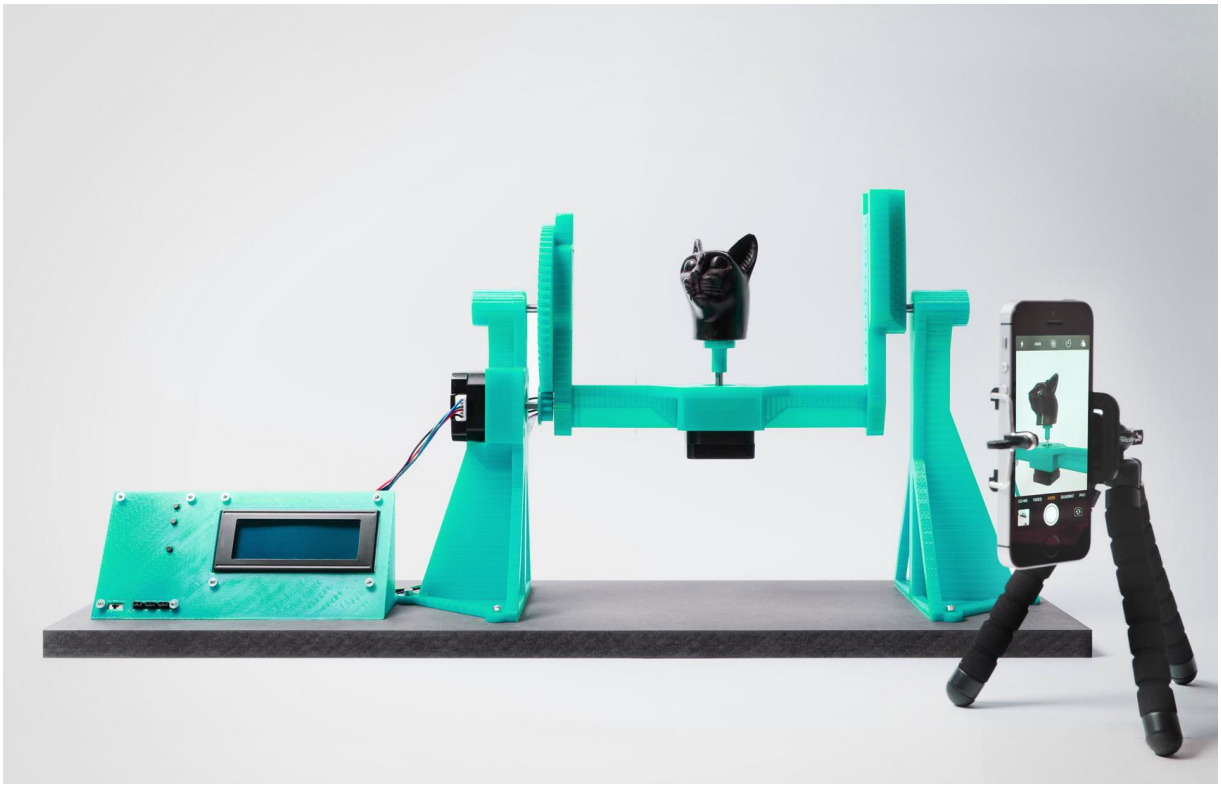
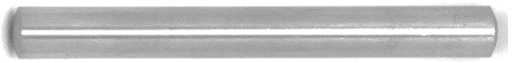
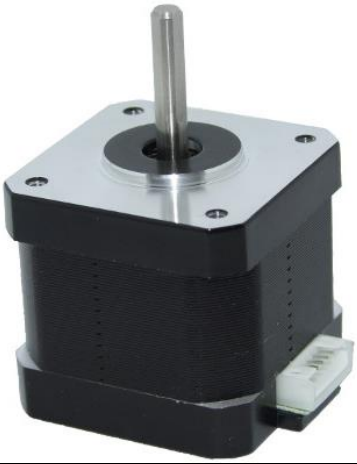
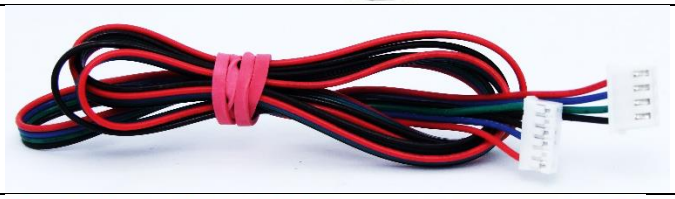
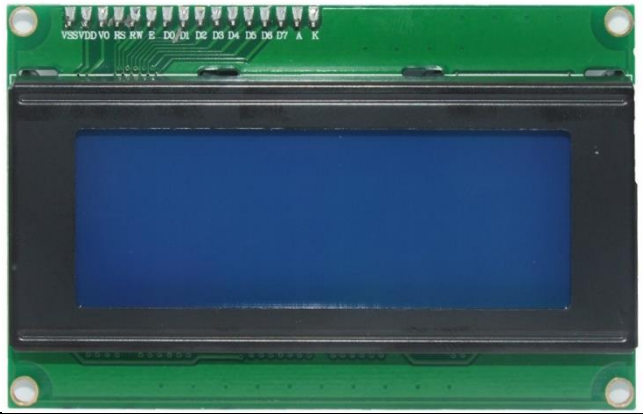
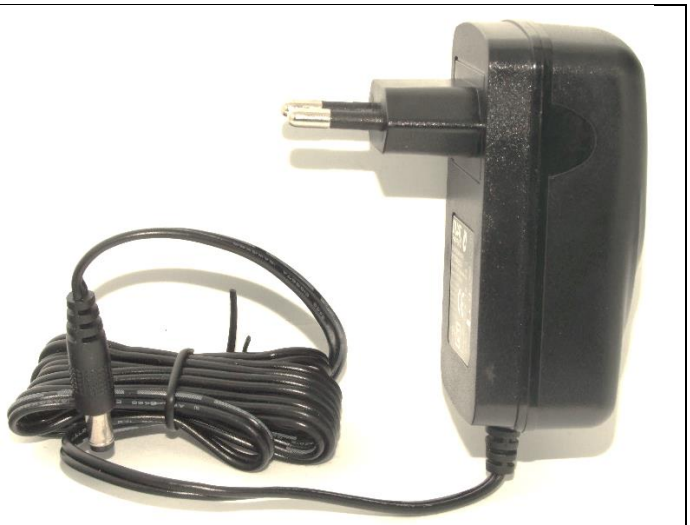
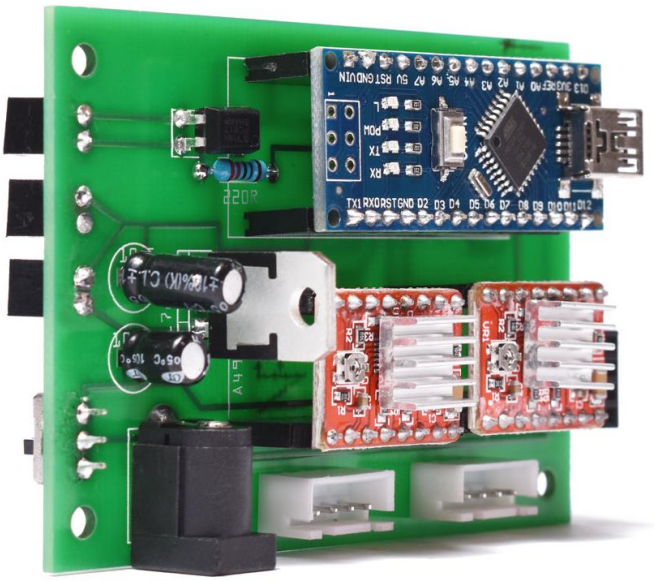
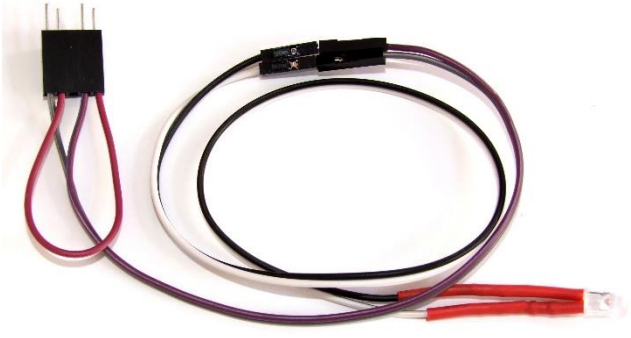
OpenScan – User Manual



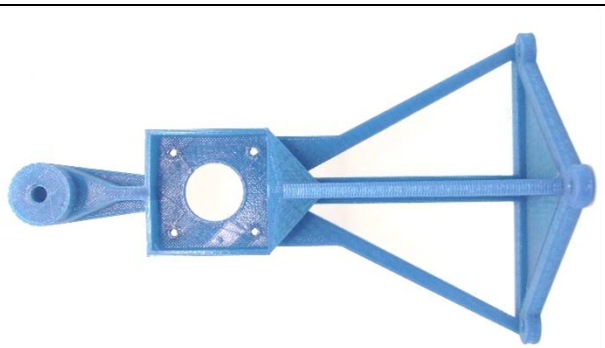
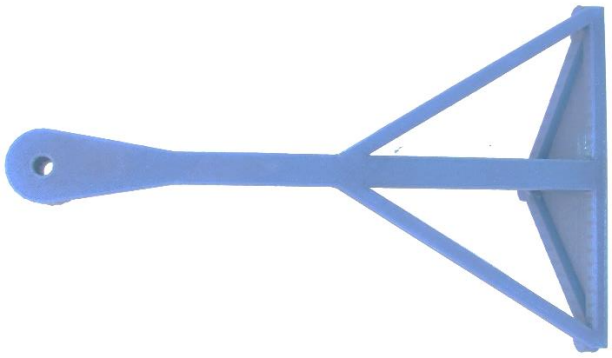
Contents

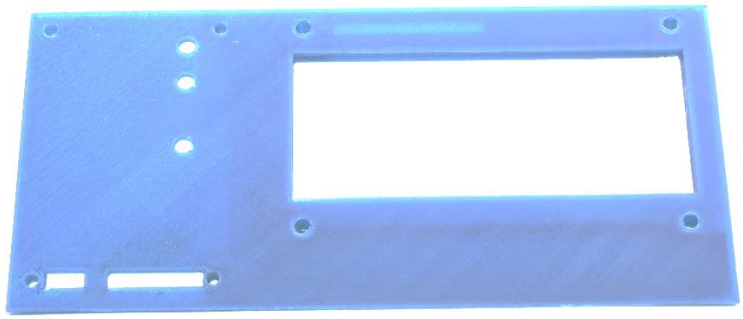
Material needed

M3 nut	8	
M3x12mm	10	
M3x8mm	8	
Steel pin (d=6mm, l>50mm)	2	
Jumper Wire 10cm m-f	4	
Nema 17 (min. 40Ncm)	2	
Stepper motor cable >70cm JST-XH-4P or 4P DuPont	2	
LCD 20x4 with I2C-Module	1	

Power Supply 12V 2A Barrel connector (5,5mm-2,5mm)	1	
Control unit	1	
Remote Control Bluetooth (optional)	1	
Remote Control Infrared (optional)	1	

3D printable parts (https://www.thingiverse.com/thing:3050437/files)

Stand1_Nema17.stl	1	
Stand2.stl	1	
Adapter1.stl	1	
Adapter2.stl	1	
Turntable_Base_Small.stl Optional:large-version	1	
Rotary_Arm.stl	2	

Control_Module.stl	1	
Gear_Small.stl (optional v2 je nach Druckertoleranz)	1	
Turntable_Adapter.stl (Optional: je nach Bedarf)	1	

Accessories for assembly:

Allen Key (2,5mm)	1	
Optional: pliers	1	

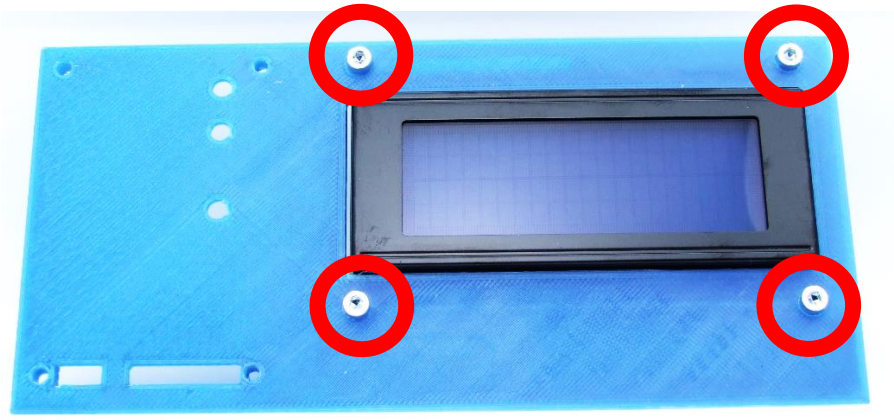
Assembly

Step 1 – LCD

Needed parts:

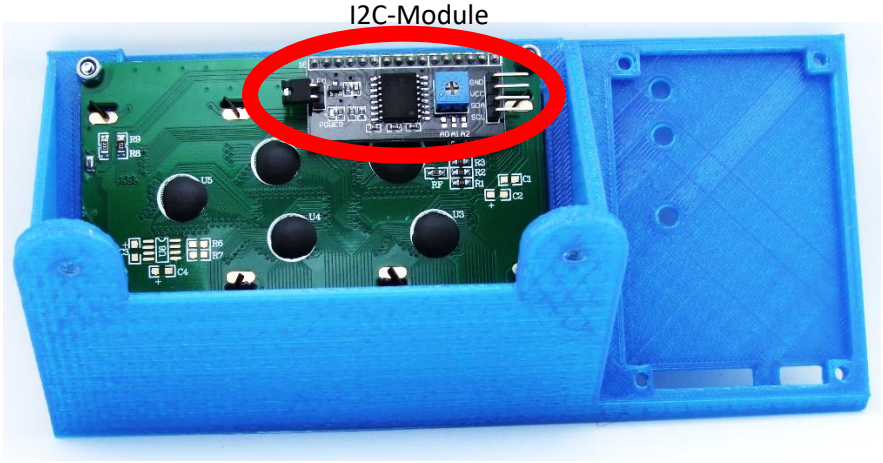
- LCD 20x4 with I2C-Modul
- Control_module.stl
- M3x12 (4x)
- M3 nuts (4x)

Front:



Back:

I2C-Module



Description:

The display is mounted on the back of the control unit using four of the M3x12mm screws. See the orientation of the display - I2C module top right.

Note:

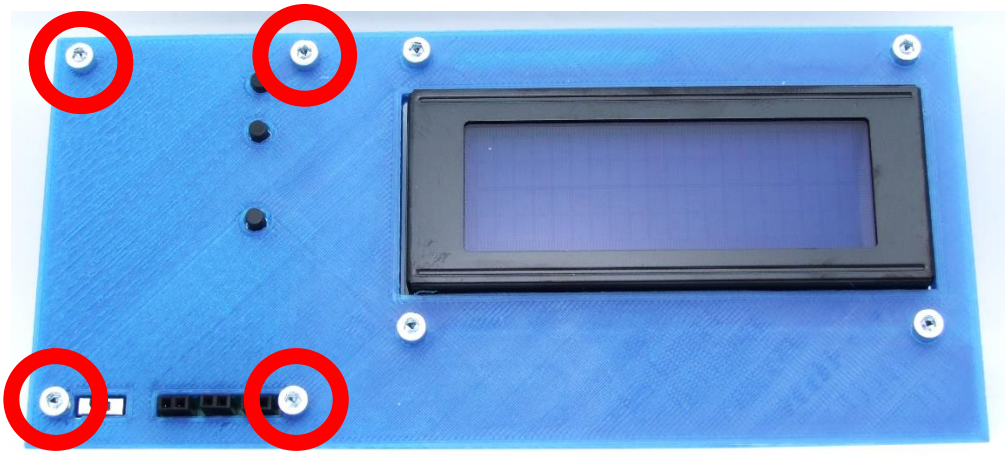
Depending on the printing accuracy, it may be necessary to pre-drill the screw holes with a 3mm drill bit.

Step 2 – Control unit

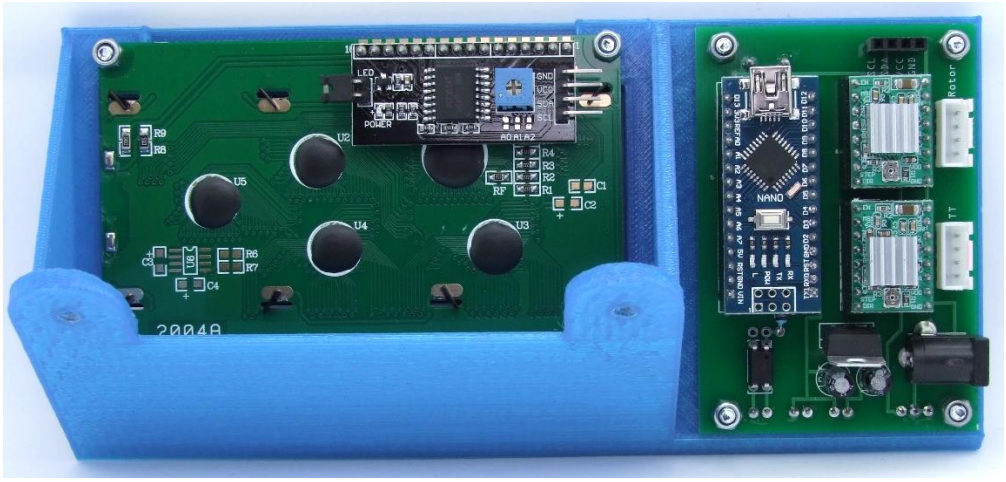
Needed parts:

- Control unit
- Control_module.stl (nach Schritt 1)
- M3x12 (4x)
- M3 nuts (4x)

Front:



Back:



Description:

The control unit is mounted on the back of the printed unit using four of the M3x12mm screws.

Note:

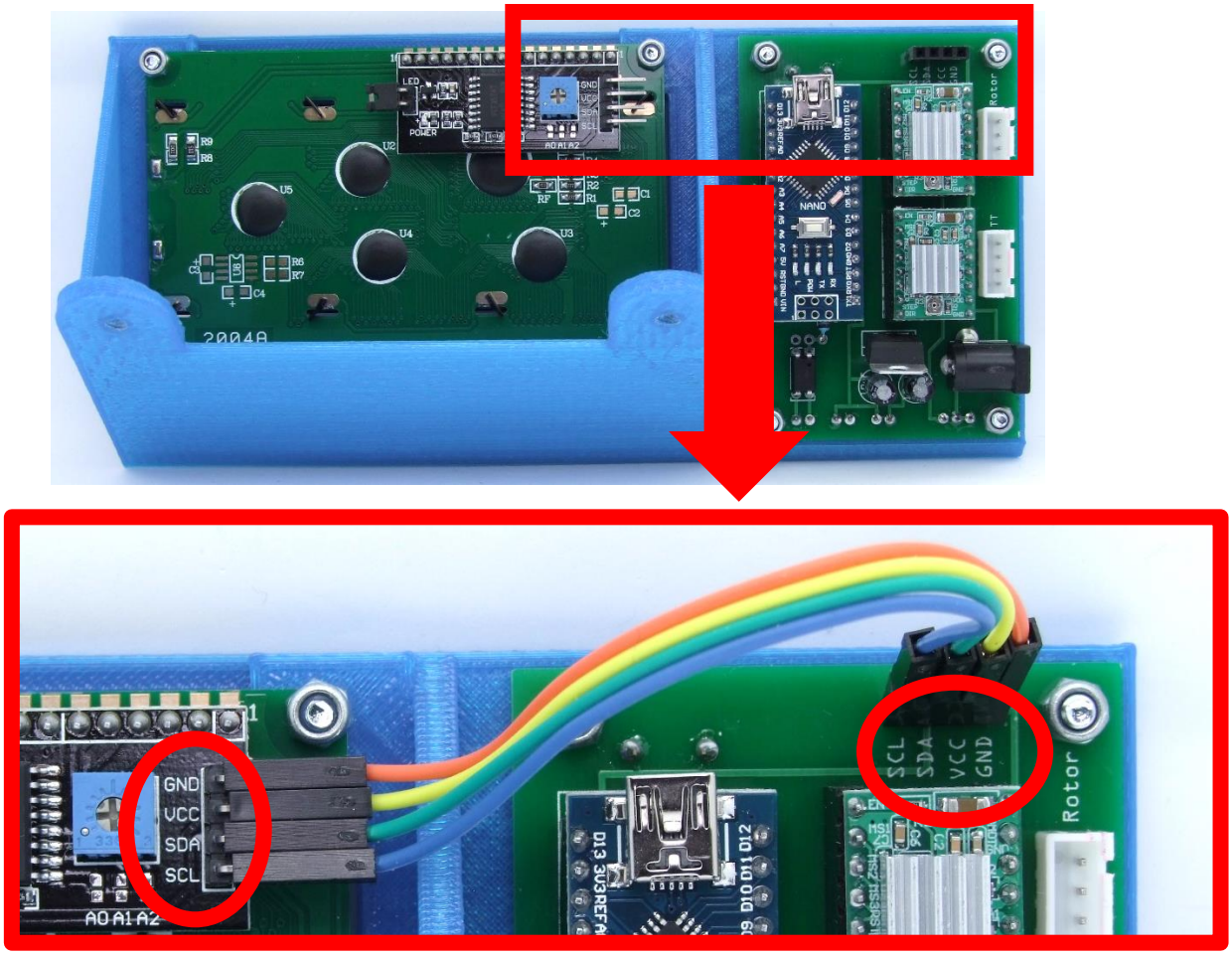
Depending on the printing accuracy, it may be necessary to pre-drill the screw holes with a 3mm drill bit. It may also be necessary to deburr / enlarge the holes for the push buttons on the front.

Step 3 – wiring the LCD

Needed parts:

- Control unit (after Step 2
- Jumper Wire 10cm m-f

Back:



Description:

Wire the connections according to their labels. (GND-GND / VCC-VCC / SDA-SDA / SCL-SCL)

Important note:

This step should be double checked to ensure that the pins are properly connected, otherwise the control unit and / or the display can be destroyed!

Step 4a – Stand 1

Needed parts:

- Stand1_Nema_17.stl
- Nema 17 (min. 40Ncm)
- M3x8mm (4x)
- Gear_Small.stl (optional v2)

(1)

(2)

Description:

(1) Mount the stepper motor with four M3x8mm Screws onto the Stand1.stl.

(2) Press the Gear_small.stl onto the motor shaft. Make sure, that the gear and the motor shaft close flush at the front.

Note:

Depending on the printing accuracy, it may be necessary to pre-drill the screw holes with a 3mm drill bit. Furthermore the gear and the motor shaft might have a tight fit and you might have to „gently“ use the help of a hammer.

Step 4b – Stand 1

Needed parts:

- Stand1_Nema_17.stl (after Step 4a)
- Adapter2.stl
- Steel pin (d=6mm, l>50mm)

(1)

(2)

(3)

Description:

(1) The steel pin is pressed into the opening of the side stand.

(2) The larger gear (Adapter2.stl) is pressed onto the steel pin.

(3) The steel pin (top) and the motor shaft must NOT protrude forward from the components and should be flush with the surface. Superglue can be used to fix the position of the gears.

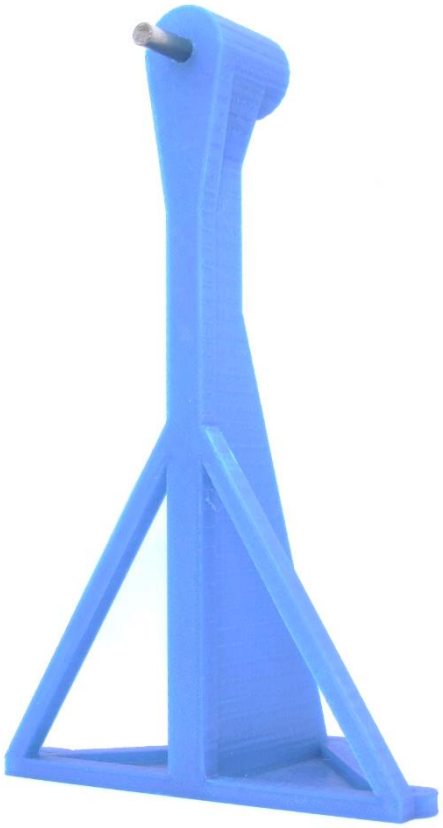
Note:

Both gears should match well and rotate relatively resistance free. If this is not the case, it may be necessary to replace the small gear with v2.stl or adjust the printer settings.

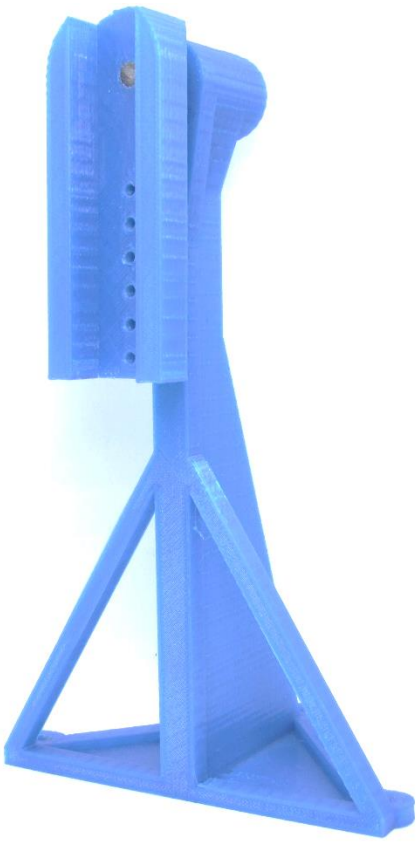
Step 5 – Stand 2

Needed parts:

- Stand2.stl
- Adapter1.stl
- Steel pin (d=6mm, l>50mm)



(1)



(2)

Description:

(1) The steel pin is pressed into the opening of the side stand

(2) The adapter1.stl is pressed onto the steel pin. It is important to ensure that the steel pin does not protrude forward from the adapter.

Note:

The adapter can be fixed with superglue on the steel pin. It must be ensured that the steel pin can rotate freely in the stand.

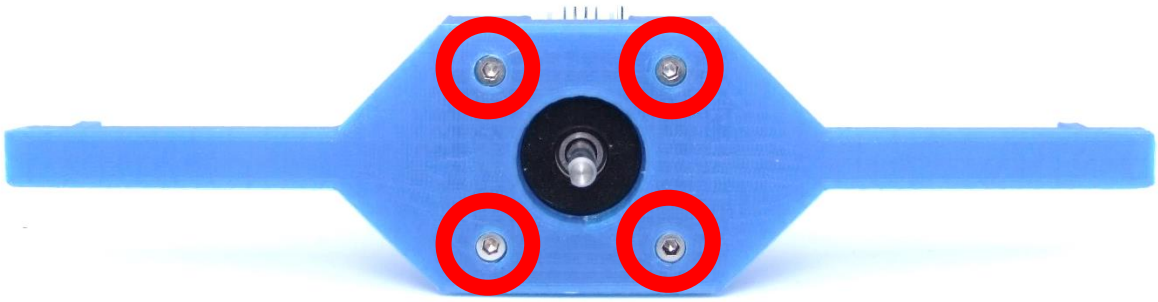
Step 6 – Turntable

Needed parts:

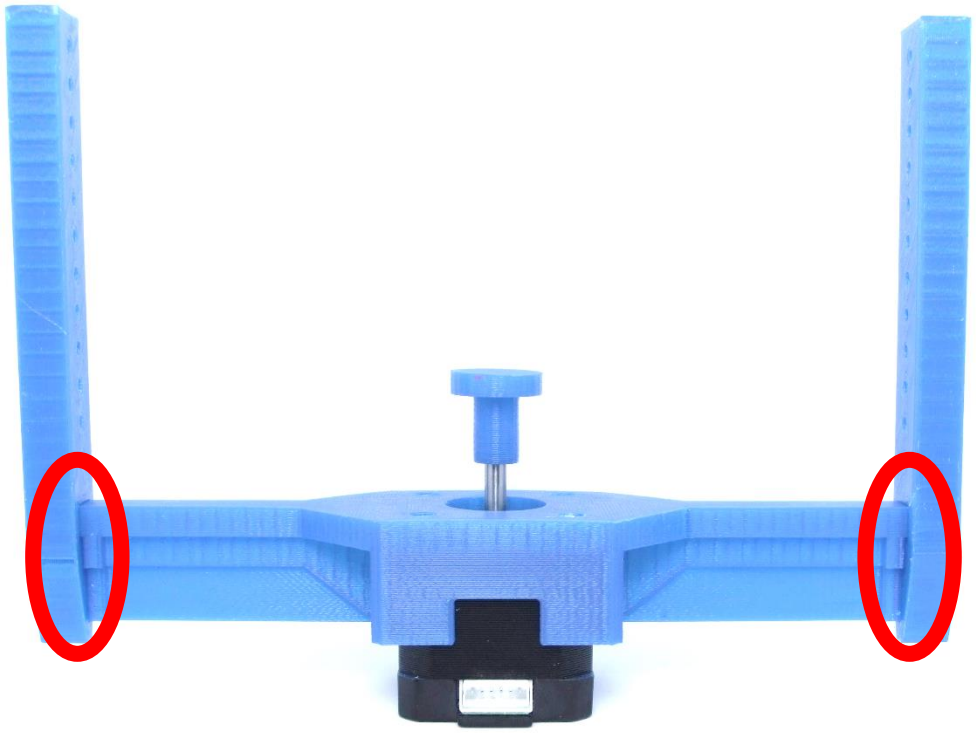
- Turntable_Base_small.stl
- Nema 17 (min. 40Ncm)
- M3x8mm (4x)
- Rotary_Arm.stl (2x)
- Turntable_Adapter.stl

Description:

(1) Connect the Nema 17 with 4 M3x8mm screws with Turntable_Base_small.stl:



(2) Place the Rotary Arm (2x) on the sides of the turntable_base.stl (red mark) and press any Turntable_Adapter.stl onto the motor shaft:



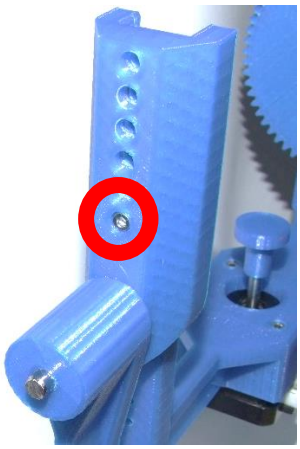
Note:

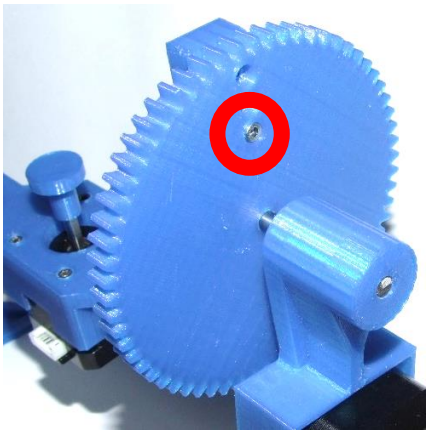
The connections marked red in the second picture can be fixed with super glue if they are too loose.

Step 7 – Tilting mechanism

Needed parts:

- Stand 1 (after step 4b)
- Stand 2 (after step 5)
- Turntable_Base_small.stl (after step 6)
- M3x12mm (2x)





Description:

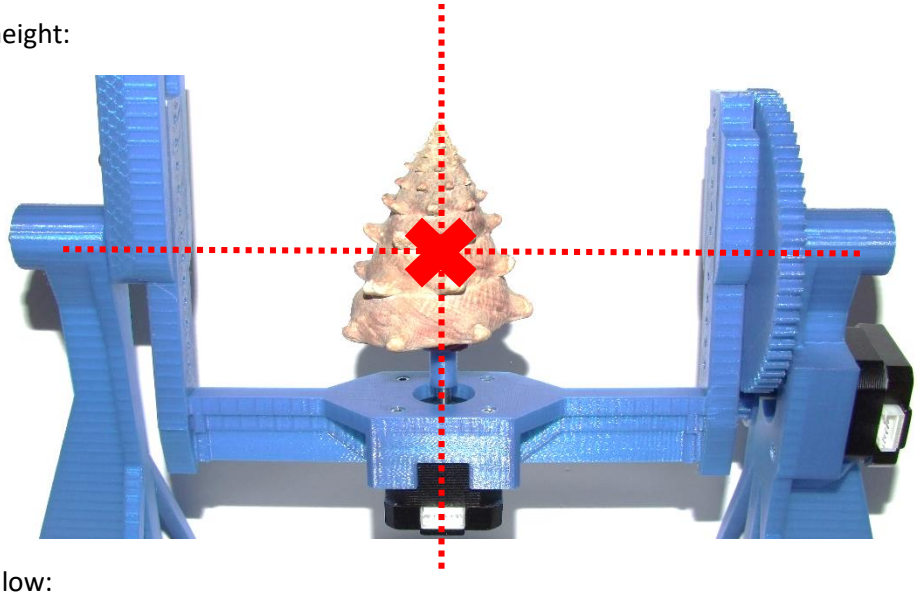
The two M3x12mm screws are screwed laterally into the adapters (red mark), so as to connect the side stands with the rotating arm (Turntable_Base + Rotary_Arm). The height has to be adapted to the print object (see next page).

Step 8 – Setting the Scanning Volume

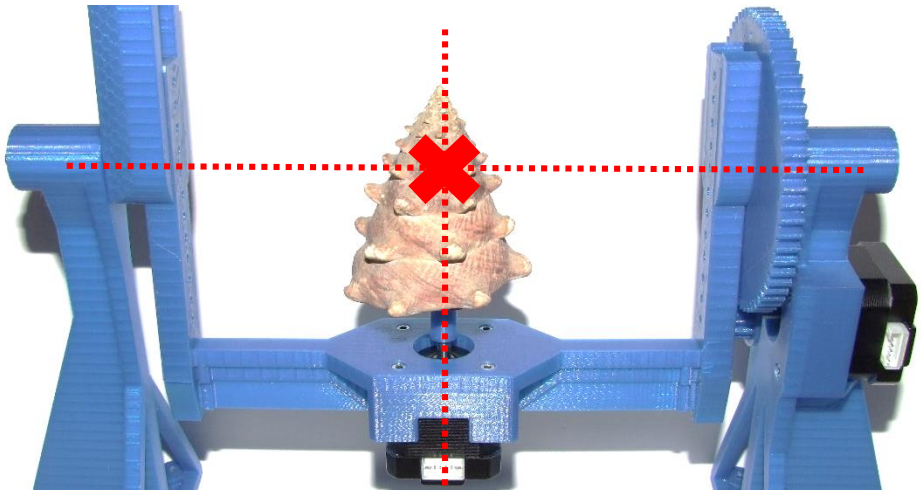
Description:

Depending on the object, the height of the tilting mechanism must be adjusted. This can be done by loosening the screws used in step 7 and adjusting the height accordingly. The goal is that the center of the object is in the center of the two roational axis, as shown in the following image:

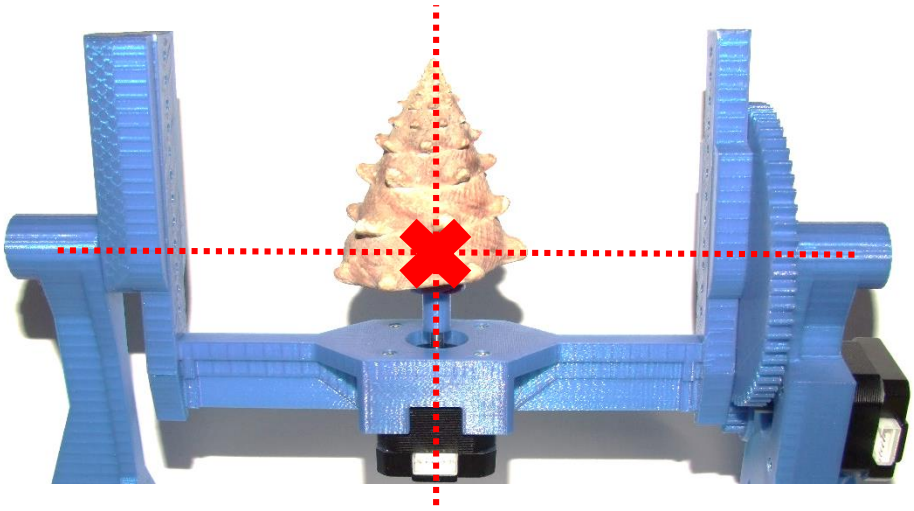
(1) optimal height:



(2) object to low:



(3) object to high:



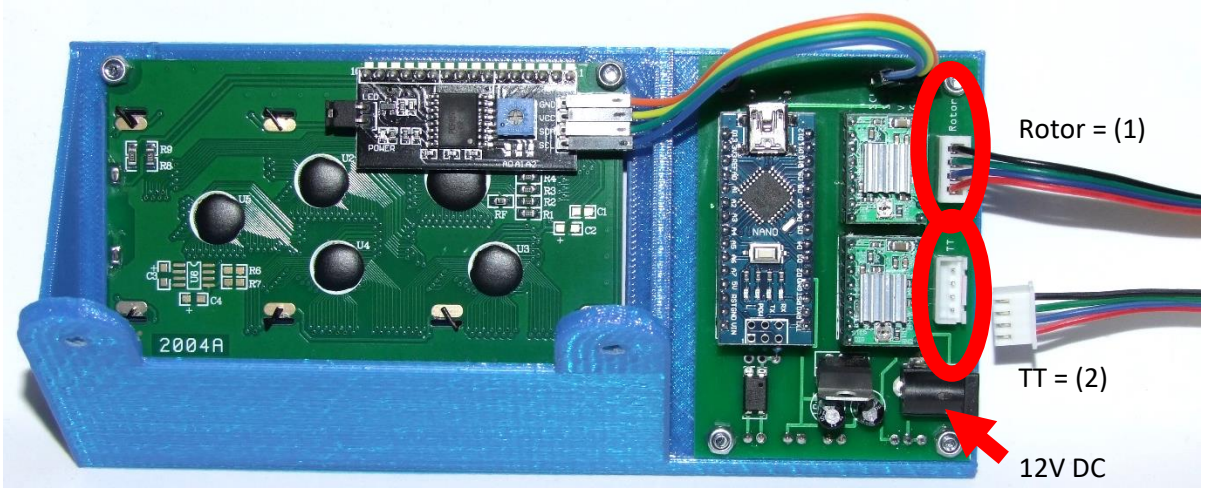
Step 9 – Wiring the stepper motors and control unit

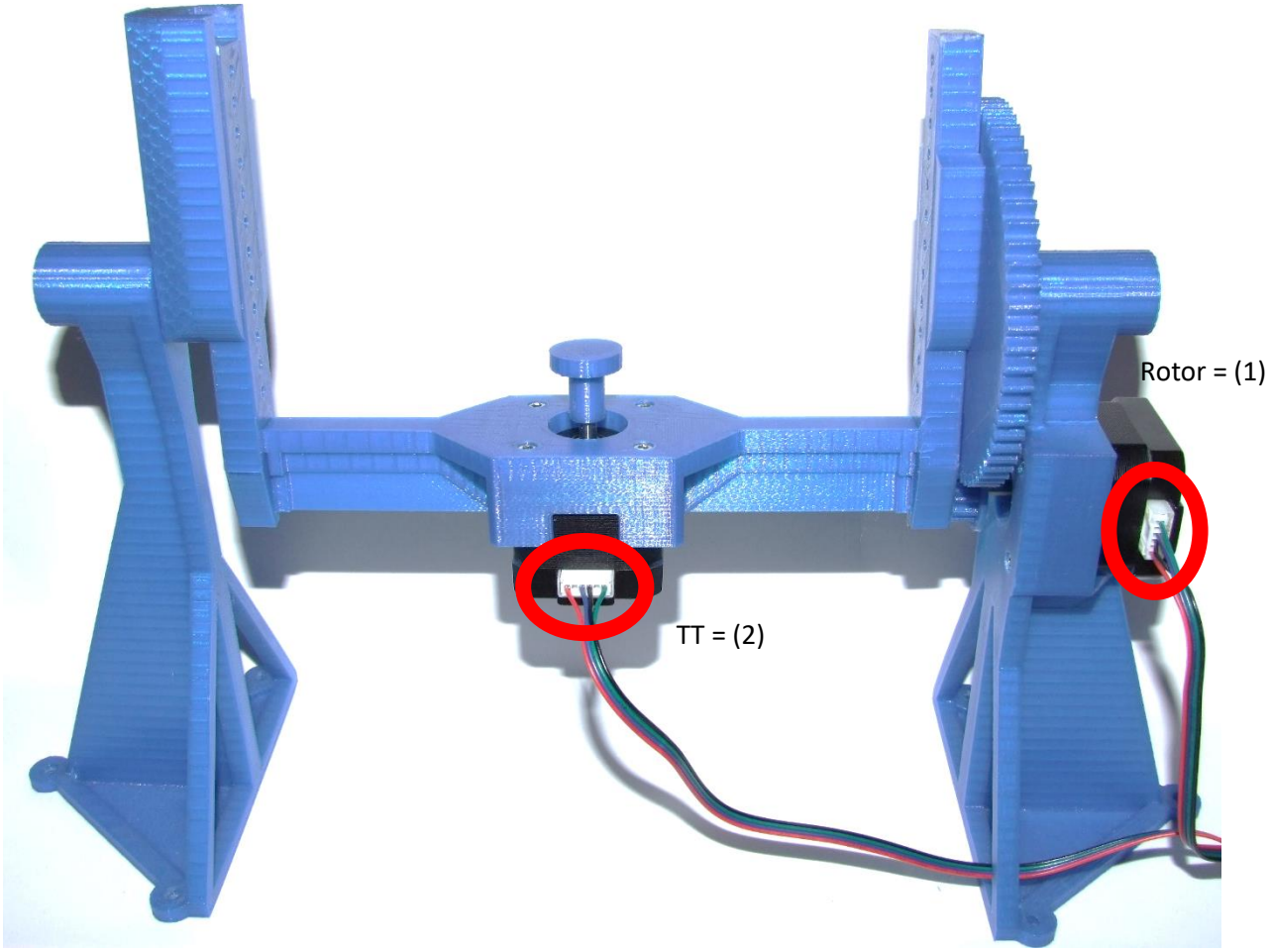
Needed parts:

- Control unit (after step 3)
- Tilting mechanism (after step 7/8)
- Stepper motor cable >70cm (2x)

Description:

The motors are connected to the control unit as shown.





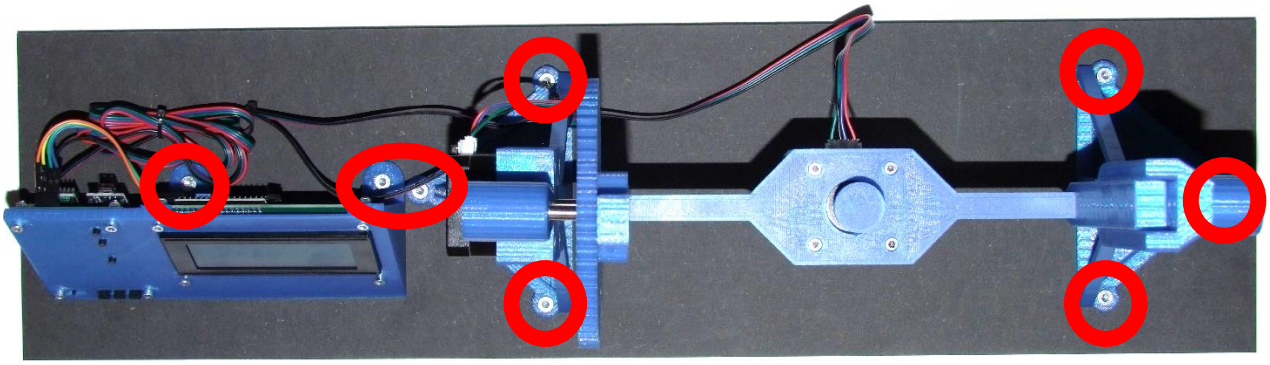
Step 10 – (optional) Mounting on a base plate / work surface

Needed parts:

- Tilting mechanism and control unit (after step 9)
- Screw for wood (d=3mm) or alternatively double-sided tape
- Wood panel (min. 600x150mm)

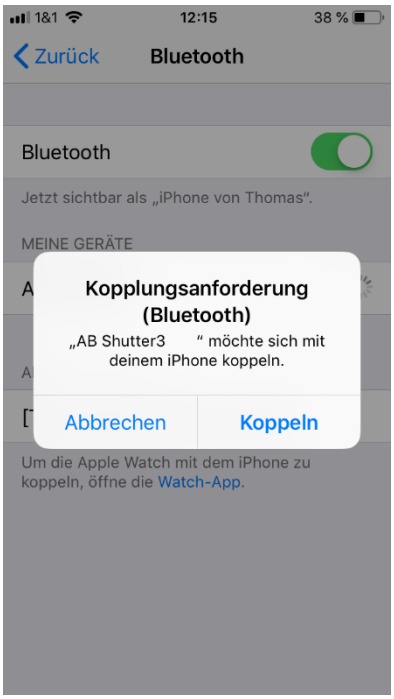
Description:

The tilting mechanism and the control unit are mounted on a base plate. This can be done either temporarily with double-sided tape or more durable with wood screws.



Accessories

Remote Control – Bluetooth for Android/iOS

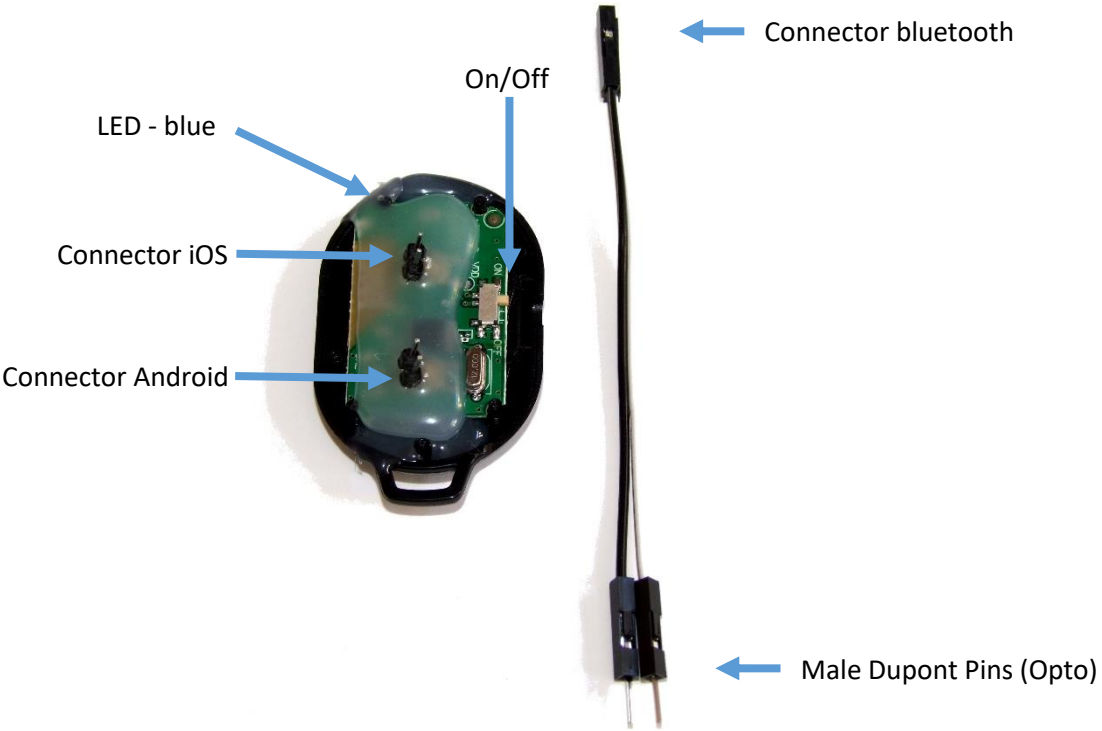


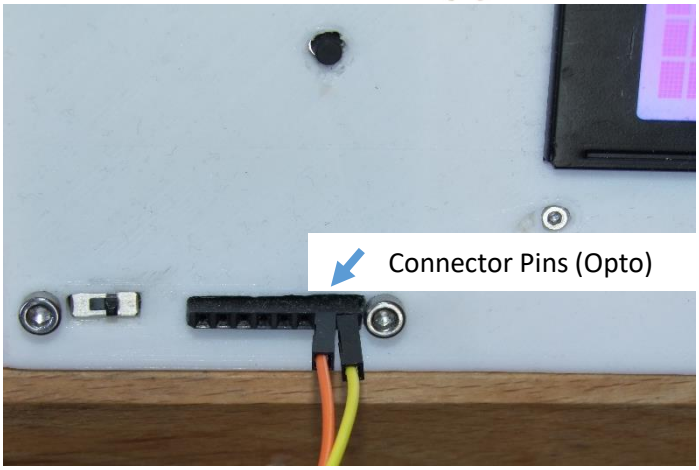
A modified Bluetooth trigger can be used to trigger most smartphone cameras. The shown module is operated with a CR2032 button cell, which must be inserted on the back. As soon as the On / Off switch has been flipped, the blue LED lights up at regular intervals. The device must then be paired with the smartphone via Bluetooth. This can be done in the smartphone's setting menu. The device should be visible as "AB Shutter 3" and has to be coupled accordingly

To connect the Bluetooth module to the control unit, the enclosed cables are used. The female DuPont plugs are plugged into the Bluetooth module. **Attention: The upper connectors are for iOS, the lower for Android! (See picture below).** You can test the functionality of the trigger by shorting the male ends of the cables.

The male DuPont plugs are then plugged into the outer-right two sockets on the control unit (Opto). **Be careful choosing the right pins, as the wrong pins might destroy the bluetooth device!**

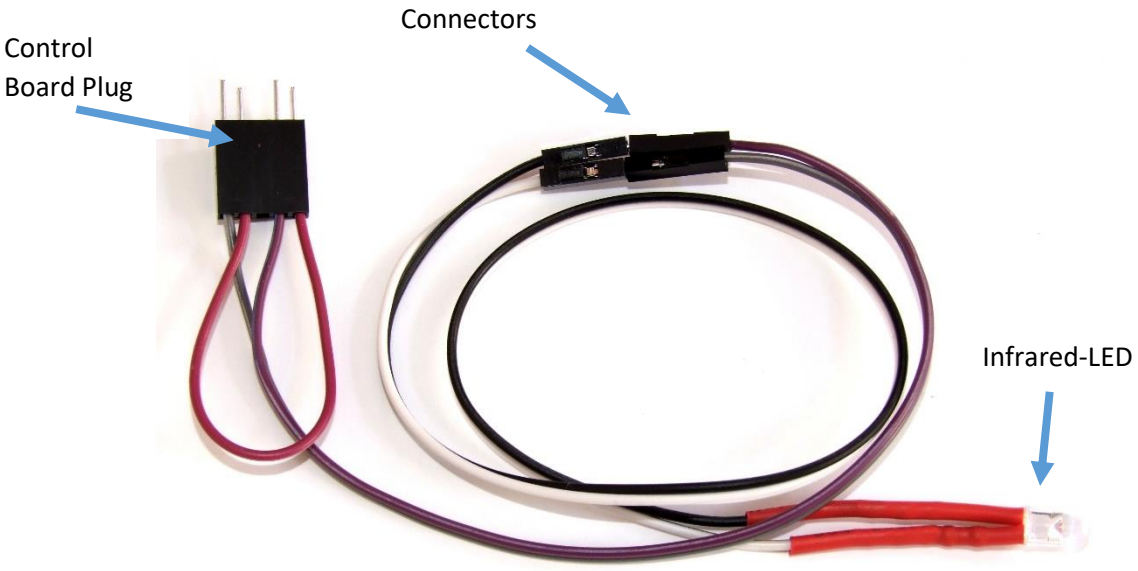
Important: See Set Camera Mode / Trigger Mechanism to "direct"



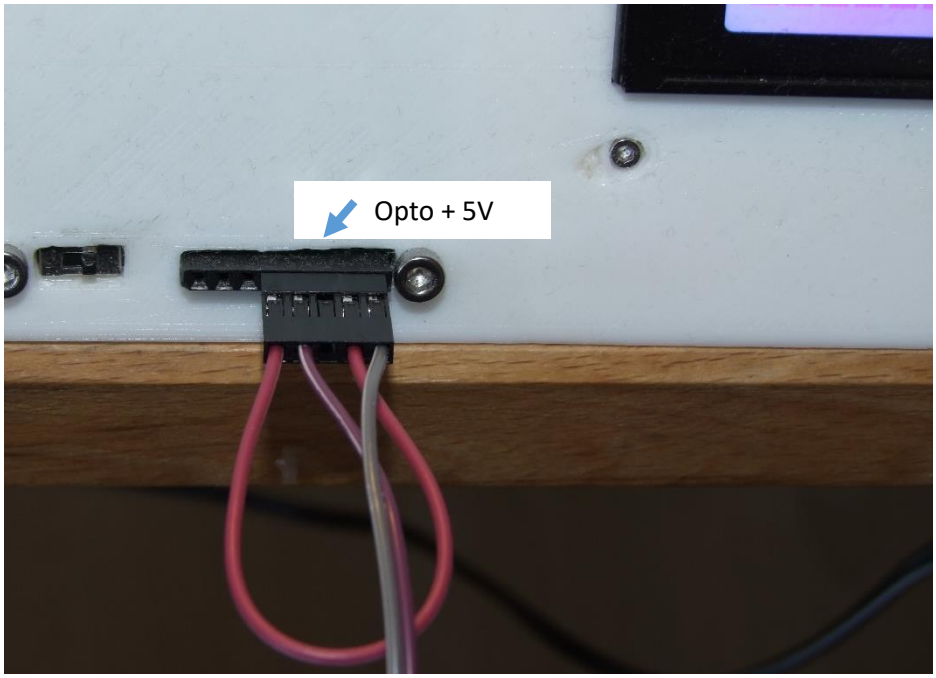


Remote Shutter Control – Infrared

Important: Set Camera mode to the appropriate camera model (settings menu)



Many cameras can be triggered by infrared. This function is to be activated in the corresponding menu of the camera (see user manual of your camera model). An infrared LED is connected to the control board of the scanner (see below) so that it emits a predefined light pulse at the given times. This light is not visible to the human eye (but not harmful either). You can sometimes see the light pulse as a slight pink flicker on the display of the camera, as the sensor of the camera registers the infrared light. However, some cameras (for example Iphones) use an infrared-filter, so the light pulses are not displayed. It should also be noted that these are very short light pulses (<0.1s). **Note: If the camera does not detect a light pulse as soon as a scan routine is started, the connectors should be reversed.**



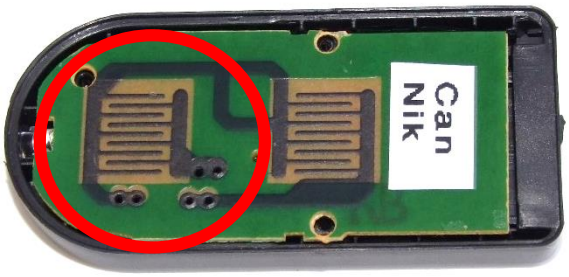
Remote Shutter Control – Modifying a remote control

For (almost) all cameras you can buy a standard remote release, which can be connected to the camera by cable. These can be modified easily and also connected to the Scanner's control unit. A very extensive source for various camera models and home-made remote releases is the following page: http://www.doc-diy.net/photo/remote_pinout/. A modified trigger can be connected to the control unit similar to the Bluetooth module (see: Remote control - Bluetooth for Android / iOS).

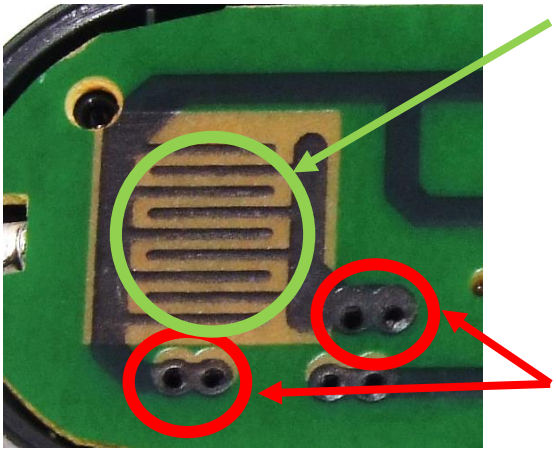
An existing remote release can be modified with minimal soldering skill and a total of two soldering points. The following pictures describe the basic procedure:

(1)-Remote Control for Nikon/Canon (ca. 5€)

(2) Opening the enclosure



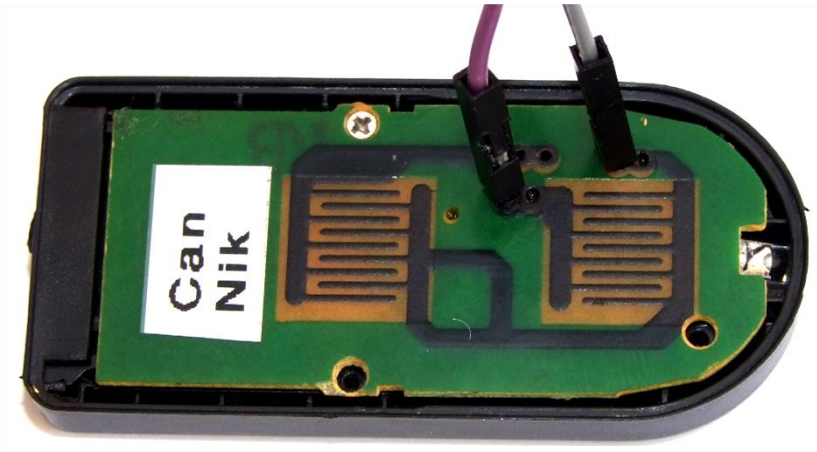
(3) Identification of the connectors



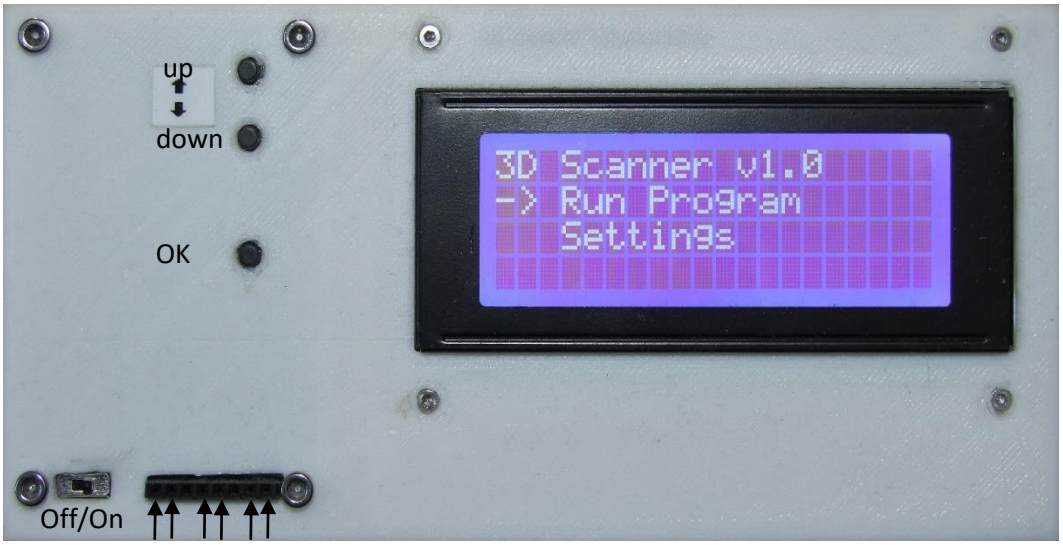
These contacts are usually bridged by pressing the button (see first image)

These contact points can be used to connect two cables, that can later be connected to the scanner's control module.

(4) The shown points (red circles) have been contacted with two male jumper wires, that can be connected to the Scanner. By shortening the two wires the remote will send a pulse to the camera and trigger the shutter.



Using the control unit (important notes!)



Be careful not to mix up the 12V/5V/Opto connectors, when connecting any accessory to the control board as this might damage or destroy the devices!

Main Menu

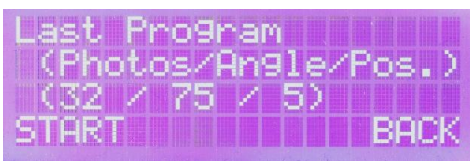
In the main menu, you can use the arrow keys to select whether a program should be loaded or started or whether settings of the scanner should be changed..

Load/Start Program

The last used program or a saved program from the internal memory can be selected (up to twelve program sequences can be stored).
Select using the arrow keys up / down and confirm with OK.

Run last program

With the selection "Run Last Program" the last program is selected and the following screen appears.



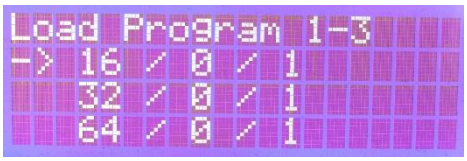
To start this program, select "Start" with the arrow keys and confirm with OK. The parameters specify the following values:

Number of Photos per Rotation: 32

Start- und final tilting angle: 75°, i.e. the object is tilted to a maximum of + 75 ° and -75 ° from the starting position

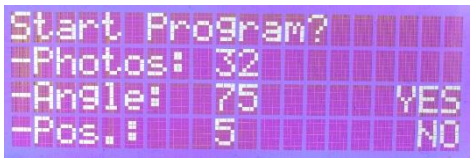
Number of positions between start and end angle: 5, ie. at -75 °, -37,5 °, 0 °, + 37,5 ° and + 75 ° one turn of the turntable is made with 32 images. The transition between these angles is done in predefined steps, defined in Settings "min. vertical angle "- by default, an additional image is taken every 10° to simplify the alignment between the planes of rotation for the reconstruction software.

Load Program



There are up to twelve stored programs available, which can be customized in the "Settings" menu. For the explanation of the values see: "Run last program". The routine is selected via the arrow keys and confirmed with OK.

Then the program will ask again if the chosen program should be started.



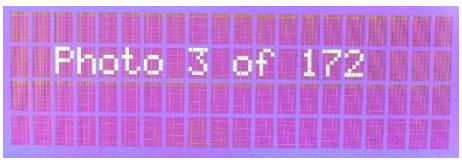
Home – Rotor and Home – Turntable

At the beginning of each program routine, the zero position of the rotor (tilting mechanism) and the turntable can be selected by using the up / down buttons to select the appropriate position and confirm with OK.

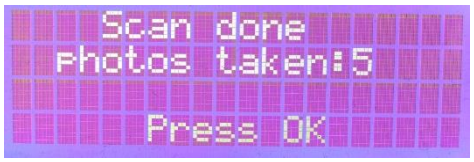
The start of the program must be confirmed again. The Ok button then starts the routine.

Programmablauf

The progress of the routine is shown on the display



If the scan is finished or has been canceled, you can see the complete number of pictures taken:



Interrupt or Stop Routine

If a program is already running and you want to cancel it, the OK button must be held down (at least 1s) and the following screen appears. You will then be able to cancel the routine by pressing the Up button.

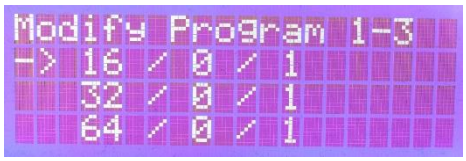
Settings

In the settings menu you can use the arrow keys and confirm with OK to:

- change the individual routines ("modify program")
- set the waiting time per photo ("time per photo")
- choose the minimum angle between the rotation planes ("Min. Vert. Angle")
- choose the trigger mechanism ("Set Camera)

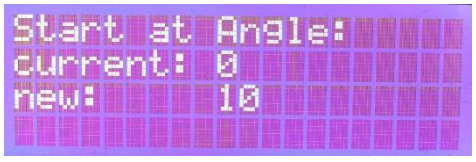
Modify Program

First, use the arrow keys to select the program to be changed and confirm with OK:



The parameters can be changed with the arrow buttons and confirmed with OK. First, choose the photos per turn of the turntable. The recommended value is 32. For primitive objects, 16 is also possible. Higher values should only be selected for very detailed objects, thereby the total number of photos will increase significantly.

Next, the start and end tilting angle are selected. Usually a maximum value of 45 ° works fine.

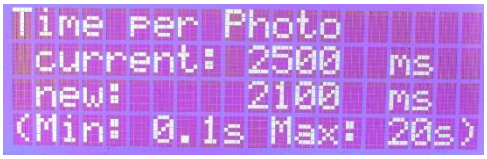


Next, the number of rotation planes between start and end tilting angle is determined. It is recommended that the planes are not more than 30° (better less) apart, i.e. that at a deflection of 30°

a value of three should be chosen. The scan arm is first tilted to -30 °, then to 0 ° and to + 30 °, and the preset number of photos is taken in each position.

Finally, you have to save the new program by selecting "Yes" and confirming with OK. The old program will be permanently overwritten.

Time per photo



Depending on the exposure and camera setting, this value should be adjusted using the arrow keys. The value indicates how much time is given to the camera after triggering to take the photo. The value varies depending on the camera and settings and is set to 2.5s by default. If you reduce this value, the entire program runtime can be significantly shortened. Caution: If the value is too small, the pictures will be blurred! After confirming the value with OK, you immediately return to the main menu and the value will be saved! – better check twice :)

Min. vertical angle

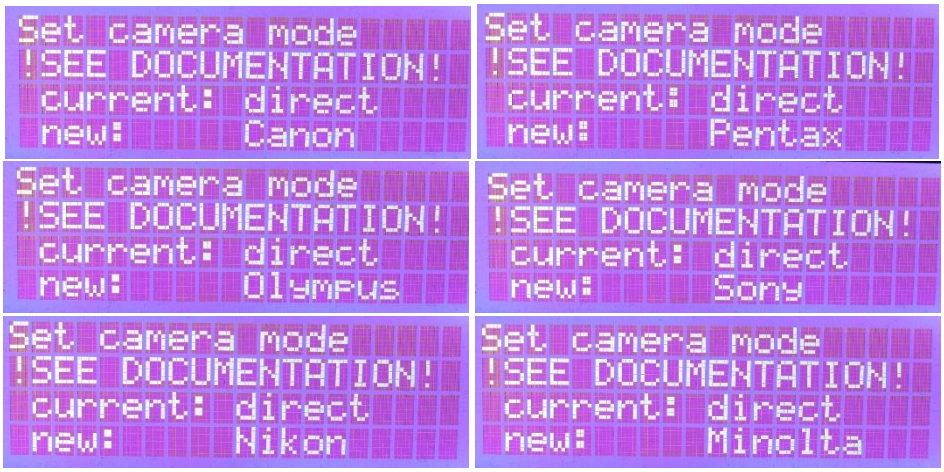
This value defines the angle between two planes of rotation without taking additional photos. As a rule of thumb, this value does not have to be adjusted and can stay 10 °. If, for example, you have the following program 16 photos/25°/2 positions, the turntable will rotate at a tilting of + 25 °, as well as at -25 °. However, since there is too much space between these two angles, the program will take an additional photo at + 15 °, + 5 °, -5 °, and -15 ° so that the reconstruction software can later better align the different layers.

Set Camera mode / Triggering mechanism

In this menu, the type of camera activation is selected. With the OK button the (changed) settings are saved immediately and you return to the main menu. Currently, basically two triggering mechanisms are supported, which can be selected using the arrow keys and selected by OK.

(1) „direct“ – Direct triggering by shorting two pins on the front of the control unit (opto). These can be connected, for example, with an external remote shutter control unit, so that the Arduino quasi takes over the button of the trigger. This option should be selected if e.g. the Bluetooth smartphone trigger or any modified remote control is being used.

(2) „Canon“/“Sony“/“Pentax“/“Olympus“/“Nikon“/“Minolta“ – Infrared-Remote based on Sebastian Setz Arduino Library multiCameraIrControl.h



Unfortunately, Sebastian Setz's project ended a while ago, so it's currently not possible to say which camera models work and can be triggered with the implemented infrared pulses. After our research, at least the following models are supported. However, it is very likely that other models of similar series will work as well:

Canon EOS: 350D, 450D, 550D, 600D, 700D, M, D5 Mark II, D6, D7

Minolta: F300

Nikon: D3000, D7000, D40, D50, D80, D90

Olympus: E-3, E-300, E-410, E-510

Pentax: K10, K100D Super, K200D, K7, S1, WG-1, X5

Sony: Alpha 330, Alpha 380, Alpha 580, CX730, NEX 5N