

What is the problem?

Our problem is that packages are commonly misdelivered.





Extensive Sources



Professionals

1. Ralph Smith

- a. Senior Networking and Distributed Systems Engineer, MITRE
- b. Principal Engineer, ARINC, Inc.
- c. Staff Engineer, Qualcomm, Inc.
- d. Principal Systems Engineer, Exelis

2. Dave Price

- a. Vice President Barney Trucking
- b. Sr. Director Logistics
- c. VP - Health Safety and Business Improvement
- d. COO - Dyno Nobel Transportation, Inc.
- e. Controller - Logistics, Dyno Nobel, Inc.

3. Scott Walch

- a. Retired 30-year employee of UPS

4. Chris Holt

- a. CEO, Campman.com
- b. Co-Founder, bergrepublik
- c. Amazon expert

White Papers (9) and Articles (6)

1. Amukele, T., Ness, P. bodM., Street, J., Boyd, J., & Tobian, A. A. R. (2016, November 11). Drone Transportation of Blood Products. *Transfusion*. Retrieved from pubmed.ncbi.nlm.nih.gov
2. Biron, B. (2019, December 3). More than 1 in 10 packages 'disappear without explanation' in major US cities, and it's a huge headache for retailers. *Business Insider*. Retrieved from businessinsider.com
3. Dolan, S. (2022, January 11). The challenges of Last Mile Delivery Logistics and the Tech solutions cutting costs in the final mile. *Business Insider*. Retrieved from businessinsider.com
4. Ganin, A. A., Kitsak, M., Marchese, D., Keisler, J. M., Seager, T., & Linkov, I. (2017). Resilience and efficiency in Transportation Networks. *Science advances*. Retrieved from <https://pubmed.ncbi.nlm.nih.gov>
5. Gupta, P., Singh, S., Ranjan, R., Kharayat, G., Raman, S., & Balaji, V. (2019). Analysis of delivery issues that customer face upon e-commerce shopping. *International Journal of Management Studies*, VI(3), 14. doi.org
6. Hill, K. (2014, April 25). If you get a misdelivered package, UPS will give A stranger your home address. *Forbes*. Retrieved from forbes.com
7. Homier, V., Brouard, D., Nolan, M., Roy, M.-A., Pelletier, P., McDonald, M., de Champlain, F., Khalil, E., Grou-Boileau, F., & Fleet, R. (2021, March 1). Drone versus ground delivery of simulated blood products to an urban trauma center: The montreal medi-drone pilot study. *The journal of trauma and acute care surgery*. Retrieved from [Manchester Metropolitan University](https://manchestermetropolitanuniversity.com)
8. IATA. (2019, March). White Paper the cargo facility of the future - IATA - home. Retrieved from iata.org
9. *If a person gets a home delivery by mistake can they keep it? yes. and, no.* Maryland Messenger. (2018, December 13). Retrieved from marylandmessenger.com
10. Kanellis, N., & Papadopoulos, D. (2017). Identification of potentially undelivered packages with an artificial neural network method. In *5th International Conference on Contemporary Marketing Issues* (pp. 314-319). essay, ICCMI.
11. Logistics, Z. (2020). *Tips for cold chain shippers: Refrigerated logistics best practices*. Tips for Cold Chain Shippers. Retrieved from info.ziplinelogistics.com
12. Luhby, T. (2018, March 28). *A trip to the emergency room is getting even pricier*. CNNMoney. Retrieved from money.cnn.com
13. Shaheen, S., Totte, H., & Stocker, A. (2018, February 27). *Future of mobility white paper*. eScholarship, University of California. Retrieved from doi.org
14. Sponsor. (2021, December 27). *Case study: How trinity expands capacity options with trucker tools*. FreightWaves. Retrieved from freightwaves.com
15. WTVF. (2019, December 3). *NY Times Report: 1.7 Million packages stolen every day*. WTVF. Retrieved from newschannel5.com
16. Zailani, M. A., Azma, R. Z., Aniza, I., Rahana, A. R., Ismail, M. S., Shahnaz, I. S., Chan, K. S., Jamaludin, M., & Mahdy, Z. A. (2021, December 5). *Drone versus ambulance for Blood Products Transportation: An economic evaluation study*. BMC health services research. Retrieved from ncbi.nlm.nih.gov

What is the solution?

A QR Code, mounted near the door, links to a website that confirms the address, geolocation, and picture of the house.

We All Contributed to the Project Idea

Project Name
package scanner
Security box
house QR
Silicone wrap
Driver Combination
Beacon GPS
Train alarm
Pallet Chain
Self drive truck distribution quick release
electric truck
crane automation
Air alert
Bullet truck (train)
jammer stealer
Utah Drydock
vaccine buying

Project Name
package scanner
Security box
house QR
Silicone wrap
Driver Combination
Beacon GPS
Train alarm
Pallet Chain
Self drive truck distribution quick release
electric truck

Narrowed it down to the top 11

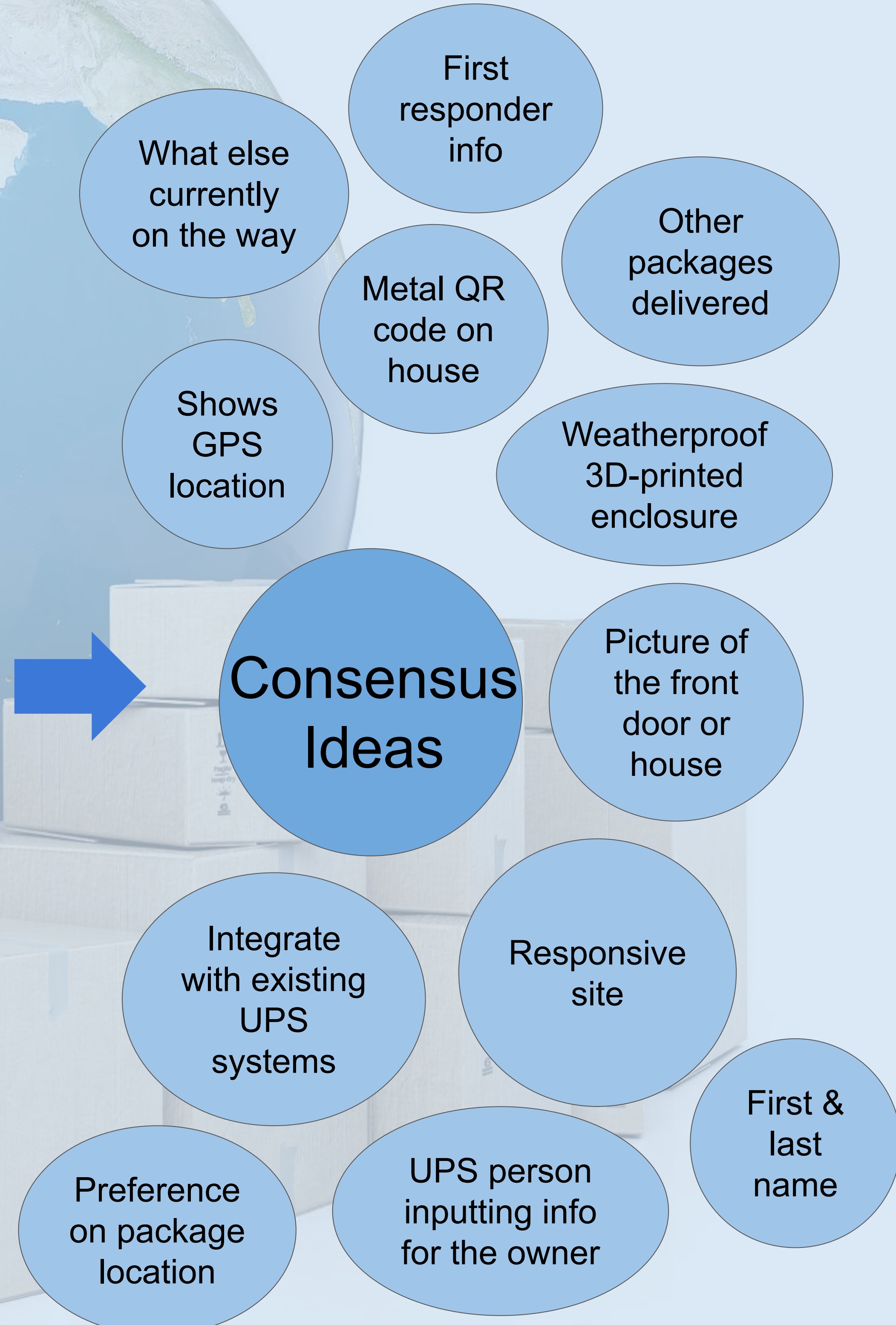
Project Name
house QR
Train alarm
Self drive truck

Determined our top 3 ideas

Project Name
house QR

Decided to pursue the top idea - a house QR code to confirm the location!

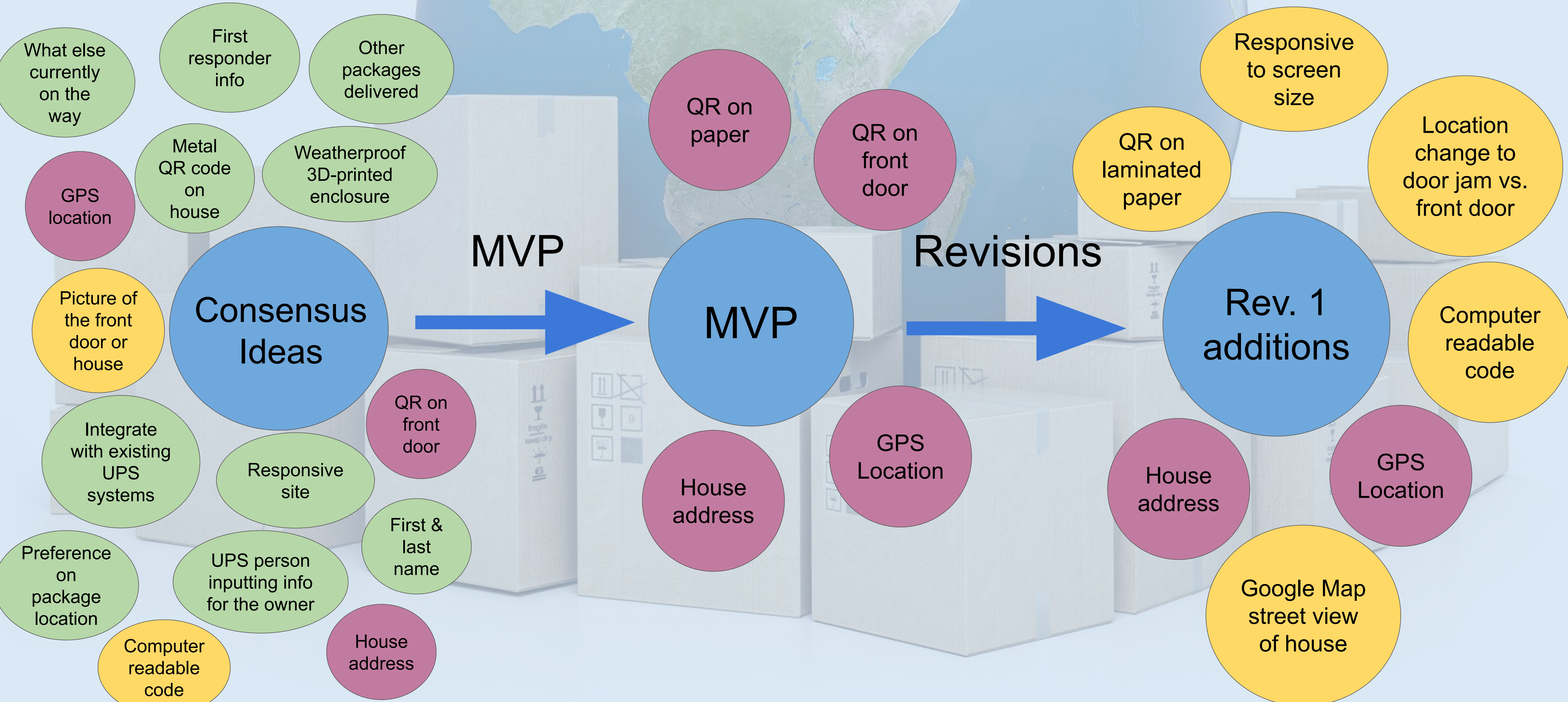
Consensus Ideas



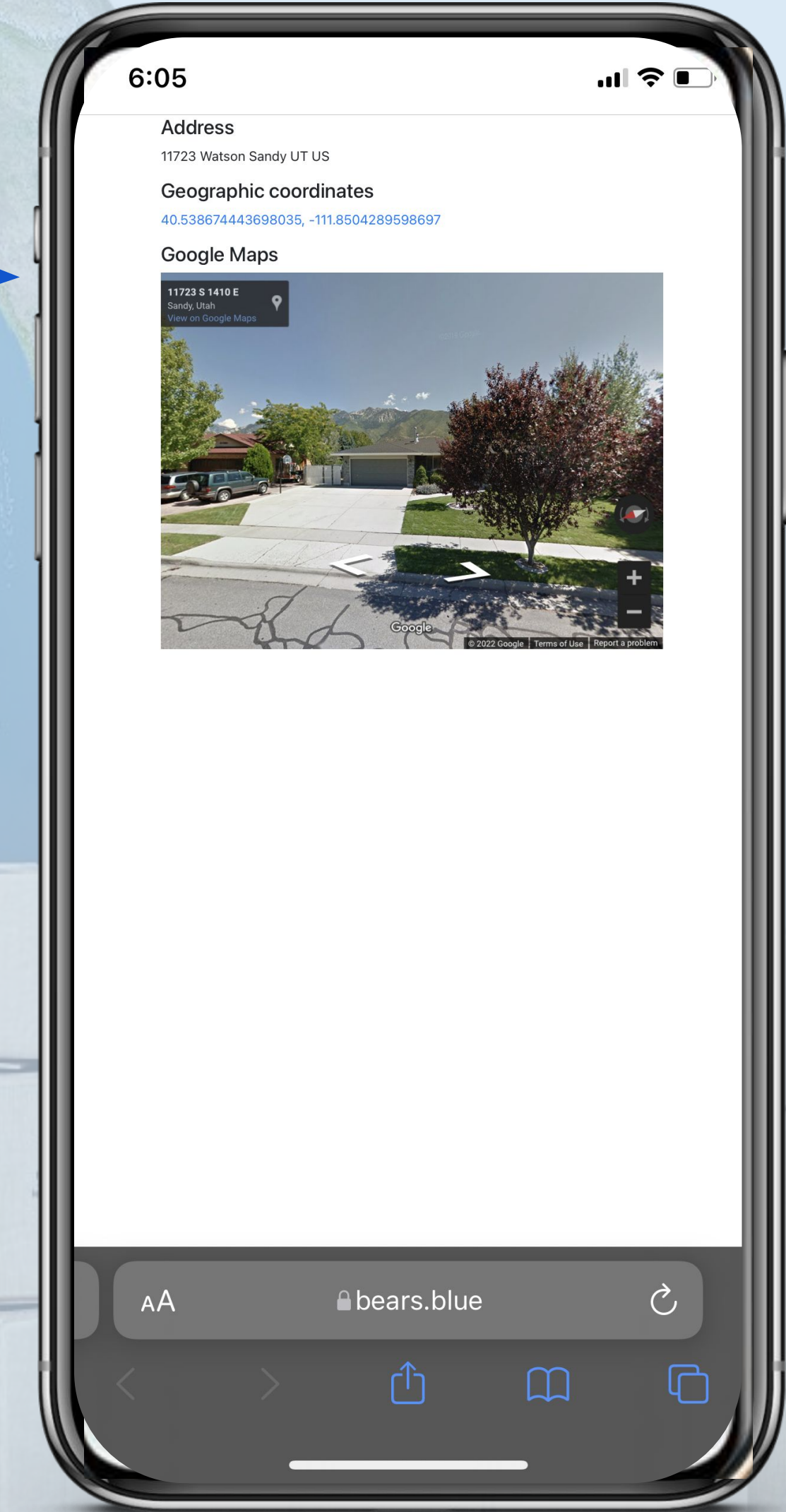
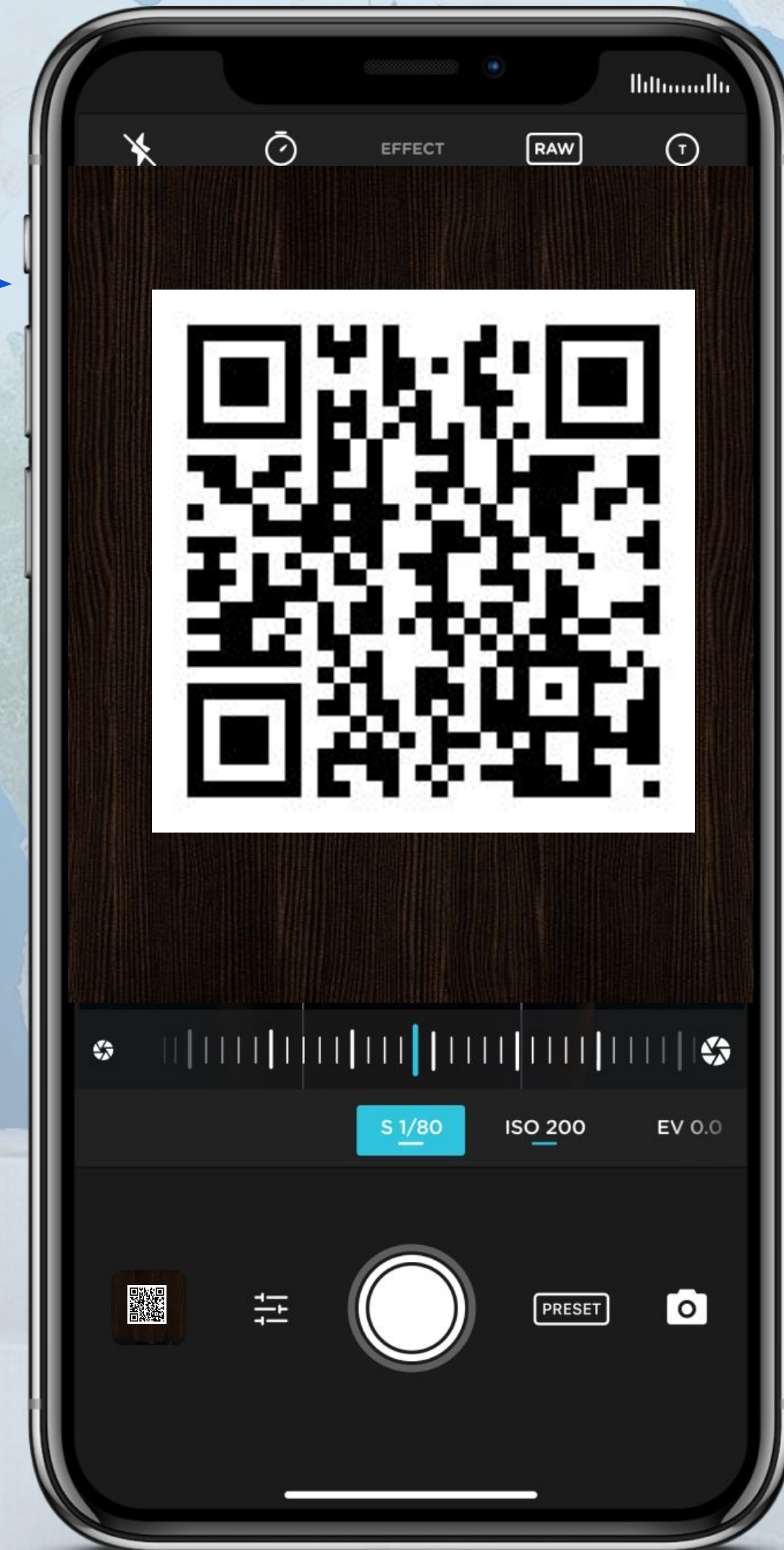
Brainstormed 18 ideas we wanted to research

Development Plan - MVP with Agile Revisions

We used a process called Minimum Viable Product (MVP). This process allowed us to focus on the most important aspects of our project and accomplish them first and then use expert advice to add the next most important features.



Bears.Blue QR Code - Scan, Link, Check



Scan - The QR code is mounted on the in between space on the door. Expert Scott Walch helped us and gave us this suggestion

Link - You can scan this QR code with just an iPhone. This will take you to a website called bears.blue.

Check - The website tells the address, the coordinates of the house, and even a google maps picture showing what the house looks like.

Sharing with Experts and Users

Experts help us understand the problems and give us feedback to make our solutions better.

Experts:

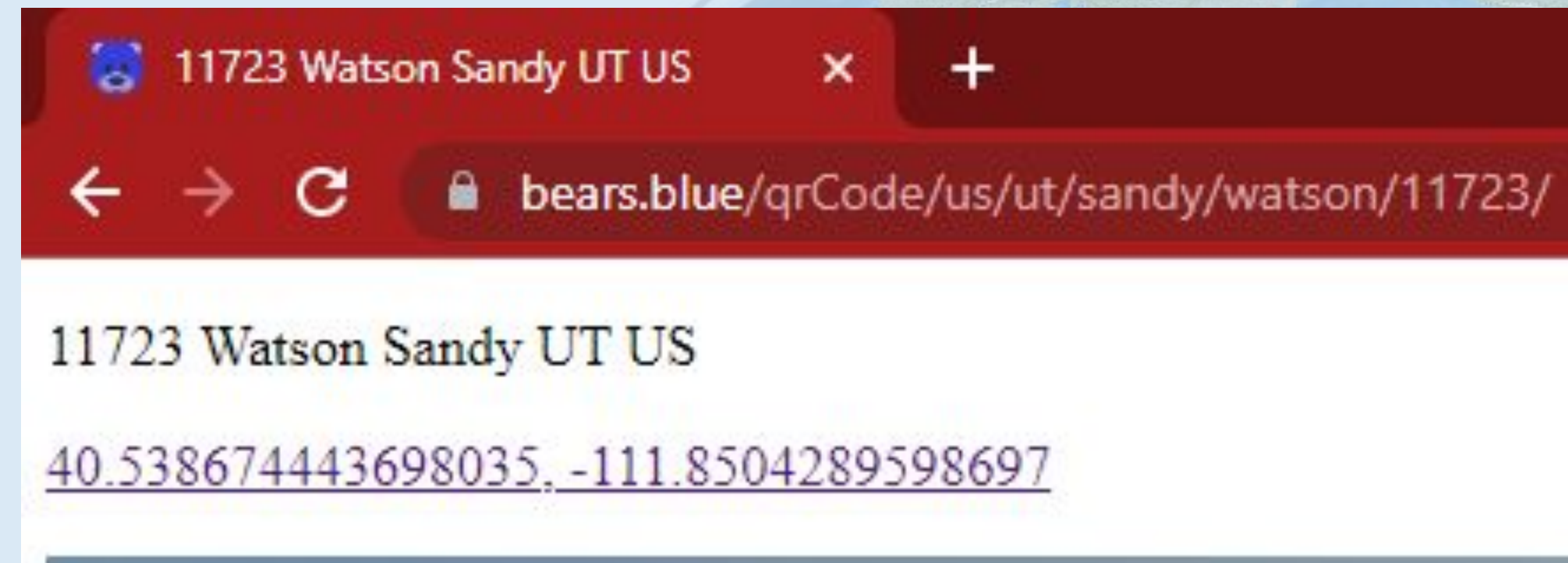
1. **Ralph Smith (Systems engineer)**
2. **Dave Price (Transportation Expert)**
3. **Scott Walch (Retired UPS employee)**
4. **Scott Allen (Retired FedEx Employee)**
5. **Chris Holt (Amazon Expert)**
6. **Jeffrey Lynch (Operations Expert)**
7. **Mark Drennan (Online Retail Expert)**
8. **Brad Schindler (Logistics Expert)**

Users are homeowners that try out our solution and give us feedback about using our solution.

Users:

1. **Kat Holt** (11723 S Watson Rd, Sandy)
2. **Kirk Drennan** (12201 Nicklaus Rd, Sandy)
3. **Paul Brooks** (10346 S 2375 E, Sandy)
4. **Tami Price** (12644 S Webb Rd., Draper)
5. **Randy Karren** (1124 E Lone Peak Ln, Draper)
6. **Sarah Mendenhall** (397 E Fairmont Hill Ct.)
7. **Tami Weaver** (13146 Ptarmigan Gate Rd., Draper)
8. **Carolynn Jennings** (851 Rosefield Lane, Draper)
9. **Mike Johnson** (1078 E 13590 S, Draper)
10. **Laura Whitehead** (13317 Corner Wood Drive, Draper)
11. **Ben Wariner** (11912 S Hidden Valley Rd., Sandy)
12. **Sue Ellsworth** (12551 Bear Castle Cove, Draper)
13. **Jana Walch** (1941 Hidden Valley Rd, Sandy)

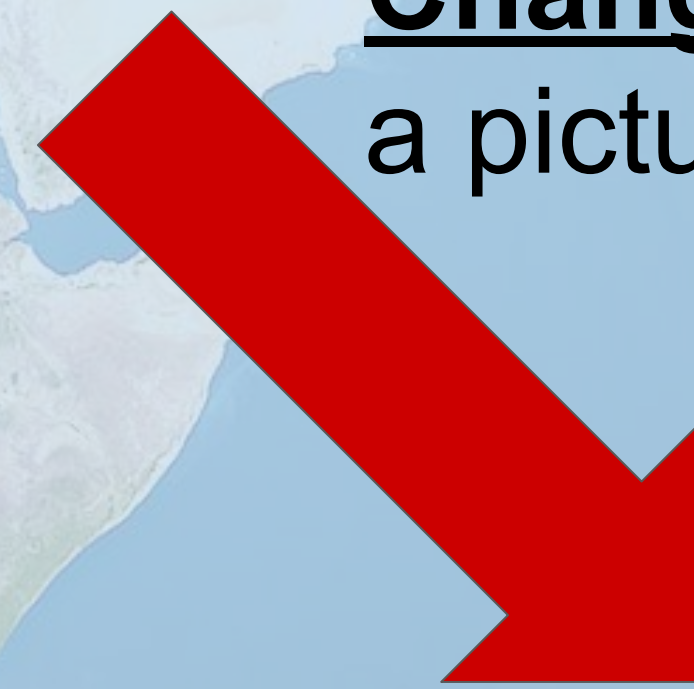
We improved our project as we got feedback



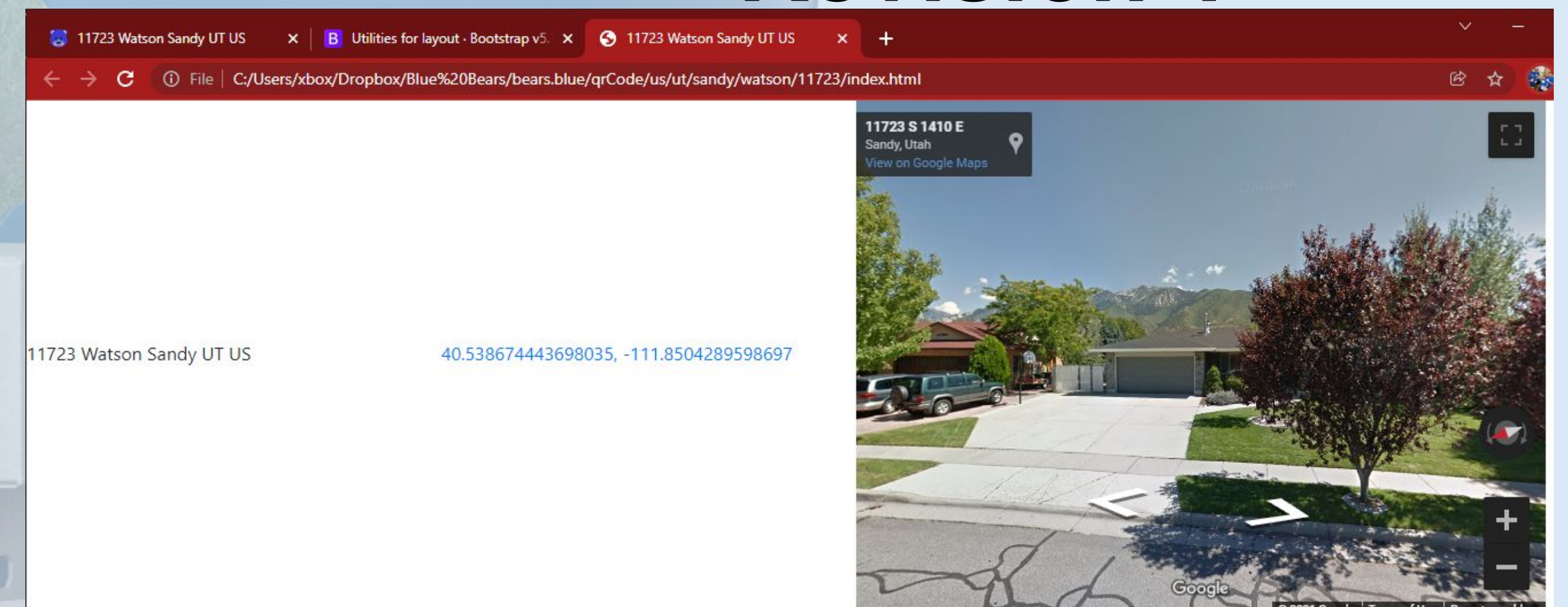
MVP (Minimum Viable Product)

MVP - Only Address and Geolocation

Change 1: Expert Chris Holt said that a picture would help with accuracy

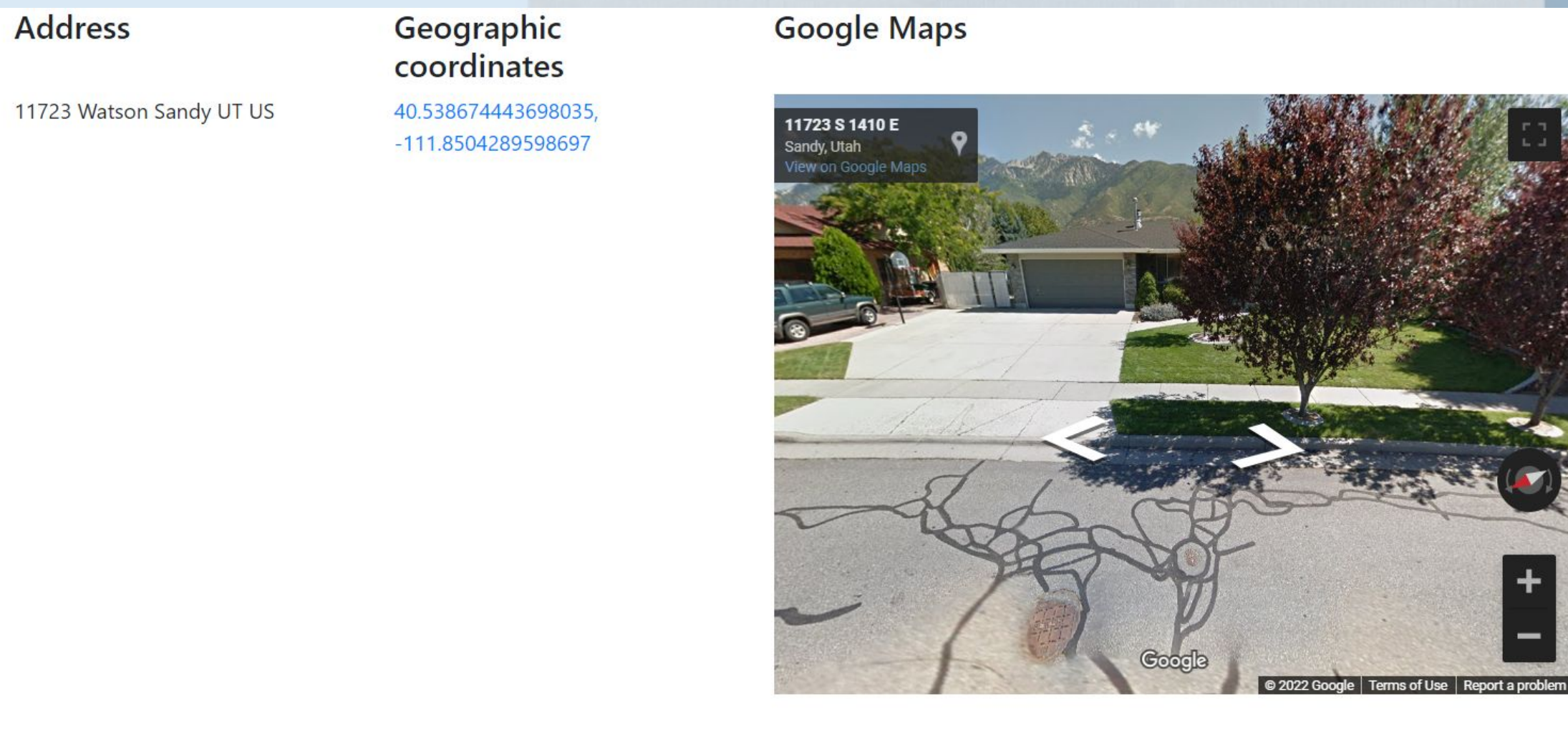


Revision 1



Rev 1 - Responsive to screen size, using a tool called Bootstrap, and added a google map picture.

Revision 2



Rev 2 - added headers and styles, including order rearranging for small views that are stacked.

Change 2: Expert Dave Price said that we needed good labeling of the data



Test it out and Scan QR Codes



Watson



Hidden Valley



Bear Castle



Bubbling Brook



Cornerwood



Lone Peak



Ptarmigan Gate



Rosefield



Webb



Fairmont Hill

Identify

Our Mission Strategy:

Efficiency!

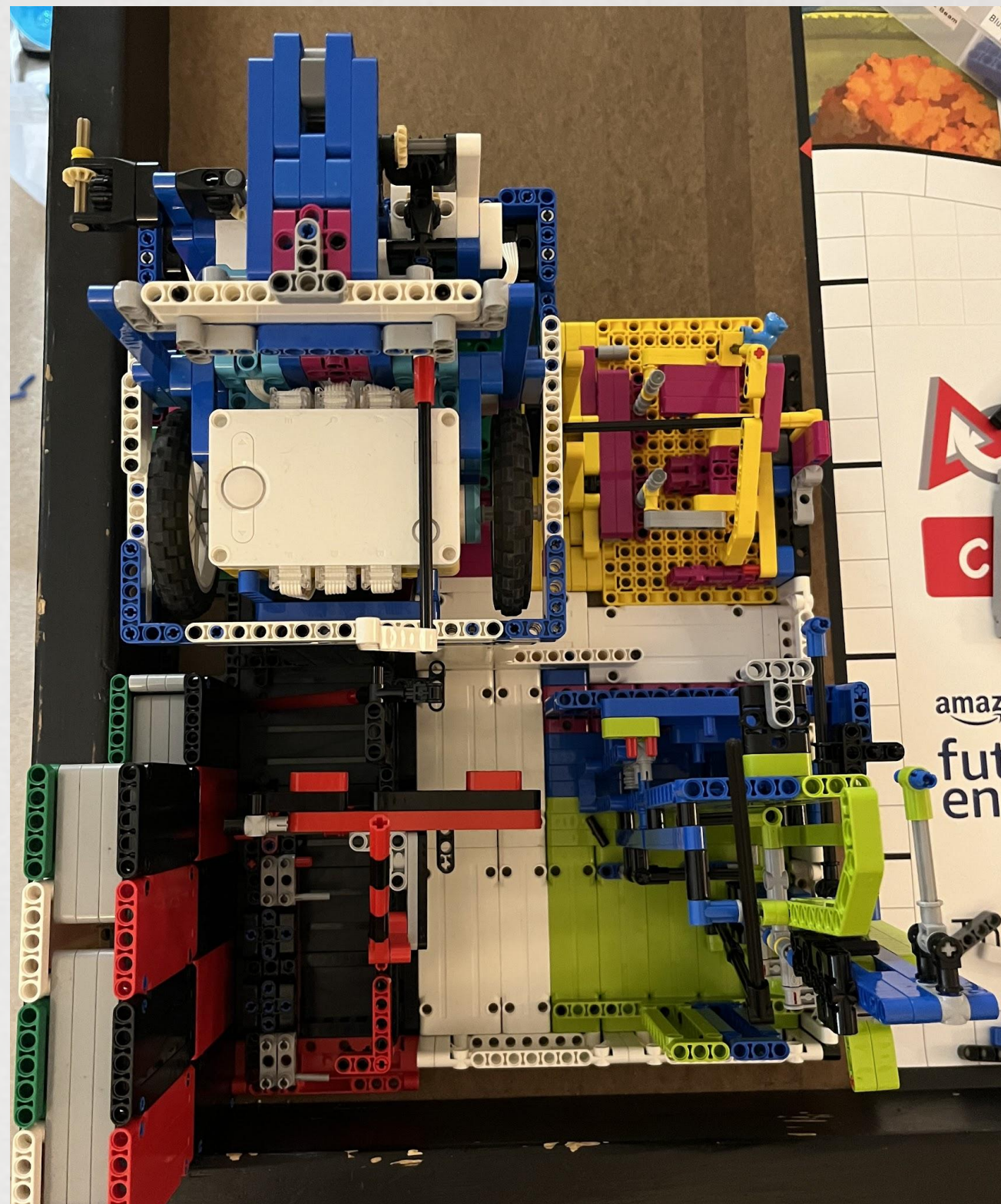
Wanted as many points as possible in the least amount of time

Programming

```
595 def oneDelivery():
596     #driving forward from launch area
597     drive(360,0,45) #370 380 400
598     #turns right
599     turnRightForward(48,30) #55 #45
600     wait_for_seconds(0.2)
601     #drives forward to cargo connect area
602     #wait()
603     drive(750,0,45) #700 580 800 750 650
604     #turns toward the cargo connect area
605     turnRightForward(20,30) #24 #26 #18 20 #16
606     #drives into the cargo connect area
607     #wait()
608     findBlack(45, 40, leftSensor)
609     drive(475, 0, 45) #750 800 700 800 850 900 1200 775 575
610     #lines up to drop off inovative attachment
```

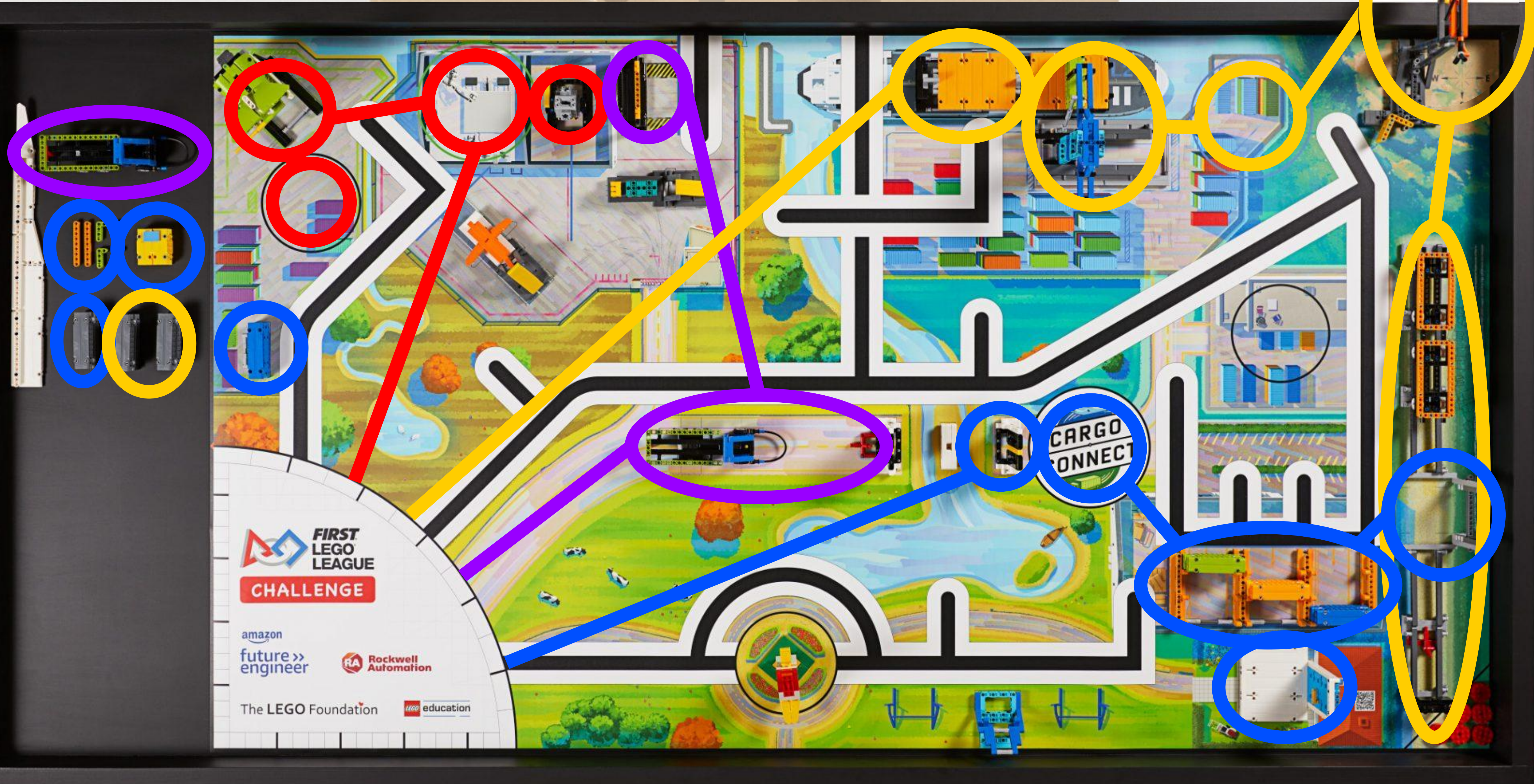
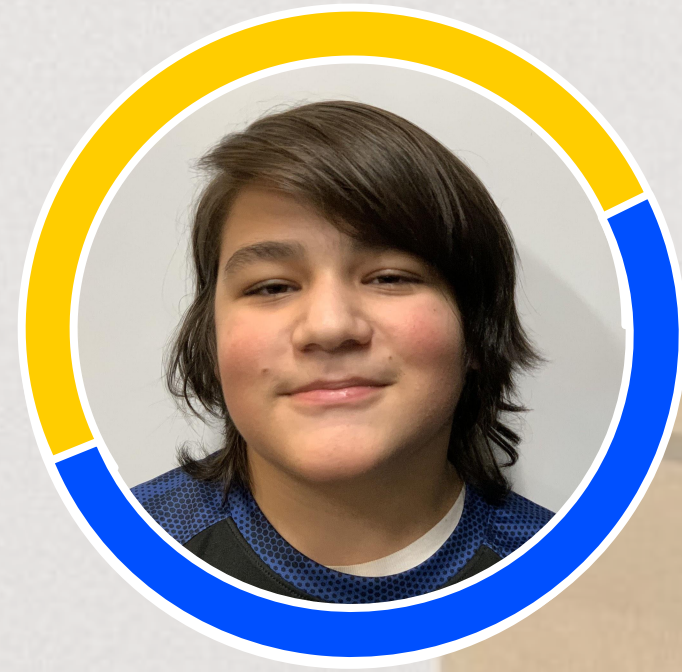
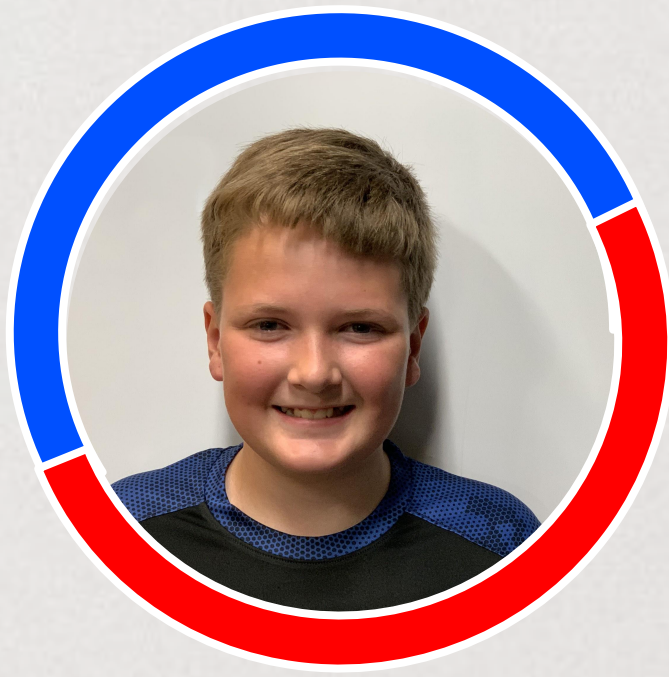


Time Management



Building

Identify



Our Work Plan:

Mission Maps

Design

Mission Matrix

Mission #	Mission Name	Real Points	Max Points	Is It Worth Time	Complexity	Distance	Gut Feeling	Difficulty	Drop off?	Total
17	Precision Tokens	50	50		6	0	6	7		19
2	Unused Capacity	30	30	yes	5	4	5	7	DB	21
0	Inspection Bonus	20	20	yes	7	4	4	9	N	24
4	Transport Journey	30	30	yes	10	8	4	10	N	32
3	Cargo Plane	30	30	yes	10	8	6	9	N	33
13	Platooning Trucks	30	30		9	9	2	13	D	33
1	Innovation project	20	20	yes	6	14	7	8	D	35
14	Bridge	20	20		7	10	8	10	N	35
7	Unload Cargo	30	30		5	16	8	10	N	39
5	Switch Engine	20	20	yes	11	8	9	12	N	40
8	Air Drop	20	40		6	20	7	7	N	40
6	Accident Avoidance	30	30	yes	12	10	5	17	N	44
11	Home Delivery	30	30		11	15	8	15	D	49
12	Large Delivery	30	40		14	10	5	22	D	51
9	Train Tracks	40	40		15	20	5	18	N	58
15	Load Cargo	60	60		17	16	10	21	D	64
16	CARGO CONNECT	140	140		18	18	6	23	D	65
10	Sorting Center	20	20		18	16	14	21	B	69
		650	680							



Code Reference Sheet

PAPER OF POWER!!!

Quick Reference Code Copy + Paste the Black (12-20-2021)

Drive

drive(amount in degrees, steering, power)
#Example: drive(300, 0, 50)

driveStraightForSeconds(power, timeInSeconds)
#Example: driveStraightForSeconds(30,2)

Attachment

moveRake(upOrDown, rakeTime) #Example:
moveRake('up', 2)

Wait

wait()
#Wait for a button push

Gyro Turns

turnRightGyroForward(end angle, power)
#Example turnRightGyroForward(90, 25)

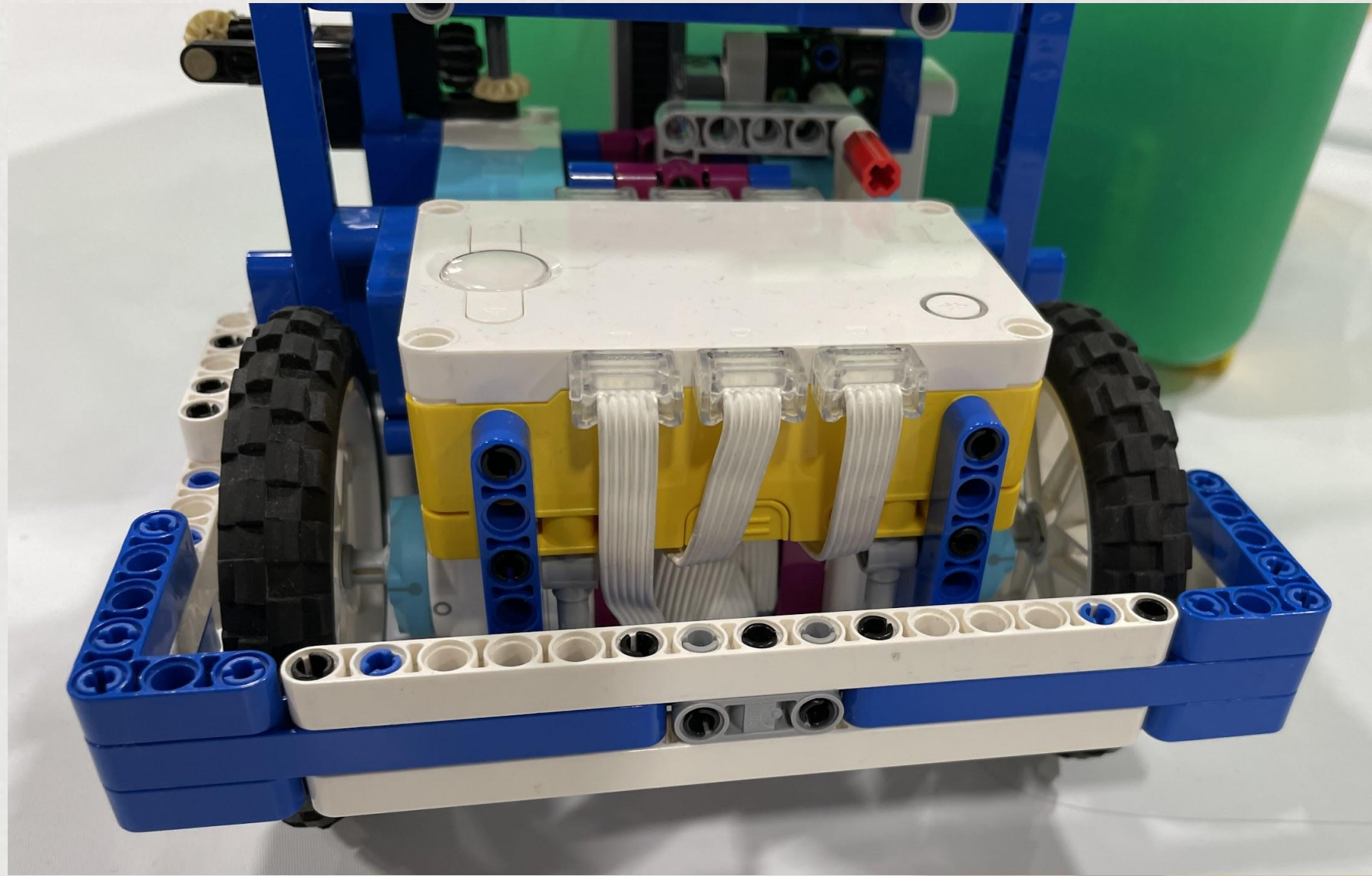
findBlack(power, light intensity, light sensor)
#Example: findBlack(50, 25, leftSensor)

alignWithLine()
#Aligns the robot with a line

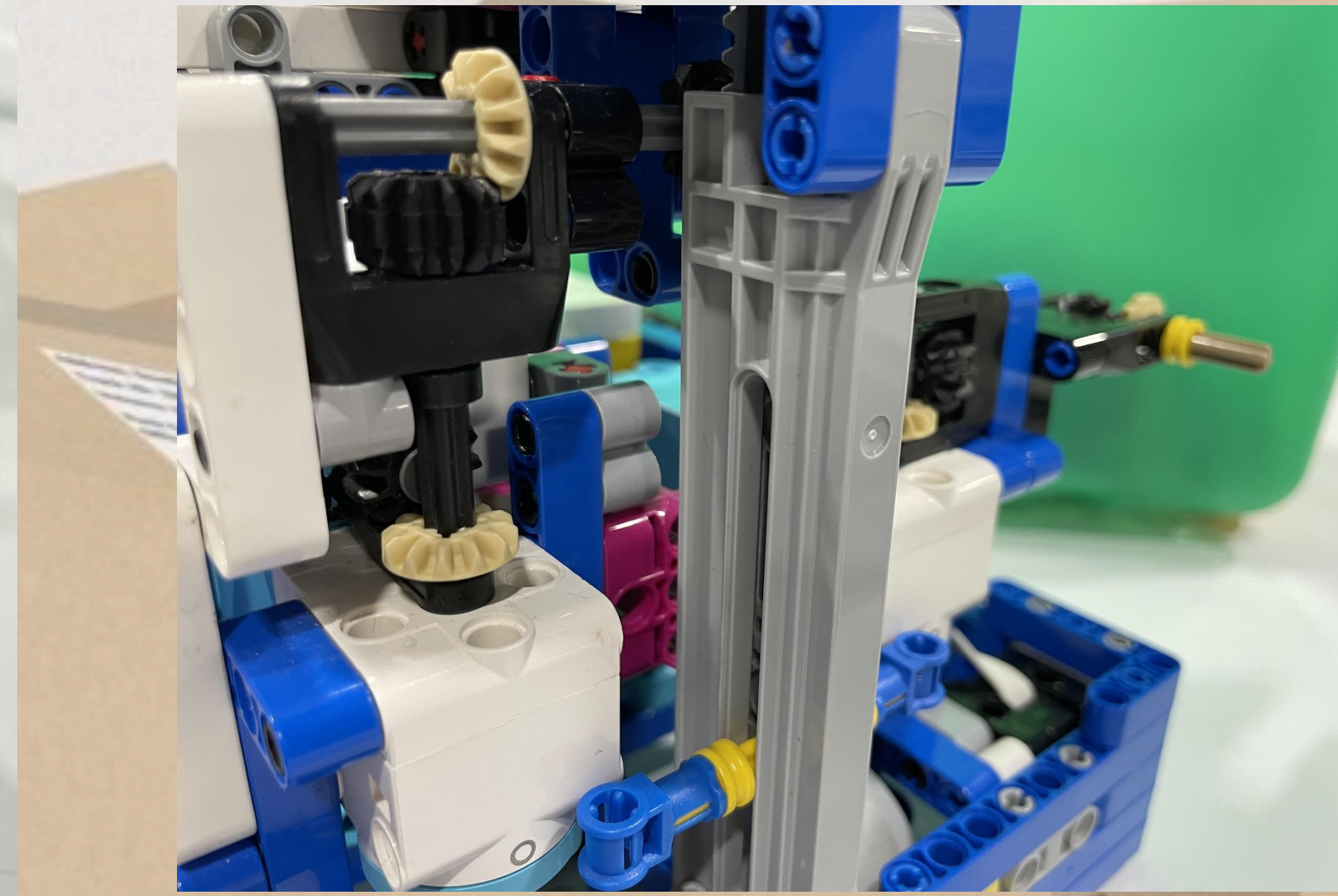
timeFollower1(lightSensor, driveTime, speed, direction)
#Example: timeFollower1(rightSensor, 0.5, 20, 'outside')

Design Robot Innovations

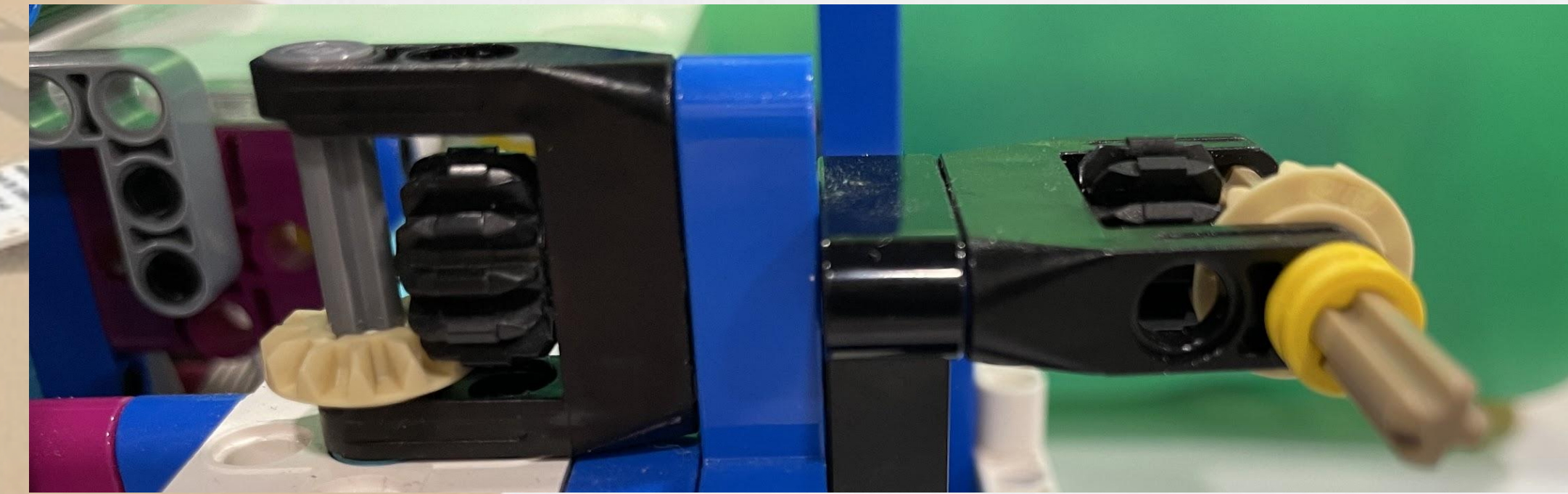
Design



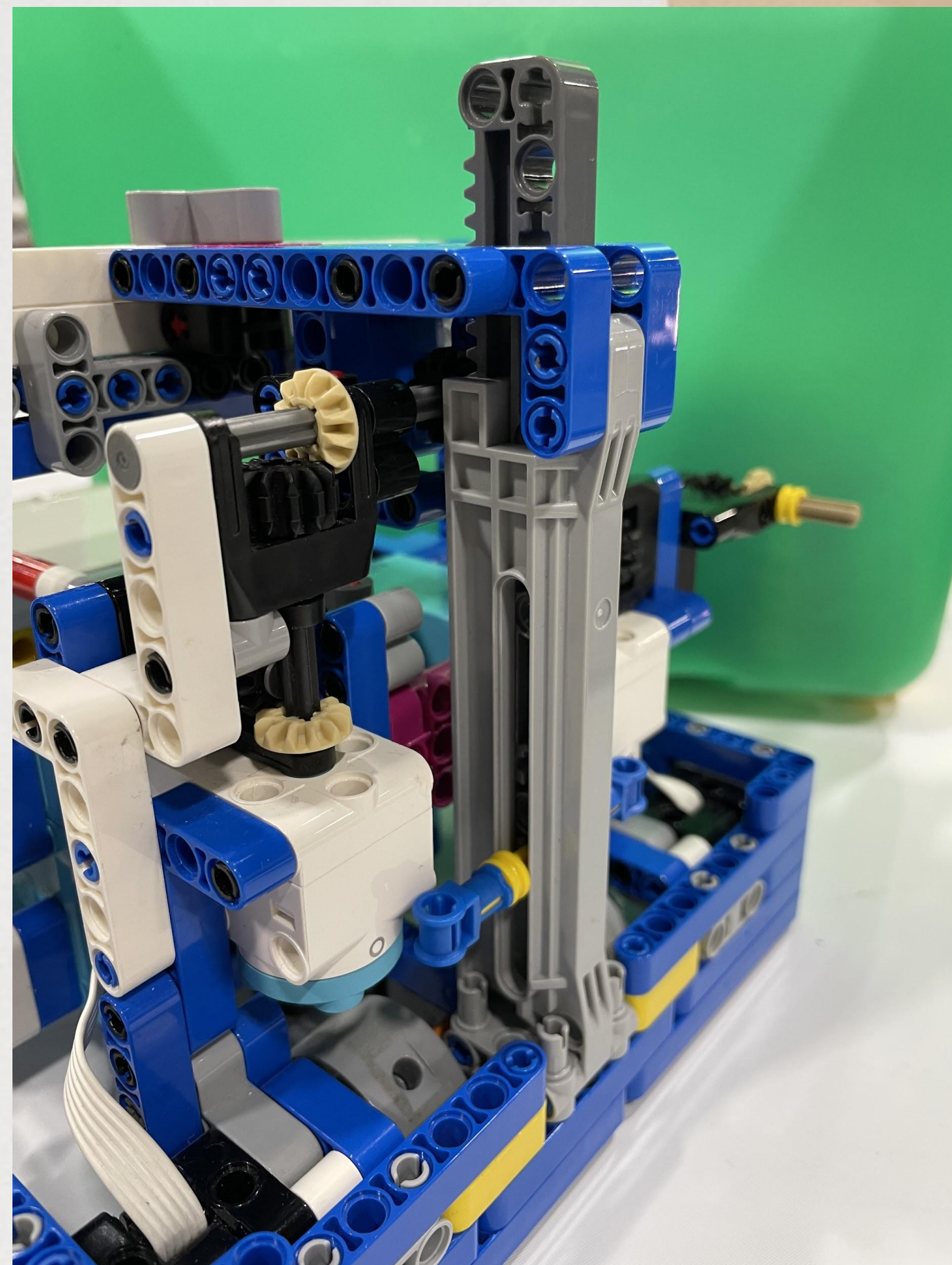
Flat back bumper lining up with the wall



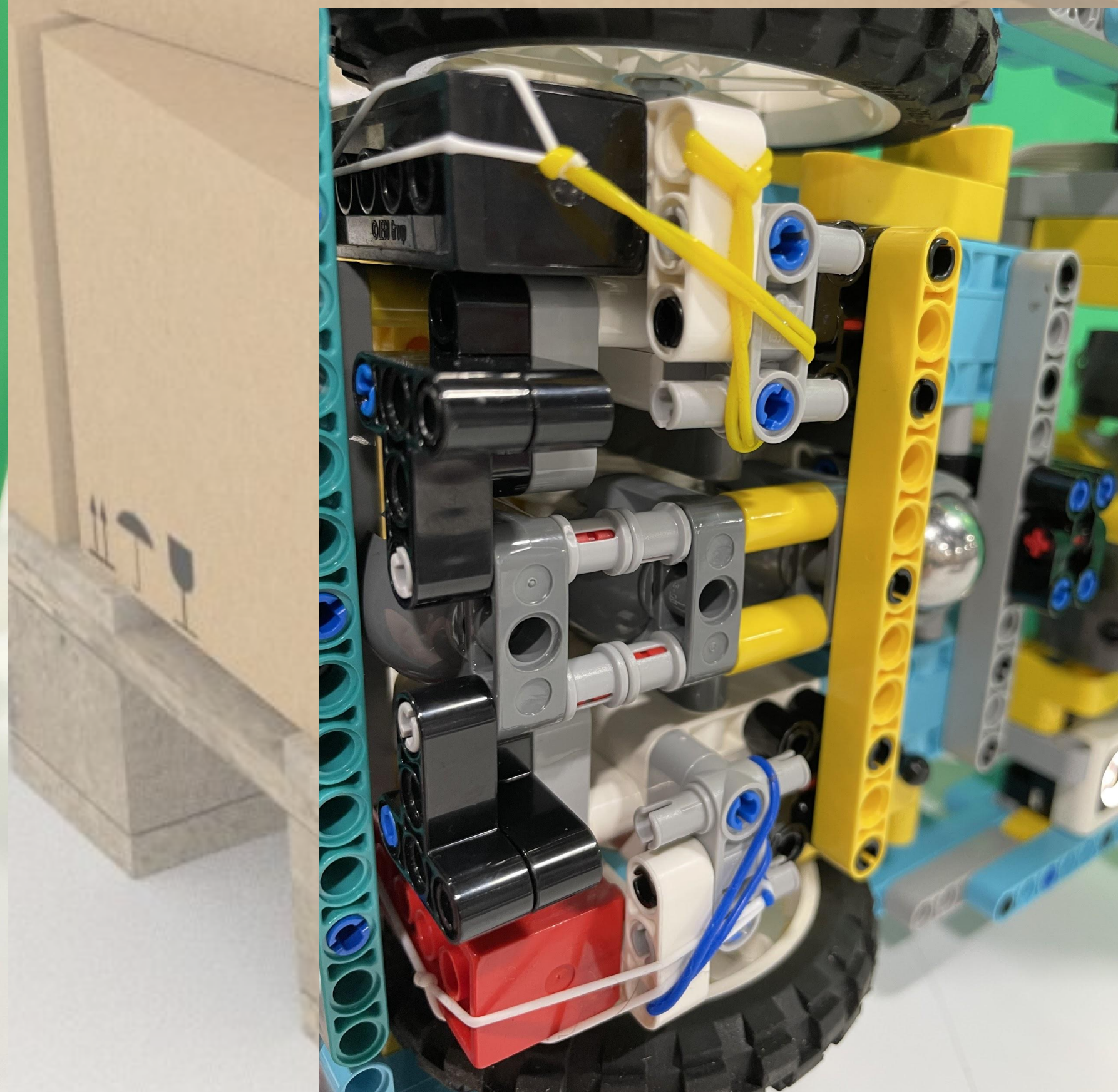
A gear train meant to lift heavy objects



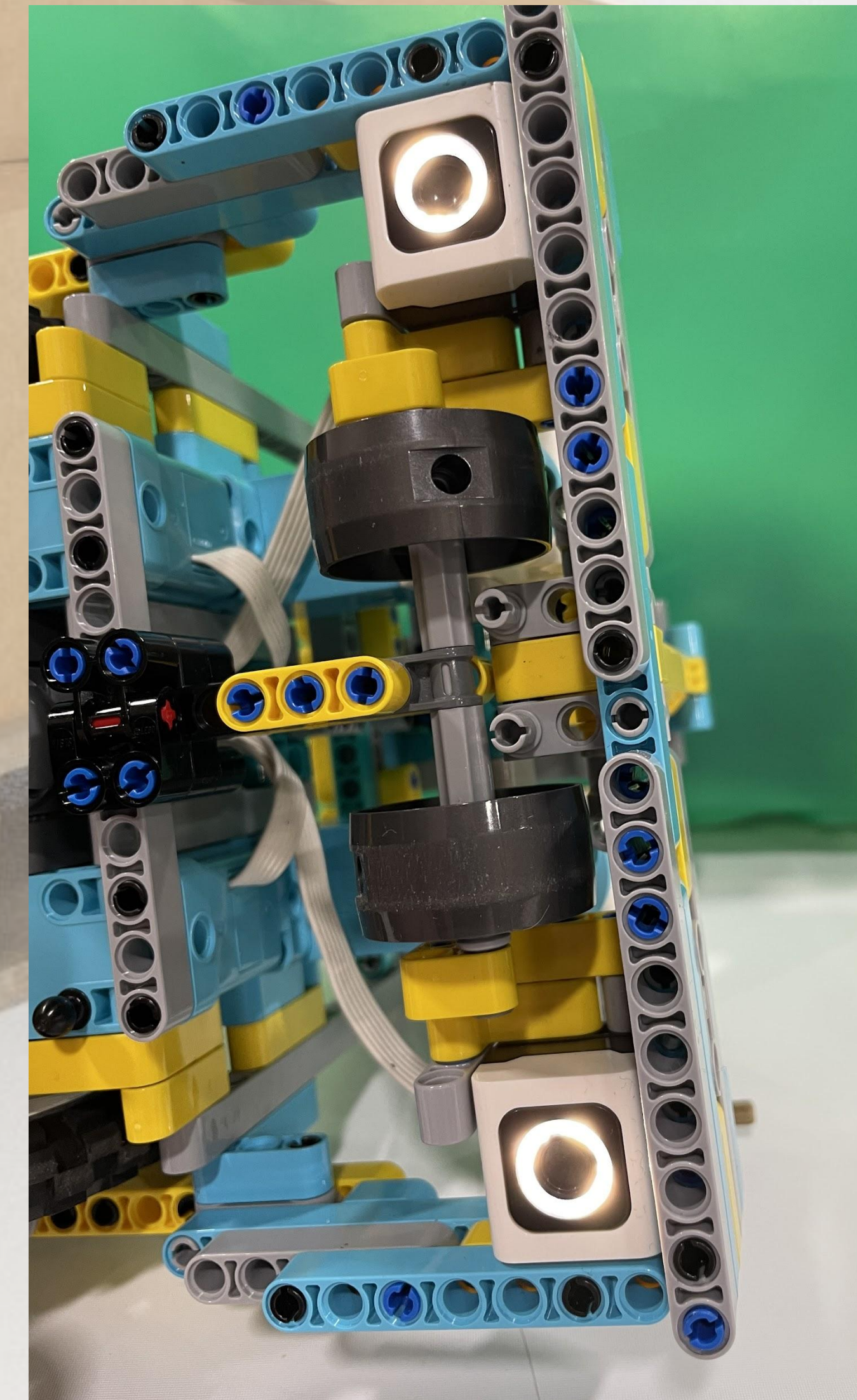
A gear train that changes direction



A rack and pinion for lifting heavy things



Weight blocks used to offset the weight of the front attachments

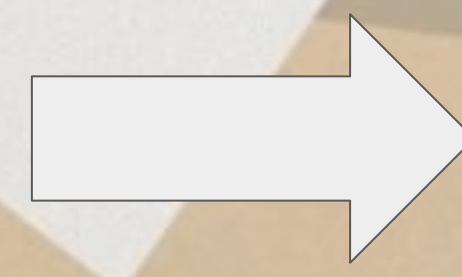


We can use sensors to find lines, align with lines and follow lines

Attachment Evolution

Create

**First
Concept**

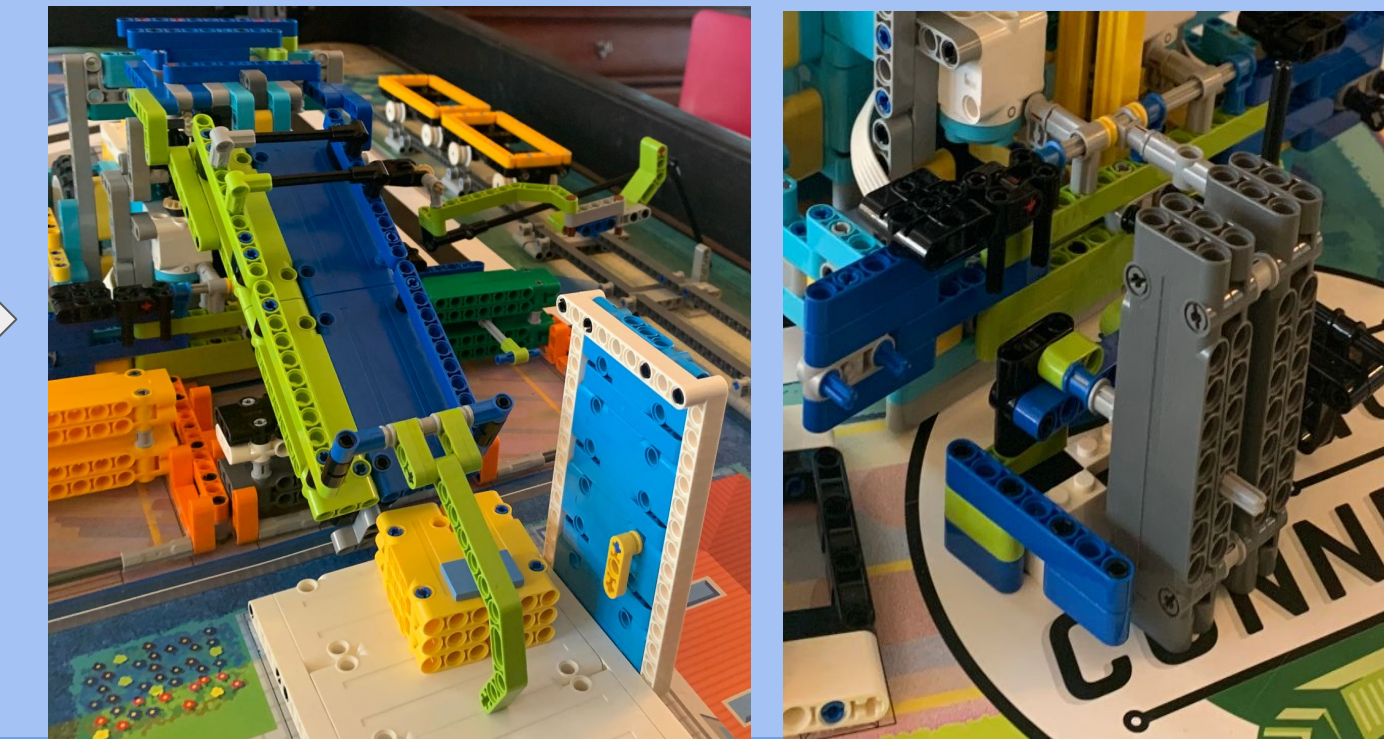
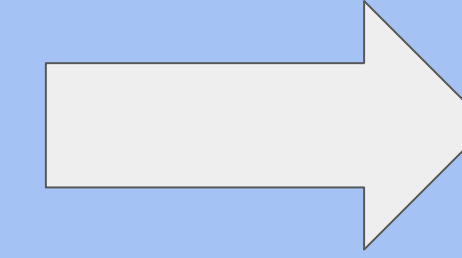
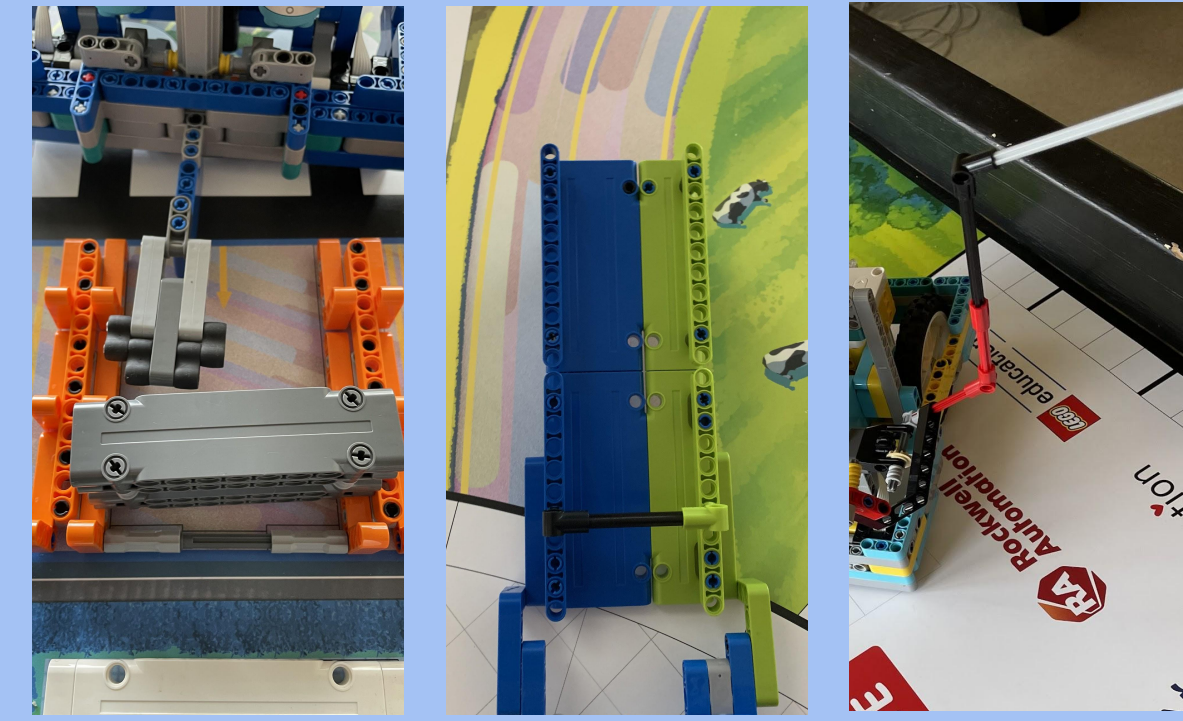
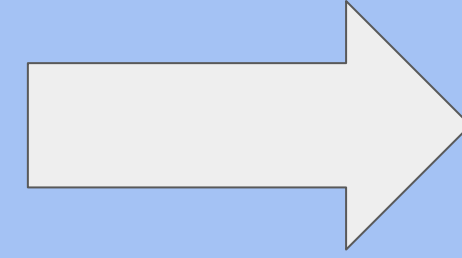
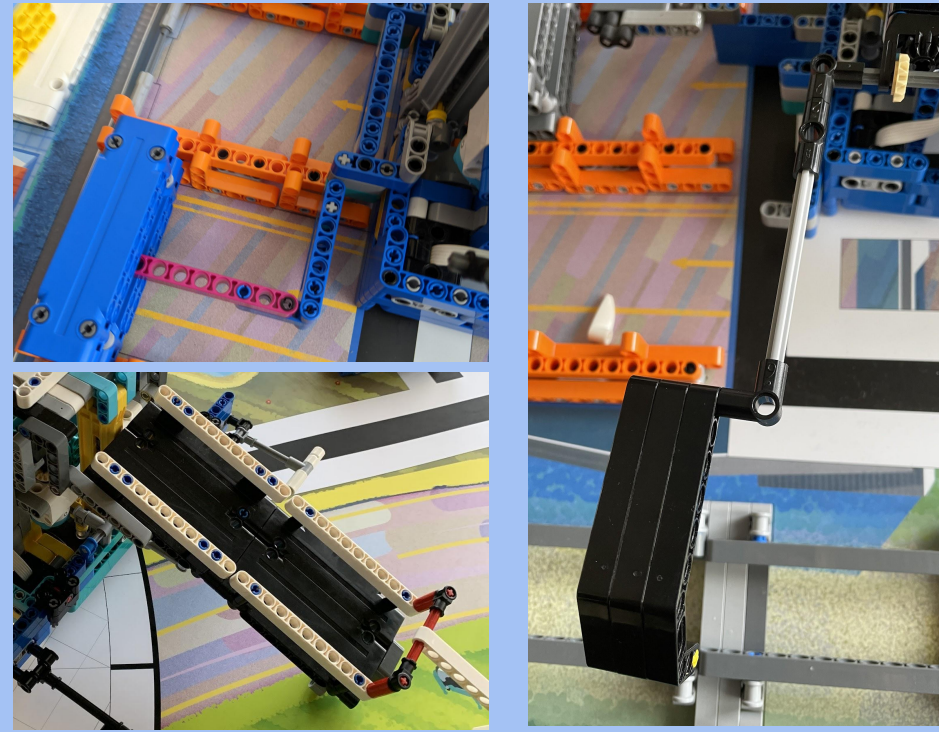


**Second
Concept**

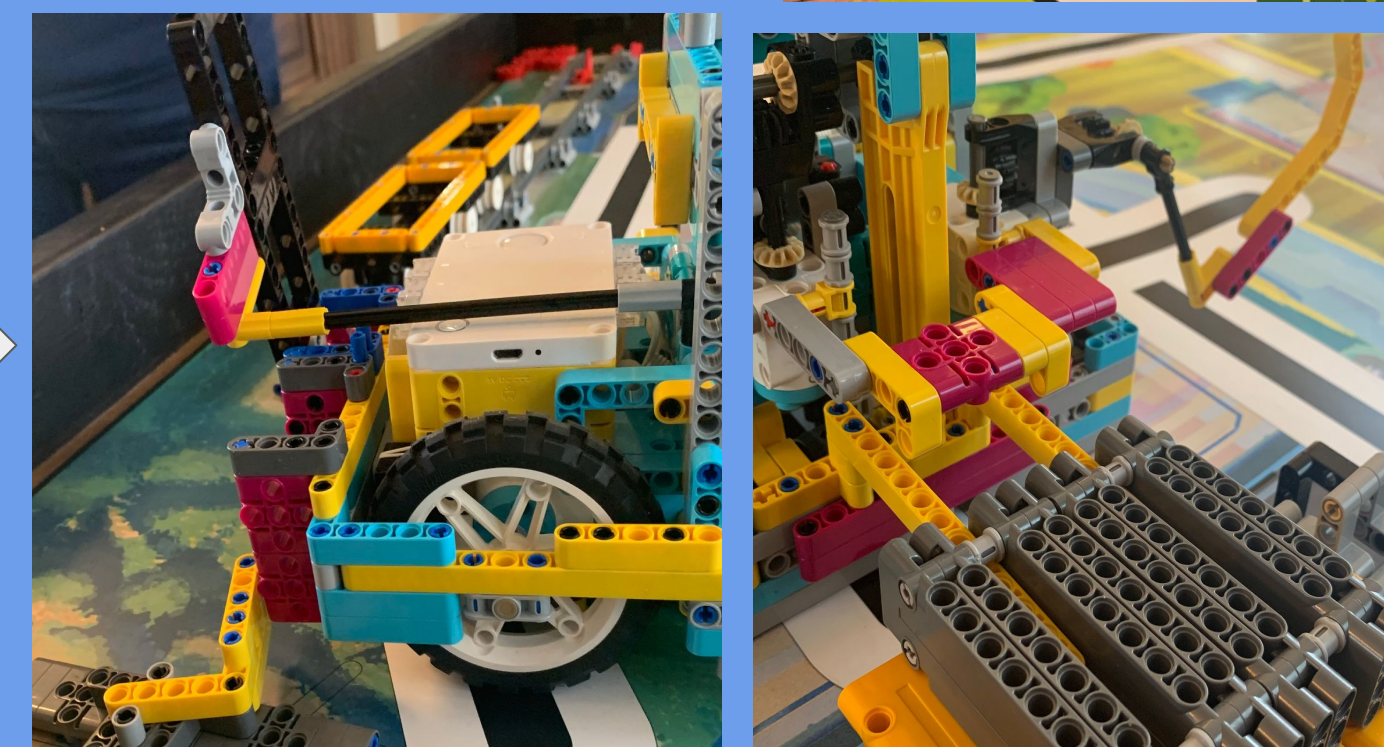
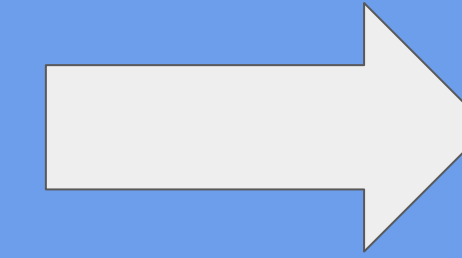
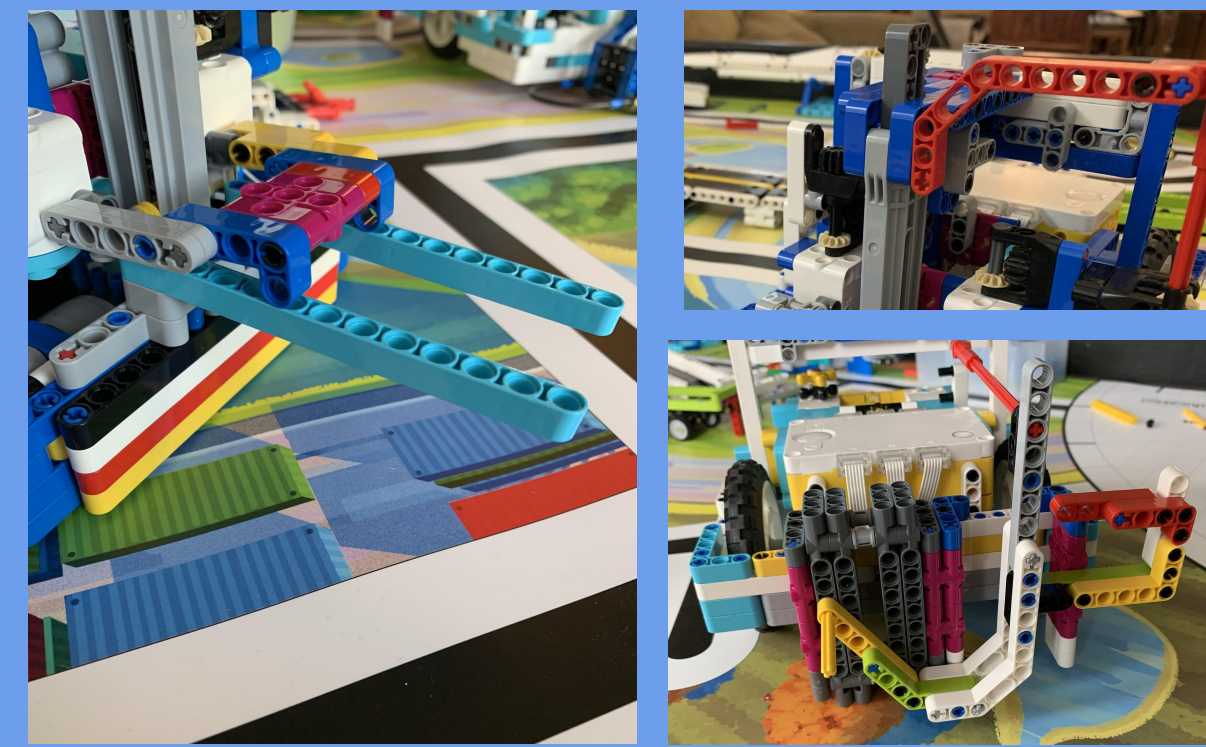
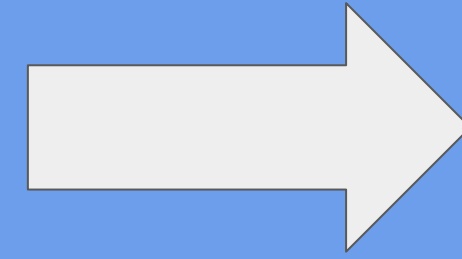
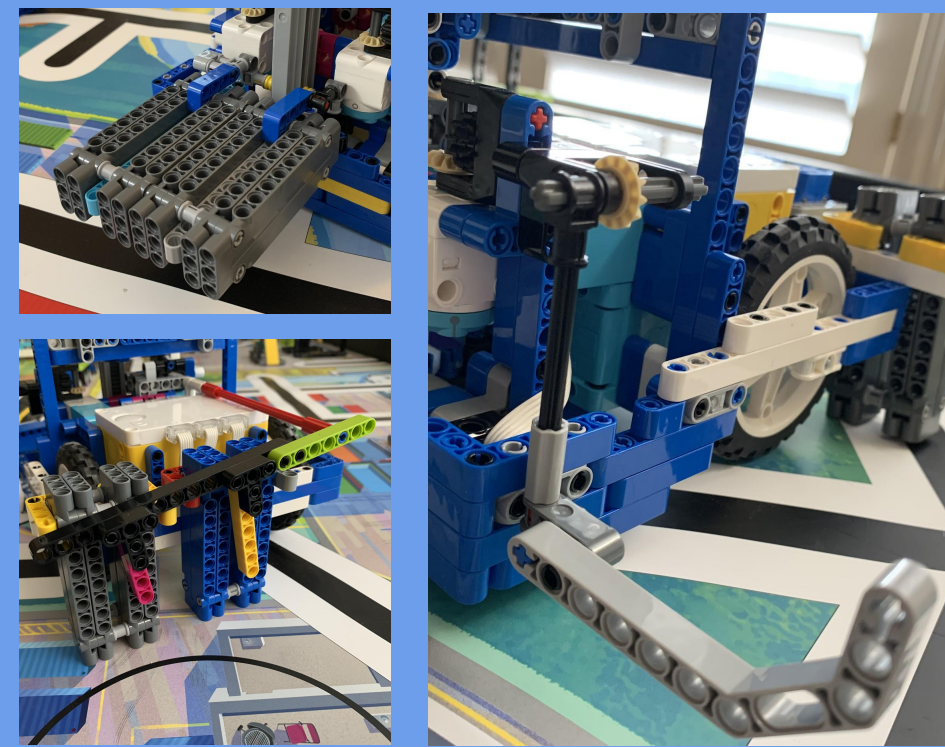


Qualifier

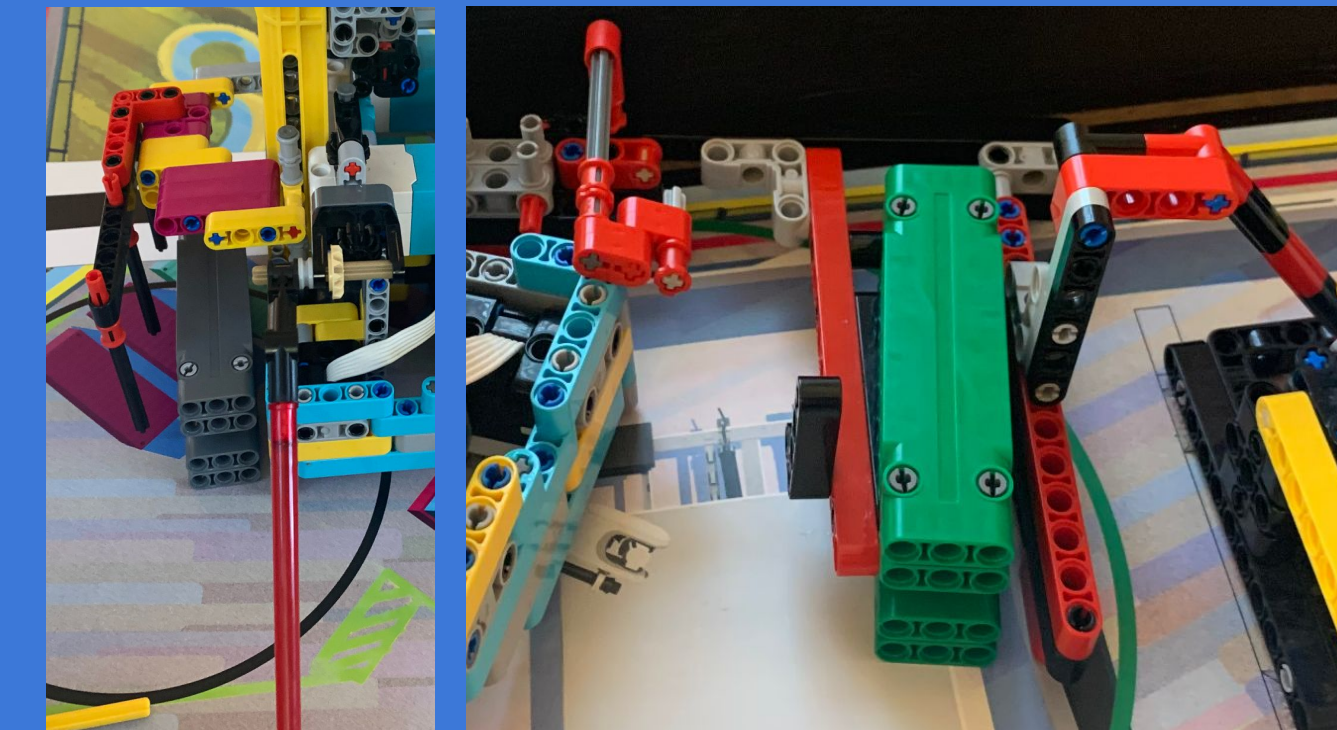
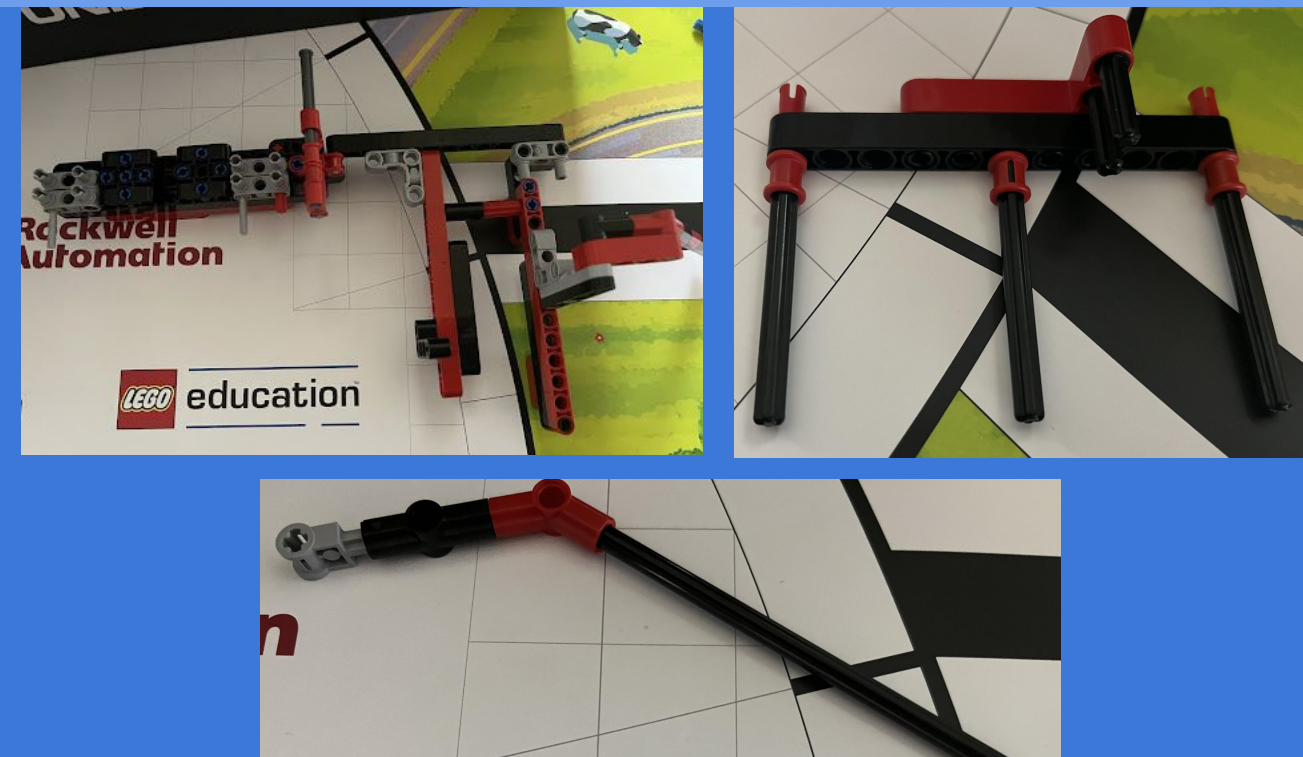
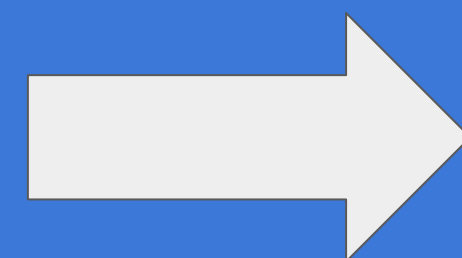
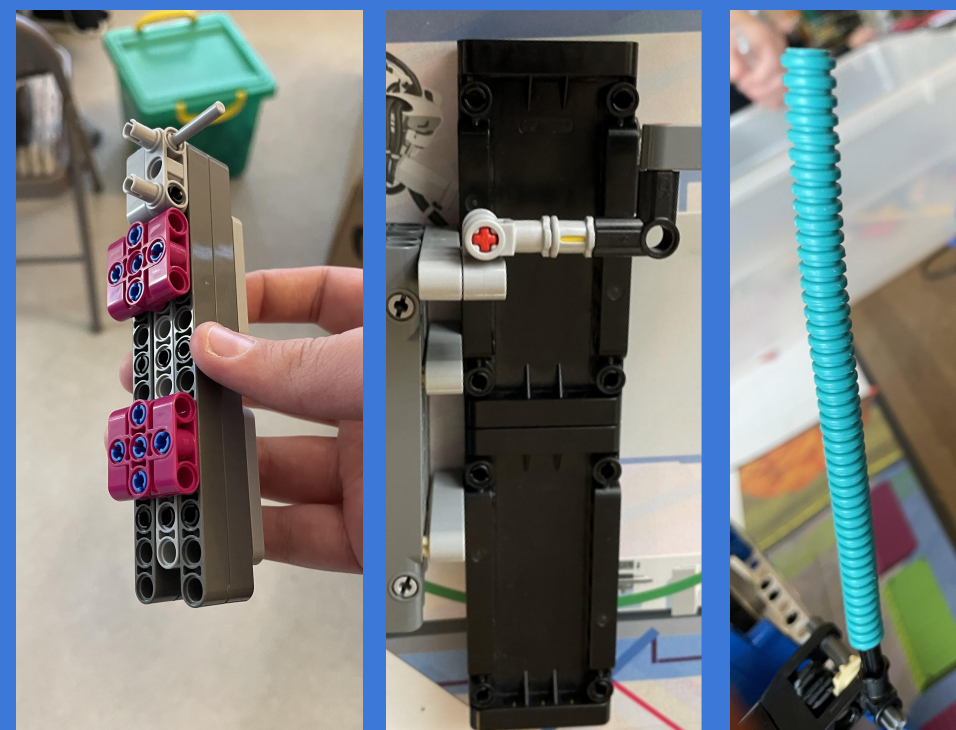
Launch 1
Missions
1, 2, 8, 9,
10, 11, 16
150 Points



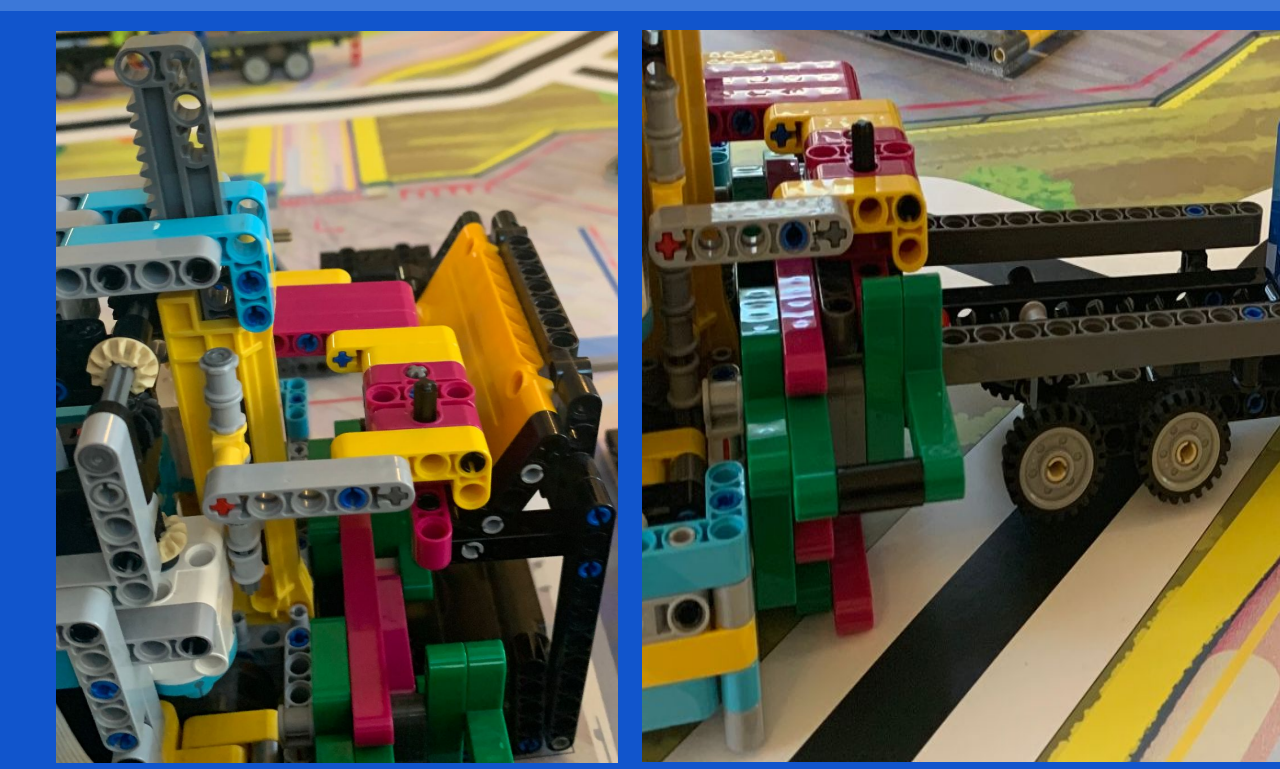
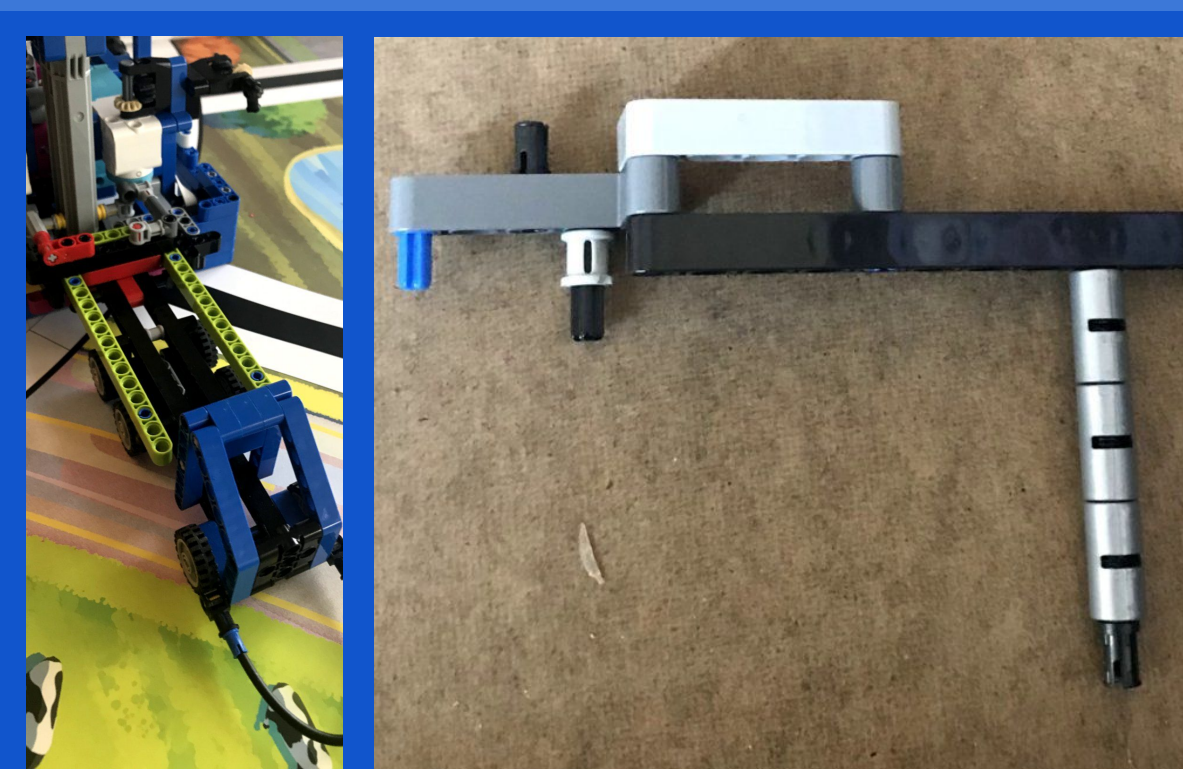
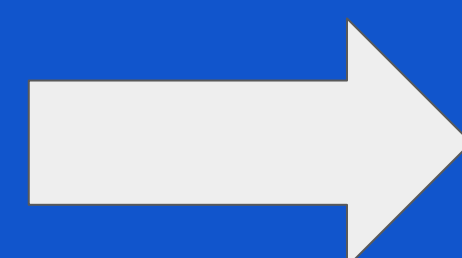
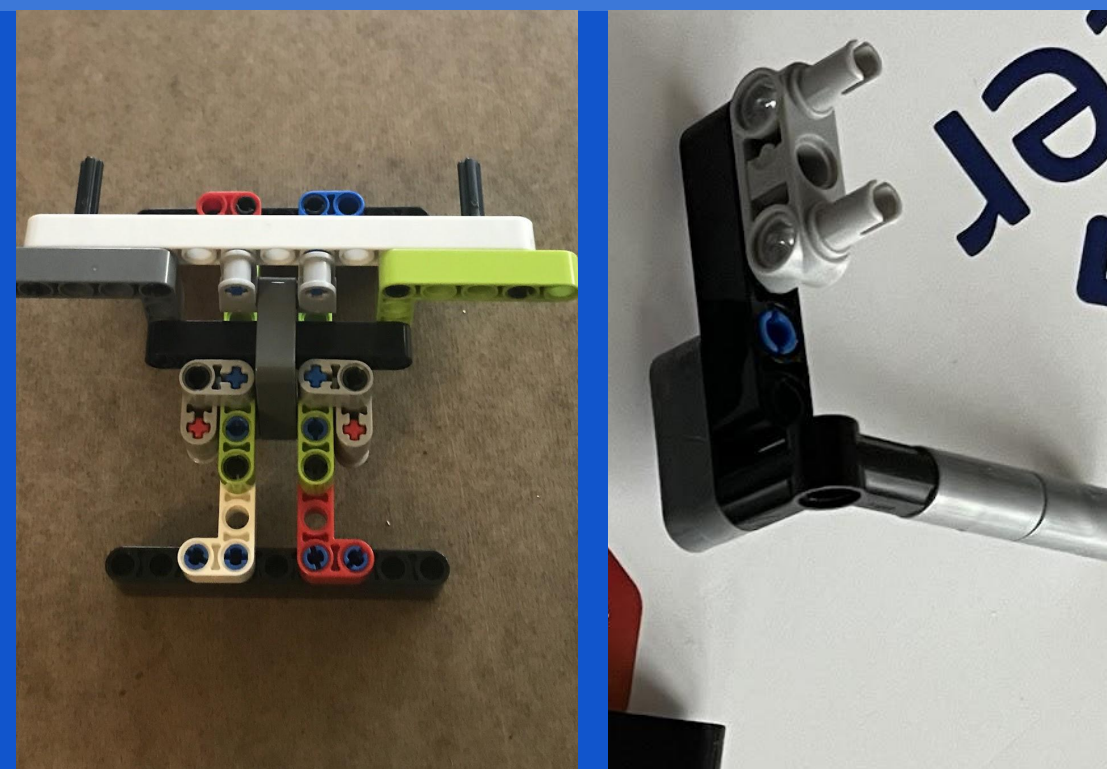
Launch 2
Missions
7, 8, 9, 15, 16
180 Points



Launch 3
Missions
3, 5, 16
110 Points



Launch 4
Missions
6, 13
60 Points



Programming Innovations

Find Line

Wait for Button Push

Previous Values

Gyro Turn

Drive Straight

Labeled Programming

```
623 #drives foward to train tracks
624 drive(150,0,45)
625 wait_for_seconds(0.2) #wait()
626 findBlack(25,30,rightSensor)
627 #drive(225, 0, 45) # we used this before we used find black ^^#500-before turn 550 450 400 350
628 #turns left to aligns itself a little more
629 #wait()
630 turnLeftForward(20, 20) #14 16 10
631 wait_for_seconds(0.2)
632 #drives a little more foward toward the train tracks
633 drive(130, 0, 45) #125 225 35 215 208 230 200 300 175
634 #turns toward the sorting center
635 turnRightForward(79, 30) #80 78 73 76 83 80 70 53 55 85 70 75
636 #wait()
637 wait_for_seconds(0.2) #wait()
638 #rake goes down so can get blocks
639 moveRake('down', 0.8, 55) #0.5
640 wait_for_seconds(0.5)
641 #drives into sorting center and gets blocks
642 driveStraightForSeconds(25, 2)
643 #has attachments lift down the train tracks and the package gets delivered
644 leftAttachment.run_for_seconds(1,-100)
645 moveRakeForDegrees(180,100)
646 wait_for_seconds(0.5) #0.2
647 #rake pickes up blocks
```


Nes'et & Tom 9-10-2021



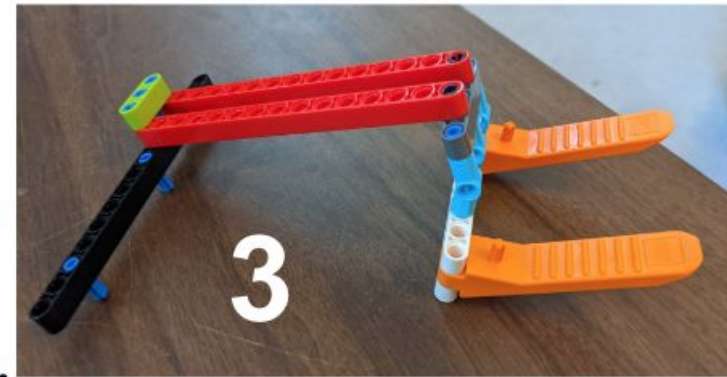
What we did:

- We discussed on what missions we are going to do
- We discussed which missions that would be on robot run 1
- We built a concept to retrieve blue and green containers from the sorting center
 - The first one (1) went underneath but didn't work very well
 - The second (2) raked the containers but sometimes the container got stuck
 - Then we looked for something to stick something under the container to lift them and eventually (3) found the lego brick separator worked very well
- We discussed ways to do the home delivery - we are considering a ramp



What we still need to do:

- Improve upon the attachment for the sorting center so that it can pick up two containers at the same time, even in different positions.
- Start working on the Innovation Project, and the Home Delivery
- Program the missions so that it can go back and forth and do the missions



What we learned:

- There is no one way to do something
- You can wear an earring holder for earrings on your ear

Thomas & Nes'et 1/15/22



What we did:

- We improved the consistency of the robot coming back, so that it is able to take the Unused Capacity block into home
- We changed the speed of the robot while it drives into the Sorting Center mission. We need to test it to see if it actually makes it consistent.
- We changed the left robot attachment so that it is within 12 inches
- Read over the rules

What we still need to do:

- We need to heavily improve the consistency on the robot coming back home
- Add the nose back on since it turns out it can be more than 12 inches in the launch area
- We need to run the mission by the sorting center 10 times to check that the new speed is working.

What we learned:

- When you're launching there is no ceiling which means our attachment can be higher than 12 inches (R12)
- If you interrupt the robot for an advantage, that mission will score zero points (R15)

NESET & KAITLYN

10/13/2021



What we did:

- The attachment that drops off the blocks in the circles (now aptly named "Fishhook" is now more structurally sound, and also is restructured to be more efficient.
- Connected the hooks that hold the crates in place
- Connected the prongs of the forklift
 - Realized that when they were attached together they were too far from the rotating plate
- Started to fix the prongs so that they are the right distance



What we still need to do:

- Begin programming our mission
- Refine our attachments further
- Recolor the fishhook, and further sturdify it
- Finish the adjustments to the prongs

What we learned:

- Form follows function, you shouldn't start with a design, you should start with how to solve a problem.
- We learned that urchin means, "a mischievous young child, especially one who is poorly or raggedly dressed."



NESET & KAITLYN

1/19/22



What we did:

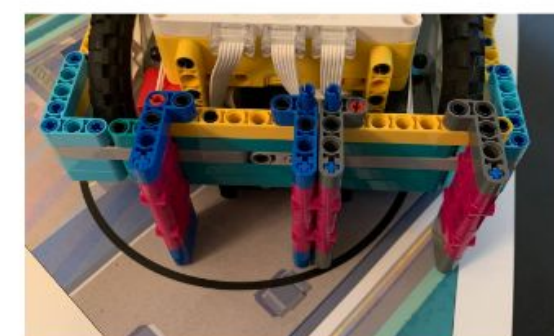
- Continue to program our robot run
 - Released the package
 - Pushed the train
 - Improved on the placement of the blue crate
 - Improved the placement of the two grey blocks on the ship
- Switched around the two colors of the attachment below (that way the blue block goes into the left slot) so that the block is not trapped at all, because we aren't dropping off the grey block as we do not have enough cargo

What we still need to do:

- Try to knock down the bridge using the hook
- Get back to home

What we learned:

- Having your hands on the table can mess up the gyro
- We learned that using wait for a button push functions to check whether the angle is right or not is super helpful



Tom & Dakota 11/15/21



What we did:

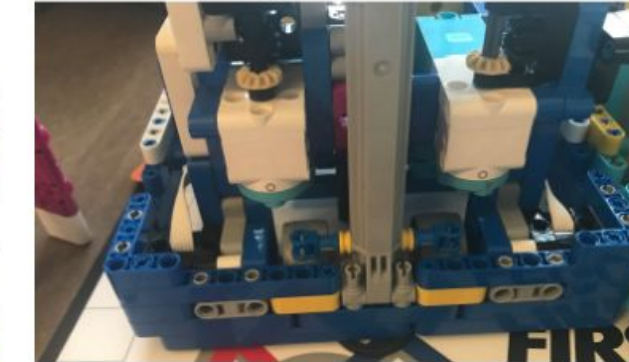
- Changed the robot so that an attachment can go in to the front of the robot and then get left on the board
- Started building a new attachment for switch engine and cargo delivery.

What we still need to do:

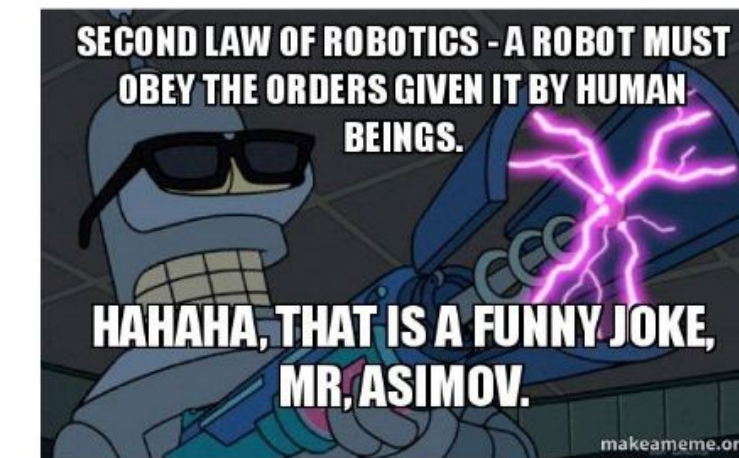
- We need to write our program
- Finish the switch engine and cargo attachment
- Make sure the attachment for the cargo plane works every time

What we learned:

- We learned that there's this peg that has a really skinny part and works well for holding onto the robot while it's going forward and then letting go when it backs up.
- We learned that Lego's don't taste like popcorn, but they don't taste terrible.



Kassie & Dakota 1/31/22



What we did:

- Action photo shoot of the robot for RDES posters
- Worked on our transition
- Decided who was going to do which parts of it
- Decided Kassie is in charge of doing Unused Capacity
- Got our transition under 10 seconds woot woot
- Added a move rake down with a wait to the beginning of our program to help it move smoother.
- Ran robot game with the whole team

What we still need to do:

- Make sure all the other missions are good to go
- Make checklists???
- Practice robot game & RDES

What we learned:

- Smooth is faster than fast
- Transition day is hard 👍

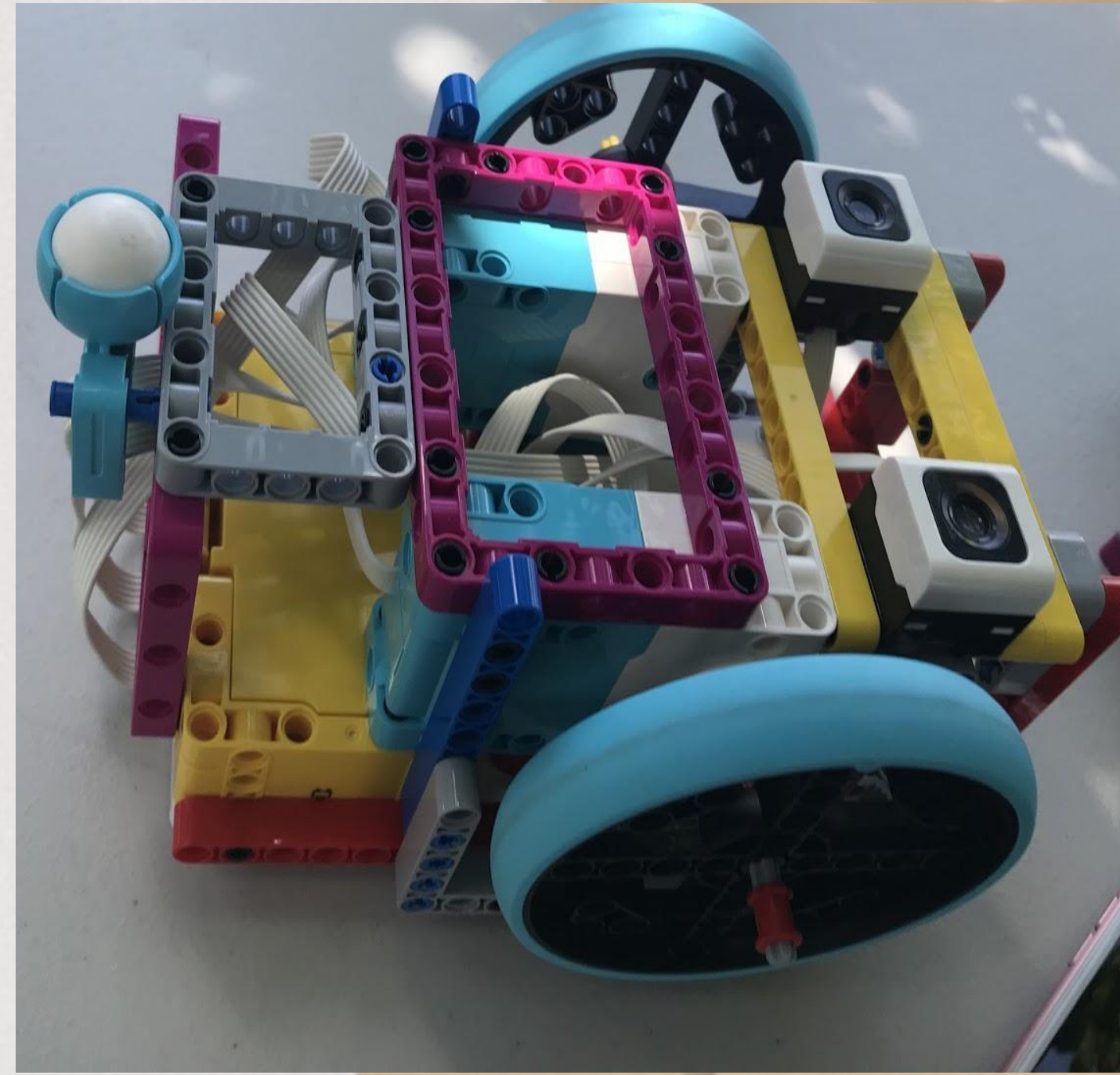
Iterate



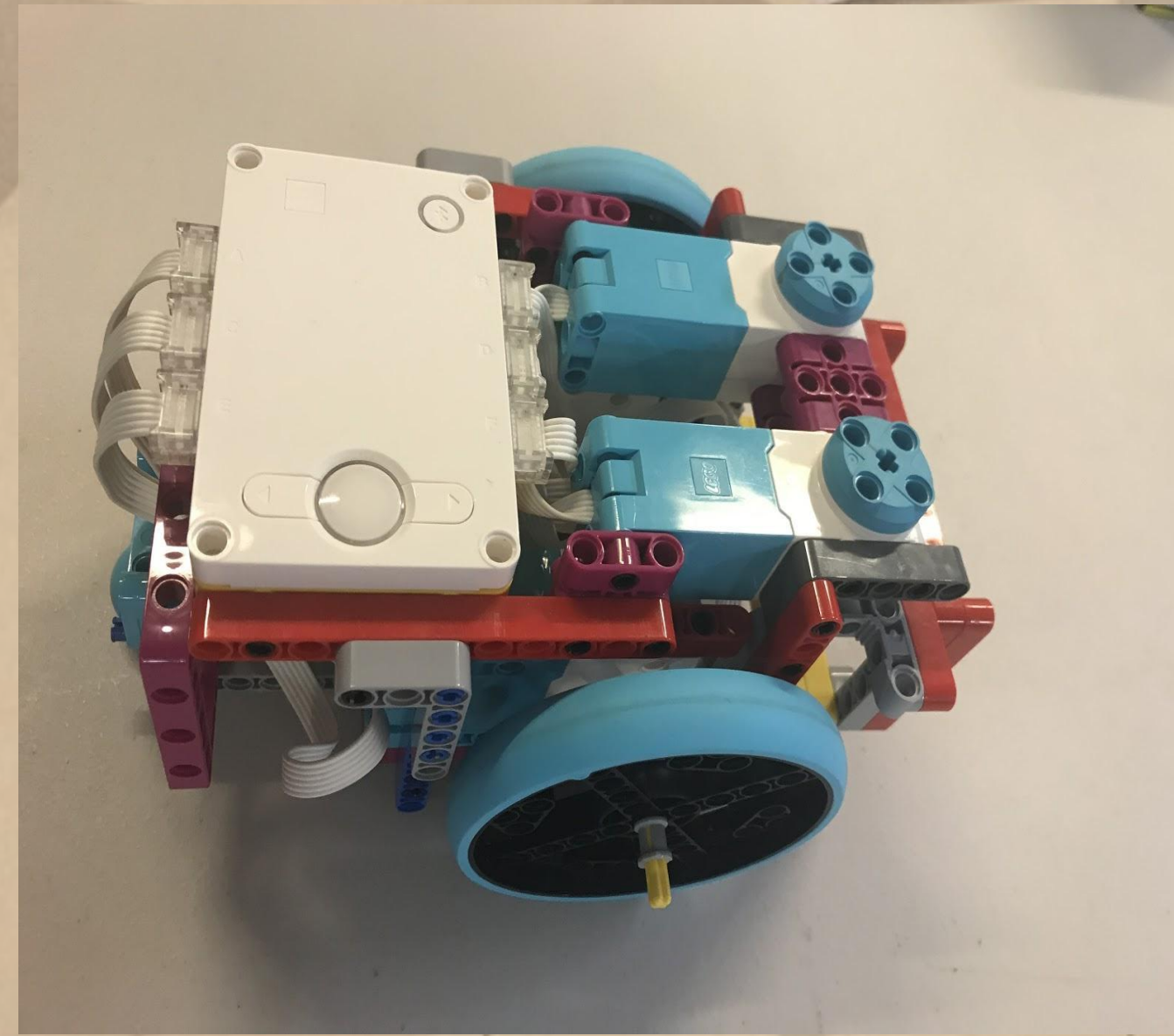
Our Robot Design Process

Communicate

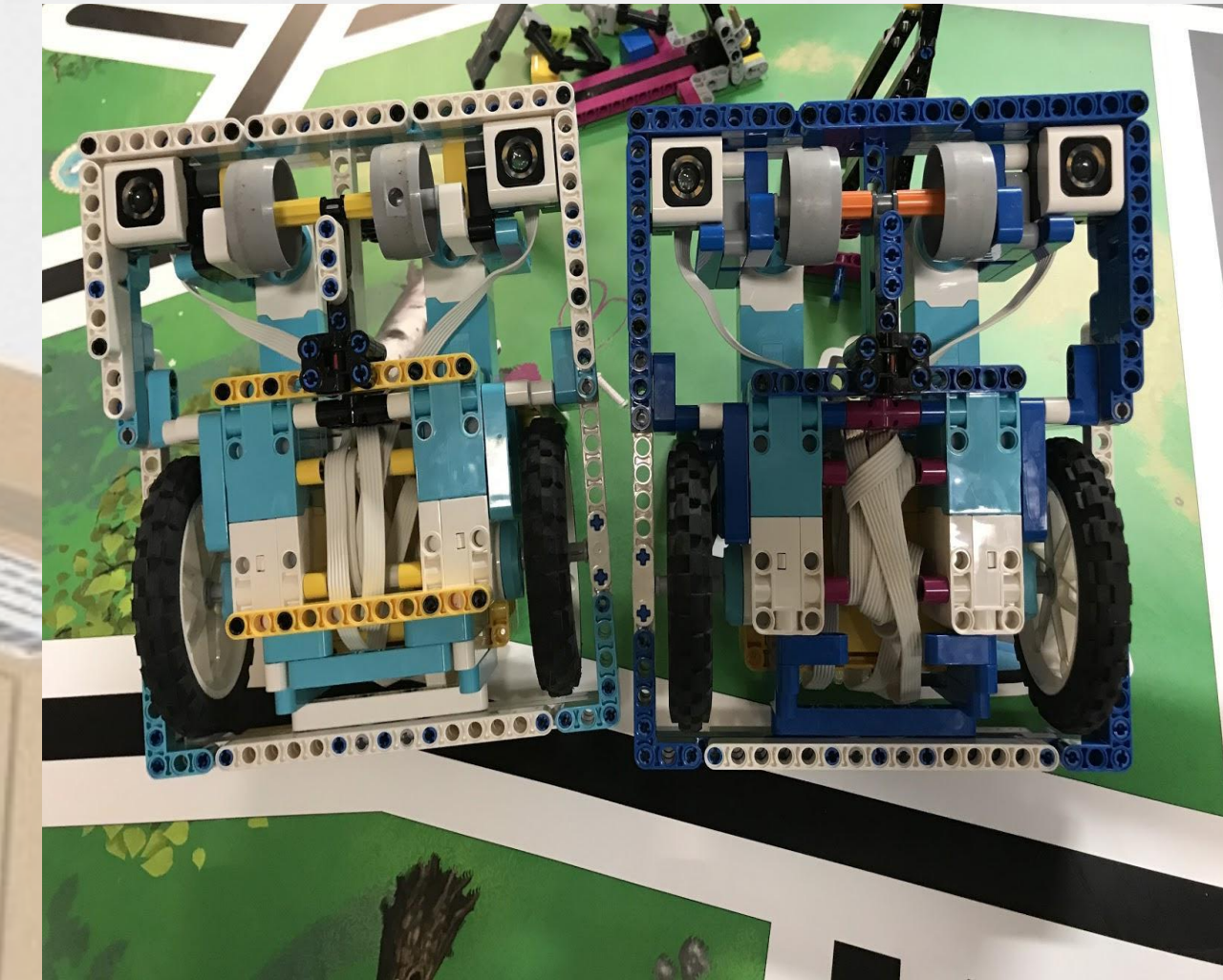
Prototype



Test



Build



Nes'et & Kaitlyn
9-13-2021

What we did:

- We discussed all of the missions and decided on a non-modular robot
- We started building on a new robot with a built-in Rack & Pinion
 - At first we built it up high but we decided it would be better if we build it lower so we had to take apart the frame of the robot
- We ate chips & salsa and airheads

What we still need to do:

- We need to finish the built-in Rack & Pinion with some more structural integrity
- We need to duplicate the robot

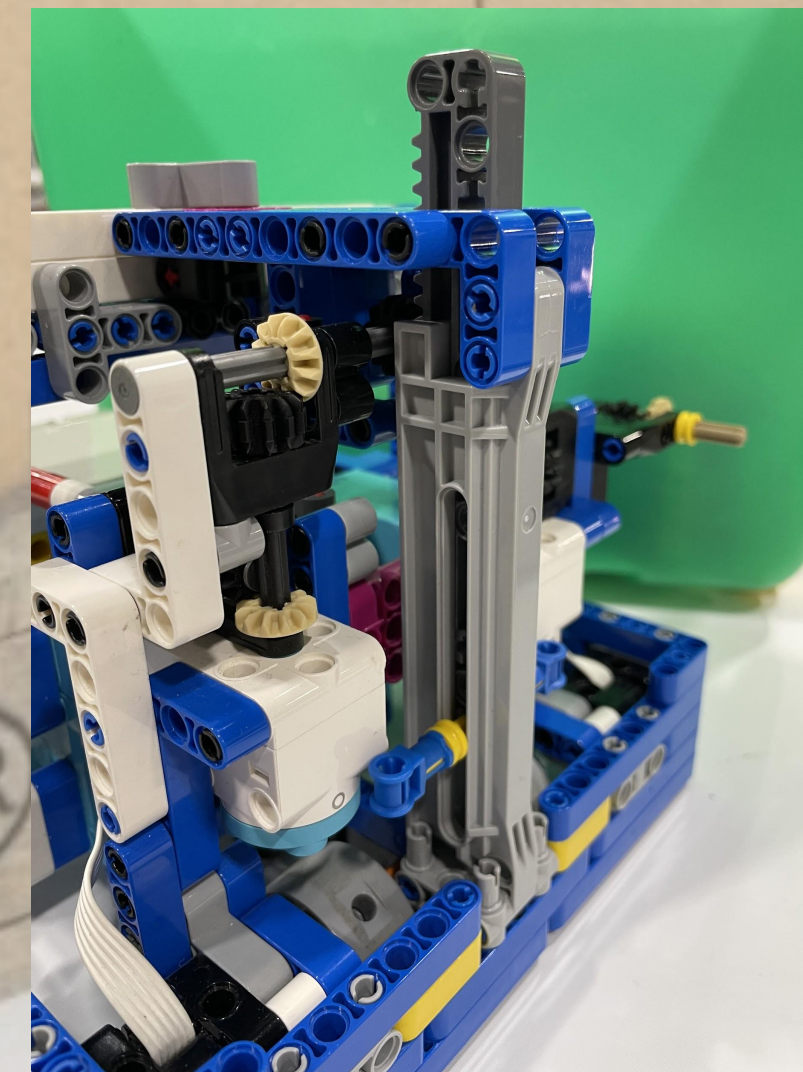
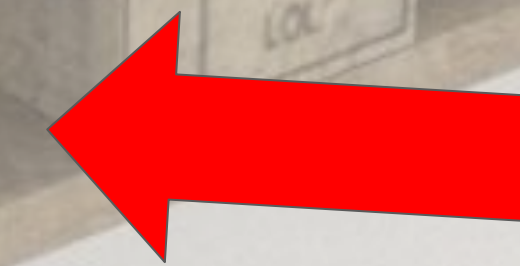
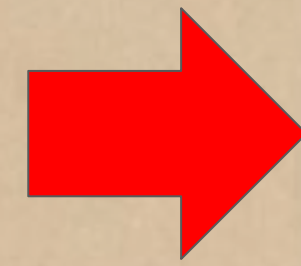
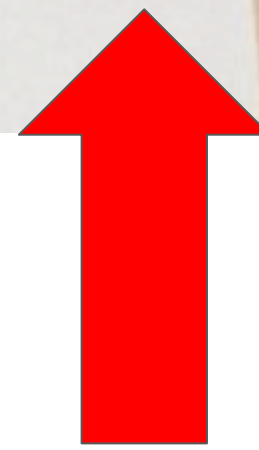
What we learned:

- Sometimes depending on the map, a modular robot is better, and sometimes it's not.

Brainstorm

Iterate

Test



Each of Us Built & Programmed Communicate



