

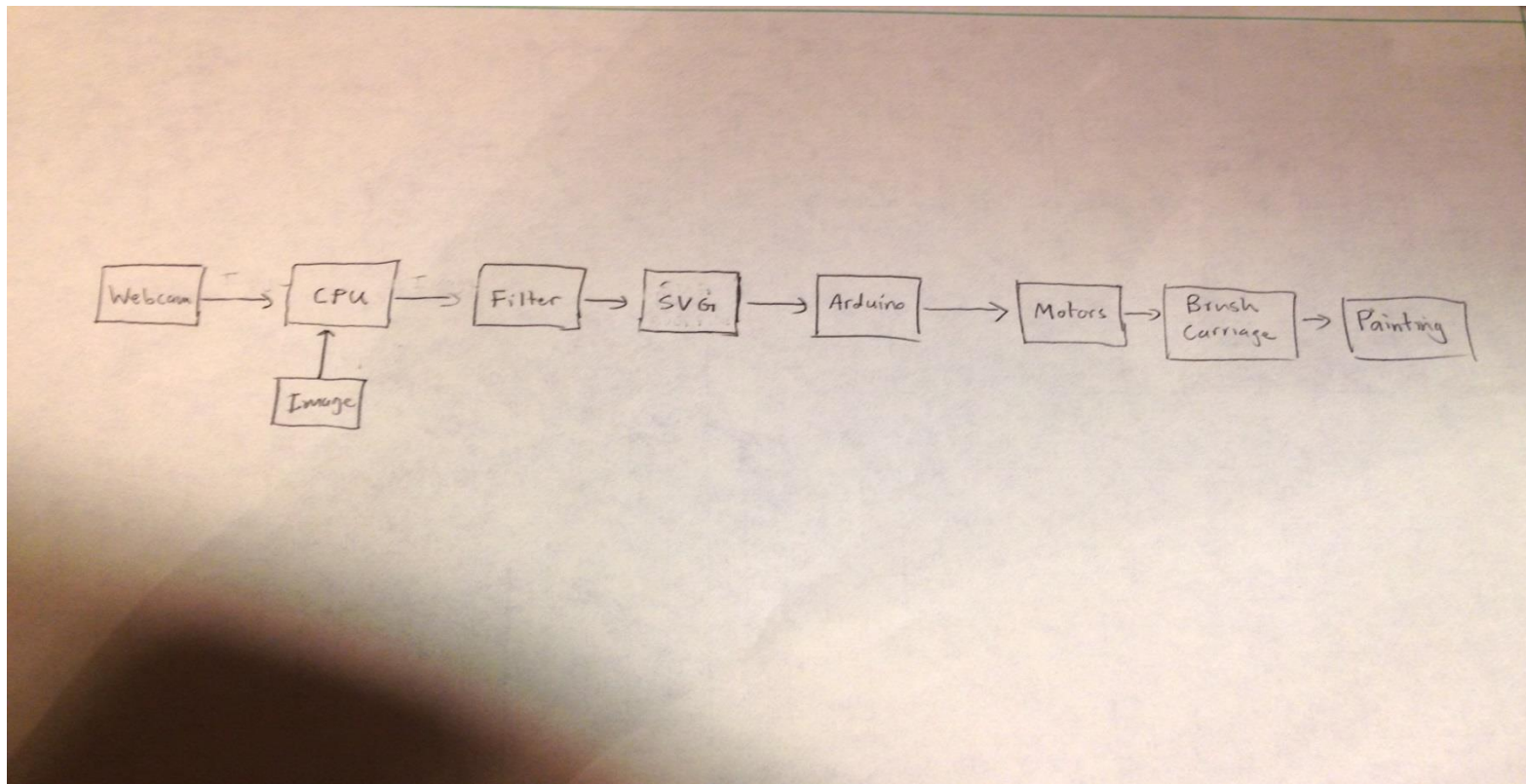
PICASSAU

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Frost, Peter Gartland**



INTRODUCTION

- Problem
- Approach



FRAMING AND SUPPORT

- PVC vs. Lumber
 - Weight comparison
 - Ease of use
- Traditional easel design vs. solid base
 - Stability
 - Size constriction
- Horizontal vs. vertical orientation
 - Natural painter's posture
- Motor mounts
 - Ability to maintain string tension at edges



MOTORS

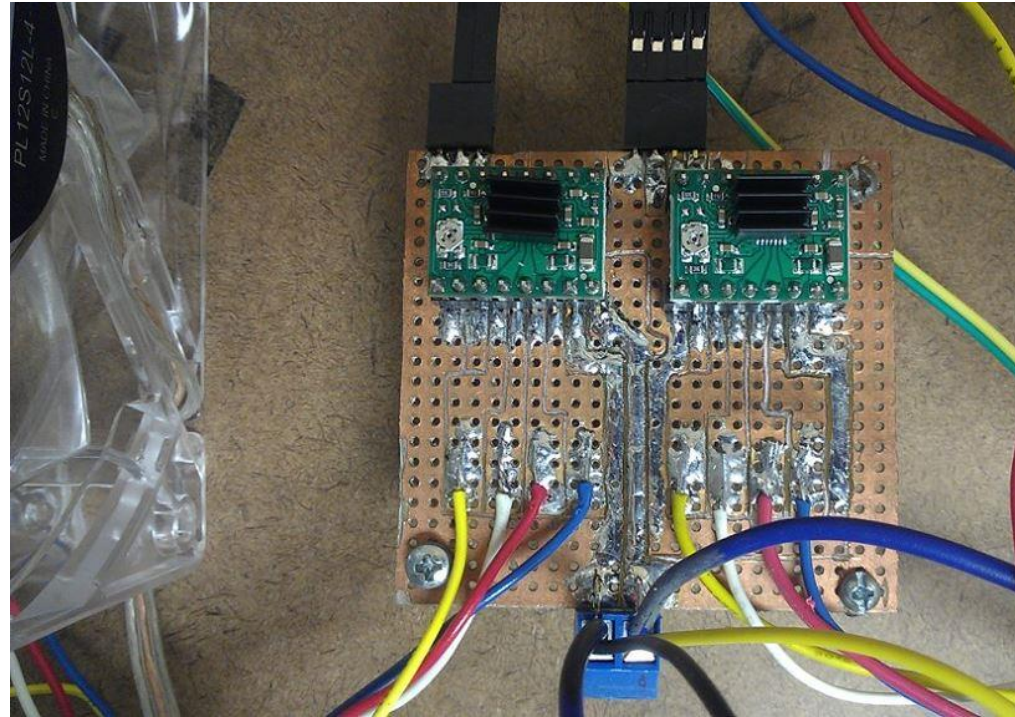
- Costs
 - 43% cheaper than expected
- Torque
 - 375% more holding torque
- Ease of use

		Motor options:				
Criteria:	Weight:	HY100 1713	SY57ST56-0606B	SY57STH56-1006A	SY57STH76-1006A	57BYGH420
Cost	4	++	0	0	-	+
Holding Torque	4	--	0	+	++	+
Weight	1	++	+	--	--	--
Ease of use	2	+	0	0	0	++
+		12	1	4	8	12
0		0	10	6	2	0
-		8	0	2	6	2
Net Score		4	1	2	2	10

MOTOR CONTROLLERS



Old – L298



New – A4988



POWER SUPPLY

- ATX Computer Power Supply
 - Cheap, powerful, easy-to-use
 - Bulky



SVG FILE TYPE

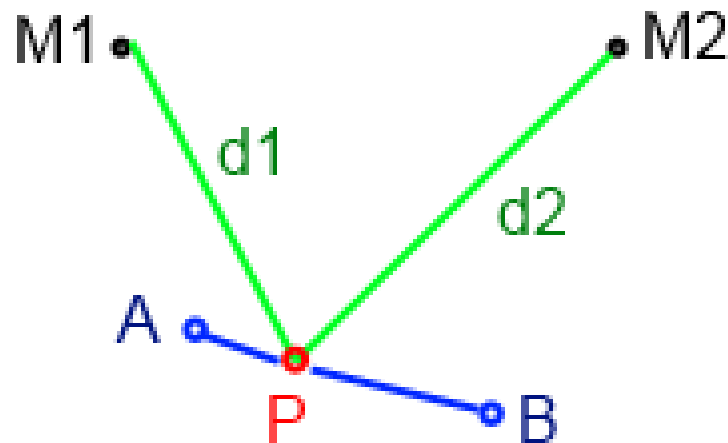
```
<svg xmlns="http://www.w3.org/2000/svg" version="1.1">  
  <path id="lineAB" d="M 100 350 l 150 -300" stroke="red"  
  stroke-width="3" fill="none" />
```

- Advantages of SVG



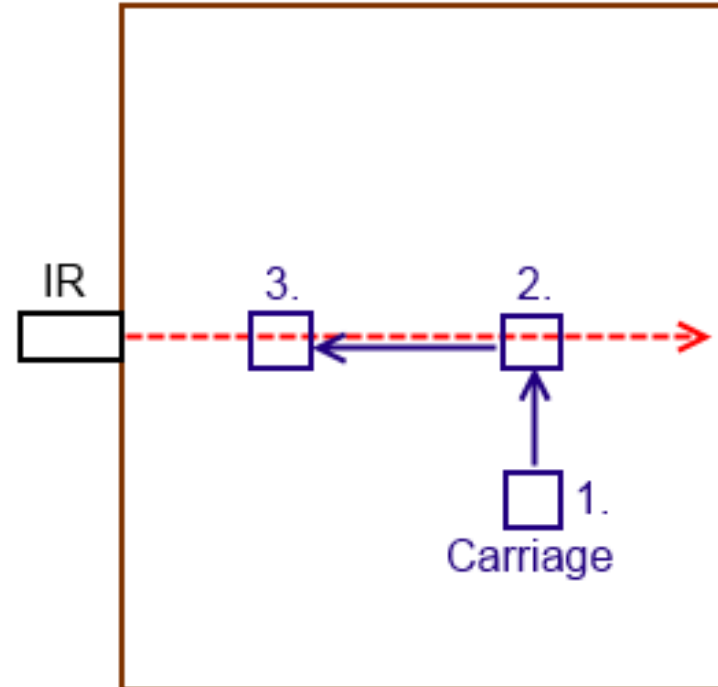
PAINTBRUSH CARRIAGE KINEMATICS

- Moving in a straight line is not a linear operation.
- Our control algorithm:
 - Limited number of possible motor movements
 - These movements can be analyzed.



PAINTBRUSH CARRIAGE - CALIBRATION

- Uses an IR sensor
- Moves carriage vertically until spotted to get the y-coordinate
- Uses the distance reported by the IR sensor to get the x-coordinate
- Fine tuning –
Moves to the range of higher sensor precision for improved calibration



SOFTWARE

- Split software onto two platforms
 - Computing tasks – Raspberry Pi: Python
 - Embedded tasks – Arduino: C/C++
- Software process
 - Accept SVG file
 - Parse paths
 - Run calculations to travel paths
 - Control motors and brush to follow paths



COMMUNICATION

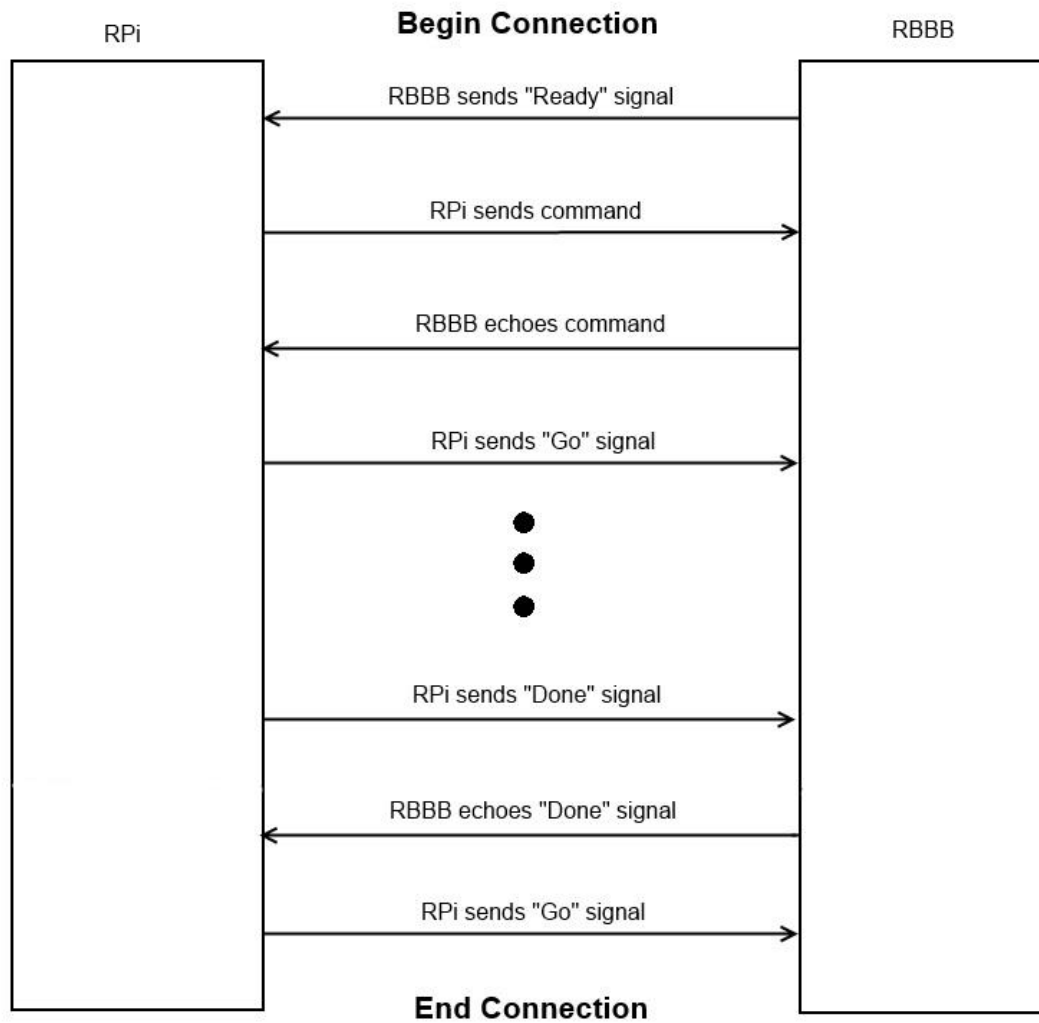


IMAGE PROCESSING – ORIGINAL



IMAGE PROCESSING – GRAYSCALE



IMAGE PROCESSING – MEDIAN BLUR



IMAGE PROCESSING – THRESHOLDING



IMAGE PROCESSING – MORPH + COLOR



CONSTRAINTS

- Cost
 - \$300 budget
- Performance
 - Required proximity to wall outlet
 - Processor speed
- Marketability
 - Novel attraction
- Sustainability
 - Fragile



BUDGET

Item	Purpose	Estimated Cost	Actual Cost
Stepper Motors	to replace the underpowered motors used in the prototype	\$100	\$57
Frame Hardware	to support the hardware	\$20	\$31
Mounting Hardware	to mount the spindles onto the motors	\$15	\$31
Painting Supplies	brushes, paint, and canvas/poster board	\$15	\$13
Motor Controllers	to drive the stepper motors	\$20	\$20
Raspberry Pi	to run the software	\$35	\$40
Display	to interface with the raspberry pi	\$15	Not yet purchased
Webcam	to take pictures to paint	\$15	\$4
Microcontroller	to interface with the hardware	\$10	\$20
Miscellaneous Electronics Hardware	wires, sensors, servos, etc.	\$20	\$16
TOTAL		\$265	\$231



TIMELINE

- Accomplished all Cycle 1 tasks
- Began Cycle 2 tasks
 - Stabilize paintbrush platform
 - An objective that incorporates 3 subsystems
 - Setup Raspberry Pi
 - A future dependency



PERFORMANCE – DEMO VIDEO

<https://www.youtube.com/watch?v=Y5Z0UUxBUv4>



CONCLUSIONS

- Current status:
 - Stable painting robot platform
 - We learned relevant skills not in curriculum
- Cycle 2 Goals:
 - Implement multiple color support
 - Generate the vectors from an image
 - Create a GUI
 - Optimize and stabilize



QUESTIONS?

