Wind Up Laptop Charger

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Introduction

The word “flatpack” usually makes people think of flat sheets of material assembling together to build a 3D form, particularly a piece of furniture. In this flatpack design studio class, we were challenged to find examples of flatpacked items. Many items we collected were objects that had multiple physical states for different use cases, and not necessarily something that was optimized for shipping: wall dividers, traffic cones, zoobles toys, menstrual cups, shoes, among many others. We occasionally questioned if some designs were truly flatpack, and what the purpose of the transformation was. Doing this exercise led me to my own conclusion, that flatpack comes in many forms for the purpose of optimizing how an object takes up space. With this way of thinking, I opened myself up to both what I could design to be flatpack, and how the transformation could work.

My interest in electronics and daily struggle with my laptop’s awful battery led me to the idea to design a laptop charger. It’s an overlooked design opportunity, and it seems most people have learned to deal with a tangle of wires--even though there can be a simple solution that makes charging your laptop a seamless experience. I took on this opportunity to explore different ways of integrating the charger with how it’s used alongside the laptop, ultimately to be less of a pain in the ass.

Research

Anatomy of a Laptop Charger

Laptops and other electronics use DC (direct current) power, which means they have to convert the AC (alternating current) from the outlet. That's what the brick is for; it converts AC to DC. It has transformers, capacitors, and diodes-- the transformer converts energy, capacitors smooth out voltage fluctuations and ensure a steady flow of power, and diodes makes sure the current flows only in one direction. Additionally, there are heat sinks or thermal regulation as some power is lost through heat.

High performance laptops are best run plugged into a high wattage charger, around 180-240W. Outlets and plug prongs aren't designed to hold much weight, and these hefty chargers require a large AC adapter--which is why many chargers are designed with it in the middle of two wires.

The cord that goes from the outlet to the AC convertor--the AC wire--carries a dangerous current, and needs thicker insulation and a more robust wire gauge. The cord that goes from the AC convertor to the laptop--the DC wire--carries safer, low voltage DC power and doesn't need to be as thick.

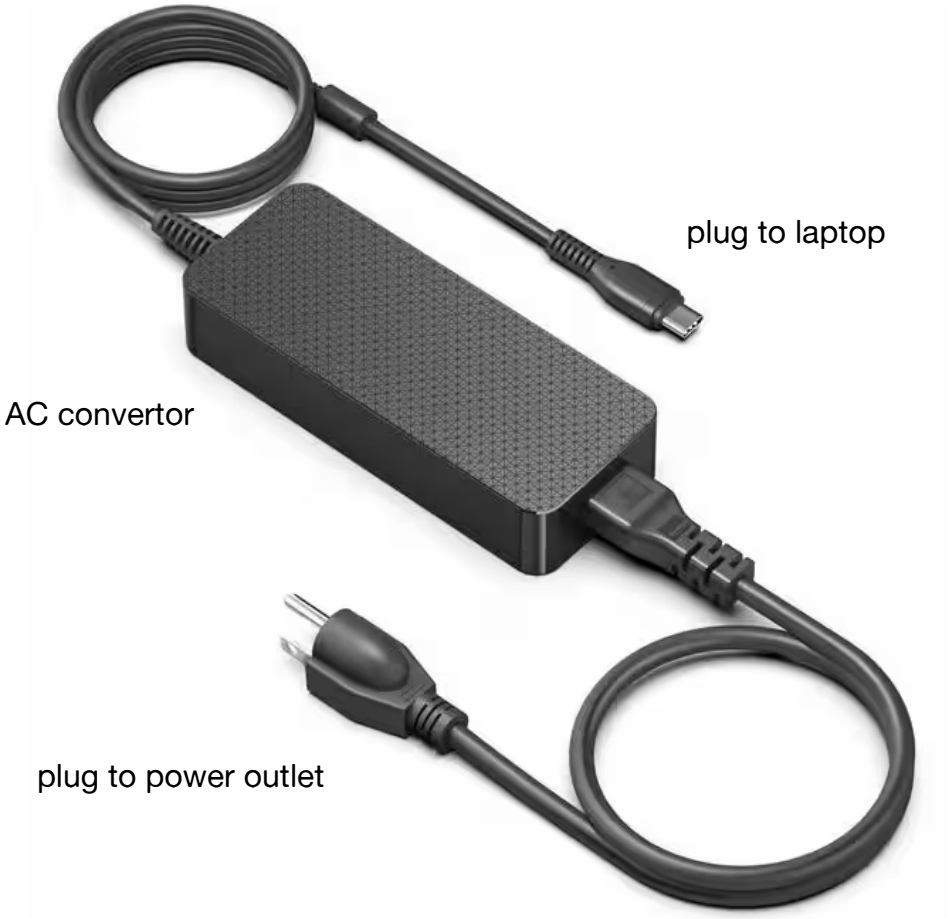


Figure 1

Precedents

The most common type of laptop charger is for non-Apple laptops, which has the AC convertor in the middle of two wires as seen in Figure 1. This picture-perfect render is decieving, as the wires will never be as neat as they were the moment before you first unraveled them. A quick Ebay search for a used laptop charger will show you how messy the cords look, even when trying to make it look neat for a staged photo. See Figures 2-4 for examples.

These chargers usually have strips of hook and loop fasteners (Velcro) to hold the cords in place once you've wrapped them up.

Figure 2

Figure 3

Figure 4

Figure 5

Apple Mac chargers are designed with the AC convertor right at the outlet, so there's only one cord that goes straight to the laptop (Figure 5). That's because their laptops only need 70-140 watts. Apple's Silicon Mx chips are fundamentally different, since they evolved out of mobile processors that were designed for maximum performance out of minimum power.

In contrast, Intel/AMD chips were initially designed to handle as many different tasks as possible, with power efficiency as an afterthought. That's where the difference in power usage comes from, and therefore the different charger structure.

Figure 6 shows an older version of Apple's Mac charger, with tabs on the corners that flip out for you to wrap the cord around. The end of the cord that plugs into the laptop has a little clip that attaches to the coiled cord to keep it from unraveling.

Figure 6

The User

My goal is to redesign the high wattage charger that has two wires with the AC adapter in the middle. This means I'm looking at users who do high performance activities, such as gaming or creative work. These two things are also important:

1. Laptops are mobile, and therefore so is the charger.

2. Using a charger is generally a hassle, and an extra step to just do what you want to do. Sometimes, it's the first object you grab (and have to untangle) when your workflow was frustratingly interrupted because your laptop died. Wouldn't the ideal situation be a laptop that you never have to plug in?

I'm designing an experience that should feel invisible, and not like untangling a nest of wires. It should be portable with the laptop, simple and quick to use, and keep the wires tangle-free--from itself and from other wires you keep in the same place.

Could I make it an enjoyable, even satisfying, experience?

Design Process

Ideation

When I began the design process, my first instinct was to add additional functionality to the charger. Since the charger comes along with the laptop regardless, it could have hidden features that doesn't disrupt the main purpose of charging the laptop, and could mean bringing around one less thing.

I thought of what people who are using these high performance laptops, and what else they usually have when they're working.

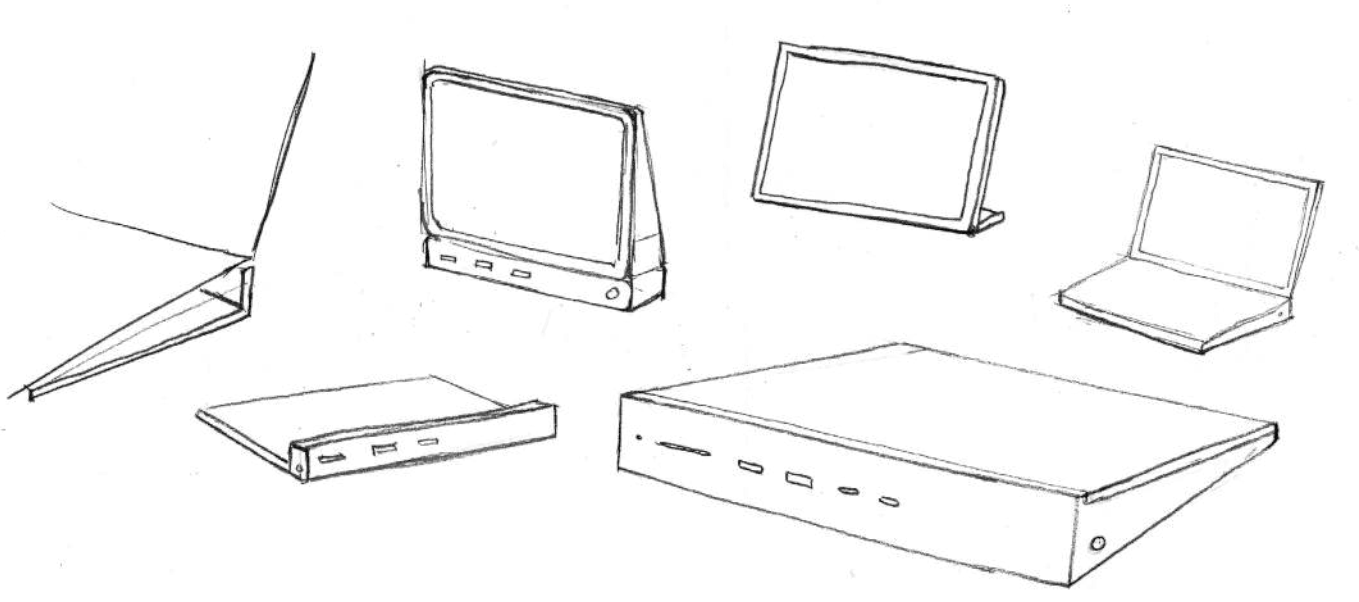
1. **power bank**: sometimes users don't have access to an outlet

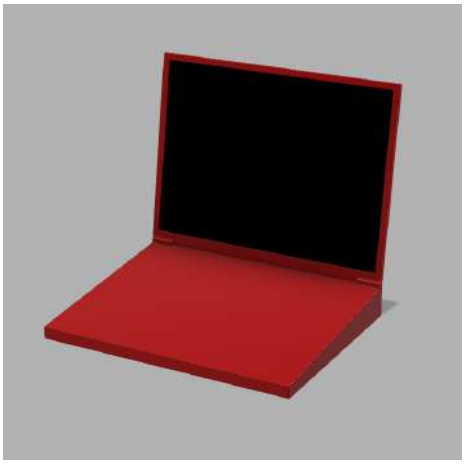
2. **mini monitor**: many users are toggling between multiple programs, and a second monitor improves workflow

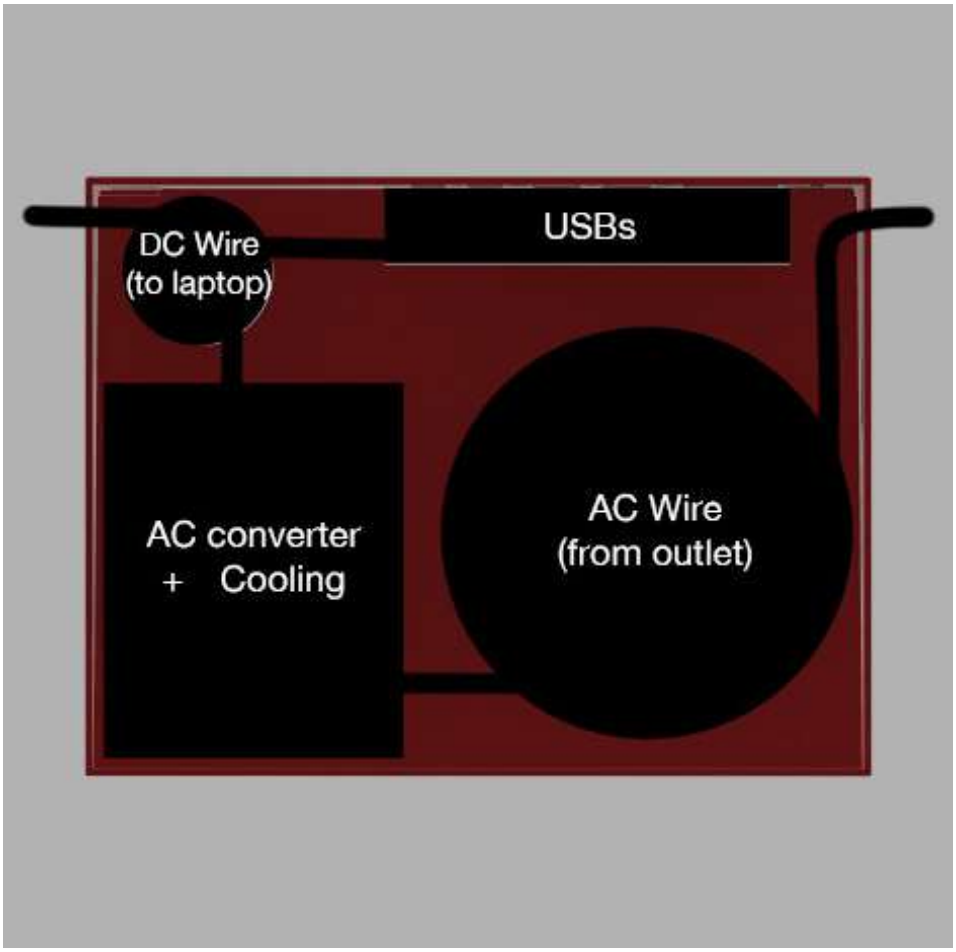
3. **laptop stand**: a tilted keyboard is more comfortable for some users, and space underneath the laptop improves cooling and airflow

4. **mousepad**: many users, especially gamers, use a mouse with their laptop, which means they also may need a mousepad or smooth surface

5. **USB hub**: users often connect other devices, such as cameras, SD cards, mice, and external monitors, and many modern laptops lack sufficient USB slots. This falls on the user to buy an additional USB hub or adapter



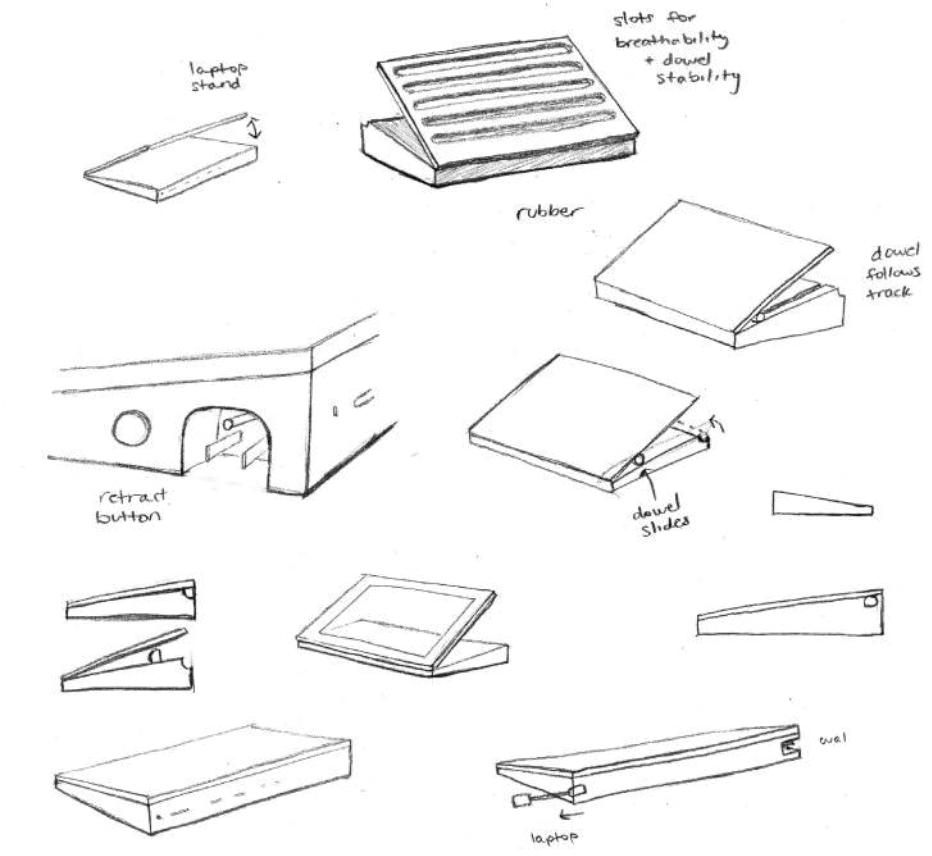




Prototype 1

I went for it all with my first prototype. A multifunctional device that charges your laptop, has USB slots, acts as a laptop stand, and flips open to reveal a mini monitor and mousepad.

My intention for the wire solution was to have them retract into the body, which I stuck with for most of my prototypes.



Prototype 2

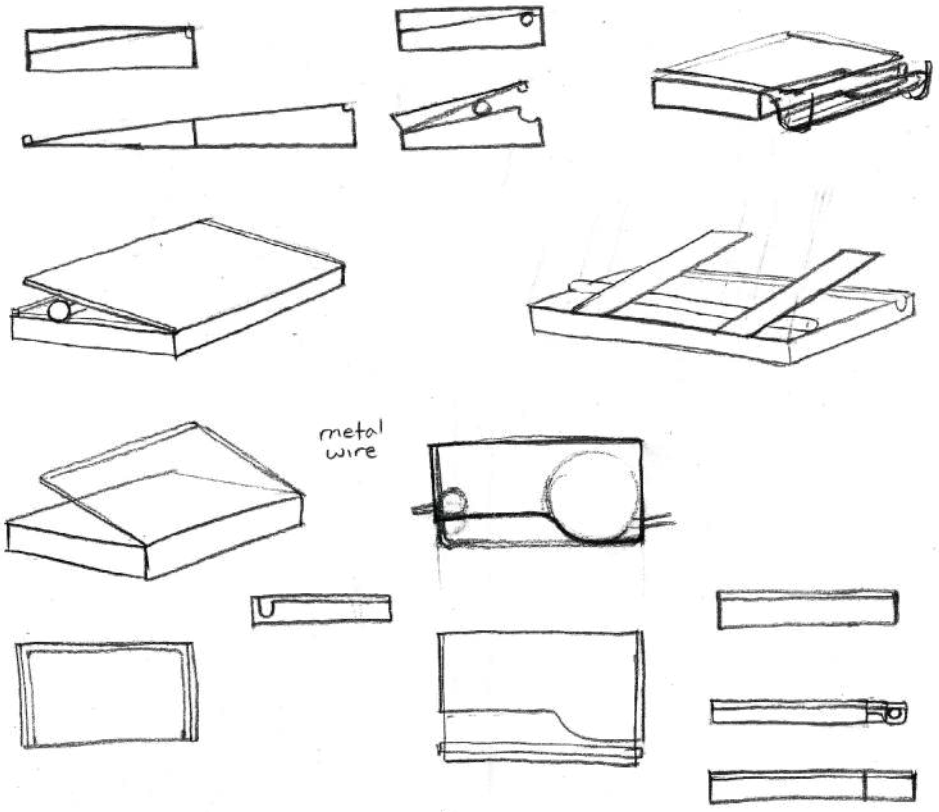
I decided to simplify and really focus on a few features, instead of overwhelming myself with more and more details that would have to be fleshed out. For this prototype, focused on the laptop stand.

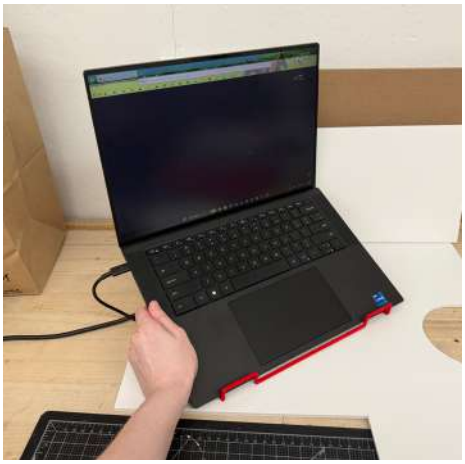
I opted for a sliding dowel to let the users adjust the angle of their keyboard, and kept with the wire retraction idea.

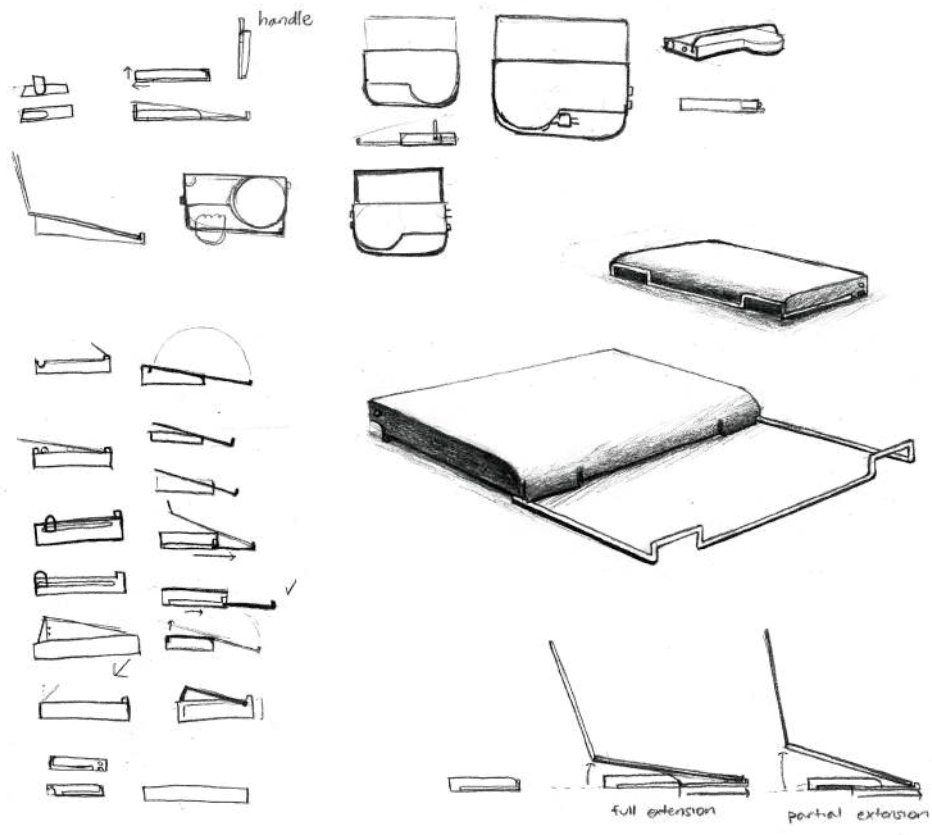
Prototype 3

At this point, I felt stuck and like the previous prototype just wasn't feasable as the best way to go about including an adjustable laptop stand. I couldn't come up with a satisfactory way to attach the dowel, and it felt too tall.

Instead, I went in a lateral direction and designed a version that flips open to a set angle. This felt much simpler, but I was still unsatisfied because I wanted to keep the adjustability. I also didn't like that the hot AC converter would be right up against the hot laptop, and restricting airflow.





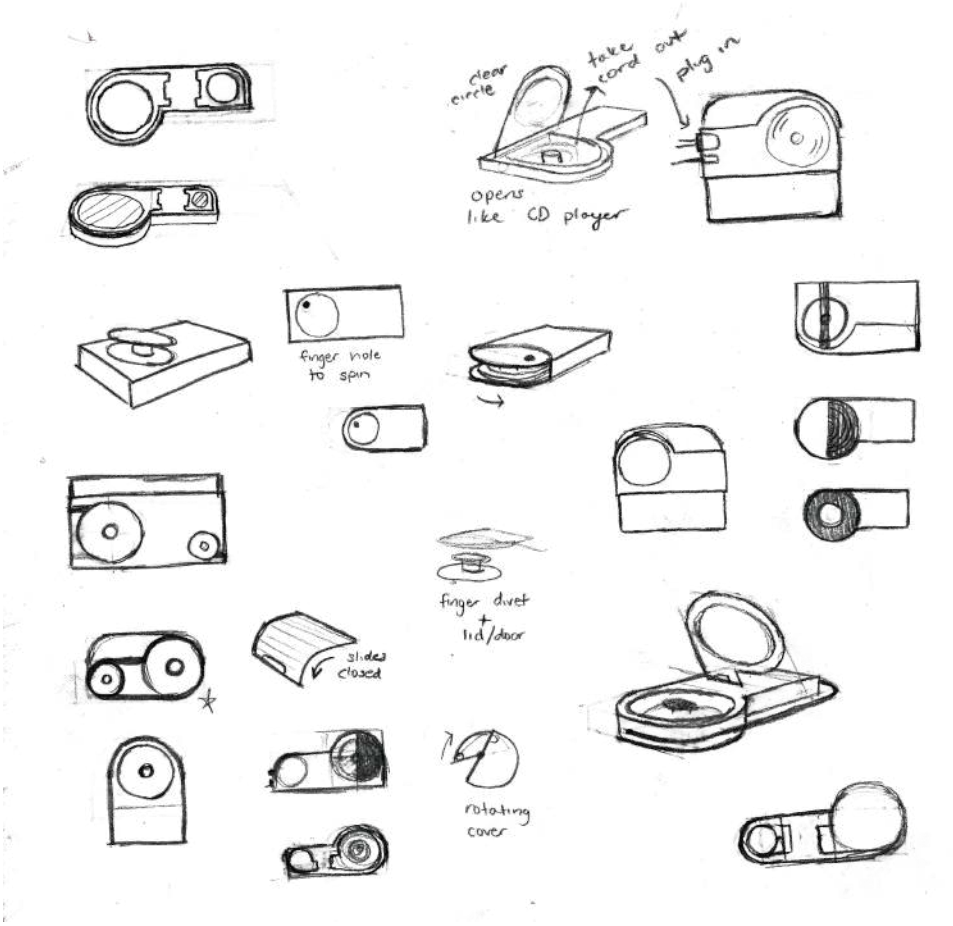


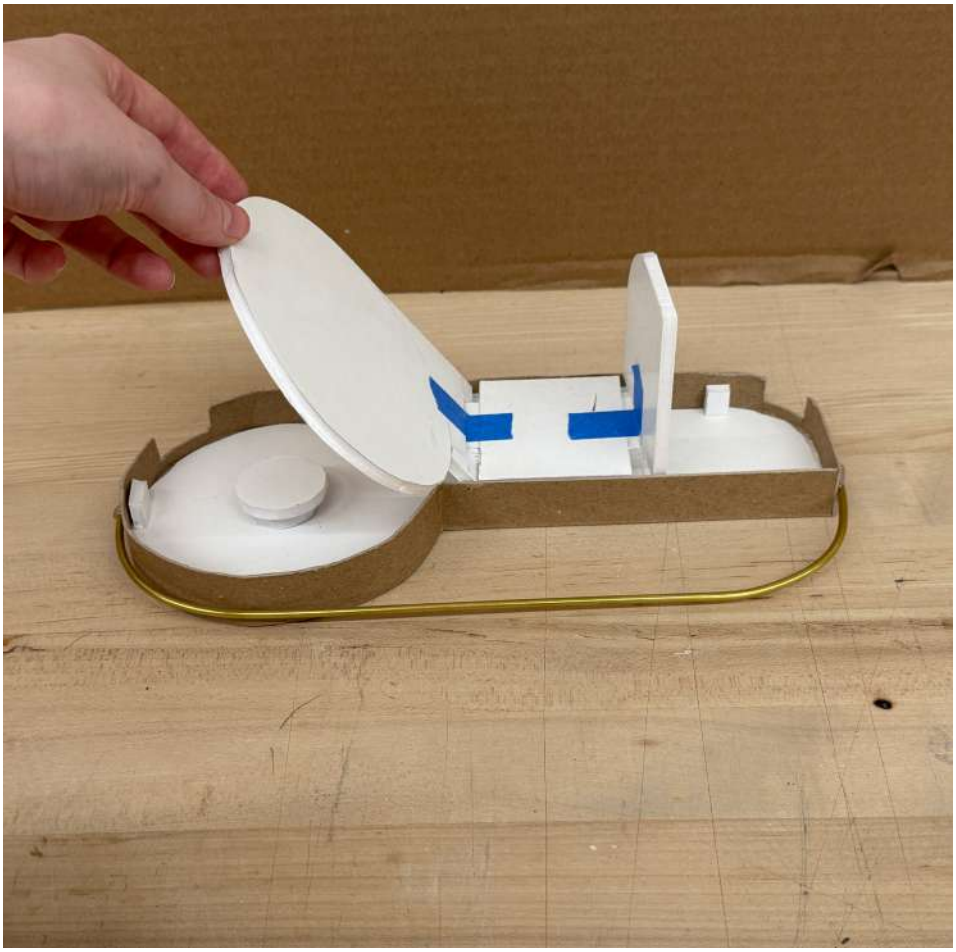
Prototype 4

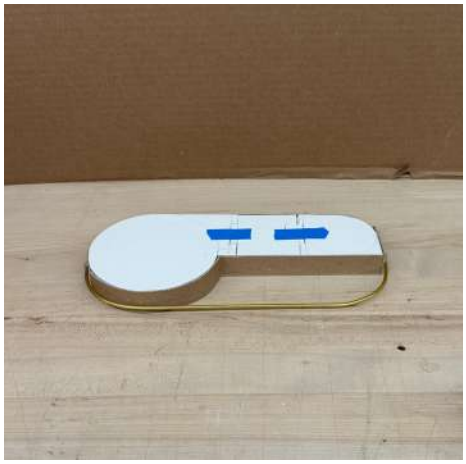
This time, I tried a version that has a lip that slides out to rest the laptop on. I also modified the overall shape and added a handle that also flips up to support the laptop.

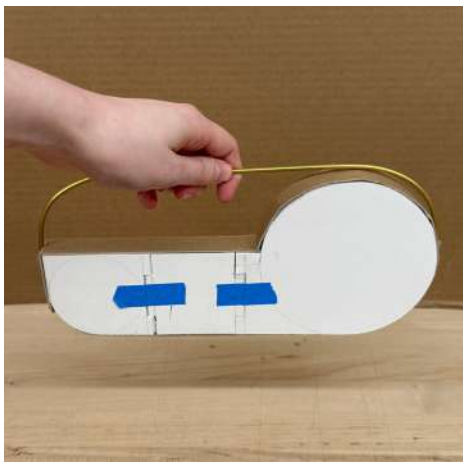
Prototype 5

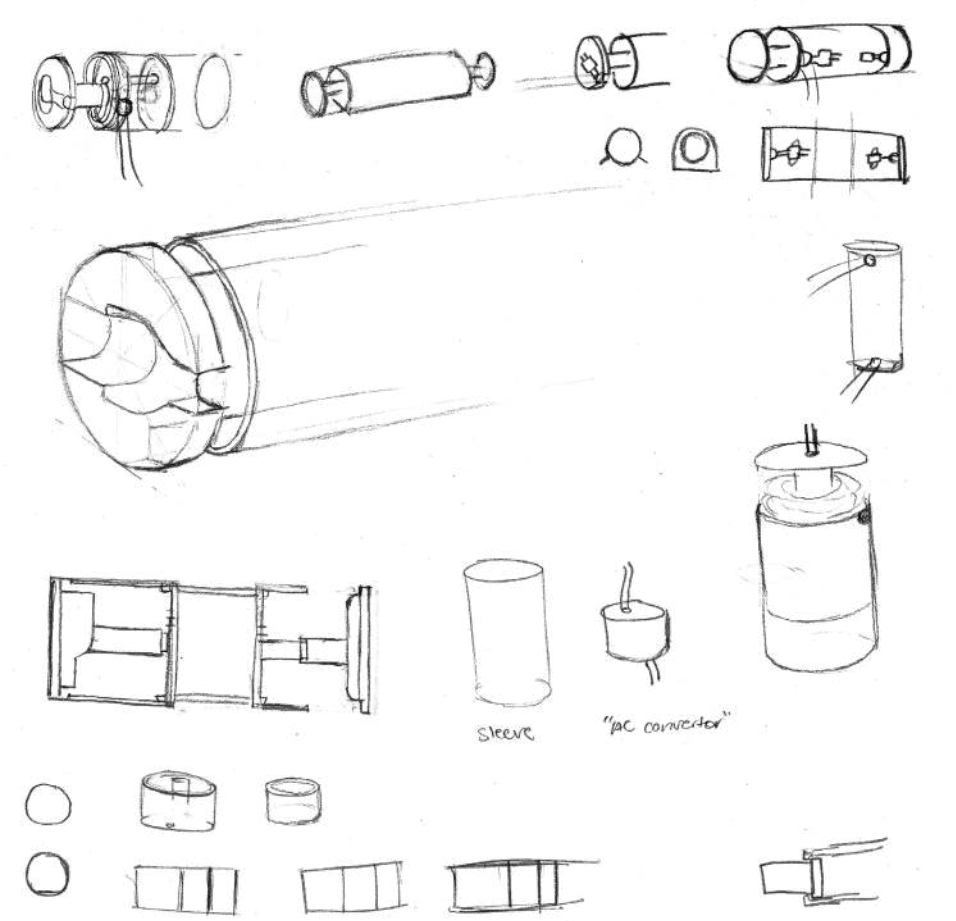
From this point, I decided to let go of the retractable cord idea to hone in on a satisfying way of wrapping up and storing the cords. It would have been cool, but ultimately felt too overengineered for the tradeoff. Plus, it opened my eyes up to the different forms I could create if I wasn't worried about the logistics of creating a complex mechanism in a short span of time. I opted to keep the circular shape that the retractable mechanism would've had, and just made two compartments that open with doors.





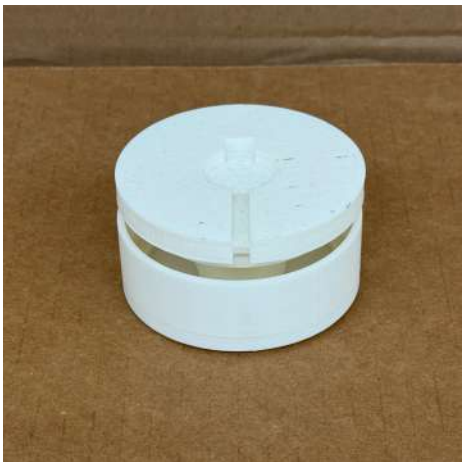






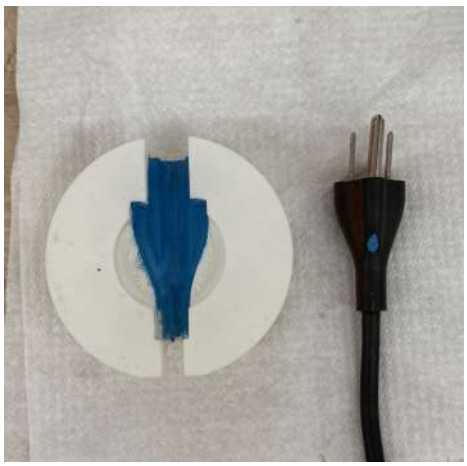
Prototype 6

I decided to change the form entirely, since the cords will be wound by hand. My instinct was to make it a cylinder with spools that come out of either end to wrap the cords around. I finally felt like my design was on the road to success.

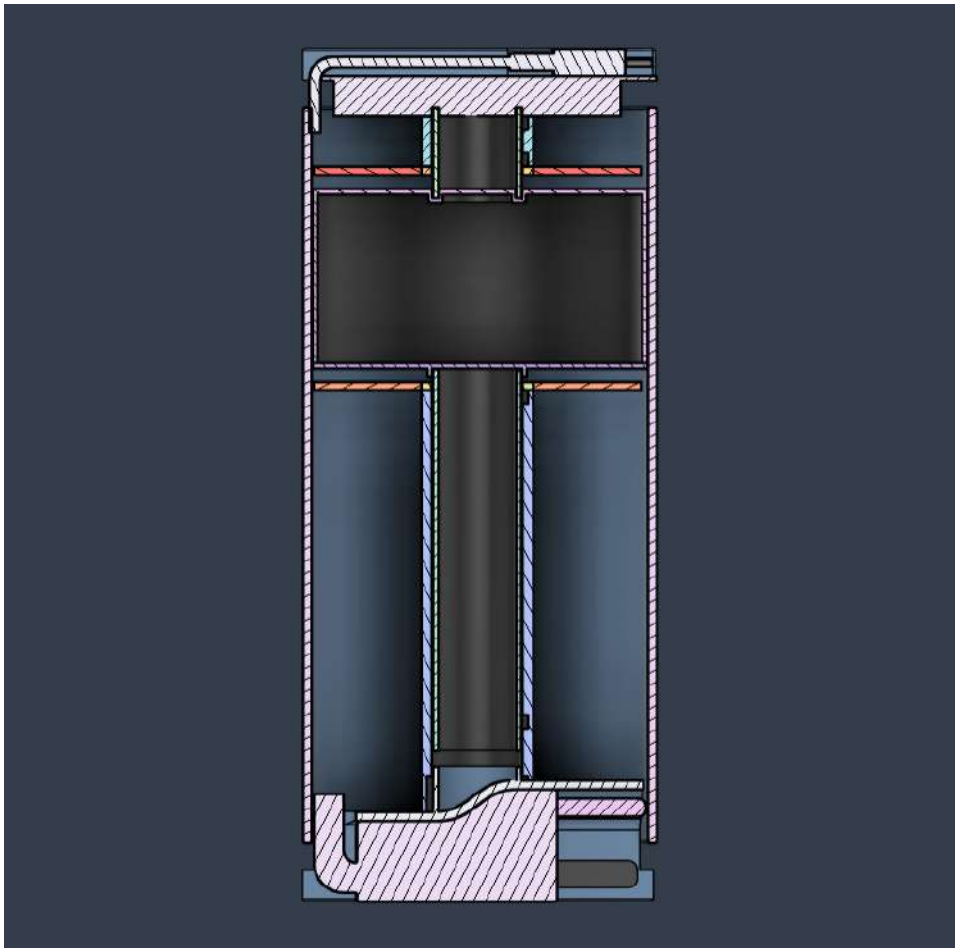


Making the Final Prototype

I made a test of the spool mechanism to see how it felt and how the plugs fit in. I found that the circular indents I added to grab the cords didn't make it easier, and the people I tested it with just pulled the cords out by the end of the plugs themselves.



The outlet plug also wasn't sitting flush, so I painted the inside and fit it back in to see where it was hitting against.



I used a bayonet locking mechanism to keep the spools in their closed and open states.

I 3D printed the main parts, and glued the plug of an old charger to thick wire. I used an old Apple USBC cable for the other cord.

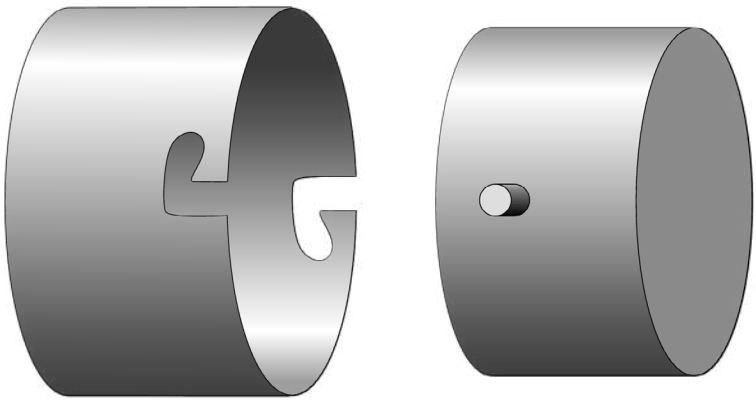
I glued rocks inside to add weight and make it seem more realistic.

CMF

The body of the charger and spool ends would be injection molded ABS, which is standard for consumer electronics housings. It handles heat well, which is important since the AC converter generates some warmth during use. The finish is a soft-touch matte coating in an off-white.

The cords would be fabric braided cable in red. Braided cables are common in higher end chargers and audio equipment, so this is a realistic production choice. Also, it's more durable than standard rubber insulation over time.

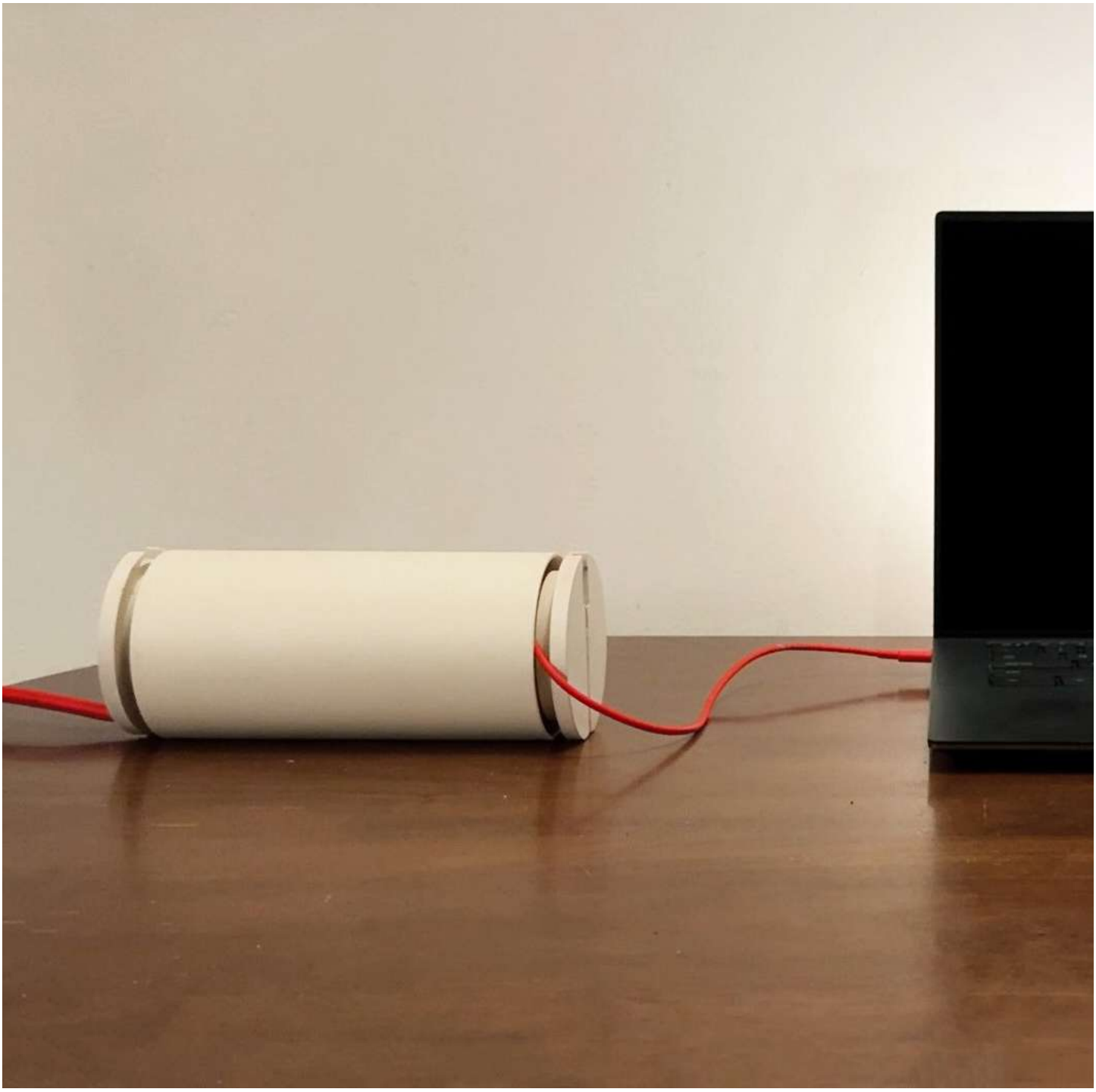
The bayonet locking mechanism that keeps the spools stable is a production mechanism used in camera lenses and medical devices, so it translates directly from the prototype to a manufactured version.



Final Design

The final prototype is a success. The wires nicely store, and it's satisfying to twist and pull the spools out. The cylindrical form fits perfectly in the waterbottle pouch of a backpack, and has a flat edge so it doesn't roll on the table. The AC wire is 10ft long, and the DC wire is 4ft long for a total reach of just under 15ft. Additionally, users can pull out as much cord as they need, and keep the rest tucked inside.

Watch a video of it in use at https://spencermaher.neocities.org/projects/sen-charger/



Conclusion

This final prototype is a result of weeks of trying new ideas, each of them not feeling right.. until I focused in on making the main function a designed experience. While a laptop charger that has a lot of other functionality built in would be quite useful, I found success in not getting too ahead of myself and keeping the design rooted in one core interaction: winding and unwinding the cords. The cylinder form followed naturally from that. It's shaped around the act of using it, not just storing it.

Letting go of the retractable mechanism and the laptop stand opened up a simpler form that closely follows function. The result is something that fits in your bag, doesn't tangle, and feels good to use, which is exactly what I set out to design.

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Figure (Apple MagSafe) — https://cdn11.bigcommerce.com/s-qfzamxn9kz/images/stencil/original/products/347000/540402/Apple_A1425_-_85W_Genuine_Apple_MagSafe_2__53102.1736212737.jpg

Figure (red braided cable) — Etsy. https://www.etsy.com/listing/102857947/6-feet-red-cloth-covered-3-wire-round

Figure (person using laptop on train) — Unsplash. https://unsplash.com/photos/a-person-playing-a-video-game-on-a-laptop-auf3GwpVaOM

Figure (gaming laptop) — BGR/Consumer Reports. https://www.bgr.com/2103663/best-portable-chargers-for-laptops-consumer-reports/