

**Problem Definition**

**Injuries & Safety Concerns Associated with Stairs:**

- >1 million stair-related injuries per year for past 23 years (USA)
- 27% of people over the age of 60 live alone (USA)
- 50% of homes have multiple floors (USA)

**Insufficient Existing Solutions:**

- Conventional walkers do not function on stairs
- Canes provide limited support
- Stair lifts are costly and stationary
- Stair railings are inconsistently available

**Stakeholder Requirements:**

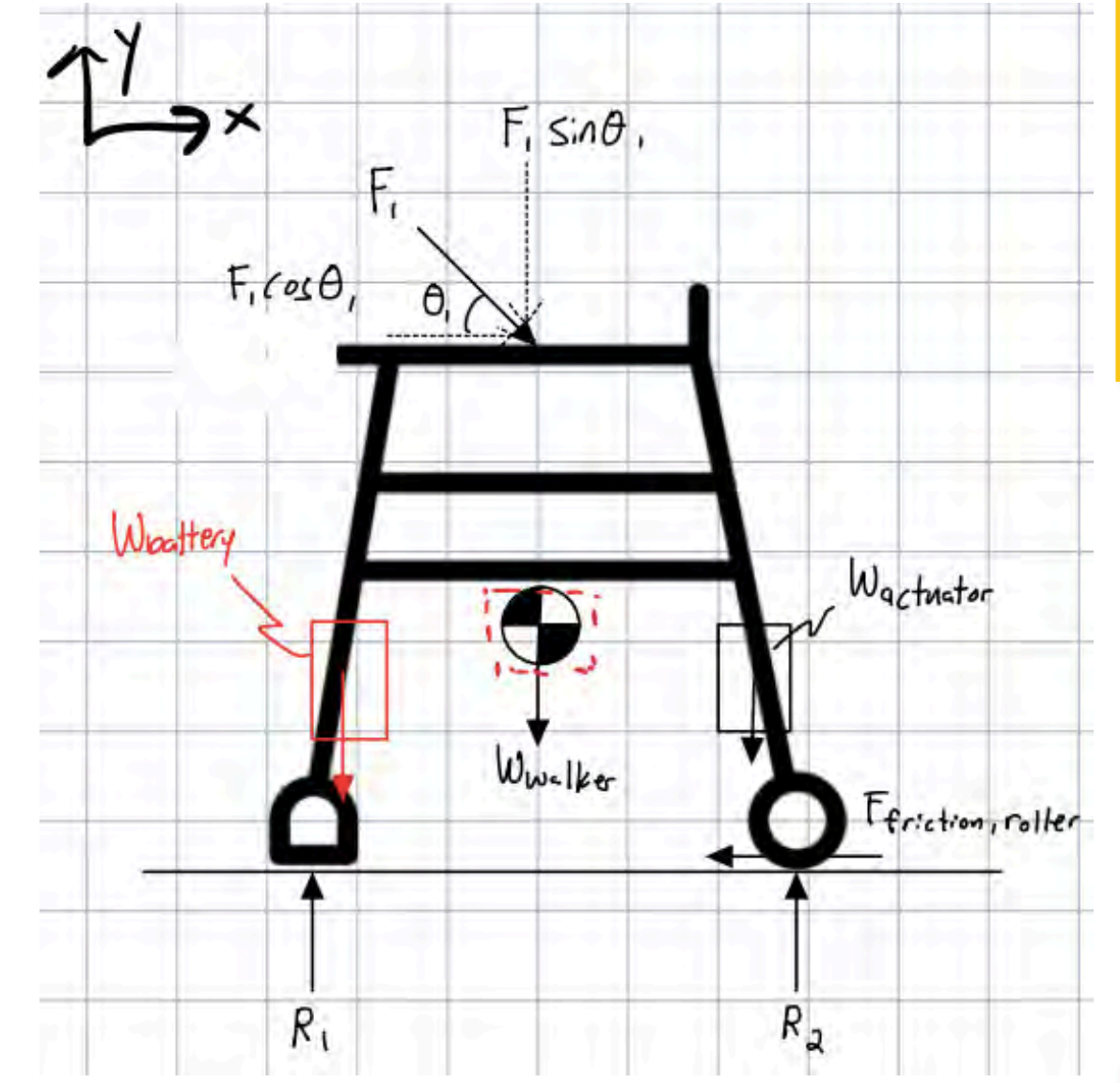
- Provide support on flat surfaces and stairs
- Allow for safe, simple, independent use
- Lightweight, inexpensive, long lasting

**Design Calculations & Analysis**

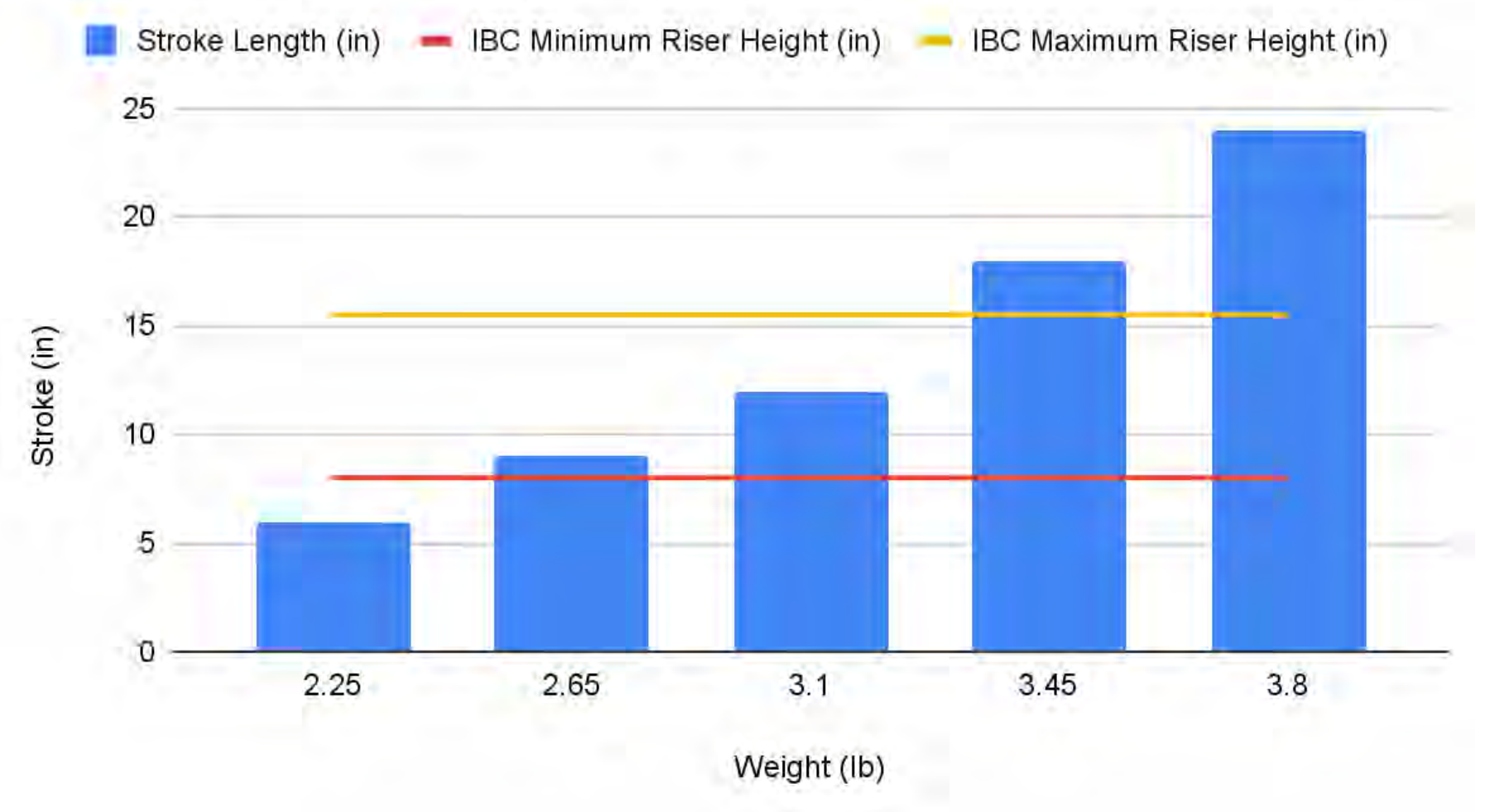
**Stress Distribution:**



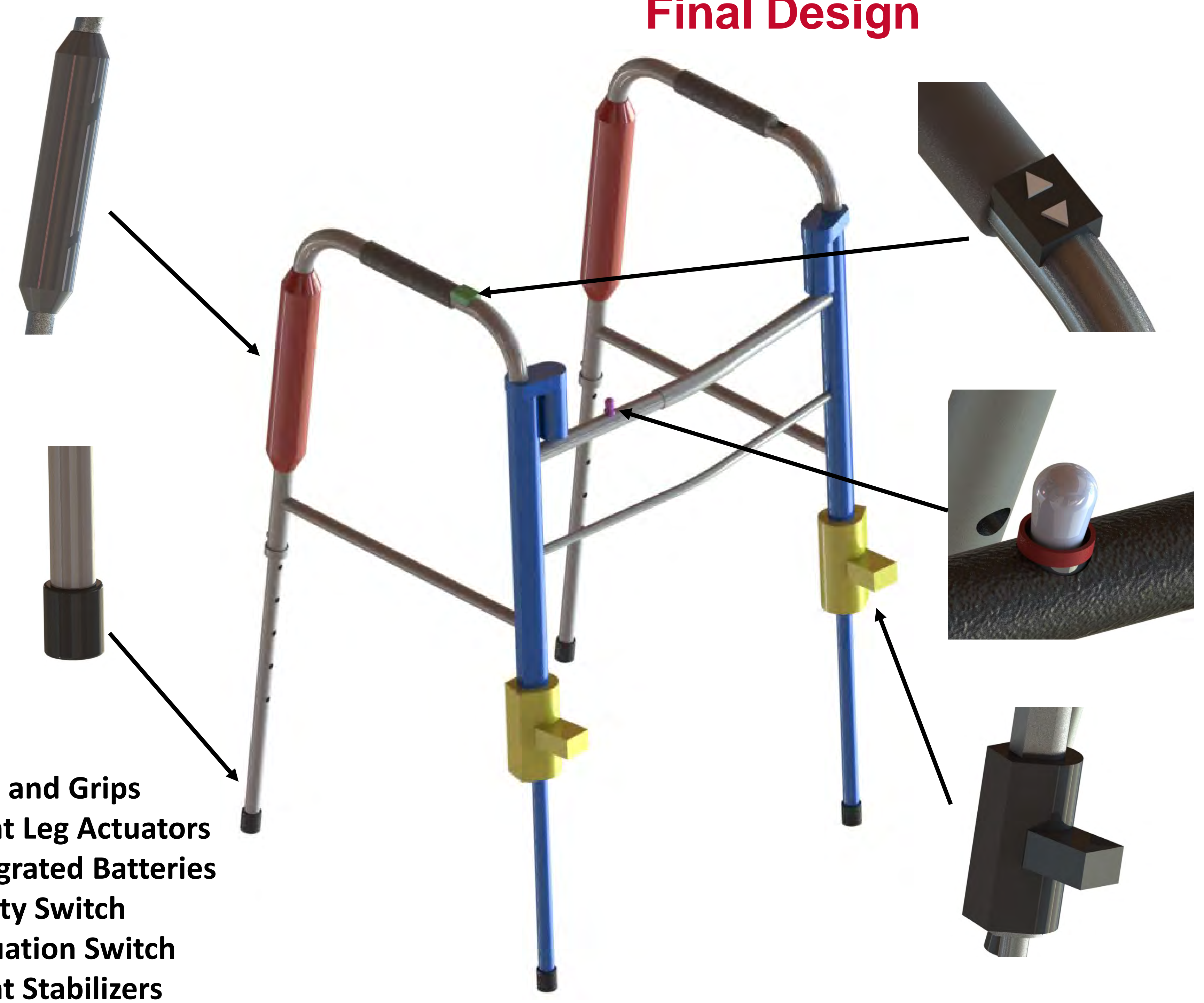
**Center of Gravity:**



**Stroke Length (in) vs. Actuator Weight (lb)**



**Final Design**



- Feet and Grips
- Front Leg Actuators
- Integrated Batteries
- Safety Switch
- Actuation Switch
- Front Stabilizers

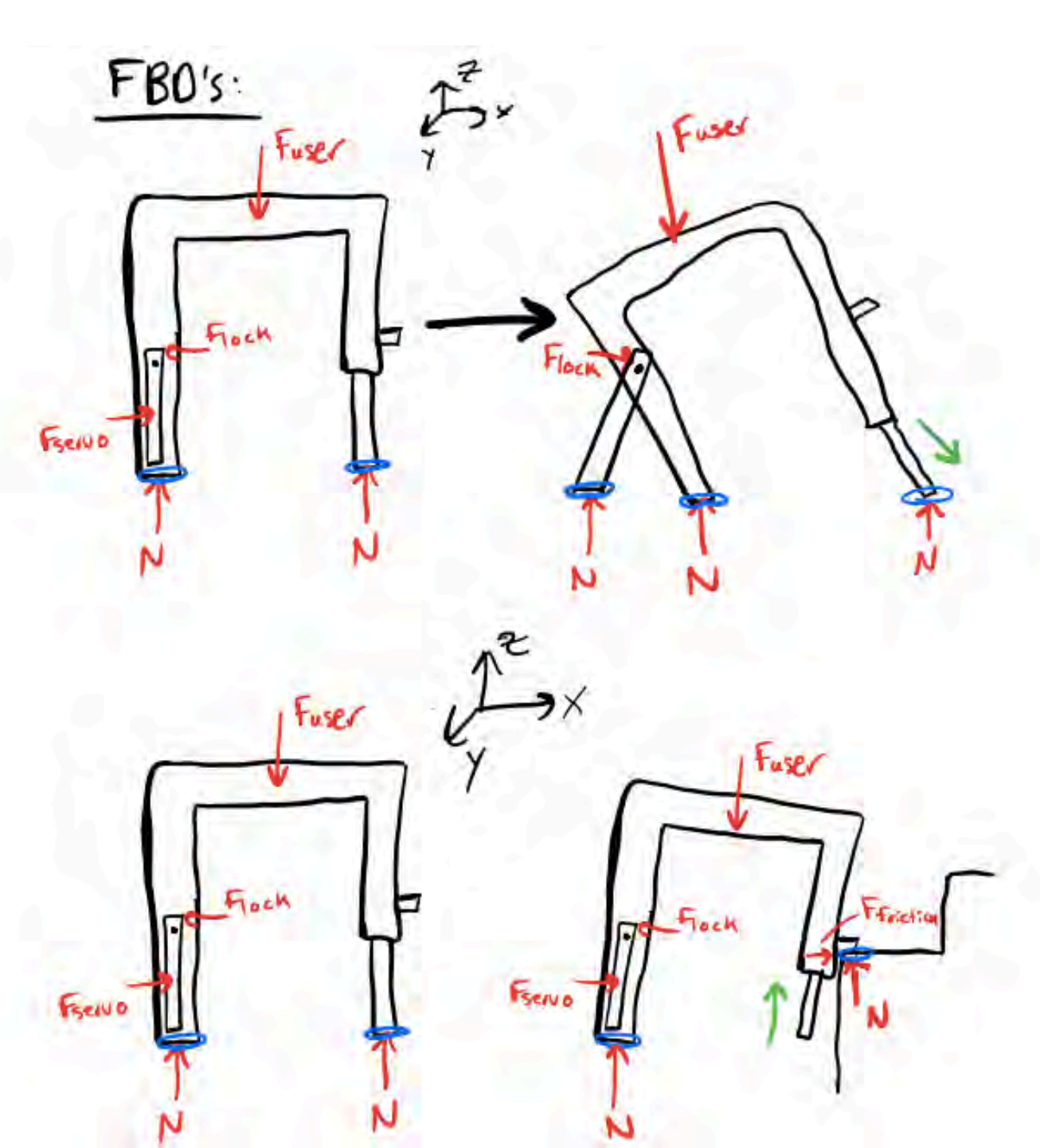
**Market-Oriented Design:**



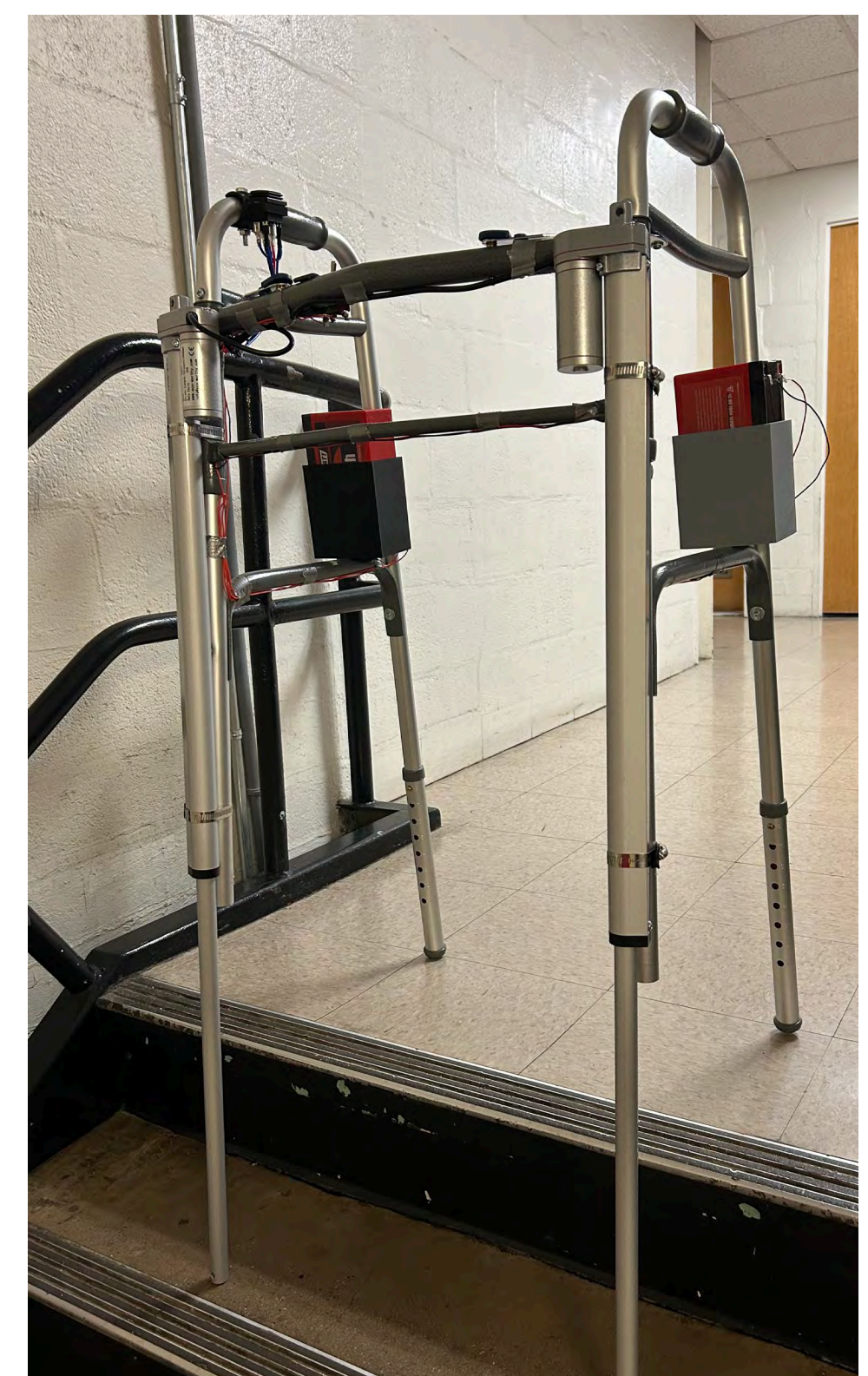
**Adjustments for Final Design:**

- Integrated, lightweight batteries
  - Integrated, higher quality switches
  - Linear actuators serve as front legs
  - Wires run through hollow legs
  - Front stabilizers
  - Lighter, custom linear actuators
- Potential Additions to Design:**
- Battery charge indicator
  - Back stabilizers
  - Safety switch position indicator

**Front and Rear Stabilizers Performance:**



**Prototype & Test Results**



**Front Leg Actuators:**

- 18" stroke length
- Support up to 330 lbs
- Actuate at ~1 "/s

**Electronics:**

- Connected batteries in series to provide more power to legs

**Custom 3D Printed Parts:**

- Switch and battery mounts

**Center of Gravity:**

- Batteries on back legs to counterbalance actuators

