Wood Case for Raspberry Pi 3

Created by Ruiz Brothers

https://learn.adafruit.com/wood-case-for-raspberry-pi-3

Last updated on 2023-08-29 03:21:29 PM EDT

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Overview

CNC Milling Enclosures

In this project, I wanted to make a case for the Raspberry Pi 3. I milled the two halves of the case out of hard wood (oak and maple). I came up with this "face plate" concept to avoid overhangs since 3-Axis CNC mills can't do them. Instead of cutting large openings, I made holes to expose the various connectors. The cutout in the top halve of the case is for an acrylic piece so you can see into the case – sorta like a window. The Raspberry Pi itself is secured to the bottom half of the case with 4 machine screws. I added an inner lip to the top half of the case so the two halves can fit together without having to use any screws.

CAD to CAM

My goal for this project was to gain some more experience with CAM tools, so this was a good exercise. I learned how to work around the limitations and tools.

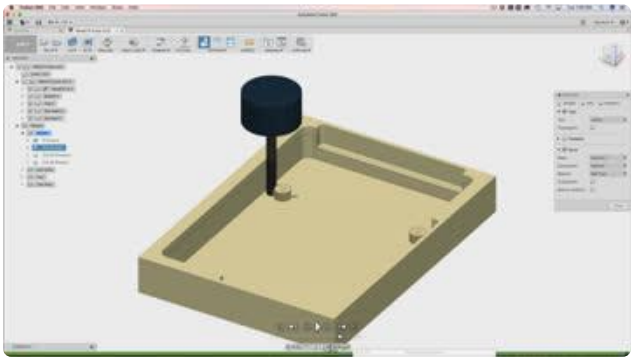
Parts & Tools List

Most of the parts used in this project are for the Othermill Pro. I sourced the materials through various online relators (amazon, inventables and local hardware store).

- Raspberry Pi 3 ()
- Othermill Pro ()
- 1/8", 1/16", 1/32" flat end mill ()

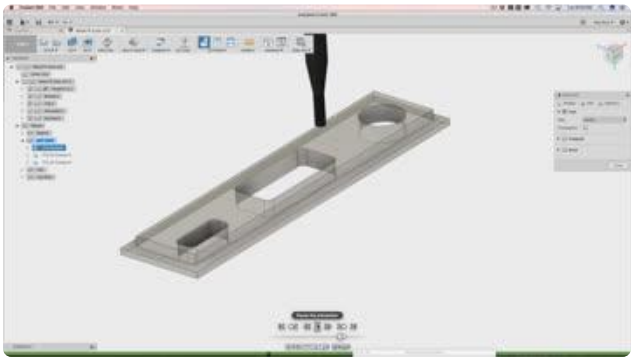
- 80˚engraving bit ()
- Double-sided Scotch tape
- NITTO tape ()
- 1/8" acrylic sheet ()
- hard maple + oak wood stock ()
- 4x M2.5 - 5mm machine screws
- Screw driver
- Sand paper

Design



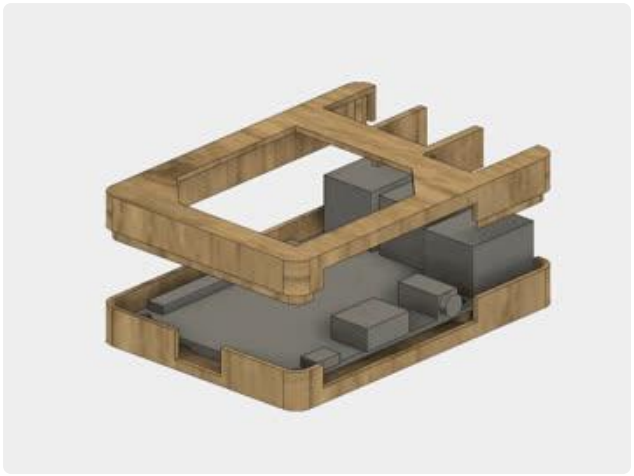
Designing for CNC

The main lesson I learned from this project was to design with the tool in mind. I had to make sure the bits could cut between the walls of the case and standoffs.
I ended up increasing the overall dimensions of the case to accommodate for the 1/8" flat end mill.



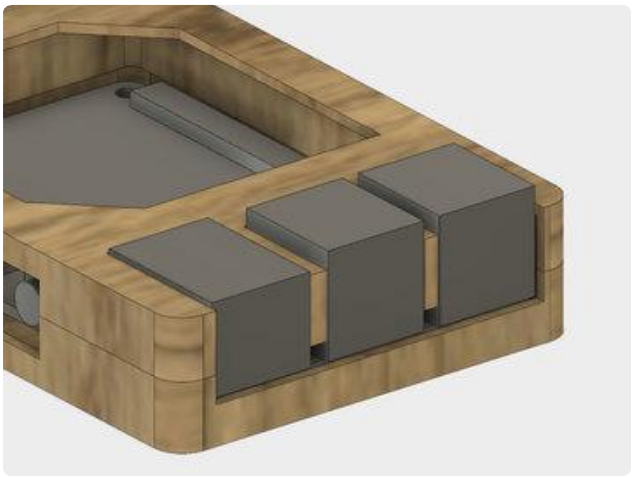
Acrylic Face Plate

For the face plate, I wanted to make wall to prevent the plate from falling into the case. I wasn't able to do this because the tool would intersect with the standoffs. Increasing the width the case wasn't a feasible option because that would make it hard to connect cables. So instead, I went with a simple recessed base that would hold in place with friction



Friction Fittings

To hold the two halves together, I added an inner lip along the edge of the top half of the case. I made sure to add a small offset (0.1mm) so there was a little bit of clearance to allow the two halves to fit together. I couldn't create certain geometry in the corners of the opening for the acrylic face plate because the 1/8" tool can't cut geometry with a smaller radius then the tool itself. So I ended up adding a chamfer to those edges.



Skinny Fingers

These fit in between the USB and Ethernet ports. I normally wouldn't make this, especially for 3D prints because they tend to be too thin and break easily. But with CNC milling, these areas can be cut just fine. I used a 3D pocket operation. Although I wasn't able to create sharp corners, the offset was enough to fit in between the ports.

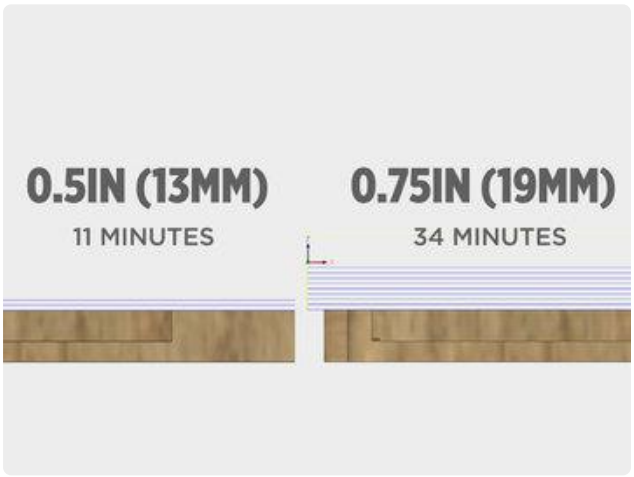
Download Source and STLs

If you're interested in checking out the design source, I made the Fusion 360 archive a public download. You can also grab the STLs if you'd like to try 3D printing the parts – However, I don't know if the tolerance will be the same.

Download F360 Source

Download STLs from Thingiverse

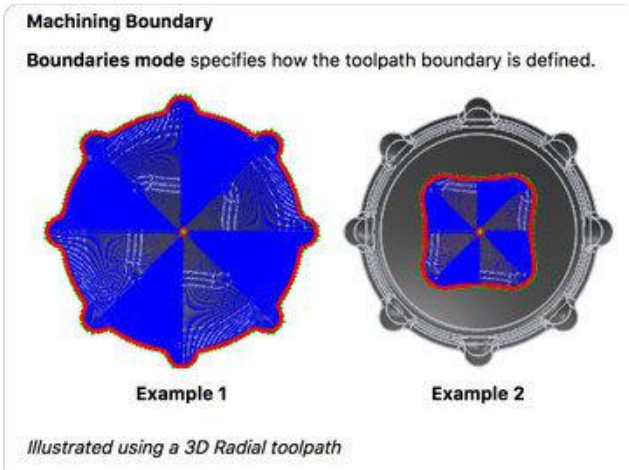
CNC Milling



Facing Materials

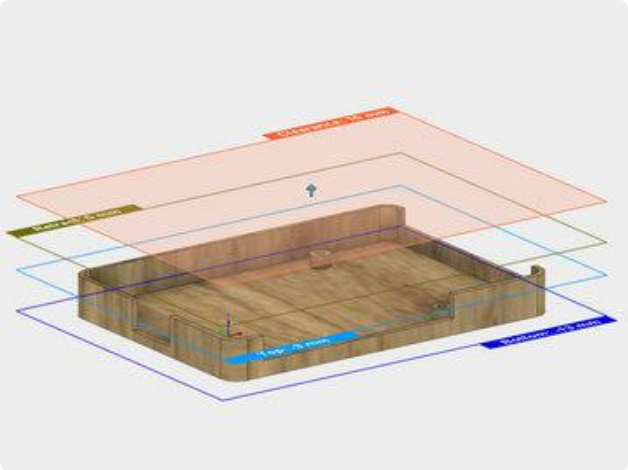
It's a good idea to use stock that is close to the desire thickness of the part you're milling. For this project, I used 1/2" hard maple and 3/4" oak stock. Because the oak stock was so thick, it took a whole lot longer to face than the maple.

The main take away I learned from this project was to face both the top AND bottom of the stock. This ensures the part is really level. Some of the corners are a bit warped and slightly bow when the two parts are fitted together.



Machining Boundary

A good way to limit an operation is to use the machining boundary. This lets you choose an edge and tells the machine to only mill material within that selection. This is great way to reduce machining time since we don't have to mill away material that doesn't matter.



Heights

It's important to set the correct heights when setting up operations. When your stock has been faced, you may need to specify where the next operation needs to start – So you can selecting an edge or surface.

Stock To Leave

This option is normally for parts that need to stay secured on the bed. The "Stock to leave" option tells the CNC machine to stop at a certain thickness. With some CNC machines, parts are secured via clamps or pins. If the excess material is milled away, the part may come free, resulting in a failed part. In my case, using the othermill pro, I don't have to worry about that as long as there's suffice tape holding the stock to the bed.

Post Processing

Test Fitting

Before post-processing any of the parts, I did a dry fit to see if everything lined up. No sense in finishing a part when it doesn't fit. I normally would 3D print the part first to do test fitting, but the tolerances are much different than CNC milled parts. PLA and ABS tend to expand when it's being extruded, so the layer lines contribute to different variable thicknesses. I found a 0.1mm offset vertically to be a good value for getting a friction fit.

Removing Burrs

There was a lot of burrs along the edges of the wooden parts. To remove them, I sanding the edges down using 320 grit sand paper. For some of the cutouts, I used a filing tool. A sanding/griding bit for a dremel tool is also a good option.

Staining, Paint, Wax

I didn't apply any solutions to the surface, but it's definitely an option worth exploring.

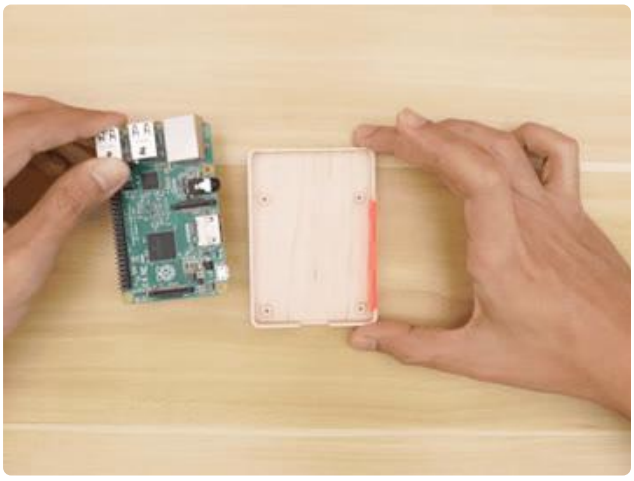
Sanding Materials

Sanding wood is definitely a lot easier than sanding 3D printed parts in PLA. However, it's easy to over do and accidentally remove too much material. The more corrosive (lower grit) the sand paper, the more material it can remove.

Assembly

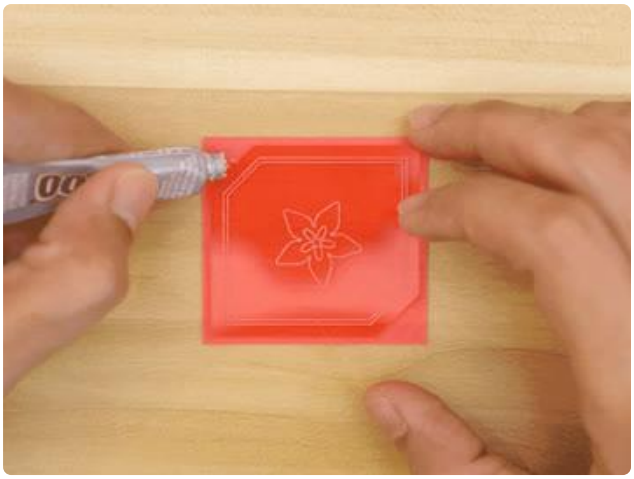
Install Face Plate

I got lucky with the acrylic face plate since it had a good fitting on the first trrry. This has an outer base that's recessed so the edges have a snug fit when it's pressed into the bottom half of the case. I have to install that first before the Raspberry Pi, otherwise it can't fit in.



Install Raspberry Pi

The Raspberry Pi rests on top of the four standoffs on the bottom half of the case. I inserted 4x M2.5 - 5mm machine screws from the top of the PCB until the head of the screw held everything in place. The screws need to be short or else it might not hold the PCB down very well. The holes in the standoffs are 2.2mm in diameter, smaller than M2.5 so that the threads can bite into the material.

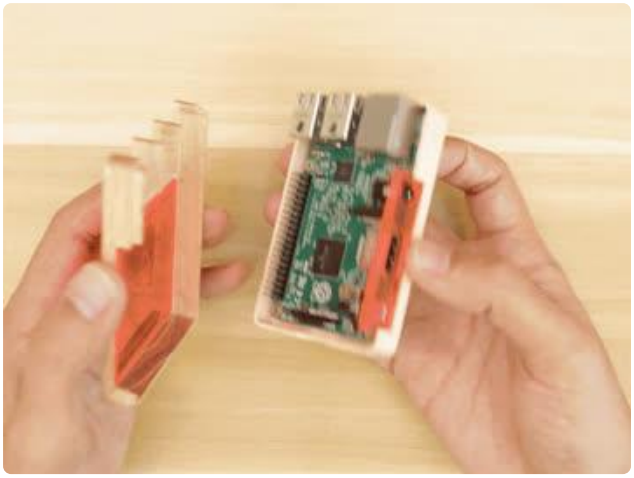


Glue Top Plate

The acrylic window for the top half of the case did not have a tight fit. It's too loose and doesn't hold it's own weight, so I had to use some glue to secure the two parts together. I included some excess material along the corners. Put a dab of E6000 adhesive on the two corners and press them together.

Secure Top Plate

I let the glue dry for a few mutes before handling. I added a bit too much, but it was easy to peel off the excess. This is a silicone based adhesive, so it's soft. Definitely don't use super glue on acrylic.



Joining Two Halves

An inner lip protrudes from the top half of the case. This slides in between the walls of the bottom half. The tolerances are tight so the two are held together with just friction. I noticed the top bows slightly when it's joined with the bottom half, not sure if it the outer edge needs a bigger offset or if the material is slightly warped.