

Ideation

I started this design process by searching through websites for inspiration. I liked the idea of a cable management system, as the cords on my desk are always getting tangled. There were many unique designs, but I was quickly attracted to the idea of a modular, customizable system. I came across a common modular system that features a hexagonal snap-on plane, allowing for the addition of various designs and tools. One person had already created a cable management module for this kind of system, but it relied on zip ties to semi-permanently connect the cable to the manager. I thought this would be extremely inconvenient for someone like me, who is often taking their charging cables around campus as they work. I didn't want to have to buy a million zip ties and cut them every time I needed to move a charger. This problem led me to another design, which had a screw-on cap and a shallow recess where a cable could lie. The design offered a much more versatile cable management option but lacked the ability to be clipped into the modular system. I felt immediately ready to sketch something based on these two designs, and my idea relied on only a simple remix. The sketch was basically a clean combination of both cable managers: it had a hexagonal base for the modular system and threading with a small indent for the cable and cap. When looking at the files for both of the designs I drew inspiration from, I figured remixing them together would be simple. I just needed to remove the bottom of the screw-on system and the top of the zip tie system. The quick remix I made in TinkerCAD confirmed this prediction, but I quickly realized I would have plenty to change and add to my new cable management system. This ideation step was key to making my plan, but unforeseen issues can sometimes only appear in a prototype, not a sketch.

TinkerCAD, OnShape, and Printing Challenges

I had used 3D design tools in middle and high school, but my experiences were limited. I never truly took this software seriously, as what I printed as a kid was always simple nonsense, quite like the name tag we first printed. Most of my designs before this project were TinkerCAD trinkets made to impress my parents and didn't have much utility. I had also never encountered remixes, where you take one or more complex designs and simply add, combine, or remove things to create something novel. Using this method, someone with little experience in 3D design can model something they could never make from scratch. My first such remix went smoothly. In TinkerCAD, I used simple tools like remove and extrude to chop both of my selected designs in half and join them with a thin, solid hexagon. More complicated pieces, like the cap and threading, I didn't alter at all. The print turned out great, and the cap worked perfectly. It also fit quite well in the modular system. I also used TinkerCAD to reduce the large hexagonal plane file I had found to a small, easy test with only 3 hexagons. This drastically reduced the time it took to test if my remix even fit in the modular system. After I printed my first prototype, it quickly became clear the design had some serious flaws. First of all, it was very difficult to remove the cable manager from the hexagon wall. They stuck in fine with some elbow grease but require the wall to be flipped around and worked with both hands to come out. This was an issue because I envisioned the hexagons adhered to some wall or desk, where the cable manager could be best used. Ironically enough, I also didn't have a good way to attach the hexagon wall to anything. So, in OnShape I set out to create two new modular components. By attaching a simple handle to the cap of the manager, I hope to make a remover tool for the modular components of the design. By instead removing material from the threaded manager pieces, I could create flat parts where command strips or other adhesives could be stuck. Both these ideas proved harder to execute

than to ideate. I distinctly remember getting frustrated because I couldn't figure out how to flip the cap over by 180° so it lay face down. However, after a few tutorials I learned more about how the tools in OnShape work and the common fundamental mechanics behind them. For example, many tools include a "mate connector" option, where translations across space or about an axis are dictated by where you place this connector. By adding a connector to the edge of the cap and changing the axis of rotation described by said connector, I was flipping things all over the place. However, the tutorials did not adequately prepare me for the most frustrating issue I encountered. My parts' dimensions became muddled when importing from TinkerCAD to OnShape. The rescaling was only happening to the parts I designed in OnShape, not the small hexagon wall or the original pieces I created. This resulted in my new components appearing many times larger than the test hexagons in Slicer. I first simply tried to scale my new pieces down, hoping the unit discrepancies occurred when mixing up millimeters and centimeters. That plan quickly failed, as my new pieces just didn't fit very well. So, I came up with a new plan. I separated all of my parts into individual STL files. I then imported each to its own OnShape document, including the original parts I didn't plan on changing. While I did have to redo some of the changes I made, I now had a well-organized collection of modular pieces of uniform dimensions. I fixed this problem just in time, as I knew I would be too busy this weekend to print another prototype. Unfortunately, this meant I couldn't address some of the printing failures that were consistently occurring, like stray plastic coming off the remover tool. I also couldn't further improve my designs. I would like to strengthen the remover tool or find a way to add more leverage so changing components can be easy. I also want to create a flat component that takes up two hexagons and allows for larger command strips or tape. While further improvements are always possible, I am happy with my finished working product.

Final Thoughts

The most interesting part of this project was the trade-offs between OnShape and TinkerCAD. With experience, the preferred choice is obviously OnShape, as it simply allows you to do more than TinkerCAD. However, as someone with limited experience with these tools, TinkerCAD provides an intuitive alternative to complex 3D design tools. Most children cannot reasonably access complex parametric software, but TinkerCAD's simple UI and limited commands can be understood by anyone with any level of expertise. Despite its simplicity, TinkerCAD can perform complex tasks when utilized effectively. Their website provides tutorials that introduce you to animation features, fun gimmicks, and other common tools. OnShape was much harder to become comfortable with. There were similar tutorials offered, and with some frustrating trial and error, I can now find my way around the software just fine. However, OnShape requires a much more calculated plan of attack when creating something from scratch. The workflow differs greatly from TinkerCAD's drag-and-drop system. OnShape requires you to be precise, offering three different ways to move an object in 3D. Both tools proved very helpful, however, in their own ways at different points in the process.

It is also important to talk about our printing constraints. The Prusa Mini does not have the capacity to produce large designs. This meant immediately eliminating large cable management devices. The modular system I took inspiration from was great for this, because the small individual pieces took only 20 minutes to print, and I could fit many of them on the small bed of the Prusa. As discussed above, there were some unresolved printing issues. However, I believe I can resolve these issues with sharp overhangs and inconsistent hexagons by smoothing out my design to make it more printable.