**1. Background**
- An assistive cane is a mobility aid used by injured or disabled persons.
- Cane users experience difficulties retrieving a dropped or fallen cane.
- There is increased risk to injury when attempting to retrieve a dropped cane.
- Canes “fall” to the ground in two scenarios:
  1. **Accidental Handling** – i.e. the cane is dropped.
  2. **Controlled Placement Attempt** – i.e. the user places the cane against a wall to complete another task, and the cane slips to the ground (this is the more common scenario).

**2. Objective**
- Develop a proof-of-concept assistive device that:
  1. Improves the method for retrieving a fallen cane, and/or;
  2. Eliminates the possibility of the cane falling altogether.

**3. Methodology**
1. Current State Analysis (of users and products)
2. Alternatives: Generation / Prototyping / Evaluation
3. Usability Testing
4. Refined Detailed Design

**4. Current State of Canes**
- Several patents and designs have been pursued to address this problem space;
- However, the 3 canes in Figure 1 are the most popular commercially, and do not address the problem adequately.

**5. Alternatives / Prototypes**
- Pairwise Comparison of alternatives against objectives identified “Ankle” as the most feasible proposed design.

**6. Usability Testing**
- 4 Healthcare Experts (HE) were selected for testing, given their knowledge of canes and intended users.
- The leg opposite of each HE’s dominant hand was restrained with a leg splint to simulate a disability.
- HEs tested the proposed design (ankle) and current products (single point, offset, quad) in 3 scenarios:
  1. **Normal Walk** – walking in a straight path on level ground;
  2. **Controlled Release** - attempt to stand cane vertically;

**7. Results**
- Usability test results suggest the proposed design has the potential of reducing the risks associated with retrieving a fallen cane (see Table 1).
- There was also feedback for improvements:
  1. The handle used was too flexible, and;
  2. The base used was too slippery on certain surfaces.

**Detailed Design**
The following is a refined prototype based on the Usability Testing Results.

**Figure 2:**
- a) Full View of the Prototype – standing vertically without user interaction or any additional support.
- b) Damper allows movement of the shaft independent of the base’s movement (“ankle-like” properties).
- c) Should the prototype fall to the ground, it can be retrieved using one’s foot to step on the base.
- d) Component breakdown of key materials used to construct the refined prototype.

**Key Features / Potential Benefits:**
1. **Controlled Placement** (Figure 2a)
   - The user can place the cane in a standing vertical position on a level surface.
   - Reduces opportunities for falling, as resting against a wall is no longer required.
2. **Ankle-like Reactions** (Figure 2b)
   - Elongated gate cycle: the base activates earlier and releases later.
   - Forces are distributed over the entire surface area of the base.
3. **Allows for Customization**
   - Theoretically can be designed as an add-on to any existing cane.
   - “Plug-and-Play” – mixing and matching of appropriate handles/shafts is possible.
4. **Low Cost of Production** (Figure 2d)
   - Prototypes were built from inexpensive products; therefore it is assumed the cost of production should not exceed the cumulative retail cost of materials (~ $15/unit).
5. **Emergency Recovery Action** (Figure 2c)
   - A method for retrieving the cane (if fallen) exists: foot props it up like stepping on the end of a rake; however, the impact on users’ balance has not been tested.

**Table 1:** The Proposed Design performed very well in Scenario 2.