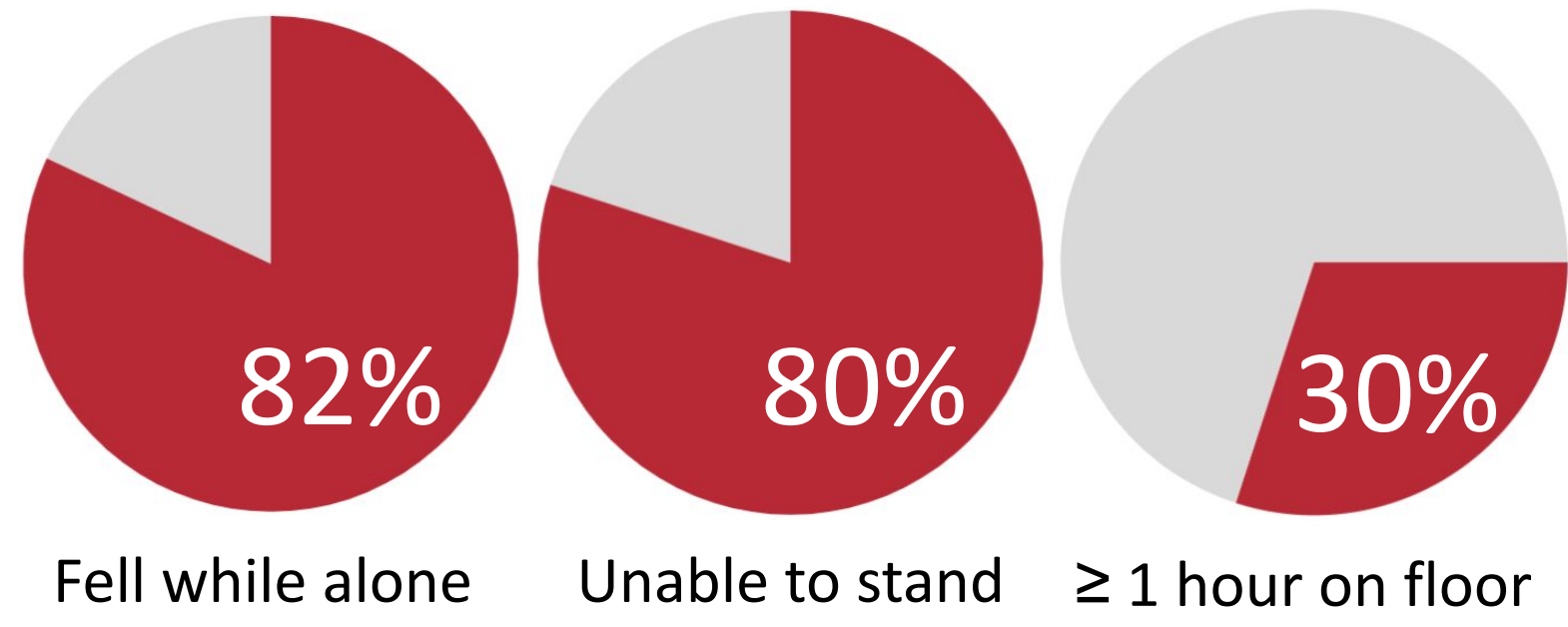


Motivation, Goal, Impact

14,000,000 annual falls worldwide [1]

In a 2008 study [2]:



The team aimed to create a device for the elderly that helps them stand back up by themselves after a fall.

This device will alleviate fear of falling, restore independence, prevent long-lie injury, and reduce medical expenses.

[1] CDC. 2023 [2] Fleming, J. 2008

Requirements

The device is accessible for people with reduced strength/mobility

→ Lift user's full bodyweight

The device is sturdy and stable

→ Prevent tipping and deflection

The device is comfortable

→ Minimize lifting time

The device is compact

→ Minimize volume, surface area

The device does not require assistance from another person

→ Simple, passive operation

Final Design

Foldable, motorized lifting chair add-on for standard walker

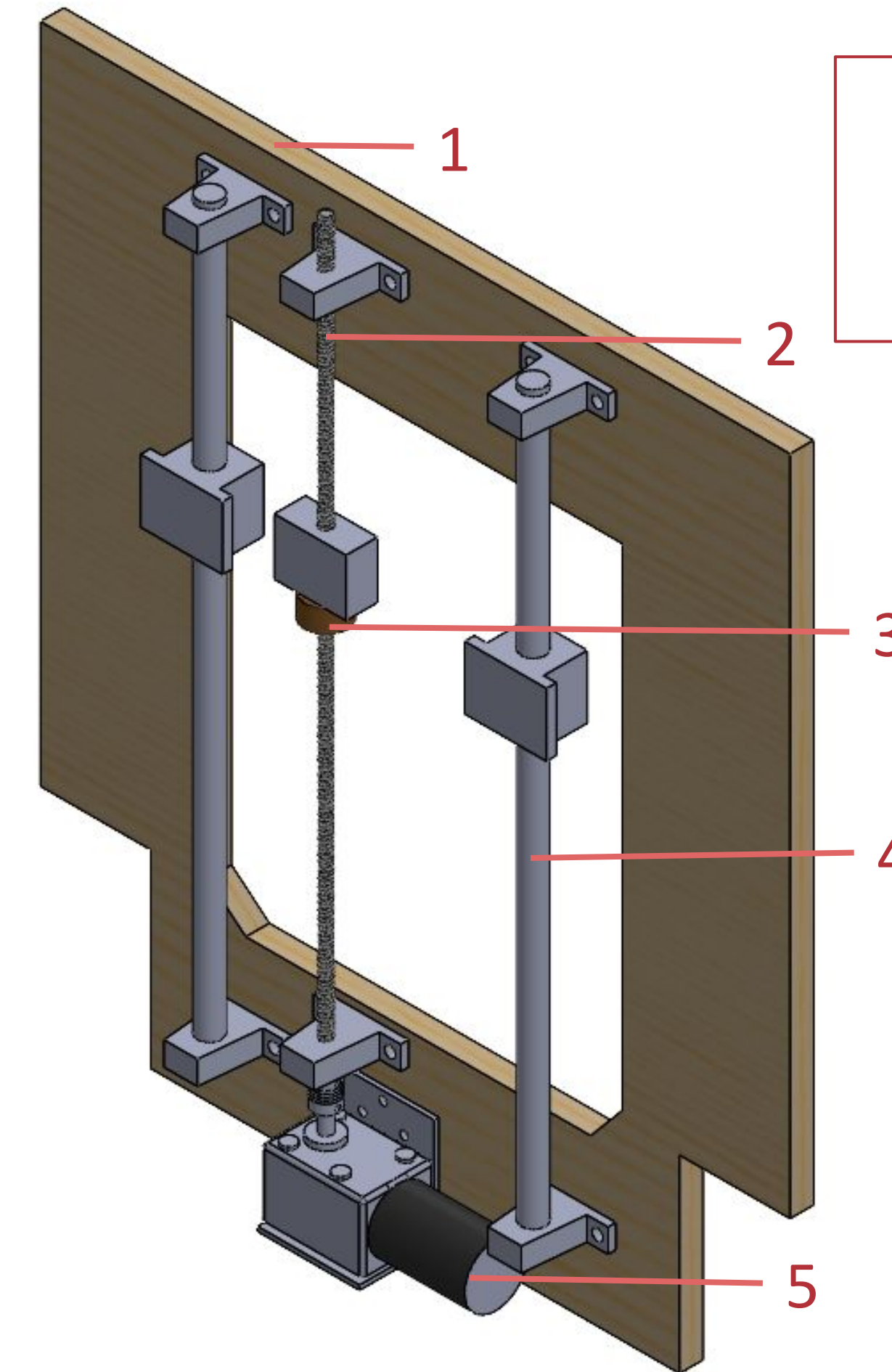


Figure 1. Lifting sub-assembly (SolidWorks)

Lifting sub-assembly components

1. Base frame
2. Lead screw
3. Lead nut
4. Linear rails
5. Motor

Full assembly components

6. Chair seat
7. Mounting collars
8. Lifting sub-assembly

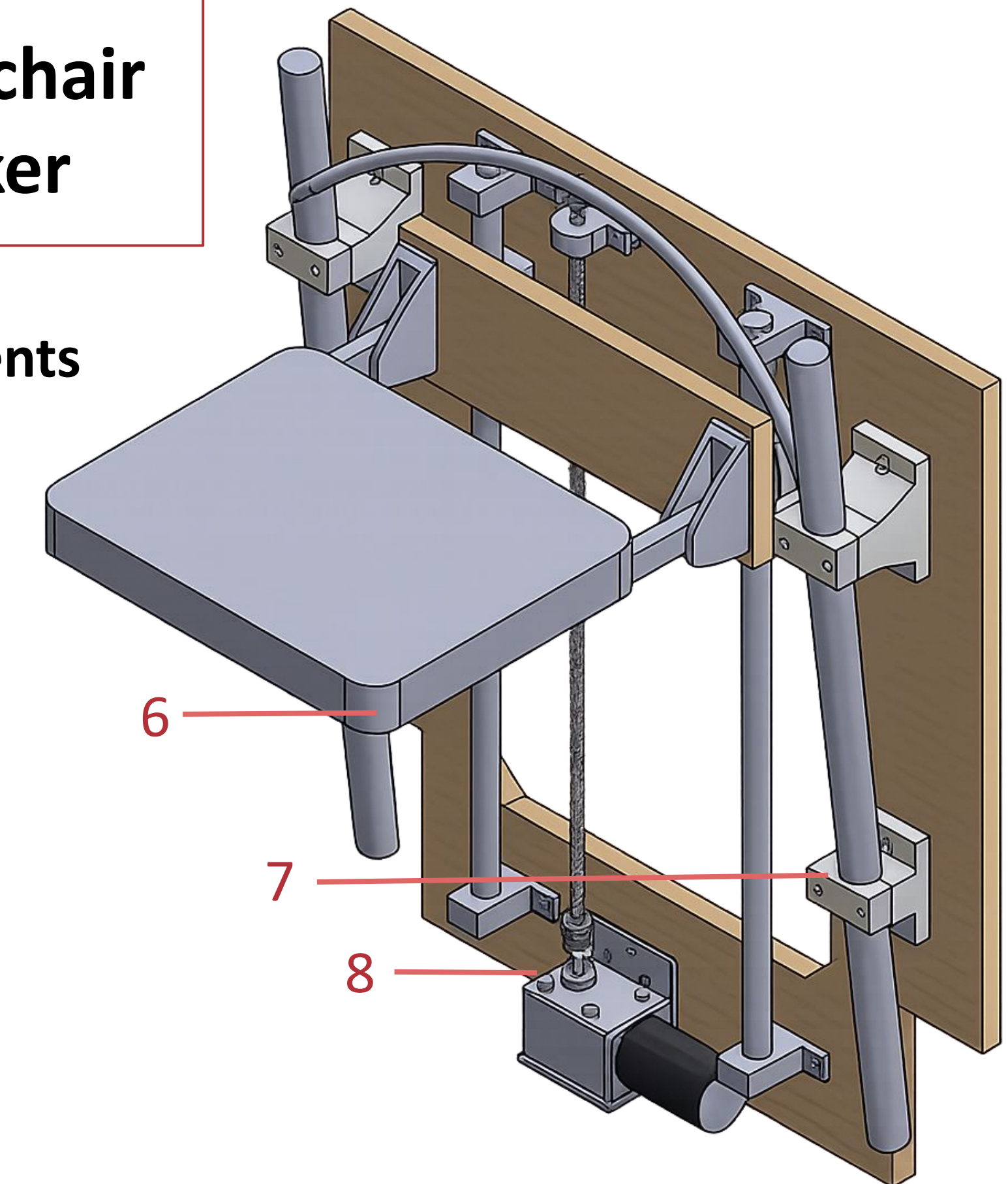
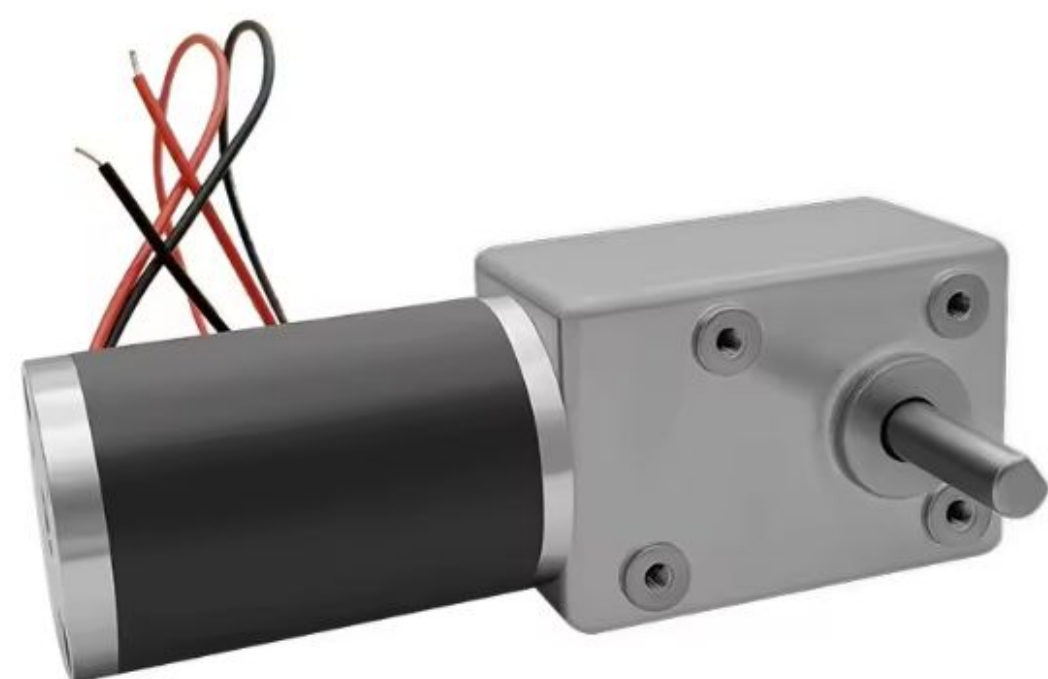


Figure 2. Full Assembly (SolidWorks)

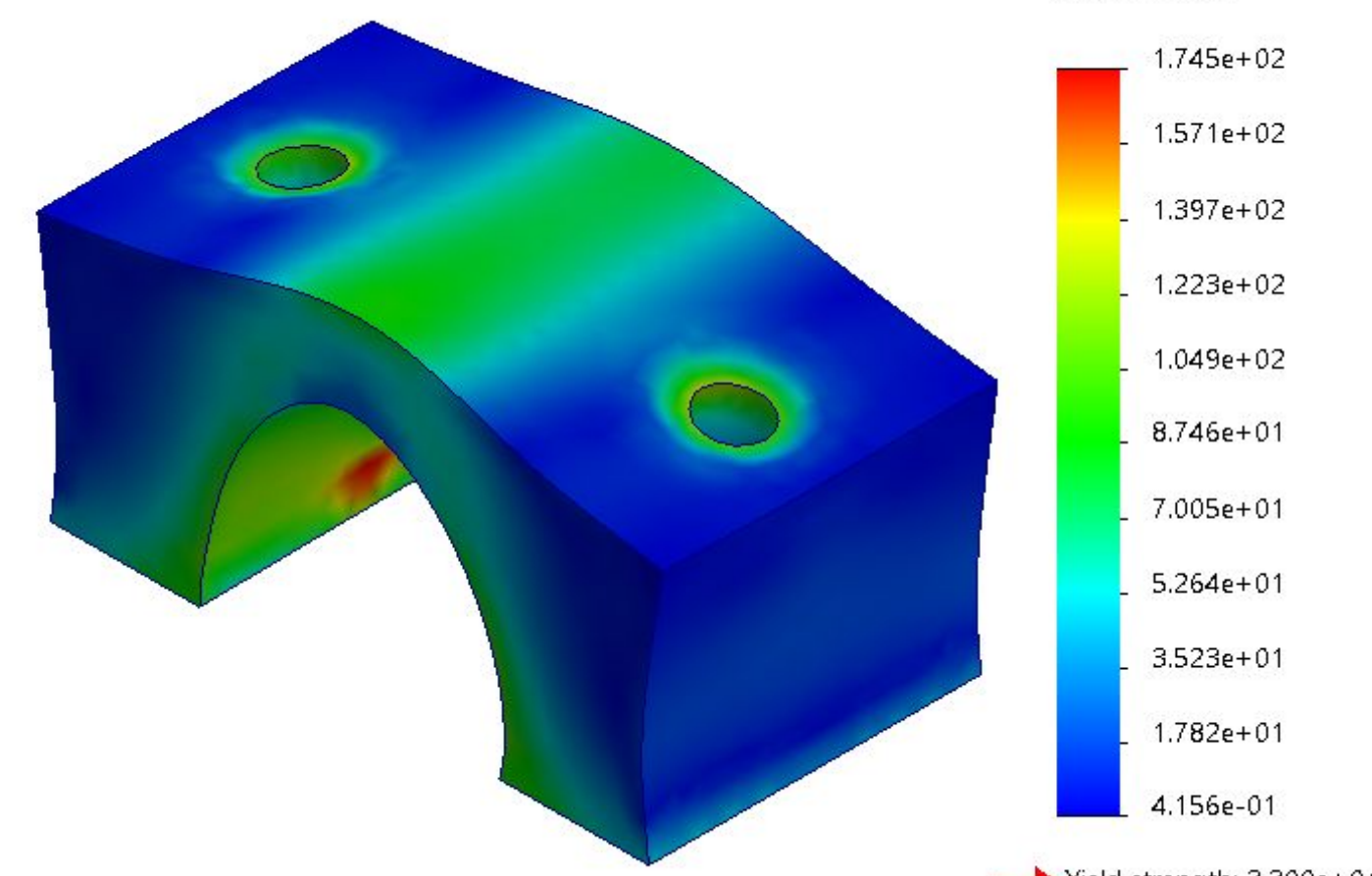
Design Calculations & Decisions



Motor selection [3]

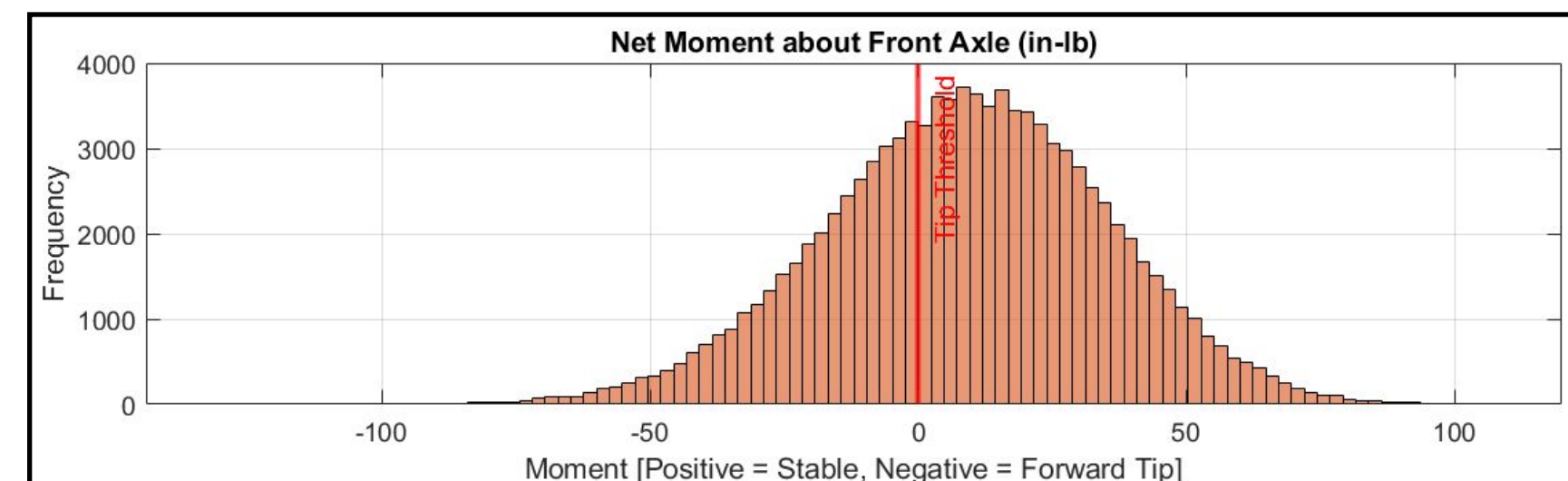


Battery selection [4]



FEA of Machined Clamps [5]

Input Data			Calculated Data
Component	Force (lb)	Coordinate Constraint(s) (in. from origin)	Optimized Z-Coordinate (in. from origin)
Battery	2.65	$-2 < z < 17.5$	$z = 17.5$
Motor	2.2	$-2 < z < -0.5$	$z = 0$
Lead Screw	0.548	$-2 < z < -0.5$	$z = 0$
Linear rail	6.211	$-2 < z < -0.5$	$z = 0$
Walker frame	7.5	$z = 5.25$	$z = 5.25$
User on handles	87.5	$z = 9.5, y = 35$	$z = 9.5$
Wood base	7	$z = z_{\text{linear rail, motor, lead screw}} + 1.375$	$z = -1.375$
Chair	3	$z = 3$	$z = 3$



Uncertainty propagation for tipping risk about front wheels (above) [6]

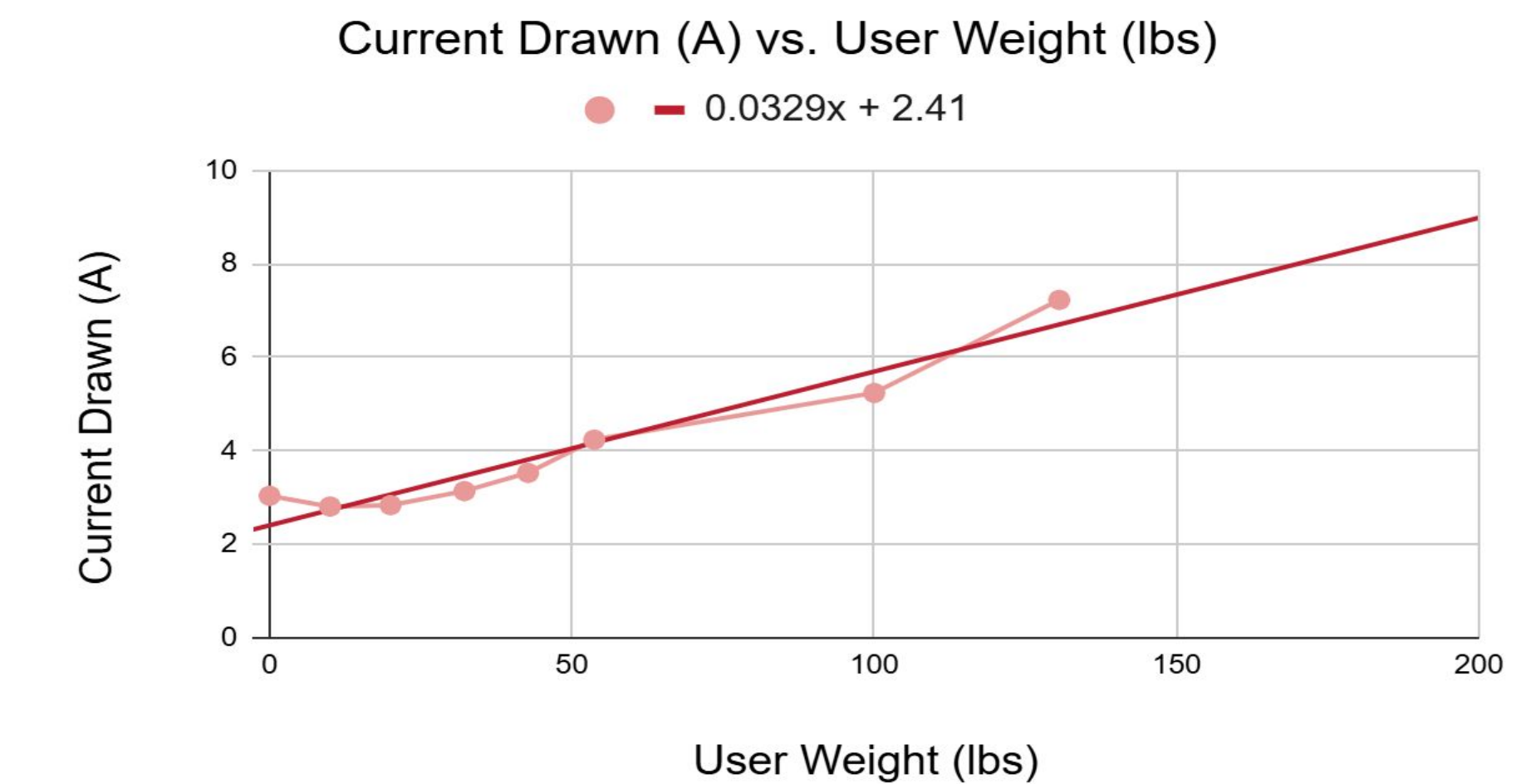
Formal optimization of component mounting locations (left)

[3] China Motor Factory Store [4] NERMAK [5] Generated with SolidWorks [6] Generated with MATLAB

Prototype & Test Results

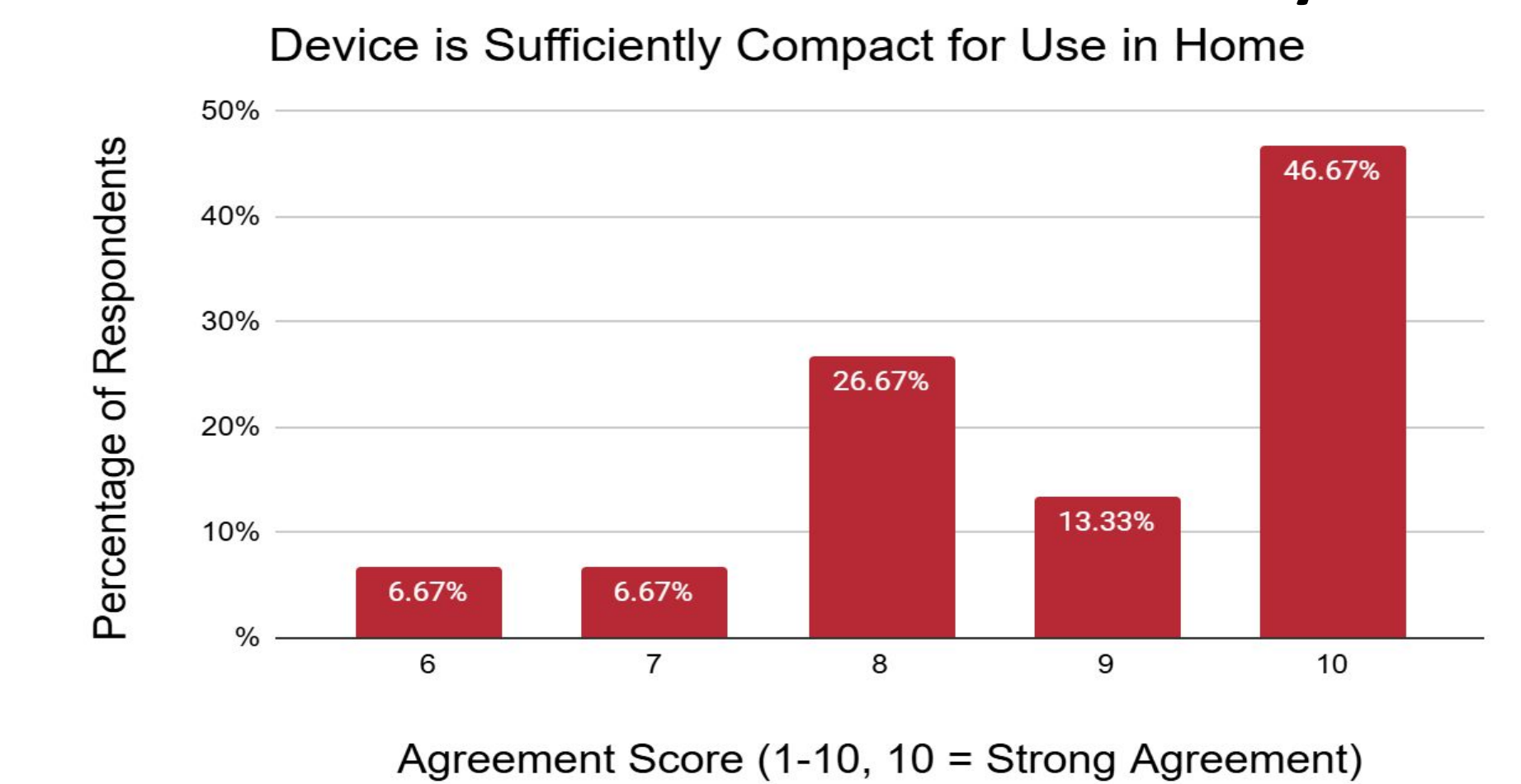


Current and Battery Charge Analysis



Relationship between weight and current to evaluate number of lifts per battery charge per user weight

Stakeholder Trust and Comfort Survey



Assessed device's fulfillment of all customer requirements