Frostburg J-1

A.C.E (Automated Cleaner and Eraser)

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Motivation, Goal, Impact

- **Motivation**: Manually erasing whiteboards is inefficient and inconsistent
- **Goal**: Design an automatic erasing system that retrofits onto existing whiteboards
- **Impact**: Saves time in classrooms and offices, improves cleaning quality, and reduces physical effort

Future Work

- Scheduled Automation
- Adjustable Blade Pressure
- Bluetooth/Smartphone Connection
- Increased Board Size Compatibility
- Ink Detection System
- Additional Spray Actuation Power

Requirements

- **Affordable**: reasonable priced parts
- **Reliable**: durable components ensuring low maintenance
- **Efficient**: smooth and quick operation
- **Easy to use**: simple interface and automated functions
- **Safe**: reliable fasteners and secure wiring
- **Modularity**: for increased compatibility with different sized rooms and whiteboards

Final Design

- **System Overview:** The ACE board cleaner combines the use of electronic and mechanical systems to automate white board cleaning. Using Arduino and two stepper motors, cleaning blades are moved laterally across the surface of the whiteboard.
- **Mechanical Systems:** (2) NEMA 17, bipolar stepper motors move a gantry plate along a 3-foot rail utilizing a belt system. Whiteboard cleaner is stored in a reservoir that is pumped through a hose located inside one of the blades. A nozzle is attached to the surface of the blade, allowing it to apply the cleaner to the board. Two different cleaning materials are used, a microfiber towel to absorb spray and whiteboard erasers to increase cleaning efficiency.
- **Electrical Systems**: An Arduino controller and limit switches are used to actuate the lateral motion of the gantry system as well as the pump mechanism.

Figure 1: Assembled Final Design

Design Calculations & Decisions

Design Calculations:

Coefficient of friction (μ) = 0.4

Eraser Force (N) = 2N

Friction Force: F=μ*N, 0.8N

Total Force: 6*F, 4.8N

Motor Torque (T): 0.06096 Nm

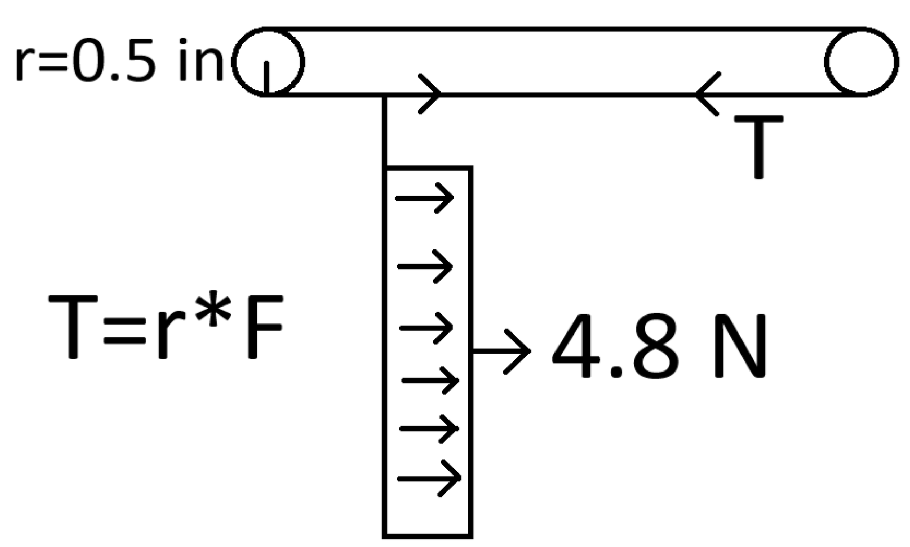

Figure 2: Torque Free-Body-Diagram

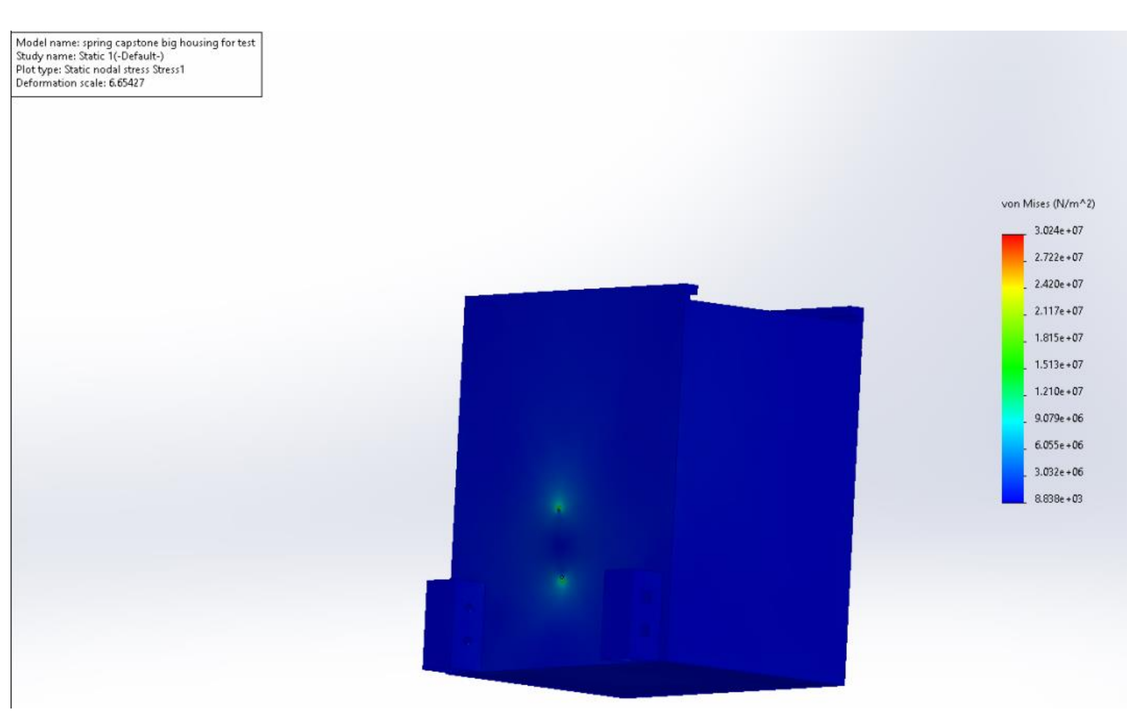

Figure 3: Reservoir Housing Finite Element Analysis

Decisions

- AHP was utilized to determine the manufacturing process for each of the housings. 3D printing was chosen for the low cost and the ease of manufacture through Inventor.
- A Weighted Decision Matrix was also utilized to determine the material of the cleaning blades. Steel was chosen for its strength and its resistance to liquid damage

Prototype & Test Results

Alpha Housing Prototype

- 3D printed from ABS
- Walls lacked stability at 0.1in
- Cleaning blades were spaced too far apart
- Fluid reservoir and cleaning blades did not fit

Beta Housing Prototype

- Wall thickness increased to 0.15in
- The dimensions of the housing were corrected
- Added screw holes for gantry connection
- Added lid stabilizer
- Lid of housing was too small

Figure 4: Alpha Housing Prototype

Final Housing Design

- 3D printed from Onyx
- Correct lid size
- Adequate dimensions
- Proper cleaning blade spacing

Figure 5: Beta Housing Prototype