Contactless Delivery Robot - Project Portfolio

Project Overview

This project was completed as part of a first-year client-based engineering design course (APS112/113) at the University of Toronto. Our client, Tiny Mile, a Toronto-based robotics startup, tasked our team with improving the unloading system of their remote-controlled delivery robot, Geoffrey, to enable contactless food drop-off. The redesigned system needed to safely place food on uneven surfaces like benches and stairs while considering real-world constraints, including urban obstacles, weather, and municipal regulations.

My Contributions

I led the definition of the robot's functional requirements using engineering tools such as the Black Box Method and Enumeration. I was responsible for identifying and structuring the robot's core functions based on stakeholder feedback and service environment analysis:

- Defined the primary function: placing food without user contact
- Defined secondary functions: preserving temperature, avoiding spillage
- Evaluated design feasibility under Toronto's downtown pedestrian, weather, and visibility conditions
- Drafted technical constraints to comply with FDA and IEEE safety regulations
- Presented research and function mapping in the final report and presentation

Functional Requirements

- Primary Function: The robot should place the food at the drop-off location without any customer interaction.
- Secondary Functions:
  - Secure food during transit to avoid spillage or damage
  - Maintain initial food temperature throughout delivery
  - Confirm delivery without user presence

Initial Sketches

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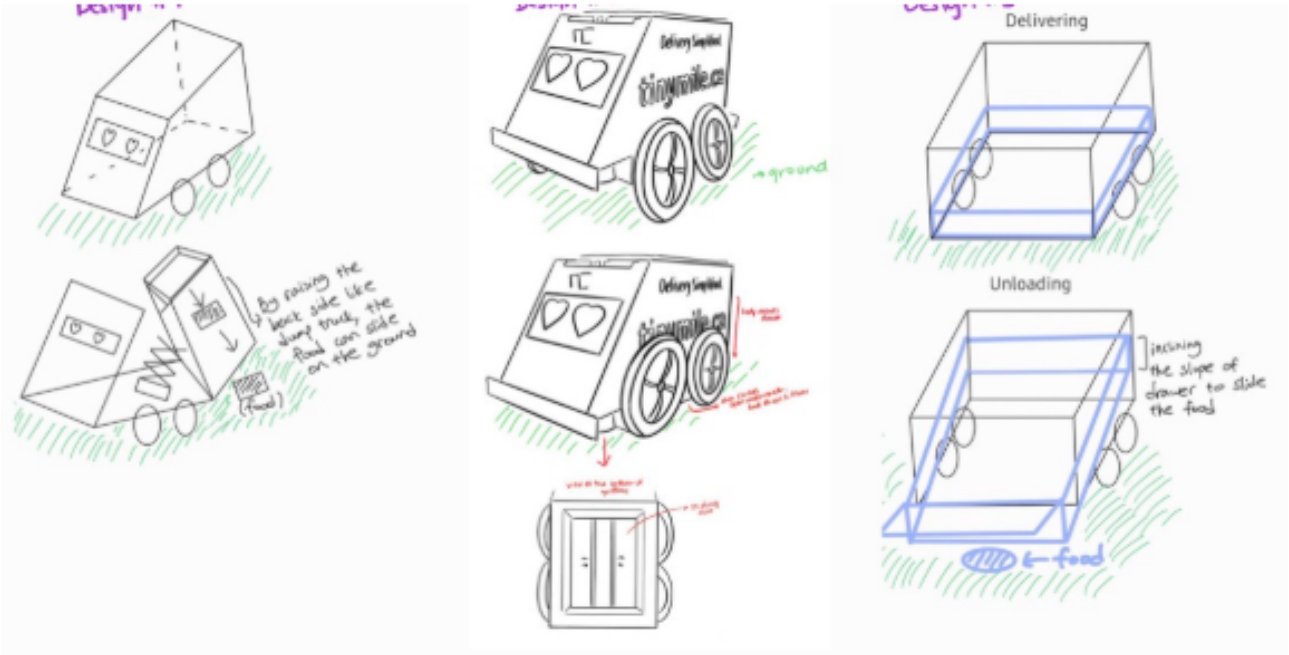

Figure: Initial sketches of all three alternative unloading designs

Alternative Design Concepts

"Squat and Place"

"Squat and Place" takes inspiration from elevators and biological beings to produce a simple unloading design that meets our primary function. Geoffrey lowers its body in a squatting manner making contact with the ground (see figure 2), and when a foldable door at the bottom opens, the food is placed on the ground.

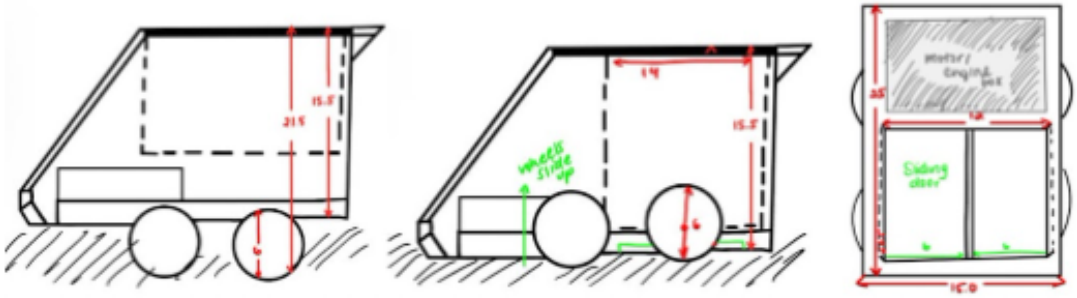

Figure 1: Original Dimensions *Figure 2: Modified Dimensions* *Figure 3: Accessory Dimensions*

Figure: "Squat and Place" Design - inspired by elevators and biological motion

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“Dump Truck”

This design features a concealed lifting mechanism under the front end of the existing cargo bay in Geoffrey.

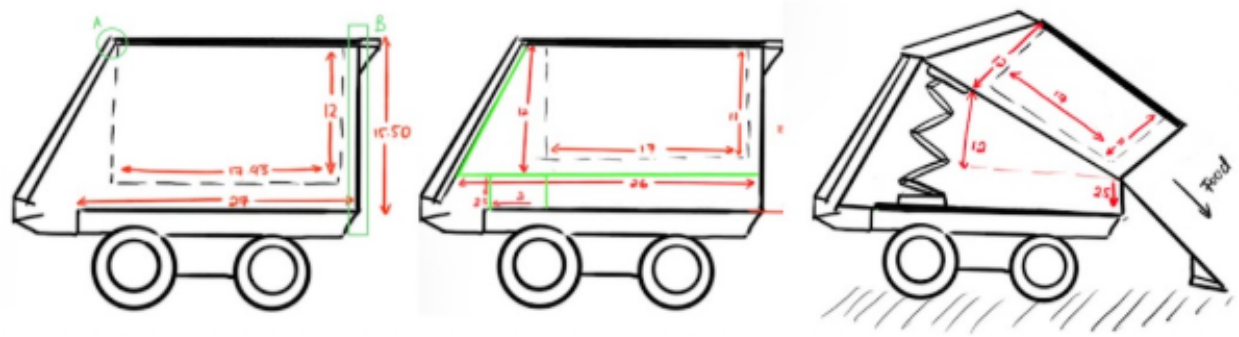

Figure 6: Original Dimensions *Figure 7: Modified Dimensions* *Figure 8: Accessory Dimensions*

Figure: "Dump Truck" Design - concealed lifting front bay mechanism

“Inclined Drawer”

The bottom platform will have two ranges of motion, see[50]. Both mechanisms will be controlled via motors (see figure 11).

When the driver deposits the food, the pusher will rise a certain amount until the optimal angle is reached and the platform will begin to slide out parallel to itself. Along the back of Geoffrey, a hatch inspired by a one-way doggy door will allow the food and the platform to easily escape from the back. The door will only be able to open towards the outside, but still, allow free movement from the inside of Geoffrey.

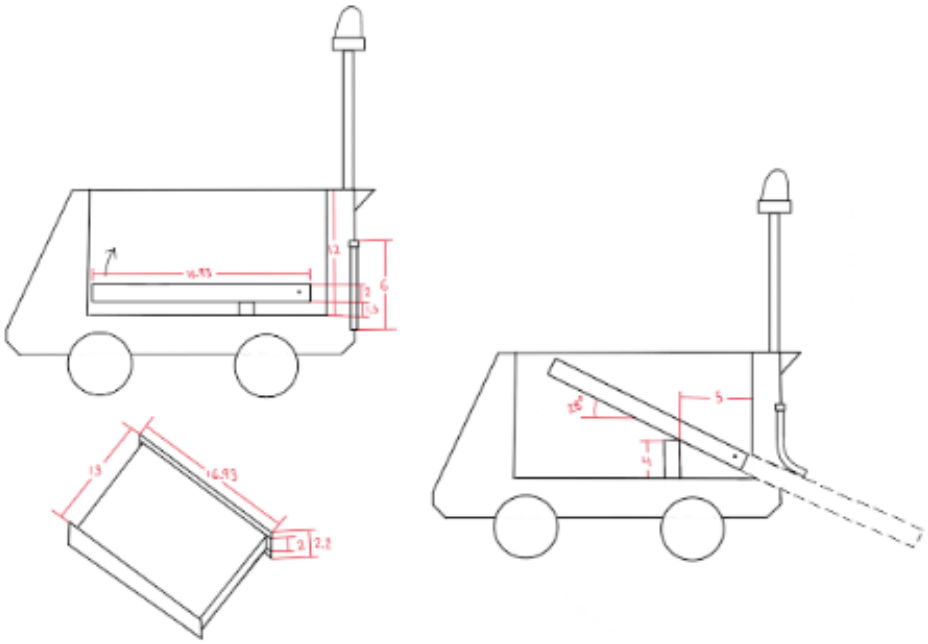

Figure 11: Side drawings of Geoffrey and bottom platform with railings. All dimensions are in inches.

Figure: "Inclined Drawer" Design - pusher slides food on angled drawer

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Design Decision: Pugh Chart

Pugh Chart

Design	Current design	Squat and Place	Dump	Inclined drawer
Unloading time	s	+1	+1	+1
Unloading distance	s	+1	+1	+1
No spills	s	0	-1	0
No damages	s	0	0	-1
Conservation of temperature	s	0	0	0
Stability	s	+1	-1	+1
Sum	s	+3	0	+2

Figure: Pugh Chart showing Squat and Place selected as final concept