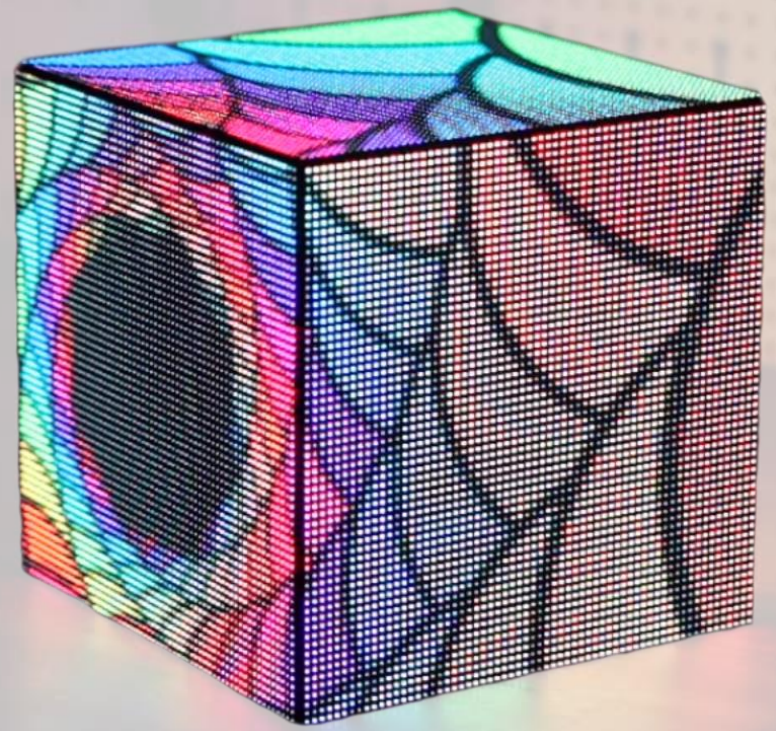
Tutorial to build a LED-Matrix cube

Or: how to waste your money on a glowing cube which will only collect dust on your shelf. Yay.



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Introduction

After watching a video from Michael Cann (https://www.youtube.com/watch?v=I_GSGFhnWwo) I thought „I need this“. Like many of you from reddit. And there are not many of these cubes around.

I‘ve done some research and part picking for around a month, thinking about if I could handle that. The designing of the 3d printing parts would be very easy for me. The only thing I struggle with is the software. I‘m not good with that.

And I can not start designing the cube if I don‘t have the panels to measure. The panels cost me around $150 (123€). A little bit expensive for testing and playing around.

I also need some other parts which are a little bit expensive (the raspberry and power distribution).

But in the end, I took the risk anyway. No regrets. And it was (in terms of the building part) one of my easiest project for years.

The panels arrived after 2 months of shipping, and I started designing the cube. The first design was done after only 1 hour. With optimizations etc. it took me around 10 hours in total to design the cube. I nearly redesigned the whole cube after starting this tutorial.

For the software I started with the git repository from hzeller (https://github.com/hzeller/rpi-rgb-led-matrix) which I luckily got to work.

Right now, I‘m trying different repositories.

Thanks to all the folks from reddit, you are awesome: reddit: Wireless LED-Matrix Cube with Raspberry Pi 4B 4GB

Warning: You must widen the holes of the raspberry with a 3,5mm drill bit!

And don’t be too picky with the tutorial. It’s my first try for something like that.

Bill of materials

An .xlsx-file is provided within the zip-file. There are also shop links inside.

I had all the hardware laying around. I searched for the actual prices right now.

That means, prices for the hardware are only „for show“.

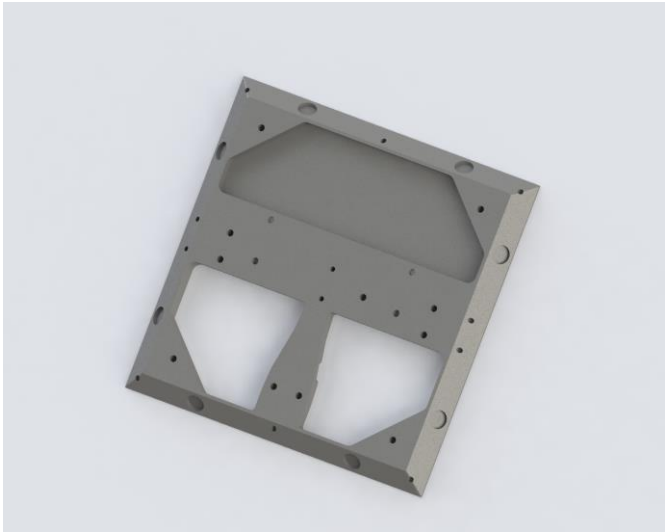
Nr.	Name	qty	category	Shop Description	Shoplink	Order-Nr.	Price	
1	Panel-Mount	6	3D-Print					
2	Middle-Mount	7	3D-Print					
3	Corner-Mount	8	3D-Print					
4	Angle-Mount_Raspberry	1	3D-Print					
5	YPG-Mount	1	3D-Print					
6	zip-tie_mount	5	3D-Print					
7	Cube-Stand	1	3D-Print					
8	LED-Panel_64x64-P3	6	electronics	64x64 indoor RGB hd p3 indoor led module video wall high quality	https://de.aliexpress.com/item/3275764740		$161,73	per 6
9	Raspberry-Pi4-B	1	electronics	Raspberry Pi 4 Computer Modell B, 4GB RAM	https://www.berrybase.de/raspberry-pi/ras	RPI4B-4GB	$70,11	per piece
10	Raspberry CPU cooler	1	electronics	Ice Tower CPU cooler for Raspberry Pi, Low Profile	https://www.berrybase.de/neu/ice-tower-c	RPI-LPCOOL	$21,00	per piece
11	GPIO-Adapter	1	electronics	GPIO Edge expansion, GPIO adaptor for Raspberry Pi	https://www.berrybase.de/neu/gpio-edge-e	EP-0121	$4,24	per piece
12	electrodragon_MPC1073	1	electronics	RGB LED Matrix Panel Drive Board For Raspberry Pi	https://www.electrodragon.com/product/rg	MPC1073	$3,63	per piece
13	YPG_20A-SBEC	2	electronics	YPG 20A HV SBEC	https://de.aliexpress.com/item/100500210		$41,29	per 2
14	40mm Fan 5V	1	electronics	use the second fan from the ICE Tower CPU-Cooler				
15	XT60 (pair)	3	electronics		amazon			
16	XT30 (pair)	7	electronics		amazon			
17	Threaded insert_M3_RS	63	hardware	RS PRO, M3 Brass Threaded Insert diameter 4mm Depth 4.78mm	https://de.rs-online.com/web/p/gewindeein	278-534	$24,52	per 100
18	Magnet_10x2	16	hardware	Neodym magnet 10x2mm	amazon		$10,28	per 52
19	Washer DIN 125 - A 3.2	70	hardware	Washer DIN 125 M3 V2A	https://gedex-shop.de/de/SCHEIBEN/Unterl	125-2-3-100	$4,52	per 100
20	M3x8_Torx	68	hardware	Pan head screw Torx A2 ISO 7380 M3x8	https://gedex-shop.de/de/schrauben/TORX	A2 ISO 7380 M3x8	$6,12	per 100
21	M3x6_Torx	4	hardware	Pan head screw Torx A2 ISO 7380 M3x6	https://gedex-shop.de/de/schrauben/TORXS	A2 ISO 7380 M3x6	$2,80	per 25
22	M3x14_Torx	2	hardware	Pan head screw Torx Edelstahl A2 DIN 7985 M3x14	https://gedex-shop.de/de/schrauben/TORX	A2 DIN 7985 M3x14	$3,77	per 50
23	M3x6-torx (optional for zip-tie mount)	5	hardware	Countersunk screw Torx A2 DIN 965 M3x6	https://gedex-shop.de/de/schrauben/TORX	A2 DIN 965 M3x6	$3,32	per 50
24	Adapter_M3x6	8	hardware	HEX. THREADED SPACER 6IO/6	https://de.rs-online.com/web/p/abstandsha	102-6491	$7,19	per 10
25	M1x5,5_Panel-Screw	72	hardware					
							$364,52	

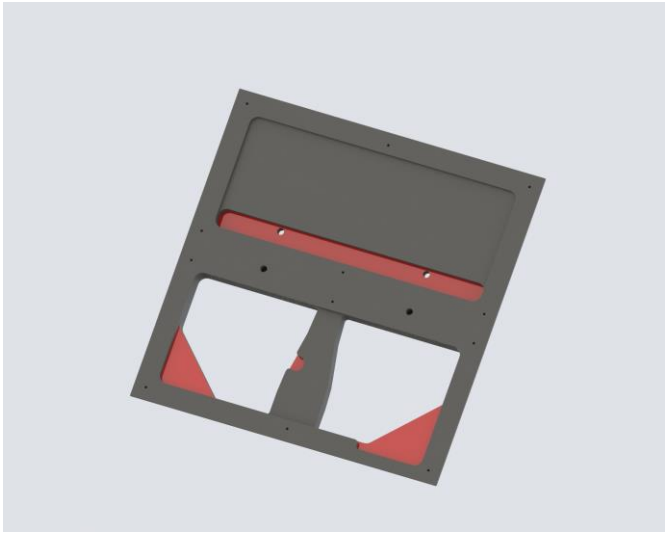
The printed parts

All parts are recommended to be printed in black pla/petg/abs

The main part is the panel-mount. It is a multi-mounting platform for the panels and all the other stuff. The panel-mount is the same part for all panels. The dimensions are 189x189x12mm. Odd dimension, right? Sure, it is. I modified my Ender3 with a direct-drive extruder and the absolute maximum I can print is 189x189mm. You must put M3 brass inlets in some of the holes. 63 to be exact. I tell you later in which panel you have to put how many and where.

On the underside are some cutouts (red) for different parts from the LED-Panel. Supports are necessary. I printed all parts with 3 walls and 20% linear infill.





Edge- and corner mounts

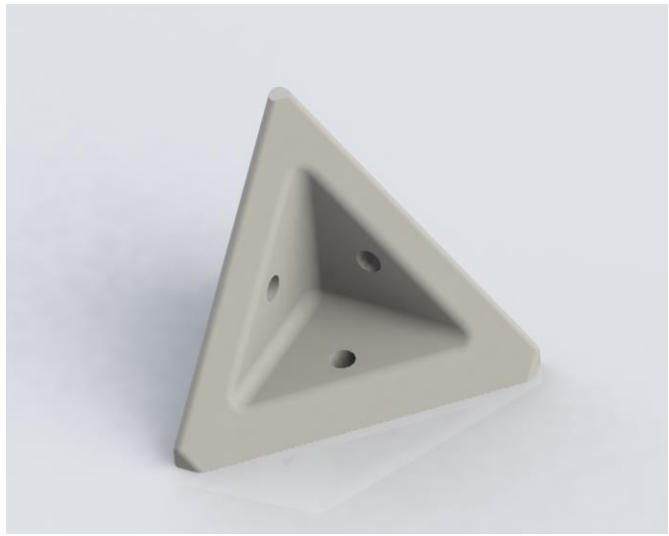
The next parts are the edge and corner mounts.

I printed these on my Anycubic photon s.

Printing these on a FDM printer also works.

Because of the possible force you should print the L-Shaped mount sideways on an FDM printer, so it won‘t break when you pick up the cube.

These are mounted with the M3 x 8mm screws.



Raspberry mount

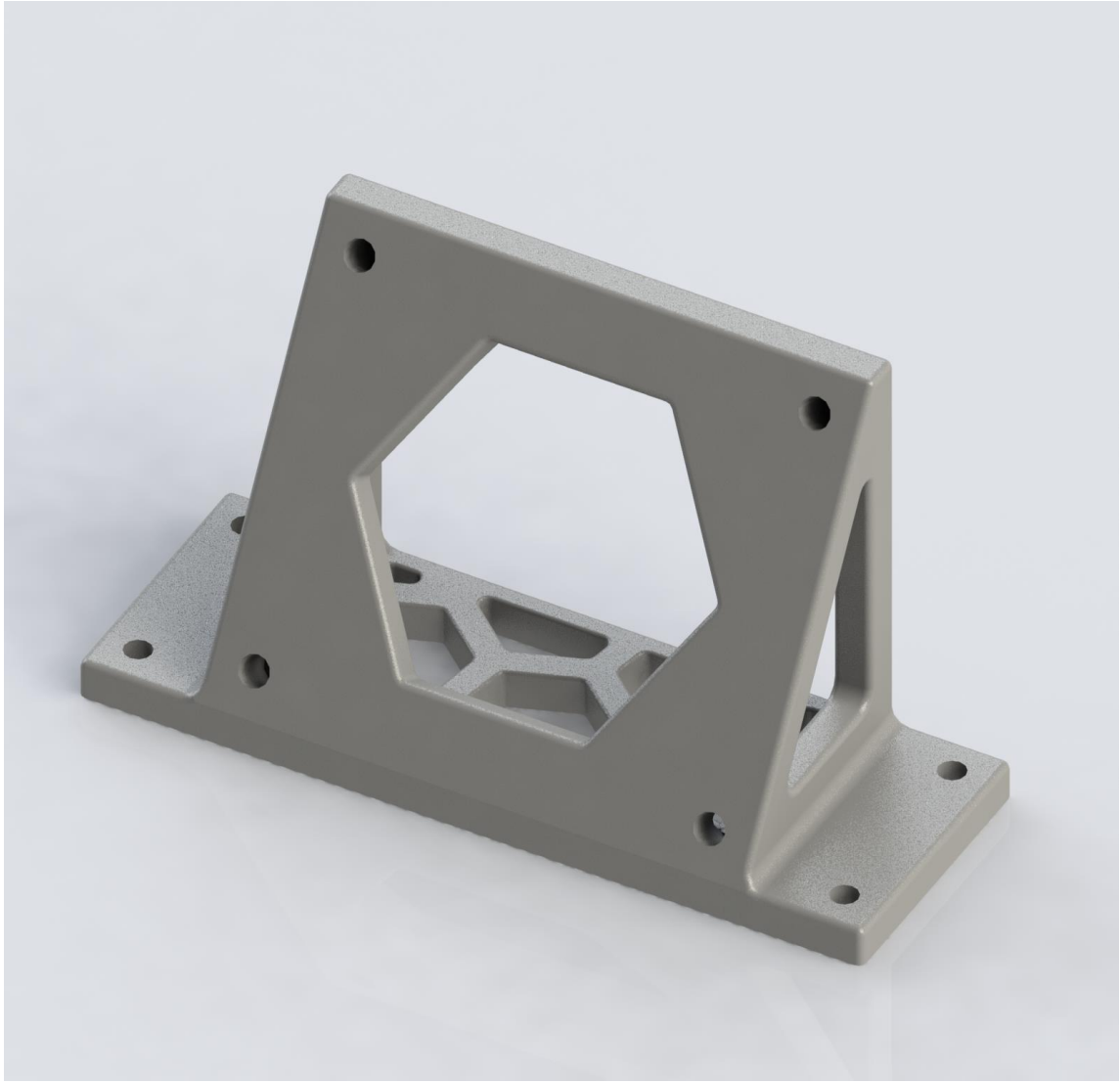
This is the part where the raspberry is screwed on. There are 4 brass inlets in the tilted surface.

I put in some hexagon cutouts, because hexagons are looking cool.

Why is it tilted? It looks good… maybe. Nope. Yeah. But it is easier to access the raspberry and the connectors on the electrodragon hat if the whole thing is tilted like that.

I tried some positions, but this was the best one.

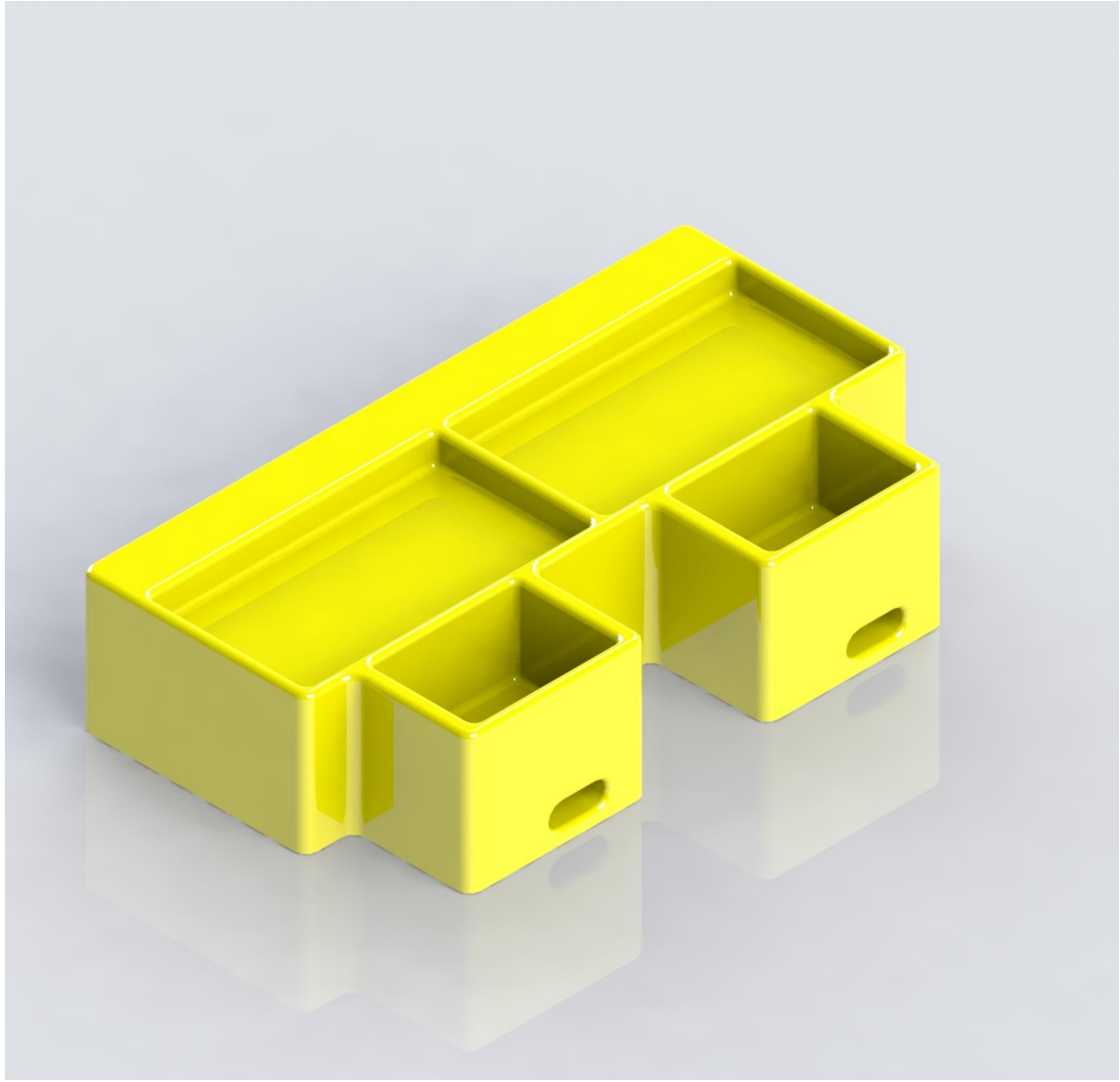
It is mounted with the M3 x 8mm on the panel-mount.



YPG 20A SBEC mount

The mount for the two YPG 20A SBEC. You fix them with zip-ties, which is shown later.

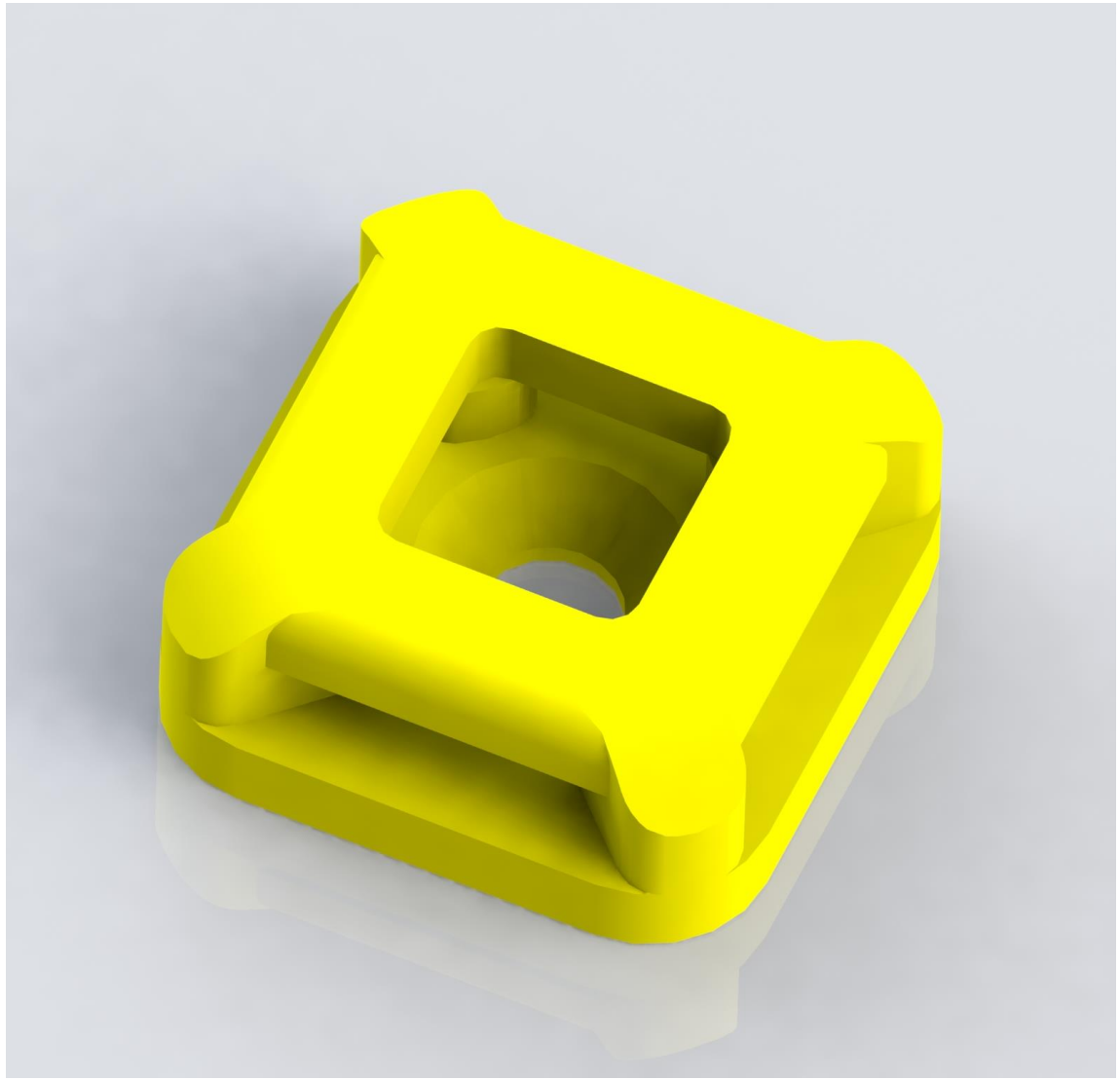
The mount itself is glued to the bottom-panel with double sided tape.



Zip-Tie mount

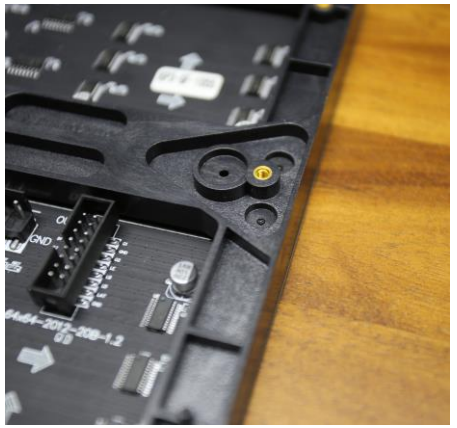
This is an optional part. In the panel mounts is a hole with a brass inlet where you could screw them in (with aM3 x 6mm countersunk screw).

If you want or need these on another place, you could glue them with double sided tape wherever you want.



Building the cube

We start with the panels. On the backside of the panels is a plastic frame which we need to remove. At first the 12 screws from the backside must be removed. The panel is fixed with these M1 x 5,5mm screws to the factory mount. Please be careful because these screws are tiny, and you need all of them for the printed mount. A Phillips P000 screwdriver is recommended.

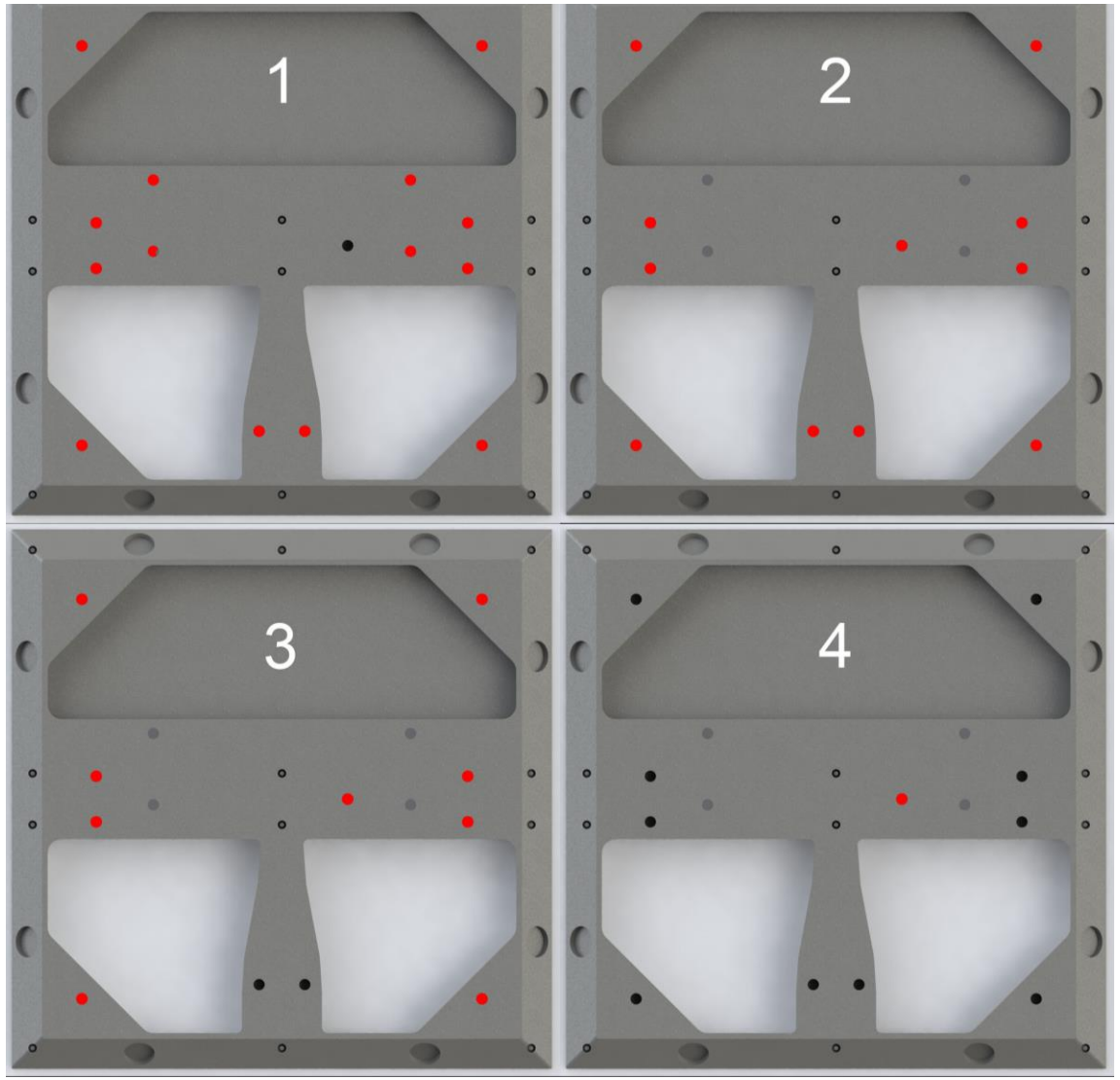


The 3D-Printed panel mounts

The printed parts are all the same. But there is a difference with the amount and position of the M3 brass inserts. We have:

1. 1 bottom panel with 14 inserts
2. 3 side panels with 11 inserts
3. 1 side panel with 9 inserts
4. 1 top panel with 1 insert

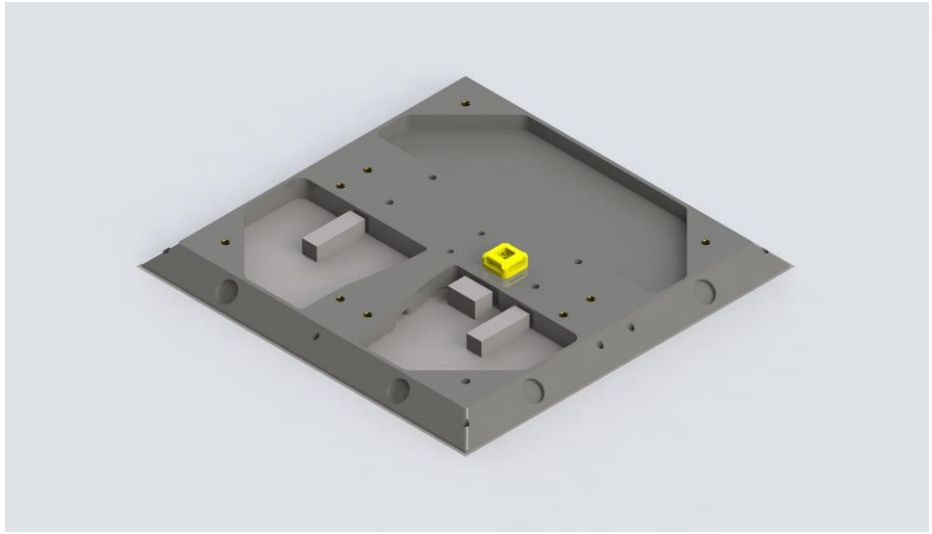
To fit the inserts into the printed part, take your soldering iron and melt them in. Hold them with tweezers and carefully press the solder tip into the insert. A temperature of 250°C (482°F) is enough. You could play around with the temperatures. I go in with 400°C (752°F) but I've done this meanwhile a thousand times. I'm not joking. I'm on my 12th package of 100 pieces of brass inlets.



Panels

If the M1 x 5,5mm panel-screw won't fit through the hole of the printed panel mount, you must drill through the holes with a 1,5mm drill bit.

Now assemble the panel-mounts onto the six panels with the M1 x 5,5mm screws. There is only one way the mount fit on the panels. Lay the panels on a soft surface (towel, big mousepad) to prevent them from scratches etc.



It is easier to start with one of the two middle screws and then do one of the edges. After that, the panel should be aligned correctly to put in the other screws.

Don’t tighten the screws too much or you rip them out of the panel. Be careful.

Side panels and top panel

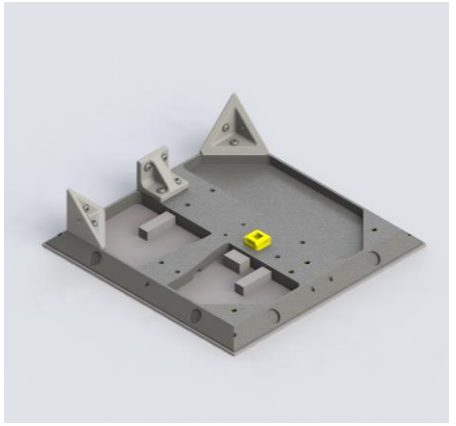
Now you must assemble the middle mounts and corner mounts onto the side panels.

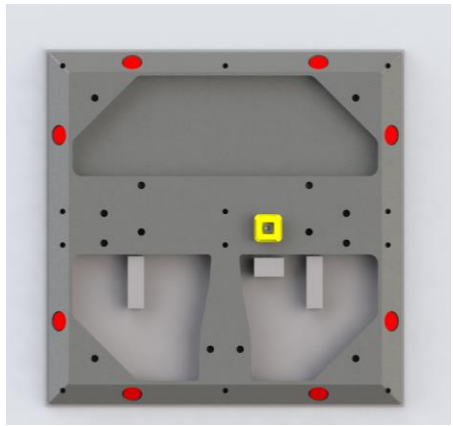
The panel in the top left corner is the single side panel. It uses one middle mount and two corner mounts.

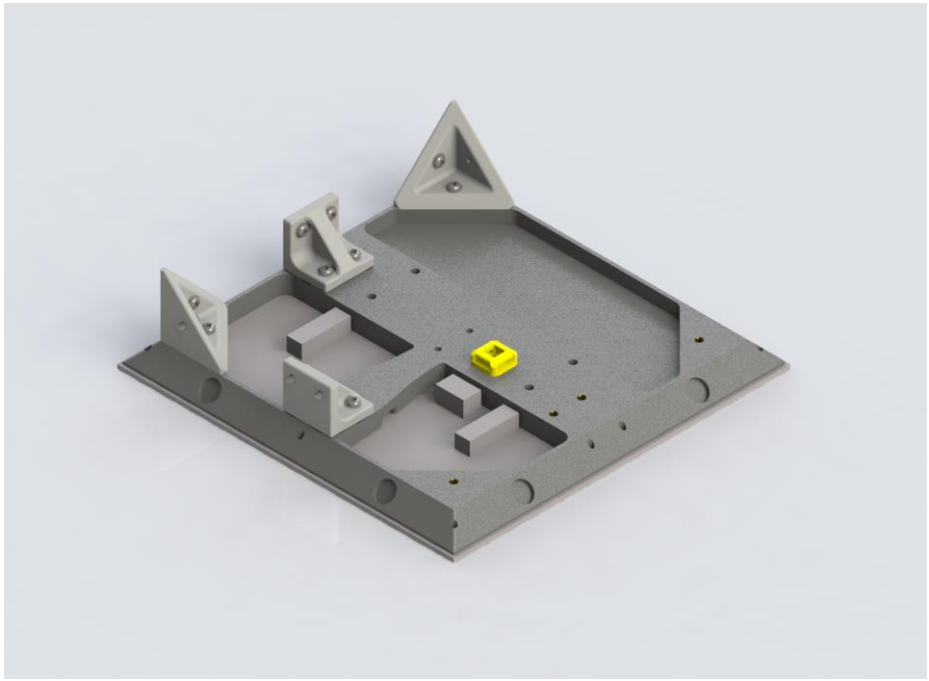
The panel on the top right corner is the top panel. Here you must glue in the magnets (in red) into the openings as shown.

The panel on the bottom is also a side panel. You need this three times. The only difference here is, you need one middle mount more than for the other one.

Use the M3 x 8mm here.





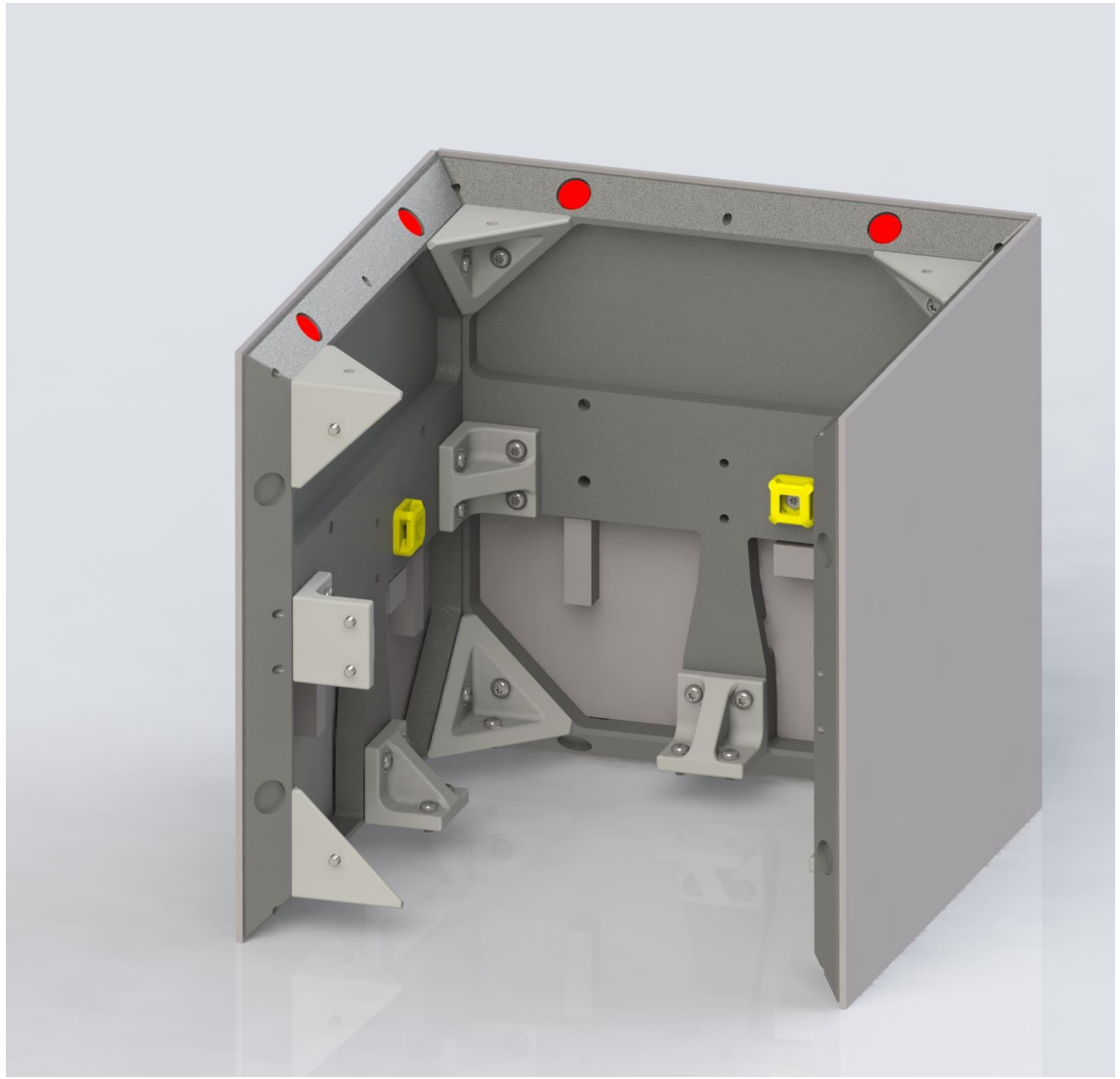


Side panels

Now assemble the sides as shown. These panels are the three side panels with the extra middle mount.

The extra middle mounts are on the bottom.

With this method it‘s a little bit easier to assemble the cube.



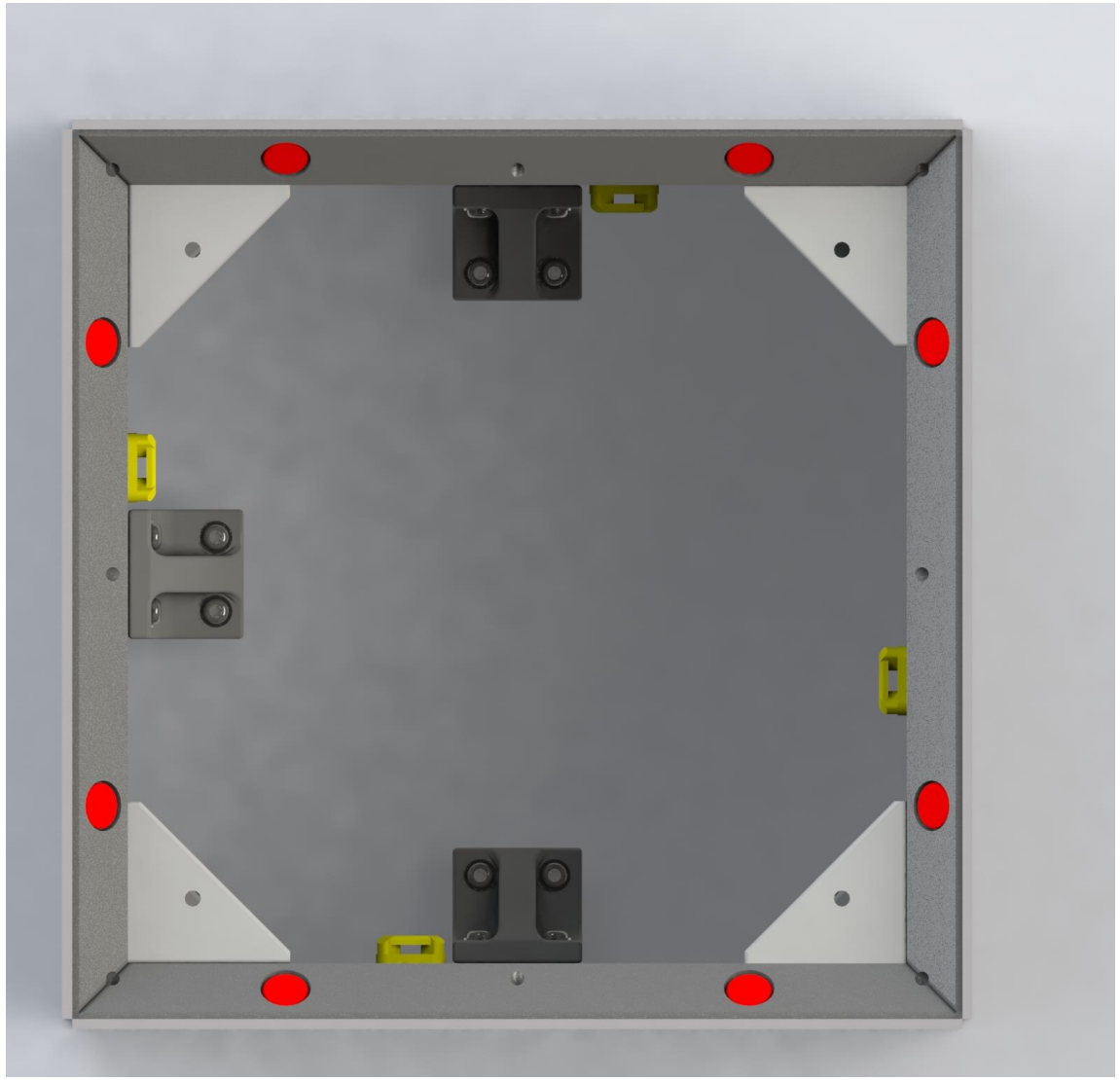
Side panels

After you made the U-Shape with the three side panels you must screw on the last side panel, without the extra middle mount. It’s on the right side of the picture.

If you look from the top, it should look like this.

After you’ve assembled the 4 side panels together, you must glue in the magnets (shown in red) on TOP of the panels.

The extra middle-mounts are on the bottom.



Power distribution module

The module with the two YPG are a little bit tricky. At first remove the heat shrink from the SBEC. Then you need long zip-ties (150x2.5) and fix the YPG with a zip-tie trough the hole in the bottom of the 3d printed holder. The zip-tie is then pressed into the heatsink. Then tighten it further.

After that you need to put in two of the brass inserts into the heat sink. If you bought the pack of 100 you could try to put in 4 of them, but I got only 3 properly in there. The openings in the heatsink are a little bit tight for that, but it works if you use a little bit of force, like a hammer. But please, don’t smash the hammer onto that thing like a maniac. Be gentle.

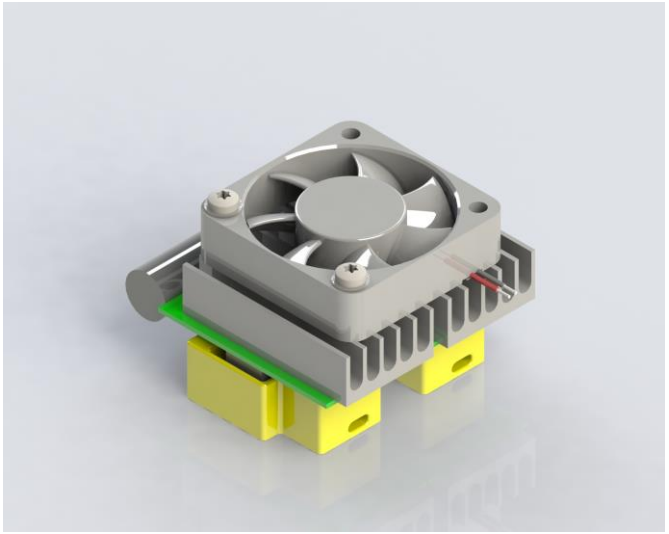
And then screw in the fan with the M3x14.

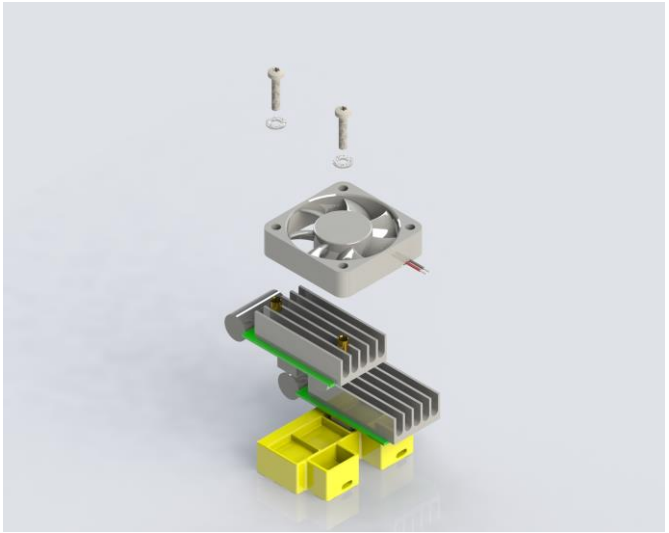
Maybe the fan is not necessary but inside of a closed cube without any air exchange, a fan won't hurt.

My connections are like this:

YPG #1: Raspberry + bottom panel + top panel

YPG #2: The 4 side panels





Power distribution module

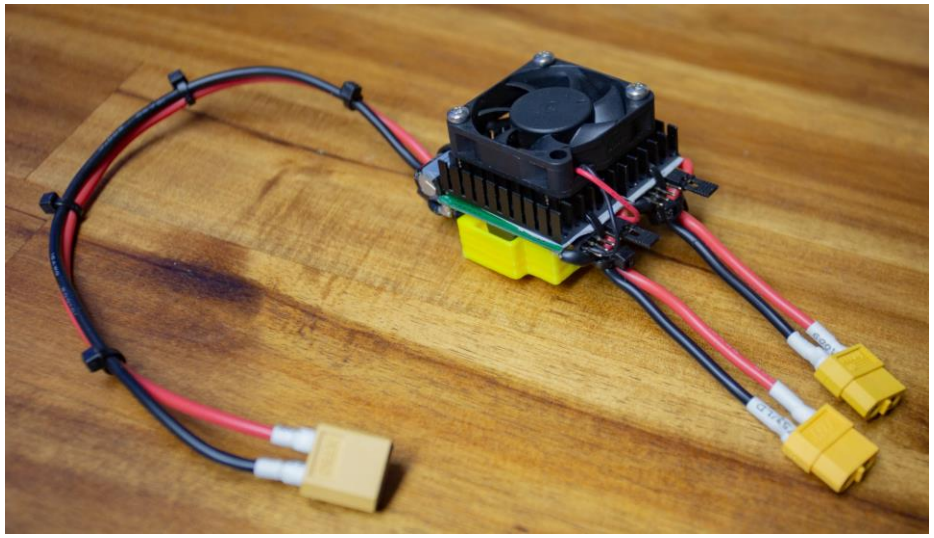
Top picture: On the left side is the battery connector. There you plug in your (lipo) battery. Minimum should be a 2S. With my 3S 2200mAh the cube is constantly running for around 1h. But it depends on the brightness and the pictures/gif you are showing. A lipo battery warner is highly recommended!

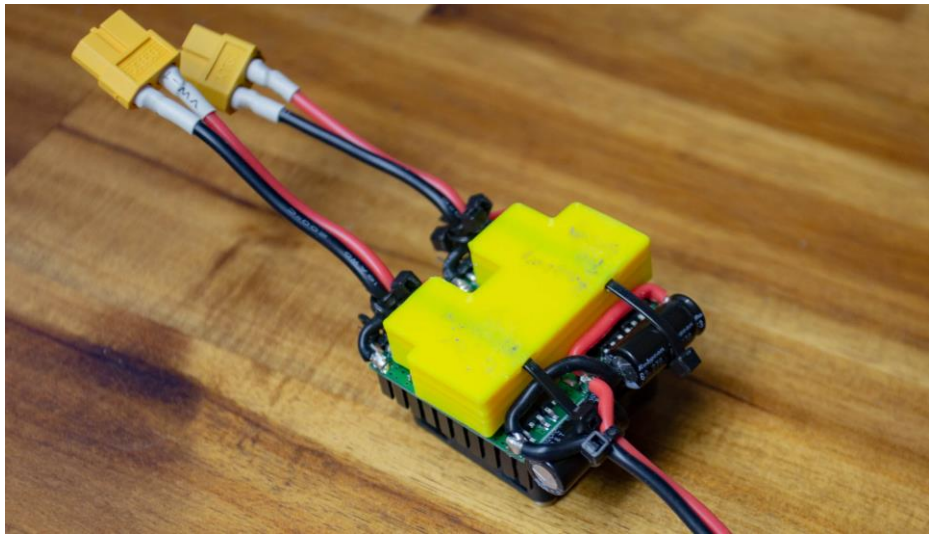
On the right side are the 5V connectors. One connector is for 4 panels, the other one is for the other 2 panels and the raspberry.

Why? Because if I wanted to use a psu, I disconnect the SBEC and plug in the 5V psu.

On the bottom picture you see the underside of the module.

I used XT60 connectors for this.



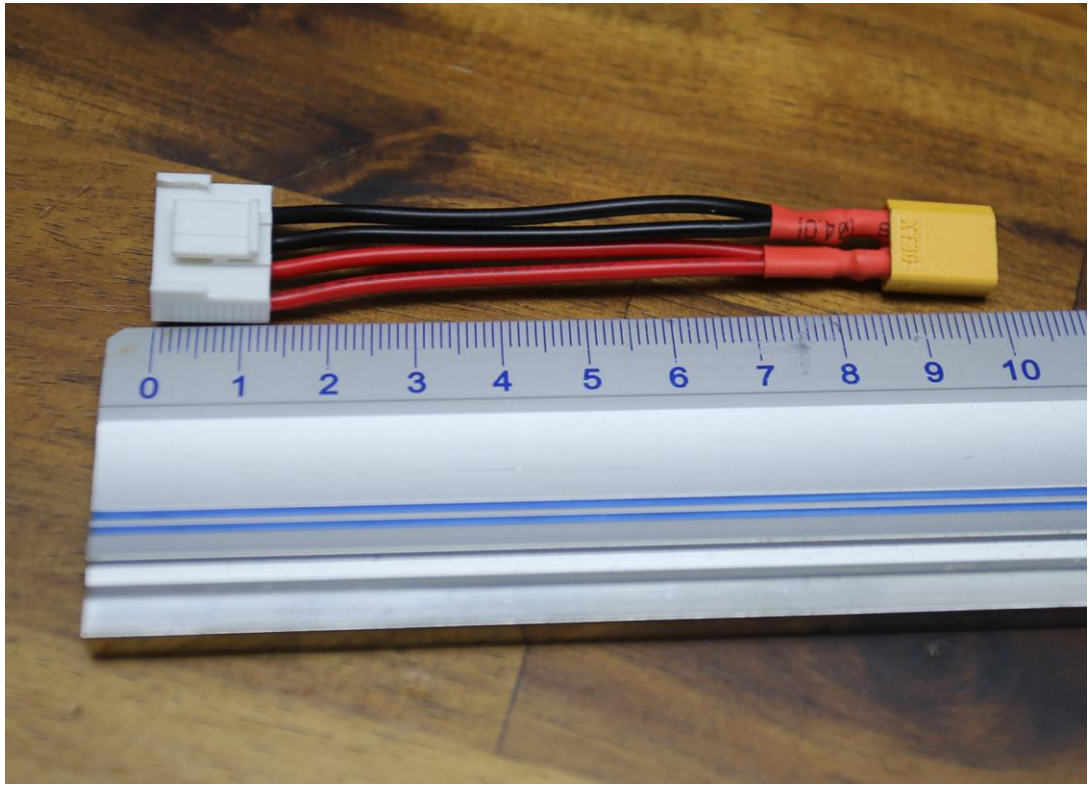


Power distribution → Cables

The power cables come with the panels, but you must add a connector to them. I shortened the cables and soldered an XT30 connector to it.

With that you could disconnect every panel from the power distribution without unplugging the battery or the SBEC. Why? Troubleshooting and stuff.

But you could figure out your own connections, power distribution, cable routing etc.



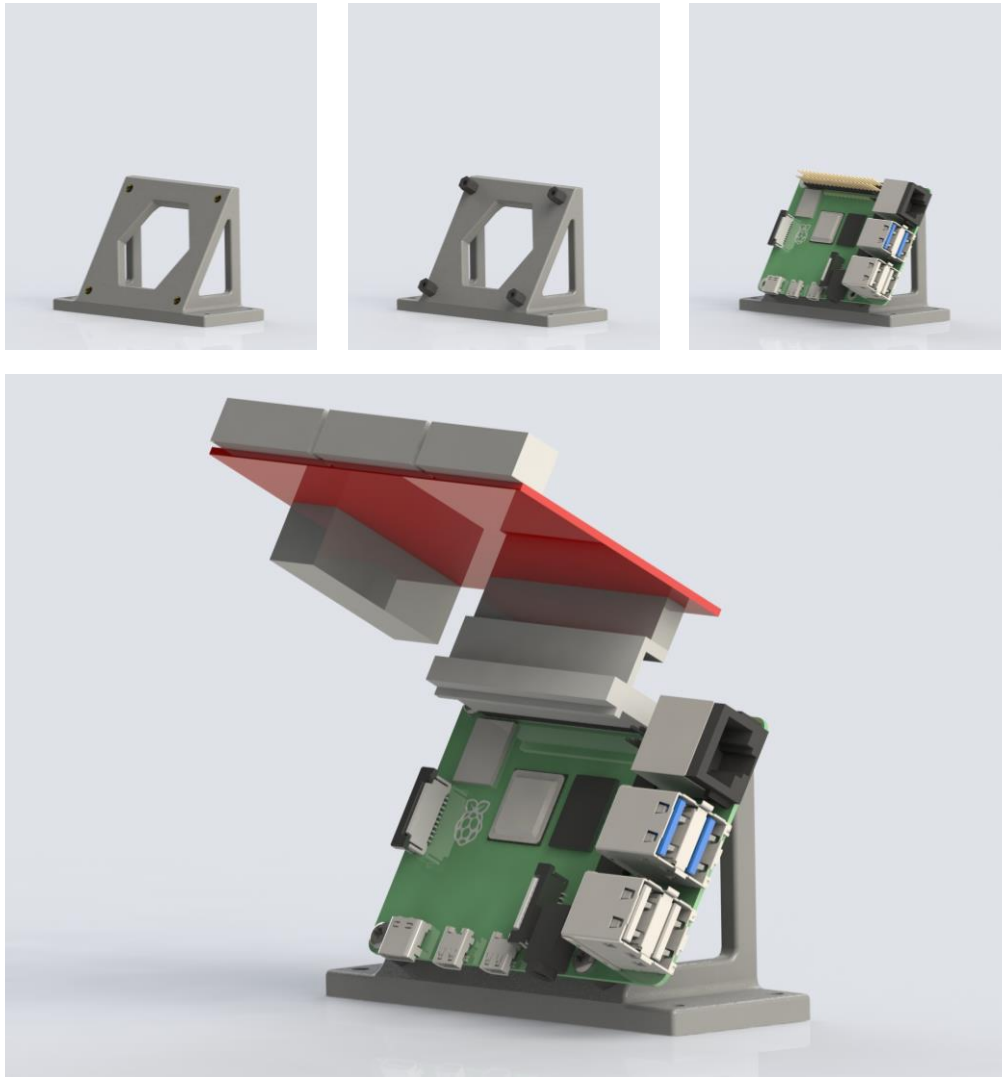
Raspberry module

At first you must fit in the brass inserts into the tilted surface with the big hexagon and screw in the nylon spacers. If the spacers don’t fit, screw in a M3 screw at first to widen the brass insert a little bit.

Now comes the part where you get a 3,5mm drill bit and run through the holes in the raspberry.

After that you could mount the raspberry with the ICE Tower cooler. I don't have a 3D model of the cooler in my design, because I was too lazy to make one.

Finally, the GPIO adapter and the electrodragon hat must be installed.



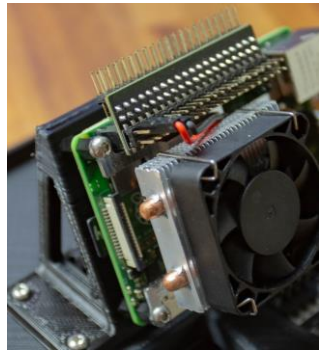
Raspberry module

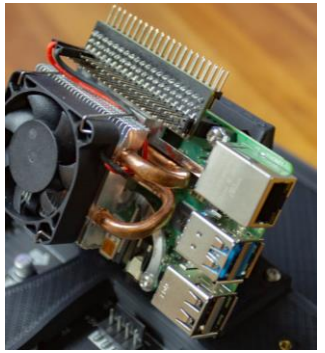
As you see in the pictures, the raspberry is sandwiched between the nylon spacers.

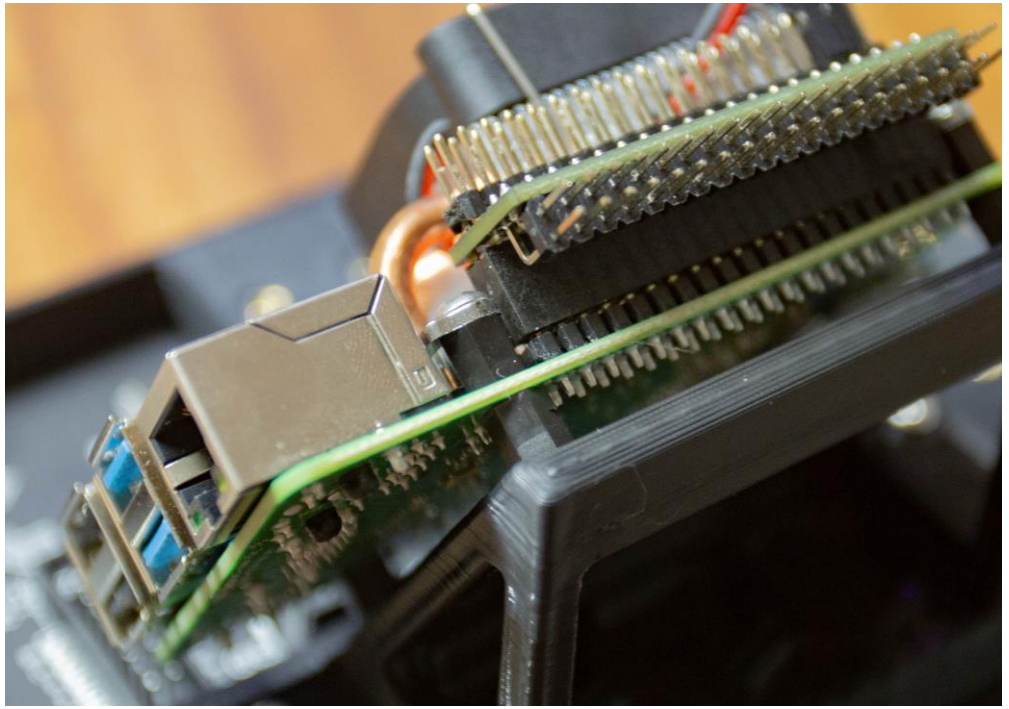
To fix them you need a 5,5mm or 6mm hex socket. Depends on your nylon spacers.

On top of that you mount the CPU cooler with the M3x6 screws.

Don’t forget to plug in your cooler.



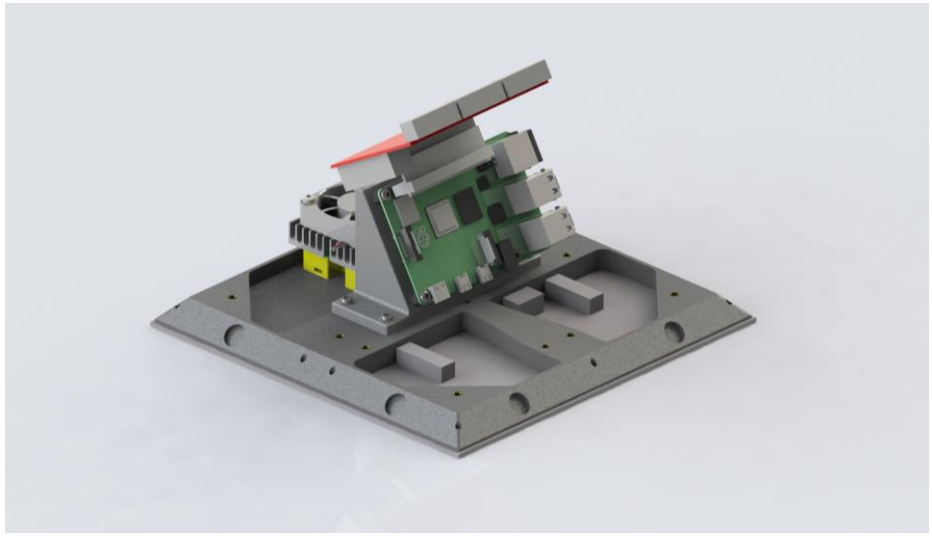


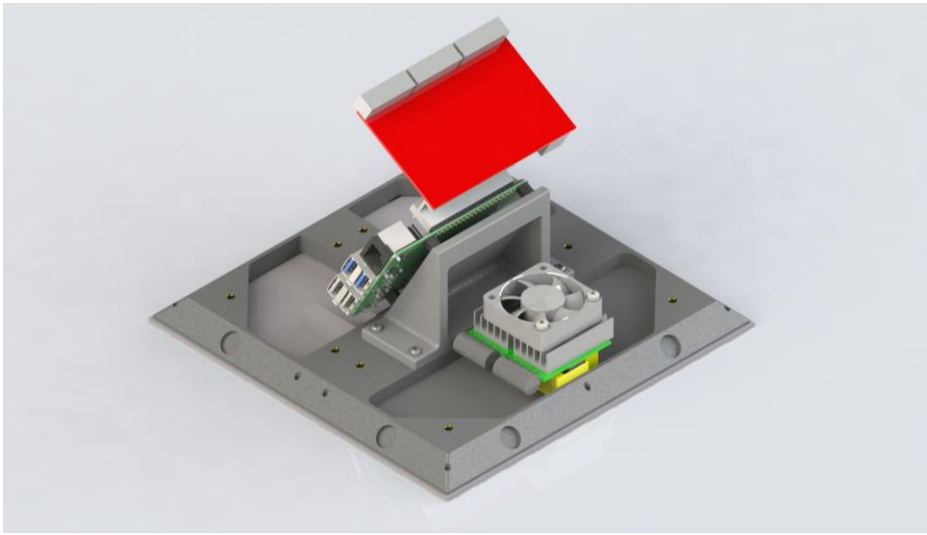


The bottom panel

With all the preparation we can now finish the bottom panel.

Screw on the raspberry module at first and then glue the power distribution module onto the bottom panel (with double sided tape).

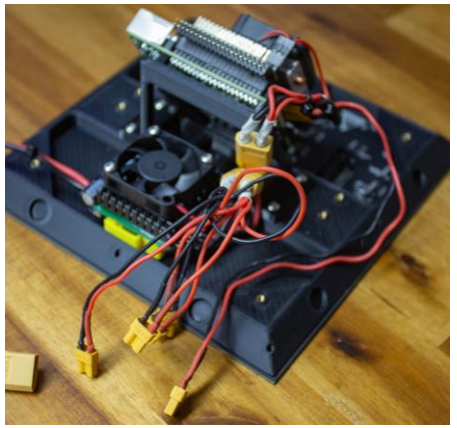


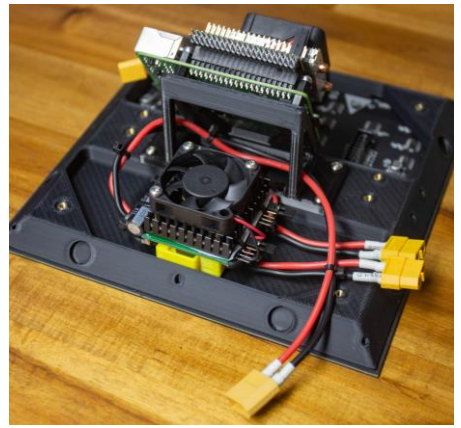


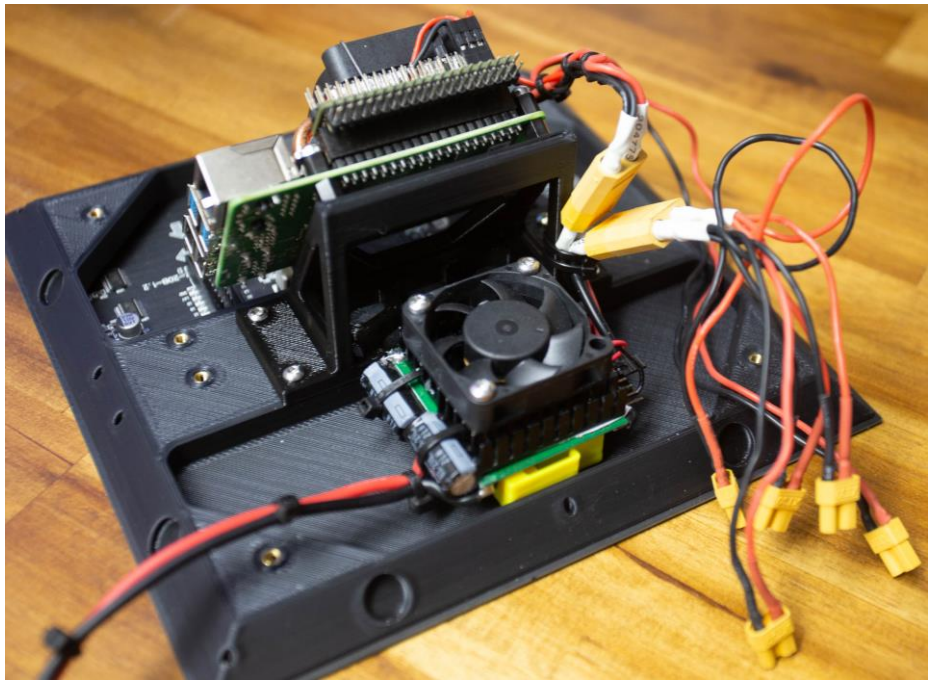
The bottom panel

It’s a little bit messy with the cables.

For the next step, put all the cables in the middle or hide them under the raspberry.







Finish the cube

It is easier to put in the screws in the middle mounts and corner mounts on the bottom, before you slip the side panels over the bottom panel.

Then throw the side panels over the bottom panel. The extra middle mounts on the side panels are on the bottom. The one side panel without the extra middle mount is here marked with 3 (on the bottom of the picture). The magnets are on top of the side panels. Be careful with the cables.

When everything fits, put in the screws with a long bit. I've used a wera Tx10 x 152mm. You could use a usual bit, but then you need tiny hands.

When the panels are all mechanically connected, you could start with the ribbon-cables.

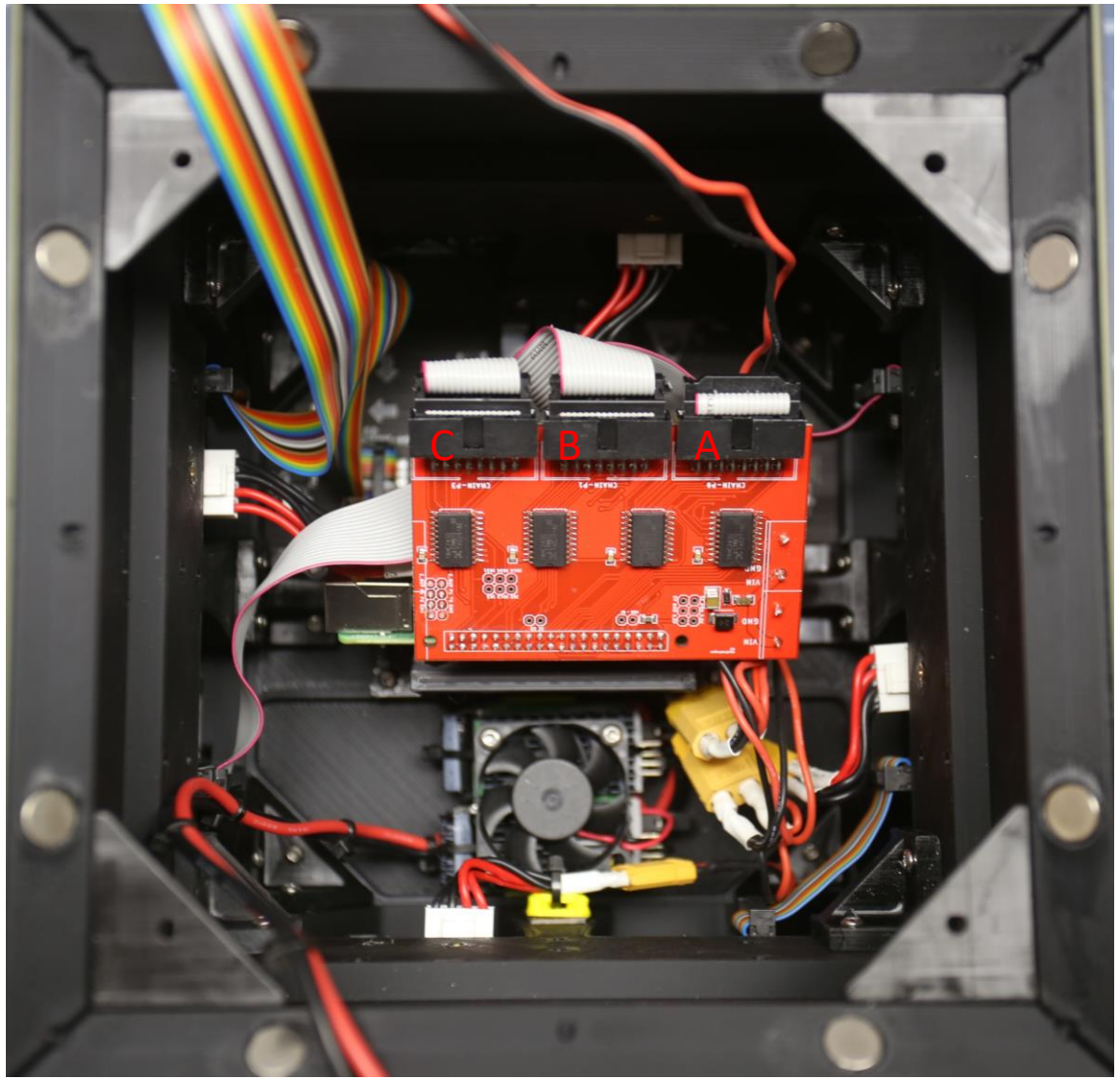
With the 3 chains available on the electrodragon hat, it's perfect to connect only two panels in a row, which is better for the framerate.

I connected:

The bottom panel and panel #1 to chain B.

Panel #2 and panel #3 to chain A.

Panel #4 with the top panel to chain C.



Software

24 pages for the build and only one single page for the software. Sorry for that.

But this is how I setup my raspberry.

I only put links in here to different tutorials which I used to setup my raspberry.

Sorry if I forgot something with the software. I‘m really not good with software.

Tutorials:
#1 Setup your raspberry (OS, SSH)
#2 Install the hzeller software
#3 Install the hzeller utilities

Here you find the description of the demo code

This is my standard „showcase“ demo code:
sudo ./led-image-viewer -f -t10 *.gif --led-rows=64 --led-cols=64 --led-slowdown-gpio=4 --led-show-refresh --led-chain=3 --led-parallel=3

It shows every .gif in the “utils”-folder for 10 seconds in a loop. Forever. Or until you press ctrl + c.
For this, you must put .gif images into the “utils” folder with FileZilla or something else.

All the code segments are described in the hzeller documentation. I’m still learning this stuff, so I really can’t help anybody with that (or coding generally).

If you connect the panels like me, your raspberry thinks you have 9 panels (a 3x3). You need a 1:1 gif or picture with a minimum resolution of 192x192 to show on your cube.
If you change the code to --led-parallel=2 then you have a 2x3 and a resolution of 128x192.
If you want to show a single picture on every panel, then you need to make a 3x3 picture (like the “test_1.jpg” in the zip-file) with the “3x3_template.psd” in the zip-file.

All of that is possible with the code itself without making extra pictures or gifs. But I have no Idea how and that’s my way to get a result.

Tools

These are the main tools I've used:

My Bosch professional drill with a Tx10 bit

A 1,5mm and 3,5mm drill bit

A Phillips PH000 for the panel screws

A bit holder with a 5,5mm hex socket

A loooong Tx10 x 152mm bit

Other tools are a soldering iron, pliers, tweezers, a wire cutter, wire stripper and a ribbon-cable press tool.

Software used, Git repos, stuff

I've used awg16 silicone wires and XT60 connectors from the battery to the YPG 20A SBEC.

After that I've used awg18 silicone wires and XT30 connectors.

My raspberry is powered over the GPIO port, not the USB.

And I used a lot of zip-ties (100x2,5mm and 150x2,5mm) and double-sided tape (3M VHB, grey, 12mm x 1,1mm)

Thank you for looking through this tutorial. If you have something to mention about it, go f.. ask me on reddit.

Software

- Pi Imager (to make the SD-Card)
- Angry IP Scanner (to find your raspberry in your network)
- FileZilla (to throw pictures and gif on your raspberry)

Git repositories

- hzeller/rpi-rgb-led-matrix
- mikecann/disco-cube-admin
- squarewavedot