

# l'écran magique

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## ABSTRACT

Lineography is an art form in which the artist does not lift their pen, pencil, paintbrush (or stylus of choice), from the canvas, once placed on it, and only does so, when complete - a single stroke masterpiece. It originated in France in the 17<sup>th</sup> century but fell into disuse by the early 19<sup>th</sup> century. However, it experienced a resurgence with the launch of the Etch A Sketch, which rightfully, was invented by André Cassagnes of France in the late 1950s. He named the toy L'Écran Magique (The Magic Screen).

In 1959, he took the toy to the International Toy Fair in Nuremberg, Germany. The Ohio Art Company initially had no interest in the toy, but eventually decided to take a chance on it and launched the product as the Etch A Sketch in the United States, in time for the 1960 Christmas season, at the peak of the Baby Boom; and the rest is history. It is one of the most memorable toys of the twentieth century and has sold over 100 million units since its launch.

As a result of which, nearly everyone knows Lineography, even if they do not by name; and what better way to honor, what I think is a beautiful art form, and one of the most iconic toys ever made, than to have it embrace this century, by converting it to a CNC machine, and to provide a little glimpse of what the next half-century (or maybe even decade) may hold, by adding a little Generative AI magic to it.

## 1 CNC

The Etch A Sketch was converted to a CNC Machine by connecting a stepper motor to each knob, and wiring the stepper motors to an Arduino. The Arduino was configured to receive instructions from a web server over a serial communication port, and the web server was connected to a web interface over a web socket. The web interface allowed the user to draw lineographic sketches on a canvas and have those exact sketches replicated on the Etch A Sketch. The web interface would send sets of coordinates to the web server over a web socket and the web server would forward those coordinates to the Arduino over a serial communication port. The Arduino would use Bresenham's line algorithm to plot the coordinates it received.

## 2 GENERATIVE AI

Open AI's large language model GPT-3 has been out since 2020, and in early 2021, they unveiled DALL-E which used a 12-billion parameter version of GPT-3 specifically trained to generate images from text descriptions. It had a diverse set of capabilities, including creating anthropomorphized versions of animals and objects, combining unrelated concepts in plausible ways, rendering text, and applying transformations to existing images. However, there were almost always certain visual artefacts that were dead giveaways that there was something "off" about the images it produced.

About a year later, in early 2022, they unveiled DALL-E 2, which uses a diffusion model. Diffusion models are neural networks trained to clean up images by removing pixelated noise that the training process adds. If you take the output of a diffusion model and feed it back to it, it will produce an even cleaner image. Open AI claims that DALL-E 2 generates more realistic and accurate images with 4x greater resolution. The images that DALL-E 2 produced were indistinguishable from what they aimed to emulate. At least within the artistic domain, the "Turing Test" had been passed.

OpenAI signed up a million users in just 2.5 months after launching the Beta. This was when they knew they hit the jackpot. Soon after, a whole slew of such Generative AI tools popped up, many that are now more popular than DALL-E 2, such as Stable Diffusion; and some in "completely unrelated" domains like GitHub Copilot. This was the first AI technology that connected with the average person and captured their imagination in a way that only life-altering technologies previously had. The most recent update in this space (about a week ago), that once again, has taken the world by storm, is ChatGPT.

## 3 CNC + GENERATIVE AI

In addition to letting users draw lineographic sketches on a canvas, the web interface also allows users to enter a prompt that will then be forwarded to an Open AI API that submits the prompt to DALL-E. Once DALL-E returns an image, a Python script preprocesses the image using PIL, and then looks for contours and hatches by applying probabilistic Gaussian filters from OpenCV and noise from Perlin, to generate a vectorized sketch of the image as an SVG that is displayed to the user. The coordinates from the SVG are then processed to optimize the order in which they are arranged so as to minimize extraneous contiguous line segments on a lineographic plotter like the Etch A Sketch. These coordinates are then sent over to the Arduino from the web interface via the web server, as previously discussed, and the Arduino uses Bresenham's line algorithm to plot a lineographic sketch with the coordinates it received.

Press +  
What would you like to sketch?  
an Arduino in the style of picasso  
This prompt will be run through DALL-E, the resulting image and a vector sketch conversion will be displayed below.



Start Drawing