

Group 50

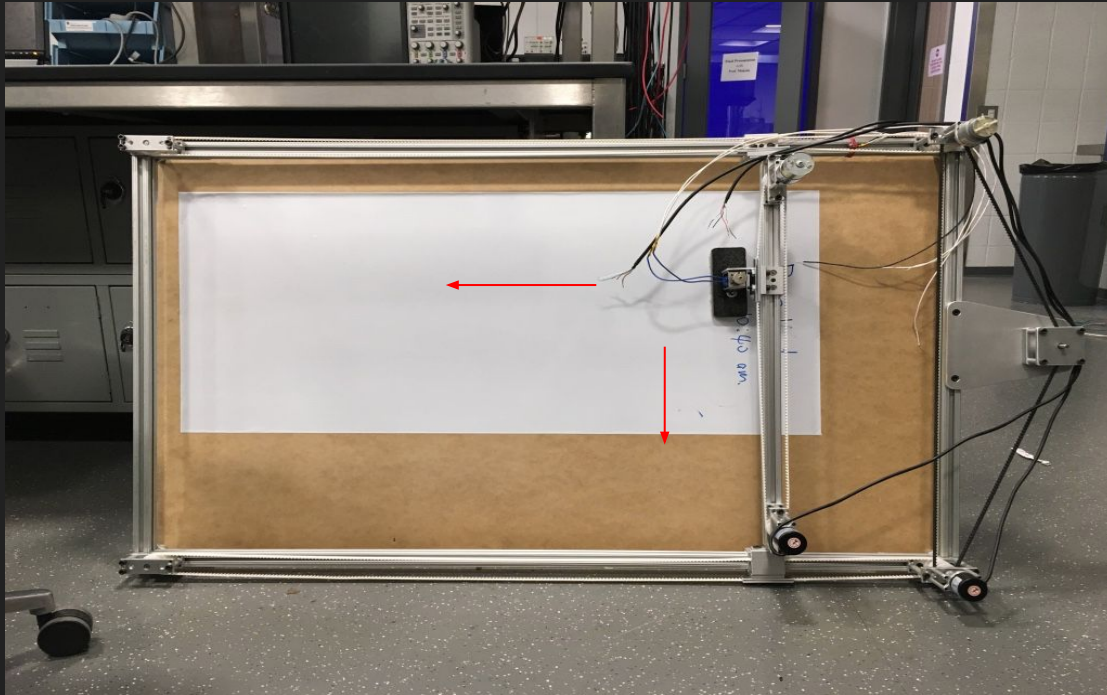
Smart Black/Whiteboard Cleaning System

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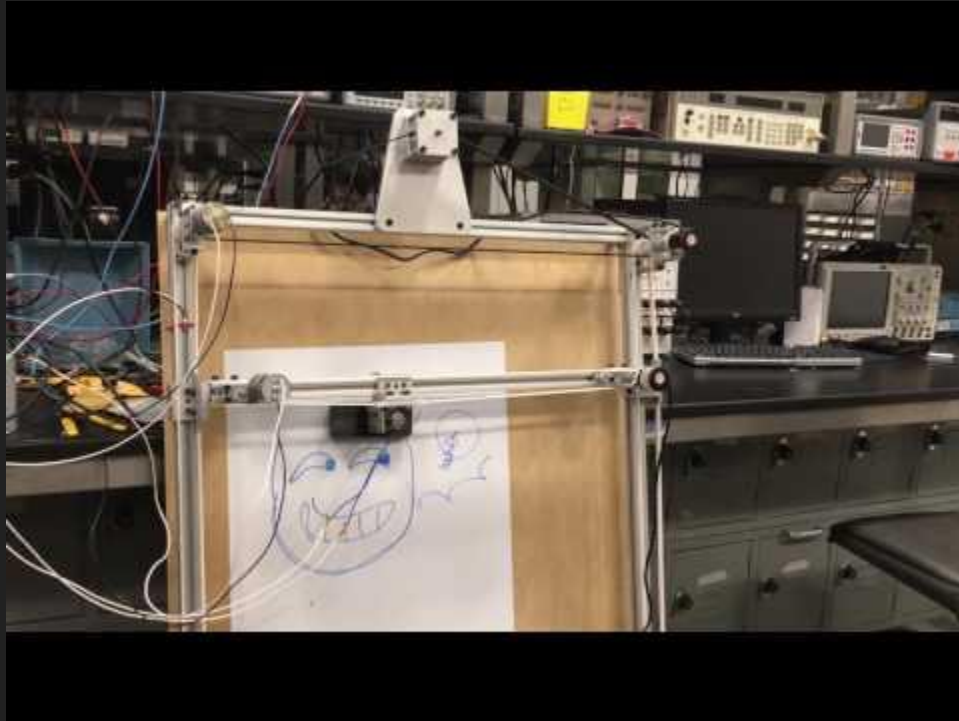
Introduction



Physical structure.

Eraser travels in indicated
red arrows directions

Features & System Overview



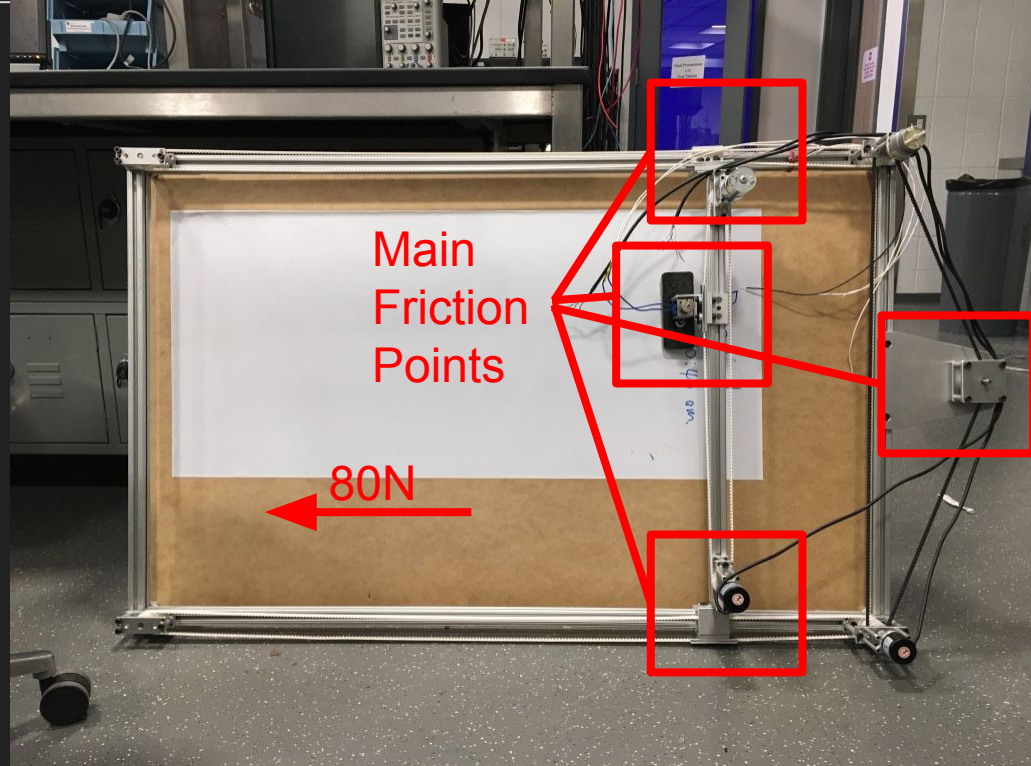
Design - Complete System Diagram



Concise System Block Diagram

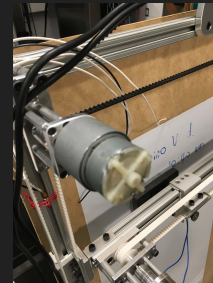
Design - Mechanical

- Required torque:
- $80 \text{ N} * 2 \text{ cm} = 160 \text{ N*cm}$
- Motor torque:
- 250 N*cm (stall)



Design - Motor & Eraser Module

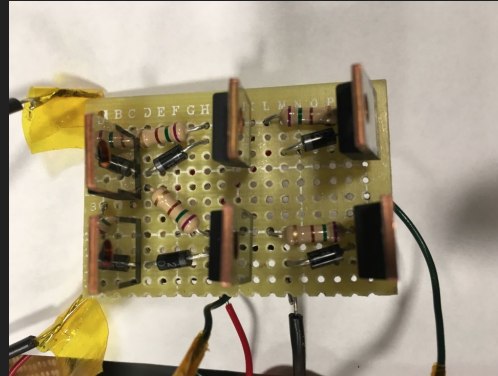
- Motor: 12-24V, 1.8A stall, 400mA at stable speed
- Solenoid Actuator: 12-24V, 1A
- Encoder: 5-24V, negligible current



Mounted encoder, solenoid, and Motor

Design - Motor & Eraser Module

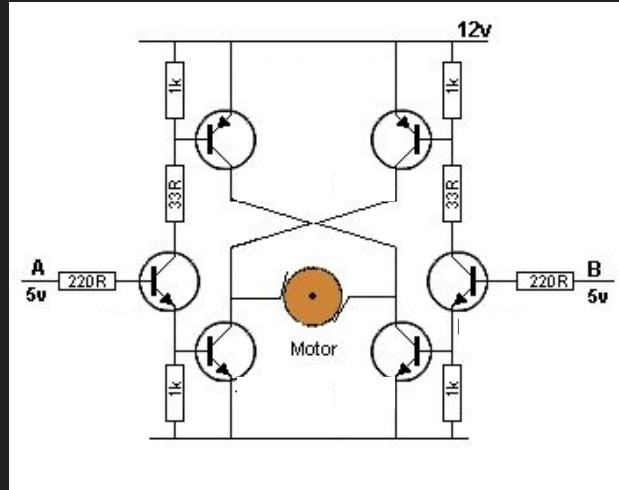
- Motor Driver: H-Bridge
- Solenoid Actuator Driver: a Transistor



H-Bridge Circuit

Design - Motor & Eraser Module

- Motor Driver: H-Bridge
- A and B port for control



H-Bridge Circuit Design [1]

Verification - Motor Module & Eraser Module

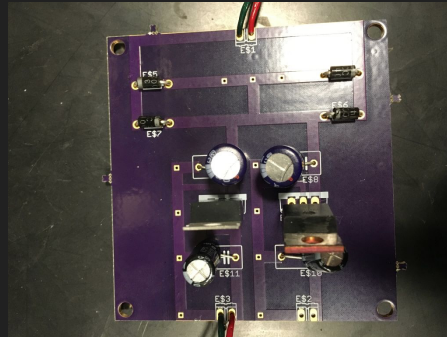
- Motor Driver: Travels back and forth
- Solenoid Actuator Driver: Pushes down when powered
- Motor: Drives at stable speed
- Solenoid Actuator: Sufficient force to press eraser, to clean the board

Design - Power Module

- Insulation Box for all circuits
- Connectors for input/output of circuits



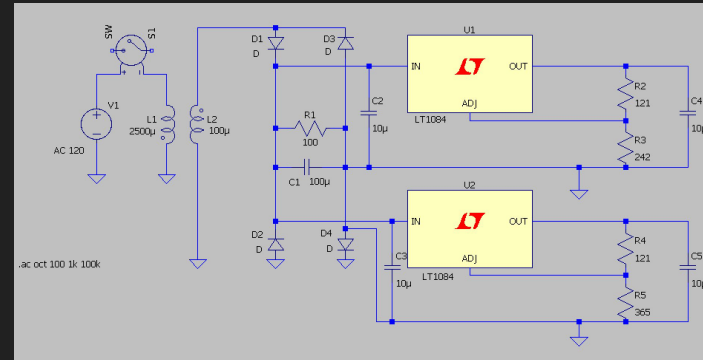
Power Insulation Box



Power Circuit

Design - Power Module

- AC - DC Converter: full wave rectifier
- Power Distribution Board: voltage regulator
- Emergency Switch



Power Circuit Simulation

Verification - Power Module

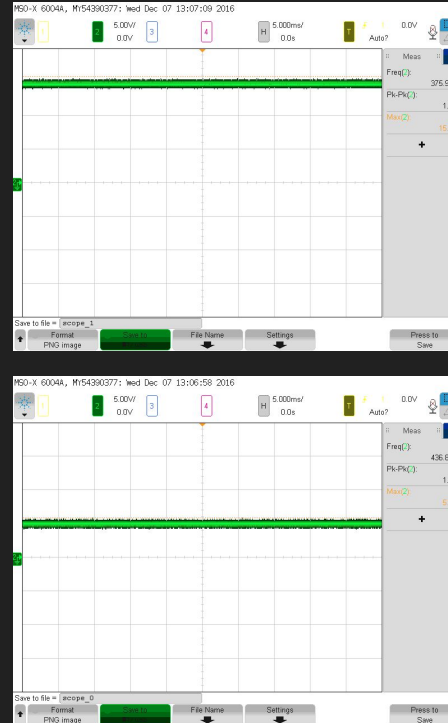
- AC - DC: Output stable $12\sqrt{3}$
 $V \pm 670\text{mV}$, 3A



Input waveform from
transformer secondary side

Verification - Power Module

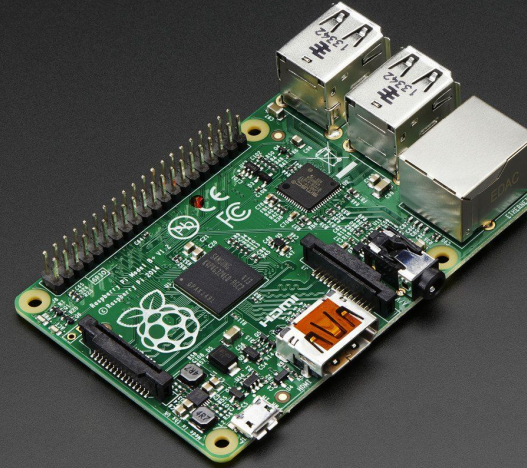
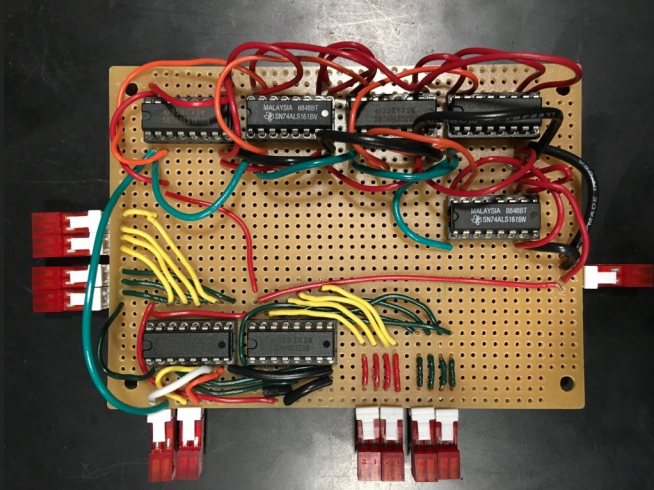
- Distribution: Output
15V±470mV, 1A and
5V±270mV, 500mA



Output Voltage Waveforms

Design - Control Module

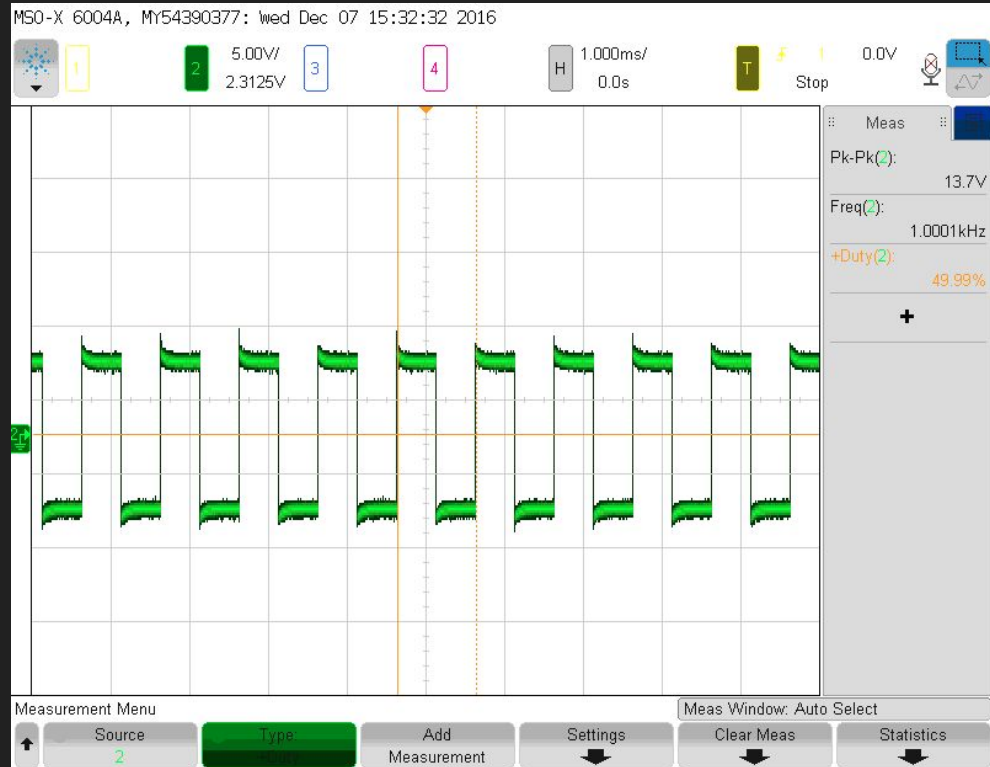
Control Board



Raspberry Pi 3 B [2]

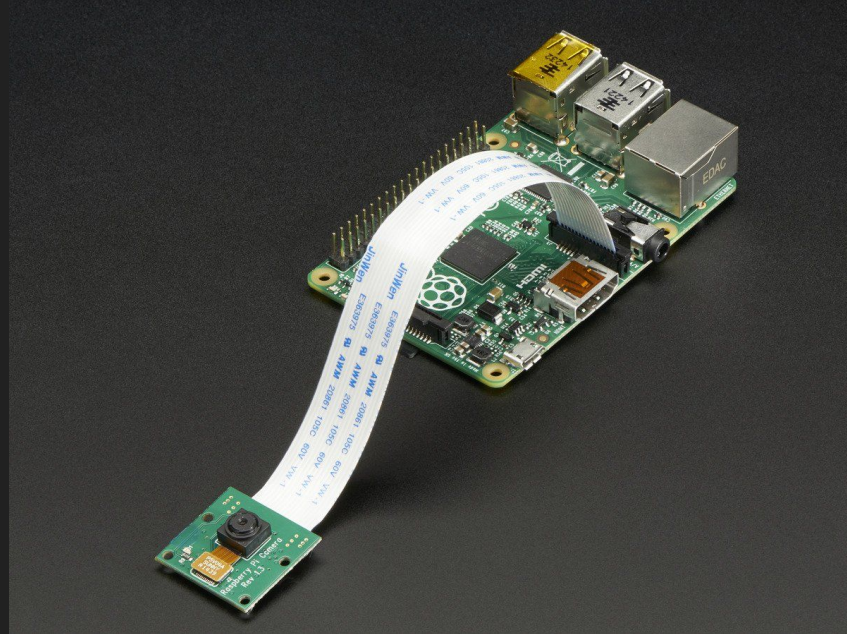
Verification - Control Module

PWM output

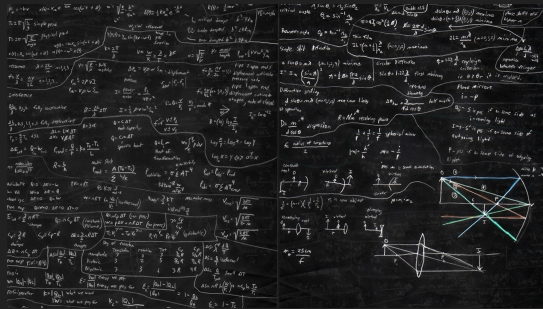


Design - Camera Module

Raspberry Pi 3 B + Camera [3]



Design - Camera Module



$$P_{\text{eff}} = \sigma \epsilon A T_{\text{eff}}^4$$

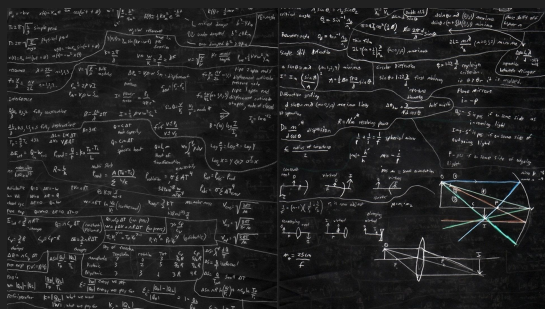


$$P_{\text{eff}} = \sigma \epsilon A T_{\text{eff}}^4$$



ABC

Verification - Camera



$$P_{\text{obs}} = \sigma^2 \epsilon^T A^T \epsilon u$$



$$P_{\text{obs}} = \sigma^2 \epsilon^T A^T \epsilon u$$



ABC

Future Work

- Handwriting recognition
- Control board
- Power

Reference

[1] “H-bridge” Talking Electronics. N.p., n.d. Web. 14 Nov. 2016

[2][Online]. Available: <https://cdn-shop.adafruit.com/1200x900/1914-01.jpg>. Accessed: Dec. 3, 2016.

[3][Online]. Available: <https://cdn-shop.adafruit.com/1200x900/1367-07.jpg>. Accessed: Dec. 3, 2016.

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Accessed: Dec. 3, 2016

Special Thanks

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Questions

