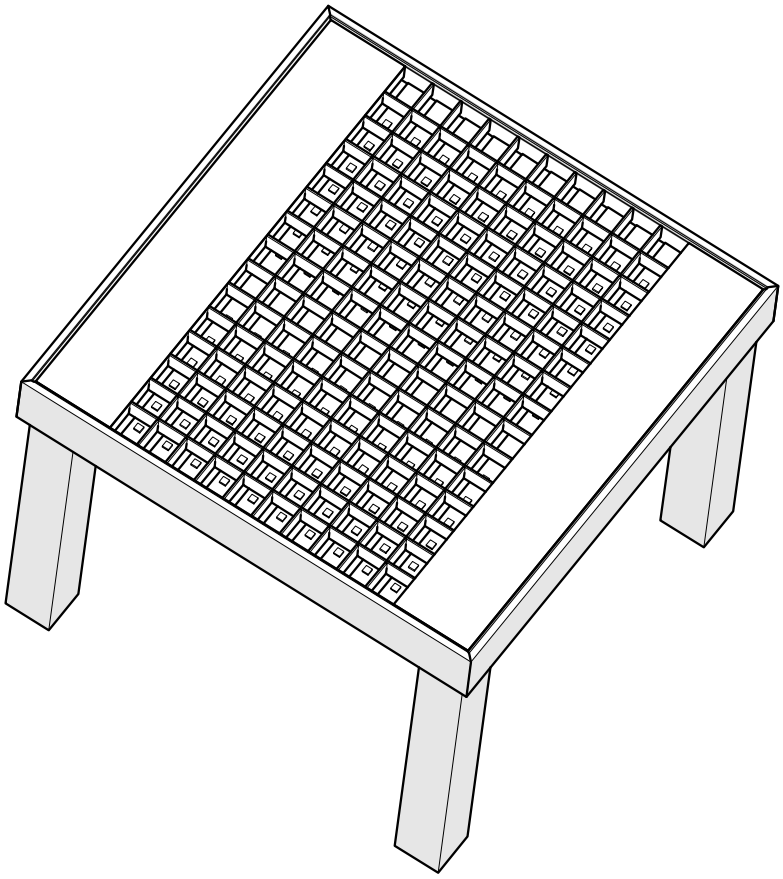
Arbalet LED table

Lack variant

Beta version, last edit: 1 November 2015

Assembly guidelines for DIY building



Preliminary notes

This document describes how to build an Arbalet LED table licensed under an Open Hardware CC-BY-SA licence. It is then permitted and formally encouraged to take inspiration from this work to build new Open Hardware items and publish them to the community.

https://github.com/arbalet-project

https://twitter.com/arbalet_project

1. Overview of the overall assembly

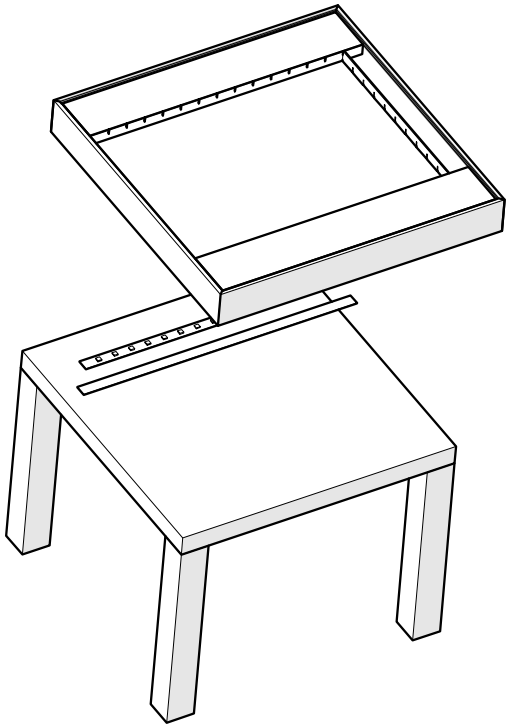


Illustration 1: Exploded view of the table: the table tray and the additional tray

The LED table is built with an Ikea Lack table. 10 LED strips are stuck over the table tray thanks to adhesive tape. An additional tray delimits the pixels and will support the weight of objects.

Illustration 1 shows the additional tray as a single block, the detail is shown on the next illustration.

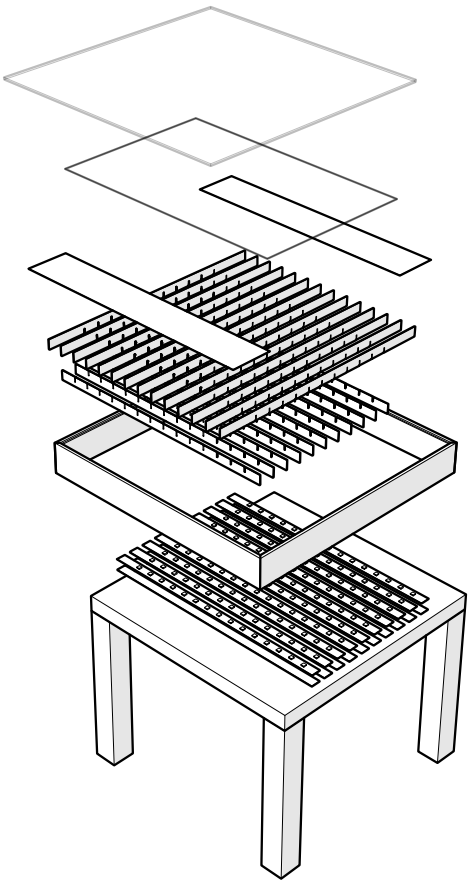


Illustration 2: Full exploded view of the table

Illustration 2 shows a complete exploded view, each layer being:

- The original Ikea table
- The LED strips stick onto the table thanks to adhesive tape
- The outer frame
- The inner grid
- 2 pieces of opaque paper hiding the unpixelated surface
- The diffuser: A piece of cooking paper
- The glass

2. All the stuff you need

- An Ikea “Lack” table

Arbalet Lack variant uses an Ikea coffee table model “Lack” dimensions 500x500 mm.

- A LED strip

A 5m LED strip with WS2812B chips of density 30 LEDs per meter. The density defines what size the final pixels will be, in this case 33.3x33.3 mm. The strip is presented as a 3 wire bus: *Power + (red, aka 5V)*, *Power – (black, aka GND for Ground)* and *Data (green, or any other color)*. The Data line is ordered, in the sense that each chip has a Data IN (DIN) and a Data OUT (DOUT), so we must always connect a Data IN to a Data OUT.

- An Arduino Leonardo microcontroller

The Arduino microcontroller will receive the pixel matrix from Python and generate the data signal to the LED strip. You can also use an Arduino Uno or any other Arduino board. Don't forget its micro USB cable (or mini USB depending on your version).

- A 5V power supply >5A

Use a regulated power supply of at least 5 amps.

- Some wires ~ 20 AWG

The wires will be used to connect the cut sections of the LED strip. We will need to connect 3 wires: *Power + (red)*, *Power - (black)* and *Data (green, or any other color)*. The 2 power wires will drive up to 5A and might melt if they are too thin. The strip is sold with a 20 AWG cable, meaning that its copper inner wire is 0.8 mm thick. You should keep this section for the 2 power wires for safety purposes. For the Data line, you might use a very thin wire as it drives very few current. If you want to calculate precisely the section of power wires, refer to the standard.

- A credit card sized soldering board

This card will go right above the Arduino, fastened to the microcontroller thanks to pin headers. You can also use soldering boards dedicated to Arduino, already mounted with PIN headers and screw connectors if you're not familiar with soldering.

- Some male pin header (optional)

Only few pins will actually be used, but using more pins will fasten the board stronger to the Arduino.

- A DC power barrel jack (optional)

Have a deeper look to the power supply you have selected and its type of plug. Order the soldering-compatible female socket that will allow to plug the power supply.

- A 16µF capacitor (optional)

If your power supply is shoddy, this capacitor can help it to provide enough energy to the LED strip in case of peaks of current, for instance when all pixels are suddenly lit from black to full brightness.

- 700x500 mm of 2 mm thick wood or plastic

This piece of wood will be used to build the grid separating the pixels from each other. Choose a material that is easy to saw.

- 260x525 mm of 10 mm thick wood

This piece of wood will be the outer frame. This frame makes a ring to the table and has to be screwed to the table tray in order not to fall down. A groove made at the top will host the glass and prevent it of slipping.

- 500x500 mm of 4 mm thick glass

The glass will finish the surface. Using toughened glass is better for safety purposes in case of breaking, however its tough properties make cutting difficult or impossible. Ask advises to your local mirror dealer. You should NOT cut it before having built the wooden frame to ensure that it will properly fit the frame.

- Other material and tools

Cooking paper or privacy sticky film to diffuse the light, some black paper with 500 mm length to be used as a cover outside at the place there is no pixel, black paint for the outer frame, > 8 wood screws to fasten the frame to the tray, double-sided tape, a soldering iron and tin, a saw or any machine to help you cutting the wood/plastic, a cutter, a long ruler, a pencil and scissors. Also do not forget that you will need a laptop connected to the Arduino since Arbalet is Python powered; alternatively you might use a raspberry pi computer or any computer able to run a Python interpreter.

3. Prepare the LED strip

A) Remove the rubber sheath

If your strip comes with a waterproof silicone rubber sheath, remove it carefully using a cutter. Be careful not to damage the LED strip itself. The 2 endpoints of the strip are drown into rubber and require special attention.

You can throw away the cut rubber sheath that is not used in this project.

B) Cut the LED strip into 10 pieces of 500 mm each (15 LEDs each)

Use scissors and make sure you keep a soldering area to resolder both sides of the string after cutting.

You have now 10 pieces of strips, two of them have factory-soldered connectors.

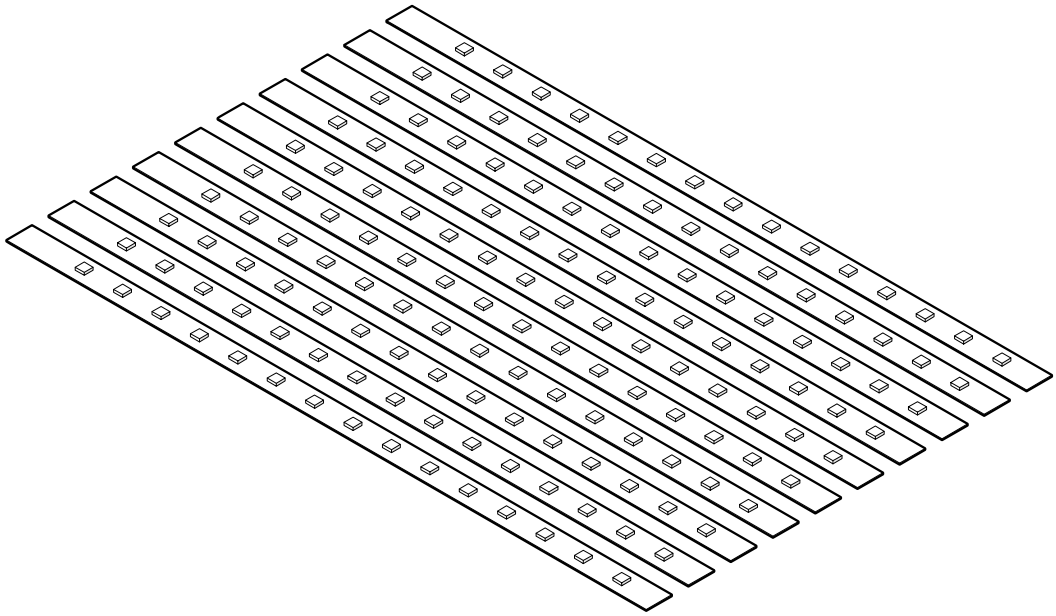


Illustration 3: 10 cut pieces of strips with 15 LEDs each

C) Unsolder the factory-soldered female connector

The LED strip comes with a male and a female connectors. Unsolder the one that is connected to a DOUT pin and keep it on hand we will reuse it for the connection Arduino ↔ LED strip. Make sure you don't overheat the strip while unsoldering. Do not unsolder the cable that is connected to the DIN side.

You have now 10 pieces of strips, and only one of them has a factory-soldered male connector.

4. Prepare the table

A) Draw 10 centred lines separated by 33.3 mm each with a pencil

These lines will help you to stick the 10 strips over the table. Make sure they are centred and separated by 33.3 mm from each other. Centring them will leave 2 empty spaces of 100 mm of both sides.

B) Arrange the strip over the tray and stick them with double-sided tape

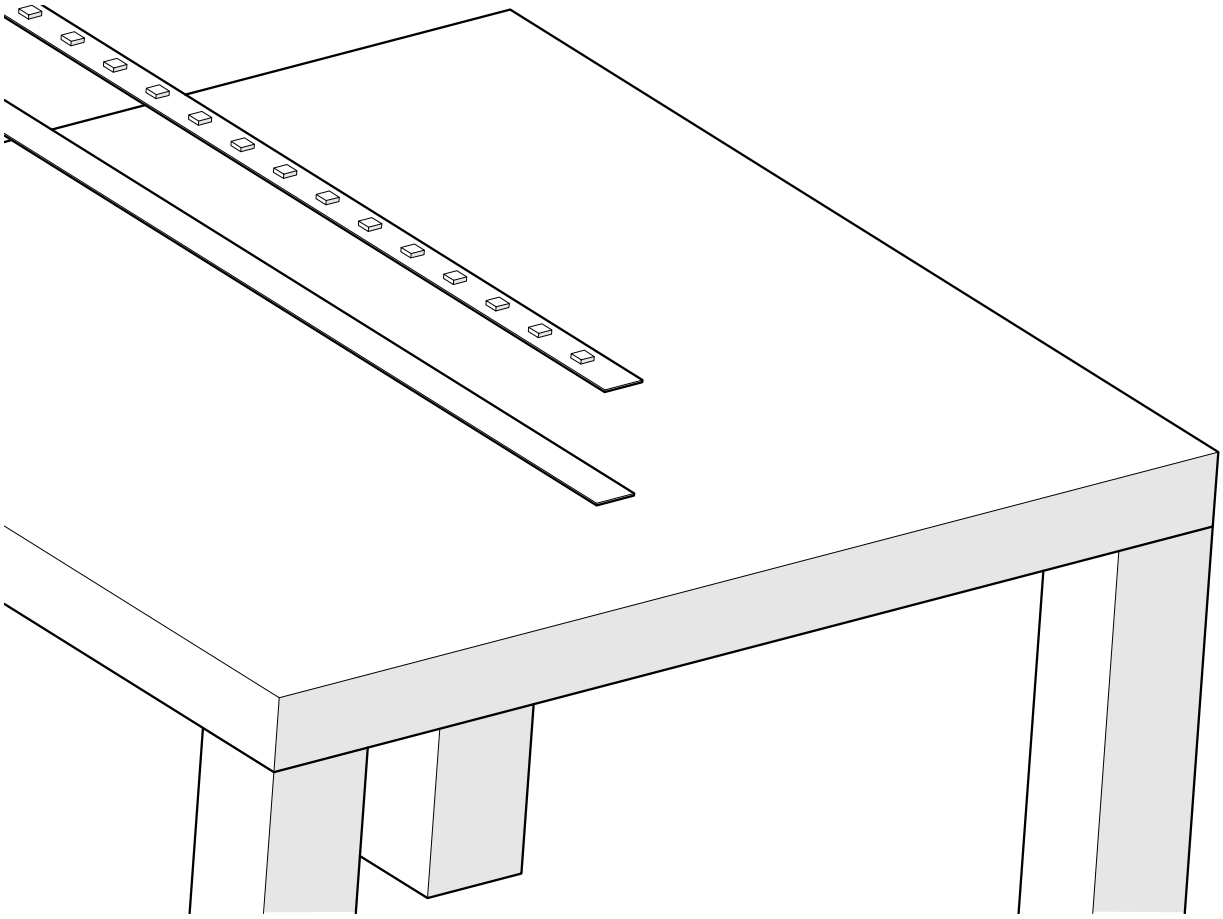


Illustration 4: Sticking of the portions of LED strips over the table using double-sided tape

WARNING: Recall that the Data line is ordered. Alternate DIN and DOUT pins to form a coil. The coil

is a succession of DIN to DOUT connections. Some strips have arrows printed to highlight the direction of the Data line.

5. Prepare wires

A) Cut 3x9 50 mm long wires

They will fix the connection we have destroyed by cutting the strip into pieces to form a new chain of LEDs. If you have 3 different colours of wires, use them to distinguish Power +, Power - and Data. Make sure they are long enough to create arcs of a circles between each strip.

Do NOT touch the female connector unsoldered at step 3C, we will use this one later.

B) Solder the wires to reform the strip

Connect all 5V (red) together, all GND (black) together, and all DATA (often green or yellow) together. Check another time that you always connect DIN to the next DOUT. Never connect ~~DIN to DIN~~ nor ~~DOUT to DOUT~~. In case of mistake, you will need to unstick the strips not correctly arranged during step 4B.

C) Solder the electronics components on the board

We have very few electronics to solder, only connectors, so this should be pretty easy compared to usual electronics hacking. You are free to place the components where you want as long as you respect the electronic diagram below.

6. Make a break and test the system

You can now make a break and check whether your electronics is fine before finishing the building of the Arbalet LED table. Follow the Hardware and Software preliminaries before continuing. If something went wrong during soldering you will figure it out during these tests before it becomes less easy to fix the hardware problems.

Jump to step 7 once you have successfully ran at least the color demonstrator on your new hardware using the `-w` flag to enable hardware. Ensure that all pixels are driven and able to light. If you meet troubles, find help in the troubleshooting section.

7. Make the grid

The inner grid separate each pixel from each other and must be strong enough to support the glass and the weight applied to its surface. The assembled grid is shown on illustration 5.

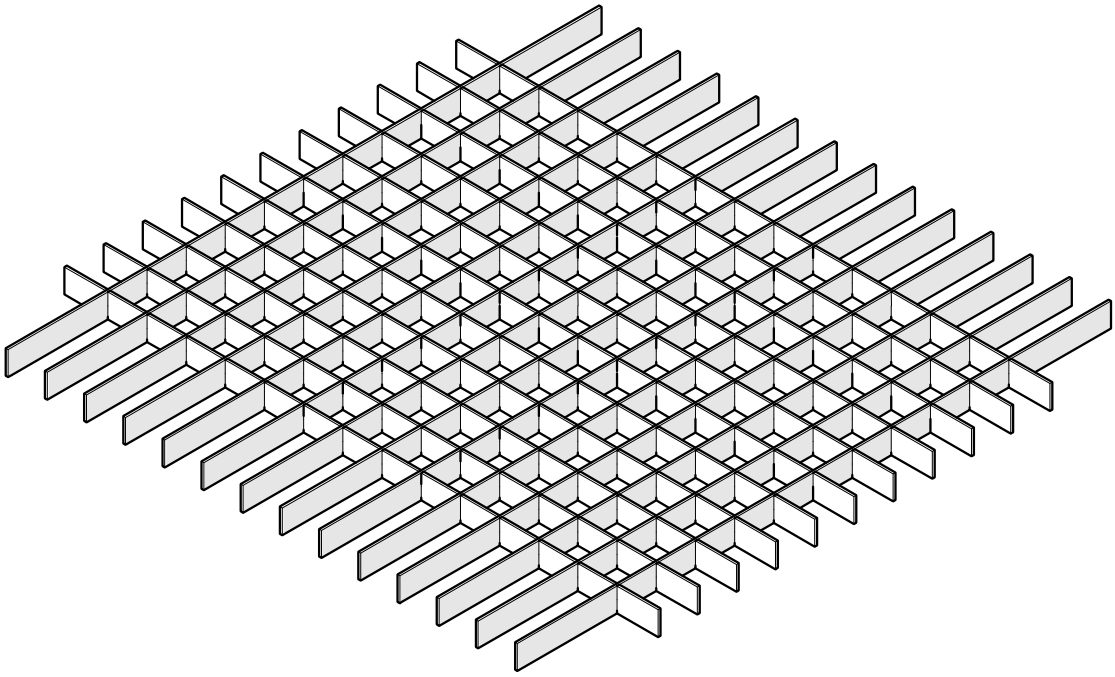


Illustration 5: Assembled inner grid

A) Cut 35 identical strips of 500 x 20 mm in the 2mm-thick wood or plastic

B) Create 14 10mm-long grooves regularly spaced

Make the grooves really slack, since addition of imprecisions will make the final crossing of the 35 strips very tight. To improve precision you should stack the 35 strips and pierce them all at once. If you want to make things cleanly only 11 strips requires 14 grooves, the 14 other strips only need 11 holes, but by piercing identically the 35 strips, the extra grooves will be hidden by a cover and not visible.

C) Insert them one inside the other

The more pieces you insert, the more stretched the construction will be. You might need to force a little bit to insert the last pieces. Start by inserting the outer sides and go inward.

The 11 hole pieces must be all perpendicular to the 14 hole pieces, as shown on illustrations 6 and 7. If you pierced all the 35 pieces with 14 holes, some holes will stay unused so make sure you make a symmetric construction.

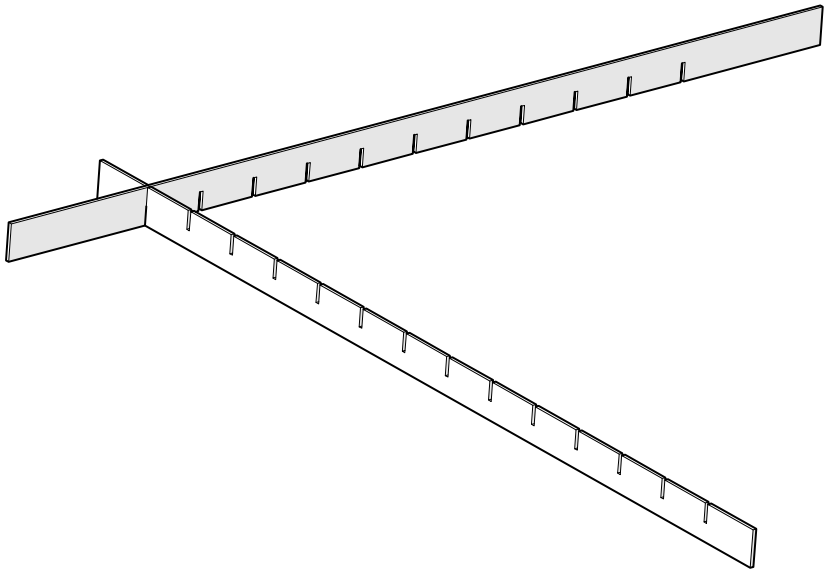


Illustration 6: Insertion of the strips of the inner grid

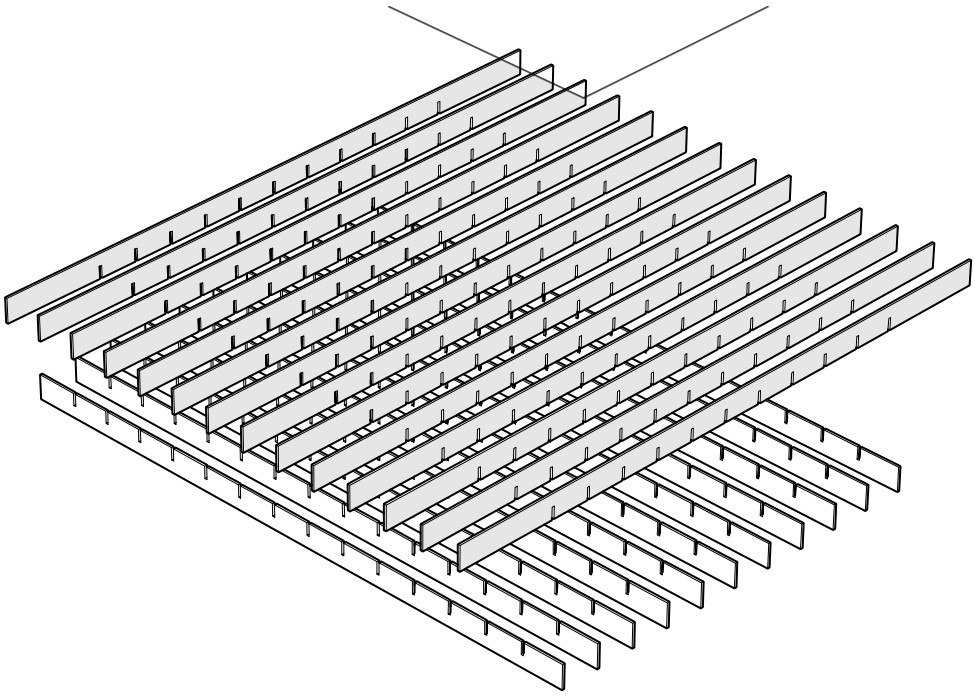


Illustration 7: Full disposition of the strips of the inner grid

8. Make the outer frame

A) Cut 4 identical pieces of wood with a groove hosting the glass

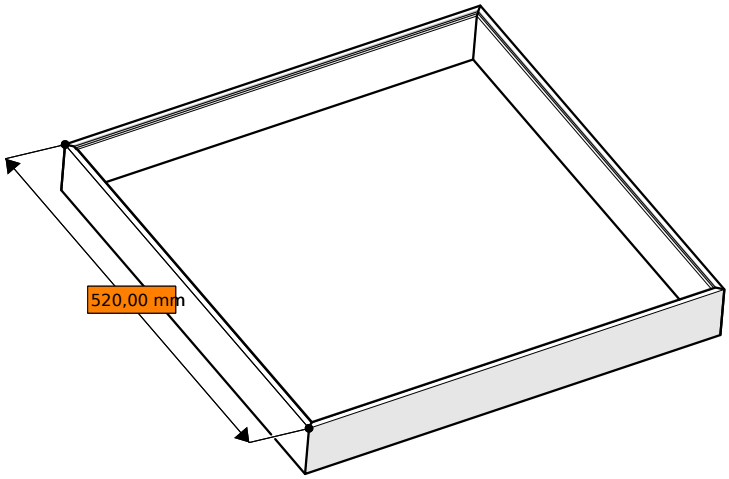


Illustration 8: Wooden outer frame hosting the glass

The groove is located to the inner top of the frame and should be large enough to host the glass. Make sure it is slack enough to host the glass without forcing but large enough to support the load.

B) Make a frame by fastening the pieces with very thin nails

Check first that the dimensions of your frame are large enough to **largely** fit **around** the table tray, as a ring.

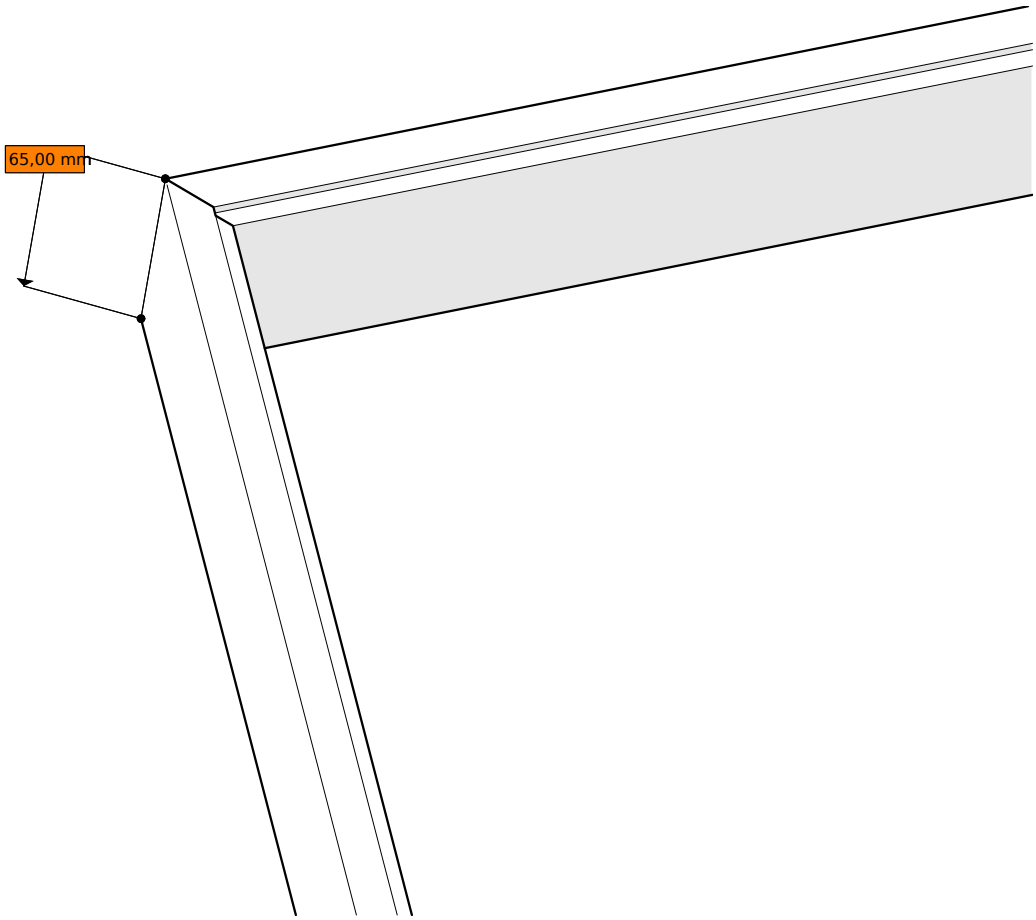


Illustration 9: Zoom on the outer frame

C) Cut out pieces of cooking paper to cover the pixelated area of 500x333 mm

The paper will be trapped between the grid and the glass. It must cover only the rectangular surface filled with pixels.

D) Cut out two pieces of black paper to hide the grid where there is no pixel.

E) Check the final dimensions available to host the glass and cut a glass according to the available space

Theoretically the frame can host a 500x500 mm glass. In practice it will depend of the precision you managed to reach during the assembly of the frame. To absorb this lack of precision measure the a actual space available for the glass and cut a piece of glass that is at least 2 mm wide less than what is available. It is a good idea to bring your frame to your mirror retailer if you are not confident into your dimensions.

The glass put down on the frame must be slightly higher than the frame itself to avoid objects gripping the wood when you slip them along the table.

9. Enjoy, and share to the community

Take pictures of the result and post them on twitter mentioning @arbalet_project we'll be delighted to reweet and share your work!

If you have made customizations you might also creating a howto similarly to this one.