Team 037
KMJ

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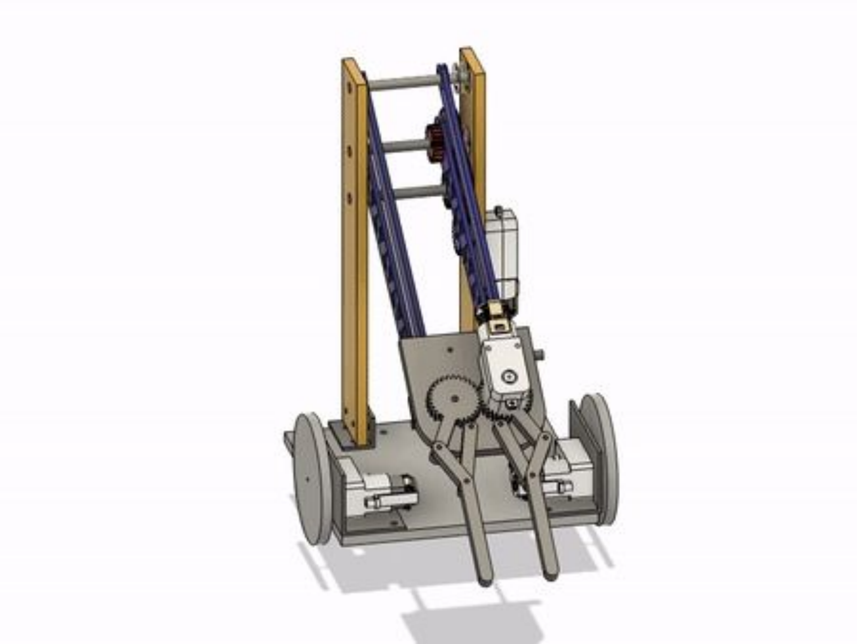
The Keyman of Today:
KMJ Robot



Major Power Components (with geared motors)

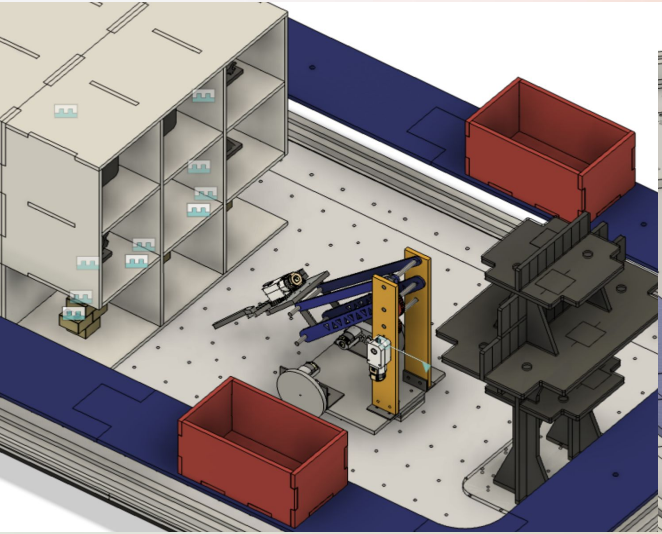
- The claw for grabbing the objects
- The four-bar linkage to elevate the claw
- The drive-train to give support for robot’s mobility

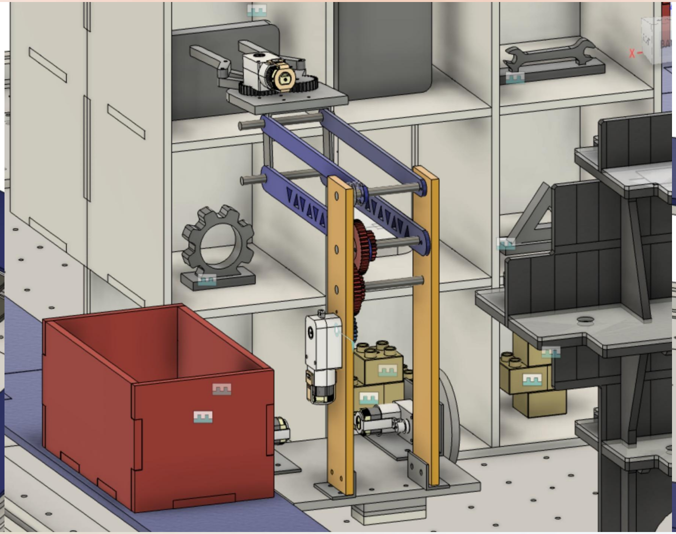
Goals When The Competition Starts

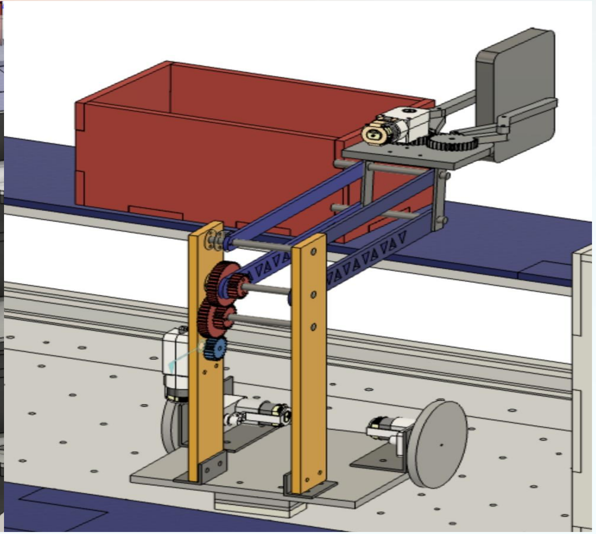
- The linkage raises to the third floor of “dorm room” to grab block objects, and the drive-train allows the robot to move to the trolly and the claw opens to place the object inside the trolly. (15+30)
- If time allows, the other objects could be placed on Geisel 2nd Floor. (15+30)

Jason Liu

✦ Step By Step Scoring the Points ✦



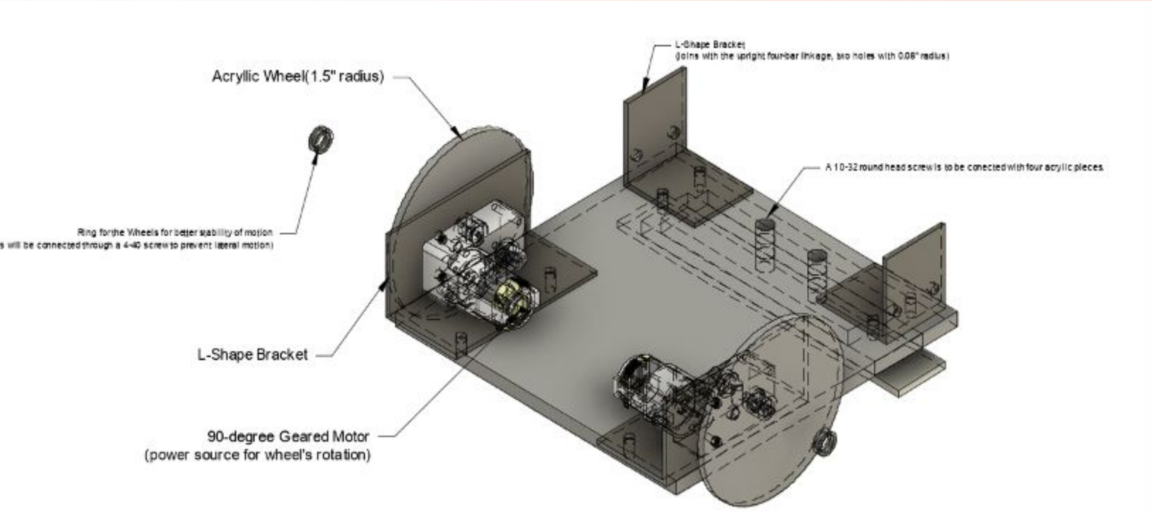


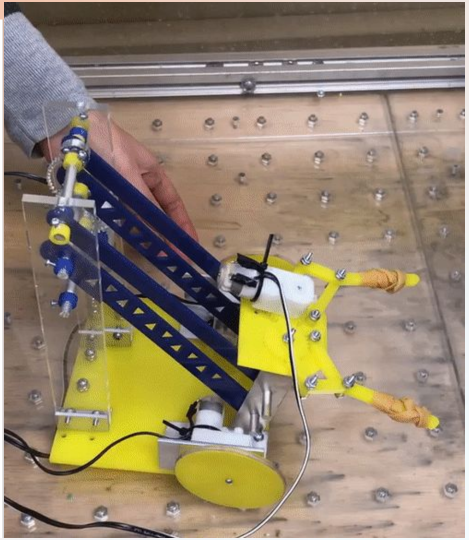


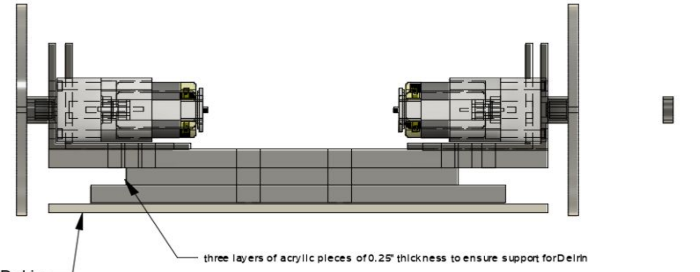
Jason Liu

KMJ’s Arsenal

Moving the Robot: Drive-Train







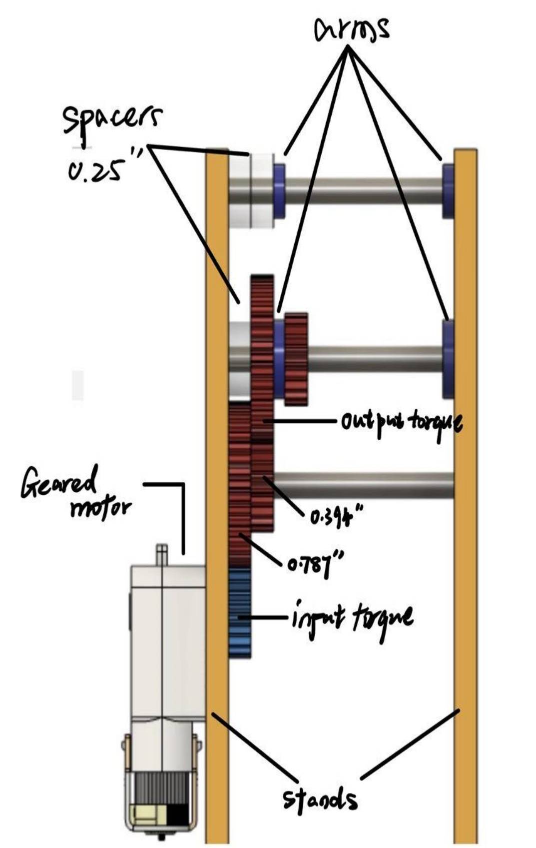
Drive-Train

- Wheels are powered by two 90-degree geared motors.
- Delrin is used for reducing the friction to facilitate sliding purpose.
- L-shaped brackets connect the base to the upright linkage.

Jason Liu

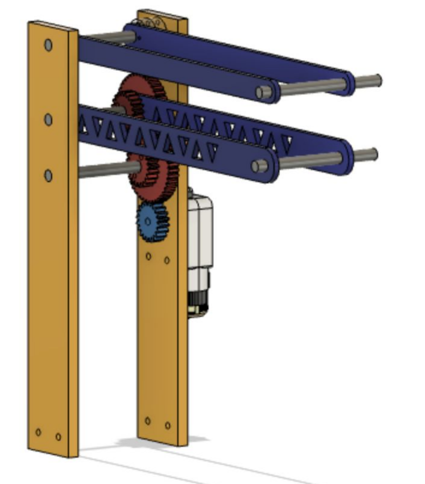
KMJ's Arsenal

Lifting Up the Robot: Four-bar-linkage



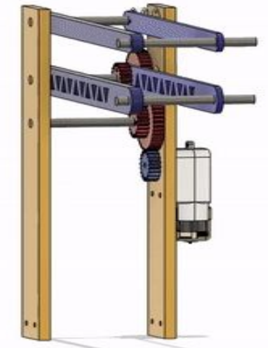
Gear Ratio

- two sets of 1:2 (total ratio of 1:4)
- torque is enlarged by four times



Four-bar-linkage

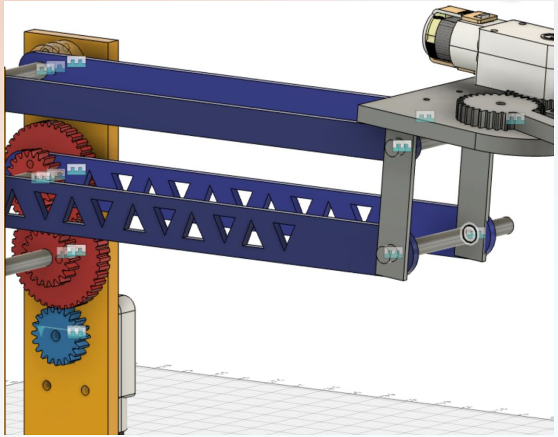
- Gears are powered by the motor.
- Motor is placed outside whereas the gear is inside to ensure stability.
- Three rods are used. Two connects arms, and one provides mechanical advantage.
- Small triangle holes are embedded to reduce the weight for arms.

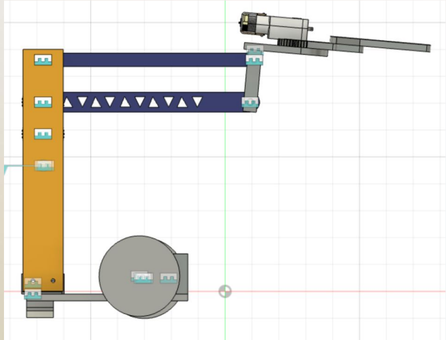


Jason Liu

KMJ key features

- Linkages with triangles located at the lower arms
- A two set compound gear system with a gear ratio of (two sets of 1:2) total of 1:4
- A sheet metal claw connector

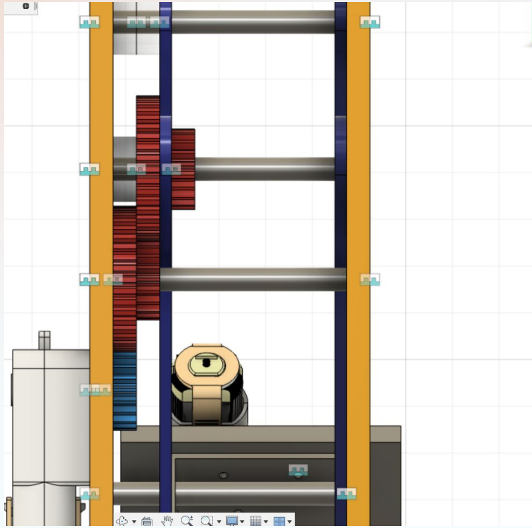




Karla balin

Functionality and Decision making of key features

- 3d gear intersects with the first gear on the bottom rod
- The first gear on the bottom rod is attached to another gear (gear 2)
- Gear 2 interacts with gear 3 (located on the middle rod)
- Both gear 2 and gear 3 are attached to linkage arm in respectively rod areas



Why?

- The set of compound provides the greatest torque
- The linkages have triangles on them to reduce the mass
- The claw connector allows the claw to go further up

Karla ballin

✦ Design process: concept generation ✦

What we did:

- created multiple design and tested them out
- Looked at functional requirements
- Used analysis based methods to test out possibility of it working

How it helped:

- With the torque issue
- Errors in material usage
- Arm not staying up

Karla ballin

Functional Requirements (Events) *Words*	*Design Parameters (Idea)* *Words & Drawings*	*Analysis* *Experiments, Words, FEA, Equations, Spreadsheets…*	*References* *Historical documents, www…*	*Risk* *Words, Drawings, Analysis…*	*Counter-measures* *Words, Drawings, Analysis…*
A list of independent functions that the design is to accomplish. Series (1,2,3…) and Parallel (4a, 4b..) FRs (Events) can be listed to create the *Function Structure*	Ideally independent means to accomplish each FR. AN FR CAN HAVE SEVERAL POTENTIAL DPs. The "best one" ultimately must be selected	Economic (financial or maximizing score etc), time & motion, power, stress… EACH DP's FEASABILITY MUST BE PROVEN. **Analysis can be used to create DPs!**	Anything that can help develop the idea including personal contacts, articles, patents, web sites….	High, Medium, Low (explain why) risk of development assessment for each DP	Ideas or plan to mitigate each risk, including use of off-the-shelf known solutions

Reciprocity: 1/R=CM?!

Lifting the Maximum Mass

Assumptions:

- No friction at the pivots/joints
- Quasistatic
- Claw and item are point masses

(1) $\sum M_A = F_N^{2}L + F_g r - \tau_m = 0$

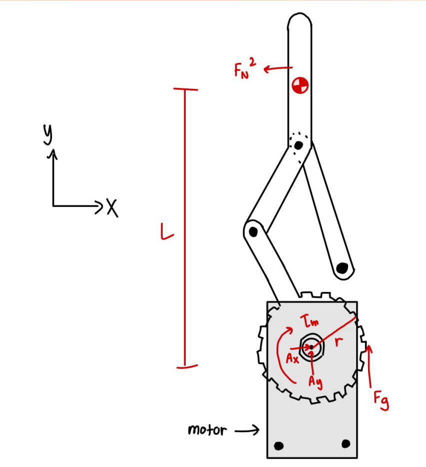
(2) $\sum M_B = F_g r - F_N^{1}L = 0$

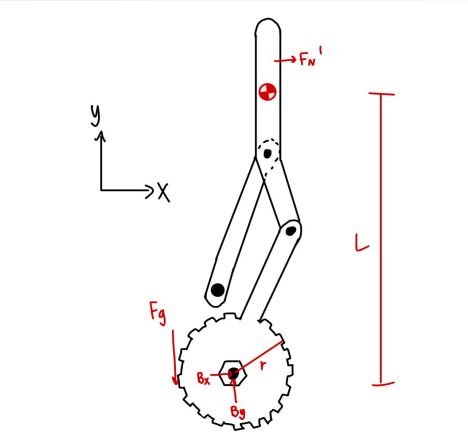
(3) $\sum F_x = F_N^{1} + F_N^{2} = 0$

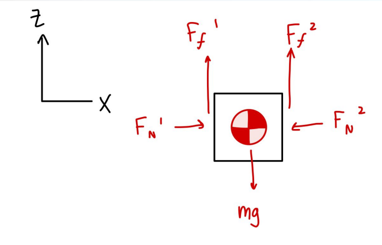
(4) $\sum F_y = F_f^{1} + F_f^{2} - mg = 0$

(5) $F_f^{1} = \mu F_N^{1}$

(6) $F_f^{2} = \mu F_N^{2}$







Marianne Jo

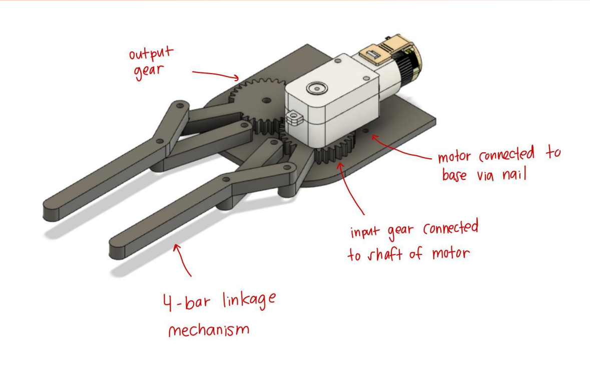
Lifting the Maximum Mass

$m = \mu \tau_m / Lg$

Known variables:

- $L = 0.06$ m
- $\tau_m = 0.321$ Nm
- $r = 0.015$ m
- $\mu = 0.5$
- $g = 9.8$ m/s^2'

Calculated Max. Mass: 272.96 g
iPad Mass: 160 g
Factor of Safety: 1.7
Experimental Max. Mass: 306 g
Percent Error: 12.1%



Marianne Jo

Test run

What we score:

- Gear placed on trolley (30 pts + 10 pts)
- Multimeter placed on trolley track (20 pts + 15 pts)
- Camera placed on the trolley track (20 pts + 15 pts)

Total points:

- 30+10+20+15+20+15=110 pts