Image 0.1:
I started by looking at my inspiration, which as you can see from the picture, was Apollo era NASA consoles. I like the old 70's function first design of these consoles which enabled one of the greatest feats of human engineering, landing humans on the moon. I noted the flat angled surfaces with clusters of buttons fitted neatly in their own sections. The larger screen panels incorporated handles to facilitate easy handling for quick maintenance.

Image 0.2:
Going forward with this design language, I quickly mocked up a 3d design just laying out what I wanted the keyboard to look like. I knew I wanted a full keyboard but with the numpad swapped to the left side, the full 24 F-keys (as supported by windows), a screen, and some form of linear/rotary physical input. I also wanted a second panel with an aggressive angle to hold the F-keys, screen, and physical input. This angled panel would call back to the various flat panels of the NASA consoles. And to evoke the imagery of old industrial equipment, I named the project "Console".

Image 1:
From the get-go, my intention was to 3d print the case of the keyboard and any component brackets required. And, after countless hours and revisions, I came up with a finalized 3d model of my console keyboard. It swapped out the rotary encoder I initially mocked up with a bank of 5 linear potentiometers for controlling various volume sources. I also created a finalized list of components to fill in the keyboard and designed around their dimensions. Not pictured, but I ran several test prints of pieces of the keyboard to make sure every component would fit properly.

The keyboard was split into a "top" and "bottom" section, so the whole keyboard could be split for ease of assembly and also printing. I also designed the main keyboard plate, the F-key plate, and volume slider plate. These plates would allow me to print these sections separately, giving me the ability to modify the keyboard down the line if I decided to make any changes. For example, I am still debating on swapping back to a large rotary encoder instead of the linear sliders.

In the "bottom" of the case, I designed a bulk head for the cable. I wanted a weighty water proof connector to give the feel of an industrial piece of equipment.

The design of the keyboard was made with the intention of using my larger custom built 3d printer. However, after acquiring a Bambu Labs P1s printer, I found the print quality to be much better and thus needed to figure out how to make the keyboard on a smaller printer.

Image 2:
After finishing the design, I set out to make the case. As mentioned earlier, I changed printers after designing, so I had to make some adjustments to my printing strategy. Fortunately, the adjustments were pretty easily made. Due to the flat simple geometry of the case, I only needed

to split the top of the keyboard into 4 quadrants. This split also meant I didn’t need to use any supports while printing, saving on material costs.

Image 3:
The bottom of the case was a similar story except it only needed to be split into the two sections, left and right.

Image 4:
After the parts were printed, I quickly clamped pieces together to make sure everything fit as I expected. Here you can see my fit the F-key plate and the screen to the upper half of the top of the case.

Image 5:
Once I was happy with everything, I taped down a sheet of sand paper to a flat surface and sanded the junctions of parts to make sure they would mate perfectly while gluing. Pictured here you can see I taped my sandpaper onto my workbench which has rubber matting, I quickly swapped to using a different section of bench that was hard wood for a flatter surface.

Image 6:
After the surfaces were made flat, I started glueing the parts together with CA glue. Here you can see I glued the left and right section of each part together first.

Image 8:
I also had to print the main keyboard plate in two pieces, so I quickly glued it together and screwed it into place and also clamped the sides together. Doing this ensured the plate would be able to fit in its proper place when it finished gluing.

Image 9:
Next I glued the upper and lower halves of the top case together, making sure to clamp it down so no gaps would form between the parts.

Image 10:
Once everything was glued, I then needed to make sure the mating surfaces between the top and bottom case parts would fit with no gaps. So I used the “bluing” technique where you apply a coloring to the surface you want to make flat. Then, as you sand, you can see what parts haven’t been sanded. This gives you an idea of which sections are uneven.

Image 11:
Here you can see that the upper left of this surface was lower than the rest of the edge because it still has some blue left. So I marked out the edge again and resanded until everything was as even as I could reasonably get.

Image 12:

After the surfaces were prepped, I then added heat set inserts to allow for the top and bottom to be bolted together.

Image 12.1:
During this process I also cut and tapped the handles that would go on the front of the case.

Image 13:
At this point everything was essentially functional, so I did another test fit and placed it on my desk to get a sense of how it would be when I’m finished.

Image 14:
Another shot of the test fitment.

Image 15:
I was happy with the way everything was turning out, so I moved to finishing the surfaces and painting. During the gluing process, I used clamps to make sure there wouldn’t be any gaps. However nothing is perfect and there were indeed small seams between all the parts I glued up. So to fix this I used bondo body filler which is like clay that is used in car body work to fill in scratches and dents among several other applications. Using a spatula, I pushed the bondo into the seams and scraped the excess to be level with the rest of the case.

Not pictured but after the bondo had set, I sanded down the surfaces to be level using the same technique of taping the sandpaper to a flat surface.

Image 16 & 17:
I also used a hand file to sand down the “fins” I designed into the top most surface of the case. They were present on the “top” and “bottom” halves of the case, and they didn’t perfectly line up after gluing.

Image 18:
Finished with sanding, I taped the inside of the case in preparation for painting. I also taped all the exposed threads to keep them from getting gummed up.

Gif 18.1:
Due to how large my parts were, I wanted a way to rotate and position them for the best angle for painting. To accomplish this, I built an adjustable stand on a lazy susan. I used some coolant hose mounted to a lazy susan and with arms on the end that I could mount to my parts. This let my angle my parts and rotate them easily while painting.

Image 19 & 20 & 21:
I set up a makeshift paint booth with some painters plastic pinned to some trees and put down a piece of cardboard and an old battery to keep the wind from blowing the plastic away. Not pictured, I also painted each plate a solid black.

Image 22:
While the paint was drying, I set to make the cable. I purchased a braided usb cable and cut off one end. I stripped back the 4 internal wires, and soldered them to my connector.

This part isn't pictured here, but I couldn't find a coiled cable long enough, so I used an 8mm rod and wrapped my straight cable around it making sure to leave a few inches on each side so the entire length of cable wouldn't be coiled, and clamped it in place.. I then used a heat gun to warm up the cable and get the plastic in the braid to reform in the coiled shape. I had also preheated the rod to make sure the cable was being heated from all directions. I then stuck everything in a lab oven and set the temp to just below 60 degrees C and this is around the glass transition temp of many nylons, which I was assuming the cable was made from. After about an hour in the oven, I pulled everything out and let it cool with the cable still clamped on the rod. Once cooled, I pulled off the cable and it retained its coiled shape. After a few weeks and some minor jostling around, the cable has lost a little bit of its tight coil, but it is still very good. If I had to do it again, I would raise the temp to just above the glass transition temperature, allowing the polymer chains in the plastic to resettle in the new shape.

Image 23:
Once the cable was done I test fit it in a small test print of the keyboard bulkhead that is on the bottom part of the case.

Image 24 & 25 & 25.1:
Continuing on with the electronic parts, I soldered up the controller, the two adc chips for more adc pins, and a multiplexer to give me more digital pins. I wired everything on a prototyping board, and connected each pin to one of three cable connectors. I separated the wires out to either the main keyboard, the F-keys, or the linear potentiometers. Keeping these cables separated will allow me to create the wiring loom easily and also give me the ability to quickly disassemble the keyboard in the future.

Image 25.2:
I also mounted a raspberry pi 3b+ on the back of a lcd touch screen. This will be a solid platform for me to develop a dashboard / screen interface for my keyboard. I want to have my pc stats like temperatures and fan speed displayed here along with some fun visuals like a rotating globe showing the location of GPS satellites and the ISS.

Image 26:
From the beginning I decided I wanted to hand wire this keyboard together, rather than designing a pcb that I could quickly solder everything to. I decided this partly as an homage to the hand wired computers sent into space by the Apollo missions, but also because I wanted to delay my learning of pcb design software [laughing emoji]. So to hand wire everything, I used some 16 awg copper wire which was easily bendable with some pliers and held its shape. I started with soldering a line down each row. During the process though, I found that at each solder joint, due to the expansion and subsequent shrinkage of the joints when soldered, the

plate would start to curl. Ultimately this wasn't much of an issue as I'll be screwing the plates into the case, which will be enough to straighten them back out. However, I think that if I used thinner gauge copper wire, this wouldn't have been an issue.

Image 28:
After doing each row on the main plate and the F-key plate, I used some kapton tape to electrically isolate the wires.

Image 30:
I then moved on adding diodes to each switch. I again used the 16 awg copper, but this time it was to wrap the diode leads around the wire. This allowed me to simply place the loop in the remaining key switch lead, holding it in place and also making a nice pocket for solder to flow into.

Image 32:
Here are most of the diodes soldered to the main keyboard plate.

Image 33 & 34:
I used a similar strategy for soldering up the volume slider plate. I first mounted the sliders to the plate, then soldered a rail for both the 5v and ground pins that were on opposite ends of the sliders. Then each slider got its own wire for the out pin that will be read by the adc chips to determine their positions.