DEPARTMENT OF MECHANICAL ENGINEERING

Elderly Item Pick-Up Device (Team B4)

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Motivation, Goal, Impact

Create an assistive device for the elderly and physically disabled to retrieve items off the ground without having to bend as most commercially available grabber tools do not have retractable mechanisms with fully encompassing end-effectors.

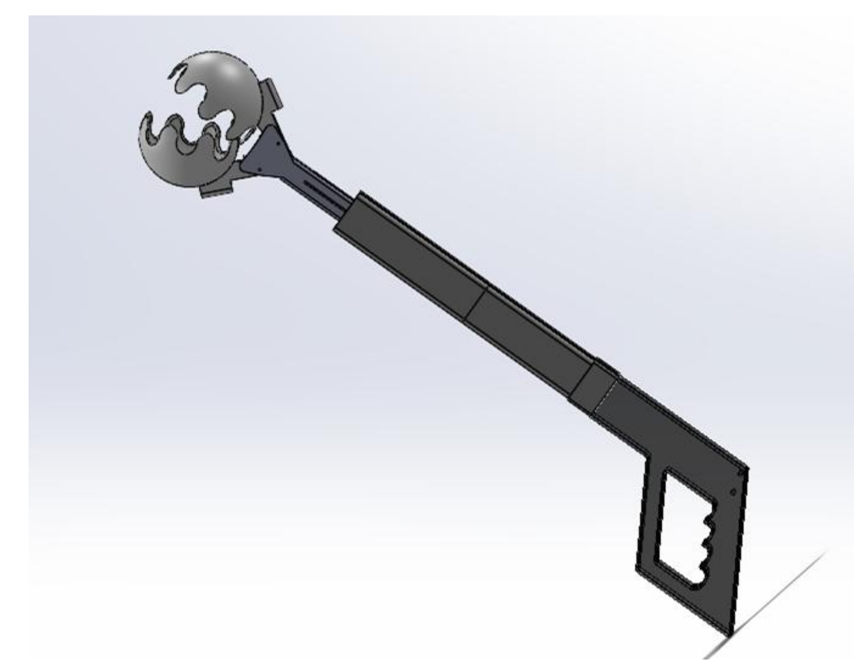
Allow the elderly to safely pick up small common items such as keys, pills, and hearing aids that they have trouble retrieving, from various surfaces such as carpet, bumpy terrains, and sand.

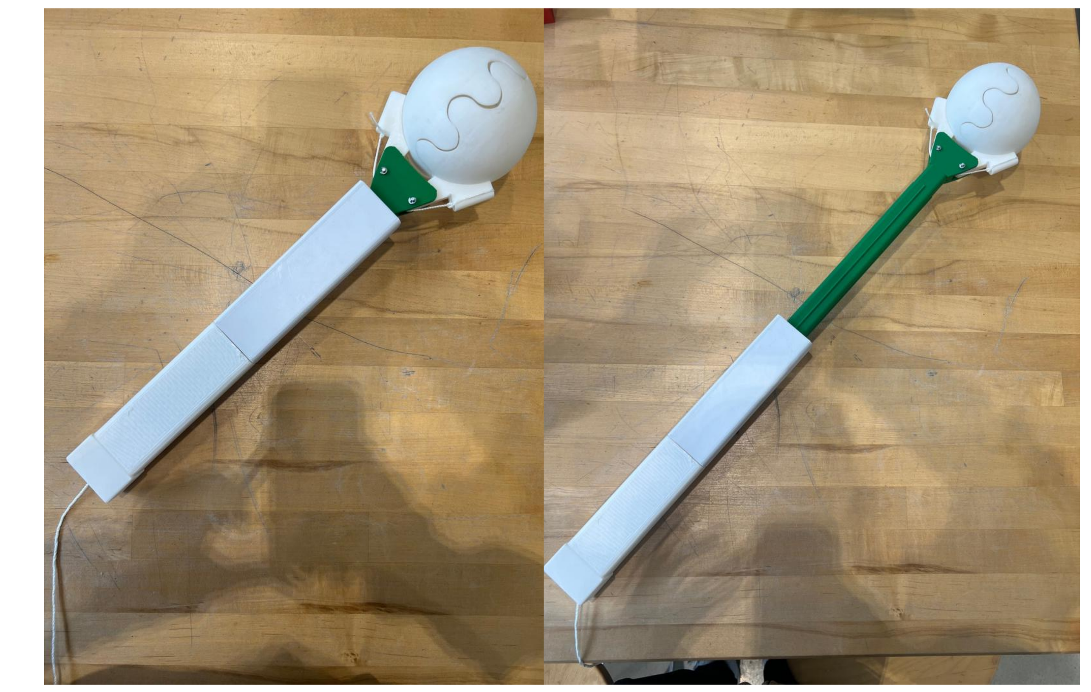
Our motivations for this project came from our experience either working with elderly assistive devices in the past in addition to having family members that would benefit from this device.

Requirements

- Fully Mechanical
- Costs <$100
- Elderly must be able to use device to pick up a tiny item (e.g. pill, key, bottle cap) from any floor (e.g., cluttered floor, carpet, beach sand) without bending and without a significant fine finger control
- Retractable length allowing for versatility of the device
- Jaws should have enough grip to grab, hold, and move objects without slipping

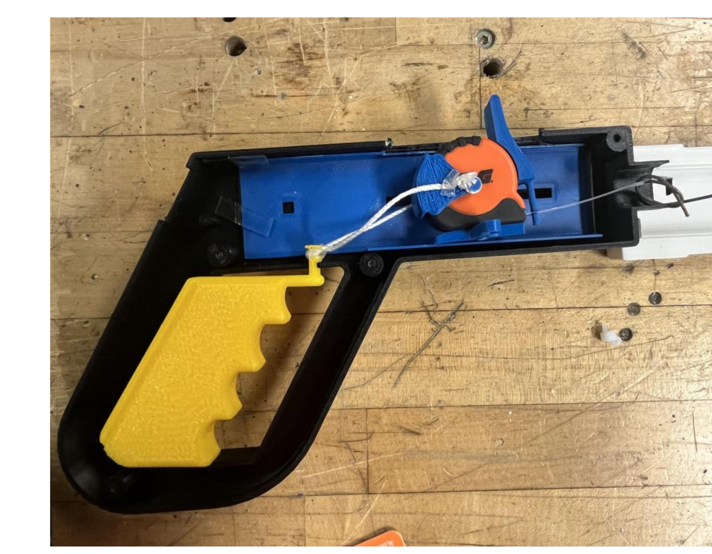
Final Design





HIPPOCHOMPER

- Final Materials for Bulk Production
  - Shaft
    - Injection Molded ABS
  - Handle
    - Injection Molded ABS
  - Jaw
    - Injection Molded TPU

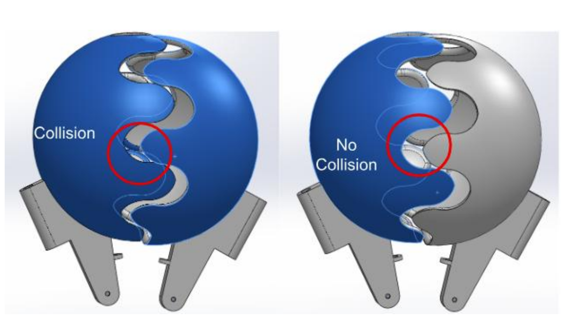


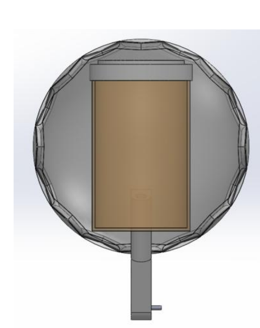
Design Calculations & Decisions

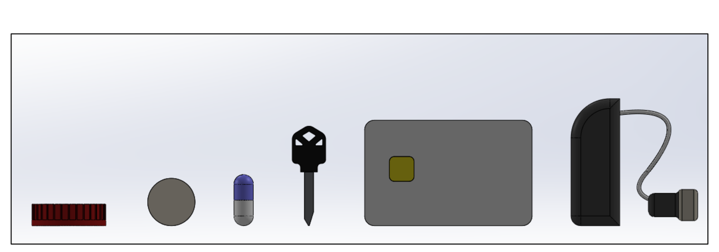
- **Geometry of Teeth & Size of Jaws**
  - Conclusion: Teeth have a rounded design, and jaws have an inner diameter of 4.00" and an outer diameter of 4.12"

TABLE 2
SMALL ITEM DIMENSIONS

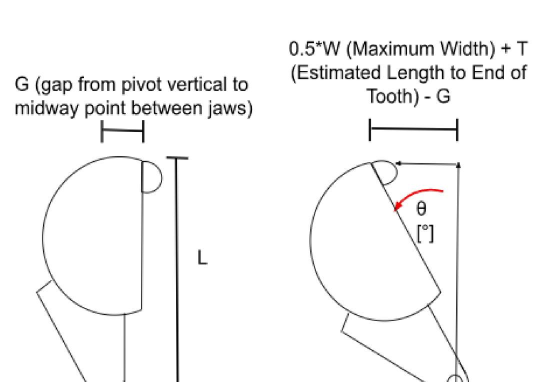
Item	Volume (cm^3)	Largest Dimension (cm)
Pill	1.37	2.61
Full Pill bottle	40.1	10.1
Typical House Key	1.42	5.21
Coin (Quarters)	0.81	2.46
Bottle Caps	12.5	3.80
ID Cards	3.51	8.60
Hearing Aids	106	6.50

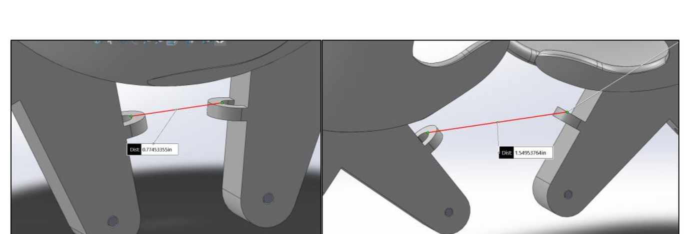






- **Jaw Spring Selection**
  - Conclusion: Spring unextended length is less than 0.775" and extended length is more than 1.55".

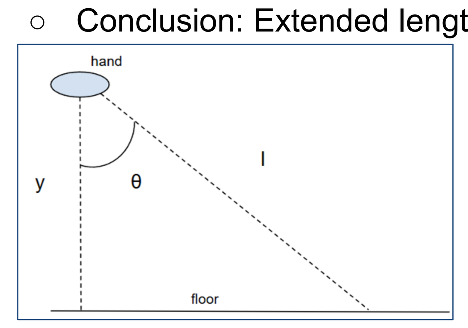




$$L\sin\theta = 0.5\,W + T - G$$

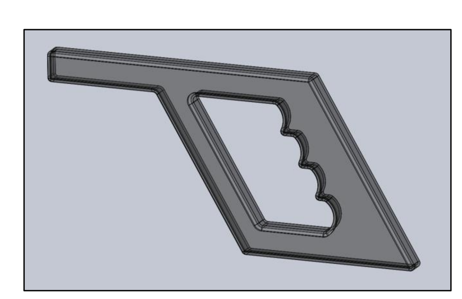
$$\theta = \sin^{-1}\left(\frac{0.5\,W+T-G}{L}\right) = \sin^{-1}\left(\frac{0.5*4[in]+1.19[in]-0.66[in]}{5.24[in]}\right) = 28.9°$$

- **Extended and Retracted Length of Device**
  - Conclusion: Extended length will be ~34.6" and retracted length will be ~24.2"



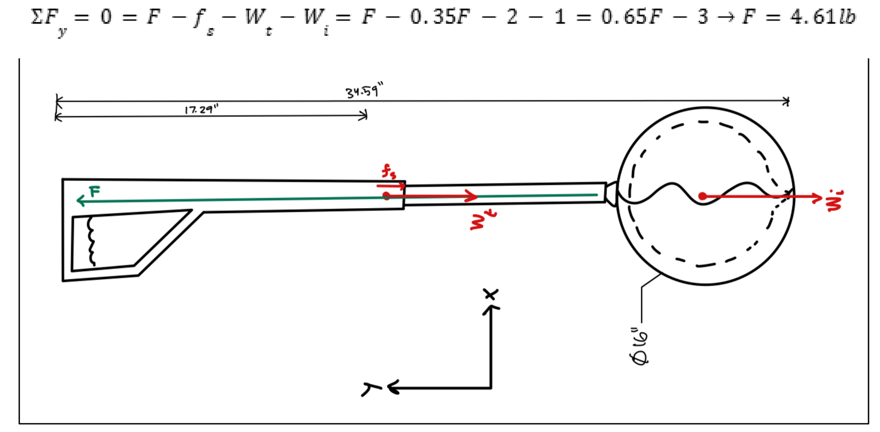
- $l_{max} = \frac{29.96}{\cos(30)} = 34.59\ in$
- $l_{min} = \frac{29.96*.7}{\cos(30)} = 24.22\ in$

- **Geometry of Handle**
  - Conclusion: Handle has a 0.827" grip width and 0.969" depth with a 0.1" shell thickness.

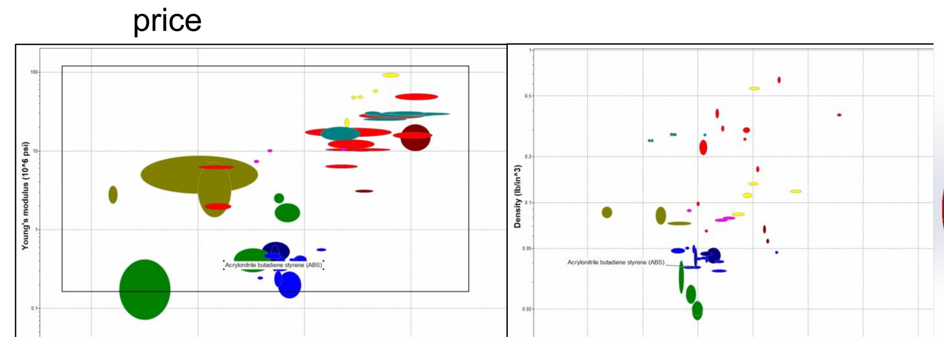


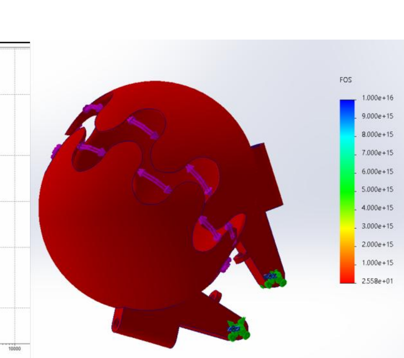
- **Clock Spring Selection**
  - Conclusion: Clock spring has a minimum spring force of 4.61 lb and a maximum width of 0.677"

$$\Sigma F_y = 0 = F - f_s - W_t - W_i = F - 0.35F - 2 - 1 = 0.65F - 3 \rightarrow F = 4.61 lb$$



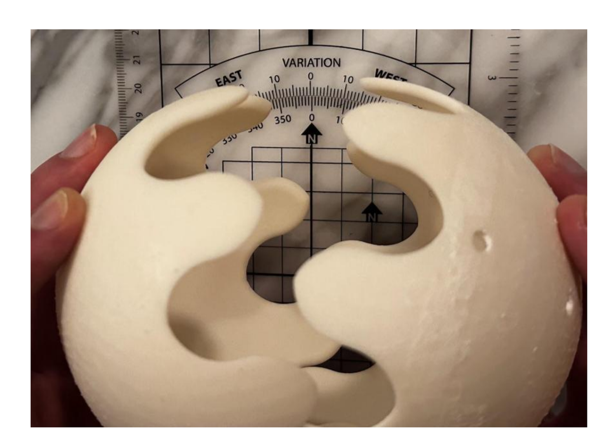
- **Material Selection of Jaws**
  - Calculations: Minimum Young's Modulus, Granta Edupack analysis, maximum price



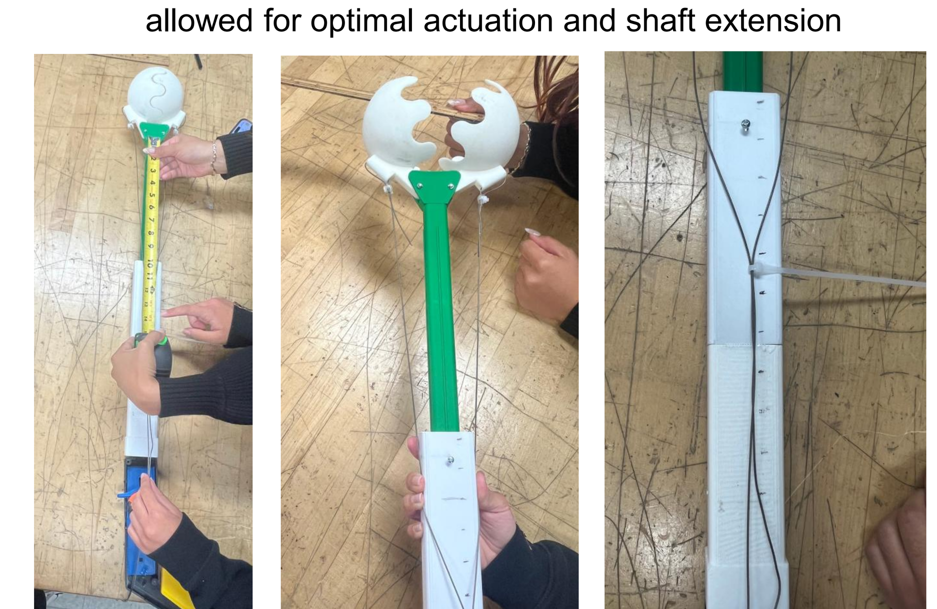


Prototype & Test Results

- **Angle of Jaw Acutation**
  - Maximum jaw opening 30° ± 2.5°
- **Jaw prototype**
  - Resin → TPU
  - Spring force: 1.3 lbf/in → 2.4 lbf/in



- **Jaw Cable Routing**
  - Jaws require less force to actuate when cables enter shaft further from them
  - Entering too low limits shaft extension
  - Entrance holes 2 inches down from pivot points allowed for optimal actuation and shaft extension



- **Clock Spring Testing**
  - Original: too strong to implement
  - Safety hazard: fully automatic retractability to user-based design

- **Angle of User Operation**
  - Functional at all tested angles
  - Materials: pill, pill bottle, mashed potato adjacent

$$\theta_1 = 0°$$

$$\theta_2 = \tan^{-1}\left(\frac{5.5}{26.25}\right) = 11.8°$$

$$\theta_3 = \tan^{-1}\left(\frac{11}{24.25}\right) = 24.4°$$