CNC Plotter / Drawing Machine

1 The function of the project

My intention is to create a device which draws a pre-programmed pattern on paper. The motion of a plotting tool (a pen or a pencil, the intention is to make it universal), will be programmed to move on the plane of a plotting platform (a piece of paper or other flat surface), and will be controlled with a series of stepper motors.

2 How it will work

The device will operate similarly to a standard 3D printer, but instead limited to motion on a single plane. The following features are necessary to make this work:

- A system of **2 stepper motors** will be required to control the position of the plotting tool, or the plotting platform (either or both).

  For the most straightforward Cartesian plotter I can think of, two systems of rails can be used to control the pen's position. This is likely the approach I will take, since this does not require a moving plotting platform, and which will provide fewer limitations on the plotting surface that I want to use.

  For a more interesting polar plotter, a system can be designed with one stepper motor controlling a rotating platform and one stepper motor controlling the distance of the drawing tool from the origin.

- The plotting tool will need to be removed and replaced on the page between strokes. This limited repetitive linear motion can be performed with a **servo motor**. A system will need to be designed for changing its rotational motion into a linear motion for moving the pen. The plotting utensil will be swappable, held in place with a thumb screw.

- The device could include an **LCD display** for information about the current drawing, simple **push-buttons** for stopping the print and calibrating the height of the pen, and a **potentiometer** for controlling the speed of the plotter.

- The device will be given simple GCODE defining the drawing the user wants to create. This will be interpreted by the MSP430 microprocessor as instructions for the stepper motors controlling the motion of the plotting tool and the servo motor controlling whether a line is drawn or not.

An sketch of the device is shown below:
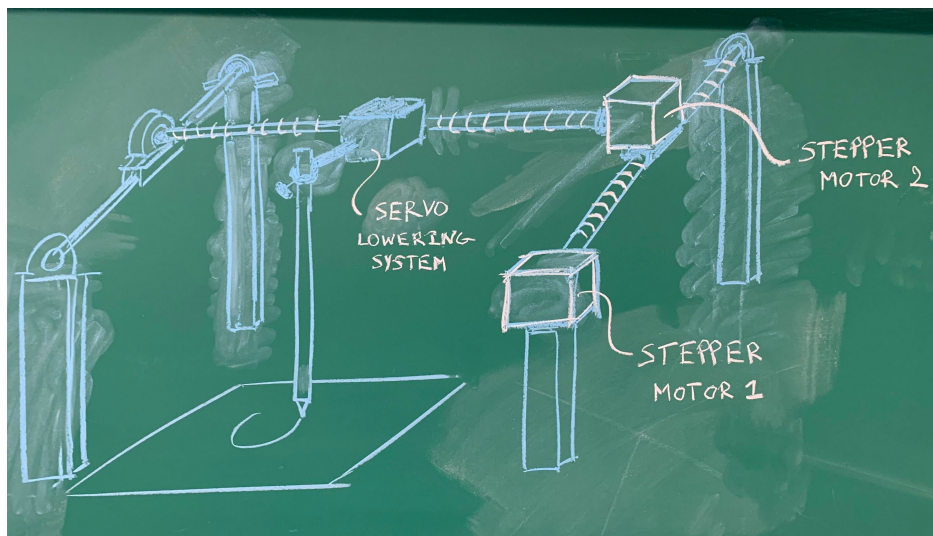
A rough sketch of the plotter.

3   Parts list (and where to get them)

- **Stepper motors**

  2 Stepper motors are needed. These could be available in the lab, and they would be controlled via the UCN58048 stepper motor driver.

  However, if the motors provided in the lab are not usable here, a standard NEMA 17 stepper motor can be pruchased on Amazon. These can be powered by the A4988 stepper driver.

- **Track lead screws, linear shafts, shaft to stepper coupling adaptor, bearing housing**

  Based on the sketch above, two track lead screws will be necessary (one for each servo motor), along with one support shaft. There will be four bearing housings necessary for supporting the rods. All of these can be sourced, along with the appropriate shaft coupling adaptor (the shaft diameter of a NEMA 17 stepper motor is 5 mm), from Amazon

- **Linear servo motor**

  A system could be developed for transferring the rotation of a regular servo into a linear motion, or a linear servo motor could be purchased from here.

- **Custom supports, custom pen clamp ring (custom parts in general)**

  The supports of the device, the attachments and adpators between various components, will need to be custom made. Most of these parts could be either made out of wood or sheet metal, or 3D printed, if access to a 3D printer is available.

- **Other extras**

  The LCD display, the buttons, the potentiometer, and resistors are all available in the lab.