

# Manufacturing of a fully functional 3D SLA DLP printer

iGEM 2015 Team TU Darmstadt

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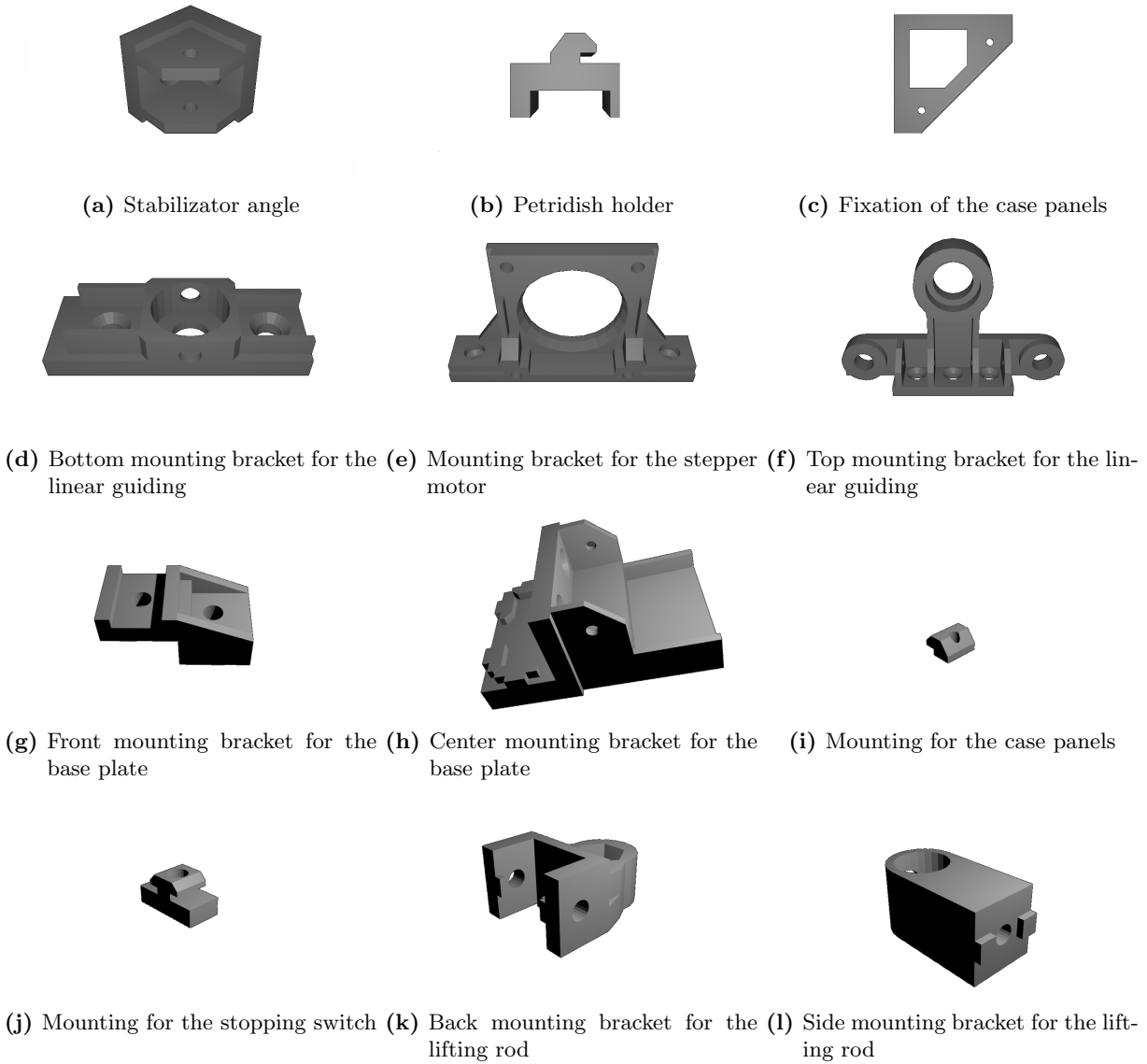
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# 1 Parts

This section contains a list of all parts necessary to build a fully functional 3D SLA DLP printer based on the construction of the team from TU Darmstadt participating in the iGEM 2015 contest.

**Table 1** – List of parts. \*: Parts were designed and printed by us. See the figure below for the appearance of the various parts. \*\*: Part designed by us. Construction instructions are provided.

Part name	Amount
Acrylic glass panel	
• Dimensions: $5 \times 40 \text{ cm} \cdot 40 \text{ cm} \cdot 0.3 \text{ cm}$ $1 \times 20.5 \text{ cm} \cdot 37 \text{ cm} \cdot 0.3 \text{ cm}$ , $1 \times 19.8 \text{ cm} \cdot 40 \text{ cm} \cdot 0.3 \text{ cm}$	7
Aluminum profiles, 20 mm $\times$ 20 mm, 6 mm groove	
• Lengths: $4 \times 40 \text{ cm}$ , $9 \times 36 \text{ cm}$ , $2 \times 20 \text{ cm}$ , $2 \times 13 \text{ cm}$ , $1 \times 7 \text{ cm}$ , $2 \times 5 \text{ cm}$	20
• Acer H6510BD Beamer	1
• Sonceboz 8660R013 V1.0 stepper motor	1
• Aluminum mirror with mounting bracket	1
• RaspberryPi 2 ADVANCED Set	1
• SNES Controller	1
• Renkforce LED Strip 5MCC316W	1
• Axle bearing fitting the linear guiding without screw thread	2
• Axle bearing fitting the linear guiding with screw thread	1
• Base plate socket *	1
• Base plate linkage *	2
• Stabilizator angles *	
• $5 \times$ custom printed (PLA), $8 \times$ commercially available (Metal)	13
• Socket for RaspberryPi *	1
• Resin basin socket *	4
• Lower mounting bracket for linear guiding *	2
• Upper mounting bracket for linear guiding *	2
• Mounting bracket for stepper motor *	1
• Case panel mounting *	48
• Case panel fixation *	24
• Resin basin **	1
• Core screw, M6	16
• Linear guiding, M8, Length: 18 cm	
• $1 \times$ with screw thread, $2 \times$ without screw thread	1
• 250 W ATX Power supply.	1



**Figure 1** – Additional parts that were designed and printed for the manufacturing of the 3D printer

## 2 Construction

### 2.1 The armature

The first step is the building of the printer armature where all the other components are attached to later on. Therefore, the following parts are required:

**Table 2** – Parts required for the armature

Part name	Amount	Additional notes
Aluminum profile	17	Keep the three short ones for later
Stabilizator angle	8	Only the metal ones
Core screw	18	

For the back side of the printer, each two aluminum profiles with lengths of 40 cm and 36 cm are tied up to form

a square. Please drill a M6 Screw thread in each of the profiles grooves, then fix the profiles using core screws. This also holds for all following aluminum profile attachments. On each of the squares corners, one of the 36 cm long profiles is attached. Another 36 cm long profile is used to form the front bottom ledge, two 40 cm long profiles are used to form the edgewise edges. Doing all this leads to a cube with the top front edge missing. One of the three remaining profiles with a length of 36 cm is attached with its lower side at a height of 16 cm above the ground profiles top side. The second of the three remaining profiles with a length of 36 cm is attached to the top side of the cube with its front side 12 cm rearward the cubes front.

The remaining five profiles are used to build the back of the resin holder and the main part of the stepper holder. Here, no core screws are required. Instead, the metal angles are used to fix these profiles. The two profiles with a length of 20 cm are mounted vertically on the bottom sides of the cube and fixated with four metal angles. Between the front profiles and the front of the holder profiles, a space of 13 cm is required. If the two vertical profiles are mounted, the last profile with a length of 36 cm is mounted horizontally between them and fixed with two metal angles mounted directly below the profile's edges. The two remaining profiles with a length of 13 cm are attached horizontally to the profile near the center of the cube pointing to its front and resting on the 36 cm long profile on the front of the cube. The outer side of these profiles should be 9 cm away from the outer edge of the cube. These are fixated using the remaining two metal angles in a way that the angles point to the cube's front edges.

## 2.2 The linear guiding

In the next step, the linear guiding is assembled. Therefore, the following parts are required:

**Table 3** – Parts required for the linear guiding

Part name	Amount	Additional notes
Mounting bracket for stepper motor	1	
Upper mounting bracket for linear guiding	1	
Lower mounting bracket for linear guiding	2	
Linear guiding, M8	3	the ones without screw thread are used for stabilization of the base plate attached later on, the one with screw thread is used to move the base plate
Stabilizator angle	5	Only the PLA ones
Screw	8	

First, the stepper motor mounting bracket is attached to the back side of the center aluminum profile in a way, that it points to the back of the cube and that its flat side is pointing downwards. Then, the two lower mounting brackets for the linear guiding are mounted on top of the center aluminum profile. Please use two screws for each part to ensure its fixation. Now, the two linear guidings without screw thread are placed pointing upwards in the lower mounting brackets on the central aluminum profile. The upper mounting bracket of the linear guiding is then attached to the aluminum profile above the center profile and also fastened with two screws. Make sure, that the two linear guidings fit into the holes in the mounting bracket and are fixated.

## 2.3 The resin basin

The basin of the printer is made of the 6 mm thick, transparent acrylic glass panel. This needs to be cut into pieces of the following dimensions:

**Table 4** – Required parts for the printers basin

x-length	y-length	Amount
19 cm	13 cm	1
18 cm	3 cm	2
11 cm	3 cm	2

The largest piece is used to build the bottom of the basin. The other parts are glued with silicon glue on the bottoms top side with 0.5 cm spacing to the edge of the bottom piece so that a basin with a depth of 3 cm is built. The basin is then inserted in the two aluminum profiles pointing from the center of the cube towards the front. For this kind of basin, no Petridish holders are required.

## 2.4 The lifting rod

The lifting rod is one of the most complicated parts to be assembled in this process. It requires the following parts:

**Table 5** – Required parts for the lifting rod

Part name	Amount	Additional notes
Aluminum profile	3	the short ones (lengths: 7 cm, 5 cm)
Lifting rod side mounting bracket	2	
Lifting rod back mounting bracket	1	
Front base plate mounting bracket	2	
Center base plate mounting bracket	3	
Screws	11	
Axle bearing	3	
Base plate	1	take an aluminum plate fitting the size of your resin basin

First, take the back lifting rod mounting bracket and attach it to the short side of the 7 cm aluminum profile using two screws. Then, attach the two lifting rod side mounting brackets using screws to two opposing long sides of the aluminum profile in a way that they directly touch the back mounting bracket. This should now form a cross. Then, take the two front mounting brackets for the base plate and attach them to the same sides of the aluminum profile as done with the side lifting rod brackets in a way, that they form a narrowing claw. Here you need to insert the two remaining aluminum profiles orthogonal to the other pieces in a way that they end up with the existing structure at the same height. The center mounting bracket for the base plate is attached to the protruding part of the aluminum profiles pointing away from the cross and again fastened with screws. The base plate is attached to the lower side of the center mounting bracket by using glue. Then insert the two axle bearings without screw thread into the side parts of the lifting rod cross structure and the axle bearing with screw thread in the crosses head and fasten them with glue. This whole structure is then put onto the linear guiding in a way, that the base plate is the lifting rods lowest point.

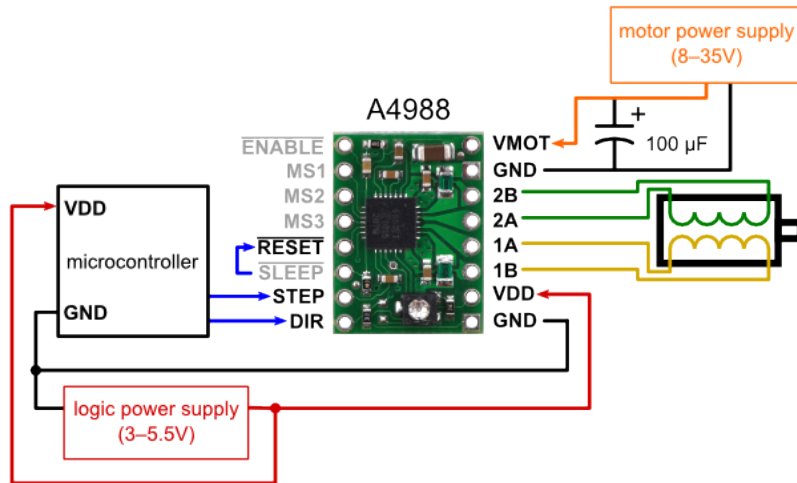
## 2.5 Electrics

After the linear guiding and the resin basin are built, the electric components are attached and connected. Therefore, the following parts are necessary:

**Table 6** – Required parts for the electrics

Part name	Amount	Additional notes
RaspberryPi 2	1	
Sonceboz 8660R013 v1.0	1	
RepRap StepStick A4988 Micro-controller	1	
Acer H6510BD Beamer	1	
Screws	4	additional required if the RaspberryPi shall also be fastened
250 W ATX power supply	1	
Brazing tools		

First, mount the stepper motor pointing upwards into the stepper motor mounting bracket. Use four screws for fastening. Then, connect the RaspberryPi, the StepStick microcontroller, the power supply and the stepper motor according to Figure 2. Note, that the RaspberryPi is mentioned there as Microcontroller and that the power supply is divided in two parts. For the connection between the ATX power supply and the other components, please check your ATX-plug pin configuration. The beamer is connected to the RaspberryPi via HDMI.

**Figure 2** – Wiring diagram for all components. The RaspberryPi is mentioned here as „Microcontroller“

## 2.6 The case

The case is the last part of the printer to be built. The following parts are required:

**Table 7** – Parts required for the case

Part name	Amount	Additional notes
Acrylic glass panel	7	
Screw	48	
Case panel fixation	24	
Case panel mounting	48	

Insert two case panel mountings in each aluminium profile in a way that they provide screw threads for fastening the screws that will hold the case panels. Align them in a way that their screw threads fit the holes in the case panel fixations. Then, drill holes into all case panels except the one with a size of 20.5 cm · 37 cm · 0.3 cm for the screws being inserted afterwards. Then, fasten the six panels with holes inside on the outside of the aluminum profiles using screws and the case panel fixations. The non-quadratic panel needs to be attached to the lower half

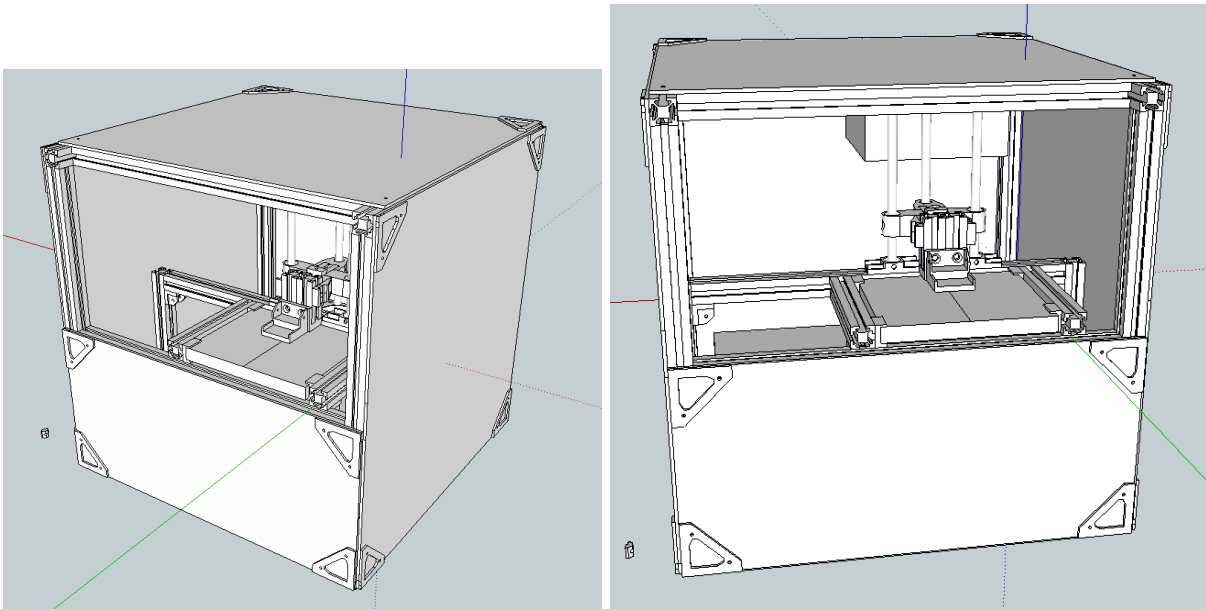
of the case front. The remaining case panel is used as a slider to open the printer case and is inserted in the open aluminum profiles vertically.

## 2.7 The optical path

For the optical path, place the beamer on the bottom of the printer case pointing to the printer front. Place the aluminum mirror and its mounting in front of the beamer lens and arrange beamer and mirror in a way that you get a sharp projection in your resin basin.

## 3 The printer

After finishing the mentioned procedures, the printer should look similar to the rendered one in the following figure:



**Figure 3** – The printer as a rendered object