

CNC VISION

Automated Artistic Portrait Drawing with
CNC Machines

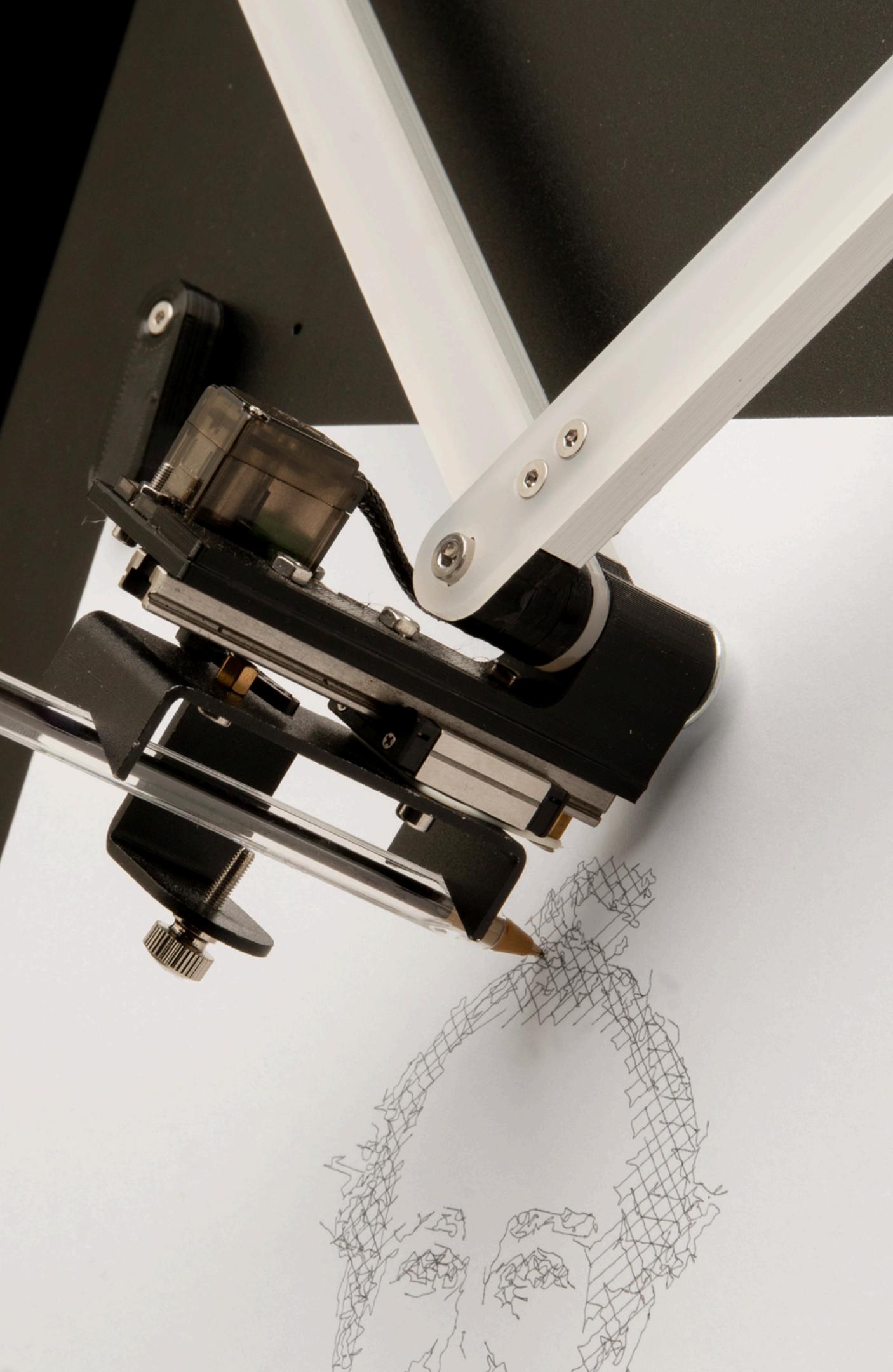
Burmese Python

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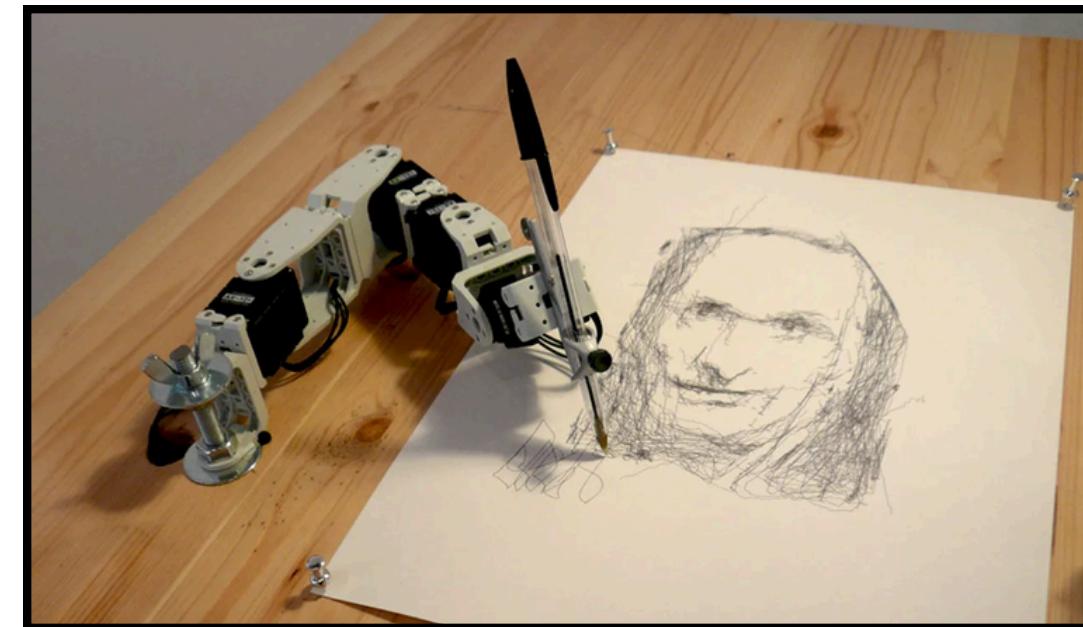
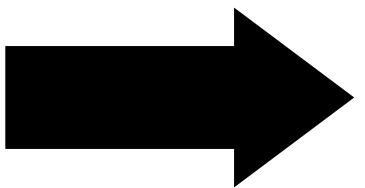
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Purpose



Explore the convergence of **computer vision** and **robot kinematics** in replicating the evolution of portrait drawing arts

What inspired us?

From **Mona Lisa's smile** to **Van Gogh's swirling soul**, portraits whisper stories across centuries.

We aim to mimic the handiwork of great minds, using advanced robotics and computer vision technology.



Concepts



In order to get an excellent portrait drawing,

- **skillful hands**
- **extraordinary eyesight**
- **drawing techniques** are necessary for a human artist.

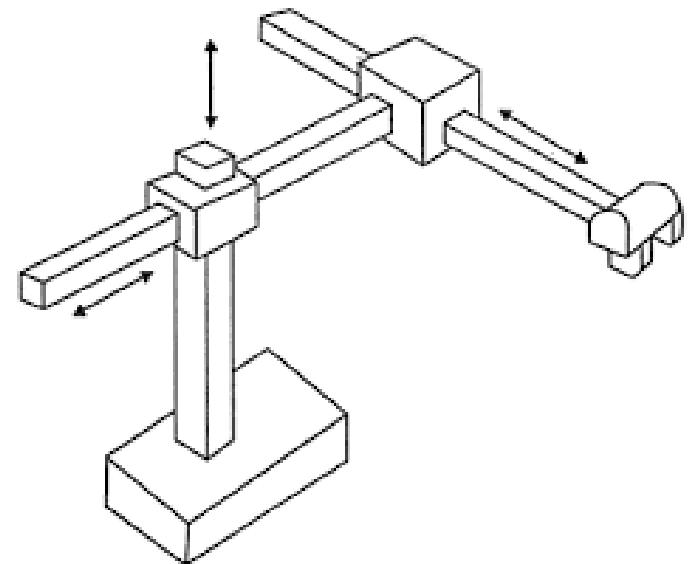


As for a robot,

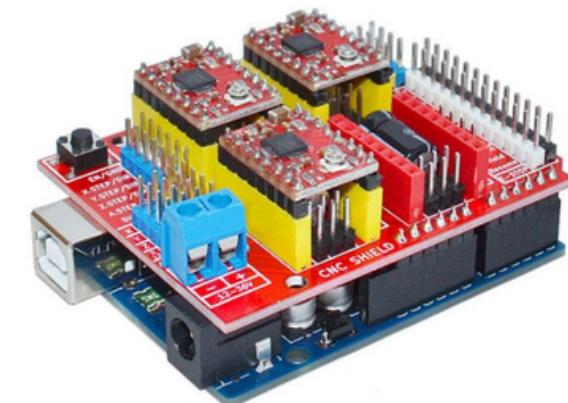
- **actuators**
- **camera**
- **image processing techniques** are sufficient to mimic an artist's skills

Actuators

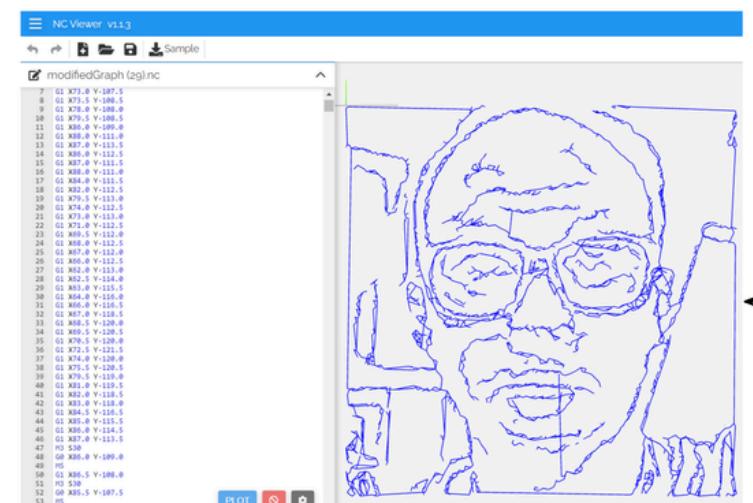
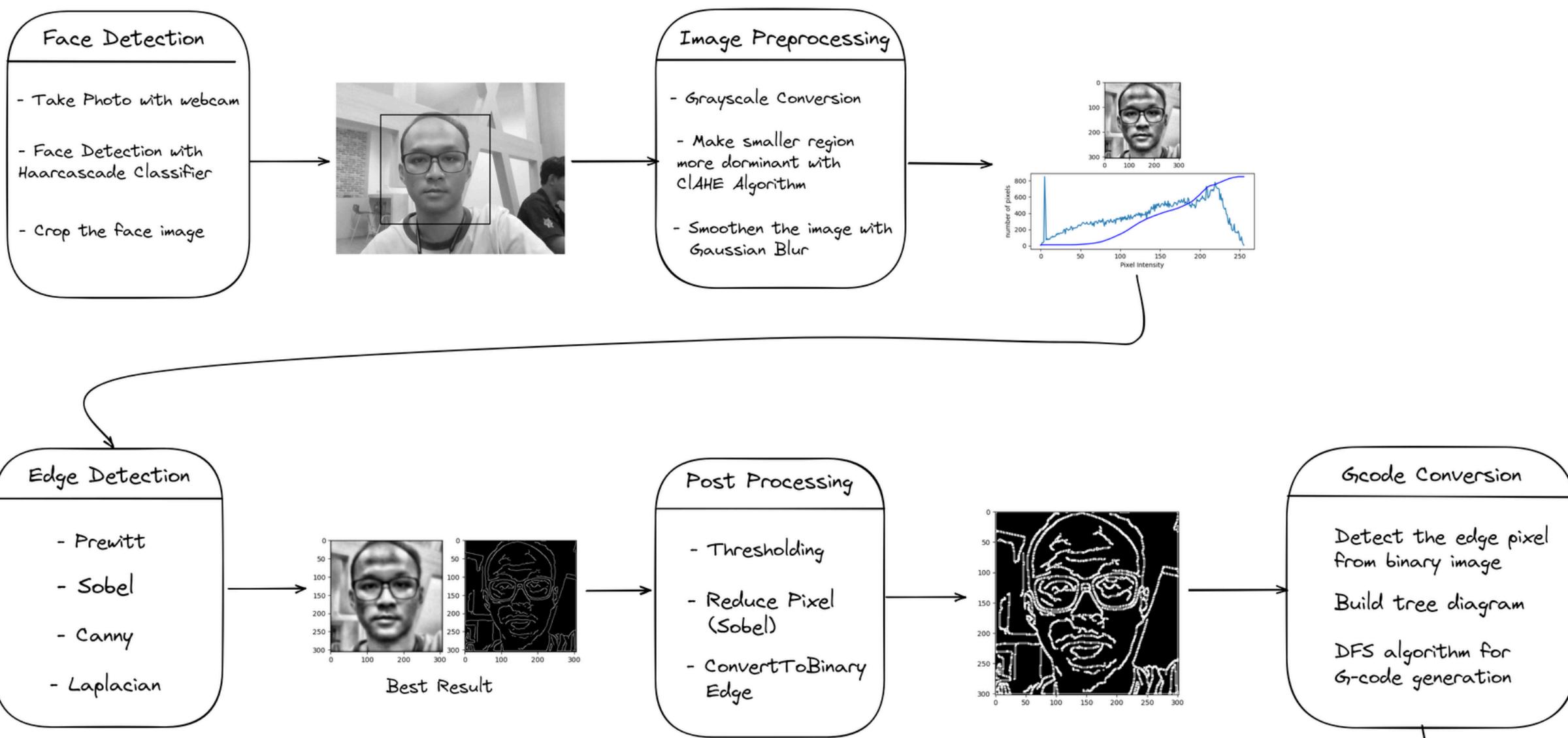
- Since the drawing canvas is a 2D surface, Cartesian(PPP) manipulator is a good fit for this project.
- CNC(Computer Numerical Control) scheme will be used to efficiently control the position of end effector by interpreting G-code descriptors.
- The robot is powered by stepper motors which are driven by Arduino firmware.



G-CODE



Computer Vision Techniques



Face detection

- Access the web cam and capture it.
- Common Techniques:
 - a. **Image Capture:** Press the capture button to capture the face and save in the directory
 - b. **Haarcascade Faceclassifier:** The photo is fed into HaarCascadeClassifier to detect face.

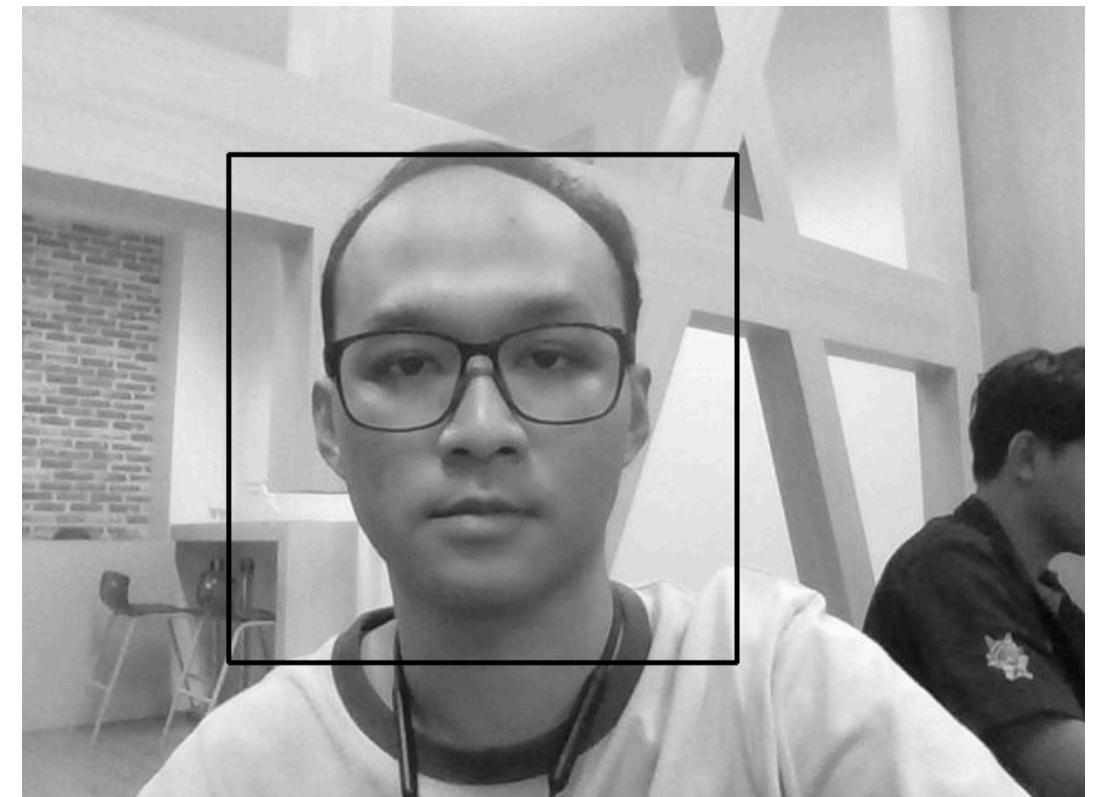
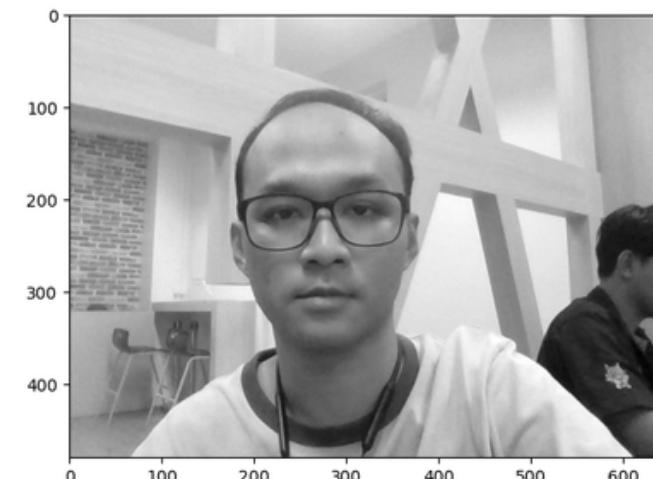
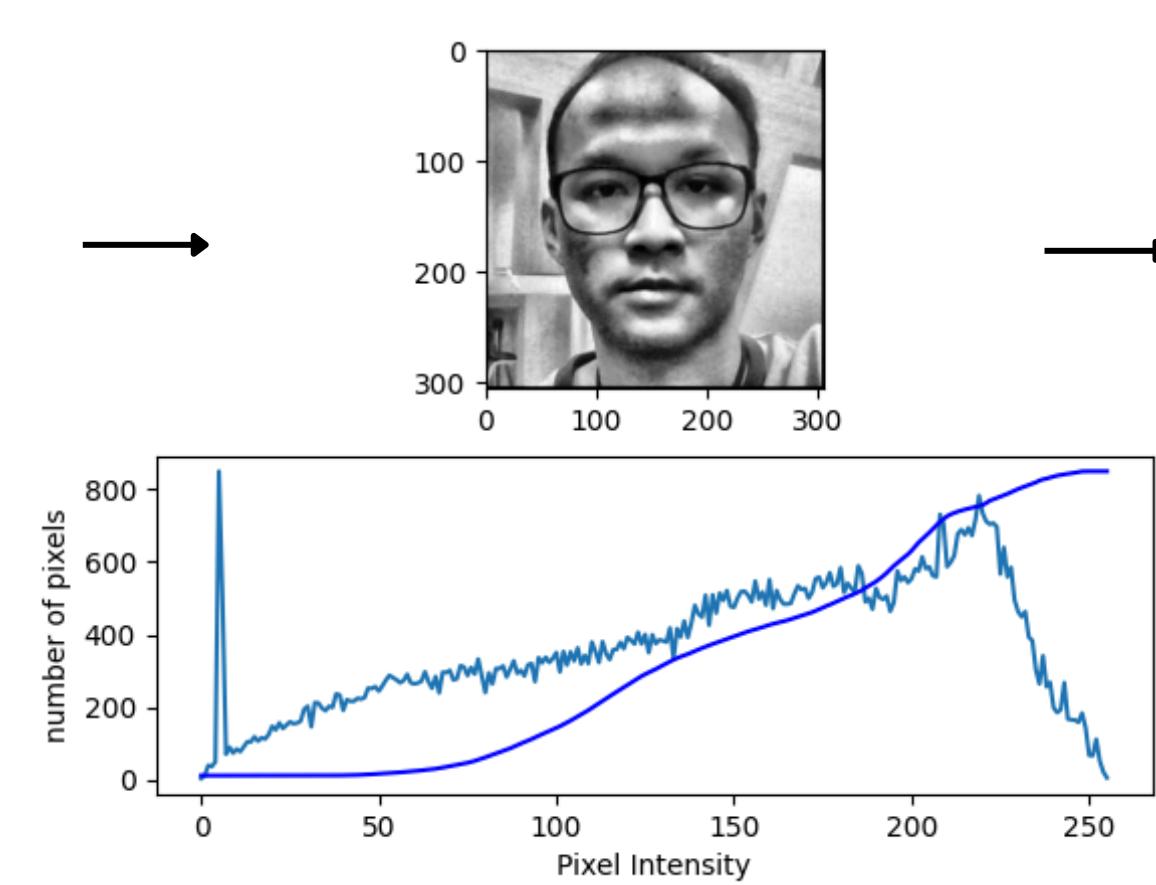


Image preprocessing

Grayscale



Histogram Equalization



Gaussian Blurring

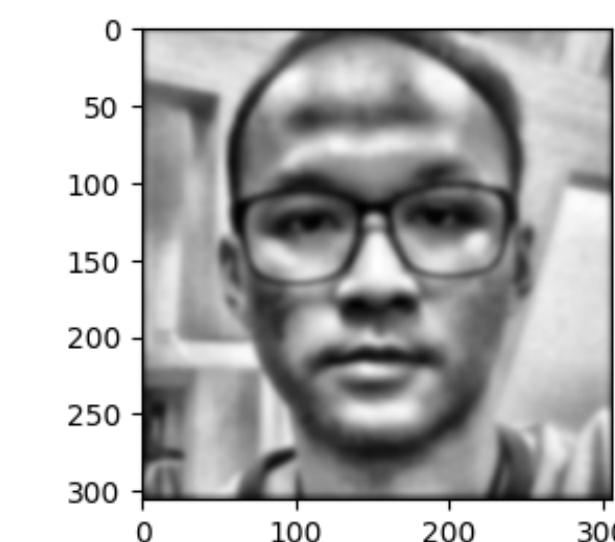


Image postprocessing

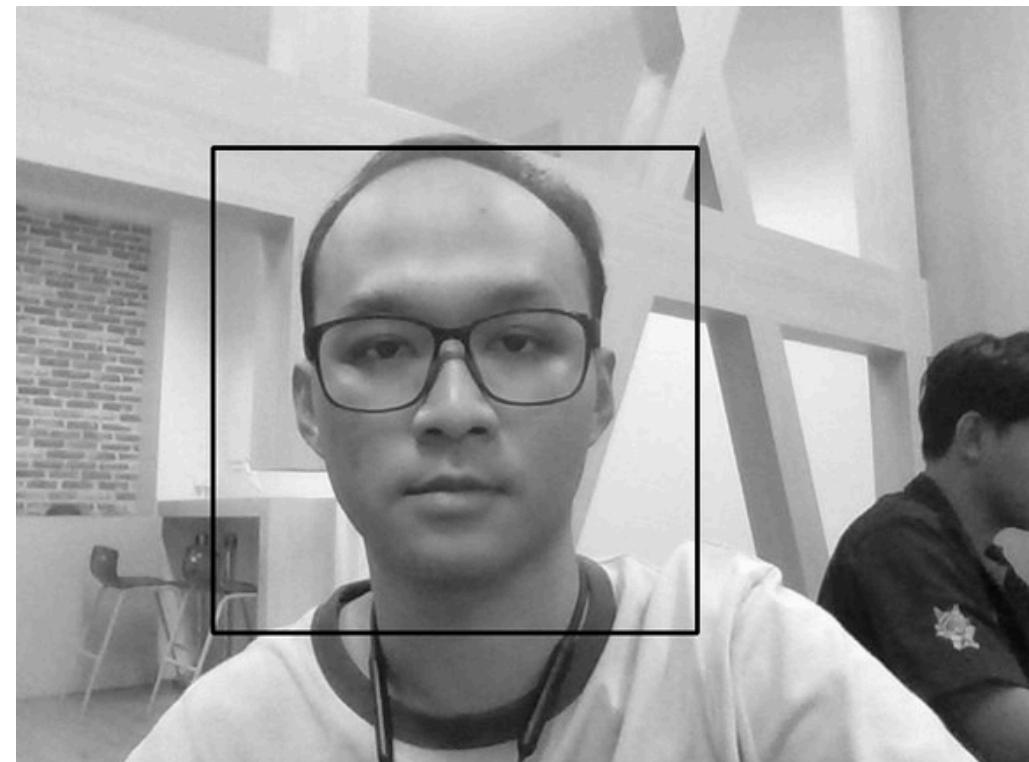
- **Thresholding:** Convert the edge-detected image into a binary image where pixels are either classified as edge pixels or non-edge pixels based on a threshold value.
- **Edge Detection:** Detect the edges of thresholded image again using Sobel Edge Detection technique.
- **Binary Edges Conversion:** Convert the resultant image into binary edges (white edges, other black) while increasing the intensity of edges.
- **Gcode Conversion :** Convert the edges to gcode for the cartesian drawing robot.

Coding on GitHub

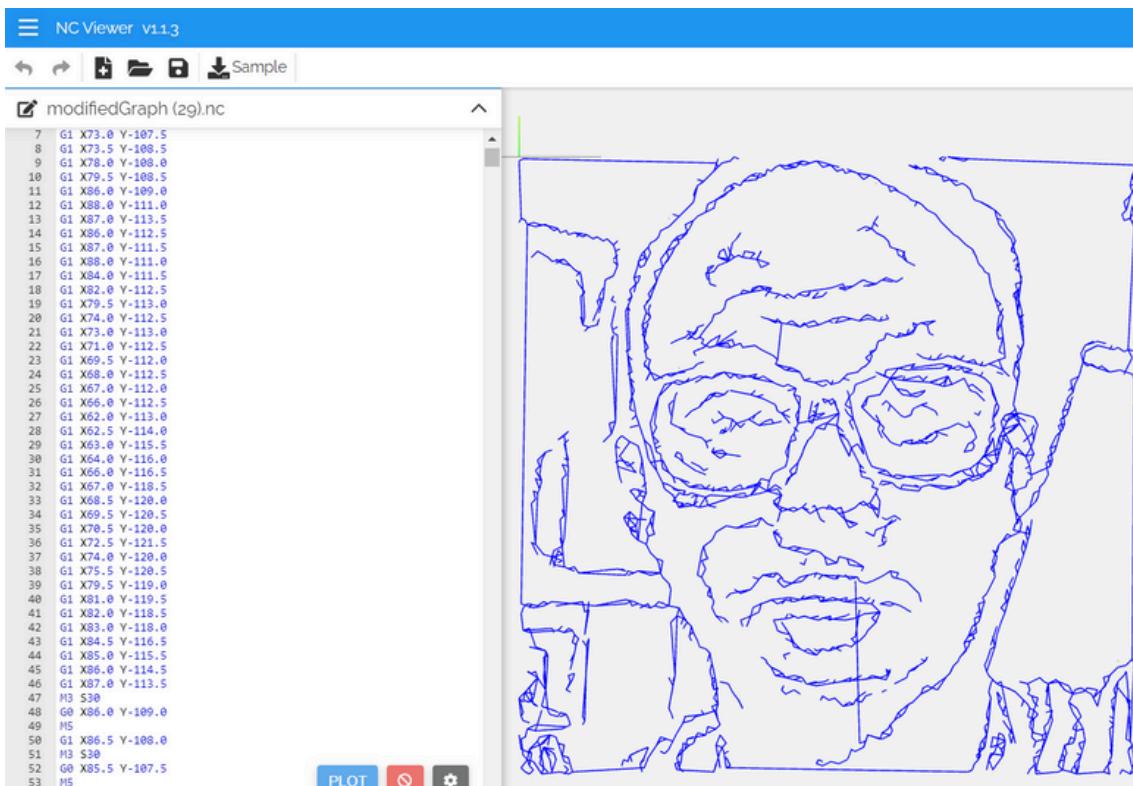


Scan Dai Krub!

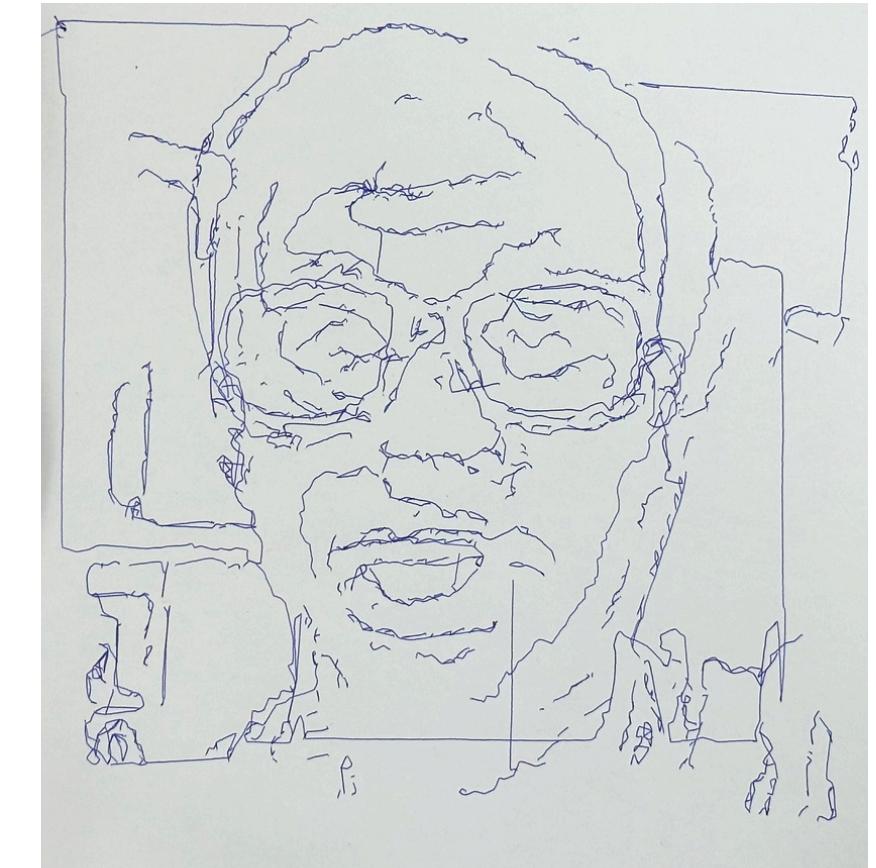
Result



Original



G-code

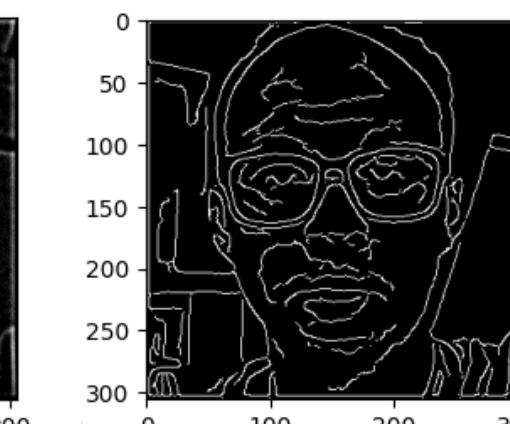
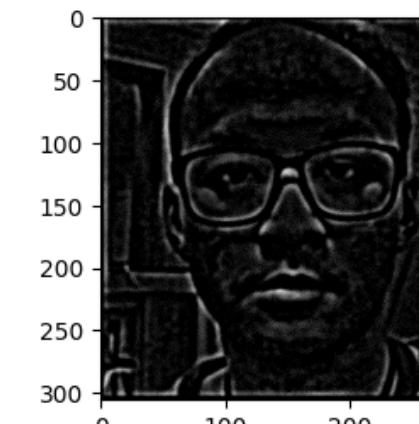
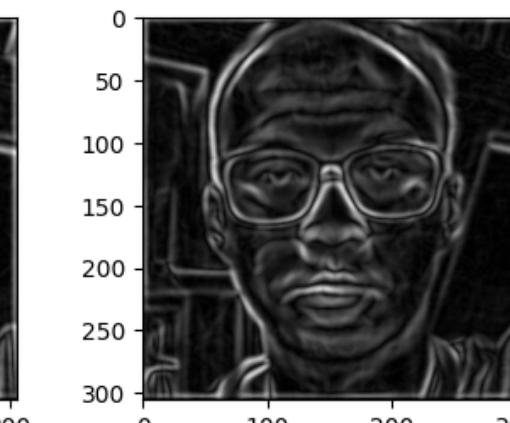
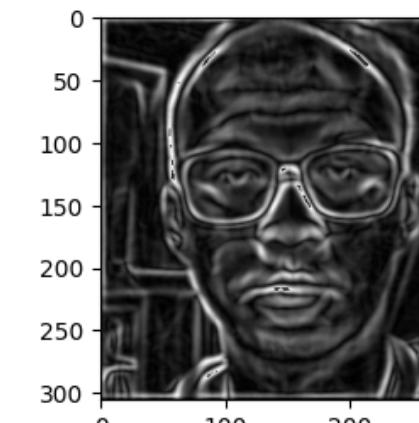


Drawing Result

Timelapse Video: [Portraits Drawing Robot I_\(Computer Vision + Kinematics\)](#)

Edge Detection

- Identify the points in the image where there is a significant change in intensity or color, which typically correspond to object boundaries or edges.
- Common Techniques
 - a. Prewitt
 - b. Sobel
 - c. Canny
 - d. Laplacian



Future Work

- Add **another layer** of shade and shadow for the detail of the portrait
- Improve G-code for trajectory algorithm for better image result.

Reference

- <https://github.com/Stypox/image-to-gcode.git>

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