Cloudmesh Raspberry PI Cluster Case

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2 Raspbery PI 5 Node Cluster Case

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TODO: move designs form

https://drive.google.com/drive/folders/1D8YjtOAh8FemuruPYPWuV4zYNxszW_wN

to this github, only keep final design here.

:o: Lots of work needed

2.1 Abstract

Why doe we need PI clusters ....

- iu course

Why do we need a case ...

- protect, students take cluster home, students bring cluster to class

How do we anticipate the case is used ...

- want to have access to the components for reuse

Based on these requiremnts we designing a Raspbery PI Case for five PI's qout of laser cut sheets with the goals of keeping the design as simple as possible, using few parts as do minimize production costs, allowing for easy assembly without screws or glue, while making it structurally sound. Furthermore we allow reproducability throup open sourcing the design.

To accomodate larger clusters in the class setting a Shelf is proposed in which we *place* the miniclusters while attaching it through a power distribution bar and a large network switch to integarte the individual clusters into the larger cluster. Furthermore we want to create a product in a box called *Cloudmesh Pi Cluster* that we can give to students so they can assemble such a cluster themself, or order the parts directly from us and we ship the parts and the cluster case to them.

2.2 Introduction :o: this is an experinec report or a result, but not an introduction

On the first day of the internship, the students talked to Gregor and were presented with a challenge to create their own design for a case for Raspberry Pi computers. Their first big hurdle in the design process was desiding on an initial design and learning the chosen modeling program well enough to build it. They brainstormed a fairly simple first design, then decided to just start modeling. OpenSCAD took a little time to get used to, because of the programming only orientation, but the students learned enough to build the first prototype. It was very simple compared to the most current versions now, but all things considered was very impressive, and it had many of the elements still central to the current design. The students had two major innovations present in their first prototypes, in one of them, the peg and slot system still used today, and the other, the smaller interlocking pieces used to distribute strain in the case. The first models had none of the refinements of the newer prototypes, but were a very important and large step in the process. These prototypes started what has been the most used and most important process in the design of the case: design, build, test, analyze, repeat.

This process allowed the students to rapidly design and test, moving the case closer and closer to completion, removing problems and adressing the requirements along the way.

2.3 Requirements

There were a few requirements presented to us at the beginning of the design process: The cluster had to hold at least 5 Raspberry Pi 3 computers as well as a network hub and a power brick, it could not use any glue to stay together, it had to fully incase all parts while having holes for any ports and ventilation, it had to keep all components secure and safe, and the code had to use only variables to define the parts so any change could be easy to adjust to. While there were other components that would be nice to have, these were the main pieces that had to be incorperated.

2.4 Design

Laser cut parts utilize 3mm cut-to-size acrylic supplied to IU from https://www.tapplastics.com/product/plastics/cut_to_ Acrylic may come cast or extruded. Choosing cast acrylic will give a higher quality in color and engraving but it is also more expensive. Here is a list of acrylic options based on the size of the case aranged as it would be for cutting; this is about 21 3/16inx 15in.

- Extruded Acrylic (Clear): $11.16
- Cast Acrylic (Clear): $16.41
- Cast Acrylic (Transparent Colors): $18.81

The list of parts not including the custom made laser cut parts is provided in Table 1.

Table 1: Parts list as copied from https://github.com/cloudmesh-community/book/blob/master/chapters/pi/case.md

Price	Description	URL
$29.99	Anker 60W 6-Port USB Wall Charger, PowerPort 6 for iPhone 7 / 6s / Plus, iPad Pro / Air 2 / mini, Galaxy S7 / S6 / Edge / Plus, Note 5 / 4, LG, Nexus, HTC and More	link
$8.90	Cat 6 Ethernet Cable 1 ft White (6 Pack) - Flat Internet Network Cable - Jadaol Cat 6 Computer Cable short - Cat6 Ethernet Patch Lan Cable With	link
$29.99	Netgear SOHO Switch, 8 port	link
($19.99)	Alternative to Netgear switch but not tested for the case: D-link 8-Port Unmanaged Gigabit Switch (GO-SW-8G)	link

Price	Description	URL
$10.49	SanDisk Ultra 32GB microSDHC UHS-I Card with Adapter, Grey/Red, Standard Packaging (SDSQUNC-032G-GN6MA)	link
$8.59	Short USB Cable, OKRAY 10 Pack Colorful Micro USB 2.0 Charging Data Sync Cable Cord for Samsung, Android Phone and Tablet, Nexus, HTC, Nokia, LG, Sony, Many Digital Cameras-0.66ft (7.87 Inch)	link
$7.69	50 Pcs M2 x 20mm + 5mm Hex Hexagonal Threaded Spacer Support	link
$7.99	Easycargo 15 pcs Raspberry Pi Heatsink Aluminum + Copper + 3M 8810 thermal conductive adhesive tape for cooling cooler Raspberry Pi 3, Pi 2, Pi Model B+	link
$34.95	5 * Raspberry Pi 3 Model B+ Motherboard	link
$6.99	HDMI Cable, Rankie 2-Pack 6FT Latest Standard HDMI 2.0 HDTV Cable - Supports Ethernet, 3D, 4K and Audio Return (Black) - R1108	link

(1) items were replaced with similar :o: note the network switch is a different one, find the one we have so it can be recreated with our part for whcih we designed the case

2.5 Alternatives

There were a few alternatives we looked into for creating the case before settling on the current solution.

- This program creates basic boxes based on any dimension provided by the user.
  - https://www.festi.info/boxes.py/

2.6 Manufacturing Facilities

Most of our testing and production of cases were conducted at the maker space at Luddy Hall of IU's School of Informatics and Computing Engineering. Luddy Hall has two laser cutters, both from Trotech; the Speedy 360 and the Speedy 400. The 360 has a 813x508mm bed while the 400 has a 1000x610mm bed. For our chosen matterial, acrylic, the machines can cut for matterial thicknesses less than 6mm. To ensure that the matterial will fit into the laser cutter, ordered acrylic sheets are limited to the dimentions of the bed minus a quater inch.

2.7 Converting the Design for Laser Cutting

To produce a phyisical copy of our prototypes, we could not simply use the file in it's SCAD format. To ready the design for laser cutting, we first hav to export the file as a SVG. One this is done, the file can be edited in a graphic design program, such as Adobe Illustrator. Edits reqired to prepare the design include the removal of the interior fill color of the case components and adjustment of the edges for cutting. The laser cutter is preset to cut along red lines with a low thickness. For the prototypes, we used a 0.03 point thickness.

The design must also be correctly scaled to the right size. So far, we have achived the corect scaling by finding a feature within the design and find the correct scale factor by measuring it. We are currently considering the posiblity of using the size of the rectangle the case fits into; this should speed up the process, since the dimentions can be viewed in Illustrator by clicking on the artboard tab on the right vertical tool bar and selecting the artboard setings button. Once the design is appropriatly scaled, the artboard must be scaled up as well.

Once all editing is done, the design can be cut. This can be done by selecting the print option in the graphic design program and clicking on setings, in Illustrator, this can be found in the lower left corner of the main print window. If the laser cutter is not selected as the printer, it will need to be selected. The dimentions in the print setings will also need to be adjusted if they are smaller than the size of the design; in Illustrator, the size can be changed under preferences, which is located directly beneath the printer selection. The setings window can now be closed and the "print" button on the main print window can be selected. This will send the file to the laser cutter as a job.

2.8 Images

Images of the case, place them wher eneeded

The case is shown in Figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17.

test fig. 17.

create proper sentences with refs for images

2.8.1 Transparent Case

Figure 1: Case

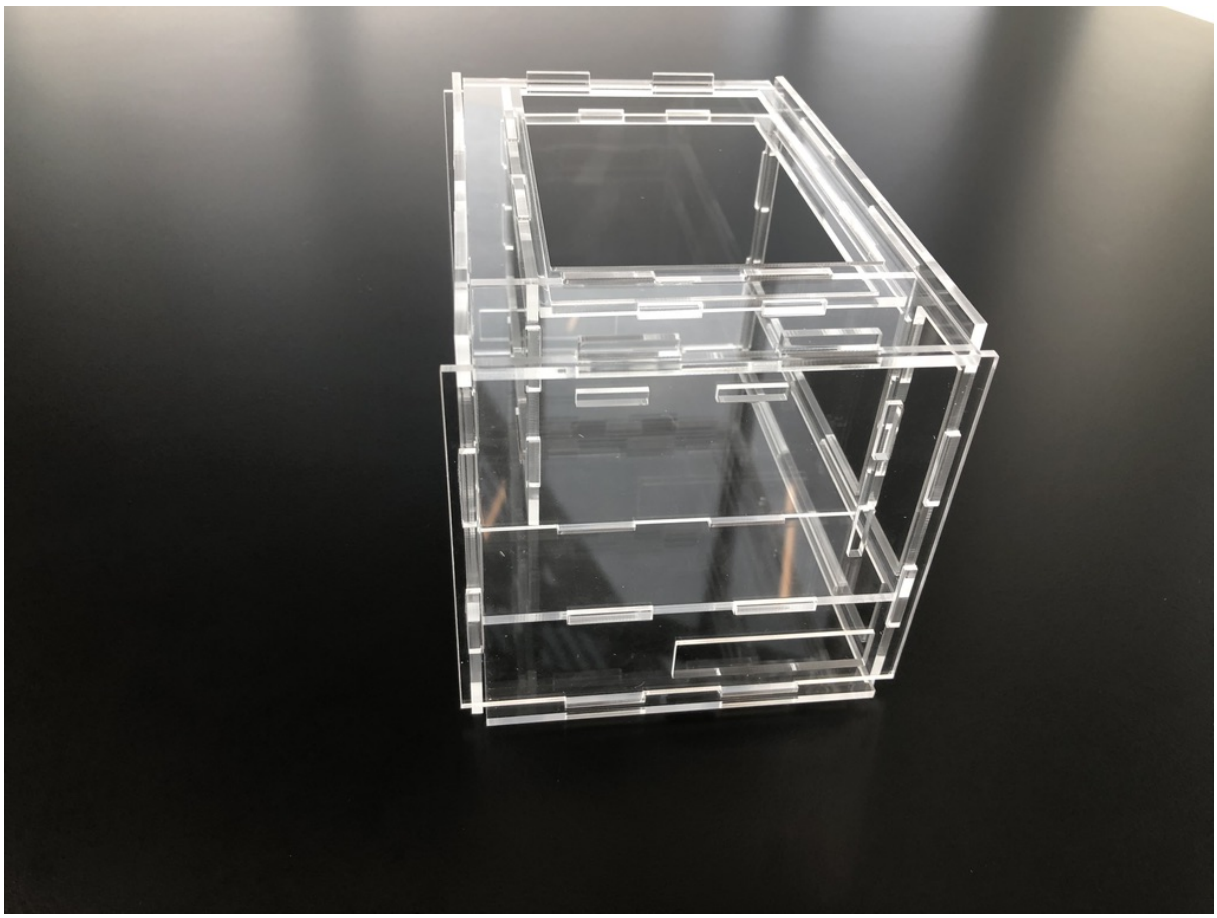

Figure 2: Case

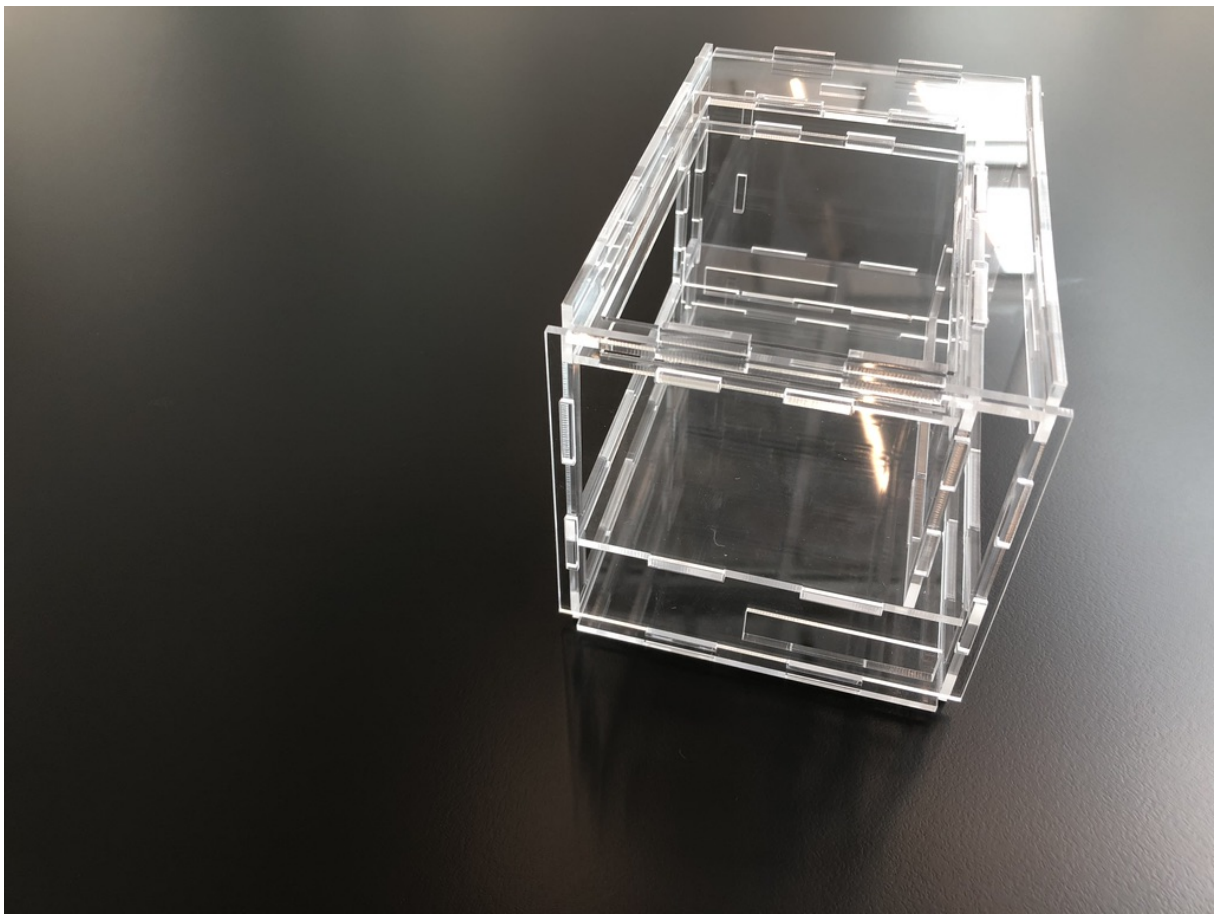

Figure 3: Case

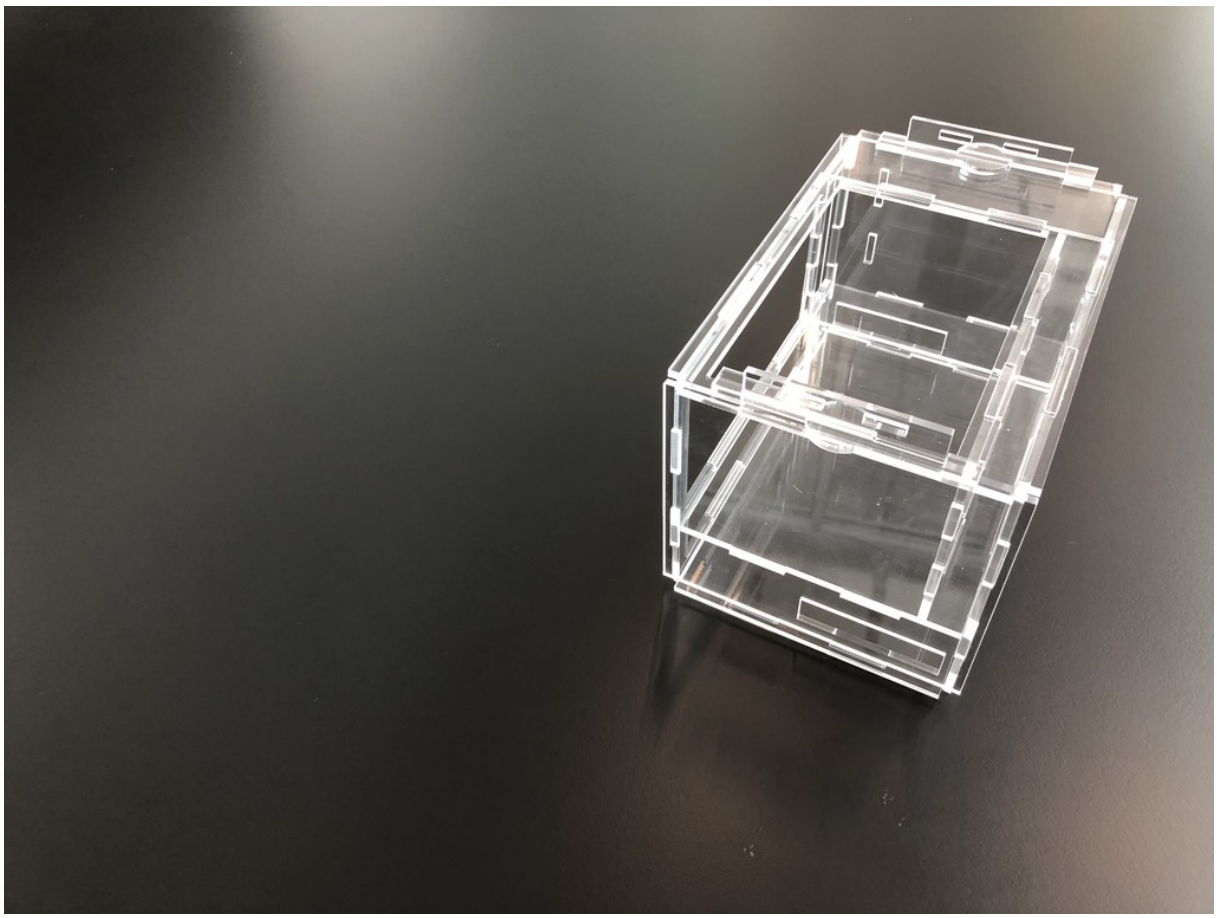

Figure 4: Case

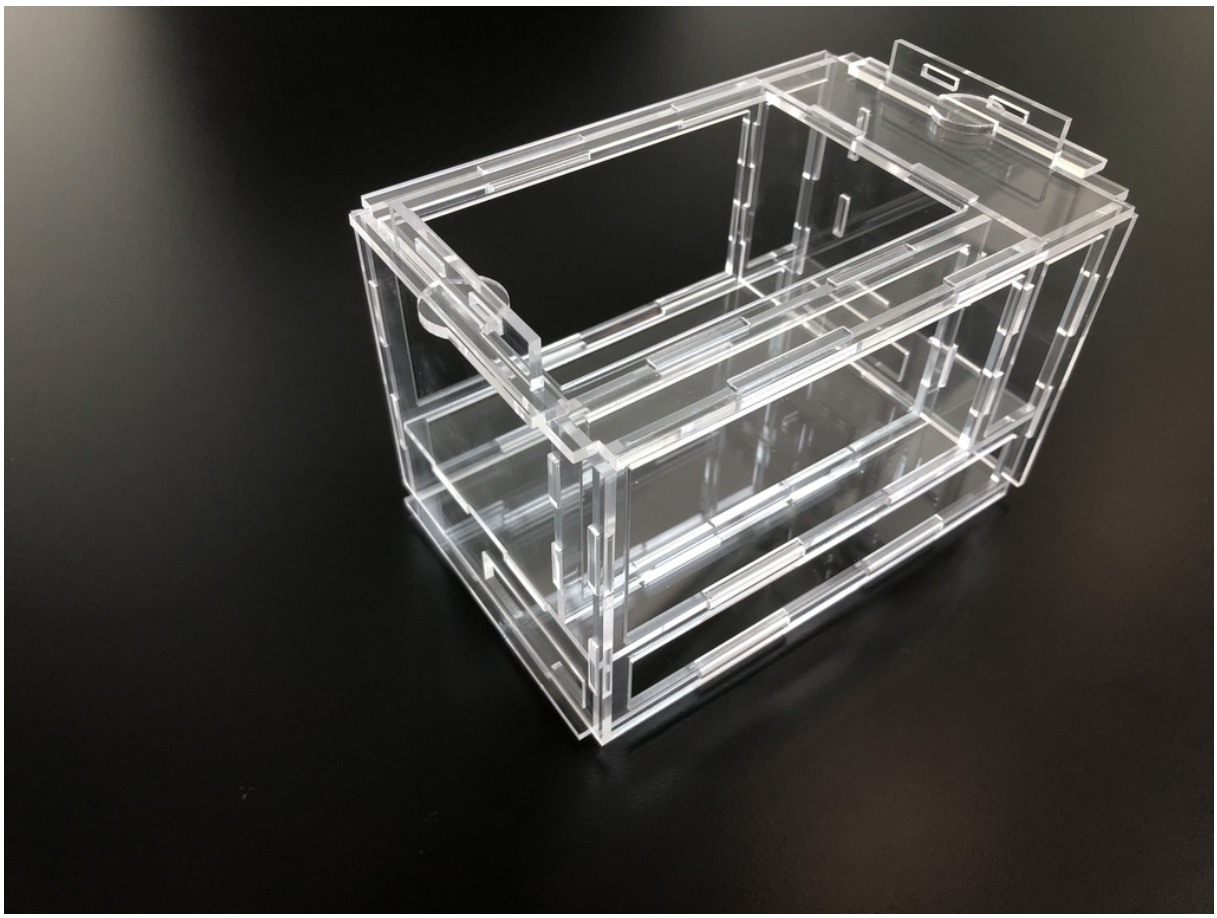

Figure 5: Case

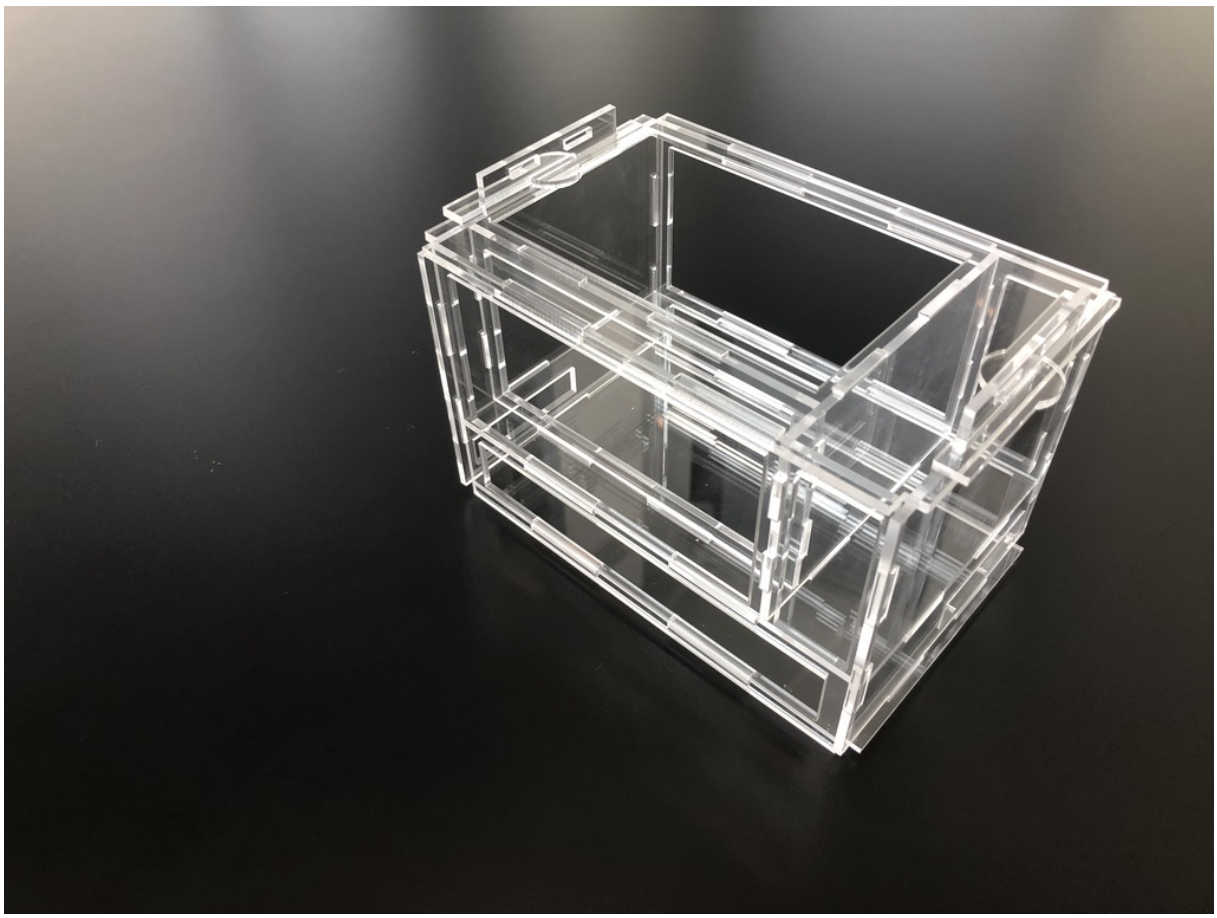

Figure 6: Case

2.8.2 Red Case

Figure 7: Case

Figure 8: Case

Figure 9: Case

2.8.3 Balck Case

Figure 10: Case

Figure 11: Case

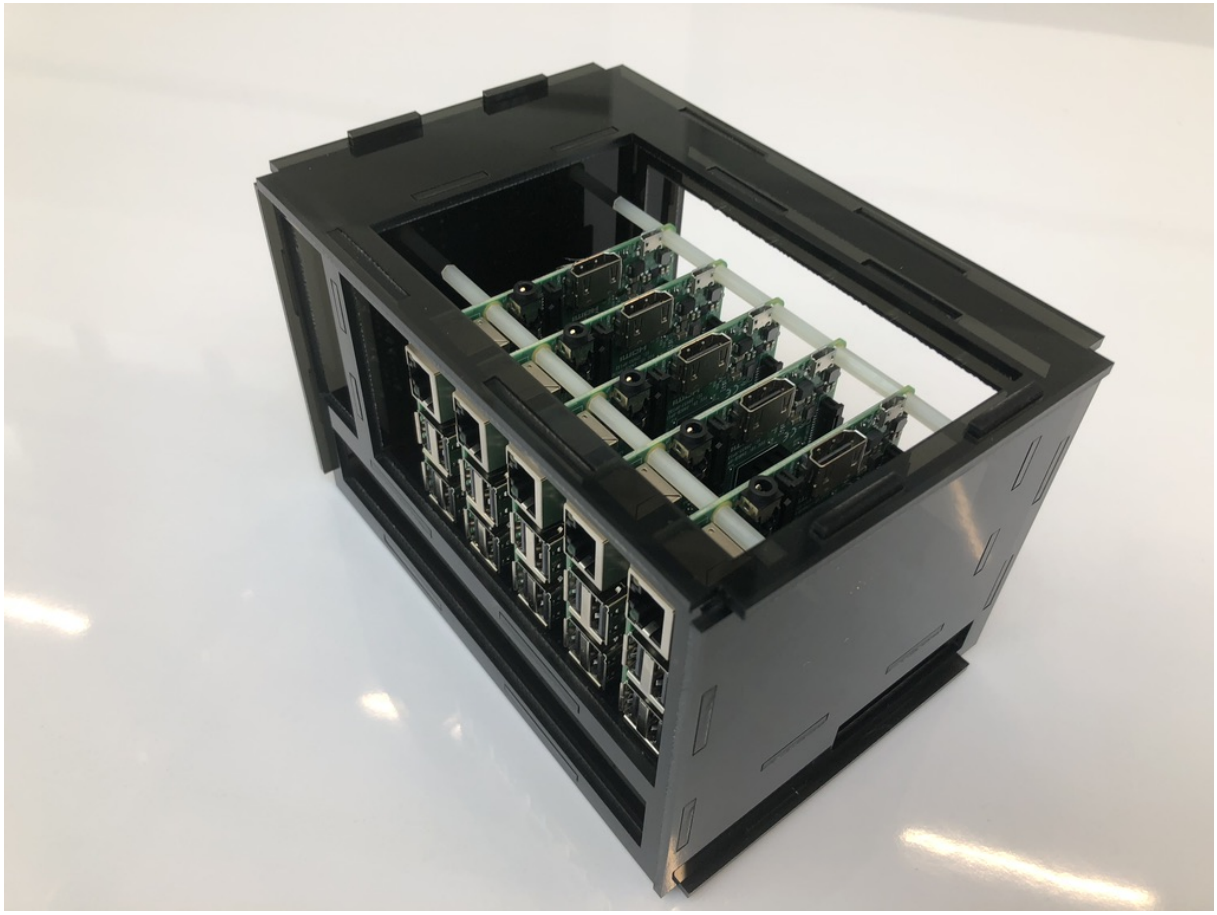

Figure 12: Case

Figure 13: Case

2.9 Exhibit

Exhibit at make vention, urls, and so forth, describe what it is

Figure 14: Case

Figure 15: Case

Figure 16: Case

Figure 17: Case

2.10 Product

Here is the progression of our design, from the first prototype to our most recent model, as well as a link to the .scad and .svg files for the most recent case designs:

- https://github.com/cloudmesh-community/case/tree/master/design/openscadfiles

COMMENT: Not sure if I should put anything else in this section

The case si shown in Figures 18, 19, 20, 21, 22.

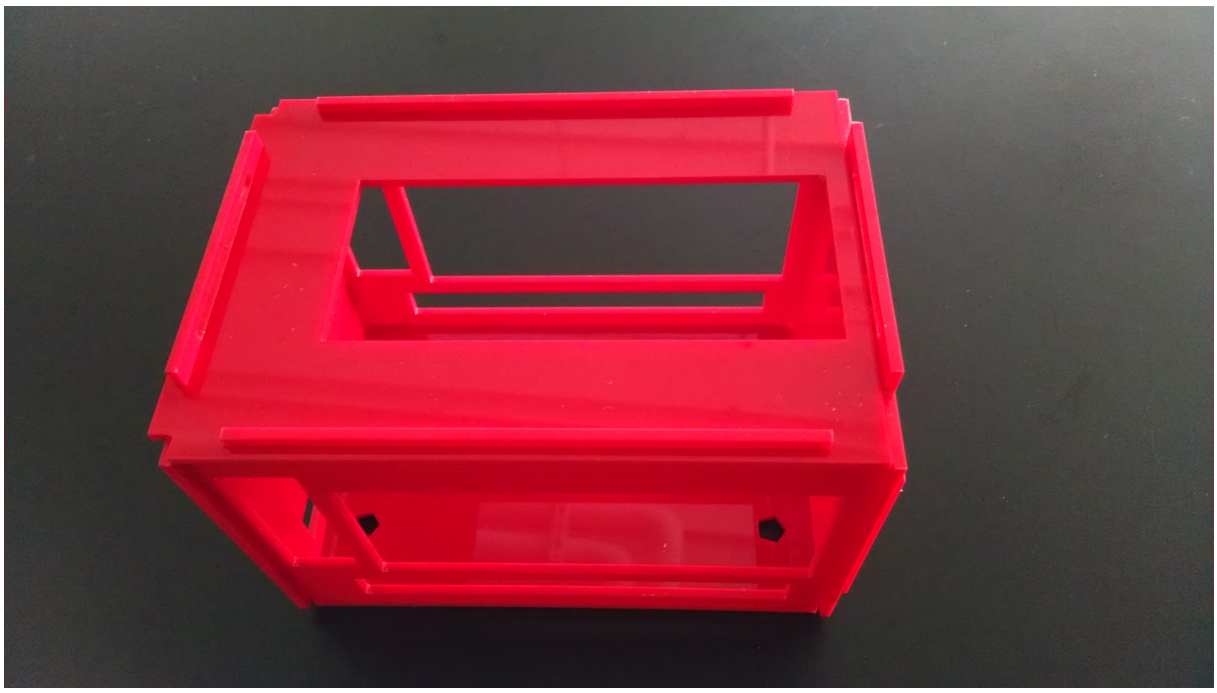

Figure 18: Prototype 1

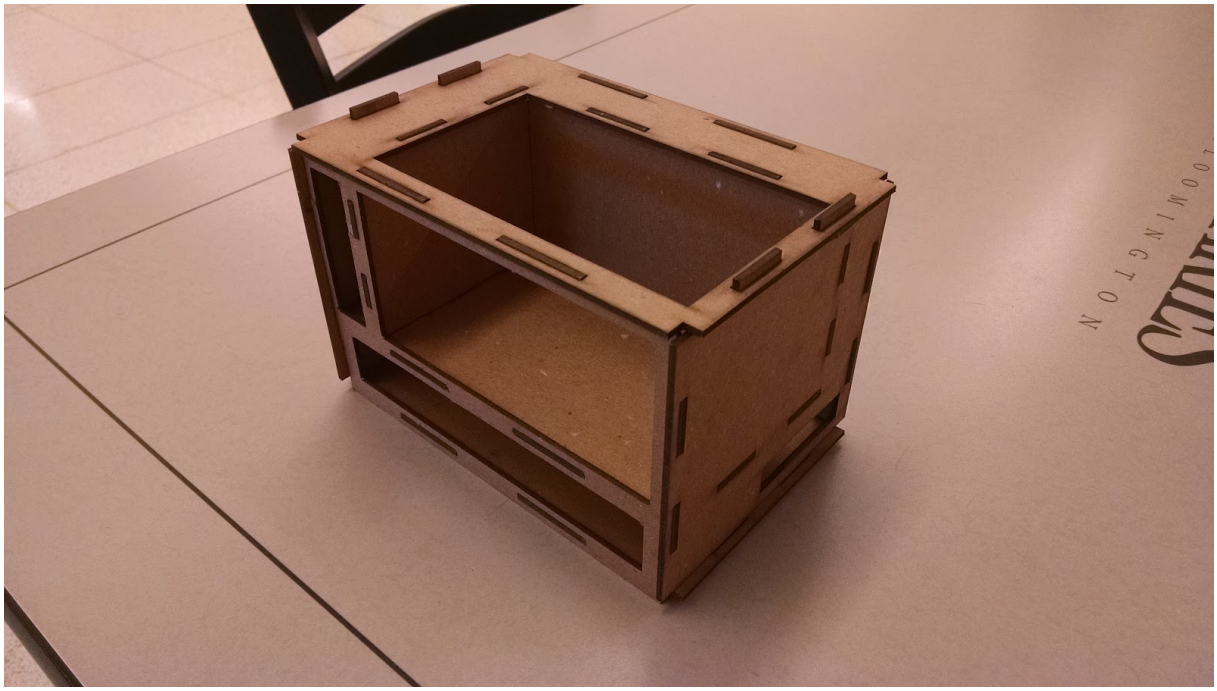

Figure 19: Prototype 2

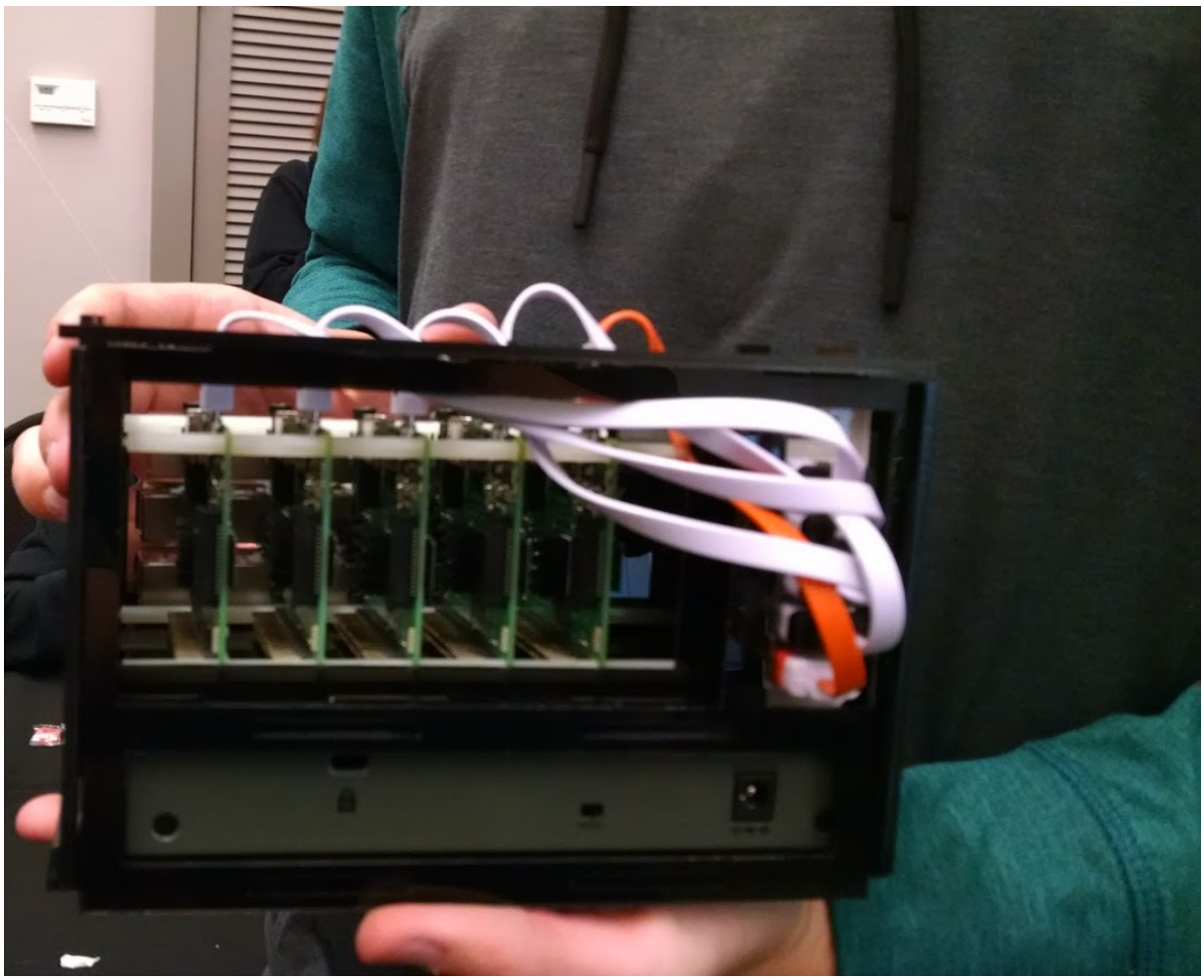

Figure 20: Prototype 3

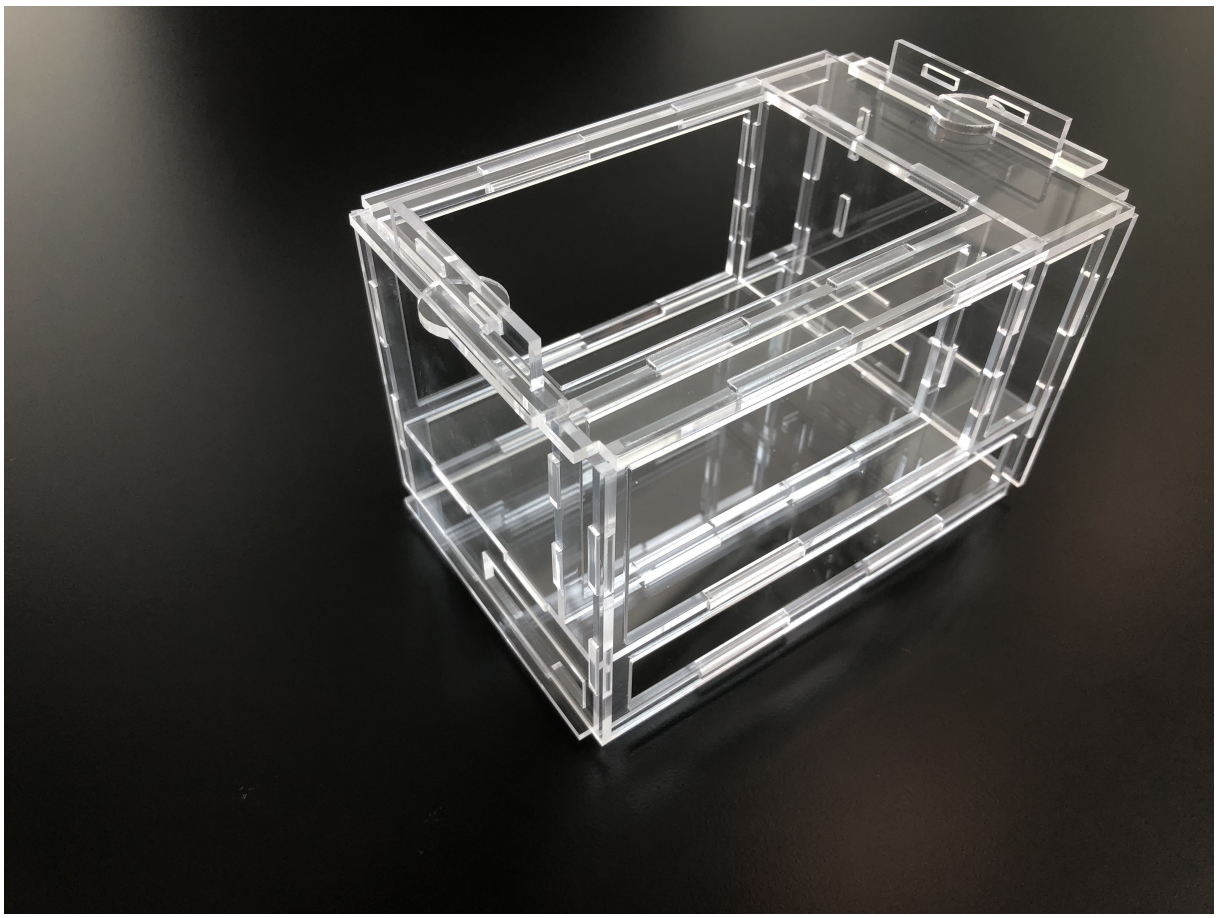

Figure 21: Prototype 4

Figure 22: Prototype 4

2.10.1 Cloudmesh Pi Cluster in a Box

This section describes the design of the box in which we package the cluster ready for shipping or didtribution to students.

2.11 Future work

We will continue to work on the current design, but it is nearing completion, and we have a few more related projects for the future:

- 19 inch rack for 40 nodes via bitscope, https://www.festi.info/boxes.py/Rack19Box
- Shelf for 5 Pi cases.

COMMENT: Should I add more here?

This section lacks details that you need to add. See the links for example in the refernces which already have some information. You also need to create the shelf in some fashipn whhile placing the clusters in it to demonstrate how the shelf would look like.

Here we test a refernce [@www-test]. They need to be placed in refernces.bib in bibtex format.

2.12 Refernces

- Other cases are at https://github.com/cloudmesh-community/book/blob/master/chapters/pi/case.md
- Website for OpenSCAD http://www.openscad.org/index.html