# Snackbot


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# Problem Definition and Team Objectives

Human interaction within the movie theater must be significantly reduced in response to the **Covid-19 pandemic** in order for theaters to survive. Eliminating the portion of the movie theater experience in which customers are lined up to order snacks and drinks at the concession stand is necessary for adhering to CDC guidelines.

We must **design a robot that** will solve this issue by delivering orders to customers while they are inside the theater, reducing human interaction.

Our team will work together to design all mechanical aspects of the robot to satisfy every necessary design attribute.

**It should also be noted that this robot is meant not for movie theaters as they currently are, but for the future **Covid-friendly theater** that is being designed by the Engineering Conference team.

Colby Henderson

# Design Attributes and Requirements

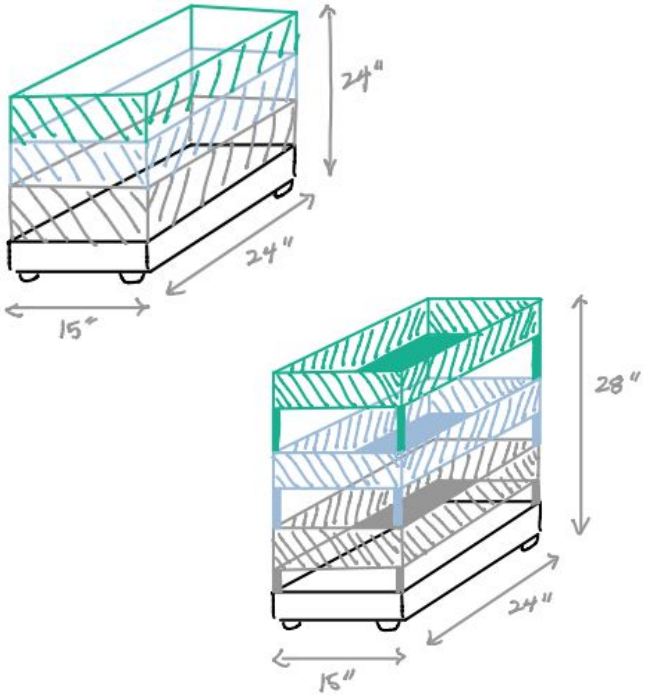
| Attribute | Importance (1-5) | Units | Min Value | Ideal Value | Max Value | Description |
|---|---|---|---|---|---|---|
| Height must be low enough to not block theater screen | 5 | mm | 575 | 610 | 760 | Guests must not be disturbed by robot moving through aisles |
| Should dispense sanitizer (dose) | 3 | ml | .4 | .6 | .9 | Sanitization will prevent germ propagation from guests to the robot while snacks are being grabbed |
| Must climb slight incline without tipping | 5 | degrees | 5 | 7 | 12 | Traveling through individual theaters requires ascending/descending ramps to reach every aisle |
| Must be able to turn | 5 | degrees | 10 | 90 | 90 | Following paths will require steering |
| Must have low center of gravity | 4 | N/A | N/A | N/A | N/A | Tipping could result in possible disaster. If heavy items are on top, robot is more prone to tipping and falling |

| Attribute | Importance (1-5) | Units | Min Value | Ideal Value | Max Value | Description |
|---|---|---|---|---|---|---|
| Can’t be too loud to interfere with movie | 4 | dB | 30 | 40 | 50 | A loud robot will distract from the movie |
| Should be relatively simple to manufacture | 3 | N/A | N/A | N/A | N/A | To produce multiple robots per theater, a simple manufacturing plan will keep costs low as most theaters are already short on money |
| Must be reliable (endurance time) | 4 | hr | 2 | 10 | 15 | If guests do not receive orders due to faulty or slow robots, they will be angry and theater will lose future business as customers will file complaints |
| Must carry both snacks and drinks | 5 | N/A | N/A | N/A | N/A | Customers will order whatever the concession stands normally offer including both drinks and snacks |
| Must carry adequate weight | 5 | kg | 20 | 30 | 50 | Drinks and snacks all have different weights and any combination of them will result in a different weight. Max load capacity should be sufficient to satisfy any order. |

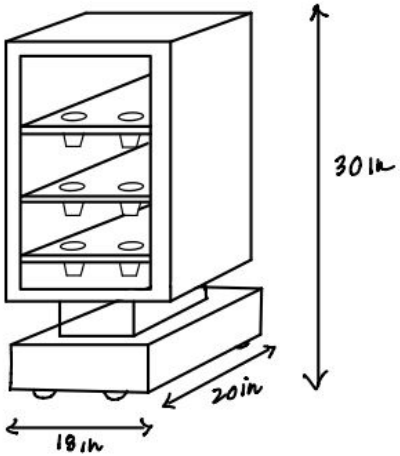
Colby Henderson

# Concept Designs: Chassis

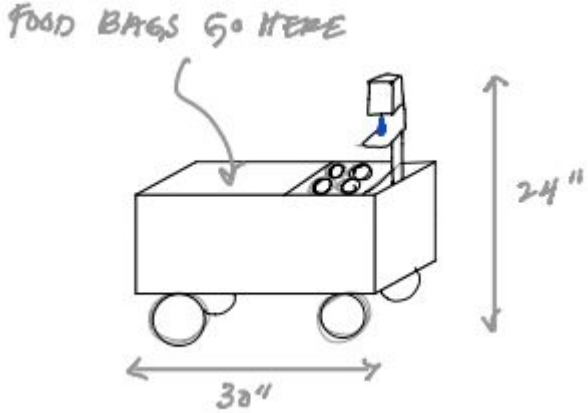
Stackable Trays




Removable Trays
(Drinks on trays)



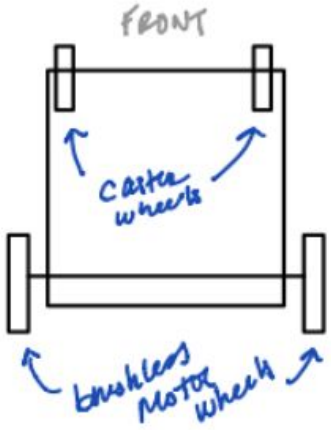

Wagon Style



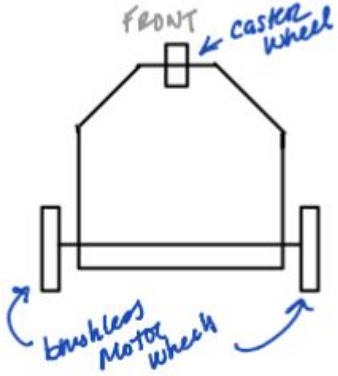

Jainam Vasa

# Concept Designs: Wheel Hub and Motor

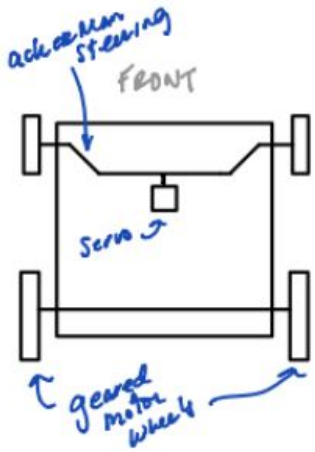
2 brushless motor wheels for the back + 2 castor wheels in front




2 brushless motors wheels for the back + 1 castor wheel in the front




2 Geared motors wheels for the back and a servo motor for 2 wheels in the front




Jainam Vasa

# Final Design Justification

**Chassis**:

- A hard and robust base for the robot.
- Compartmentalized structures with removable trays
- Sanitizer dispenser on either side
- A screen at the top to display order number

**Sizing**:

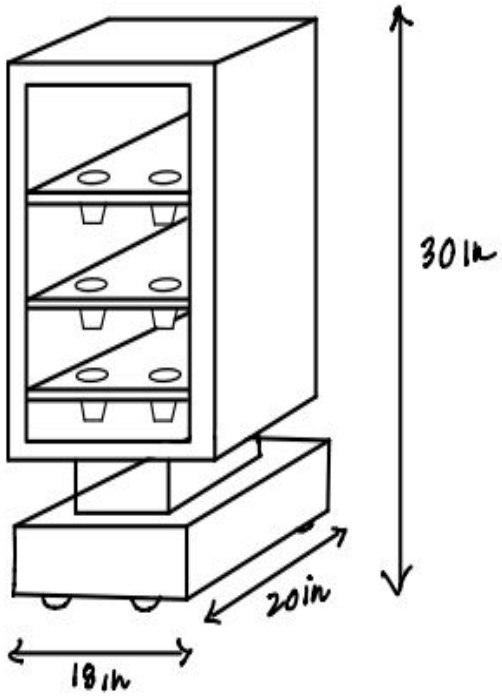
- 30 inches tall , 18 inches wide and 20 inches deep.

**Steering**:

- 2 brushless motor wheels at the back
- 2 passive castor wheels in the front
- Cost effective and can be easily purchased

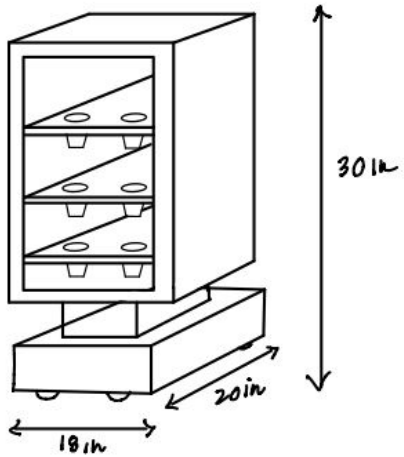
**Material Selection** :

- Aluminium 6061 -T6 for the overall chassis
- High Ultimate Tensile Strength of 315 MPa
- HDPE for removable trays
- Ultimate Tensile Strength of about 10-45 MPa



# Concept Selection: Proposed Design

Our team selected a chassis with a strong and robust base and a set of removable trays on the top, guarded by acrylic doors.




| Strengths | Weaknesses | Opportunities | Threats |
|---|---|---|---|
| Walls surrounding trays provides **protection** as well as optional additions (i.e. screens). | Robot proportions could cause issues with **center of gravity**, decreasing stability. | Could end up being used for **other areas**, not just delivering food inside theaters. (hospitals, factories, etc.) | If robot isn't strong/stable enough, **accidents** could ruin a movie experience for a customer. |
| Removable trays decrease **germ propagation**. | Large orders could slow down **delivery time** as trays are limited. | Could make delivering snacks more **sophisticated** due to automation. | A **shortage of trays** for any reason makes the robot essentially useless. |
| Optional **doors** provide extra protection. | Door could increase germ propagation if customers do not **properly sanitize**. | | May cause snack/drink **sales to decrease**, as customers are more likely to buy things if they see it in front of them. |
| Robot body provides option for added **lights** for customers to easily find their orders. | Needing to make base of the robot heavy could add to **overall cost** due to extra material. | | |

# Detailed Schedule

| | Projects | Week 6 | Week 8 | Week 9 | Week 10 | | Week 11 |
|---|---|---|---|---|---|---|---|
| | | 2/7/21 | 2/22/21 | 3/3/21 | 3/8/21 | 3/14/21 | 3/19/21 |
| Projects | Final Presentation | | | ☐ | | | |
| Ch 1 | Design Review Setup | | | | ☐ | | |
| Ch 2 | Design Review | | | | | ☐ | |
| Ch 3 | Final Report | | | | | | ☐ |
| Ch 4 | Detailed Analysis/Testing | | Begin (if possible) | | cont. | | ☐ |
| Ch 5 | BOM | | First Draft | | Final Draft | | ☐ |
| Excess | Assembly Drawings | | First Draft | | Final Draft | | ☐ |
| | Prototype Plan | | First Draft | ☐ | Final Draft | | ☐ |
| | Prototype Risk Assessment | | First Draft | ☐ | Final Draft | | ☐ |
| | Updated Cost Estimates | | First Draft | | Final Draft | | ☐ |
| | Design Verification | | First Draft | ☐ | Final Draft | | ☐ |
| | Prototype Verification | | First Draft | ☐ | | Final Draft | ☐ |
| | Final Design Description | | First Draft | ☐ | | Final Draft | ☐ |
| | Safety/Risk Assessment | | First Draft | ☐ | | Final Draft | ☐ |
| | Summary | | | | | First Draft | ☐ |
| | Future Designs | | | | | First Draft | ☐ |
| | Lessons Learned | | | | | First Draft | ☐ |
| | Conclusions | | | | | First Draft | ☐ |
| | Complete Report | | | | | | ☐ |

Colby Henderson

# Concerns

- Best way to make the base heavy to **improve stability without increasing overall cost**.
- How to test if our robot will be stable **holding maximum load up an incline**.
- **Best materials** for each part (cost effective, reliable, etc.).
- How to correctly **machine** each aspect of the robot.
- How to avoid any issues if **accidents** happen, like a drink spills all over the robot.

Colby Henderson

# Future Tasks

Oscar: Will join Colby to work on steering and wheel hub

Nausir: Will join Jainam to work on Chassis/body

Analysis/testing will be team effort once SolidWorks model comes together

Oscar/Nausir