Sponge Desiccation and Microbial Sanitation System for Individuals with Muscular Weakness

CEO Ananth Gomattam, **CTO** Corey Lu, **CMO** Rohan Gulati, & **CIO** Jasmine Palit

Advisor: Kevin Crowthers, Ph.D.

Problem Statement

Individuals with **musculoskeletal disorders** and **age-related muscle weakness** lack a low-effort, automated mechanism to simultaneously **desiccate** and **sanitize** kitchen sponges, preventing them from **independently** completing everyday cleaning tasks without risking bacterial contamination.

Muscular Weakness

↓

Inability

Users are unable to wring out wet sponges independently.

Over-Reliance	Bacteria
Lack of independence for basic house chores such as scrubbing the dishes.	Increased bacterial growth in wet sponges, lead to harmful effects when the "cleaned" dishes are used for dining (Ikawa & Rossen, 1999).

Level 1 Requirements

- The device must remove at least **90%** of free water in the sponge.
- The device must have a **fast cycle under 20 seconds.**
- The device must have a deep clean cycle under **10 minutes**.
- The device must require a grip strength of less than **34.86 kg** to operate.
- The device must be **physically** and **electrically safe** with **no electronic** parts **exposed** to **water**.
- The device must **protect** the **structural integrity** of the sponge.

Designs

Design 1: Sandy

Features

- **8 mm** compression distance
- **Flat** rollers

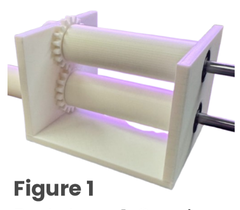

Figure 1
Prototype 1: Sandy

Pros

- Water Removal through Compression

Cons

- Ineffective Grip
- Loose Handle
- User Placement Requirement

Design 2: Larry

Features

- **5 mm** compression distance
- **Flat ridged** rollers
- Flat **raised platform**

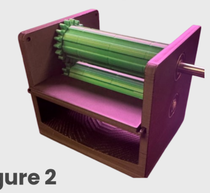

Figure 2
Prototype 2: Larry

Pros

- Increased Roller **Grip** and **Compression**
- User **Sponge Placement**
- Functioning Handle

Cons

- Lack of **Food Debris Removal** from Rollers
- Ineffective **Platform Angle**

Design 3: Mrs. Puff

Features

- 5 mm compression distance
- Spike ridged rollers
- Angled raised platform

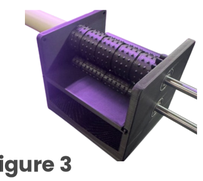

Figure 3
Prototype 3: Mrs. Puff

Pros

- **Food Debris** Removal
- Effective **Placement Angle** for Sponge

Cons

- Lack of Sufficient **Compression** in **Subsequent** Passes

Design 4 (Current Design): SpongeBob

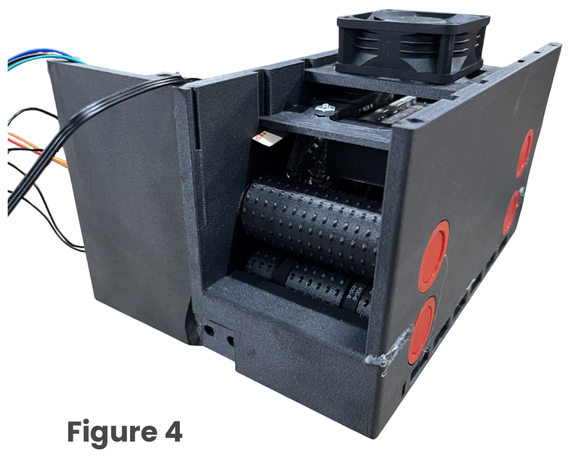

Figure 4
Prototype 4: Spongebob

Features

- **5 mm** compression distance.
- **Spiked** rollers for the 1st compression.
- **Flat ridged** rollers for the 2nd compression.
- Functioning **belt system** to transport the sponge.
- **Fan** and **heater system** to disinfect the sponge through its cycle.
- **UV Light disinfection system** through the cycle.

Pros

- Multiple **methods** of **disinfection**.
- **Fast Cycle** and **Extended Disinfection Cycle**.

Cons

- Limited **reflection** inside frame for **UV Light**.
- **Single-side** heating for only **one side** of the sponge.

Methodology

Design Roller Compression System using CAD (Onshape).

↓

Test and Identify the Ideal Roller Shapes and Distance.

↓

Assemble the Autonomous Roller System.

Design the Frame and Heater-Fan Structure.

↓

Wire and Assemble the Heating and UV Light Systems.

Combine the Roller System with the Disinfection System Inside the Final Frame.

Design Study 1

Roller Distance and Type

Purpose: To identify the ideal distance and type of roller water removal.
Independent Variable: Roller Type
Dependent Variable: Grams of Water Removed
Conclusion: Spiked Rollers for 1st squeeze. Ridged Rollers for 2nd squeeze. 5 mm compression distance for sponge. 34.8 grams of water removed in total.

Figure 5
Roller Distance and Type Study Setup

Design Study 2

Heated Temperatures

Purpose: To identify how many seconds it would take the sponge to reach the ideal temperature of 140° F.
Independent Variable: Time (sec)
Dependent Variable: Temperature the of Sponge in Fahrenheit
Conclusion: Through 5 trials, it takes 90 seconds for the sponge to reach 140° F.

Figure 6
Time to Ideal Temperature Study

Design Study 3

Bacteria Testing with Heat

Purpose: To identify how the PTC heater affects bacteria on sponges.
Independent Variable: Temperature of the Sponge
Dependent Variable: Amount of Bacteria Present
Conclusion: The sponge should be placed with the yellow side closest to the heater, as it contains the most bacteria.

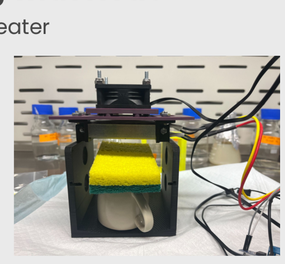

Figure 7
The Affect of Heat on Bacteria

Conclusion and Future Work

- The final prototype effectively **eliminates water** from the sponge by **compression** and **heating**.
- The heater also has the ability to **sterilize** the sponge and **remove bacteria** for safer usage.
- The prototype effectively uses **UV lighting**, preventing **surface bacteria**.
- Safely increase the **temperature** of the sponge to greater than **160° F** for **maximum sterilization**.
- Allow the user to **place the sponge** away from **open machinery** to encourage safety.
- Allow for the **roller distances** to be **adjustable** for **different sized** sponges.