THIS IS OUR

MOBILE ROBOTICS TECHNOLOGY ENGINEERING NOTEBOOK 2023-2024

Why are we documenting digitally?

- Improve **neatness** and **readability** of design documentation
- Practice using modern documentation tools and techniques

Our approach *(during each meeting):*

1. Create digital entry of **important activities/accomplishments**
2. **Print** entry/s from the meeting
3. **Tape** into this notebook and **sign** to ensure **evidence of chronological progression**

- Alden & Anthony,
Team:

FIRST MEETING

Team Goals

Utilize all scoring methods of the game

- It is important when designing our robot to consider all aspects of play.
    - This will allow us to become more adaptable during the National's competition as the game is subject to change.

Create an autonomous that is consistent and operates successfully

- Due to the resources presented to us, the previous years of competing did not allocate for experience creating or testing an autonomous program.
    - This will strongly assist us during our competitions as it is a large portion of it.

Organize parts and have a fluent workflow

- Last year created a hectic habit of just putting something on the robot and crossing our fingers that it worked
    - Breaking this habit in the form of creating versions of our work and looking into future expansion greatly helped us create a neater and well laid out robot

Focus on one project at a time

- Getting sidetracked was another one of our weak points.
    - We implemented a simple documentation system that kept us on track with a checklist that we updated at the end of every meeting

HOW TO READ THIS NOTEBOOK

TITLE	This font will be used for project titles.
Subtitle	This font and format will be used for subtitles.
LABEL	Labels for diagrams, sketches, etc .will be all capitalized.
Section Heading	A box around words will indicate a section heading.
(notebook, page)	References to a specific page number(s) will have this format.
Important	The most important information in this notebook will be highlighted.
Normal	Most other text will be written in this standard type. Some changes to this font are anticipated and acceptable.

Colors and Tabs

RED	**IDENTIFY PROBLEM**
YELLOW	**BRAINSTORM SOLUTIONS**
GREEN	**SELECT AND PLAN**
BLUE	**BUILD SOLUTION**
PURPLE	**TEST SOLUTION**

Identify Problem tab

Brainstorm Solutions Tab

Select and Plan Tab

Build Solution Tab

Test Solution Tab

Design Process Tab

CAD Tab

Sketches Tab

Timeline Tab

ENGINEERING DESIGN PROCESS

Identify Problem

- Problem description with words and pictures
- Problem statement
- Solution requirements & Goals

Brainstorm Solutions

- Possible solutions with positives and negatives
- Labeled diagrams
- Citations from outside sources
- Prototyped solutions

Select and Plan

- Testing steps and results for prototypes
- Decision Matrix
- Sketches of Solution
- CAD Model of Solution

Build Solution

- Steps to build the solutions
- Parts list for build
- Completed assembled build

Test Solution

- Steps to test the solution
- Test Results
- Conclusion based on results

BUDGET

Goal

We will layout a budget and quote for this year to better allocate funds and optimize our spending

Robotics Club Budget Cap: *$3,000*

Item	Quantity	Subtotal
#8-32 Nylock Nut (100-pack)	3	$13.17
#8-32 x 1/4” Screw (100-pack)	1	$8.49
#8-32 x 3/8” Screw (100-pack)	1	$8.49
#8-32 x 1/2” Screw (100-pack)	1	$8.49
#8-32 x 3/4” Screw (100-pack)	1	$10.99
Metal & Hardware Kit	2	$179.98
Booster Kit	2	$399.98
Aluminum Structure Kit	2	$179.98
Long Aluminum Structure Kit	1	$89.99
Aluminum Chassis Kit 25x25	1	$39.99
1x3x1x35 Aluminum C-Channel (6-pack)	1	$32.99

Item	Quantity	Subtotal
1x2x1x25 Aluminum C-Channel (6-pack)	1	$32.99
2x2x2x20 Aluminum U-Channel (6-pack)	1	$39.99
Angle Coupler Gusset (8-pack)	1	$21.99
6T High Strength Socket (8-pack)	1	$14.49
12T High Strength Socket (4-pack)	1	$14.49
18T High Strength Socket (4-pack)	1	$14.49
24T High Strength Socket (4-pack)	1	$14.49
30T High Strength Socket (4-pack)	1	$14.49
V5 Smart Motor (11W)	4	$179.96
Smart Motor 36:1 Cartridge (100 RPM)	2	$22.98
Smart Motor 6:1 Cartridge (600 RPM)	2	$22.98
Smart Cable Stock (8m)	2	$13.98
Smart Cable Connectors (50-pack)	1	$3.49
Smart Cable Crimping Tool	3	$69.99
V5 robot Batter Li-Ion 1100mAh	1	$69.99

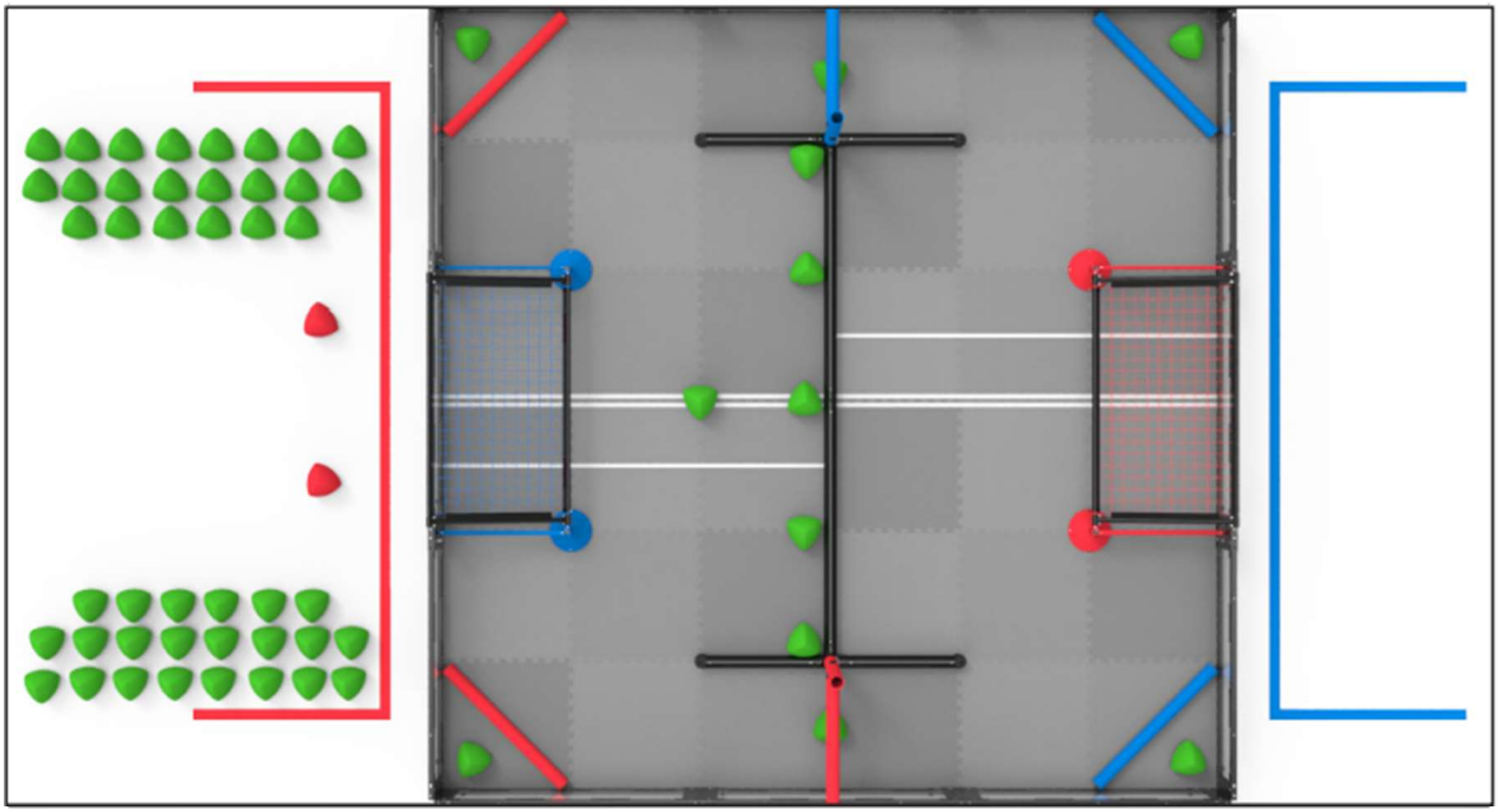
Item	Quantity	Subtotal
VRC Over Under Full Game & Field Element Kit	1	$574.99
Straight Flex Wheel (4” OD x 1” WD, 1-1/8” ID, 30A)	1	$4.49
1/2” VersaHex Adapters v2 (1/4” Square Bore, 1/8” Long) (8 Pack)	1	$2.49
1/2” Hex Bore Plastic Versahub v2	1	$2.49
V5 Flywheel Weight (2-pack)	1	$20.99
Distance Sensor	1	$47.99
V5 GPS Sensor	1	$199.99
Bumper Switch 6N (2-pack)	1	$14.99
Limit Switch (2-pack)	1	$14.99
4” (320mm Travel) Omni-Directional Anti-Static Wheel (2-Pack)	3	$82.47
Shipping & Handling	-	$238.52
Tax	-	$164.50
Grand Total	-	$2,950.54

IDENTIFY GAME PROBLEM

VRC Over Under, SkillsUSA Mobile Robotics Technology

Goal

We will analyze both VRC's "Over Under" and SkillsUSA Mobile Robotics Technology's Rules so that we can better understand this year's game



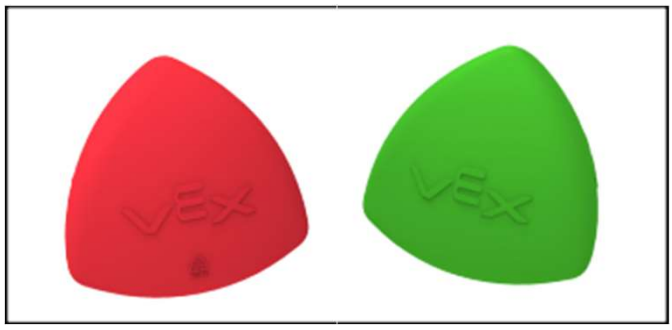
Field Elements

- Final total of possible 58 Triballs in play for SkillsUSA Matches
- 12 Triballs start on field
- Preloads add 2 more
- Match loads add 44 more

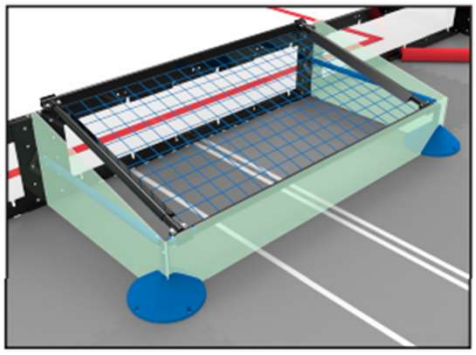
- Mass 110g ± 20g

- Approximately 6.18" tall

Triball



- 5 pts for each Triball in a Goal
- 2 pts for each Triball scored in an Offensive Zone



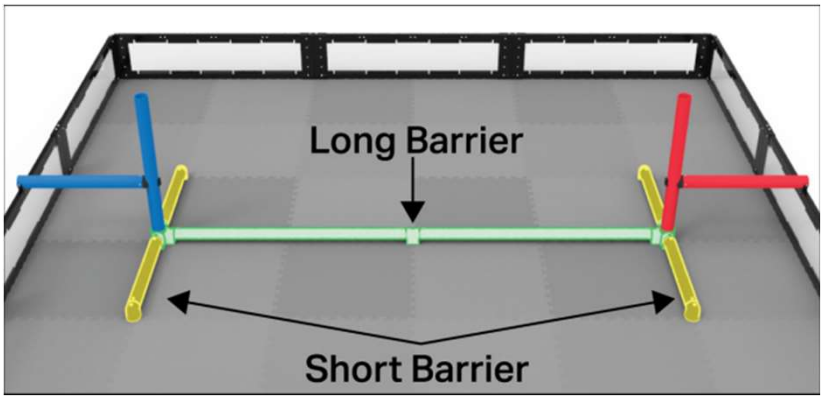
Goal

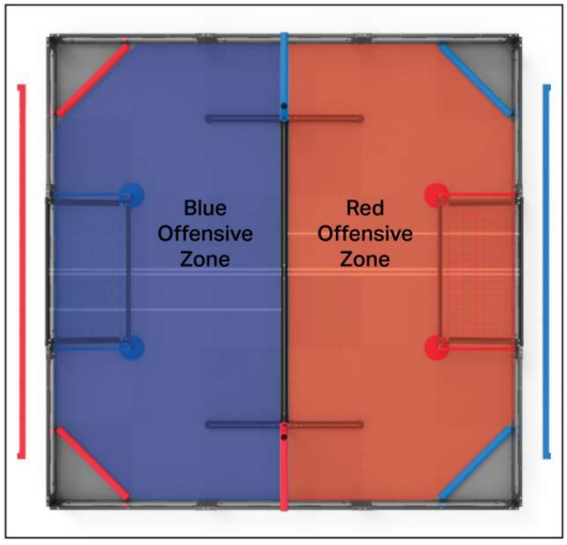
- 2 Goals total
  - 1 Goal per Offensive Zone

- 47.13 inches long (from post to post)
- 23.08 inches wide (from post to wall)
- 39.37 inches long (from base of cone to base of cone)
- 19.20 inches wide (from base of cone to wall)
- 5.78 inches tall (from horizontal post to tile)
- Each Triball in Goal is worth 5 pts
  - For a Triball to be scored, it must have 2 corners under the Goal

Barrier

- Long Barrier
  - Separates the Offensive Zones
  - 96 inches long
- Short Barriers
  - 48 inches long
- Made from 2” Schedule 40 PVC
  - 2.375” outer diameter

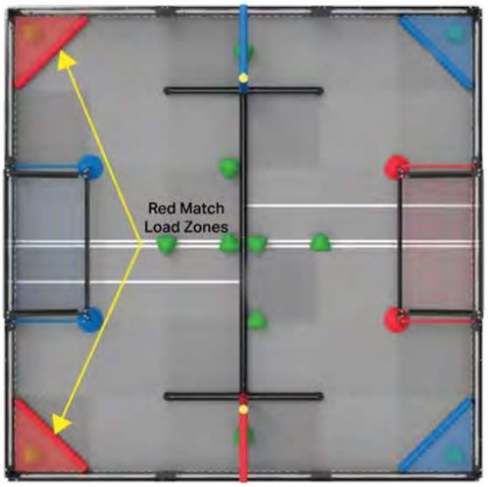




Offensive Zones

- Each Offensive Zone consists of the gray foam tiles on one side of the Barrier
- The Match Load Zones are not considered to be part of either Offensive Zone
- Each Triball in the Red Offensive Zone is worth 2 pts

Match Load Bar & Match Load Zones



Match Load Bar

- made up of 2” Schedule 40 PVC pipe
- 2.375” outer diameter

Match Load Zone

- Robot must break the plane behind load bar
- Allows for Triball placement on robot or in zone

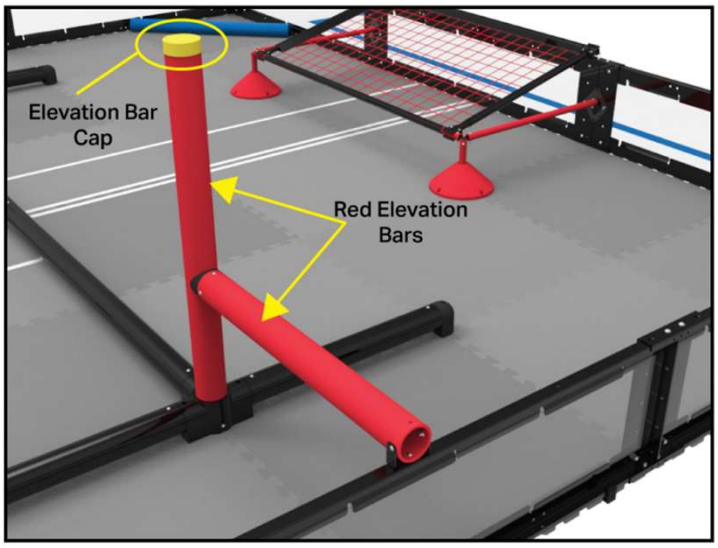
Elevation Bar & Elevation Bar Cap

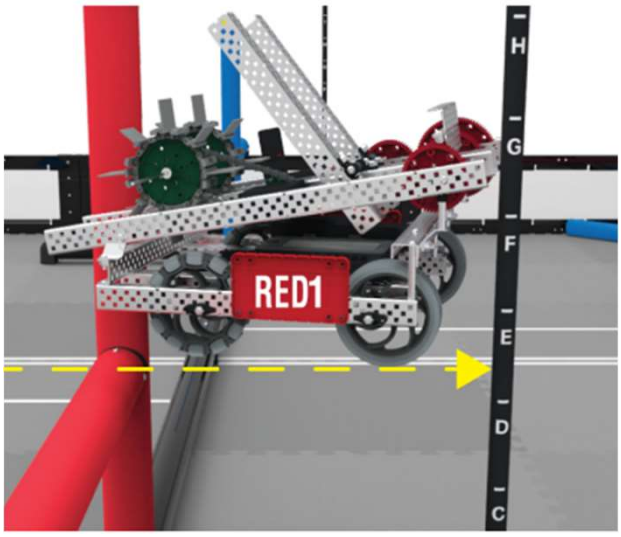
Elevation Bar

- Alliance-colored PVC pipes, two red and two blue, at either end of the Barrier
- Allows for robot to elevate itself above the tiles

Elevation Cap

- The yellow plastic piece at the top of each set of Elevation Bars
- A Separate field element and is NOT considered part of the Elevation Bar
    - Meaning you can not elevate by holding onto the cap





Elevation Tier and Height Guide

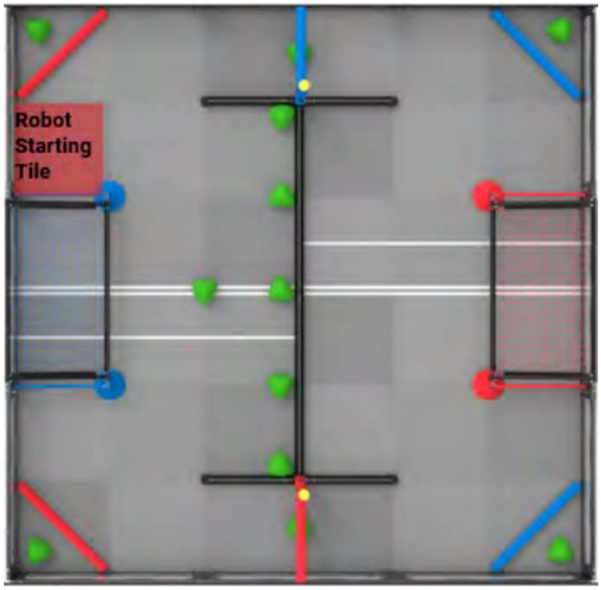
Elevation Tier

- Different height levels, or tiers, allow for a different amount of points scored
    - 1st tier: H or higher (20 Points)
    - 2nd tier: E-G (15 Points)
    - 3rd tier: B-D (10 Points)
    - 4th tier: A (5 Points)
- Height Guide (black PVC pipe) used to determine the Elevation Tiers at the end of a Match

Starting Tile

- The gray foam tile along the edge of the field perimeter to the left of the Blue Alliance Goal

- This rule is specific to SkillsUSA
    - VEX <RSC2> states: Robots may start the Robot Skills Match on any legal Starting Tiles for either Alliance.



UNDERSTAND GAME RULES

VRC Over Under, SkillsUSA Mobile Robotics Technology

Goal

We will understand the game rules for the SkillsUSA Mobile Robotics Technology Competition to develop different game strategies

<SG1>

Standard rule explaining the legal robot setup

1. Contacting the Robot Starting Tile. See: (Starting Tile, page 10)
2. Not Contacting any other gray foam field tiles, including the Match Load Zones.
3. Not contacting any Triballs other than a maximum of one (1) Preload.
4. Not contacting any Barriers or Elevation Bars
    1. Contact with the field perimeter and/or Match Load Bars is permitted, but not required
5. Completely stationary (no motors or other mechanisms are in motion
6. Teams may use the two (2) Red Alliance Preloads as follows:
    1. One Preload must be placed per <SG4>
    2. The second Red Alliance Triball may be placed in any non-scored position in the Blue Offensive Zone and not touching the Robot, or may be used as a Match Load per <SG6>

<SG2>

Rule that limits horizontal expansion

1. 36” Horizontal Limit
2. This limit refers to expansion relative to the field (would be enforced if robot tips and breaks limit at any moment)
3. There is no height limit on Robot expansion

<SG3>

Rule that explains what happens to Triballs that may leave the field

1. Triballs that leave the field during Match play, whether intentionally or unintentionally, will be returned to the field by being placed in a Match Load Zone nearest the point at which they exited
2. Referees will return Triballs to the field at their discretion
    1. This is not considered a “Match Load”
3. Incidental contact with other Triballs may occur in the Match Load Zone
    1. Triballs can be placed on top of other Triballs that are already in the Match Load Zone
4. Referees may also direct a nearby Drive Team Member or other volunteer to return the Triball to a specific Match Load Zone
    1. This should not be done by Drive Team Members proactively without referee acknowledgment

Note: Triballs which come to rest on top of the Red Goal may not be retrieved by a Drive Team Member or
Referee during the Match. Triballs which come to rest on top of the blue Goal may be retrieved by a Drive
Team Member.

<SG4>

Rule that explains the restrictions for the Preloads and Alliance Triballs

1. Prior to the start of each Match, one Alliance Triball / Preload that is used must be placed such that it is:
    1. Contacting one Robot of the same Alliance color as the Preload.
    2. Not contacting the same Robot as another Preload.
    3. Fully within the field perimeter.
2. The second Red Alliance Triball may be placed in any non-scored position in the Blue Offensive Zone and not touching the Robot, or may be used as a Match Load per <SG6>

<SG5>

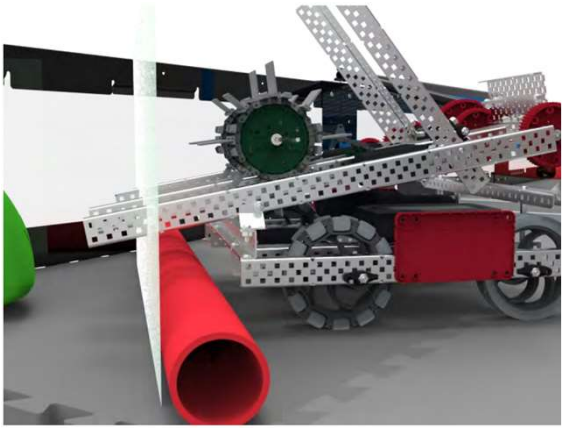
Rule that states robots should stay away from the nets on the Goals

1. Robots should be careful and avoid entanglement with the nets on either Goal
    1. This is a violation of the rules and will result in a disablement
2. Lifting the net structure in an attempt to add or remove Triballs is also considered a Violation

<SG6>

Rule that discusses Match Load Triballs and that Teams may utilize the forty-four (44) Match Load Triballs within the guidelines set forth by <SG5>

1. Match Load Triballs begin the match in the Red Alliance Station
2. Match Load Triballs must be introduced from the Red Alliance Station per <SG6>
3. Match Load Triballs may be introduced during the Autonomous Coding Skills Matches



Note that when Loading Triballs onto a robot, the robot must break the plane behind the Match Load Bar as shown in this image here:

<SG7>

Rule that explains Possession rules

1. Possession is limited to one (1) Triball
2. There are no rules prohibiting Plowing multiple Triballs. However, Robots which employ Plowing strategies should be cognizant of any accidental Possession risks while doing so, such as a Triball rolling into an intake mechanism while another one is already there.

GAME STRATEGIES

VRC Over Under, SkillsUSA Mobile Robotics Technology

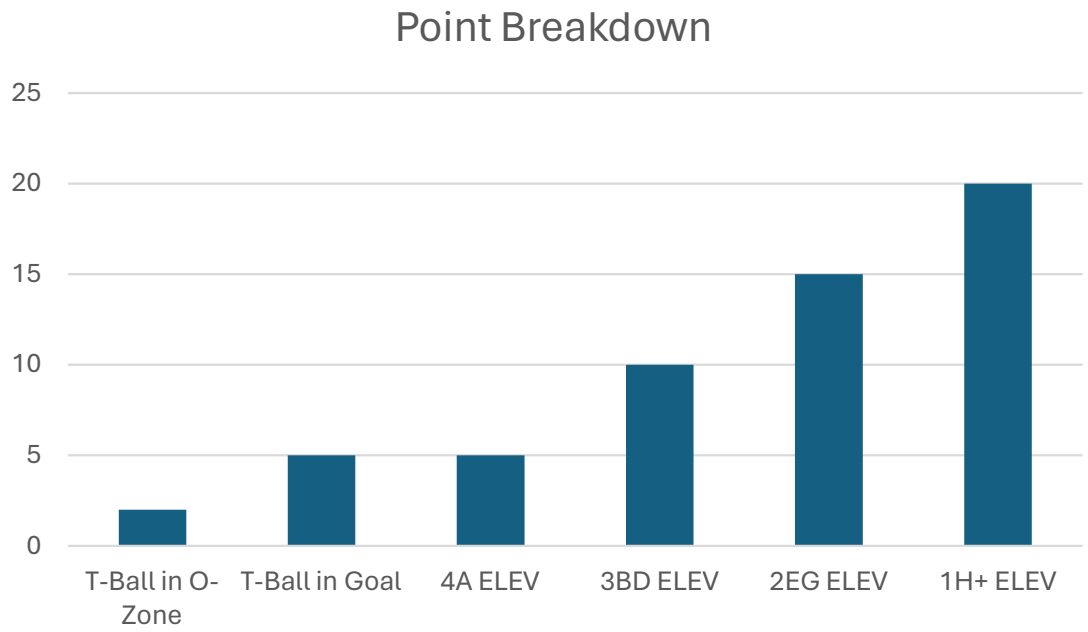
Goal

We will develop strategies for this year's game so that we can have a better understanding of what points we should prioritize

Scoring Prioritization

Scoring Method Points

- 2 Points for each Triball in Offensive Zone
- 5 Points for each Triball scored in either Goal
- 5 Points for 4th tier elevation (A)
- 10 Points for 3rd tier elevation (B-D)
- 15 Points for 2nd tier elevation (E-G)
- 20 Points for 1st tier elevation (H or higher)



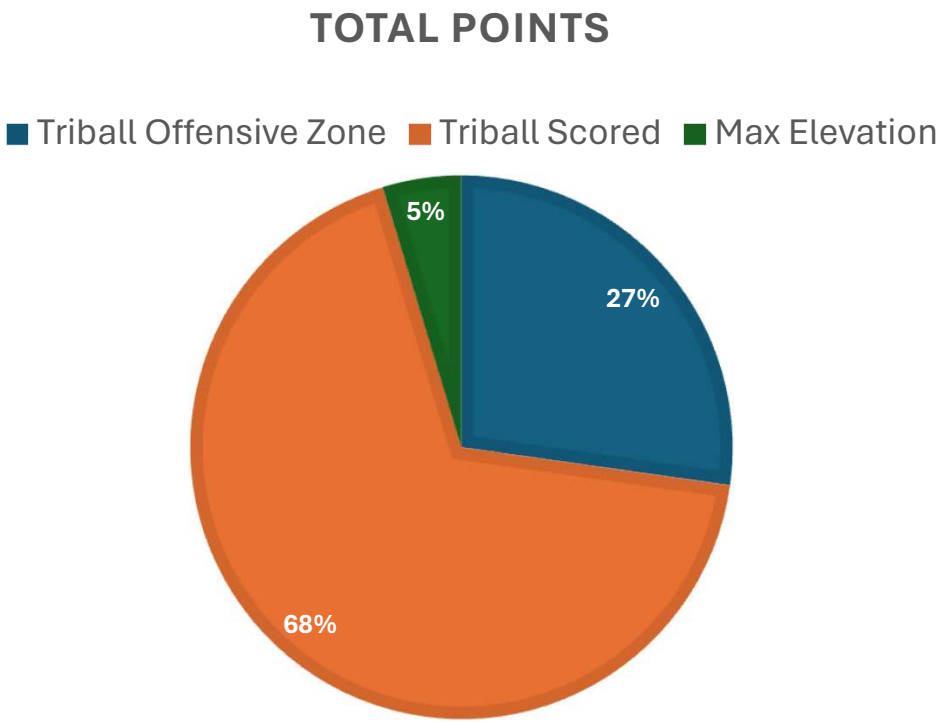
Observation

- Elevation from the 1st tier (Level H or higher) is worth the most points
- Triballs in the Offensive Zone are worth the least points

- The time it takes to complete the various tasks will result in different point values match wise
- Triballs can be both scored in the Red Offensive Zone and in the Goal, totaling for 7 points if both are successfully executed

Total Points:

- 116 pts can be scored from all Triballs being in the Red Offensive Zone
- 290 pts can be scored from all Triballs in the Goal
- 20 pts can be scored from the maximum elevation (Level H or higher – 1st tier)



Observations:

- Triballs in the Goal are worth the most points
- Maximum Elevation is worth the least points
- Triballs scored in Goal fluctuate based on how many can fit in a Goal along with how many Triballs are in the Red Offensive Zone
- Have to keep in mind that not all Triballs can both score points for being in Goal and score points

Game Strategies

Getting Triballs in Offensive Zone

POSITIVES	***NEGATIVES***
• Not much work behind it • Simple • Lots of room to score • Can really add up if efficient	• Lots of Triballs to account for • Can be very scattered • Only 2 points per ball

Getting Triballs in Goal

POSITIVES	***NEGATIVES***
• 5 points on either side of field • Lots of possible points • Can combine with Triballs in Offensive Zone	• Not all Triballs easily fit in one Goal • Difficult to obtain and score all Triballs since there are so many

Elevation Tier 4 (A)

POSITIVES	***NEGATIVES***
• Only at most 3.7 inches off ground • (Maybe) robot can sit on barrier and count for elevation	• Takes time away from scoring • Only 5 points

Elevation Tier 3 (B-D)

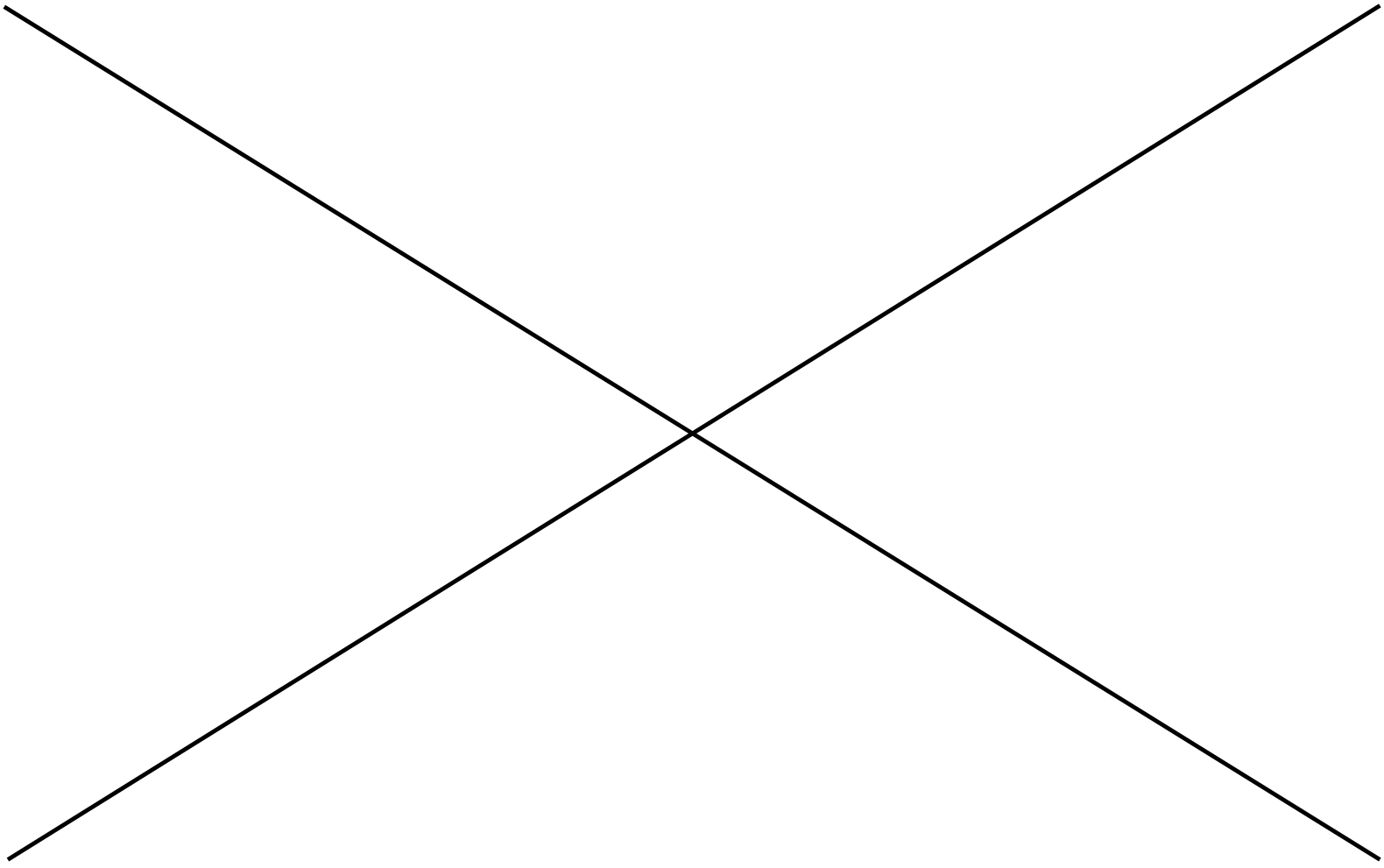
POSITIVES	***NEGATIVES***
• Not the hardest to accomplish, can use vertical elevation bars to accomplish • More points than previous tier	• Only 10 points • Takes time away from scoring

Elevation Tier 2 (E-G)

POSITIVES	***NEGATIVES***
• More points than previous tiers • 15 points	• Takes time away from scoring • More complex elevation method

Elevation Tier 1 (H+)

POSITIVES	***NEGATIVES***
• 20 points • More points than previous tiers	• Takes time away from scoring • Most complex elevation method

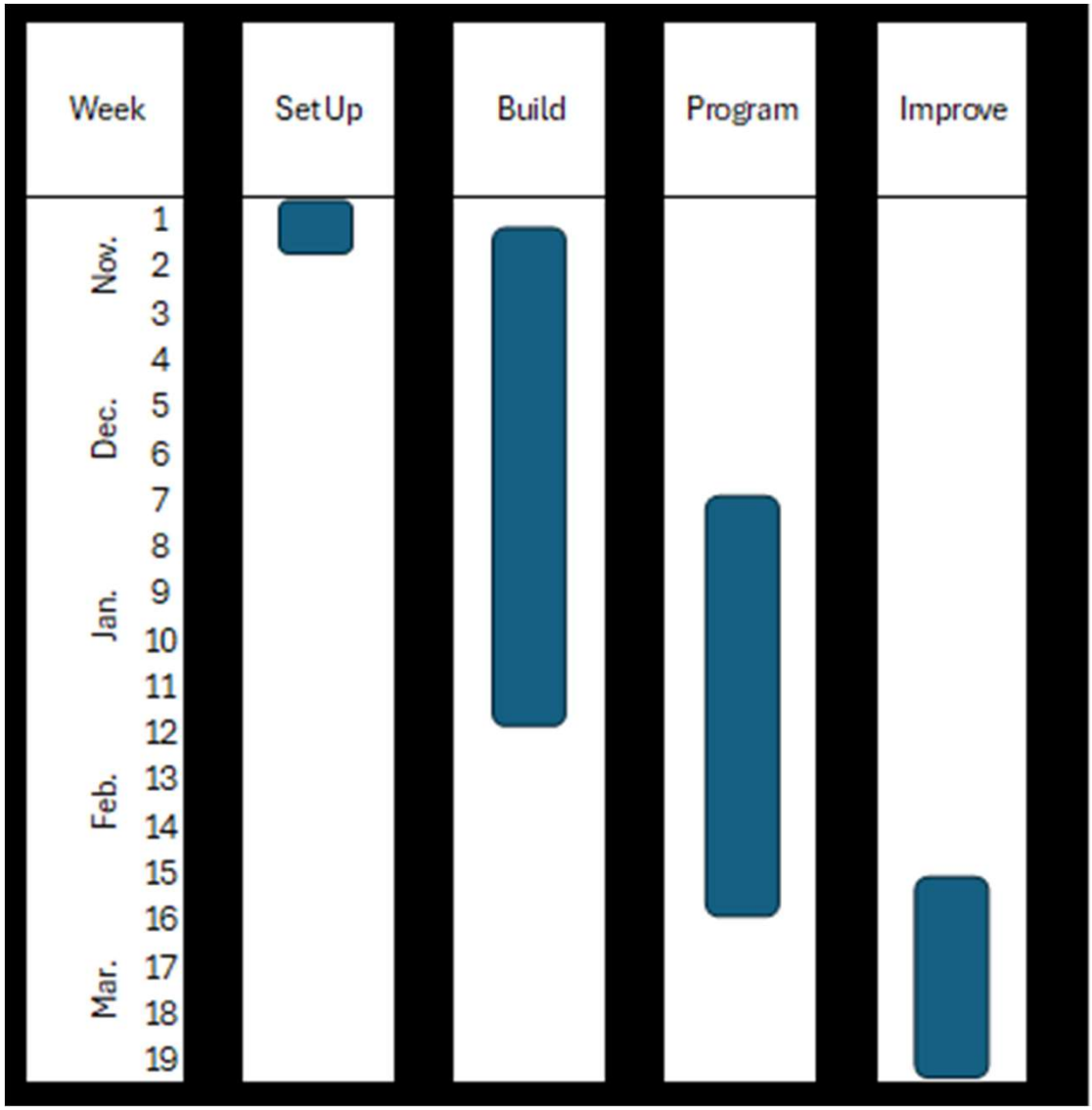


GANTT CHART

VRC Over Under, SkillsUSA Mobile Robotics Technology

Goal

We will create a Gantt Chart for this season so that we can manage our time effectively.



*This serves as a guideline for how we will manage our time effectively

* Schedule flexibility is shown through overlapping blocks

IDENTIFY PROBLEM

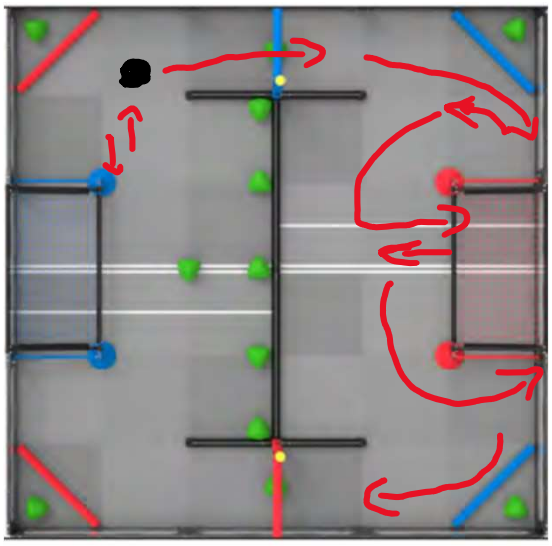
Drivetrain

Goal

We will identify an objective for our robot so that we can address it and build an effective drivetrain

Problem Statement

We need a mechanism to move around the field so that we can interact with the game objects



Solution Requirements

- Must only use legal VEX Robotics Competition Parts
- Must fit within 18”x18”x18” cube

Solution Goals

- Must traverse the length of the field in less than 5 seconds
- Turn a single revolution in less than 2 seconds
- Have enough traction to push Triballs in Goal

BRAINSTORM SOLUTIONS

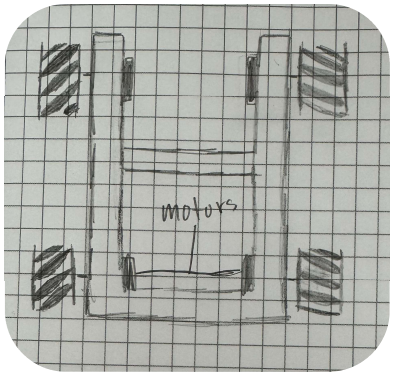
Drivetrain

BRAINSTORM SOLUTIONS

Goal

Brainstorm possible solutions to create a solid drivetrain to be able to expand upon

Possible Solutions



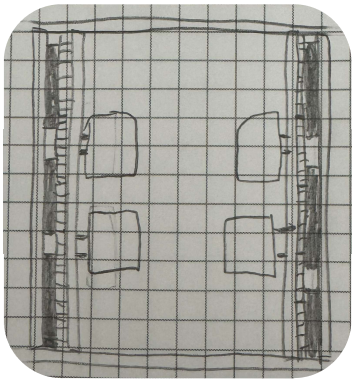
Square body with Mecanum wheels

- Equally square body with four Mecanum wheels on each corner
- One motor on each wheel controlled individually

POSITIVES	***NEGATIVES***
• Nimble • Fast • Movable in all directions • Easy to drive	• Bad Traction • Inconsistent accuracy • Hard to code autonomous without multiple sensors

Tank Drive with Omni-Wheels

- Body made up of C Channels that is open at the front with room for an intake
- Two motors on both sides, each group of two controlling 3 wheels at once.

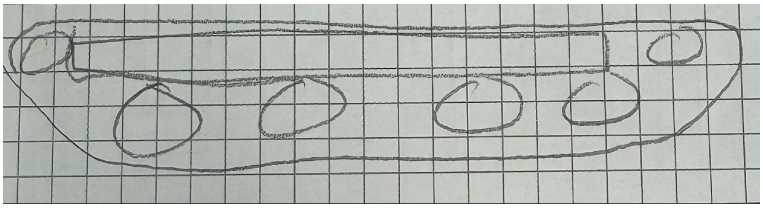


POSITIVES	***NEGATIVES***
• Fast • Accurate • Great traction • Simple to drive	• Not drivable diagonal or sideways • Able to move side to side

Possible Solutions

Traditional Tank Drive

- 6 wheels on each side with tank treads to help with traction
- Each side would be individually controlled



POSITIVES	***NEGATIVES***
• Traction over the middle bar • High torque	• Slow • Hard to maneuver • Impractical

BRAINSTORM SOLUTIONS

BRAINSTORM SOLUTIONS

Possible Solutions – Cartridge Type

Red Cartridge

- Uses the green cartridge preset in motors
- Spins up to 100rpm
- Usually used for mechanisms requiring extra strength

POSITIVES	***NEGATIVES***
• Very Strong • Great Acceleration	• Very Slow • Loses a lot of speed to friction in the cartridge

Green Cartridge

- Maintains the green cartridge preset in motors
- Spins up to 200rpm
- Usually used for mechanisms requiring a balance of strength and speed

POSITIVES	***NEGATIVES***
• Has a good balance between speed and torque	• Loses speed to friction in the cartridge

Blue Cartridge

- Uses the green cartridge preset in motors
- Spins up to 600 rpm
- Usually used for mechanisms requiring extra speed

POSITIVES	***NEGATIVES***
• Very Fast • Places little friction on the motor	• Very low torque • Very weak

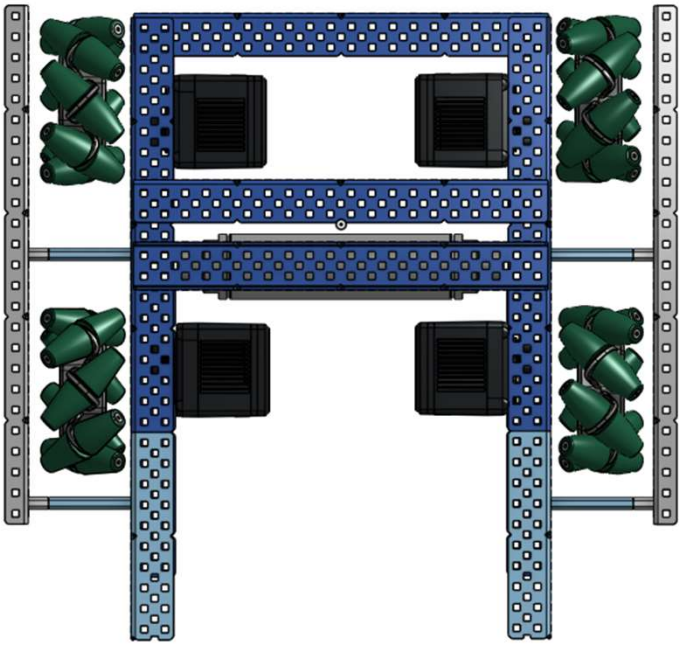
SELECT AND PLAN

Prototype solutions

We decided to go with the tank drive wheel configuration.

We are now going to prototype and edit this design based off our needs with the game.

Early versions



← Last years design

- Maneuverable
- Using 4 green cartridges in the motors
- Very inaccurate and bumpy
- Able to move side to side and diagonal

First iteration of drivetrain (one side) →

- Using green motors spinning together using a motor group
- This design would be replicated on both sides
- This design is strong, and extremely accurate
- Using wheels we had, 4 inch omni wheels on the way

SELECT AND PLAN

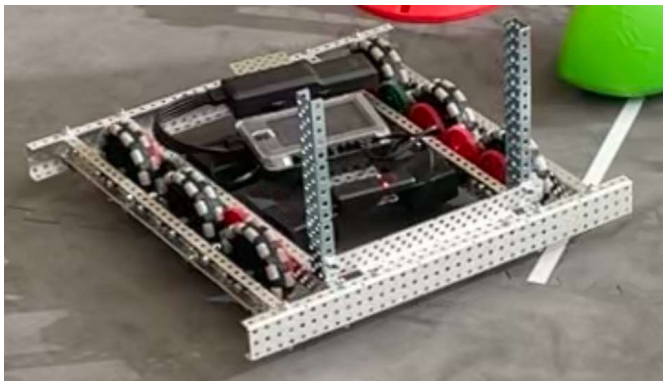
Drivetrain

SELECT AND PLAN

Goal

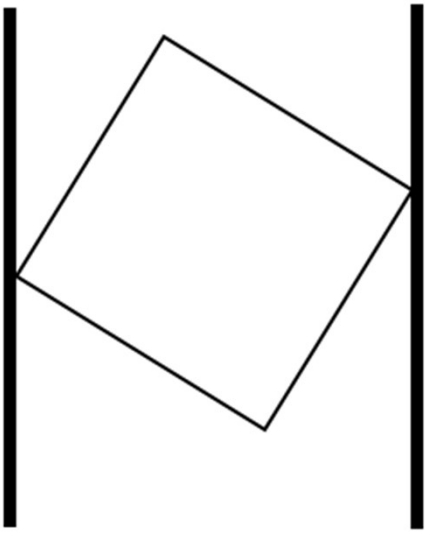
We will select the solution that is best for our team so that we can plan how to build it

Initial Test



We chose to use the design of a 6 wheel tank drive

This concept was what we built and first tested

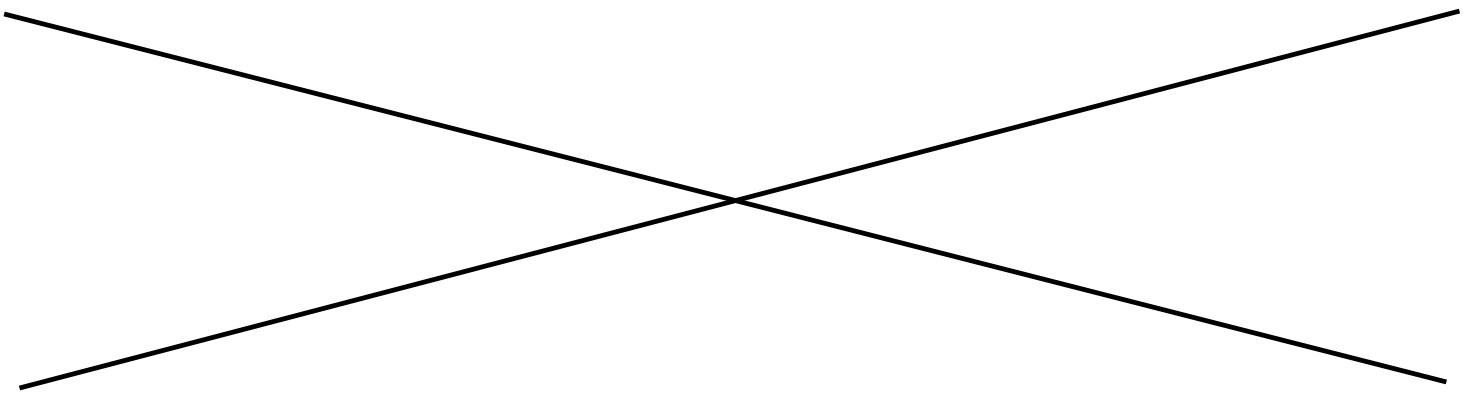


A problem that we ran into during testing was that the boxy structure of our robot had terrible clearance when passing through the left and right side of the field

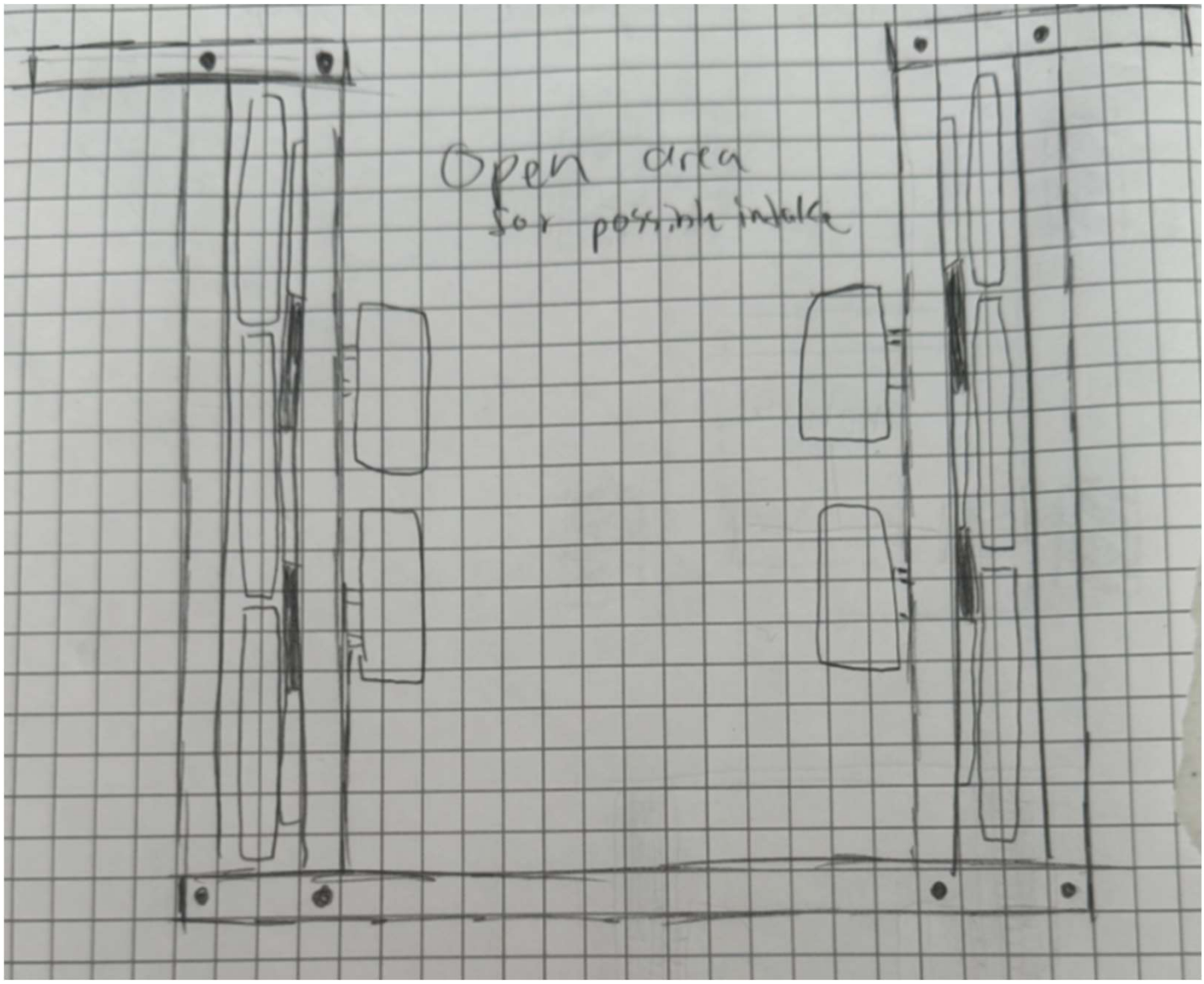
Any sort of turning would bind up the robot completely and make it completely inoperable

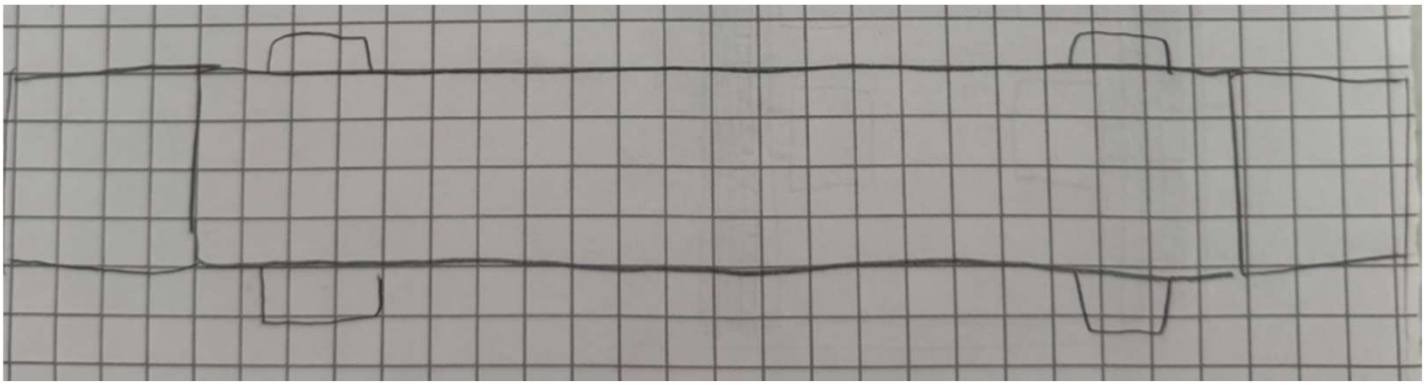
This led us to trim down the chassis both in length and width

This shrunk the dimensions of the robot from 17.5 x 17.5 inches down to 15.1 x 16.4 inches



Sketch Plan



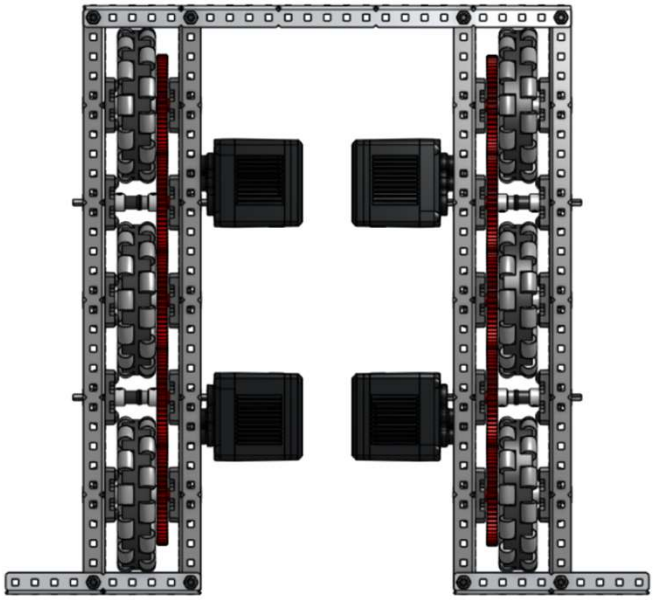


SELECT AND PLAN

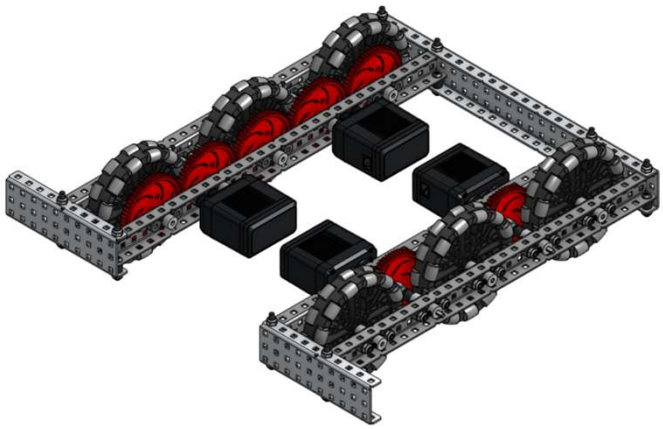
CAD Plan

SELECT AND PLAN

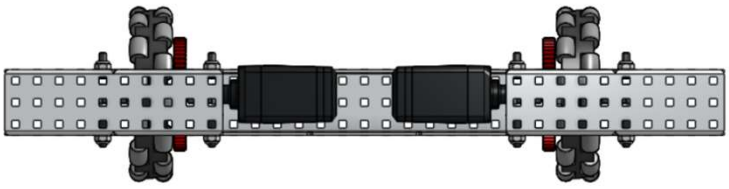
[TOP VIEW]



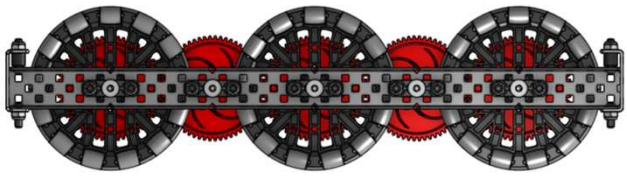
[ISOMETRIC VIEW]

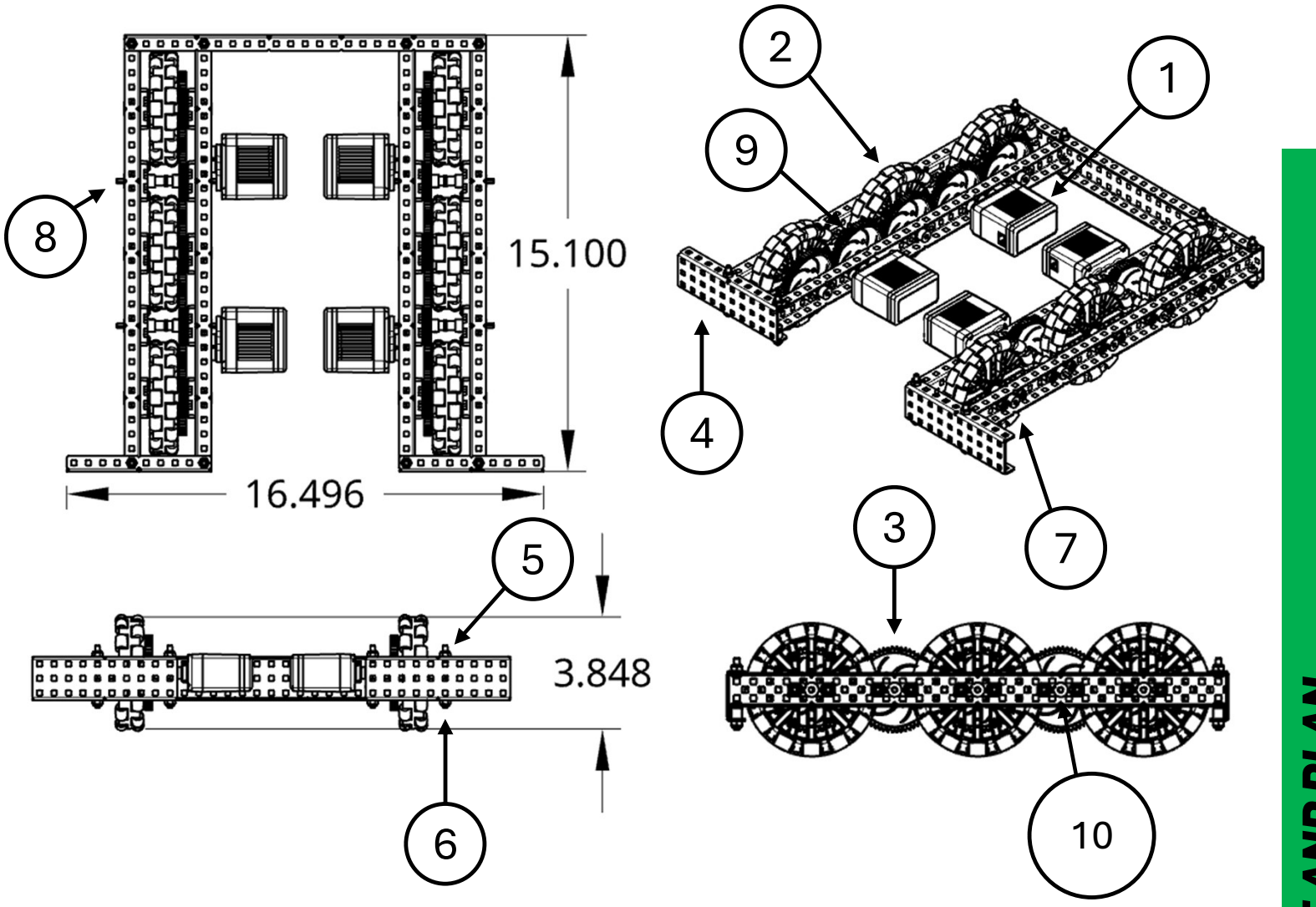


[FRONT VIEW]



[SIDE VIEW]





Drivetrain BOM

Item	Quantity	Part #
V5 Motor	4	1
4” Omni Wheel	6	2
60T Gear	10	3
Assorted Metal Structure	n/a	4
Assorted Screws	n/a	5
Assorted Nuts	n/a	6
Shaft Collars	n/a	7
Assorted Square Shafts	10	8
Assorted Spacers	n/a	9
Shaft Bearings	40	10

SELECT AND PLAN

BUILD SOLUTION

Drivetrain

BUILD SOLUTION

Goal

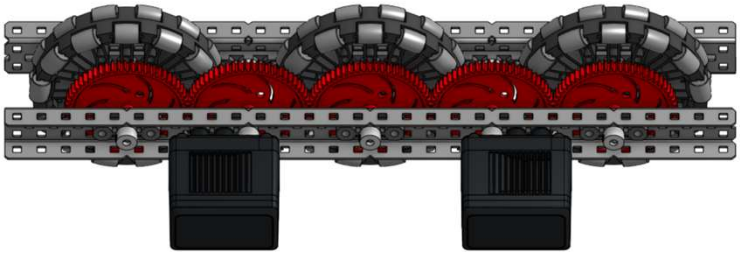
We will build our planned solution for the drivetrain so that we can test its performance.

Process of Assembly

Begin with (2) 15” long C-channels.

Attach (8) bearings to middle row of C-Channels

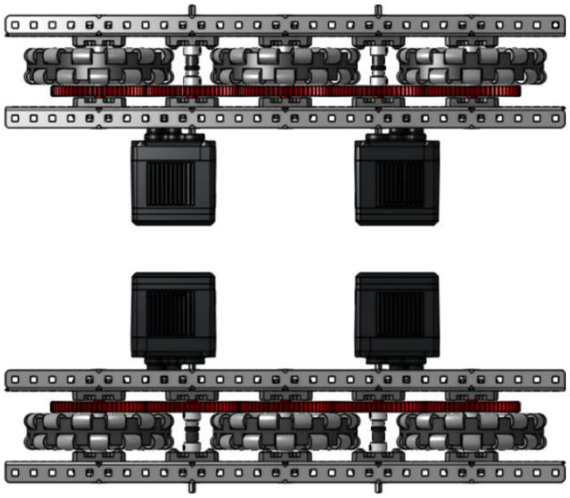
Attach (2) Motors to bearings



Attach additional bearings where needed to support gears and wheels

Attach (5) 60 T gears to so that the teeth are touching

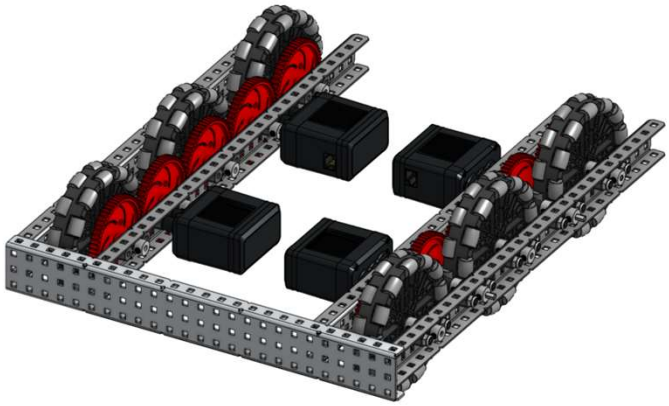
Connect 4” wheel and gear together and attach to C-Channels



Mirror assembly to create opposite side of drivetrain.

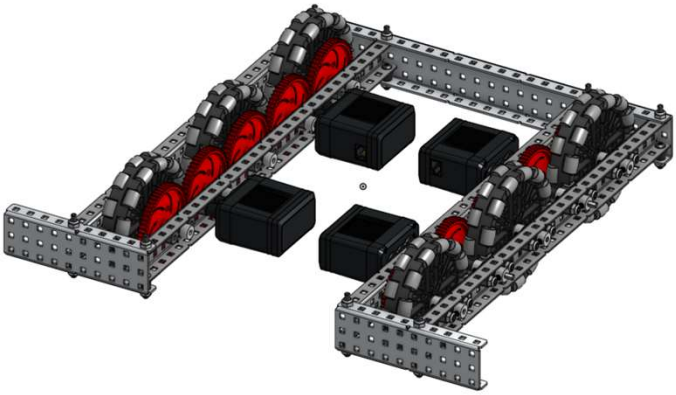
Note: Do not just duplicate and rotate!

Think of it as the mirrored assembly. Right side looks the same as the original’s left side!



Connect two sides of drivetrain together with a 12.5” 1x3 C-Channel along the back of robot.

Connect open ends of drivetrain sides with 5” 1x3 C-Channels to add supports to the front end of Robot



Assembled Build

Our new drivetrain addresses our problem of not being able to fully rotate under the elevation bar. It also has room to build off of if additional build improvements are needed.

This build is also very lightweight, and perfectly allows an opening for one Triball, allowing for possession just with the drivetrain!

We will now test this solution to assess which aspects work and which don’t.

TEST SOLUTION

Drivetrain

TEST SOLUTION

Goal

We test the performance and reliability of our newly updated drivetrain

Testing : Driver Match

Testing for the driving match was successful, showing that our edits to the drivetrain made a world of a difference for our driver

Making this change has also changed many other things:

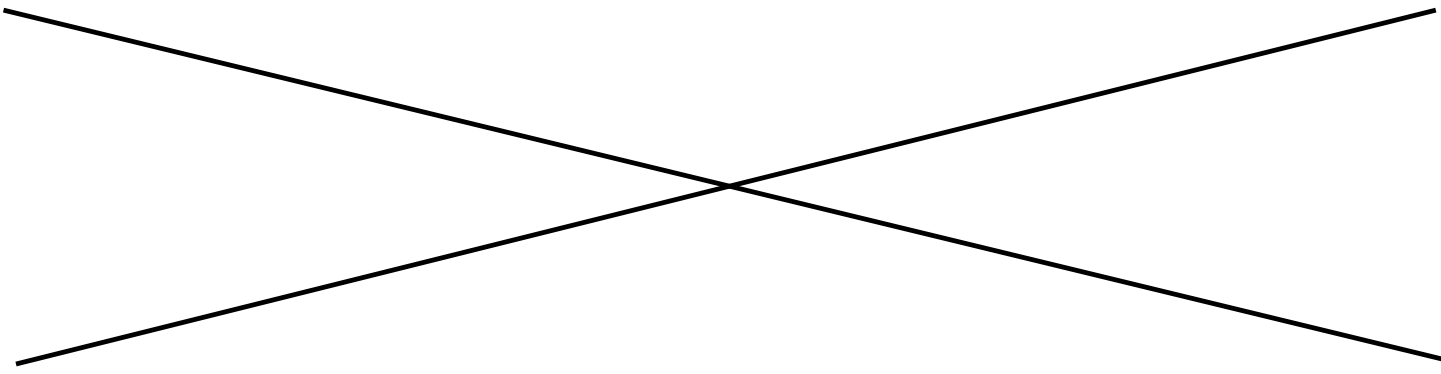
- Allowing us to have overhangs with the size constraints
- Opening the front of the robot which gives space for an intake
- Lighter frame
- Faster and more maneuverable base
- Less space wasted
- Easier to add cross beams for future expansion

Testing : Autonomous Match

Testing for an Autonomous match was not much different than a driver match

The drivetrain was easily able to prove its maneuverability and accuracy when given commands by the autonomous code.

This opened the path to now be able to code the robot both for autonomous but also for driver.



IDENTIFY PROBLEM

Shell of Robot

Goal

We will identify an objective for our robot so that we can address it and build an effective shell that can support and be the “bones” for our next additions

Problem statement

We need a way to build the next ideas for our Robot and keep everything in or close to itself to use space efficiently

Solution Requirements

- Must only use legal VEX Robotics Competition Parts
- Must fit within 18”x18”x18” cube

Solution Goals

- Keep Robot as light as possible
- Stay within a 11.63” height restriction to fit under the elevation bar
- Be open inside for motors and mechanisms to fit inside
- Be sturdy and reinforced while maintaining a light weight

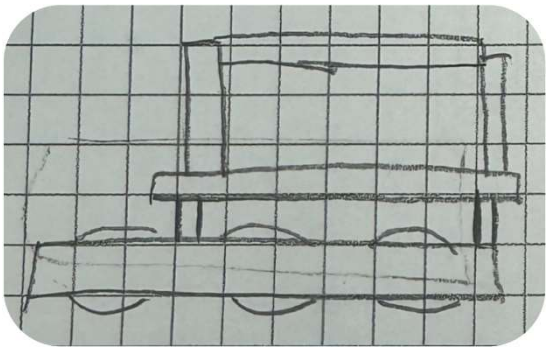
BRAINSTORM SOLUTIONS

Shell of Robot

BRAINSTORM SOLUTIONS

Goal

Brainstorm possible solutions to create an easily expandable shell for our robot



Possible Solutions

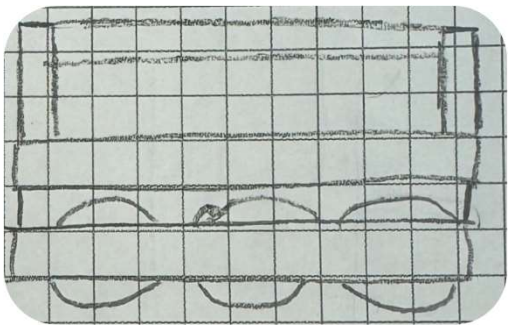
Square Upward Expansion

- Using standoffs to connect to robot
- Three cross bars across the whole frame
- Four U Channels from front to back

POSITIVES	***NEGATIVES***
• Easily expandable • Fits on the footprint of the robot • Open space for intake • Light	• Less sturdy

Rectangle Upward Expansion

- Copied structure of chassis
- Using U Channels To hold copy of chassis above the rest of the robot

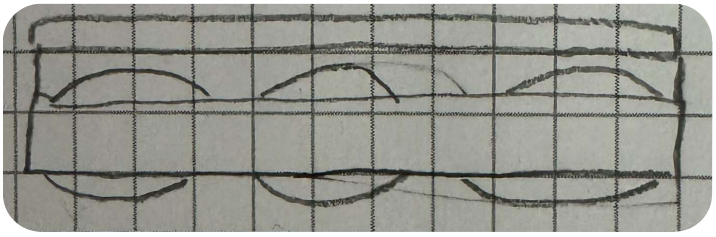


POSITIVES	***NEGATIVES***
• Lots of room to expand • Sturdy • Gives drivetrain lots of support	• Bulky • Tall • Barely fits under bar • Hangs over sides of robot • Heavy

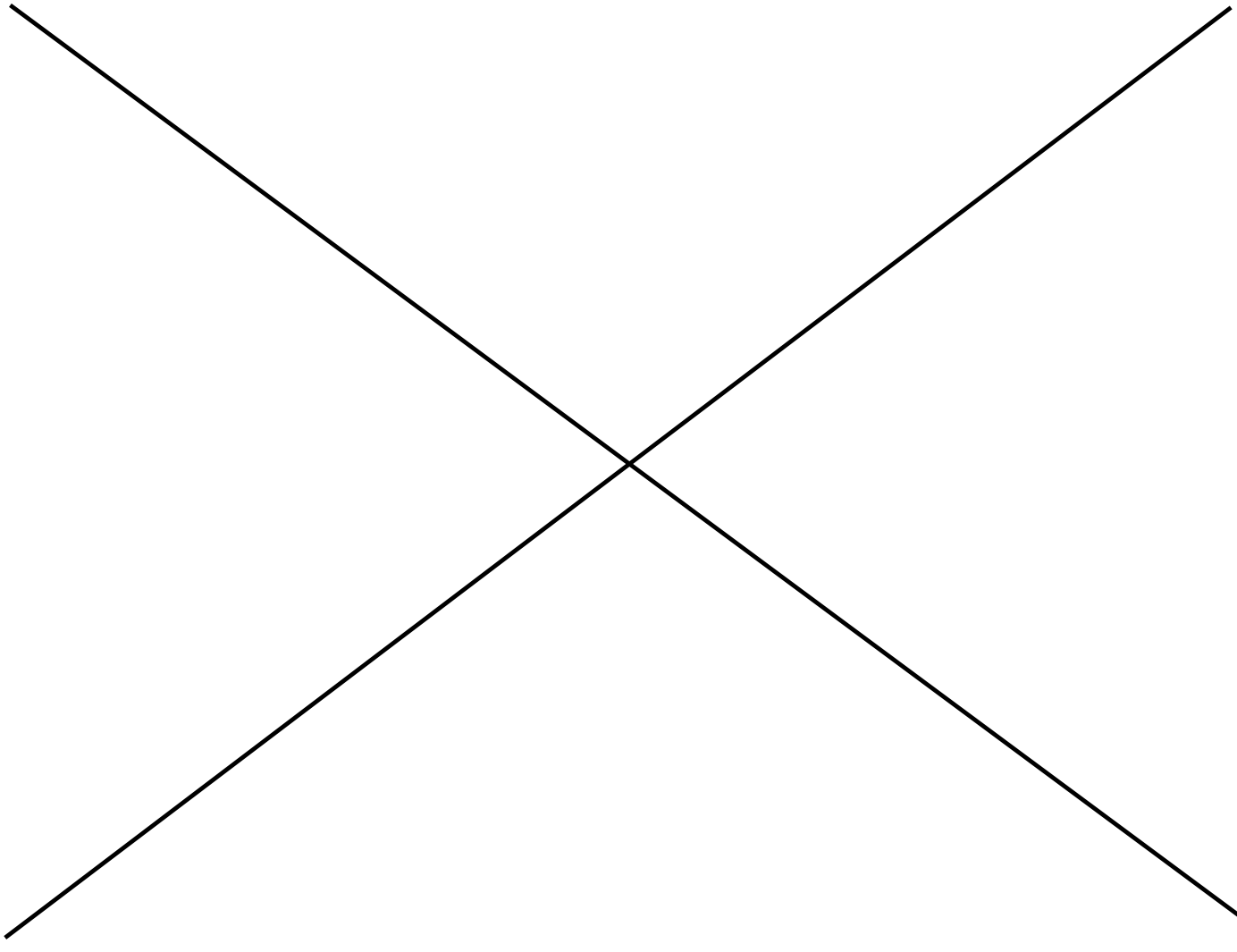
Possible Solutions

Short upward expansion

- Cut U Channels to make the robot short
- Connected with 90-degree angle pieces



POSITIVES	***NEGATIVES***
• Fits under bar • Fits under goal	• Not easily expandable • No room for anything • Being able to fit under goal allows for potential de-scoring



BRAINSTORM SOLUTIONS

SELECT AND PLAN

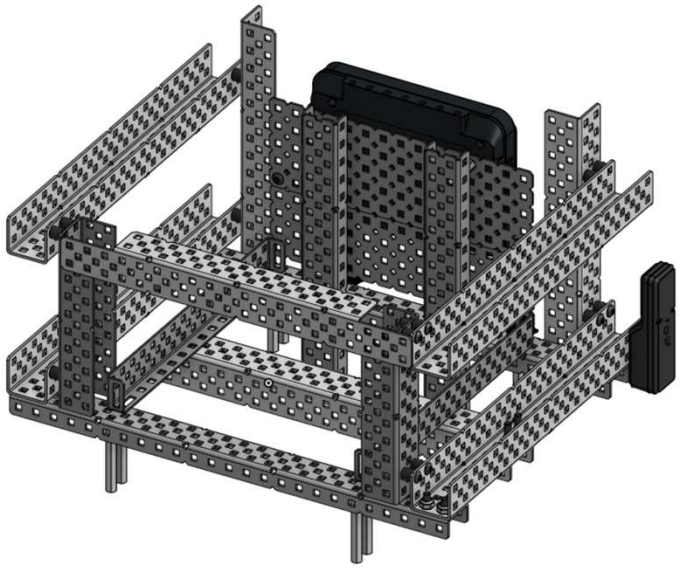
Shell of Robot

SELECT AND PLAN

Goal

We will select the solution that is best for our team so that we can plan how to build it

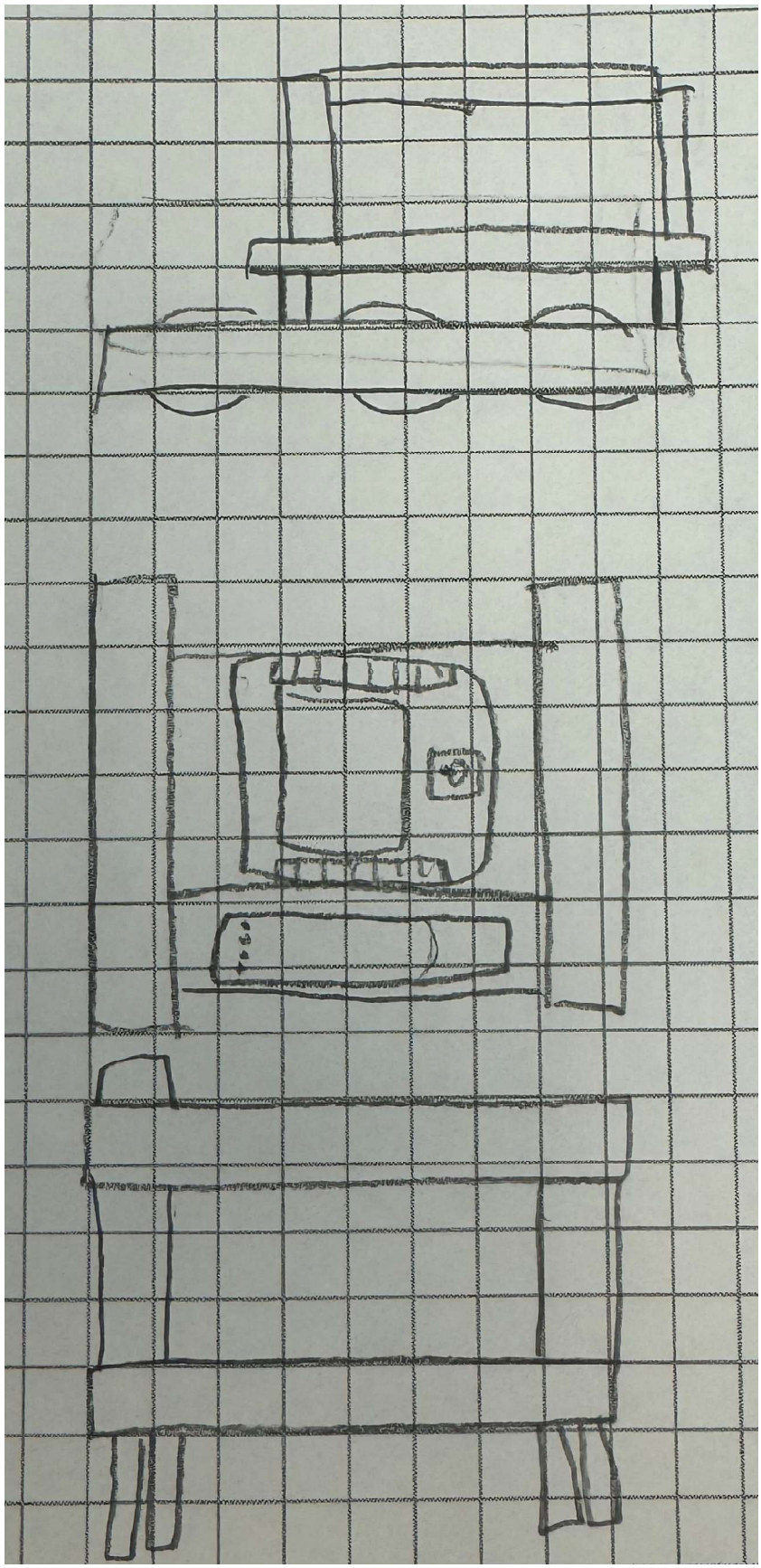
Initial Test



We took the first design, making sure that it is sturdy and able to be expanded upon

Adding this base gave us a good lifting point for the robot and added structural stability to the drivetrain; minimalized flex

Sketch Plan

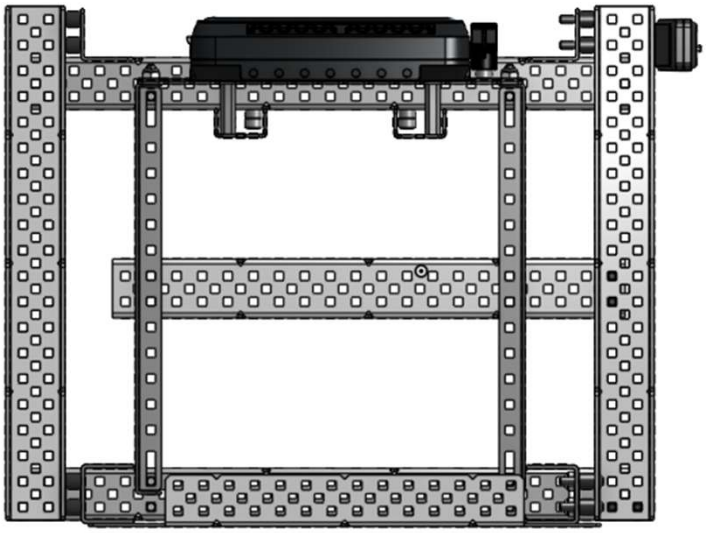


SELECT AND PLAN

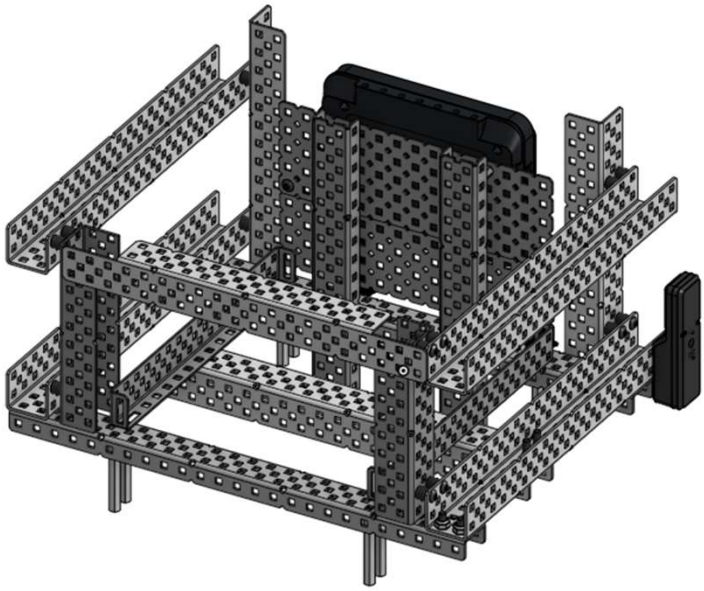
CAD Plan

SELECT AND PLAN

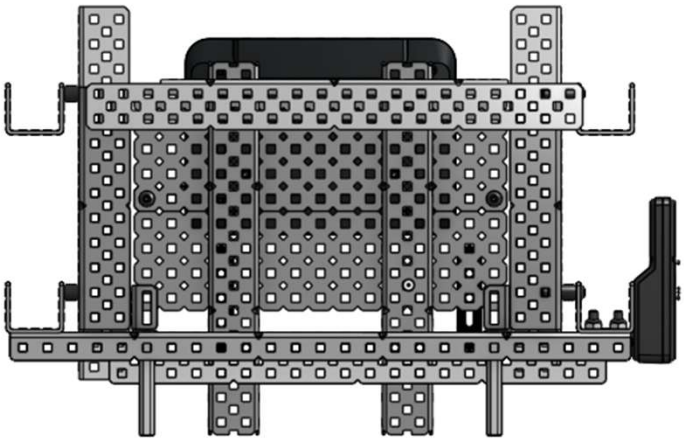
[TOP VIEW]



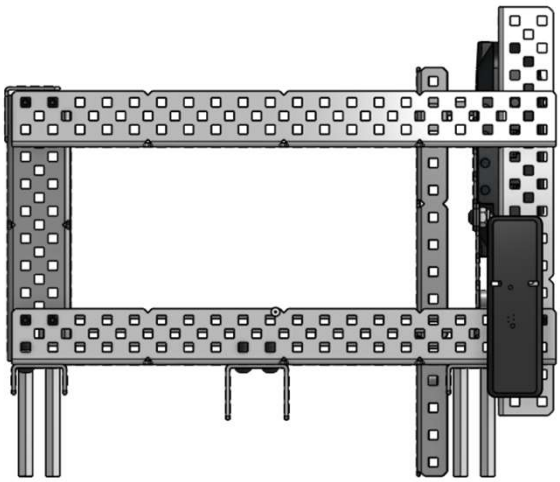
[ISOMETRIC VIEW]



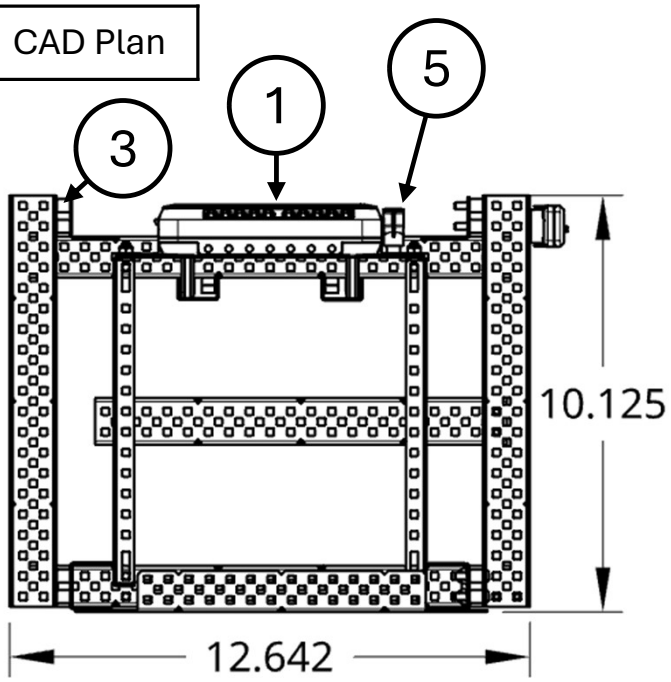
[FRONT VIEW]

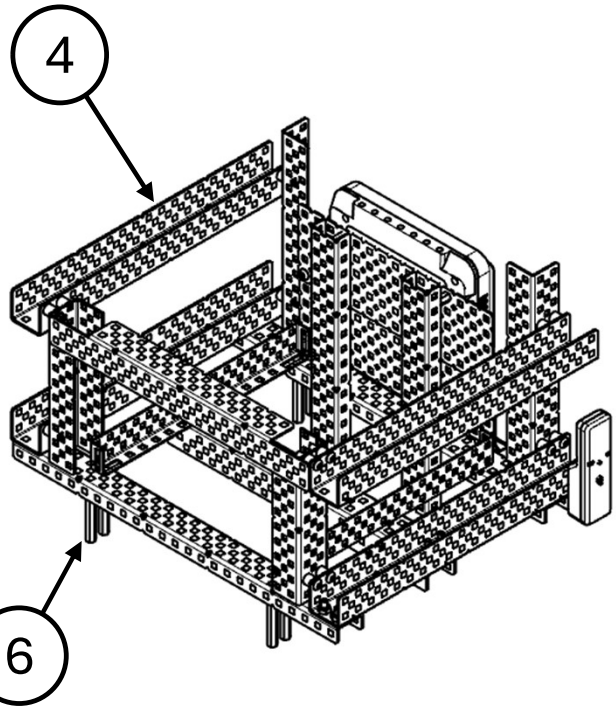


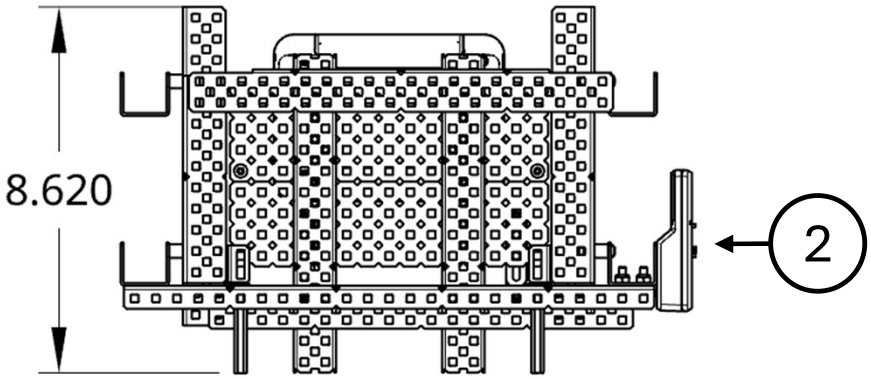
[SIDE VIEW]

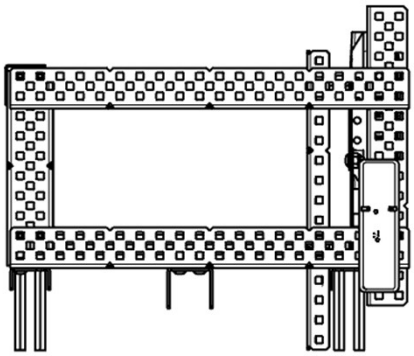


CAD Plan









SELECT AND PLAN

SHELL BOM

Item	Quantity	Part #
V5 Robot Brain	1	1
V5 Robot Radio	1	2
Assorted Spacers	26	3
Assorted Metal Structure	n/a	4
V5 Battery Clip	2	5
2” Standoff	8	6

BUILD SOLUTION

Shell of Robot

BUILD SOLUTION

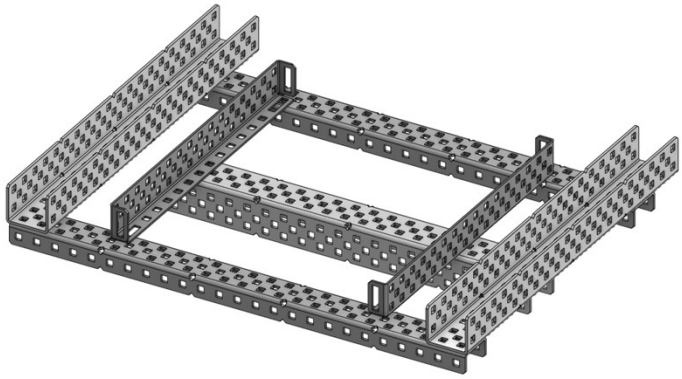
Goal

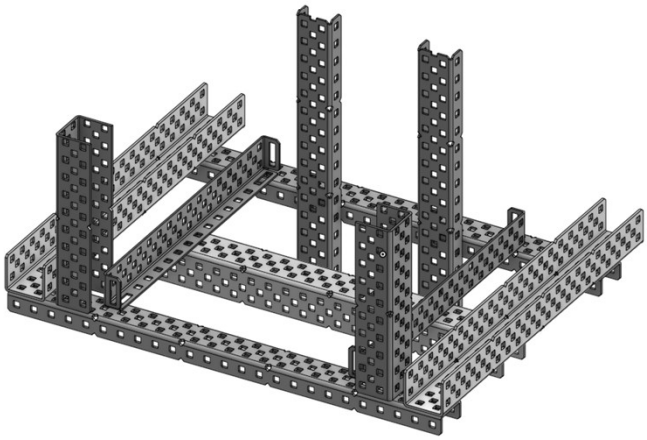
We will build our planned solution for the Shell of our robot so that we can test its performance.

Process of Assembly

Begin with (2) 12.5” C-Channels and one (1) 10” U-Channel

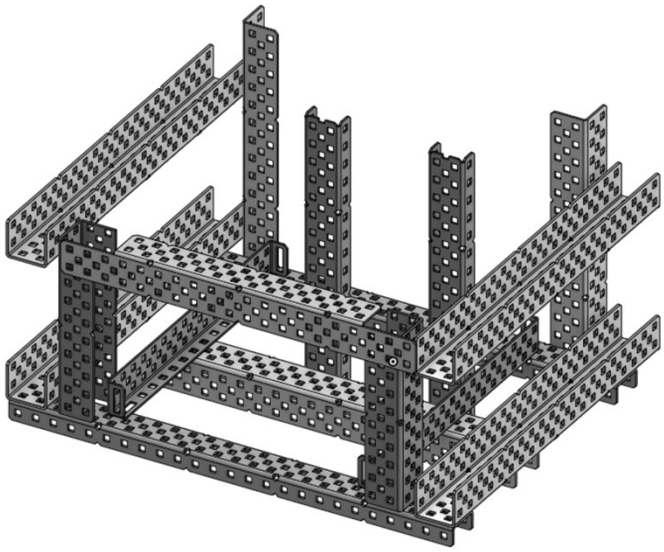
Connect C-Channels and U-Channel with (2) 8” Rails and (2) 10” U-Channels as shown





Attach (2) 7.5” C-Channels to the backside C-Channel

Attach (2) 5” U-Channels to the topside of the C-Channel in the front

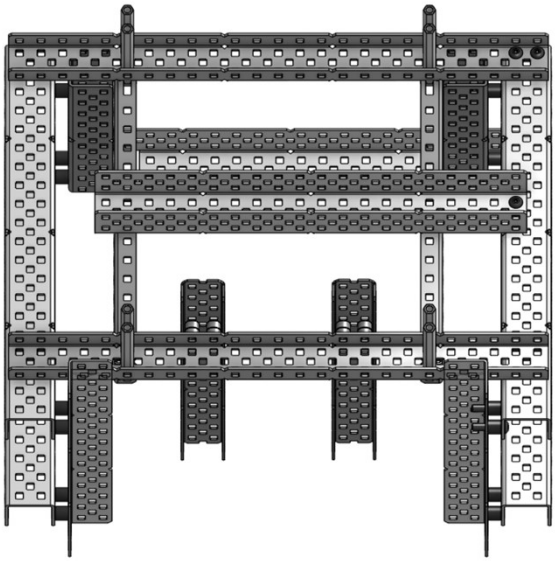


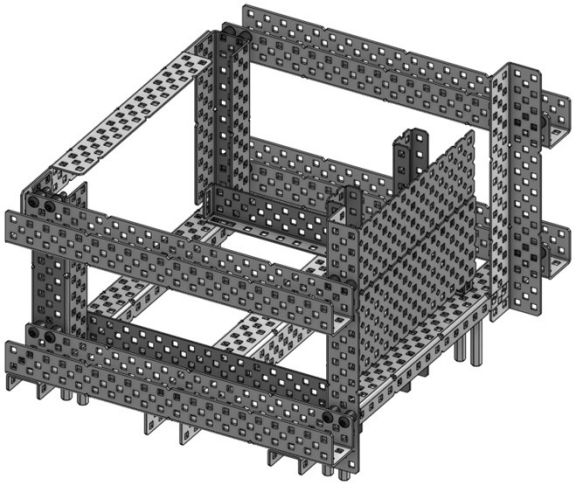
Attach (2) 7.5” Angles to U-Channels

Attach (2) 10” U-Channels to Angles and U-Channels

Attach (1) 2x2x14x20 Angle to the 5” U-Channels along the front as shown

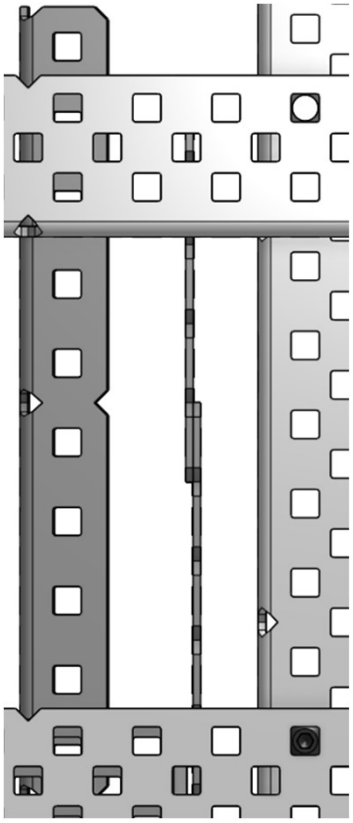
Flip Robot over and attach (8) 2” Standoffs within the C-Channels as shown.





Flip Robot back over and attach (2) 5x15 Plates to the Upright C-Channels along the backside of the Robot. See Next page for a more detailed look

BUILD SOLUTION

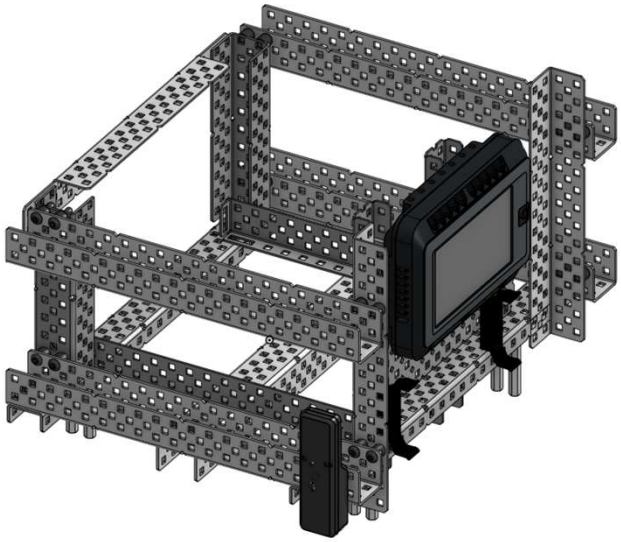


The plates should overlap and connect as shown here.

Connect V5 Robot Radio to U-Channel

Connect V5 Robot Brain to the Plates as shown

Also place (2) V5 Battery Clips onto Plates to for proper battery support as shown



TEST SOLUTION

Shell of Robot

Goal

We test the stability and pros of our new shell

Testing

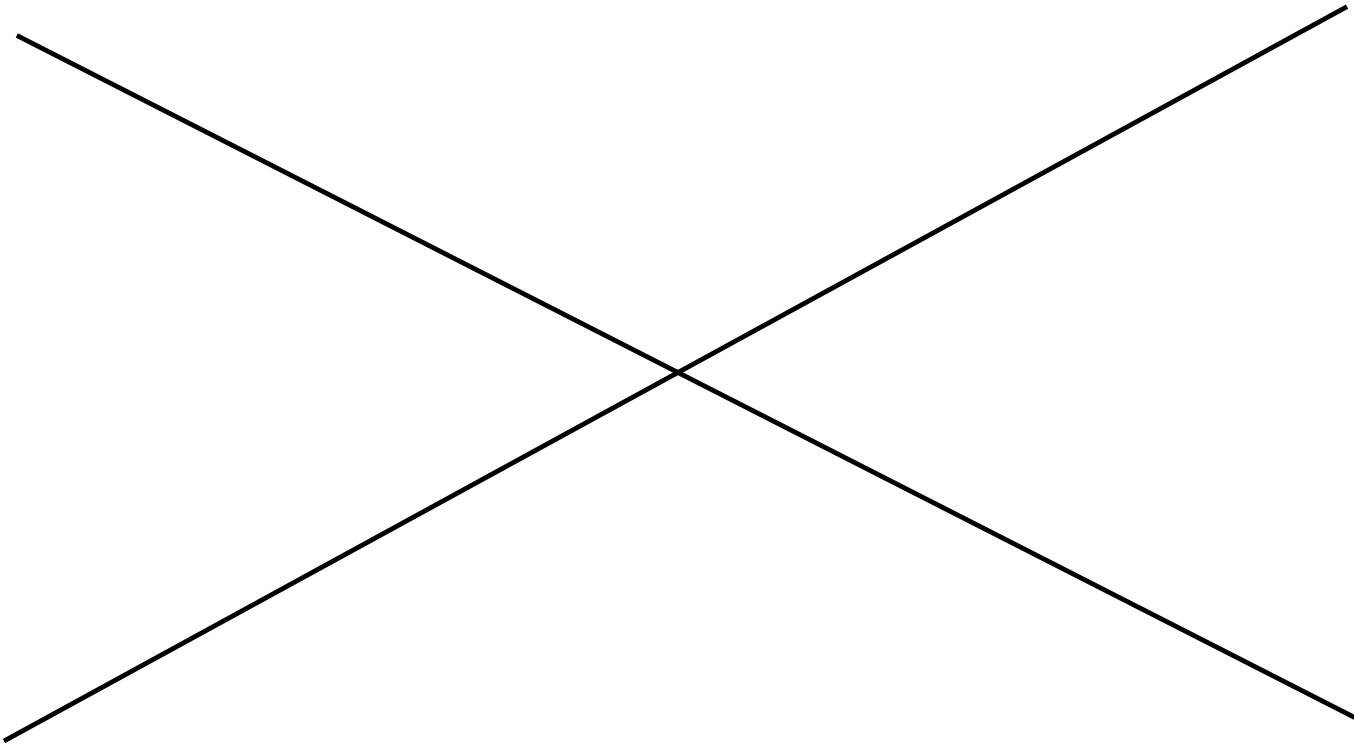
The first test of this design was extremely successful.

We decided to do no further testing after our initial test based off the success and proven performance in the first test

The chosen design greatly increased handling of the robot and stability of driving

Adding more weight, the chance of the wheels slipping after an emergency stop was near to zero

Even though weight was increased, the robot was still extremely light compared to last year



TEST SOLUTION

IDENTIFY PROBLEM

Intake

IDENTIFY PROBLEM

Goal

We will identify an objective for our robot so that we can address it and build an effective Intake system.

Problem statement

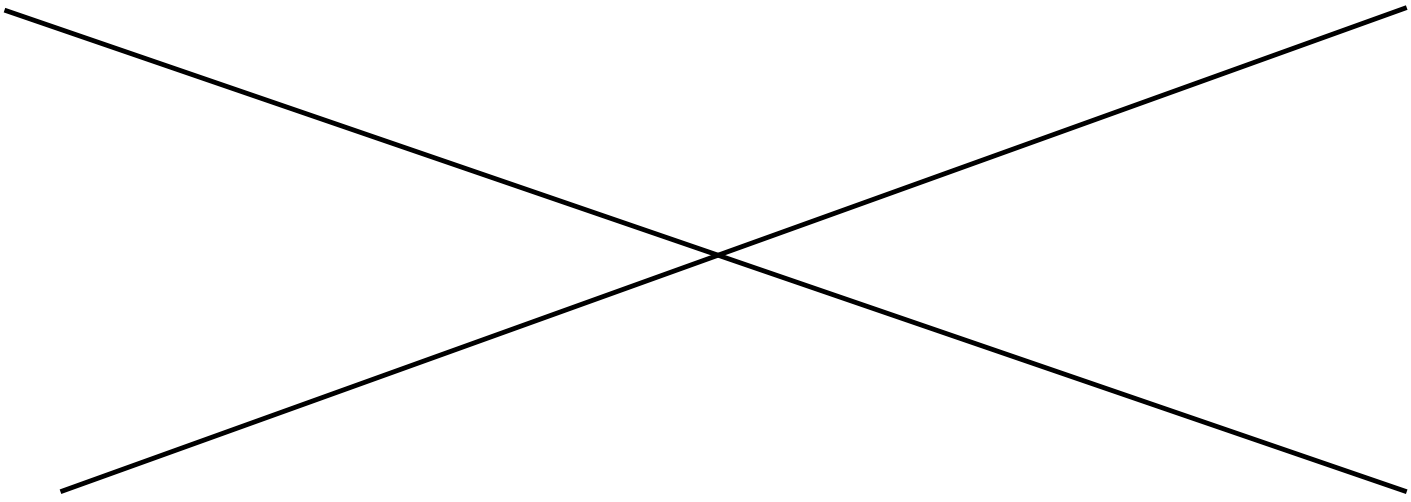
We need a mechanism to pick up Triballs from the field and be able to move them into the Goals and Red Offensive Zone.

Solution Requirements

- Must only use legal VEX Robotics Competition Parts
- Must fit within 18”x18”x18” cube
- Must only be able to hold and possess ONE (1) Triball at a time
- Must not interfere with nets on Goal

Solution Goals

- Have a reliable intake that works without robot being in motion
- Be able to hold onto Triball without being active
- Does not accidentally possess more than one Triball
- Lift Triball up from ground to prevent friction problems



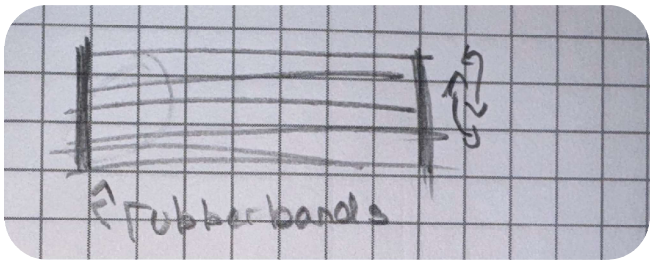
BRAINSTORM SOLUTIONS

Intake

Goal

Brainstorm possible solutions to create a consistent and fast intake system

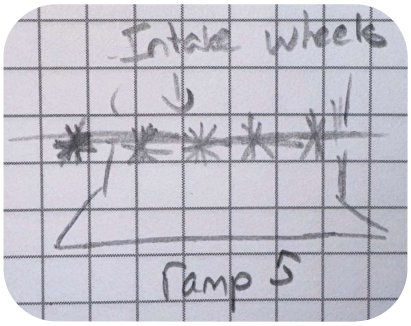
Possible Solutions



Intake with rubber bands

- Using a U-shaped structure with an axle across the end of the structure
- Rubber bands wrapped around two gears at opposite ends of the axles

POSITIVES	NEGATIVES
• Lots of grip • Consistent • Fast • Light	• Rubber bands have the chance to break



Intake with VEX Intake Wheels

- Same U-shaped structure but with intake wheels spanned across the axle
- Using the vex intake wheels

POSITIVES	NEGATIVES
• Fast • Expandable	• Heavy • Low traction • Inconsistent • Small

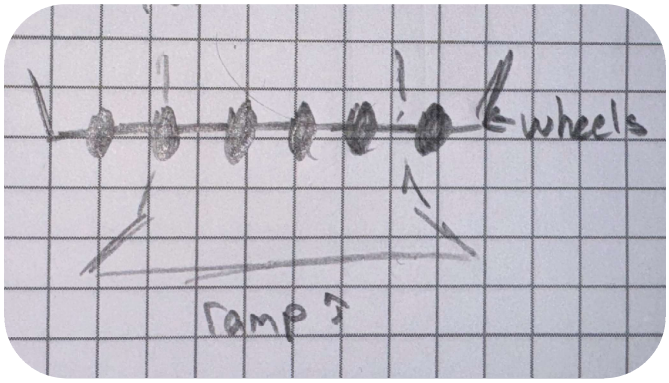
BRAINSTORM SOLUTIONS

BRAINSTORM SOLUTIONS

Possible Solutions

Intake with VEX Traction wheels

- Same U-shaped structure but with wheels spanned across the axle
- Using wheels we had laying around



POSITIVES	***NEGATIVES***
• Fast when it works • Already built from last year	• Heavy • Low traction • Inconsistent

SELECT AND PLAN

Intake

Goal

We will select the solution that is best for our team so that we can plan how to build it

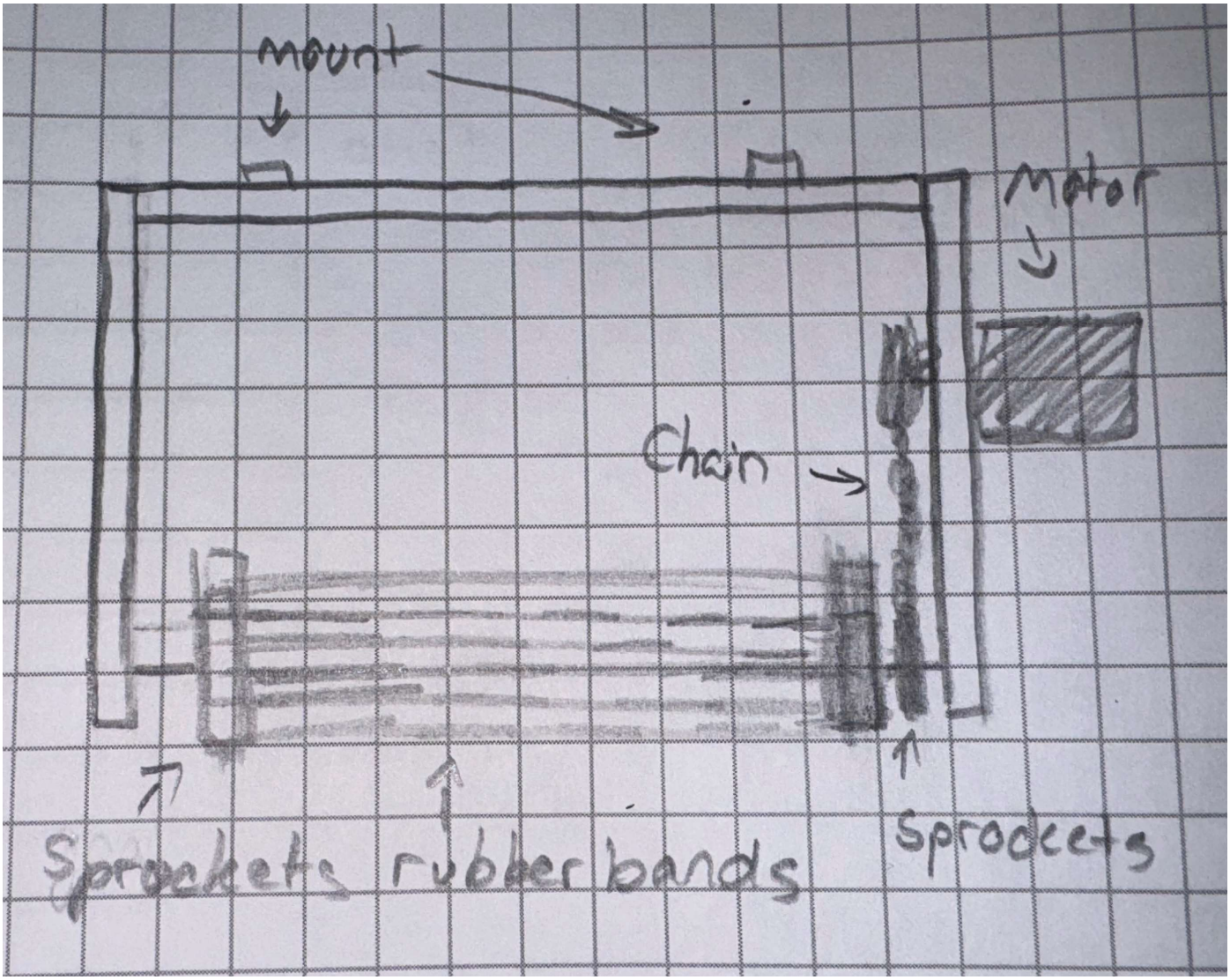
Initial Test

We took the new design, scrapping last years

This design was far superior in consistency and just easily adaptable for this year's game

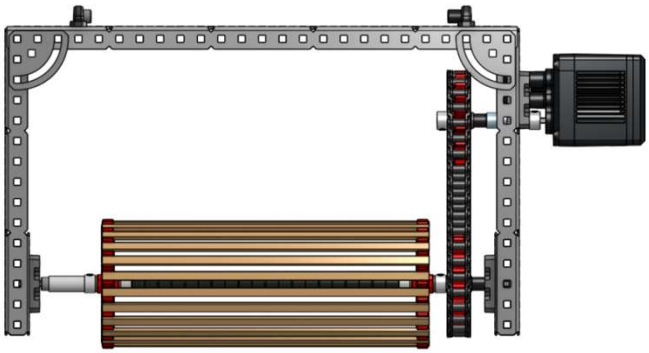
Sketch Plan

SELECT AND PLAN

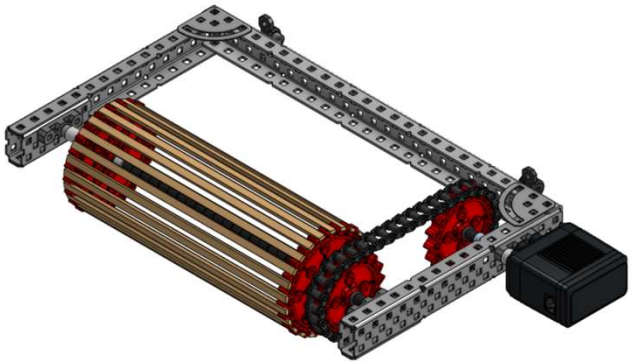


CAD Plan

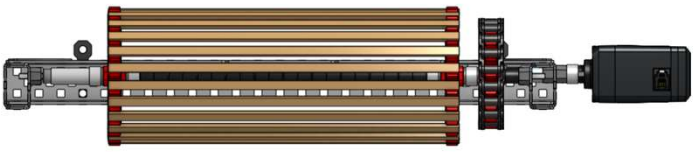
[TOP VIEW]



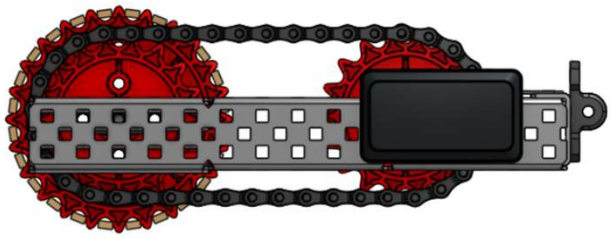
[ISOMETRIC VIEW]



[FRONT VIEW]

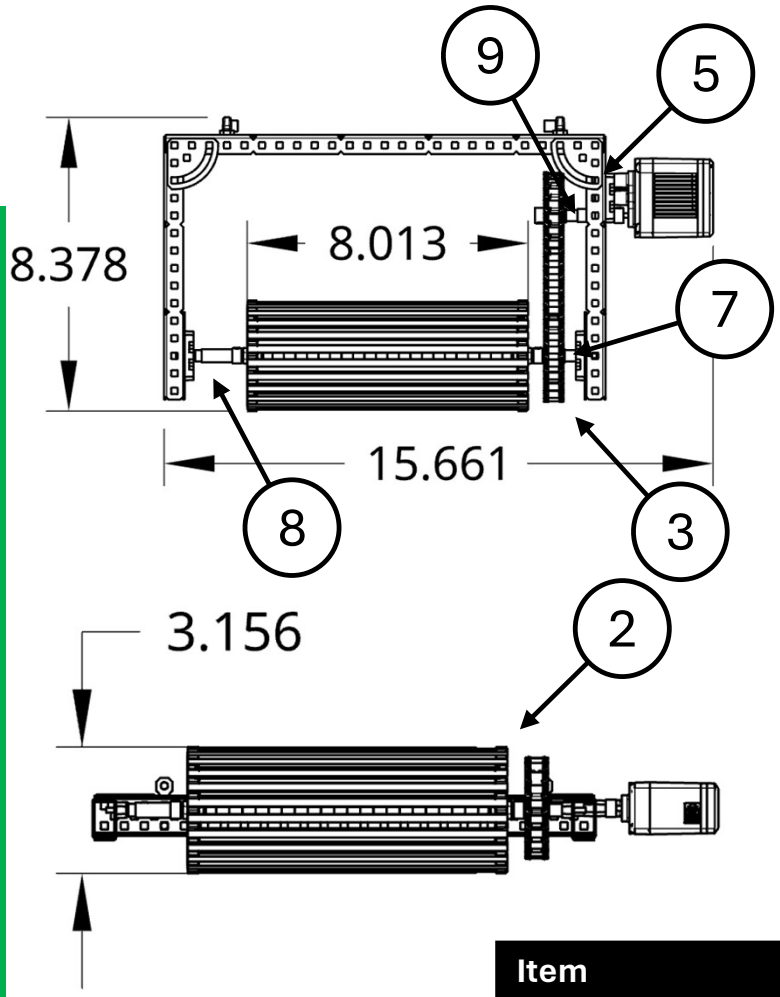


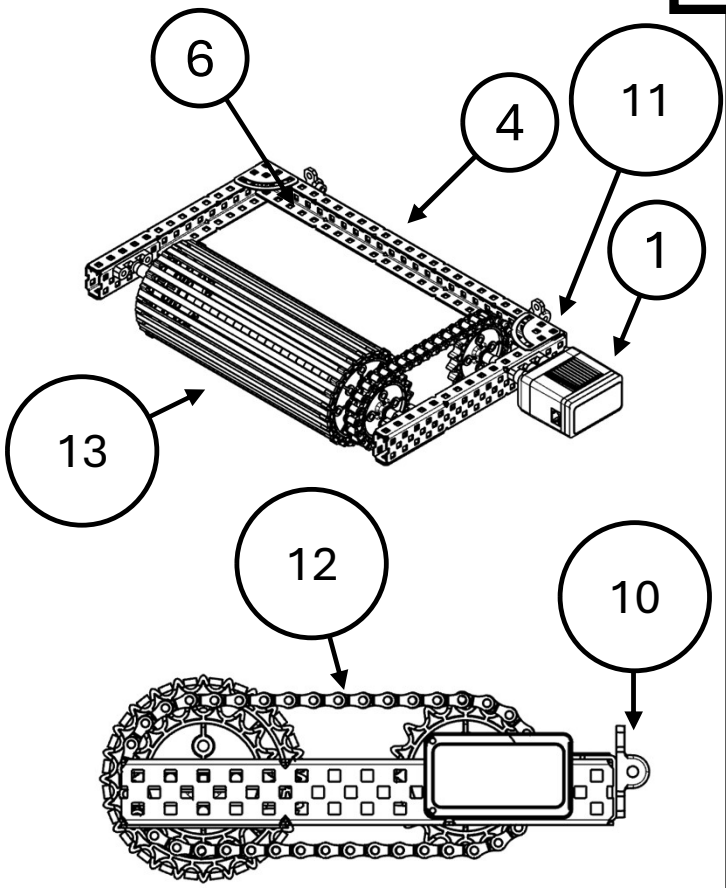
[SIDE VIEW]



SELECT AND PLAN

SELECT AND PLAN





Intake BOM

Item	Quantity	Part #
V5 Motor	1	1
24T High Strength Sprocket	2	2
18T High Strength Sprocket	2	3
Assorted Metal Structure	n/a	4
Assorted Screws	n/a	5
Assorted Nuts	n/a	6
Shaft Collars	n/a	7
Assorted Square Shafts	2	8
Assorted Spacers	n/a	9
Shaft Pillow Bearings	2	10
Bearing Flats	4	11
Pivot Gussets	2	12
High Strength Chain	n/a	13
Rubber Bands	n/a	14

BUILD SOLUTION

Intake

Goal

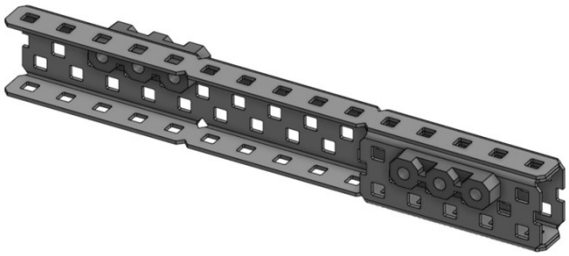
We will build our planned solution for the Intake so that we can test its performance.

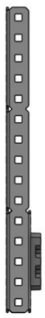
Process of Assembly

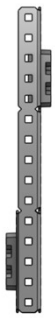
Begin with a 7.5” C-Channel

Attach a bearing flat on both the inside and outside of the C-Channel as shown

Insert and attach a 2.5” C-Channel as shown with a bearing flat on the outside

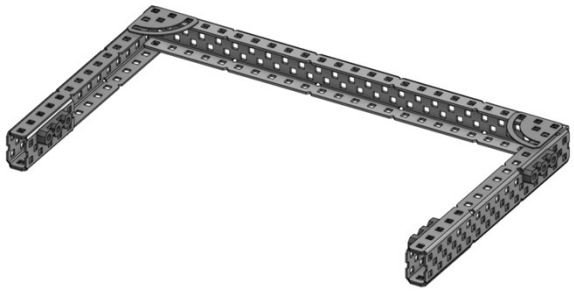






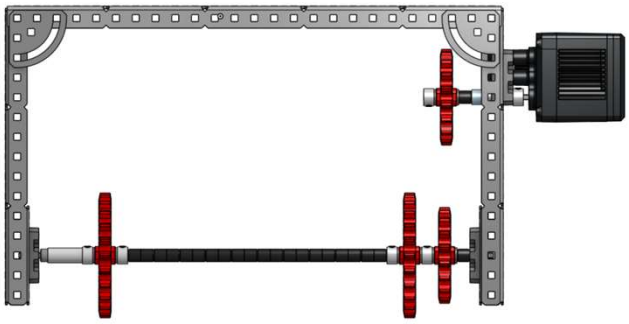
Repeat these steps, but do not place bearings shown in step one.

Attach the two C-Channels together with (2) Pivot Gussets and a 12.5” C-Channel

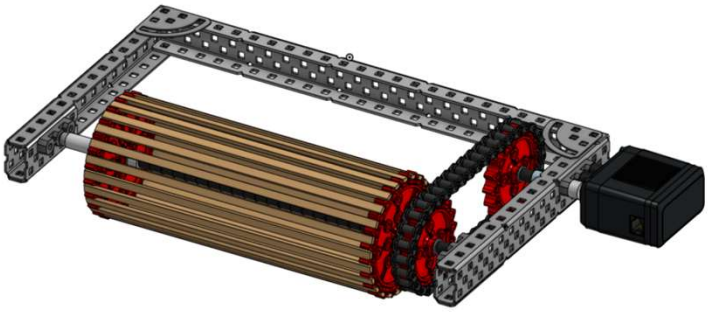


BUILD SOLUTION

Then attach a V5 Motor to the bearing flat that was placed in step one

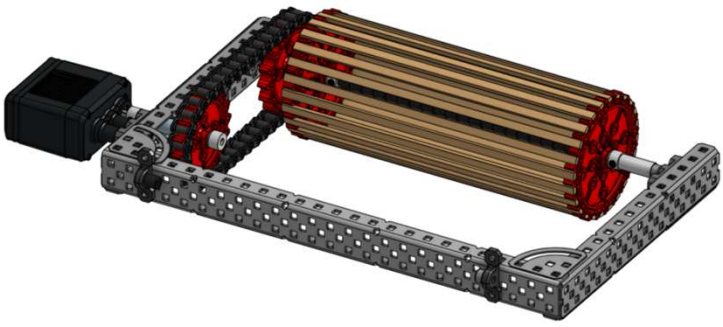


Attach Shafts, spacers, (2) 24T High Strength Sprockets, and (2) 18T High Strength Sprockets as shown



Attach Rubber Bands across the 24T High Strength Sprockets and connect the 18T High Strength Sprockets with High Strength Chain

Attach (2) Pillow Block Bearings and spacers to Back of Intake. This will be used to mount intake to the Shell of the Robot.



TEST SOLUTION

Intake

Goal

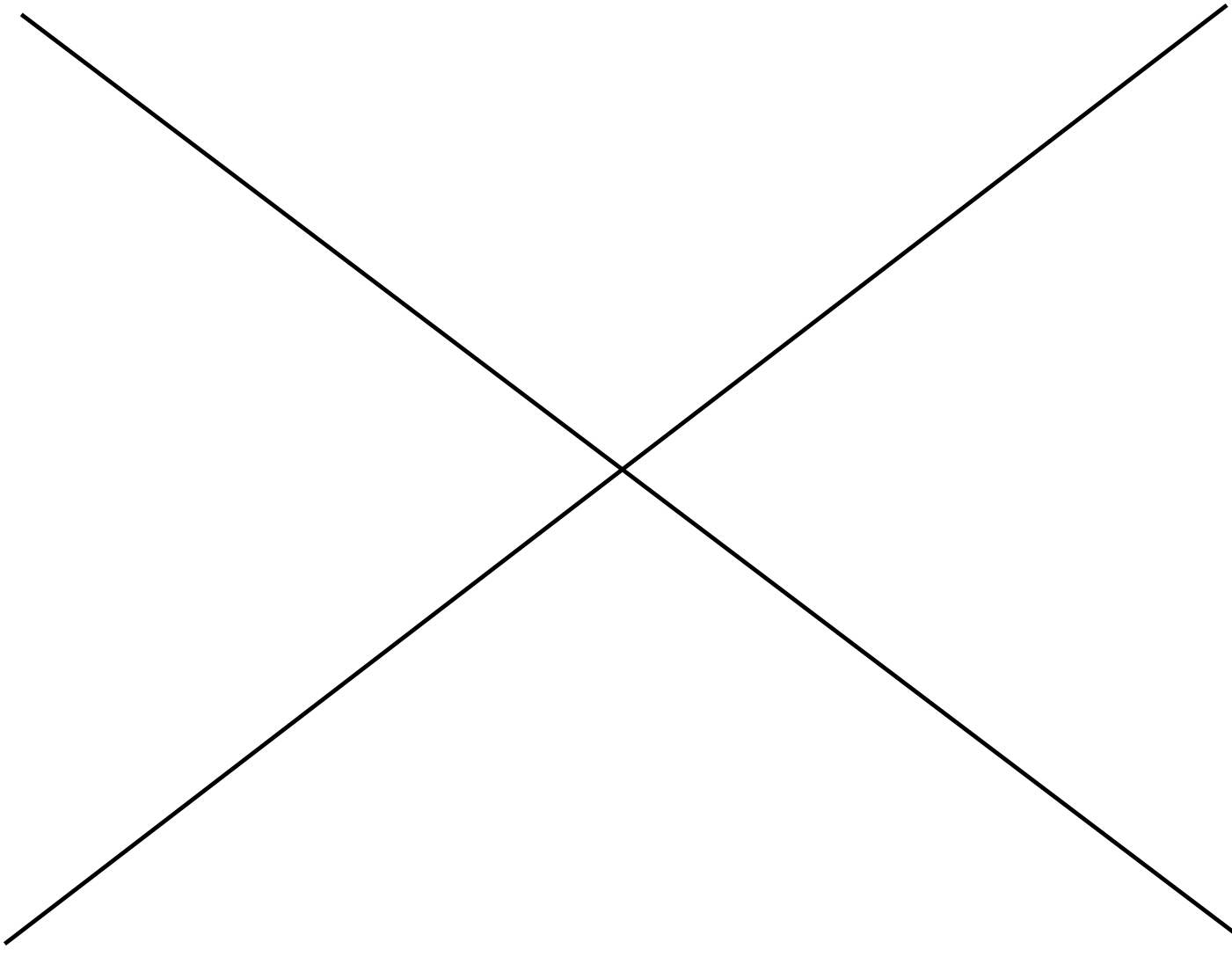
We test the performance and reliability of our intake

Testing

The initial test of this was very successful and required no modifications

The intake was able to properly intake and hold tribals to our liking

We intend to keep this design with no modifications from its prototyped version



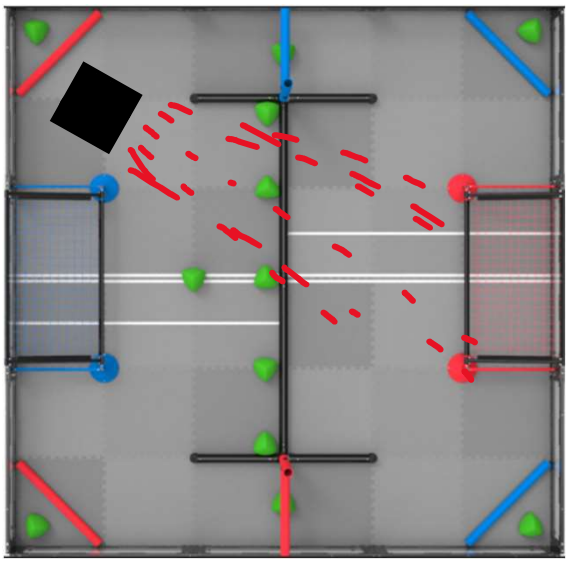
IDENTIFY PROBLEM

Launching System

IDENTIFY PROBLEM

Goal

We will identify an objective for our robot so that we can address it and build an effective Launching System



Problem statement

We need a mechanism to launch Triballs from the Match Load Zones and have it reach the Red Offensive Zone

Solution Requirements

- Must only use legal VEX Robotics Competition Parts
- Must fit within 18”x18”x18” cube
- Must only be able to hold and possess ONE (1) Triball at a time

Solution Goals

- Does not have a long pause between each Triball shot
- Can be used more than once
- Durable
- Precise and Accurate

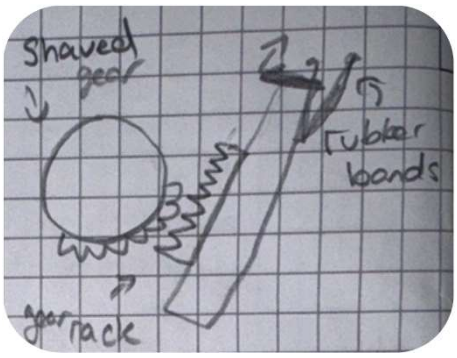
BRAINSTORM SOLUTIONS

Launching System

Goal

Brainstorm possible solutions to create an efficient launching system

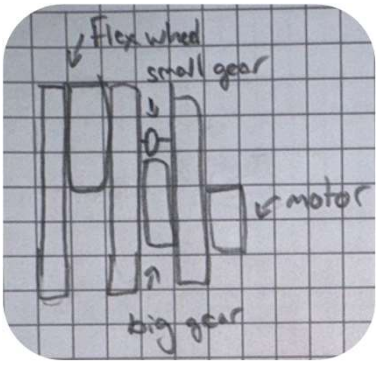
Possible Solutions



Rack and pinion

- Uses a rack and pinion assembly
- Shaved gear to keep the gear spinning
- 6 rubber bands to pull the rack gear up

POSITIVES	NEGATIVES
• Easy to build • Easy to implement in current robot	• Extreme wear • Slow • Does not shoot far



Flywheel

- Geared up blue motor to reach fast speeds
- Using a Flex Wheel to launch triballs across the middle bar
- Flywheel weights added to each side for extra inertia

POSITIVES	NEGATIVES
• Extremely fast • Shoots tri balls far • Compact • Efficient	• Overheats • Can slow down if used too much

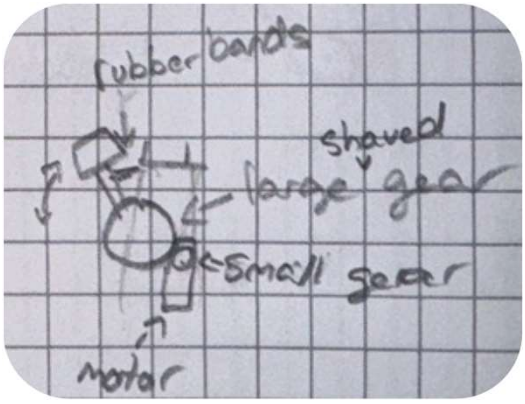
BRAINSTORM SOLUTIONS

BRAINSTORM SOLUTIONS

Possible Solutions

Puncher

- Two gears, one shaved
- Small impact area
- Rubber bands holding back the head of the puncher



POSITIVES	***NEGATIVES***
• Fast • Shoots tri balls far	• Hard to implement • Uses ratchets (something we don't know how to make)

SELECT AND PLAN

Launching System

Goal

We will select the solution that is best for our team so that we can plan how to build it

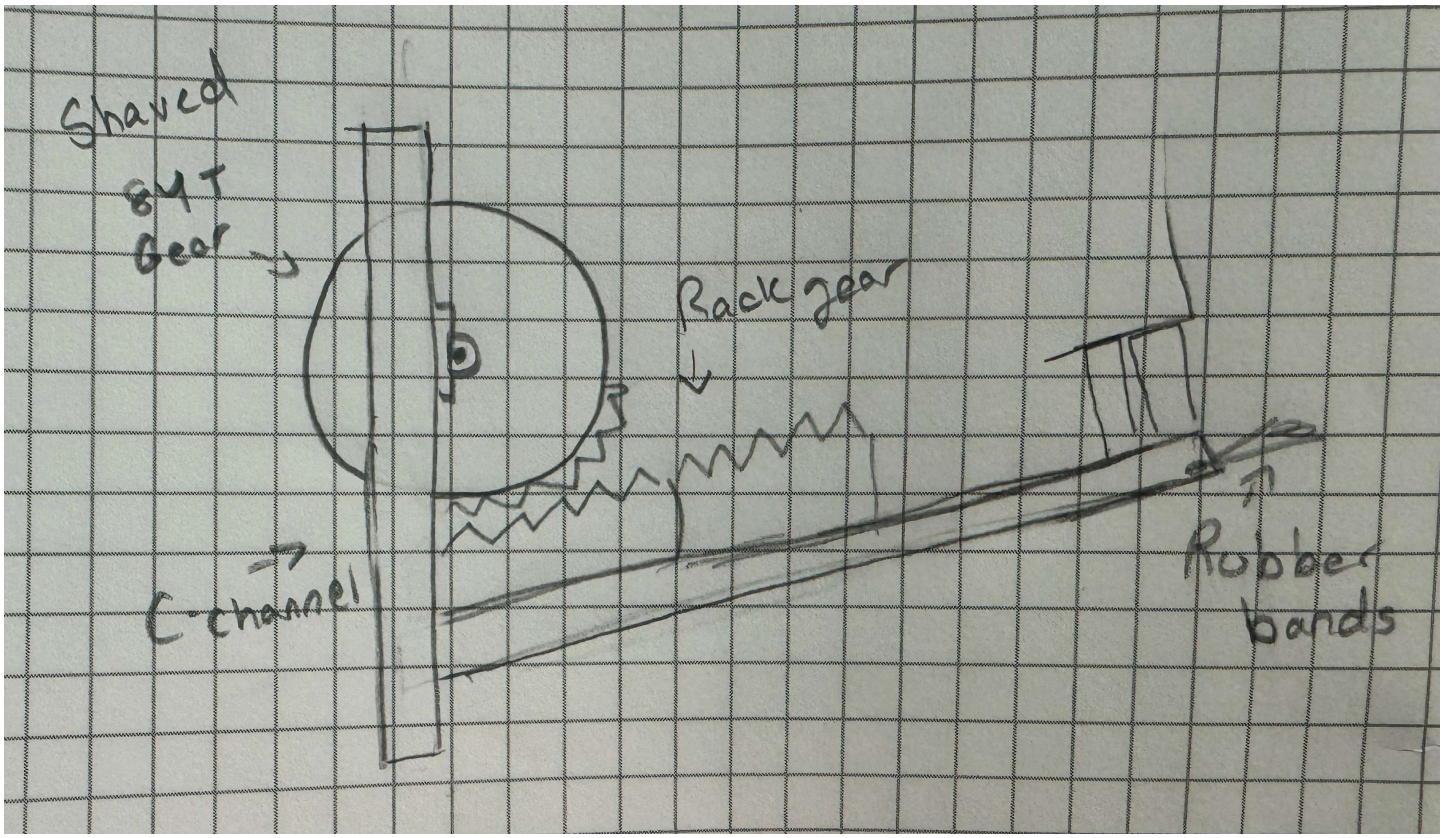
Initial Test

We chose to pick the rack and pinion shooting system, due to its simplicity and how easy it was to implement

This worked relatively well, and we decided to stick with it and moved on to our next order of business

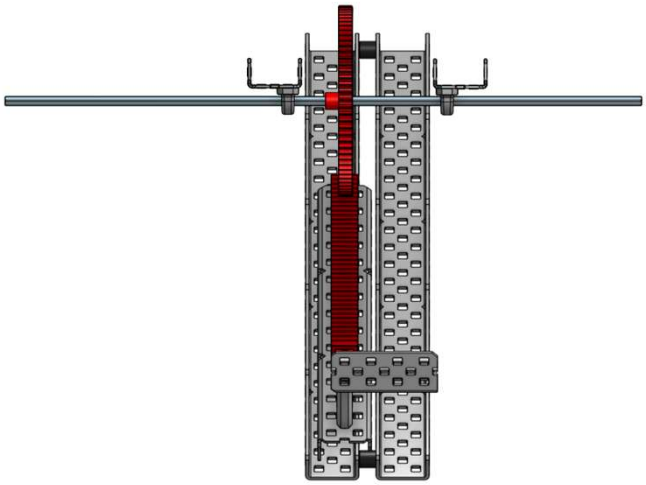
Sketch Plan

SELECT AND PLAN

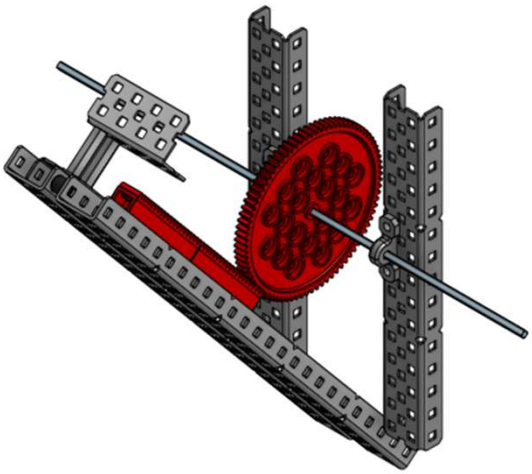


CAD Plan

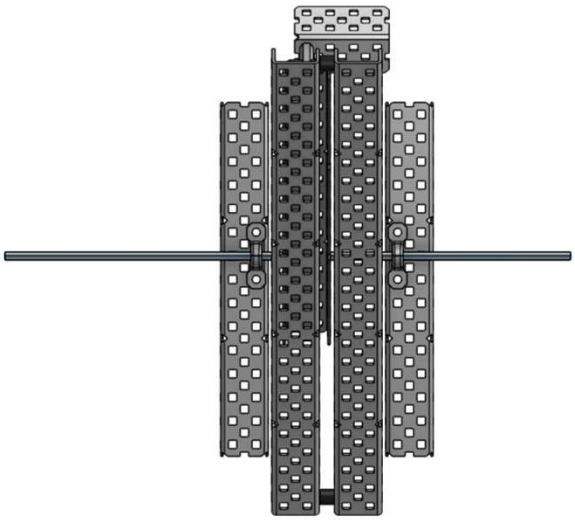
[TOP VIEW]



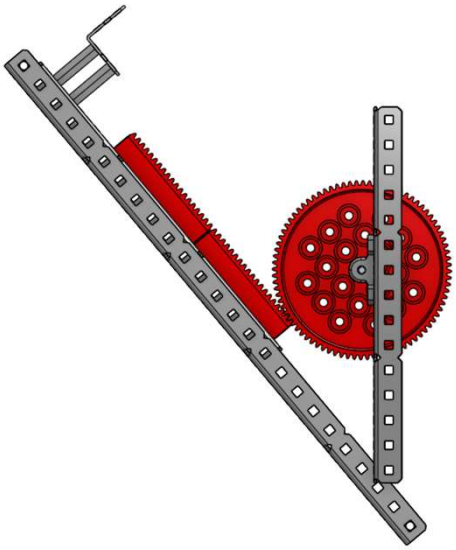
[ISOMETRIC VIEW]



[FRONT VIEW]

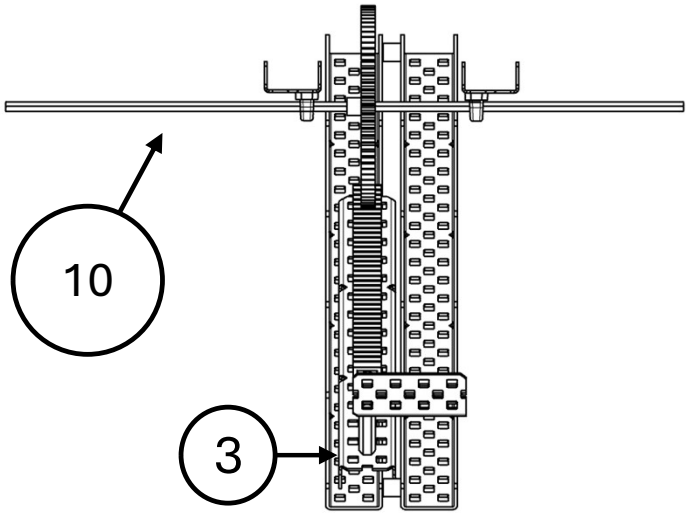


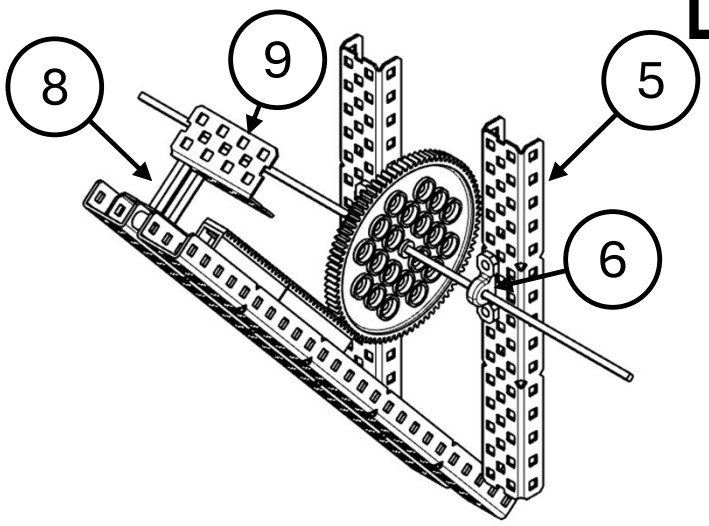
[SIDE VIEW]

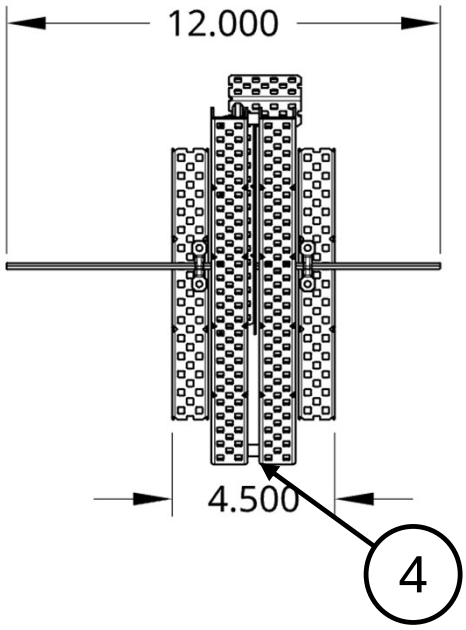


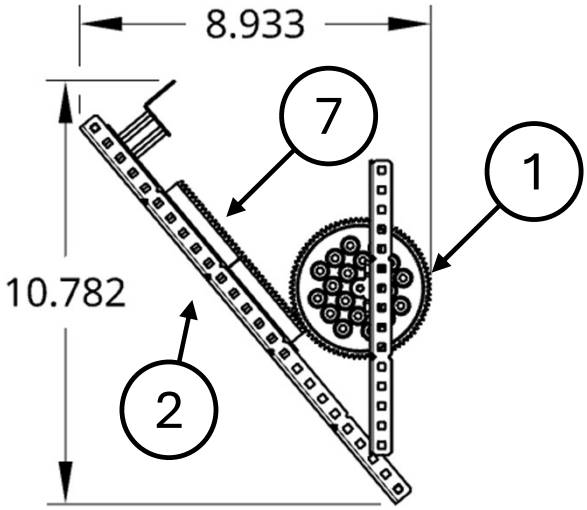
SELECT AND PLAN

SELECT AND PLAN









Launching Mechanism BOM

Item	Quantity	Part #
84T Gear	1	1
10” C-Channel	2	2
7.5” C-Channel	1	3
8mm Spacers	2	4
Mounted 7.5” C-Channels	2	5
Pillow Bearing	2	6
Rack Gear	2	7
1” Standoffs	2	8
2” Angle	1	9
12” Drive Shaft	1	10

IDENTIFY PROBLEM

Launching System Improvement

IDENTIFY PROBLEM

Goal

We will identify an objective for our robot so that we can address it and build a more effective Launching System

Problem statement

After Repeated use, current launching mechanism seems to be breaking. As the 7.5” C-Channel continues to bend and have lots of friction problems.

Solution Requirements

- Must only use legal VEX Robotics Competition Parts
- Must fit within 18”x18”x18” cube
- Must only be able to hold and possess ONE (1) Triball at a time

Solution Goals

- Does not have a long pause between each Triball shot
- Can be used more than once
- More Durable
- Precise and Accurate

BRAINSTORM SOLUTIONS

Launching System Improvement

BRAINSTORM SOLUTIONS

Goal

Brainstorm possible solutions to create a more efficient launching system

Possible Solutions

Fix the Rack and pinion

- Uses a rack and pinion assembly
- Shaved gear to keep the gear spinning
- 6 rubber bands to pull the rack gear up

POSITIVES	***NEGATIVES***
• Easy to build • Easy to implement in current robot	• Extreme wear • Slow • Does not shoot far

Implement Different Idea - Flywheel

- Geared up blue motor to reach fast speeds
- Using a Flex Wheel to launch Triballs across the middle bar
- Flywheel weights added to each side for extra inertia

POSITIVES	***NEGATIVES***
• Extremely fast • Shoots tri balls far • Compact • Efficient	• Overheats • Can slow down if used too much

SELECT AND PLAN

Launching System Improvement

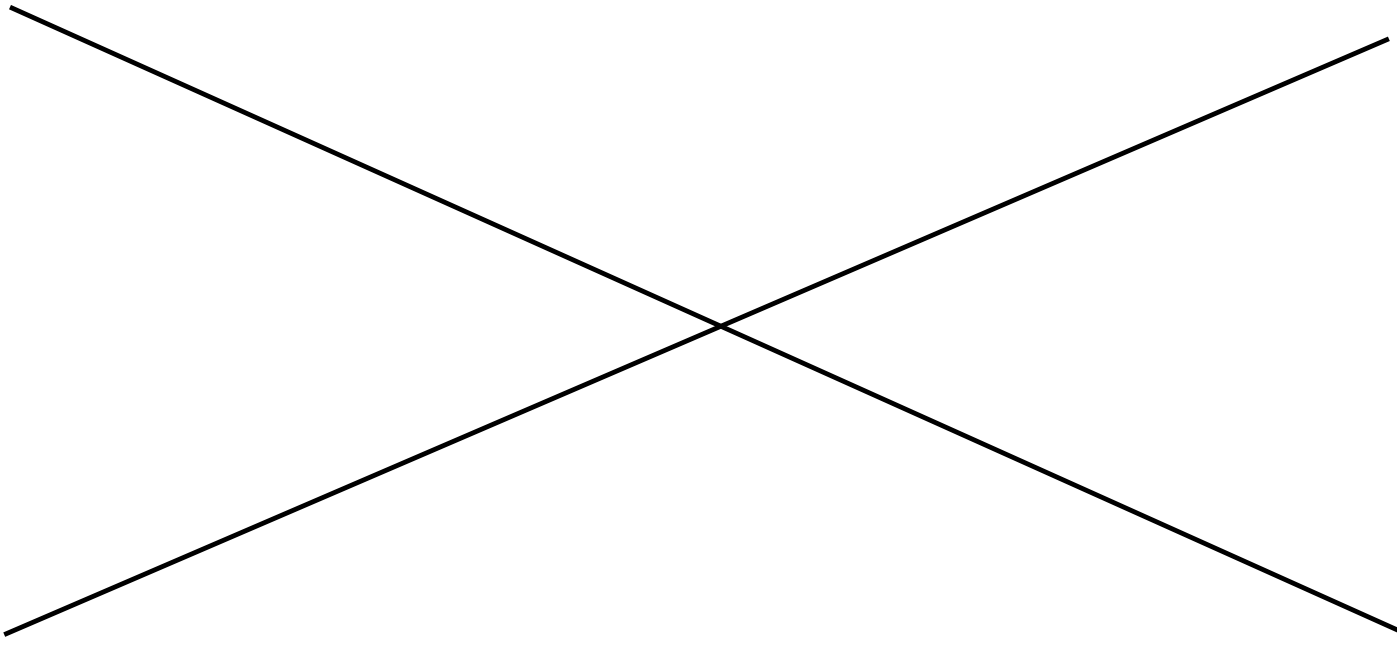
Goal

We will select the solution that is best for our team so that we can plan how to build it

Initial Test

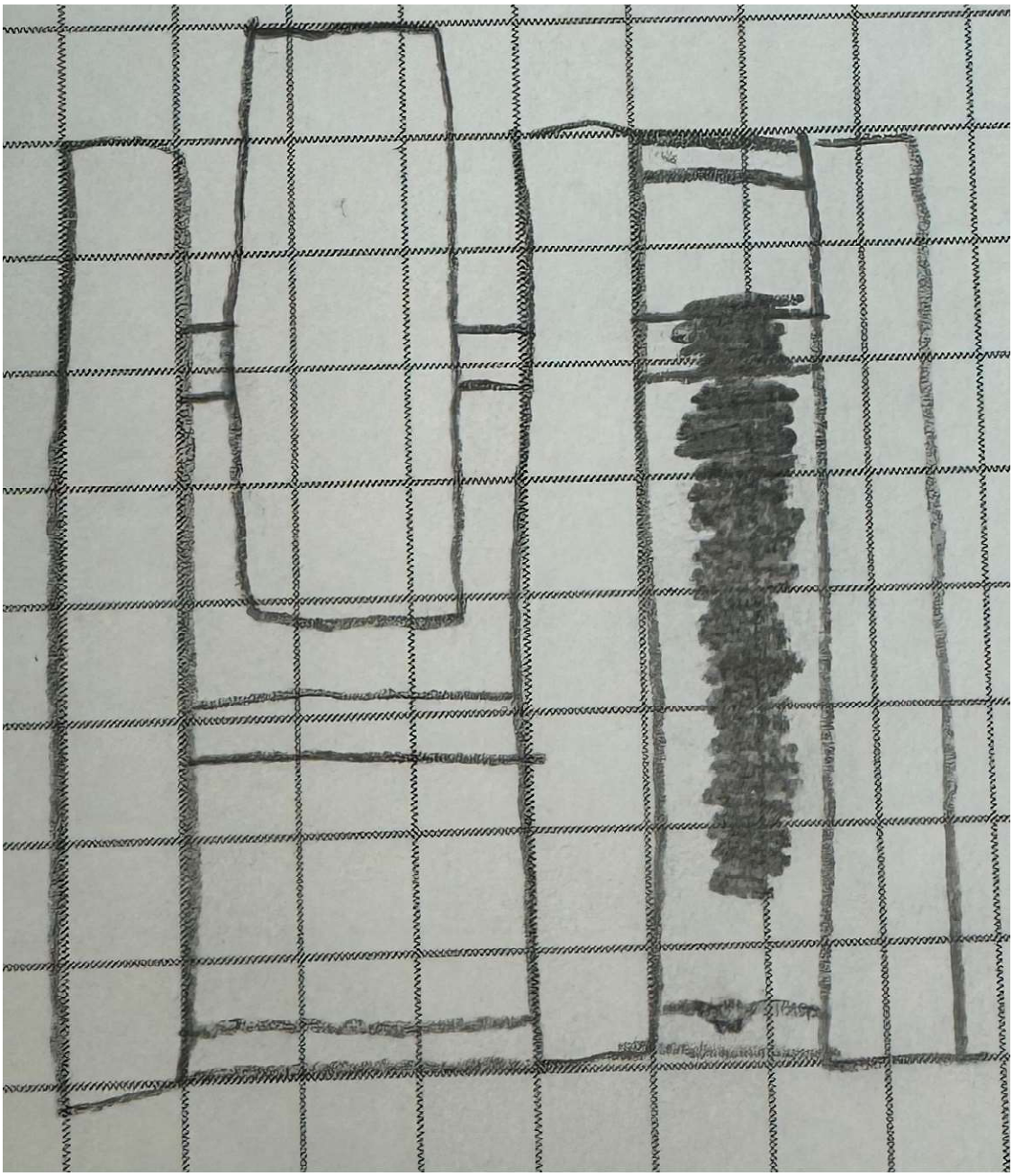
After struggling with the Rack and Pinion idea, we decided to choose the Flywheel option since it was already used last year. Upon testing our mechanism from last year and it working successfully, we intend to redesign it to better fit our needs this year

An example of this is making it more compact so It can fit within the space of our robot



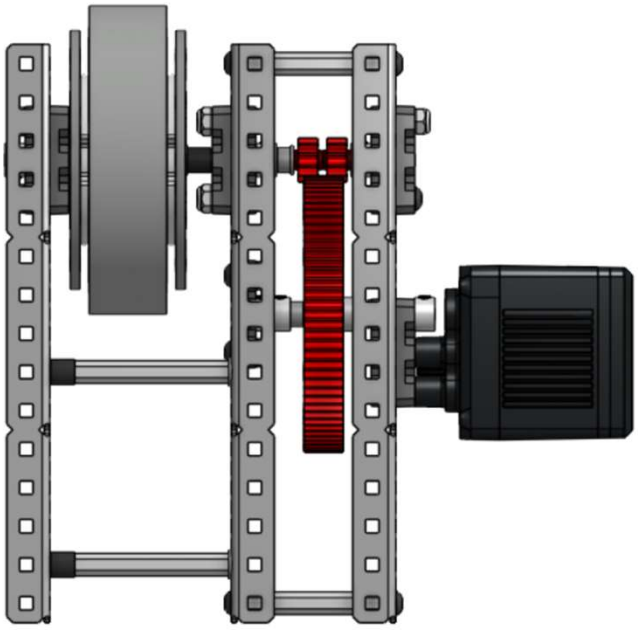
Sketch Plan

SELECT AND PLAN

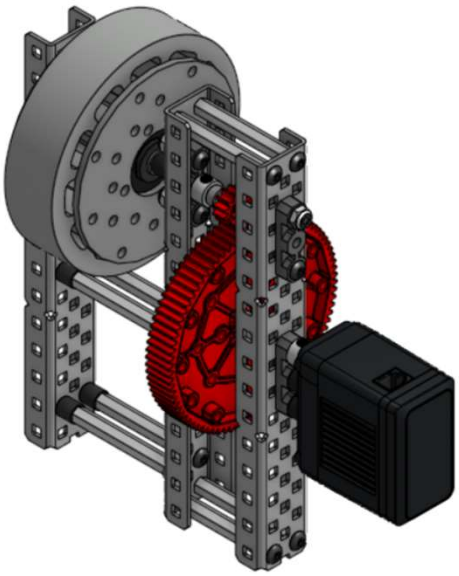


CAD Plan

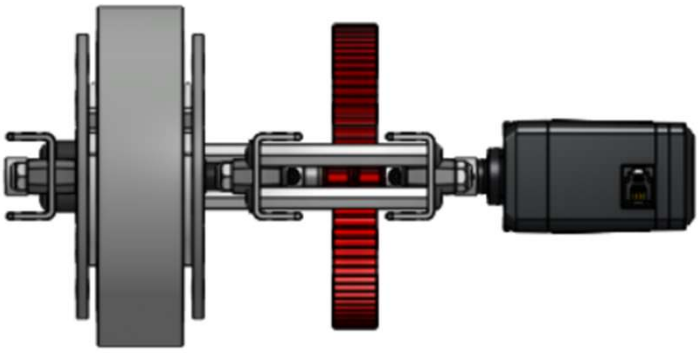
[TOP VIEW]



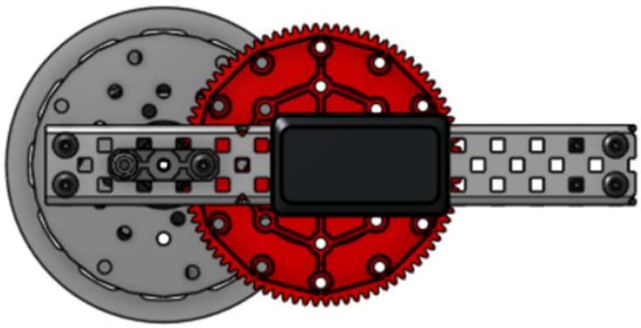
[ISOMETRIC VIEW]



[FRONT VIEW]

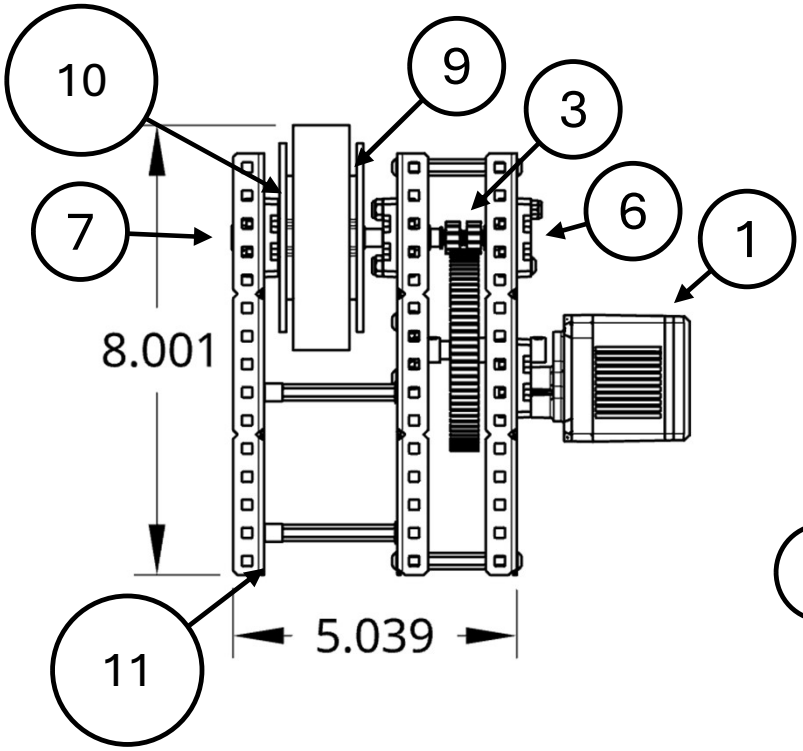


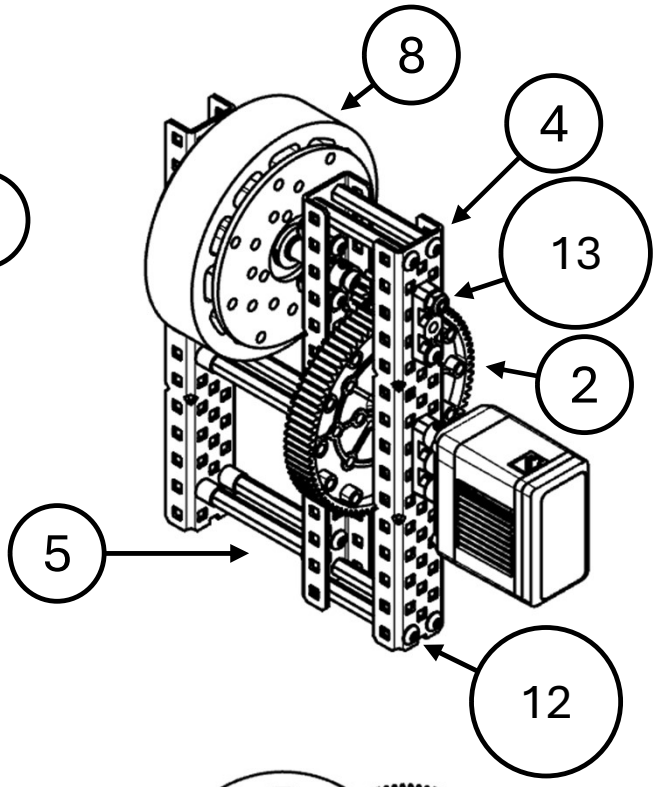
[SIDE VIEW]

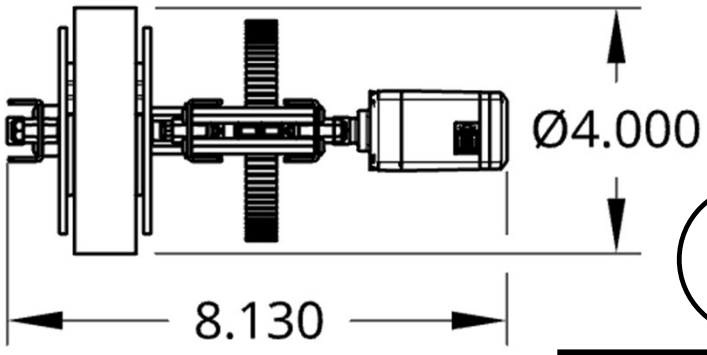


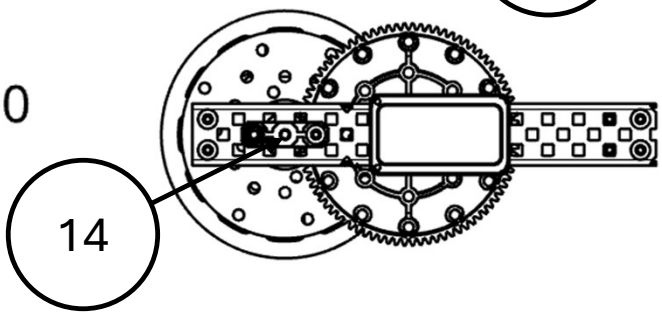
SELECT AND PLAN

SELECT AND PLAN









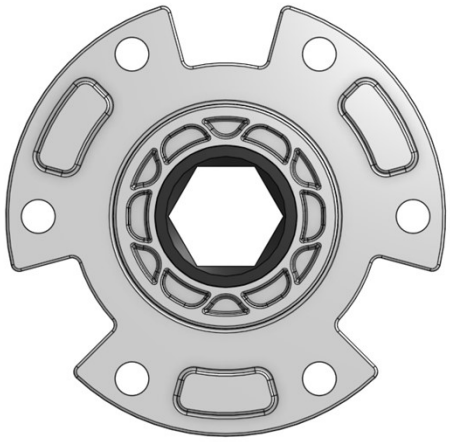
Launching Mechanism Improvement BOM

Item	Quantity	Part #
V5 Motor	1	1
84T High Strength Gear	1	2
12T Gears	2	3
7.5” C-Channel	3	4
Assorted Standoffs	8	5
Bearing Flat	9	6
Assorted Shafts	2	7
30A 4” Flex Wheel	1	8
1/2” Plastic Versahub v2	1	9
3D Printed – 1/2” Plastic Versahub v2	1	10
Assorted Spacers	n/a	11
Assorted Screws	n/a	12
Nylock Nuts	n/a	13
Shaft Collars	n/a	14
Flywheel Weight	2	15

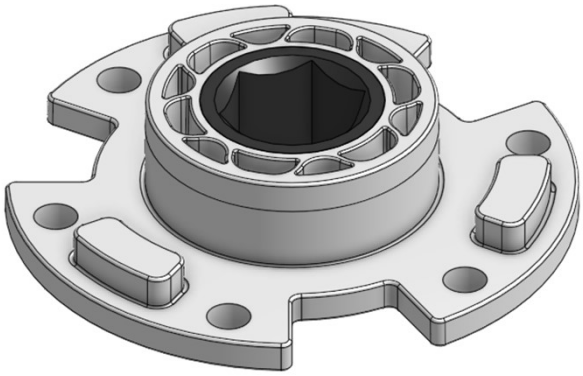
3D PRINTED PART

1/2” Plastic Versahub v2

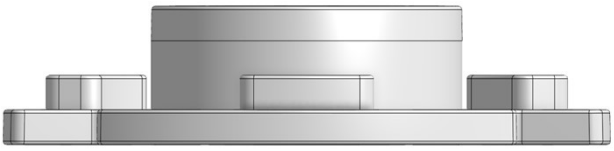
[TOP VIEW]



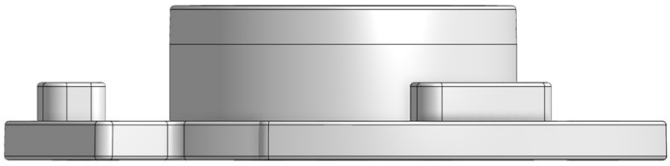
[ISOMETRIC VIEW]

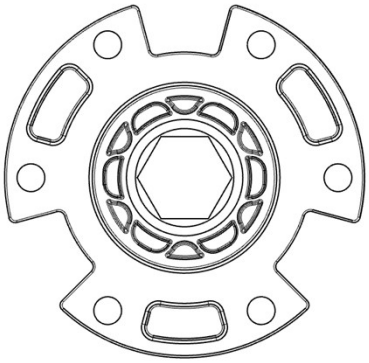


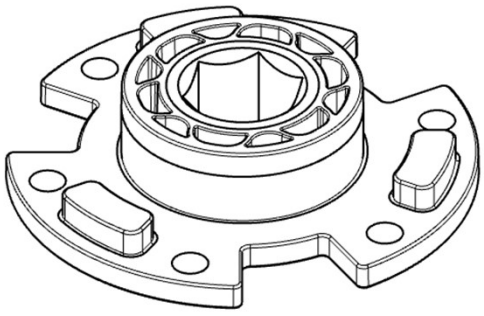
[FRONT VIEW]

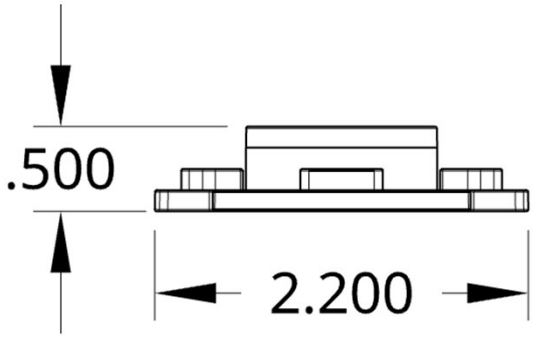


[SIDE VIEW]









BUILD SOLUTION

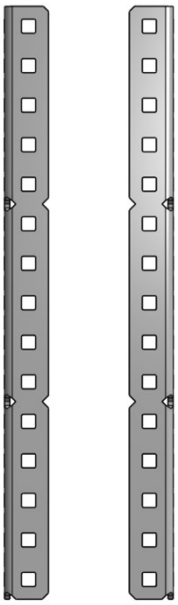
Launching System Improvement

BUILD SOLUTION

Goal

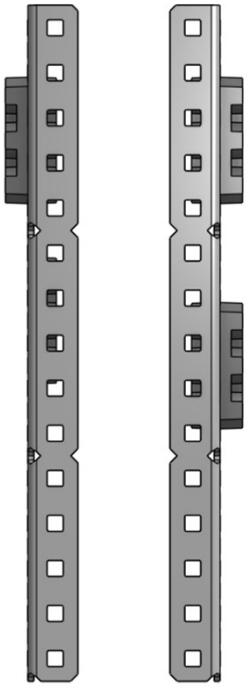
We will build our planned solution for the Launching System so that we can test its performance.

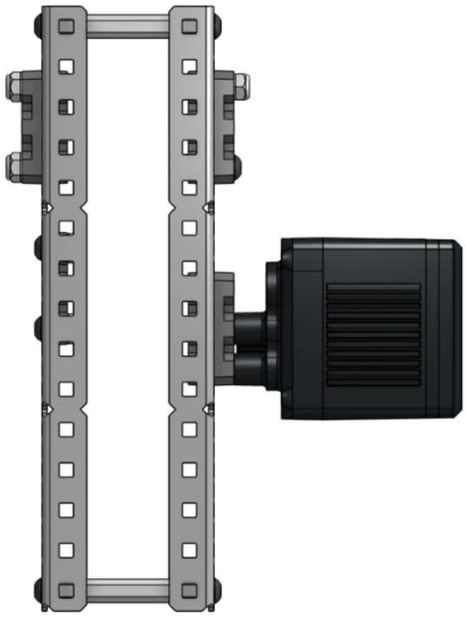
Process of Assembly



Start off with (2) 7.5” C-Channels

Add (6) Bearing Flats as shown.

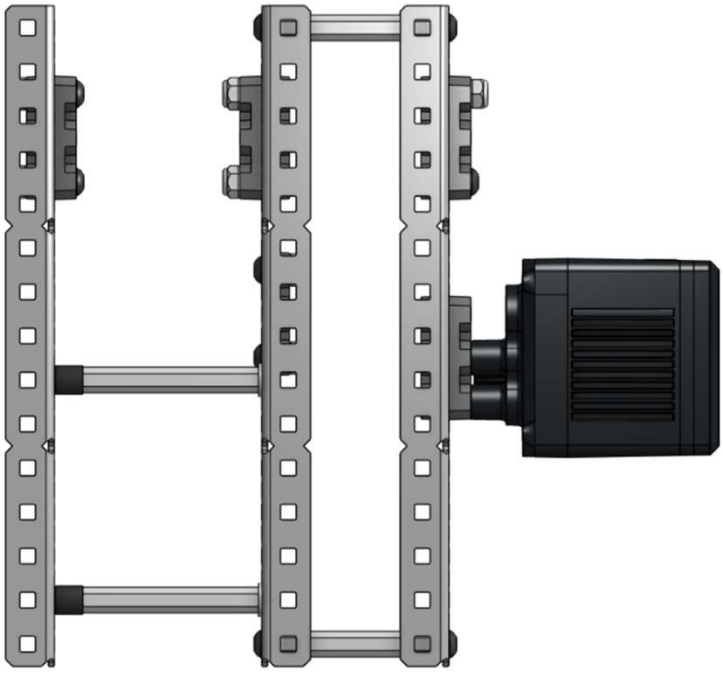




Add V5 Motor as shown to bearing flat

Attach (4) 2” Standoffs to connect both C-Channels

Attach additional Bearing Flat to C-Channel



Obtain an addition 7.5” C-Channel

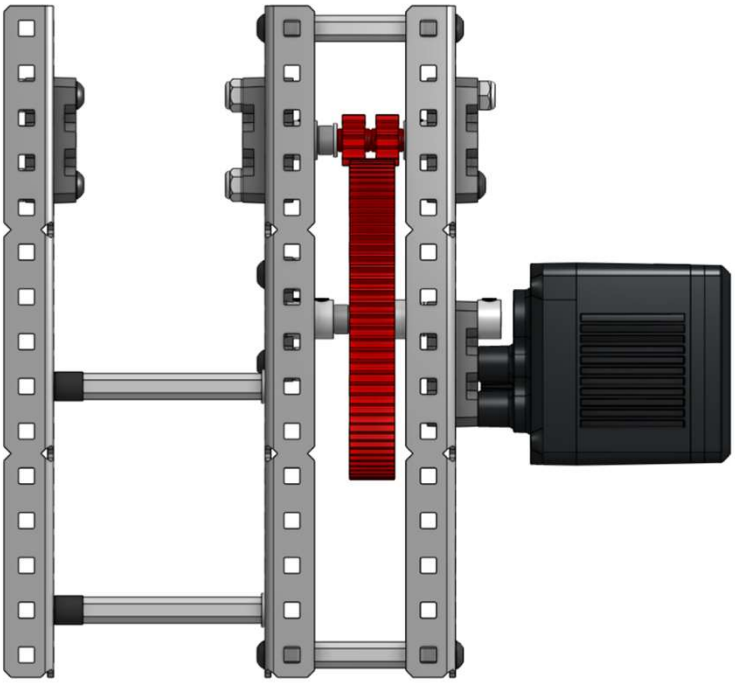
Connect (4) 2” Standoffs with (4) Nylon Spacers and (4) 8mm Spacers to connect the additional C-Channel with the others

Attach (2) Bearing Flats to additional C-Channel

This is what the current state of the build should look like

BUILD SOLUTION

BUILD SOLUTION

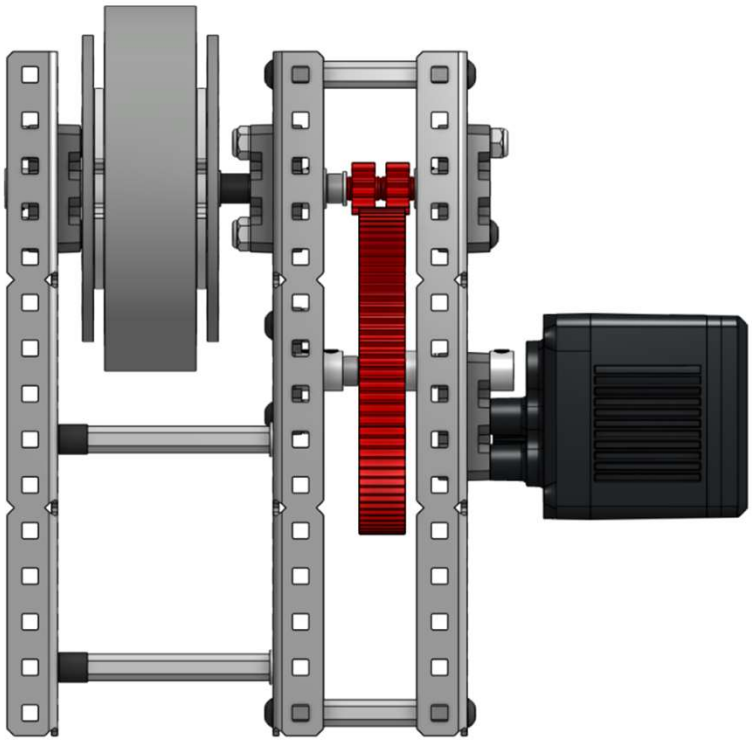


Add (1) 84T High Strength Gear and (2) 12T Gears as shown

Add Spacers and Shaft Collars where necessary and as shown

Connect both the Plastic VersaHub v2 and 3D Printed VersaHub with the VersaHex adapters, and attach to a 30A 4” Flex Wheel

Attach (2) Flywheel Weights to the Versahubs. Slide Wheel onto Shaft after adding spacers where shown.



TEST SOLUTION

Launching System Improvement

Goal

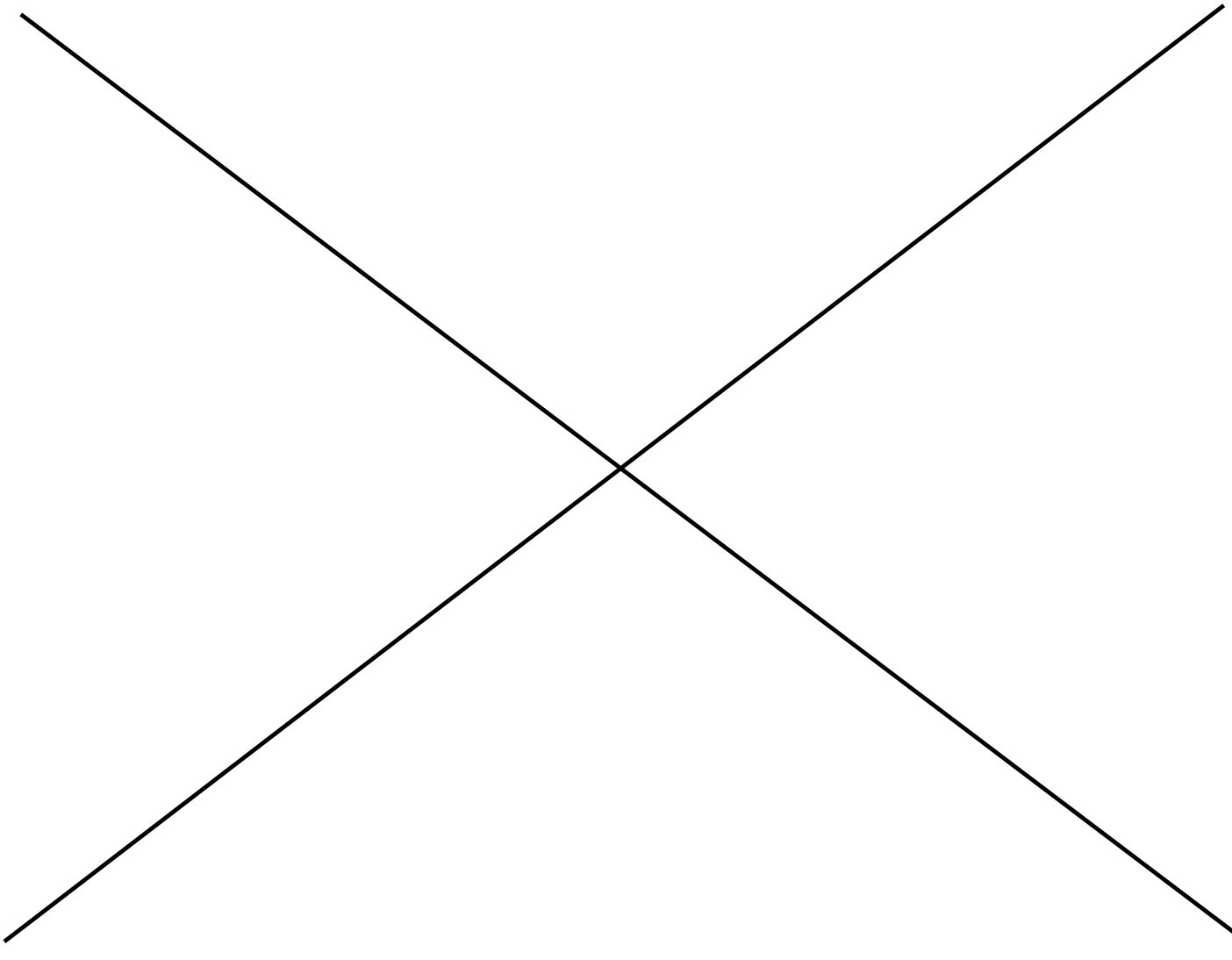
We test the performance and reliability of the chosen launching system

Testing

The initial test of this was very successful and actually overshot

We lowered the velocity of the blue motor down to 50% and it still shot the triball over the walls

Eventually we tried and tried and found the sweet spot was at 35%



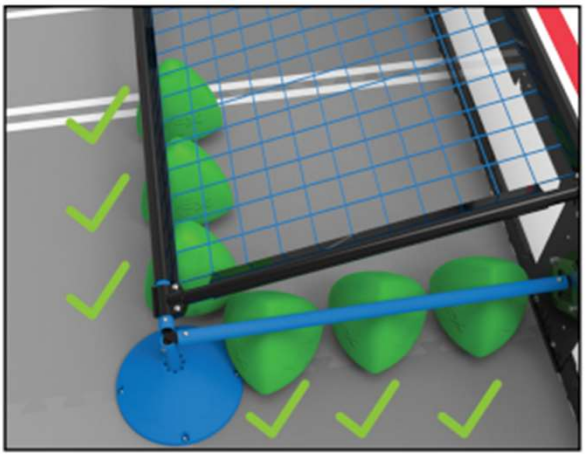
IDENTIFY PROBLEM

Pushing Mechanism

IDENTIFY PROBLEM

Goal

We will identify an objective for our robot so that we can address it and build an effective Pushing Mechanism



Problem statement

We need a way to push more Triballs into the goal in one motion, rather than backing up and taking a different angle multiple times

Solution Requirements

- Must only use legal VEX Robotics Competition Parts
- Must fit within 18”x18”x18” cube
- Cannot Possess any Triballs, but may plow Triballs
- Cannot exceed horizontal expansion limit of 36 inches

Solution Goals

- Does not easily move
- Easy to activate
- Be able to collapse into current frame of Robot
- Does Not Concave

BRAINSTORM SOLUTIONS

Pushing Mechanism

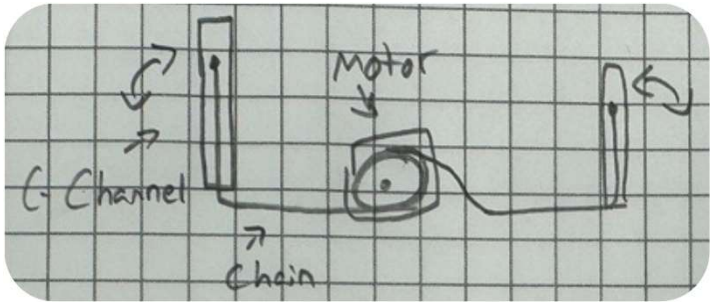
Goal

Brainstorm possible solutions to create an easily expandable pushing mechanism for our robot

Possible Solutions

Double wing design

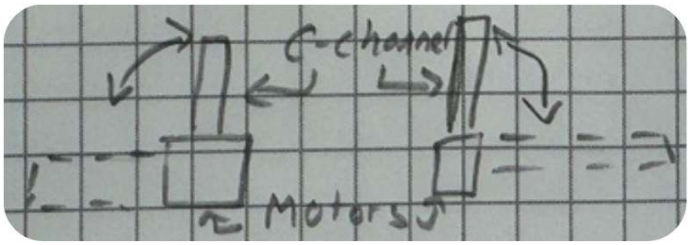
- One motor with a gear and a chain to pull them down
- Two C Channels that get pulled down



POSITIVES	NEGATIVES
• Strong • Big wingspan	• Slow • Clunky

Motor Fold Up & Down

- Two motors with C Channels on small axels
- Rotatable 90-Degrees in both directions

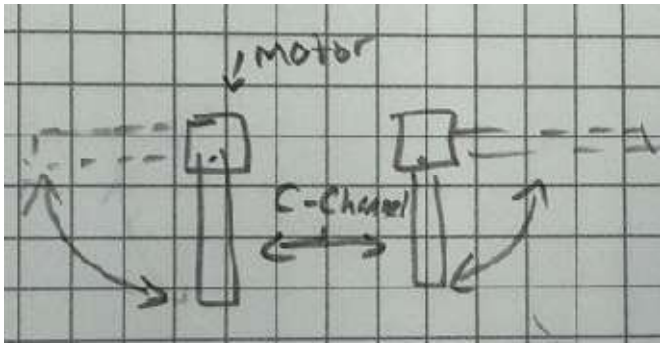


POSITIVES	NEGATIVES
• Strong • Big wingspan • Fast	• Can overshoot (more than 90-degree turn) • Can get easily stuck under nets

BRAINSTORM SOLUTIONS

Motor Fold In & Out

- Two motors directly attached to two C-Channels
- Two C-Channels that get spun in and out



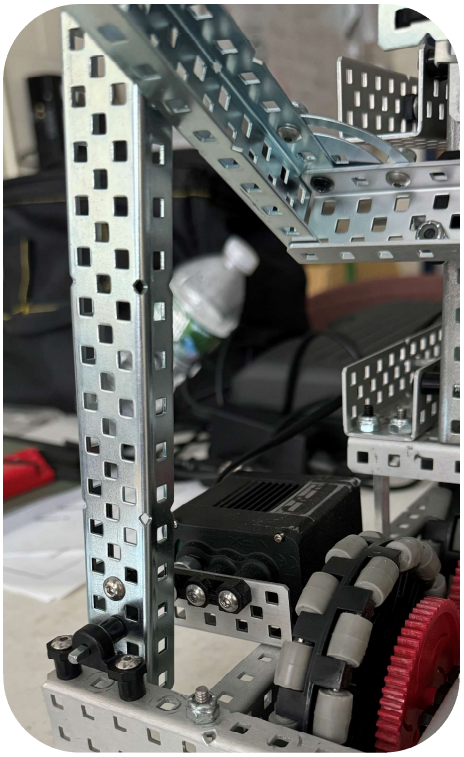
POSITIVES	***NEGATIVES***
• Retracts into the robots frame • Allows more protection to side of robot • fast	• Could possibly concave • Easy to move

SELECT AND PLAN

Pushing Mechanism

Goal

We will select the solution that is best for our team so that we can plan how to build it



Initial Test

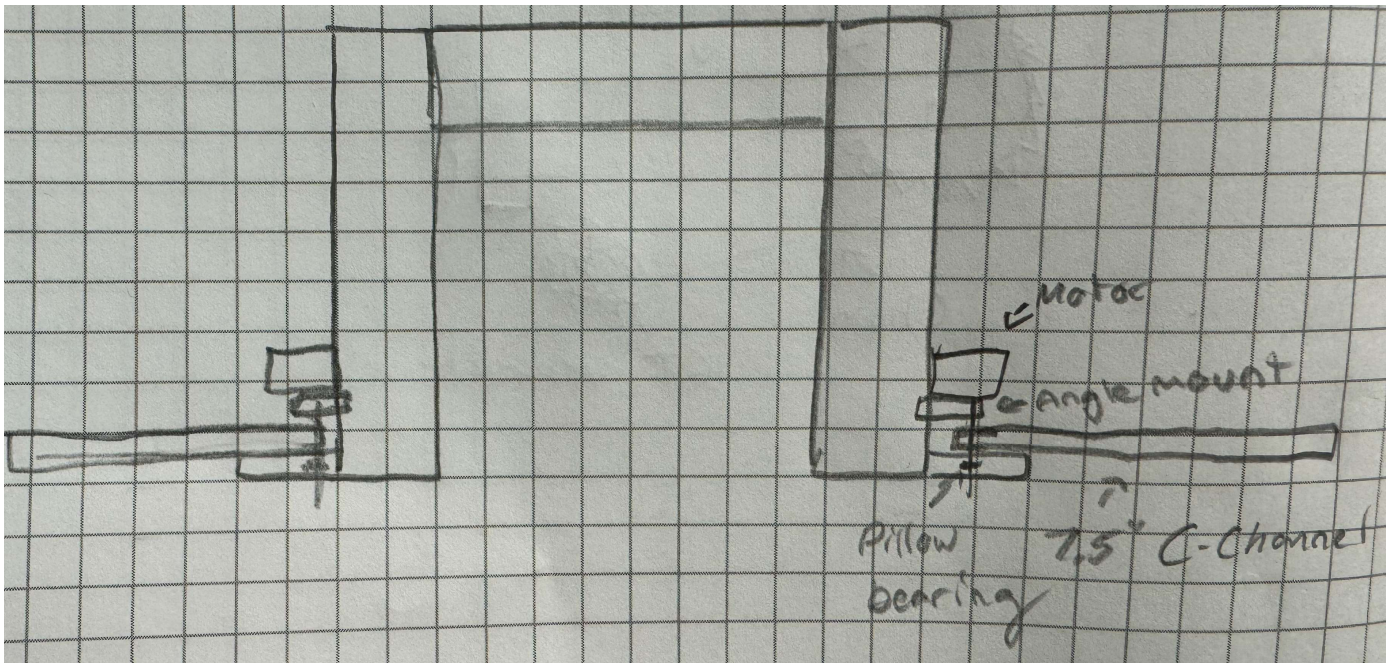
We decided to choose the option of the motors mounted at 90 degrees facing the front (Motor Fold Up & Down)

We chose this because it is basically impossible for there to be backwards flex when pushing Triballs

These will be created using the green cartridges in the motors

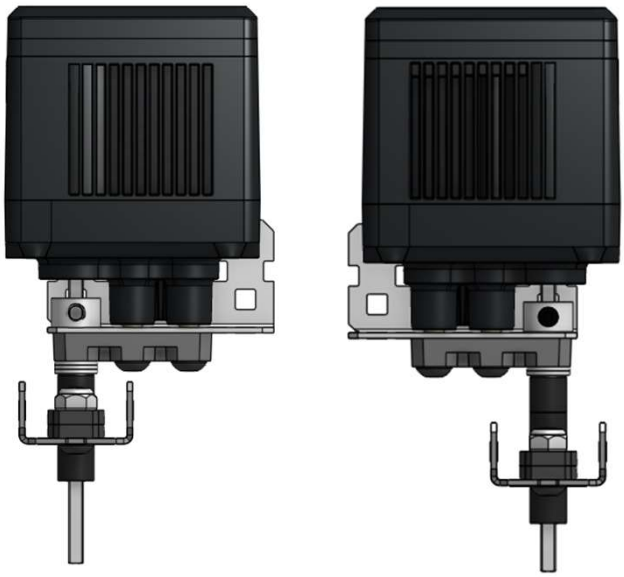
Sketch Plan

SELECT AND PLAN

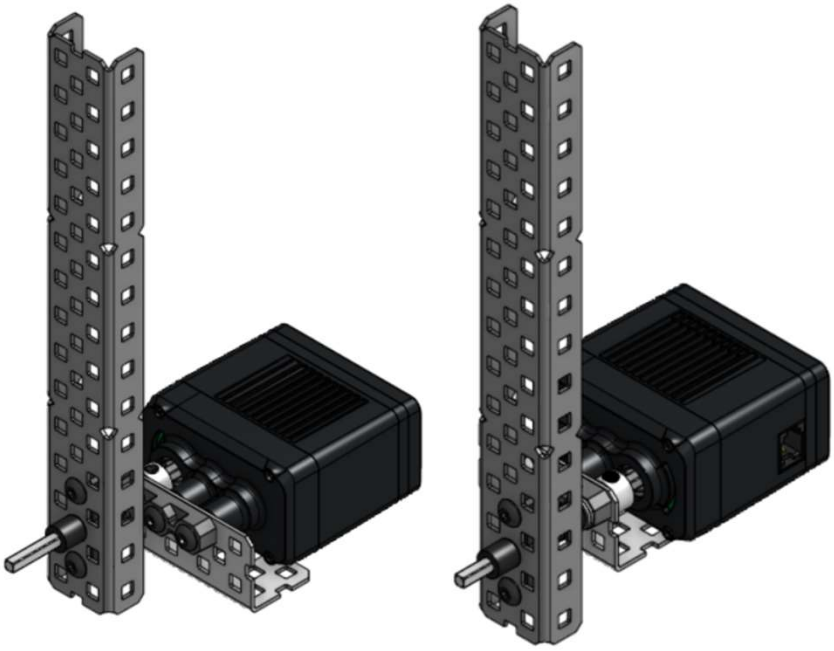


CAD Plan

[TOP VIEWS]

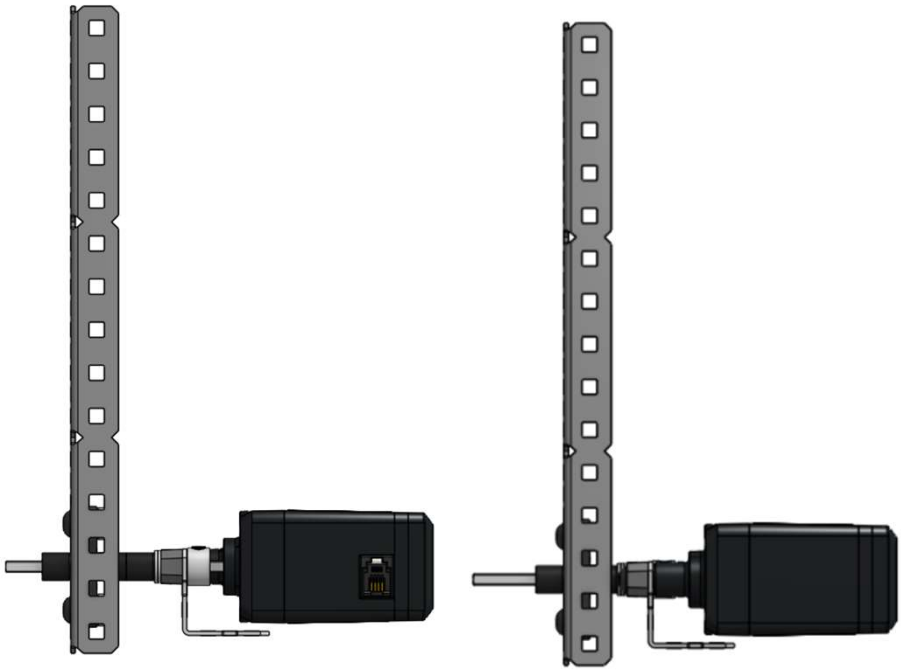


[ISOMETRIC VIEWS]



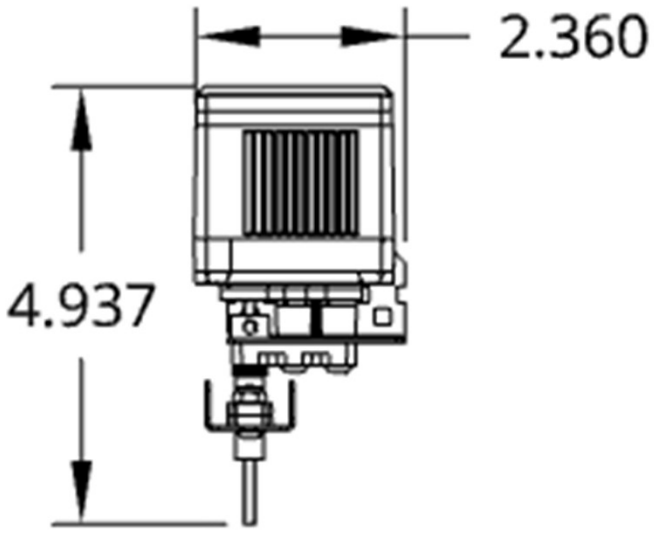
[FRONT VIEWS]

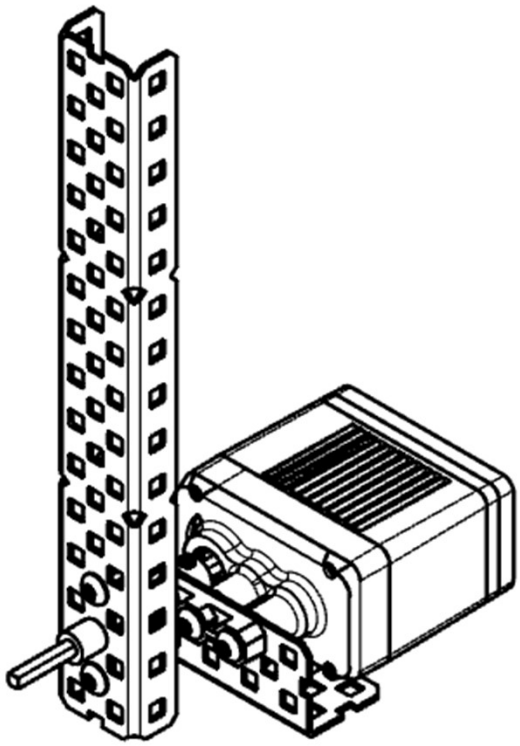
[SIDE VIEWS]

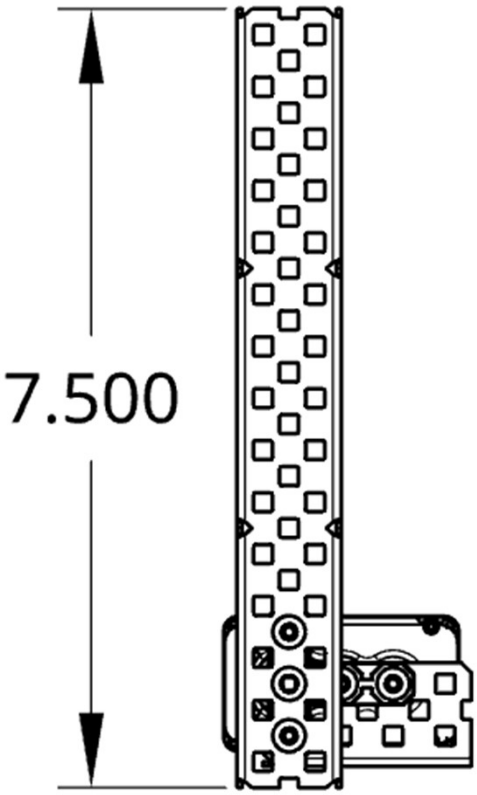


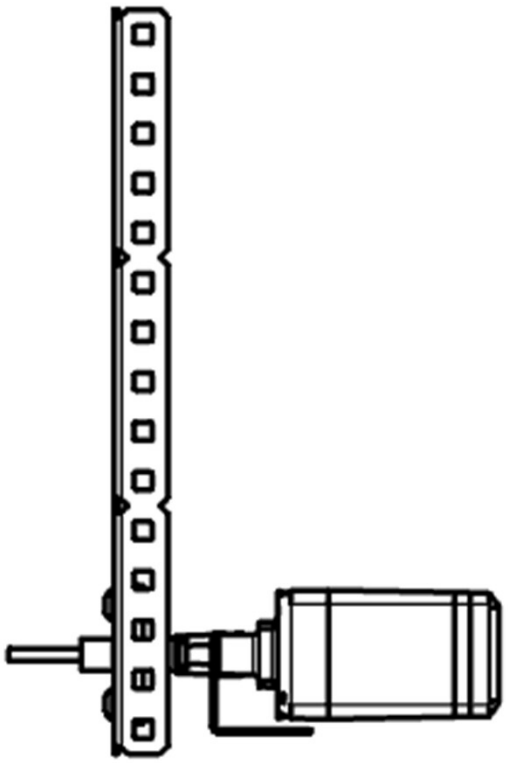
SELECT AND PLAN

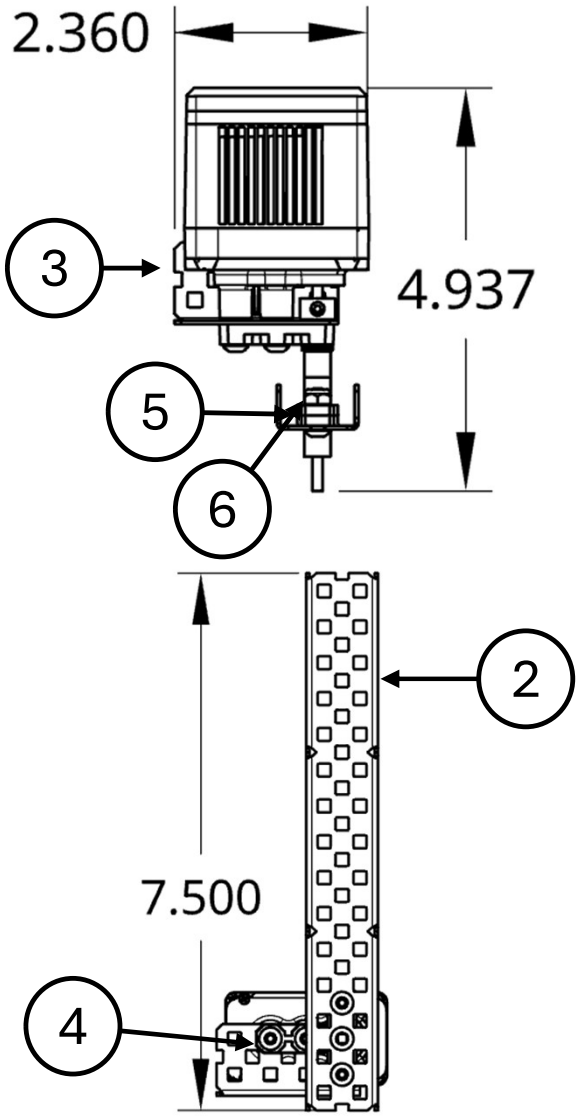
SELECT AND PLAN

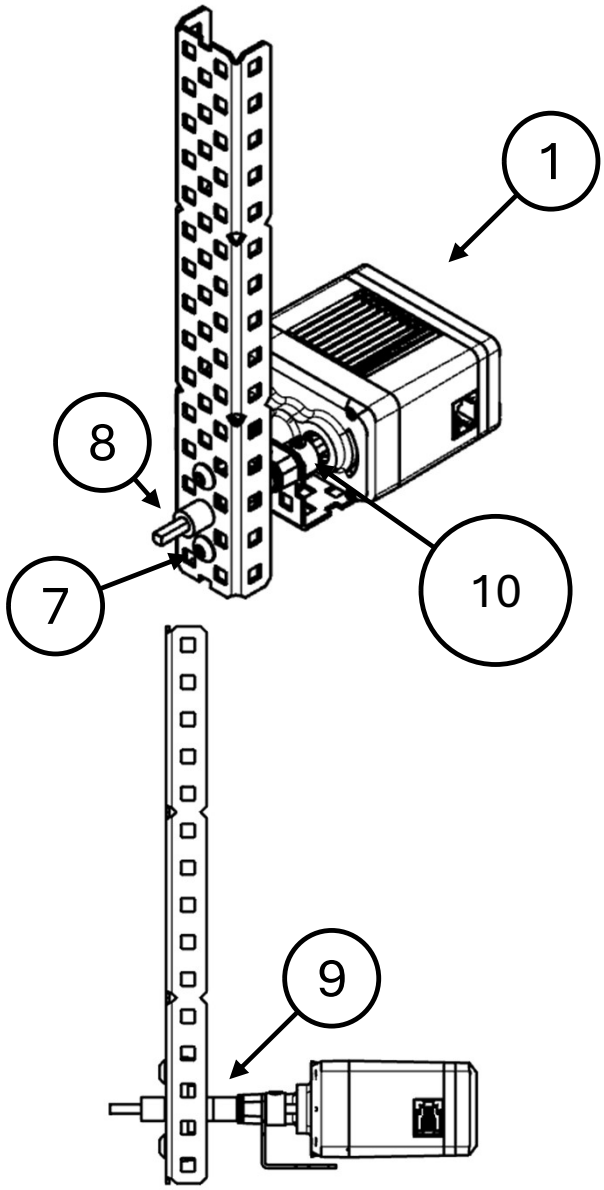












Pushing Mechanism BOM

Item	Quantity	Part #
V5 Motor	1	1
7.5” C-Channel	1	2
2.5” Angle	1	3
Bearing Flat	1	4
Lock Flat	2	5
Lock Nut	2	6
Assorted Screws	4	7
3” Square Shafts	1	8
Assorted Spacers	4	9
Shaft Collars	1	10

SELECT AND PLAN

BUILD SOLUTION

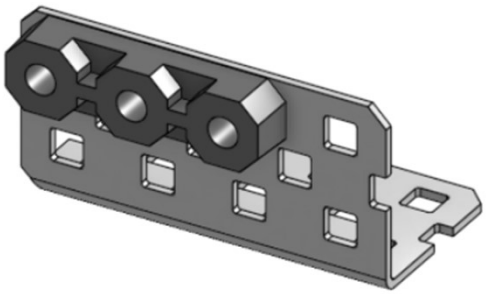
Pushing Mechanism

BUILD SOLUTION

Goal

We will build our planned solution for the Pushing Mechanism so that we can test its performance.

Process of Assembly



Start with a 2.5” Angle and attach a bearing on its side

Attach a V5 Motor to the angle as shown

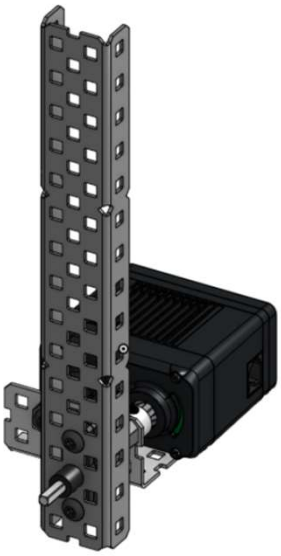
Obtain a 7.5” C-Channel and attach (2) Lock Plate Bearings on top of each as shown

Attach 7.5” C-Channel and Lock Plates upright to bearing on the Angle as shown. Attach spacers and axle locks as shown.

Mirror assembly to create opposite side for the pushing mechanism.

Note: Do not just duplicate and rotate!

Think of it as the mirrored assembly. Right side looks the same as the original’s left side!



BUILD SOLUTION

IDENTIFY PROBLEM

Elevation

IDENTIFY PROBLEM

Goal

We will identify an objective for our robot so that we can address it and build an effective elevation system

Problem statement

We need a mechanism to lift our robot up from the field and be able to have a clear view that it is elevated off the ground

Solution Requirements

- Must only use legal VEX Robotics Competition Parts
- Must fit within 18”x18”x18” cube at start
- No Vertical Expansion Limit

Solution Goals

- Have a reliable intake that works without robot being in motion
- Be able to hold onto Triball without being active
- Does not accidentally possess more than one Triball
- Lift Triball up from ground to prevent friction problems

BRAINSTORM SOLUTIONS

Elevation

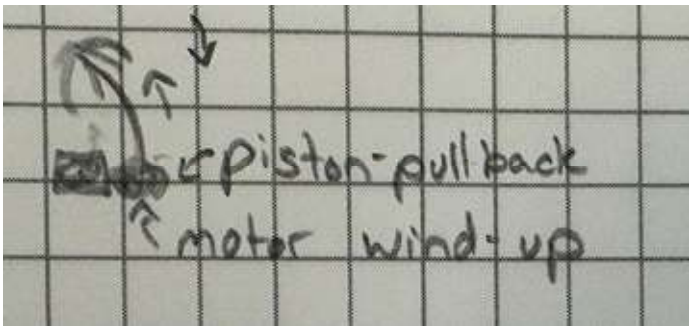
Goal

Brainstorm possible solutions to create an elevation system for our robot

Possible Solutions

Grapple Mechanism

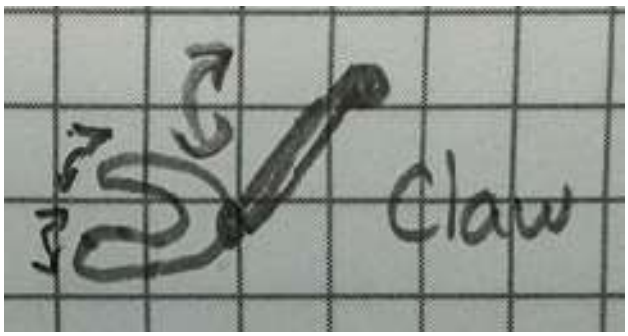
- Uses a shooting mechanism to latch onto the elevation bar
- Uses ratchet to crawl up



POSITIVES	NEGATIVES
• Can be small • Easily adaptable	• Must be very precise • Can take to long to reset

Claw

- Already designed using VEX V5 Clawbot
- Uses claw to grab elevation pole
- Pulls Robot up above claw



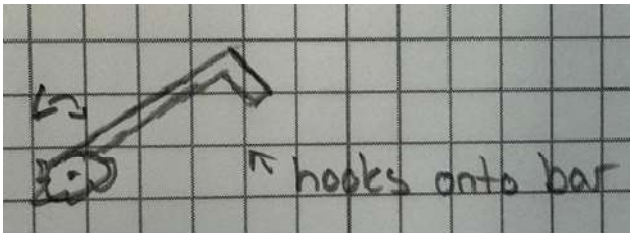
POSITIVES	NEGATIVES
• Easy to make • Can be strong if made correctly	• Might Slip • Robot Could be too heavy • Might Break size restraints

BRAINSTORM SOLUTIONS

BRAINSTORM SOLUTIONS

Hook and Latch

- Gear for Torque attached to a U-Channel with a Hook on the end
- Grabs Horizontal Elevation Bar



POSITIVES	***NEGATIVES***
• Easy to make and implement • Very Strong	• Does not reach high elevation • Can cause issues with the flywheel due to clamping

SELECT AND PLAN

Elevation

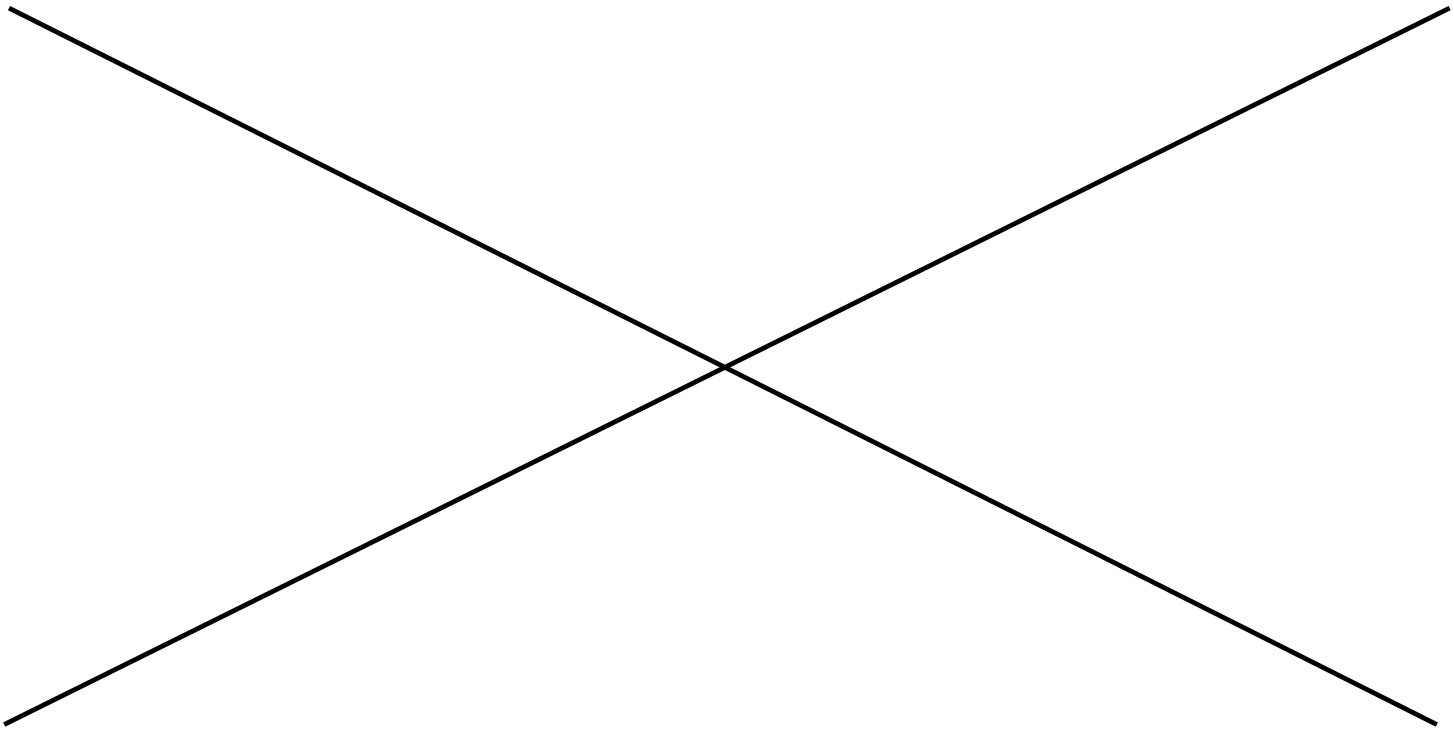
Goal

We will select the solution that is best for our team so that we can plan how to build it

After many discussions, we chose the Hook and Latch Elevation Idea. We believe that Elevation is not too important, so something quick and simple that can get those extra few points will can definitely help.

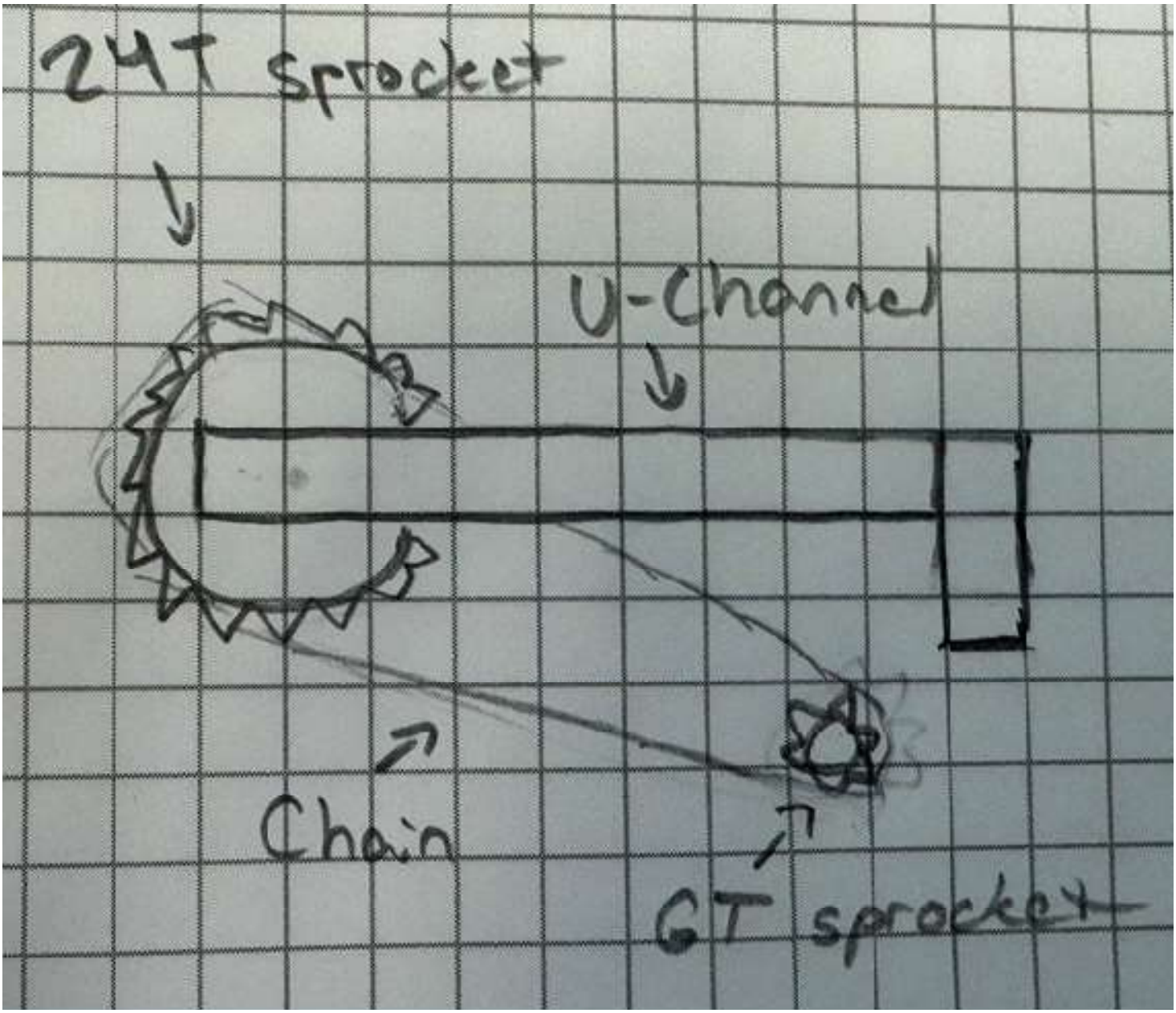
However, we will need to adapt the Idea for this by adding an idler gear so the Flywheel Motor can fit between the chain without interference. This may cause some issues down the line.

The following page shows our general sketch for the Elevation Plan.



Sketch Plan

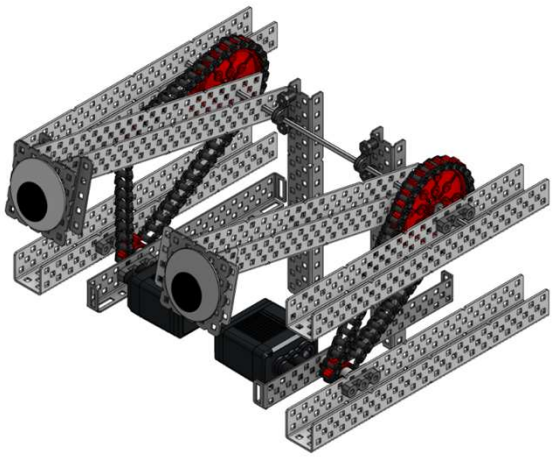
SELECT AND PLAN



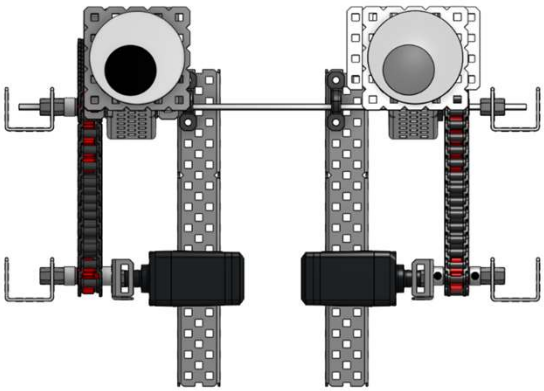
CAD Plan

[TOP VIEW]

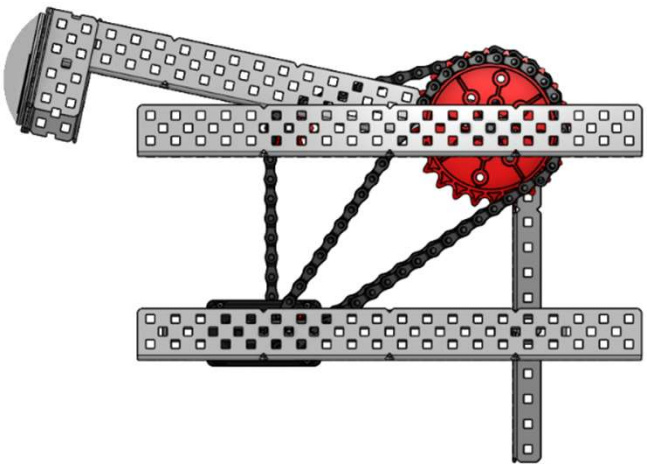
[ISOMETRIC VIEW]



[FRONT VIEW]

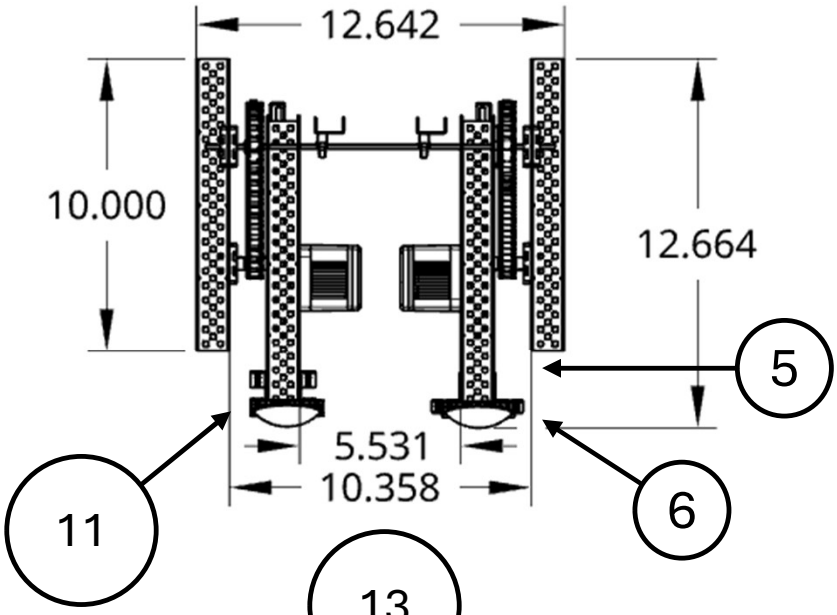


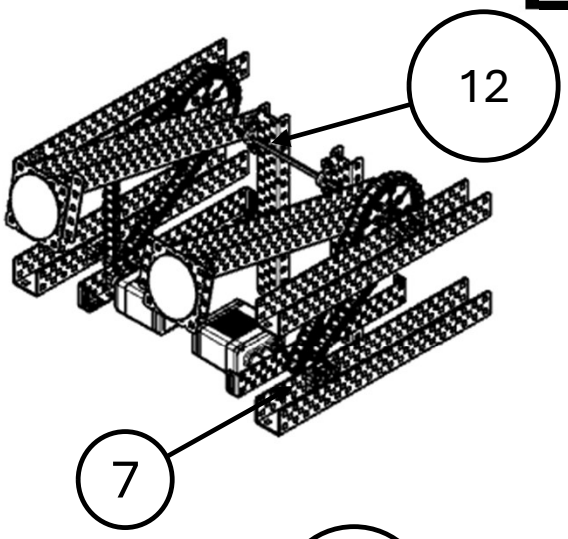
[SIDE VIEW]

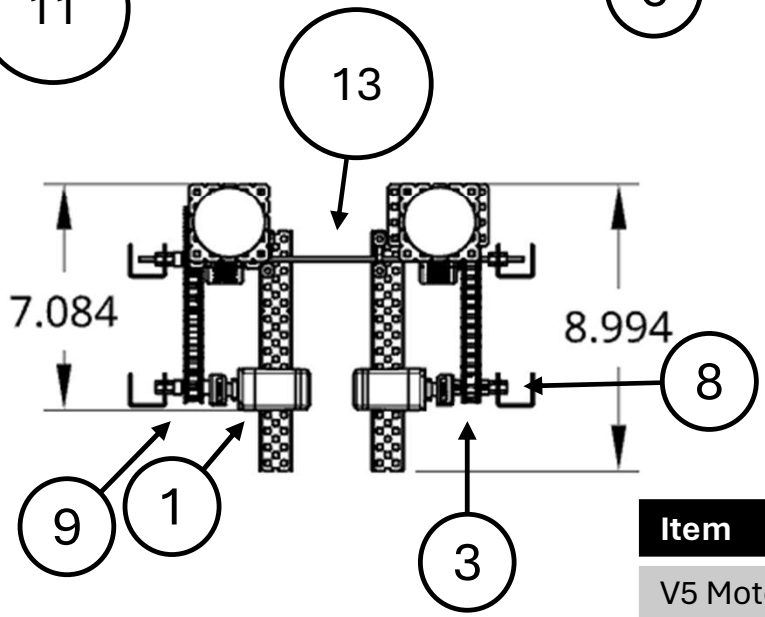


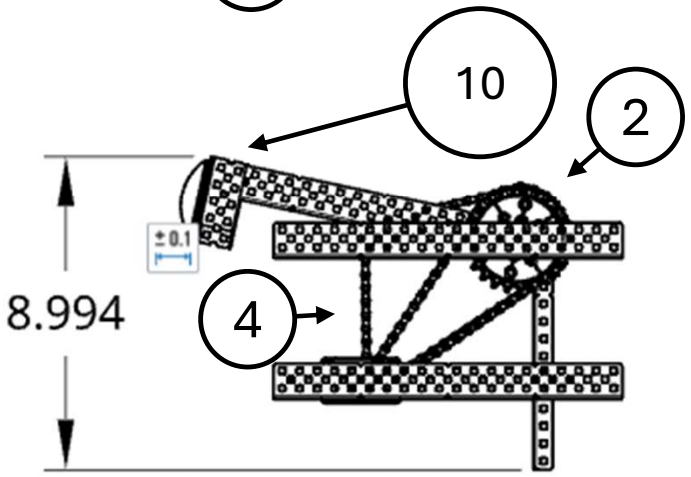
SELECT AND PLAN

SELECT AND PLAN









Elevation BOM

Item	Quantity	Part #
V5 Motor	2	1
24T High Strength Sprocket	2	2
6T High Strength Sprocket	3	3
High Strength Chain	n/a	4
10” U-Channel	2	5
5x5 Square	2	6
Bearing Flat	11	7
Shaft Collars	6	8
Assorted Spacers	n/a	9
2” Angle	2	10
2.5” C-Channel	2	11
Pillow Bearing	2	12
12” Shaft	1	13

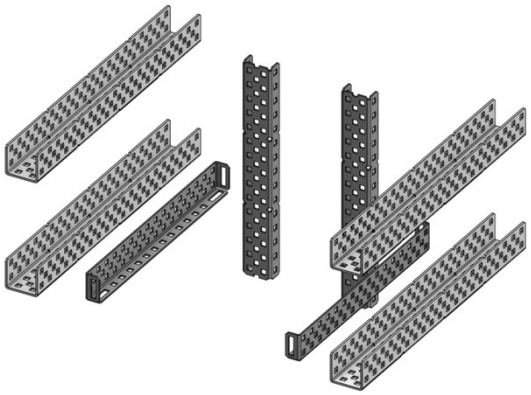
BUILD SOLUTION

Elevation

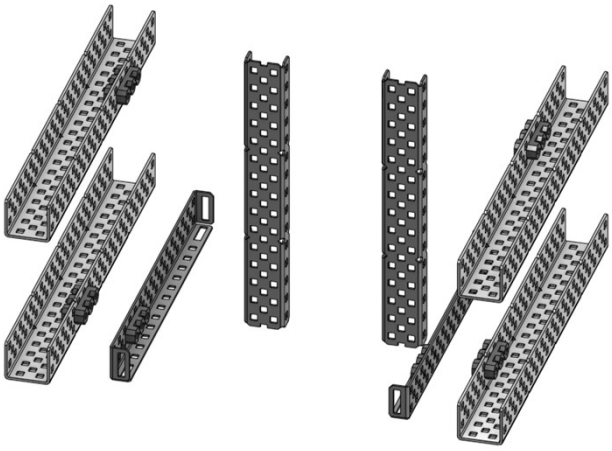
Goal

We will build our planned solution for the Elevation so that we can test its performance.

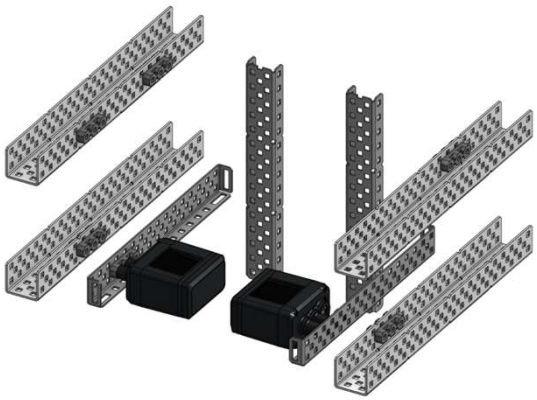
Process of Assembly



Start with these pieces from the robot's shell (other parts hidden for convenience purposes)



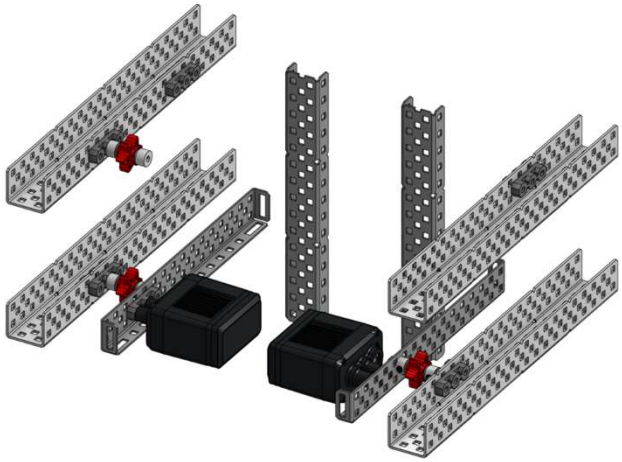
Attach (10) Bearing Flats as shown.



Attach additional (2) Bearing Flats to the left side U-Channel

Attach two V5 Motors to the bearings attached to the rails

BUILD SOLUTION

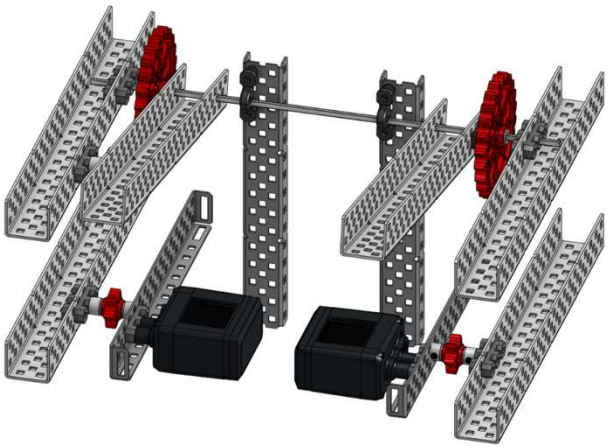


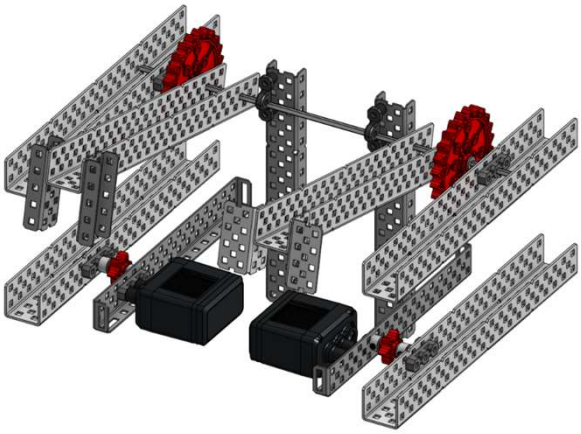
Attach (6) Shaft Collars and (3) 6T High Strength Sprockets together and place them as shown next to the bearings

Attach (2) 24T High Strength Sprockets to (2) 10” U-Channels.

Run a 12” Drive Shaft between the two and be sure to use (2) Lock Plates to hold the Shaft and U-Channels together

Use (2) Pillow Bearings and attach them the rear C-Channels as shown, Use spacers if not alligned

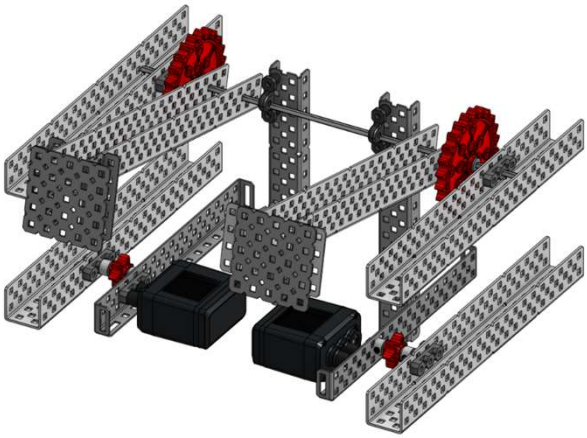


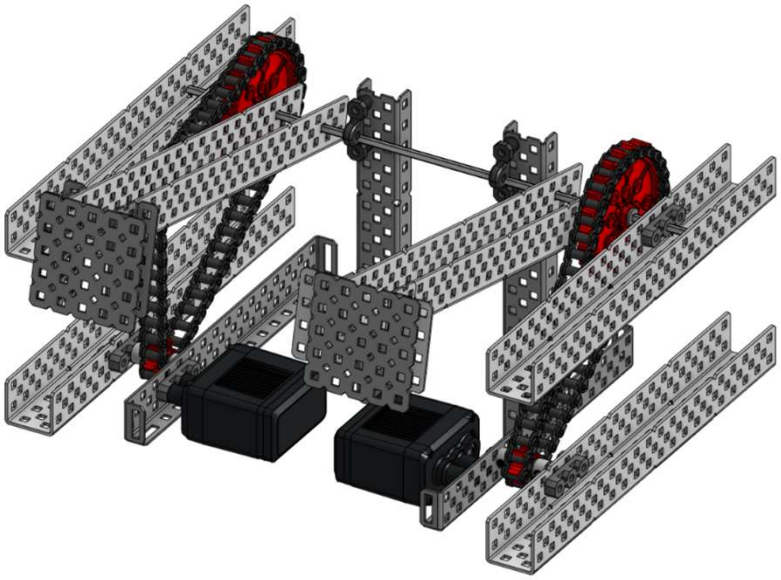


Attach (2) 2.5” C-Channels to Left U-Channel Arm

Attach (2) 2” Angles to Right U-Channel Arm

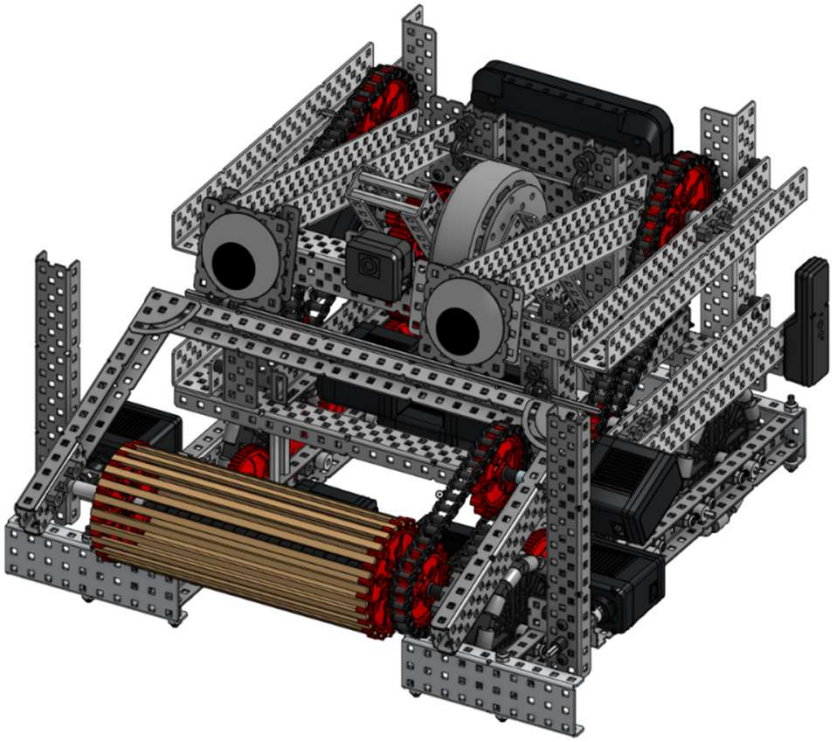
Attach (2) 5x5 Squares connecting the C-Channels together along with Angles together





Attach High Strength Chain, connecting the sprockets together on each side of the robot as shown.

Left Side chain over the 6T Idle Gear to clear room for the Launching Mechanism's Motor



View of Elevation Mechanism in Robot

TEST SOLUTION

Elevation

TEST SOLUTION

Goal

We test the performance and reliability of our Elevation

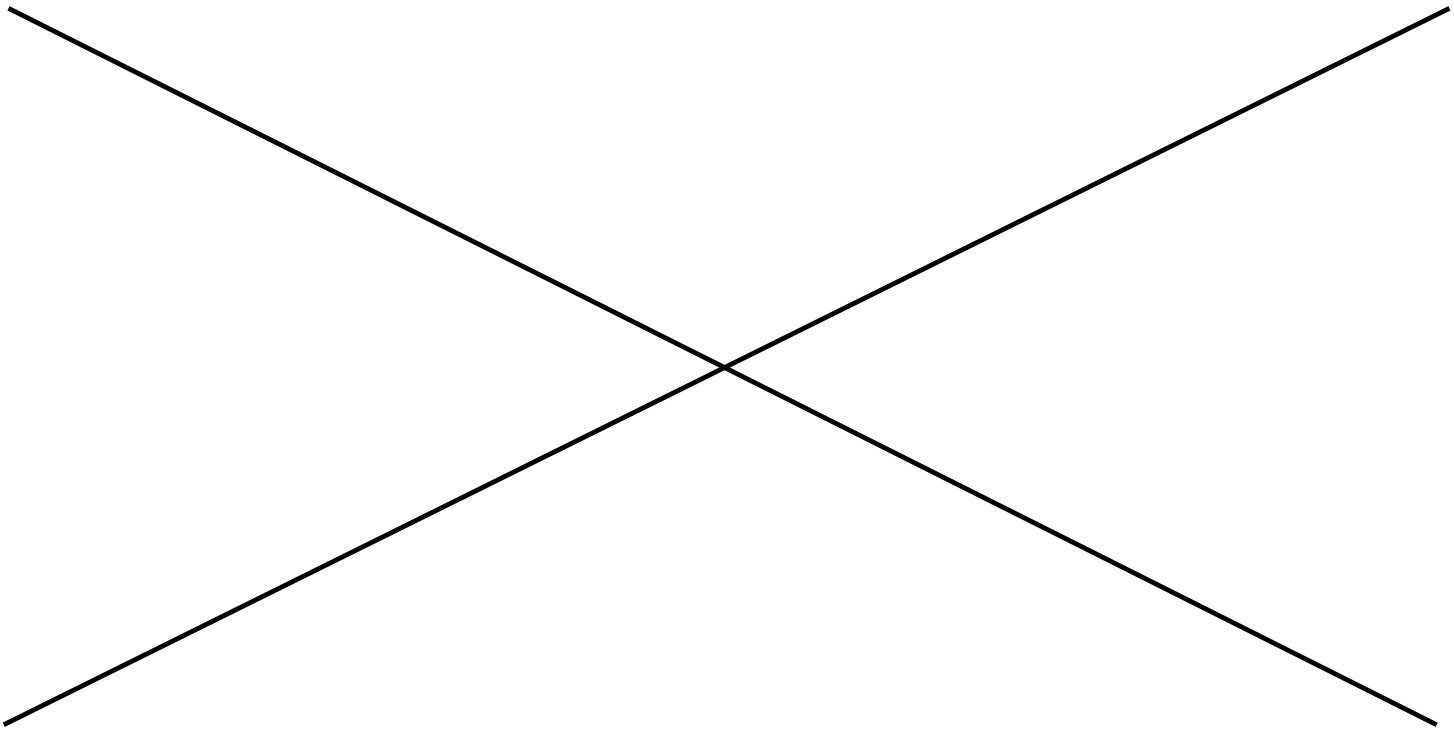
Testing

During testing, we experience several different results. During our first test, the robot successfully elevated for a moment before quickly falling back down. To fix this, we changed our motor braking to “HOLD” instead of “COAST”

During our second test, the Robot successfully held itself up, but it tipped forward, keeping the front of the Robot on the tiles.

This kept happening in the next 3 tests we ran

We will work on a solution to this problem



IDENTIFY PROBLEM

Elevation Improvement

Goal

We will identify weak points in the previous design and see what changes are needed

Problem statement

Our robot is lifting off the ground, but not complete

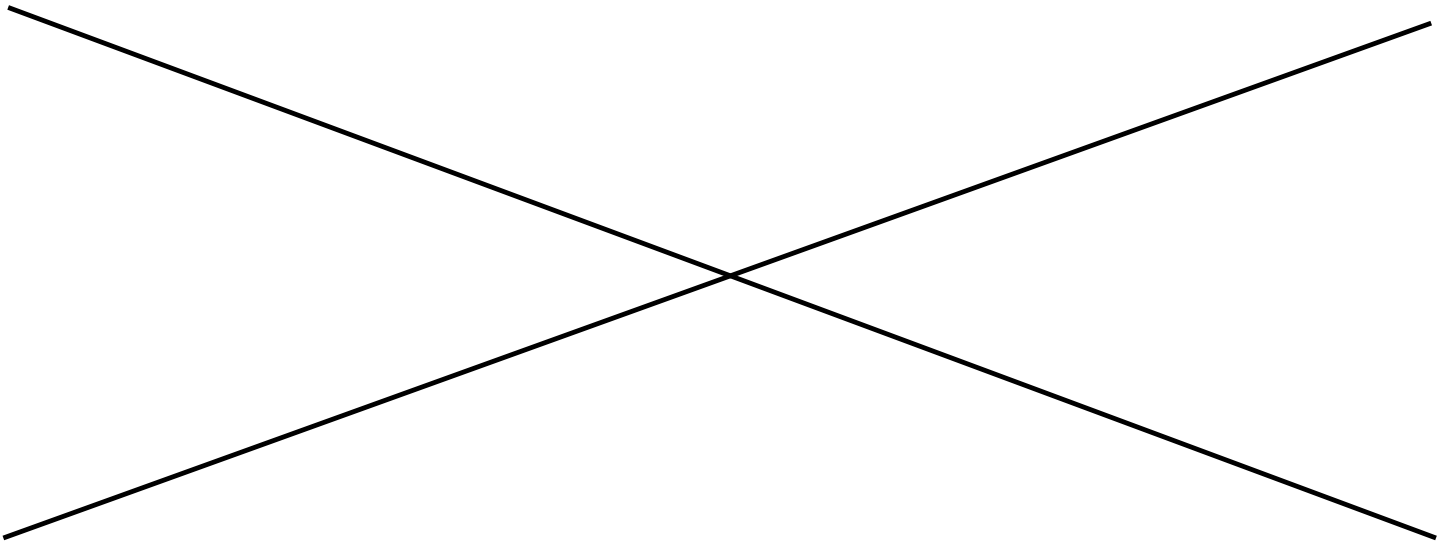
We need to shift weight or change the design so it is balance when hanging

Solution Requirements

- Must only use legal VEX Robotics Competition Parts
- Must fit within 18”x18”x18” cube at start
- No Vertical Expansion Limit

Solution Goals

- Center the hang of the robot
- Get robot completely off the ground
- Fix chain popping
- Give more torque



BRAINSTORM SOLUTIONS

Elevation Improvement

BRAINSTORM SOLUTIONS

Goal — Brainstorm possible solutions to create a better elevation system

Possible Solutions

Make Elevation more centered to the Robot

- Trim Down U-Channels
- Remove Eyes idea (Cosmetic)

POSITIVES	***NEGATIVES***
• Would improve Elevation	• Loss of material by cutting down U-Channel • Would have to be perfect with no room for error

Change Idea Entirely

- Go Back to our brainstorming ideas for the elevation solution and select something different

POSITIVES	***NEGATIVES***
• Would give new results • Might work more effectively	• Time spent redesigning

Standoffs

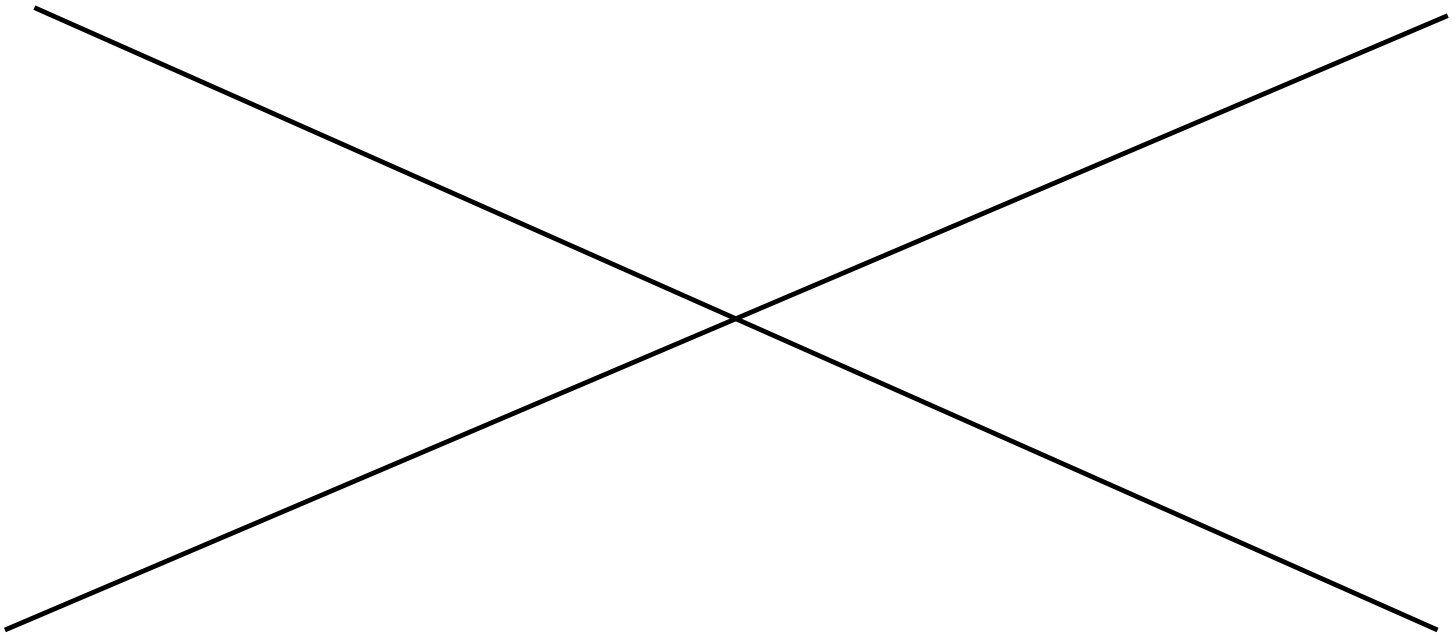
- Attach Standoffs to existing U-Channels

POSITIVES	***NEGATIVES***
• Can test different positions of the Standoffs for best results • High Strength Solution • Simple	• Standoffs can loosen if not supported properly

Move Robot weight towards the back

Attach misc. objects to weigh down the backside

POSITIVES	***NEGATIVES***
• Would not have to lose material • Allows for better weight distribution when driving	• Clutters the Robot • Might cause other problems regarding size



BRAINSTORM SOLUTIONS

SELECT AND PLAN

Elevation Improvement

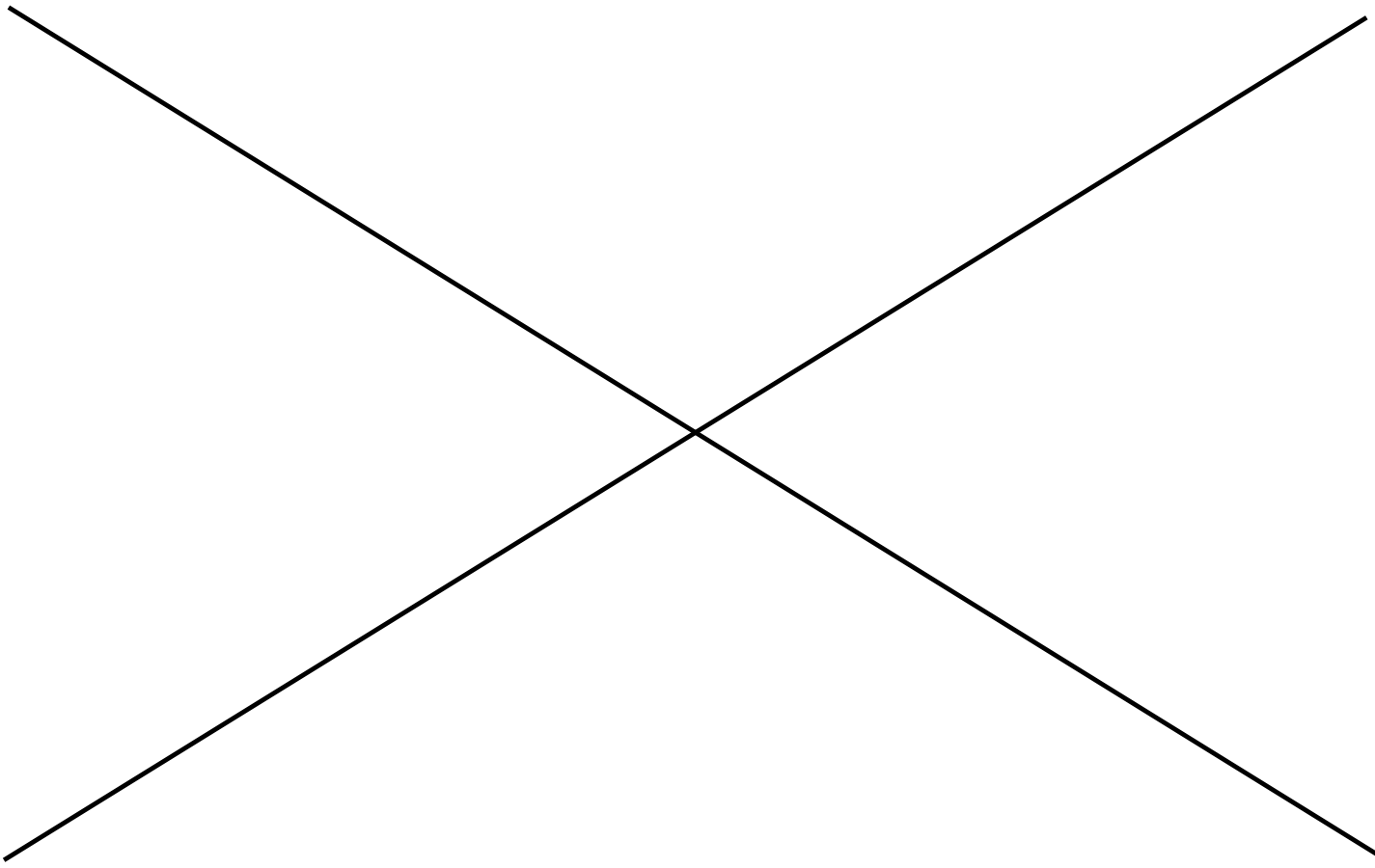
Goal

We will select the solution that will help fix the problem of not being able to hang

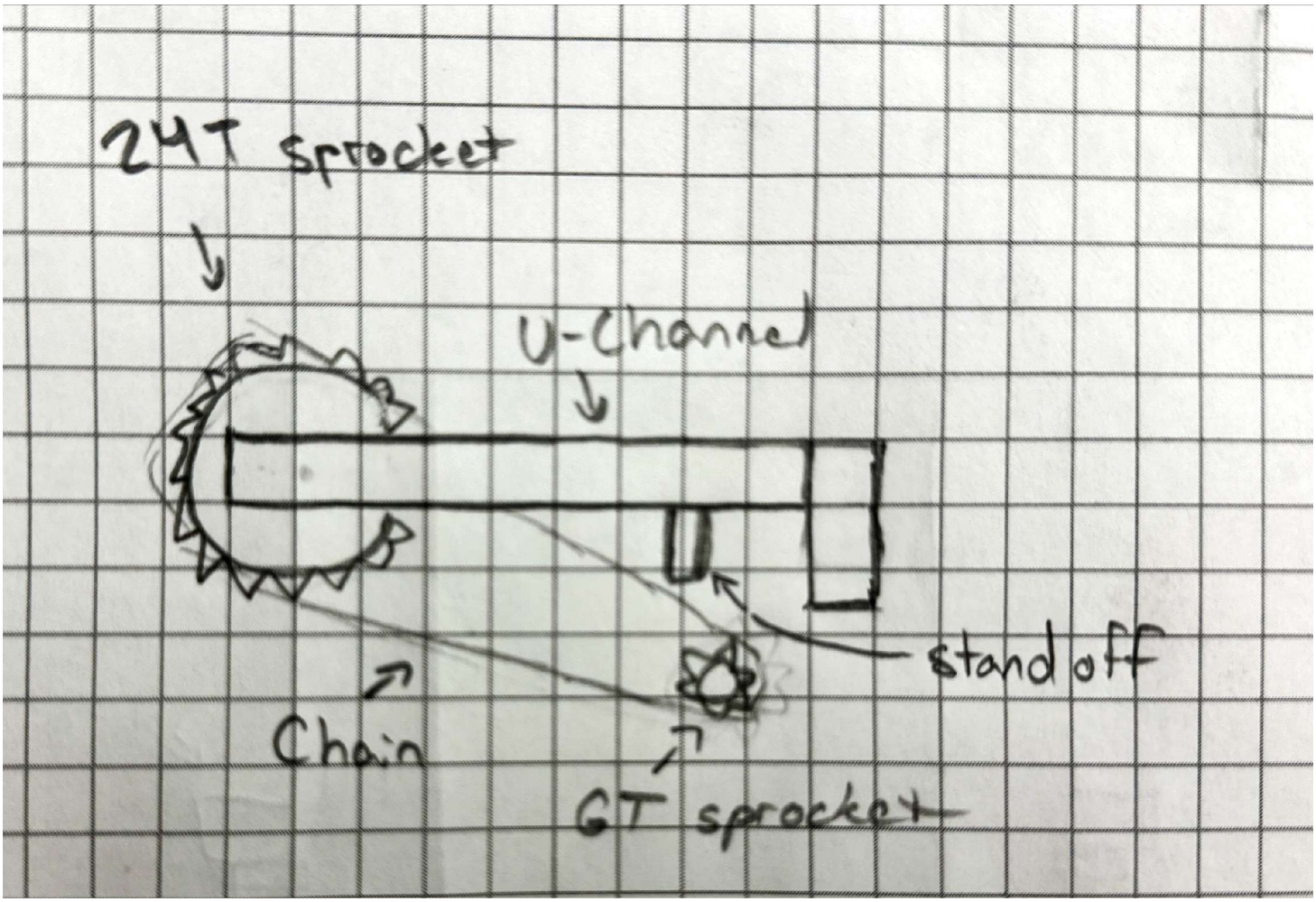
We decided to go with the most painless upgrade and easiest to implement

We added standoffs at the lower end of the U Channel to create a lower hang point on the arms

This will possibly center the point that the robot hangs from and hopefully fix our unbalanced problems



Sketch Plan

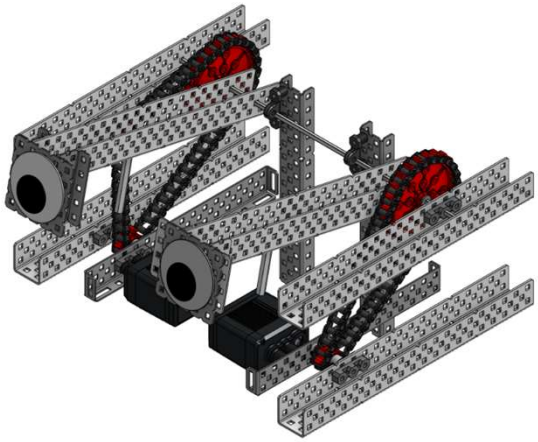


CAD Plan

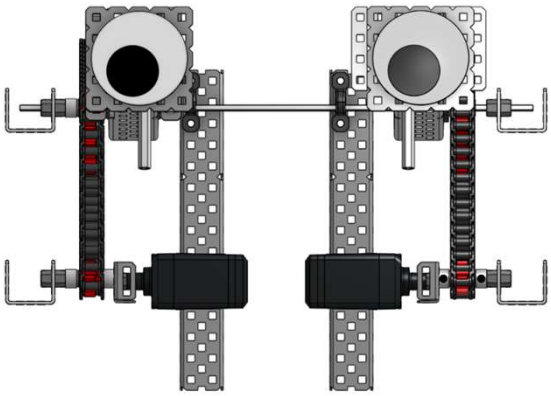
SELECT AND PLAN

[TOP VIEW]

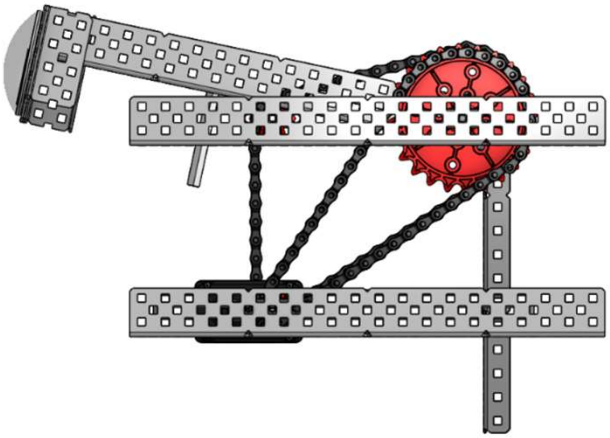
[ISOMETRIC VIEW]

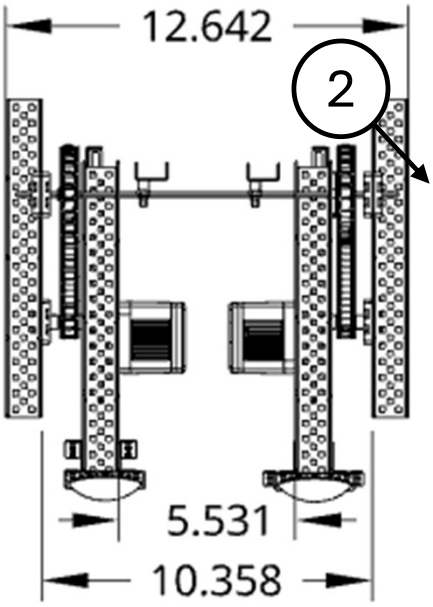


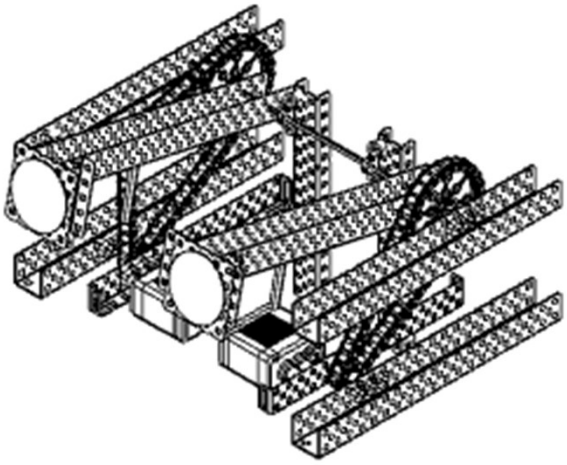
[FRONT VIEW]

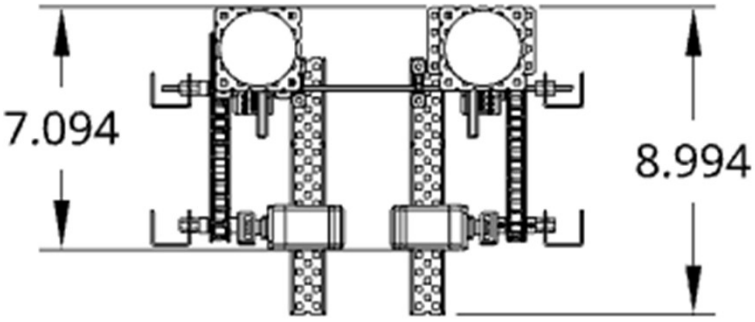


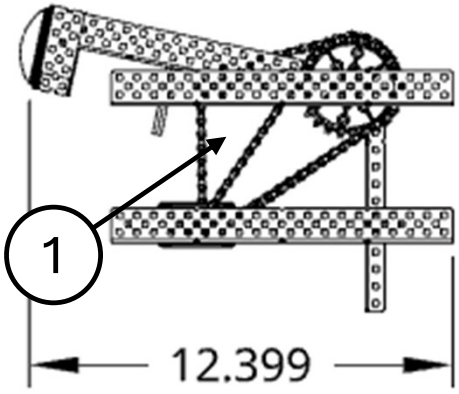
[SIDE VIEW]











Elevation Improvement BOM

Item	Quantity	Part #
See BOM from page_	n/a	n/a
2” Standoffs	2	1
Lock Plate (Not Mentioned on last BOM)	2	2

SELECT AND PLAN

BUILD SOLUTION

Elevation Improvement

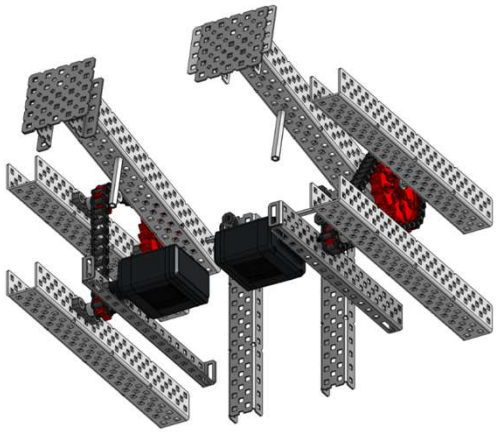
BUILD SOLUTION

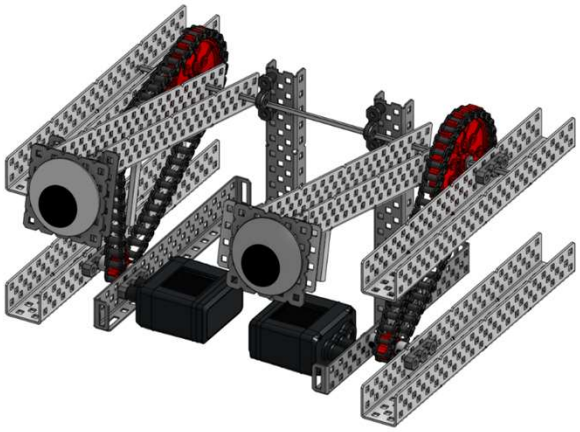
Goal

We will build our planned solution for the Elevation so that we can test its performance.

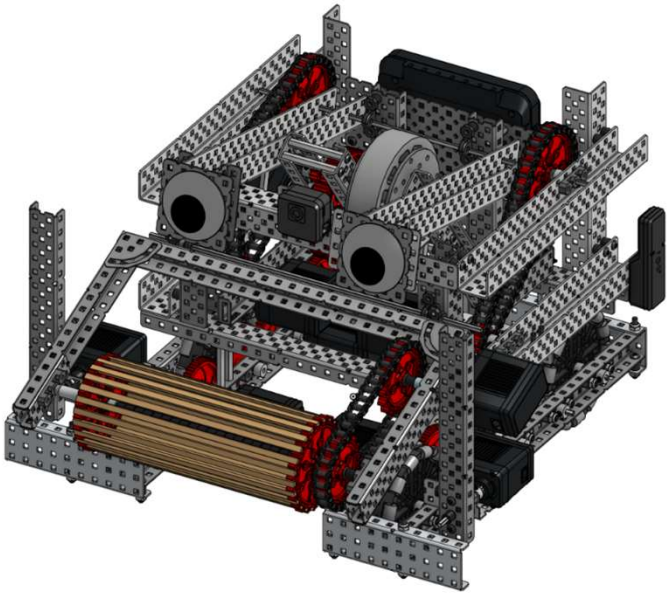
Process of Assembly

Add (2) 2” Standoffs to the U-Channels as shown





2.4” Googly-Eyes for cosmetic purposes



Elevation Improvement viewed with robot

TEST SOLUTION

Elevation Improvement

Goal

We test the performance and reliability of our Elevation Improvement

Testing

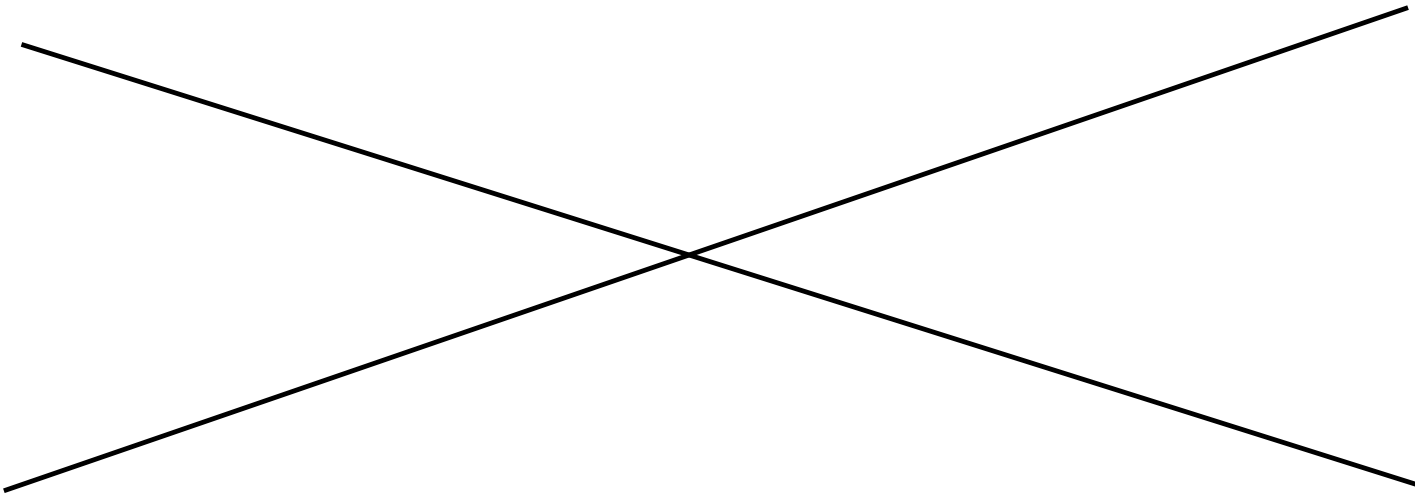
After our previous incident with the robot falling forward, adding standoffs to both U-Channels helped solve the problem. By keeping the mass of the robot more centered, the robot was able to successfully lift itself off the ground, leaving a large enough space to see that it is clearly elevated.

To get this result, we tested different placements for the Standoffs. During our first Trial, the Standoff was approximately at the 5” mark on the U-Channel. At this level, it could not successfully get over the Horizontal Elevation Bar.

Our second Trial had the standoffs placed around the 3.75” Mark on the U-Channel. This distance gave us enough clearance to have the standoffs reach overtop of the Horizontal Elevation Bar.

When testing the Elevation Abilities, we were surprised to find that this worked extremely well. We tested this 4 more times with the same results.

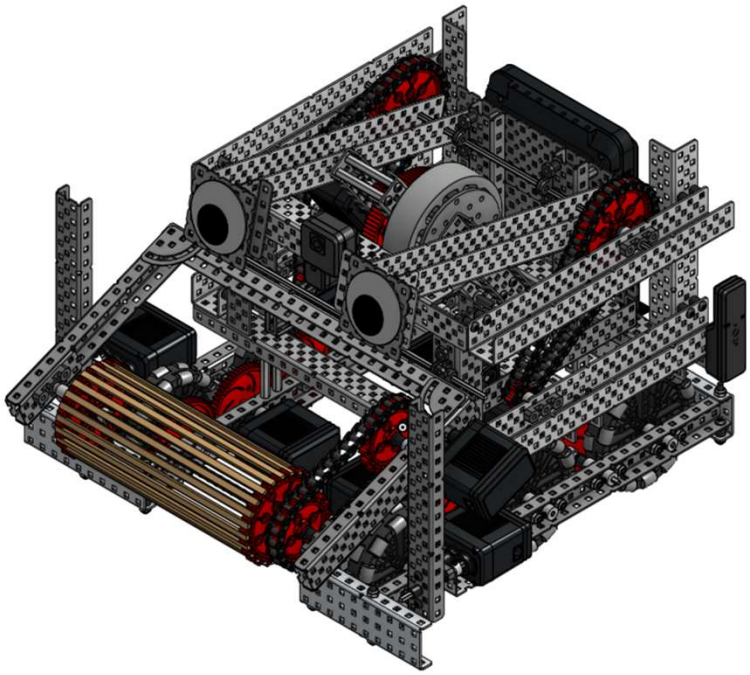
There was no leaning forwards or backwards, and our robot was successfully elevated.

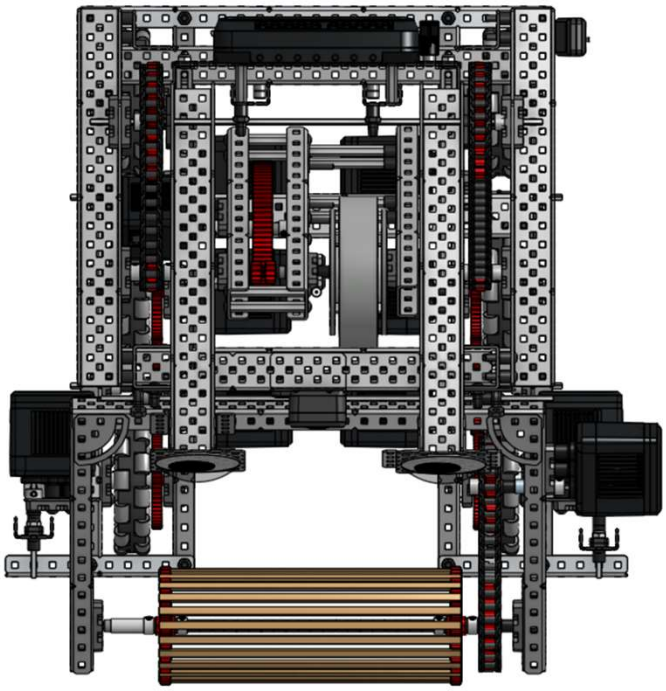


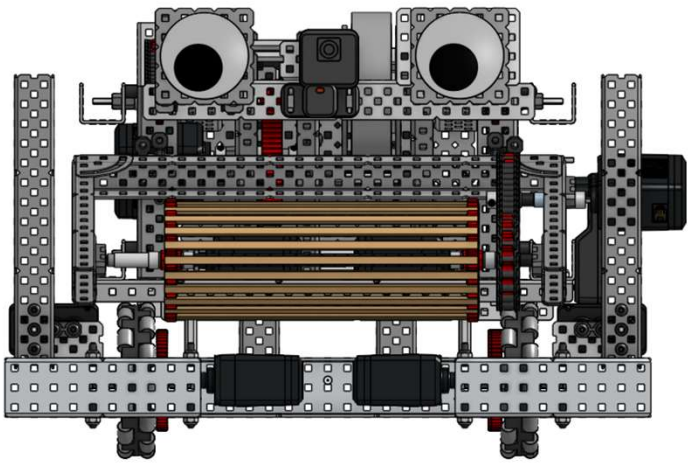
FINAL DESIGN

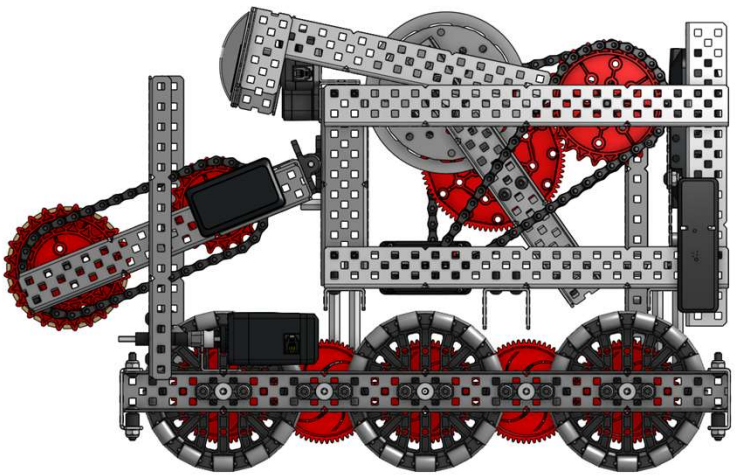
Our Robot for the 2023-2024 SkillsUSA State Competition

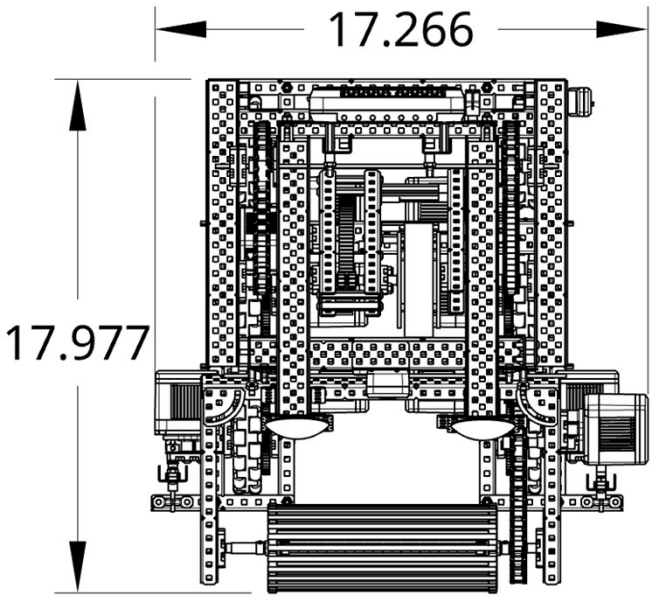
CAD Model







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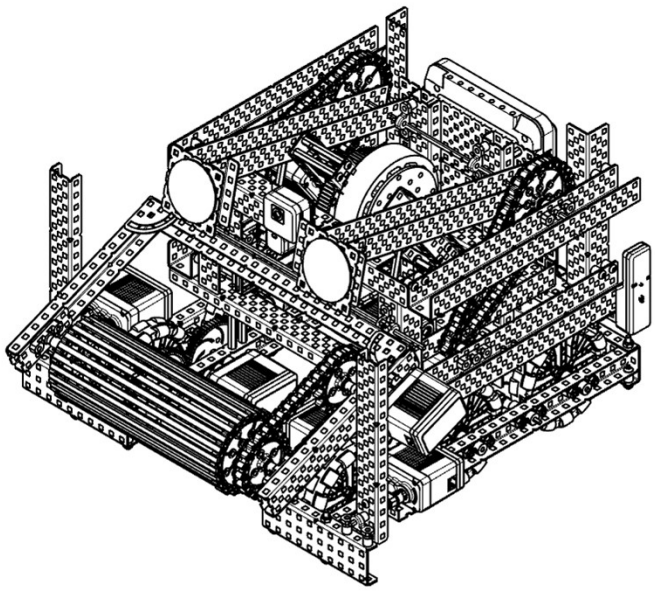

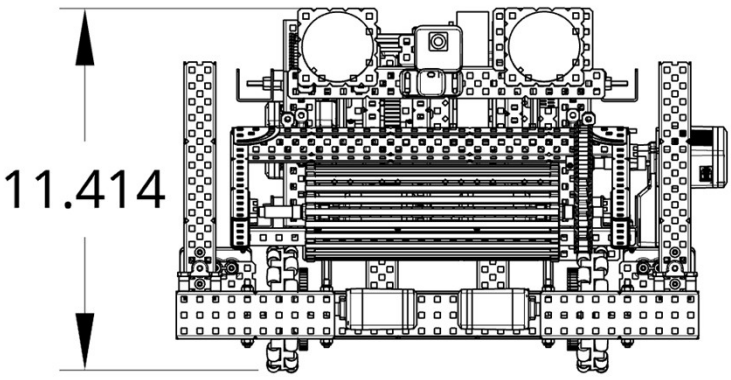
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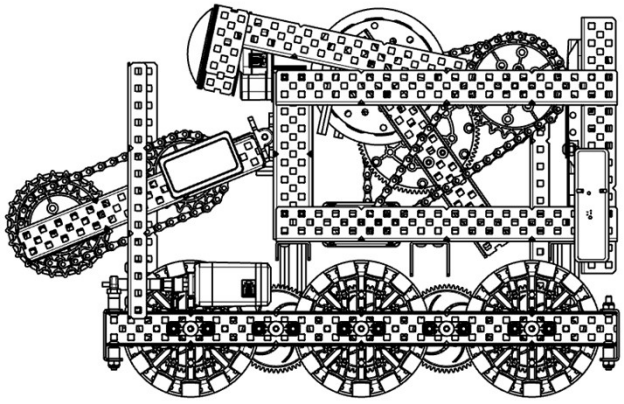
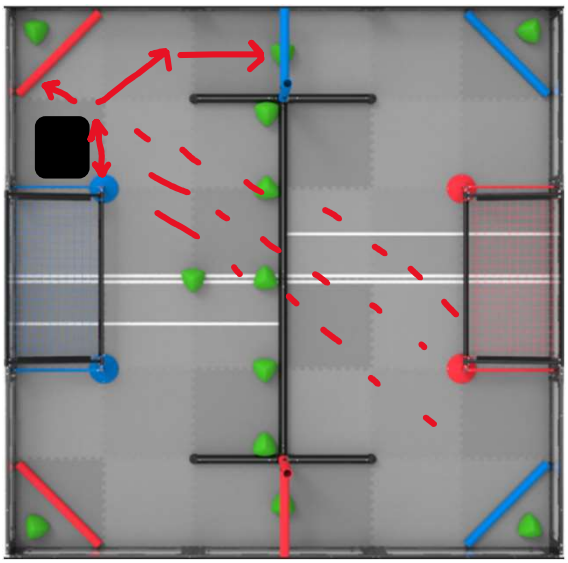


PROGRAM SOLUTION

SkillsUSA Autonomous Coding Skills Matches



Steps

Start

Push Triball in and reverse out of goal

Have robot use GPS sensor to line up back with loading zone

Reverse to break loading zone area

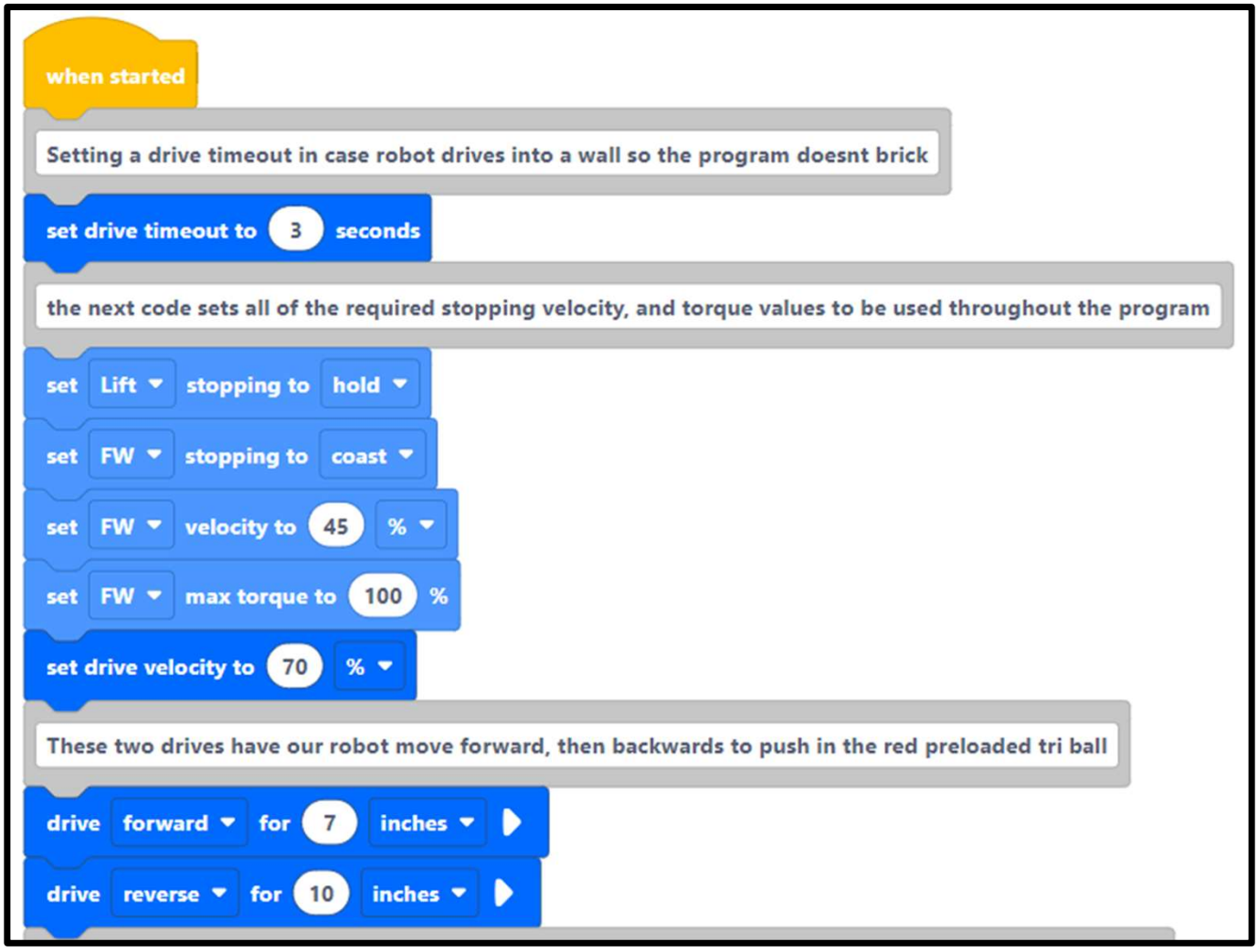
Spin up Flywheel and start shooting Triballs over

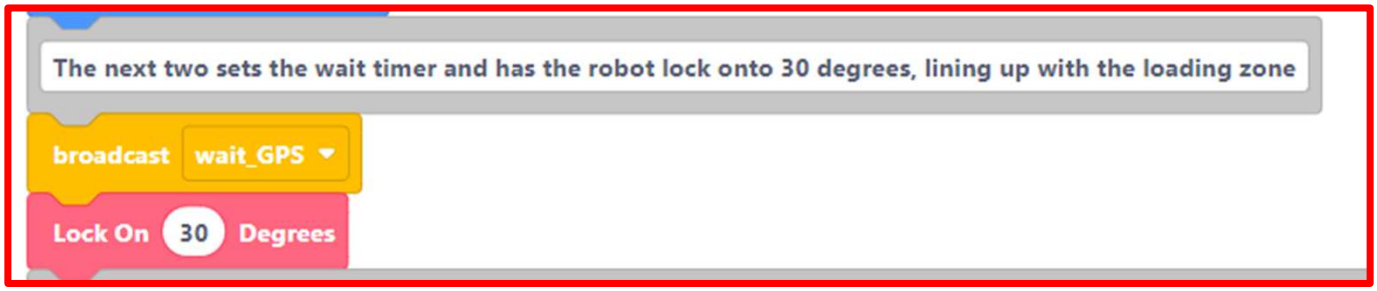
Use GPS sensor to turn to about 30 degrees

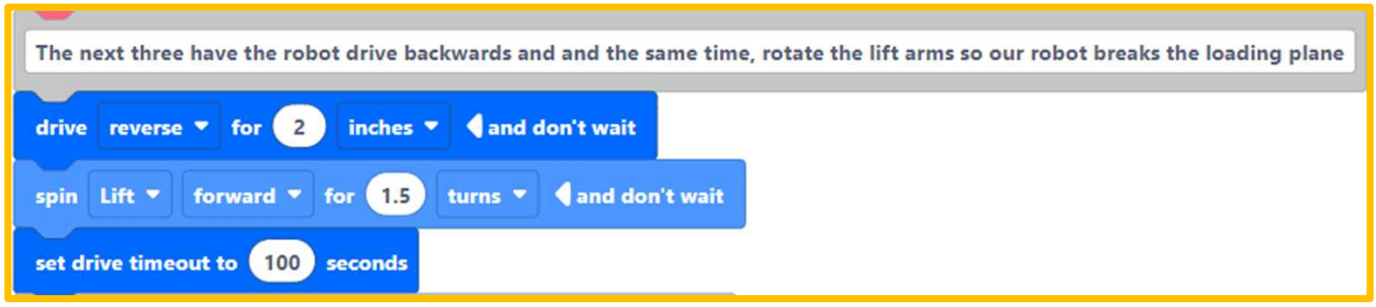
Drive forward and use GPS sensor to face 0 degrees

Drive forward and hang on the hang bar

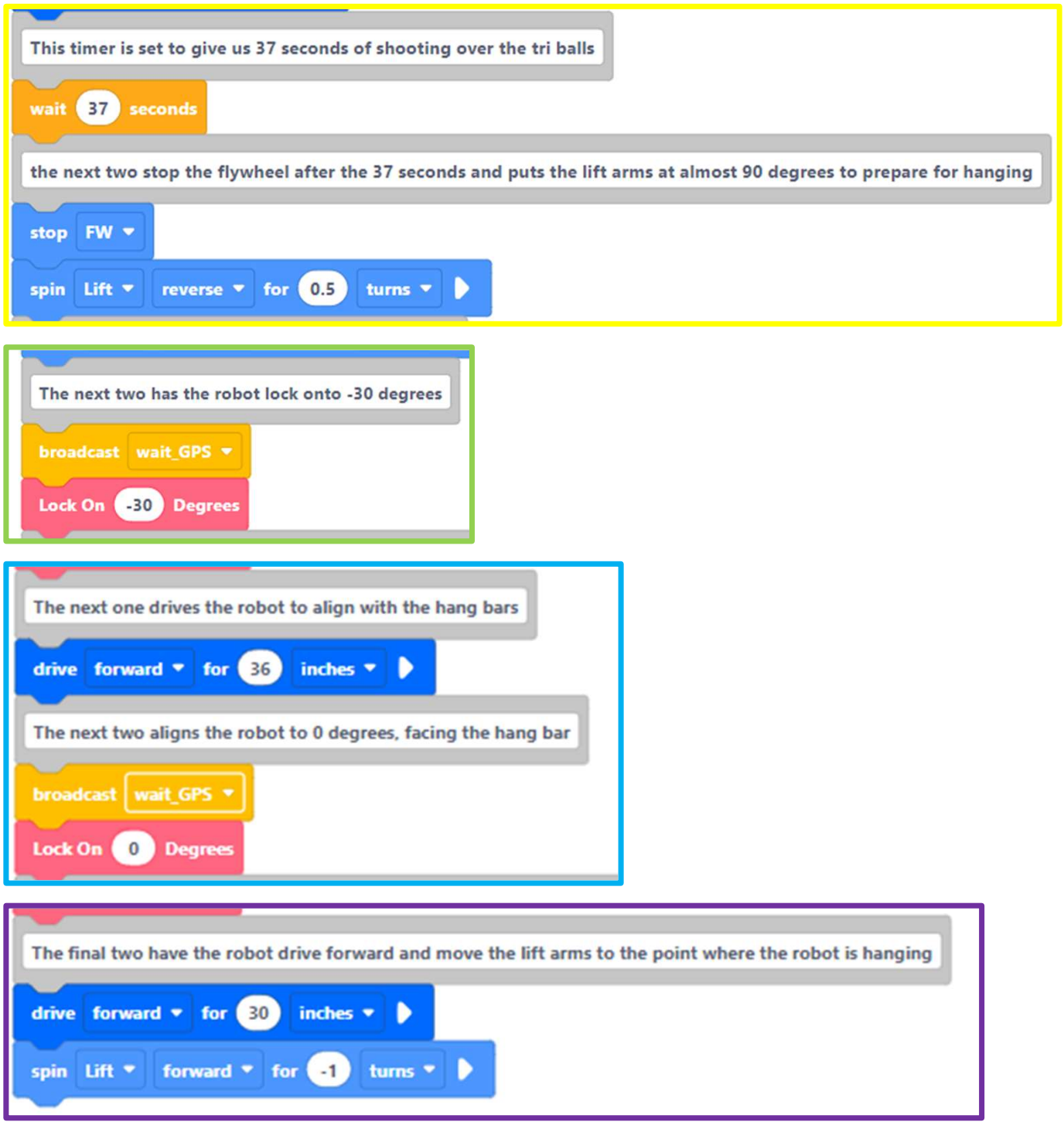
Code


when started
Setting a drive timeout in case robot drives into a wall so the program doesnt brick
set drive timeout to 3 seconds
the next code sets all of the required stopping velocity, and torque values to be used throughout the program
set Lift stopping to hold
set FW stopping to coast
set FW velocity to 45 %
set FW max torque to 100 %
set drive velocity to 70 %
These two drives have our robot move forward, then backwards to push in the red preloaded tri ball
drive forward for 7 inches
drive reverse for 10 inches


The next two sets the wait timer and has the robot lock onto 30 degrees, lining up with the loading zone
broadcast wait_GPS
Lock On 30 Degrees


The next three have the robot drive backwards and and the same time, rotate the lift arms so our robot breaks the loading plane
drive reverse for 2 inches and don't wait
spin Lift forward for 1.5 turns and don't wait
set drive timeout to 100 seconds

Code Continued



Functions and Extras

Functions and Extras Cont.