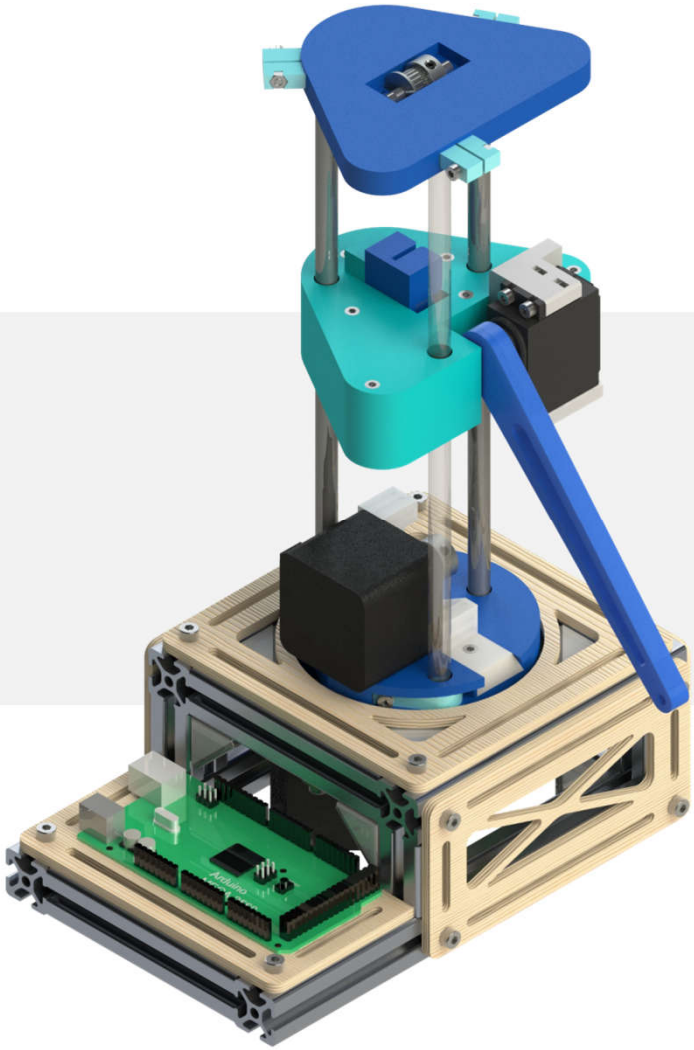
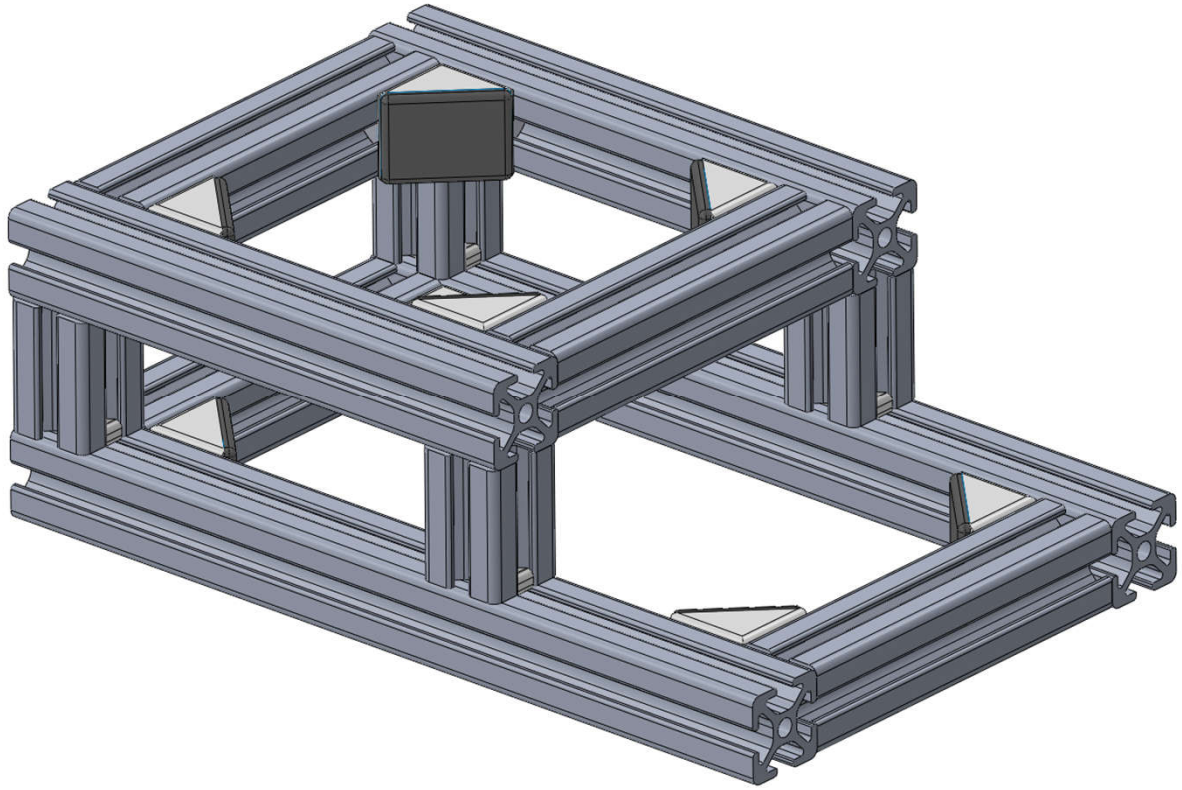


RPR-Bot

Construction

Inhaltsverzeichnis

Base Frame



5 Steps

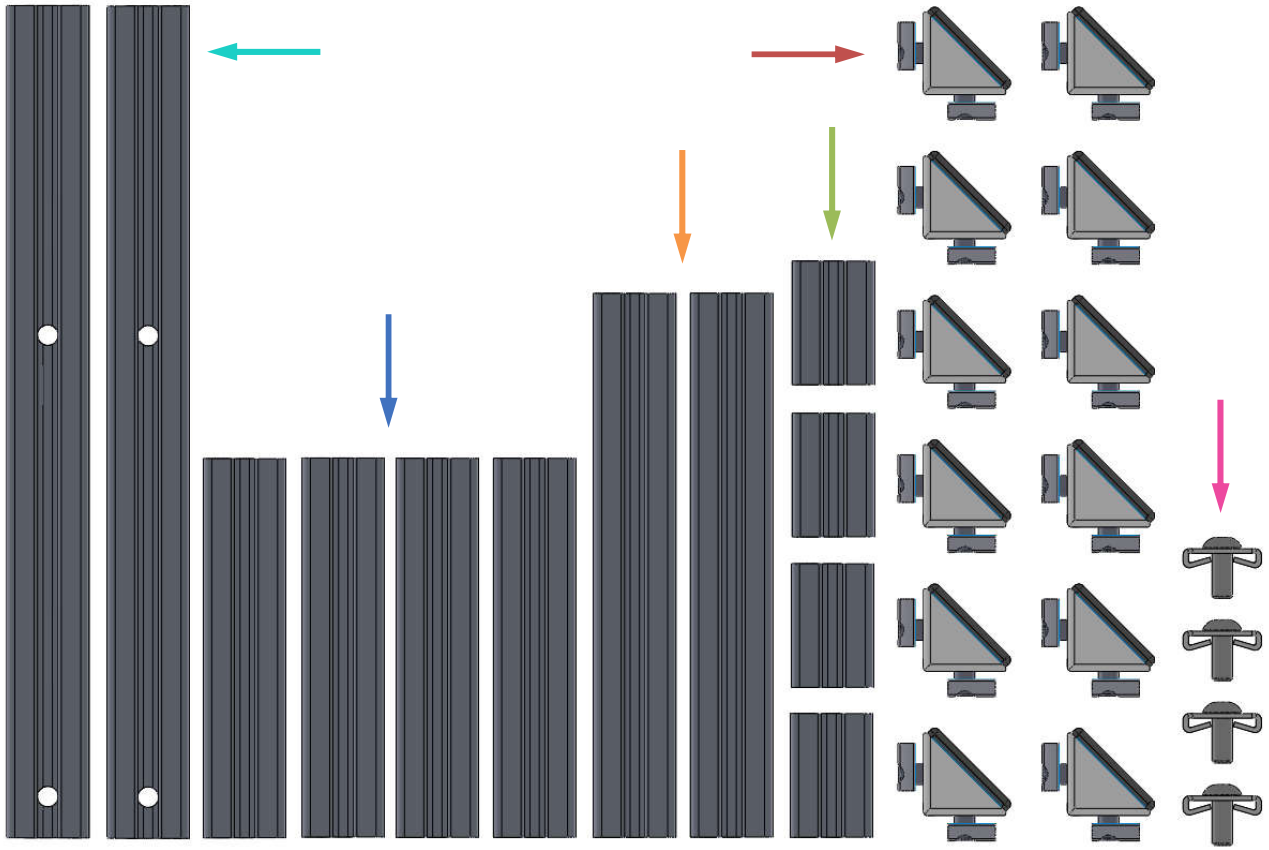
30 Minutes

Allen Key

Step 1

Necessary Parts

Base Frame



Profile A: 202 mm (2x)

Profile B: 92 mm (4x)

Profile C: 132 mm (2x)

Profile D: 30 mm (4x)

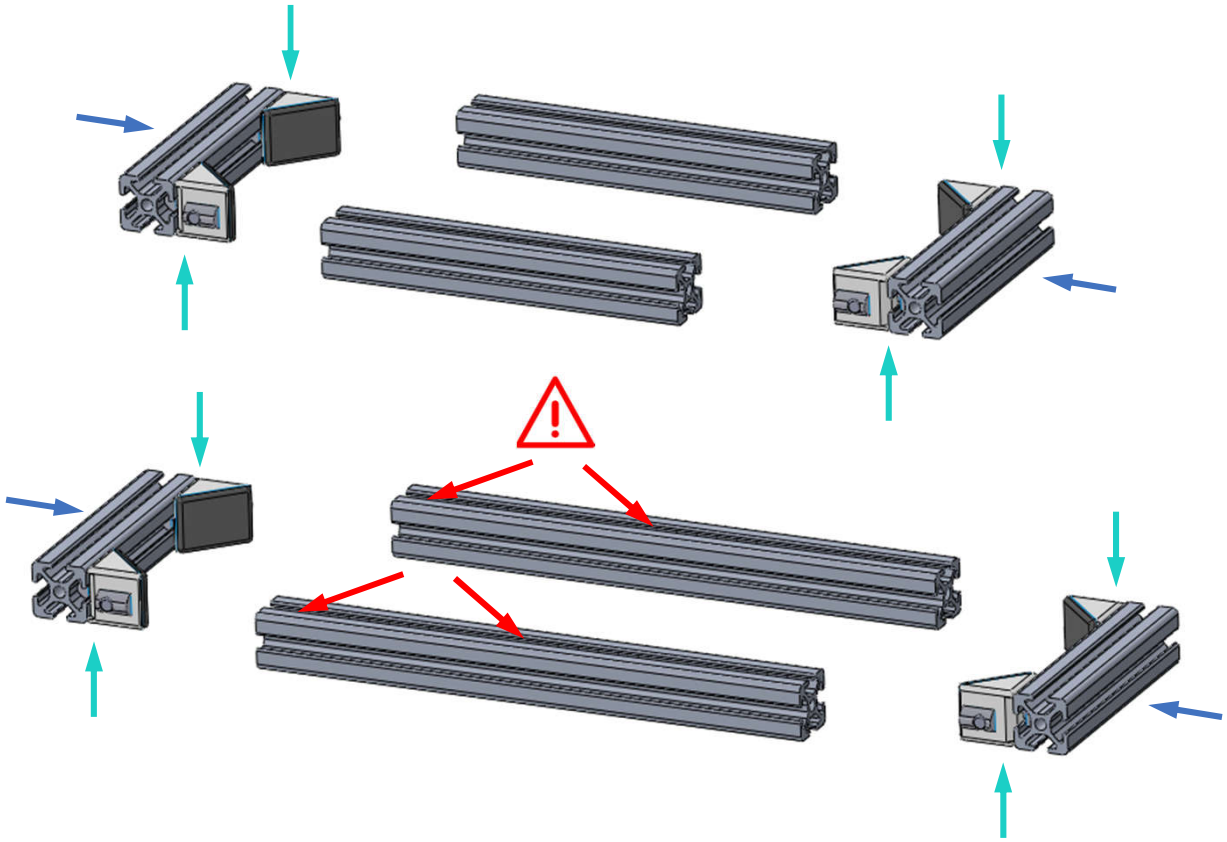
Angle connector (12x)
including Nuts und Screws

Standard connector set (4x)

Step 2

Construction of the
upper and lower base frame

Base Frame



Screw 2 angle connectors to profiles B (92 mm)

Slide the profiles into profiles A (202) and C (132) and tighten the screws to create 2 rectangular frames

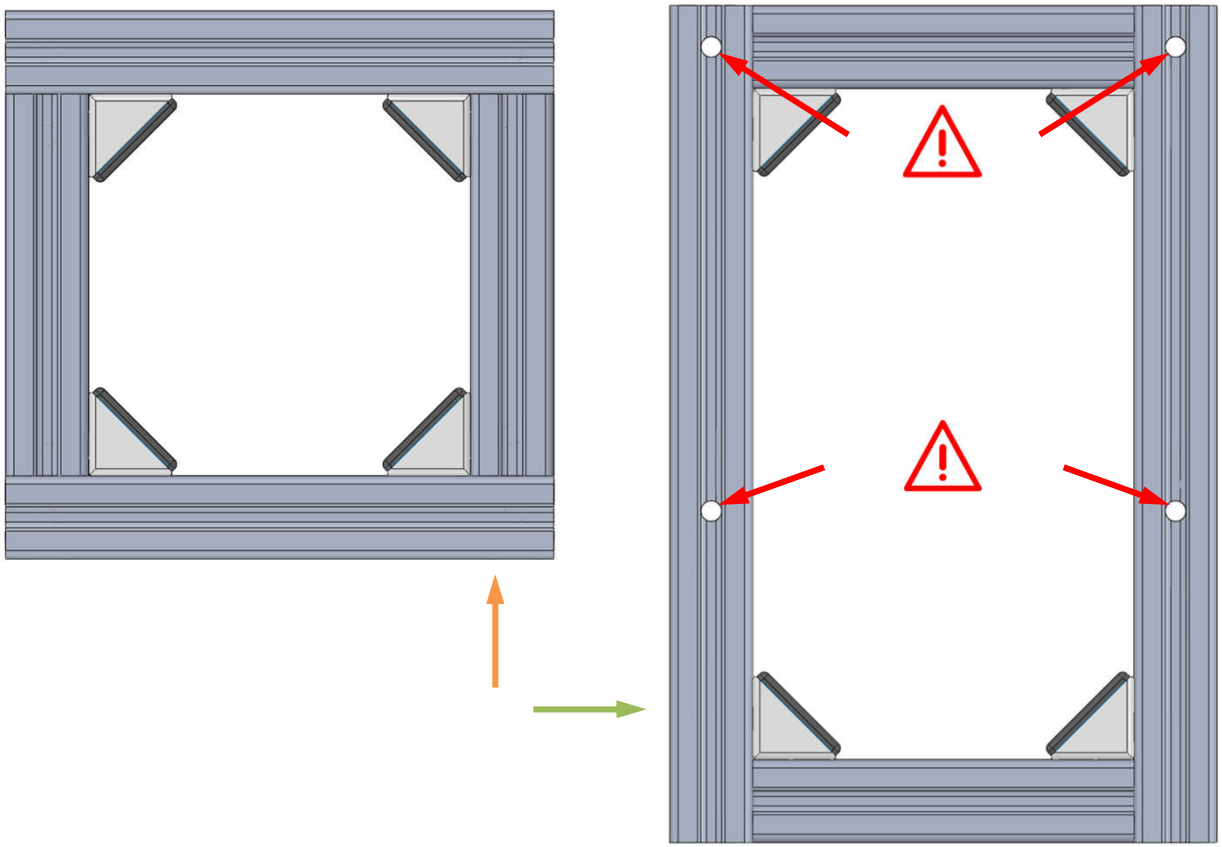
The holes of the two profiles A must be aligned correctly!

The sliding blocks can either be pushed sideways into the profiles, or inserted directly through slight tilting.

Step 2

Assembly of the upper and lower frame

Base Frame



Upper frame

Lower frame

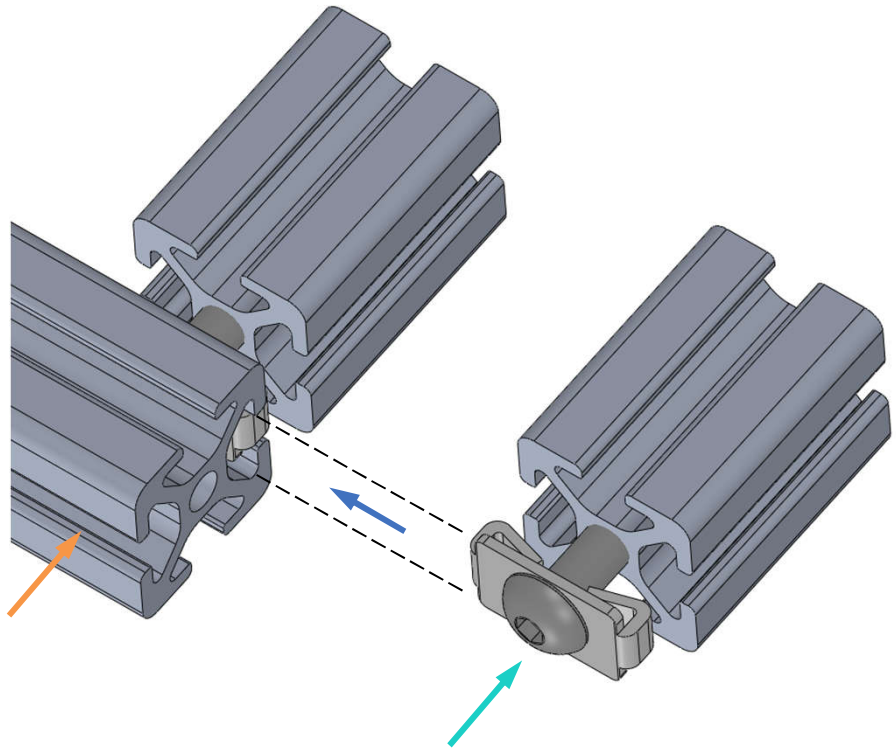
The holes of the two profiles A must be aligned correctly!

The sliding blocks can either be pushed sideways into the profiles, or inserted directly through slight tilting.

Step 3

Attach the uprights to the lower frame

Base Frame



Screw the standard connector sets about 5 mm into Profile D (30 mm)

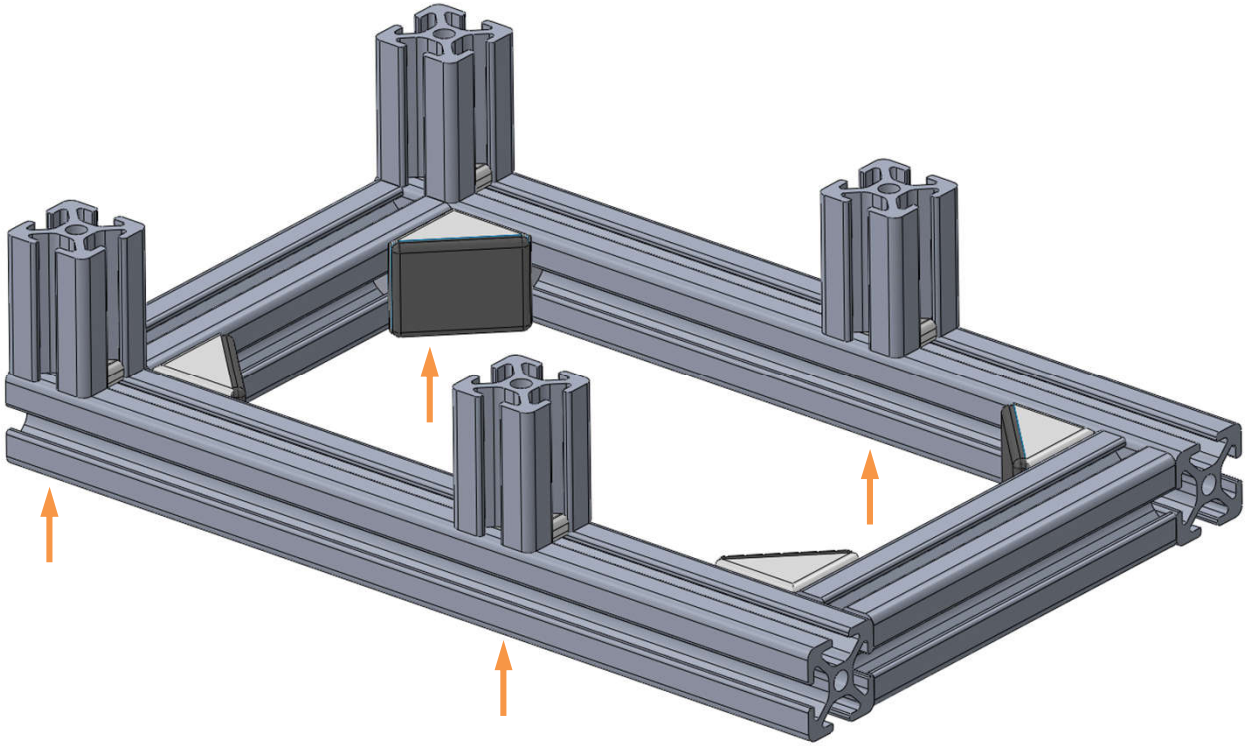
Insert the assembled parts into the profiles of the lower frame

Tighten the screws through the holes in the profiles of the lower frame

Step 3

Attach the uprights to the lower frame

Base Frame

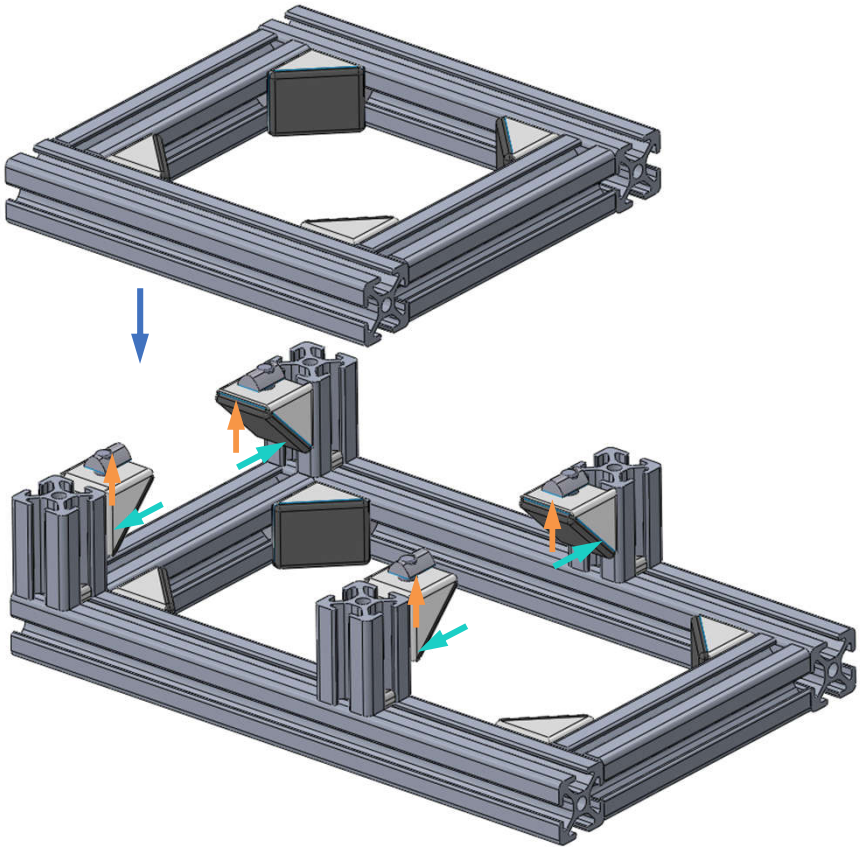


Tighten the screws through the holes in the profiles of the lower frame

Step 4

Attach the upper frame

Base Frame



An jedem der Steher einen Winkelverbinder zur Befestigung des oberen Rahmens anschrauben

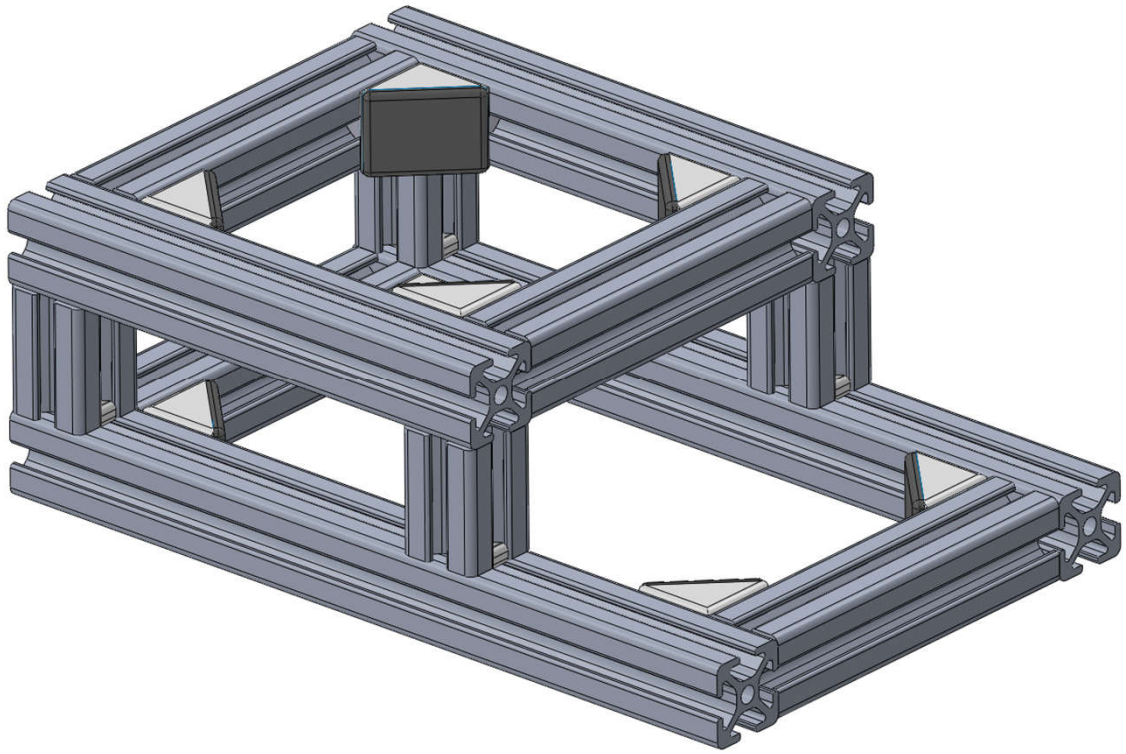
Fit or insert the upper frame

Tighten the angle connector bolts to secure the top frame

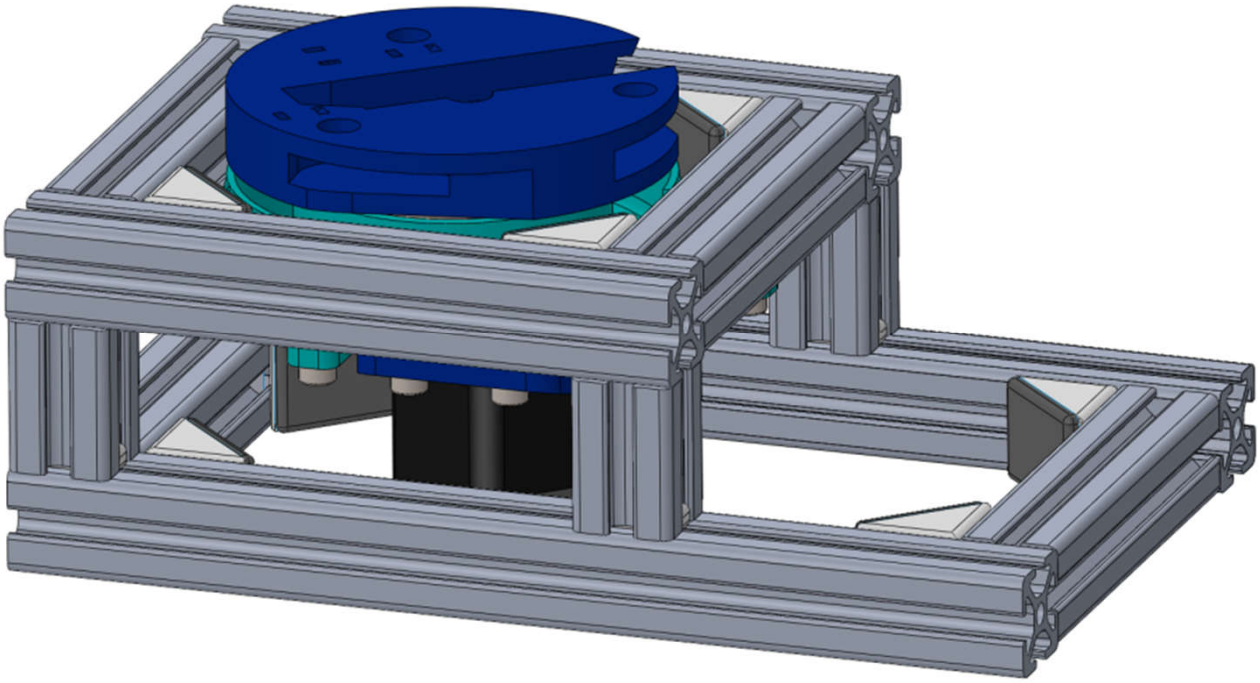
Step 5

The base frame is ready

Base Frame



R1-Axis



17 Steps

90 Minutes

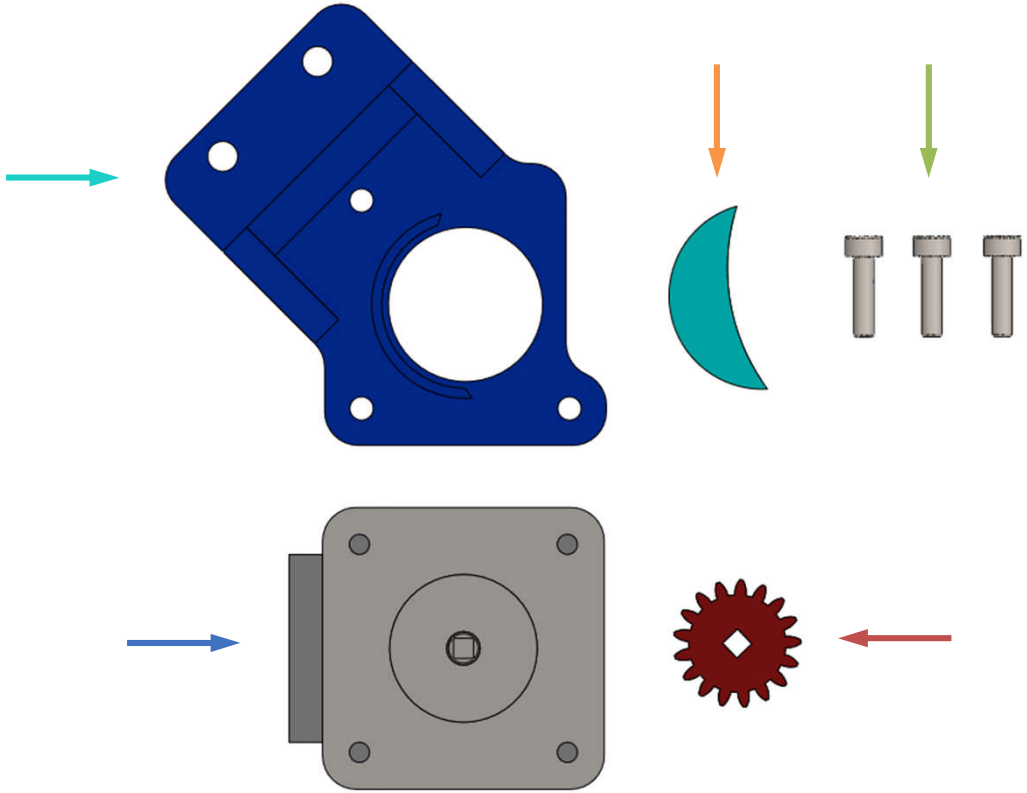
Allen Key

Glue

Step 1

Assembly of the motor unit
Necessary parts

R1-Axis



Motor Holder (1x)

Steppermotor NEMA 17 (1x)

Gear cover (1x)

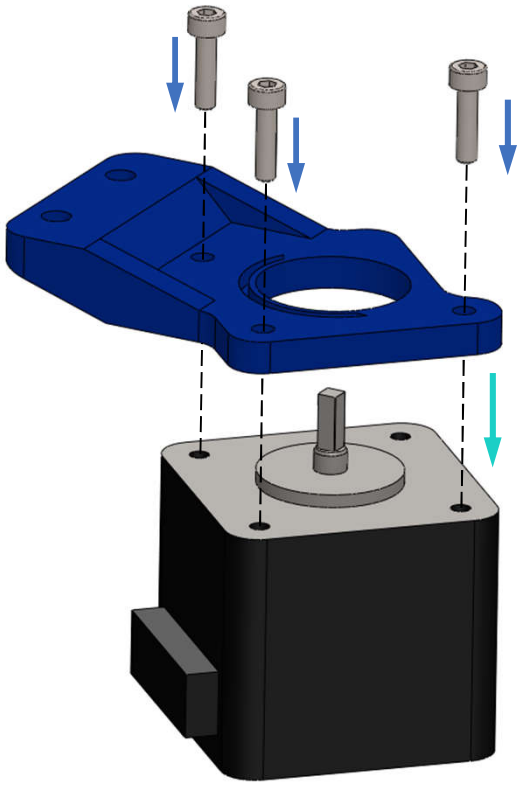
Allen screw M3x12 (3x)

Small gear

Step 2

Mounting the motor unit
Screw on the motor holder

R1-Axis



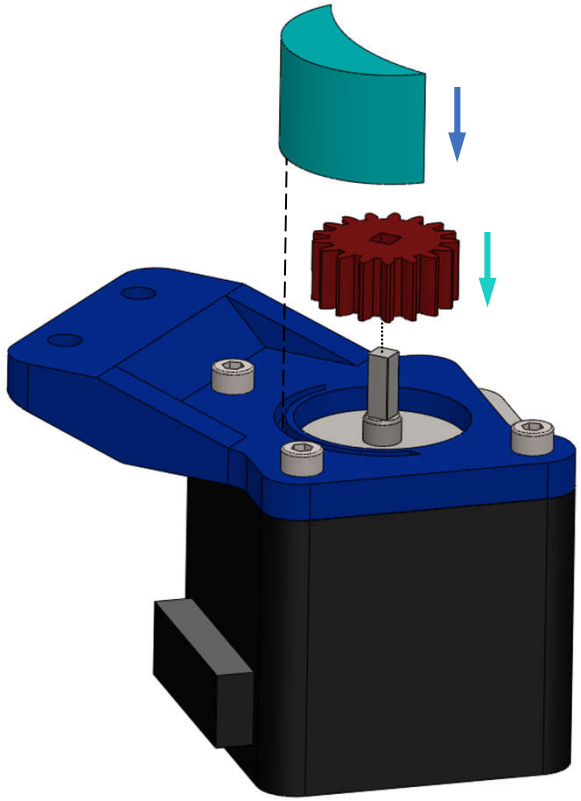
Place the motor holder on the step motor

Fix the motor holder to the step motor with the 3 screws

Step 3

Mounting the motor unit
Attaching the gear and cover

R1-Axis



Put the small gear on the shaft of the engine

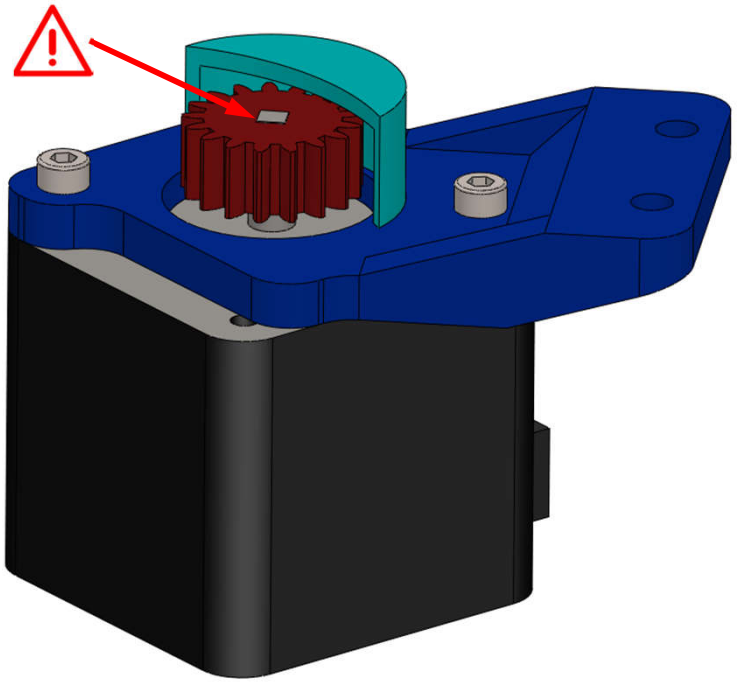
Press the gear cover into the recess in the motor mount with some force

The gear must be pressed onto the shaft until it sits flush!

Step 4

The motor unit is ready!

R1-Axis

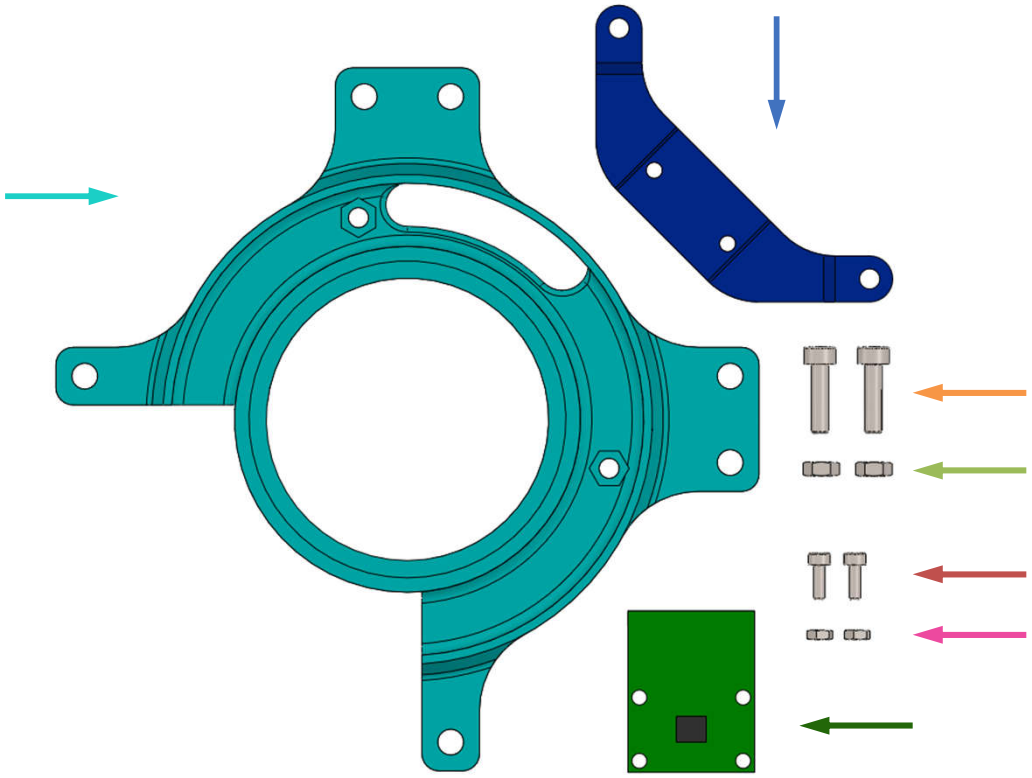


The gear must be pressed onto the shaft until it sits flush!

Step 5

Assembly of the bearing unit
Necessary parts

R1-Axis



Bearing holder (1x)

Sensor holder (1x)

Allen screw M3x12 (2x)

Hex nut M3 (2x)

Allen screw M2x6 (2x)

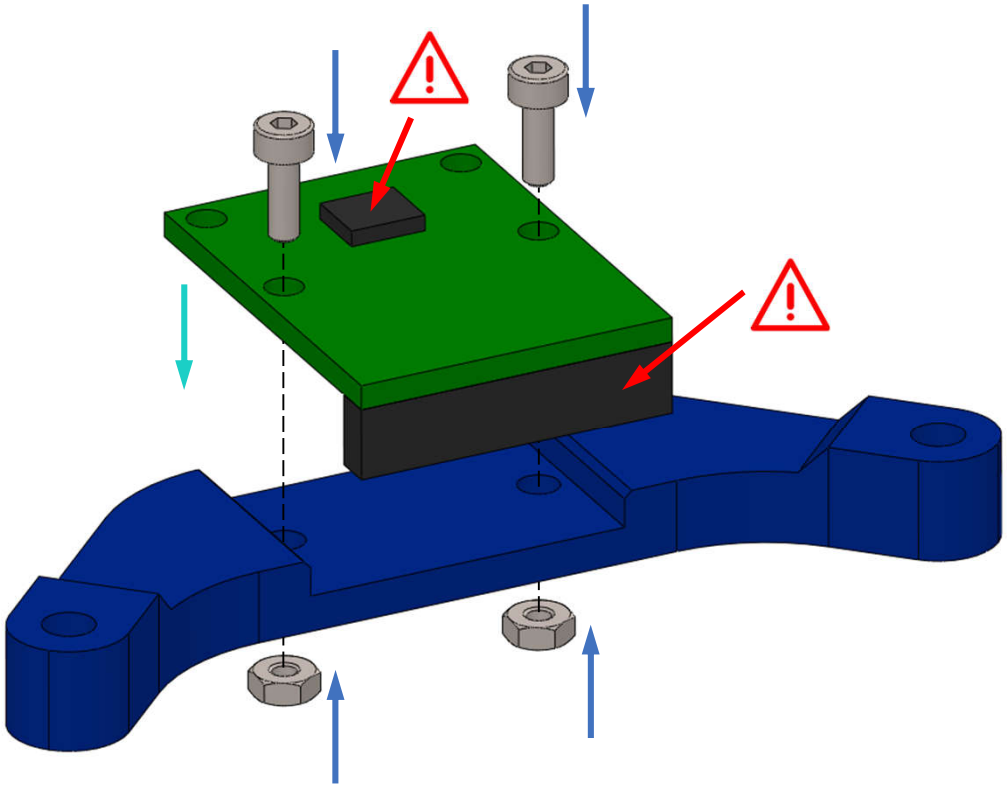
Hex nut M2 (2x)

Rotation sensor board (1x)

Step 6

Assembly of the bearing unit
Attach the sensor board

R1-Axis



Attach the sensor board to the sensor holder

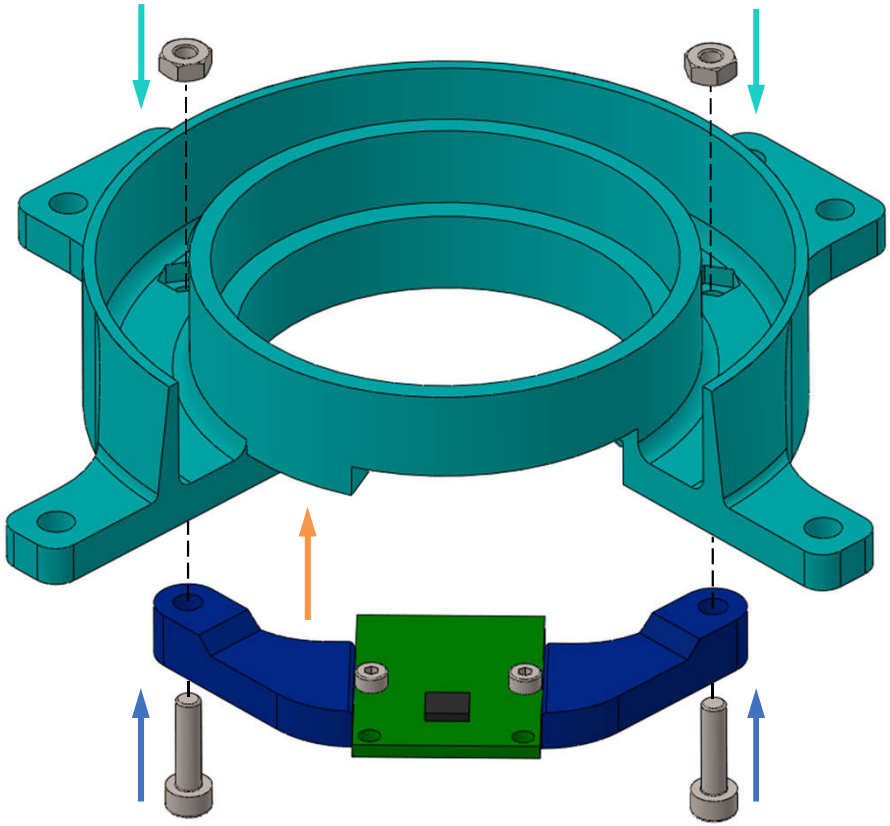
Use the M2 screws and nuts to fix the sensor to the bracket

The sensor must be on the top side, the connection pins on the bottom of the sensor holder!

Step 7

Assembly of the bearing unit
Attach the sensor unit

R1-Axis



Insert the M3 nuts into the recesses provided in the bearing bracket

Insert the M3 screws from below through the already assembled sensor unit

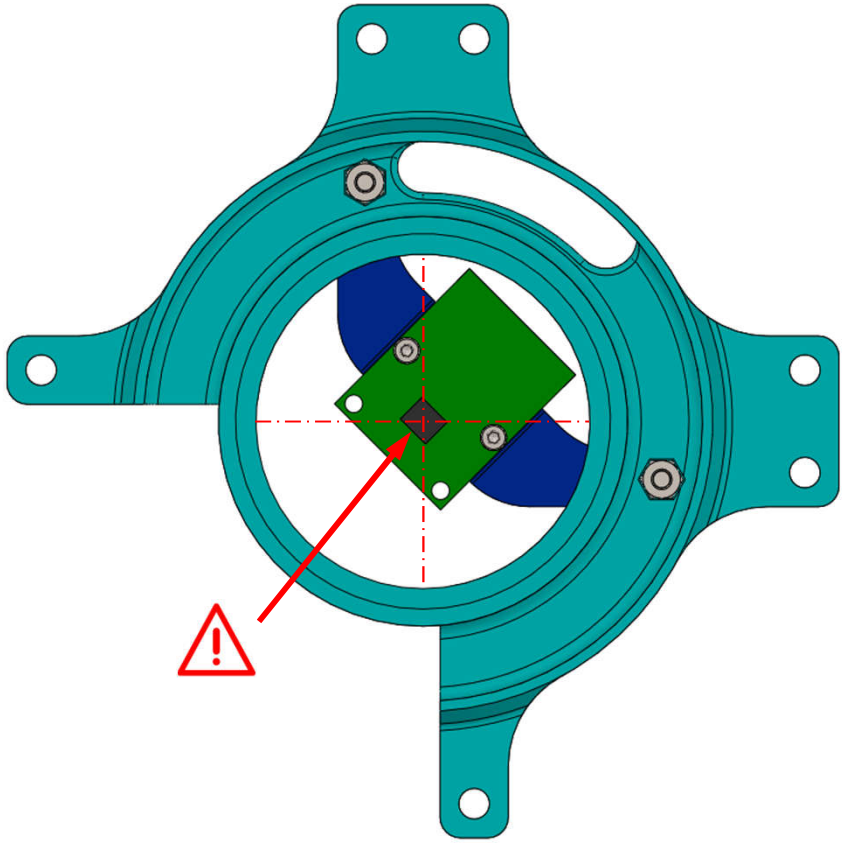
Screw the sensor unit to the nuts with the screws

⚠ The sensor unit must be aligned so that the sensor is in the middle of the bearing bracket!

Step 8

The bearing unit is ready!

R1-Axis

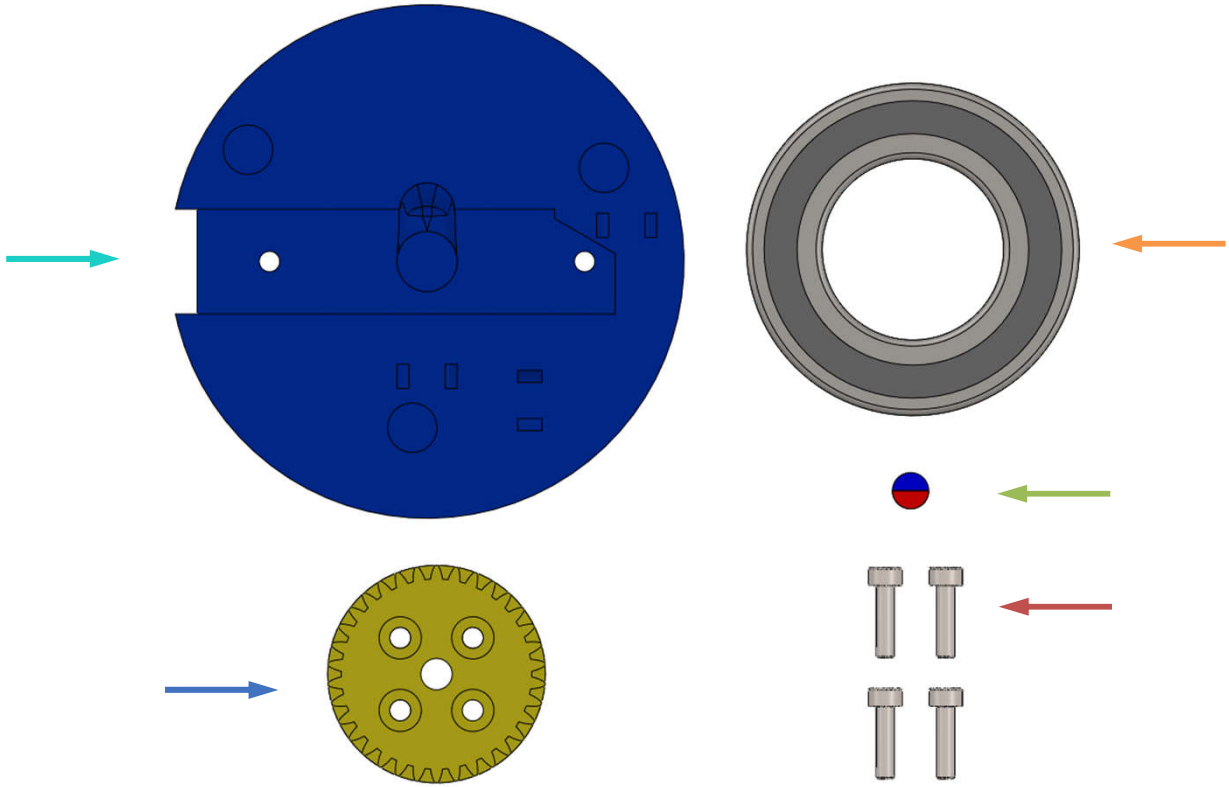


The sensor unit must be aligned so that the sensor is in the middle of the bearing bracket!

Step 9

Assembly of the turntable
Necessary parts

R1-Axis



Turntable (1x)

Big gear(1x)

Deep groove bearing
55x30x13 mm (1x)

Magnet (1x)

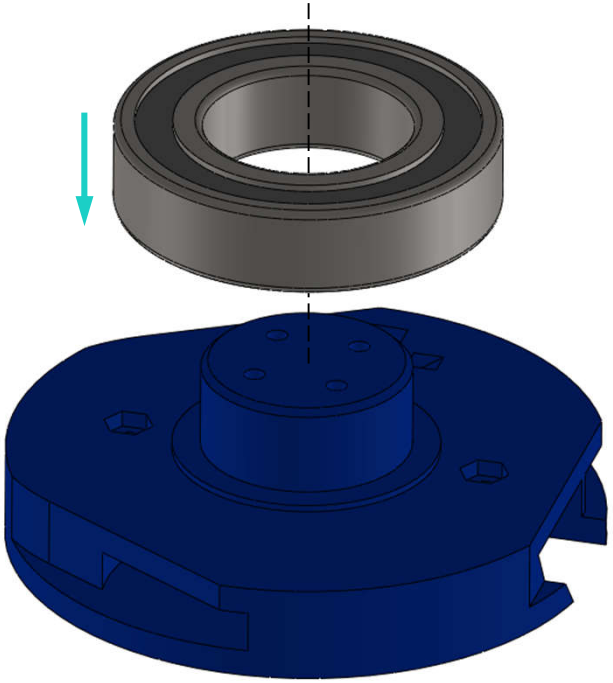
Allen screw M3x12 (4x)

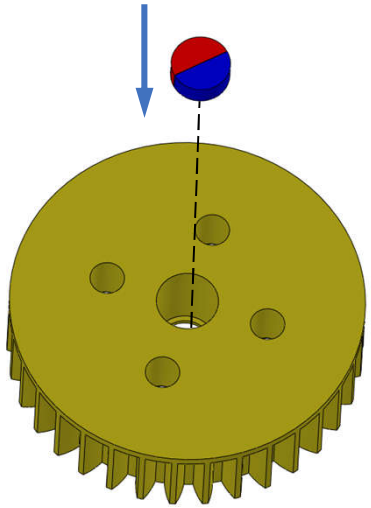
The magnet is silver in real-life

Step 10

Assembly of the turntable
Fix bearing and magnet

R1-Axis





Press the ball bearing onto the turntable with a slight application of force

Press the magnet into the large gear from above and secure against twisting with a drop of superglue

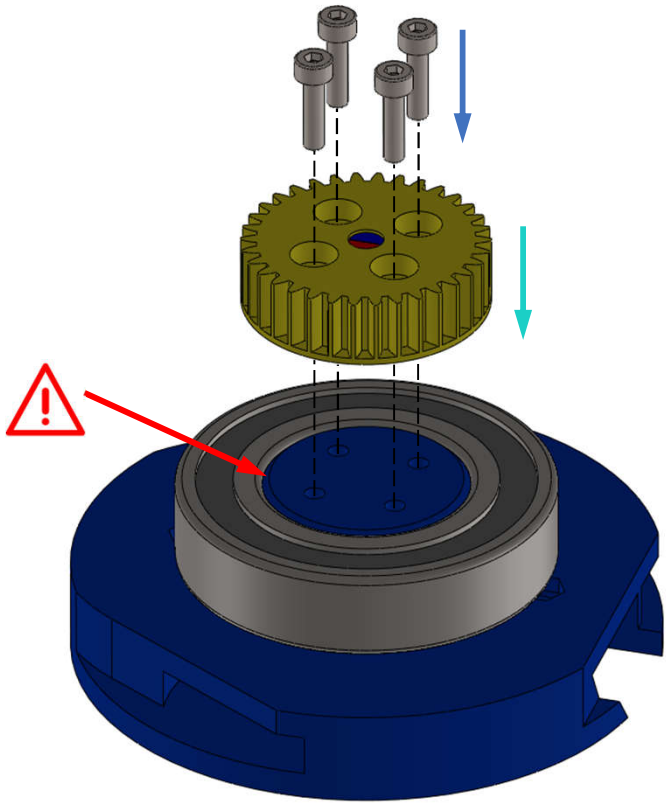
The magnet is silver in real-life

Press on the ball bearing until it is flush!

Step 11

Assembly of the turntable
Attach the pinion to the turntable

R1-Axis



Place the large gear with magnet on the turntable

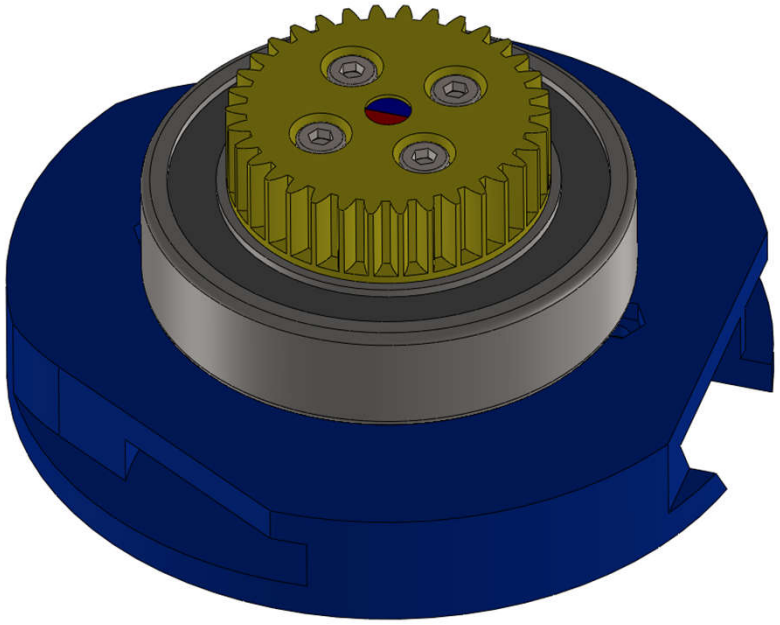
Fix the two parts together with the screws

The screws cut their thread into the turntable (requires some effort)

Press on the ball bearing until it is flush!

Step 12

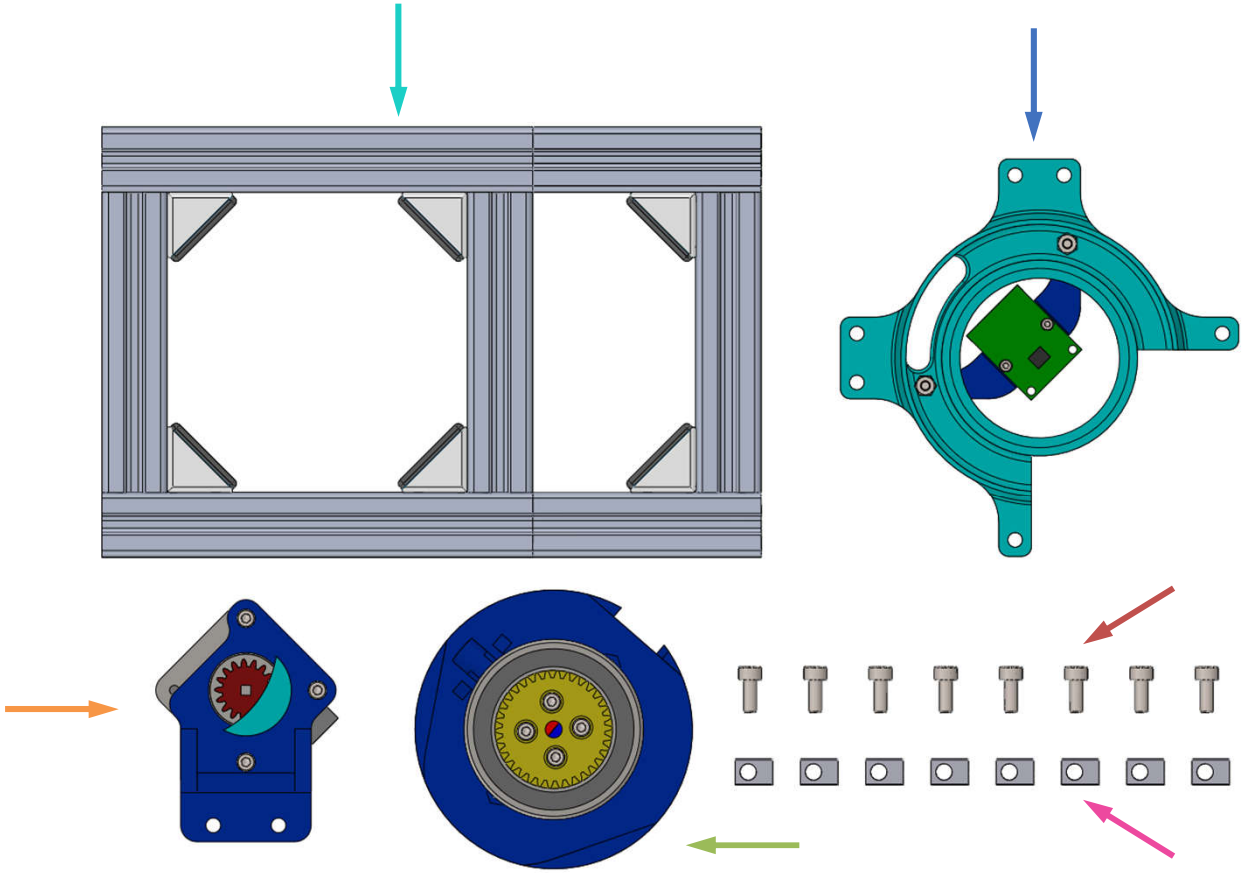
The turntable is ready!



Step 13

Assembly of the R1 axis
Necessary parts

R1-Axis



Base frame (1x)

Bearing unit (1x)

Motor unit (1x)

Rotary unit (1x)

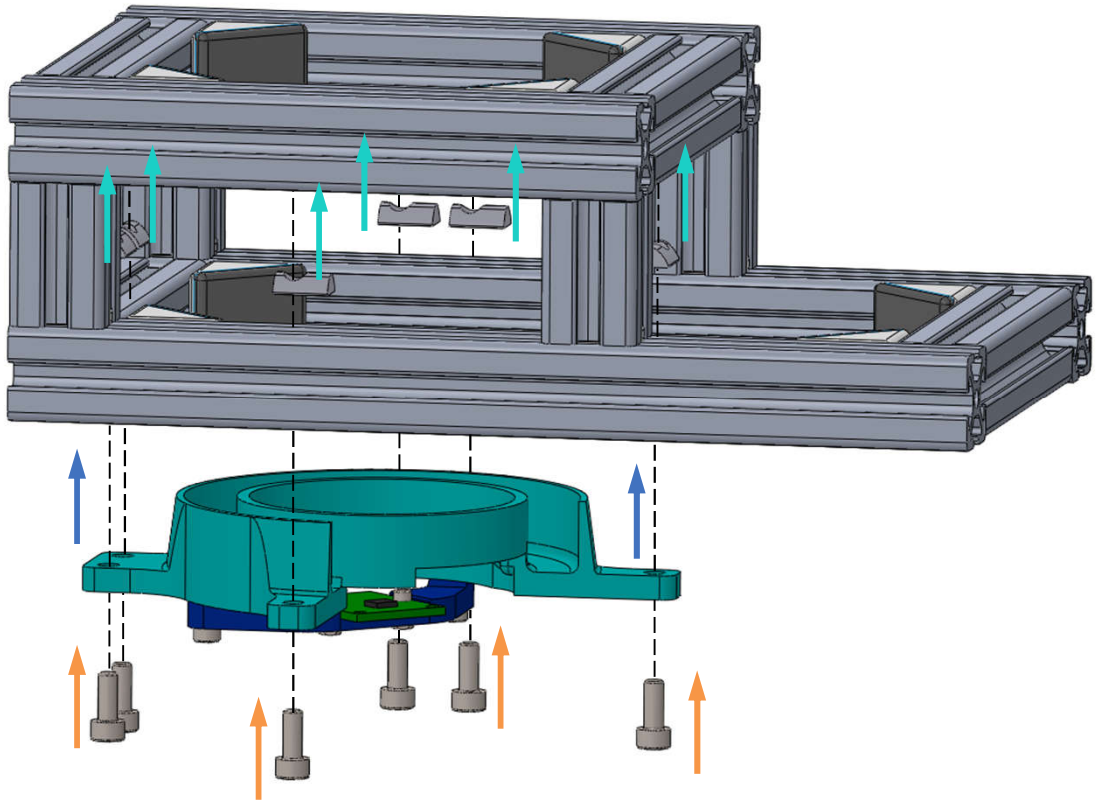
Allen screw M4x612 (8x)

Sliding block (8x)

Step 14

Assembly of the R1 axis
Screw on the bearing unit

R1-Axis



Insert the slot nuts in the corresponding positions in the base frame

Insert the bearing unit and align the slot nuts over the holes

Screw the bearing unit with the slot nuts using the screws

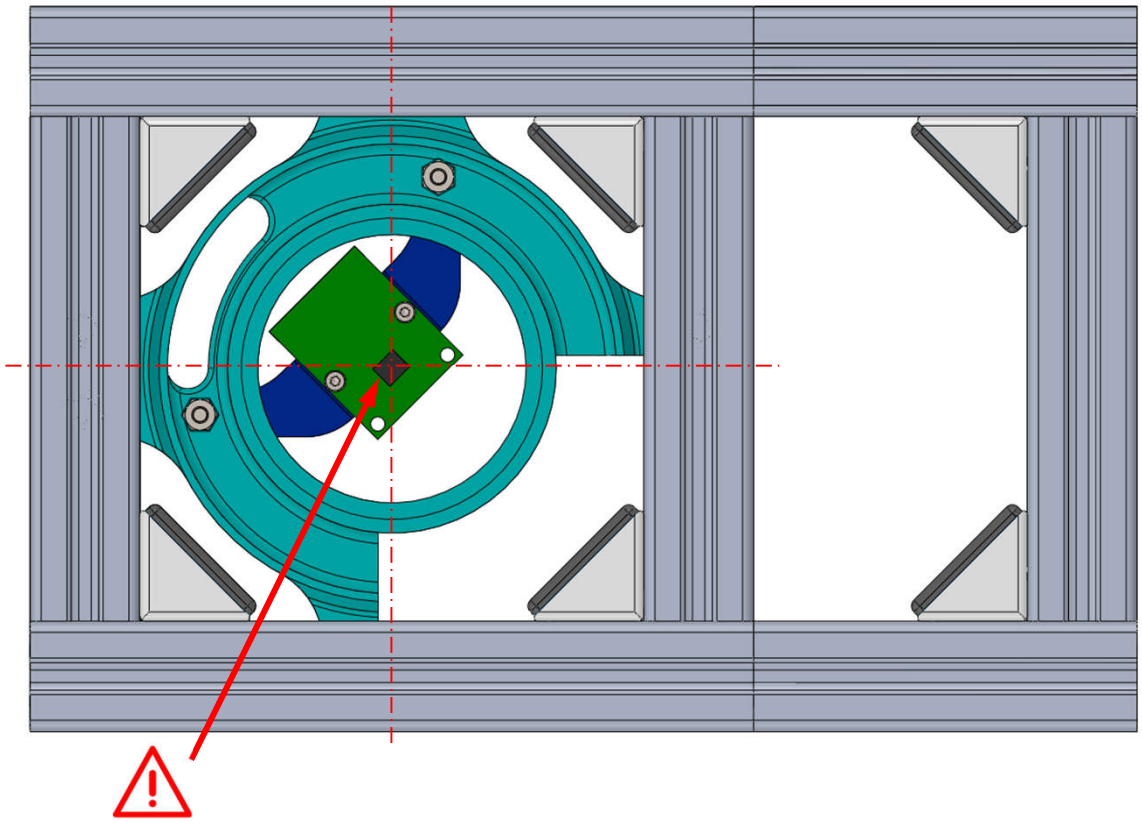
⚠ The storage unit must be centered in the base frame!

⚠ Pay attention to the orientation of the bearing unit!

Step 14

Assembly of the R1 axis
Screw on the bearing unit

R1-Axis



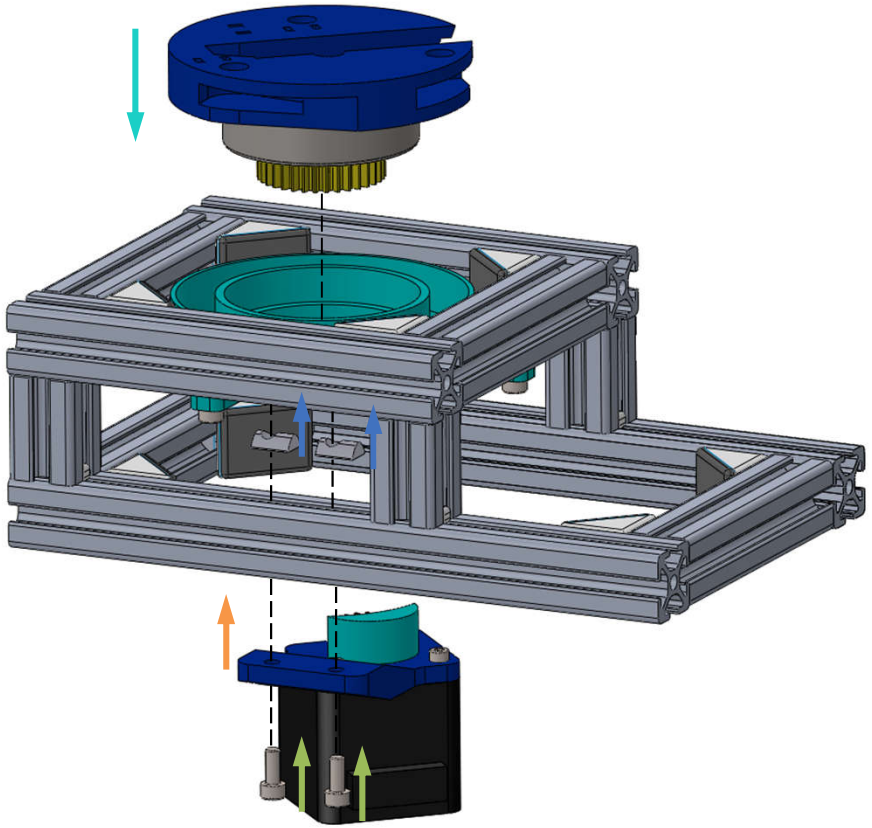
The storage unit must be centered in the base frame!

Pay attention to the orientation of the bearing unit!

Step 15

Assembly of the R1 axis
Screw on the motor unit

R1-Axis



Press the turntable unit into the bearing unit with gentle pressure until it stops

Insert the slot nuts in the corresponding positions in the base frame

Insert the motor unit and align the slot nuts over the holes

Loosely screw the motor unit with the slot nuts using the screws

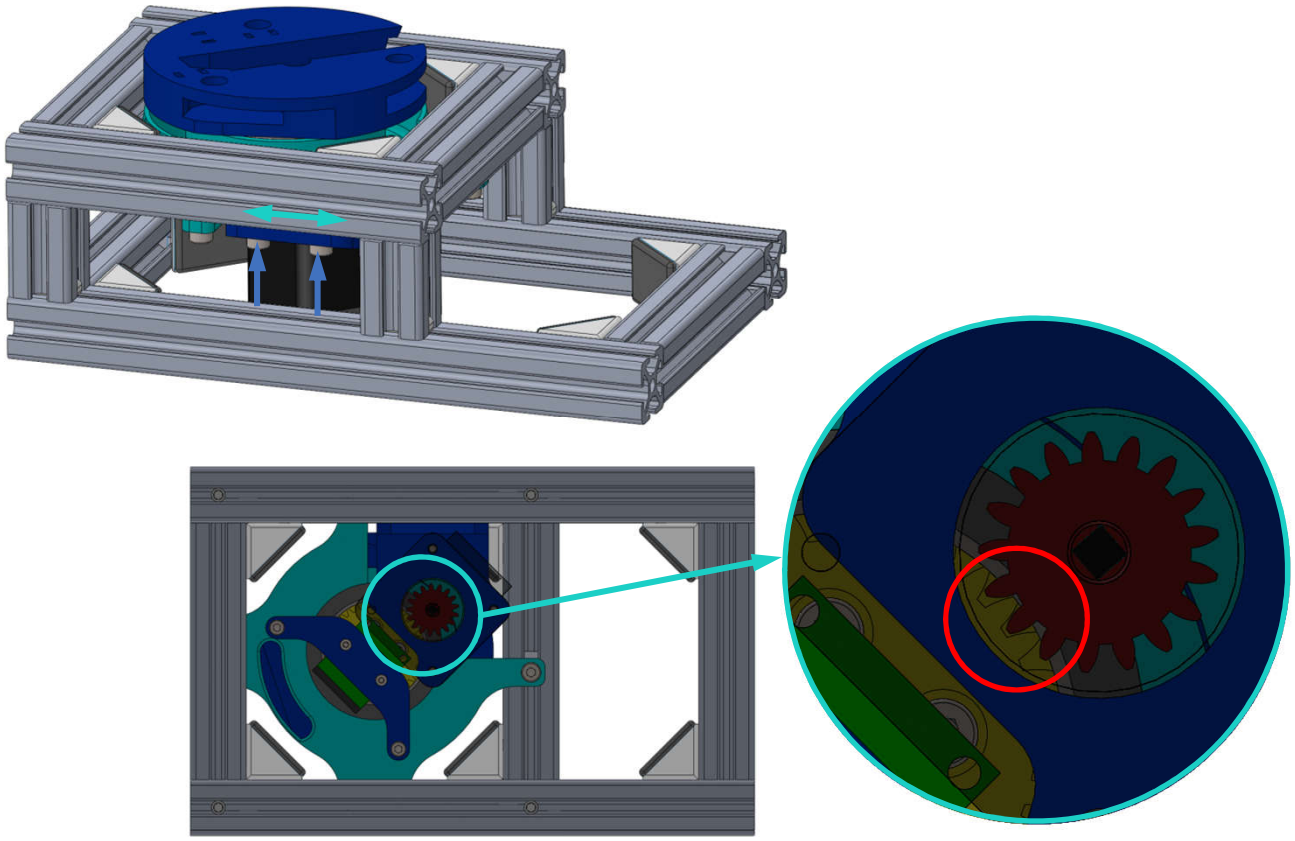
Pay attention to the orientation of the motor unit!

Step 16

Assembly of the R1 axis

Align the motor unit

R1-Axis



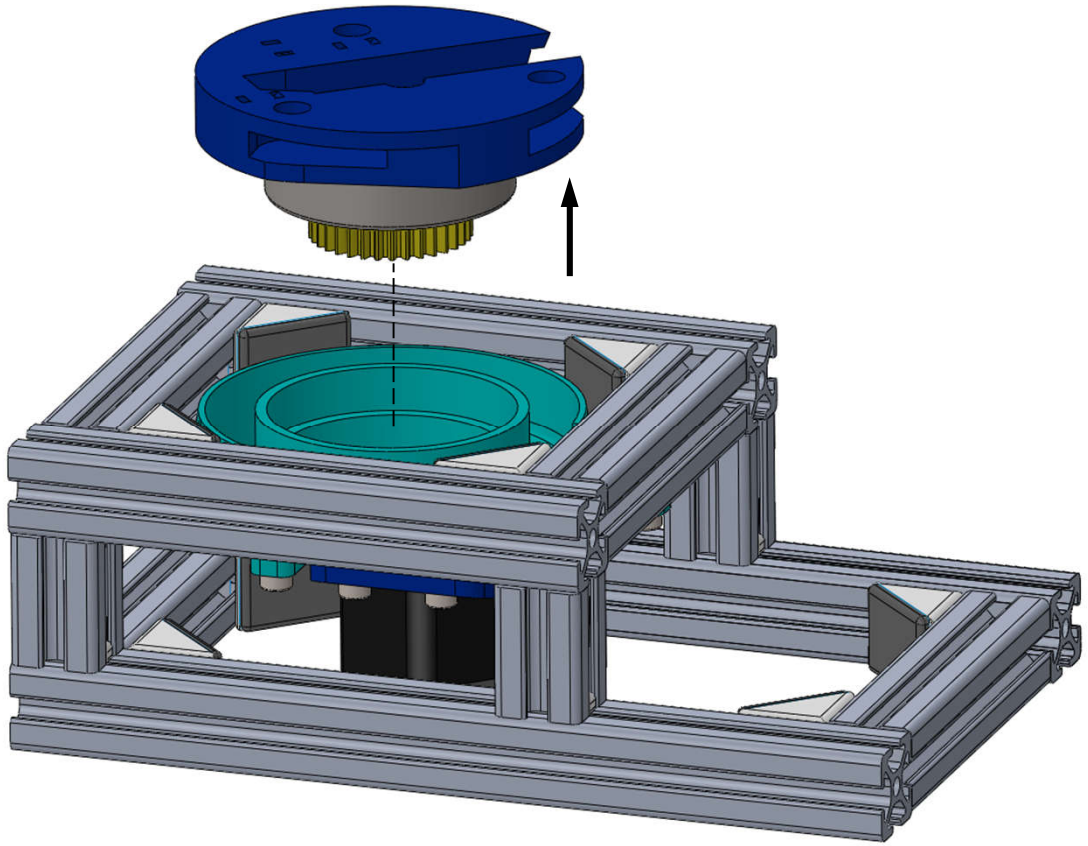
Move the motor unit to the center until the two gears mesh (see detailed view from below)

Then tighten the still loose screws of the motor unit completely

Step 17

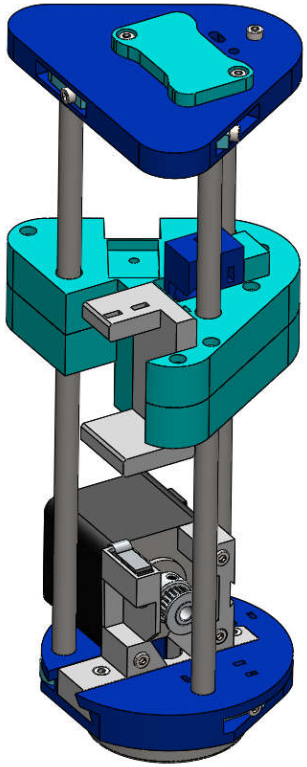
The R1 axis is ready!

R1-Axis



To facilitate further assembly of the P-Axis, the turntable can be easily removed again

P-Axis



23 Steps

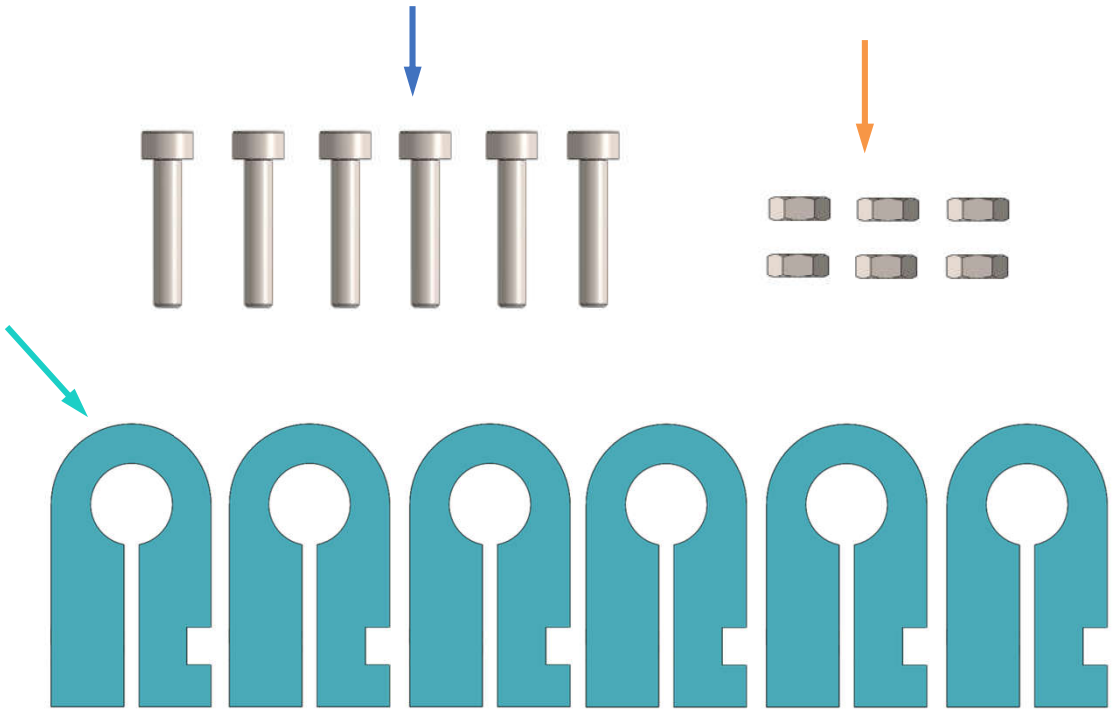
120 Minutes

Allen key

Step 1

Mounting the axis fixation
Necessary parts

P-Axis



Axis fixation (6x)

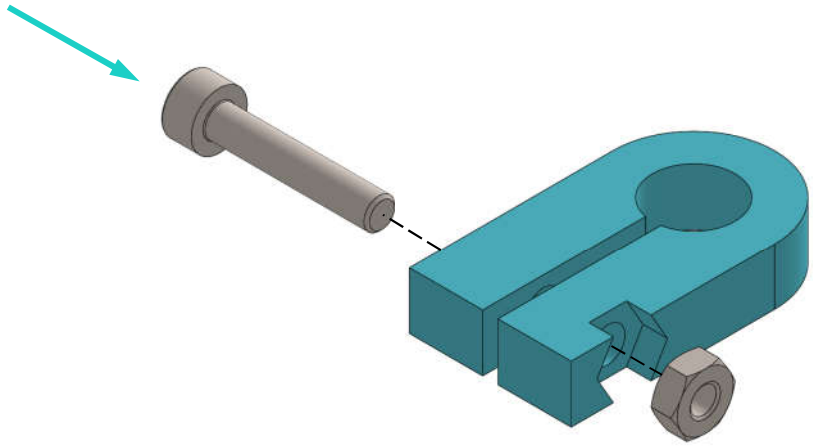
Allen screw M3x16 (6x)

Hex nut M3 (6x)

Step 2

Assembly of axle fixation
Screw together (6x)

P-Axis



Loosely screw the screw through the provided hole with the nut

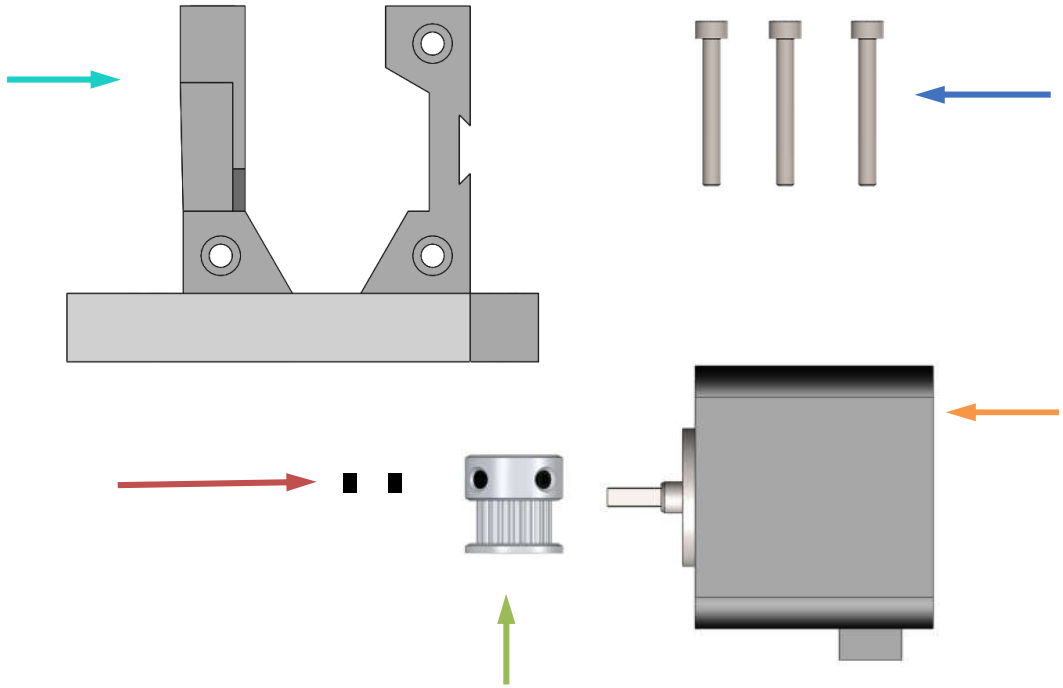
- Repeat this step six times
- The screws are tightend in a later step

Step 3

Mounting the stepper holder

Necessary parts

P-Axis



Stepper holder(1x)

Allen scew M3x35 (3x)

Stepper Motor (1x)

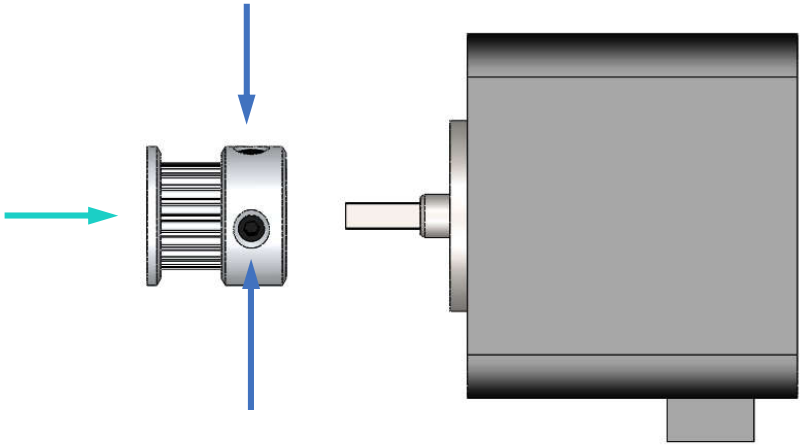
GT20 Pulley (1x)

Headless scews(2x)

Step 4

Assembly of the stepper holder
Fixate the pulley

P-Axis



Push the Pulley onto the axis of the Stepper Motor as far as it will go.

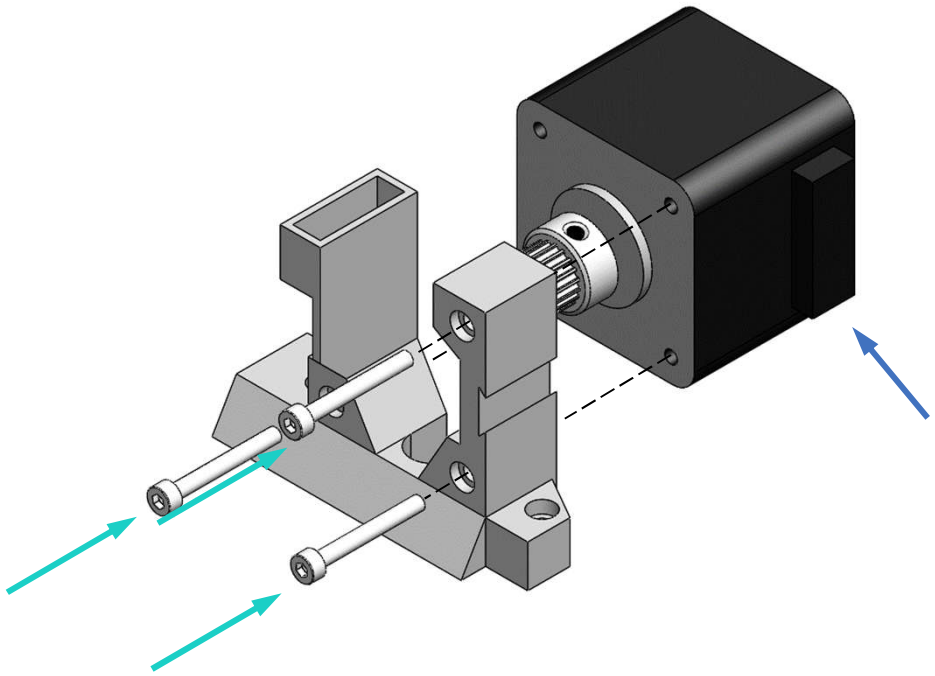
Fix the pulley by means of the two grub screws. Tighten both grub screws.

⚠ Check that the Pulley is as close to the motor as possible

Step 5

Assembly of the stepper holder
Mounting the engine

P-Axis



Use the screws to connect the stepper motor to the stepper mount.

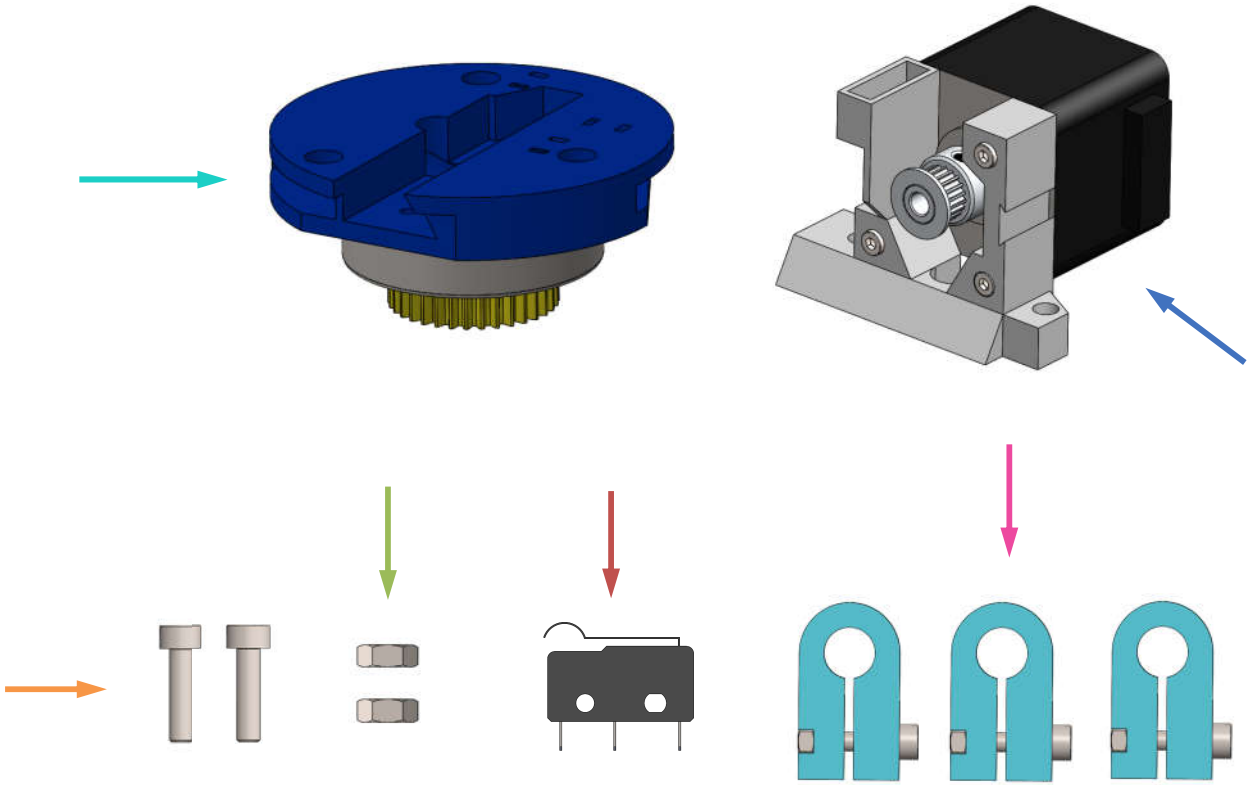
The cable output of the stepper motor must be oriented correctly!

Step 6

Assembly of the P base

Necessary parts

P-Axis



R1 turntable from before = P-base

Stepper holder from step 5 (1x)

Allen screw M3x12 (2x)

Hex nut M3 (2x)

Limit switch (1x)

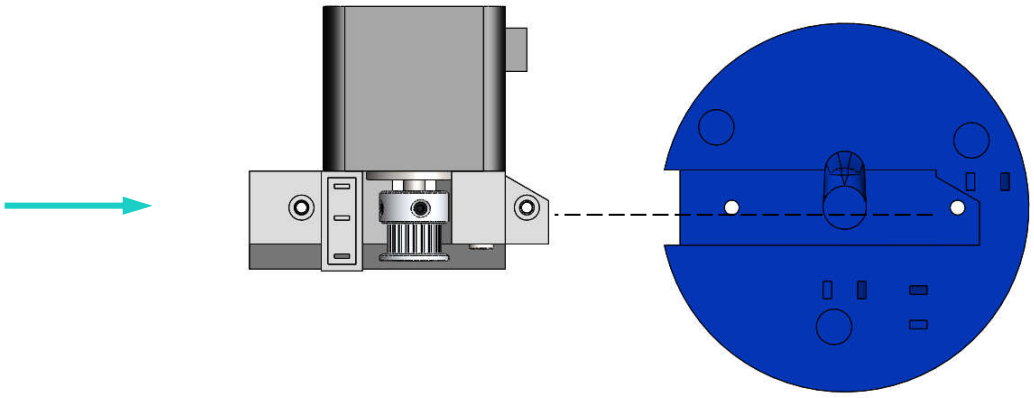
Shaft fixations (3x)

Step 7

Assembly of the P base

Inserting the motor into the base

P-Axis

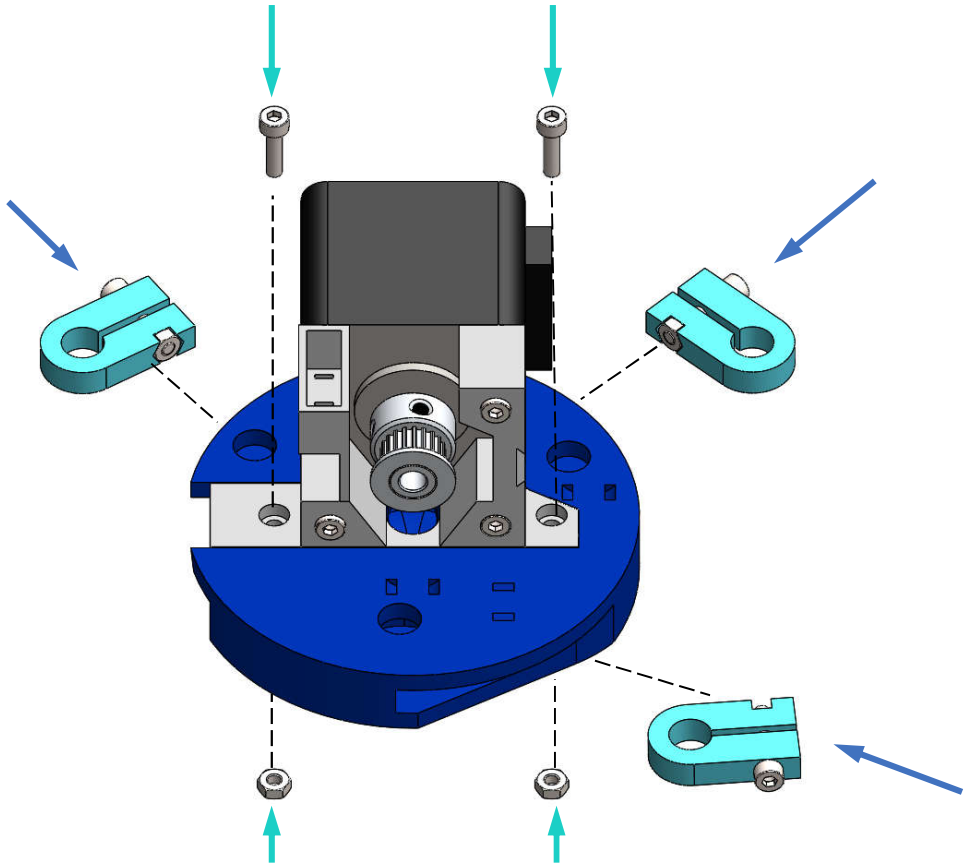


Stepper holder is pushed into P-base (turntable) as far as it will go.

Step 8

Assembly of the P base
Assembling the P-base

P-Axis



Use the two screws together with the nuts to fix the motor mount to the base.

Insert the axle fixings in the recesses provided for this purpose.

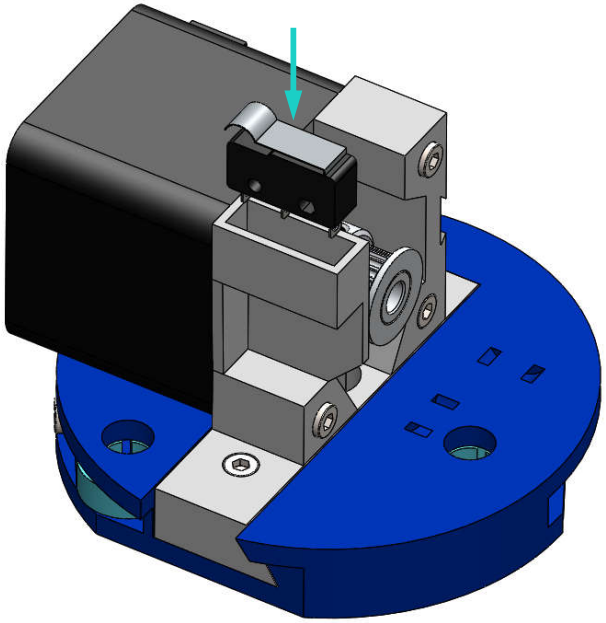
Pay attention to the orientation in this step

The screws of the axle fixings remain loosely tightened.

Step 9

Assembly of the P base
Inserting the endstop sensor

P-Axis



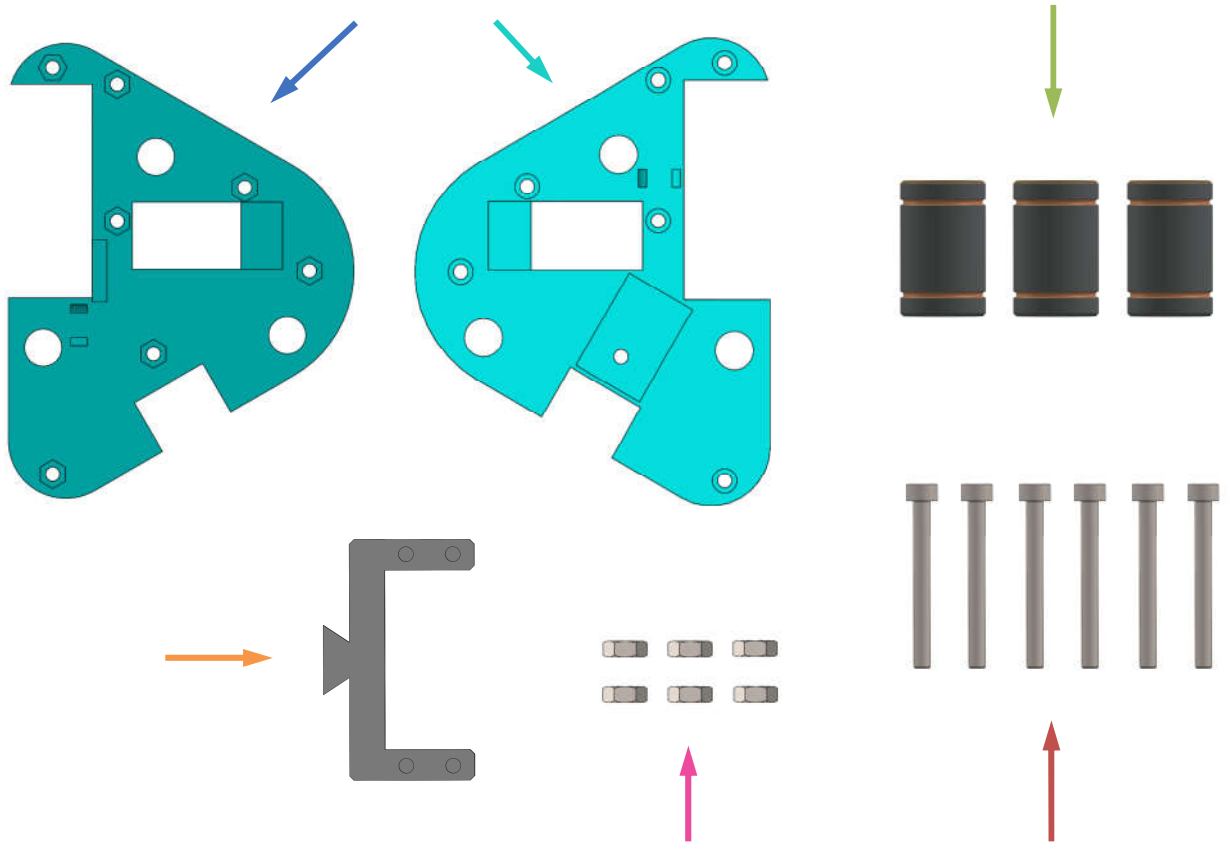
The end stop sensor is placed in the opening provided for this purpose. The contacts have to protrude completely out of the holes.

Pay attention to the orientation in this step

Step 10

Assembly of P-Mobile
Necessary parts

P-Axis



P-Top (1x)

P-Bottom (1x)

Servo-Holder (1x)

Linear bearing (3x)

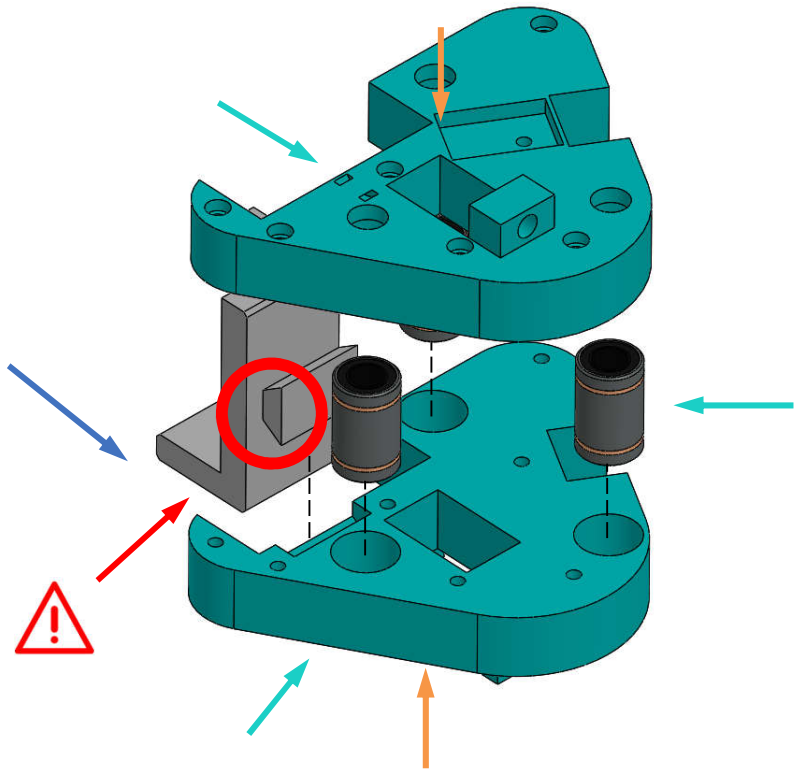
Allen screw M3x30 (6x)

Hex nut M3 (6x)

Step 11

Assembly of P-Mobile
Assemble shells

P-Axis



Press the linear ball bearing into the holes of the P-bottom.

Place the servo bracket between the two shells.

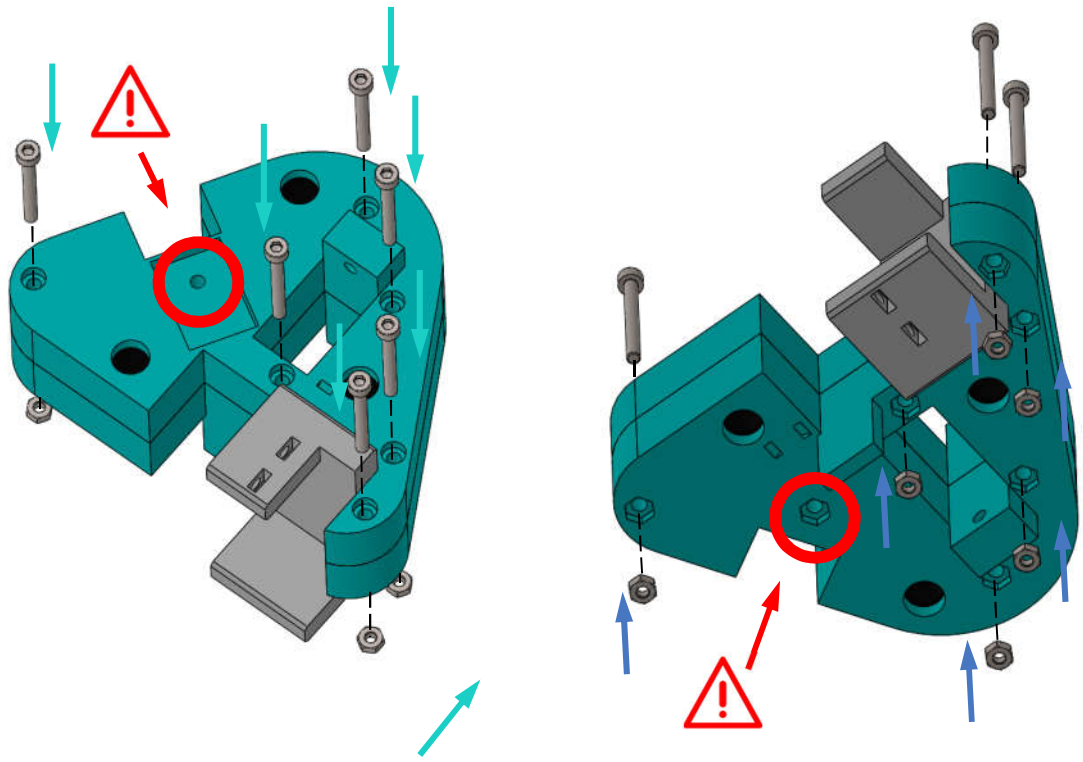
Take care of orientation here

With a little pressure, press P-top on the components and P-bottom. P-top should now lie directly on P-bottom, the bearings are no longer visible.

Step 12

Assembly of P-Mobile
Screw shells together

P-Axis



Slide the six screws through the marked screw holes.

The nuts are held from the other side into the indicated recesses.

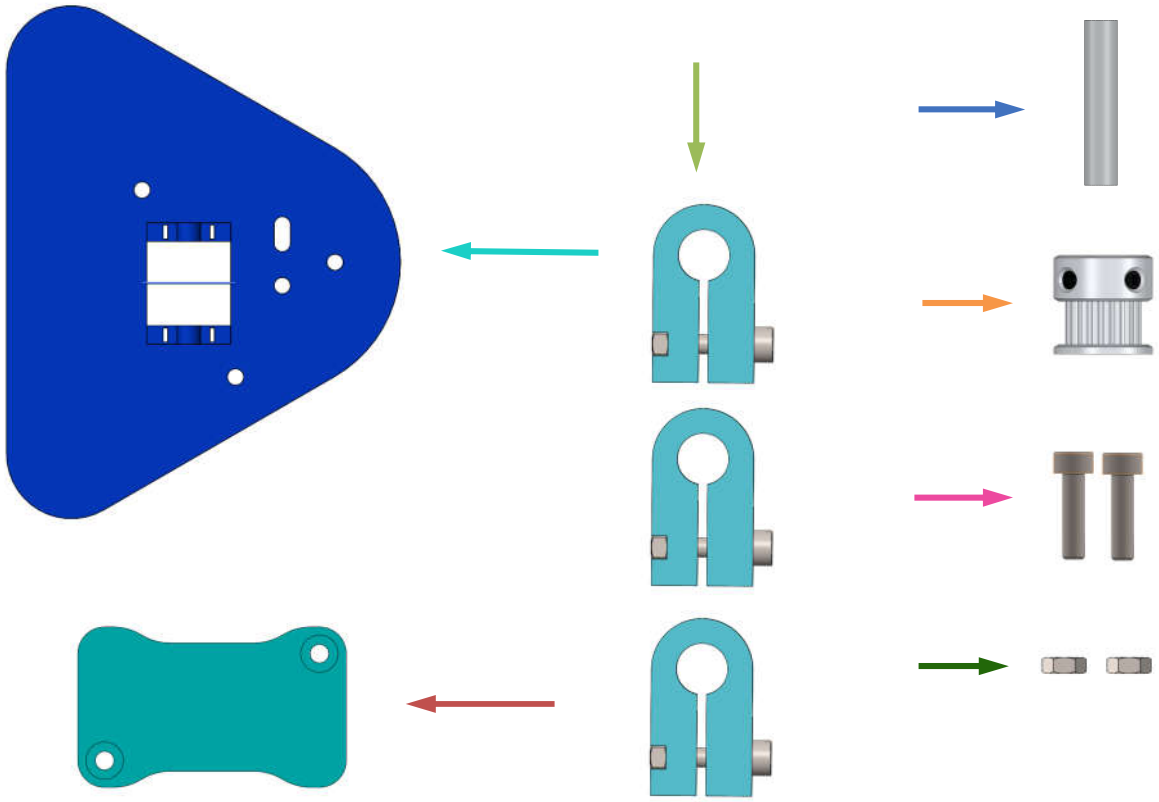
The hole marked by the red circle isn't used in this step

Screw bolts and nuts together.

Step 13

P-Head assembly
Necessary parts

P-Axis



P-Head (1x)

5mm-Axis (1x)

GT20 Pulley (1x)

Axis mounting (3x)

Cover (1x)

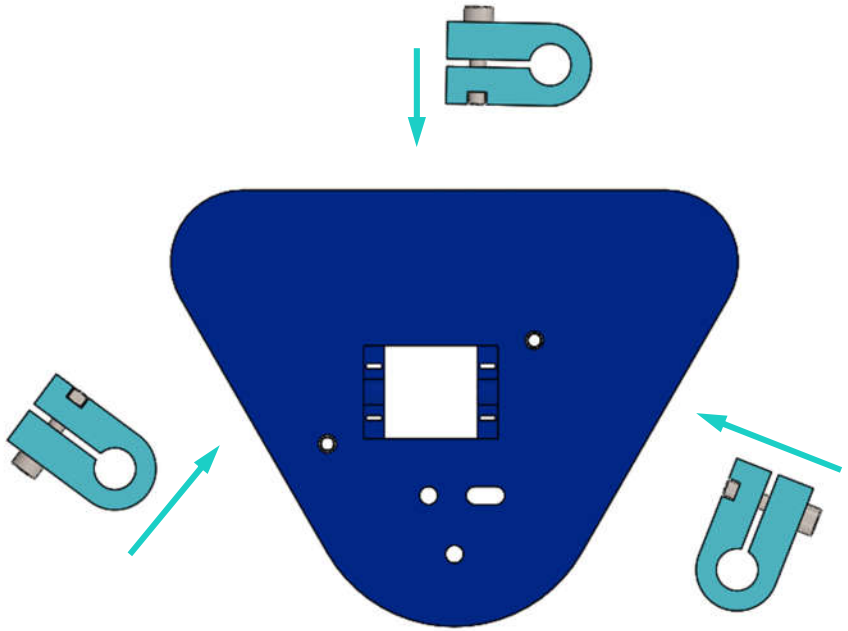
Allen scew M3x12 (2x)

Hex nut M3 (2x)

Step 14

P-Head assembly
Inserting the axis fixation

P-Axis



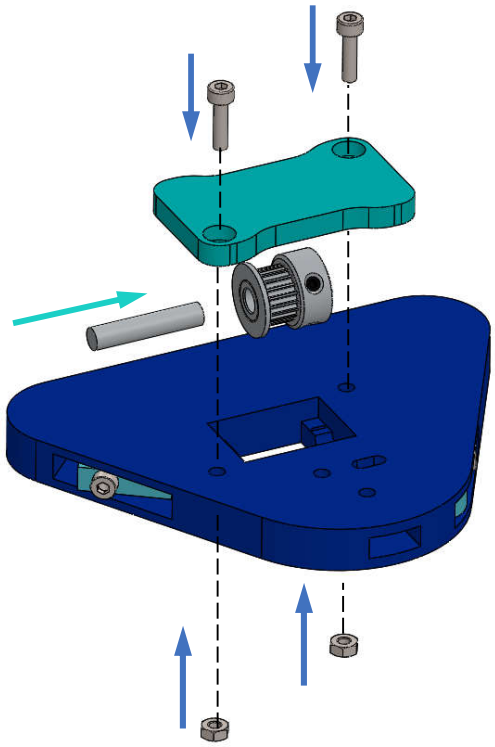
Insert axle fixings into the recesses of P-head in the correct orientation.

Axis fixation orientation is important here

Step 15

P-Head assembly
Assembly of the pulley

P-Axis



Insert axles into the pulley.

As shown in the graphic, place the Pulley with the Axis in the storage and fix the cover with the screws above.

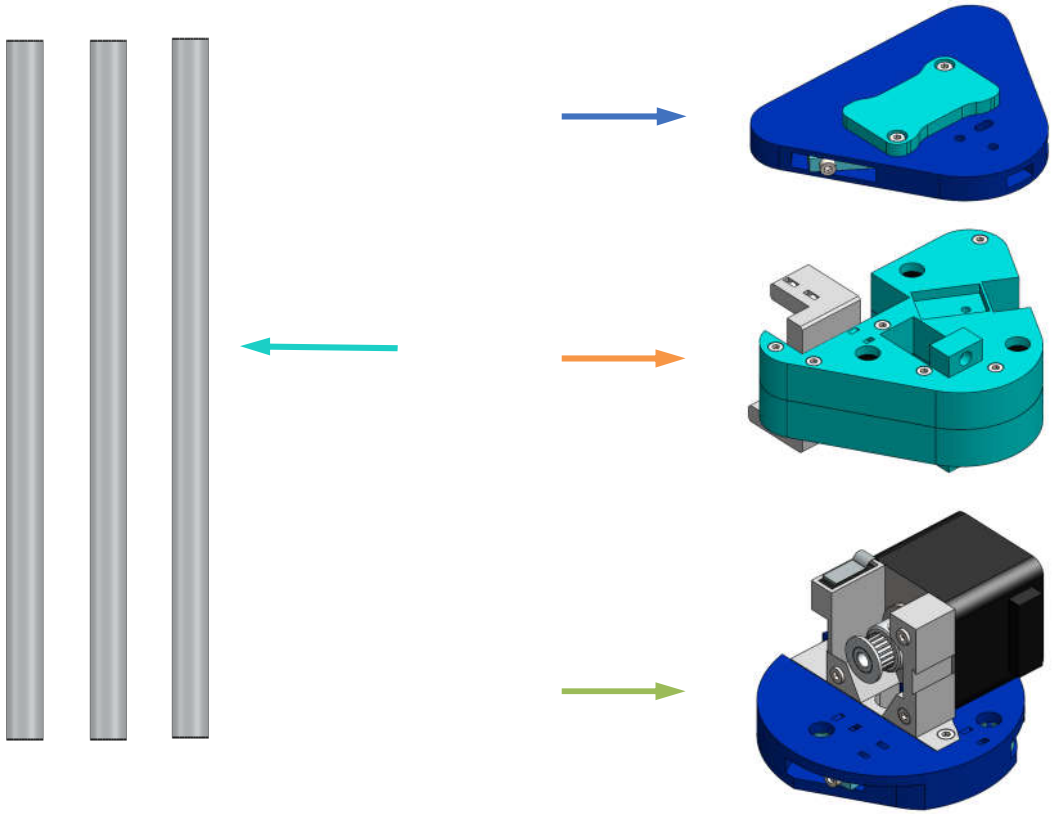
The bottom of the head part has recesses for the nuts on the bottom.

The remaining holes will be needed later for cable routing and camera mounting.

Step 16

Assembly of the linear guides
Necessary parts

P-Axis



Linear axis (3x)

P-Head
from Step 15 (1x)

P-Mobile
from Step 12 (1x)

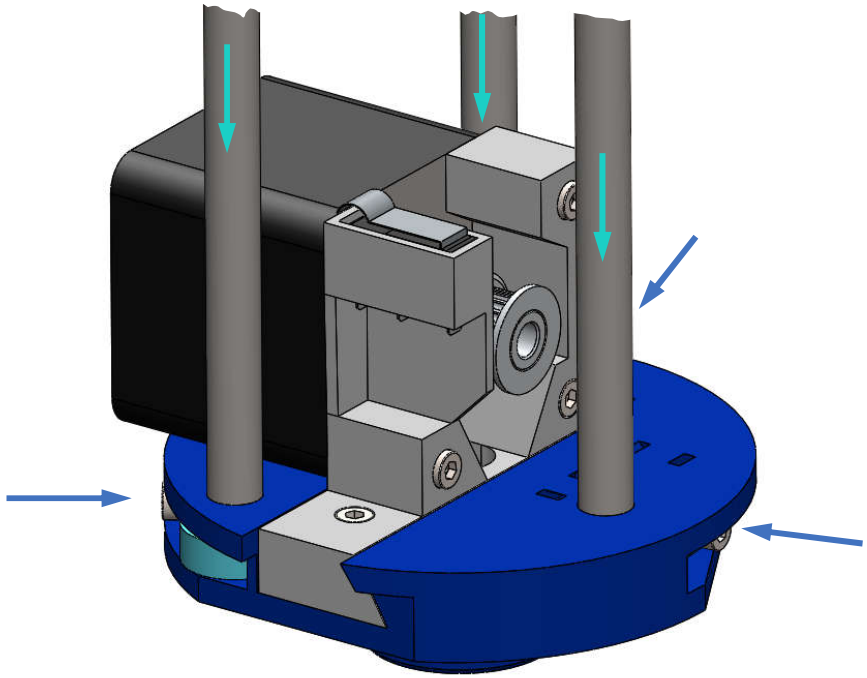
P-Base
from Step 9 (1x)

Step 17

Assembly of the linear guides

Mount guides in base

P-Axis



Stick the axles through the guiding holes – through the three axis fixations.

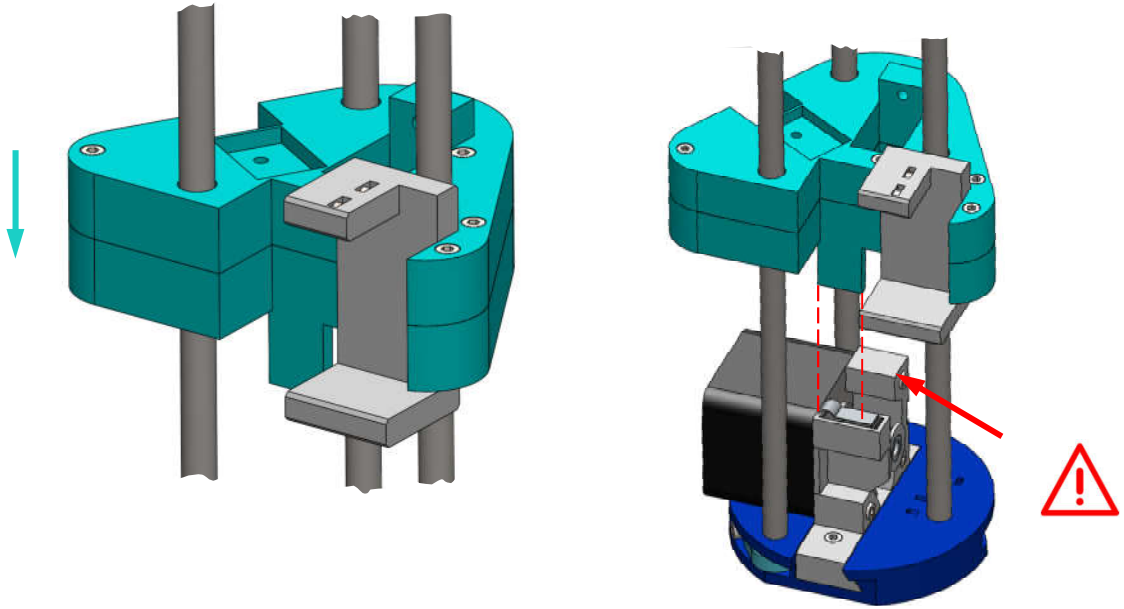
Tighten the three axis fixation screws until the guides can not be pulled out of the P base.

The axle fixations are deformed after this step and should not be reopened afterwards.

Step 18

Assembly of the linear guides
P-Mobile on the guides

P-Axis



Slide P-Moving onto the guide rails

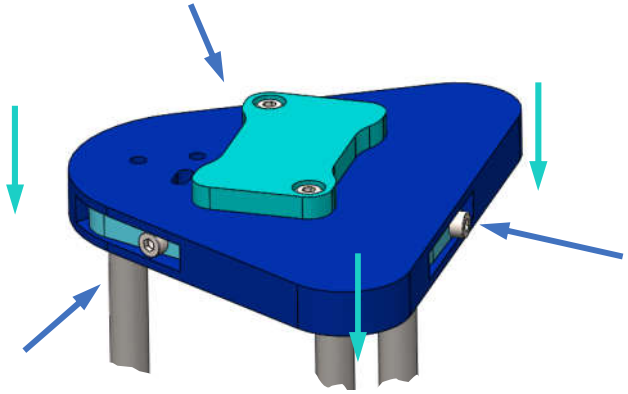
The extrusion on P-Mobile must be aligned with the limit switch!

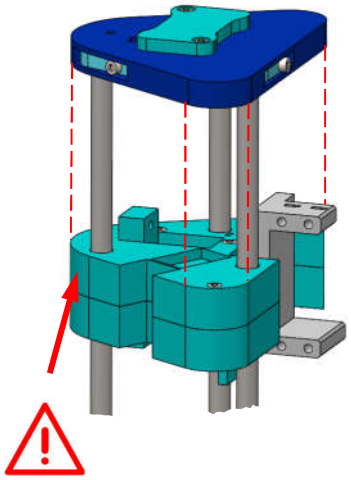
P Mobile may rest on the Endstop Sensor while the next steps are being performed.

Step 19

Assembly of the linear guides
Mount the P-Head

P-Axis





Stick guides through the holes in P-Head, all the way through the axis fixers.

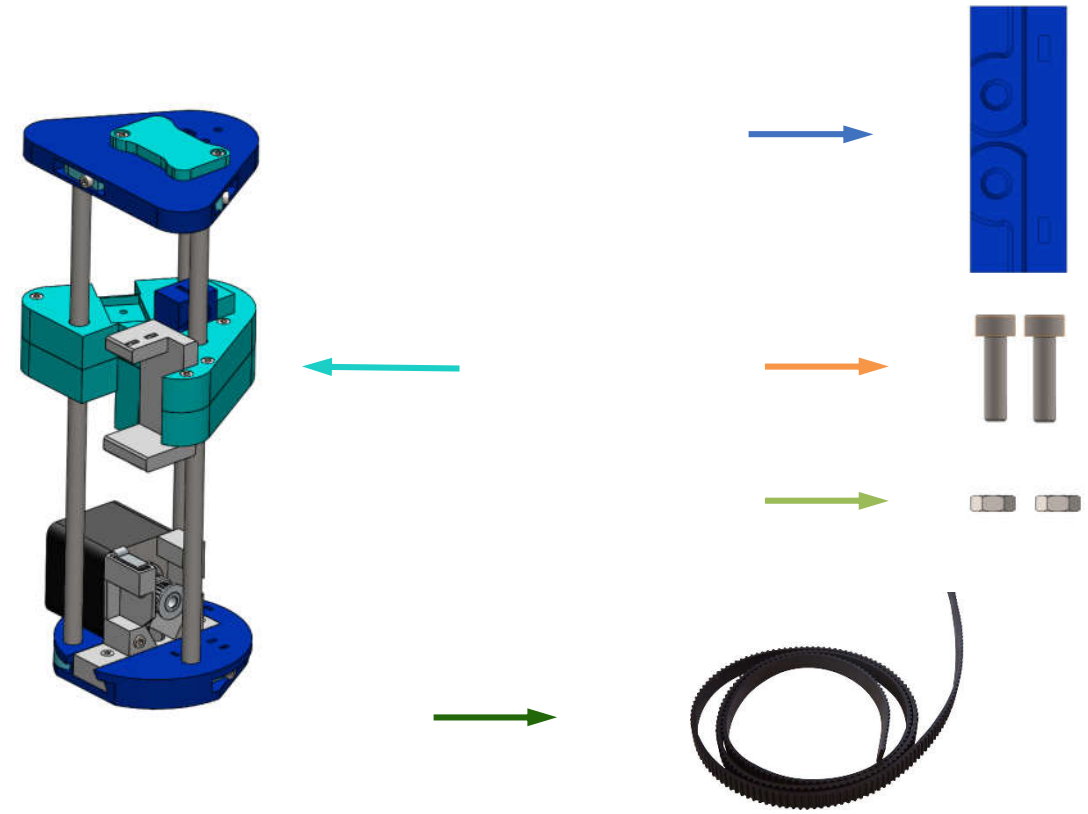
Tighten the screws of the three axle fixers until the guide rails are stable in P-Head. The connection from head to base should now be completely stable.

P-Head must be turned in the same direction as P-Mobile!

Step 20

Belt and belt clamp
Necessary parts

P-Axis



Entire P – construction

Belt Clip (1x)

Allen screw M3x12 (2x)

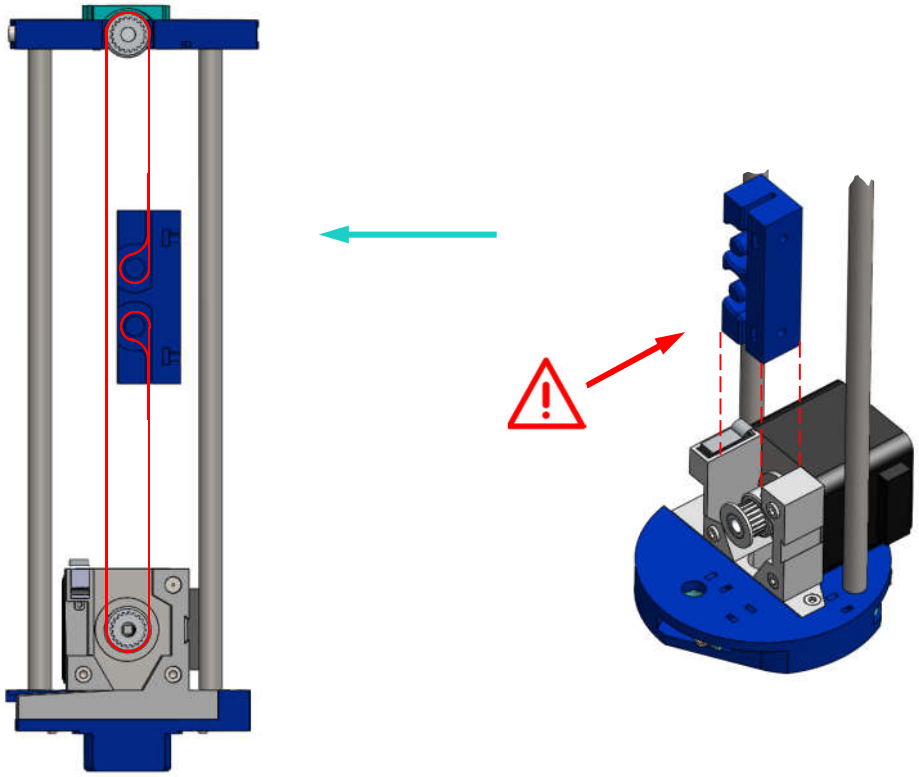
Hex nut M3 (2x)

Belt 60cm (1x)

Step 21a

Belt and belt clamp
Belt course through P

P-Axis



Course of the belt through the belt clamp. Graphic without P - Mobile.

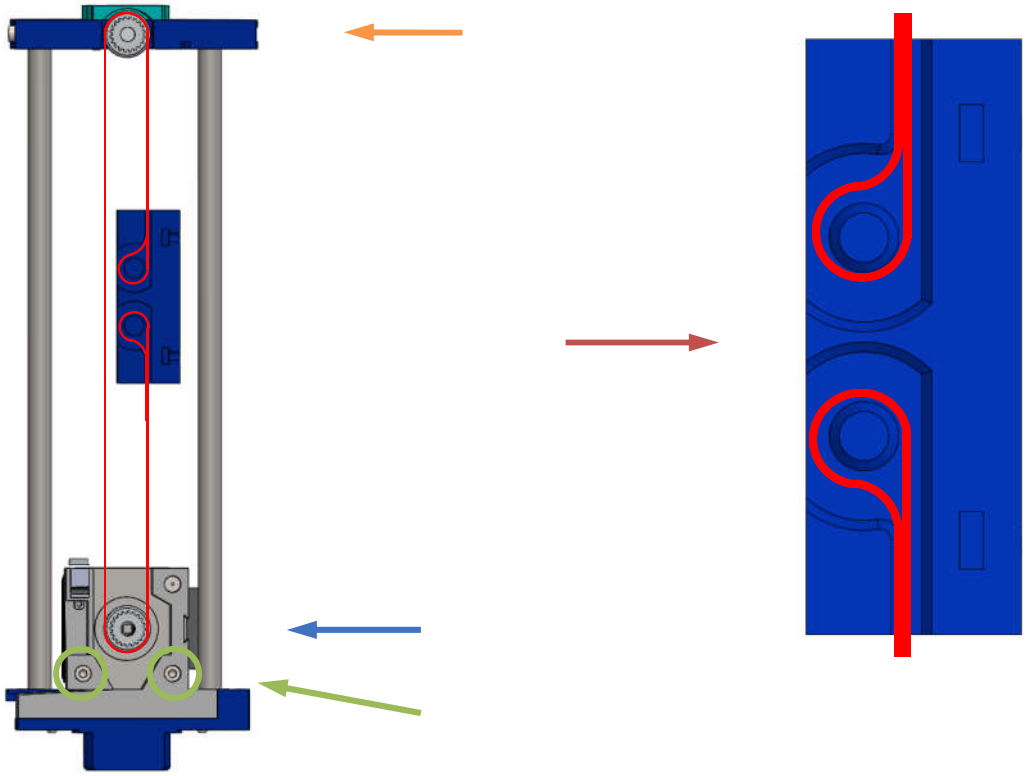
The belt must be tensioned in the belt clamp before the belt clamp is screwed in the next step with P-Moving.

Pay attention to the orientation of the belt clamp, otherwise the belt can not be strained!

Step 21b

Belt and belt clamp
Tension the belts

P-Axis



Guide belt through pulley on motor side.

Guide the belt through the pulley in the P-Head. Here, the cover can be removed, if it should be a hindrance.

Loosen the marked screws of the motor so that the motor has some play around the top screw.

Tighten the belt firmly with the belt clamp. If necessary, press it in with a screwdriver.

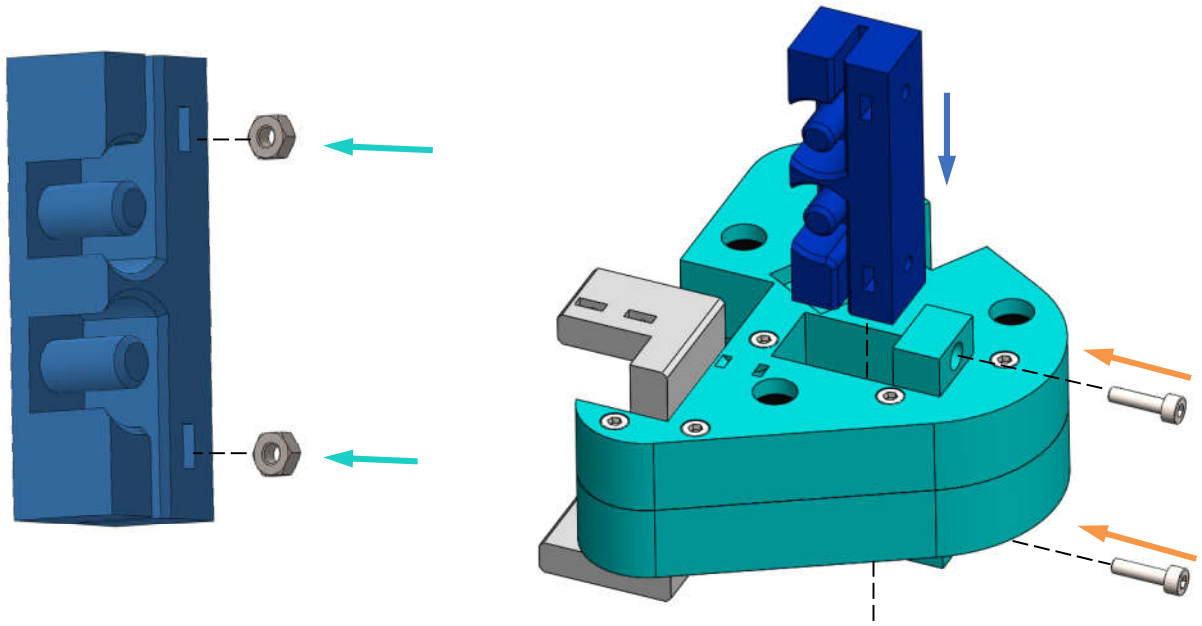
Tighten the motor screws again.

Step 22

Belt and belt clamp

Assembly of the belt tensioner

P-Axis



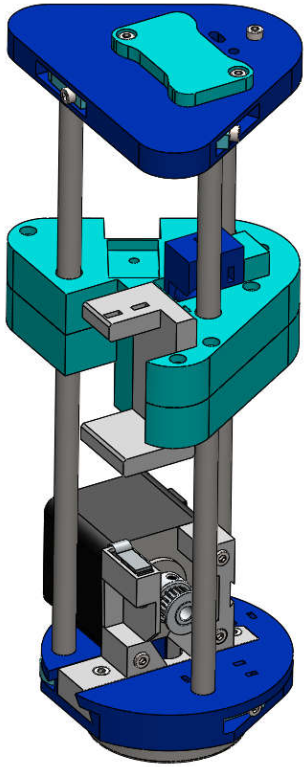
Insert nuts into the provided holes of the belt tensioner.

Insert the strap clamp into the P-Mobile so that the screw holes are at the same height as the nuts.

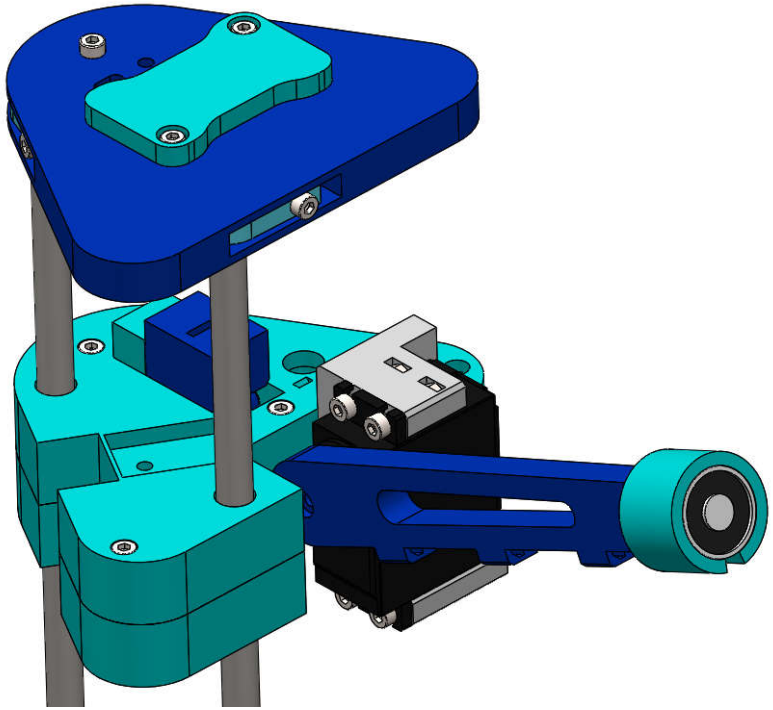
Secure belt clamp with screws.

Step 23

The P-Axis is ready!



R2-Axis



7 Steps

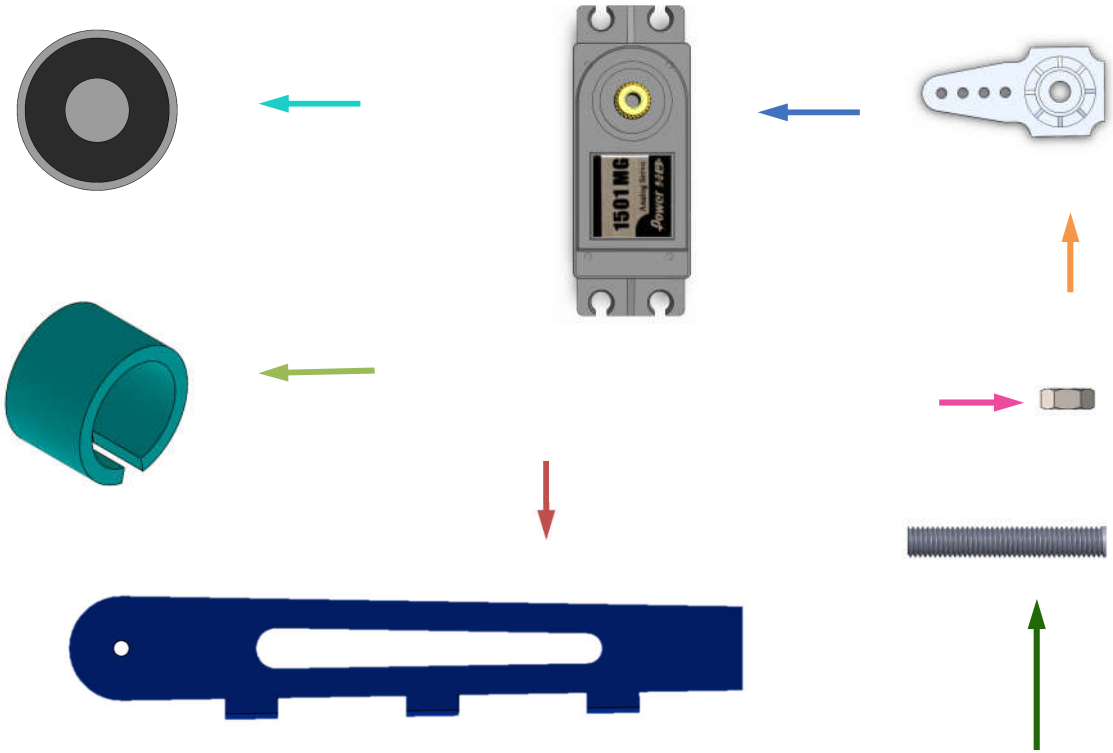
20 Minutes

Allen Key

Step 1

Assemble R2 Axis
Necessary parts

R2-Axis



Electromagnet (1x)

Servomotor (1x)

Servohorn cut (1x)

Magnet holder (1x)

R2 Axis (1x)

Kex nut M4 (1x)

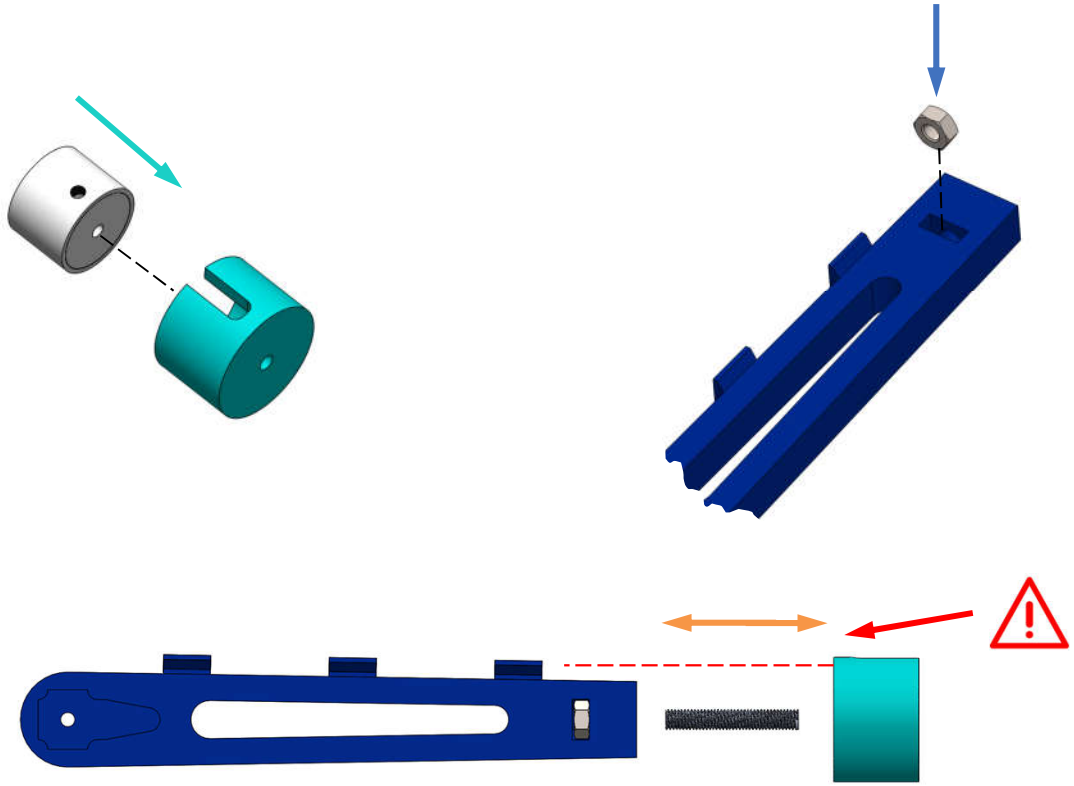
Threaded rod 30 mm (1x)

Step 2

Assemble R2 Axis

Attach the electromagnet

R2-Axis



Insert the electromagnet into the magnet holder. The cables are routed through the slot provided.

Insert the nut into the R2-Axis.

Screw the threaded rod through the hole with the electromagnet.

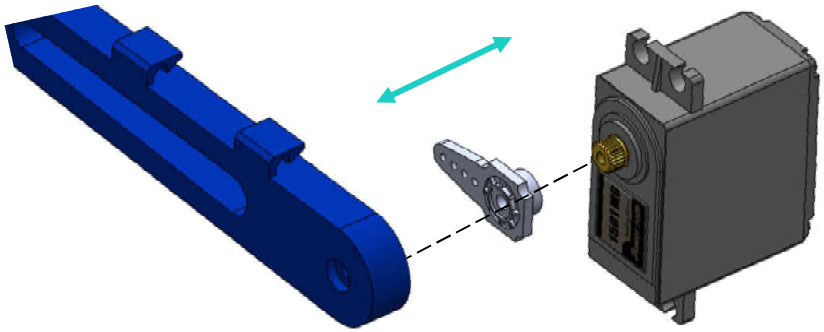
The orientation of the cable exit of the electromagnet must be in the same orientation as the R2 clips!

Step 3a

Assemble R2 Axis

Connect servomotor to Axis

R2-Axis



Connect the servo horn to the R2-Axis and the servomotor

Rotate clockwise. At the stop, push the servo horn as shown in the picture.

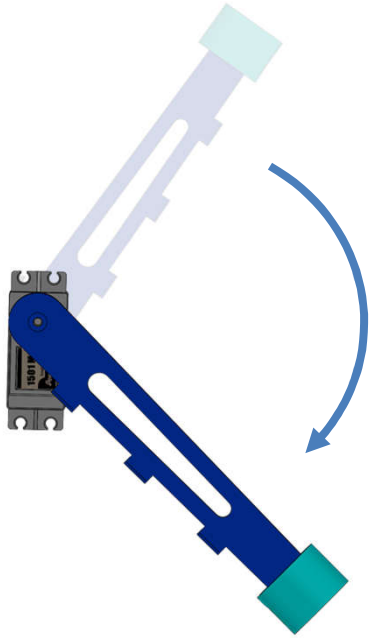
The servo horn must have exactly the angle specified in the drawing. If this is not the case, the robot must be recalibrated later.

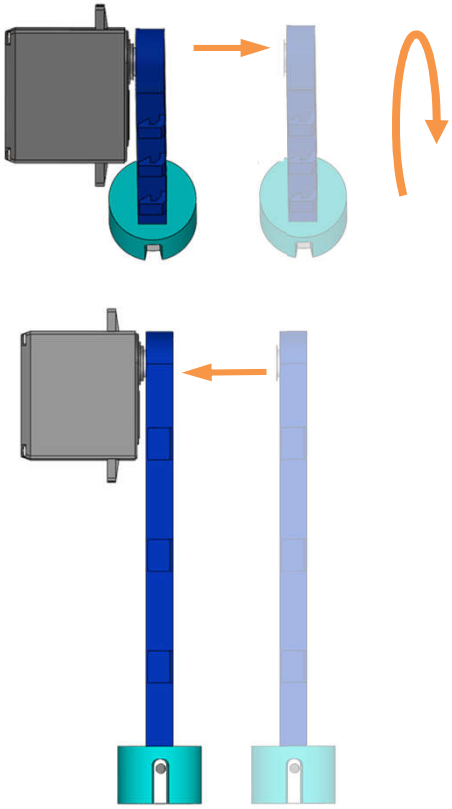
Step 3b

Assemble R2 Axis

Position servomotor correctly

R2-Axis





Turn clockwise until the servomotor is fixed to the stop.

⚠ Do not turn further if the servomotor shows resistance.

Reverse the servo horn as shown in the illustration so that the bottom of the motor shows the R2 axis down.

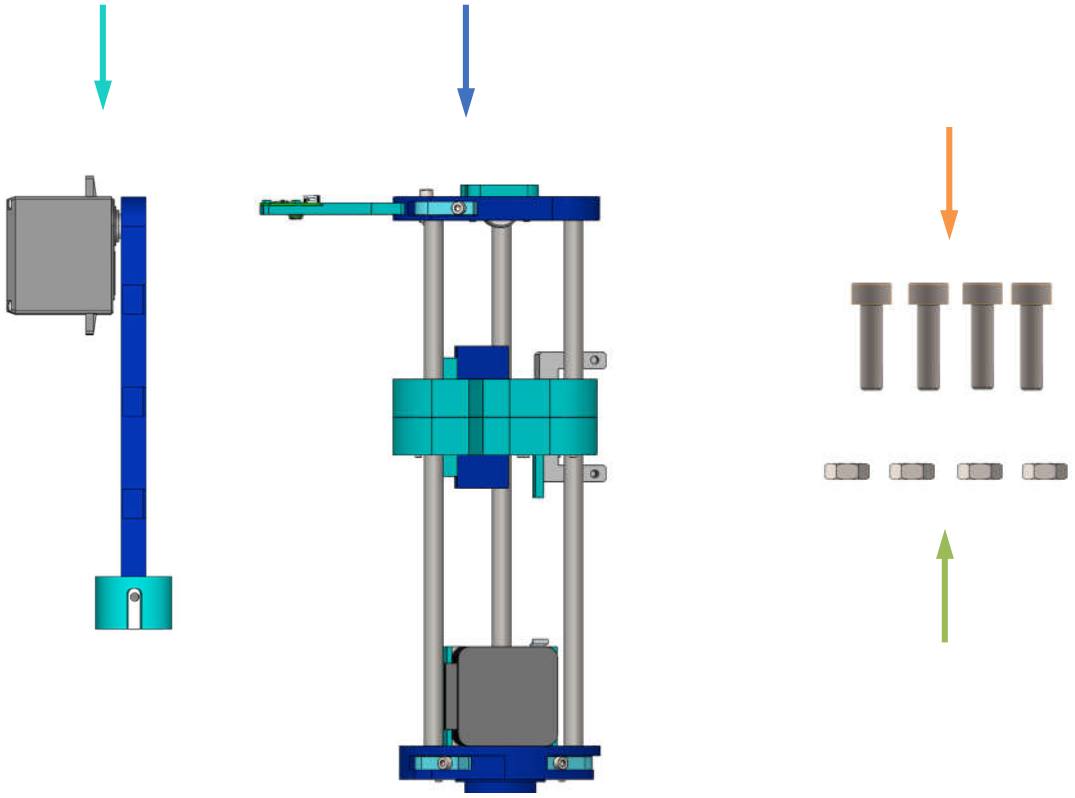
ⓘ The servo horn must have exactly the angle specified in the drawing. If this is not the case, the robot must be recalibrated later.

Step 4

Mount servomotor on P-Axis

Required parts

R2-Axis



Previous R2-Axis

Previous RPR-Robot

Allen screw M3x16 (4x)

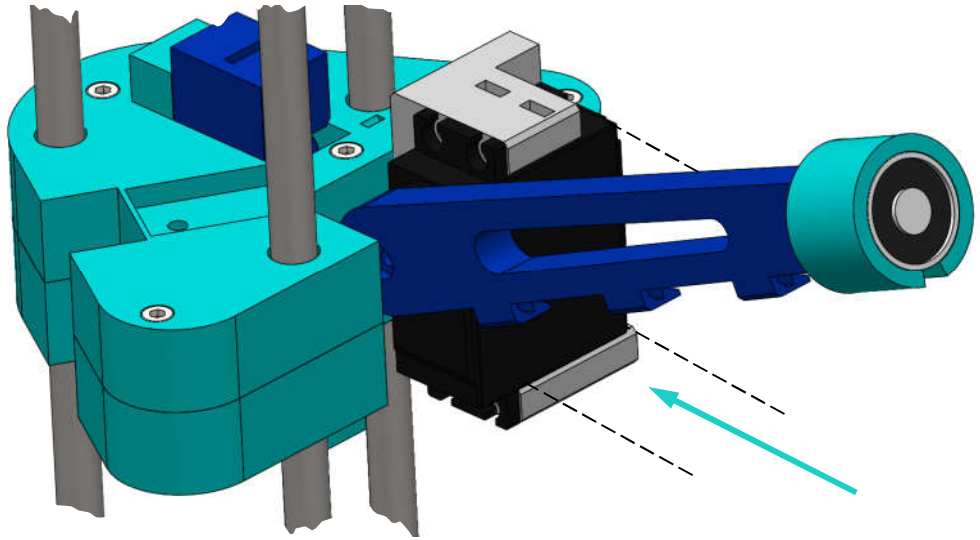
Hex nut M3 (4x)

Step 5

Assemble R2 Axis

Mount servo motor on P-Axis

R2-Axis



Slide the servomotor into the servo mount.

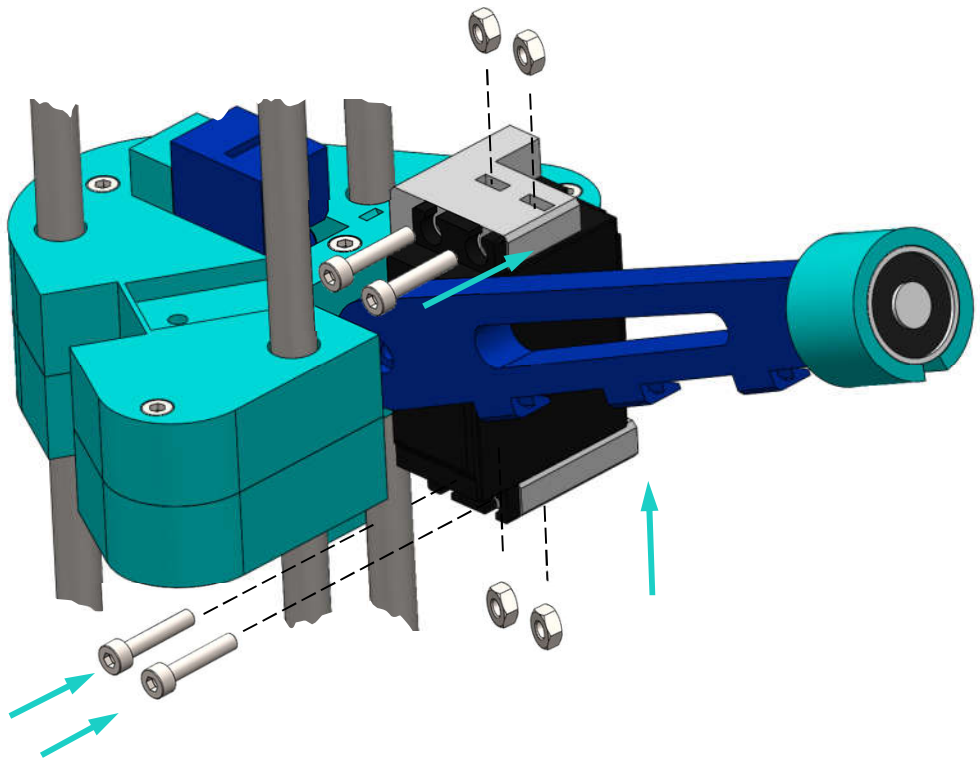
⚠ The servo must be oriented upwards with the servo horn.

Step 6

Assemble R2-Axis

Mount servo motor on P-Axis

R2-Axis



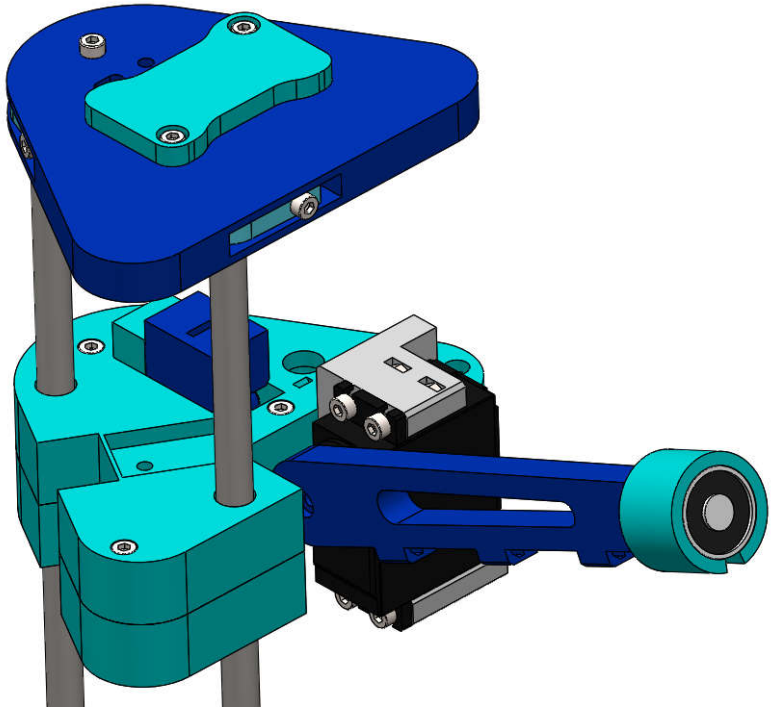
Insert nuts into the holes and screw them through the holes in the servo using the four screws.

The R2-Axis can already be rotated arbitrarily to facilitate assembly.

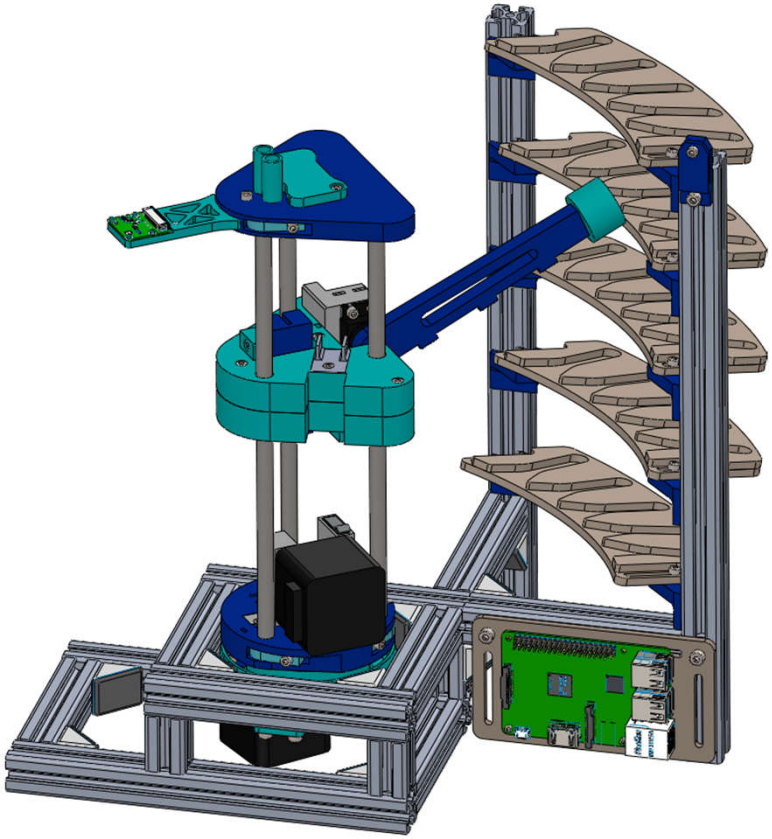
The lower nuts must be held with one finger in the hole while the screws are screwed.

Step 7

The R2-Axis is ready!



Application: shelf and camera



13 Steps

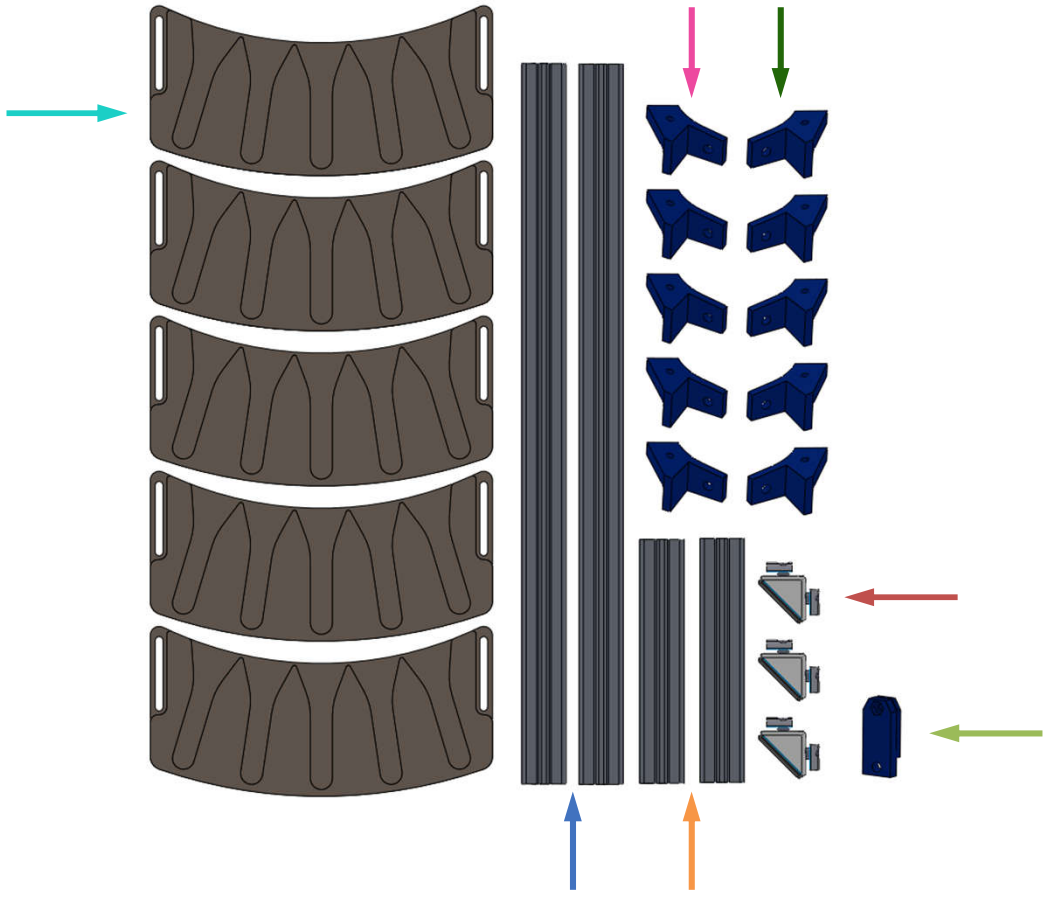
45 Minutes

Allen key

Step 1a

Assembly of the shelf
Necessary parts (1)

Shelf and Camera



Shelf (5x)

Profile E: 325 mm (2x)

Profile F: 110 mm (2x)

Camera cable clamp (1x)

Angle connector (3x)
including nuts and screws

Left shelf holder (5x)

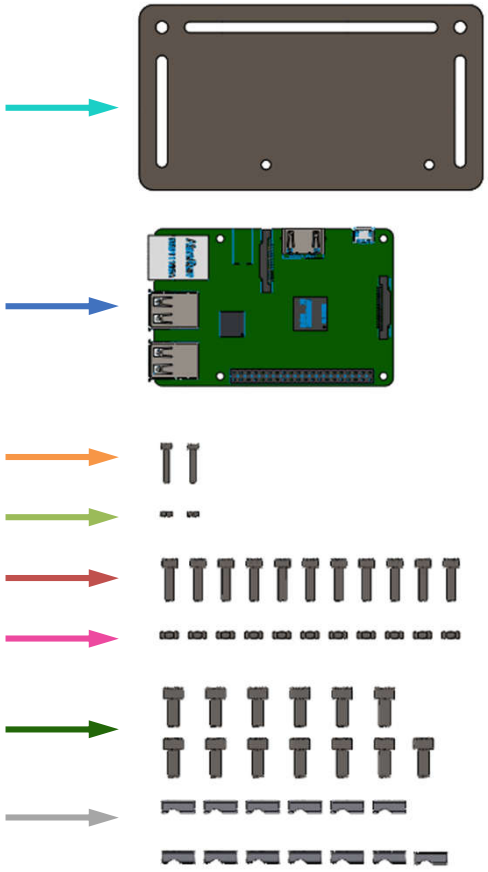
Right shelf holder (5x)

The left/right shelf holders are mirrored parts

Step 1b

Assembly of the shelf

Necessary parts (2)



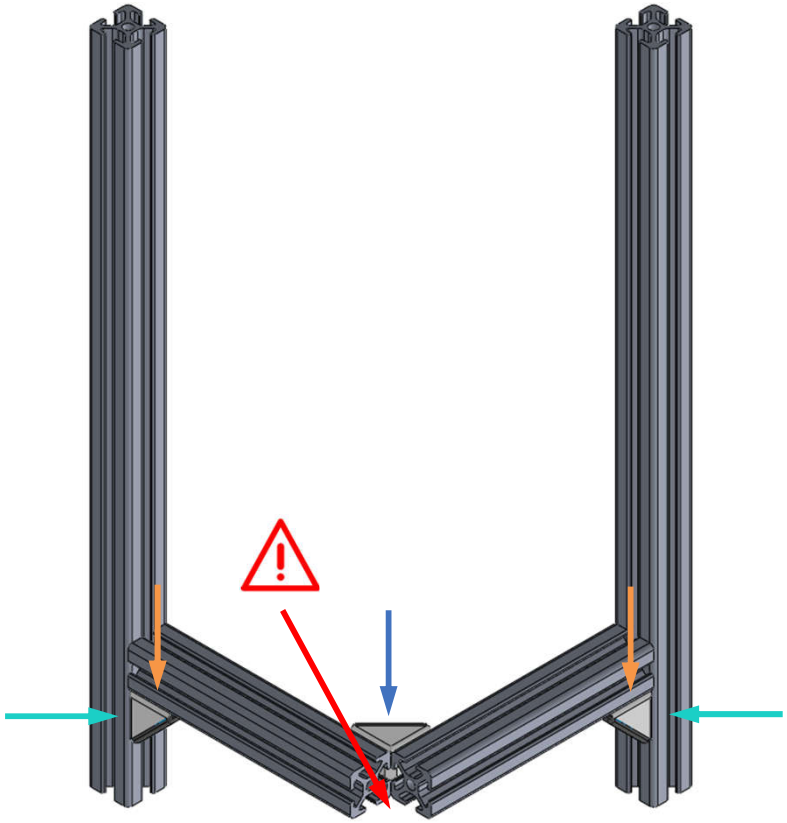
Shelf and Camera

- Microcontroller holder (1x)
- Raspberry Pi (1x)
- Allen screw M2x12 (2x)
- Hex nut M2 (2x)
- Allen screw M3x12 (11x)
- Hex nut M3 (11x)
- Allen screw M4x10 (13x)
- Sliding nut (13x)

Step 2

Assembly of the shelf
Connection of the profiles

Shelf and Camera



At a height of 50 mm, attach an angle connector to the long profiles E

Screw the two short profiles F together with another angle

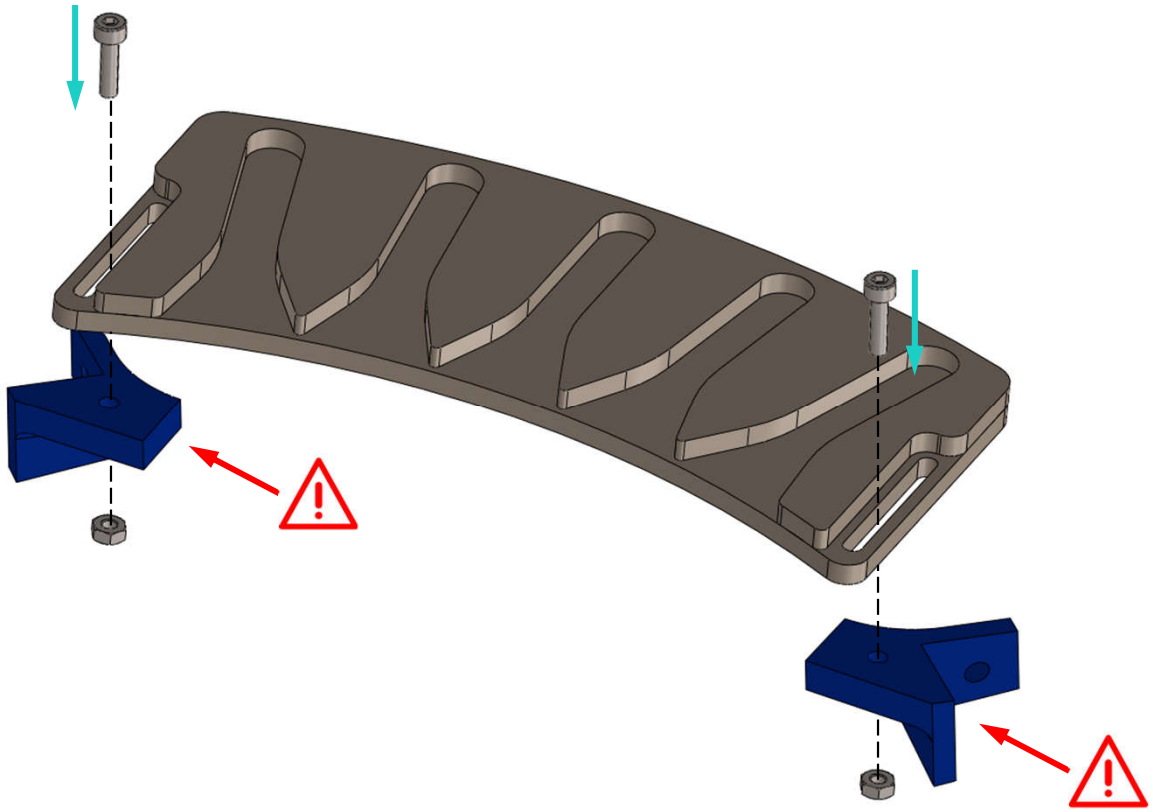
Make sure that the corner is empty!

Screw the short profiles to the angle connectors of the long profiles to create a symmetrical construction

Step 3

Assembly of the shelf
Assembly of shelves

Shelf and Camera



Connect the shelves to the left and right brackets using the M3 screws

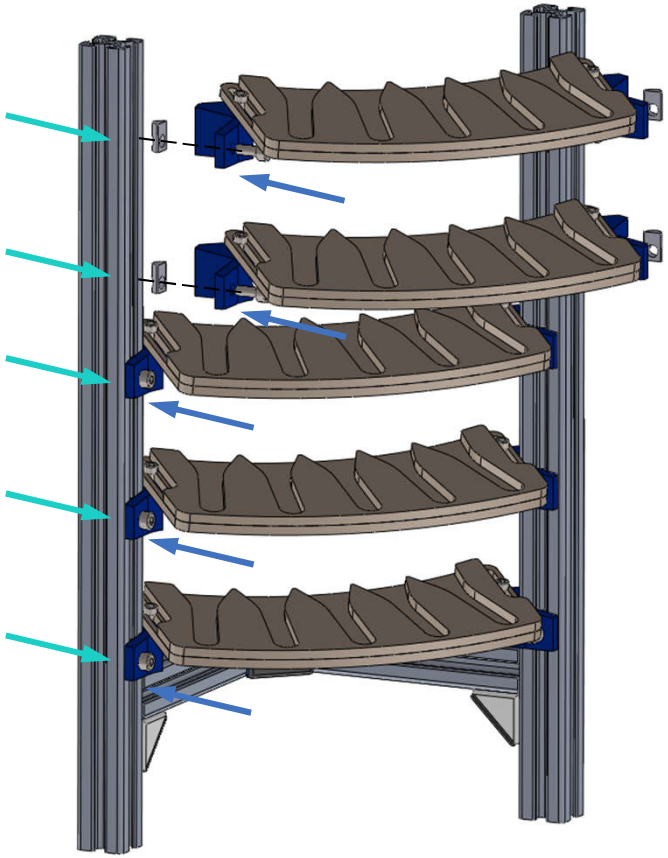
Pay attention to the alignment of the brackets!

Do not tighten the screws completely so that you can still adjust the position

Repeat this step five times

Step 4

Assembly of the shelf
Installation of the shelves



Shelf and Camera

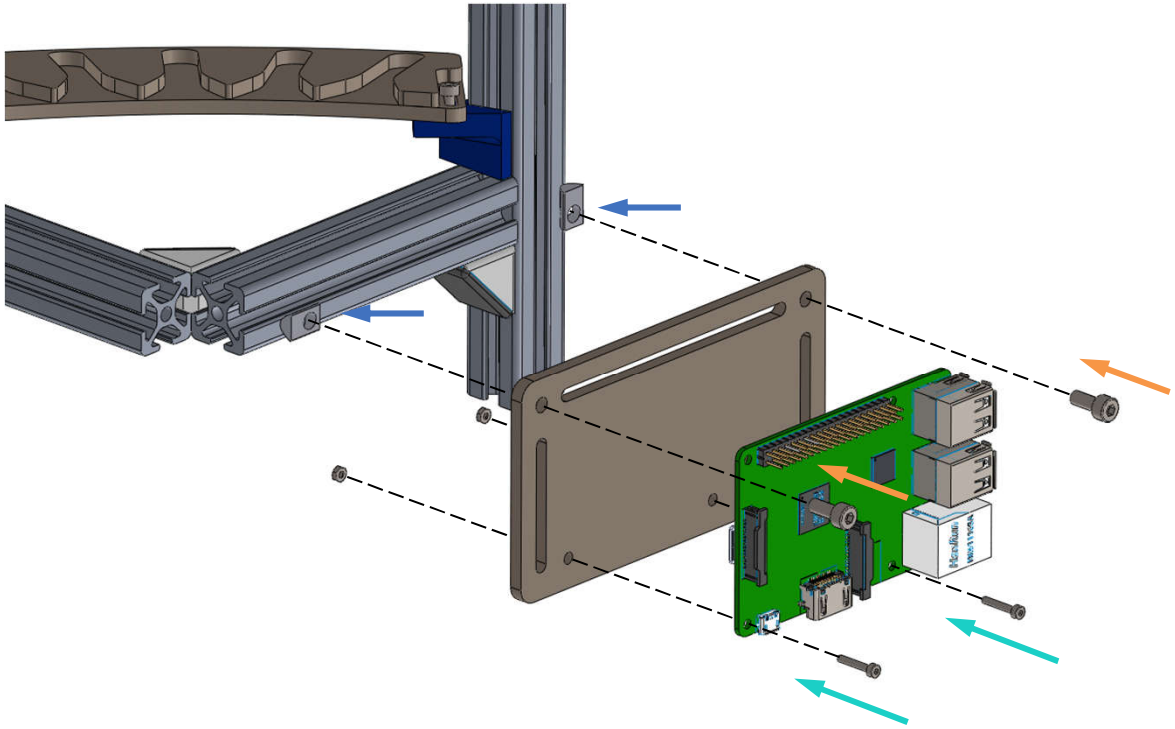
nsert 5 slot nuts on each side of the structure into the profile

Use the M4 screws to connect the shelves with the slot nuts in the profiles

Step 6

Assembly of the shelf
Attachment of the microcontroller

Shelf and Camera



Using the M2 screws and nuts, screw the Raspberry Pi to the microcontroller holder

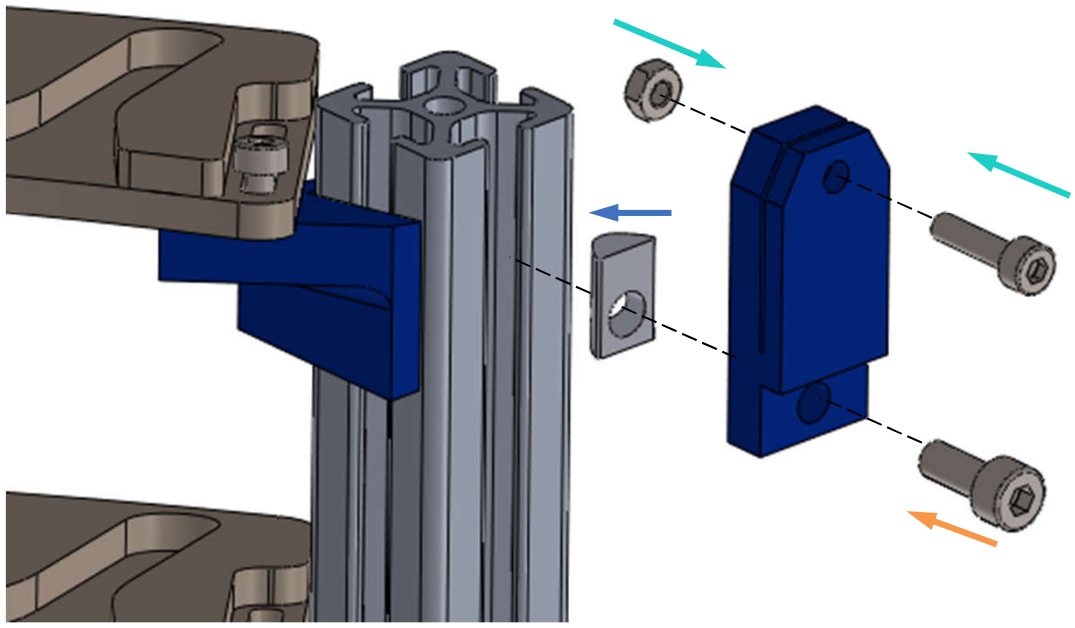
Insert two slot nuts in the profiles

Connect the microcontroller holder with the M4 screws using the sliding blocks

Step 7

Assembly of the shelf
Attachment of the cable holder

Shelf and Camera



Loosely screw the M3 screw and nut in the smaller hole of the cable clamp. This part will later be used to clamp the camera cable

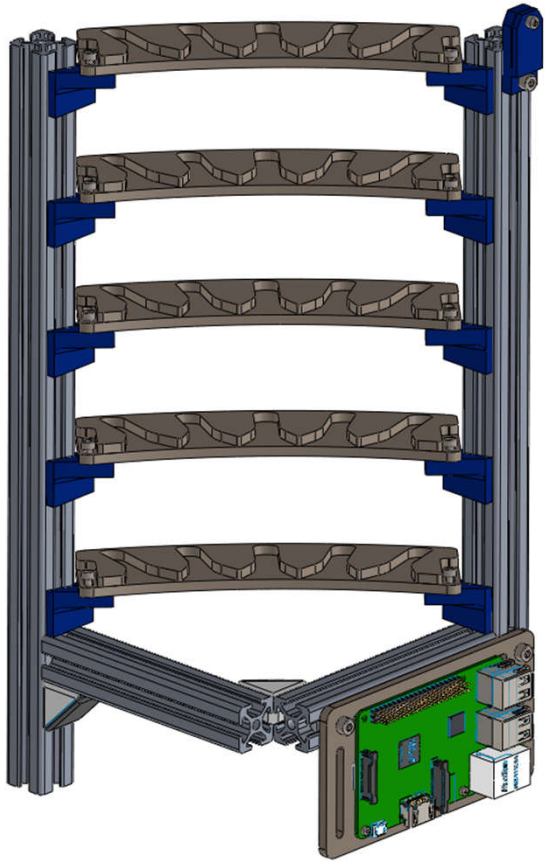
Insert a slot nut into the profile

Screw the cable clamp to the profile with the M4 screw using the slot nut

Step 8

Assembly of the shelf

The shelf is ready!

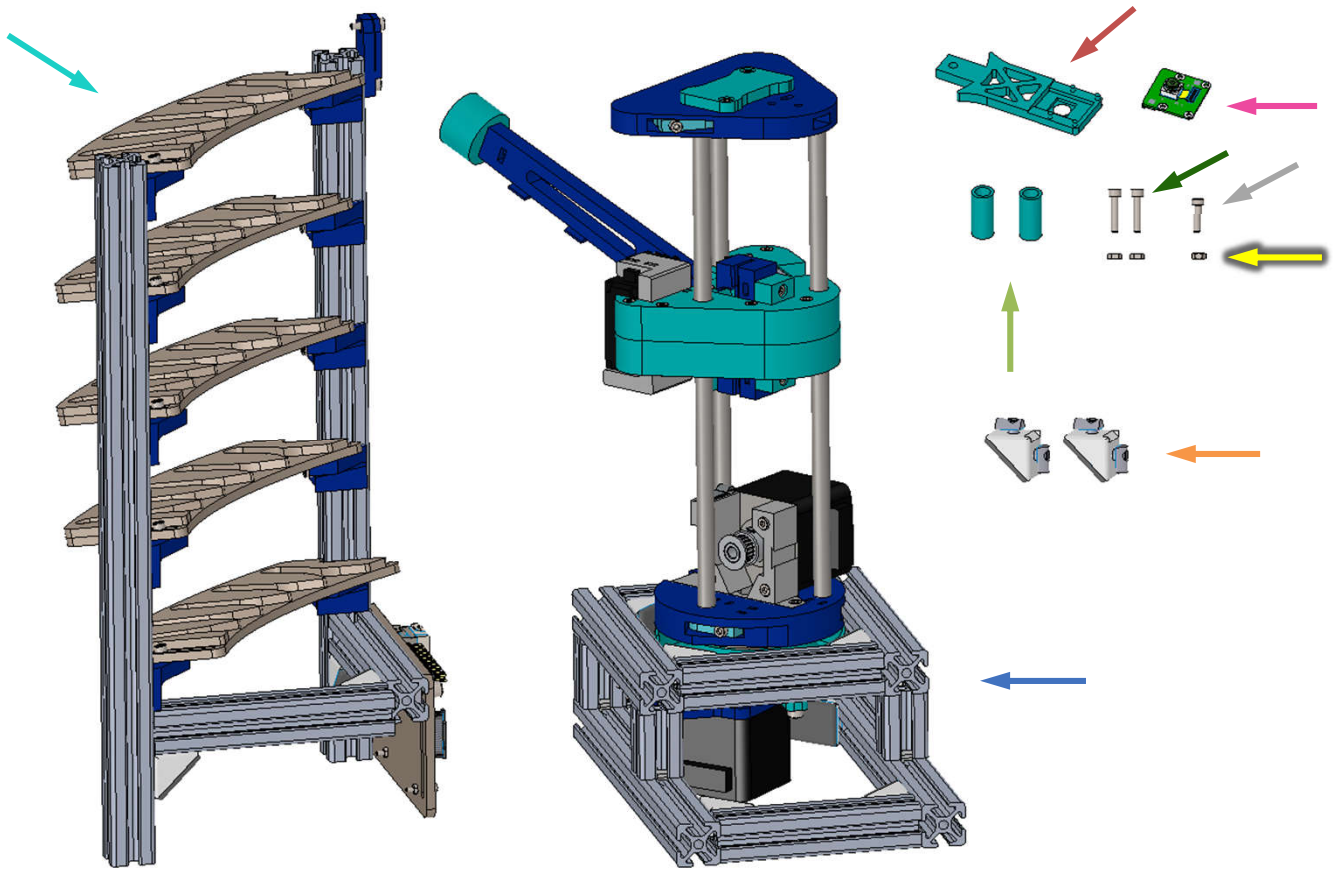


Shelf and Camera

Step 9

Integration shelf and robot

Necessary parts



Shelf and Camera

Previous shelf construction

Previous RPR robot

Angle connector (3x)
including slot nuts and screws

Camera Cable Holder (2x)

Camera holder (1x)

Raspberry Pi Camera (1x)

Allen screw M3x16 (2x)

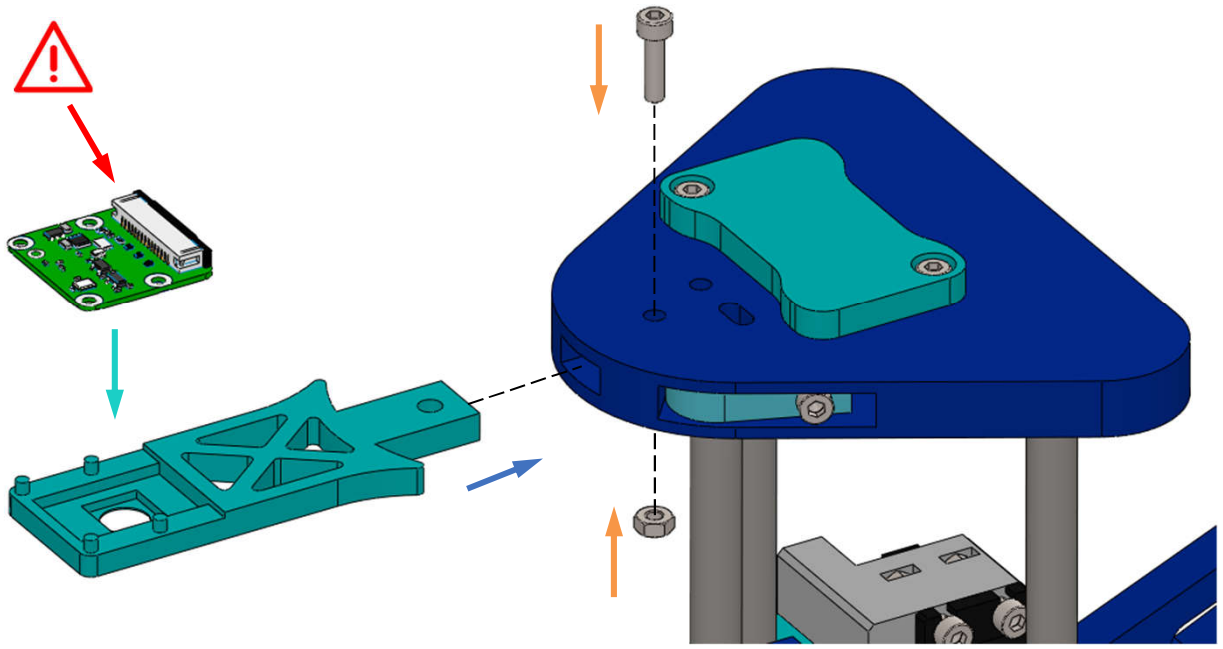
Allen screw M3x12 (1x)

Hex nut M3 (3x)

Step 10

Integration shelf and robot
Attachment of the camera

Shelf and Camera



Put the camera on the camera holder with light pressure

Pay attention to the orientation of the camera!

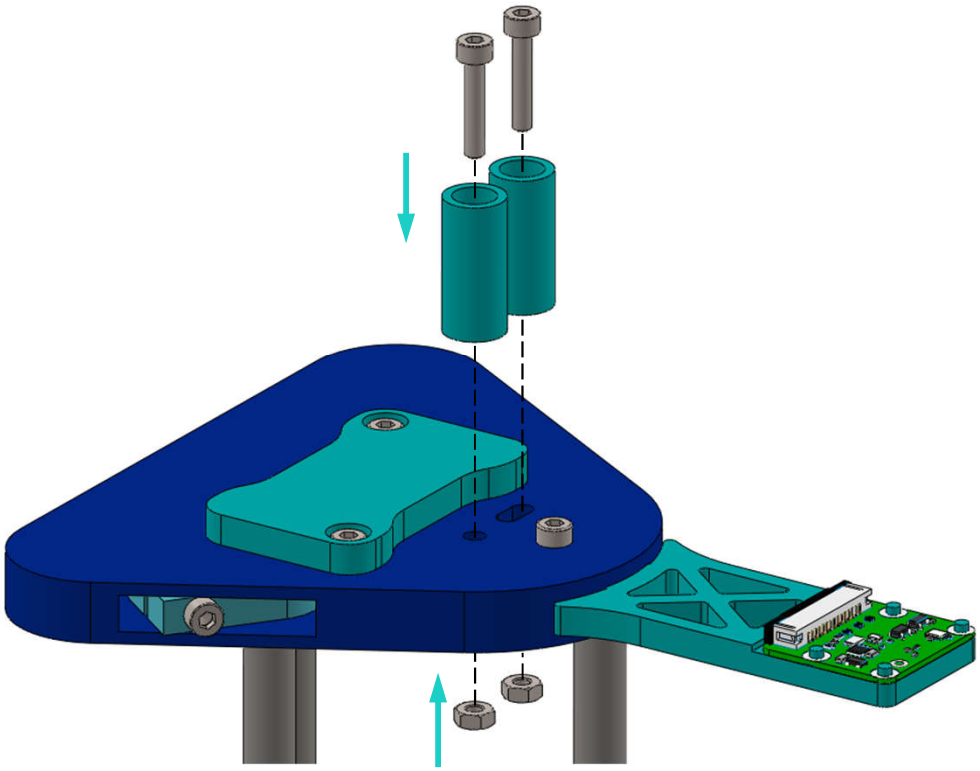
Insert the camera holder into the P-Head all the way

Screw the camera holder with the P-head with the short M3x12 screw and the nut

Step 11

Integration shelf and robot
Mounting the cable holder

Shelf and Camera



Use the long M3x16 bolts and the corresponding nuts to screw the two cable clamps to the P-Head

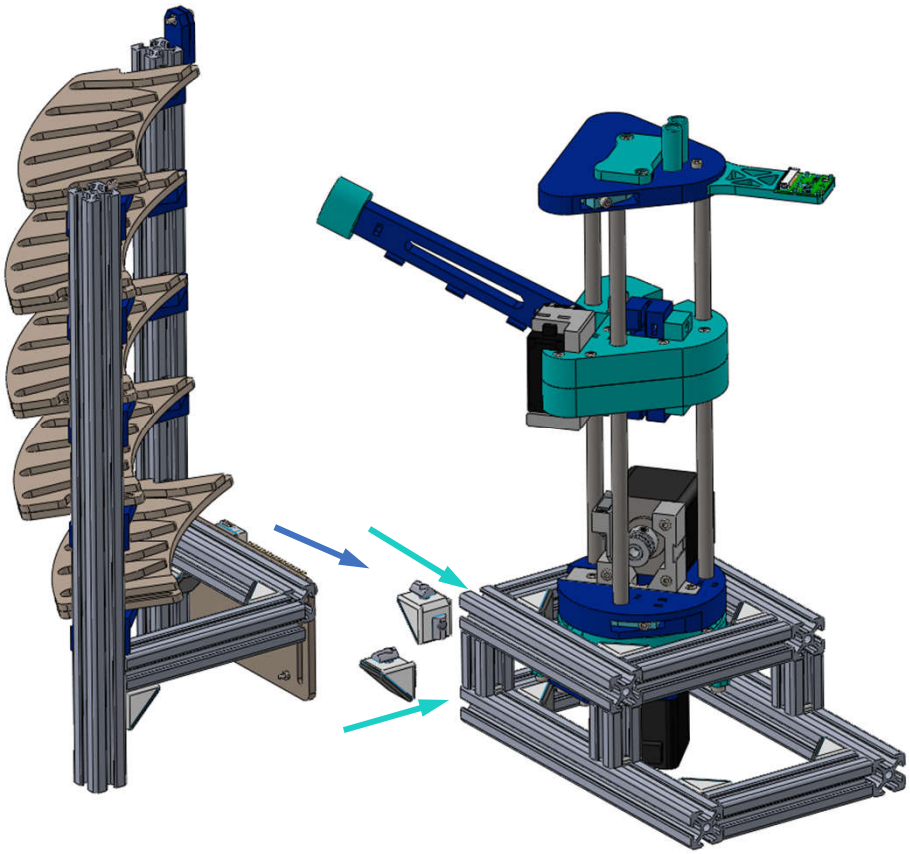
Do not fully tighten the screw in the slot. The screw is tightened later, when laying the cables.

Step 12

Integration shelf and robot

Fixing the shelf

Shelf and Camera



Attach the two angle connectors to the short profile of the robot

Use the other two slot nuts and screws to attach the shelf to the robot

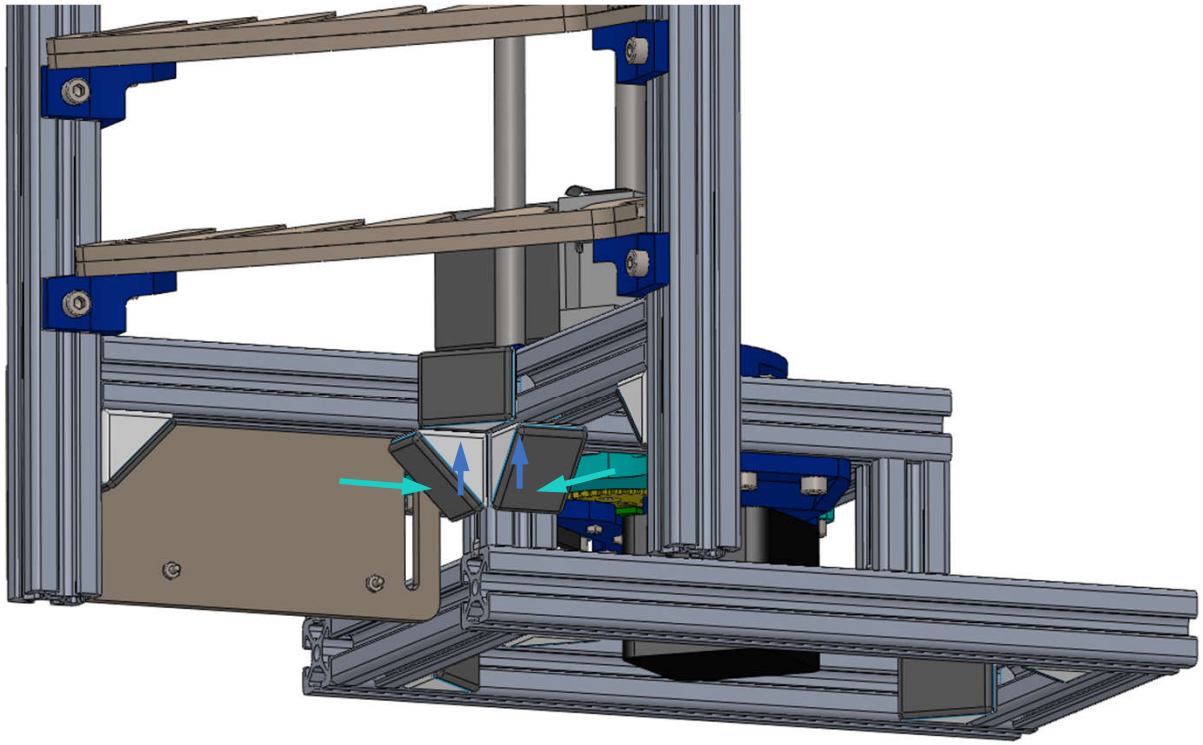
It is also possible to attach the shelf to the other corner of the robot

Step 12

Integration shelf and robot

Fixing the shelf

Shelf and Camera



Attach the two angle connectors to the short profile of the robot

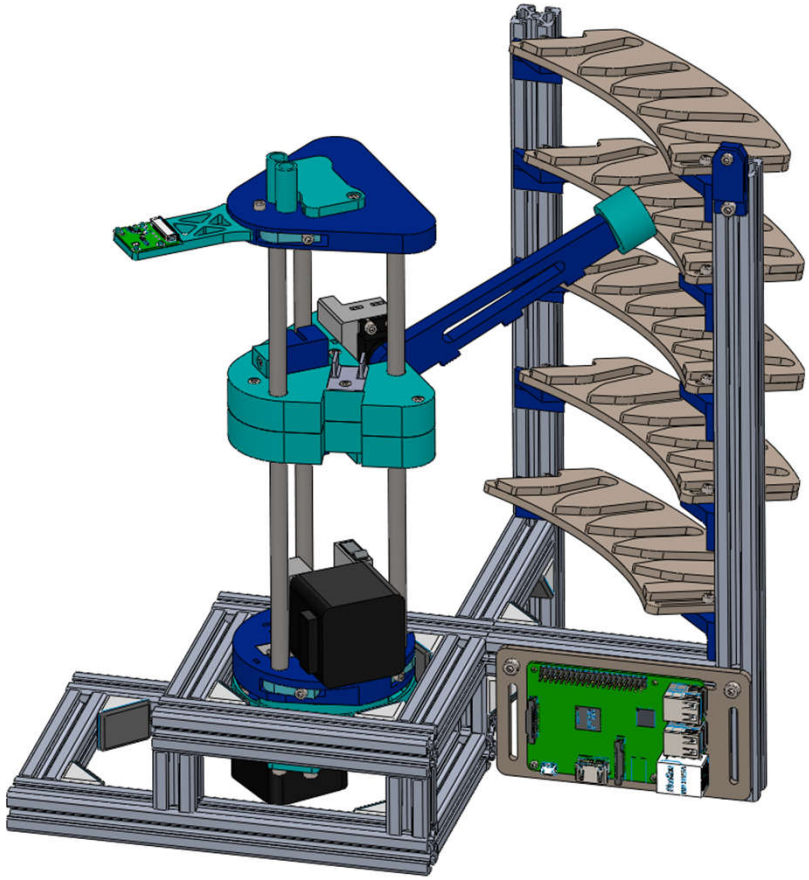
Use the other two slot nuts and screws to attach the shelf to the robot

It is also possible to attach the shelf to the other corner of the robot

Step 13

The shelf and the camera are attached to the robot!

Shelf and Camera



Cable management

8 Steps

30 Minutes

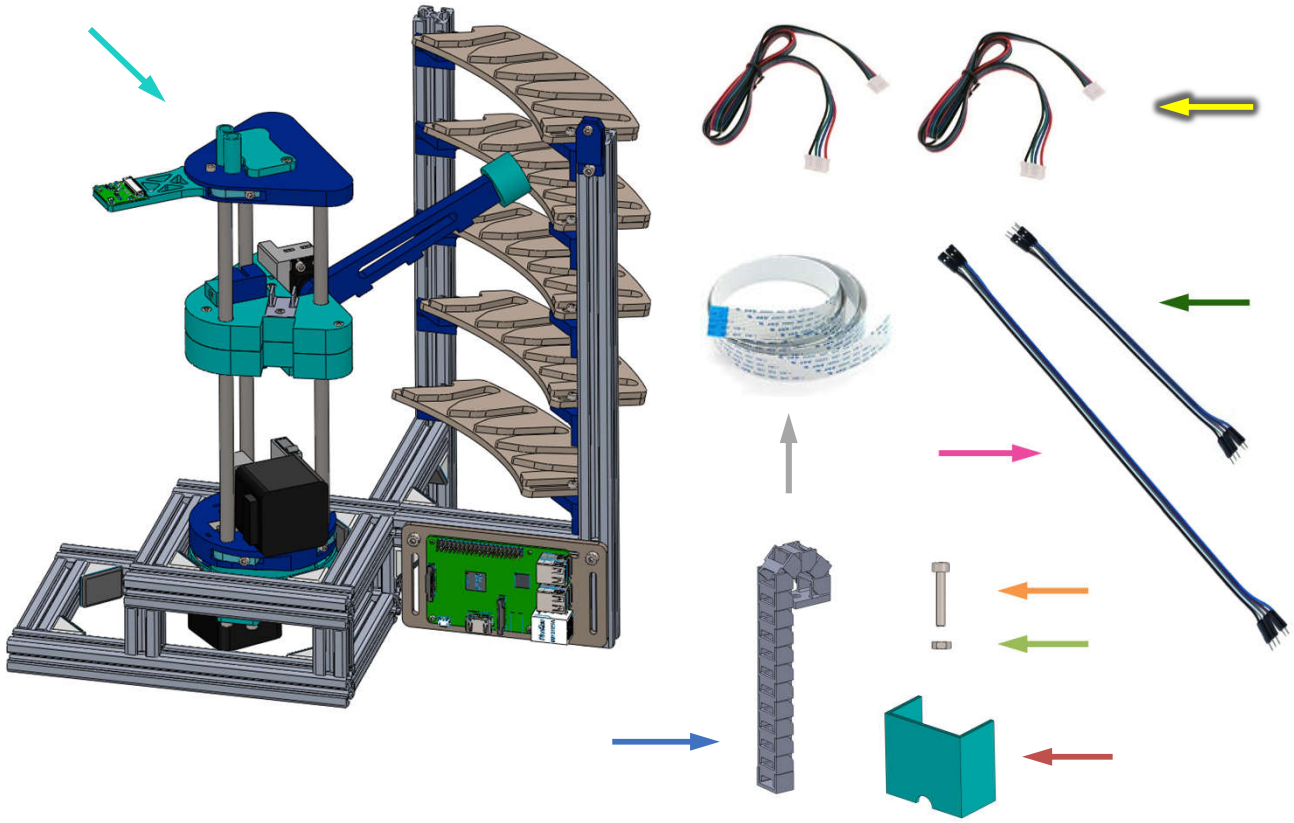
Double-sided tape

Allen Key

Step 1

Necessary parts

Cable management



RPR-Robot with shelf

Cable chain (1x)

Allen screw M3x30 (1x)

Hex nut M3 (1x)

Step motor cover (1x)

Ribbon cable
5-core, 600 mm (1x)

Ribbon cable
4-core, 200 mm (1x)

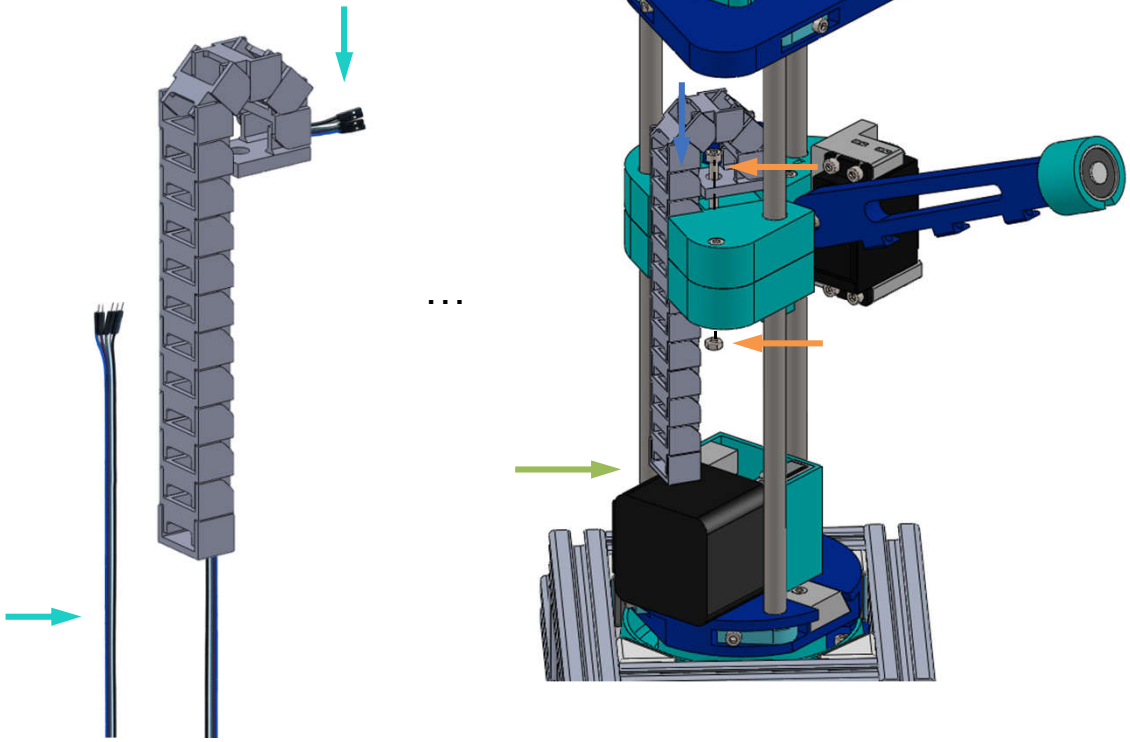
Ribbon core
16 Pin, 700 mm (1x)

Step motor cable
4-core, 300 mm (2x)

Step 2

Installation of the cable chain

Cable management



Insert the 5-core ribbon cable into the cable chain. Make sure that about 2 cm of the female cable ends protrude from the top

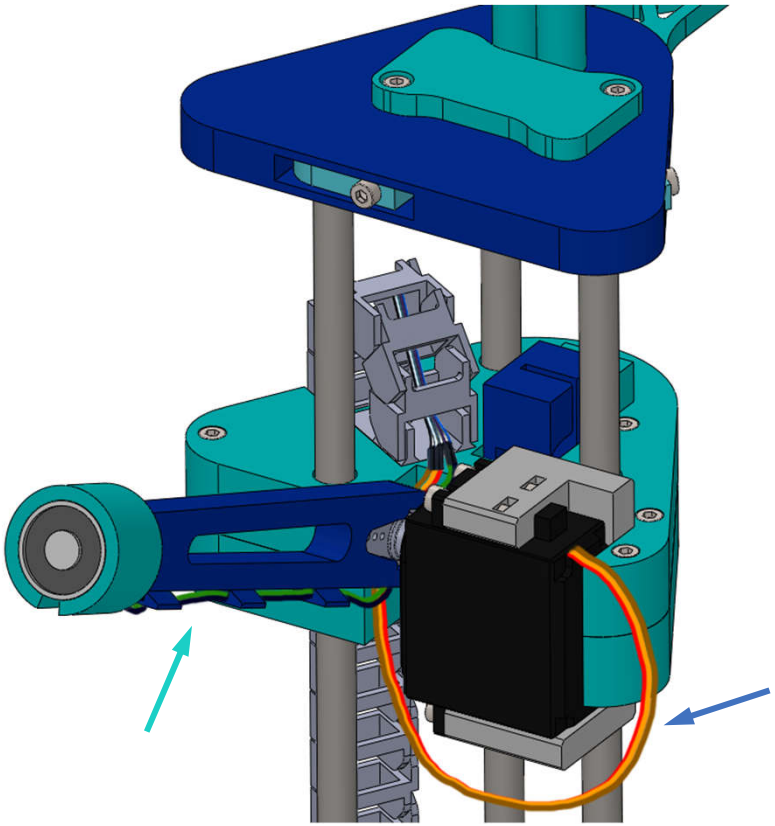
Then insert the cable chain in P-Mobile

Use the M3 screw and its associated nut to screw the cable chain onto P-Mobile

Attach the lower end of the cable chain to the stepper motor with double-sided adhesive tape

Step 3

Connecting servomotor and magnet



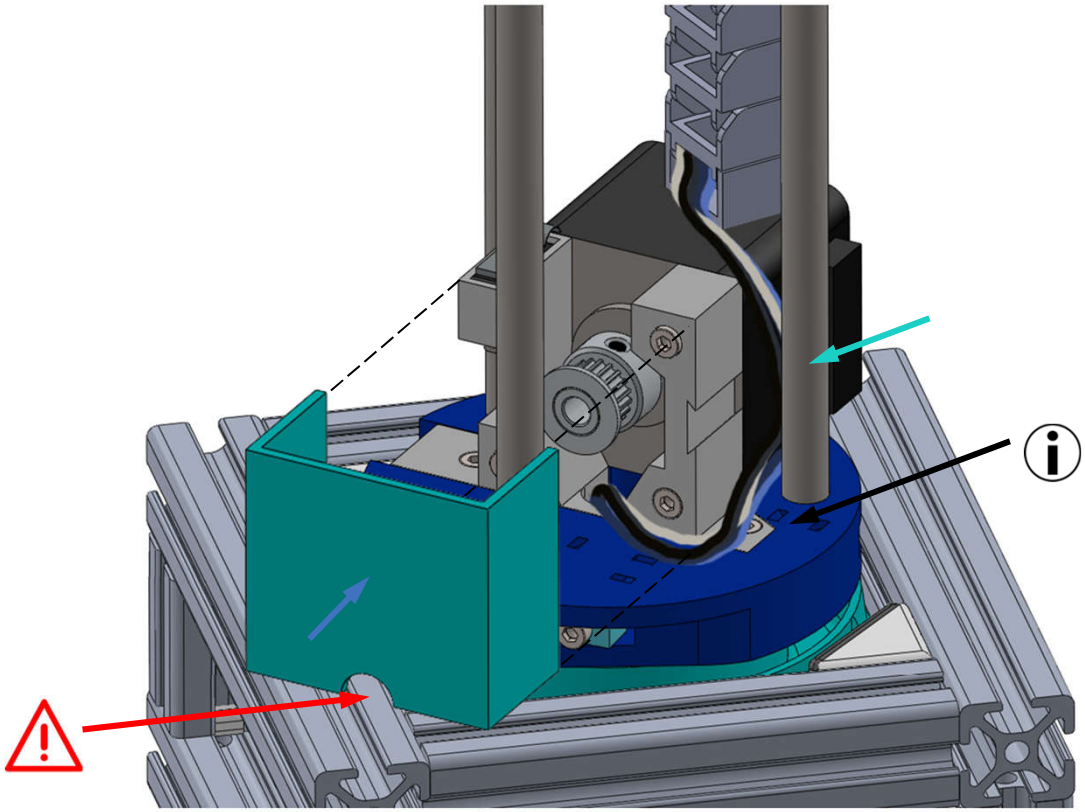
Cable management

Route the cables of the electromagnet backwards over the holders in the R2 axis and connect them to the cable ends in the energy chain

Route the cables – including the ones of the servo motor – underneath the R2 axis and connect them with the cables in the cable chain.

Step 4

Cable routing into the R1 axis



Cable management

Lead the cables at the lower end of the energy chain into the hole in the middle of the turntable

Connect the stepper motor cable and also lay in the hole

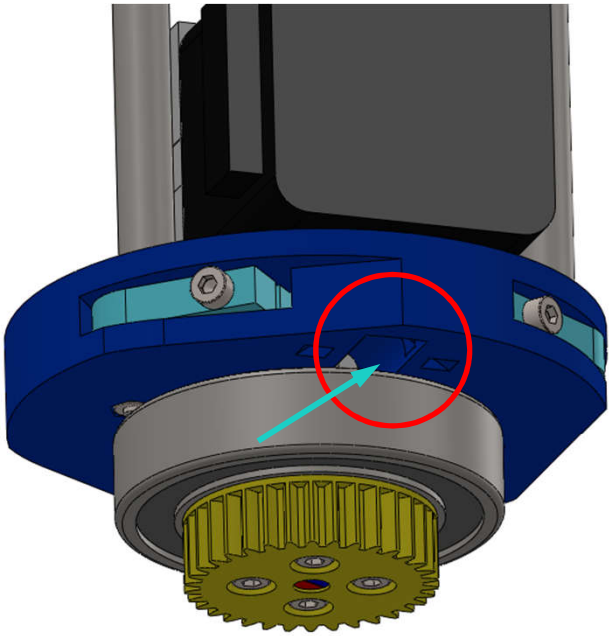
Then attach the stepper motor cover

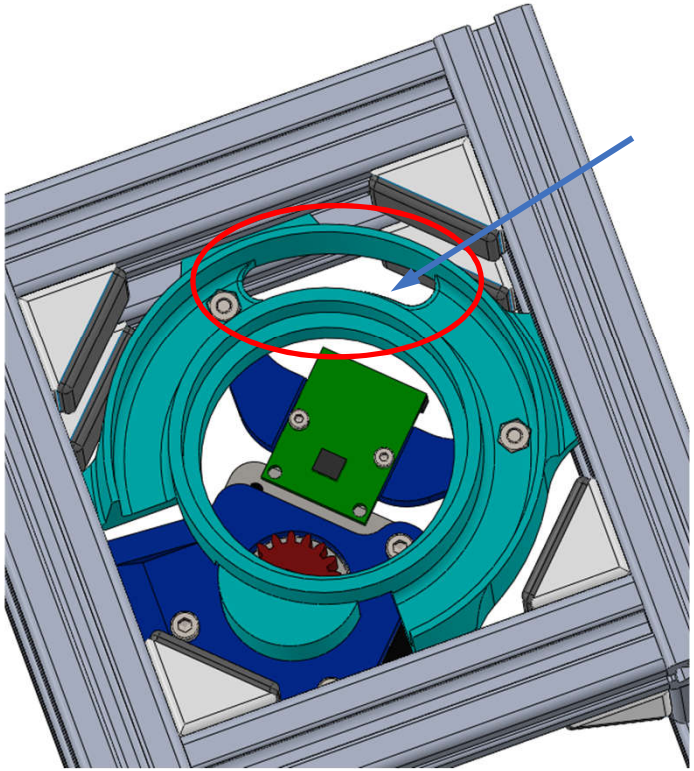
Lead the cables through the recess in the cover

The cables can be attached to the turntable using cable ties

Step 5

Cable routing into the base frame





Cable management

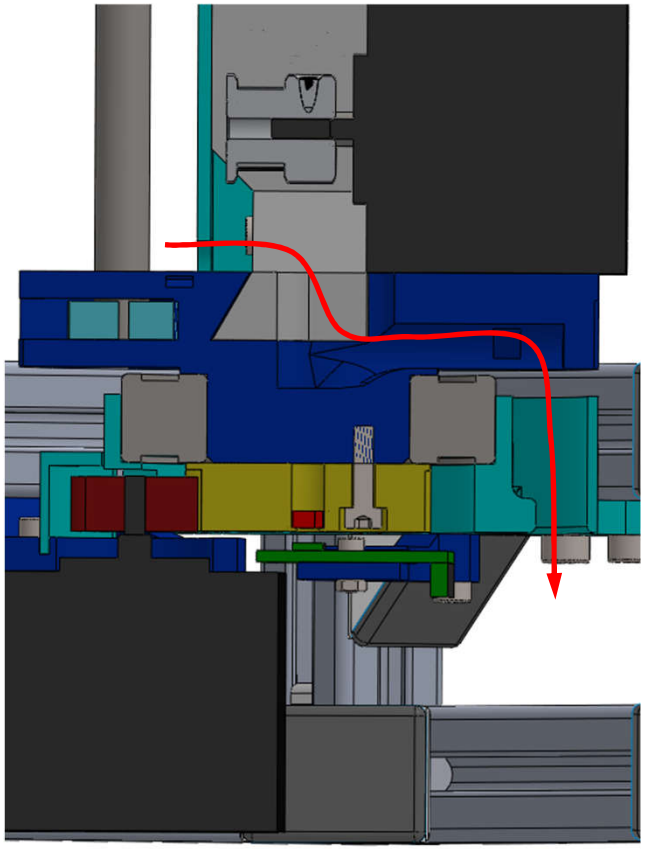
Lead the cables out of the side hole in the turntable

Then pass them through the slot in the bearing unit

During a rotary movement of the robot, the cables in the storage unit can deflect left and right so that the robot can make a 360 ° turn.

Step 5

Cable guide into the base frame



Cable management

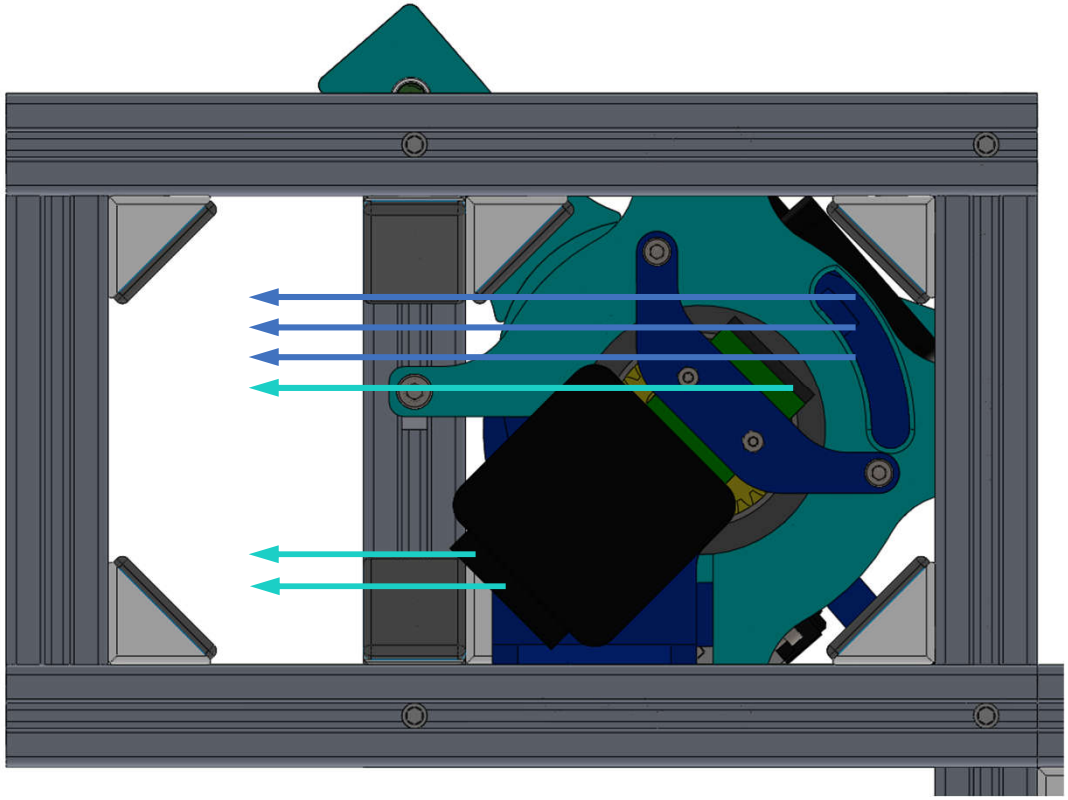
Lead the cables out of the side hole in the turntable

Then pass them through the slot in the bearing unit

During a rotary movement of the robot, the cables in the storage unit can deflect left and right so that the robot can make a 360 ° turn.

Step 6

Connecting stepper motor and position sensor



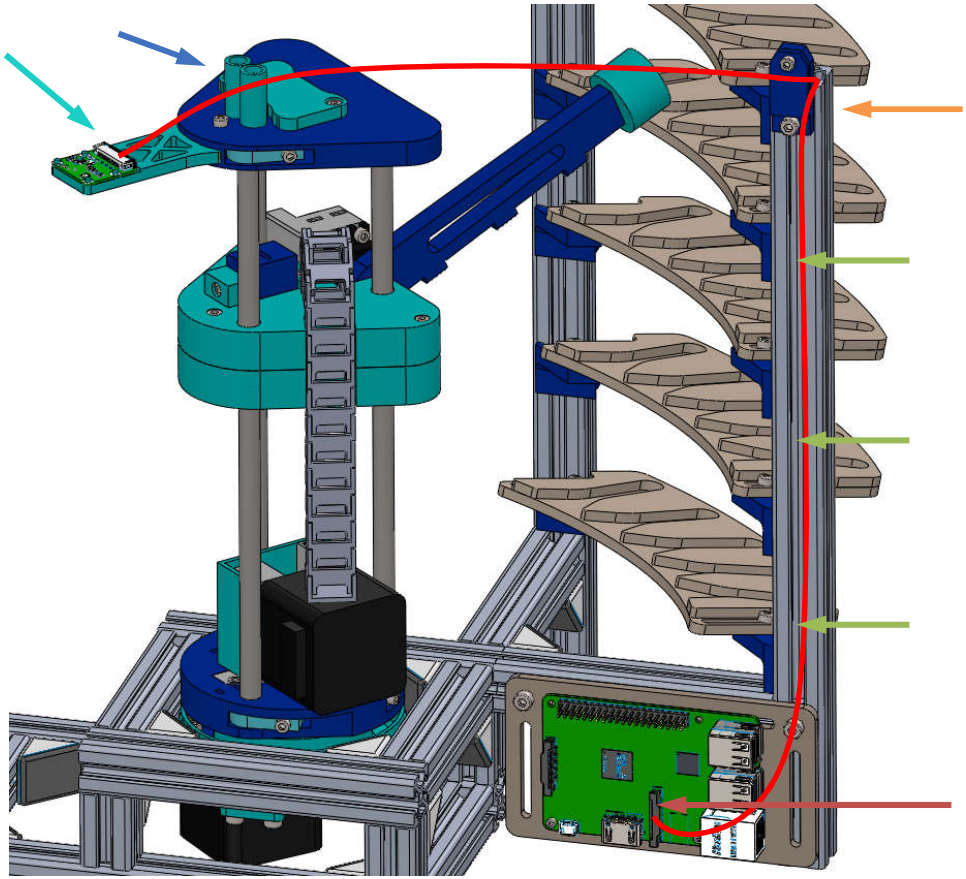
Cable management

Finally connect the step motor or the position sensor with the corresponding cables

Route all cables together to the wider side of the base unit where the microcontroller will later be mounted

Step 7

Connect the camera to the Raspberry Pi



Cable management

Connect the ribbon cable to the camera

Pull the cable through the cable clamps and fix the movable clamp

Pass the cable through the cable holder and tighten it as well. **Leave enough play that the robot can turn freely!**

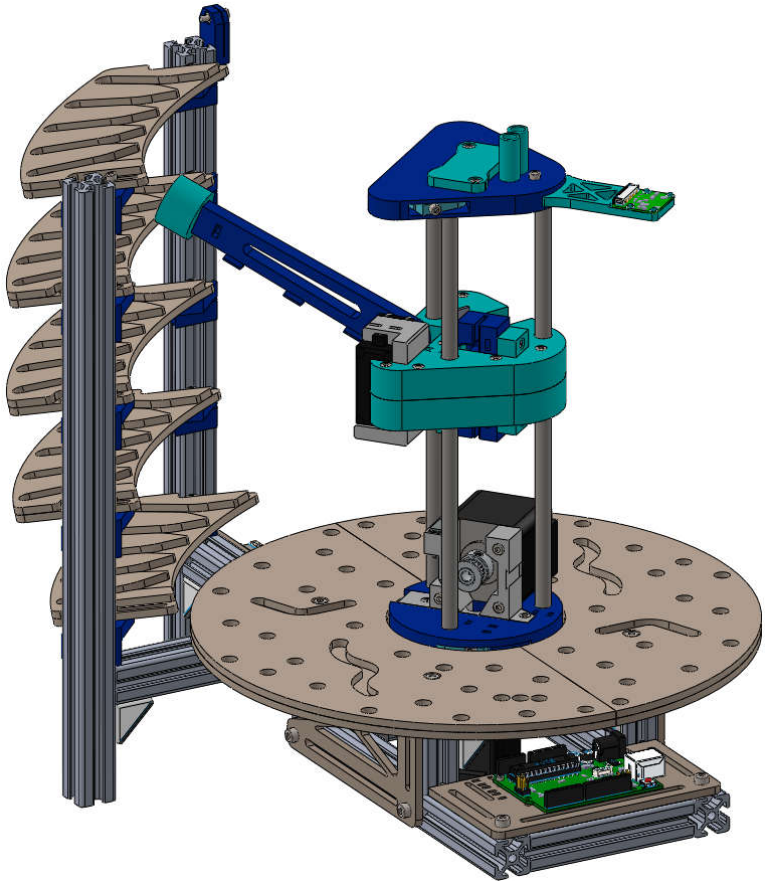
Attach several cable ties to the profile where the cable is going down

Plug the ribbon cable into the appropriate connector on the Raspberry Pi

Step 8

Cable management is now complete!

Finalizing the robot



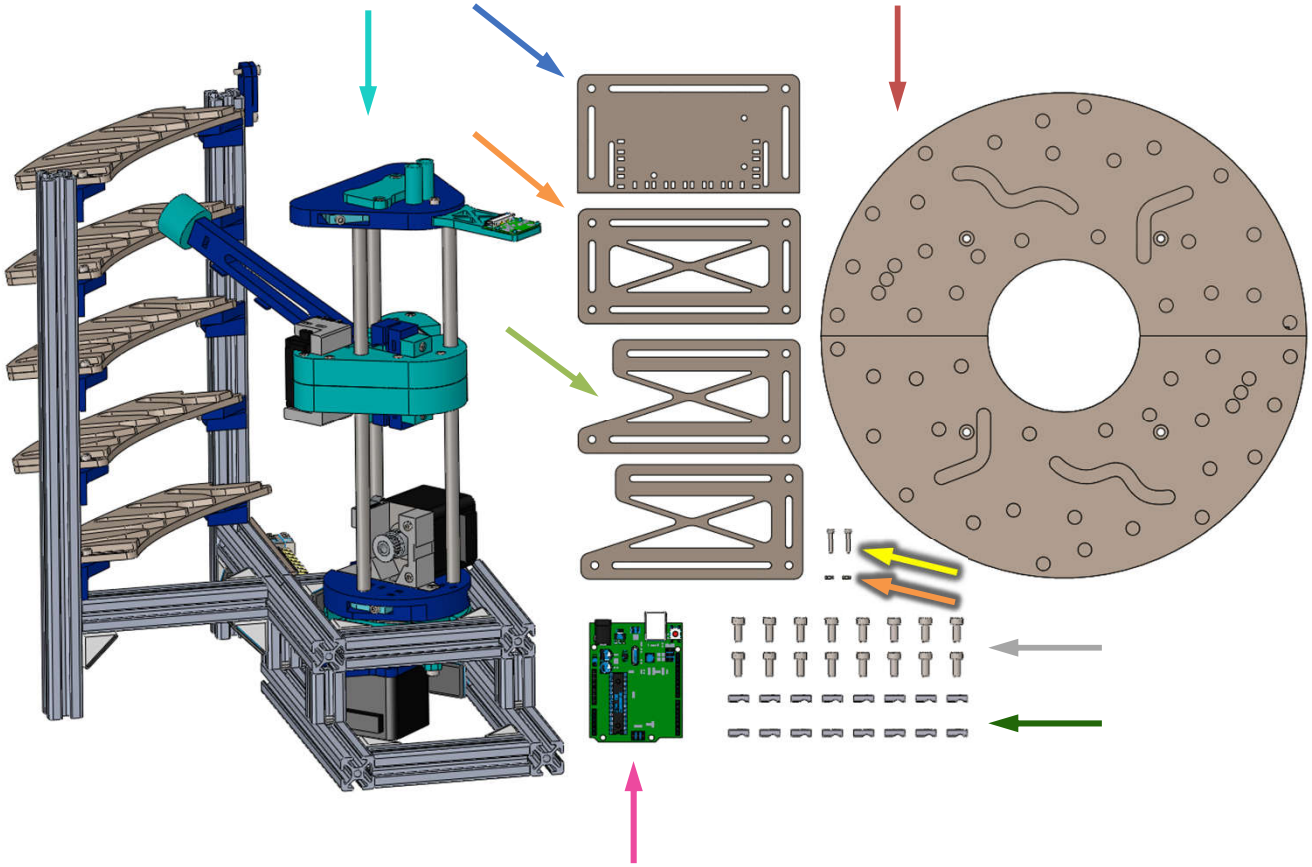
6 Steps

45 Minutes

Allen key

Step 1

Necessary components



Finalizing

RPR-Robot with shelf

Mikrocontroller holder (1x)

Cover (1x)

Cover Cut-Out (2x)

Ball plate (1x)

Arduino Uno (1x)

Sliding nut (16x)

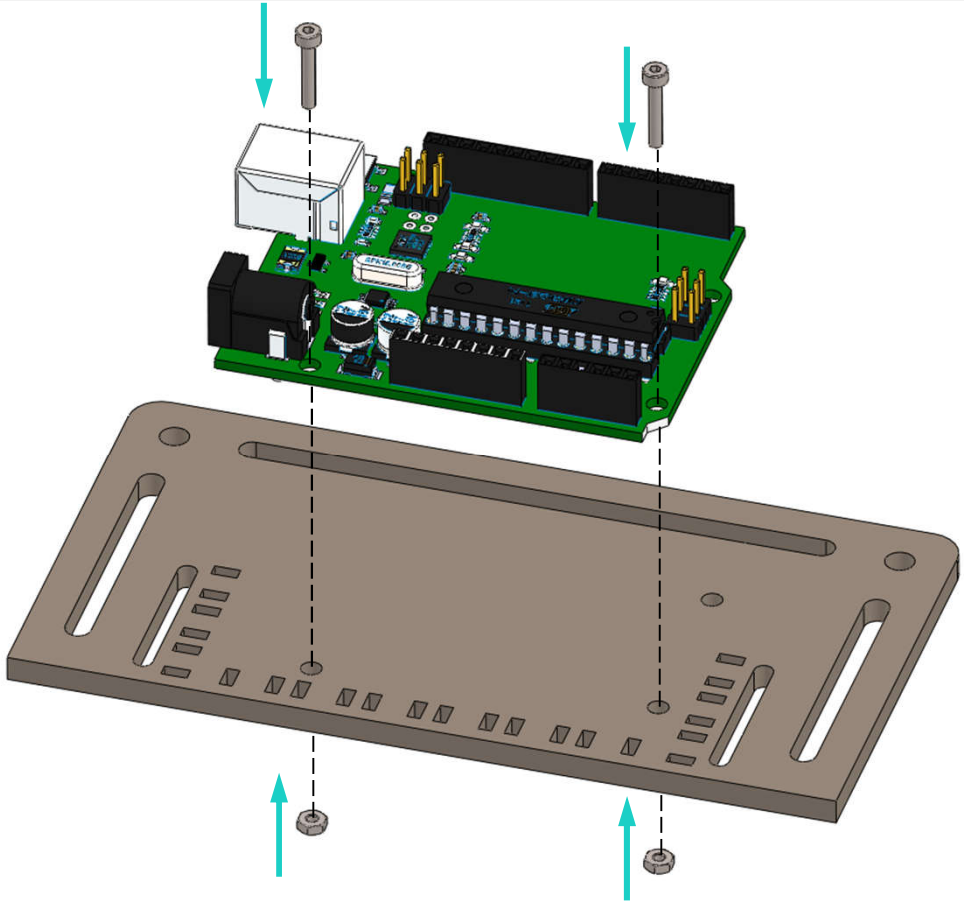
Allen screw M4x10 (16x)

Allen screw M2x12 (2x)

Hex nut M2

Step 2

Mounting the microcontroller



Finalizing

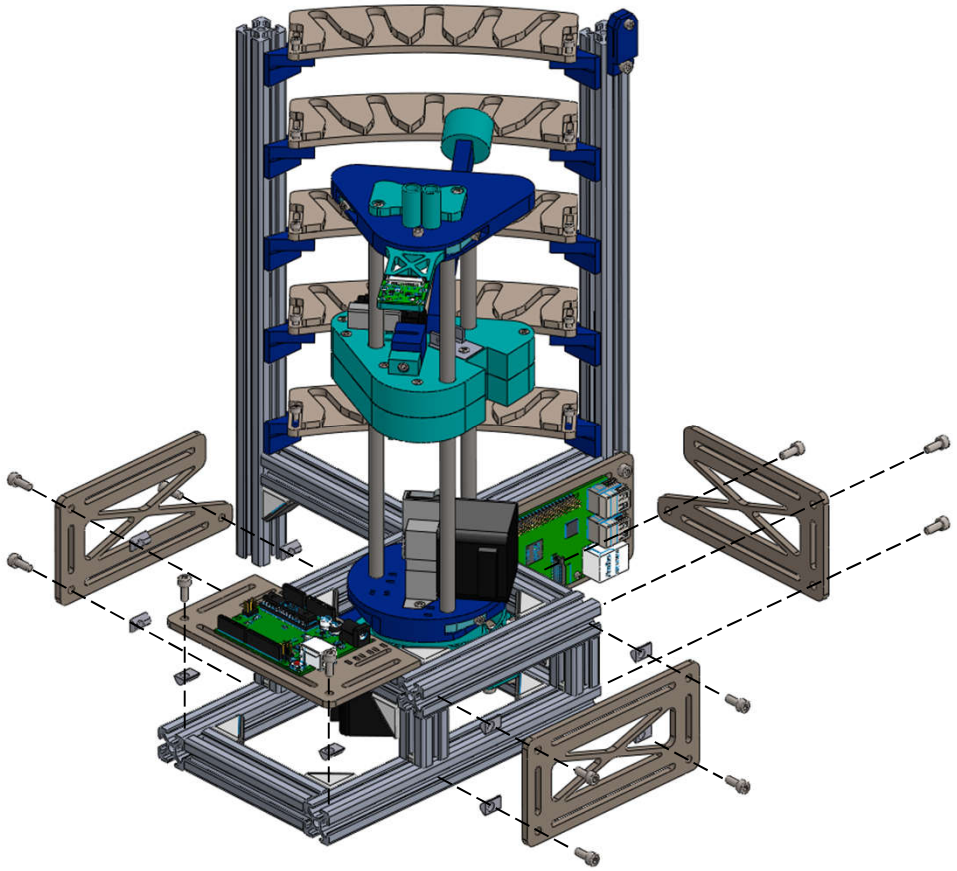
Fix the Arduino to the microcontroller bracket with the M2 screws and nuts

⚠ Pay attention to the alignment of the components!

Step 3

Mounting the cover plates

Finalizing



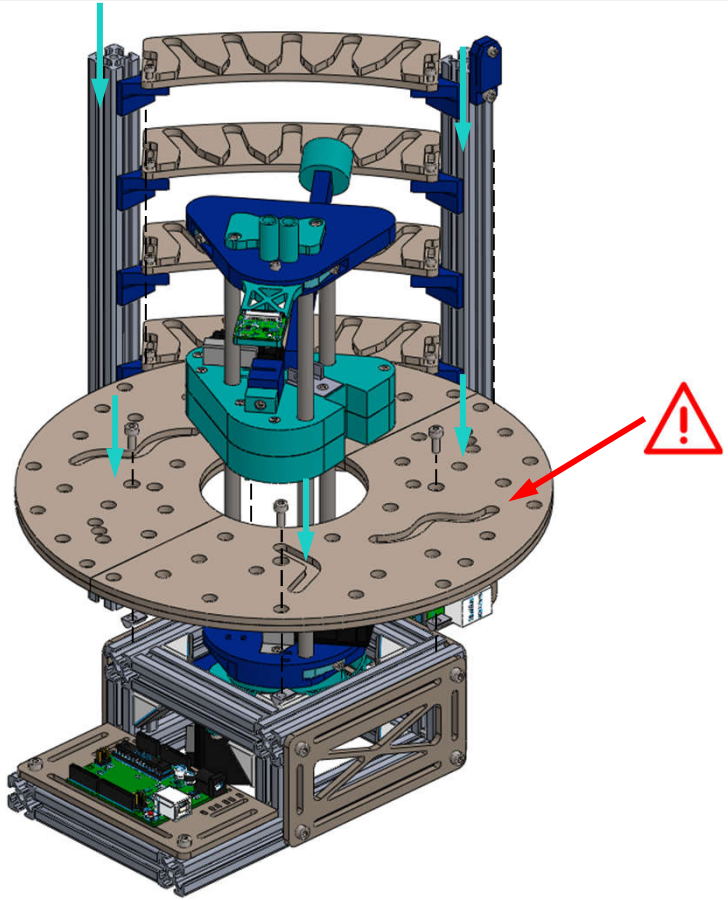
Install the covers on the robot using the M4 screws and slot nuts.

The microcontroller holder with the Arduino is connected the same way to the robot.

Step 4

Mounting the microcontroller

Finalizing



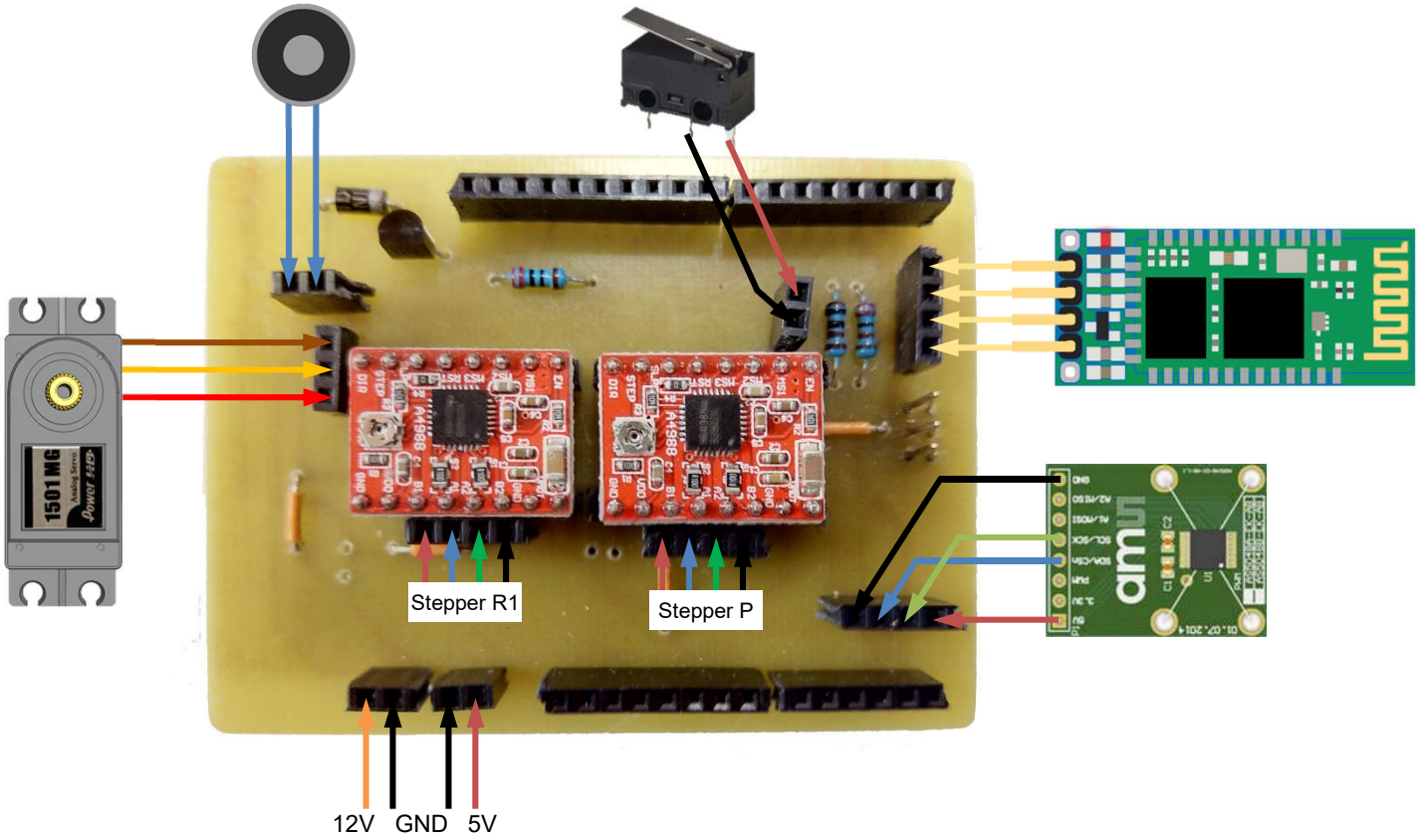
Use the remaining four M4 screws and slot nuts to secure the two mounting plates to the robot

Pay attention to the alignment of the plate!

Step 5

Connect the cables to the printed circuit board attached to the Arduino

Finalizing



Step 6

The RPR robot is now completely assembled!

Finalizing