The Acorna Stratos model B (powered by Acorn Risc Machine)

FEATURES

- Raspberry PI 4, with GPIO ports available under a magnetic metal cover (on the left)
- Mechanical keyboard
- 9 inches LCD (cheapo, poor quality) on a hinge so can stay flat
- DIY USB C drive bay for cheap kingdian SSD (very convenient !)
- 24000 mAh battery with specific USB C port for recharge
- 4+2 available USB (5 usb 2.0, 1 usb 3.0) anyway, I'm limited to 3 Amps for the whole project, so I can not populate them all. 2 ports are on the top, and it's convenient.
- 1 ethernet, on the top, quite practical.
- 1 HDMI out
- Full steel case… well, not great for wifi signal

Some power buttons and power lights behind the screen

Connectors at the back, screen folded

Drive bay and SD Card on the side

WHY I MADE THIS
I wanted something unique to do some devs for my other raspberry vintage radiobot project (work in progress). Inspiration came naturally from the 80's as it was my starting point in computing. In the 80's, I used as a kid :

- a sharp PC1500 (link:https://en.wikipedia.org/wiki/Sharp_PC-1500),
- a ZX81 (link:https://en.wikipedia.org/wiki/ZX81),
- a BBC MICRO (link:https://en.wikipedia.org/wiki/BBC_Micro) ,
- and lastly an ATARI ST (link: https://en.wikipedia.org/wiki/Atari_ST) before going mainstream … on a 486 PC I bought with my own money in 1992.

That's why I do have a taste for english computers of this era and there were a plenty : https://en.wikipedia.org/wiki/List_of_British_computers

All those computers were all-in-one (screen excepted) and had a wedge shape including the keyboard. I wanted a thinner one but still all-in-one, wedge shaped, so, nothing like a laptop.

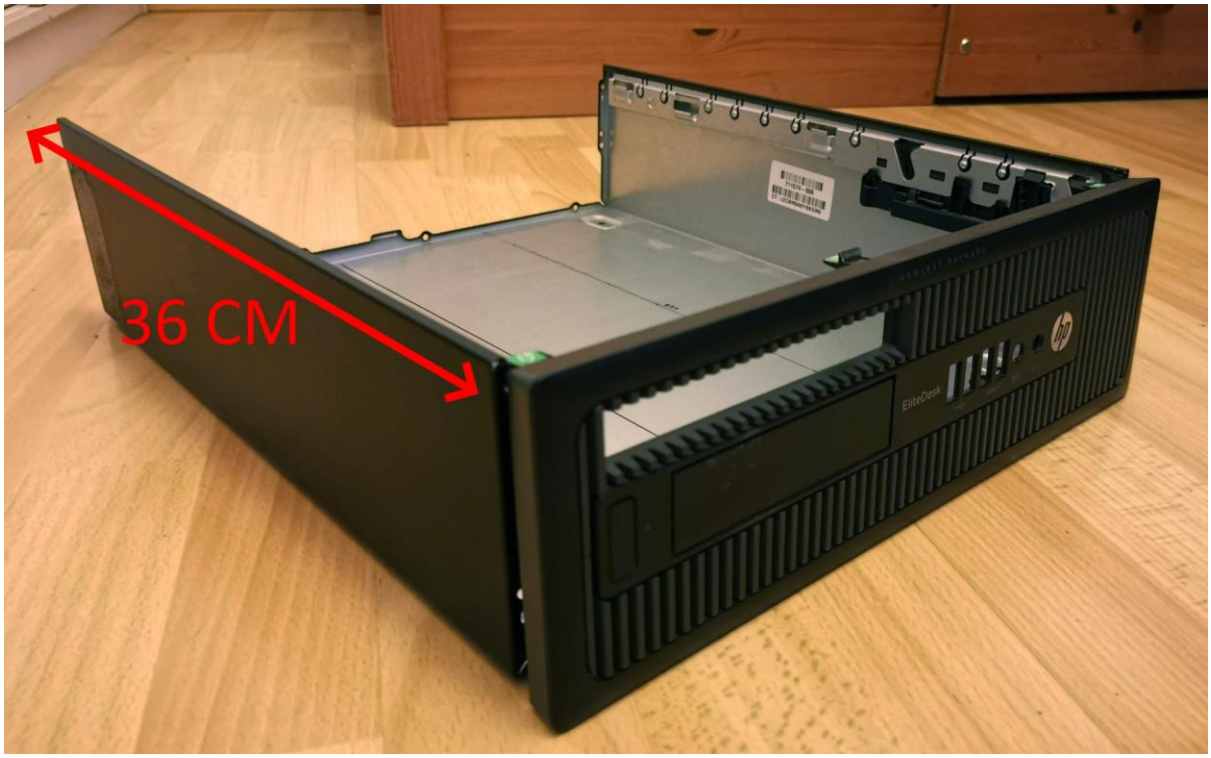
I started with some fusion 360 learning, that's tough… but a good starting point to think about dimensions and components : I wanted a full fledged mechanical keyboard, so that's around 36 cm wide for a ten key less.

Some of my first ideas on fusion 360

At first, I had the idea of a sliding screen, but it was a bit too tight.

NO 3D PRINTER? GREAT, EVEN CHEAPER!

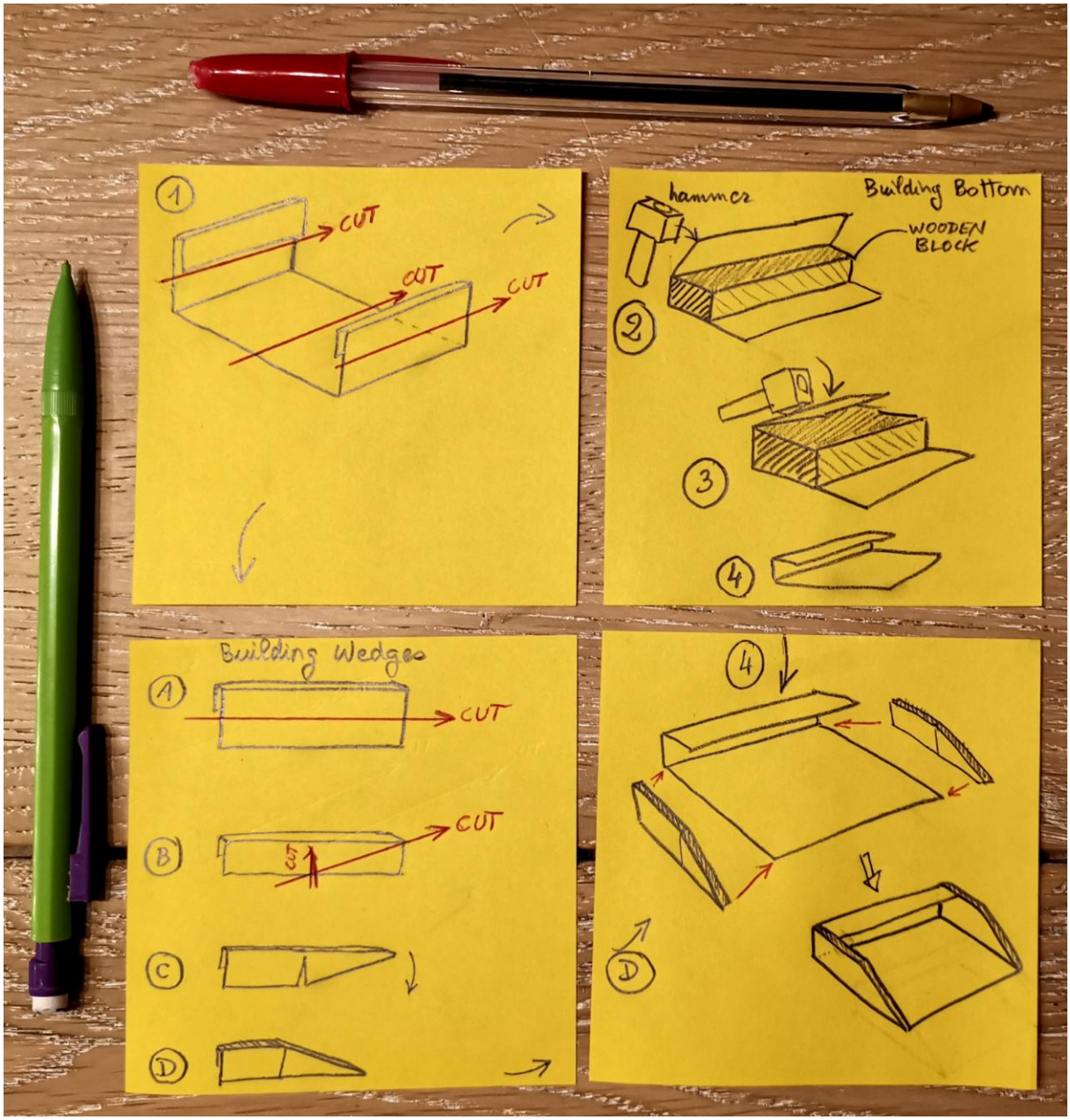
Then I found an empty HP Desktop PC case and when I discovered it was 36 cm deep : just like a TKL keyboard. I thought it could be fun to make an all metal computer. Of course, I had to strip it down and cut wedge shape pieces for the side.


36 CM
EliteDesk

Metal-case : HOW TO

Here is the method I used to build the case. See that the left and right edges were thick as metal was folded in the HP factory process. I wanted to keep those nice thick edges on my final product.

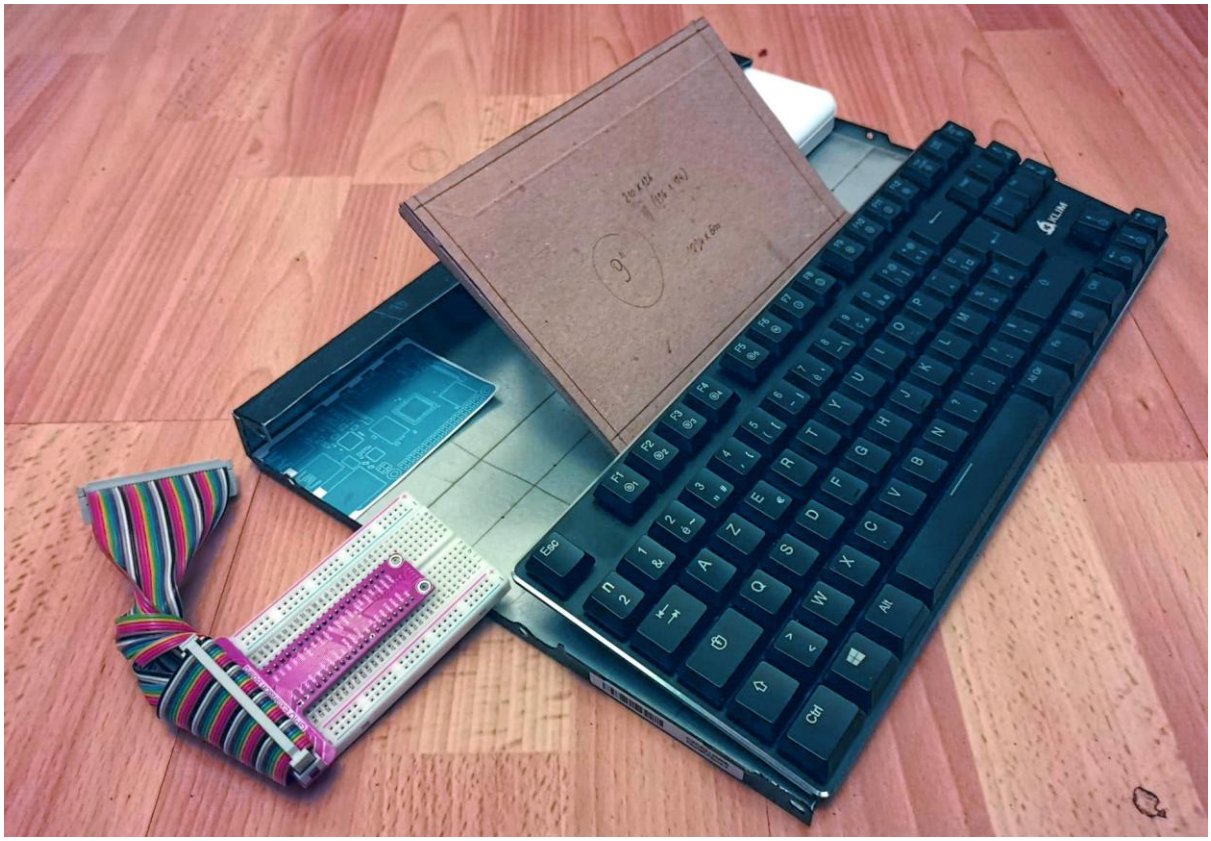
Some drawing to explain how I built it



So here I went with hammer :

Using a piece of wood to avoid damaging the steel surface :

Then I checked the dimensions with some CAD (Cardboard Aided Design… yes, a very good way of prototyping)



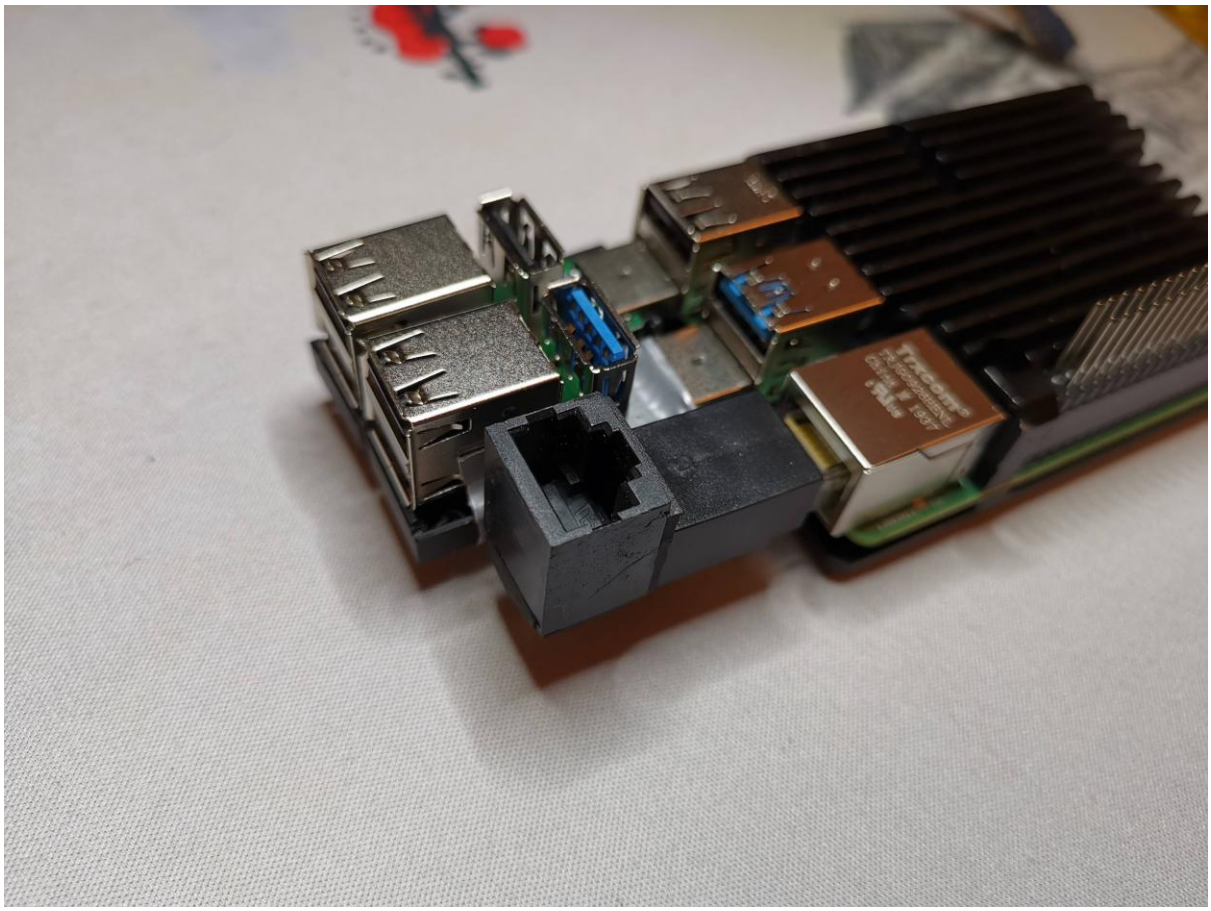
HIDING ALL CABLES INSIDE
I finally changed my mind about the raspberry placement : I wanted to have all the cables inside. That was quite some hard work to make all fit !

So I needed some way to get more USB ports for outside and two inside : one for the keyboard and another one for the USB SSD drive.

I found a solution with 2 mini usb hubs and removed the plastic cover for minimal footprint.

cheapo mini hub before removing the plastic case

Raspberry with 2 hubs and an ethernet 90 degrees : far more compact than cables.



This setup leaves the two USB I needed inside and add 4 new ones for the back and even 2 more on the top of the computer. I added an 90 degrees angled Ethernet.

STORAGE

For the storage, I wanted to avoid the unreliable and slow sd card and use the same usb C ssd you can find for around 30 € at kingdian (120 GB model). I designed a bay to be able to swap it easily. Just some metal pieces with epoxy and it's done.

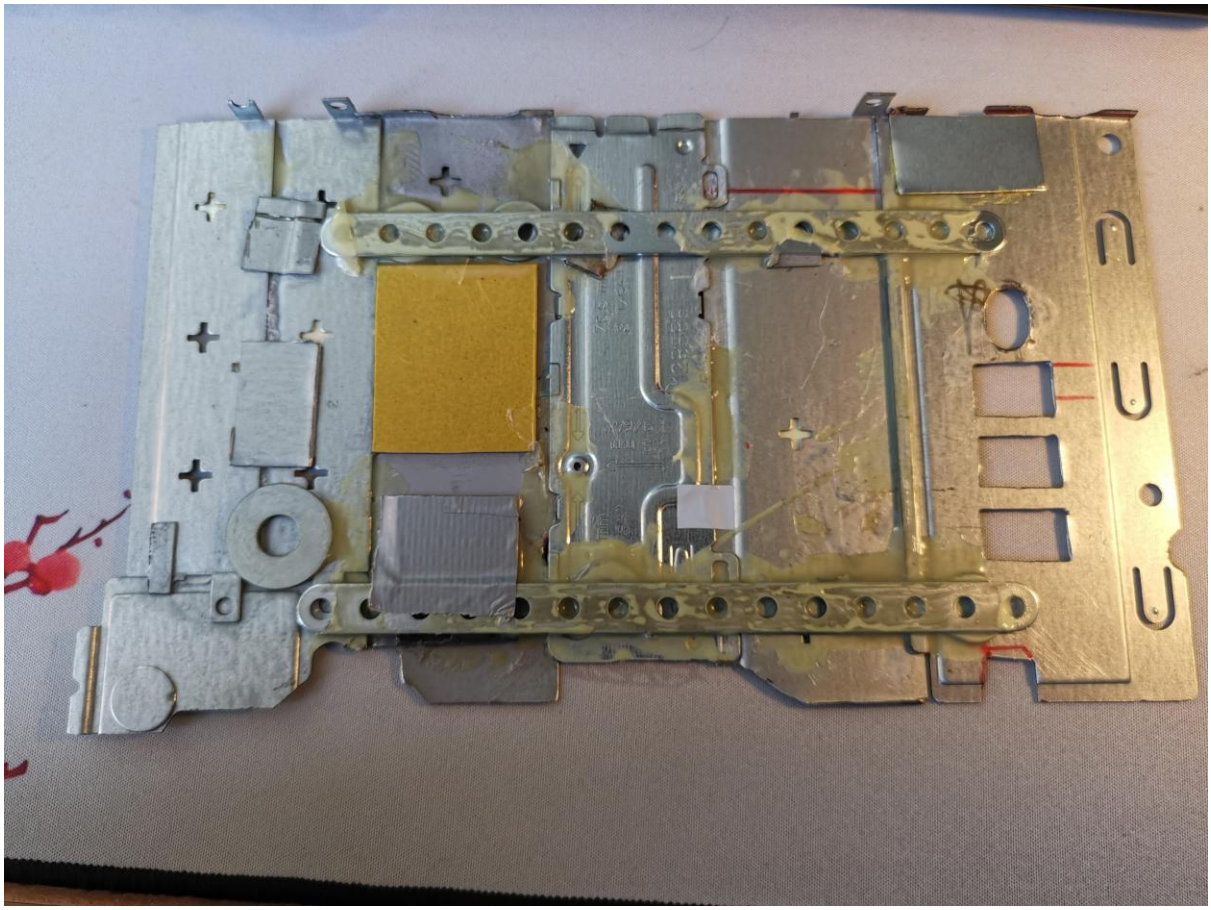
Cable routing from raspberry (on top of picture) to the DIY bay (on the bottom)

Drive bay

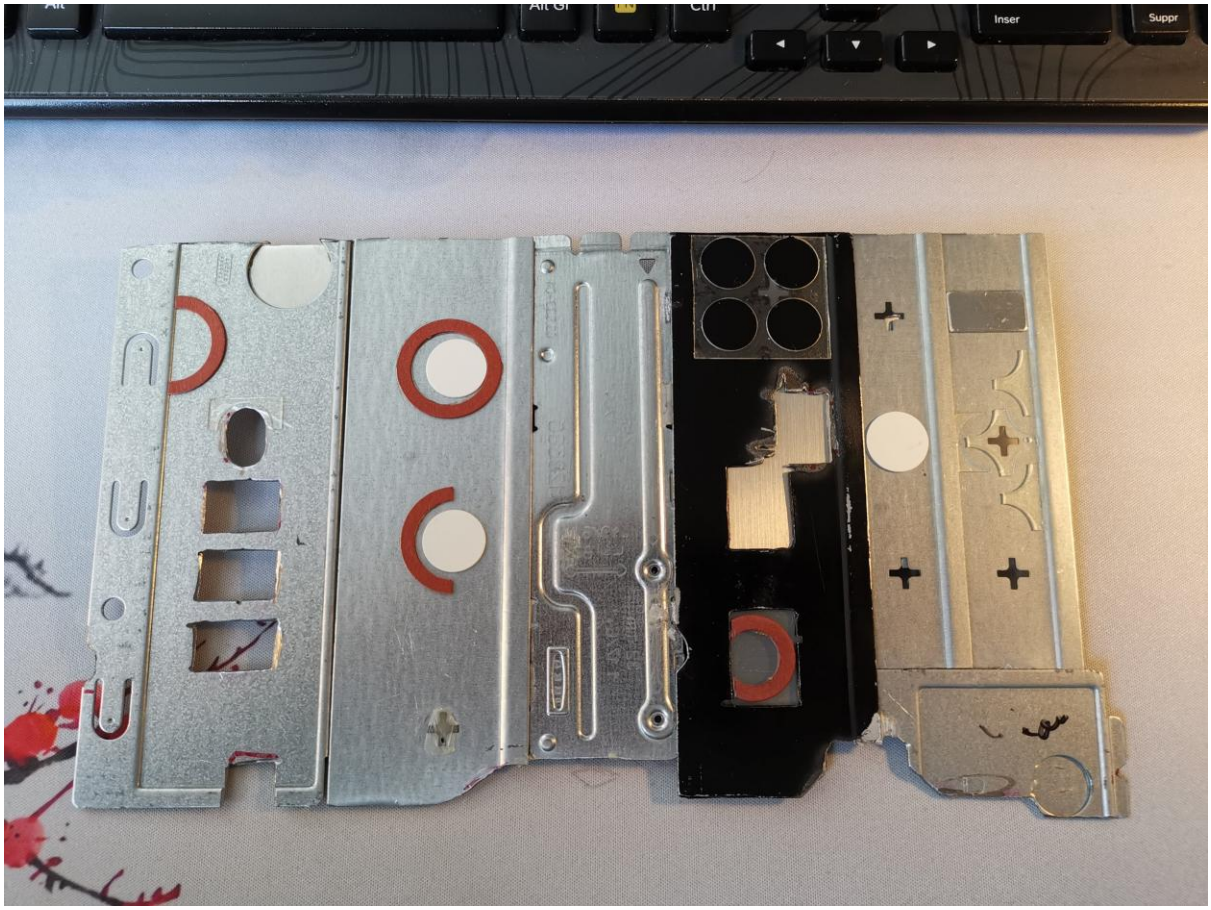
I also put a micro sd card extender, but the long flat cable doesn't help with the poor reliability of those supports.

TOP COVER
For the top cover, I gathered old parts, some from 90's pc, some from ikea, or unknown origins :

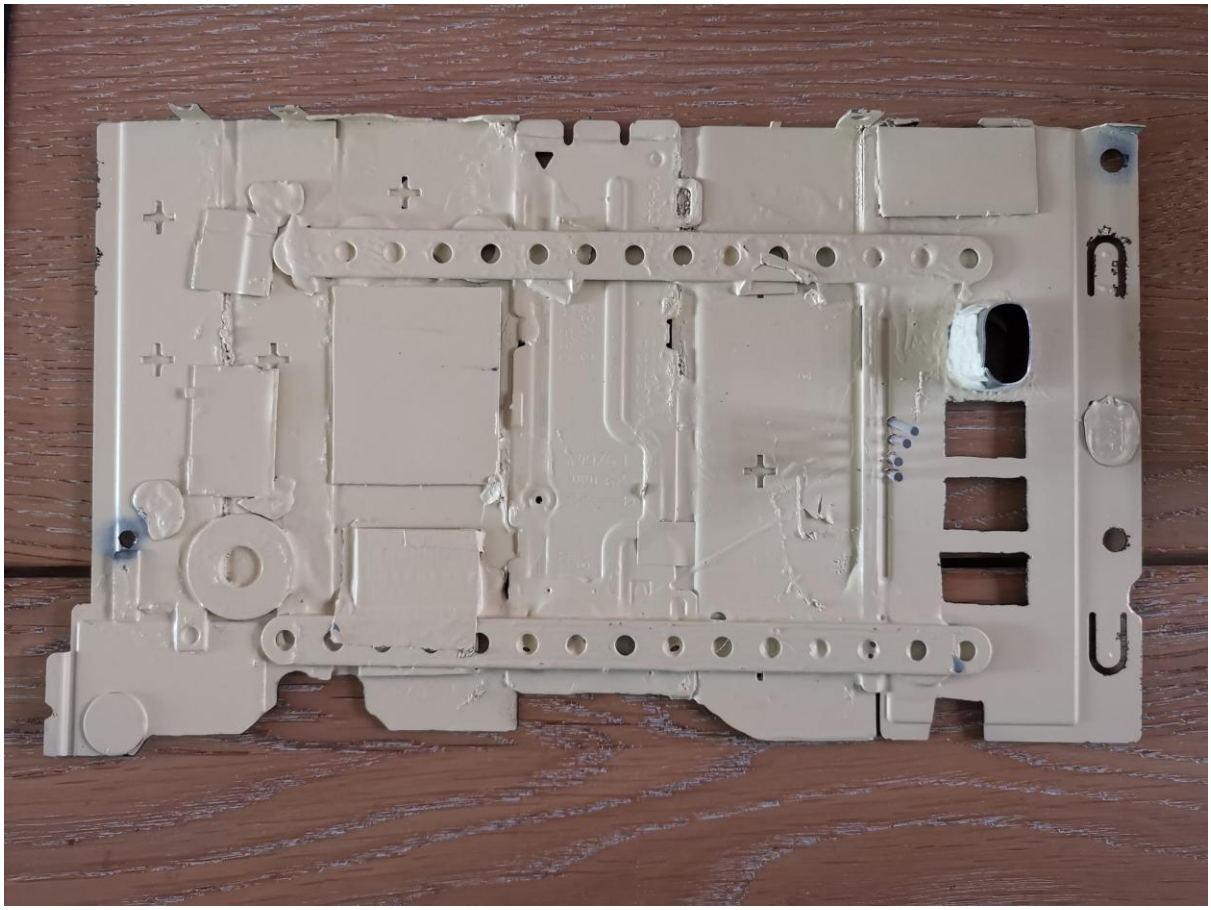
Added some pieces to glue them tight with epoxy before some painting :



I added some stickers as I didn't want too much flat surface. It needed to look techie



Beige paint on the back



Black paint on the top

STEEL CASE PROS AND CONS

PROS:

- More original than most 3D prints projects and anyway I did not own a 3D printer :)
- Drilling, bending, epoxy : there is a lot of way of crafting with those with a proper dremel-like tool
- You can easily use magnets to have removable parts
- Sturdy even with thin parts

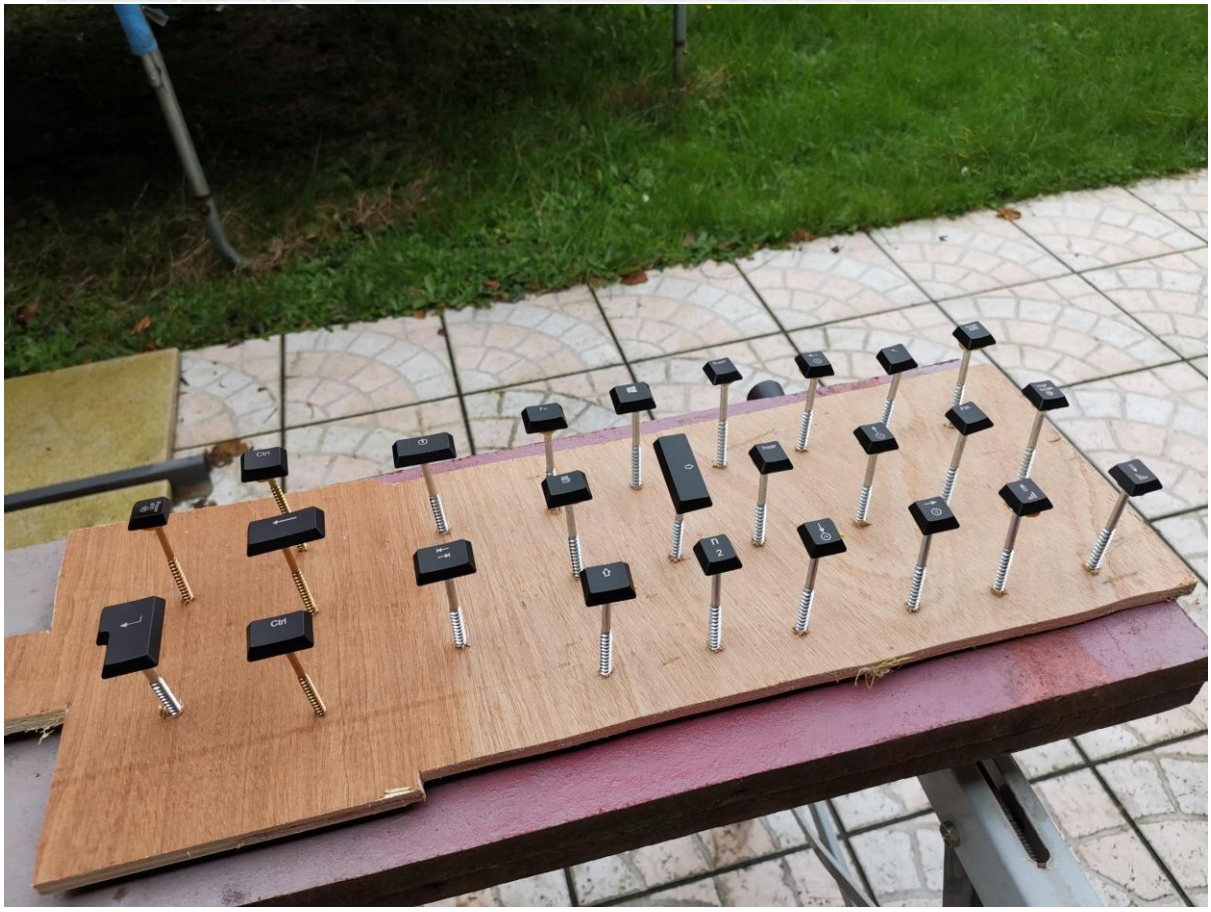
CONS:

- Heavy
- You must add some plastic sheets to isolate most boards
- Working with metal is noisy, can be a bit dangerous, and you get metal dust everywhere : bad for electronics (advice : use powerful magnets to catch it)
- Bad for wifi signal
- You can not just reprint a part when you failed somewhere

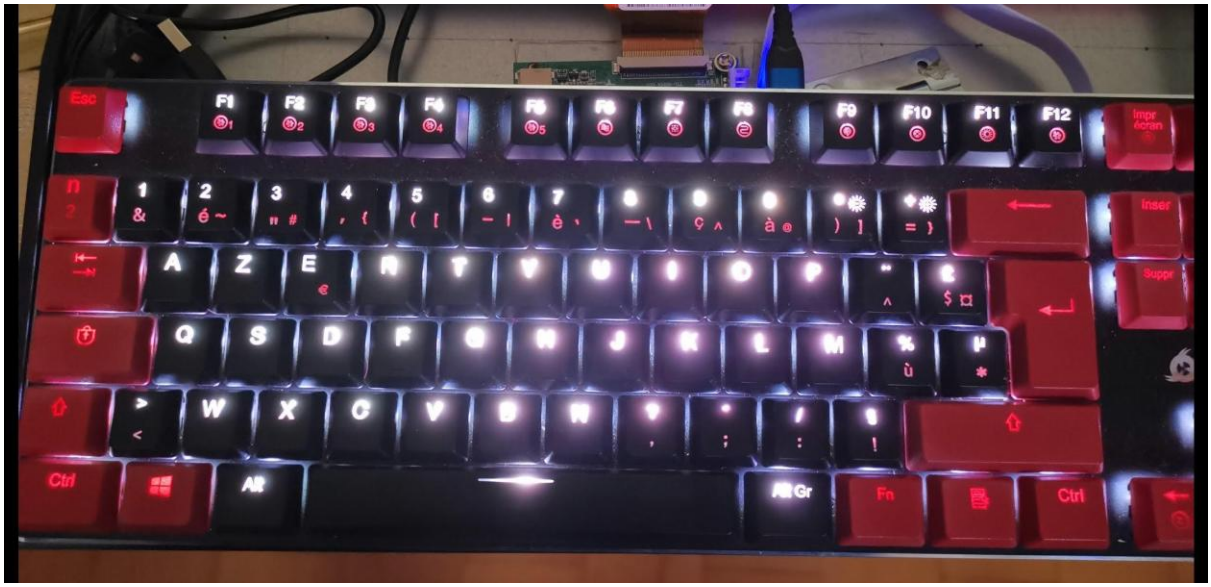
KEYBOARD

This is just a wire mechanical keyboard, but a slim one. The switches are red Kailh “choc”, that I like a lot. Only drawback is there are not many alternative keycaps if you want to change them, and that’s why I did a paint job for the control keys.

KLIM DASH TKL slim keyboard (red kailh choc) < 70 $



You can see the light find its way through the red paint without much problem.



POWER

I started with a big DIY powerbank for 8x18650 you can find for cheap (5 € without batteries), and added 8x18650 samsung for around 3 € each, that’s less than 30 € for a powerful powerbank. Battery life was really good (over 6h and much more depending on usage)

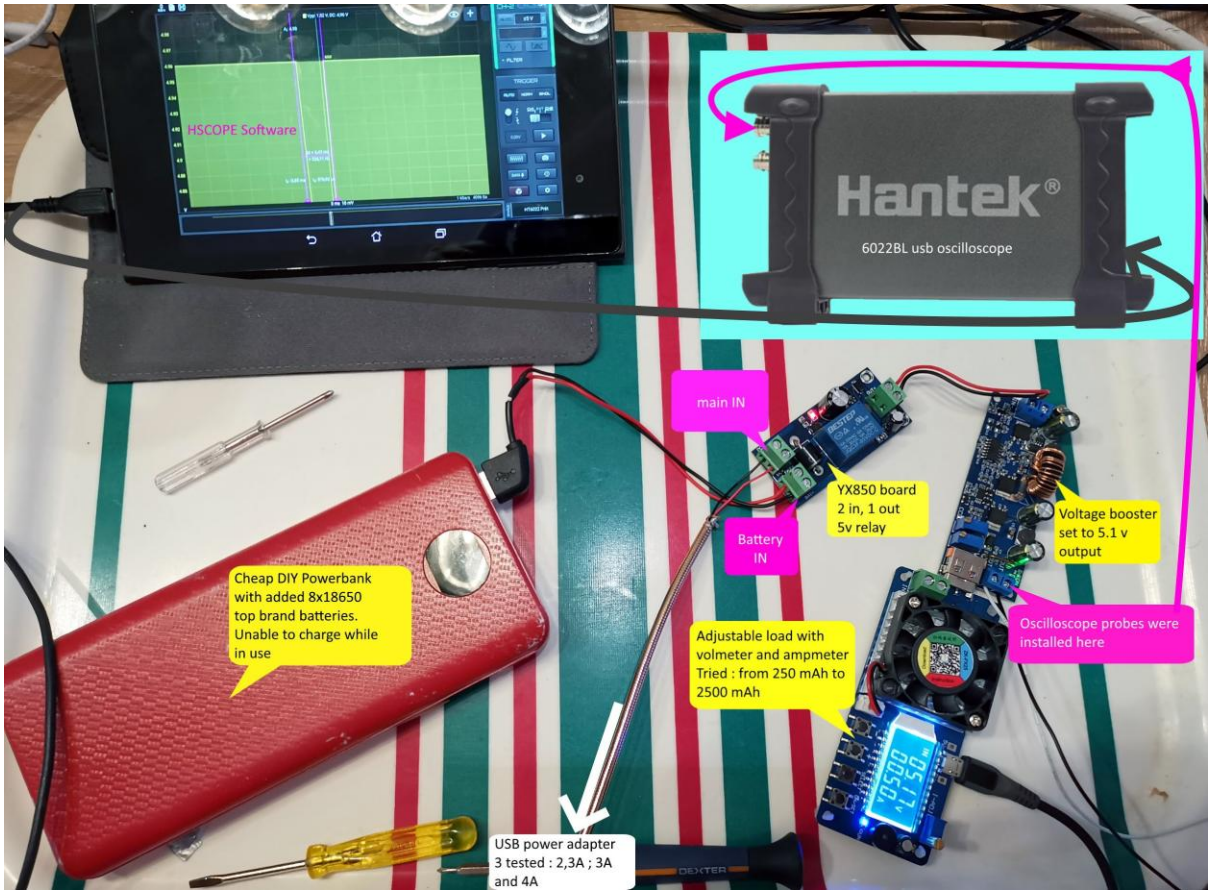
Cheapo DIY battery pack (5 €) on a famous marketplace

But there is no way to charge and use it at the same time, like most powerbanks. The reason is a raspberry pi 4 eats up to 3 Amps and the little boards inside most powerbanks can not handle some charge (let say 2 Amps) additionally. Some can, but most turn off and on when connecting to the main, so that would reset the computer.

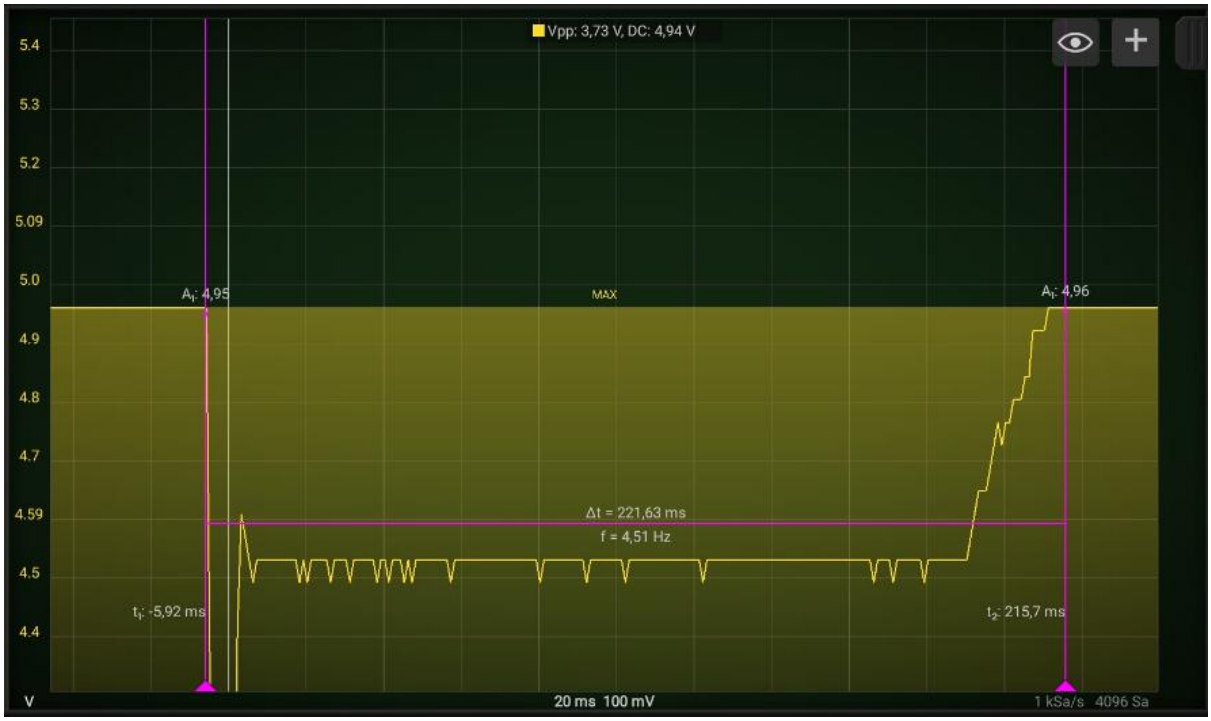
Trying to transform a powerbank into an UPS : no luck there

I tried using a little relay board (2 power inputs, 1 output) and a power regulator board. Those are very cheap (less than 5 €). But I had no luck : I had several 100 ms when connecting to the main, when the power consumption is anywhere above 600 mA (and raspberry needs 3000 mA)

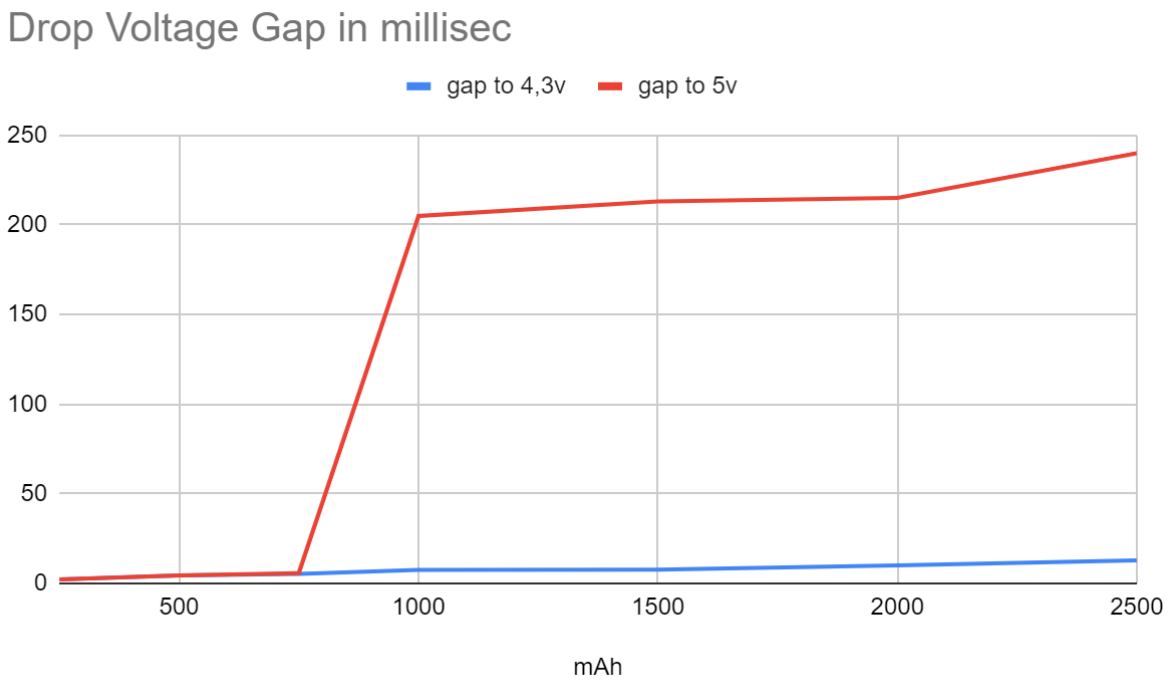
Debbuging power with an adjustable load and a cheapo oscilloscope



Graph on Android Tablet with Hscope software (great stuff)



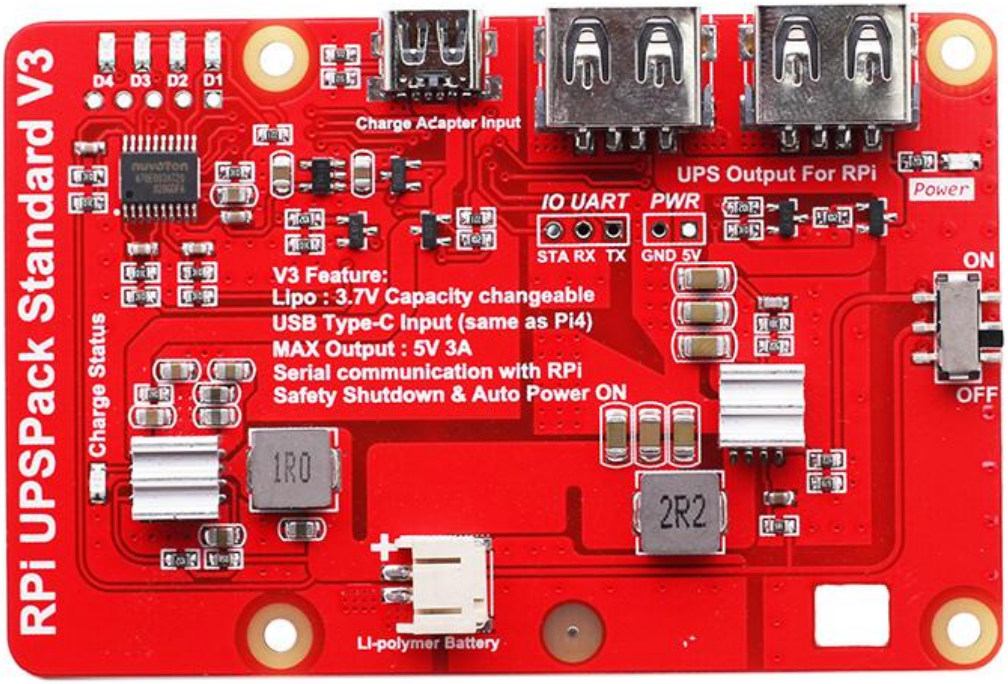
Some analytics



As you can see on my measures, if you need anything above 750 mA, this board takes too long to switch from one power (battery) to another (main supply). There is not enough capacitance and it would take a lot of capacitors to fill the gap (>3 Amps, 5.1 Volts, 200 millisec). There are a lot of ways of designing power switching, some are overheating, some are dangerous, some needs voltage difference between the 2 sources… I stopped digging :) and wanted to find a simpler, more integrated solution in my cramped little computer.

RPI UPS V3 : A “Not too pricey” solution, but limited to 3 Amps

RPI UPS V3 board



Source info on github about this [RPI UPS V3] : do consider it's designed for 3 Amps : that can be low for some projects.

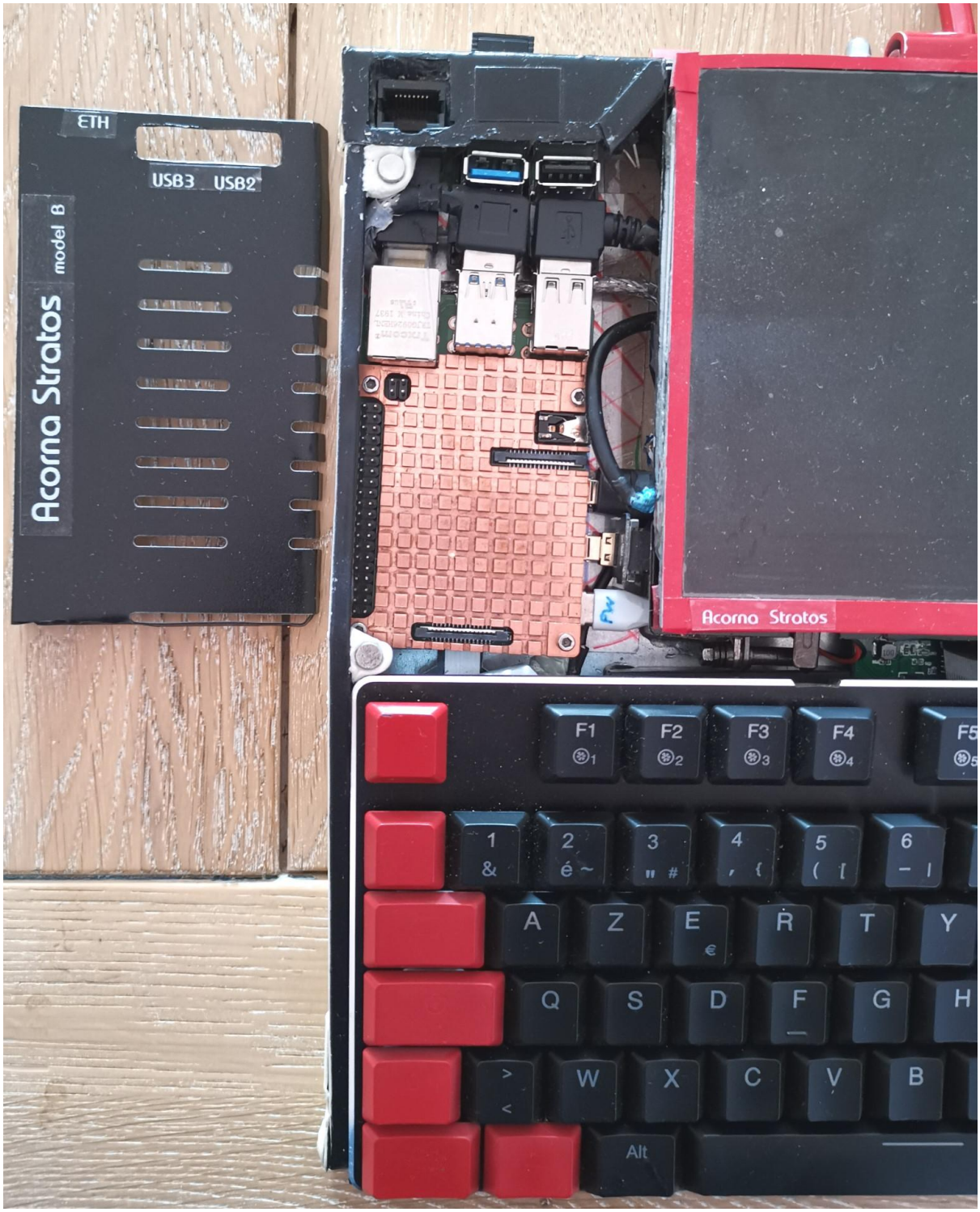
I used a more expensive solution in an older project ([Geekworm X750] that can go up to 8 Amps !) but the cost for 8 x batteries slots would be too high (over 50€), this new board is below 20 € and I just had to buy some batteries holders (around 1 € each) :

Battery holder

Of course, you should be aware that building that kind of stuff is risky. Polarities must be respected as well as perfect isolation and proper wire thickness. All batteries (in parallel) must have the same voltage and same wear. If you miss something, it would not just catch fire but could explode ! You must check everything before each test with probes and some knowledge. Maybe this part is not for you, and you can try something else like a mini ups you can buy off the shelf.
For now, the board is running fine, but I still need to test it in all scenarios.

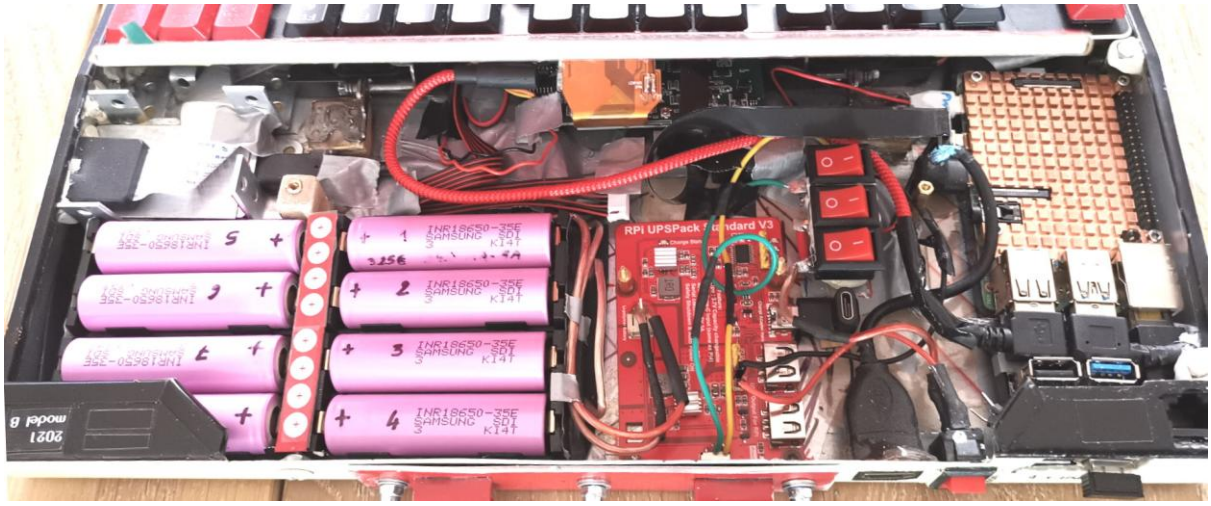
SOME PIC OF THE MESS INSIDE
Routing all cables, even after cutting and soldering them to the right size, is a mess. I used some heavy duty tape for that. I'm not very proud of the result but it works.
For better results, I would need to design my own PCB, but I don't have the time to learn and do all that, for now.

Access to the Raspberry and GPIO from magnetic metal cover



All covers unscrewed

Yes, it’s a mess.



CONCLUSION

I hope this article could help or inspire you. I still think I could have done a better work building my own PCB and 3D print mixed with some aluminium, but it was a fun journey and those switches are very nice to use.
The only regret comes from the cheapo screen. Bad vision angles, bad contrast… I didn't need a great resolution (1280x800 is okay for linux consoles) but those IPAD LCD are so much better and not that expensive in China, even with an HDMI controller board.

I hope my english is correct enough as I'm french and learned english at school but they maybe some obscure sentences, feel free to contact me on reddit : u/plepoutre

You can find some more pictures and parts in this google gallery

I wrote this article for the cyberdeck cafe in april 2021, which is a nice resource : https://cyberdeck.cafe/

EPILOGUE : 11/07/2021
RPI UPS BOARD FAILED : not powerful enough, going to swap it with a Geekworm X708