Element D: Design concept generation, analysis, and selection

Our team wanted to come up with a minimum of 30 brainstorming ideas because we felt this number would force us to think beyond the obvious solutions. We struggled with this. Initially, our team already had a solution in our head as we started to generate ideas and when that happens, it's hard to move away from those original thoughts. Our first brainstormed ideas were all similar, with minor variations from our "perceived" solution, i.e. a holder mounted on a crutch.

We exhausted that list of ideas pretty quickly, and then the "real" brainstorming began. Nothing was too expensive or too outlandish- and we came up with some pretty unique ideas- not all practical, but unique.

Some of our wilder ideas included:

- hiring help

- training your dog

- a pulley system extending from the ceiling

- holder on a remote control car

Going through this stage enabled us to be more creative, less restrictive, and possibly come up with portions of ideas that could be used later.

After this stage ran its course, we wanted a few more ideas. These became our "middle of the road" ideas; practical, yet something that we never thought to consider. Some of these ideas were a holder on a belt, shoe, or upper arm.

Our list of thirty ideas are as follows:

1. *Pivot at shoulder level since shoulder is most stationary part of body when on crutches*
2. *Have a long "reacher / pincher/grabber" so person can grab tray and move to table*
3. *Have a pulley system that attaches to counter and crutch, (removable) tray is transferred along pulley line from counter to table*
4. *Removable tray that extends out in front of one crutch*
5. *A cup holder that pivots and is mounted inside the crutch. The cup holder will extend outward.*
6. *A cup holder that pivots and is mounted to the crutch handle bolt. The holder extends outward.*
7. *A tray that is attached by a rope and drags the tray along behind. Use some type of lift system to*

bring tray up to table

8. *Tray holder that snaps to side of crutch and not in the way of hands*

9. *Have a short "reacher / pincher/grabber" attached to crutch so person can grab tray and move to table*

10. *Have a tray supported by a tether on the ceiling that can move anywhere in room.*

11. *Make a little cart on wheels that can be pulled behind while attached to crutch- like a wagon*

12. *Cup holder that attaches to waist with a belt*

13. *Cup holder that attaches to upper arm with a band*

14. *Metal support device connects to unused crutch handle holes. An axle connects to this support device which in turn holds up a beverage container*

15. *Hire Help to carry things for the patient*

16. *Attach a plastic or fabric bag to crutch with a piece of cardboard on bottom for stabilization.*

17. *Helmet with a cup holder on top*

18. *Football shoulder pads with holders mounted on each shoulder*

19. *Replace crutch handle with a beverage holder*

20. *Mount holder on a shoe for the non-weight bearing foot*

21. *Cup holder on a shoulder strap*

22. *A one piece crutch system freeing up other hand to hold beverage*

23. *Pressure fit system that attaches to the crutch handle*

24. *Hook on the crutch and a simple platform attached to stabilize mug*

25. *Double shoulder holders*

26. *Mini bean bag attached to foot or crutch*

27. *Cup holder mounted to a remote control car*

28. *Steel and/or plastic cup with magnet and a magnet mounted on crutch*

29. *Holder with attached, customized mouth piece*

30. *Holder system on harness to go on dog, train dog to bring beverage over.*

Our next step was to evaluate each of the thirty brainstorm ideas against our design specifications, and eliminate as many as possible. Many were eliminated because they did not meet criteria # 1 (minimize spills) and #2 (inexpensive, $9..00 - $15.00) When we did this, we were left with 7 ideas:

1. *Pivot at shoulder level since shoulder is most stationary part of body when on crutches*

2. *A cup holder that pivots and is mounted inside the crutch. The cup holder will extend outward.*

3. *A cup holder that pivots and is mounted to the crutch handle bolt. The holder extends outward.*

4. *Cup holder that attaches to waist with a belt*

5. *Cup holder that attaches to upper arm with a band*

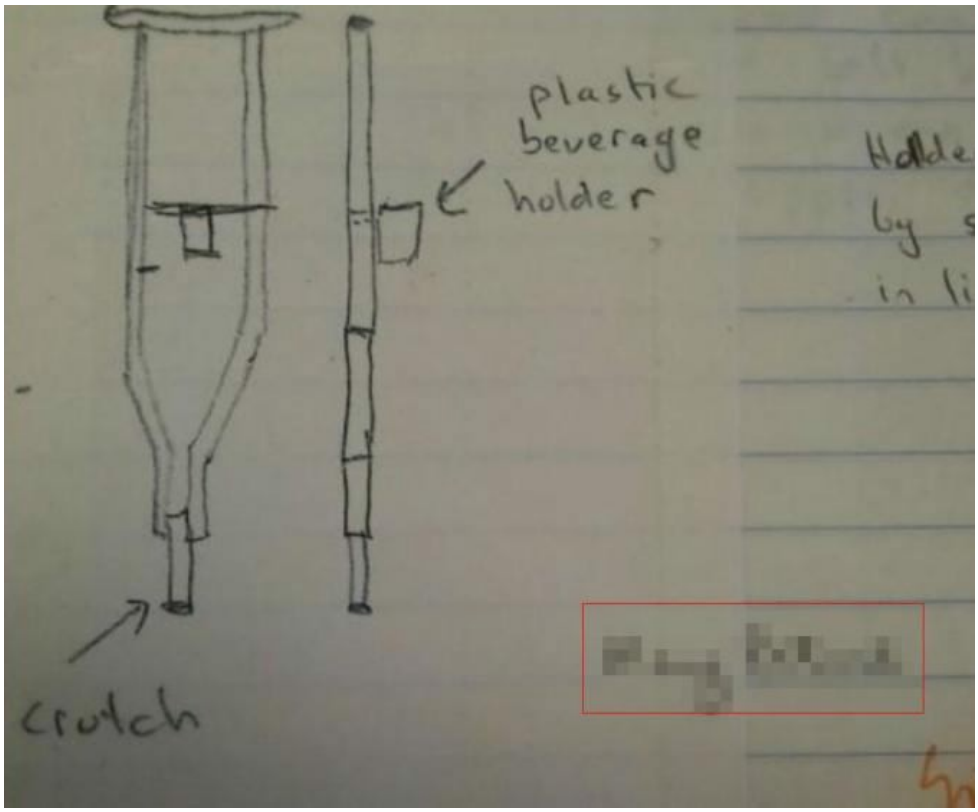
6. *Metal support device connects to unused crutch handle holes. An axle connects to this support device*

which in turn holds up a beverage container

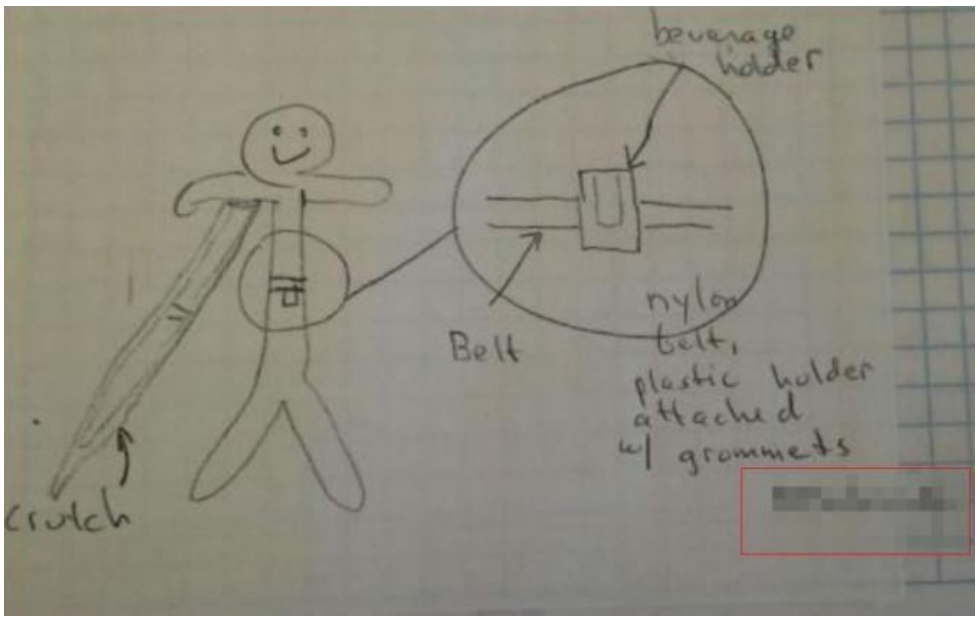
7. Replace crutch handle with a beverage holder

Sketches of # 2, 4, 5 are below:

Sketch #2

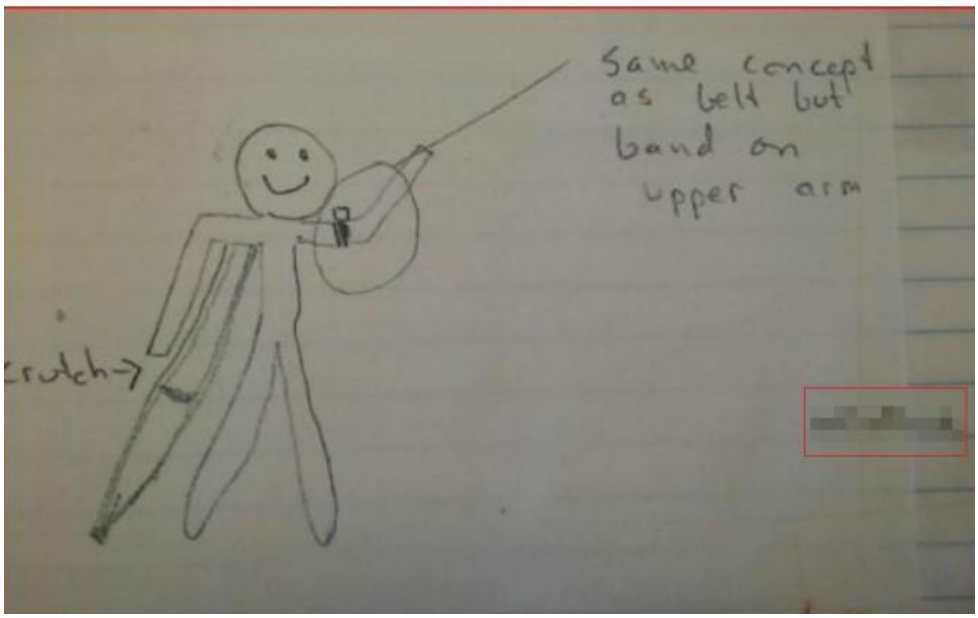


Sketch # 4



Sketch # 5

We then used a decision matrix process to narrow down our options even further. This allows us to systematically evaluate each proposed solution. We took our 9 design criteria, gave them weights from 1 – 3 based on importance, (decision matrix link below) and evaluated these 7 ideas.



Decision Matrix

Problem: Individuals who need assistance of underarm crutches for mobility currently do not have an effective, feasible way to transport open containers of food or beverages a short distance without spilling.	Weight	Shoulder Beverage Holder		Extended Pivotable Beverage Holder		Extended Beverage Holder (Crutch Handle)		Waist Beverage Holder		Upperarm Beverage Holder		Metal Beverage Holder (Unused Handle Holes)		Crutch Handle Replacement Beverage Holder	
Specifications		**Rating**	**WeightedScore**	**Rating**	**WeightedScore**	**Rating**	**WeightedScore**	**Rating**	**WeightedScore**	**Rating**	**WeightedScore**	**Rating**	**WeightedScore**	**Rating**	**WeightedScore**
Minimize Spillage	3	2	6	4	12	4	12	2	6	1	3	3	9	2	6
Sturdy	2	1	2	4	8	4	8	4	8	3	6	3	6	4	8
Diameter	2	4	8	4	8	4	8	4	8	4	8	4	8	4	8
Height	2	4	8	4	8	4	8	2	4	2	4	3	6	3	6
Non-Beverage Items	1	3	3	4	4	4	4	2	2	3	3	4	4	4	4
Dishwasher	1	4	4	4	4	4	4	3	3	3	3	2	2	1	1
Inexpensive	3	2	6	3	9	3	9	4	12	4	12	2	6	2	6
Lightweight	2	2	4	3	6	3	6	4	8	2	4	2	4	2	4
Fit on Standard Crutch	3	1	3	4	12	4	12	1	3	1	3	4	12	4	12
Total			44		71		71		54		46		57		55
	Scoring Key: We rated our brainstorming concepts from 1-4. 4 being meets the design specification the best, and 1 being the worst.														

EDD_2012_Decision_Matrix.xlsx

This process reduced our possibilities to 3 ideas:

1. *A cup holder that pivots and is mounted inside the crutch. The cup holder will extend outward.*

2. *A cup holder that pivots and is mounted to the crutch handle bolt. The holder extends outward.*

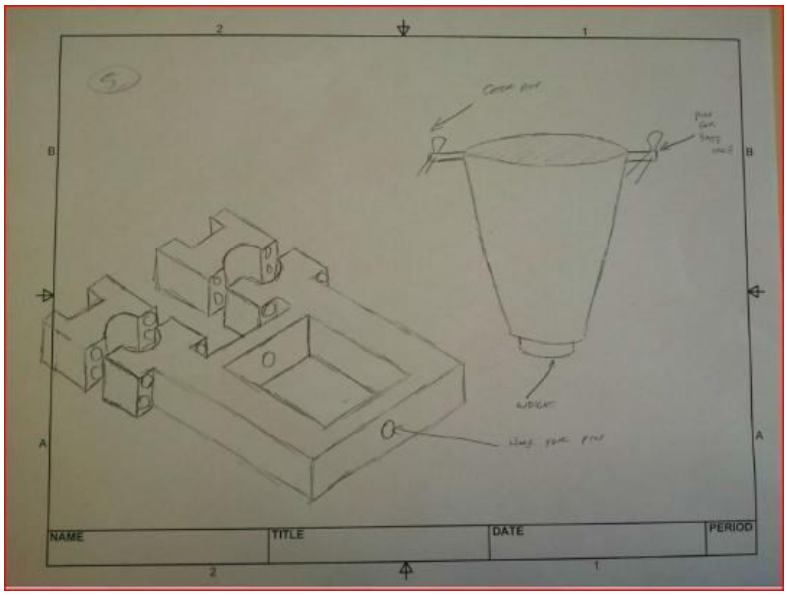
3. *Metal support device connects to unused crutch handle holes. An axle connects to this support device which in turn holds up a beverage container.*

At this point, we made detailed sketches of our top three, and took them back to our end user for evaluation. The things that were most important to our user were: minimizing spills, sturdy, and can hold various mug sizes (A Starbucks Venti!).

Sketch #1

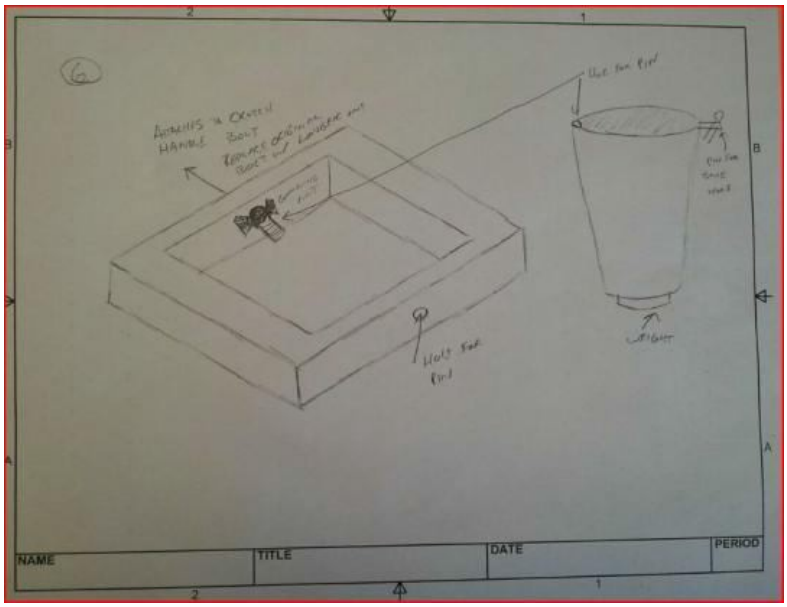
Sketch #2

sketch # 3

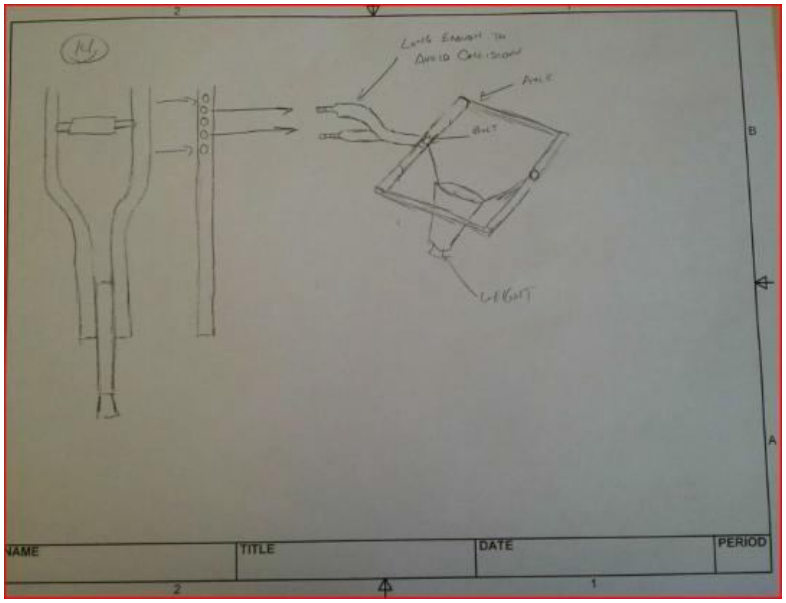


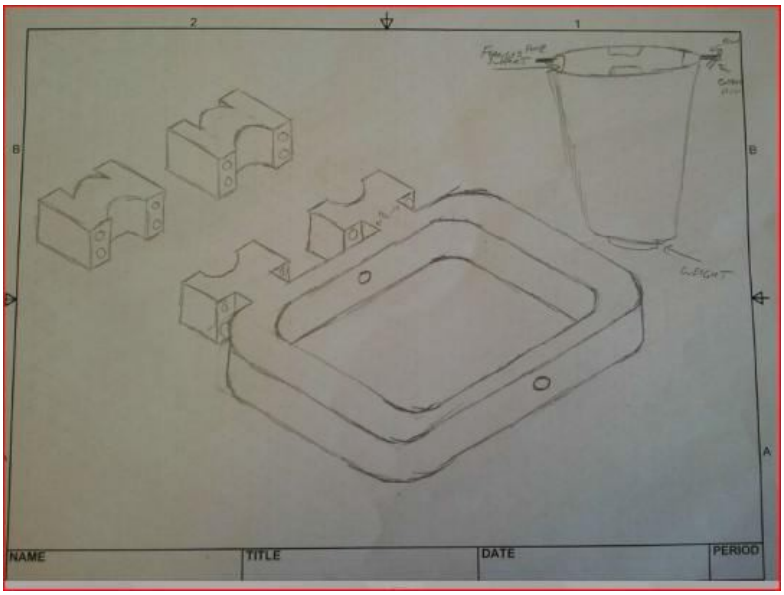
Our patient on crutches preferred #1, she was a little concerned about the holder mounting on the handle, and wondered about the weight of the metal support device.

Back to designing. We took design #1 and made it more round in shape to reduce the weight of the beverage holder, and make it more aesthically pleasing.



The sketch below details our first attempt at a final sketch:

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