Building a temperature controlling system using a box3d electronics pack

box3d

Introduction

This box3d electronics pack adds temperature control to a 3D printer enclosure. Enclosures can be made custom to almost any printer. A 3D printer enclosure reduces warping and improves layer adhesion by controlling the temperature. The electronics pack adds a system that controls and regulates the temperature inside your enclosure.

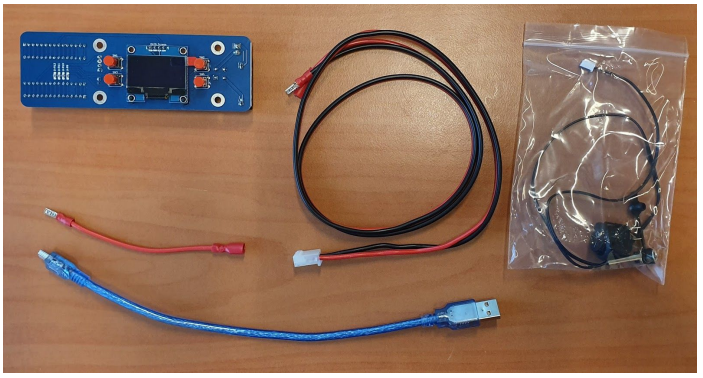
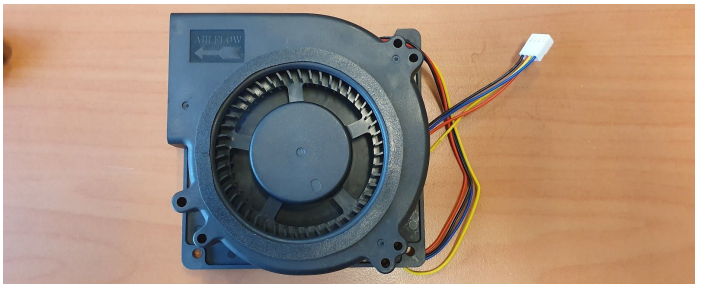
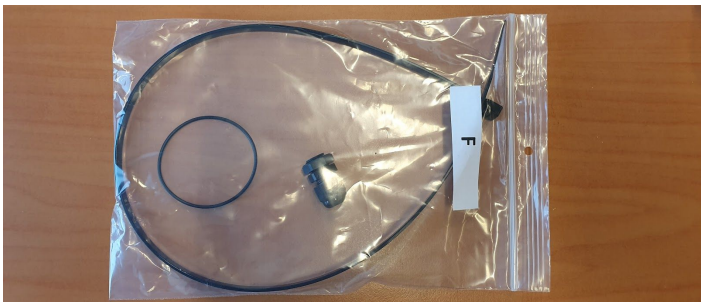
As part of the instructions the box3d electronics pack has been mounted on an enclosure made for a Prusa Mk3S. This enclosure has been made out of Ikea Lack tables. These instructions can be used as guidelines for other types of enclosures.

These instructions are for installing the electronics pack only.
The details of making this enclosure can be found on the Prusa website.

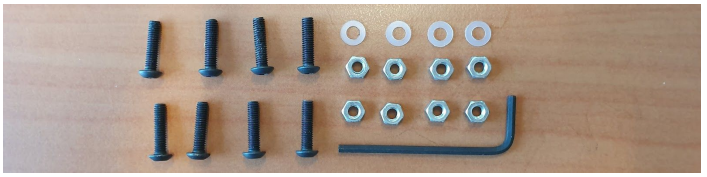
https://blog.prusaprinters.org/cheap-simple-3d-printer-enclosure/

Contents of the Box3D electronics pack

Items included in the electronics pack

Electronics box: Controller Short cable (Red) Long cable (Red / Black) USB cable (Blue) On/off button Temperature sensor Power connector	
Fan	
Bag F: Tie wrap O-ring Gland	

Power adapter (EU) (Alternative US)	

Bag: 8x inbus M4x16mm 8x M4 Nuts 4x M4 Plastic washers 1x Inbus M4 Wrench	

Box3d logo sticker Safety sticker	

3D Printed Items

The printed parts can be found on the box3d website
https://box3d.eu/shop/box3d-electronics-pack/
The printed parts for this Lack enclosure can be found on thingiverse.com
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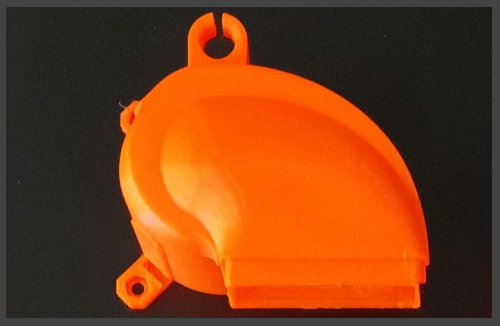
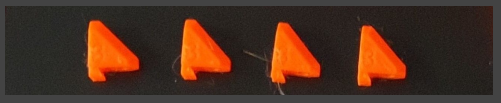
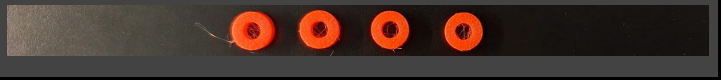
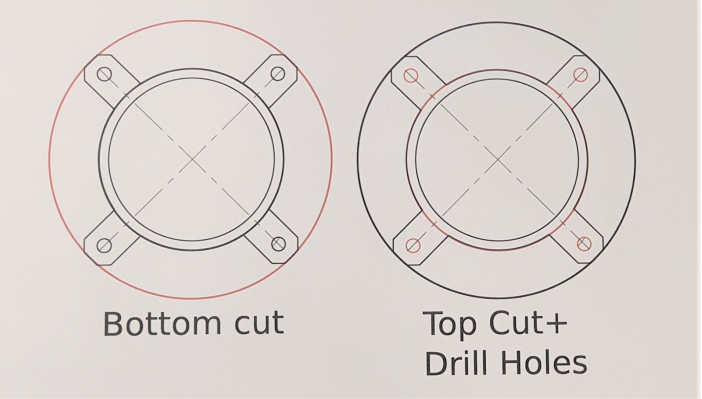
1x Screen Casing (3D Print)	
1x Fan Outlet #9 (3D Print)	
1x Top Cover (3D Print)	
4x Corner #3 (3D Print)	
4x Controller Spacer #8 (3D Print)	

2D Printed Items

It is important that this template will not be scaled. This template can be printed in black and white but the colors indicate what lines to use.

1x Template (A4 Print)	

Printing preparation

Most parts already come with the electronics pack, however some files need to be 3D printed before they can be used.

On the box3d website the files for their full enclosure can be found.
https://box3d.eu/download/

For this enclosure we need the top cover, the modified fan outlet, four #3 corner pieces, the screen casing and 4 controller spacers.

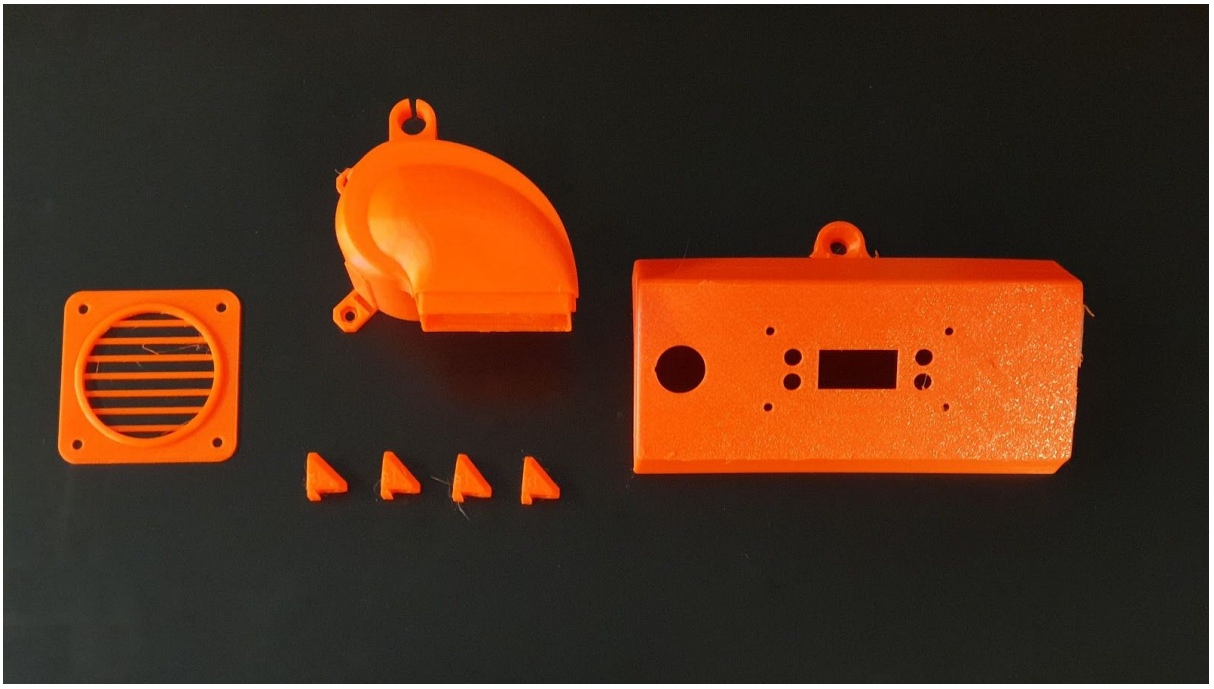


Fig 1: The printed parts for the example enclosure, Top Cover, Fan outlet, corner #3 and Screen_cover

Print out the cutting template, which also can be found on the box3d website.
Make sure your printer settings **do not** scale the drawing.

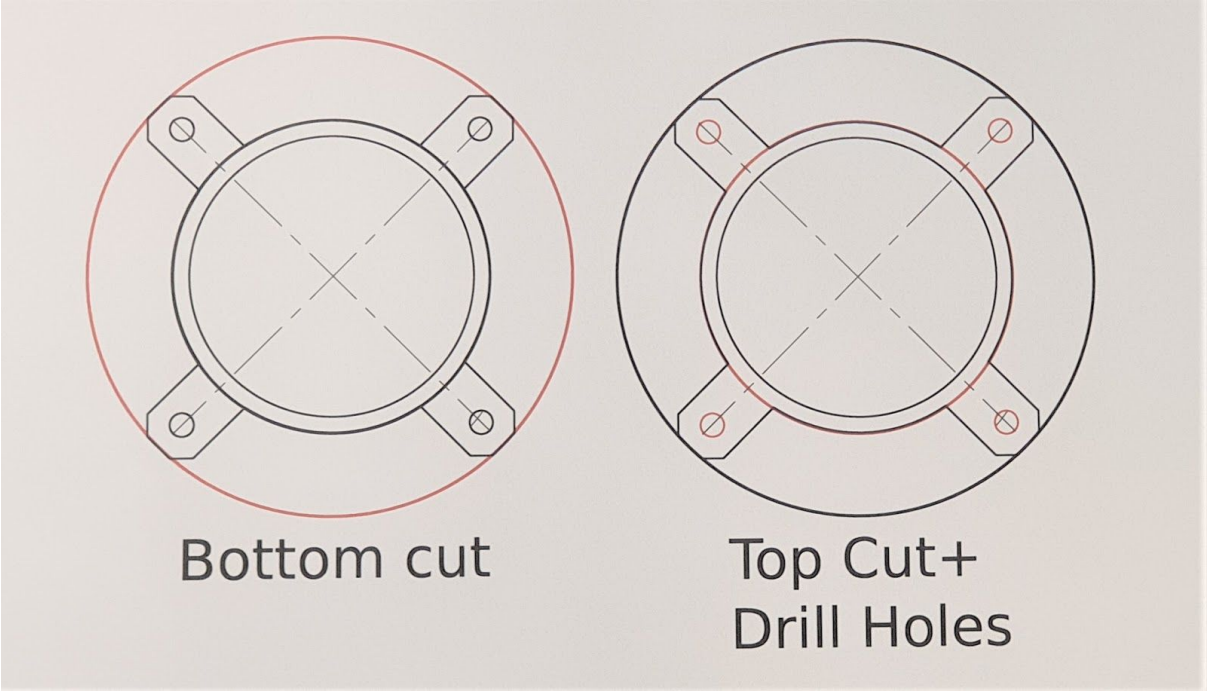


Fig 2: Cutting template

Roughly cut out the templates and make little holes in the middle of the templates as shown in the image.

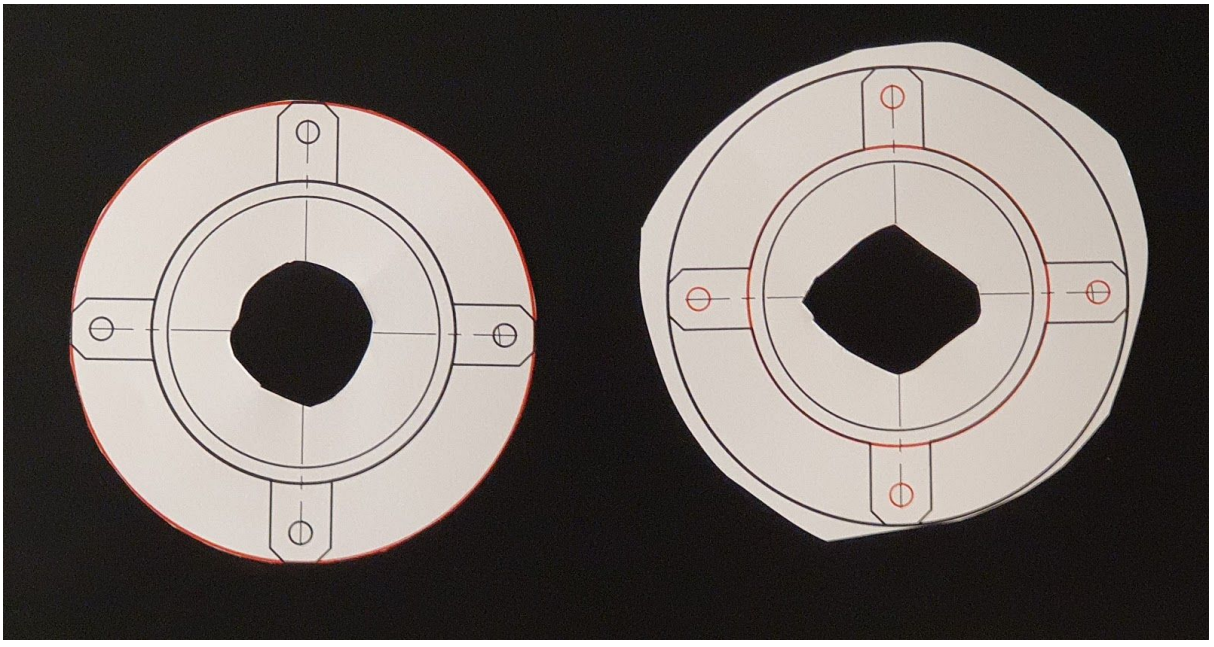


Fig 3: Printed and cut templates

Part preparation

The fan outlet needs some preparation. First insert the four M4 nuts into the holes.

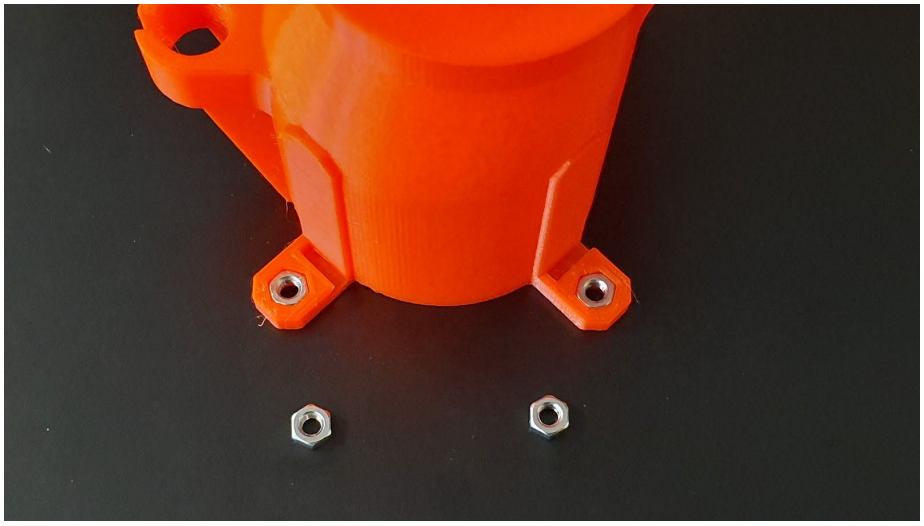


Fig 4: Nuts placed into the fan outlet holes.

Parts needed

1x Fan outlet
4x M4 nuts

Afterwards the nuts need to be covered by sliding the four corner #3 parts into the fan outlet so the nuts won't fall out of their slots.

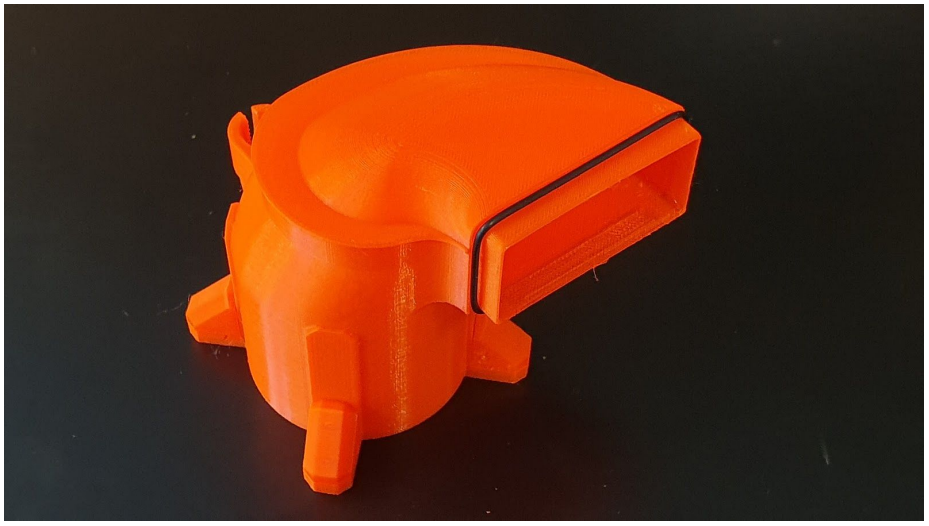


Fig 5: Corner #3 placed on the fan outlet

Parts needed

4x Corner #3

Cutting the top panel

Find the middle of the top and bottom of the Lack table. This can be done by drawing the diagonal lines from corner to corner.

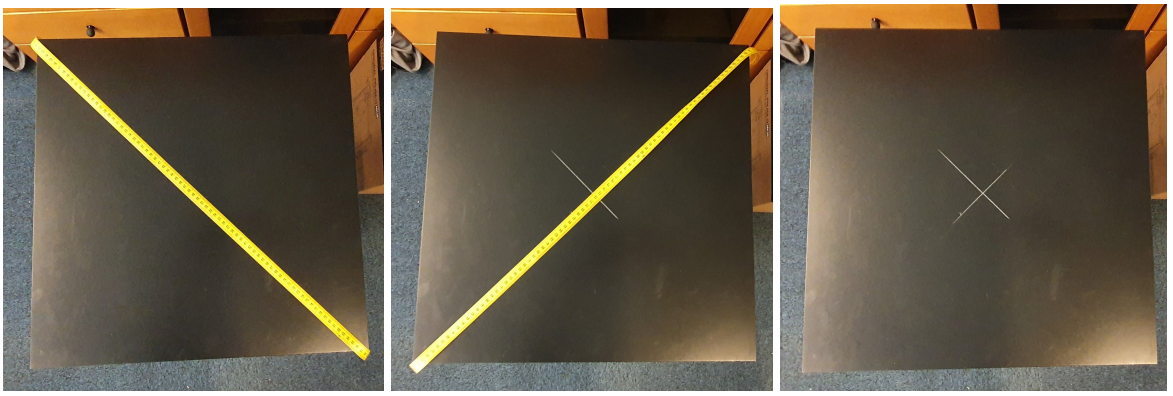


Fig 6: Finding the middle of the table.

On the top, tape the cutting template marked (Top Template). Align the diagonal lines of the template with the diagonal cross on the table.

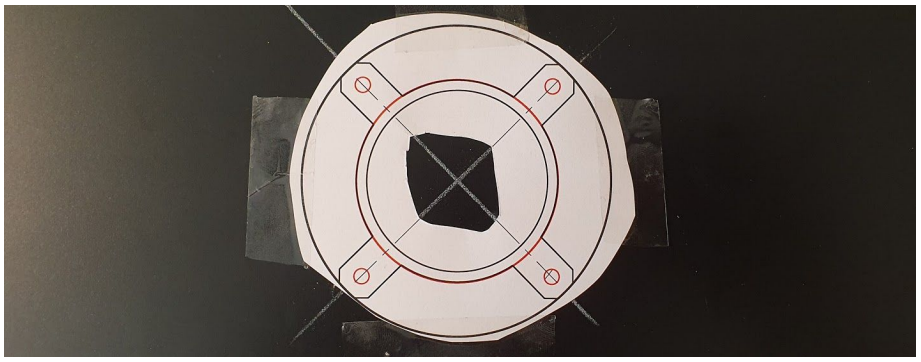


Fig 7: The template centered and taped on the table.

Parts needed

1x Cutting template

Use a 5mm drill to drill out the 5 holes at the place marked with small red circles, be careful because the top layer is only a few millimeters thin.

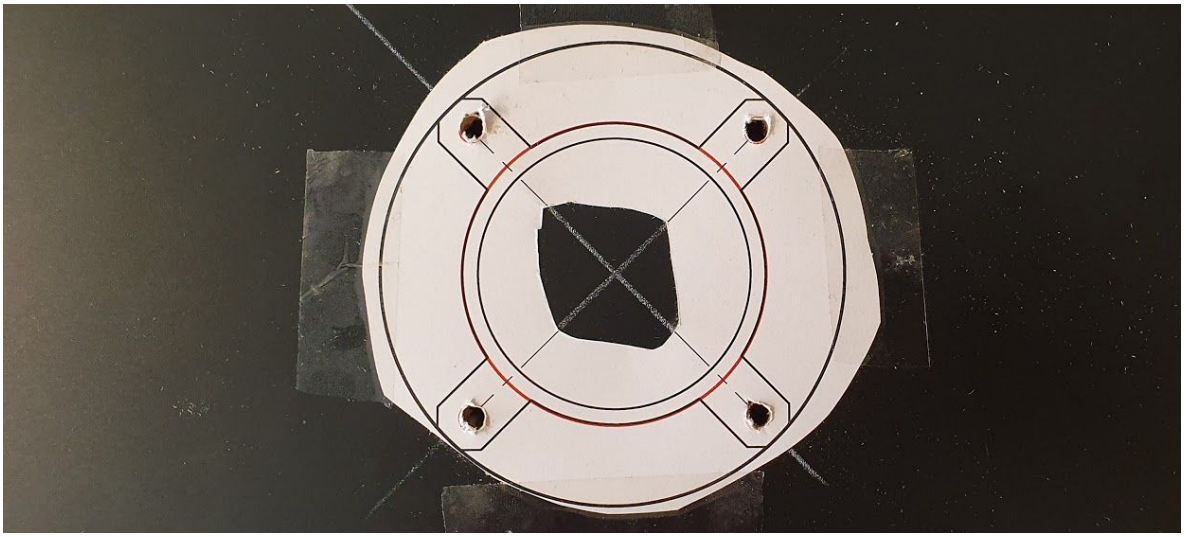


Fig 8: 5mm holes drilled in the marked spots

Using a sharp knife or small saw cut trace the red circle of the cutting template. This doesn't have to be too accurate since there will be a 3D printed part covering it up later.

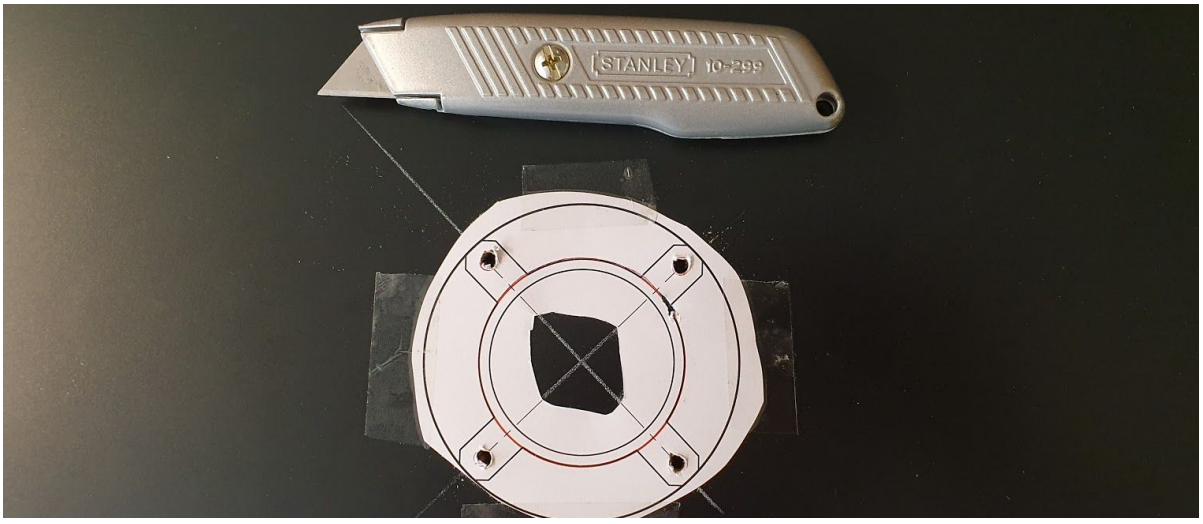


Fig 9: A sharp knife is being used to cut the big red circle between the drilled holes.

By passing the circle several times with a sharp knife the circle should come loose and can be removed, after this remove the cardboard inside to get a clean hole.

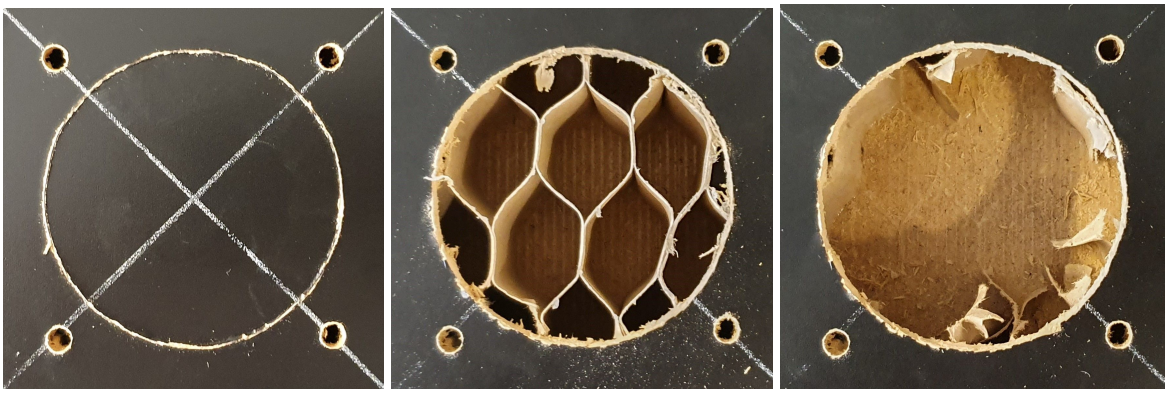


Fig 10: the three steps of cutting the circle through the top of the table.

Using the same method, find the middle, align the bottom template and cut out the hole at the bottom of the table. Remove the cardboard around the drilled holes.

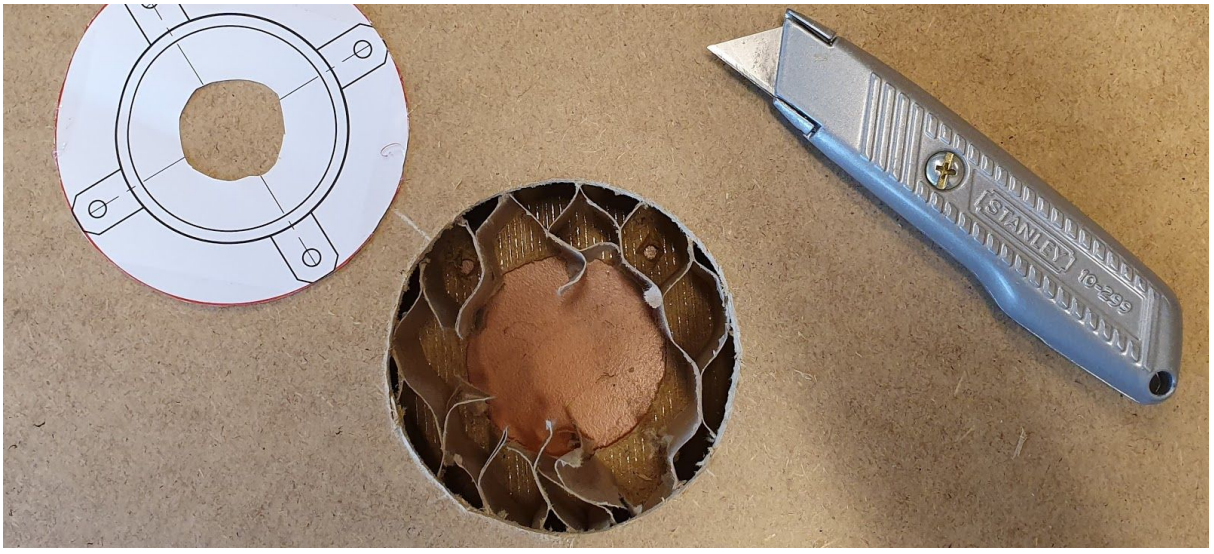


Fig 11: The process repeated for the hole on the bottom of the table.

Drill two holes of roughly ⦸8mm and 20mm apart. Drill these in the middle of the table roughly 40mm from the front of the table. When drilling these holes you decide which side the front of the enclosure will be. The holes will be covered later so this does not have to be very precise. Drill the holes all the way through the bottom of the table.

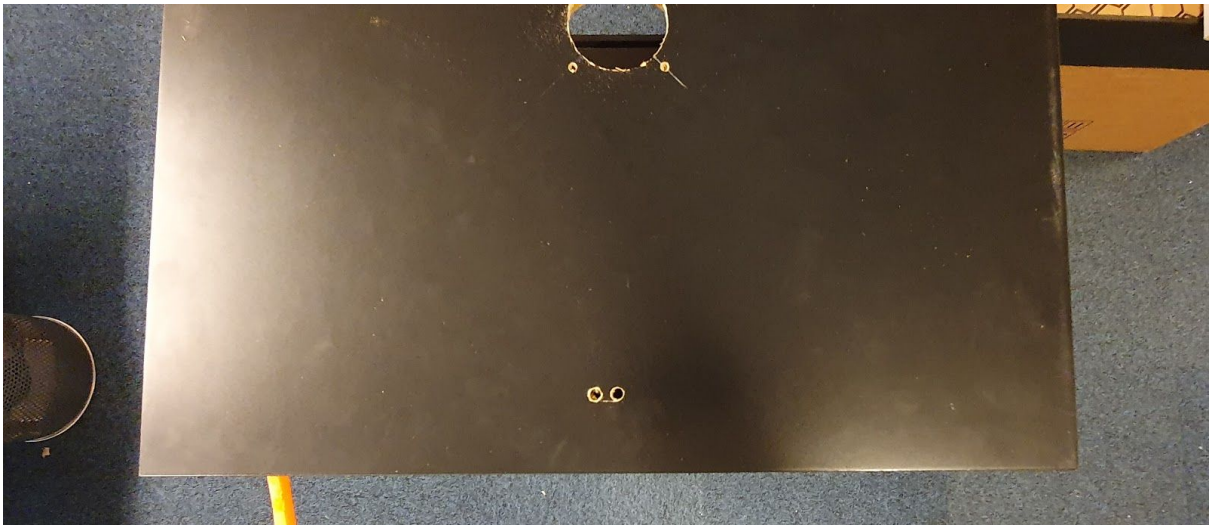


Fig 12: Two holes drilled at the front of the table

Using a sharp knife make a slot by cutting the space between the holes. Repeat this step for the bottom side of the table. Check if the slot is big enough to fit the connectors of the fan and the temperature sensor.

Fig 13: The holes are cut into slots with a sharp knife.

Installing the fan outlet

For this step we need the gland, temperature sensor and O-ring that came with the box3d electronics pack. First screw the temperature sensor in the gland, make sure the sensor sticks out the gland for roughly 10mm as the image shows. Then place the wire of the sensor through the slot on the fan outlet. After that screw it into the 3D printed thread. Lastly add the O-ring to the fan duct.

Fig 14 & 15: The sensor screwed into the gland and pulled through the fan outlet.

Parts needed

1x Temperature sensor
1x Gland

Next fit the fan outlet into the bottom of the table, make sure the four holes drilled into the table match the four legs of the fanduct. In this case the hole had to be slightly enlarged to fit the temperature sensor.

Fig 16: the fan outlet being testfit into the bottom hole.

Grab four of the M4x16mm inbus bolts and the M4 inbus wrench.

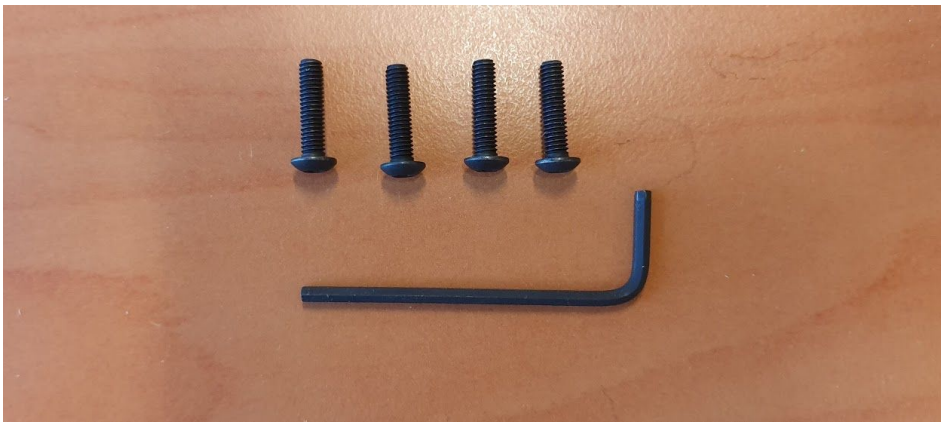


Fig 17: The screws needed to connect the fan outlet.

Place the top cover 3D printed part in the hole on the top and align the holes. Now hold the fan outlet in place at the bottom of the table, placing the side with the O-ring towards the front of the enclosure.

Place the four M4x16 Inbus bolts in the four holes on the top and loosely screw them into nuts that are in the fan outlet. Once all screws are attached screw them tight.

Fig 18: Top view of the table when the screws are attached.

Parts needed

4x M14 inbus bolts
1x M4 inbus wrench

1x Top cover (3D print)

Using the tie wrap and the fan that came with the box3d electronics pack, place the fan on the 3D printed fan outlet and secure it into place with the tie wrap.
The fan outlet 3D printed part has a small ridge that keeps the tie wrap into place.

Fig 19: Tie wrap connecting the fan and the fan outlet

Parts needed

1x Fan
1x Tie wrap

On the bottom, feed the connector from the fan and the connector from the temperature sensor through the hole. Make sure they both come out of the top of the table.

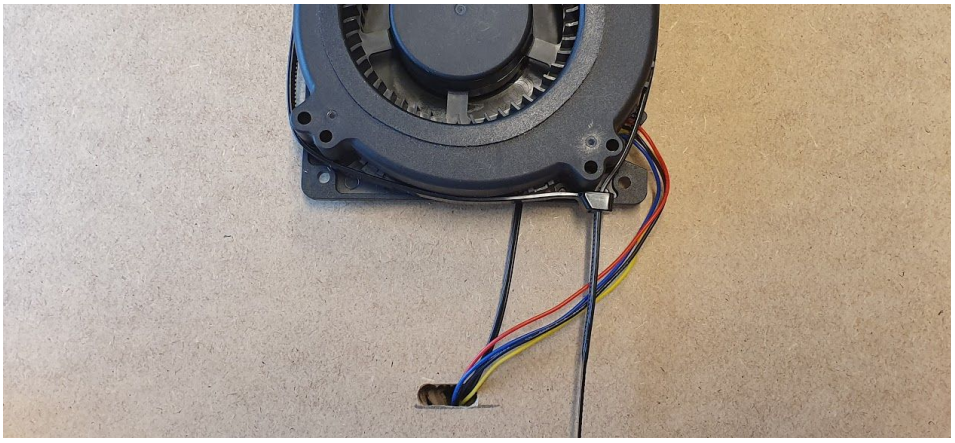


Fig 20: the cables are fed through the hole on the bottom

Prepare the controller board

Grab the remaining four M4 nuts, the M4 plastic washers, the four 3D printed spacers, the M4x16mm Inbus bolts and the M4 Inbus wrench.

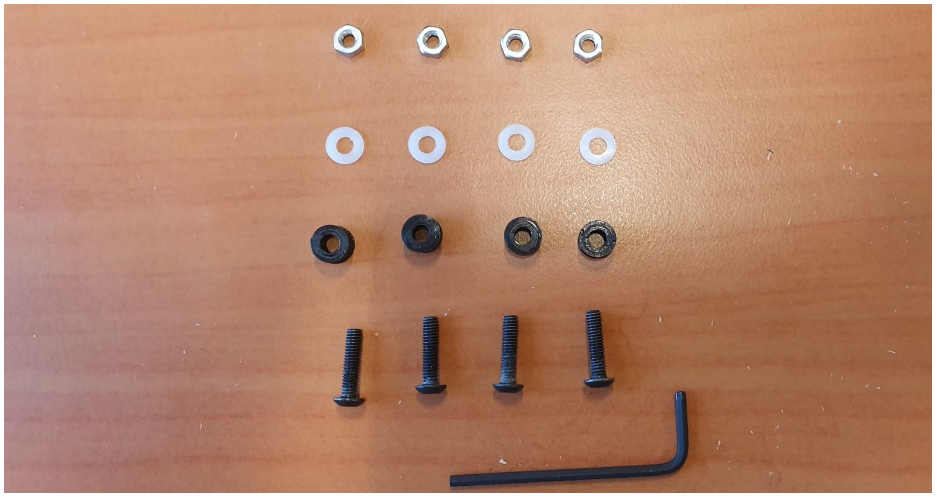


Fig 21: Components needed in this stage

Parts needed

4x M4 nuts
4x M4 washers
4x controller spacers
4x M4x16mm bolts

1x M4 Inbus wrench

Unpack the box3d controller.

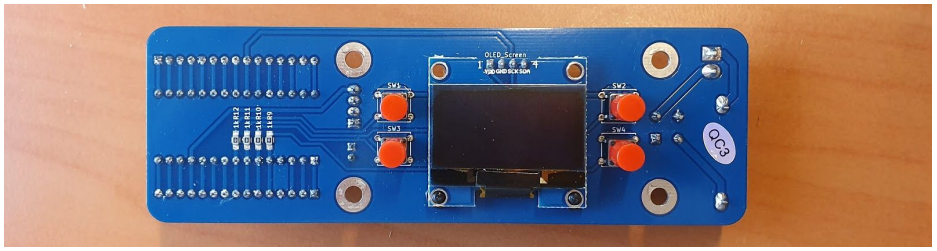


Fig 22: The box3d controller

Parts needed

1x Box3d controller

Grab the 3D printed screen casing and place the four M4x16mm bolts into the four holes.

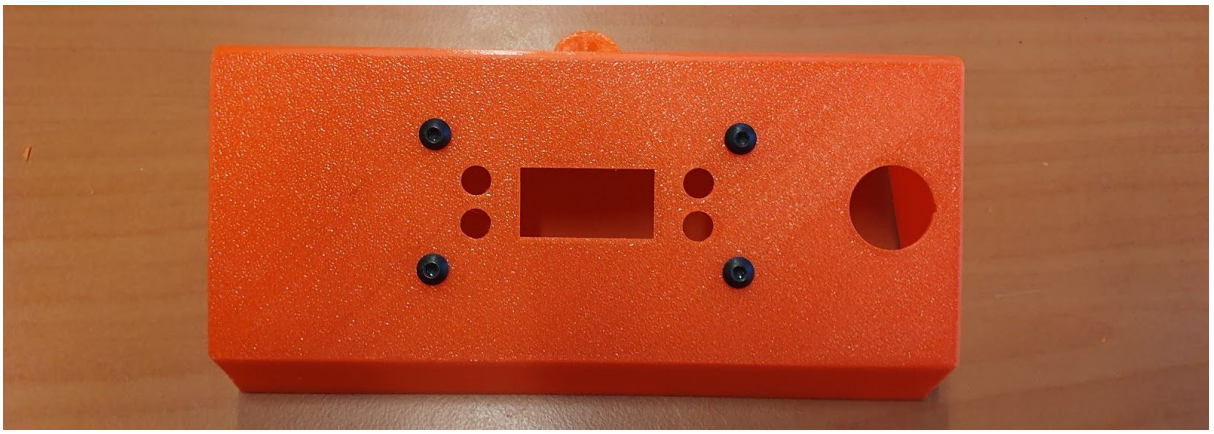


Fig 23: the Screen casing with the screw placed into the correct holes.

Flip the case and place the controller spacers over the bolts on the inside.

Fig 24: The controller spacers (black) placed over the four screws

In this order, add the controller, the plastic washers and the M4 nuts on each bolt.

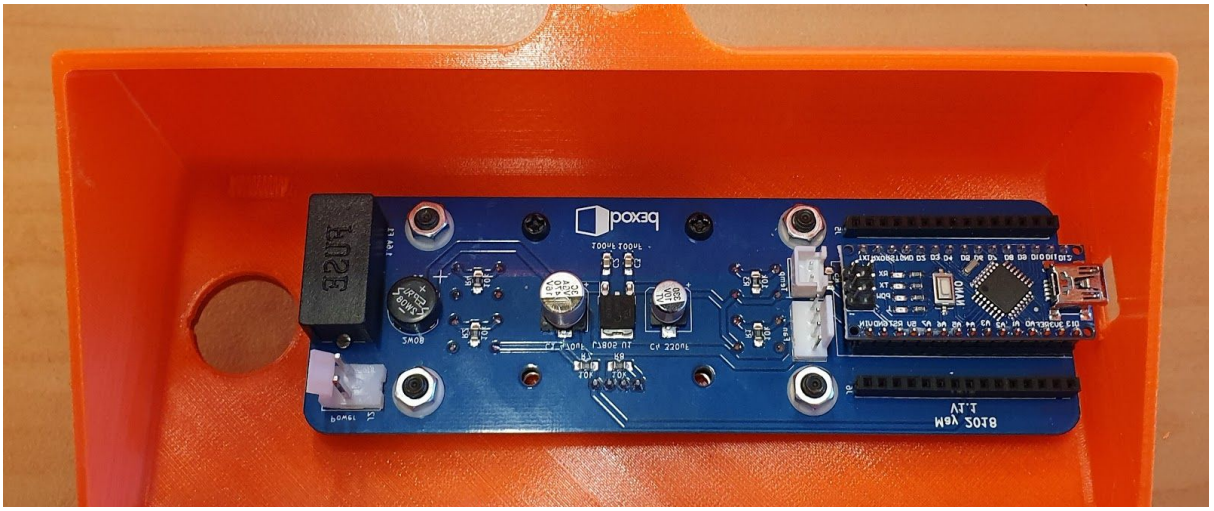


Fig 25: the controller, washers and nuts placed on the screws.

Turn the casing. With a little bit of force press the on/off button in the hole from the outside, push it all the way into the hole.

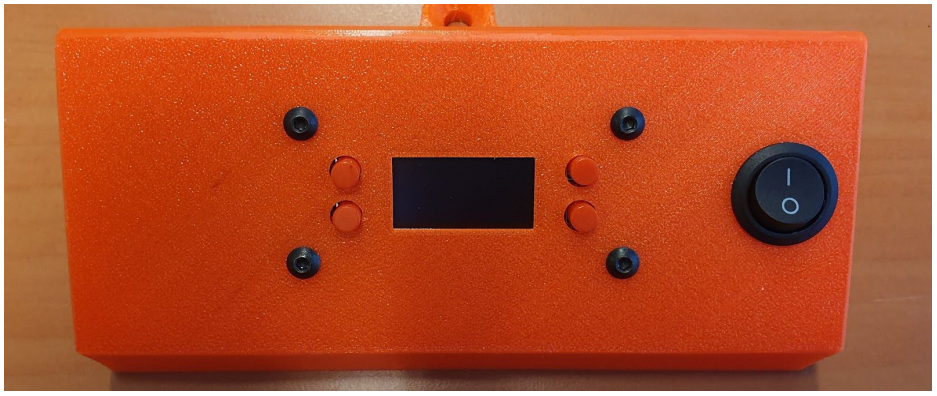


Fig 26: the button pressed into the hole.

Parts needed

1x on/off switch

Turn the casing and add the power socket from the outside into the hole. Place the nut from the inside and screw it tight.

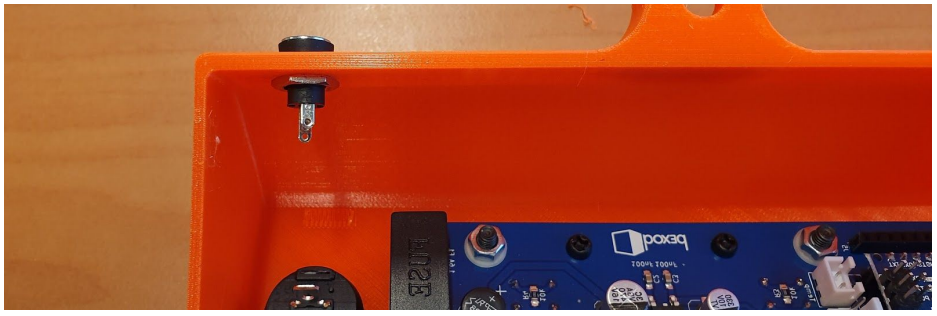


Fig 27: power socket placed into the casing

Parts needed

1x power connector

Connecting the wires

Use the short cable to connect the on/off switch with the power connector.

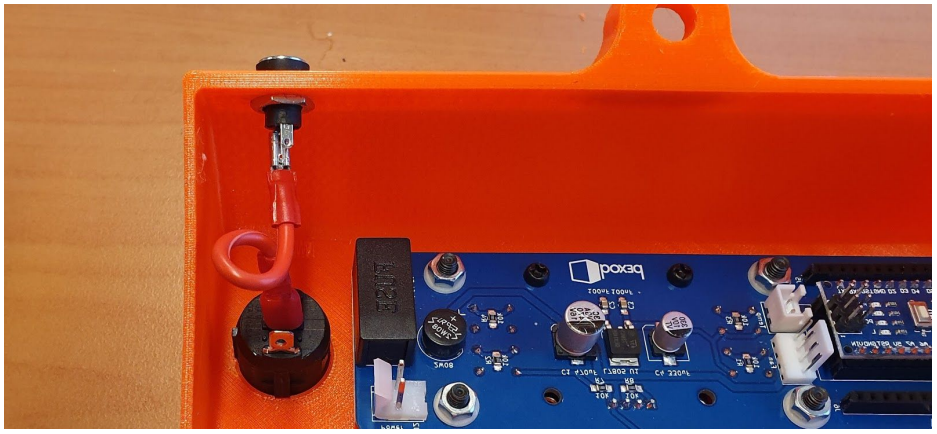


Fig 28: The short cable connected.

Parts needed

1x Short cable (red)

Use the long cable and connect it to the power connector and the on/off switch.

Fig 29: The long cable connected.

Parts needed

1x Long cable (red/black)

Plug the other end of the cable on the controller.

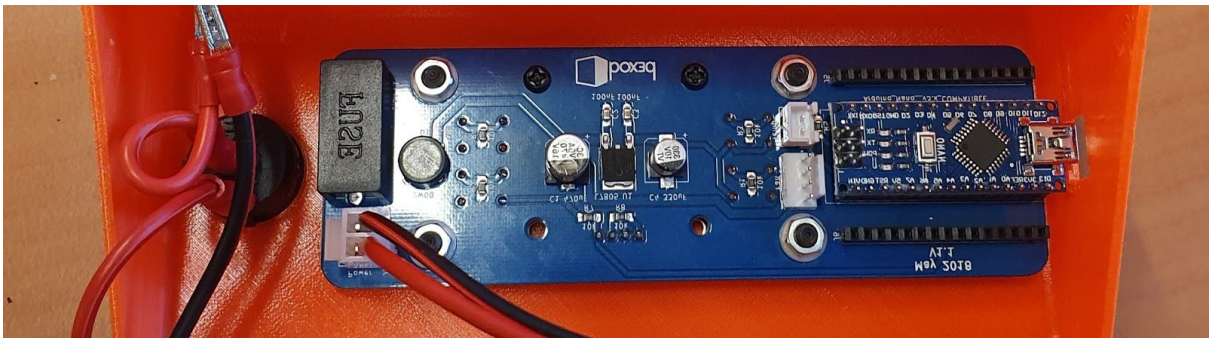


Fig 30: Power cable connected to the board.

Using a small tie wrap, combine the cable in a nice bundle so it will fit in the casing.

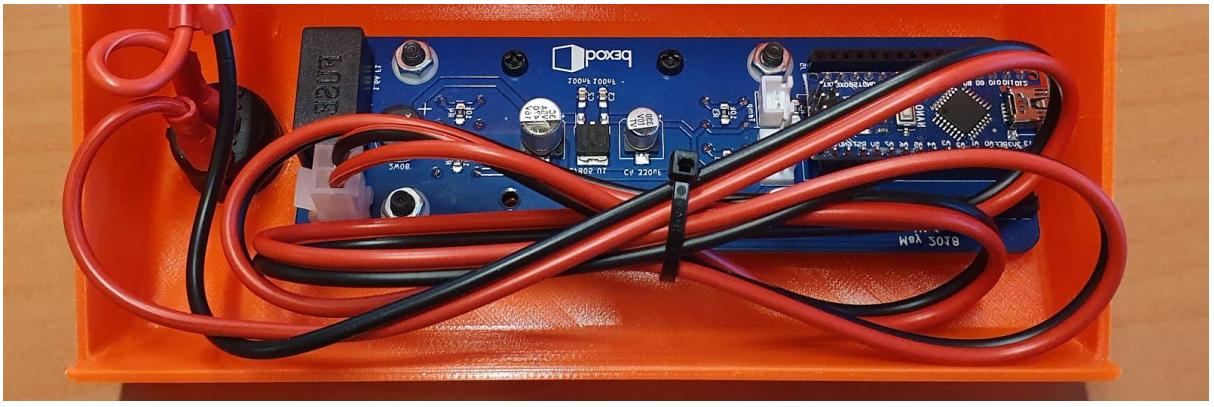


Fig 31: cable management in the screen casing.

Place the casing on top of the table

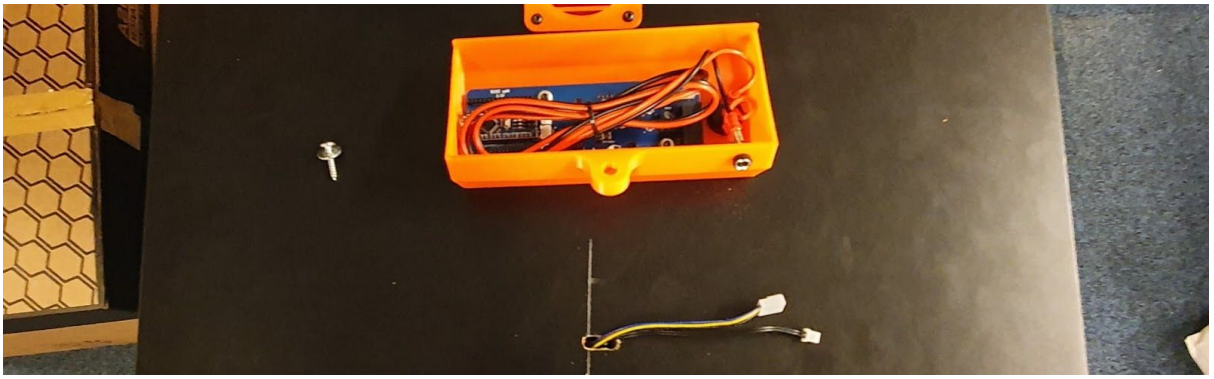


Fig 32: Top view of the table.

Connect the cables of the fan and the temperature sensor to the controller.

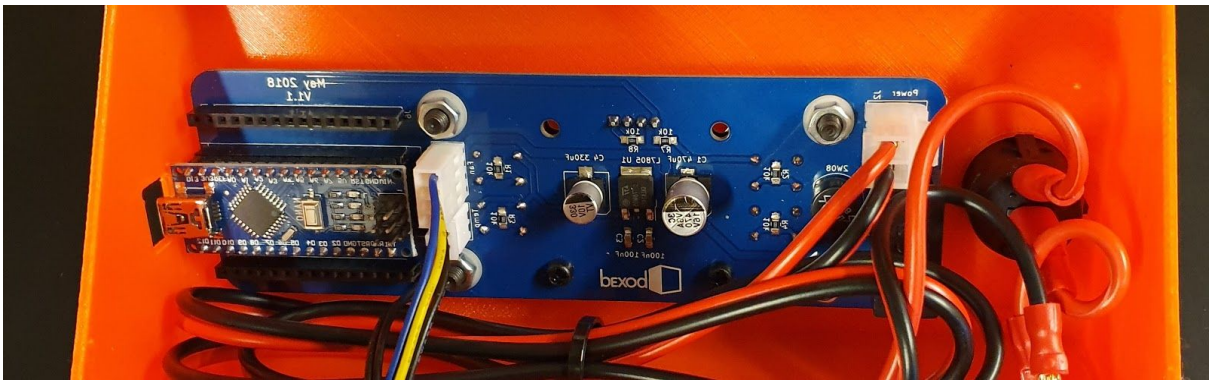


Fig 33: Fan cable and temperature cable connected to the board.

Finalizing the box3d

Turn the panel, position it in the front and attach it to the table with a screw.

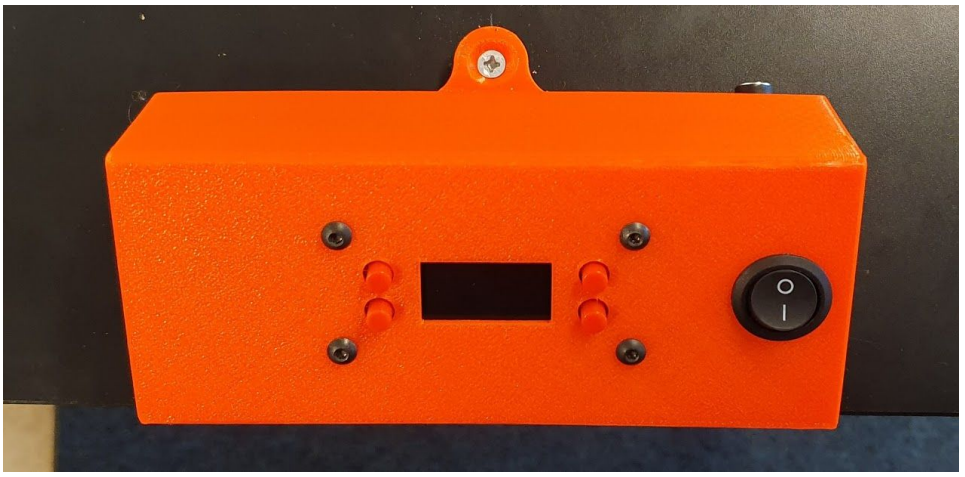


Fig 34: The look of the completed display screen.

Lastly plug in the power adapter to the power connection.
Check it the air temperature (Tair) inside the enclosure matches room temperature.
Try increasing the temperature at which the fan turns on (Tset) by pressing the top right button, the fan should go to 100% when Tset is greater than Tair.

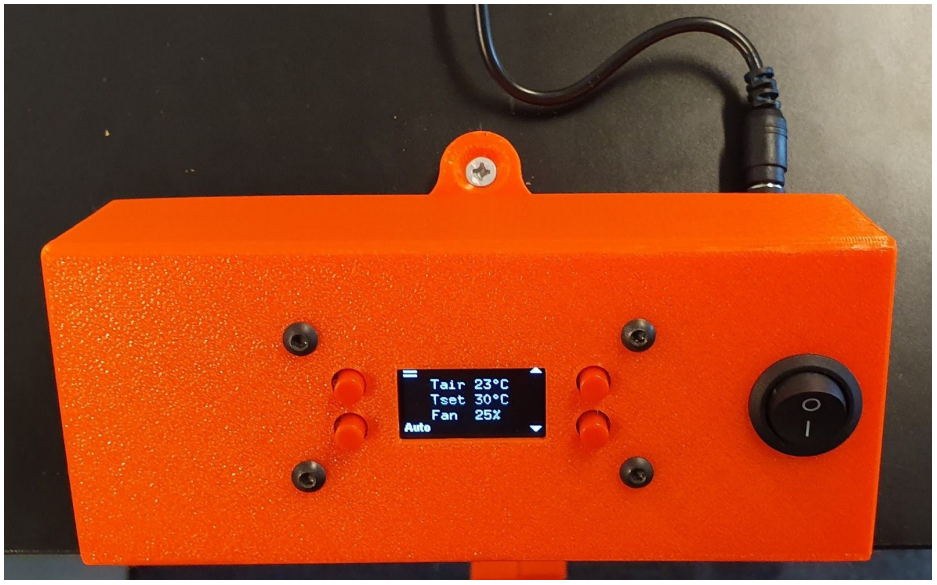


Fig 35: The box3d temperature controller working.

Parts needed

1x Power adapter

Lastly place the box3d warning sticker on a visible place next close to the controller.

And enjoy your temperature controlled 3D printing enclosure.