

# Assembly of XYZ Stage

This document should explain a step by step guide on how to build the XYZ-stage for the UC2.

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V0; Date



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## Motivation

- In Microscopy one usual needs to scan a ROI (Region of Interest), because the FOV (Field of view) of an microscope objective lens is too small)
- We will do that by scanning the sample in X and Y
- In Z one usually needs to manipulate the objective lens to focus/refocus the image on the detector
- We will do that by adjusting the Z-position of the objective lens

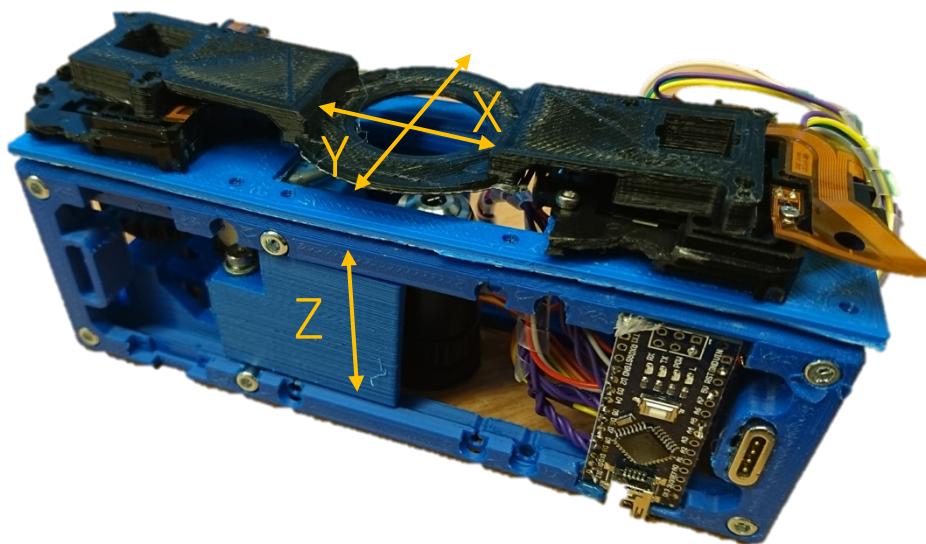


FIGURE 1: FULLY FUNCTIONAL XYZ-STAGE BASED READY TO USE FOR THE I2C-EQUIPPED UC2 SYSTEM

## Goals

This guide tells you:

- Which parts are necessary?
- Buy the parts?
- How to print the parts?
- How to assemble the parts?
- How to get the software ready to make it work?

## Full Setup

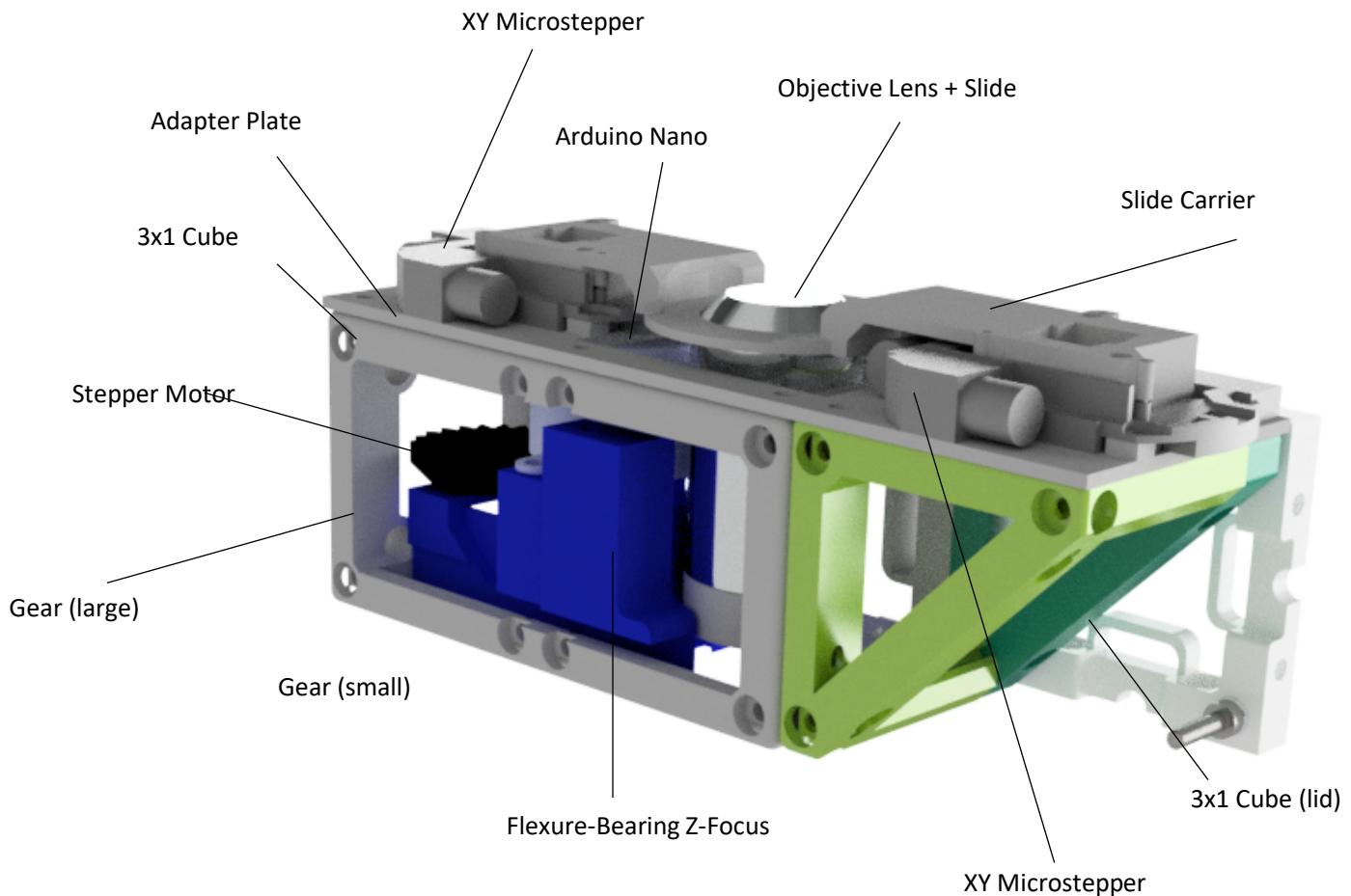
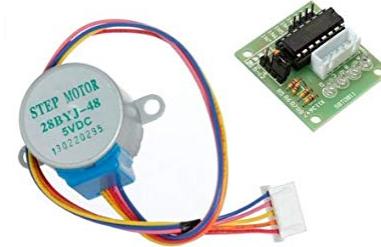


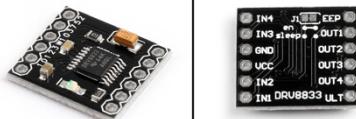
FIGURE 2 – THIS IS HOW IT SHOULD LOOK LIKE ONCE IT'S READY.



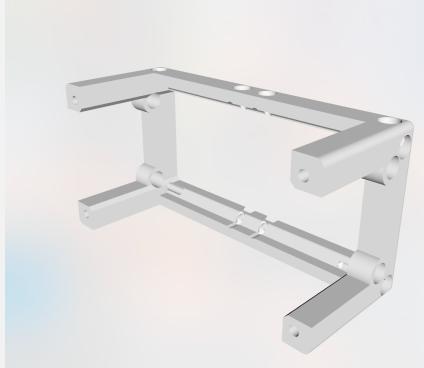
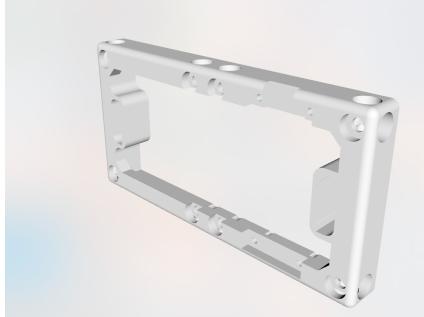
## Bill of Materials

QUANTITY	DESCRIPTION/NAME	IMAGE	PRICE
2	Microstepper XY-Stage <ul style="list-style-type: none"> <li><a href="https://www.aliexpress.com/item/Micro-stepping-motor-cross-platform-small-mobile-digital-microscope-XY-axis-table-experiment-two-slide/32790147861.html">https://www.aliexpress.com/item/Micro-stepping-motor-cross-platform-small-mobile-digital-microscope-XY-axis-table-experiment-two-slide/32790147861.html</a></li> </ul>		3€
1	28BYJ-48 ULN2003 5V Stepper Motor + ULN2003 Driver Board for Arduino <ul style="list-style-type: none"> <li><a href="https://www.amazon.com/ELEGOO-28BYJ-48-ULN2003-Stepper-Arduino/dp/B01CP18J4A/ref=asc_df_B01CP18J4A/?tag=hyprod-20&amp;linkCode=df0&amp;hvadid=312106041990&amp;hvpos=1o2&amp;hvnetw=g&amp;hvrand=188168084368003844&amp;hvptone=&amp;hvptwo=&amp;hvqmt=&amp;hvdev=c&amp;hvdvcmdl=&amp;hvlocint=&amp;hvlocphy=9001989&amp;hvtargid=pla-567948185662&amp;psc=1&amp;tag=&amp;ref=&amp;adgrpid=62149807356&amp;hvptone=&amp;hvptwo=&amp;hvadid=312106041990&amp;hvpos=1o2&amp;hvnetw=g&amp;hvrand=188168084368003844&amp;hvqmt=&amp;hvdev=c&amp;hvdvcmdl=&amp;hvlocint=&amp;hvlocphy=9001989&amp;hvtargid=pla-567948185662">https://www.amazon.com/ELEGOO-28BYJ-48-ULN2003-Stepper-Arduino/dp/B01CP18J4A/ref=asc_df_B01CP18J4A/?tag=hyprod-20&amp;linkCode=df0&amp;hvadid=312106041990&amp;hvpos=1o2&amp;hvnetw=g&amp;hvrand=188168084368003844&amp;hvptone=&amp;hvptwo=&amp;hvqmt=&amp;hvdev=c&amp;hvdvcmdl=&amp;hvlocint=&amp;hvlocphy=9001989&amp;hvtargid=pla-567948185662</a></li> </ul>		3€
1	Arduino Nano (equivalent) <ul style="list-style-type: none"> <li><a href="https://www.amazon.com/HWAYEH-Arduino-Nano-V3-0-Micro-Controller/dp/B07D6TM4Y1/ref=pd_day0_hl_147_6?encoding=UTF8&amp;pd_rd_i=B07D6TM4Y1&amp;pd_rd_r=f06b6c14-f83f-11e8-b5bc-bd52b7fe7240&amp;pd_rd_w=1iWt8&amp;pd_rd_wg=oXyNT&amp;pf_rd_i=desktop-dp-sims&amp;pf_rd_m=ATVPDKIKX0DER&amp;pf_rd_p=ad07871c-e646-4161-82c7-5ed0d4c85b07&amp;pf_rd_r=9CHF5YAP4GA0M9MN9ZD0&amp;pf_rd_s=desktop-dp-sims&amp;pf_rd_t=40701&amp;psc=1&amp;refRID=9CHF5YAP4GA0M9MN9ZD0">https://www.amazon.com/HWAYEH-Arduino-Nano-V3-0-Micro-Controller/dp/B07D6TM4Y1/ref=pd_day0_hl_147_6?encoding=UTF8&amp;pd_rd_i=B07D6TM4Y1&amp;pd_rd_r=f06b6c14-f83f-11e8-b5bc-bd52b7fe7240&amp;pd_rd_w=1iWt8&amp;pd_rd_wg=oXyNT&amp;pf_rd_i=desktop-dp-sims&amp;pf_rd_m=ATVPDKIKX0DER&amp;pf_rd_p=ad07871c-e646-4161-82c7-5ed0d4c85b07&amp;pf_rd_r=9CHF5YAP4GA0M9MN9ZD0&amp;pf_rd_s=desktop-dp-sims&amp;pf_rd_t=40701&amp;psc=1&amp;refRID=9CHF5YAP4GA0M9MN9ZD0</a></li> </ul>		3€

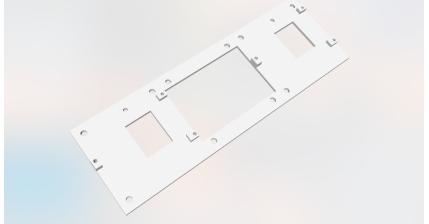
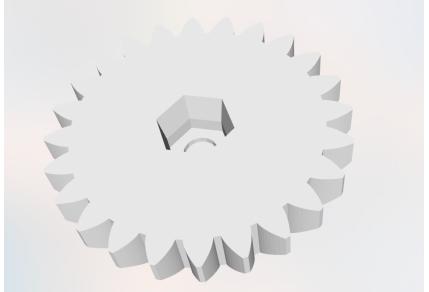
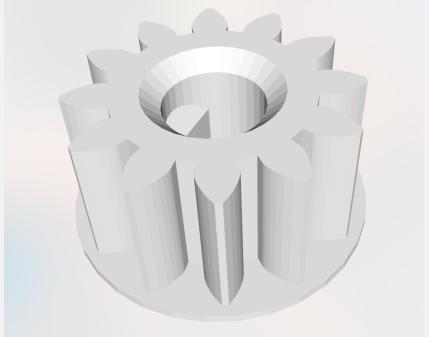


<b>1</b>	<p>Stepper Driver 8833, 2 Kanal DRV8833 DC Motor Driver Modul 3V-10V 1.5A H-Bridge Für Arduino <a href="https://www.ebay.de/itm/263933082352">https://www.ebay.de/itm/263933082352</a></p>	
<b>16</b>	<p>Schrauben (DIN 912, M3, 18mm, kein Edelstahl! Müssen magnetisch sein-&gt; Eisen!)</p> <ul style="list-style-type: none"> <li>- <a href="https://www.conrad.de/de/toolcraft-839670-zylinderschrauben-m3-12-mm-innensechskant-din-912-iso-4762-stahl-88-geschwaerzt-100-st-839670.html">https://www.conrad.de/de/toolcraft-839670-zylinderschrauben-m3-12-mm-innensechskant-din-912-iso-4762-stahl-88-geschwaerzt-100-st-839670.html</a></li> </ul>	

The following parts can be downloaded from the Github repo /CAD/XYZ-Stage

QUANTITY	DESCRIPTION/NAME	IMAGE	PRICE
<b>1</b>	1x3 Cube (lower part)		3€
<b>1</b>	1x Cube (electric-lid)		3€



<b>1</b>	1x Flexure Bearing Z-Focusing Mechanism		3€
<b>1</b>	Adapter Plate		3€
<b>1</b>	Slide Mount		3€
<b>1</b>	Gear (Large) Borrowed from R. Bowman		3€
<b>1</b>	Gear (Small) Borrowed from R. Bowman		3€



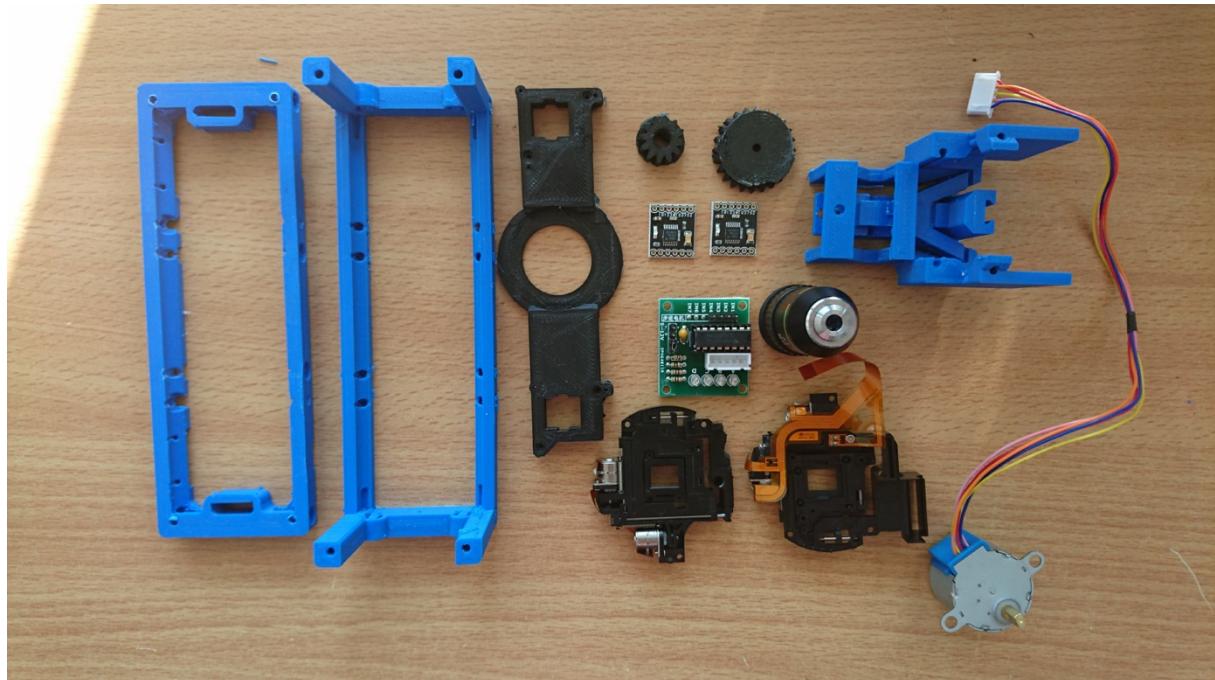
## 3D Printing

All “.stl” files in the folder /CAD/XYZ-Stage should be downloaded and printed. Don’t be confused by the CAD model above, we updated it to make it easier to assemble. We printed with an Ultimaker 2+ with a 0.4 Nozzlesize. Printing settings: Default at medium quality (0.1mm layer height) and Avistron ABS. Use the glue stick to make sure the first layer sticks! Don’t use BRIM or any other adhesion techniques!

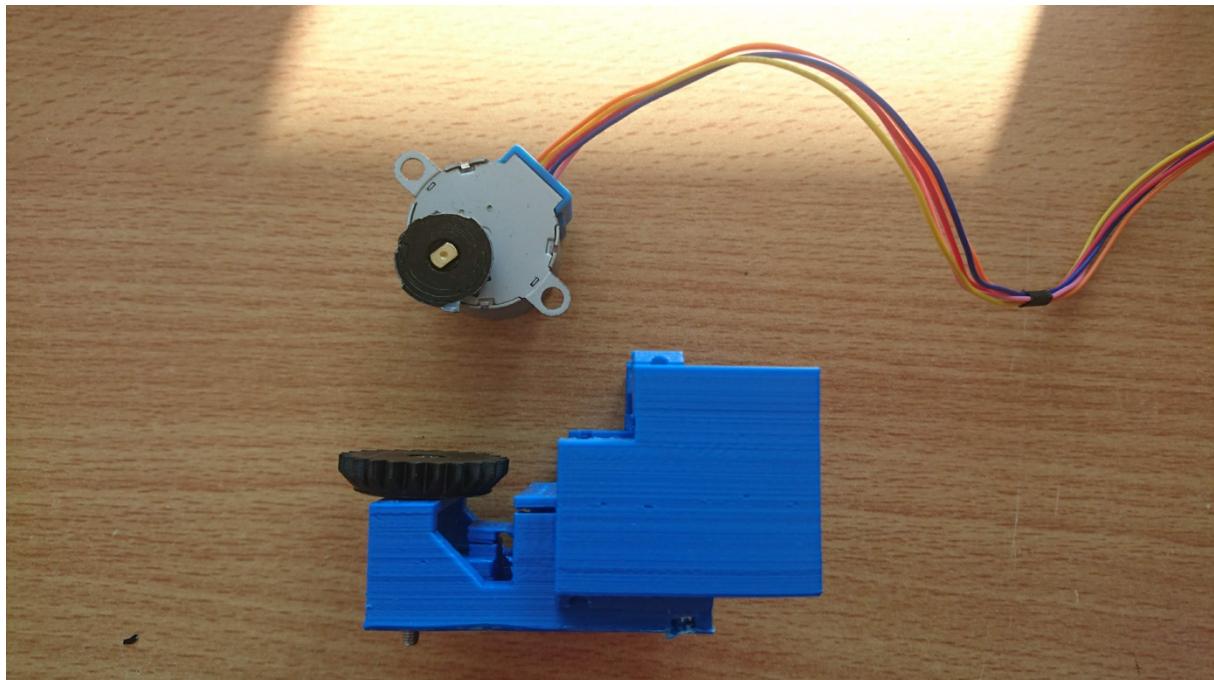
## Assembly

Below you'll find a step-by-step guide on how we assembled it. If you're lacking any additional steps, please don't hesitate to file an issue. We're willing to help!

### 1<sup>st</sup> Step – Get the parts ready

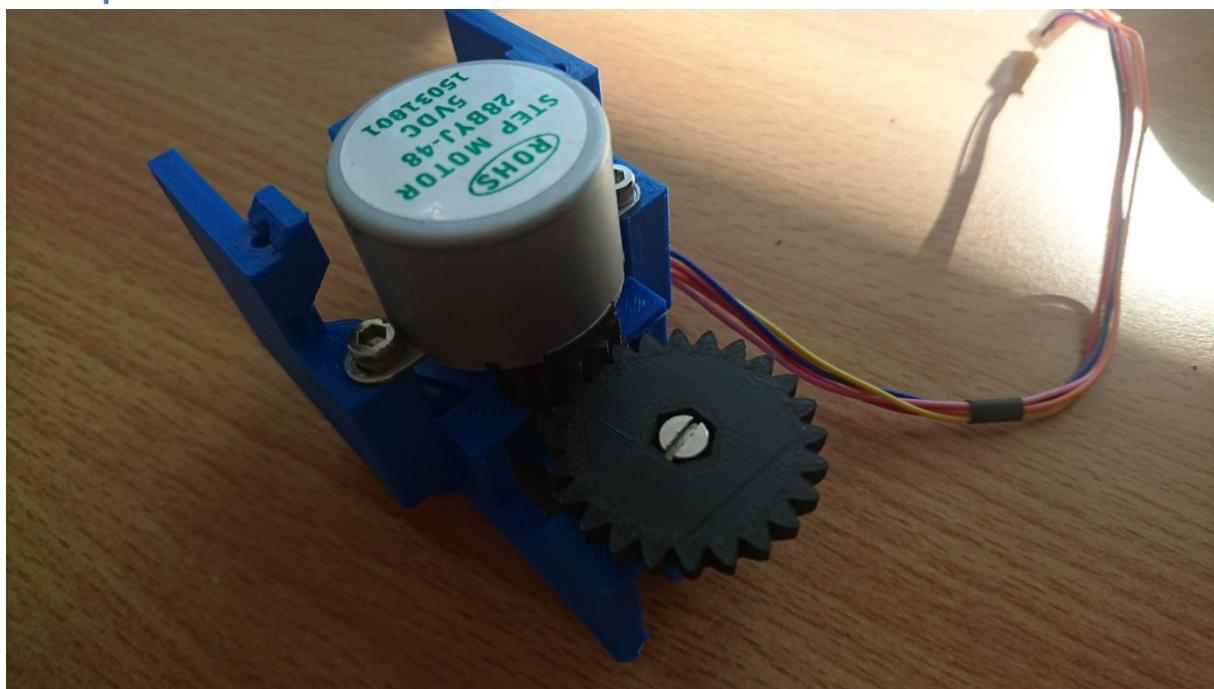


## 2<sup>nd</sup> Step Mount the stepper and the gears



Optional: Place a spring between the gear and the level-arm so that it gets back in the rest position easier.

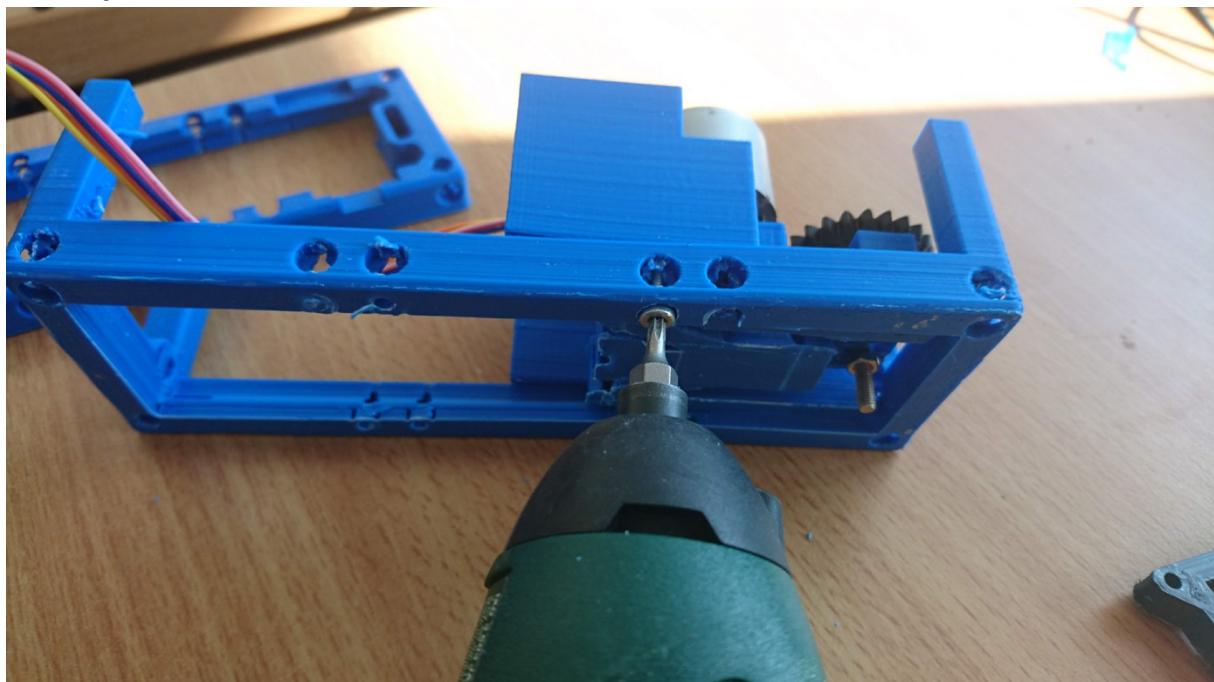
## 3<sup>rd</sup> Step – Observe Result



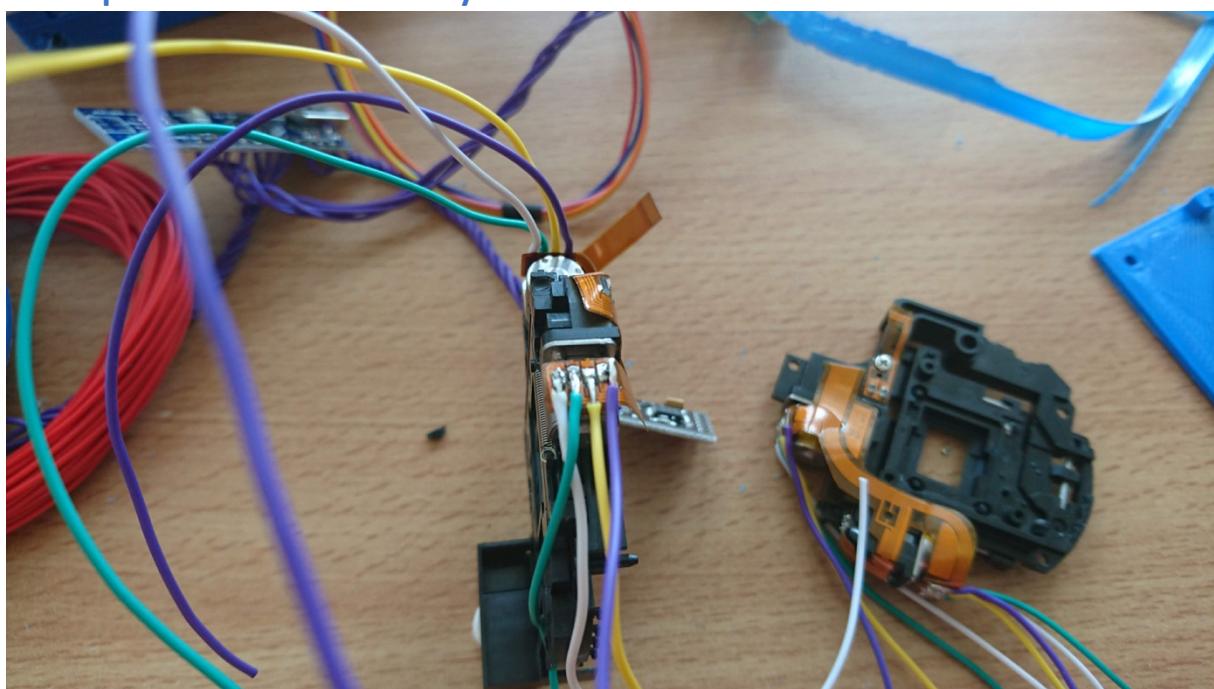
Advice: The Gear turns the screw and the nut (glued) to the level arm acts like a worm-drive pulling the level-arm up and down.



#### 4<sup>th</sup> Step – Mount Z-Motor in the Cube with M3 Screws



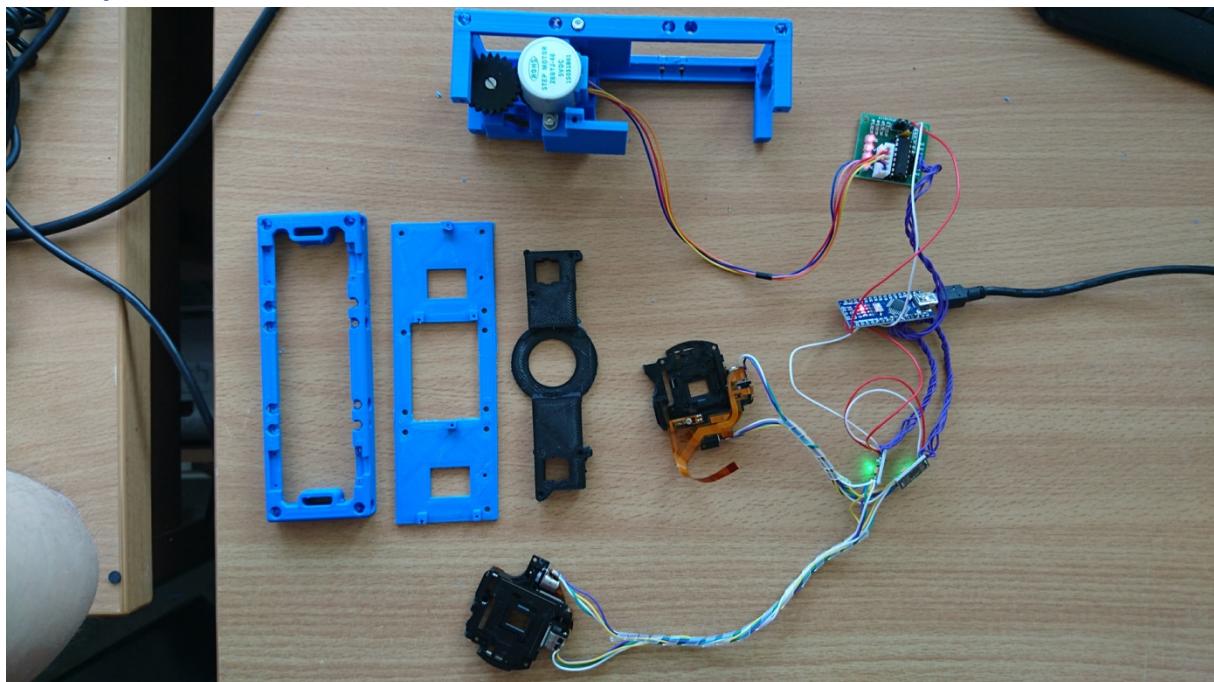
#### 5<sup>th</sup> Step – Get the cables ready



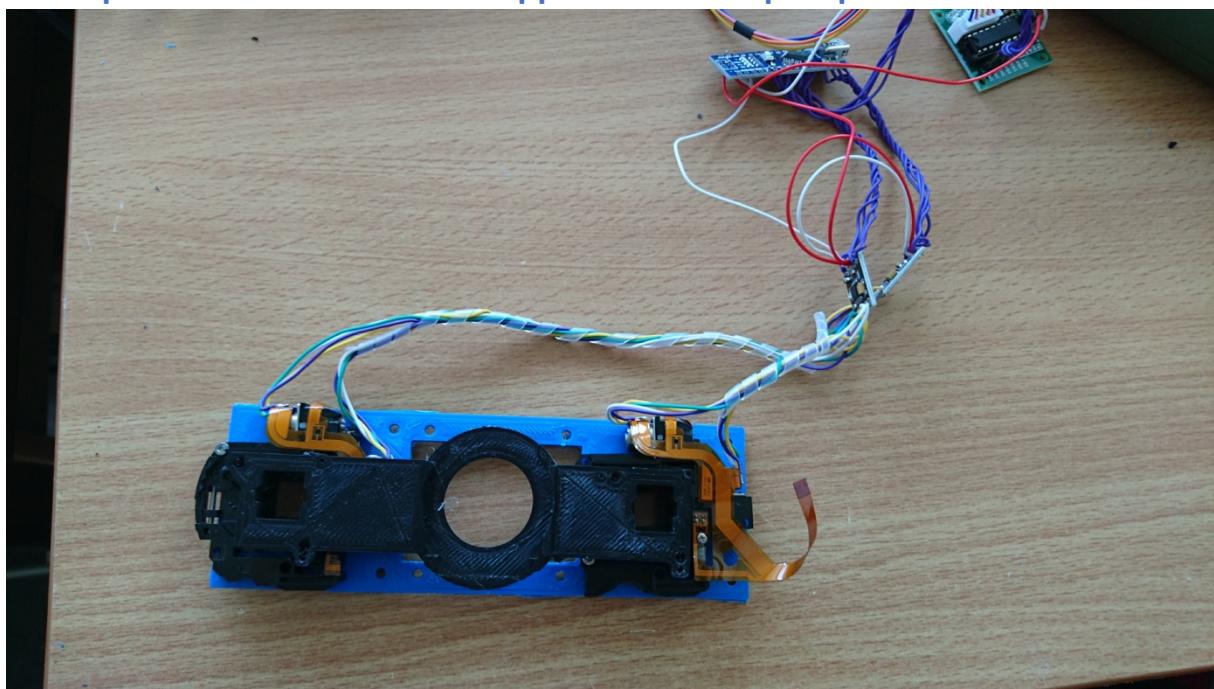
This follows the guide in our electronics section. You need two XY Microstepper, the 28-Y Motor and its driver. All connects to the Arduino and a 5V power source which is coming from the I2C wires.



## 6<sup>th</sup> Step – Observe the result



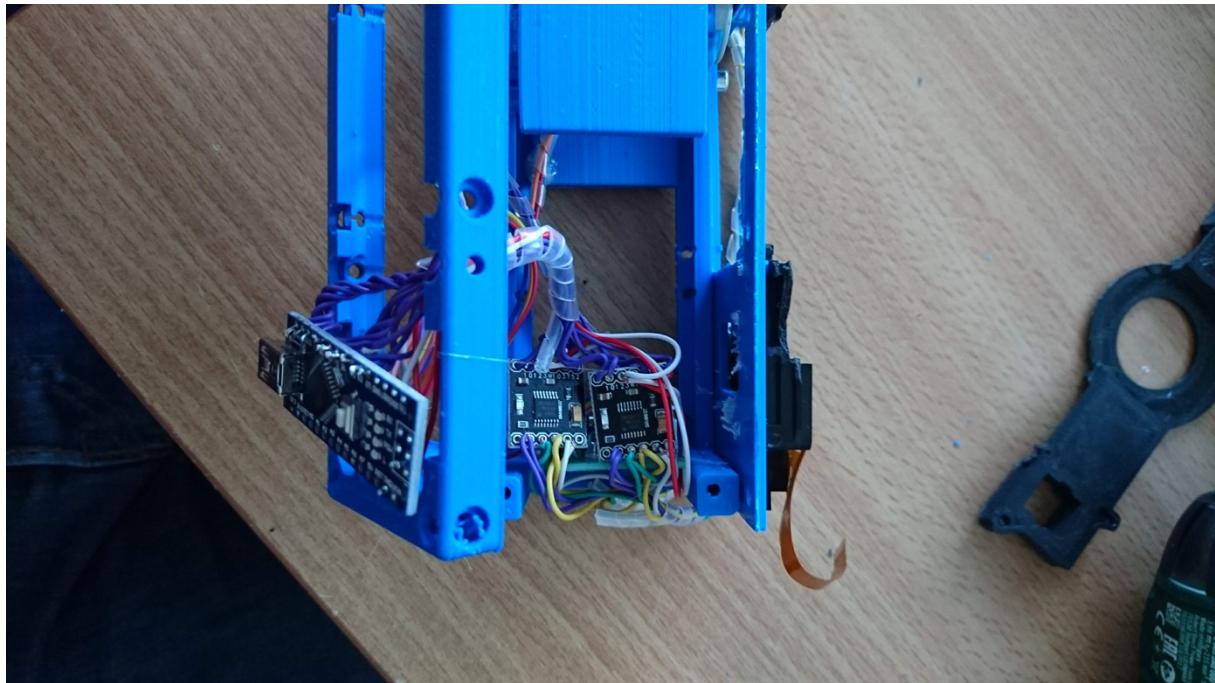
## 7<sup>th</sup> Step – Mount the XY Microstepper on the adapter plate



The slide-adapter (black) can be placed on the XY-Microsteppers via a press-fit mechanism. Depending on the printers precision, one has to modify the part a bit or simply glue it with hot-glue.

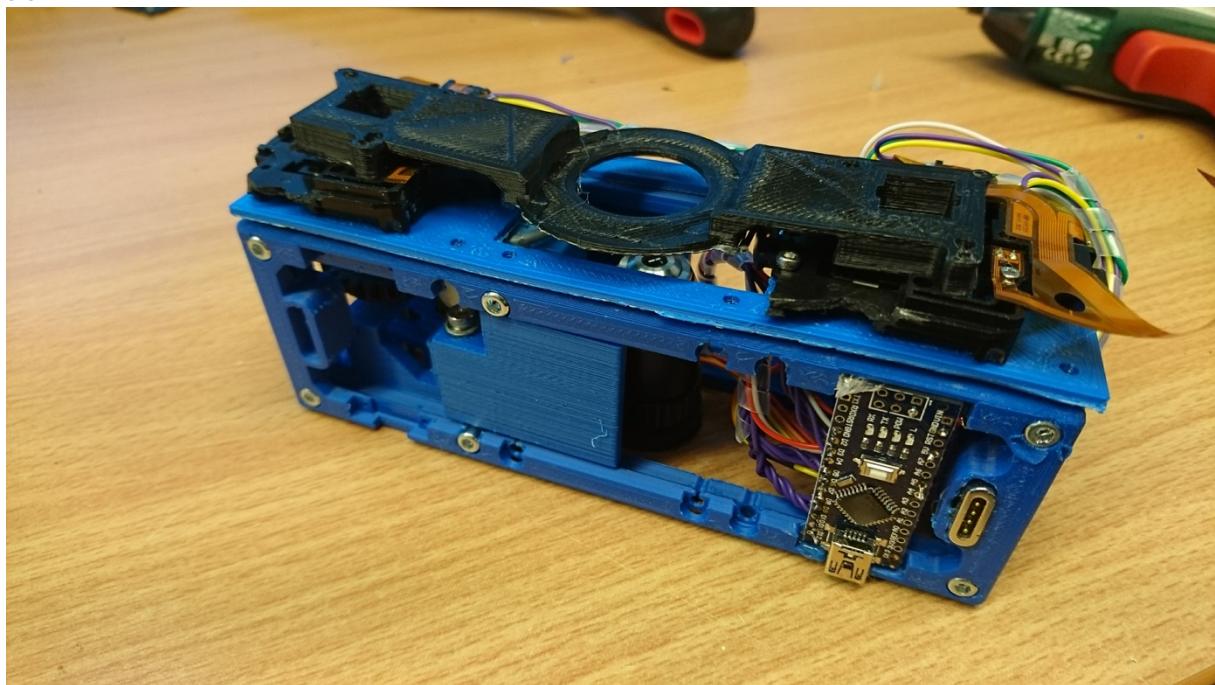


**8<sup>th</sup> Step – Put/Hide the electronics inside the cube and mount the Arduino in its place**



Advice: Pack the cables tightly together!

**8<sup>th</sup> Step – Put everything in place and mount the slide-mount, Use magnetic (!) screws**



Tadah! If you made it this far, you're simply great! Take a break!



## Software

Please download the motor.ino from the Software folder and flash it to the Arduino. If everything went right, it should work like a charm.

## Resources

### Links

<https://www.waterscope.org/wp-content/uploads/OpenFlexure-microscope-assembly-instructions.pdf>

