Project Drawing Robot

Instruction Manual

Assembled By: Jonathan K

Approximate cost for all the parts is $100

Parts List

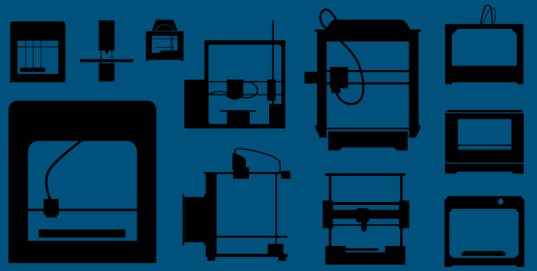
Components

- **(2)** Nema 17 Stepper Motors Link
- **(2)** Linear Rod M8 x 450mm, X Axis
- **(2)** Linear Rod M8 x 350mm, Y Axis
  - Note: I purchased 4 Linear Rods that were longer, which I cut to length later Link
- **(2)** Linear Rod 3mm , Z Axis (CDROM)
- **(1)** Threaded Rod M8 x 470mm Link
- **(8)** LM8UU Bearings or printed Link
- **(1)** Servo Sg90 Link
- **(1)** Spring Link
- **(2)** GT2 Pulley, 16 teeth Link
- **(5)** Bearing 624zz Link
- 2000mm GT2 belt Link
- **(1)** Arduino Uno Link
  - CNC Shield Link
  - **(4)** A4988 Stepper Drivers Link
  - **(16)** Jumpers Link
- **(1)** 12V 2A Power Supply Link
- **(2-4)** Limit switches (optional) Link

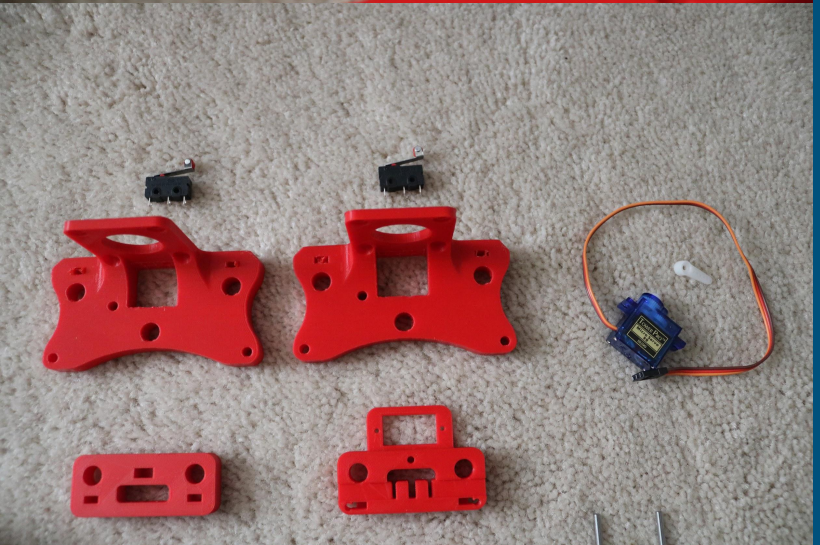
Hardware

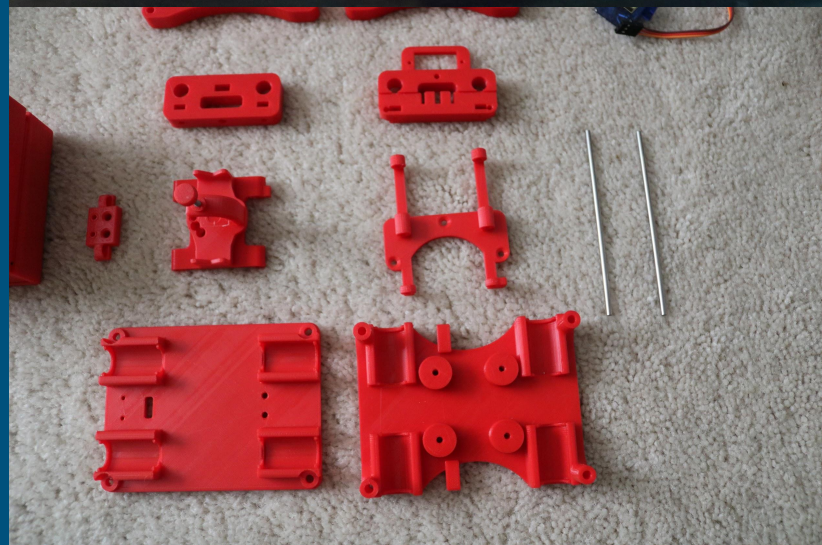
- Nuts
  - **(7)** M3-0.5
  - **(5)** M4-0.7
  - **(4)** 5/16in-18
- Screws
  - **(13)** Phillips M3-0.5 x 16mm
  - **(4)** Phillips M3-0.5 x 6mm
  - **(5)** Phillips M4-0.7x 35mm
  - **(1)** Hex M3-0.5 x 20mm
- Washers
  - **(4)** 5/16in washer
  - **(4)** M3 washers

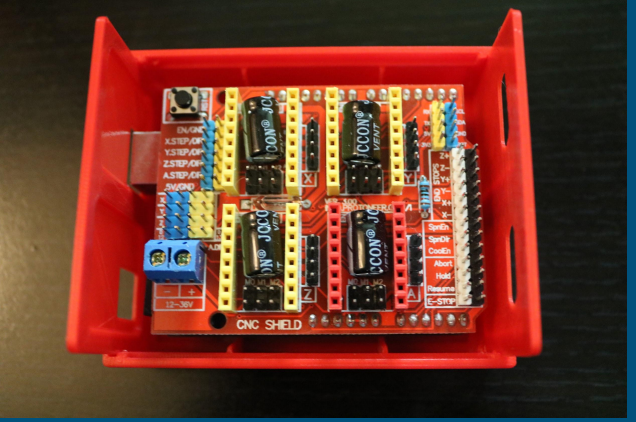
3D Printing



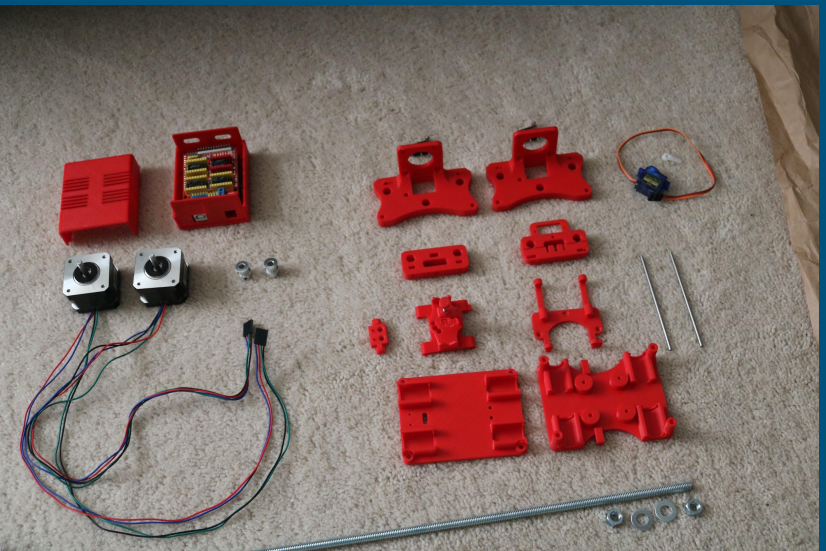
- To begin this project, start by downloading the files from Thingiverse: Link
- Open the 3D models in your slicer(Cura, Sli3er, Simplify 3D, etc.)
- I recommend using Cura as I have heard that people have had issues with some of the models using Sli3er
- Note: I also printed one more part that was not listed in the original thing. This part is to help the GT2 belt from slipping off the 624zz bearings. Link
- Input the settings that you will be using on the parts
    - I used 100% infill on all the parts (An infill of 40 - 100% will work as well)
    - Printed all the parts with 0.15mm layer height
    - Printed with Hatchbox Red PLA Link
    - Use supports on the Penholder, Slider, X_Support_L and the X_Support_R (Remove the supports from these parts once they are printed)
- The longest part took around 9hrs and the shortest took 30 minutes to print






CNC SHIELD


HATCHBOX
3D PRINTER FILAMENT
PLA



Cut your Linear Rods to Length

- If you purchased rods that were cut to length, then skip this step
- Use a measuring tape and sharpie to mark the spots where the rods need to be cut
  - Use a vise to hold the rods in place when you cut them
  - Remember that you need **(2)** 350mm and **(2)** 450mm long linear rods
  - On the threaded rod, mark your cutting point at 470mm
- I used an angle grinder to cut the rods
- Then I took a bench grinder to smooth the ends that were cut


CRAFTSMAN
4-1/2-in. Angle Grinder


2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21


CRAFTSMAN
CRAFTSMAN
CRAFTSMAN


2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

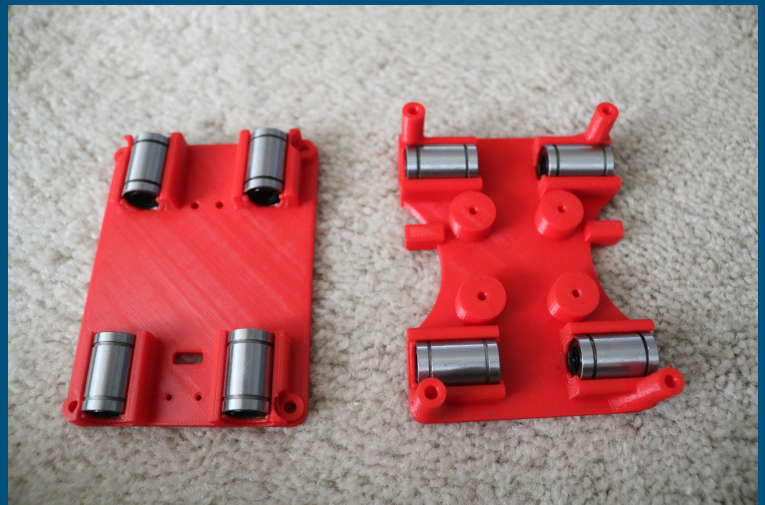
Assemble the X-Axis (Linear/Threaded Rods)

- Take the **(2)** 450mm linear rods and insert them into either x-support part
  - Use may need to use a round file to smooth out the holes that you insert them in
  - Also, you can use a rubber mallet to help insert the rods
- Now take the threaded rod and insert it in the hole below. Feed a 5/16in washer and 5/16in nut on both sides of the x-support part


3D

Assemble the X-Axis (Bearings)

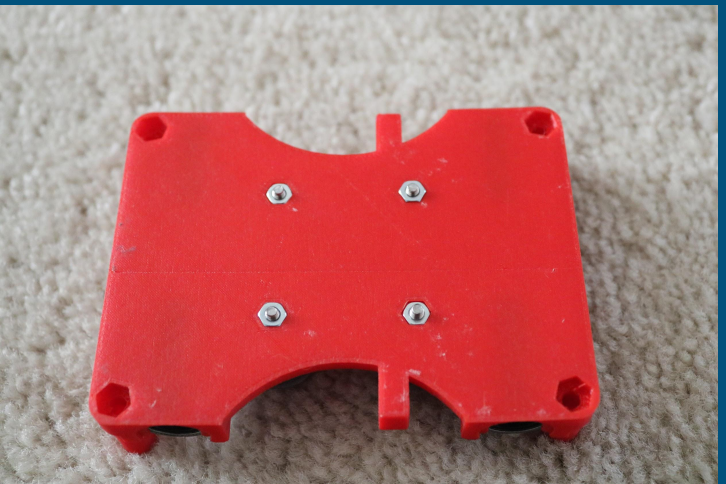
- Now you want to push the LM8UU bearings into their place on the top and bottom clamshell
  - The top and bottom clamshell take **(4)** bearings each
- Take **(4)** 624zz bearings and push them through the 3D printed idler pulleys. Leave the 5th bearing for later when you assemble the Y-axis



Assemble the X-Axis (Carriage)

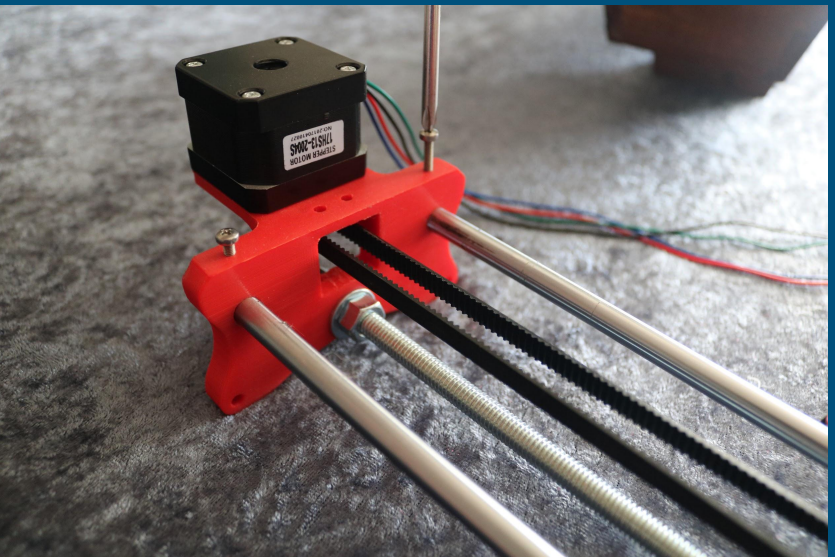
- Get **(4)** M3-0.5 x 20mm screws, **(4)** M3 nuts, **(4)** M3 washers and **(4)** 624zz bearings with the idler pulleys installed
- Take one screw and feed a washer through it, the washer will rest on the bearing. The nut will be at the bottom of the carriage, which will secure the bearing in place

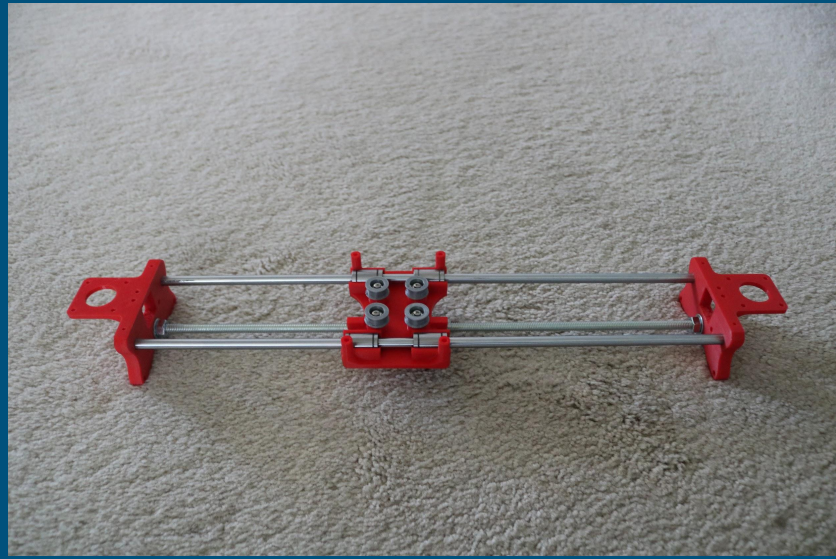

MADE IN USA



Assemble the X-Axis (X-Support)

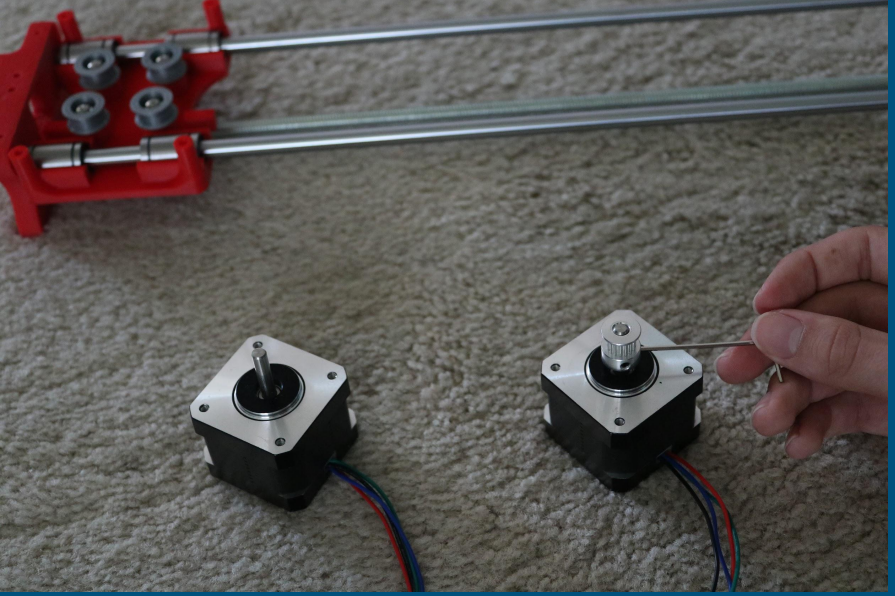
- Slide the clamshell through the 450mm linear rods
- Use a rubber mallet again to attach the last X-support on the linear rods
  - Make sure that the rods stick out equally on both sides
  - Slide the other end of the threaded rod through the hole on the X-support
- Put on the last set of nuts and washers to hold the X-support in place
- Now that the X-axis is complete, you can use **(2)** Phillips M3-0.5 x 16mm screws per X-support to help keep the linear rods from sliding





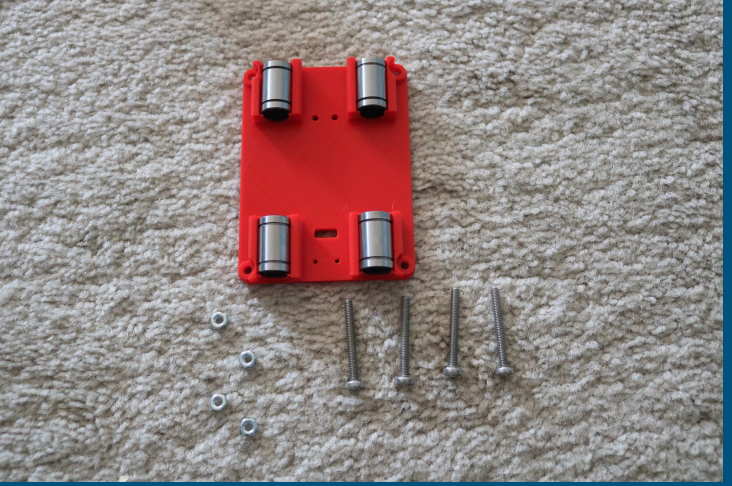
Assemble the X-Axis (Stepper Motors)

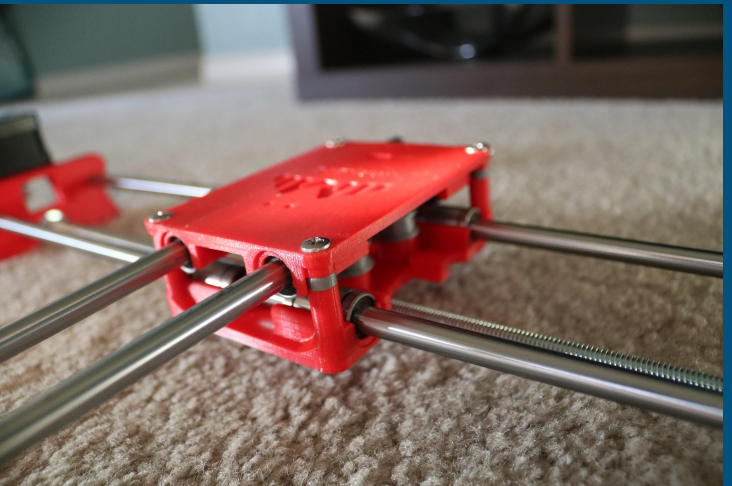
- Use an appropriate size allen wrench to attach the 16 teeth pulleys on the stepper motor shafts
- Flipping the entire robot around will make it easier to attach the stepper motors
- Use **(8)** M3-0.5 x 6mm screws and a screwdriver to attach the **(2)** stepper motors



Assemble the Y-Axis (Clamshell)

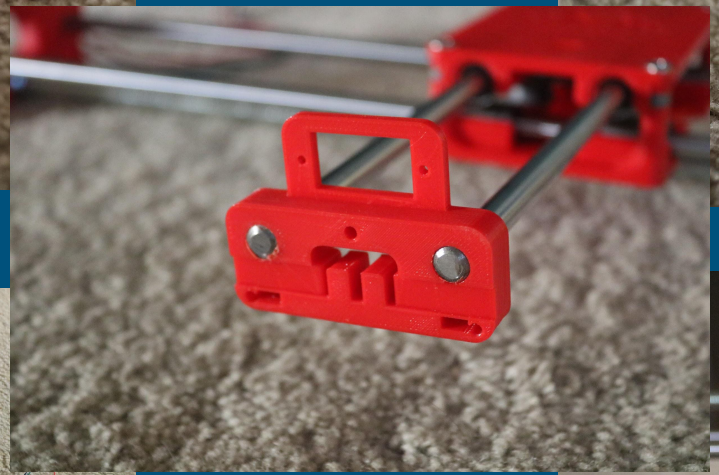
- Grab **(4)** M4-0.5 x 35mm screws and **(4)** M4 nuts
- Make sure that you have the idler pulleys and the washers printed: Link
- Screw the top and bottom clamshells together

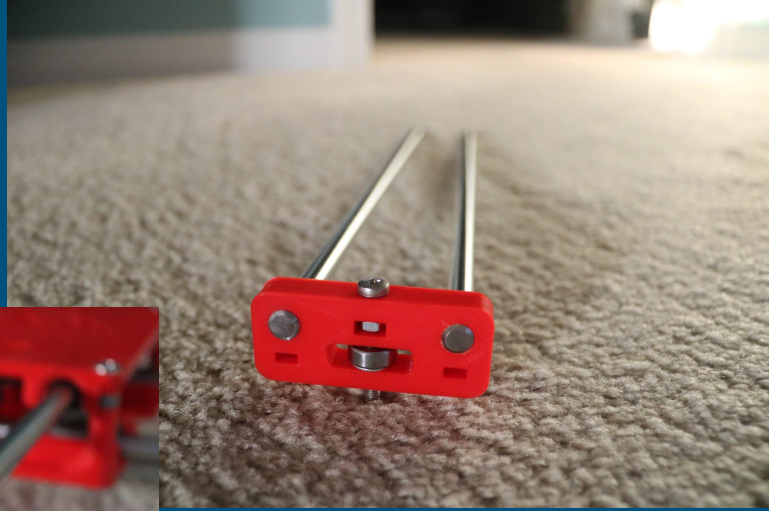


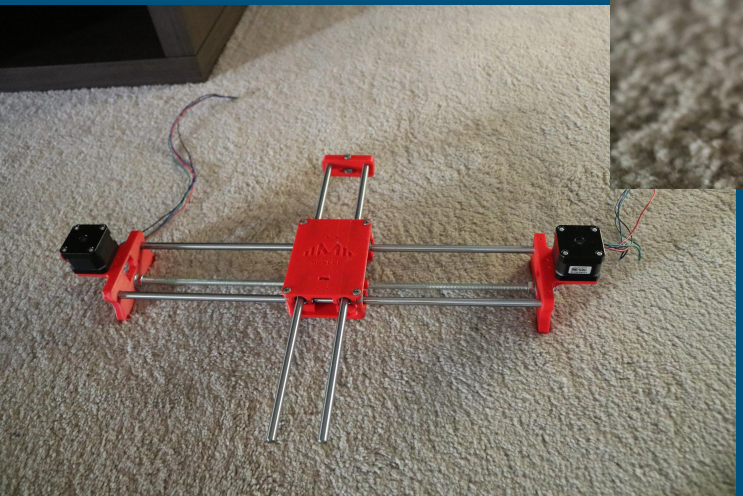


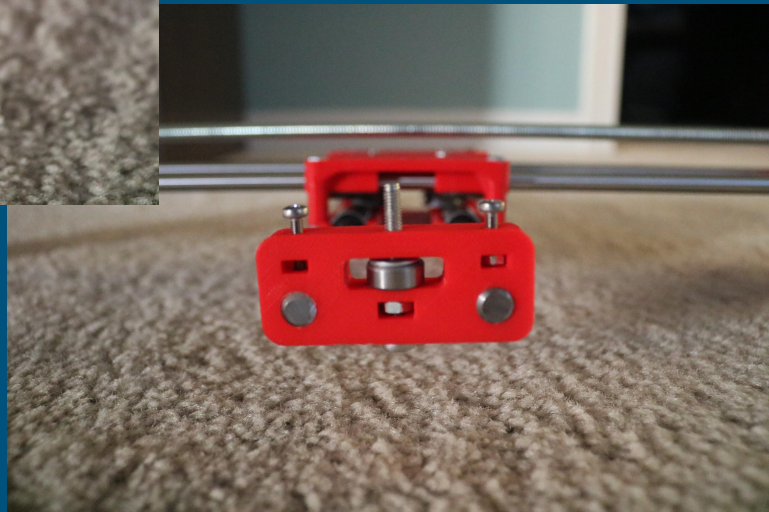
Assemble the Y-Axis (Y-Back/Front)

- Y-Back:
  - Take the **(2)** 350mm linear rods and insert them the Y-back piece by using a rubber mallet
  - Get **(1)** M4-0.5 x 35 screw, **(1)** M4 nut and the 5th 624zz bearing
  - Get **(2)** M3-0.5 x 16 screws to secure the linear rods
  - Slide in the bearing when inserting the screw through the Y-back piece
- Y-Front:
  - Slide the the linear rods/Y-back piece through the LM8UU bearings and attach the Y-front piece using a rubber mallet





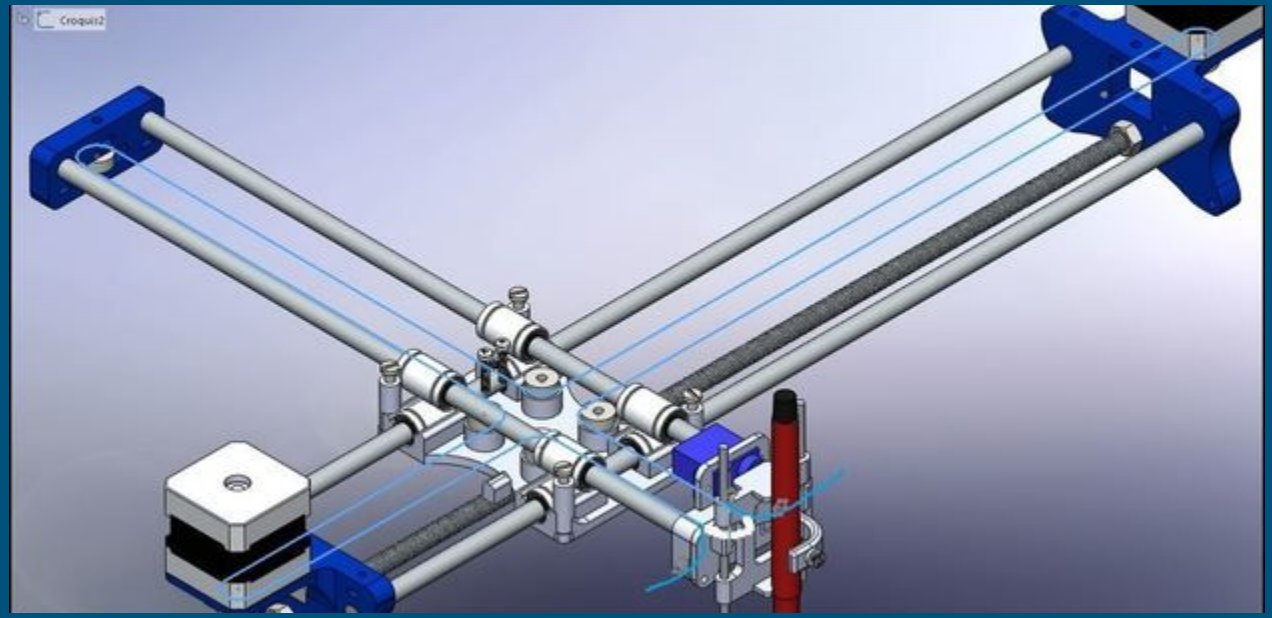


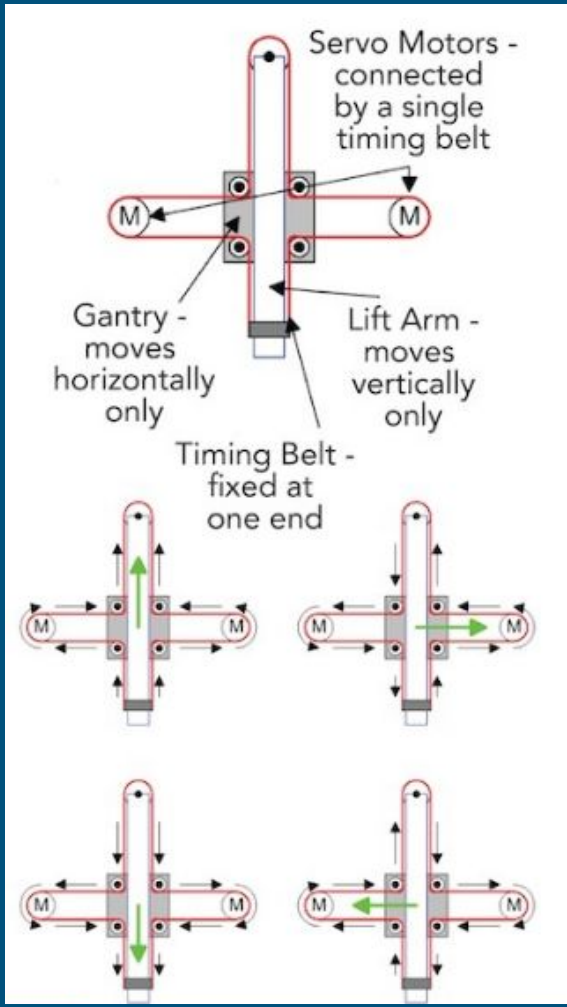


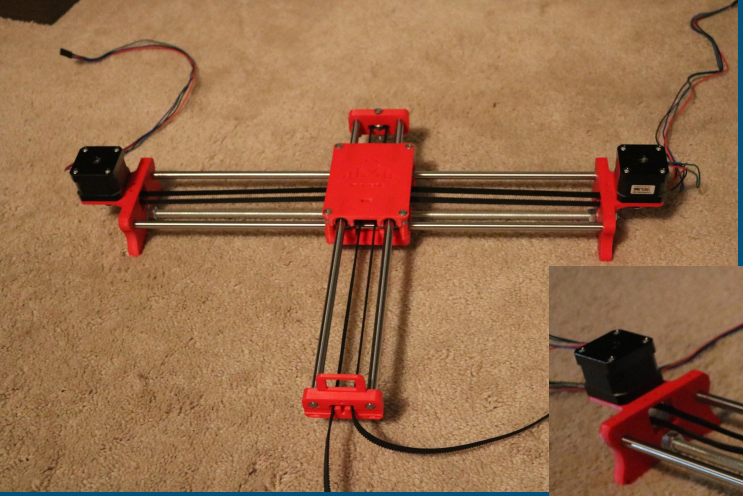
Assemble the X-Y Axis (Belt)

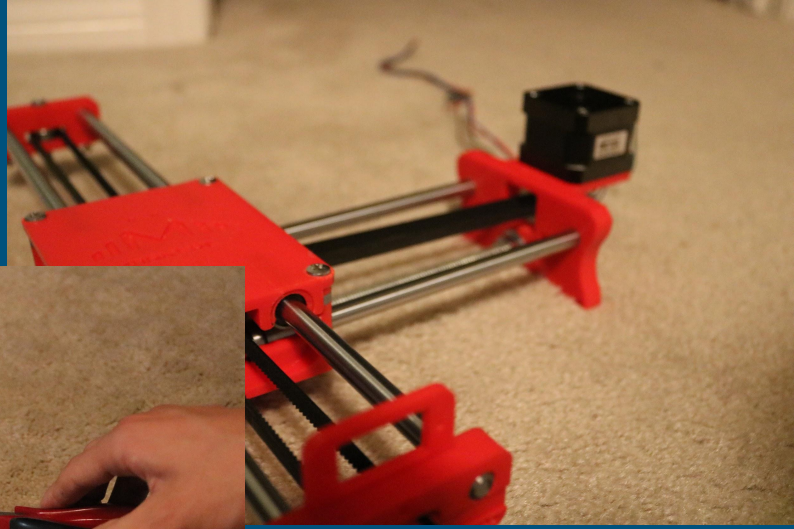
- Use a pair of needlenose pliers to help guide the GT2 belt more easily belt though the clamshell
- Take the two ends of the belt and slide them through the “teeth” on the Base Slider
- Note that once the GT2 belt is on, it is normal for the clamshell not to move easily

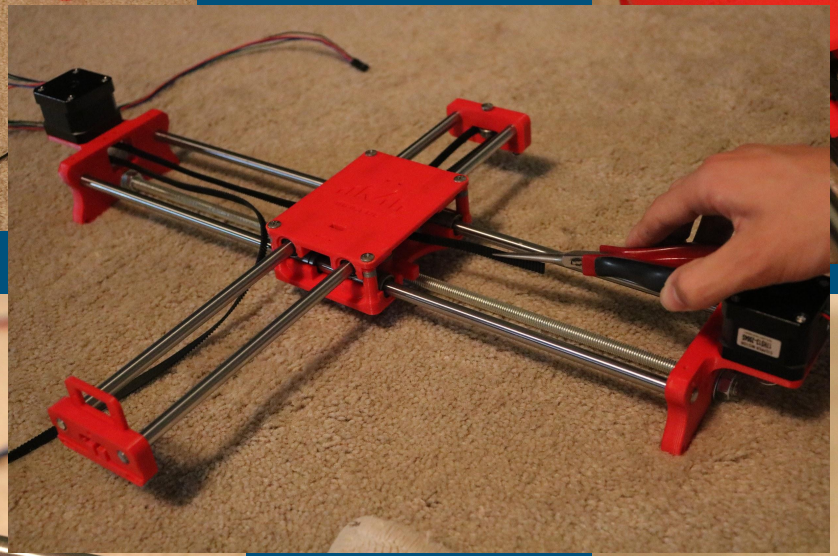
Diagram

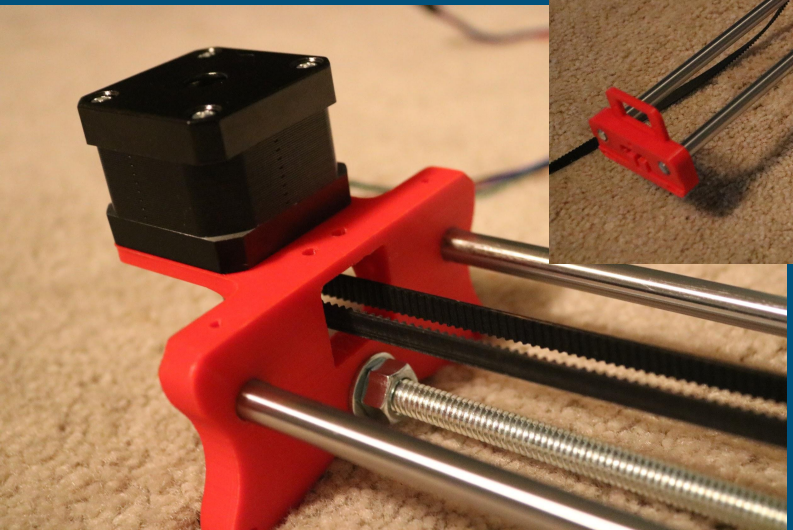



Servo Motors - connected by a single timing belt
M
M
Gantry - moves horizontally only
Lift Arm - moves vertically only
Timing Belt - fixed at one end
M
M
M
M
M
M
M
M



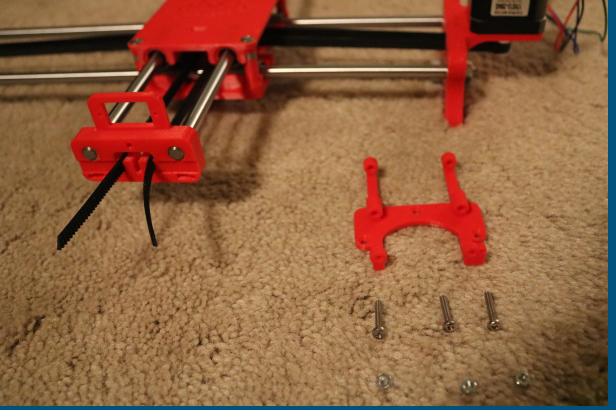


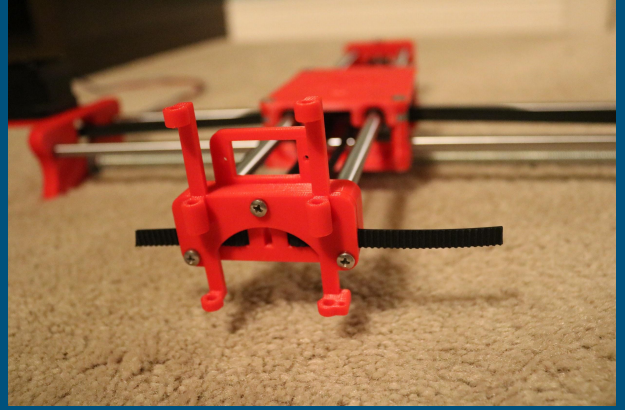


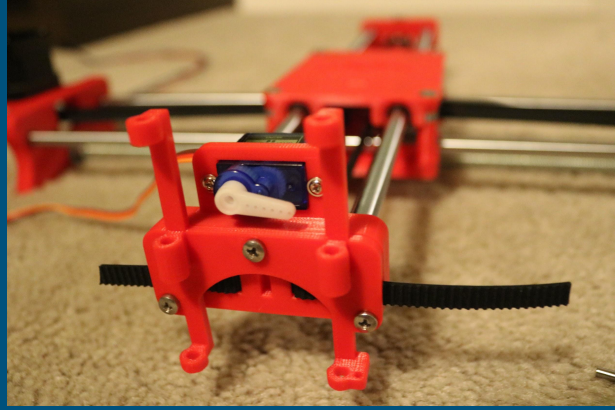


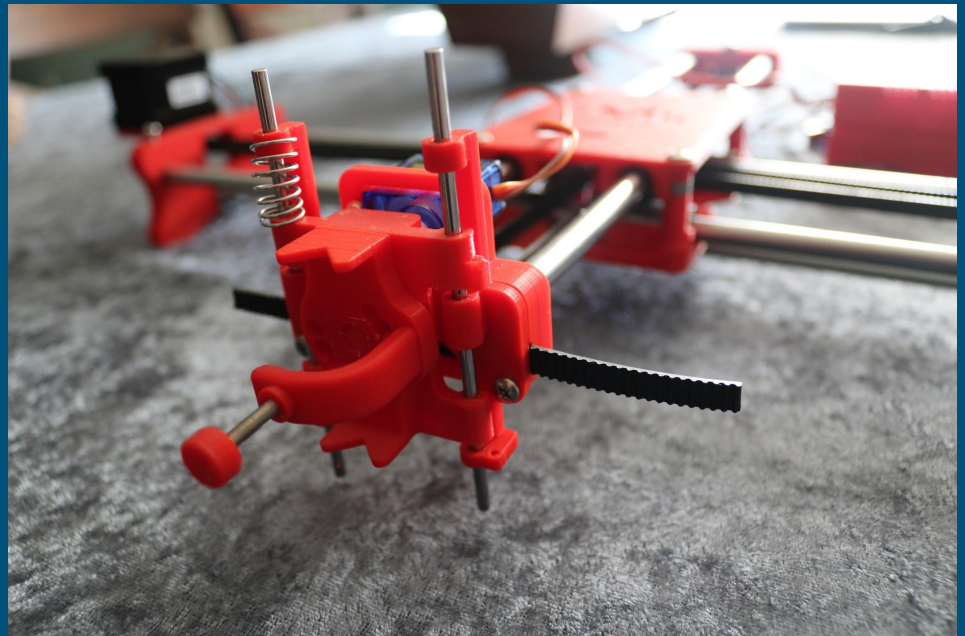
Assemble the Drawing Mechanism

- Get **(2)** 3mm linear rods and the 3D printed parts including:
  - Slider
  - Pen Holder
  - Base Slide
  - 3MM Metric Thumb Screw
- Get **(1)** Hex M3-0.5 x 20mm screw and the Metric Thumb Screw and push them together
- Get **(3)** M3-0.5 x 16mm screws which you will use the secure the Base Slide to the Y-Front part. You may need to use **(3)** M3-0.5 nuts in order to hold it in place
- Push the Slider and Pen Holder together to make one piece
- Now take that new part and the **(2)** 3mm linear rods and slide the rods through the holes. Place a small spring in between the two parts so there is a little bit of pressure to lift the Slider



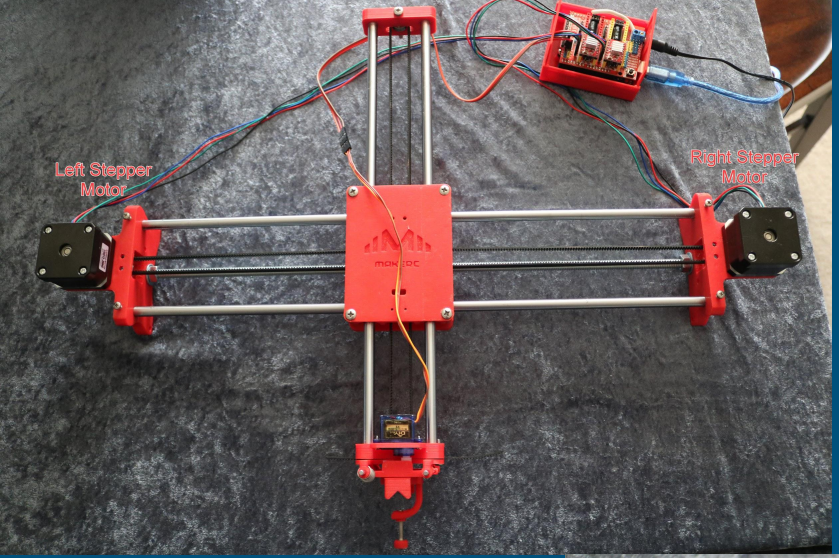


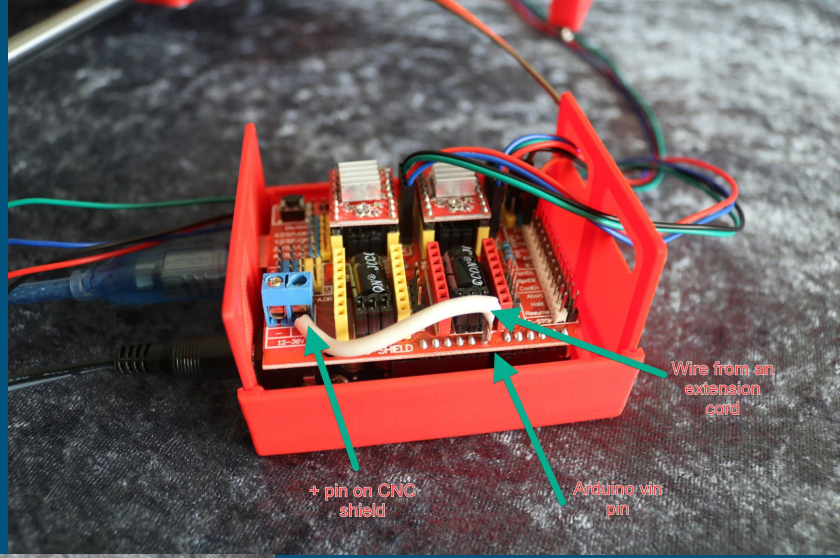


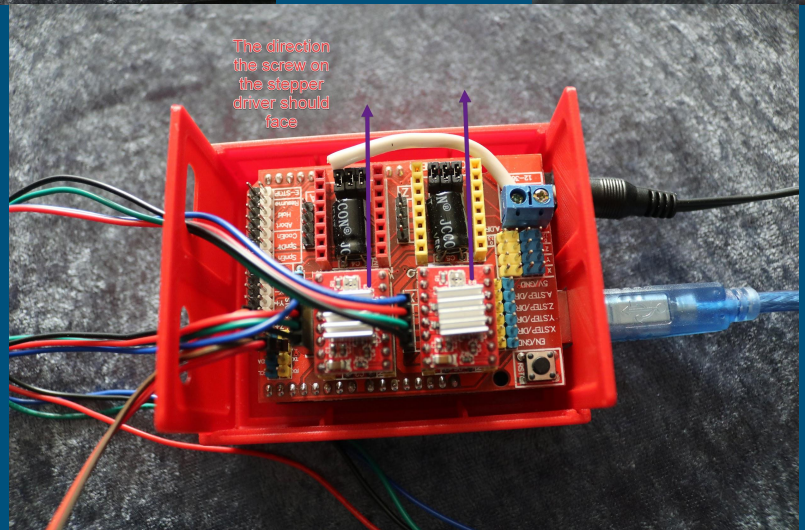


Connecting the CNC Shield

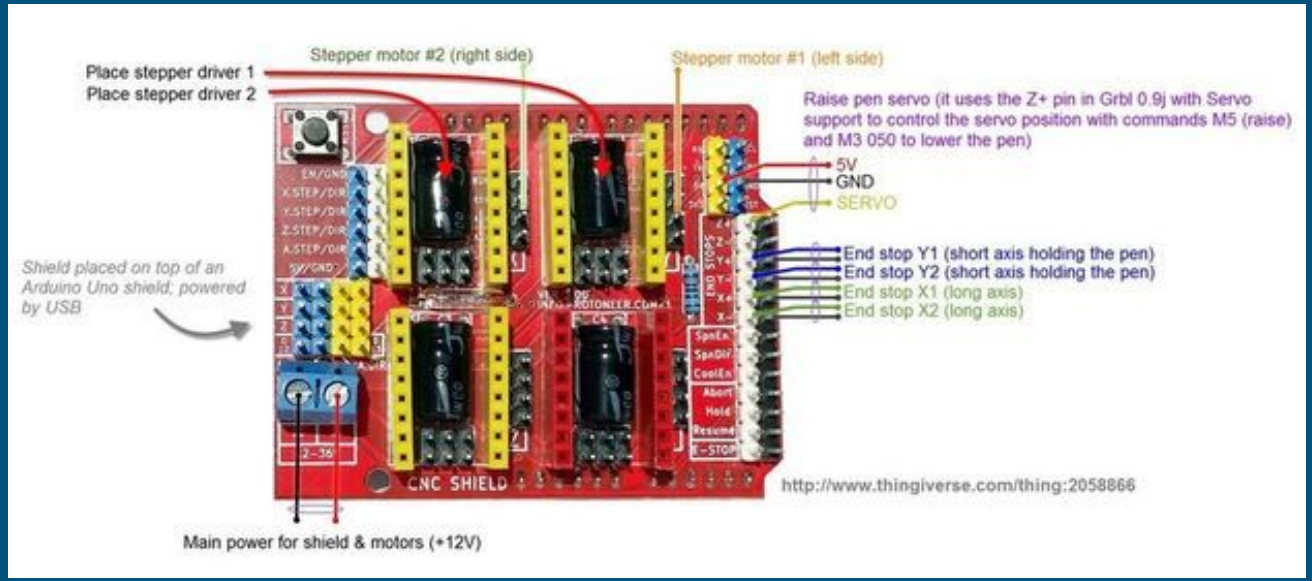
- There one of two ways to power the CNC shield:
  - Solder an 18 gauge wire that connects the arduino vin pin and the + pin on the CNC shield. Then use the power supply and plug it into the power socket on the arduino
  - ---------- or ----------
  - Connect the adaptor that comes with the power supply and run a Power and GND wire to the + and - pin on the CNC shield
- Install 3 jumpers on the CNC shield for each stepper driver
- Connect Stepper Drivers:
  - Connect the stepper driver with the screw facing away from the pushbutton as seen in the photos.Once they are plugged in you can test if they work by moving the robot around using the Rabbit GCode Sender. If your robot moves very slowly or does not move at all, double check all your wiring or use a small screwdriver and adjust the screw on the stepper driver. Note: you may or may not need to adjust the screw but if you do, adjust it ***very*** slightly
- Wire the servo:
  - Connect the Brown wire to the GND pin on the shield
  - Connect the Red wire to the 5V pin on the shield
  - Connect the Orange wire to the Z+ pin on the shield
- Connect the stepper motors:
  - The blue wire on the stepper motors should be positioned closest to the x/y letter on the CNC shield
  - The left stepper motor is connected to the Y pins on the shield and the right stepper motor connects to the X pins


Left Stepper Motor
Right Stepper Motor

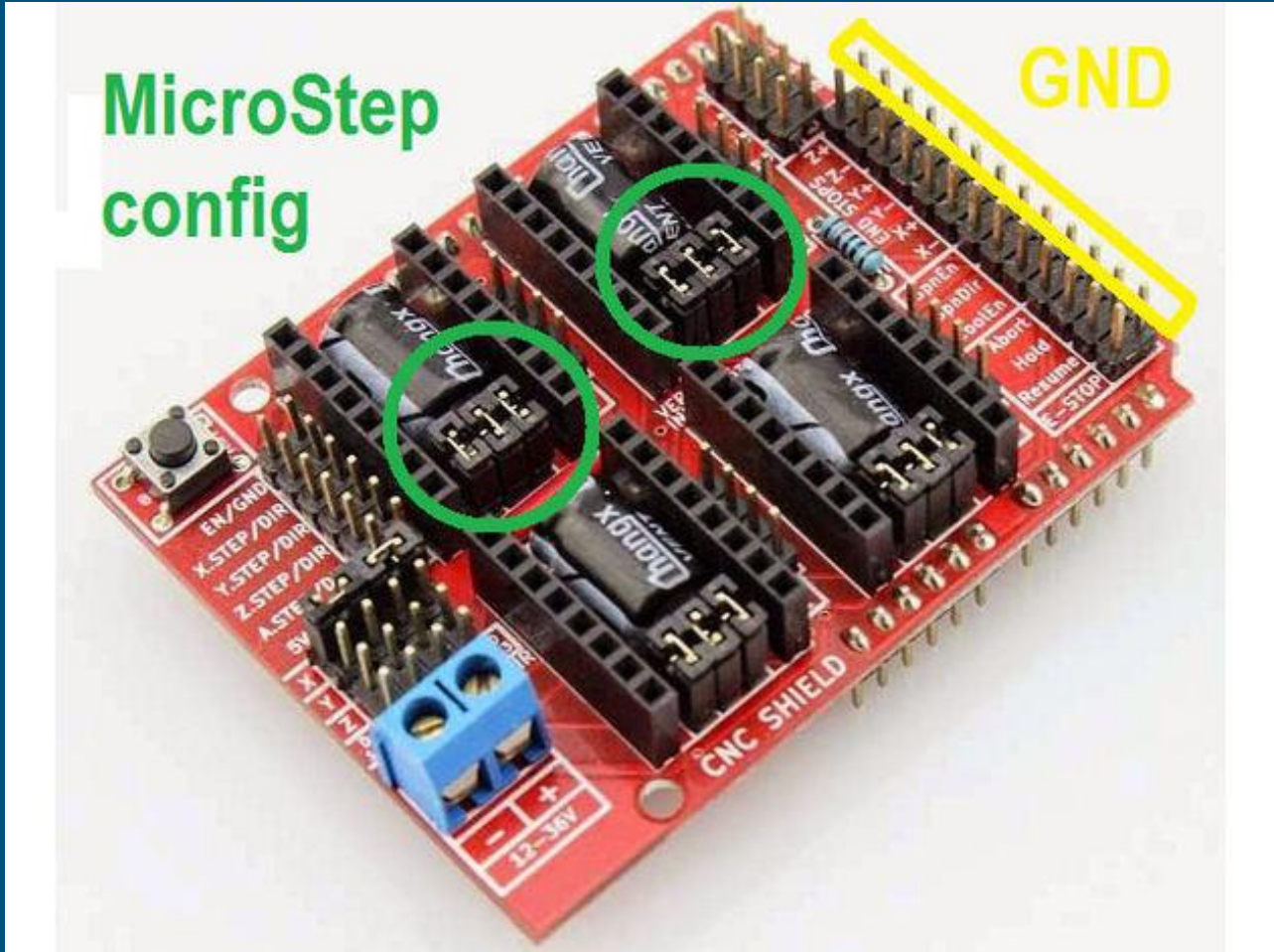

Wire from an extension cord
+ pin on CNC shield
Arduino vin pin


The direction the screw on the stepper driver should face

Wiring Diagram



Stepper Driver Setup



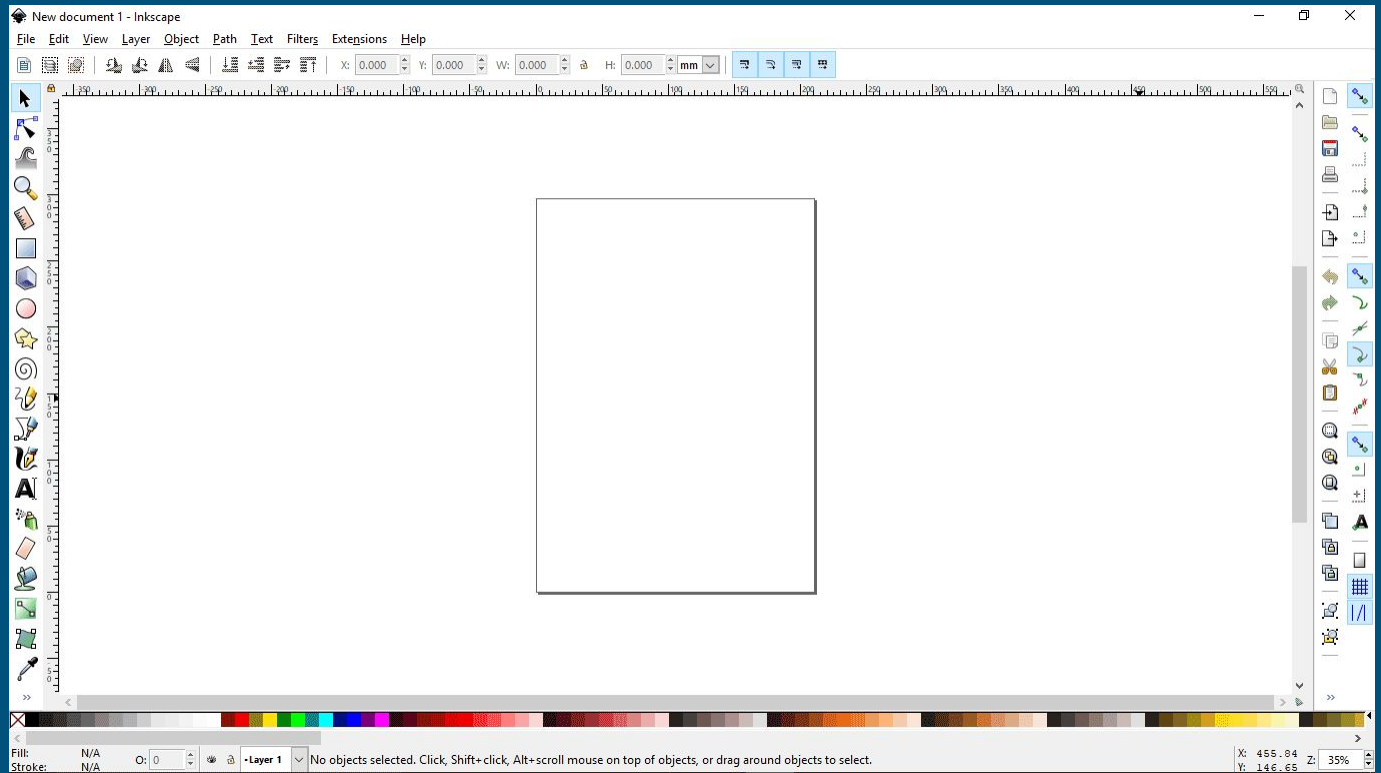
Install GRBL onto Arduino

- GRBL first needs to be installed on your Arduino Uno in order for you to send Gcode files with the Rabbit Gcode Sender
- Download the GRBL firmware here: Link
- You can follow the guide on how to install GRBL here: Link
    - Before compiling the arduino sketch, locate the config.h file and replace it with the new one from the thing download

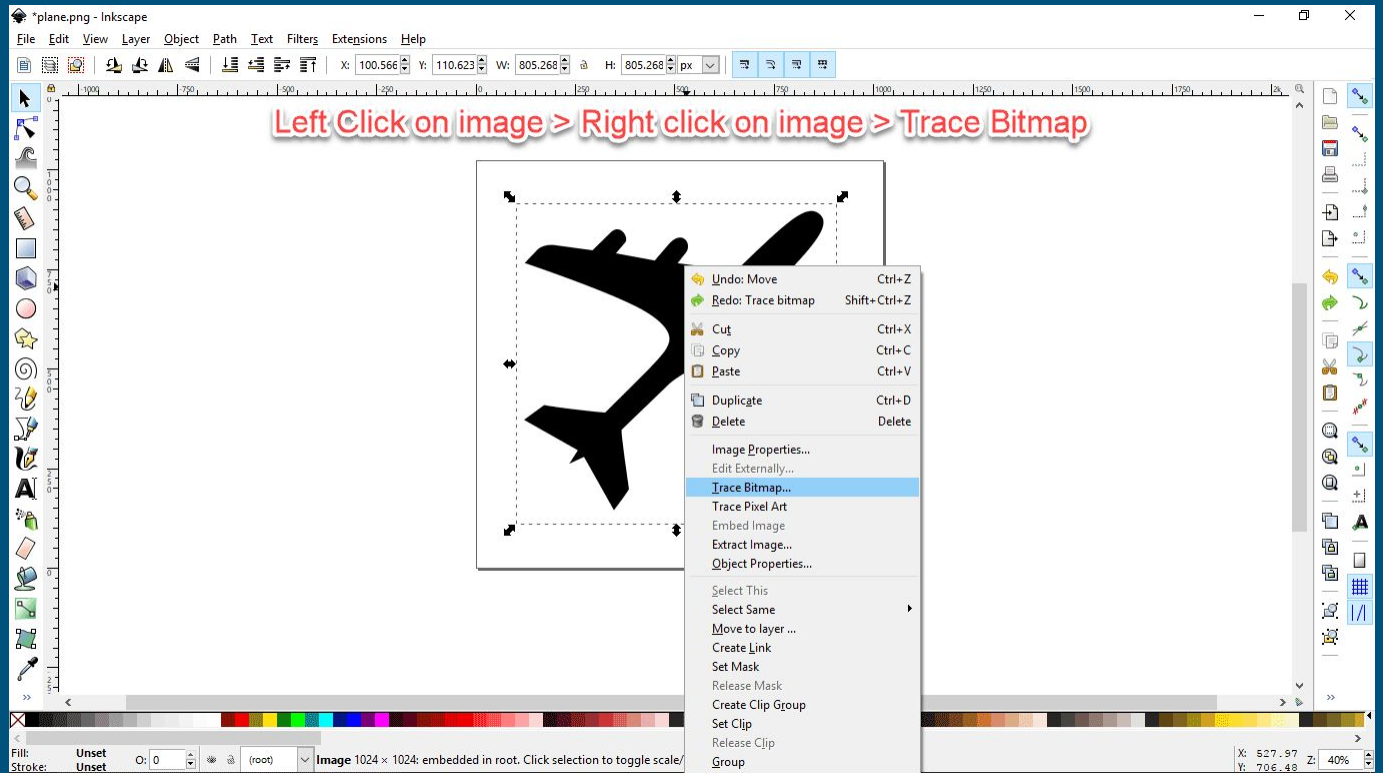
Inkscape

- Download the latest version of inkscape for your computer here: Link
- I will run you through the steps on how to generate Gcode files using Inkscape:

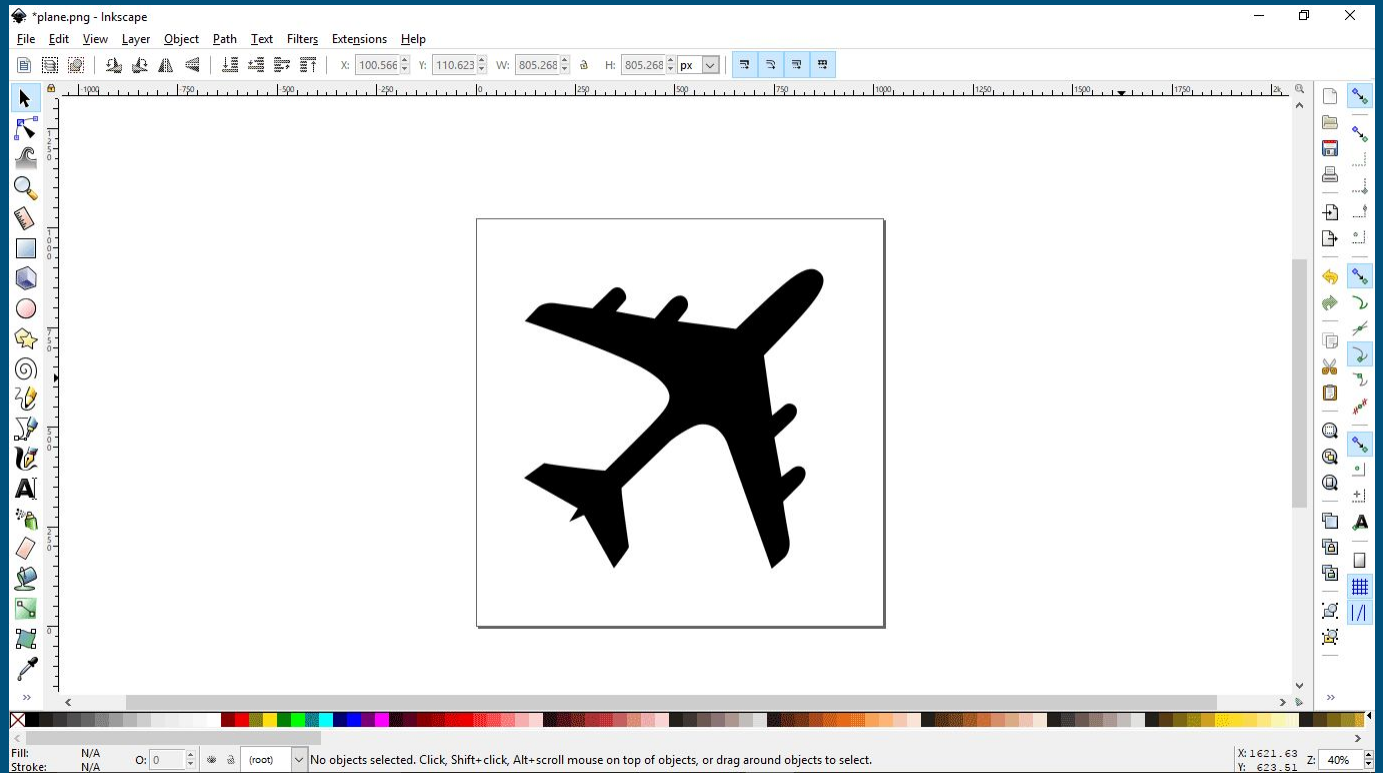
Step 1 (Import Image)



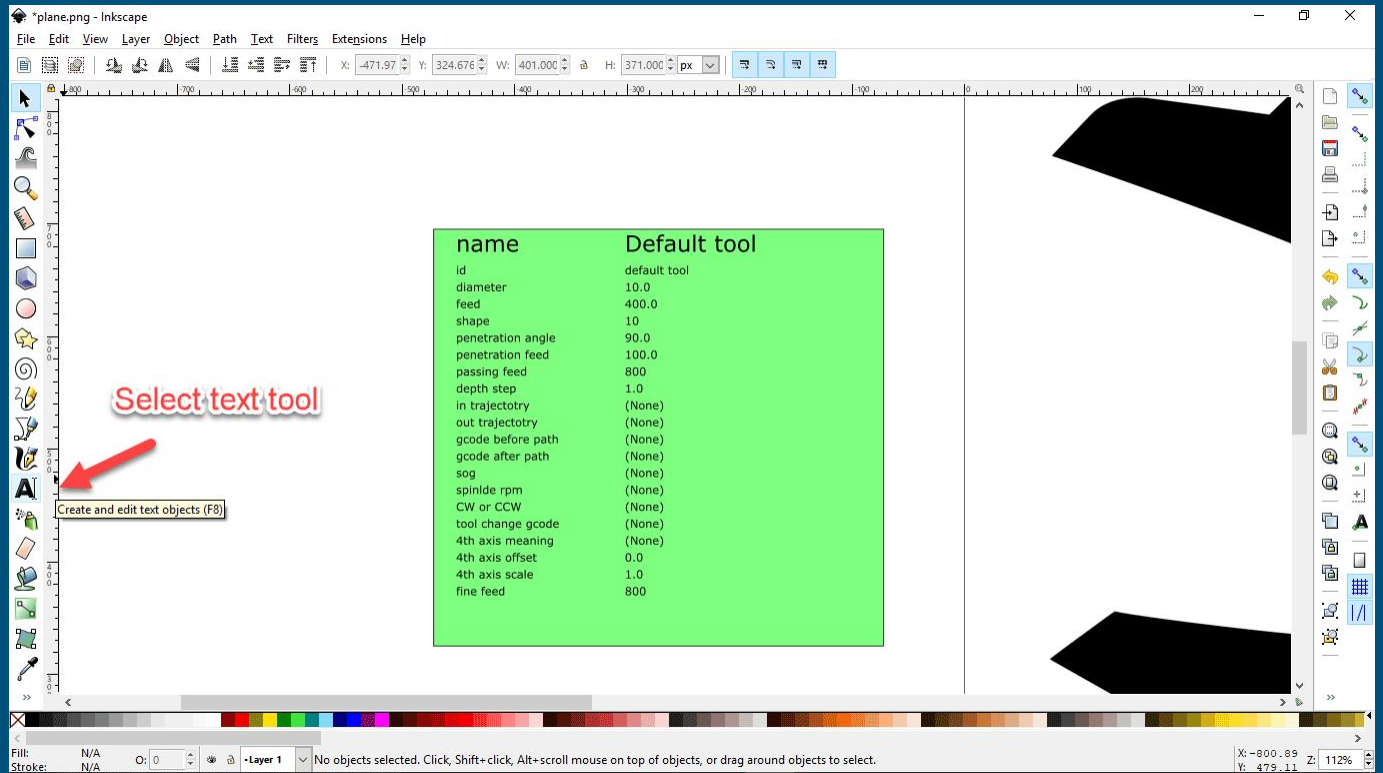
Step 2 (Create path from Image)



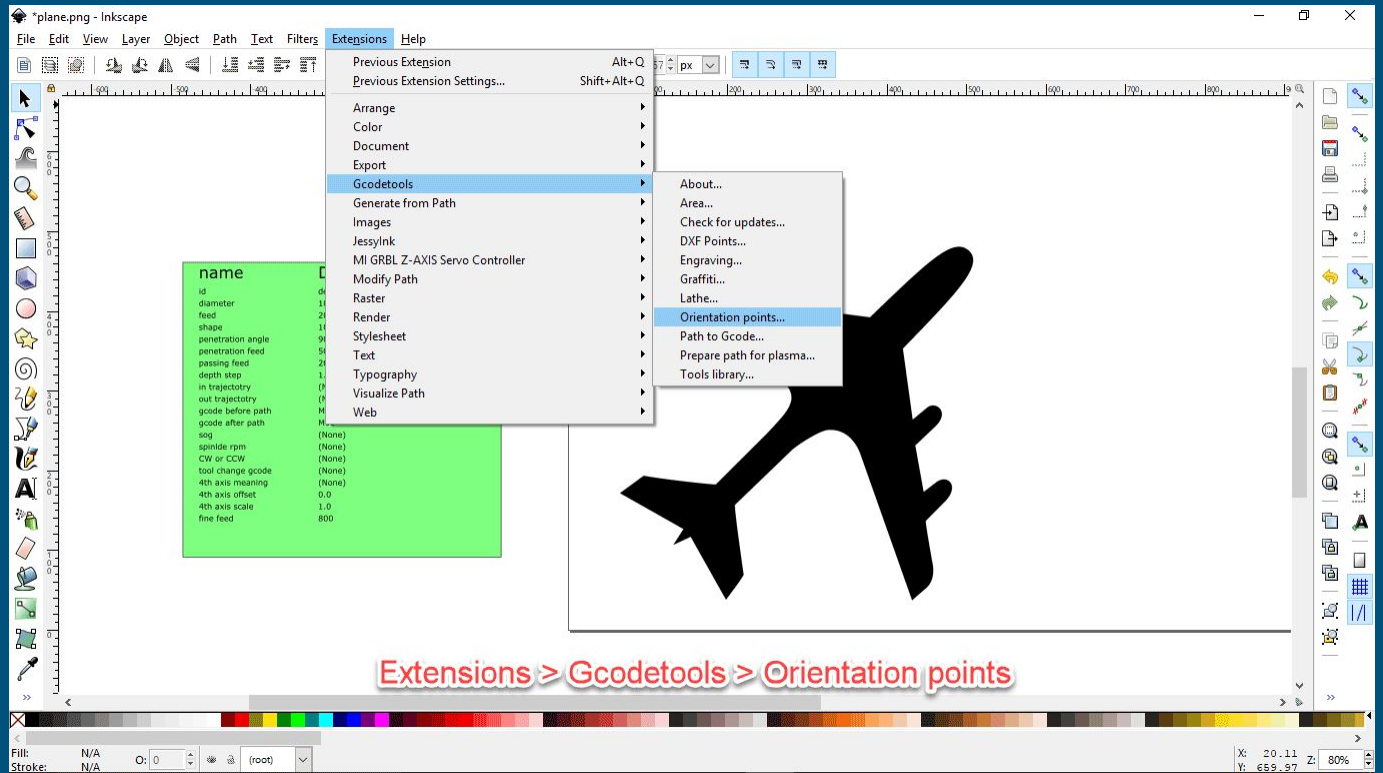
Step 3 (Open Tool Library)



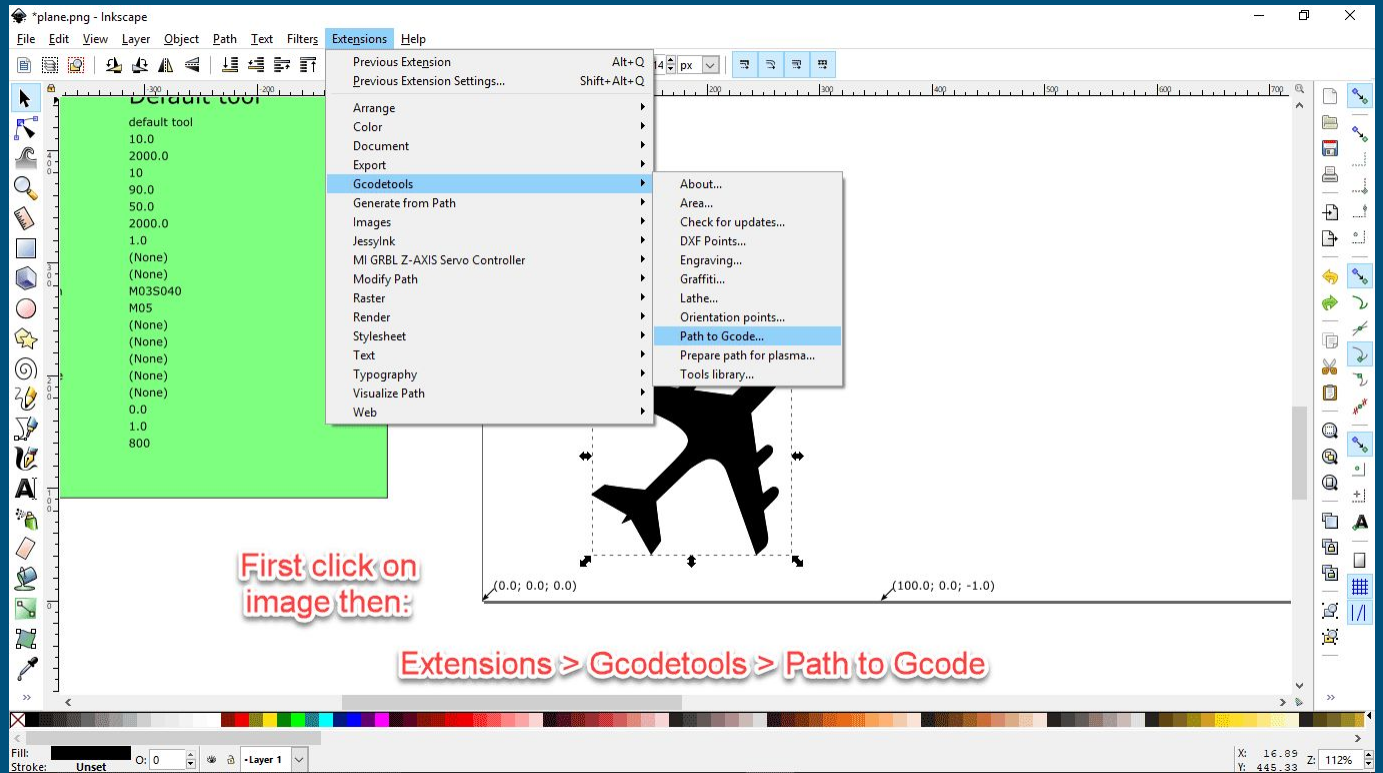
Step 4 (Input values in Tool Library)



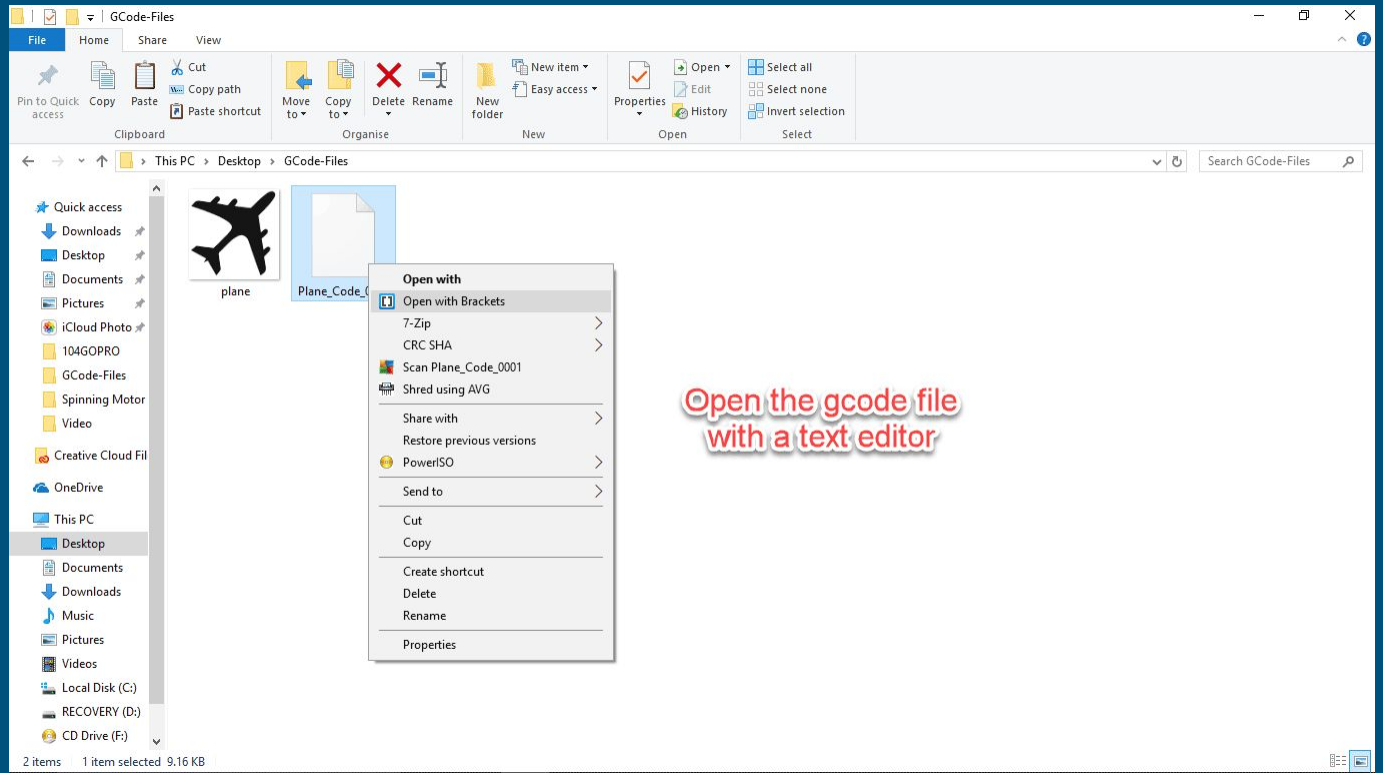
Step 5 (Create Orientation Points)



Step 6 (Export Gcode)



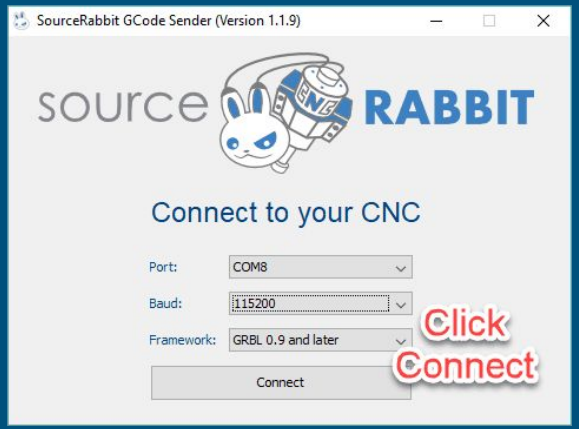
Step 7 (Check GCode)



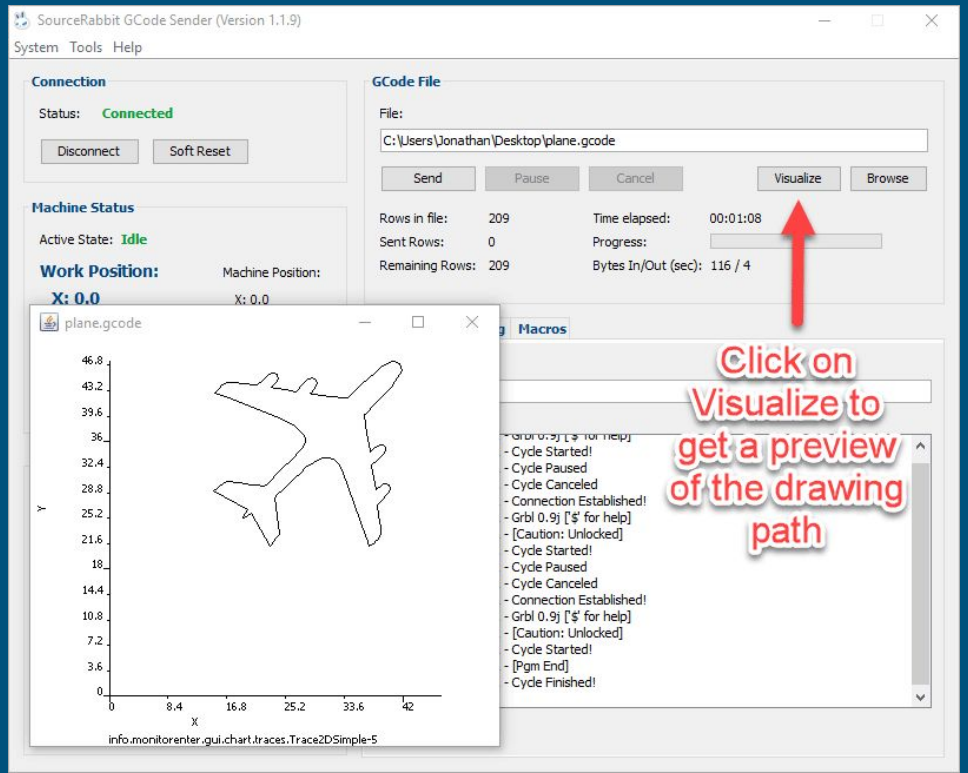
Rabbit G-Code Sender

- Download the latest version of the Rabbit GCode Sender for your computer here: Link
- I will show you how simple it is to send GCode commands to your drawing robot:
- First begin by plugging in the power supply, and then connecting the usb port on the arduino to your computer

Getting Started



Functions


SourceRabbit GCode Sender (Version 1.1.9)
System Tools Help
Connection
Status: Connected
Disconnect
Soft Reset
Machine Status
Active State: Idle
Work Position:
X: 0.0
Machine Position:
X: 0.0
GCode File
File:
C:\Users\Jonathan\Desktop\plane.gcode
Send
Pause
Cancel
Visualize
Browse
Rows in file: 209
Sent Rows: 0
Remaining Rows: 209
Time elapsed: 00:01:08
Progress:
Bytes In/Out (sec): 116 / 4
Macros
plane.gcode
46.8
43.2
39.6
36
32.4
28.8
25.2
21.6
18
14.4
10.8
7.2
3.6
0
0
8.4
16.8
25.2
33.6
42
X
Y
info.monitorenter.gui.chart.traces.Trace2DSimple-5
- Cycle Started!
- Cycle Paused
- Cycle Canceled
- Connection Established!
- Grbl 0.9j ['$' for help]
- [Caution: Unlocked]
- Cycle Started!
- Cycle Paused
- Cycle Canceled
- Connection Established!
- Grbl 0.9j ['$' for help]
- [Caution: Unlocked]
- Cycle Started!
- [Pgm End]
- Cycle Finished!
Click on Visualize to get a preview of the drawing path

Test your Robot

1. Plug in the power supply
2. Plug in the USB cord into your computer connecting your arduino
3. Launch the Rabbit GCode Sender and browse for your gcode file
4. Test your robot with one of the sample codes:
    a. Link

Contact

- Contact me through my Thingiverse account: Link if something was missing or needs to be changed in this instruction manual. Feel free to ask me to add more photos to the instructions or to clarify anything.