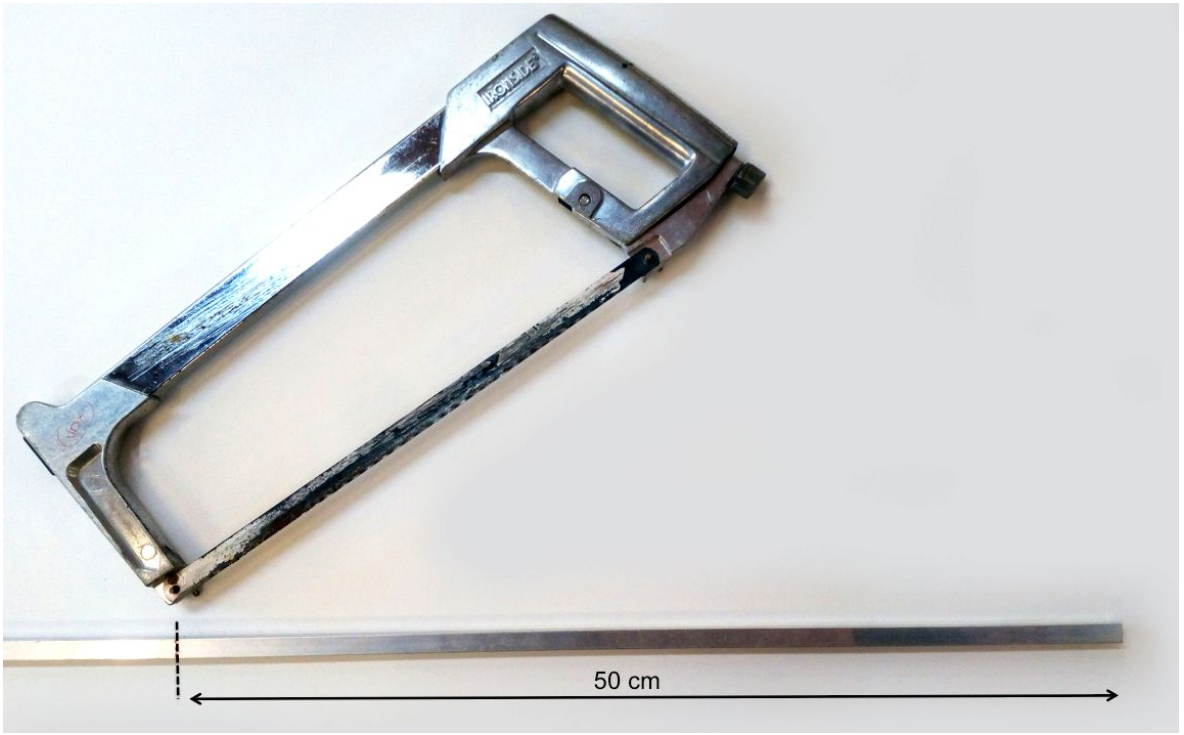
9

Cover up your solder joint with heat shrinking material. Use a heat gun or a lighter to shrink your heat shrink to protect your solder joints and then test one more time to be certain of a proper connection.

10



Cut your aluminium profile to 50cm length with a metal hand saw and smoothen the cut edges to avoid injuring yourself with the exposed metal.

11

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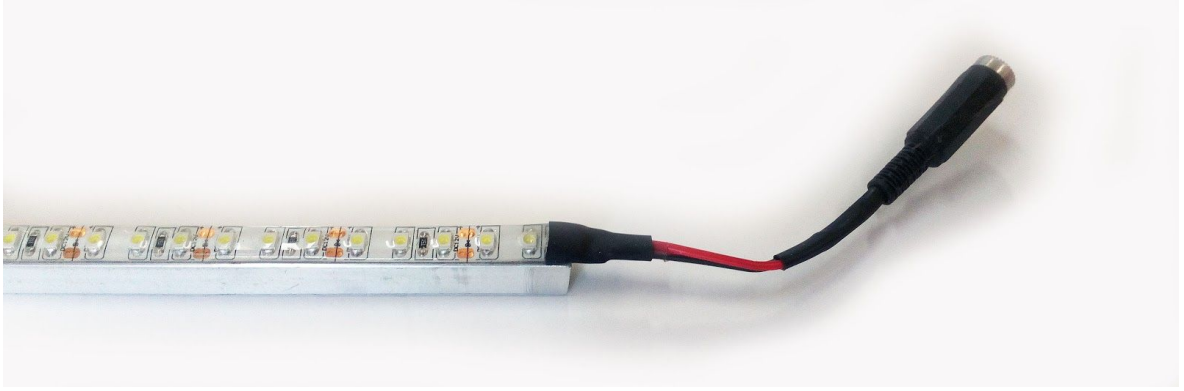
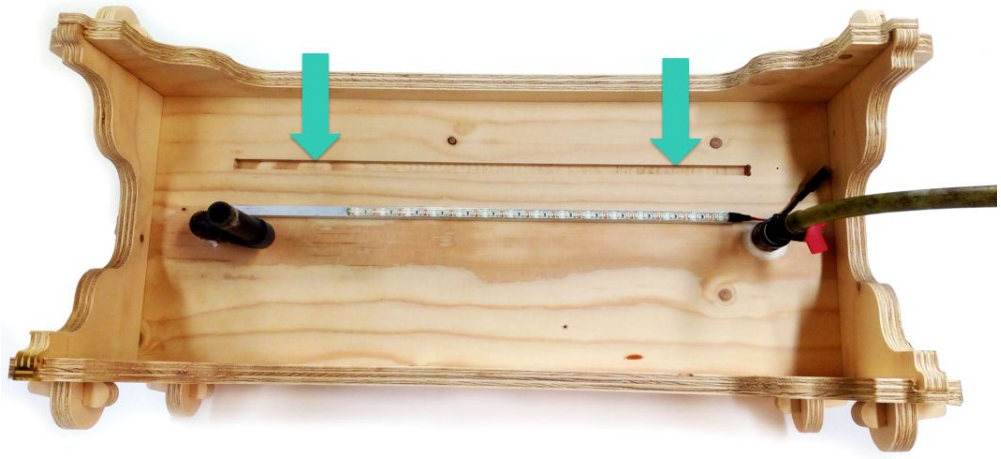
Clean the aluminum surface with alcohol to create a smooth clean surface, then simply stick the LED strip light onto the aluminium profile.

12



Make sure your solder joint is positioned at the end of the aluminium profile.

13



Below the growbed, you will see a pocketing in which we will fit the aluminium profile.

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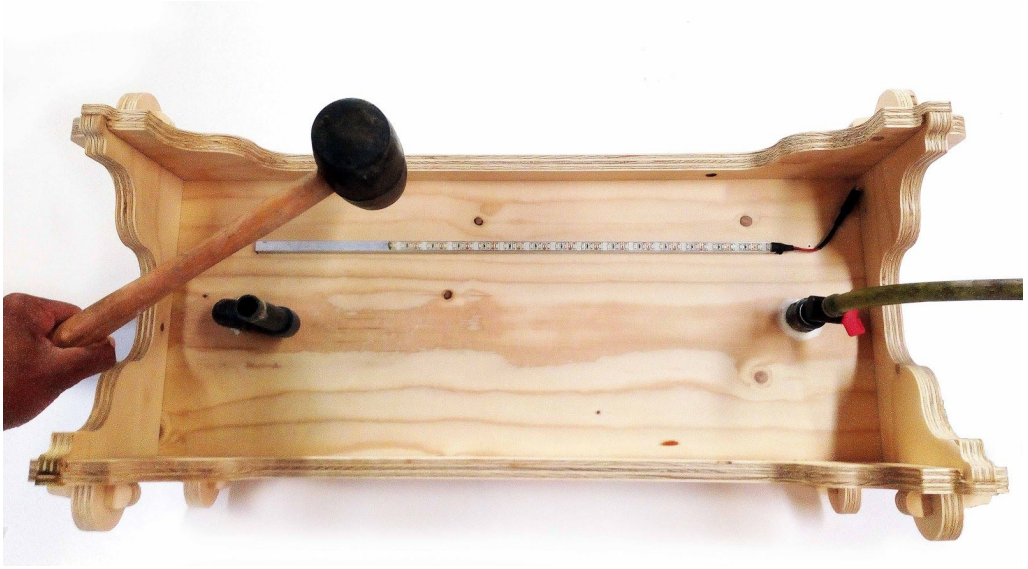
14



Depending on the precision of the CNC milling you have been using, you will be able to press fit with your fingers or with the help of a RUBBER hammer. Never use a regular hammer as it will destroy your LED's. Pay attention to the orientation oft he connector, which should face the same side as the red valve.

15

Once in place, the aluminum profile will look like this.

16

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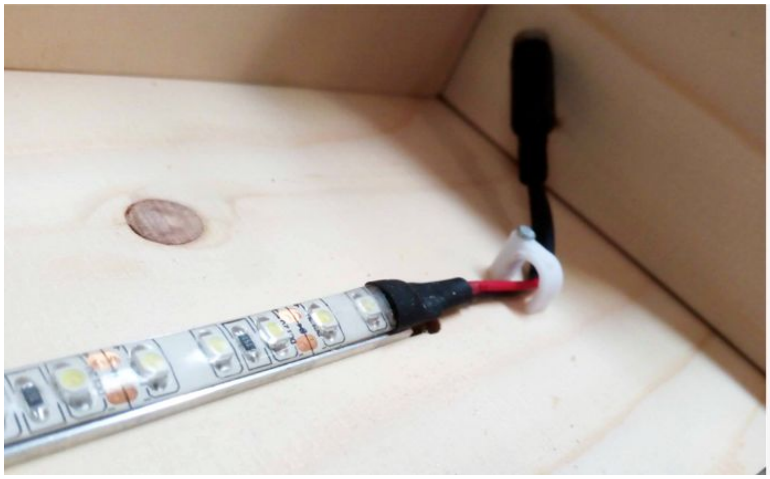
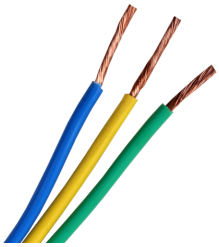


To protect your soldering connection, nail a wire gripper over the wire.

STEP 2: THE ELECTRICAL BOX

Time expected	Expected cost
30 min	170 €

For this you will need the following materials:

22 x 17 x 8 cm IP65 Waterproof box	3 connector strip	electrical wires (3 colors)	220V AC to 12V 1A DC adaptor charger for LED strip	120 W LED Grow Light
				
Price: 5€	Price: 0,50€	Price: 0,50€	Price: 3€	Price: 150€
Male rewireable 2 Pin grounded Plug	Power cable for GrowLight 2.5m	3-socket splitter	Analog Timer	2-Pin-DIY-Rewirable-socket-EU female

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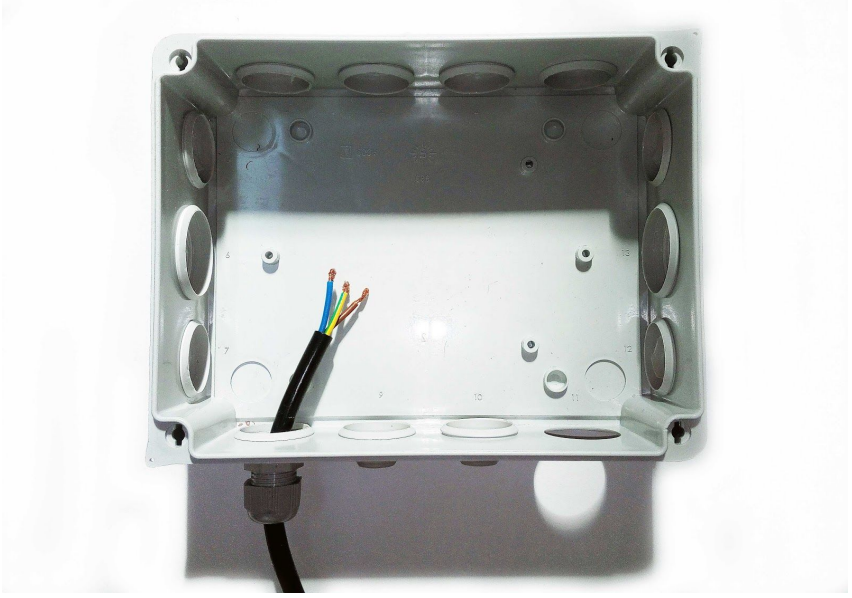
Price: 1€	Price: 6€	Price: 2,5€	Price: 3,5€	Price: 1€
2-Pin-DIY-Rewireable-socket-EU female shuko	3G1. 5 mm2 black cable 1.5m long			
Price: 1€	Price: 2€			

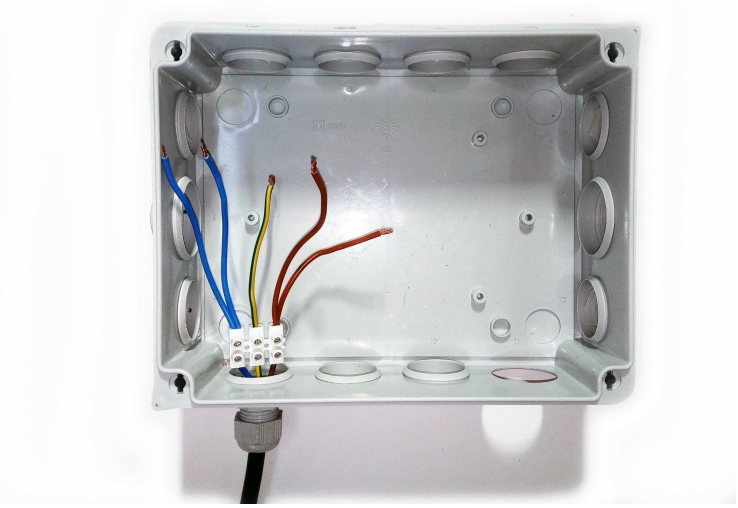
Part by part, please follow the next steps:

17



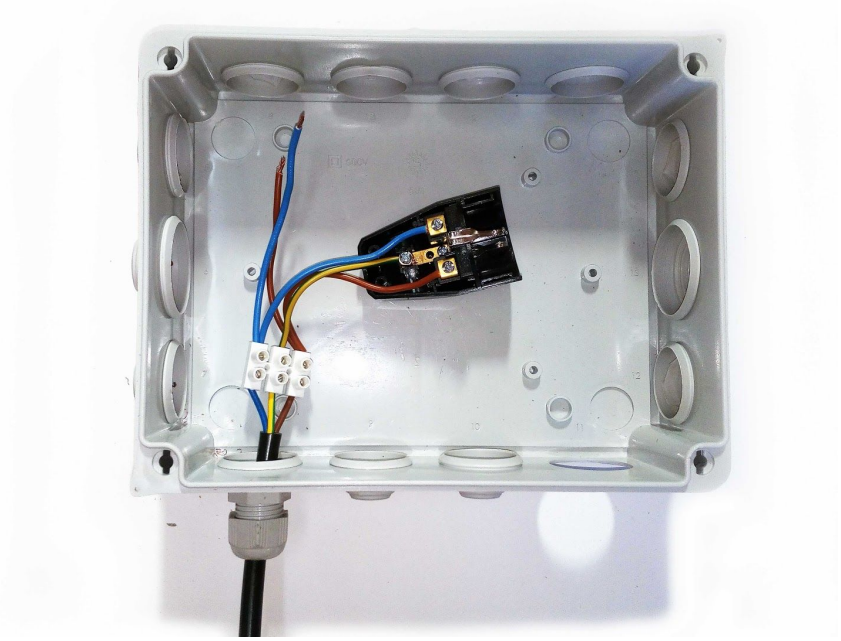
Remove 5 cm of rubber insulation to be able to use the wires of the the 3G1. 5 mm2 black triple wire cable before inserting it inside the electric box.

18



Use a 3 connectors strip to connect the single 12cm leads to the 1,5G cable, making sure to match wire colors. The live (brown) and blue (neutral) need to be split into 2 wires each since there will be two separate sockets in the box: 1 on timer for the growlight, and 1 for the remaining devices. Only 1 ground wire (green & yellow) is needed since the only grounded device used in the system is the growlight.

19



As illustrated above, connect the grounded socket to each of the leads. Be sure to connect the ground lead (green & yellow) to the appropriate terminal with the grounding symbol.

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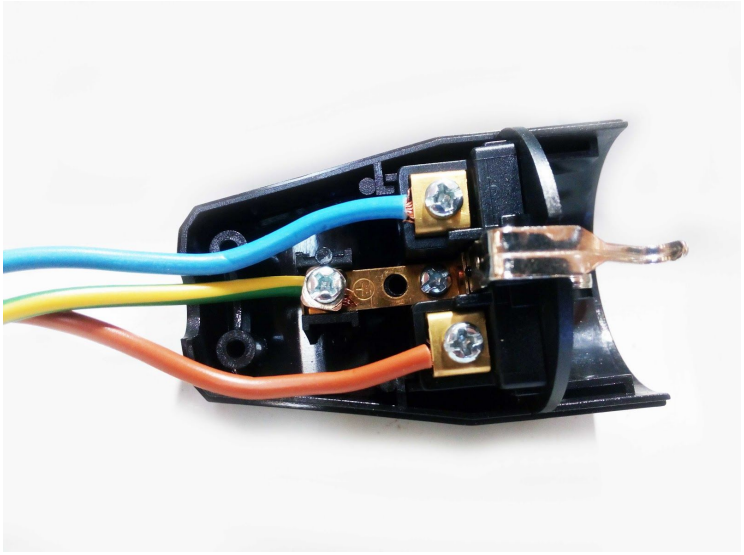
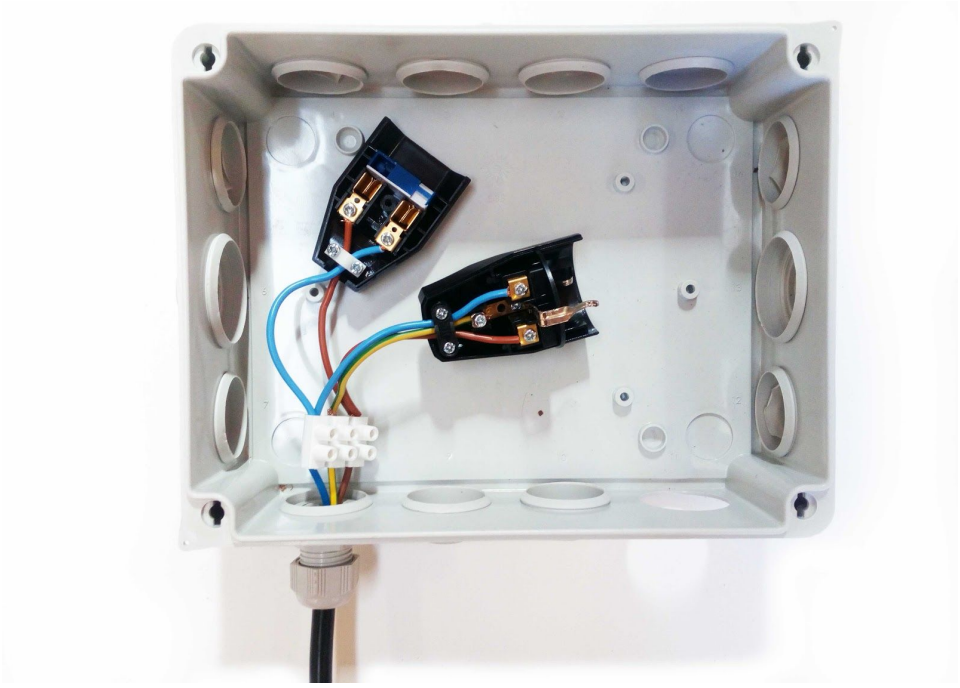


Detailed view of the wiring.

5.



Repeat the wiring for the non-grounded connector with the remaining brown and blue leads.

21

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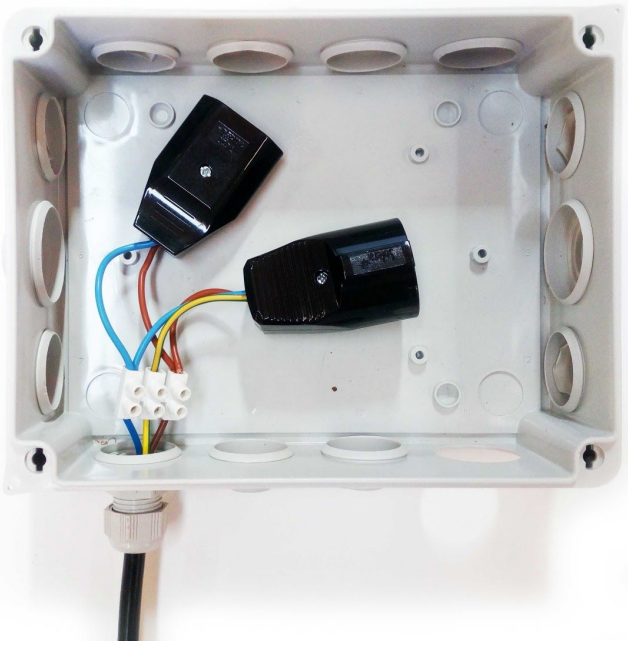

With the help of a screwer, close the two sockets.

22

Connect the timer to the grounded socket, and the 3-way splitter to the other socket.

23

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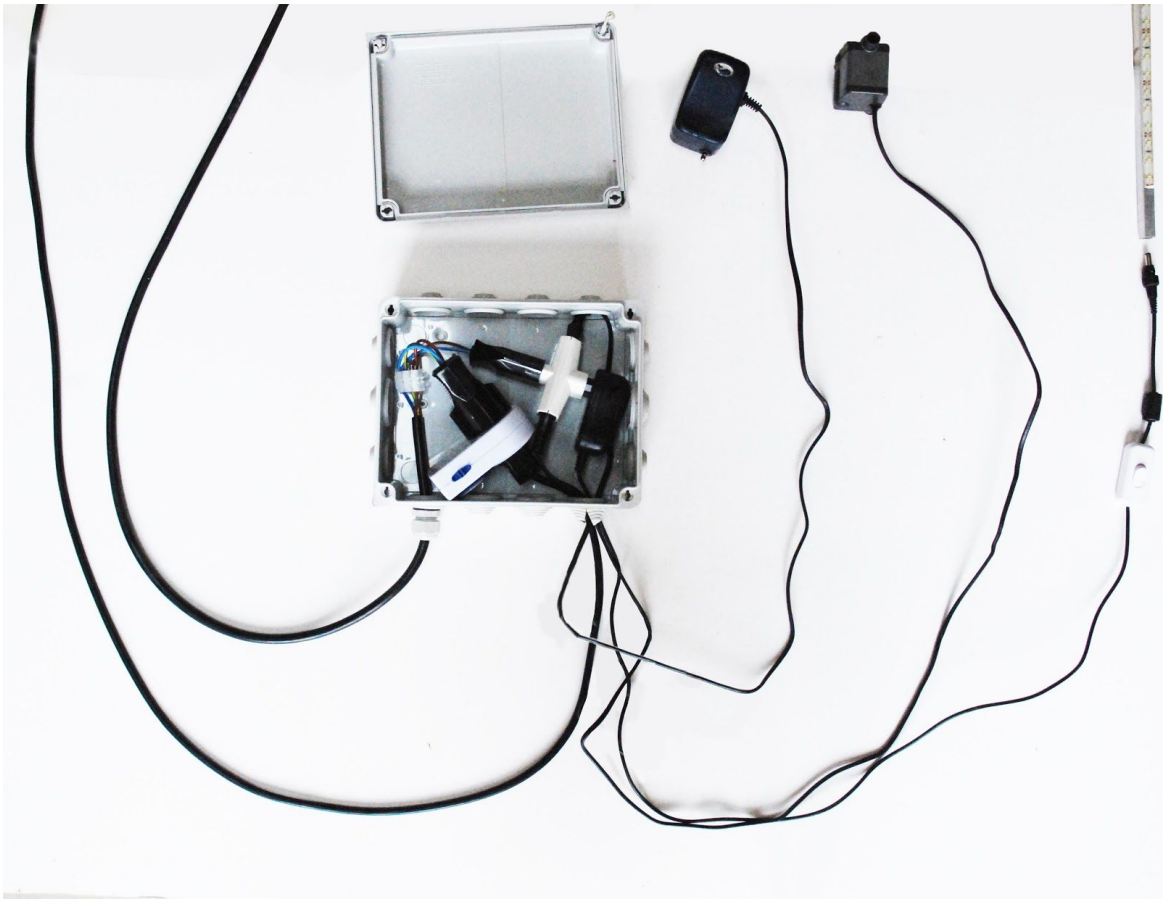

Then following the illustration above, connect the water pump, the air pump, the LED strip and the growing LED lighting system. Make sure your setup entirely fits into the box without forcing. Be especially careful not to jam the rotating timer as this would interfere with the proper light cycle for your plants. Set the timer to 14 to 16 daily light hours. Depending on your preferences, you can choose to run your lights during the day or during the night.

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STEP 3: CONNECTING THE ELECTRICAL SYSTEM

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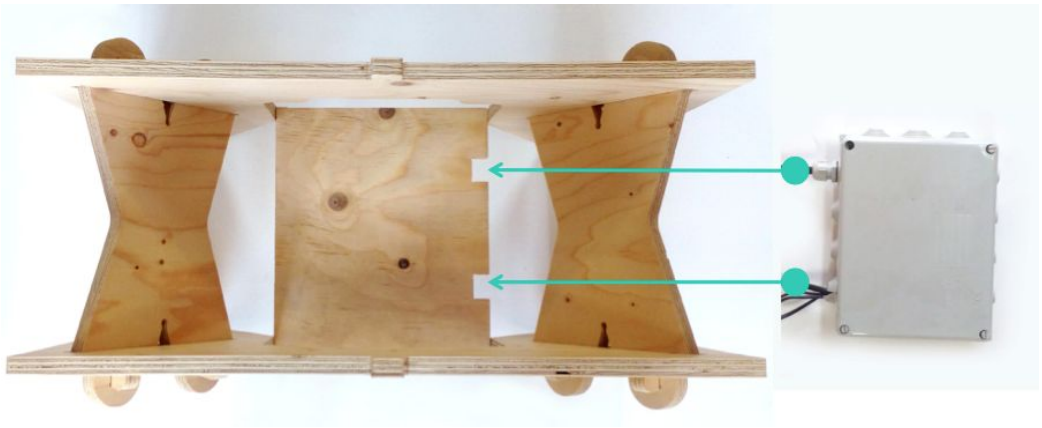
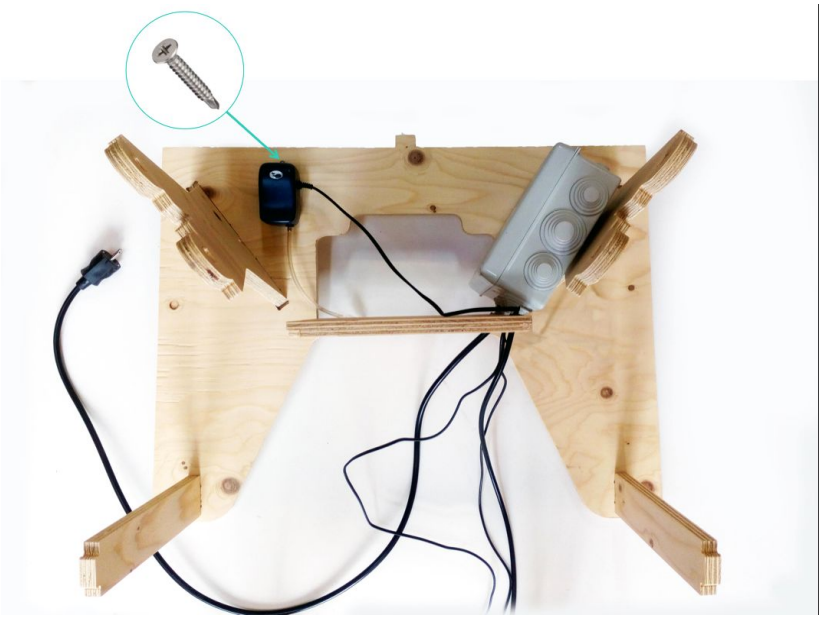


Place the waterproof electric box on the right hand side of the legs plate as in the above picture to ensure that the electrical wires can be well positioned.

25



In order to avoid noise issues coming from the vibration of the air pump, we recommend you to fix the air pump with a screw on the left hand side of the back leg.

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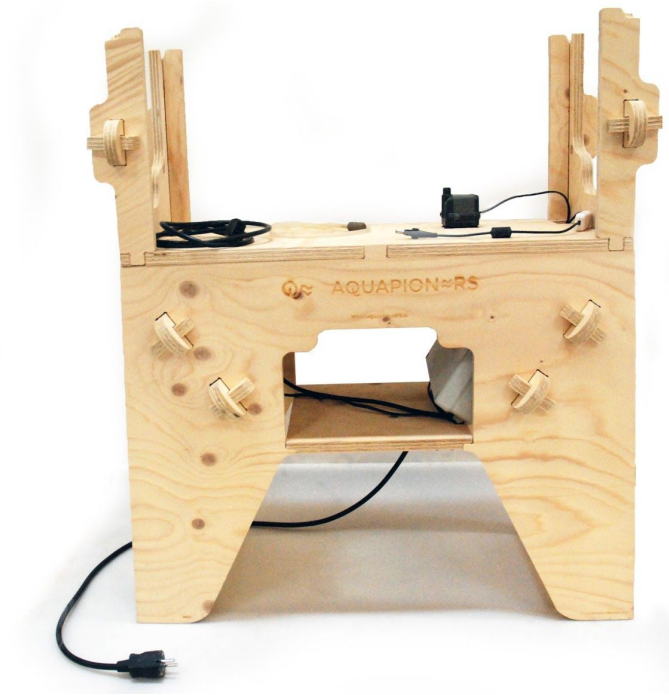
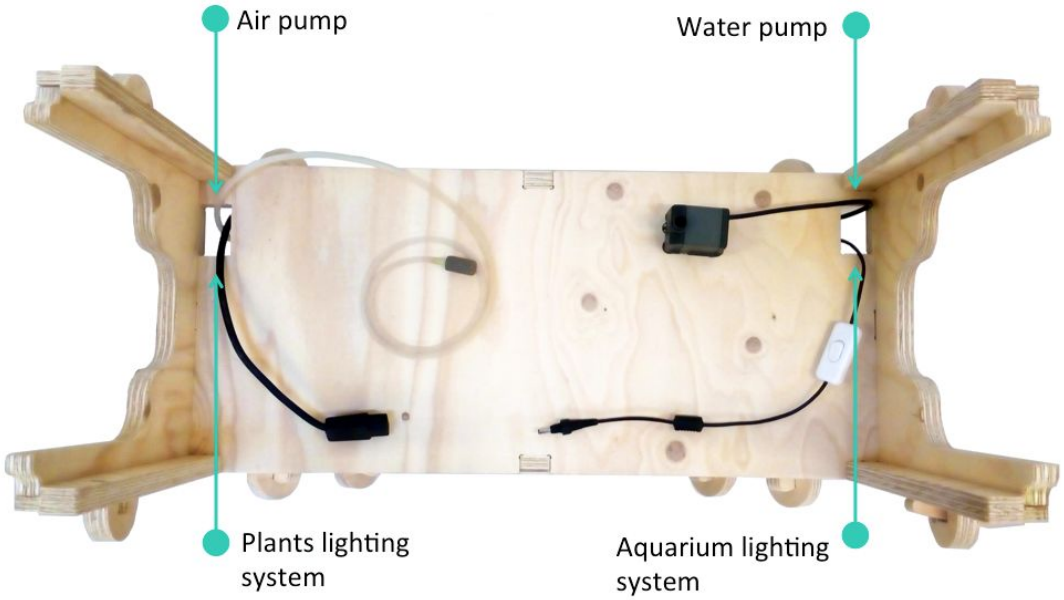


Then add the aquarium base plate and pass the water pump cable and LED strip cable through the left hand plate hole and the growing LED cable and air pump tube through the right hand hole as shown below.



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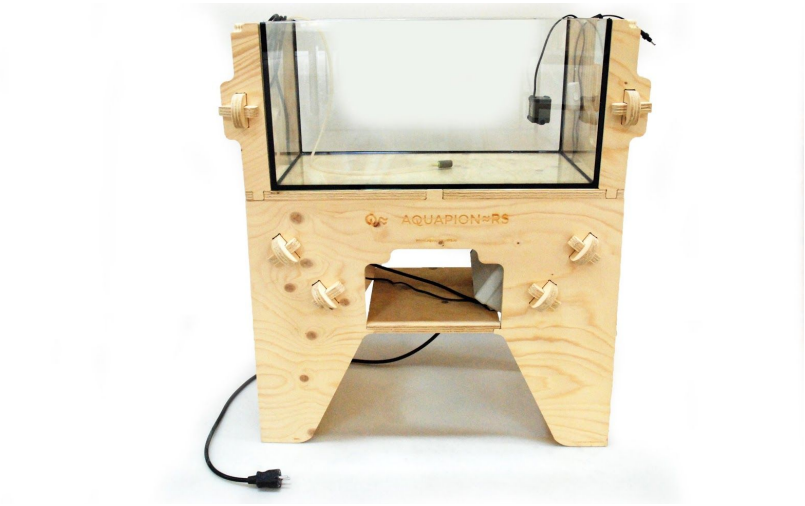
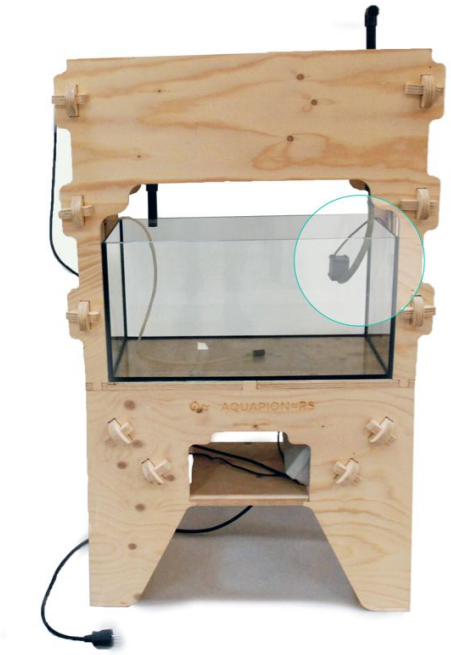


Then place the aquarium on a highly recommended 5mm foam-like protection layer (You could use cardboard as well) to avoid possible damage to it. Glass aquariums are very fragile and should be handled with maximum care. This will ensure your tank lies completely flat and doesn't risk cracking. Cut a piece of "60 x 30 cm" and place it between the aquarium side panels to fit the outer perimeter of the aquarium support frame. Carefully slide the aquarium between the side pieces and be sure it fits the outer perimeter of the 5mm insulation layer. Then place the water pump and air diffuser inside the aquarium.

28



Carefully place the growbed on top of the aquarium side panels and be sure it fits correctly. Then connect the flexible pipe to the water pump connector and the 12 Volts LED strip Female - Male socket together as shown on the picture below.

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29

Make sure to run the LED cable the furthest to the corner as possible, in order not to interfere with the use of the red flow valve.

30

Last but not the least, add the growing light wooden frame above the media bed. Then pass the electrical cable into the pocketing space and connect it to LED light as described above.

The entire electrical system is now in place, but **"Do not plug your system to the mains power"** until there is water in the fish tank, as this will run your water pump dry and possibly destroy it. Make sure your electrical box is sealed before you connect your system.

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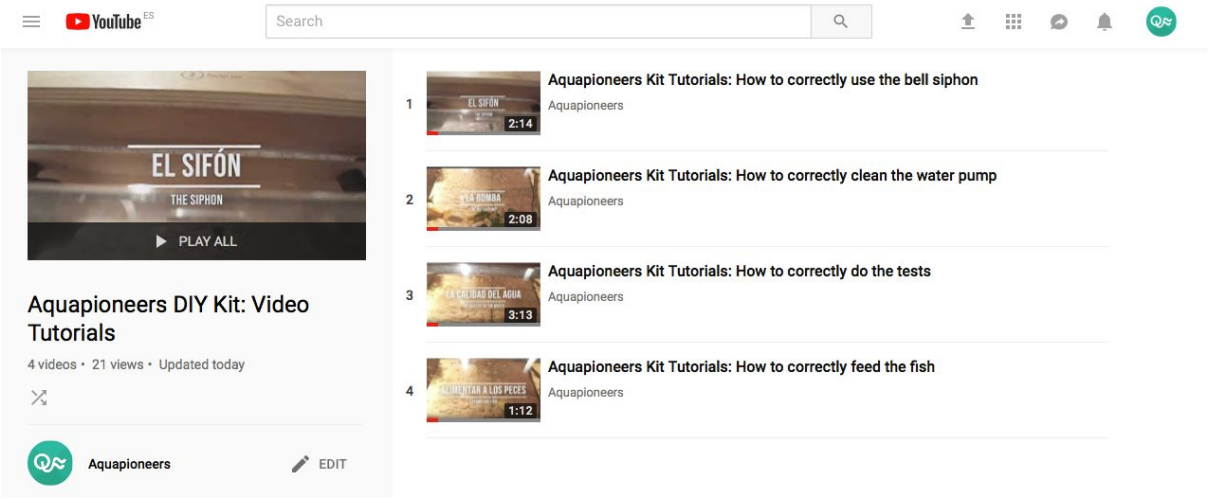
You are almost ready to add water in it and start cycle your ecosystem. This information is available in the fourth part of our documentation manual aka « The Life ». You will be able to find more info on how to maintain the ecosystem thanks to several video tutorials on our Youtube channel: https://www.youtube.com/playlist?list=PLUFhb7gQAOXpYl2u4EjiyPYbu-uKQxlLc .



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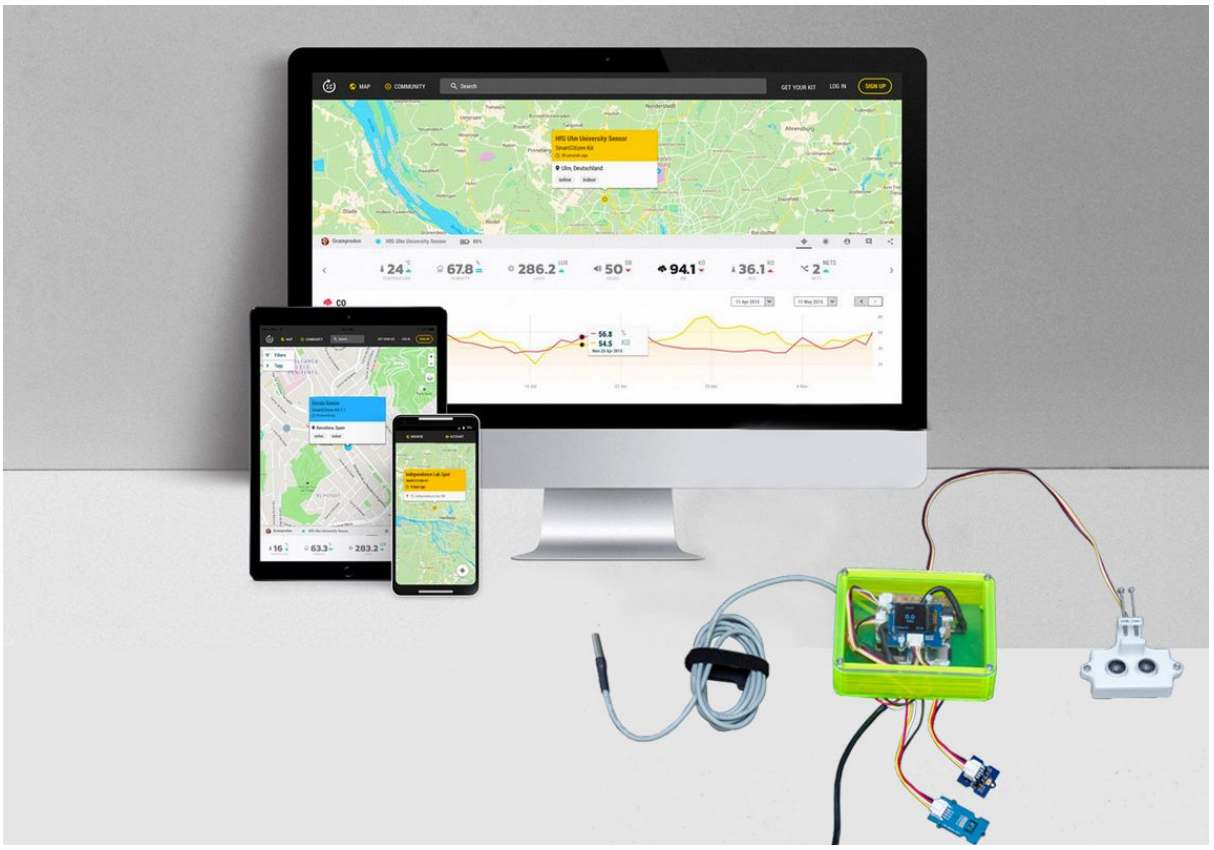
THE AQUAPIONEERS MONITORING SYSTEM



The goal of the Monitoring kit is to be able to check the state of the Aquaponics kit remotely from your smartphone or computer and also on the optional display. **This monitoring kit is optional on Aquapioneers kit and is not required for correct functioning of the ecosystem.** However, it can provide insightful data on the environmental parameters of your system such as air & water temperature, air humidity, water level and light intensity. This information can help you to describe your environmental settings to the Aquapioneers community, help you troubleshoot your system as well as optimize environmental parameters for optimal plant growth and fish health.

*** If this section is not relevant for you, you may go ahead and enjoy your fully functional aquaponic kit!**

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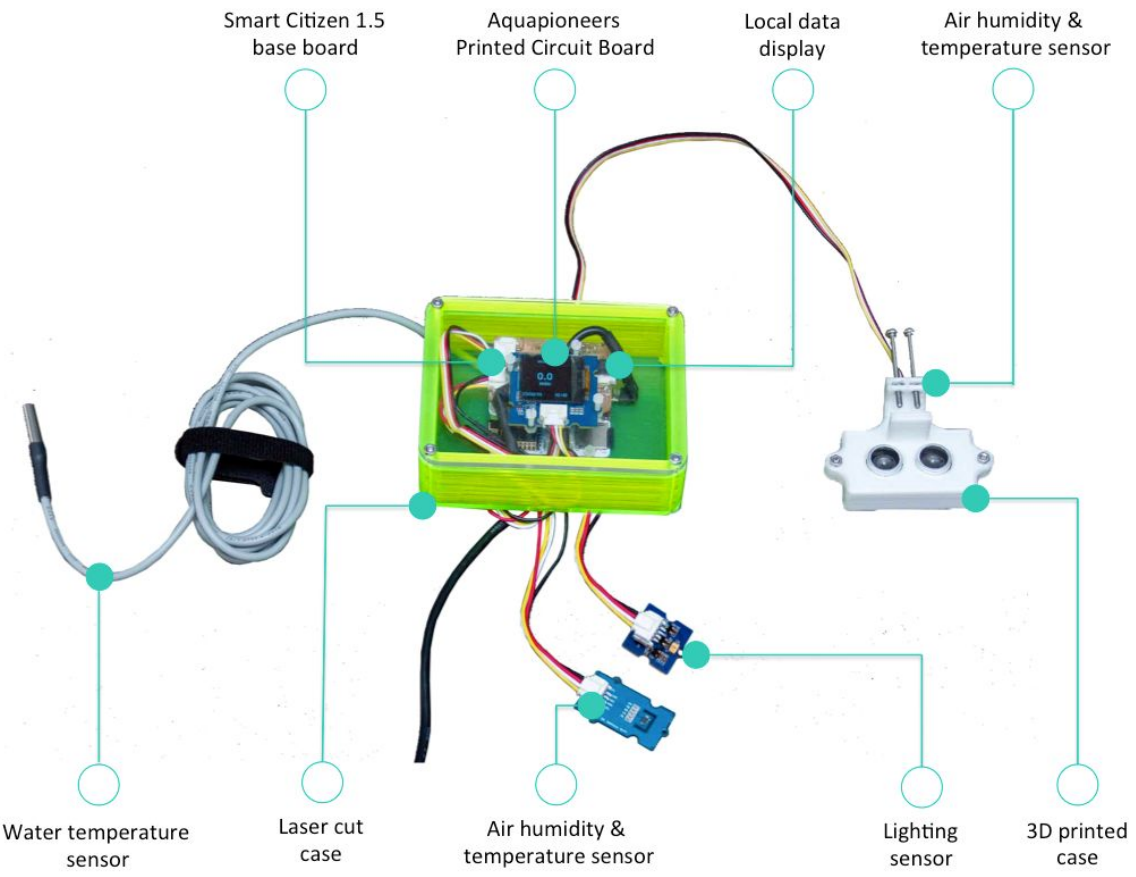
BILL OF MATERIALS

The Aquapioneers Citizen Kit is built upon the Open Source Smart Citizen 1.5 environmental kit and data visualization platform and made out of different parts.



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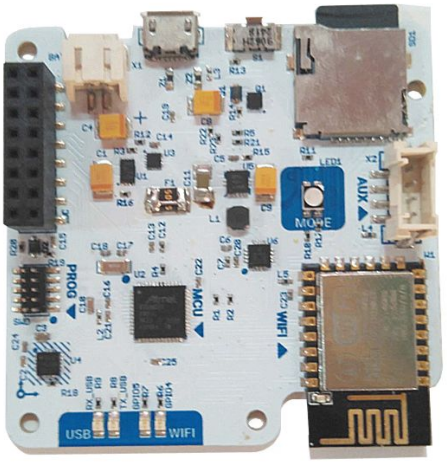
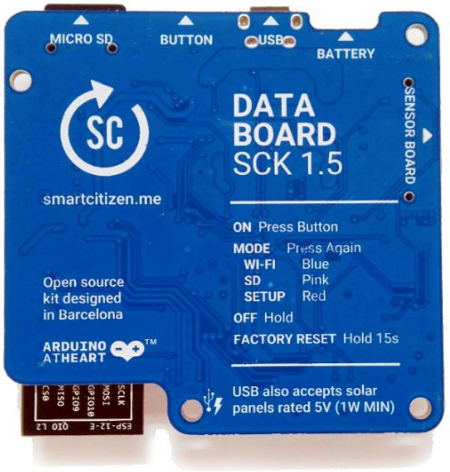
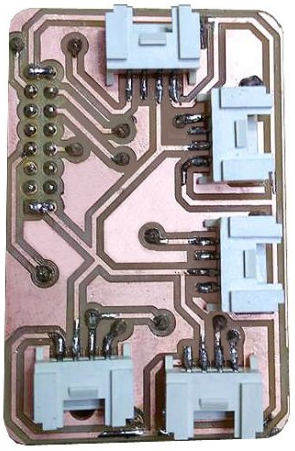
THE BOARDS

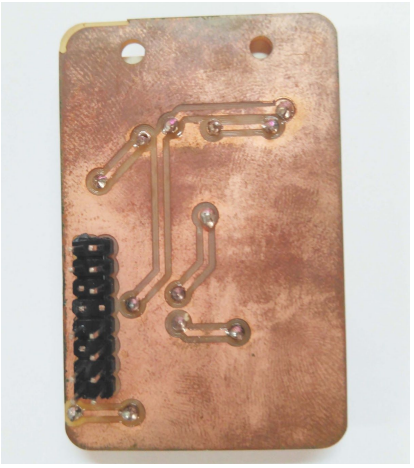
The Smart Citizen 1.5 Base board





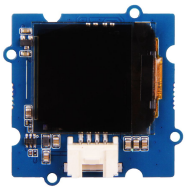
Price: 45 €





The Aquapioneers Printed Circuit Board
Price: 0 € - Fab Lab made

CC BY NC

THE SENSORS					
SHT-31		Ambient Humidity and Temperature	https://www.seeedstudio.com/Grove-Temperature%26amp%3BHumidity-Sensor-%28SHT31%29-p-2655.html	GND VCC SDA SCL	$11.90
Ultra sonic ranger		Water level Water filling and emptying times	https://www.seeedstudio.com/Grove-Ultrasonic-Ranger-p-960.html	GND VCC NC SIG	$3.90
1 Wire Temperature Sensor		Water temperature	https://www.seeedstudio.com/One-Wire-Temperature-Sensor-p-1235.html	GND VCC NC DQ	$7.50
TSL2561		Luminous flux on the plants	https://www.seeedstudio.com/Grove-OLED-Display-1.12%27%27-V2-p-3031.html	GND VCC SDA SCL	$14.90
OLED display 1.12		Data display	https://www.seeedstudio.com/Grove-Digital-Light-Sensor-p-1281.html	GND VCC SDA SCL	$9.90

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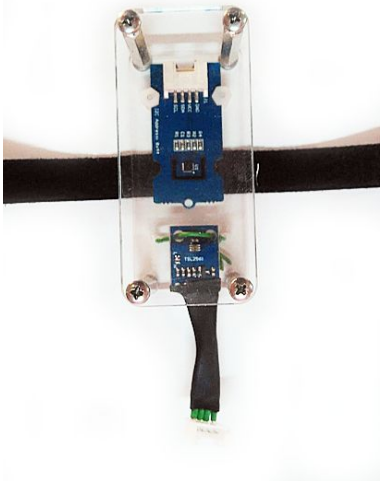
THE CASES		
		
A laser cut boards case	A 3D printed Ultrasonic Ranger case	A laser cutted the SHT31 and Light sensor case

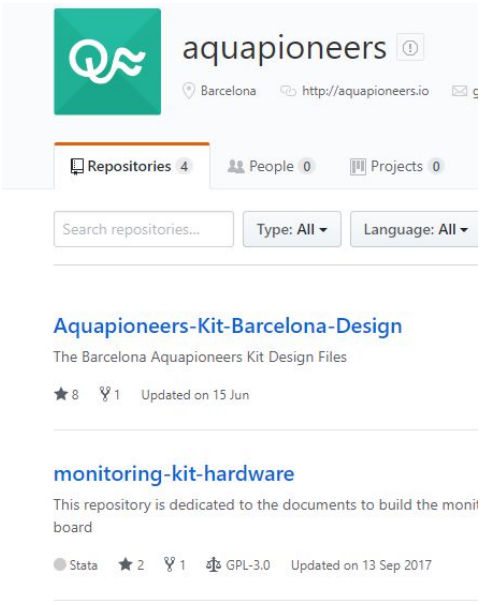
ASSEMBLY

ASSEMBLY 1: The Aquapioneers board

Tools you will need for this part:

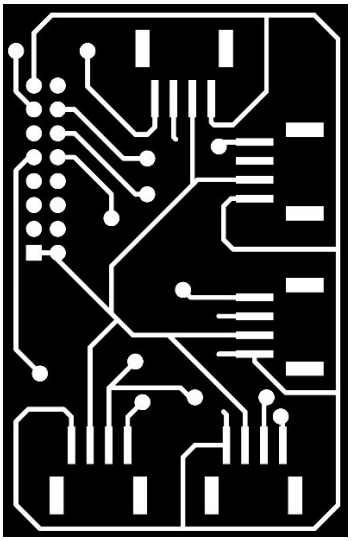
A PC	A compact milling machine (ex:SRM-20)	Soldering iron	Grove connectors	Breakway Male header Pin headers (2.54mm)	Resistors

1

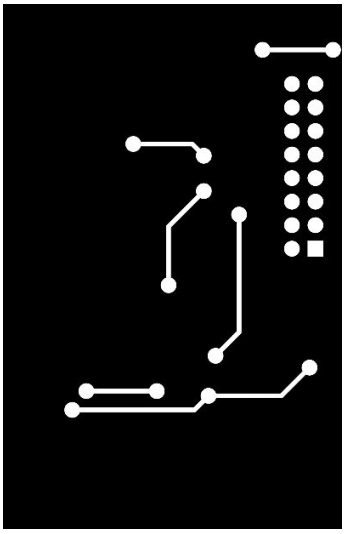


Connect to our Github at https://github.com/aquapioneers and download the .png of the Aquapioneers Board files.

2



.png trace A



.png trace B

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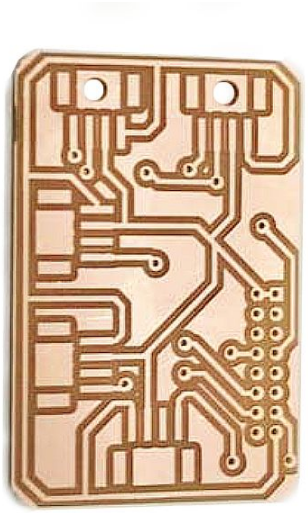
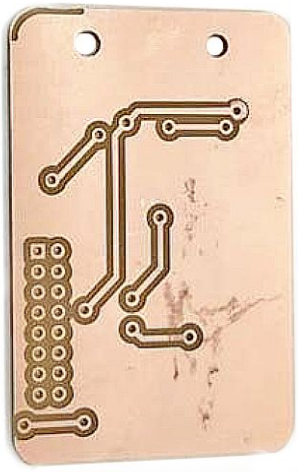
Mill the PCB by following the Fab academy tutorial :
http://fabacademy.org/2018/docs/FabAcademy-Tutorials/week4_electronic_production/srm20_windows.html





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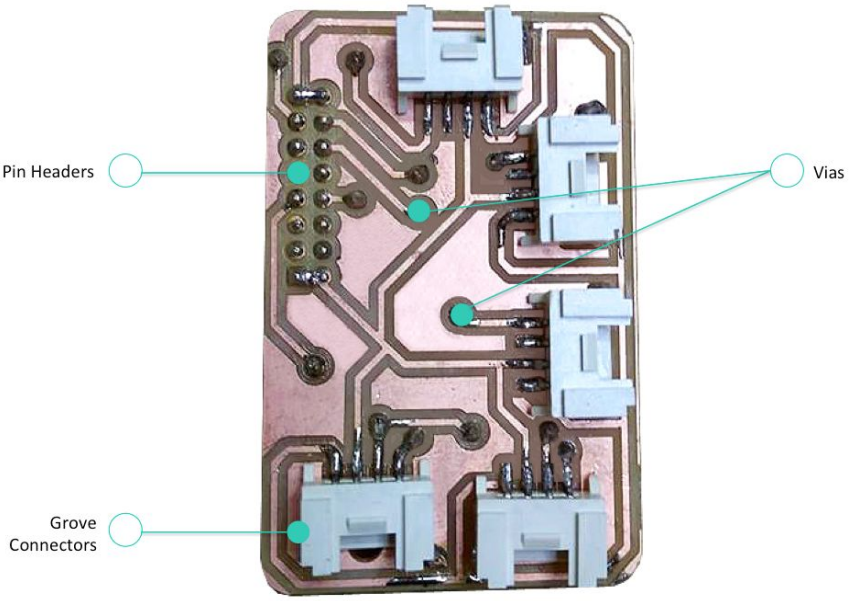

Solder Vias using Resistors lead connectors to make a connection between both sides.
Solder Pin headers and Grove connectors on board.

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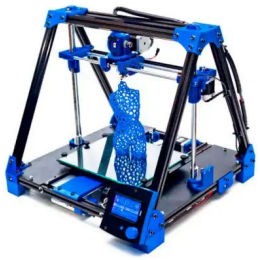
ASSEMBLY 2: The 3D printed ultrasonic sensor case

Tools you will need for this part:

3D printer	2 bolts and 2 nuts M3, 10mm long 2 bolts and 2 nuts M3 40mm long
	

4
Go on our Github at https://github.com/aquapioneers and download the .png of the Aquapioneers Board files.
5
The files contain Solidworks files so that you can modify the dimensions if you used a different sensor
6

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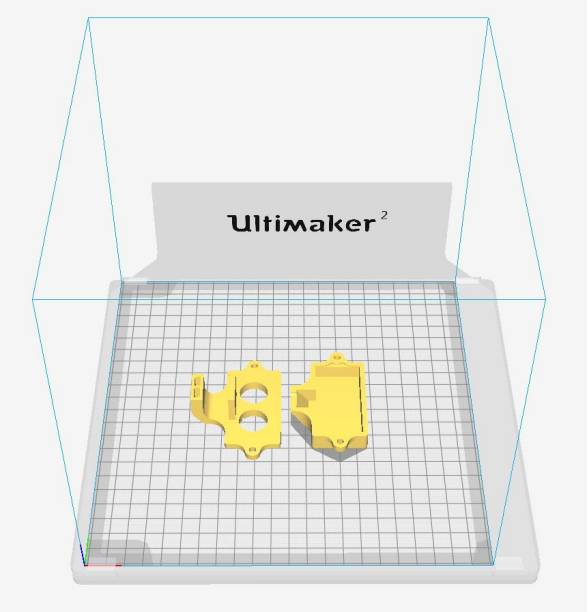
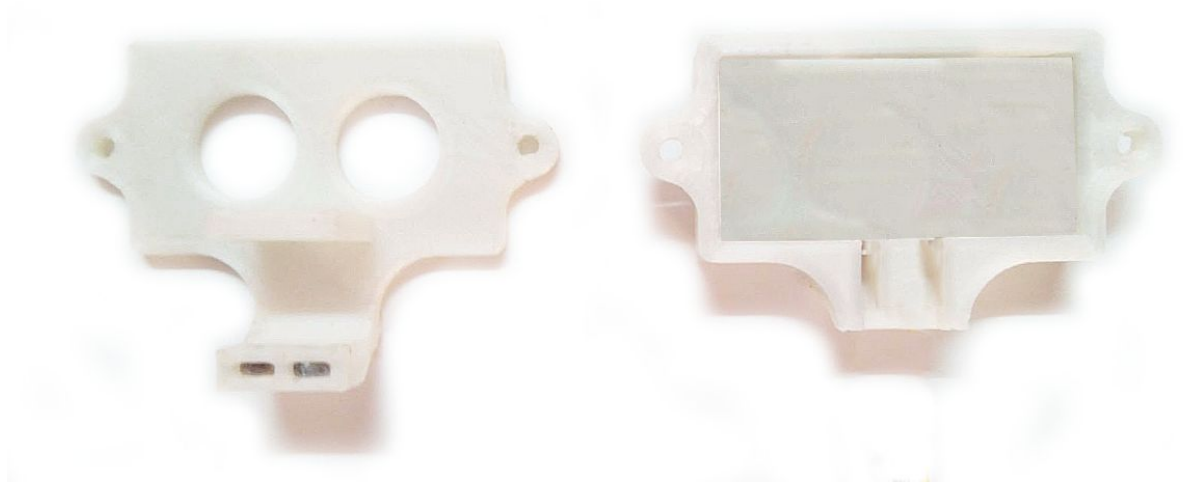


Open the STL files with the software Cura. Rotate and move them so that they fit.

7

Use recommended settings for your machine, or customized if you prefer, and transfer on SD card by clicking Save to File

8



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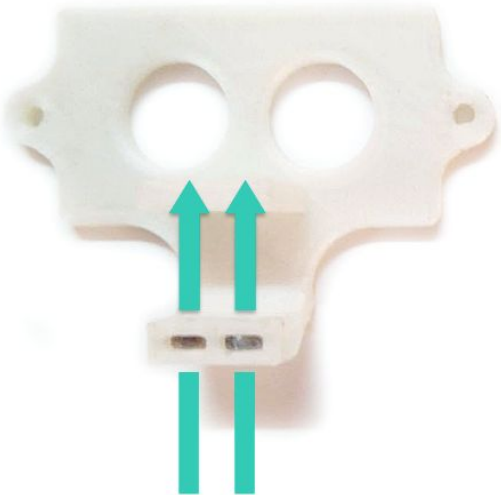
Print files on your 3D printing machine

9



Insert bolts in bottom part

10

Add Ultrasonic ranger in top part of the casing with the Grove cable

11

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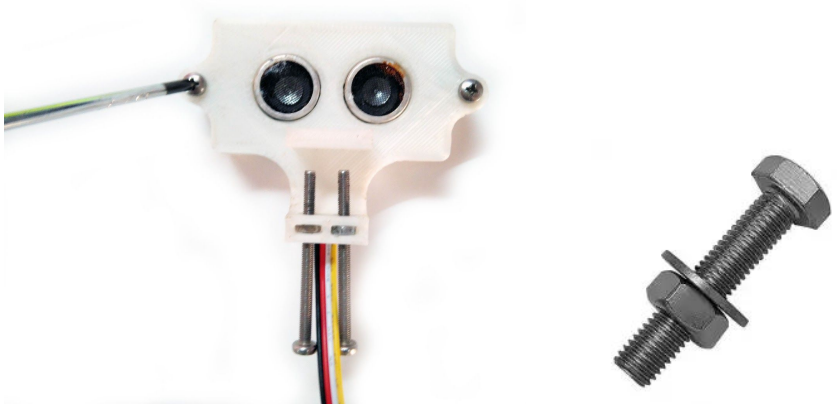
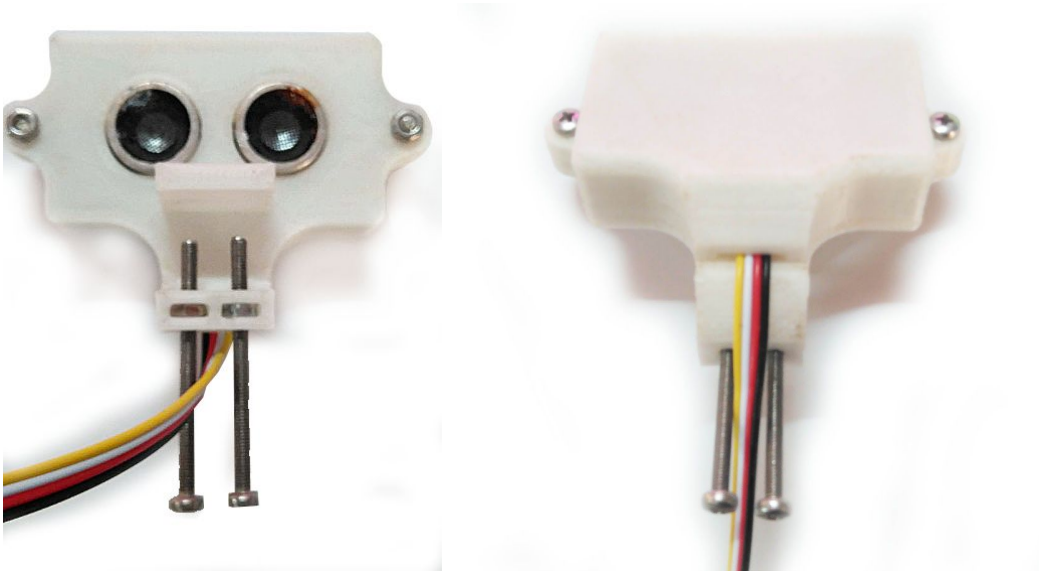


Screw both parts together using bolts and nuts

12



Screw in 40mm bolts on case

13

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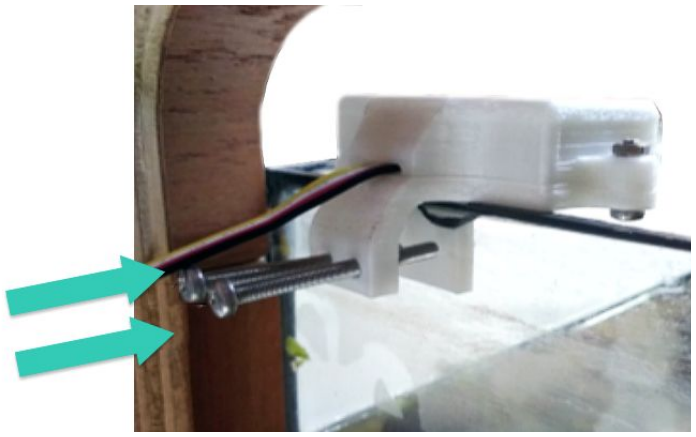

Place the case on the tank’s side and screw it on so that it’s fixed

ASSEMBLY 3: The SHT-31 and Digital Light sensor

Tools you will need for this part:

Laser cutting machine	8 M3 bolts	4 M3 spacers	12 mm x 20 cm Velcro strap	Plastic bolts M2 and nuts for electronics	Screwdriver

14

Get Nesting files from Github

15

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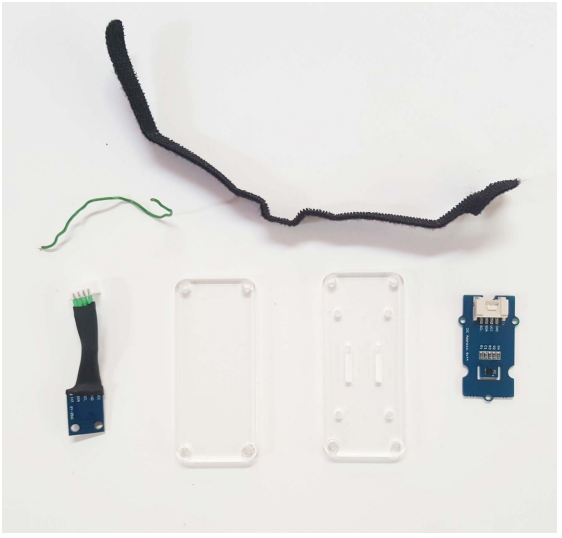

Laser cut the two parts on acrylic sheet

16

Insert velcro strap through hole in bottom part of casing

17

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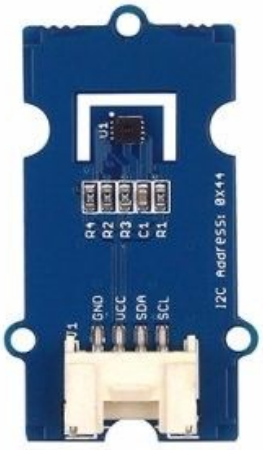
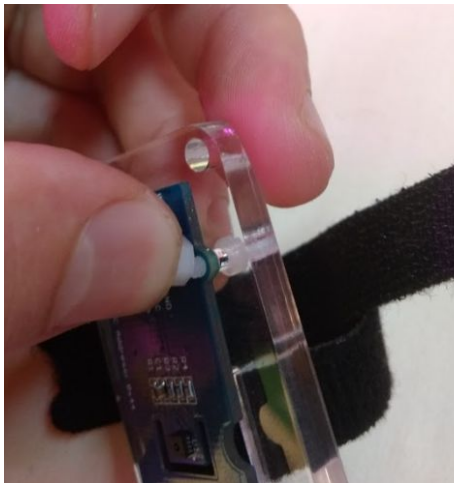
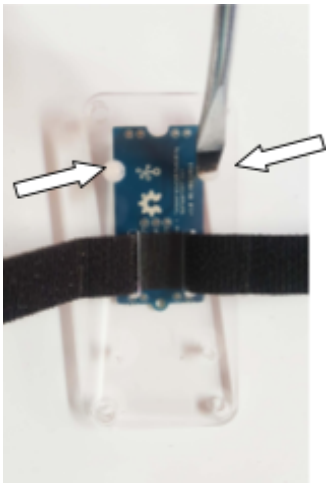
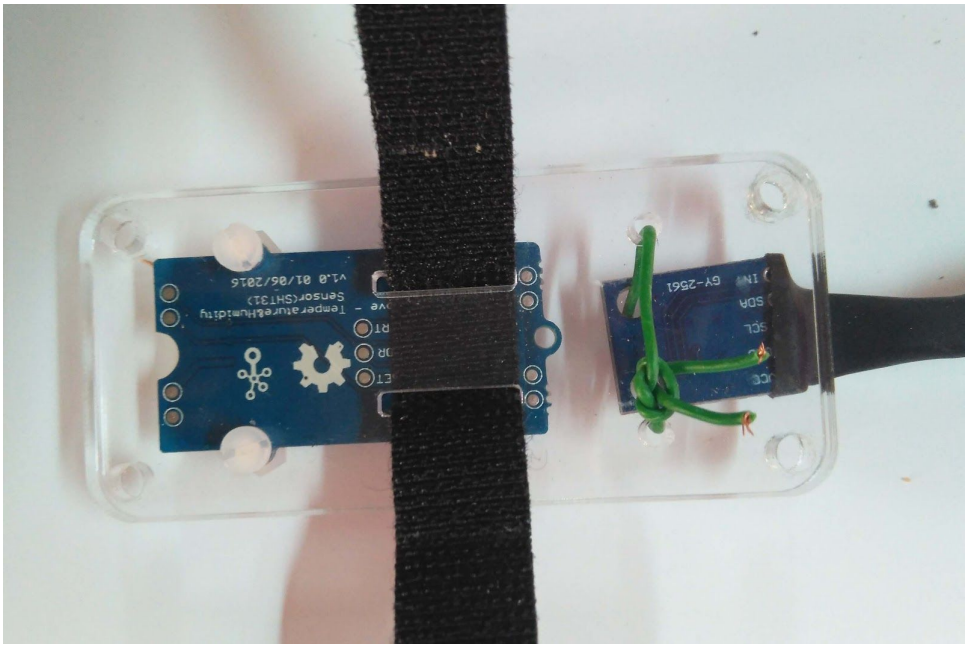


Screw plastics bolts to fix SHT-31 sensor to the back of the casing

18



Fix the light sensor to the back of the casing

19

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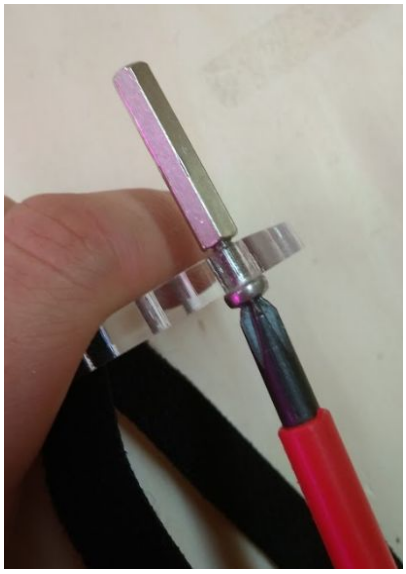
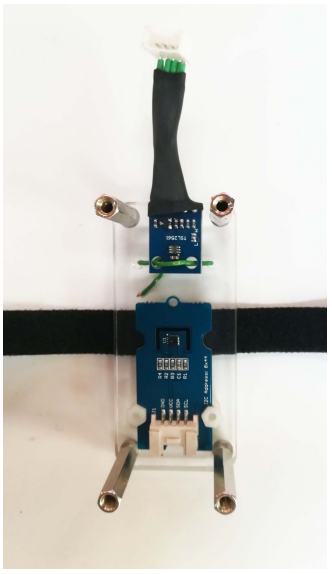
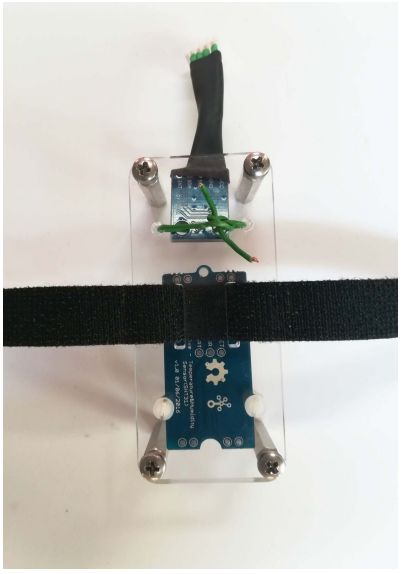
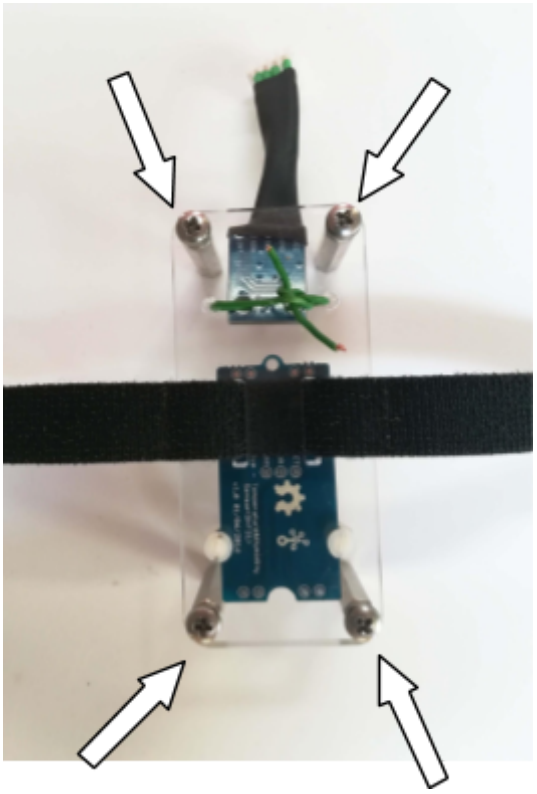




Insert metal bolts in each corner of the back of the casing. Screw on spacers

20



Repeat same procedure with the top part of the casing

21

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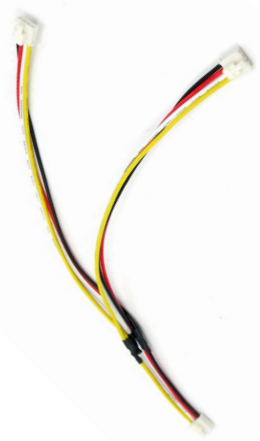


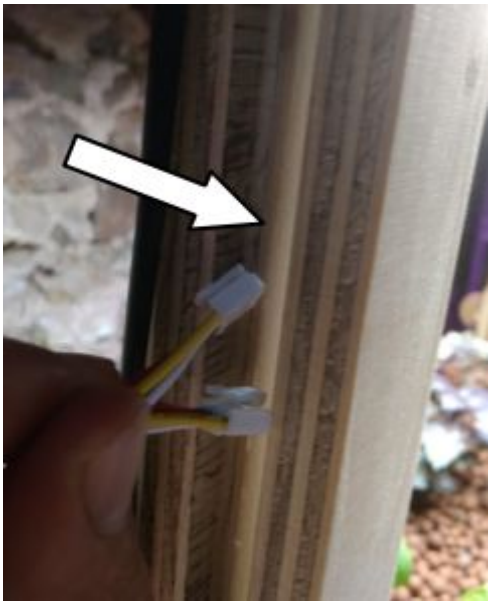
Get Grove Branch cable ready.

22

Separate slightly the two parts of the lamp frame.

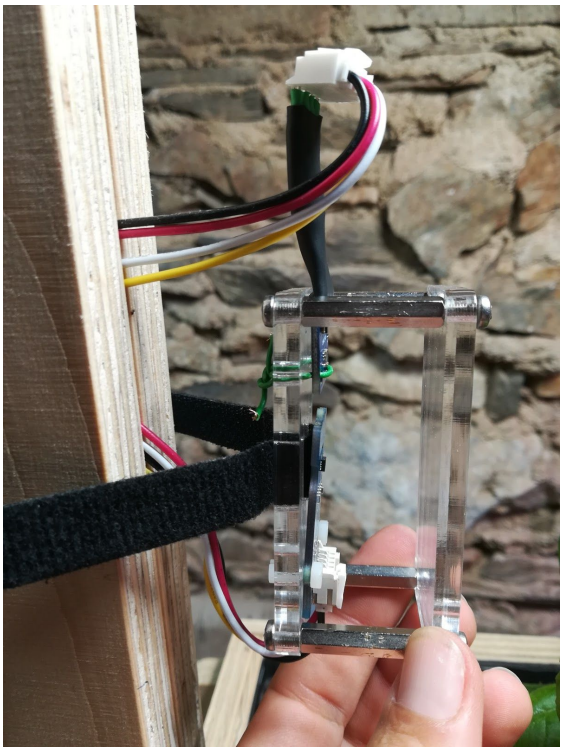
23

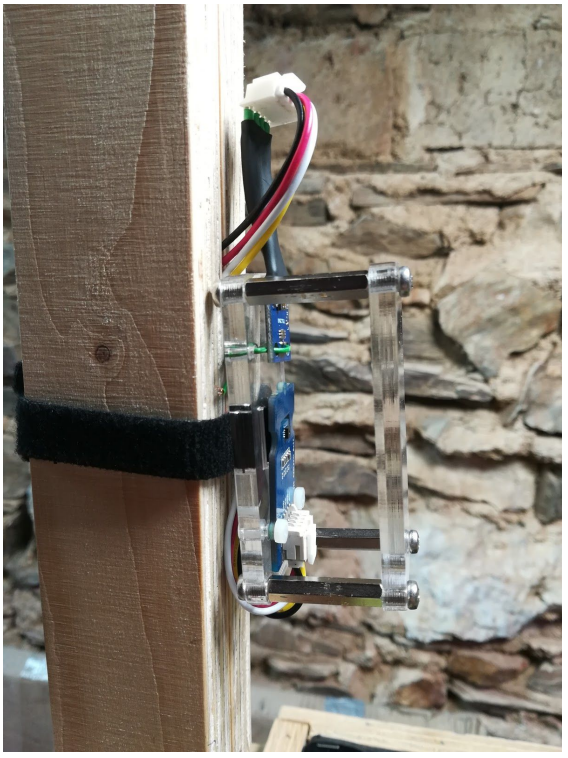
CC BY NC



Insert cables through the gap between the two parts.

24





Attach the casing on the frame using the velcro strap

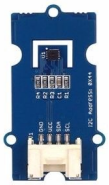
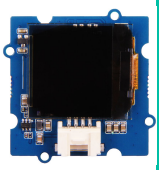
CC BY NC

ASSEMBLY 4: The board case and the sensors

Tools you will need for this part:

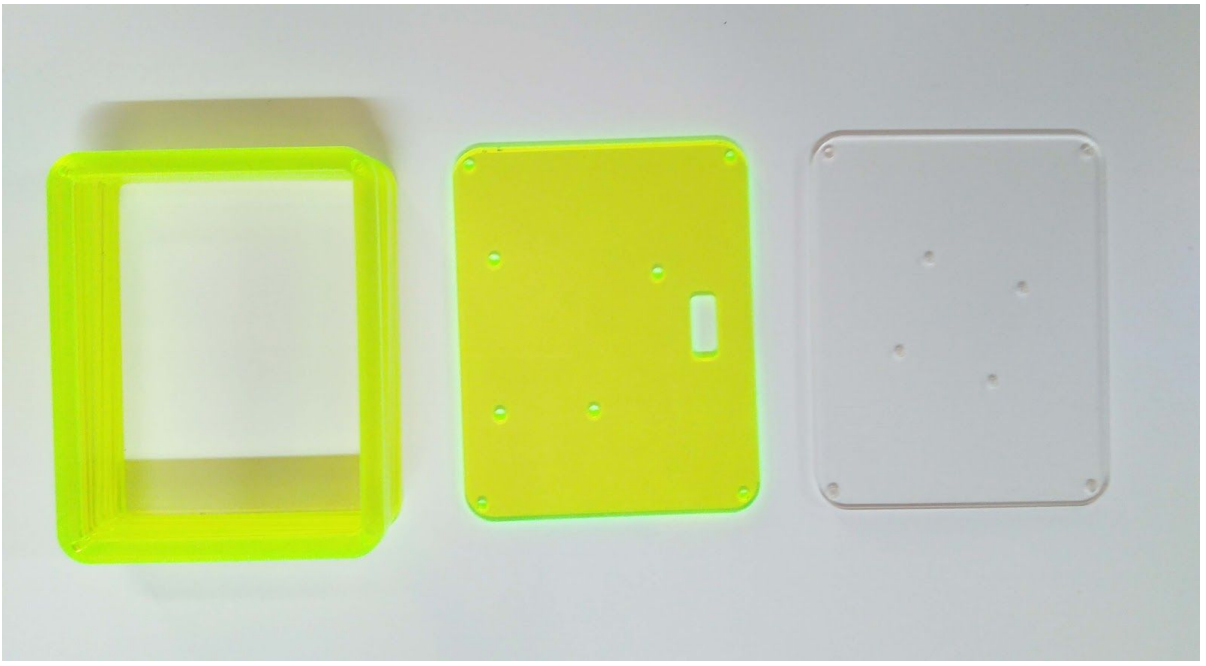
Laser cutting machine	4 bolts and 4 nuts M3, 40mm long	Plastic bolts m2 and nuts for electronics	Screwdriver

You will also need the different sensors:

SHT-31	Ultra sonic ranger in its casing	1 Wire Temperature Sensor	TSL2561	OLED display 1.12	Grove cables	Grove Branch cable
						

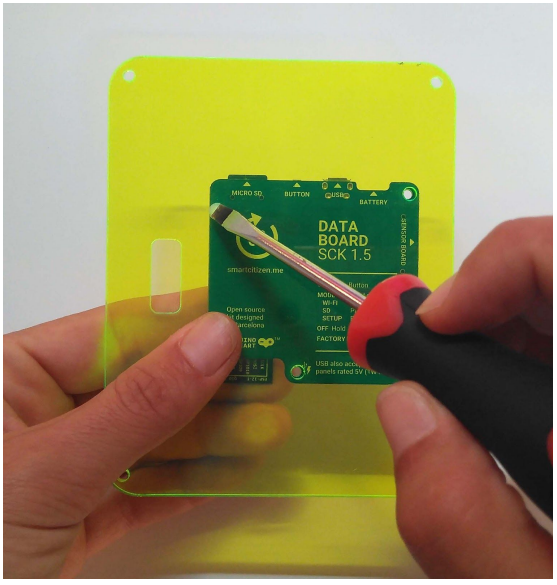
THE BOARDS CASE
25
Get files from Github
26

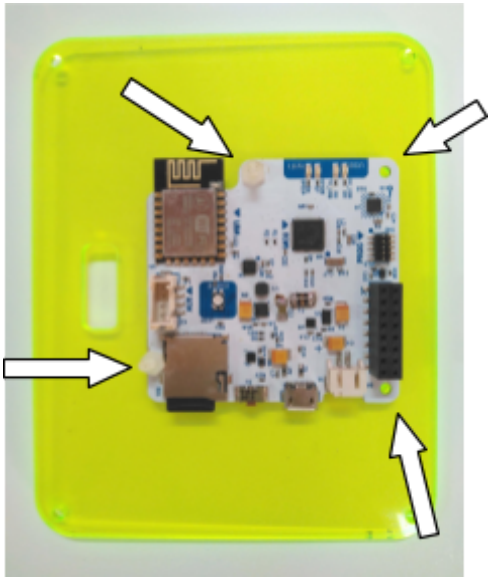
CC BY NC



Use nesting files to cut 3mm thick acrylic with laser cutting machine. You can use whichever color you want. There should be 10 layers in between the top and bottom layers

27





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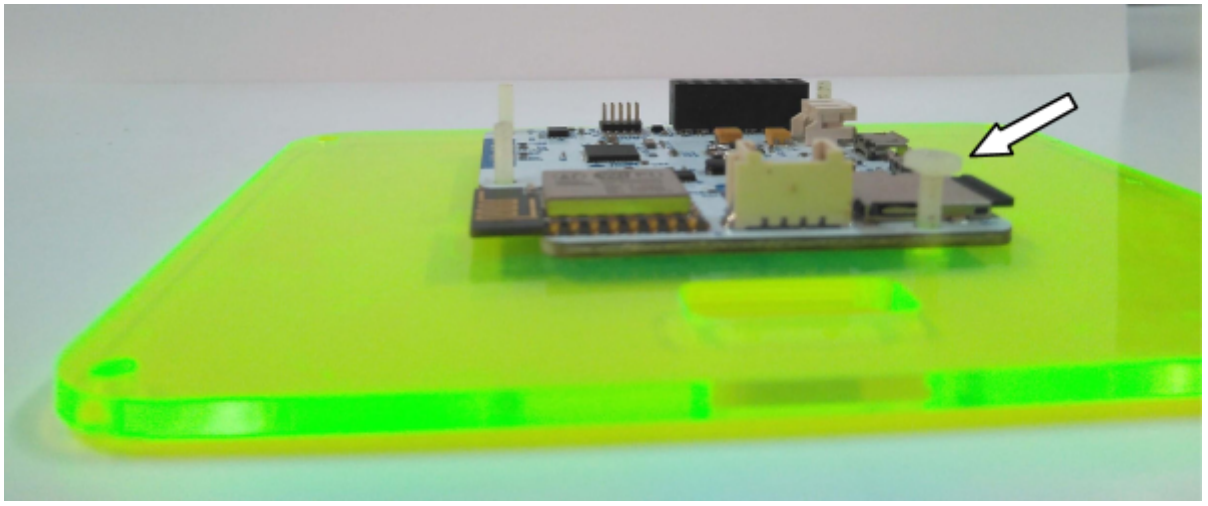
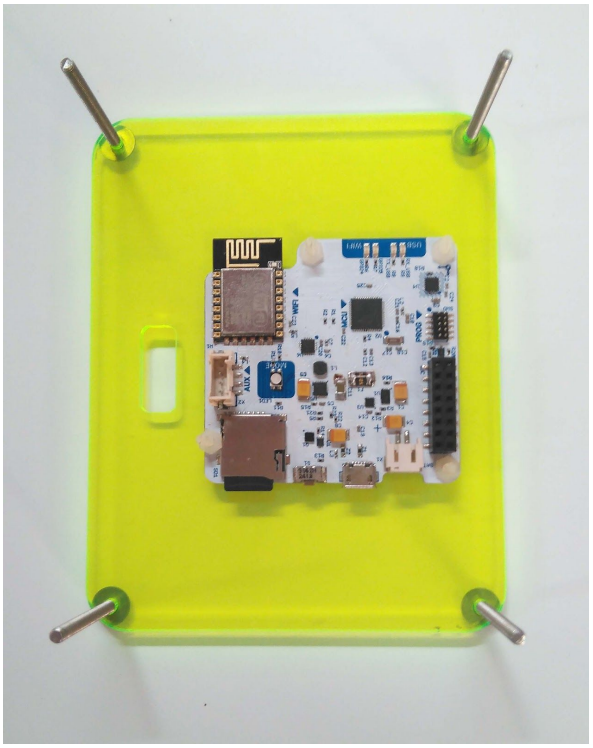


Screw the Base board on the bottom layer using the plastic bolts and screws

28



Add metal bolts underneath bottom layer

29

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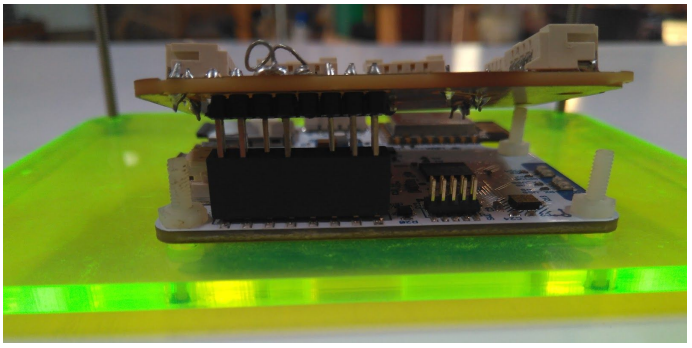
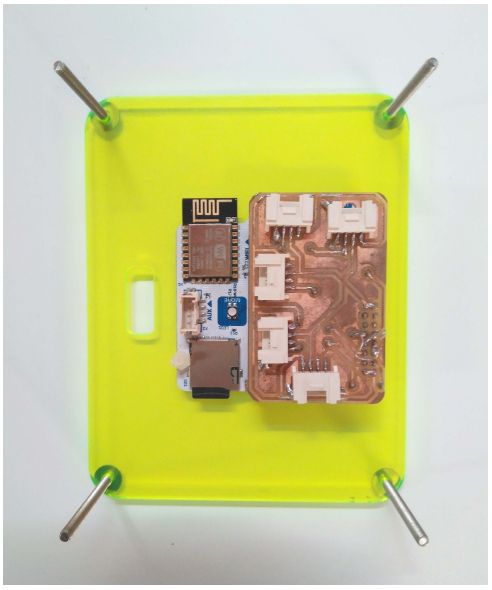
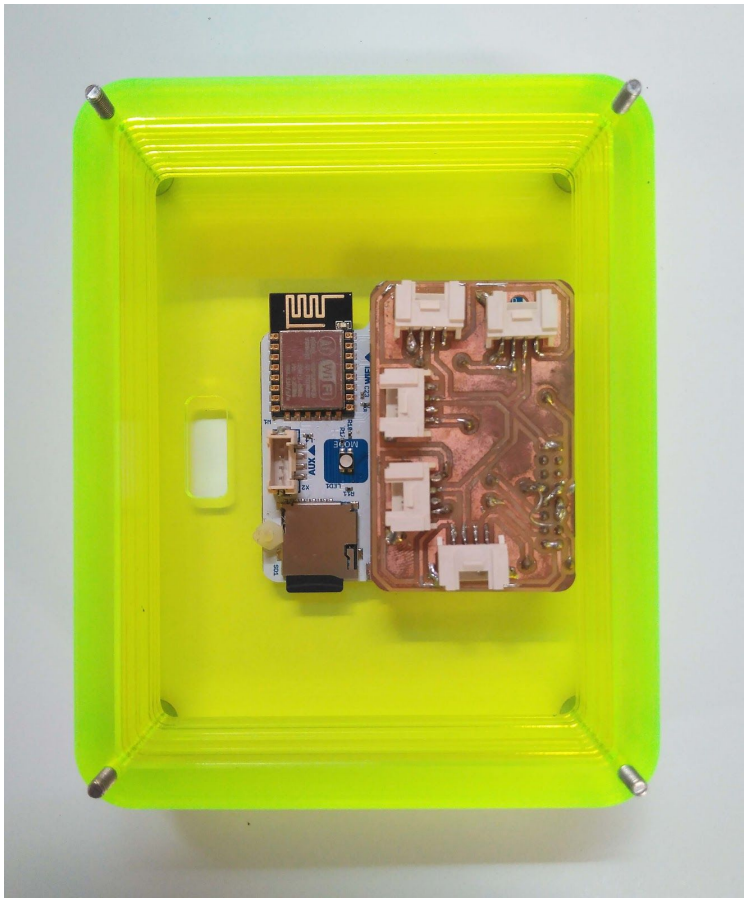




Plug in the Aquapioneers board onto the base board

30



Slide intermediate layers of acrylic on the bolts

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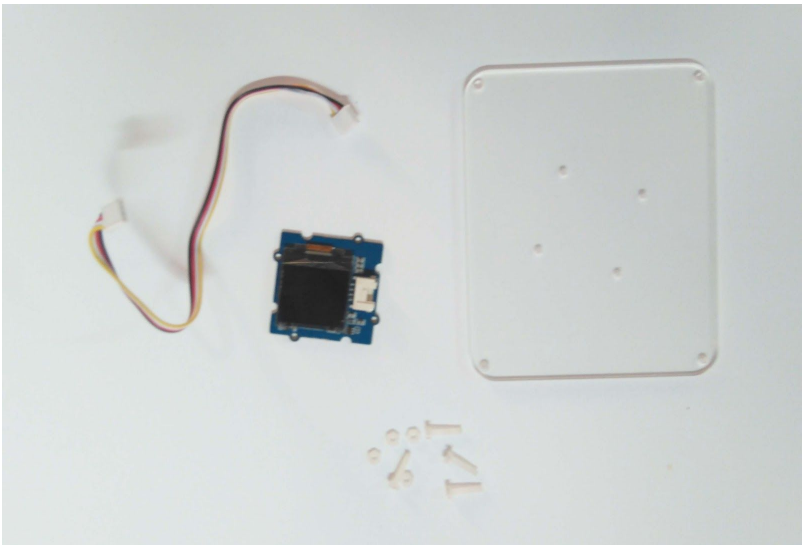
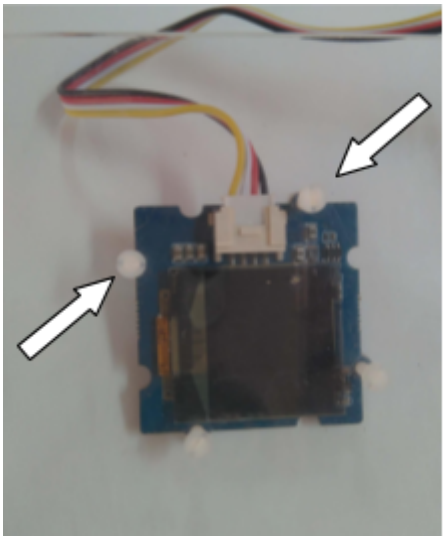
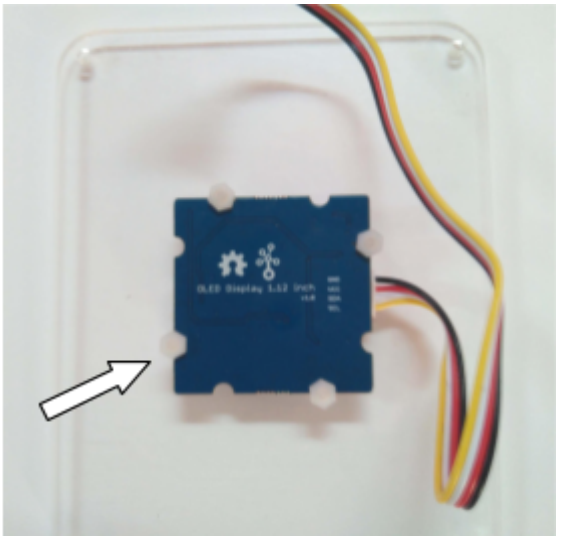
The sensors
31

Connect Grove cable to OLED screen.
32
 

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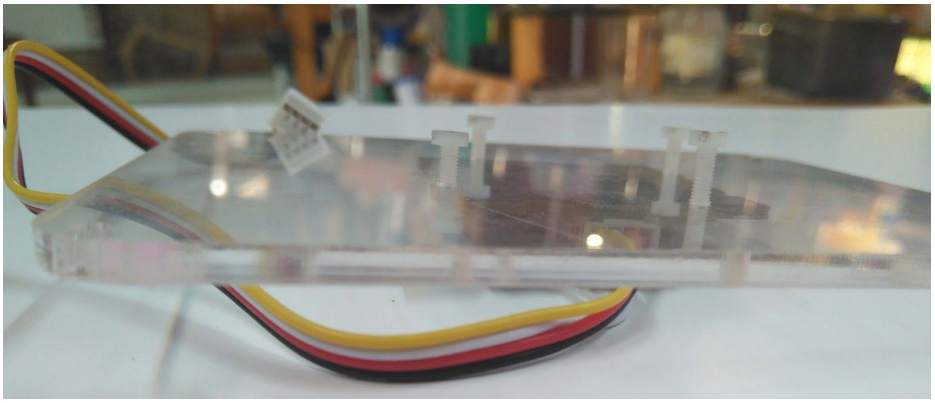
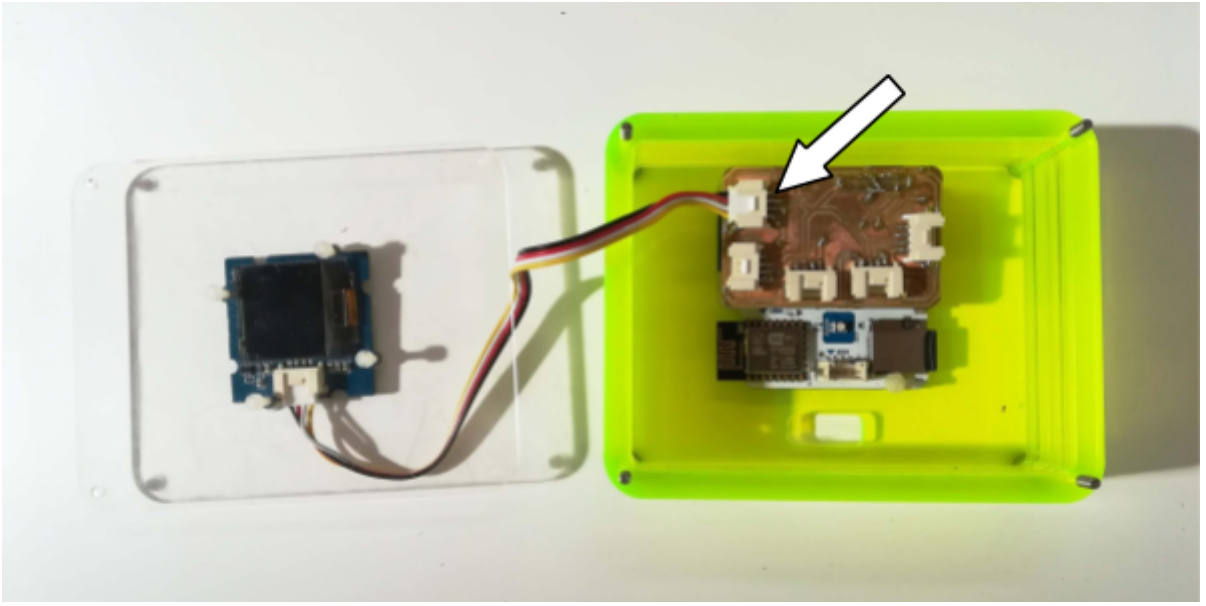


Take front part of the case and screw the screen. Be sure that the screen is touching the plastic.

33



Plug in the OLED screen cable in the indicated connector.

34

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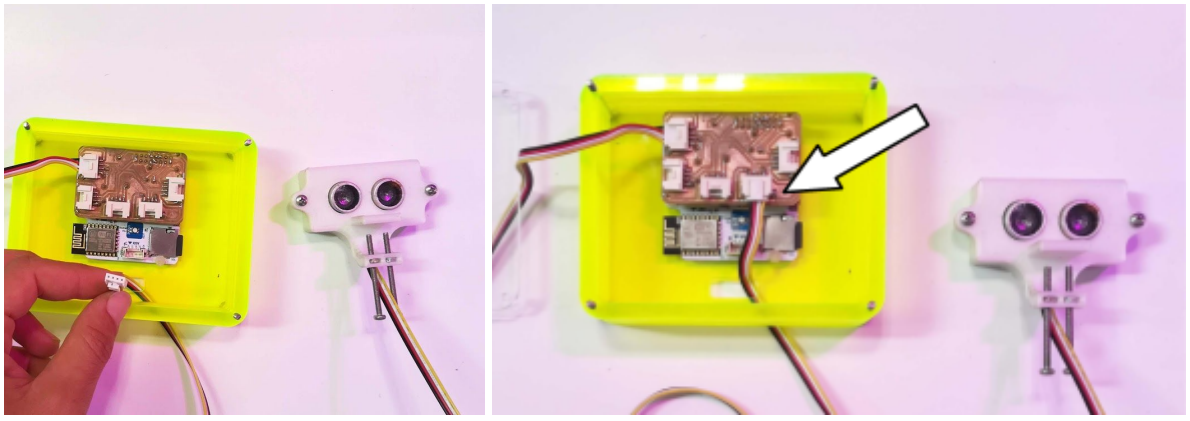
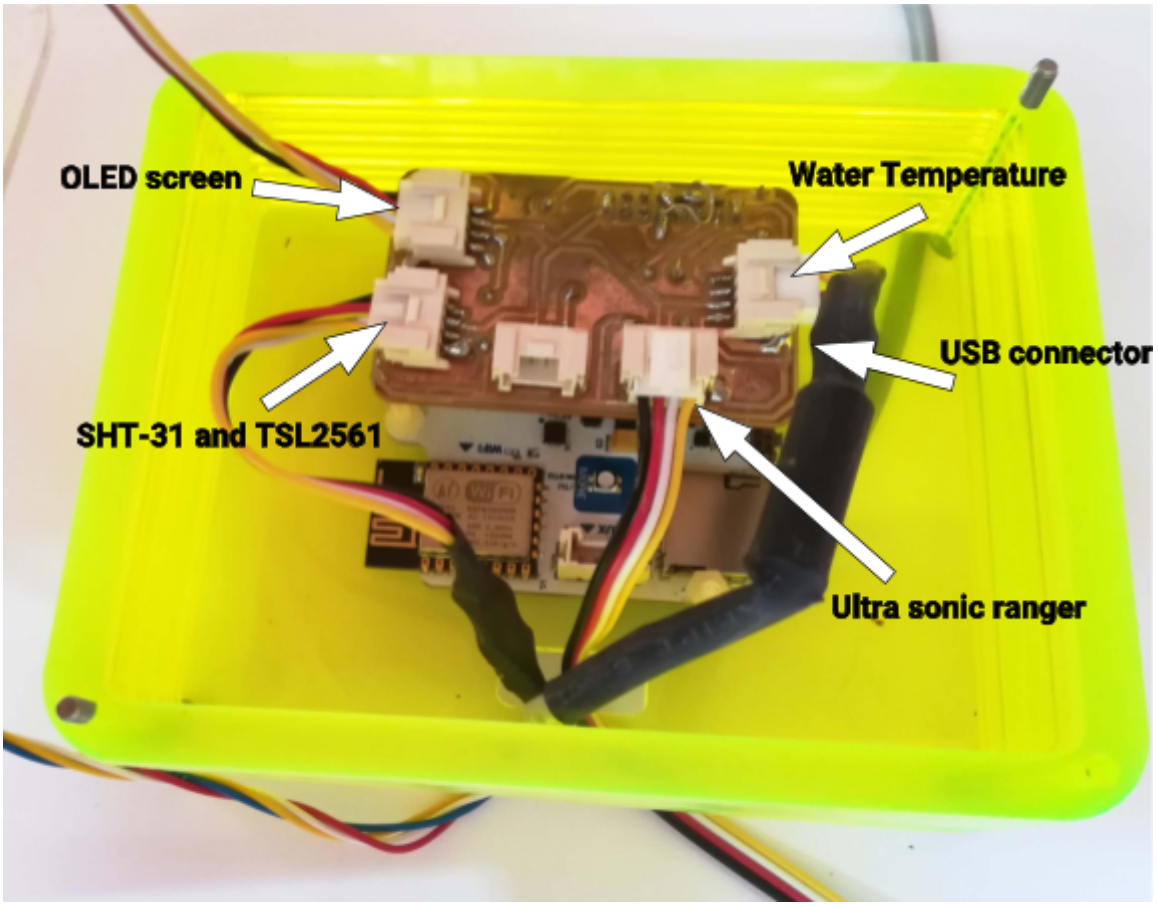


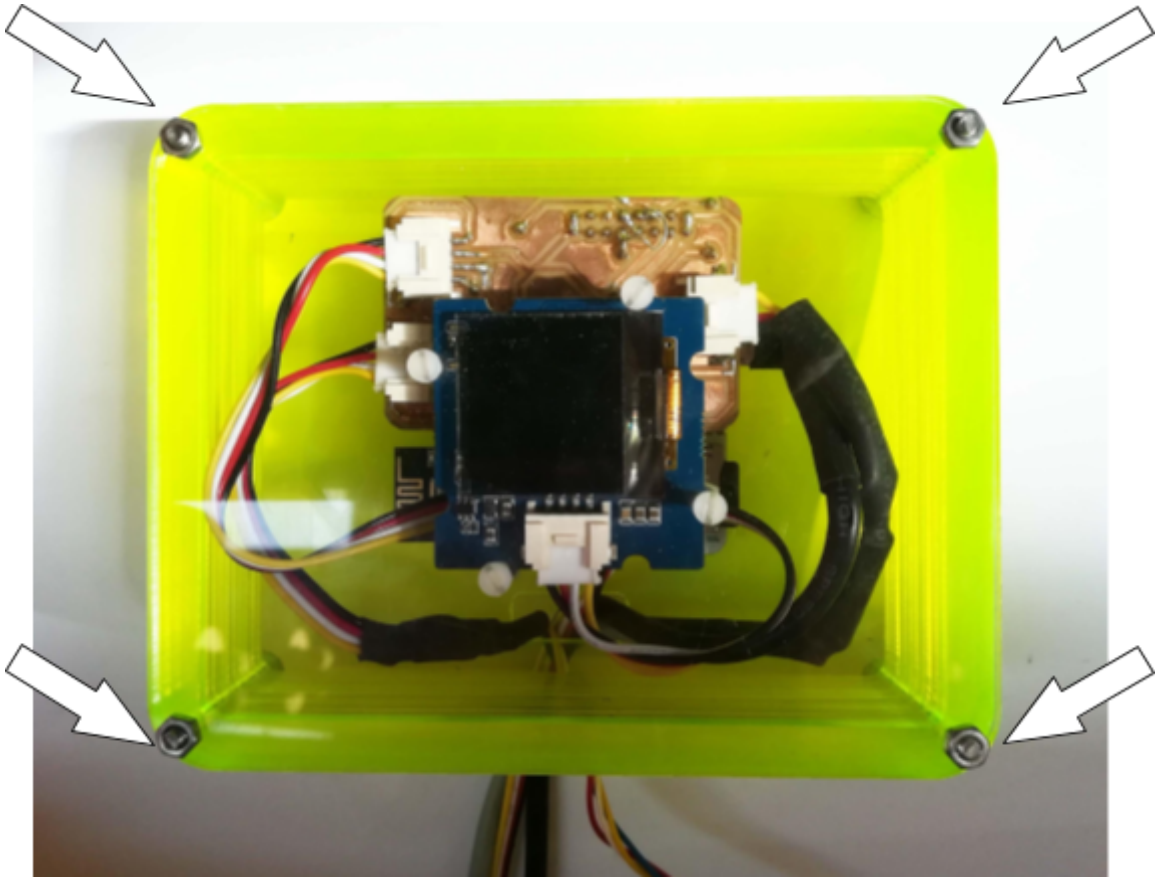
Plug the ultrasonic sensor cable in the indicated connector.

35



Plug in all the connectors onto the Aquapioneers board as shown above.
There are one extra connector for an extra sensor.

36



Screw top layer onto the case.

37

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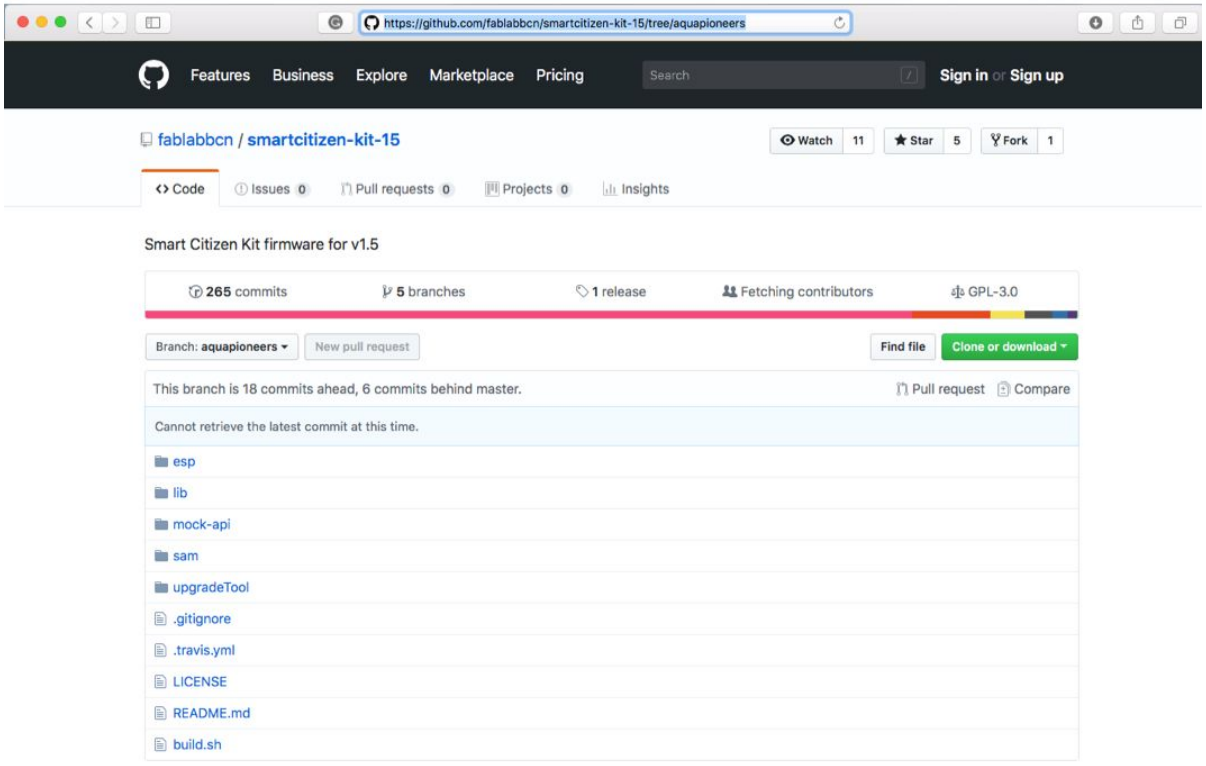
SOFTWARE : How to setup your Monitoring Kit

Once the sensors are mounted, you should connect the Aquapioneers kit to your computer through a USB cable to upload the source code.

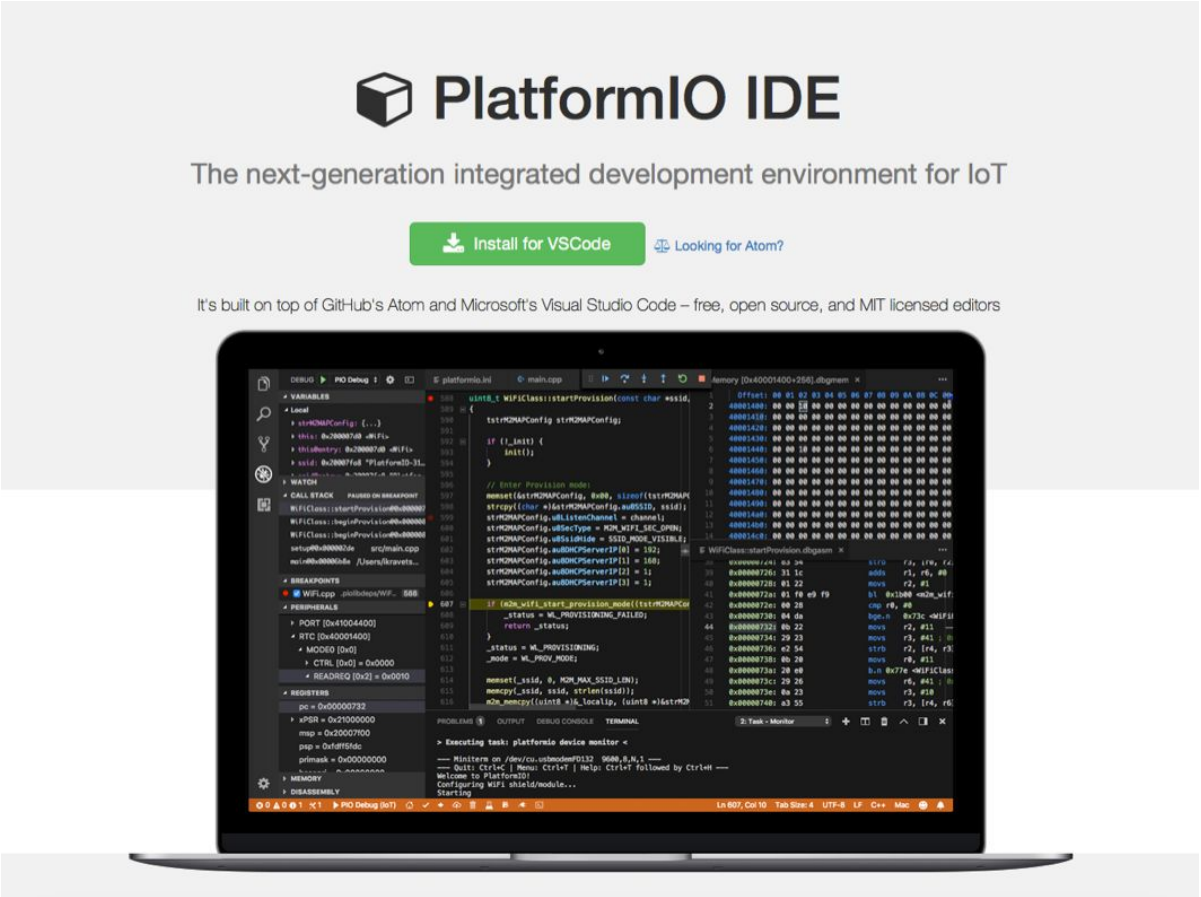
Check the source code

39 Downloading the firmware



Aquapioneers Monitoring Kit firmware could be downloaded from the Smart Citizen / Aquapioneers Github branch: https://github.com/fablabbcn/smartcitizen-kit-15/tree/aquapioneers

40 Uploading the firmware



To upload the firmware to the Aquapioneers citizen kit, you will need to use “PlatformIO IDE” that can be download here: https://platformio.org. Then follow the next steps.

1. In folder ./sam/ do:

   ```
   pio run -t upload
   ```

2. in folder ./esp/ do:

   ```
   pio run -t upload
   ```

3. To upload the Frontend website code to the filesystem do:

   ```
   pio run -t uploadfs
   ```

41 Configure & connect to WIFI

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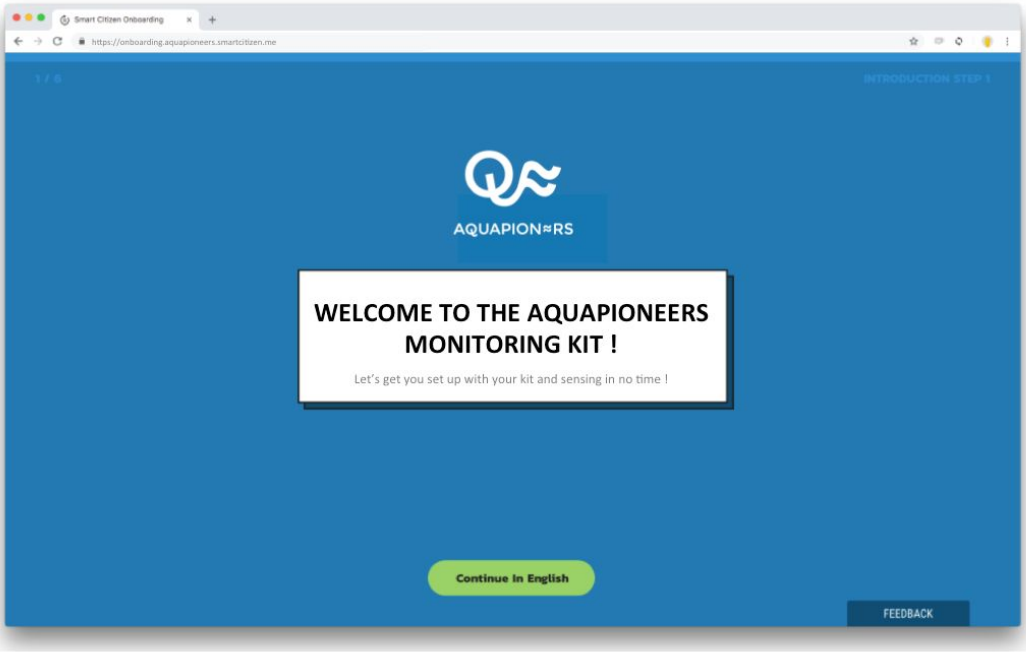
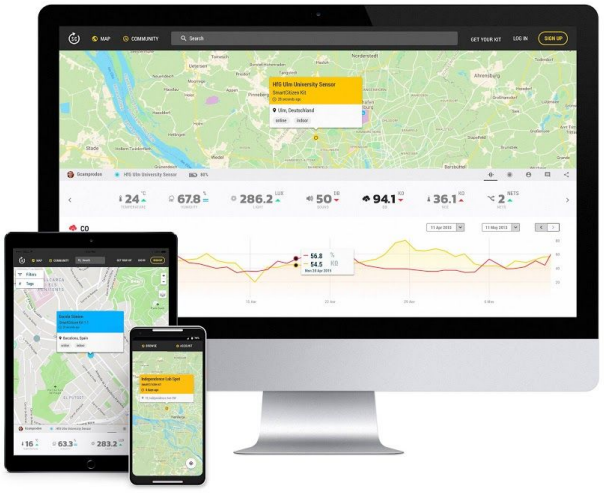


You will be able to configure it by following the instructions at **https://onboarding.aquapioneers.smartcitizen.me**/

42 Visualize your datas



After the configuration your data will be available on the SmartCitizen platform (**https://smartcitizen.me/kits/**). You can explore the data there or download it using the CSV Download option.

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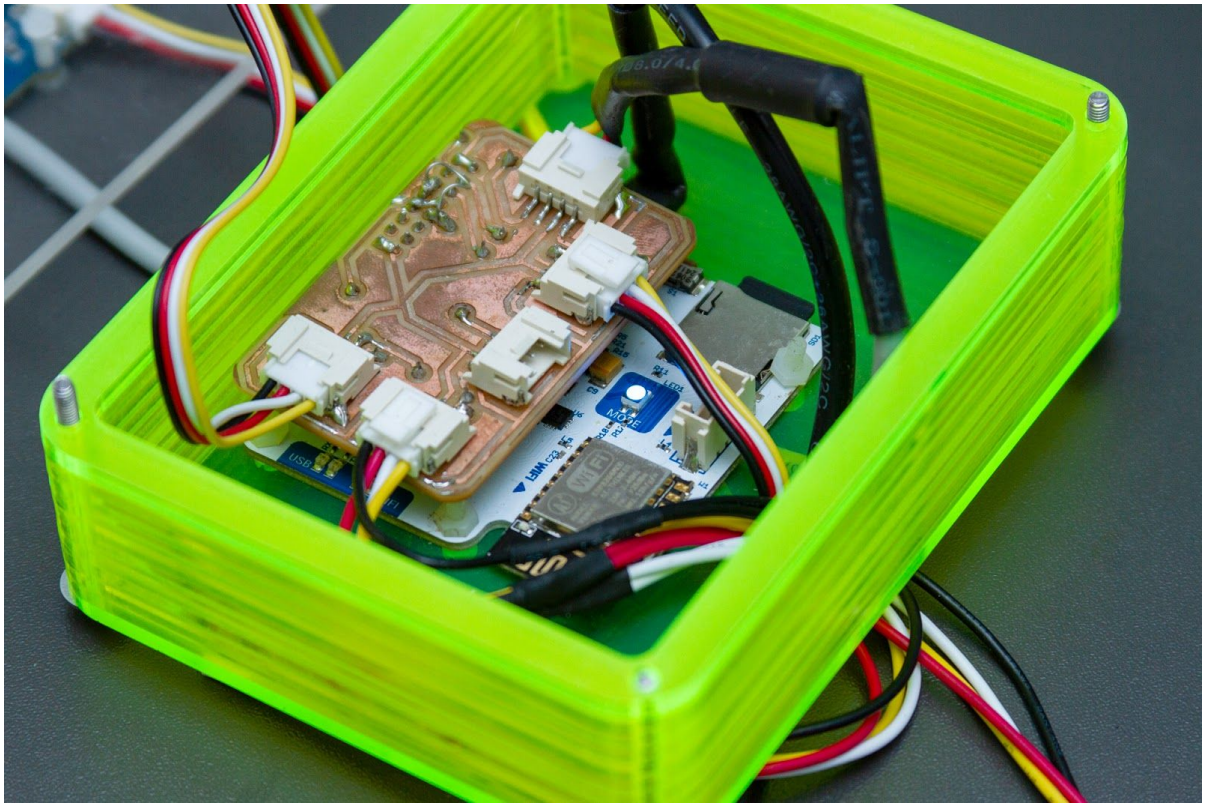
43 Troubleshooting



For any other FAQs related to:

- the state of the monitoring kit
- operation modes
- troubleshooting
- SD card mode (offline)

Please check the Smart Citizen sensors documentation on:
https://docs.iscape.smartcitizen.me/Citizen%20Kit/ or contact the smart citizen team at **support@smartcitizen.me.**

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https://openmaker.eu/

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https://www.ulule.com/aquapioneers/

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