Project Outline (Rough):

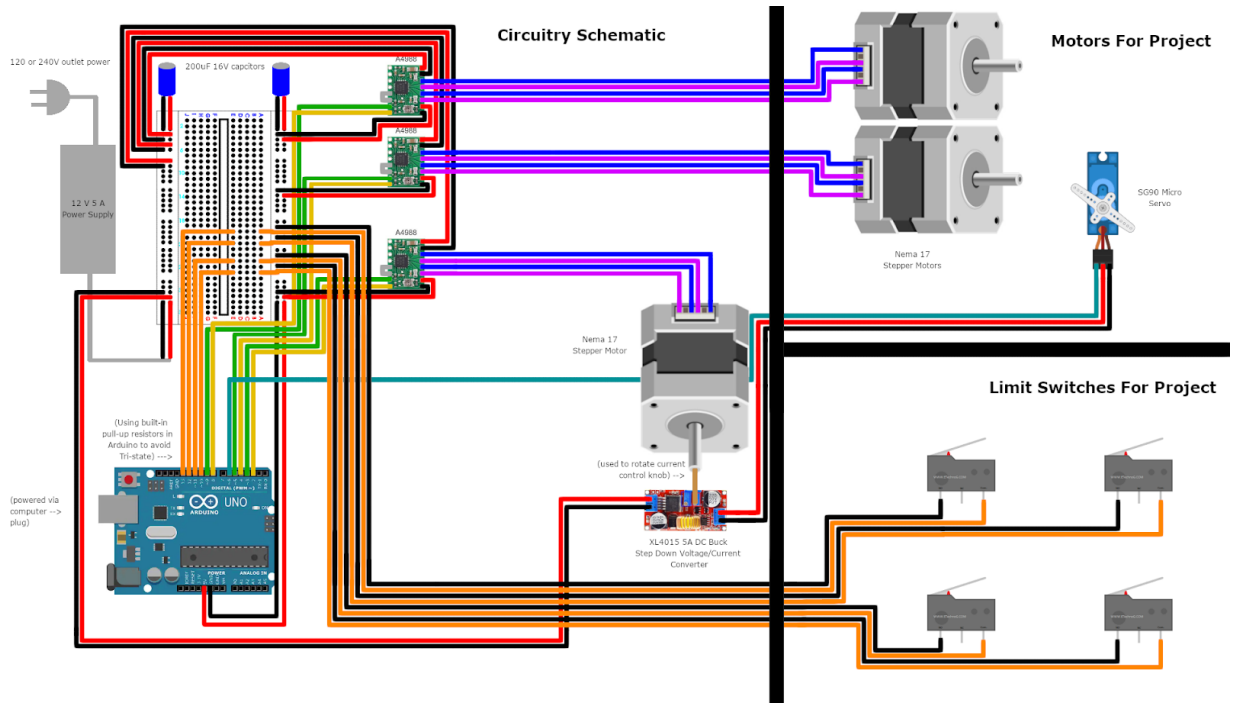
1. Research other peoples arduino printers for inspiration
    - no need to be formal (e.g., notes); just browsing is fine
    - Make a sketch idea (no need to be formal again; just enough of an outline of big parts/ideas so you can fill in the blanks later)
2. Develop Circuitry
    - Determine exactly what motors, micro controllers, power sources, limit switches*, and writing utensils you want to use
        - Probably a usb power source (so you can interface w/ computer) + bic mechanical pencils for consistency and convenience
        - Maybe hook up movement motors and LED motor to separate power sources to prevent voltage variance while moving
    - Wire up electronic components in a circuit simulator
3. Develop Robot body
    - CAD all parts of robot + circuitry and create an assembly
        - Download all premade models (e.g., arduino uno, bic pencils, etc.)
        - Make sure to keep wires in mind
        - Design body to be stable, but also portable (atleast to the extent that it can be disassembled to be brought back to the US)
        - *Design body to be open on the bottom (allows for possible latter modification with carving lasers)
4. Program robot and *run in simulator*
    - Try to get your program to take dxf files (depth can correlate to pressure/opacity)
    - See if you can't find a super simple arduino sim online, otherwise just skip the simulation step
5. Print/Purchase parts and assemble robot in real life

Notes/Comments:

- Parts Lists
    - Anything that is highlighted in light green on your parts list you should ask if dad/mom can bring for you to denmark from home
    - You should try to source stuff locally where it makes sense (will likely be cheaper than what you find on Amazon)

Develop Circuitry:

CIRCUIT SCHEMATIC



ELECTRICAL PARTS LIST

Name	Quant.	Purpose	~ Cost
Nema 17 stepper motors	3	XY actuation of drawing head + current regulator adjustment (purchase quant: 4)	26$
A4988 Stepper Motor Driver Module	3	Controlling Nema 17 stepper motors (purchase quant: 5; must purchase with heatsink; **must calibrate before use**)	10$
MUZHI SPDT 1NO 1NC Micro Limit Switch	4	Homing and limiting xy-stepper motors (purchase quant: 12; CAD)	6.50$
SG90 9g Micro Servo	1	Extruding and retracting pencil led at different pressures (purchase quant: 4)	10$
Arduino uno	1	Controlling Printer System	18$
breadboard	1	Wiring everything temporarily (purchase quant: 3)	7$
DC 12V 5A Power Supply	1	Powering project from wall socket	13$

Adapter			
100 μF Capacitors (V rating > 12 V)	2	Smoothing out current from power supply to motors (purchase quant: bulk variety)	10.50$
Buck Step Down Voltage Converter	1	Controlling current/torque of DC motor (purchase quant: 2)	7$
Wire	~	Wiring all components	16$

Reddit Posts
DC Motor Current Regulator
Circuitry Peer Review: Does this look like it should work?

Develop Robot Body:

LED Choice: 0.7mm colored or black lead (See Colored Lead)

Extruder wheel: unchosen but max diameter = 1 in (lego wheels?)

MECHANICAL PARTS LIST			
Name	**Quant.**	**Purpose**	**~ Cost**
0.7 mm Colored Mechanical Pencil Lead	1	To provide multiple colors of pencil lead for printer	11$
30.4mm x 14mm Lego Wheel	1	To extrude and control lead while drawing	21$
M2 M3 M4 assorted nuts and bolts	1	For attaching parts and creating rotational joints	20$
M3x6mm Bolts	~	For attaching linear rails to makerbeams	9$
< 23.80mm lego technic axle	1	To provide a axle and alignment aid for construction of extruder wheel assembly	N/A
300 mm Linear rails (q.3) and carriages (q.5)	3	To hold the extruder and print bed while moving	63$ + 22$
Nema 17 6mm belt wheels and 6 mm 3D printer belt	~	To allow Nema 17 motors to drive printer belts (belt wheels) and to actuate the extruder and bed along the x and y axis (belt)	15$
Super glue	~	Sticking certain parts in assemblies together	~
M5 bolts + lock nuts	2 each	Providing axle for 2nd belt gear (opposite of motor) in belt setup	~
*machine lube (probably not necessary)	1	Reducing friction on moving parts (e.g., axles)	~
HP P3015 Feed rollers	2	Moving paper back and forth perpendicular to the direction of the extruder	35$
3/16” Nylon Washers	8	To reduce friction between the print rollers and the bearings	14$
0.7 mm drill bit	1	Expanding 3D Printed Lead Holding Tube If Necessary	~

Nema 17 Mounting brackets	2	Mounting Nema motors to printer body (quant. 5)	14$
Makerbeam 100mm	16	General Structure	22$
Makerbeam 600mm	2	Structure (mounting linear rails)	27$
91290A258_Black-Oxide Alloy Steel Socket Head Screw	1	Axle for static belt gear mount	~
94645A102_High-Strength Steel Nylon-Insert Locknut	1	^hold everything on to axle for static belt gear mount	~
57155K469_Stainless Steel Ball Bearing	1	^allows static belt gear to spin	~
Makerbeam Nuts	50	Attaching pieces along makerbeam sides (compare price on makerbeam site (may be cheaper than Amazon))	20$
¾ in wood screws	8 min	Attaching printer structure to wood board (and maybe electronics too)	~

Design to-do

- See if it is possible to make design only using 12 maker cubes (remember you can 3D print supports too)
- Look into moving belt print bed attachment under bed