ME 370 Fall 2025: Project 1

Project Overview

As campus life grows more dynamic, the need for efficient delivery systems is becoming increasingly important. From package **drop-off in dorms**, to **delivering lab supplies across departments**, to dispensing **medication at McKinley Health** Center, the University of Illinois faces challenges like those being solved worldwide by delivery, medical, military and service robotics.

To address this, campus management has approached the ME 370 class with a design challenge: create a scaled prototype (about 1/10 scale) of a legged dispensing robot that can travel down hallways and deliver items on demand. This design must demonstrate decoupled operation—dispensing and movement must be able to occur independently.

The task is to design and build a dispensing robot that will **travel down a building hallway**, **store multiple payloads**, and **release them in sequence at controlled times**. Teams have the freedom to decide what their robot dispenses, within the specified payload constraints (size, weight, and number of items).

In addition to meeting these technical requirements, the **objective is also to discover, define, and meet the requirements of an identified user case**. This means teams must select a realistic context—such as dormitory package delivery, lab supply distribution, or medication dispensing at a health center—and demonstrate that their robot design addresses the needs, constraints, and expectations of that chosen scenario.

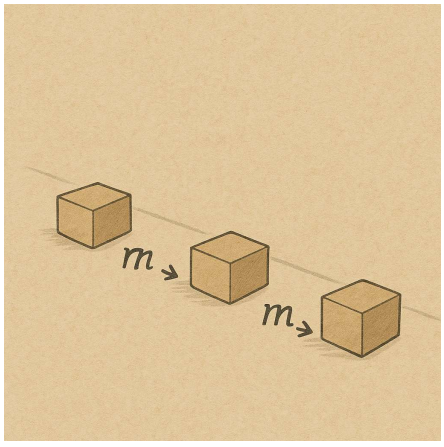
To accommodate most campus requirements, the design should be efficient, use as few components as possible, and be optimized for rapid movement and stability.

To help guide the process, the project will be divided into two stages:

- Project 1 – Stationary Manual Dispensing & Timing Mechanism
- Project 2 – Motorized legged Robot

Project 1 - Manual Dispensing & Timing Mechanism Stage

Functional Requirements



- During each full cycle (which may correspond to N turns of the crank), the dispensing mechanism must release exactly one object from its storage bin.
- The dispenser should hold at least 5 objects to be dispensed, each weighing 25 g or less.
- The dispenser will be hand-cranked, with no other human input other than loading objects at the beginning of the sequence.
- The dispensing mechanism in Project 1 will be adapted to the Motorize legged robot in Project 2 to dispense a single object every 2m.

- Teams must carefully design and plan for their payload in accordance with the identified user group. The payload and dispensing mechanism should have a theme to align with the user group.
- Payload dispensing should be stable (no bouncing) and result in consistent orientation.
- Creativity, aesthetics, and human-centered design must be incorporated into the project. Teams will be evaluated on how well functional requirements are met, the simplicity of the design, the creativity of the theme, and how specific design choices enhance or detract from the intended user experience.

Physical Requirements

- Gravity-assisted dispensing is allowed, but a mechanism (linkage, gears, cams, belts, etc.) must be used to release the payload.
- Keep the design light and easy to crank to preserve mechanical power for mobility.
- When integrated with the walker, the **entire** robot (frame, legs, mechanism, and storage) must fit inside a standard shoebox ($18 \times 18 \times 30$ cm^3).
- The dispenser must be fully mechanical (linkages, gears, cams, belts, etc.). Be creative and entertaining!
- The dispenser should be built using rapid prototyping materials and show good craftsmanship. Components bearing loads or transmitting forces must use good engineering practices (use fasteners) and cannot be glued or taped. Tools available in the Jackson Innovation Studio or basic hand tools may be used. Recycled or scrap materials (wire, wood, tin cans, acrylic, etc.) are acceptable, but all items found must be documented in the expense report.

Manual Design Budget:

Each team has a tracked budget of $50.00 for internal purchases from the Innovation Studio (here)

- Student independent purchases should be minimized and authorized by instructor. If an instructor determines that the use of student's own funds has unfairly advantaged them, they reserve the right to assess a point penalty.
- You may use freely available materials such as recycled scraps offered for this purpose in maker spaces, but their total value should not exceed 1/2 of the design budget and the team must inform their section's TA of the material use on or before the demo day.

Procedure

Your goal is to create a dispensing mechanism later adapted to a campus service robot. The rest of this project document provides a scaffold for you to learn the rudiments of design thinking in a holistic manner:

1. **Identify** a general user group and the user experience your team is interested in exploring, for example, package drop-off in dorms, delivery of lab supplies across departments, or medication dispensing at McKinley Health Center.
2. **Empathize** with this user group through research, interviews, and simulated exercises to gain some understanding of the wants and needs of your users. Exemplify needs of users such as a well-suited design for the operational environment according to the identified user segments. For example: *"Medical dispensers must be easy to clean"* or *"Laboratory dispensers must be rugged and simple."*. Use the empathy materials from Lab 2 (Design Lab 1). Deliverable 1 (Lab 2: pre-lab assignment): Complete the prelab for Design Lab 1. Additional details can be found in the Lab 2 manual. This delivery must be an individual (not a team) effort.

3. **Define** the desired experience and user group that your team wants to design for. Use a mind-map to organize and synthesize your individual lists during Lab 2 (Design Lab 1). Do not criticize your teammates during the initial ideation: it is good to have ideas that seem silly or outlandish. Then, ideate by expanding the mind map until you agree on a common goal as a group. Use Post-its to group and eliminate ideas until you converge on a final idea. Deliverable 2 (Lab 2: in lab assignment): Compile documentation of your ideation process. A full list of the materials that must be included can be found in the Lab 2 manual.
4. **Generate** ideas as a team**.** Capture your concepts by sketching them on paper so they can be easily shared. If you are not confident in your sketching ability, we recommend reviewing some basic sketching techniques and strategies with some of the Sketch A Day videos found here. As a team, select the designs to be explored using low-fidelity, cardboard prototyping. During Lab 3 (Design Lab 2) use cardboard to prototype the two most exciting or high-risk options in 3D to explore their potential before deciding on a final design. The intention of transforming your sketches into physical models is to explore, touch and reevaluate your ideas and account for any unforeseen challenges. Deliverable 3 (Lab 3 post-lab assignment): Complete the post-lab for Design Lab 2, which will help you to think about the prototyping process, and how it can be used to answer key design questions. A full list of the materials that must be included can be found in the Lab 3 manual.
5. **Evaluate** your final design: Deliverable 4: Your team will present your dispenser and its cardboard prototype(s) in a critique session format during Lab 4 (Conceptual Design Review). Create a PowerPoint slide to share the vision for the user experience you would like to achieve. A full rubric for the presentation will be provided separately. If possible, return to your user group with prototypes for feedback to understand how well your design accomplishes its goals.
6. **Create** CAD models and mechanism simulations to verify mechanical designs.
7. **Fabricate a final prototype** using the equipment in the Jackson Innovation Studio. Deliverable 5: Create your final dispenser prototype and a product pitch in the form of a 3-slide presentation and a one-page instruction manual. The manual should primarily utilize images to show the operation of the dispenser, rather than explaining the motion with words. The slide presentation should be designed to clearly reveal which types of linkage mechanisms and gears you used. The final dispenser should not be made with any “low fidelity” materials such as cardboard. The final prototype and 3-slide presentation will be delivered and reviewed during Lab 7 (Project 1 final). A full rubric will be provided separately A template for the supplemental expense report required in the presentation will be provided separately. Please note that the expense report should be briefly shown in the presentation but does not count as one of the 3 slides.

Project organization, timeline, and grading

This project has four deliverables (Table 1). Some details of deliverables may be subject to change, but advance notice will be given if they do. Details of deliverables follow below.

Week	Task	Grade
9/1 – 9/5	**Deliverables 1 and 2:** Individual brainstorming and sketches (10%). Team brainstorming on user experience and system requirements (15%) During Lab 2 (Design Lab 1): Ideate	Lab 2 grade
9/8 – 9/12	**Deliverable 3**: Initial prototyping and ideation activity During Lab 3 (Design Lab 2): Prototype	Lab 3 grade
9/15 – 9/19	**Deliverable 4:** Low-fidelity prototype(s) and presentation Due in Lab 4: Conceptual Design Review	40%
10/6 – 10/10	**Deliverable 5:** Final Prototype and Presentation Due in Lab 7: Project 1 Final	60%
	Peer Evaluation Multiplier – Individual final project grade will be modified based on team member CATME peer evaluations. Complete after D4 and D5.	