



BathMate



Supporting Independence, One Bath at a Time.

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Problem Statement

ME/CFS affects ~3.3 million U.S. adults and severely limits energy, making basic tasks like **bathing physically debilitating** (Vahratian et al., 2023). Existing solutions fail to address this, leaving many **unable to maintain hygiene independently**.

Methodology

1

Concept Generation
→ Multiple design ideas

2

Design Selection
→ Proof of Concepts & Pugh Chart

3

CAD Modeling
→ 3D printed support structures, soap holder

4

Prototype Development
→ Mechanical & Electrical Build

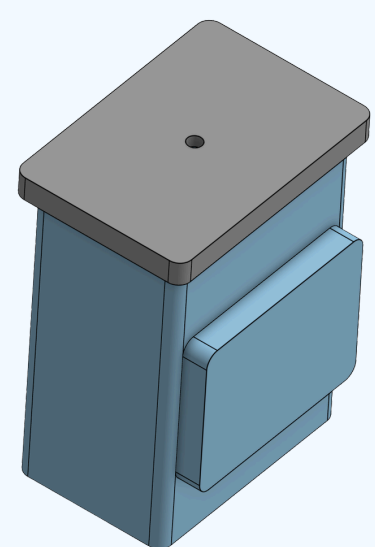
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Testing & Iteration
→ Performance, Safety, Versions

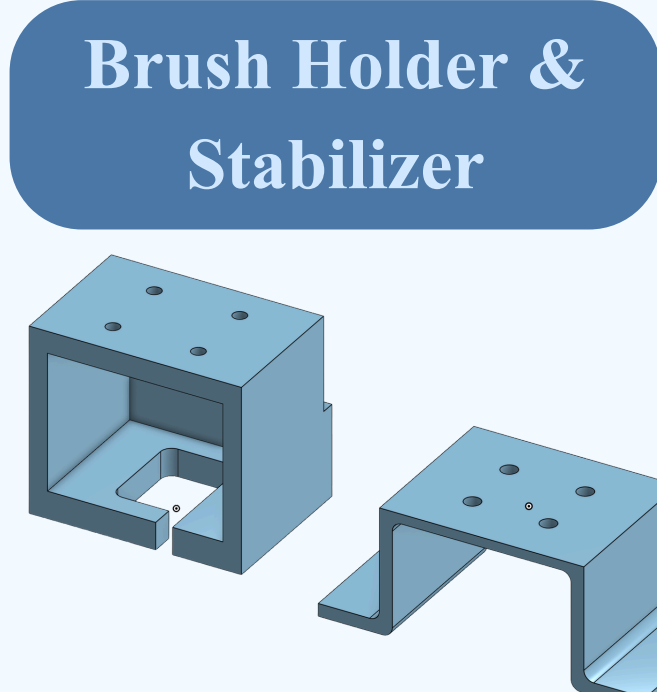
Requirements

Criteria	Current Design
User independence	Yes
User support during use	Yes
Reduction of arm/overhead movement	Yes
Motion performance (precision + coverage)	Yes
Speed of operation	Yes
Stability during operation	Yes
Size/space compatibility	Yes
Cost effectiveness	Maybe
Durability/material quality	Yes
Ease of maintenance & cleaning	Yes
Adjustability/user adaptability	Yes

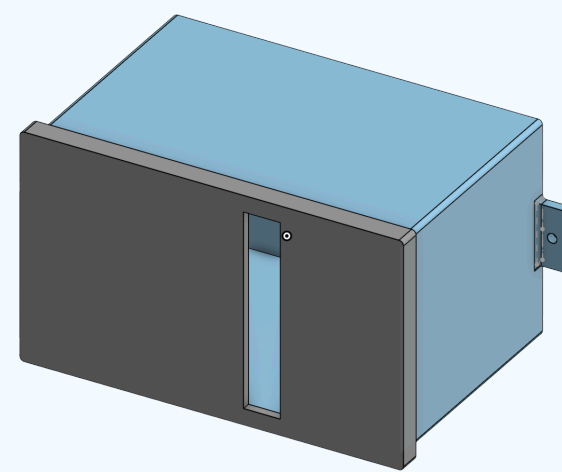
Important CAD Designs



Soap Box



Brush Holder & Stabilizer



Electrical Box

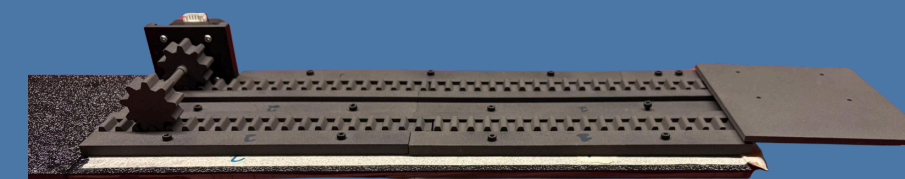
Engineering Goal

The goal of this project is to create an **affordable, non-invasive bathing device** that allows individuals with ME/CFS to maintain hygiene independently while **minimizing physical exertion**. By automating the cleaning process, BathMate helps preserve users' limited energy and **improve quality of life**.

Design Versions

Version 1

Rack and Pinion



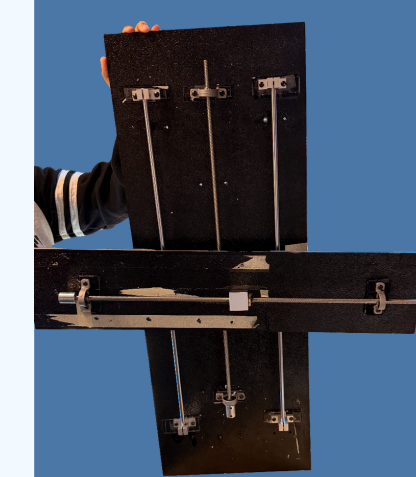
Used a 16" rack and pinion for horizontal movement.

Pros: Fast, Smooth

Cons: Unstable, extends off board

Version 2

Double Lead Screw

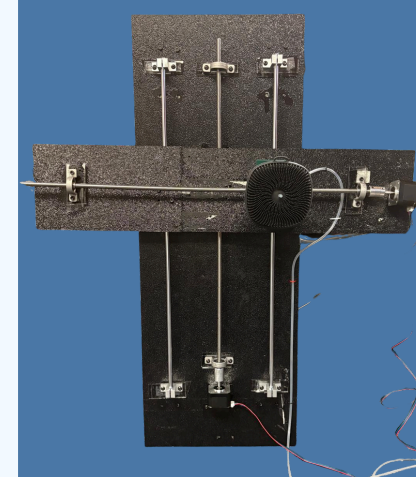


Used a double lead screw mechanism for horizontal and vertical movement

Pros: Clean Movement

Cons: Slow

Version 3

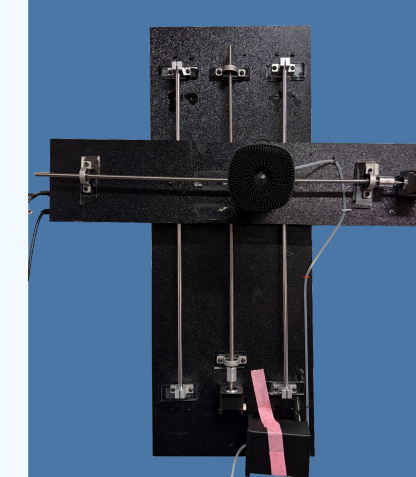


Added brush scrubber and holder and tubing for the soap dispenser.

Pros: Pumps soap

Cons: Detached soap box and unstable brush

Version 4



Added soap box and coded step sizes for motors

Pros: Clean soap pumping and stable brush

Cons: Open wiring with no waterproofing

Conclusion

- Successfully created a **non-invasive** device capable of scrubbing a ME/CFS patient's back **without** having them **move** or **overexert** themselves.
- The device has **optimal cycle times** and smooth **axial movement**.

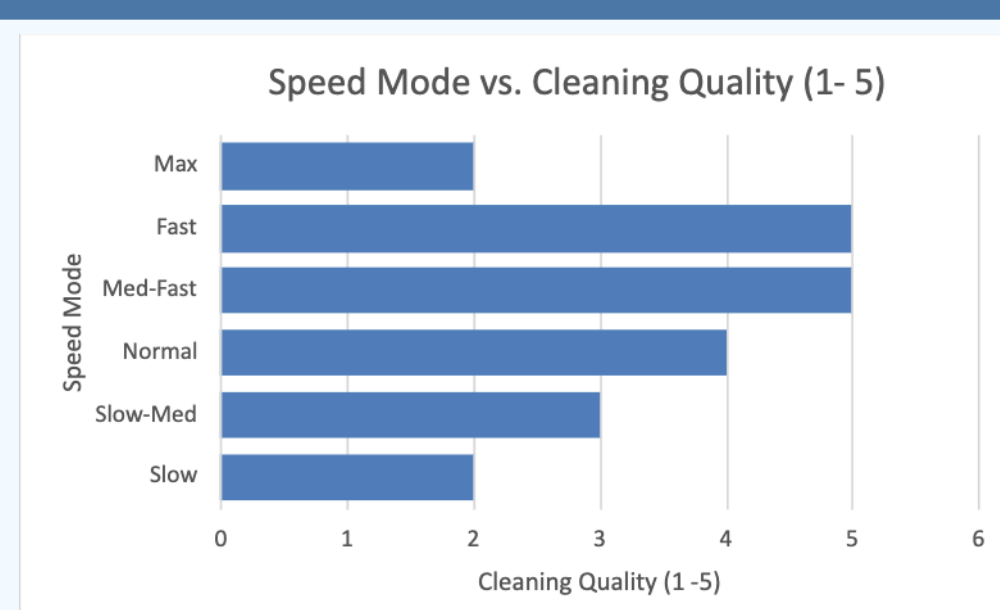
Future Work

- **Hide piping and wiring** for a cleaner, safer design.
- **Improve electrical security** and protection.
- Add **water-resistant protection** around wiring and piping.
- Create a more advanced, **user-friendly interface** with clearer controls.
- Add **remote control** for machine speed and direction.

Design Studies

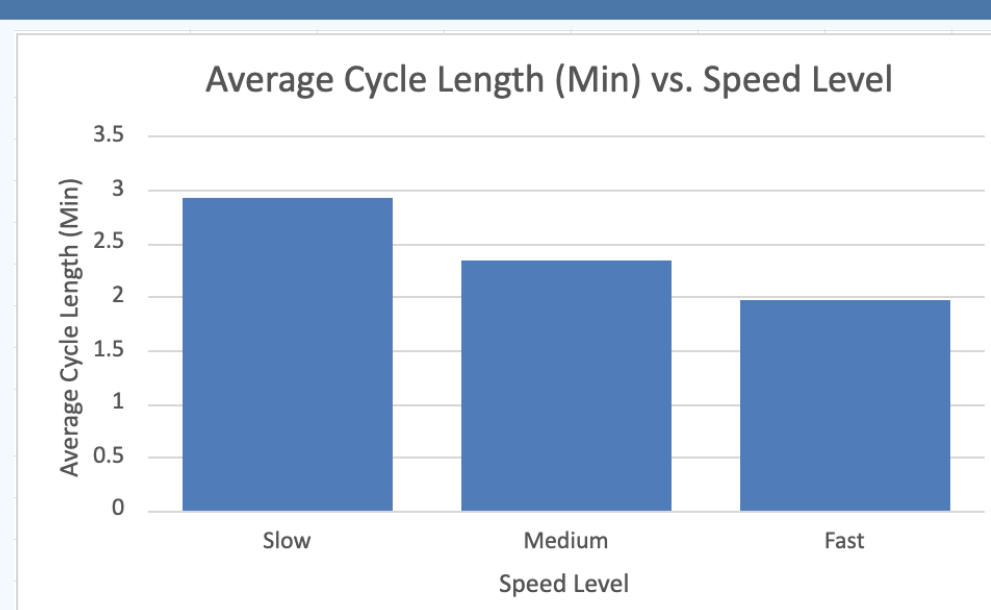
Design Study 1:

Cycle speeds for the user



Design Study 2:

Time for one cleaning cycle



Design Study 3:

Soap canister position and speed

