Leonardo Da Robot
Final Presentation

Team D0

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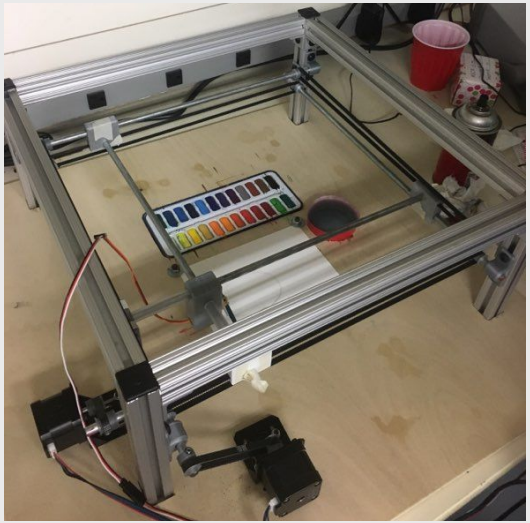
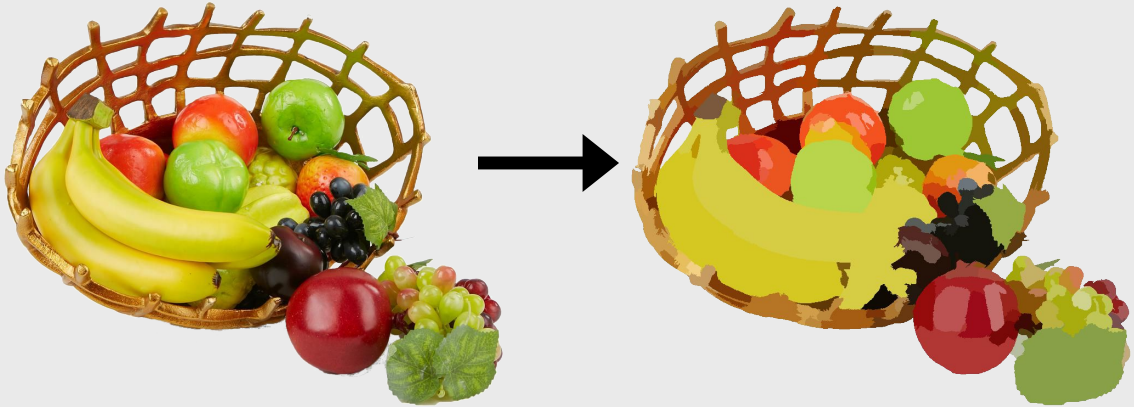
Overview

- A robot that paints a picture on a sheet of paper
- Looks at a digital image to draw
- The goal is to paint an image which looks like it’s been painted by a person

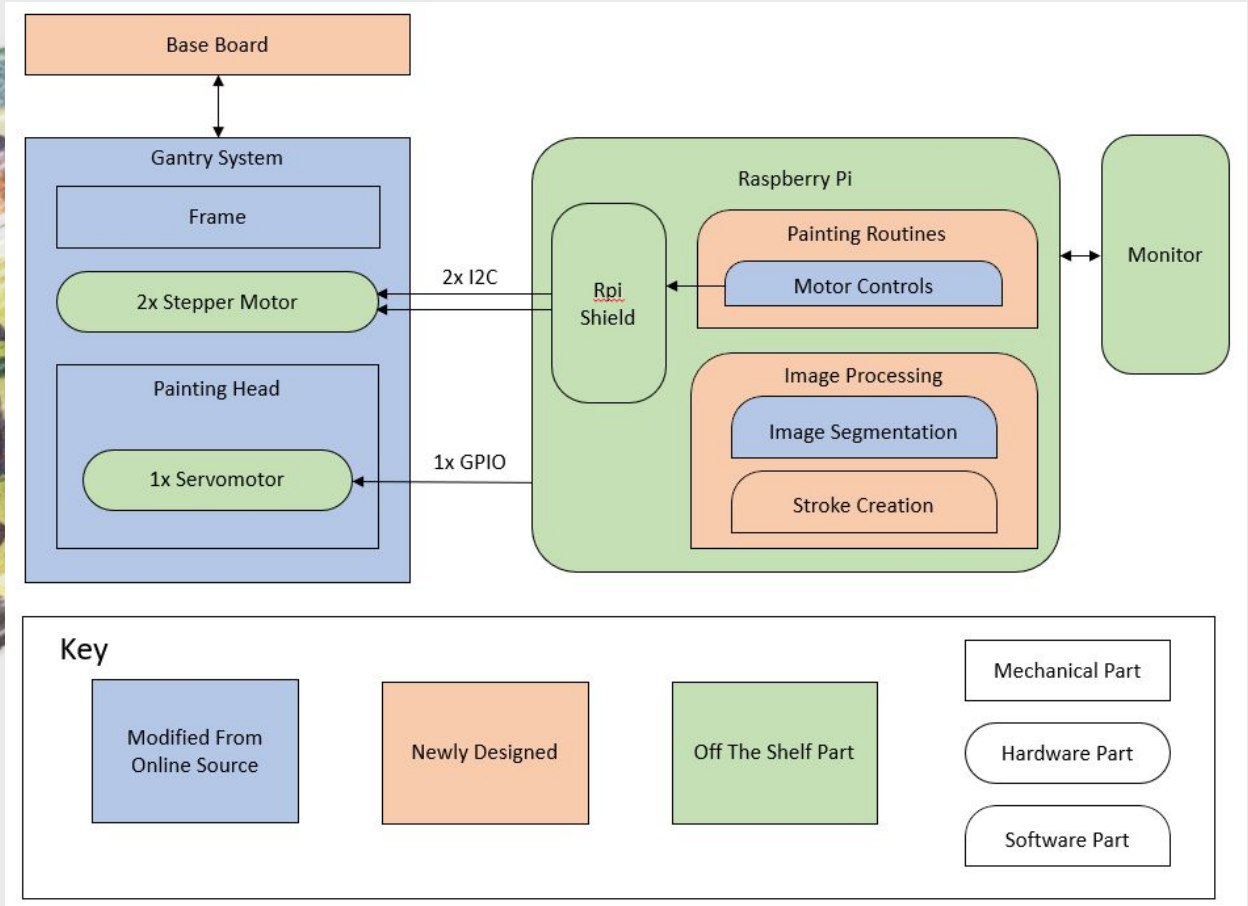


Solution Approach

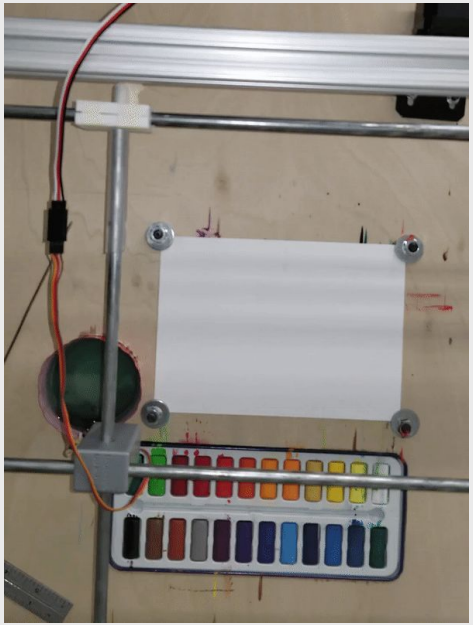
- Use a 2D gantry inspired by 3D printers, controlled through Pi motor shield
- Preprocessing of image into objects of uniform color using mean shift segmentation
- Send coordinates and color of segment to robot

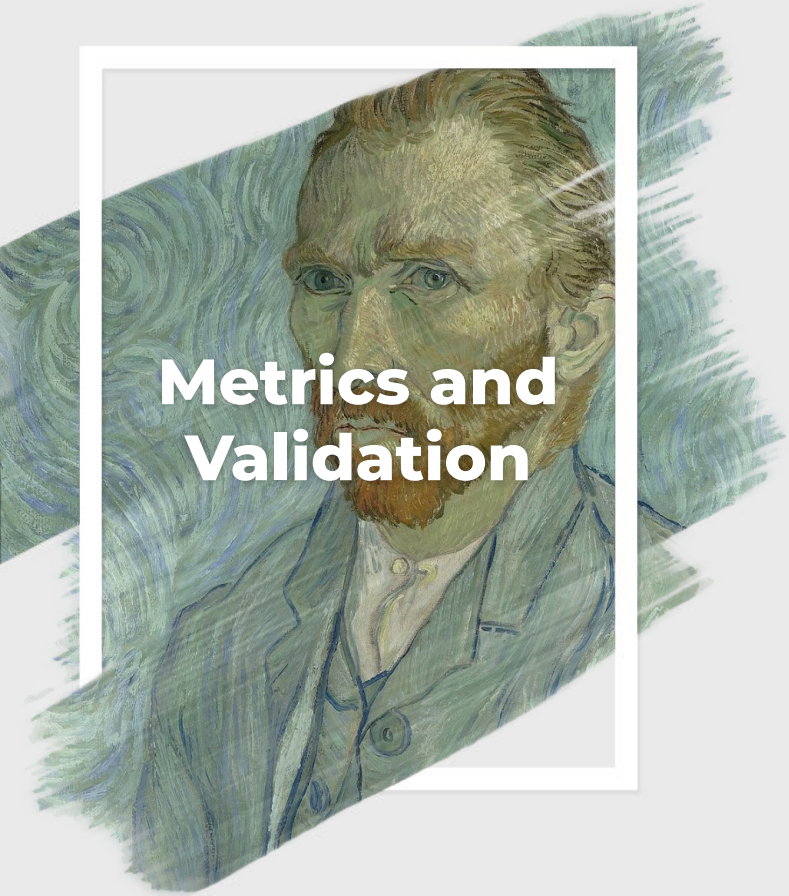


Block Diagram

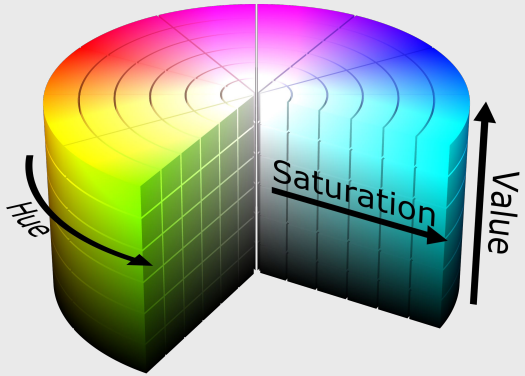


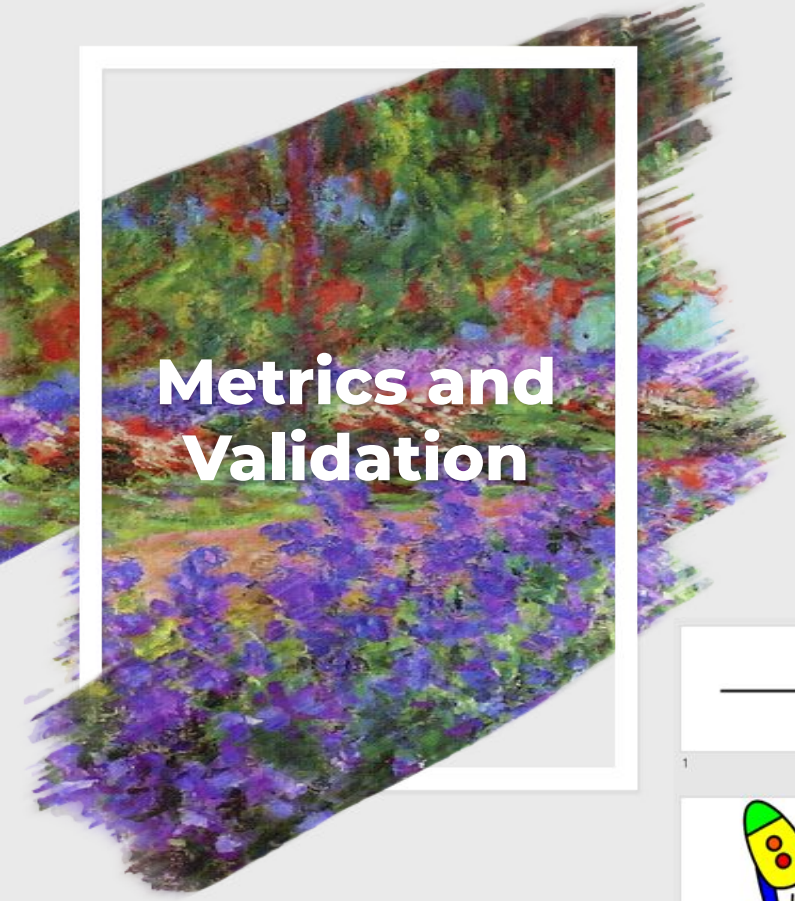
- Gantry will be painting a small image
- Users can run the software portion and view a segmented version of their input image
- Video will be playing of a more complex painting





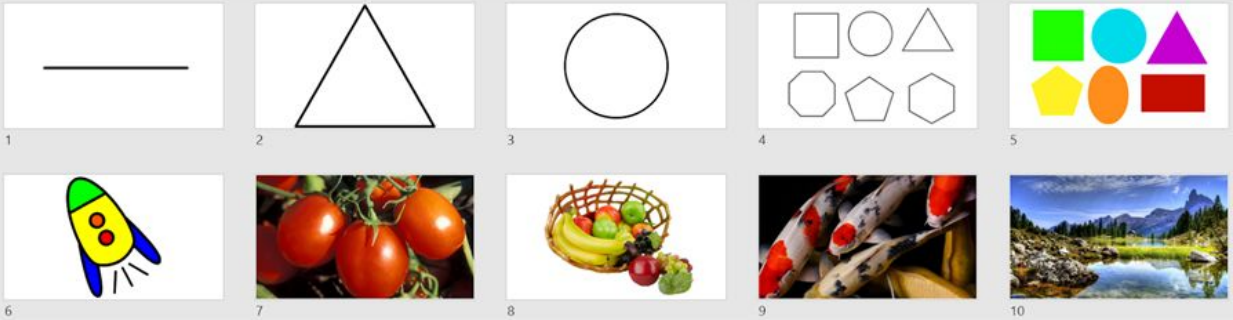
- Use various sized image inputs
  - Successful render from any image input
- Use color sample image to test color performance
  - Ensure closest numerical HSV color is used





Metrics and Validation

- Bank of 10 benchmark images
  - Quantitatively score using structural similarity index, aim for 0.2
- Use increasing complexity benchmark to test for time vs complexity performance
  - Aim for under 8 hours max



- Every tested input so far can be successfully rendered
-

Category	Number of Colors
Correct	14
Close	7
Incorrect	3

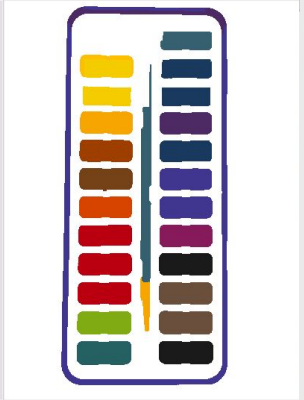
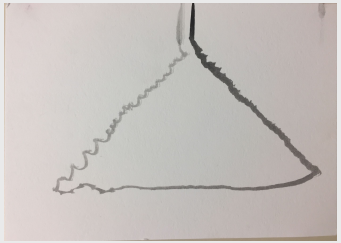
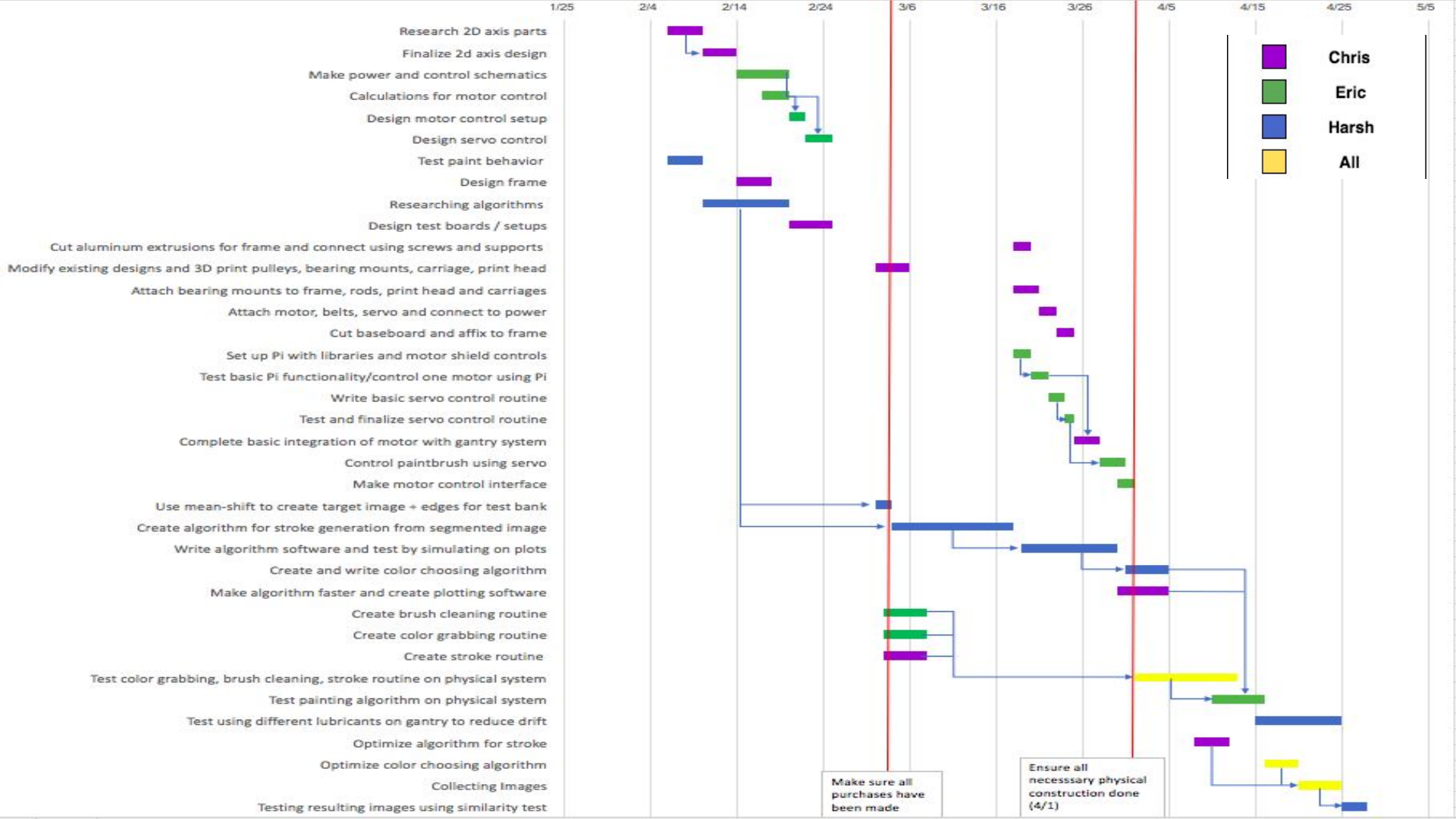
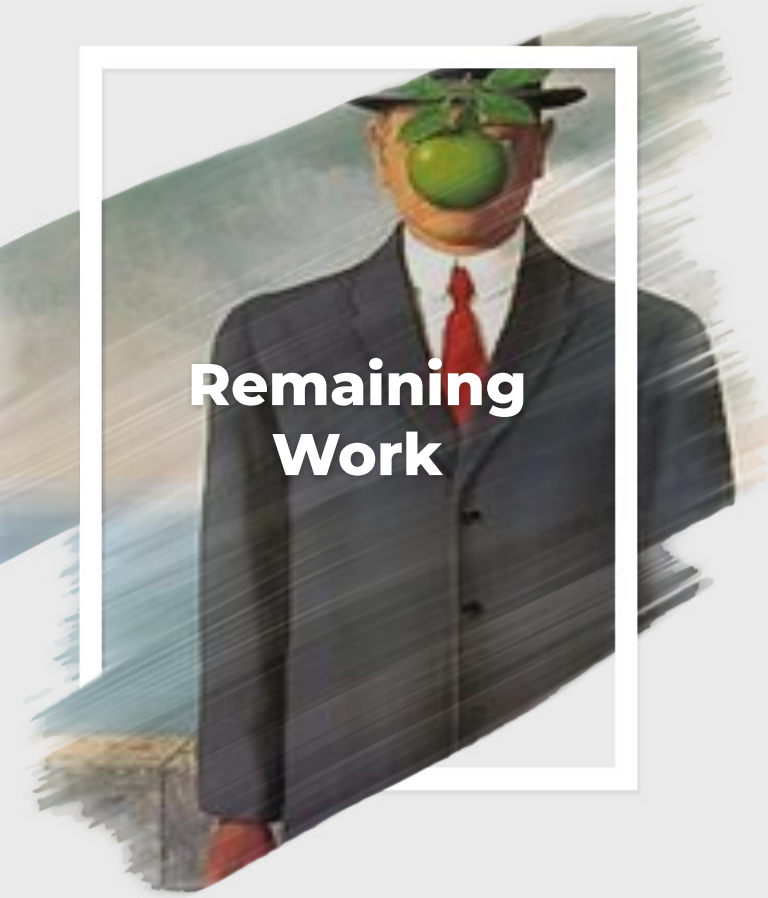
Original	Segmented	Rendered
		

Image	Image Number	Time Taken (seconds)	SSIM
	1	46	0.693
	2	54	0.641
	3	55	0.705
	4	336	0.531
	5	542	0.280
	6	813	0.261

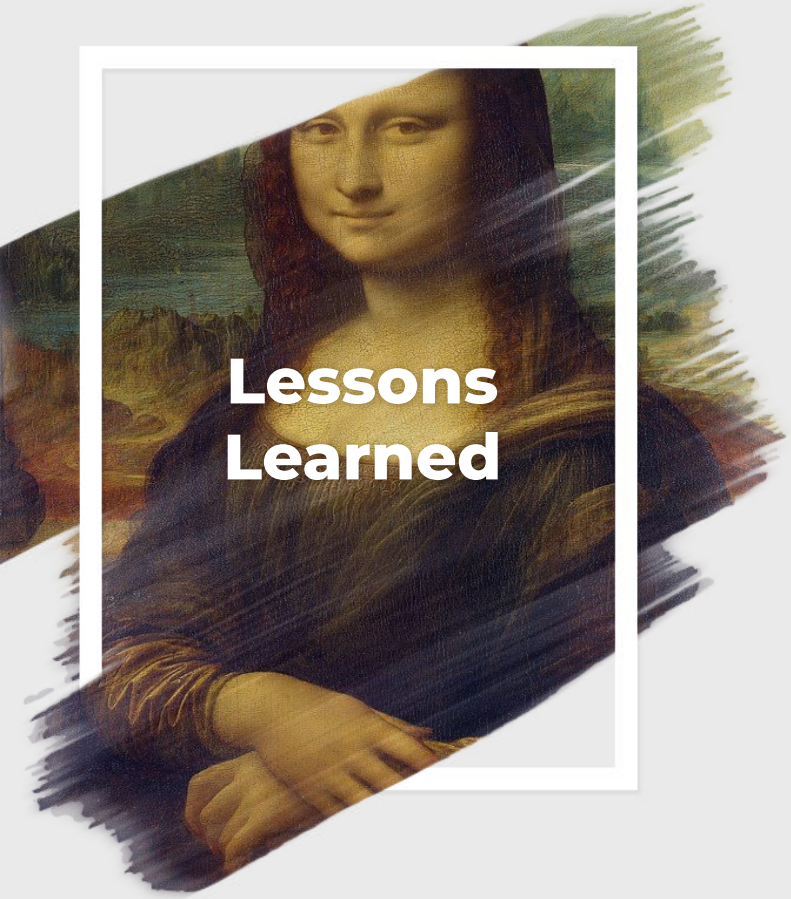



1/25
2/4
2/14
2/24
3/6
3/16
3/26
4/5
4/15
4/25
5/5
Research 2D axis parts
Finalize 2d axis design
Make power and control schematics
Calculations for motor control
Design motor control setup
Design servo control
Test paint behavior
Design frame
Researching algorithms
Design test boards / setups
Cut aluminum extrusions for frame and connect using screws and supports
Modify existing designs and 3D print pulleys, bearing mounts, carriage, print head
Attach bearing mounts to frame, rods, print head and carriages
Attach motor, belts, servo and connect to power
Cut baseboard and affix to frame
Set up Pi with libraries and motor shield controls
Test basic Pi functionality/control one motor using Pi
Write basic servo control routine
Test and finalize servo control routine
Complete basic integration of motor with gantry system
Control paintbrush using servo
Make motor control interface
Use mean-shift to create target image + edges for test bank
Create algorithm for stroke generation from segmented image
Write algorithm software and test by simulating on plots
Create and write color choosing algorithm
Make algorithm faster and create plotting software
Create brush cleaning routine
Create color grabbing routine
Create stroke routine
Test color grabbing, brush cleaning, stroke routine on physical system
Test painting algorithm on physical system
Test using different lubricants on gantry to reduce drift
Optimize algorithm for stroke
Optimize color choosing algorithm
Collecting Images
Testing resulting images using similarity test
Chris
Eric
Harsh
All
Make sure all purchases have been made
Ensure all necesssary physical construction done (4/1)



Remaining Work

- Minimizing the extra line drawn by the rotating brush
- Refine the UI for choosing an image
- Optimize the color picking algorithm
- Making the gantry run smoother and more consistently



- Don’t be afraid to make changes
- Ask for advice and take inspiration from others when relevant
- Software is easier to fix than hardware
- Front-load difficult and unfamiliar tasks, but do not rush into them