

# Designing a Mechanized Dog Feeder for Wheelchair Users

CEO: Kiara Lavana; CMO: Smita Bhogle; CTO: Eeman Saud; CIO: Diksha Sriram

Advisor: Dr. Kevin Crowthers, Ph.D.



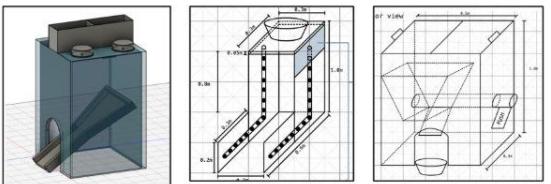
## Problem Statement

The standard process of providing food to dogs using a dog bowl on a floor with the products on the market is ill-adapted to individuals without full use of their legs.

## Level 1 Requirements

Criteria	Type	Y/N
Accessible 1 meter above the ground for a person in a wheelchair.	user	Y
Regulates specific amounts of food to be dispensed. These measurements are specified as $\frac{1}{2}$ cup and 1 cup of food.	functional	Y
Produced using a water-resistant, non-corrosive food safe container.	physical	Y
Total cost is under \$125.00 (USD) to produce.	cost	N

## PDR/CDR Preliminary Designs



## Final Prototype

Picture of our final device

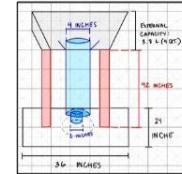


## Build Process



## Design Studies

- Post-CDR development
- Determined ideal dispenser height
- Determined the volume of dog food dispensed
- New "Design D"



Sketch of Design D, our final prototype

## Conclusion/Future Work



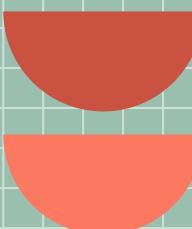
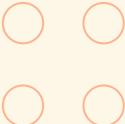
The dog of Client X

- Client delivery and testing → assessment → improvements
- Iterate process, refine details
- Final delivery to client
- Continual feedback

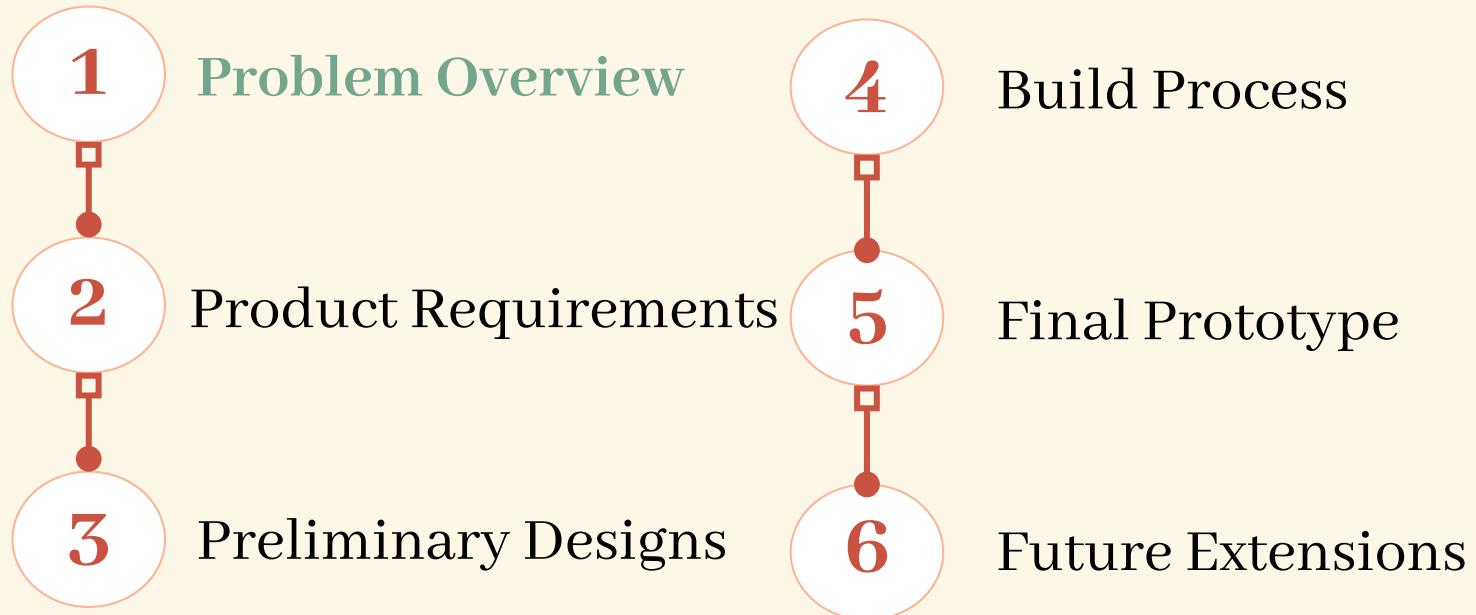
# Designing a Mechanized Dog Feeder for Wheelchair Users

Acceptance and Delivery Review

Smita Bhogle, Kiara Lavana,  
Eeman Saud, Diksha Sriram



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# Meet Client X

- Individual using a wheelchair
- Dog owner
- Feeding process hindrances
  - Food from container
  - Bending down
  - Dog bowl on ground
  - Wrist movement



## Problem Overview

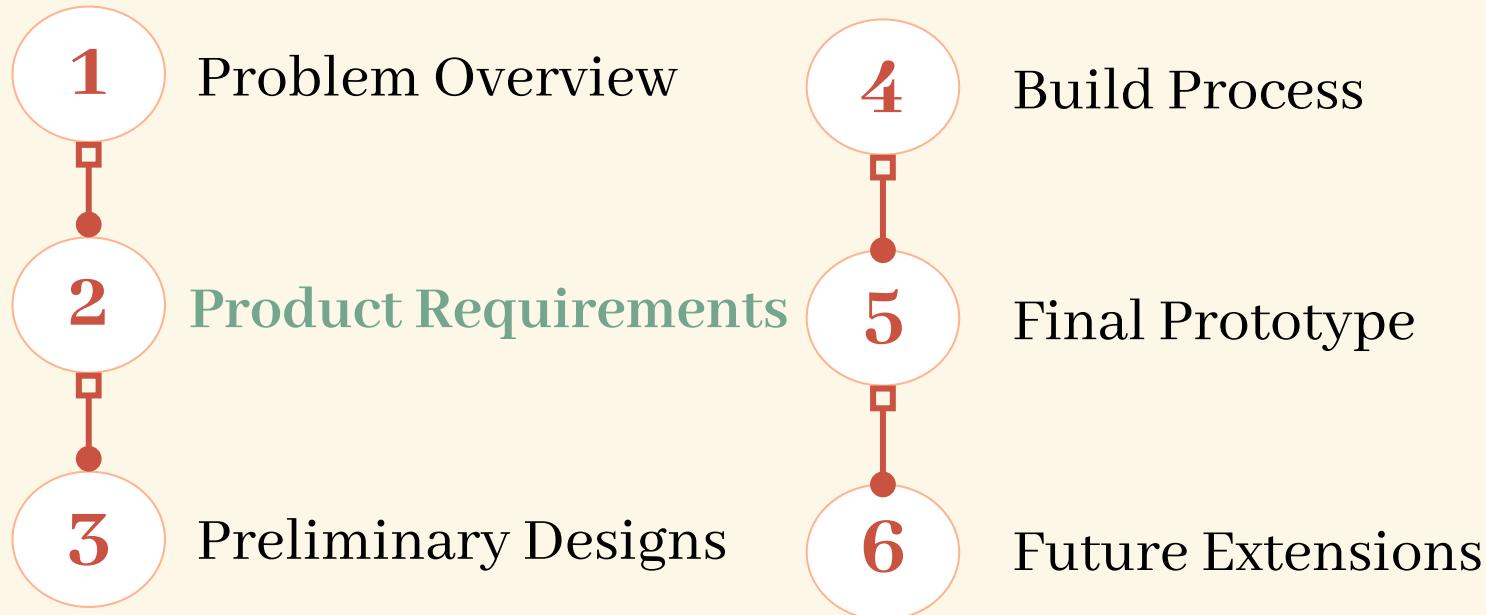
## Client Needs

# Project Objective



**Construct a machine  
for dog feeding adapted  
for individuals using a  
wheelchair through  
mechanized  
dispensation of dog  
food.**

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# Level 1 Criteria

Table 1: Level 1 criteria

	Criteria	Type	Level
1	The device can be accessed at least 1 meter above the ground and accessible to a person in a wheelchair.	user	1
2	The device can regulate specific amounts of food to be dispensed. For Client X, these measurements are specified as $\frac{1}{2}$ cup and 1 cup of food (based on the client's current feeding process).	functional	1
3	The food storage container is produced using a water-resistant, non-corrosive material that is food-safe (will not contaminate the contents of the bowl).	physical	1
4	The user is able to disassemble and withdraw the food storage bowl from the device for washing.	functional	1
5	The device in total costs under \$125.00 (USD) to produce, inclusive of materials and different iterations.	cost	1

# Level 2 Criteria

Table 2: Level 2 criteria

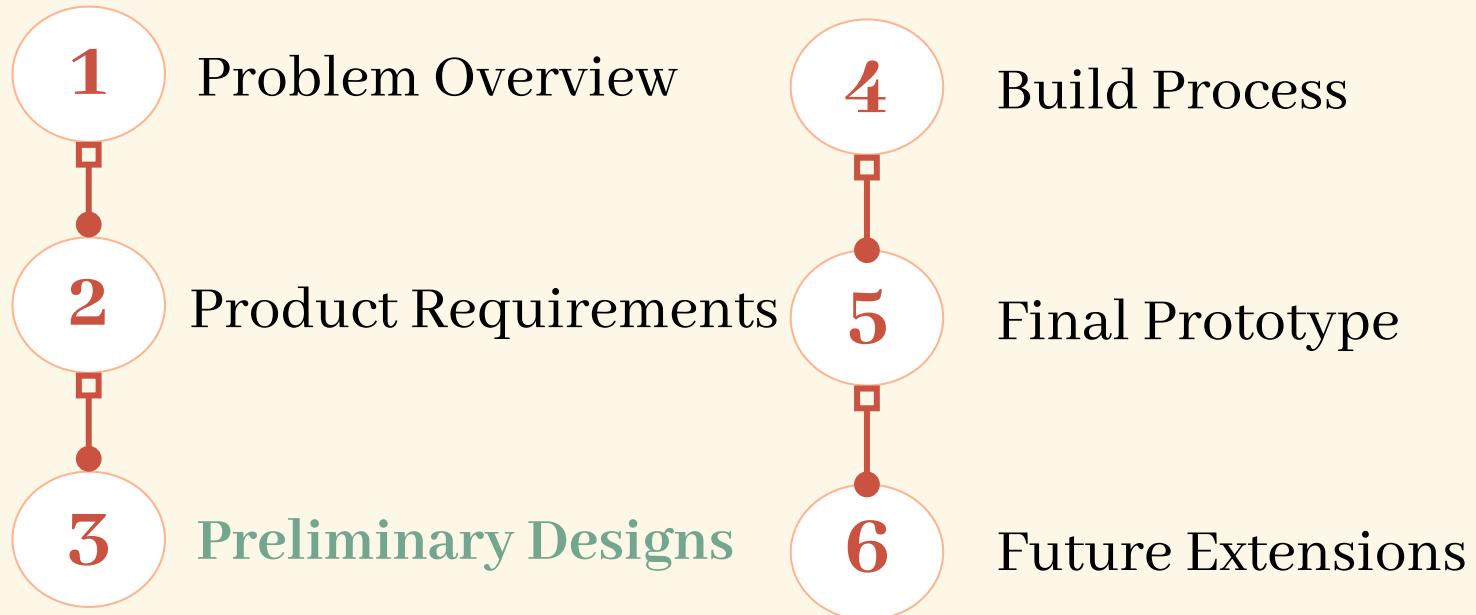
	Criteria	Type	Level
6	A metal storage container will be implemented into the design to ensure food-safe material for the food storage.	physical	2
7	Device also provides access to the food content so that the user can physically access the food. The client specified that he would not want a closed design where the food is inaccessible to quickly grab when giving his dog treats (as opposed to a full meal).	functional	2
8	The storage container possesses a capacity of at least 5 L of dog food to last no less than 7 days before refilling.	functional	2
9	The product is stable and cannot be knocked over, even with a great amount of force	functional	2

# Level 3 Criteria

Table 3: Level 3 criteria

	Criteria	Type	Level
10	The device is lightweight (under 5 kg) to enable transportation for when the user is traveling.	physical	3
11	The food storage portion of the device remains beyond reach to the dog through use of a hinged door or other mechanism that requires human aid to open.	functional	3
12	Dishwasher safe food bowl	functional	3
13	The product includes a user manual for Client X to reference if he needs help operating the machine.	documentation	3
14	The product has a lid to cover the external storage of food	physical	3
15	The product can be placed anywhere within the common household	physical	3

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# Design A

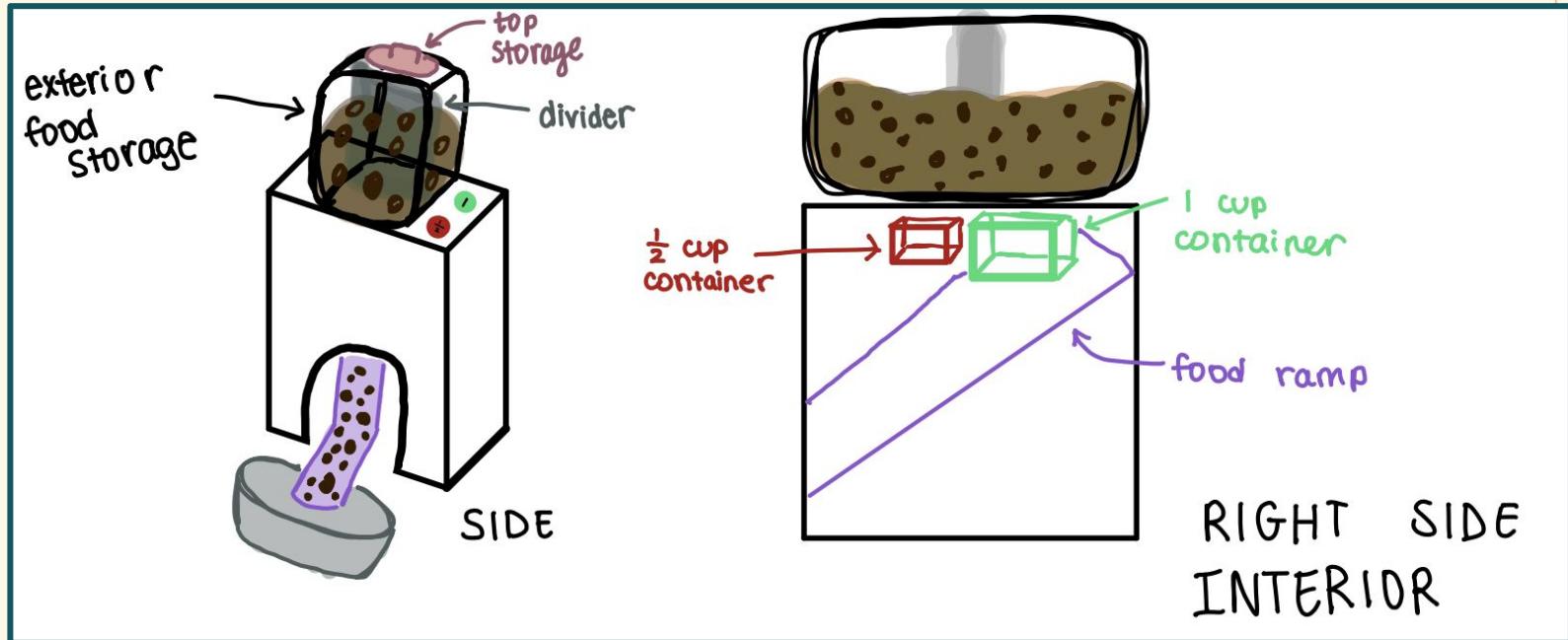


Figure 1: Sketch of Design A

# Design B

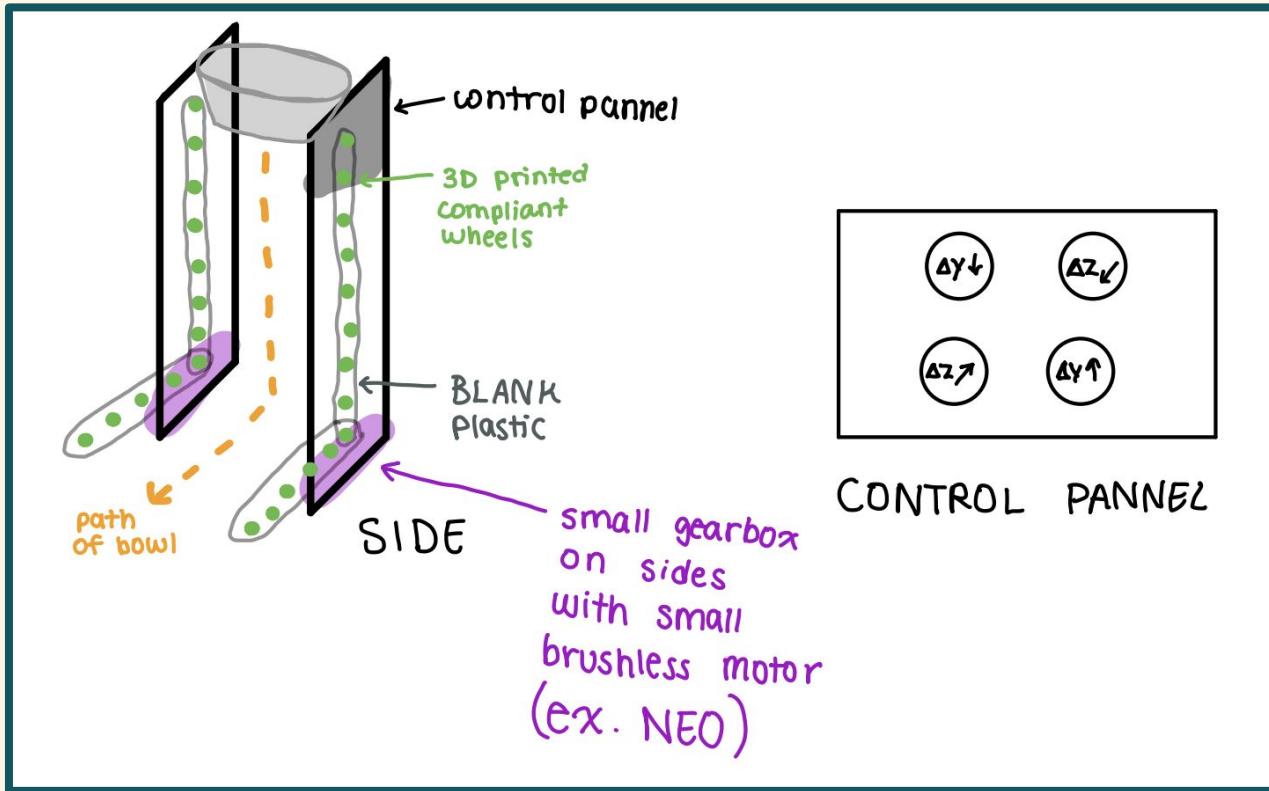


Figure 2: Sketch of Design b

# Design C

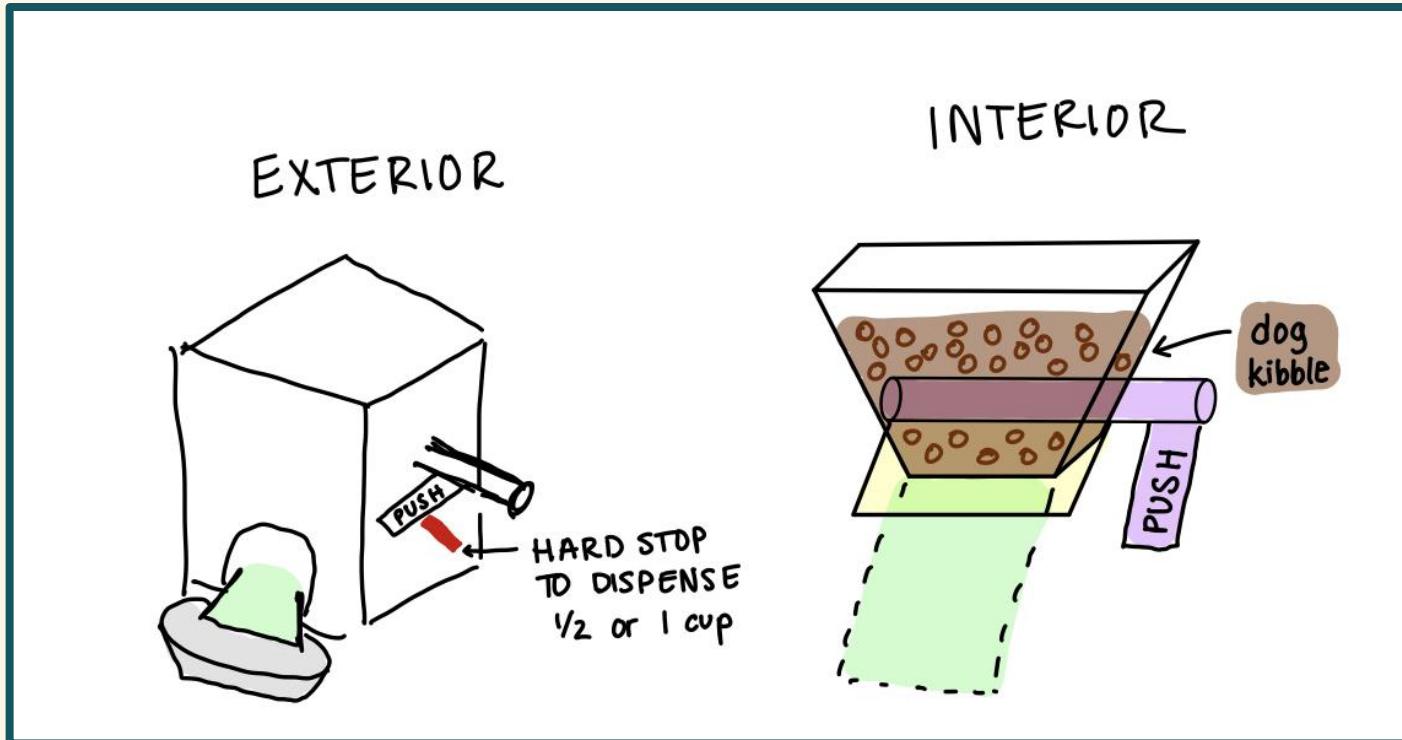


Figure 3: Sketch of Design C

# CDR Progress

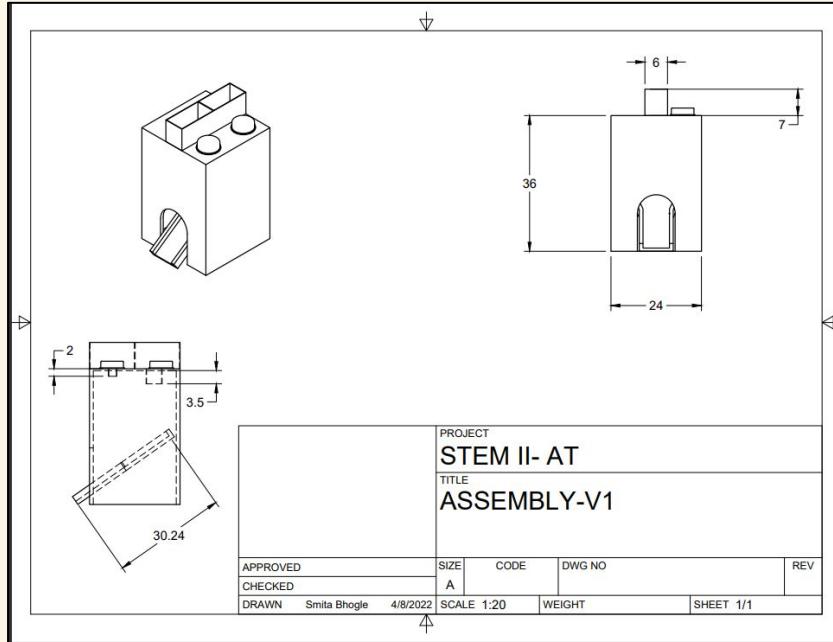
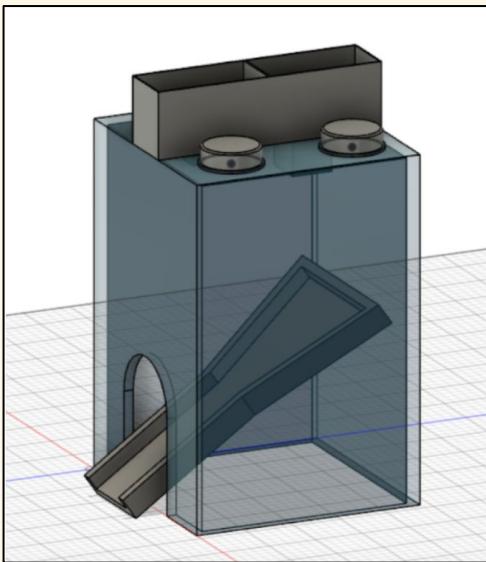


Figure 4: CAD rendered sketches

- At CDR → Design A based on decision matrix
- Since then → CDR feedback, simplification of mechanisms, combination of previous designs

## PROOF OF CONCEPT TESTING

# Initial Prototype



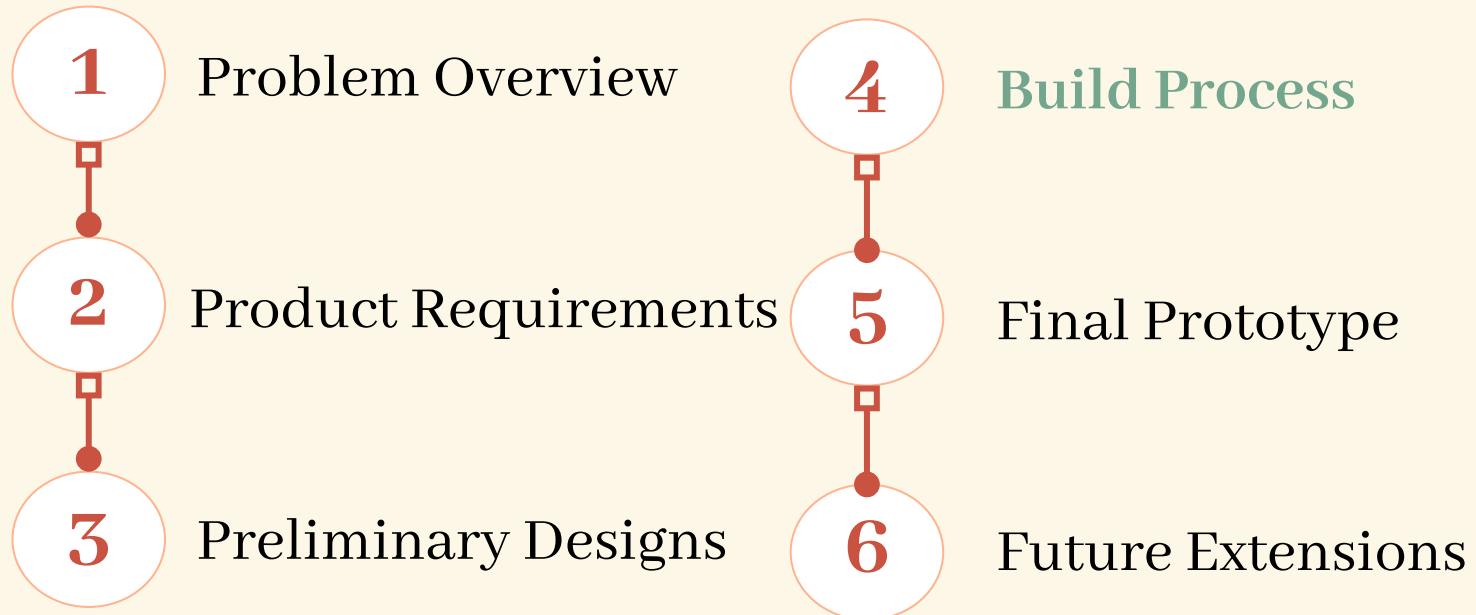
**Figure 5:**  $\frac{1}{4}$  scaled down 3D printed rotational mechanism

- Multiple iterations
- Tested using PLA pellets to reach  $\frac{1}{4}$  scaled down quote of  $\frac{1}{2}$  cup
- Tested rotational mechanism of device
- Successful ejection of pellets from device
- Anticipated: 20 mL
- Experimental: 10 mL



**Figure 6:** Scaled down rotational mechanism filled with PLA pellets for testing

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# Design D

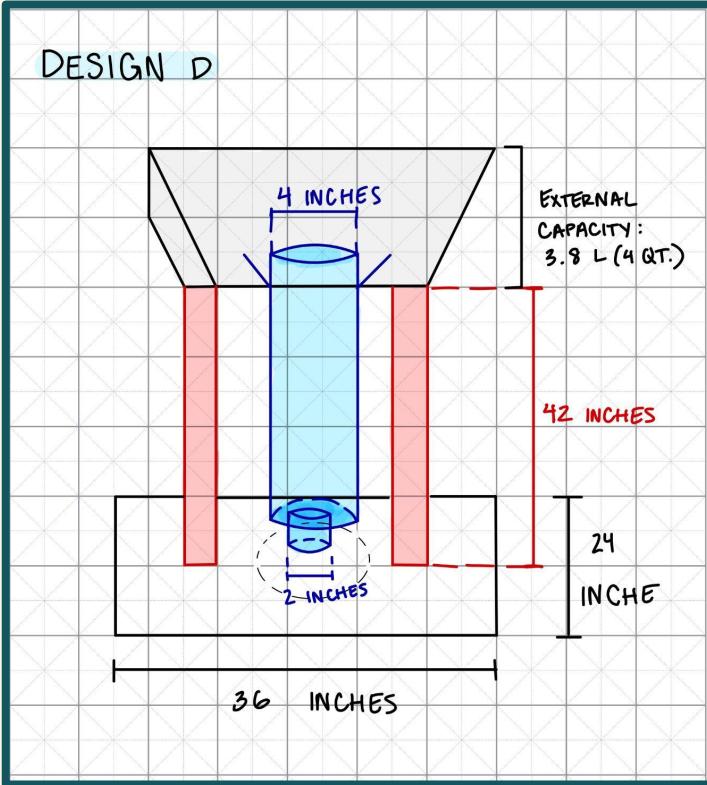


Figure 7: Design D sketch

- Open source CAD for rotating dispenser
- PVC for storage, container for external storage
- Wooden beams for support
- More stable, combined previous ideas
- Design studies to determine height, handle placement

# General Material List

Table 4: Materials List with Costs and Suppliers

Material	Supplier	Quantity	Price (\$)	Total (\$)
Rubbermaid Commercial 4 Qt Food Storage Container	Rubbermaid Commercial Products Store (Amazon)	1	\$12.09	\$12.09
Rubbermaid Commercial Food Storage Container Lid	Rubbermaid Commercial Products Store (Amazon)	1	\$6.85	\$6.85
2 ft by 1 ft Plywood Board Base	Home Depot	1	\$5.00	\$5.00
2 in by 6 in by 4 ft Wooden Beams	Home Depot	2	\$21.85	\$43.70
3D Printer Filament (for 3D printed components)	Mass Academy of Math and Science	--	0	0
Aluminum Foil	Mass Academy of Math and Science	1	0	0
5 in Philips Head wood screws	Home Depot	1	\$15.98	\$15.98
1-1/2 in Zinc-plated Corner Braces	Home Depot	1	\$8.73	\$8.73
Double-sided Adhesive Strip Velcro	Mass Academy of Math and Science	1	0	0
4 in diameter 2 ft PVC Pipe	Home Depot	1	\$24.00	\$24.00
1-1/2 in diameter 1 ft PVC Pipe	Home Depot	1	\$8.13	\$8.13
			Total Cost:	124.48

FINAL BUILD

# 3D Printing Components

01

**Print the following components using a  
3D printer with 20% infill**



Bottom PVC funnel connector

1 inner circular funnel

2 circular brackets

1 dispenser handle

1 rotating dispenser

# Preparing Materials

02



**Cut 2 in x 6 in x 4 ft wooden beams  
from 48 in to 42 in**

03



**Measure location and circumference of  
handle on wood and PVC pipe**

Via design studies → Hole is 22 inches above  
the ground

# Preparing Materials

05

Cut hole with diameter of 3 inches into the right wooden beam 22 inches above the bottom

Drill a smaller hole into the PVC using  $\frac{3}{8}$  inch drill bit



06



# Constructing the Device

07



**Secure wooden beams onto 1ft by 2ft plywood with metal elbow brackets**

08



**Drill the circular brackets to the wooden beams. Mount the PVC to the beams by sliding it into the brackets.**

# Constructing the Device

09

Place the inner funnel and rotational dispenser inside of the 4 in PVC pipe

10

Attach the outer funnel to the bottom of the 4 in PVC. Attach the smaller 1.5 in PVC to this funnel.



# Food Storage Preparation

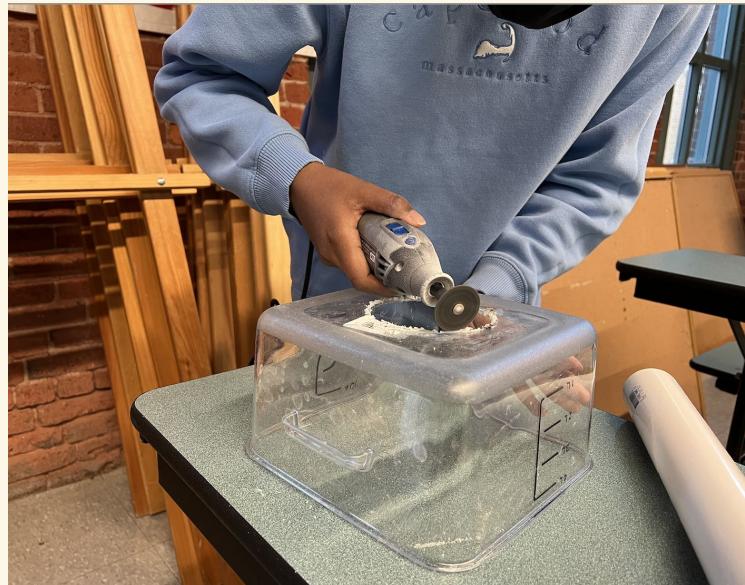
11

Line any plastic containers  
that come in contact with  
the food with aluminum foil



12

Use a dremel to cut a 4 inch  
diameter hole in the food  
safe storage container.



# Final Steps

13

Line the 4 in diameter circle up with the 4 in diameter PVC

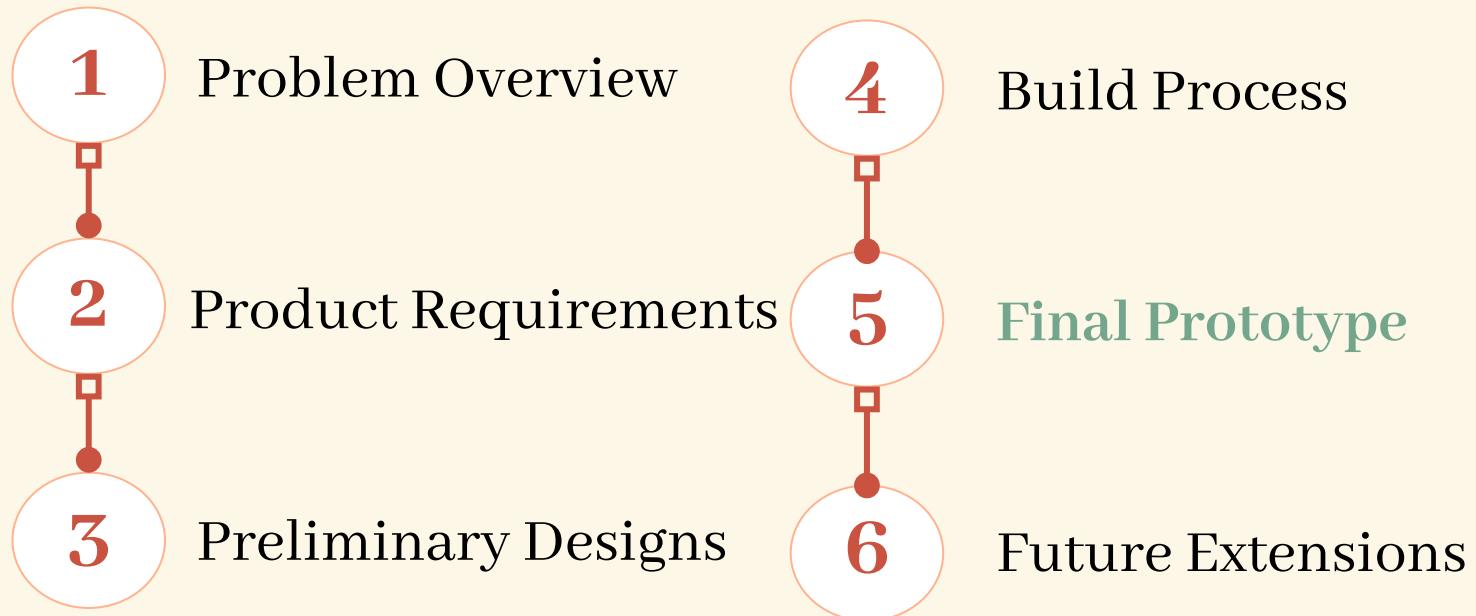


14

Done!



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# Final Device

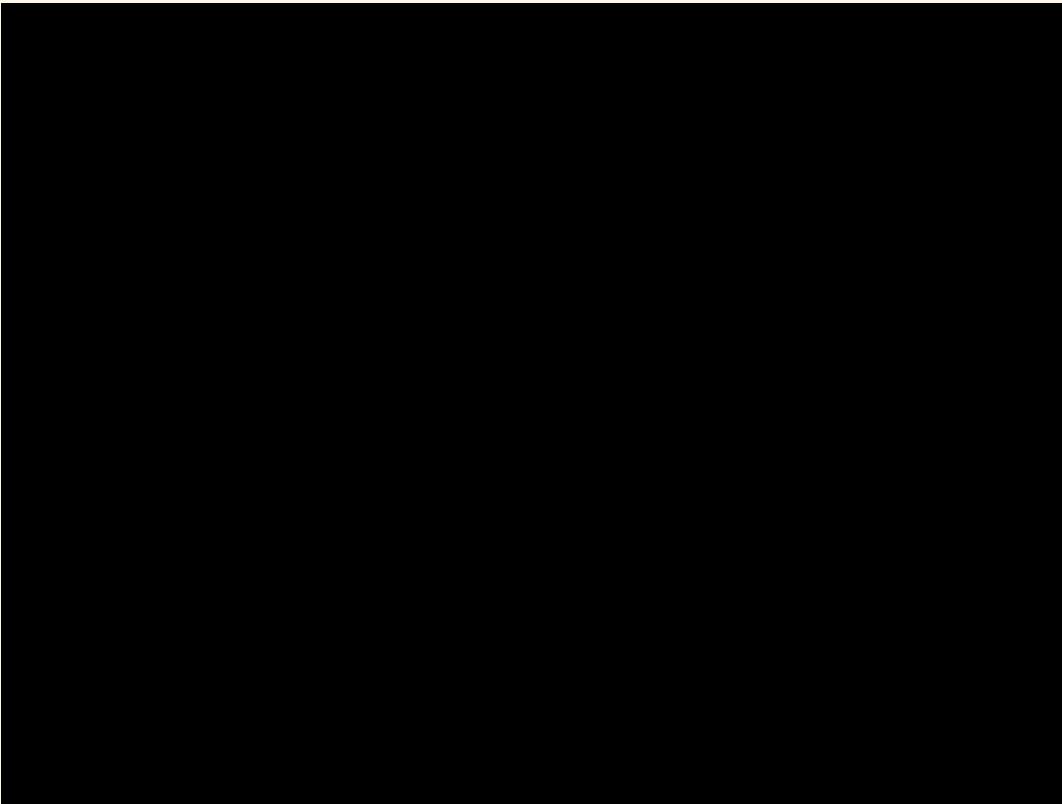


Figure 8: The final prototype



Figure 9: The final prototype in use shown to scale with the wheelchair

# Demonstration!

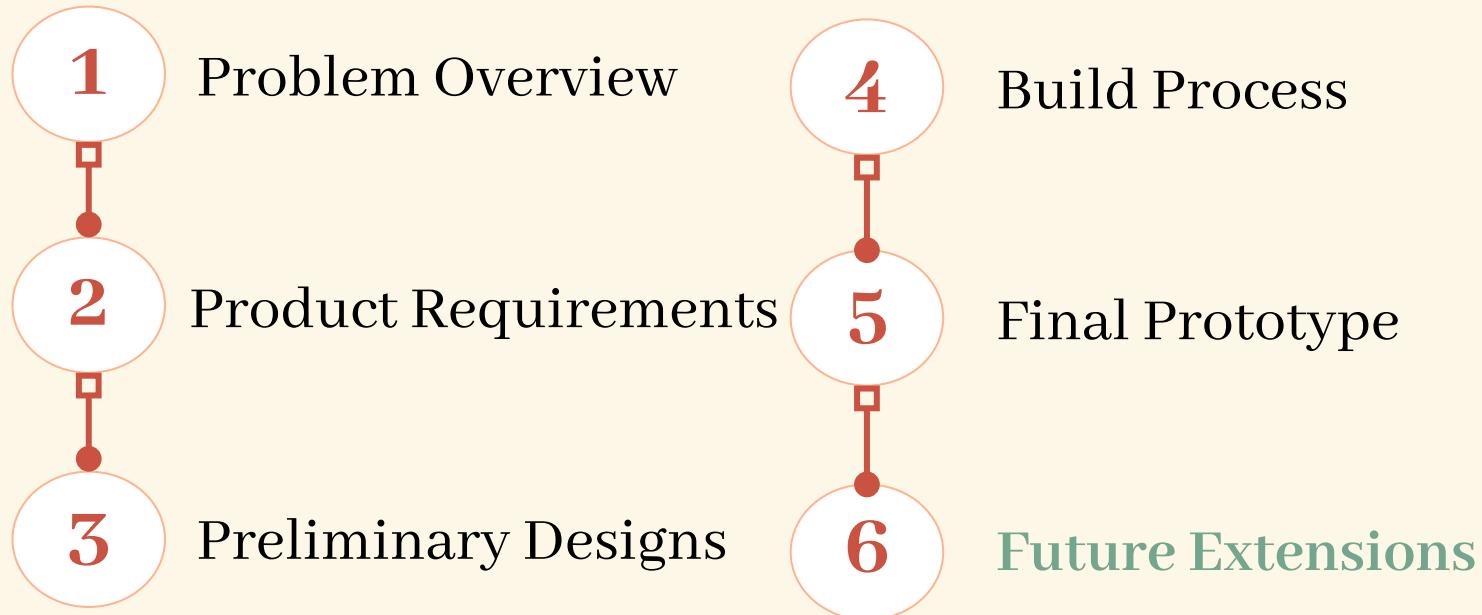


# Final Requirements

**Table 5:** Final Requirements Decision Matrix

	Criteria	Type	Level	Design D (final prototype)					
1	The device can be accessed at least 1 meter above the ground and accessible to a person in a wheelchair.	user	1	Yes	7	Device also provides access to the food content so that the user can physically access the food. The client specified that he would not want a closed design where the food is inaccessible to quickly grab when giving his dog treats (as opposed to a full meal).	functional	2	Yes
2	The device can regulate specific amounts of food to be dispensed. For Client X, these measurements are specified as $\frac{1}{2}$ cup and 1 cup of food (based on the client's current feeding process).	functional	1	Yes	8	The storage container possesses a capacity of at least 5 L of dog food to last no less than 7 days before refilling.	functional	2	Yes
3	The food storage container is produced using a water-resistant, non-corrosive material that is food-safe (will not contaminate the contents of the bowl).	physical	1	Yes	9	The product is stable and cannot be knocked over, even with a great amount of force	functional	2	Yes
4	The user is able to disassemble and withdraw the food storage bowl from the device for washing.	functional	1	Yes	10	The device is lightweight (under 5 kg) to enable transportation for when the user is traveling.	physical	3	No
5	The device in total costs under \$125.00 (USD) to produce, inclusive of materials and different iterations.	cost	1	Yes	11	The food storage portion of the device remains beyond reach to the dog through use of a hinged door or other mechanism that requires human aid to open.	functional	3	Yes
6	A metal storage container will be implemented into the design to ensure food-safe material for the food storage.	physical	2	No	12	Dishwasher safe food bowl	functional	3	N/A
					13	The product includes a user manual for Client X to reference if he needs help operating the machine.	documentation	3	No
					14	The product has a lid to cover the external storage of food	physical	3	Yes
					15	The product can be placed anywhere within the common household	physical	3	Yes

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# Future Work

- Client delivery and testing → client assessment
- Implement their suggestions/improvements
- Iterate process, refine details
- Final delivery to client
- Continual feedback

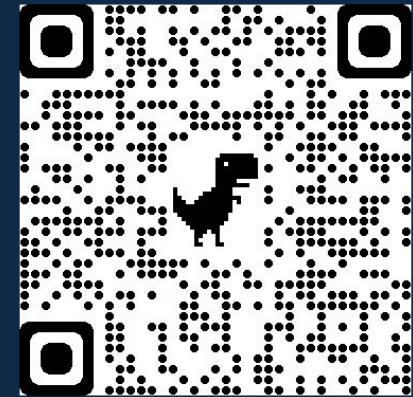


**Figure 10:** The dog of Client X

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# Designing a Mechanized Dog Feeder for Wheelchair Users



**STEM II: Assistive Technology Project Design Review**

**Smita Bhogle, Kiara Lavana, Eeman Saud, Diksha Sriram**

**Thank you! Any Questions?**

# Designing a Mechanized Dog Feeder for Wheelchair Users

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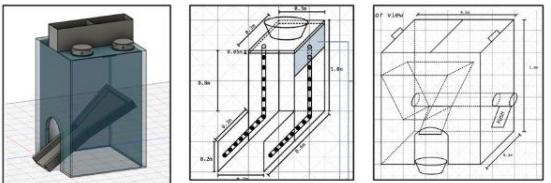
## Problem Statement

The standard process of providing food to dogs using a dog bowl on a floor with the products on the market is ill-adapted to individuals without full use of their legs.

## Level 1 Requirements

Criteria	Type	Y/N
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Produced using a water-resistant, non-corrosive food safe container.	physical	Y
Total cost is under \$125.00 (USD) to produce.	cost	N

## PDR/CDR Preliminary Designs



## Final Prototype

Picture of our final device



## Build Process

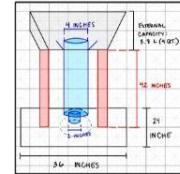


## Project Objective

To construct a machine for dog feeding adapted for individuals using a wheelchair through mechanized dispensation of dog food.

## Design Studies

- Post-CDR development
- Determined ideal dispenser height
- Determined the volume of dog food dispensed
- New "Design D"



Sketch of Design D, our final prototype

## Conclusion/Future Work



The dog of Client X

- Client delivery and testing → assessment → improvements
- Iterate process, refine details
- Final delivery to client
- Continual feedback