

### Motivation, Goal, Impact

#### Motivation

- Rapid growth in pickleball among older adults (~9M players 51+)
- Repetitive downward bending leads to strain & instability
- ~78k pickleball injuries/year (90% in 51+) with falls as leading cause

#### Goal

Design a lightweight, one-handed device that retrieves balls without bending or disrupting play

#### Impact

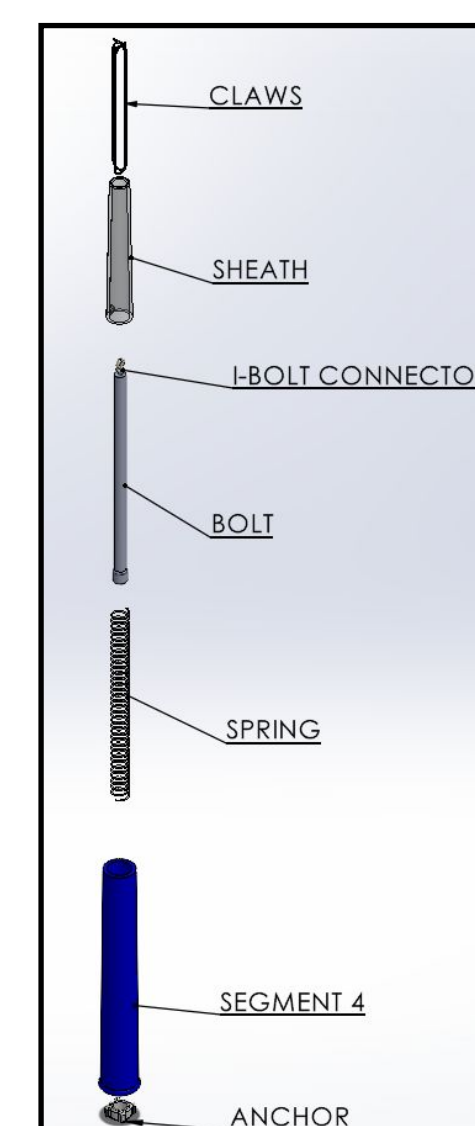
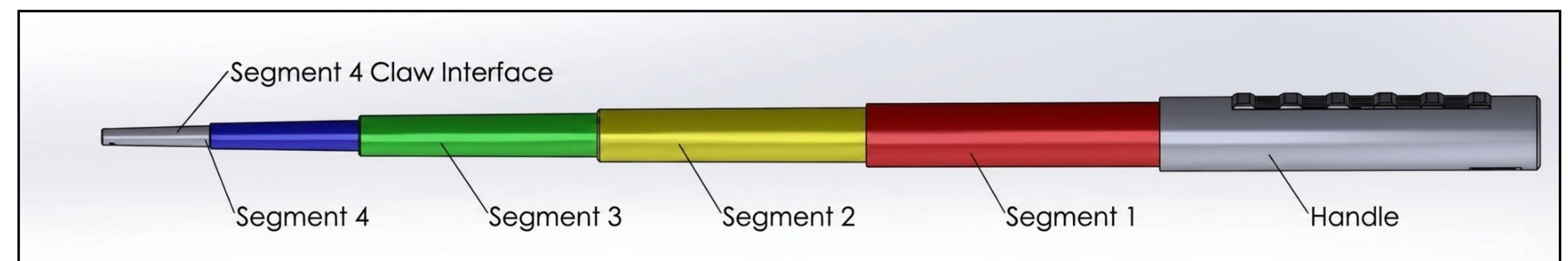
Reduces fall risk & strain, improving accessibility, confidence, & longer participation in pickleball

### Requirements

- Extend user reach to enable upright pickup
- Pickup from any orientation without precise alignment
- Quick ball retrieval
- Low activation force for one-handed operation
- Stable, safe operation (no pinch points or sharp edges)
- Lightweight and portable to operate and maneuver
- Durable for repeated outdoor use (dust, moisture, wear)
- No scratching or deformation to pickleballs or court surface

### Final Design

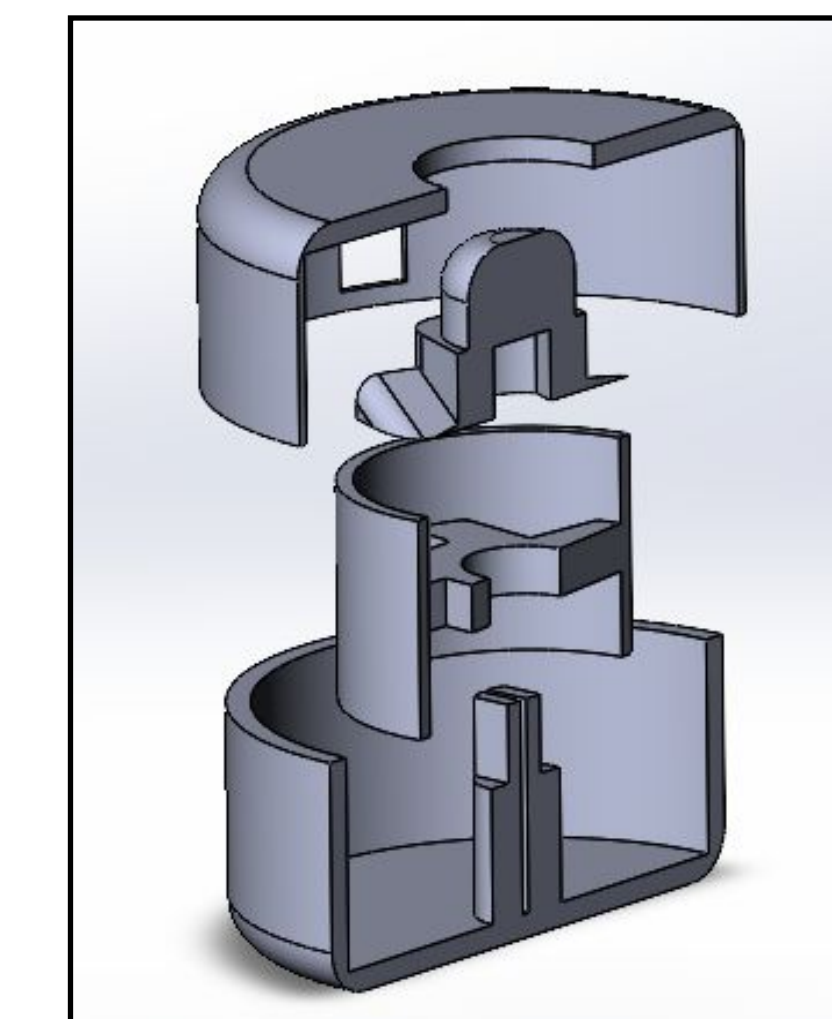
Small, handheld design consisting of three major systems (housing, claw, and ratcheting systems) that fit into a 9" long cylindrical profile



#### Ball Retrieval

Claw is housed in the 4th segment, within the protective sheath

- Prevents claw degradation
- Compact design



#### Retraction

Spool system provides on command retraction of the cascading segments reducing the size of the device

### Design Calculations & Decisions

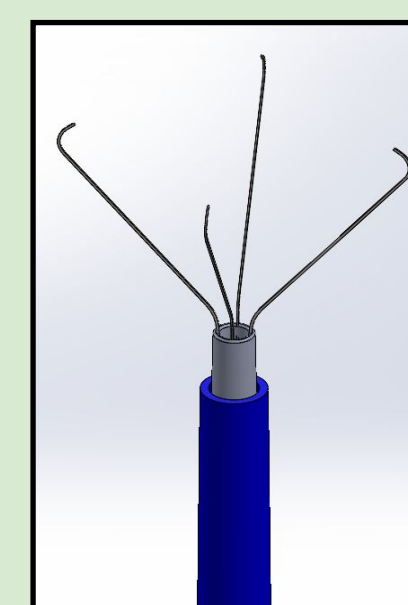
#### Housing Subsystem

- 1. Device Length & Ergonomics:** 32 inches, extended target length  
*Basis:* Anthropometric data (29"-33" hand-to-ground height) and user testing, 32" eliminated bending for heights 5'5"-6'4"
- 2. Handle & Grip Geometry:** 1.5" diameter x 8" length  
*Feature:* Textured non-slip surface for secure single-handed actuation
- 3. Telescoping System Configuration:** 4-segment design with 1" overlap  
*Basis:* Used the parametric relationship  $Segment\ Length = [(Target\ Length - Handle\ Length) / n] + Overlap$



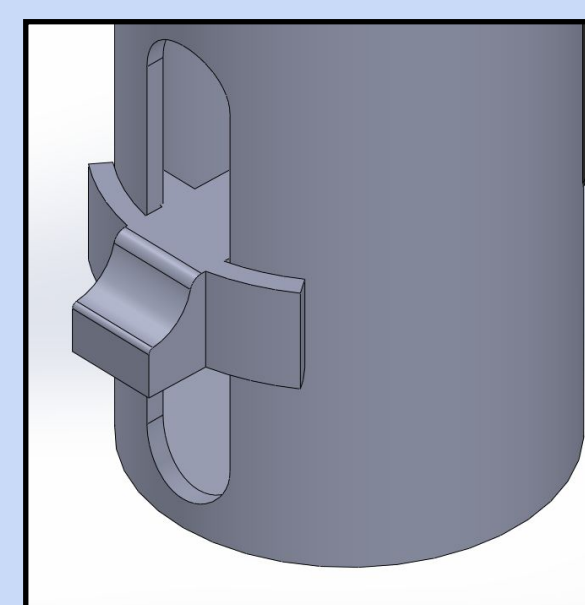
#### Claw Subsystem

- 4. Sheath & Actuation Mechanism:** 2.75" length with a 0.5 mm radial clearance  
*Calculations:* Based on  $F = kx$ , a 2" stroke requires only 1 lb of force, ensuring accessibility
- 5. Claw Geometry & Kinematics:** 4-prong spring steel at a 47.64° nominal angle  
*Basis:* Optimized the geometry to allow for ability to grab pickleball in any orientation



#### Internal Ratcheting Subsystem

- 6. Retraction System (Clock Spring):** 302 Stainless Steel clock spring (21.5" long)  
*Basis:* Engineered for a 32" total travel distance, the spring specifications ensure full, reliable retraction over the device's entire range
- 7. Slider & User Interface:** 0.23" thumb tab with 0.5 mm slide fit  
*Calculations:* Reducing tab length from 0.5" to 0.23" decreased normal stress by 54%  
*Assembly:* 0.04" chamfers enable self-alignment during clamshell housing assembly



### Prototype & Test Results



#### Reduced Range of Bending

Manual = 60 - 80°  
With Device = 0 - 20°

(Averages from Data Collection of Users 5'5" - 6'4")

#### Average Testing Data

Test Type	Time [s]
Full Extension	0.41
Ball Securement	4.26
Ball Removal & Retraction	5.72
Full Process	11.13

