UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

ME 370

Package Dispensing Legged Robot

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10/24/2025

Desired Outcomes For Dispensing Robot

Theme Considerations:

1. **Visibility**
   a. Easy to distinguish in operating environment
   b. Remove risk of collision with people
2. **Compatibility**
   a. Deliver packages of different sizes

Technical Considerations:

1. Low center of mass for balance and no rollover.
2. Place the package every 2 meters. High accuracy.
3. Pushing down the package quickly not cause any lag. Gear ratio and partial gear

Desired Outcomes For Dispensing Robot

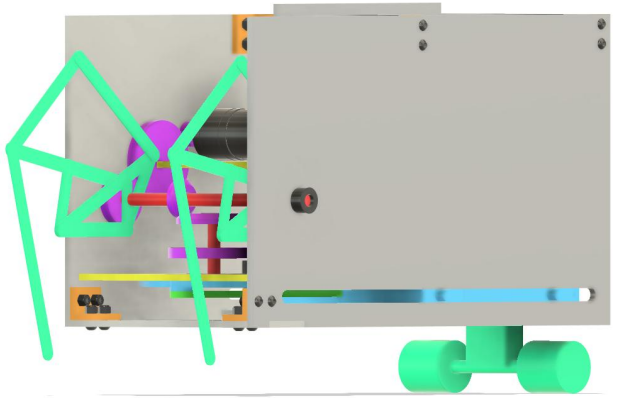
Dispensing

1. **Robustness**
    a. Crank, pusher, and pushrod link must be able to handle the weight of the 5 packages and still operate smoothly
2. **Compactness**
    a. The majority of the robot volume should be for the packages, not the mechanisms to dispense them
        i. Purpose of the robot
3. **Quick Operation**
    a. Dispensing packages quickly at drop-off intervals
    b. Not slowly pushing the package and it falling off by itself after certain distance

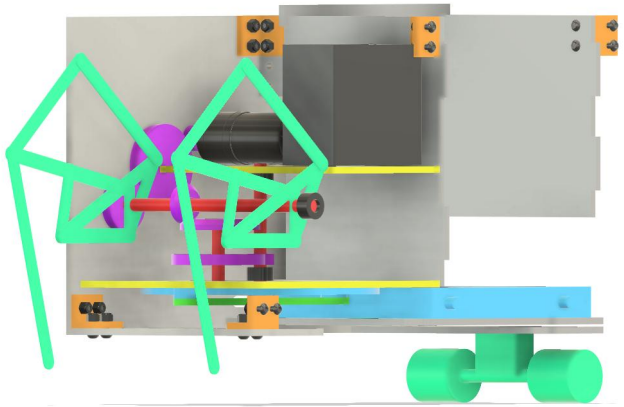
Idea 1

Overview

- Move crank for dispensing mechanism to be horizontal -> create more space for legs motion and drivetrain
- Use partial gear on crank to allow for dispensing every 2 m
  - Less often then leg movement but movement needs to be quick
- Two passive wheels and two legs
  - Klann linkage
  - Legs out of phase so always 3 points of contact



Isometric View of Complete Walker

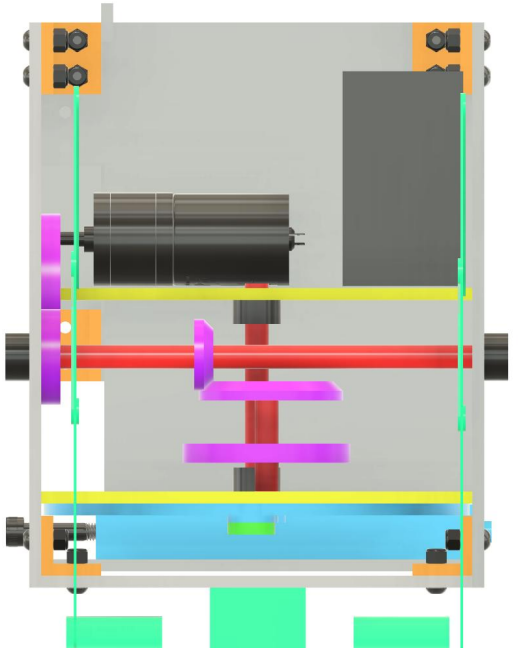


Isometric View of Walker with One Wall Removed

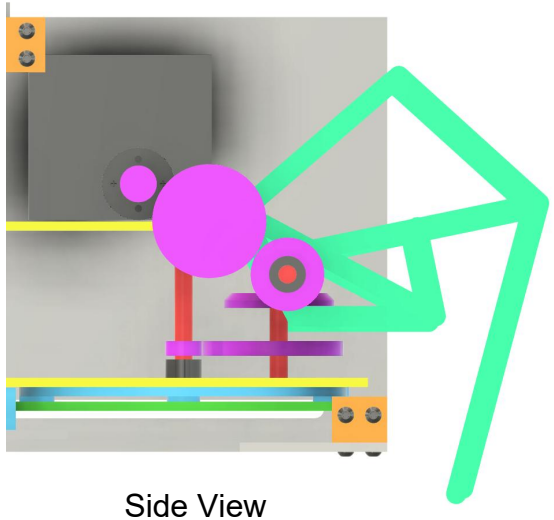
Idea 1

Drivetrain

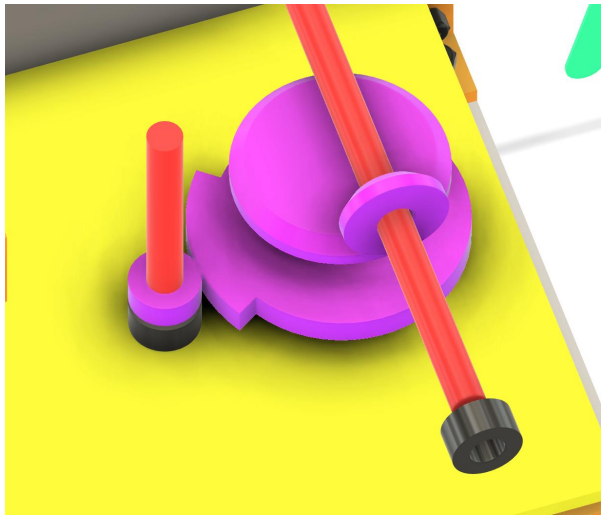
- Gears connecting motor to leg driveshaft for legs
- Bevel gear reduction off of leg driveshaft to partial gear
- Partial gear connects to much smaller gear on crank
  - Crank gear must be small enough so all of partial gear motion corresponds to 1 full crank rotation
- Shaft collars used to constrain driveshafts



Front View



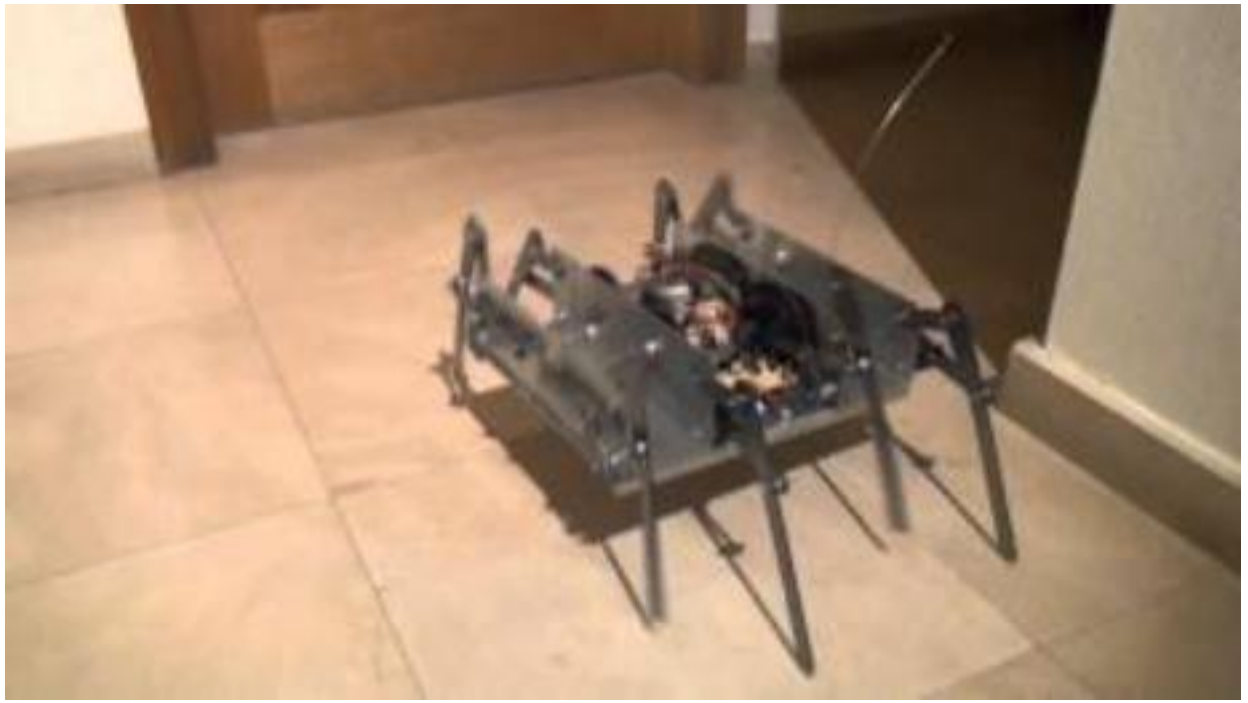
Side View



Detailed View of Partial Gear

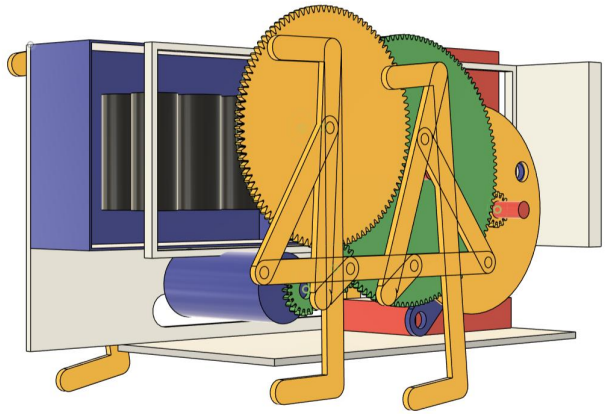
Walking Mechanics

1. **Stability**
    a. Ensure that packages stay stable
        i. Instability can disturb operation of dispensing mechanism
2. **Smooth Motion**

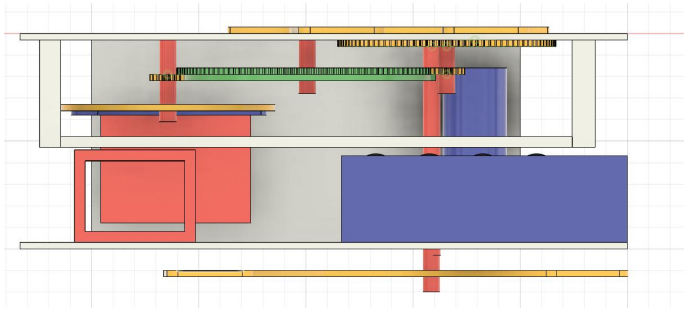


Overview

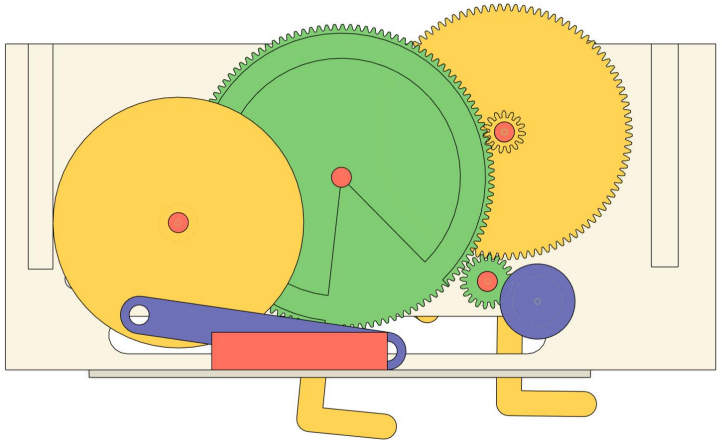
- **Drivetrain Mechanism (why not 1:39 but 5:35)**
  - **Partial geer transmission**
  - **Total Cycle:** 40 rotations of the leg gear.
  - **Phase 1 (5 rotations):** Dispenser is engaged, completing one full action.
  - **Phase 2 (35 rotations):** Dispenser idles.
- **Leg Mechanism (Balance)**
  - Chebyshev's plantigrade machine
- **Placement (Top View)**
  - **Top Half:** Drivetrain & Motor
  - **Bottom Left:** Dispensing Mechanism
  - **Bottom Right:** Battery Box



Isometric View of Complete Walker



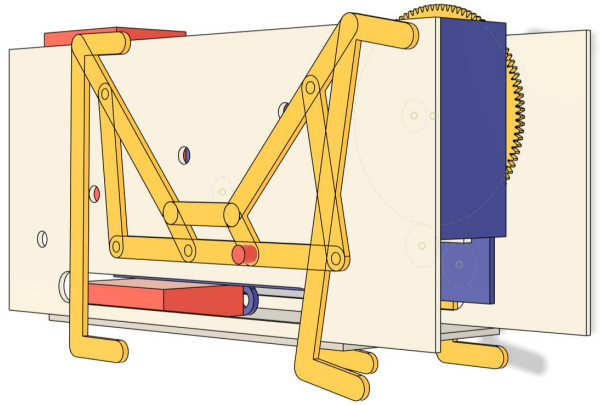
top view



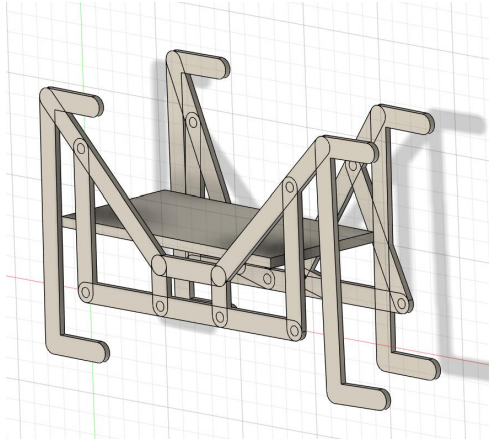
side view-detailed view of the drivetrain

Leg mechanism (Chebyshev's plantigrade machine)

- **Grouping:** Legs are coordinated in diagonal pairs (e.g., Left-Front/Right-Rear).
- **Coordination:** Pairs are driven 180° out-of-phase.
- **Gait :** While one diagonal pair is in the **Stance Phase** (propelling on ground), the other is in the **Swing Phase** (lifted and advancing).
- **Stability:** The walker always maintains two diagonal support points, keeping the center of mass stable.



Side view of the leg mechanism



A detailed view of the legs

Compare and contrast of ideas

Idea 1:

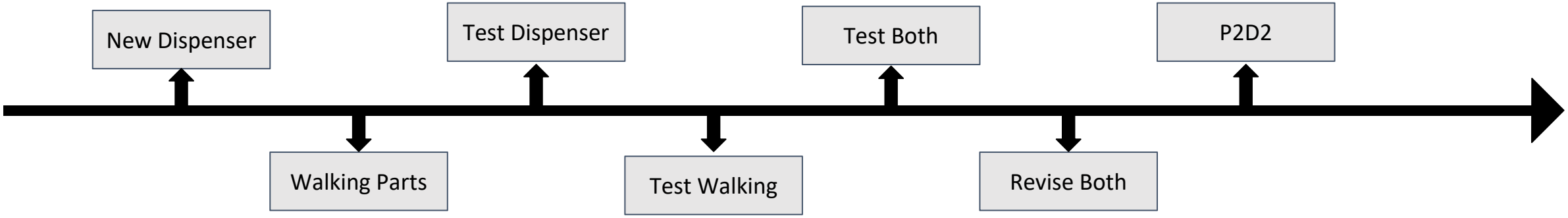
- Two passive wheels and one leg always in contact with ground, stable.
- Requires bevel gears, a more complex drivetrain structure.
- Occupies a large internal space, limited space for packages.

Idea 2 :

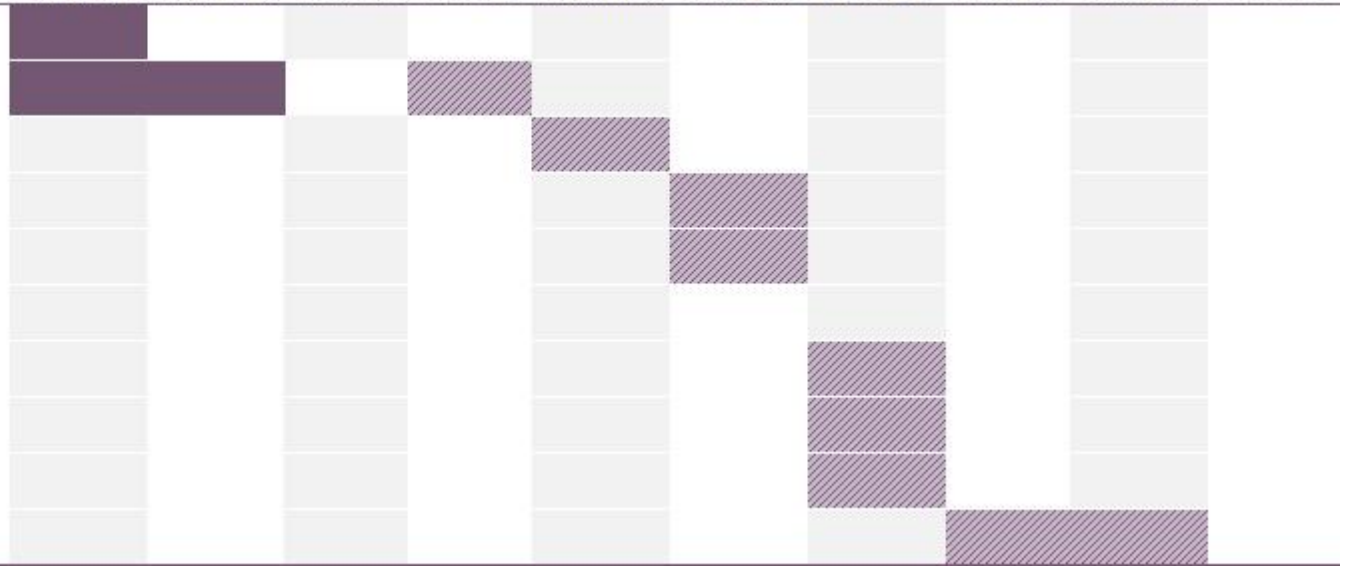
- Two feet on the ground when walking, unstable.
- Only install drivetrain structure on one side, simpler in structure. More space for packages.
- Too large gear may exceeds the specified height.

We will choose to use the Idea1 leg structure design because it is more stable, considers using fewer transmission structures like Idea 2, avoids exceeding the specified size, and leaves enough space for placing packages.

Future plans



ME370 To Do List	Task Owner	Start Time	Finish Time	Precent
Discuss ideas and prototype designs	Together	2025/10/19	2025/10/24	100%
CAD model design	Together	2025/10/19	2025/11/15	30%
Simulation	Daniel, Yuan	2025/11/15	2025/11/17	0%
3D printing	Yuan, Bing	2025/11/17	2025/11/23	0%
Laser cutting	Daniel, Sebastiar	2025/11/17	2025/11/23	0%
Tolerance adjustment	Sebastian, Bing	2025/11/20	2025/11/23	0%
Project 1and 2 Assembly	Together	2025/11/24	2025/11/30	0%
Assembling the motor	Daniel, Yuan	2025/11/24	2025/11/30	0%
Take the video	Together	2025/11/30	2025/12/7	0%
Final presentation	Together	2025/12/7	2025/12/17	0%



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