# Project Overview:

This project aims to create an automated and interactive drawing robot that can produce highly precise artworks and designs through a combination of hardware and software components. significant progress has been made in terms of 3D printed components, equipment acquisition, support removal, and software setup.
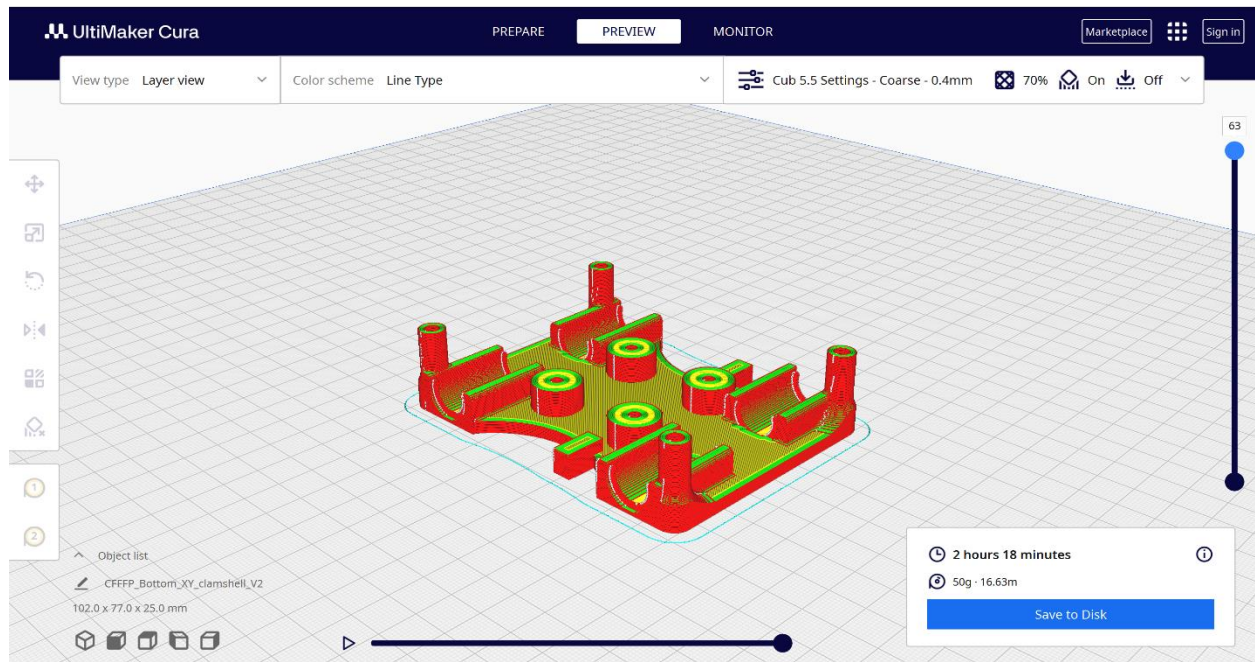
3D Printed Objects:

Designed and successfully 3D printed key components, such as the drawing arm, carriage, using PLA filament.
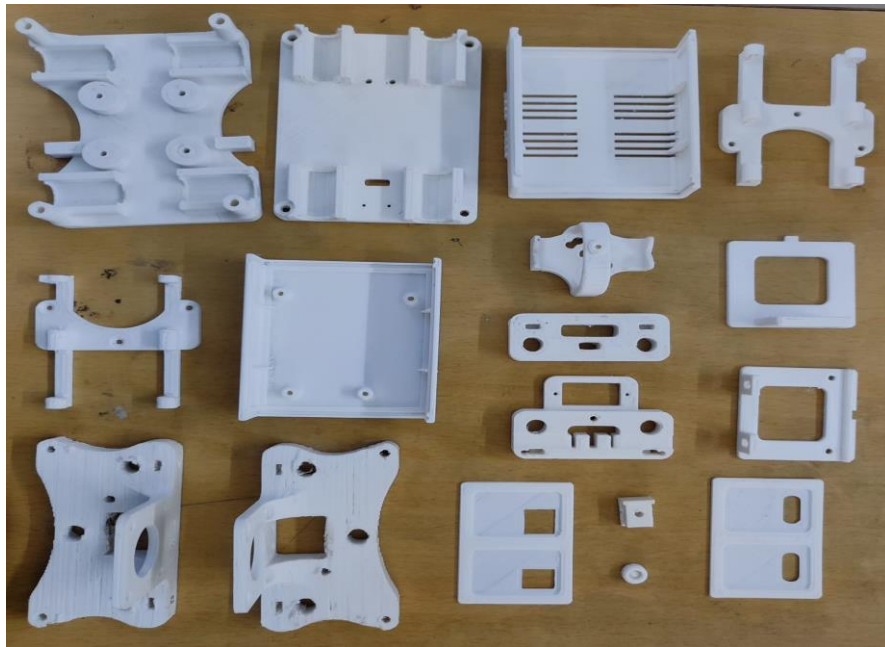
UltiMaker Cura:

We utilized Ultimaker Cura to slice our object designs into G-codes, which serve as a precise set of instructions for the 3D printer to create the objects."

Here is an image of the G-code obtained by slicing the above object:

```
1   T0
2   M140 S75
3   M105
4   M190 S75
5   M104 S210
6   M105
7   M109 S210
8   G28 ;Home
9   G1 Z15.0 F6000 ;Move the platform down 15mm
10  G1 F200 E3
11  ;Prime the extruder
12  G92 E0
13  G1 F1500 E-6.5
14  M107
15  G1 F600 Z2.1 ;adjusted by z offset
16  G92 Z1.8 ;consider this the original z before offset
17  G0 F2400 X222.519 Y234.97 Z1.8
18  ;TYPE:SKIRT
19  G1 F600 Z0.3
20  G1 F1500 E0
21  G1 X223.302 Y234.3 E0.04627
22  G1 X223.721 Y233.994 E0.06957
23  G1 X224.474 Y233.513 E0.10969
24  G1 X225.009 Y233.224 E0.13699
25  G1 X225.825 Y232.885 E0.17667
26  G1 X226.312 Y232.727 E0.19966
27  G1 X227.167 Y232.506 E0.23931
28  G1 X227.931 Y232.366 E0.27418
29  G1 X229.15 Y232.304 E0.32899
30  G1 X250.357 Y232.3 E1.28121
```

❑ **Software Setup and Image-to-G-Code Implementation:**

❑ We installed several open-source software such as GRBL, Inkscape, Inkscape GRBL Extension, Universal G Code Sender to support the project's functionality.

❑ We configured Inkscape with the GRBL extension to facilitate image to G-Code conversion. We also set up Universal G-code Sender for smooth communication with the Drawbot.
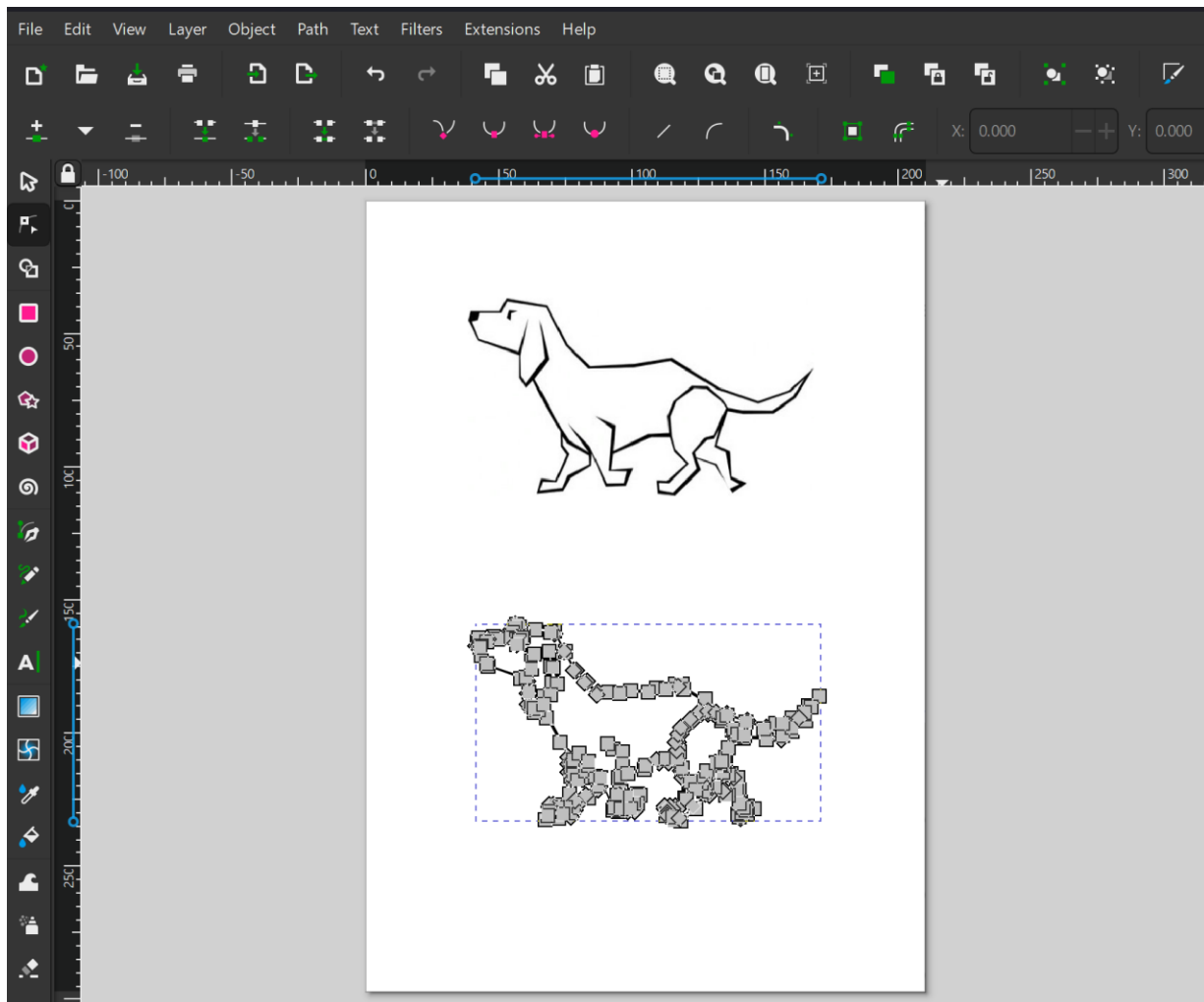

Fig.1 : Image showing conversion of a drawing of a dog to its bitmap using stroke tracing in Inkscape.

```
 2   (Generated by gcodetools from Inkscape.)
 3   (Using default header. To add your own header create file "header" in the output dir.)
 4   M3
 5   (Header end.)
 6   G21 (All units in mm)
 7
 8   (Start cutting path id: path1)
 9   (Change tool to Cone cutter)
10
11   G00 Z5.000000
12   G00 X115.996700 Y64.118970
13
14   G01 Z-1.000000 F100.0(Penetrate)
15   G02 X113.412523 Y64.969389 Z-1.000000 I0.747945 J6.624278 F400.000000
16   G02 X112.729070 Y66.004730 Z-1.000000 I0.692903 J1.200654
17   G02 X112.595705 Y67.400212 Z-1.000000 I28.613181 J3.438644
18   G02 X112.559410 Y68.390320 Z-1.000000 I14.403266 J1.023713
19   G01 X112.557410 Y69.382510 Z-1.000000
20   G01 X114.475640 Y69.392510 Z-1.000000
21   G01 X116.393870 Y69.402510 Z-1.000000
22   G01 X119.744090 Y72.369380 Z-1.000000
23   G03 X123.026906 Y75.385823 Z-1.000000 I-80.535028 J90.941404
24   G03 X123.272670 Y75.733120 Z-1.000000 I-0.763452 J0.800862
25   G03 X123.225497 Y76.084190 Z-1.000000 I-0.306116 J0.137572
26   G03 X121.303580 Y78.121340 Z-1.000000 I-16.187214 J-13.346396
27   G01 X119.156140 Y80.112690 Z-1.000000
28   G01 X118.281430 Y82.883840 Z-1.000000
29   G01 X117.406720 Y85.654990 Z-1.000000
30   G01 X113.886700 Y85.729090 Z-1.000000
31   G01 X110.366670 Y85.803190 Z-1.000000
32   G01 X104.781310 Y83.373680 Z-1.000000
33   G03 X96.604554 Y79.557198 Z-1.000000 I68.175431 J-156.732388
34   G03 X96.165067 Y79.071520 Z-1.000000 I0.402306 J-0.805728
35   G03 X96.006583 Y78.451178 Z-1.000000 I2.649084 J-1.007200
36   G03 X95.742884 Y76.007600 Z-1.000000 I41.371515 J-5.700626
37   G01 X95.550475 Y73.548040 Z-1.000000
```

Fig 2. Output G-code produced by the Inkscape GRBL G-code Extension for the drawing of the dog in fig 1.

Testing:

We tested the NEMA 17 motors using a multimeter. The DRV8825 drivers we had acquired from the lab were non-functional as its motor output pins – A1, B1, A2, B2 – had zero voltage output as confirmed with a DSO(oscilloscope). We had to look for alternative motor drivers – L293D and L298N.

Finally, we resolved to L298N driver and the NEMA 17 motor draws around 1.5 amps current for operation. The L293D driver failed to provide this much current as it has a upper limit of 1A and operational current supply of 600mA per channel. The L298N driver worked fine with the motor, though the size of the driver is a bit undesirable.

To solve this, we are planning to use the A4988 motor drivers finally, but those are still to come so we couldn't test them yet.

Assembly:

1. Cut the M8 axial rods to the required length, from 50 cm long rods to 35cm for the y-axis and 48 cm for x-axis.
2. Successfully integrated 3D printed parts into the drawbot assembly, enhancing its functionality and customization.
3. Visited the workshop to precisely fit components, ensuring a seamless and accurate assembly process.
4. Made electrical connections – between the Arduino, cnc shield and the motor drivers.
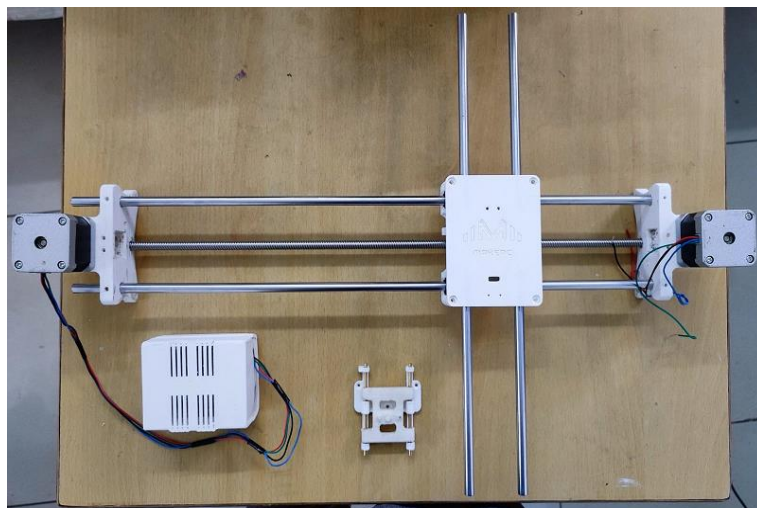
Challenges Faced:

- Compatibility issues emerged between different parts due to Version mismatches in various software components.

- While installing several open-source software packages, we encountered challenges related to specific configuration files that required customization to align with the requirements of our small-scale DrawBot project.

- The motor drivers were overheating after a short duration of time.