Superquest fall 2019: Oregon VEX Idea Factory

Approximate Schedule

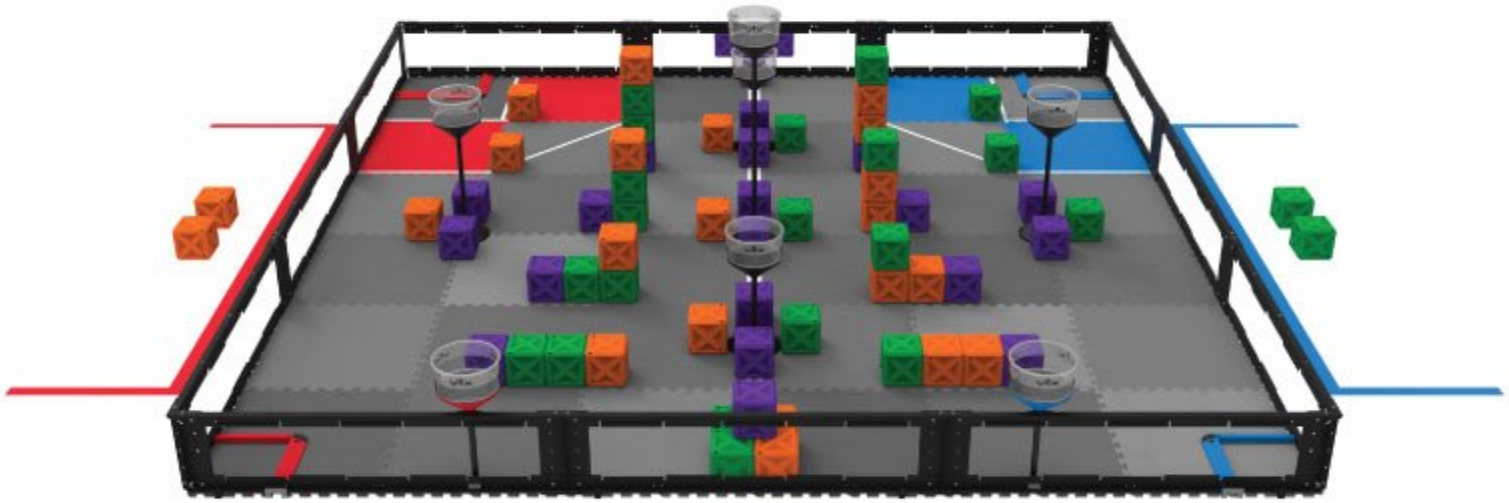
Students will be available to help your teams get going throughout the event.

- 9:00 Welcome/ Opportunities
  - Introductions
  - VEX in Oregon Program Overview
  - SkillUSA Mobile Robotics Technology/ Urban Search and Rescue
- 10:30 Best Practices: Drive systems, arms, manipulators.
- 12:00 Lunch
- 1:00 After Lunch Teams Select what would help your team the most

Computer Lab (A116)	Fabrication Lab (A117)
VEXCode	Build, practice, Scrimmage
Getting Started: Write/compile and download first program	Build, practice, Scrimmage
Autonomous Motion	Build, practice, Scrimmage
Driver Control Coding	Build, practice, Scrimmage
Using the Competition Template	Build, practice, Scrimmage
Scrimmage	Scrimmage

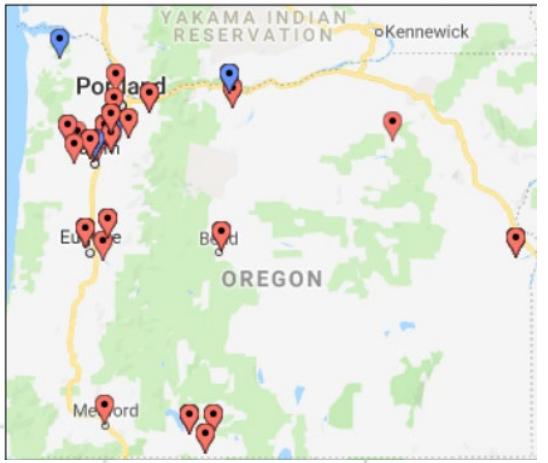
9:00 Welcome

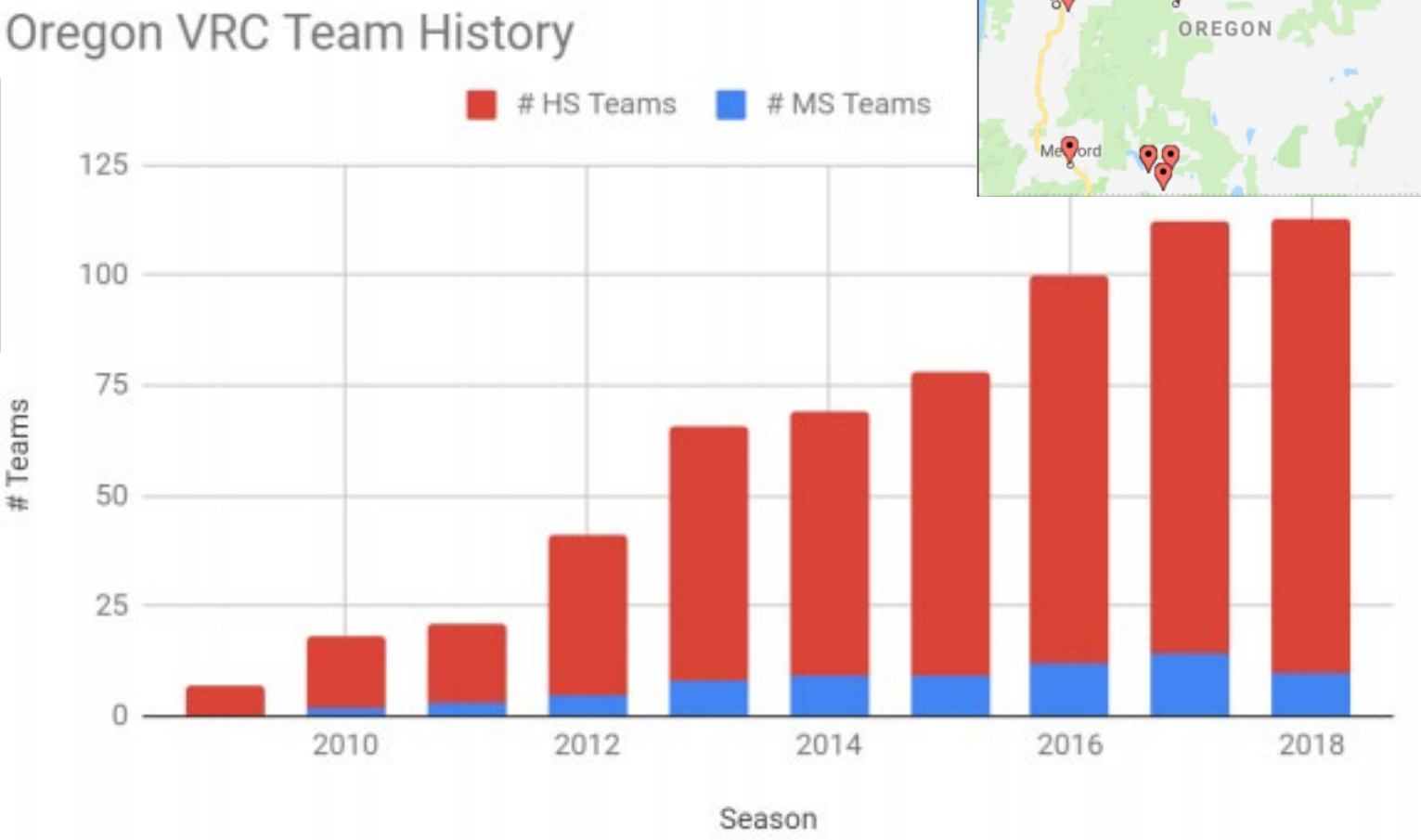
- Introductions
  - Name, School, Experience



VEX in Oregon

As of last night
80 HS VRC Teams
23 Middle School VRC Teams





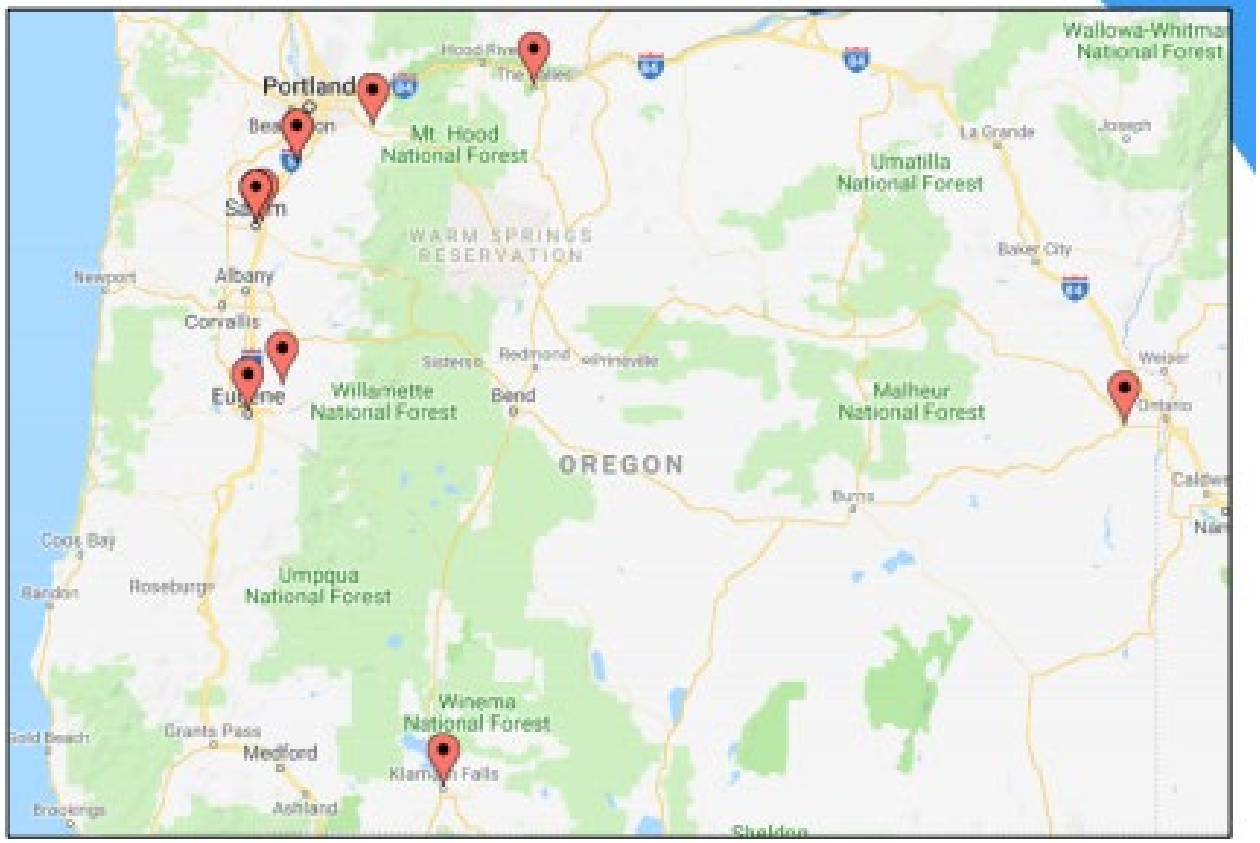
Season	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
# MS Teams	0	2	3	5	8	9	9	12	14	10
# HS Teams	7	16	18	36	58	60	69	88	98	103

Tournaments Last Season

2018 – 2019 VRC Events

Summary:

- **11 Qualifying Tournaments**
- **1 League**
- **State Championship (MS/HS)**
- **9 Event Partners**



Events per Team
(Excludes teams with no events)

	HS	MS
AVG	4.6	3.9
MIN	1	1
MAX	9	6

Tournament Qualifying Criteria

No significant changes:

- Deadline to post a qualifying event is October 1, 2019. Team registration must be open 8-weeks prior the event.
- Event must include a minimum of 16 teams, 6-organizations or no more than 33% from one organization (not including invitational only events). League criteria only includes 16 team minimum, but number of state championship spots are related to league diversity and size.
- Must follow Game Manual rules and Judge's guide/rubrics. Events that offer Excellence award must offer Design Award. A minimum of 10 teams per grade level to offer separate Excellence Awards (State Championship is excluded).
- Events that do not include judged awards may include (2) Teamwork/Tournament Championship and possibly (1) Robot Skills Champion State Championship spot.
- Events with 24 or more registered teams must offer Robot Skills. **Events must offer exactly (3) Driver and (3) Programming Robot Skills attempts.**
- Organizations that host an Invitational Only event must host another equal sized or greater tournament the same season in the same program following all criteria. Number of qualifying spots will be determined by RSM and will depend upon the event size and diversity.

VEX Tournaments in Oregon/Vancouver

- 11/9/2019 West Salem (Filled)
- 11/14/2019-2/26/2020 Salem VEX League
- 11/23/2019 North Marion HS
- 1/11/2020 Sandy HS
- 1/18/2020 North Marion
- 1/24/2020 West Salem HS Friday Night
- 1/25/2020 West Salem Saturday (Filled)
- 2/1/2020 Klammath Falls
- 2/8/2020 Willamette High School (Eugene)
- 2/8/2020 Vancouver, WA (Invitation only. Middle school focus)
- 2/15/2020 The Dalles
- 2/21/2020 Vale
- 2/22/2020 Marcola
- 2/22/2020 Vancouver, WA
- 3/14-3/15/2020 State Championship: Chemeketa CC (Salem)
- 3/14-3/15/2020 SkillsUSA State Leadership Conference
- 4/22-4/25/202 VEX World Championship Louisville, KY

Register ASAP!

Qualifying Event Schedule / Info.

- Typically 5 Randomly Selected 2 vs. 2 Qualifying matches
- Teams are ranked by their performance
  - Win/Loss Record
  - Autonomous Points (Bonus to alliance that wins 15 second autonomous period)
  - Strength of Schedule (Sum of scores of losing alliances for your matches)
- Team Interview
  - All teams in the pits
- Skills Challenge: (Up to 3 drivers and 3 programming per event)
  - 1-Minute Programming and 1-Minute Driving. Scores are added to give total score. Usually first come first served while the qualifying matches are occurring sometimes with a limited number of runs.
- Alliances are selected (Tournaments will have up to 16 Alliances)
  - Start at the top seeded team
  - Pick an alliance partner (Yes – Join, No – cannot be picked by anyone else)
  - First alliance to win advances, losing alliance is eliminated.
- Awards Ceremony

Tournament Structure: Elimination Rounds

- **Still Best-of-One for Qualifying Events, but BO3 for Finals match at State Championship.**
- **NEW: Number of Alliances**
  - Tournaments with less than twenty-four (24) teams will have eight (8) or more alliances in the Elimination Rounds.
  - Tournaments with twenty-four (24) to thirty-one (31) teams will have twelve (12) or more alliances in the Elimination Rounds.
  - Tournaments with thirty-two (32) or more teams will have sixteen (16) alliances in the Elimination Rounds.

Judged Awards Given at Events

- Judges
  - Team that deserves special recognition for efforts leading up to, and during, the event
- Robot Skills: (Some events)
  - Team with top combined Driving and Programming Skills Challenge score
- Design (Engineering Notebook Required, top 5 or 20% considered)
  - Team with a professional design approach (i.e. Engineering Notebooks!)
- Excellence (Engineering Notebook Required, top 5 or 20% considered)
  - Looking at teams with the top 5 or 20% based on Engineering Notebook.
  - Considers…
  - Rank after Qualifying Rounds
  - Rank in Skills Challenge
  - Awards where they were considered as finalists
  - Usually judges narrow it down to the top few and then talk with referees/judges

Qualifying for State Platinum High School Division

- **VRC Non-Judged Qualifying Events / Leagues:**
- (2) Tournament Champions
- **VRC Judged Qualifying Events (<30 Registered Teams):**
- (1) Excellence
- (2) Tournament Champions
- **VRC Judged Qualifying Events (30+ Registered Teams):**
- (1) Excellence
- (2) Tournament Champions
- (1) Design
- (2) Tournament Finalists

Middle School has a Separate State Championship!

- All middle school teams qualify for the Middle School State Championship!
- This is the first year for a separate Middle School State Championship!!!

State Gold Division

- All teams that do not qualify for State Platinum Division qualify for the State Gold Division.
- It is recommended that teams compete in at least two events.
- Gold Division teams cannot qualify for Worlds based on their performance at State. Either by performance at this event or by Skills Challenge scores at this event.
- A Gold Division team could potentially qualify for Worlds if they had a strong official Skills Challenge score posted before state.


Oregon State Championship

Worlds Qualifying Slots

2020 VEX World Championship

Louisville, Kentucky

VRC & VEX U: April 22 – 25

VEX IQ: April 26 – 28

Increasing capacity from 1600 to 2400 teams!

VEX World Championship Spots	
VEX IQ – Elementary School	3
VEX IQ – Middle School	3
VRC – Middle School	1
VRC – High School	9

NOTE: Spots will be updated January, 2020

How Worlds Spots are Allocated

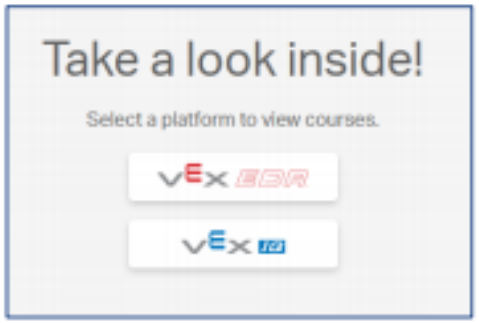
Spot Level	Excellence Award	Tournament Champions	Design Award	Robot Skills Champion	Tournament Finalists	Semi Finalist	Amaze, Think, Innovate, Build, Create**
1 Spot	1	-	-	-	-	-	-
3 Spots	1	2	-	-	-	-	-
4 Spots	1	2	1	-	-	-	-
5 Spots	1	2	1	1	-	-	-
6 Spots	1	2	1	-	2	-	-
7 Spots	1	2	1	1	2	-	-
10 Spots	1	2	1	-	2	4	-
11 Spots	1	2	1	1	2	4	-
12-16 Spots	1	2	1	1	2	4	1-5

- This could change in January depending on this season's registrations
- The **last two High School spots** will be taken from the **Oregon Robot Skills** list

Referee Certification

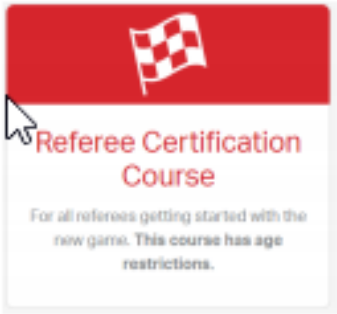
Referee Certifications

1. https://certifications.vex.com
2. **Login / Register**
3. **Scroll to the bottom of the website and select program:**



4. **Start Referee Certification Course**

VRC / VEXU



VIQC

5. **Referee Certification requires scoring 80% or better. User will receive printable certificate with QR code and access to Referee forum.**

SkillsUSA Mobile Robotics Technology

- **SkillsUSA: Mobile Robotics Technology**
- Teams of 2
- Cost: +/- $70/Person for State
- Uses the same field elements as VRC
- Less restrictive on parts. 3D printed parts can be used.
- Includes resume, presentation
- More industry focus
- At Nationals you bring your robot (new last year)

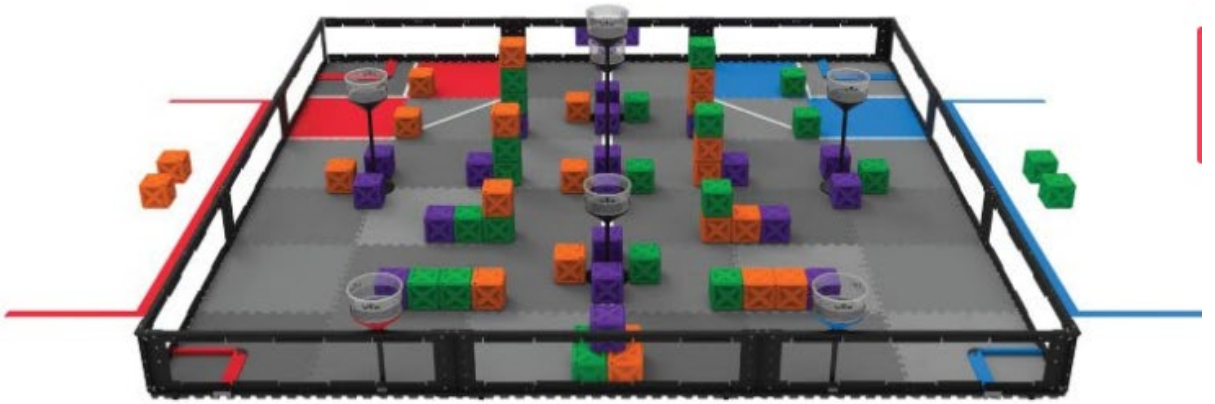
SkillsUSA Urban Search and Rescue

- **<u>SkillsUSA: Mobile Robotics Technology</u>**
- Teams of 2
- Cost: +/- $70/Person for State
- No programming
- Camera mounted on Robot
- Find and pick up ordinances and place into a bucket.
- Several robot platforms can be used. Most were Tetrix, several VEX and some totally custom.

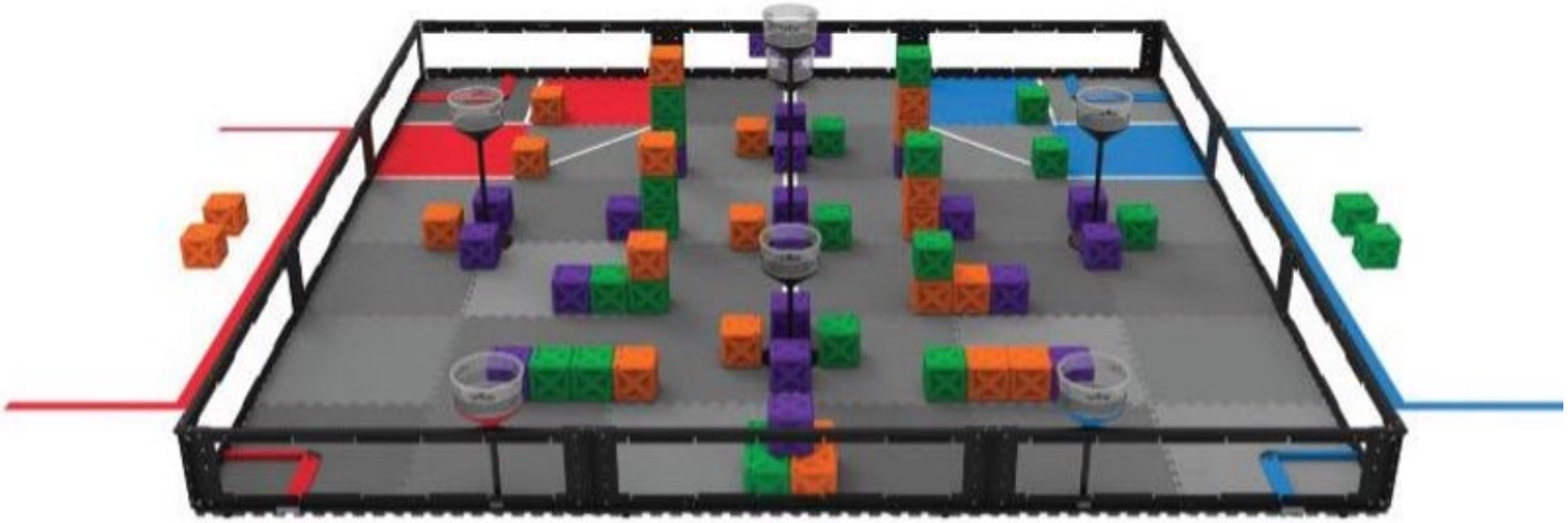
10:00 The Challenge: Tower Takeover Game and Rules

- It all starts with a challenge…
- VEX Turning Point Page
- Video of Challenge

VEX ROBOTICS COMPETITION TOWER TAKEOVER



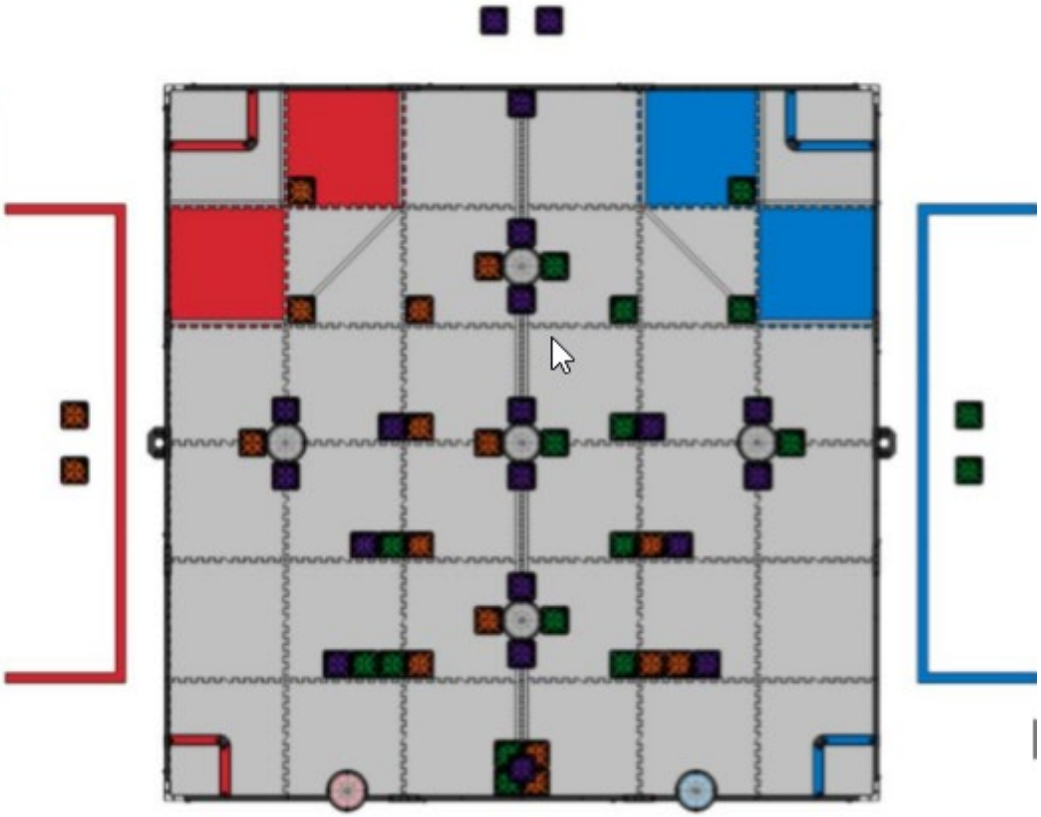
Game Overview



- 2 Red Robots vs 2 Blue Robots
- Robots starting size no larger than 18”X18”X18”
- Robots can start anywhere along Alliance Starting Wall
- Once a match begins robots can expand
- Robots cannot cross middle of field in autonomous!
- Must start with preloaded Cubes
- Objective of game is to stack Cubes in a Goal Zone

Scoring

Number of Placed Cubes in a Tower of a Color	Point Value for Cubes of that Color
0	1
1	2
2	3
3	4
4	5
5	6
6	7
7	8



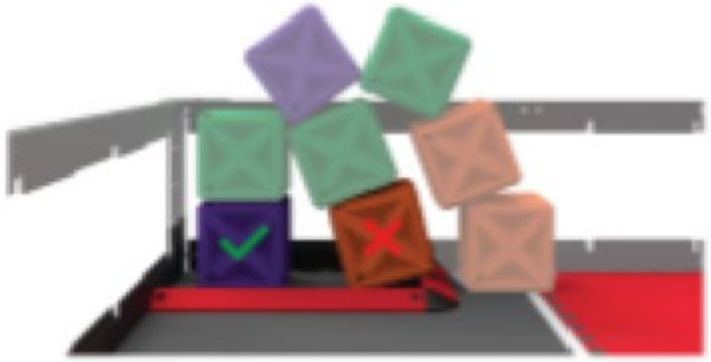
Each Green Cube Scored in a goal	1 point + 1 point for every Green Cube Placed in Towers
Each Orange Cube Scored in a goal	1 point + 1 point for every Orange Cube Placed in Towers
Each Purple Cube Scored in a goal	1 point + 1 point for every Purple Cube Placed in Towers
Autonomous Bonus	6 points

Scored Cube

Scored - A Cube status. A Cube is considered Scored in a Goal Zone at the end of a Match if it is not contacting a Robot of the same Alliance color as the Goal Zone, and meets the criteria of being either a Base Cube or a Stacked Cube.

• **Base Cube** - A Cube status. A Cube is considered a Base Cube if it meets the following criteria at the end of the Match:

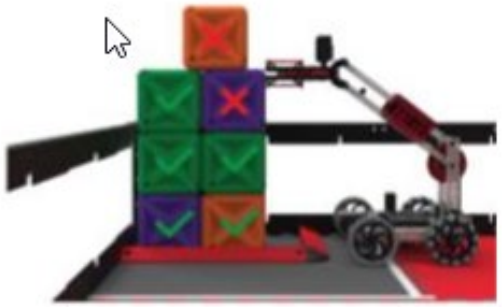
1. Contacting the gray foam tile within a Goal Zone.
2. 2. Level or “flush” with the gray foam tile.

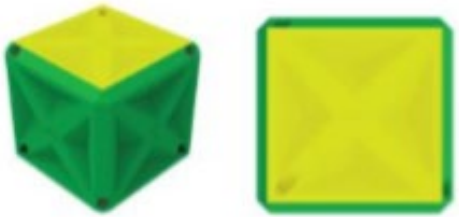


Stacked Cube

Stacked Cube - A Cube status. A Cube is considered a Stacked Cube if it meets the following criteria at the end of the Match:

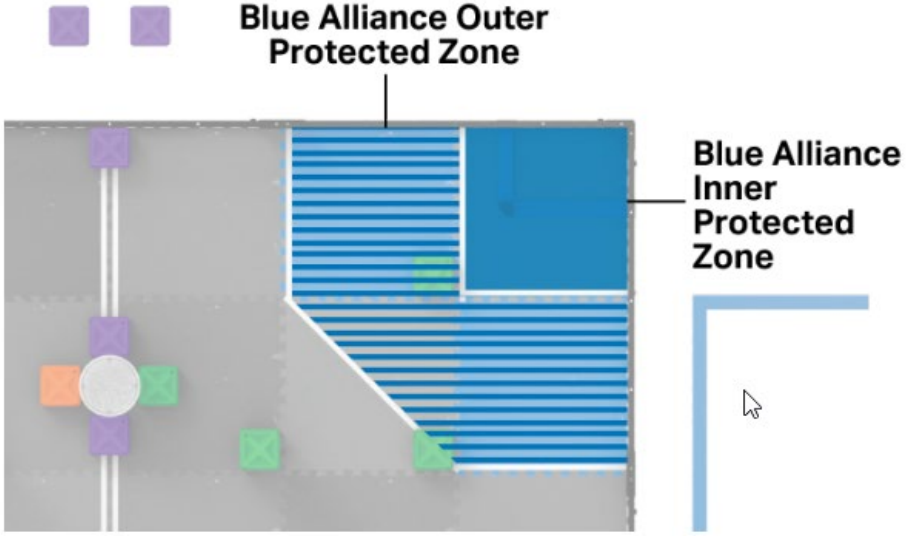
1. Contacting the Top Surface of a Base Cube or Stacked Cube.
2. Not contacting the top of the field perimeter wall.
3. Not contacting the Top Surface of any Cubes which are not Scored.





Be Careful!!!

GAME RULES



<SG3> Stay away from your opponent's protected areas. *Robots* may not intentionally or accidentally, directly or indirectly, perform the following actions:

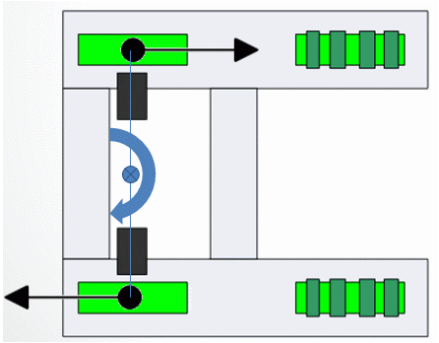
Case	Action	Violation
A	Contact an opponent *Robot* which is fully contained within their *Protected Zone*.	Minor violations of points A, B, C, or D that do not affect the *Match* will result in a warning. *Match Affecting* offenses will result in a *Disqualification*. *Teams* that receive multiple warnings may also receive a *Disqualification* at the *Head Referee*'s discretion.
B	Contact any *Scored Cubes* in either of opposing *Alliance*'s *Goal Zones*.	
C	Contact any *Placed Cubes* in the opposing *Alliance Tower*.	
D	Contact either of the opposing *Alliance*'s *Goal Zones* or *Barriers*.	
E	Contact an opposing *Alliance*'s *Inner Protected Zone*.	Any violation of points E, F, or G will result in a *Disqualification*, whether the interaction was *Match Affecting* or not.
F	Cause *Scored Cubes* within the opponent's *Protected Zone* to no longer meet the definition of *Scored* (i.e. "knock over their stack").	
G	Cause a *Cube* which is *Placed* in the opposing *Alliance Tower* to no longer meet the definition of *Placed* (i.e. "remove it from the *Alliance Tower*").	

11:00 Best Practices Drive Trains simplerobotics.org

- Drive Train Samples
  - Show robots from Teams
  - Simple Robotics Comparison

Skid Turn: Two Wheel Drive

2 wheel drive - This type of drive has only two wheels driven each wheel , driven by at least one motor A K A 2 wheel tank .(. . .)



Pros-

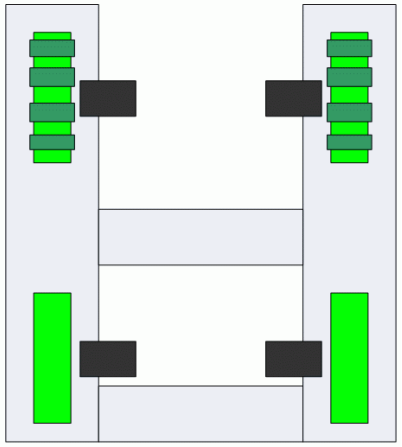
- simple to build
- very flexible
- Not easy to push from side if traditional wheels are used

Cons –

- more difficult to control than other options
- the non driven wheels take weight off of the drive wheels -
- limited power in the drivetrain

Summary: Good for starters

Skid Turn: 4-6 Wheel Drive



Pros : Relatively Simple: Common at Competitions

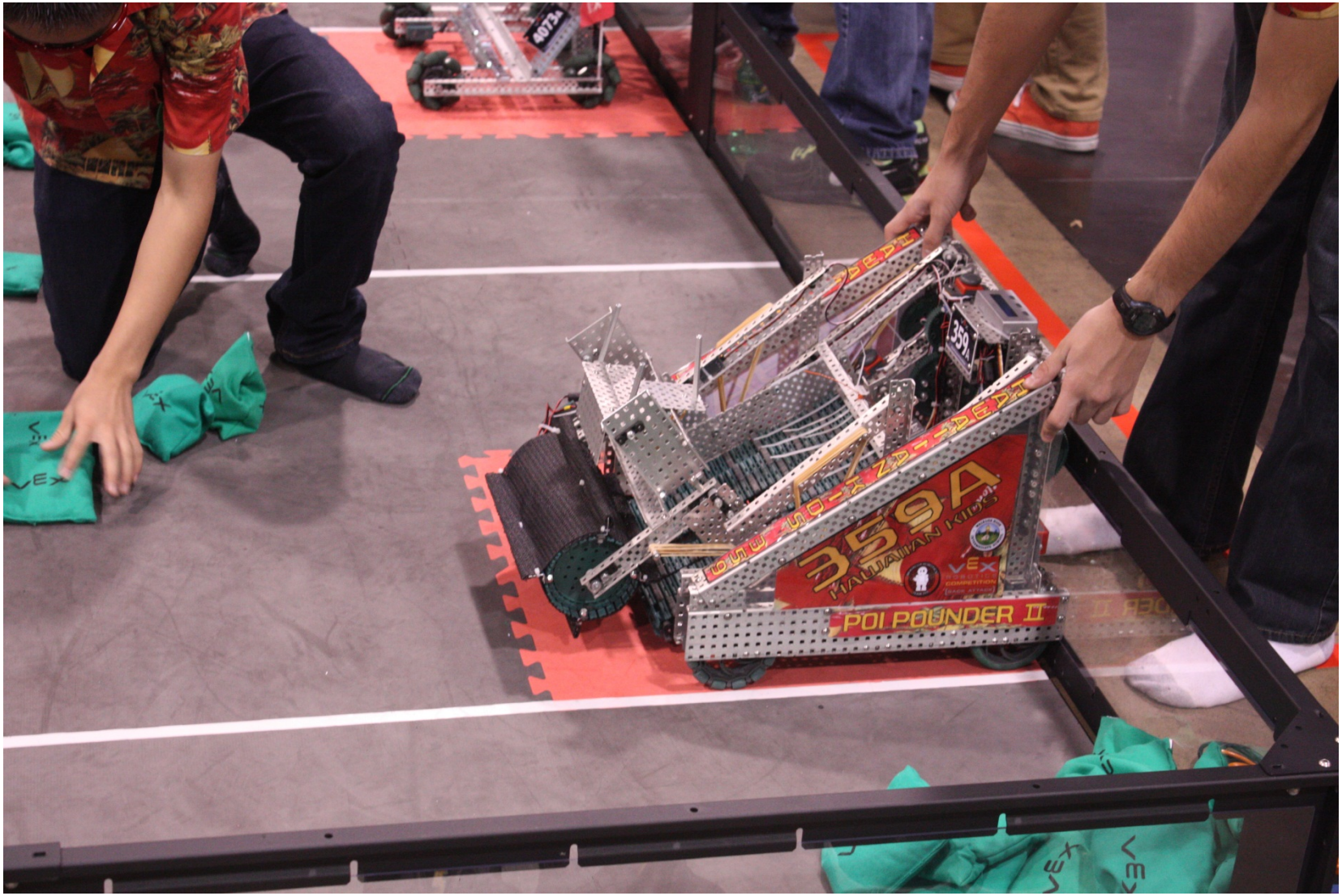
- relatively simple to build
- can utilize multiple motors
- used by many strong teams
- Not easy to push from side if traditional wheels are used

Cons:

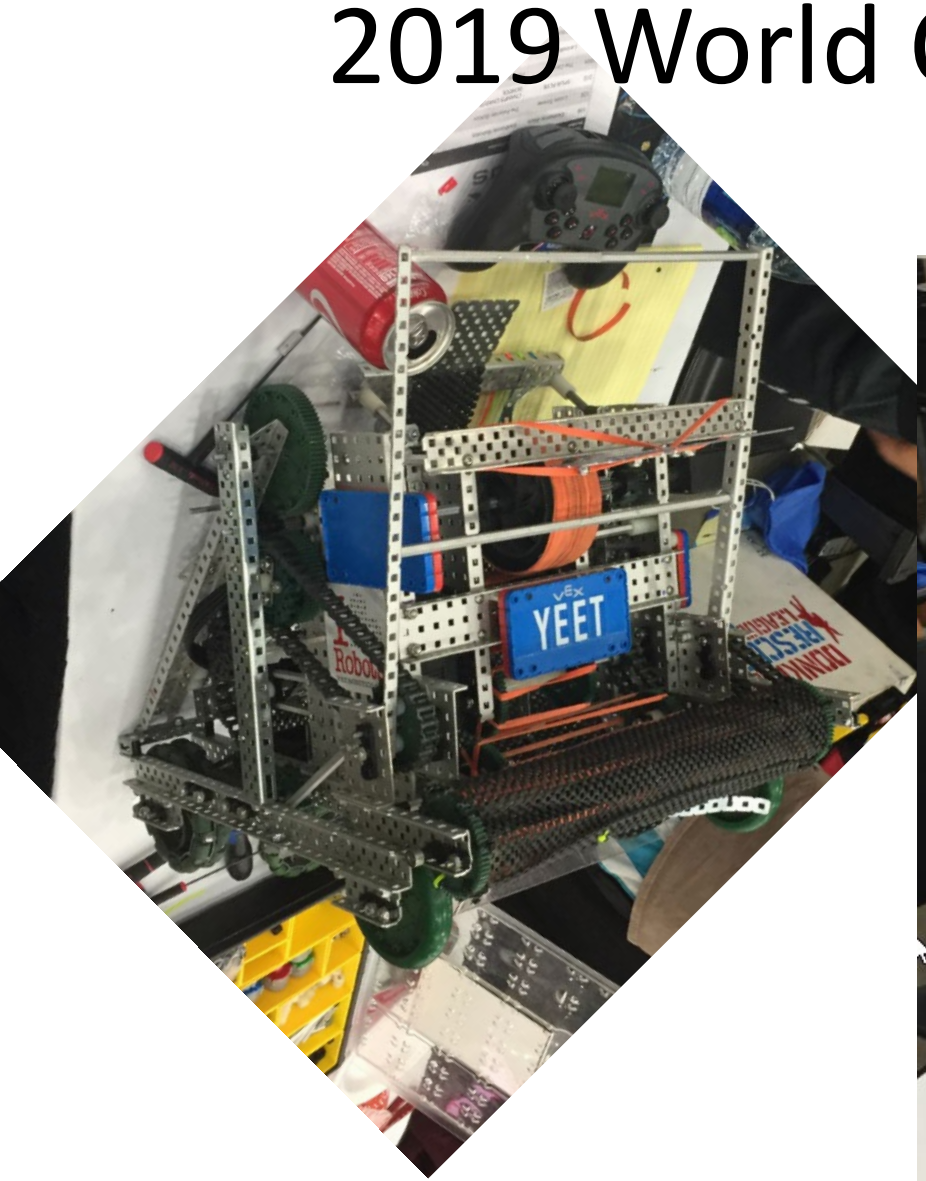
- if gears are used the distance between drive shafts are determined by the gears used
- multiple motors draw more current and use up motor ports on controller
- Can be more difficult to repair and more components to fail
- all the drive wheels need to be close to the same size or they will fight with one another

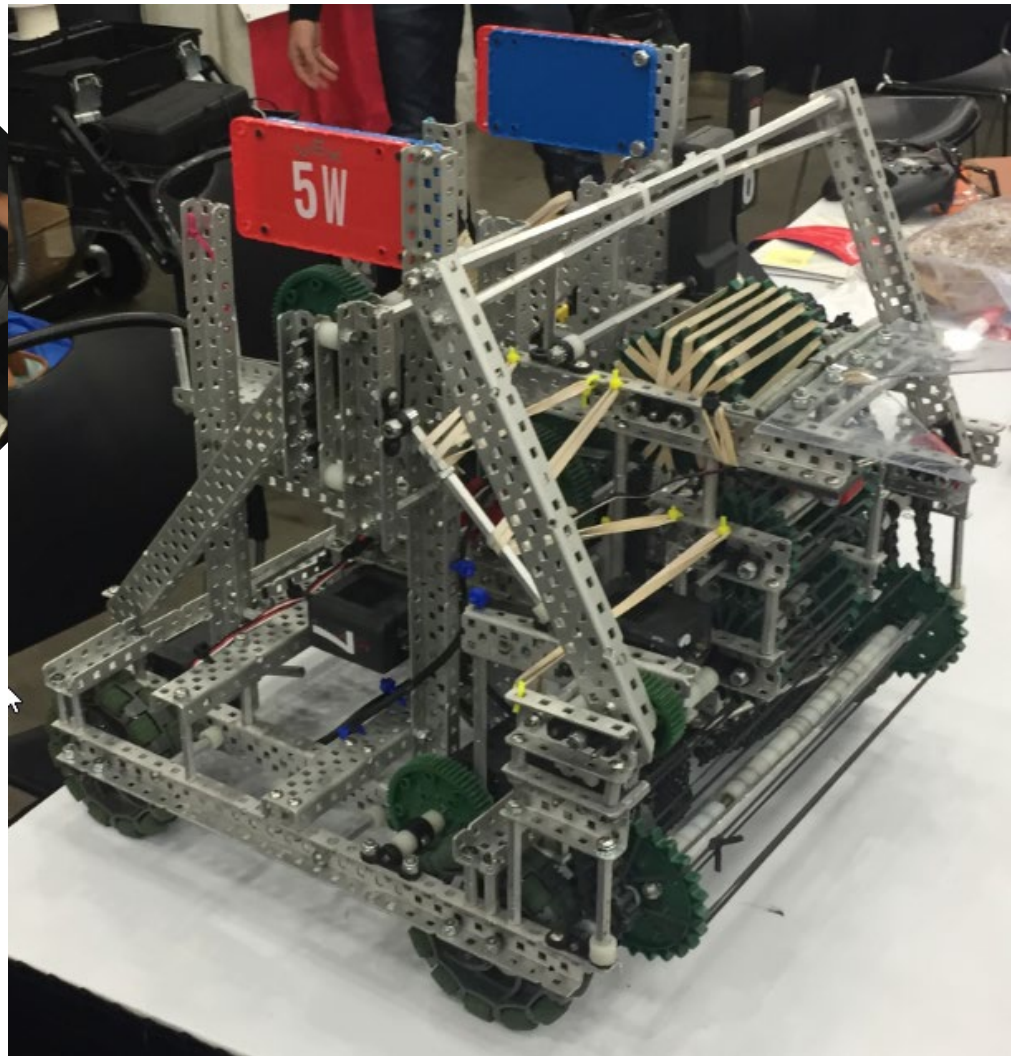
Summary: Strong, relatively simple

Example: Four Omni Wheels

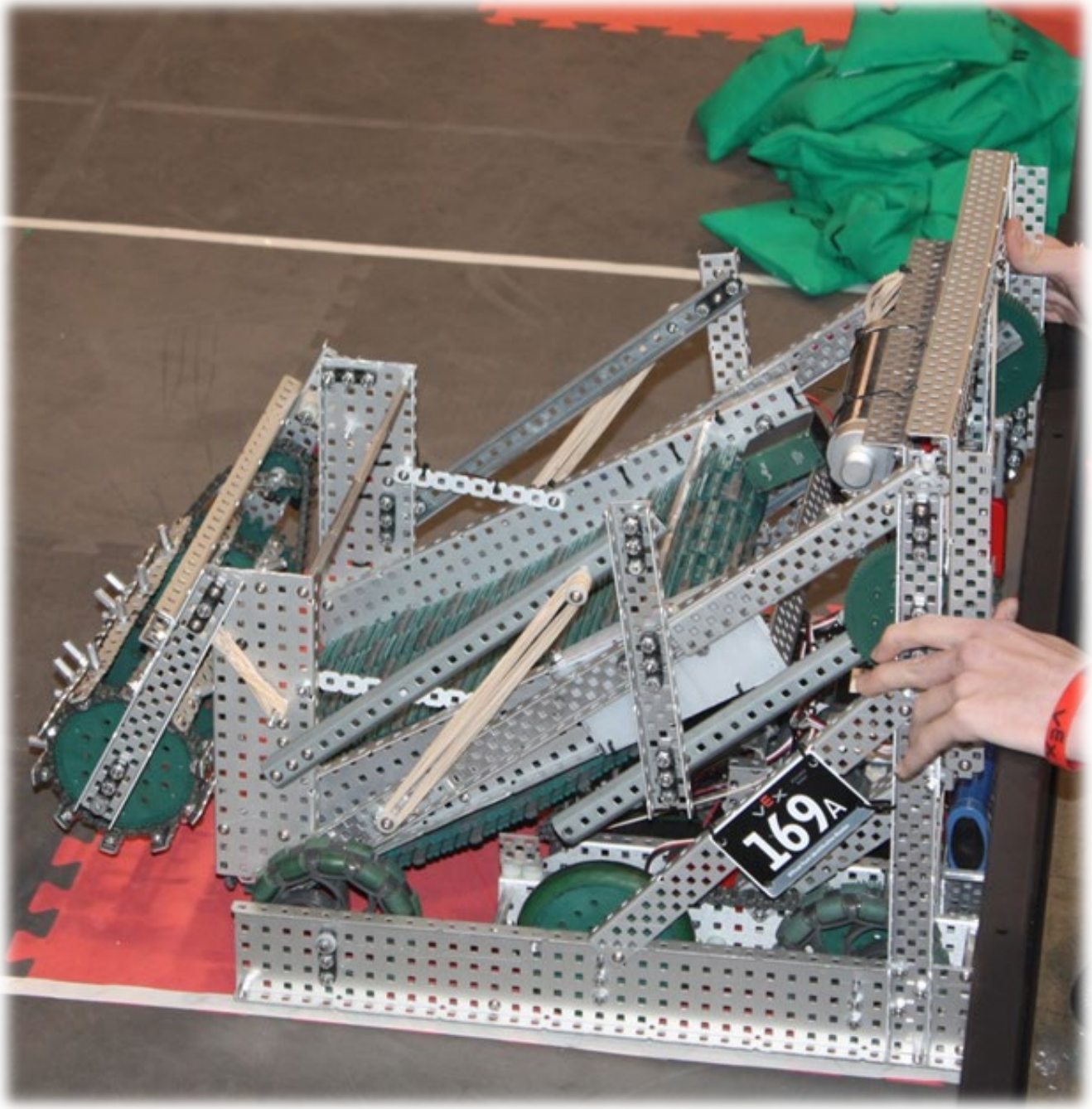


2019 World Championship

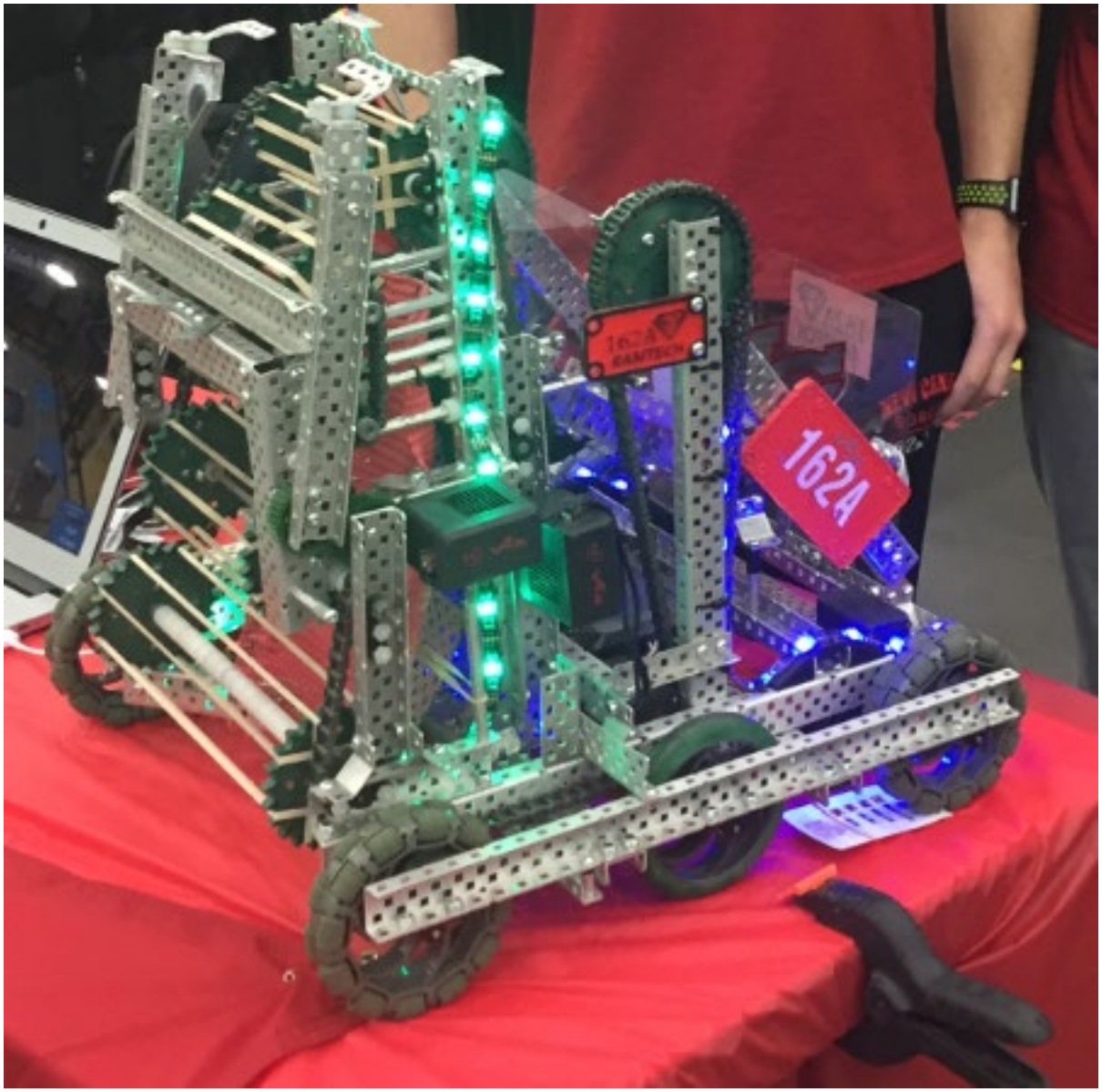




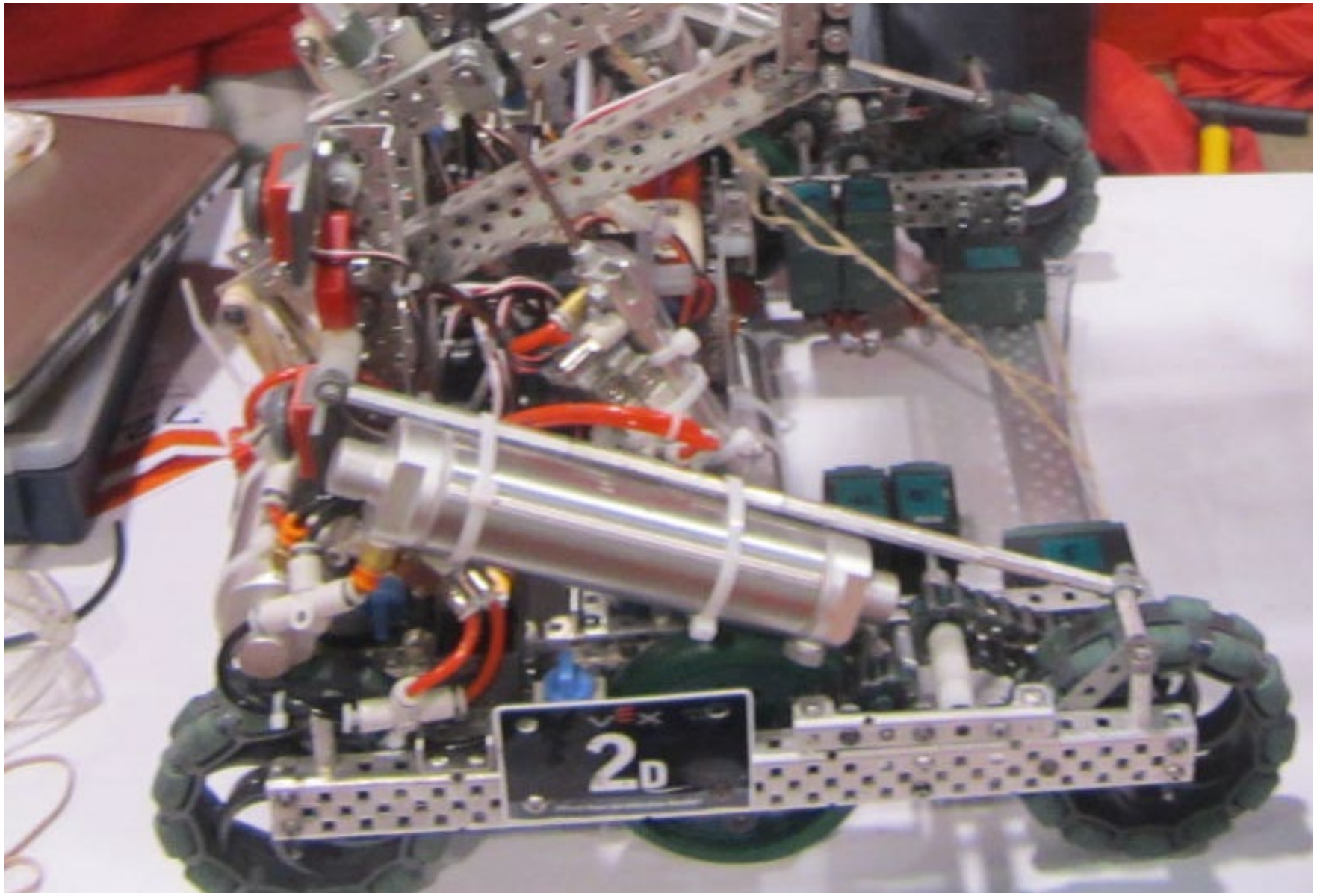
Omnis Outside, Traction Middle



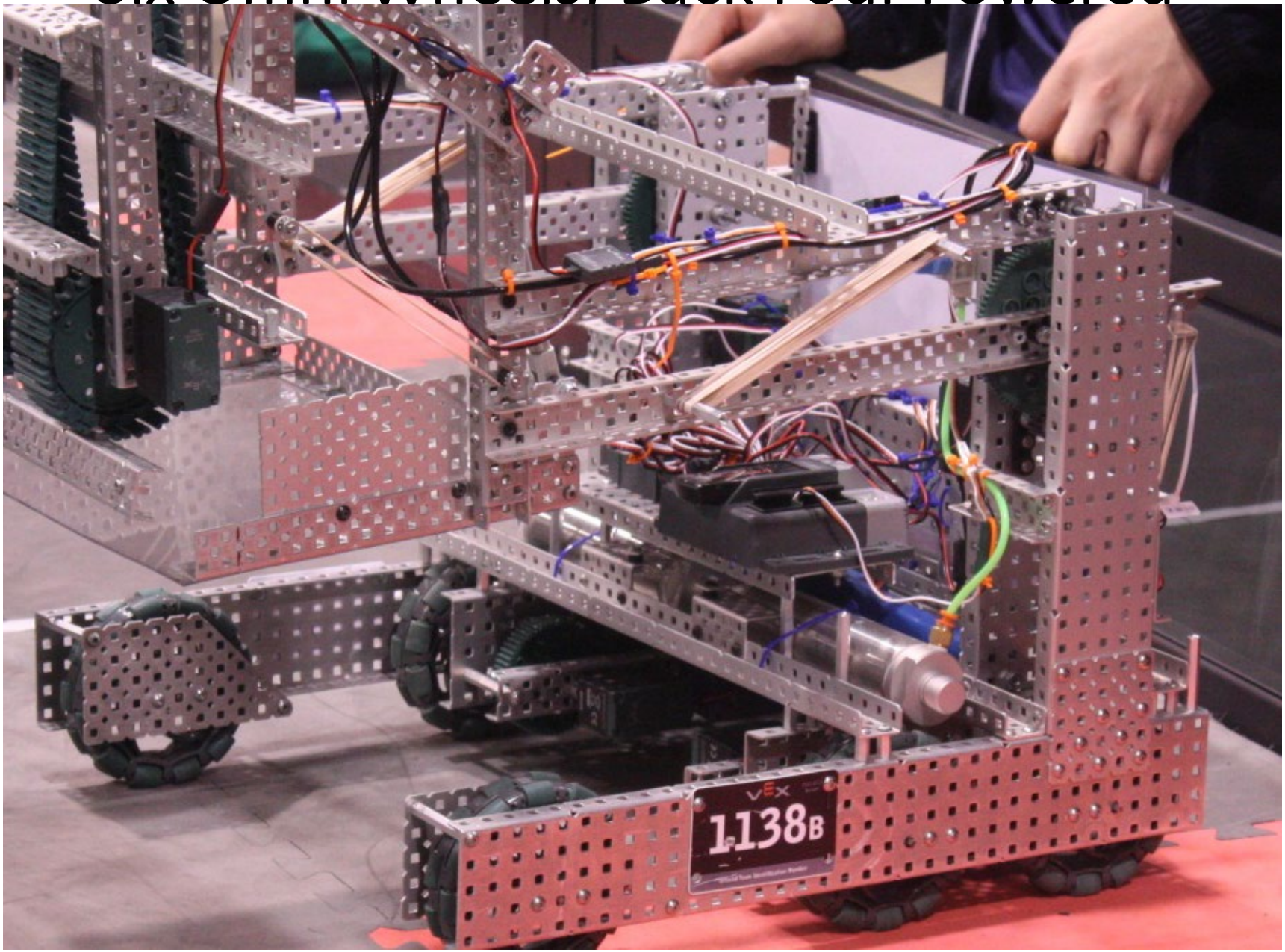
Another Omni Outside Traction Middle



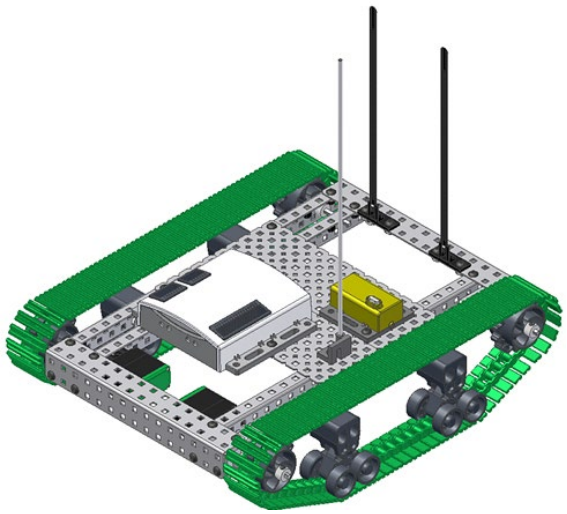
Close up



Six Omni Wheels, Back Four Powered



Track System



Pros

· pivot point is at the center of the drive system

· can use only 2 drive motors or multiple motors

· extra traction treads are available (**P/N:** 276-2214)

· able to climb over field obstacles

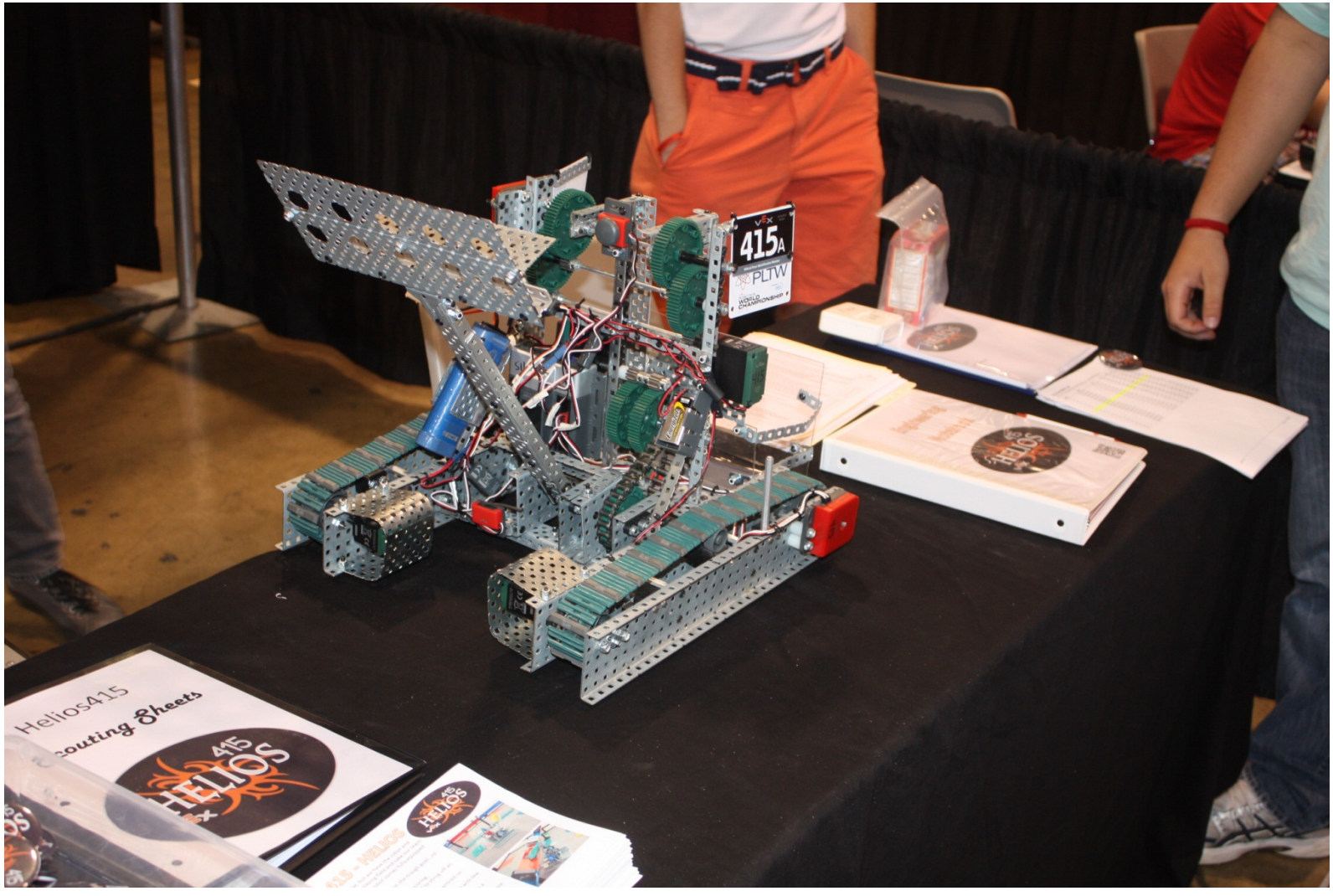
Cons

· Slick: the standard track lacks traction on some surfaces

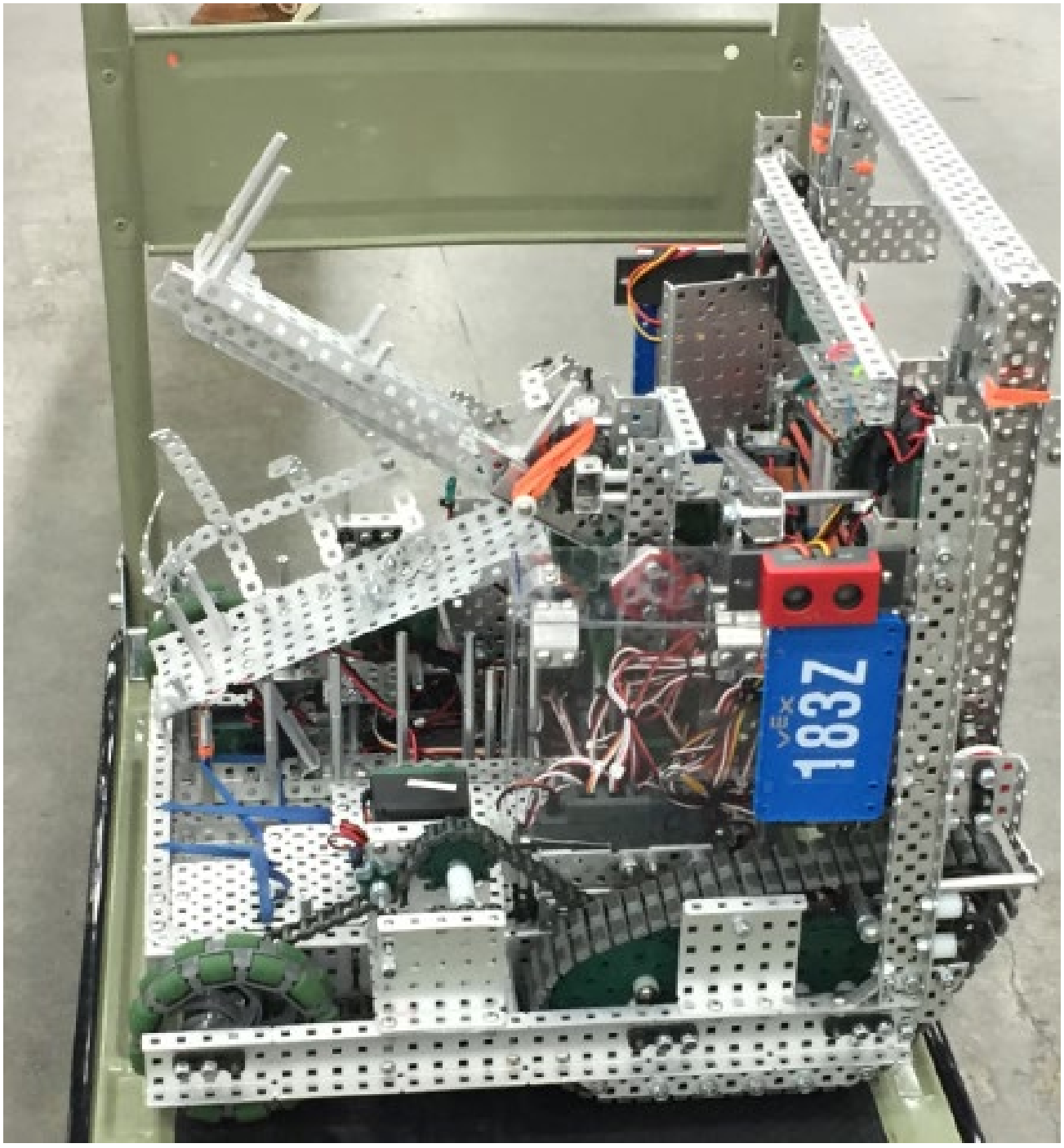
· Slow: the distance traveled per rotation is limited by the size of the drive sprocket (note some teams have used the larger high strength chain sprockets, **P/N:** 276-2252 as drive sprockets to over come this limitation.)

Summary: Looks cool and can climb, but vulnereable

Sack Attack Track Bot

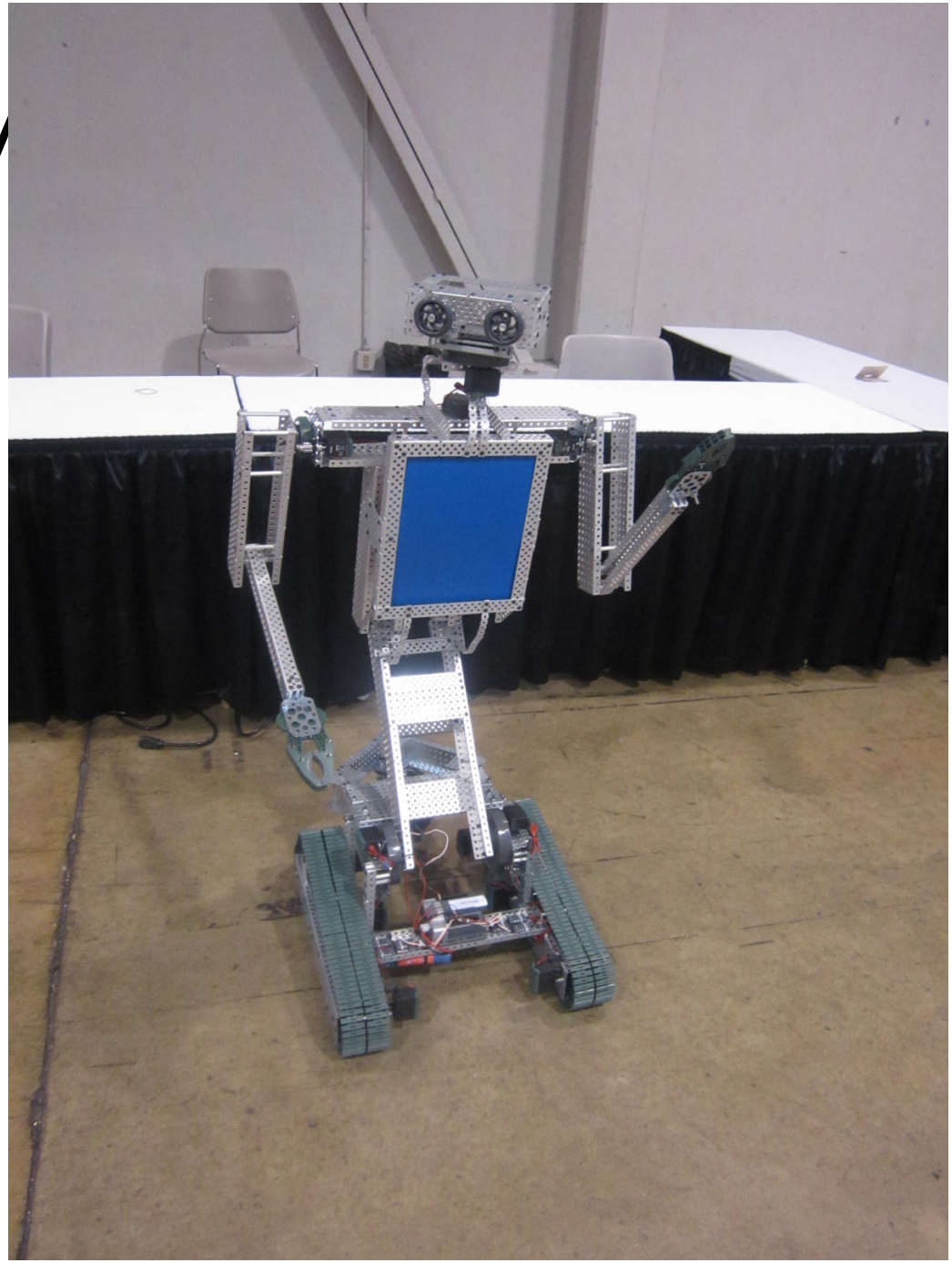


2019



Nerf Tank Gun

M



Mecanum

Pros

· can move in 2 different planes (front to back and sided to side), plus pivot

· very hard to trap in a corner

· very effective for lining up with game pieces

Cons

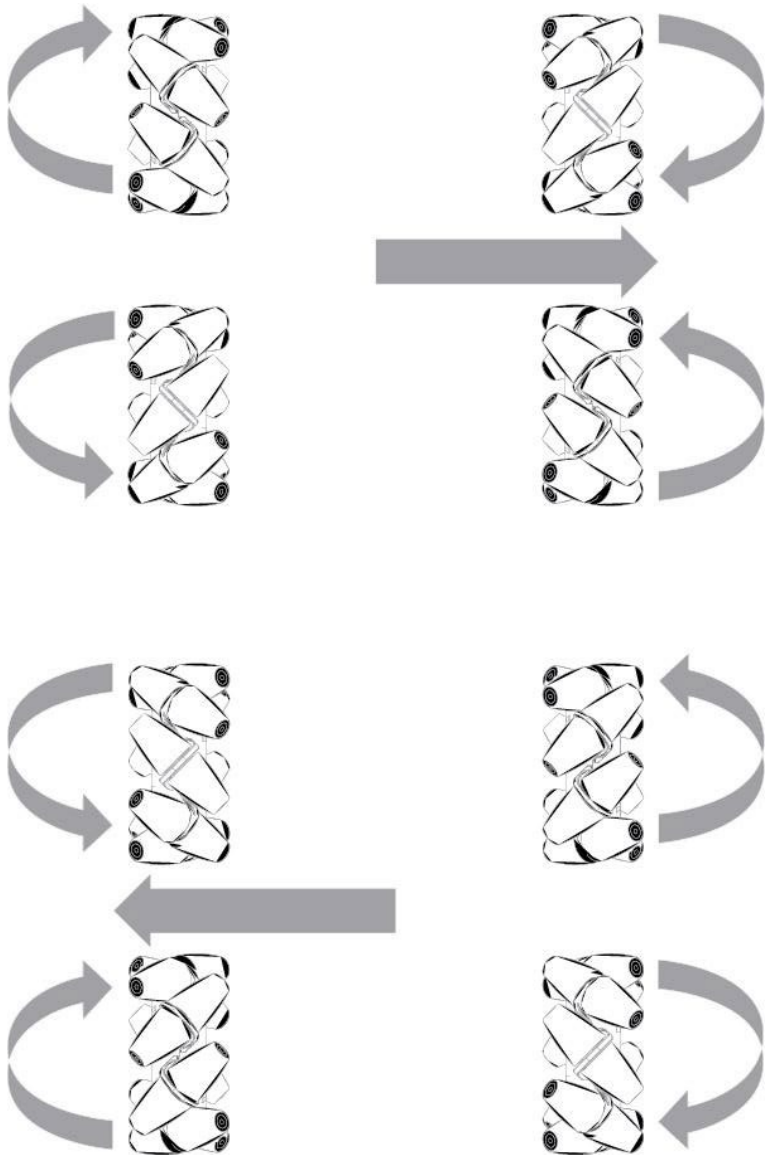
·Four motors

- Bumpy

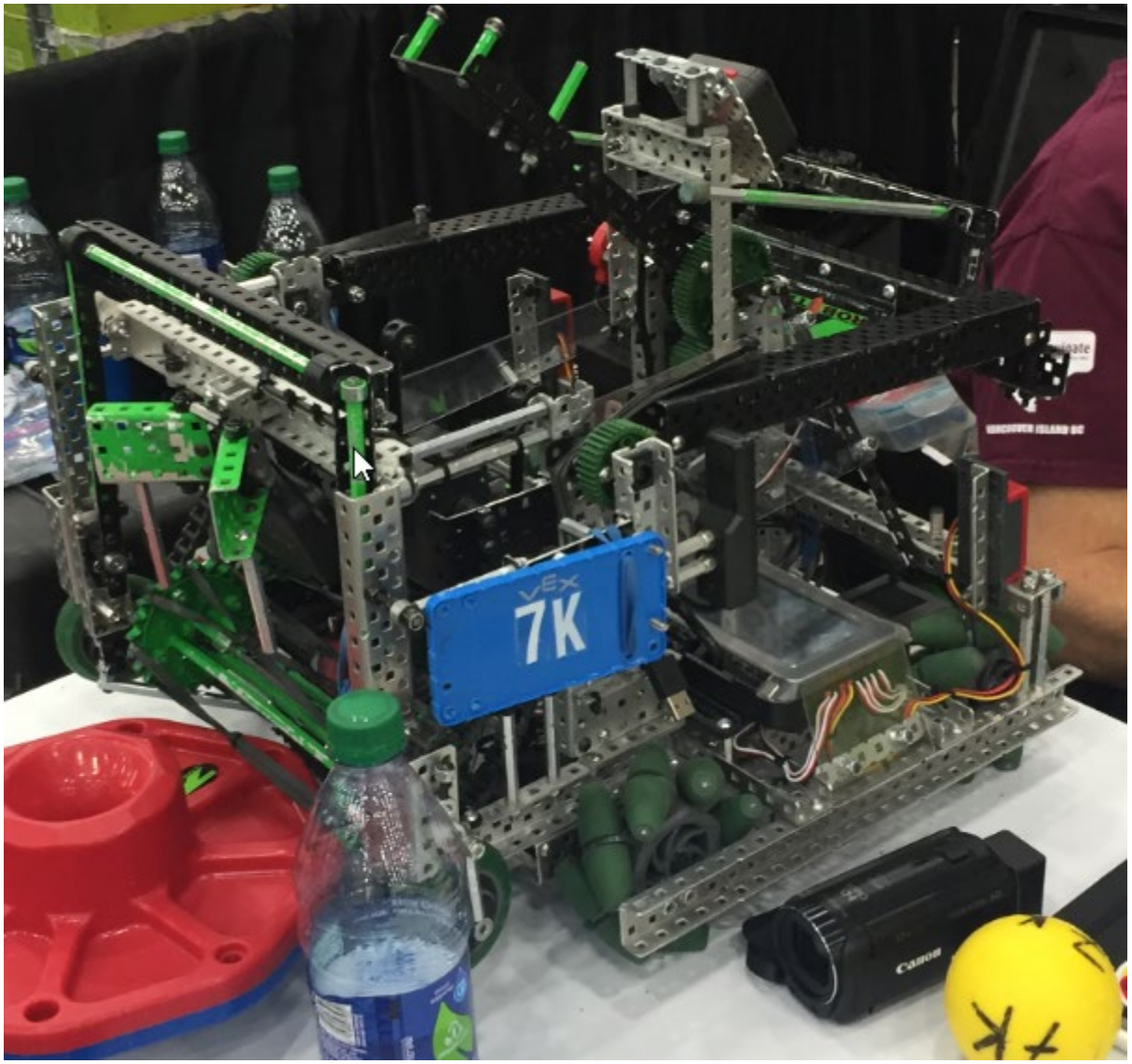
· need driver training

· multiple motors draw more current and use up motor ports on controller

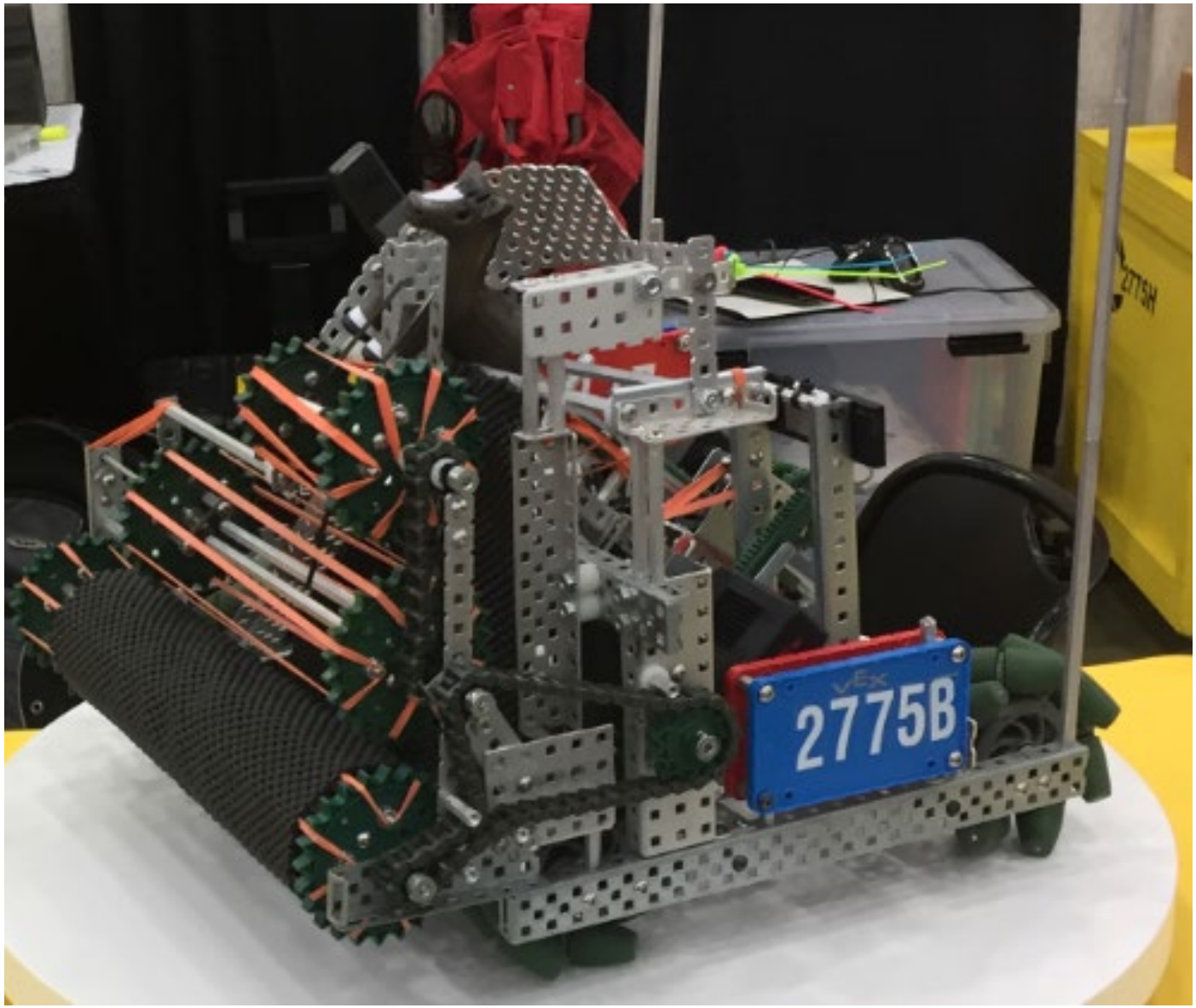
· does not climb field obstacles well



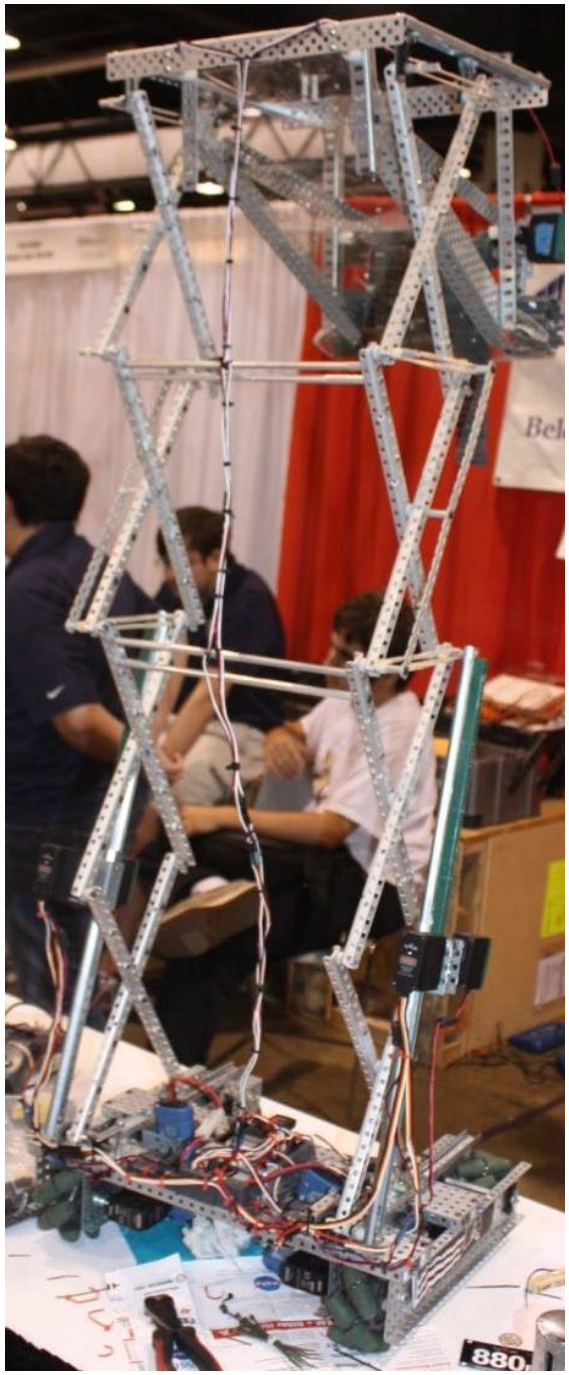
Mecanum: USCreate Open Champion 2019



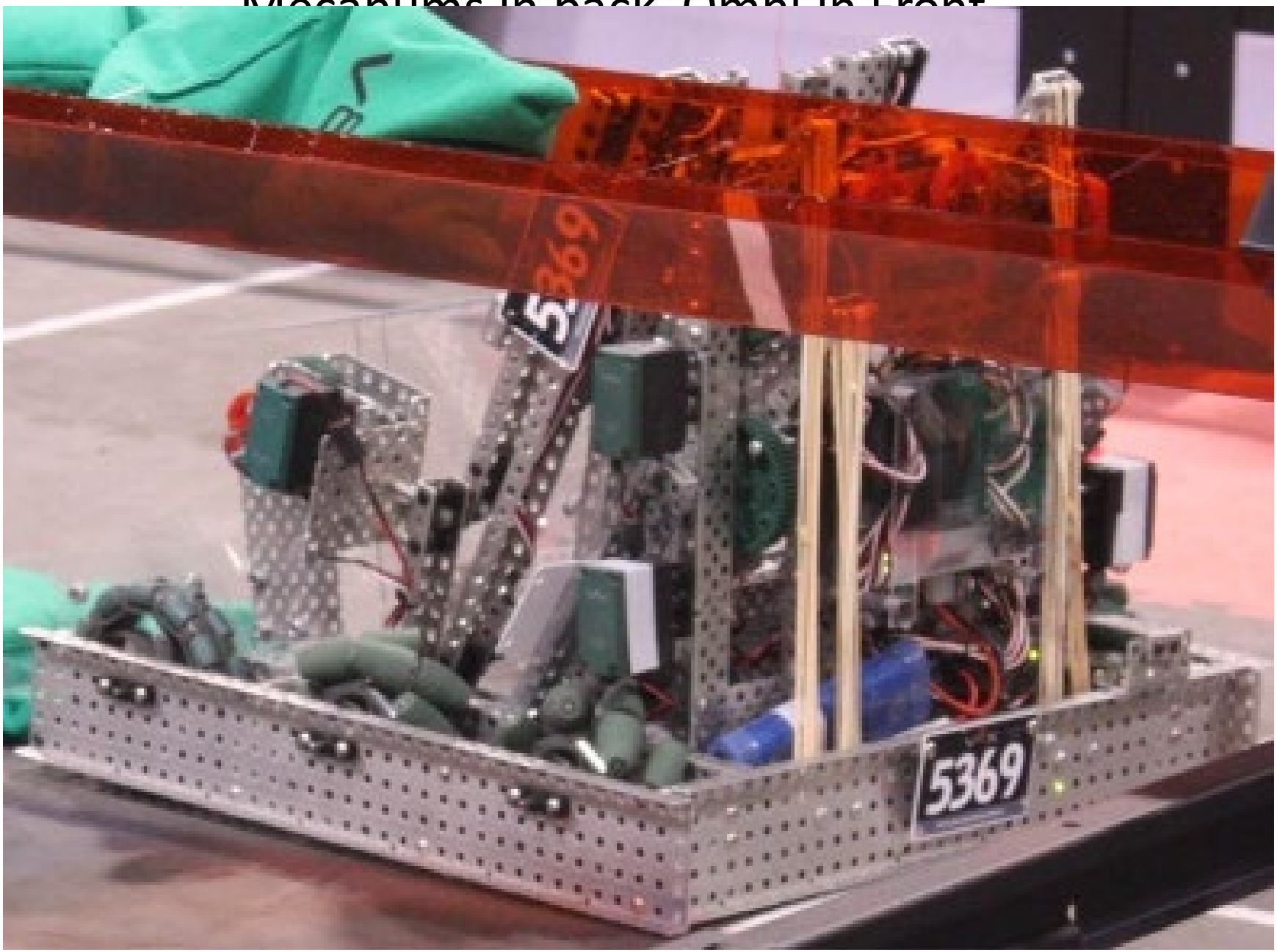
2019



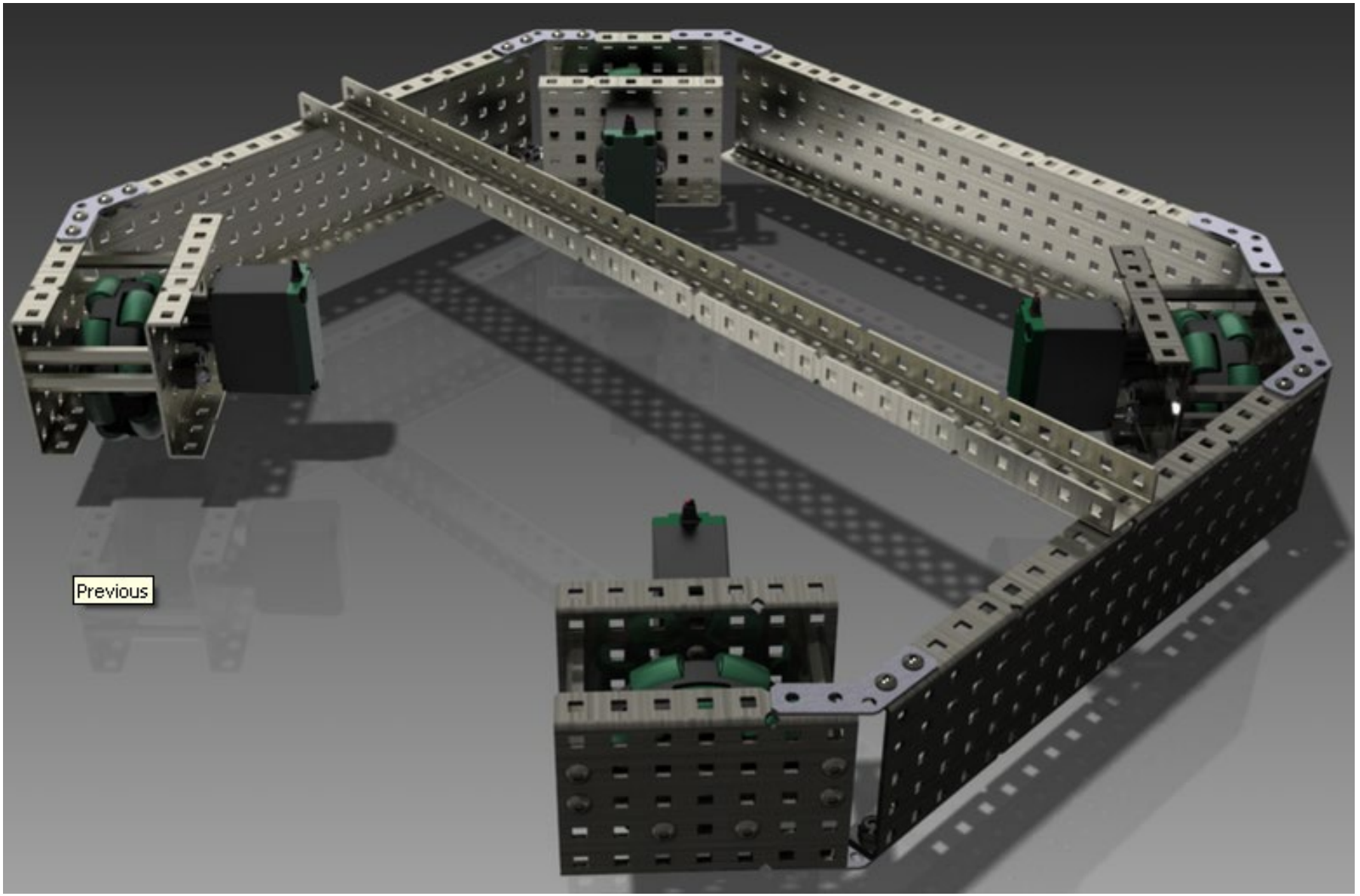
Mecanum



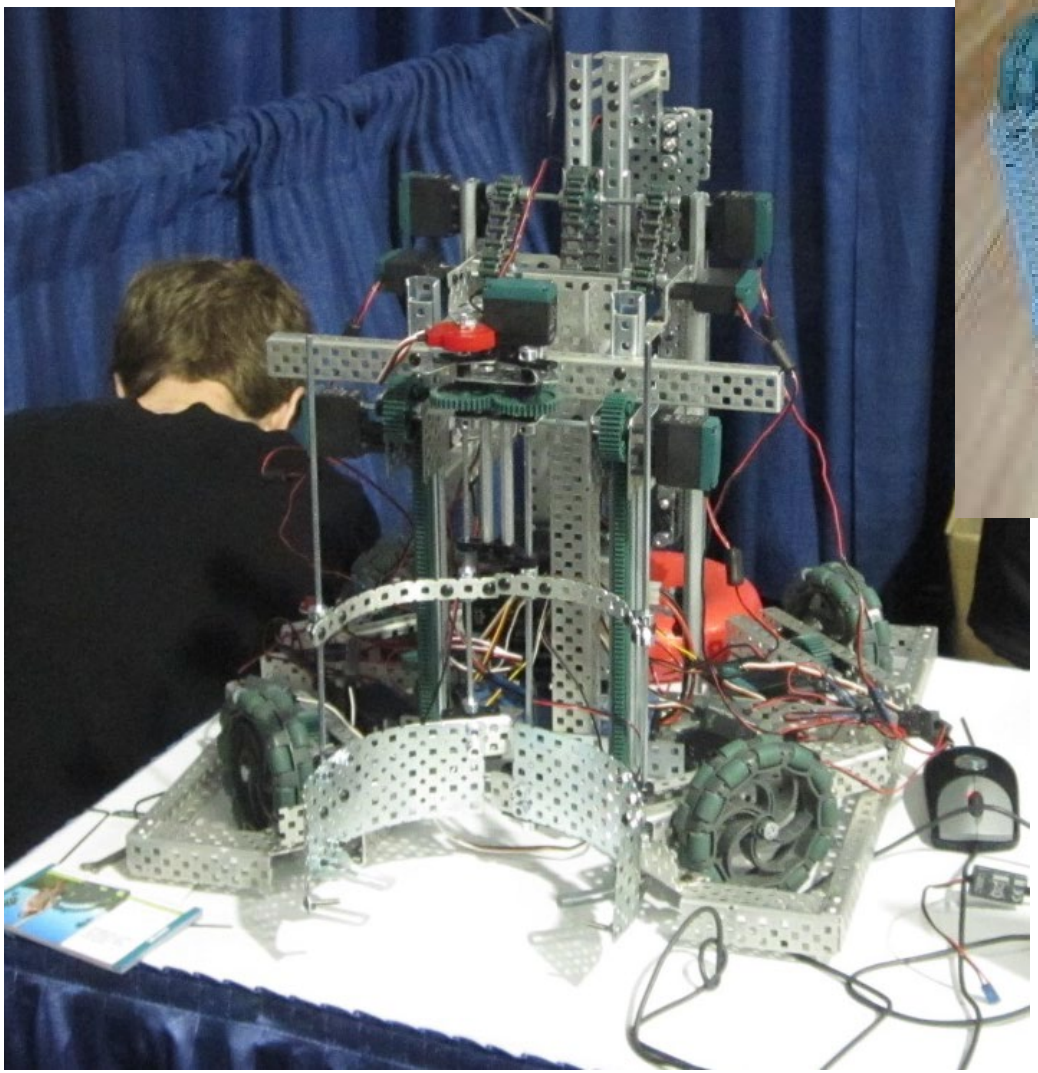
Mecanums in back, Omni in Front

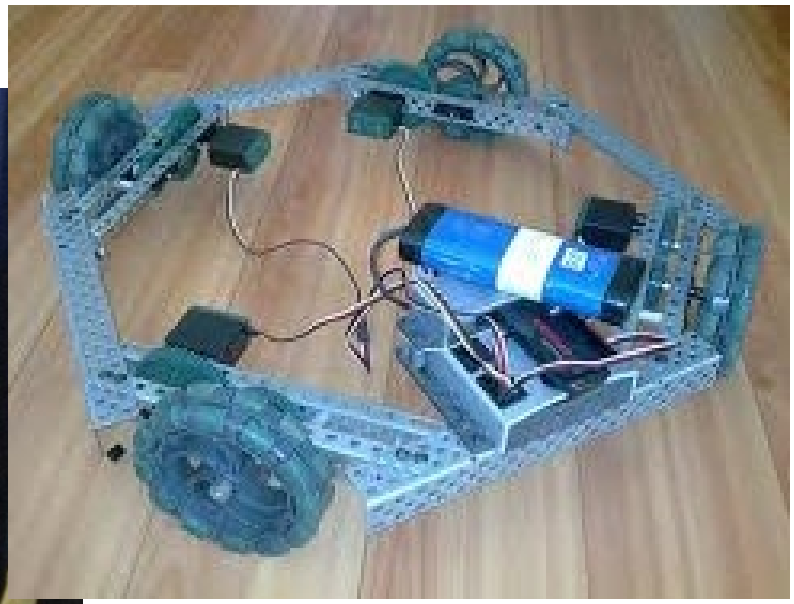


X-Drive



X-Drive





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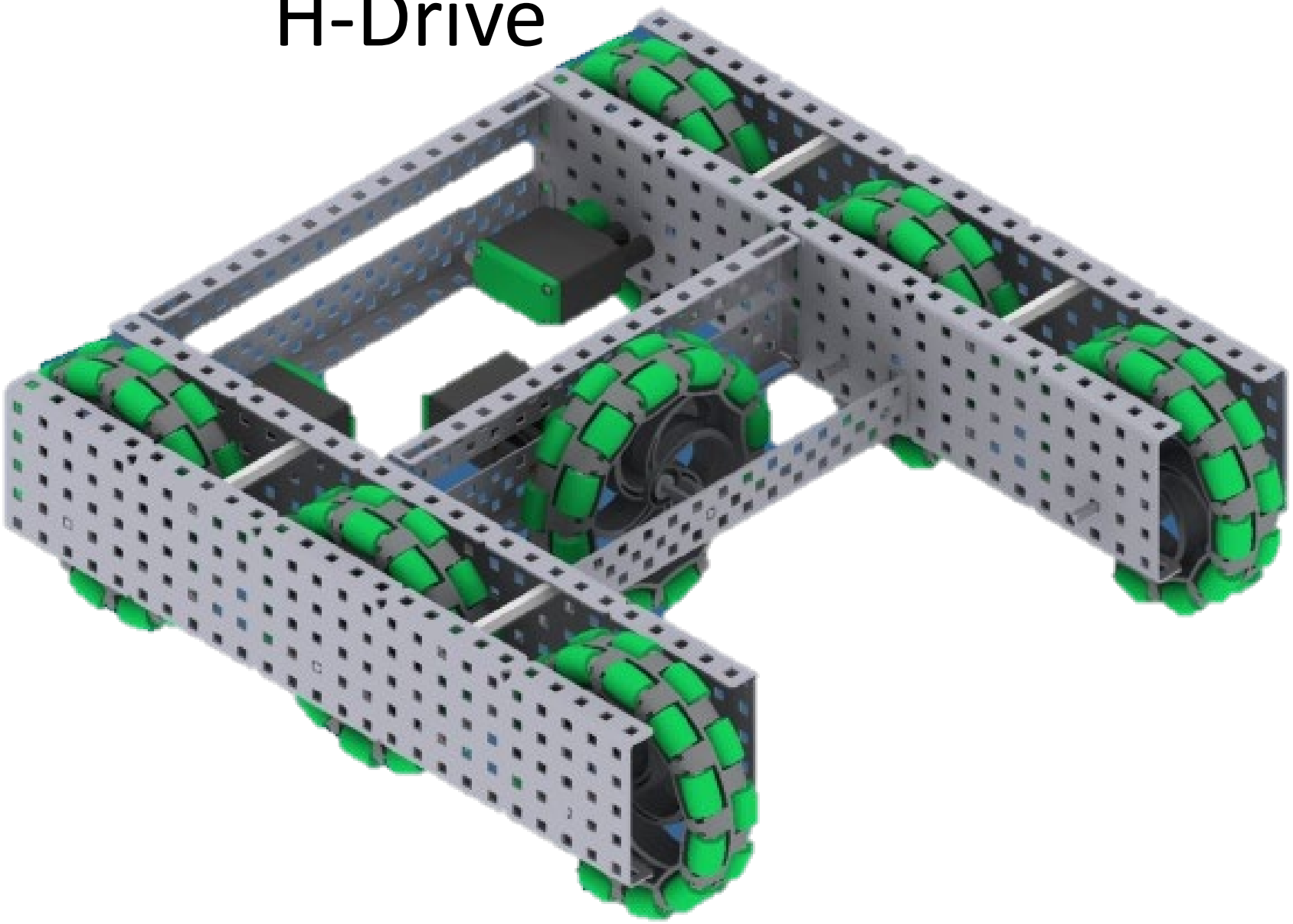

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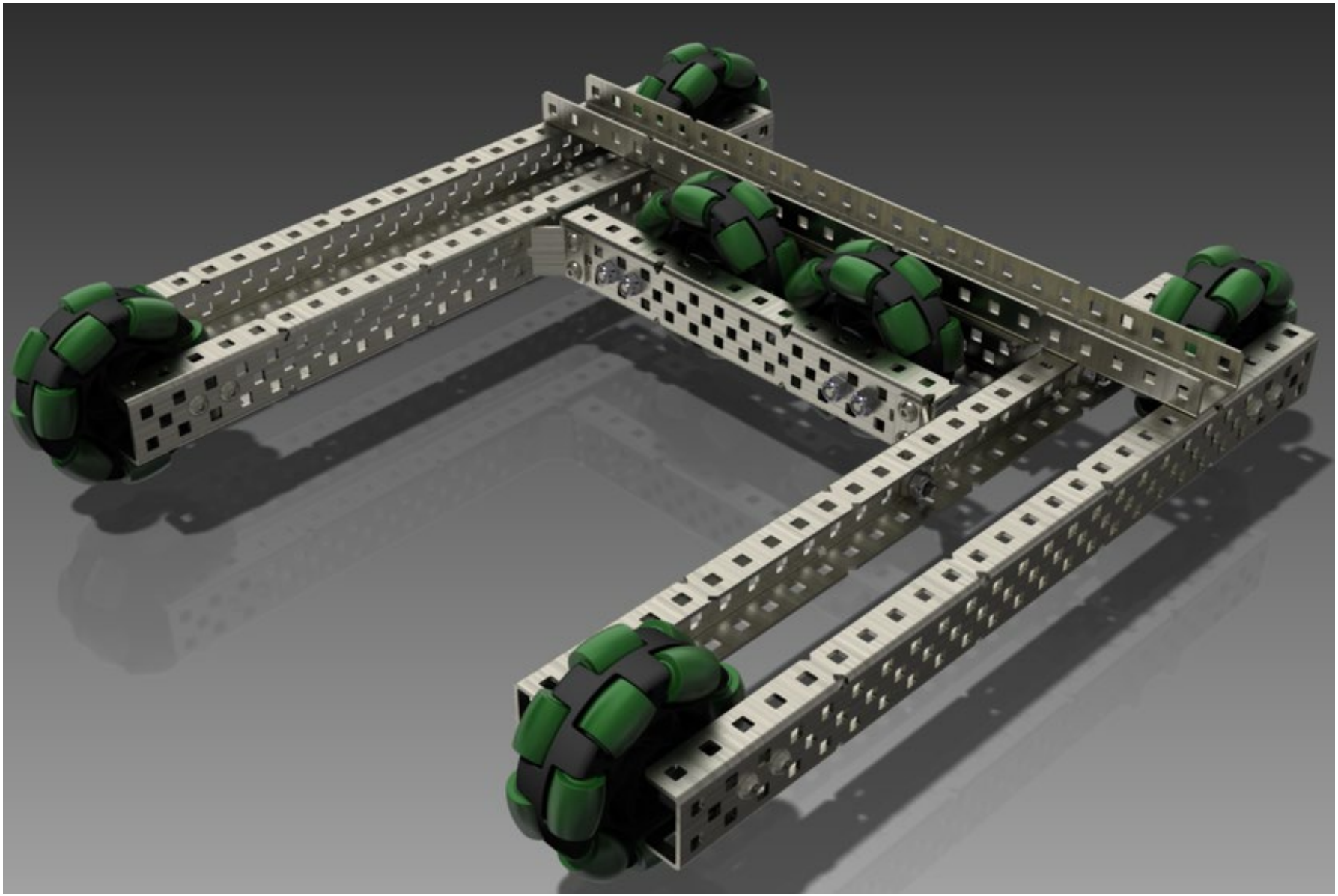

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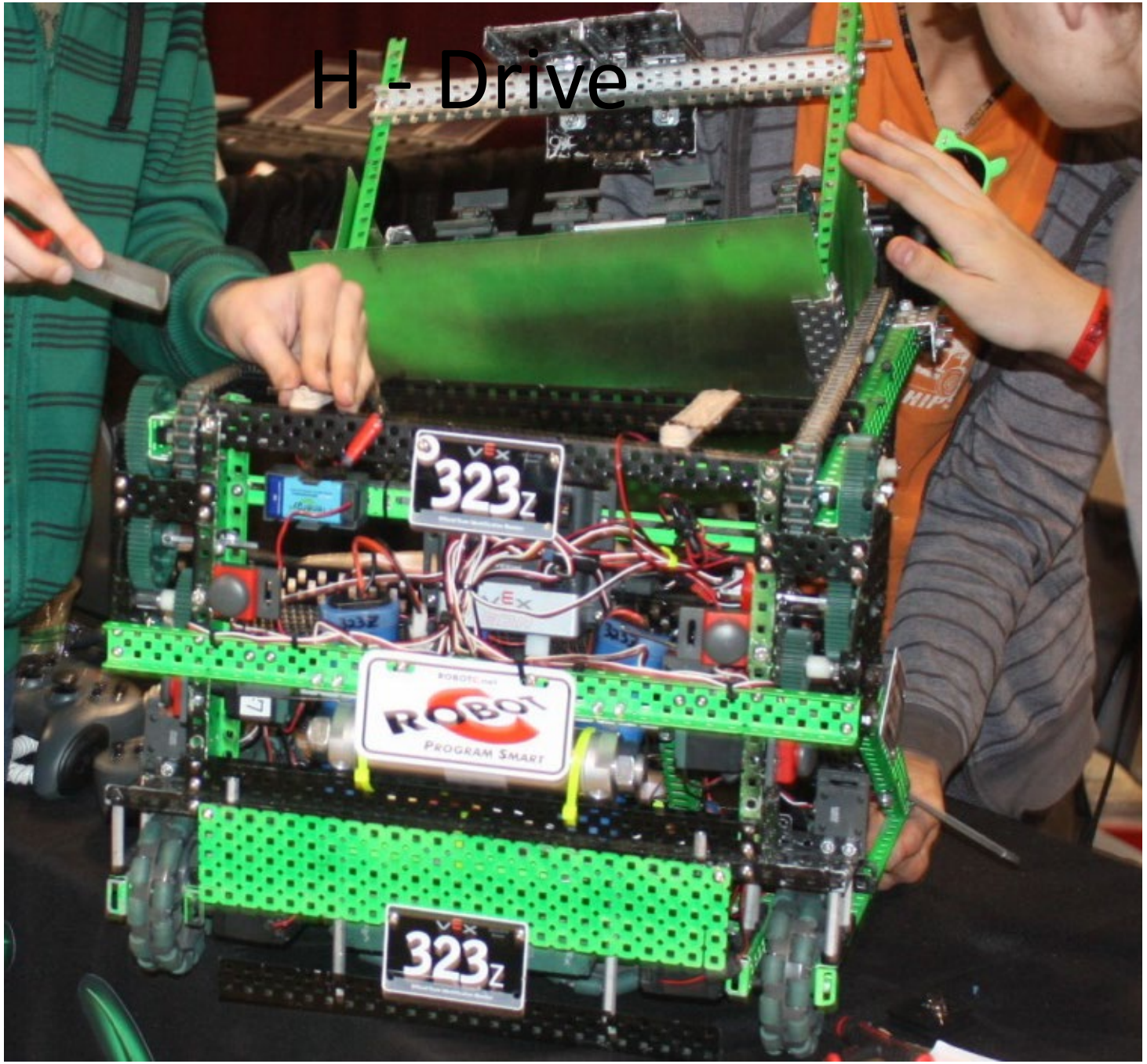
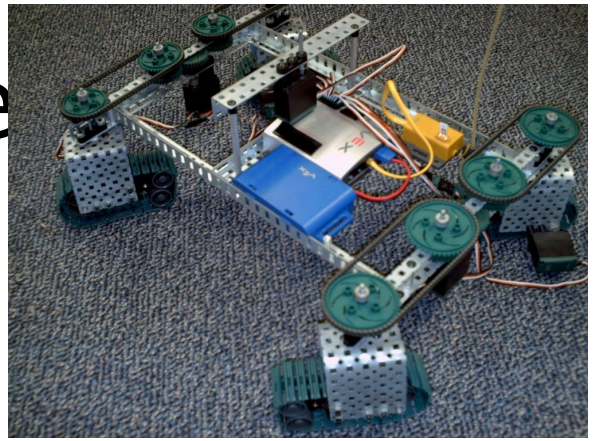


Swerve Whe



Pros

· agile!

· can climb field obstacles

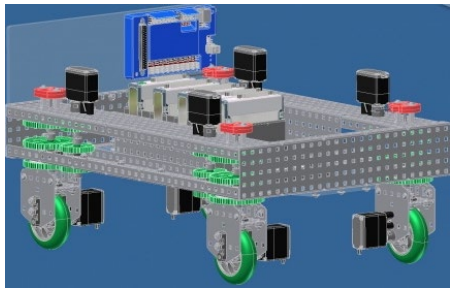
Cons:

· requires a motor for each wheel and motors to activate the swerve action

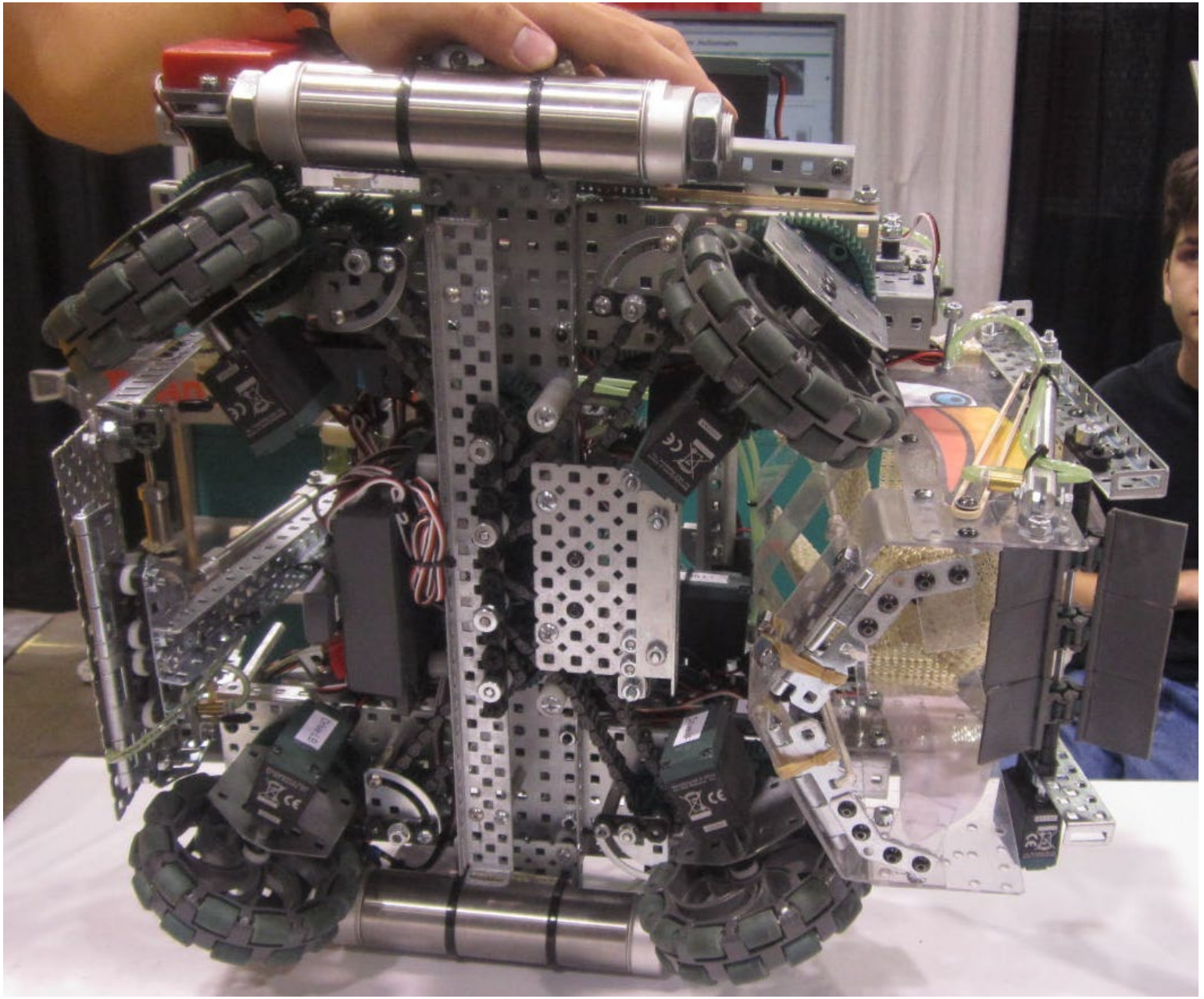
· complex

· most designs have a higher center of gravity

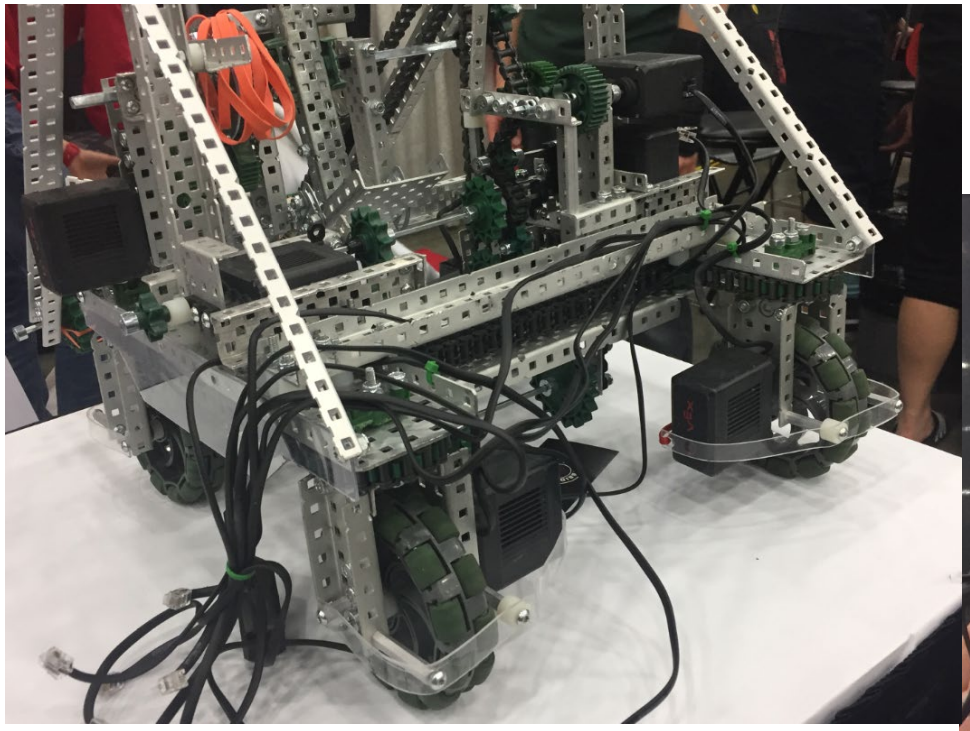
Summary: Very agile, very complex and requires extra parts. Make sure to give yourself time and resources if you are to implement this option.

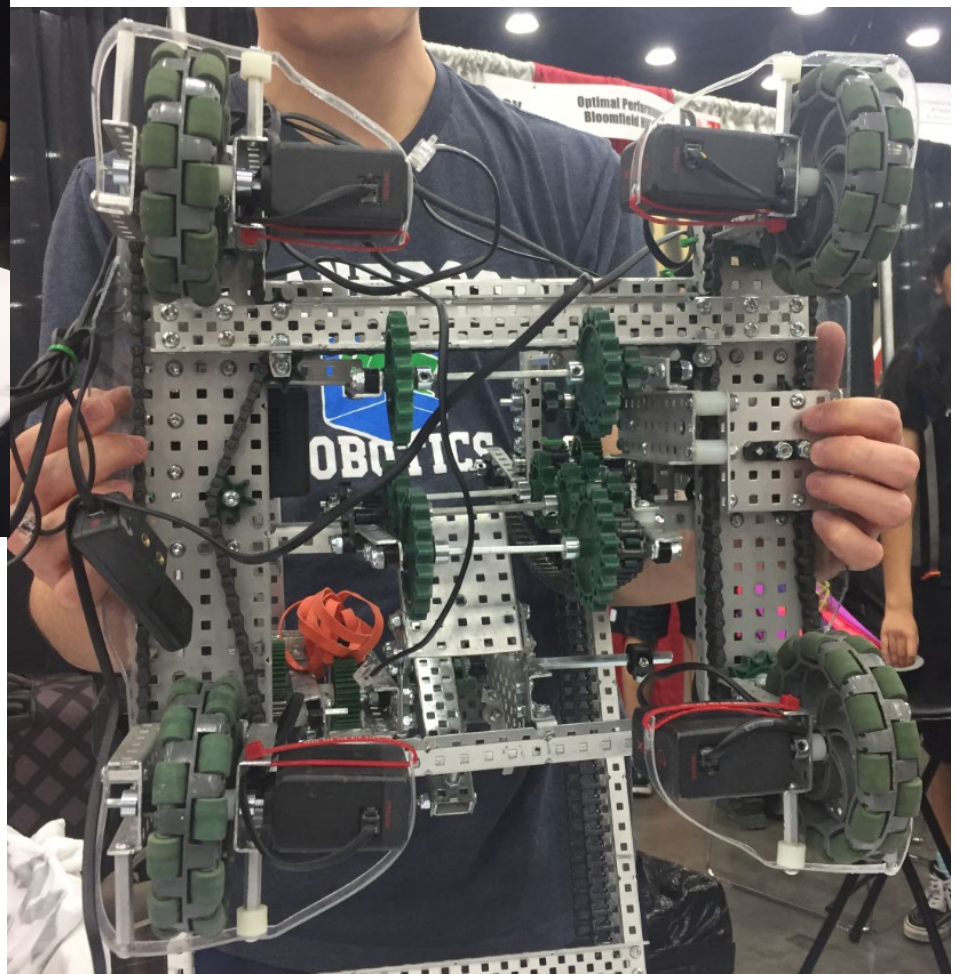


Swerve Drive



Swerve Drive





Tips for Drive Systems

- Always **support drive shafts on two points** (gears, sprockets, track drive sprockets, wheels).
- Always use **Delrin** bearings flats (**P/N :** 276-1209) when placing a drive shaft through a metal structure.
- Always have a **shaft collar** (**P/N:** 276-2010) orientated so as to **hold the drive shaft** into the motor.
- Check that **no** gears, sprockets, drive chains, or wheels are **rubbing** against a surface that will cause additional friction to drive system. This can be tested by spinning the drive system without the motor attached.

More Tips

- It is a good practice **to test the mo**tors before attaching them to the drive system.
- Try to orientate **motor screws for easy access** because they have a tendency to loosen up after use.
- Use the high strength **stainless steel (6-32) motor screws** they are less likely to strip.
- Use as long of screws as you can when attaching the motors. They are known to strip the threads in the motor.
- When using 6- or 8- wheel drive systems it is advantageous to have **the center wheels lower or a slightly larger** size than the end wheels

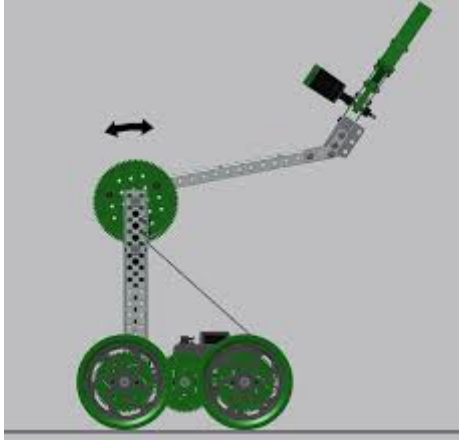
More Drive Train Tips

- **Large** wheels are **faster** (all else equal) and provide **less torque**
- Smaller wheels accelerate quicker but have a slower top speed.
- Smaller wheels can be placed closer to the corners
- With skid turn designs, short-wide designs are easier to turn than long-narrow

Sample Arms

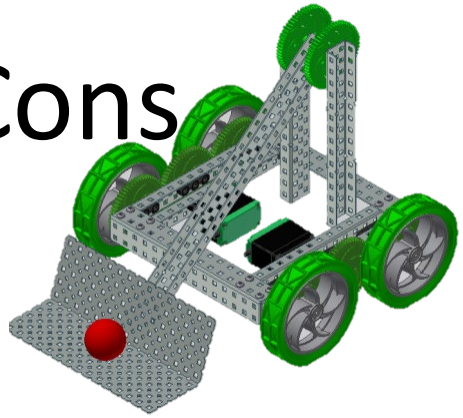
- Look at arms of Robots
- Samples
  - Look at some arms from current robots.

Single Arms



- **Arms** – These manipulators consist of a pivot point and at least 1 motor.
- Arms can be single and supported on each side by a tower
- Arms are levers, the closer the pivot point is to the end of the arm, the longer the arm, and larger the load the more torque is required to lift it.
- Torque is usually the most difficult thing to overcome when designing an arm.

Simple Arm Pros and Cons

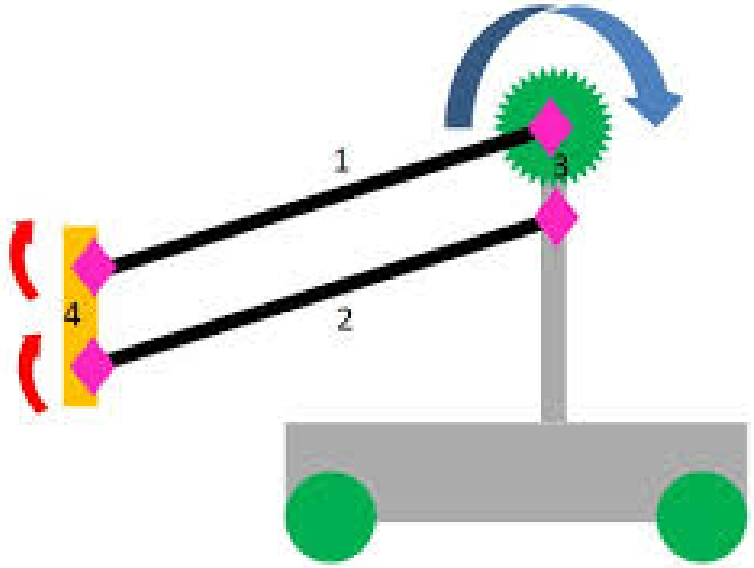


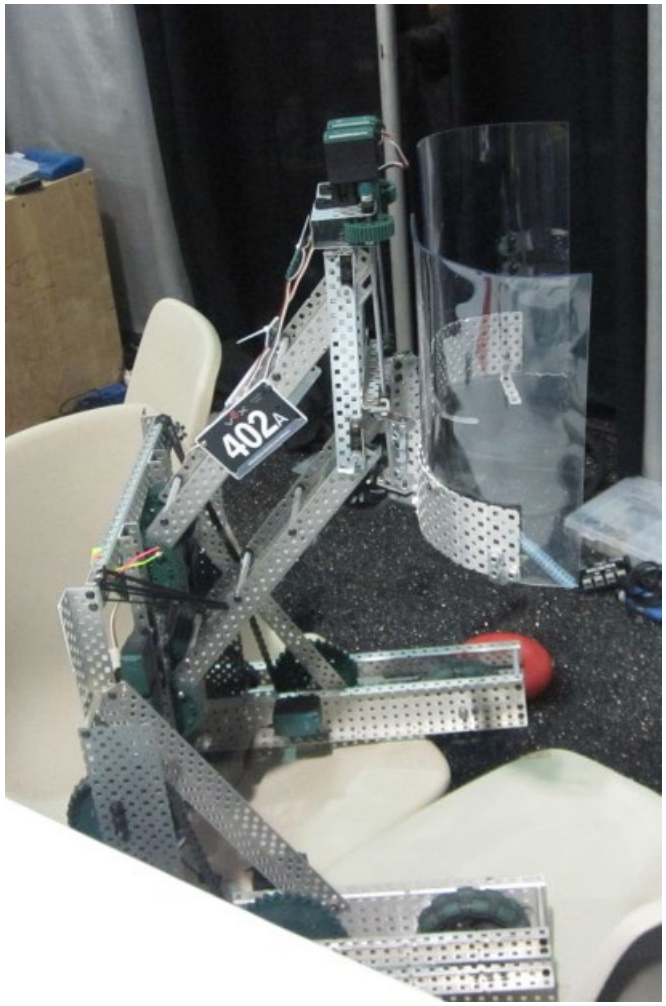
- ***Advantages –***
- Lifts an object from the field surface.
- Relatively easy to design and construct.
- Can be designed to pivot from one side of the robot, over the top to the other sided of the robot.
- ***Disadvantages –***
- Easy to create a design with a high to very high torque situation which can lead to broken drive shafts, stripped gears, broken drive chains, stripped lock plates, etc.
- Back dive when not powered
- Creates a higher center of gravity when lifted.
- The object being picked up maintains its orientation with the arm as it arcs up and may not be aligned with the final manipulation goal.
- ***Summary: A great first arm that can be enhanced with gatherers.***

Simple Arms

Four-Bar Linkage

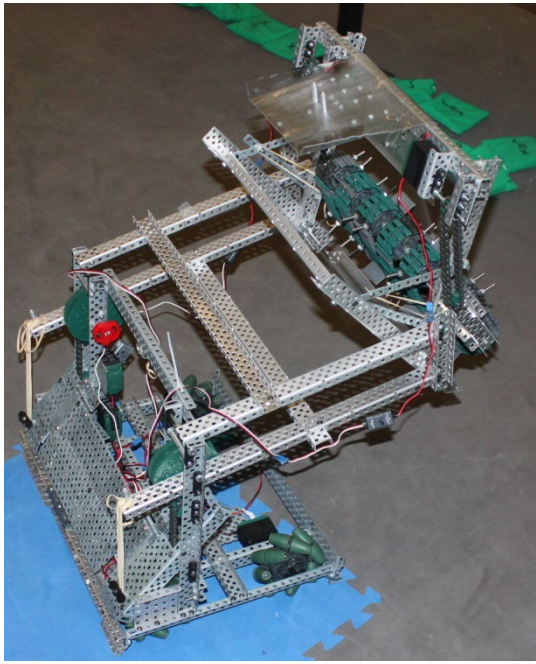
- Usually the four structures consist of a tower, two arms, and a hand.
- Creates a parallelogram
- The closer the linkages are to one another the less they can pivot.

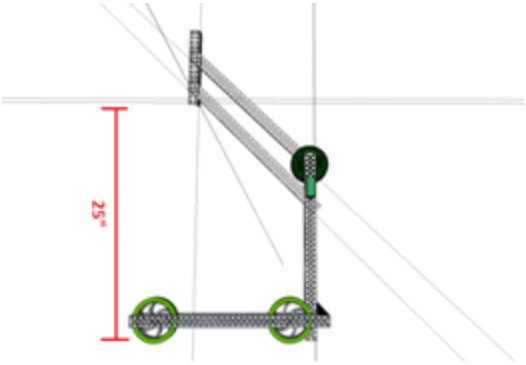




Four-Bar Linkages Pros and Cons

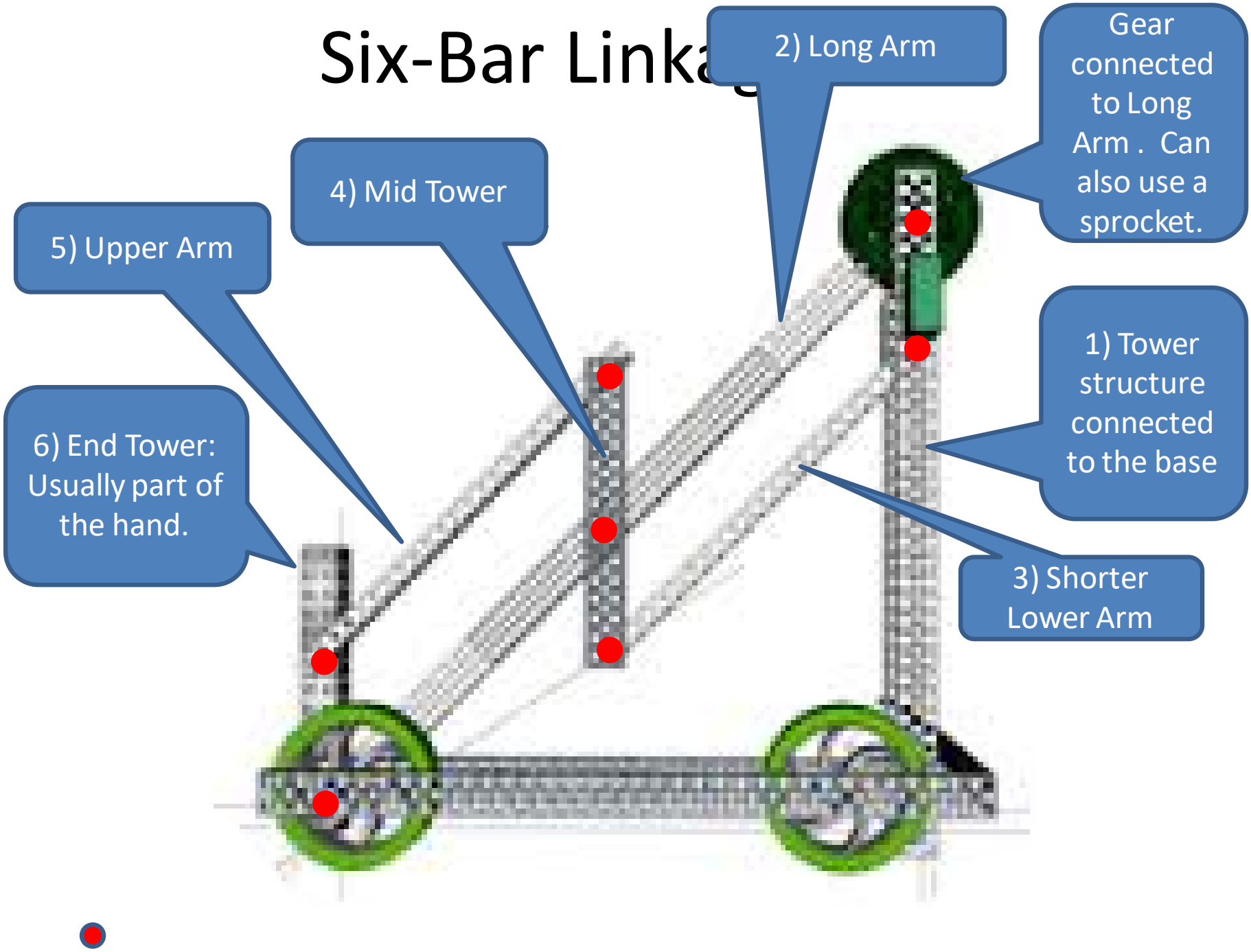
- ***Advantages –***
- The orientation of an object can be changed in respect to the arm as it is pivoted up.
- Elastic forces can be added between the linkages to reduce the amount of force the activator needs to apply.
- ***Disadvantages –***
- Easy to create a design with a high to very high torque situation
- Back dive when not powered
- Can not rotate from one side of the robot over to the other side.
- Creates a higher center of gravity when lifted
- **Summary: A good option that keeps the orientation of the hand, but limited by how high you can reach.**





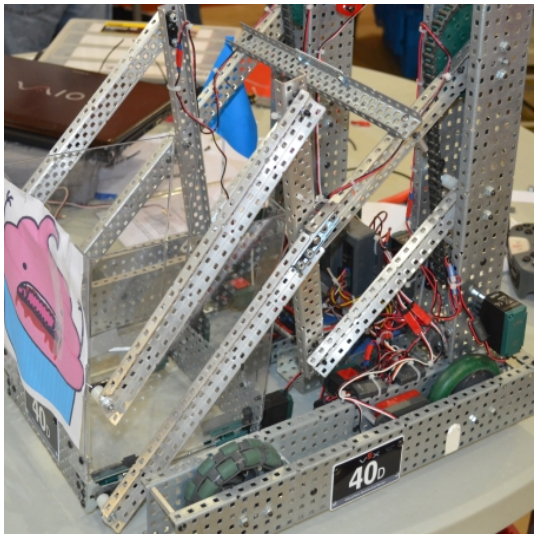
Four bar in raised state

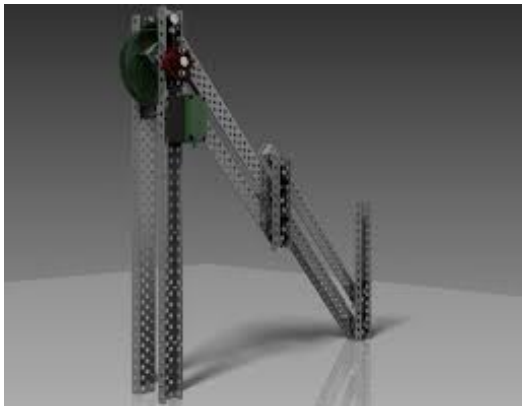
Six-Bar Linka



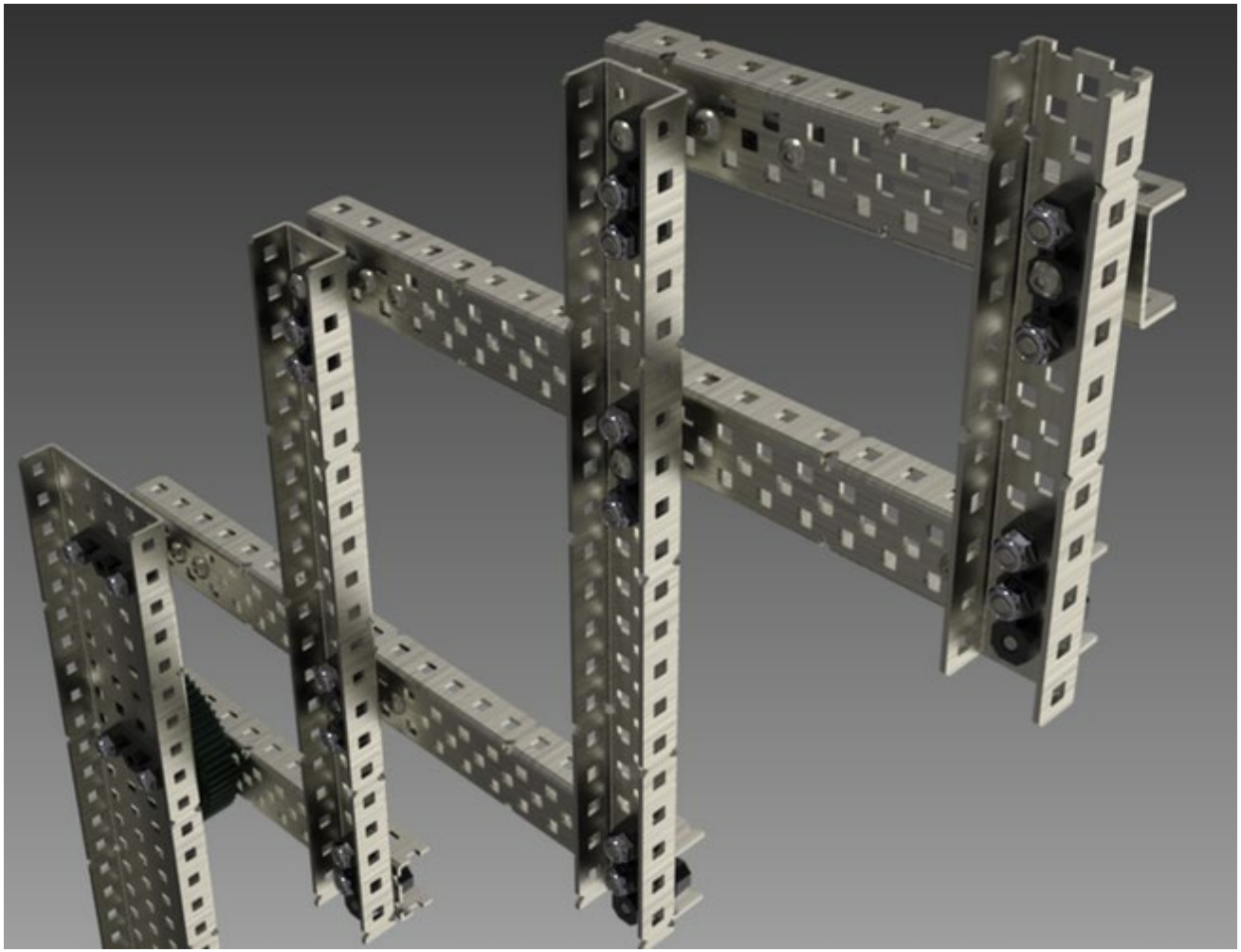
Six-Bar Linkages Pros and Cons

- ***Advantages –***
- The orientation of an object can be changed in respect to the arm as it is pivoted up.
- Elastic forces can be added between the linkages to reduce the amount of force the activator needs to apply.
- ***Disadvantages –***
- Easy to create a design with a high to very high torque situation
- Back dive.
- The amount of pivot is limited by the distance between the arms. Can not rotate from one side of the robot over to the other side.
- Creates a changing and higher center of gravity when lifted
- **Summary: A four-bar linkage on steriods. You can lift higher, but it is a bit more complex to build**





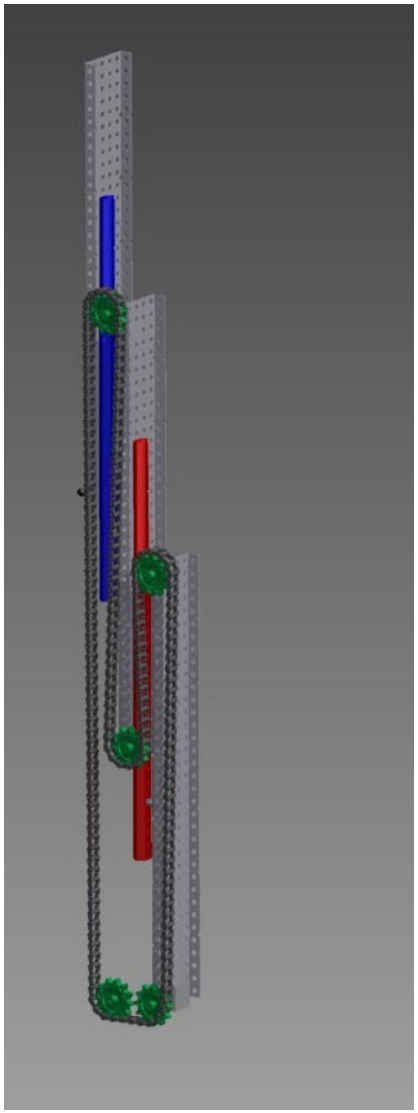
8-Bar Linkage … A Six-Bar Linkage on Steroids



8-Bar Sample

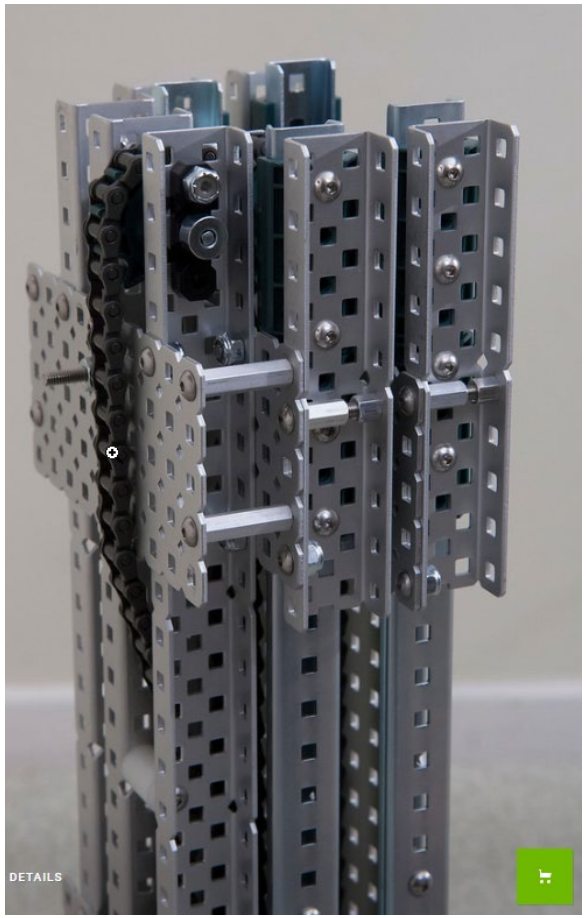
Linear Slide Pros and Cons

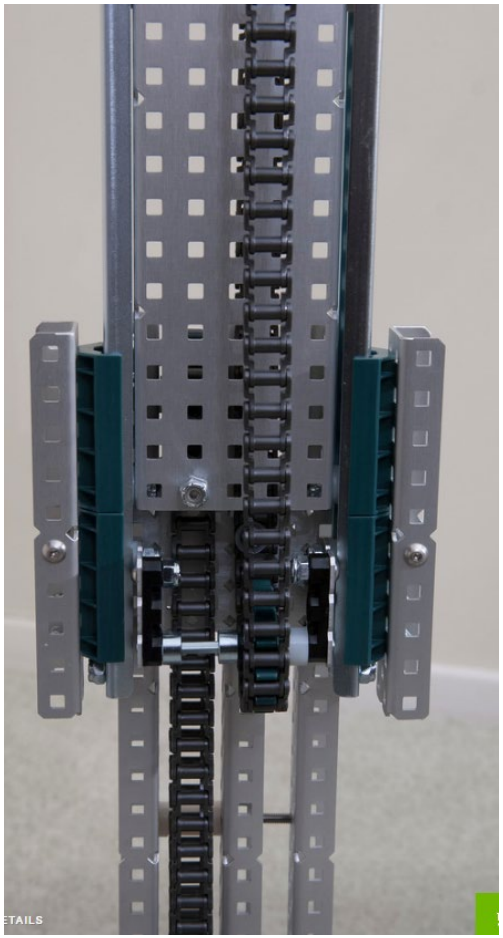
- ***Advantages –***
- Very effective linear lift from floor surface.
- Linear motion kit has very little sliding friction.
- Takes up little volume on the robot.
- You can add ‘stages’ to increase the distance the slide can travel.
- ***Disadvantages –***
- The gear teeth on plastic racks can strip.
- Creates a higher center of gravity when lifted
- Difficult to build and keep friction down.
- **Summary: Can be tricky to limit the friction, but gives the advantage of lifting straight up and taking up little room.**

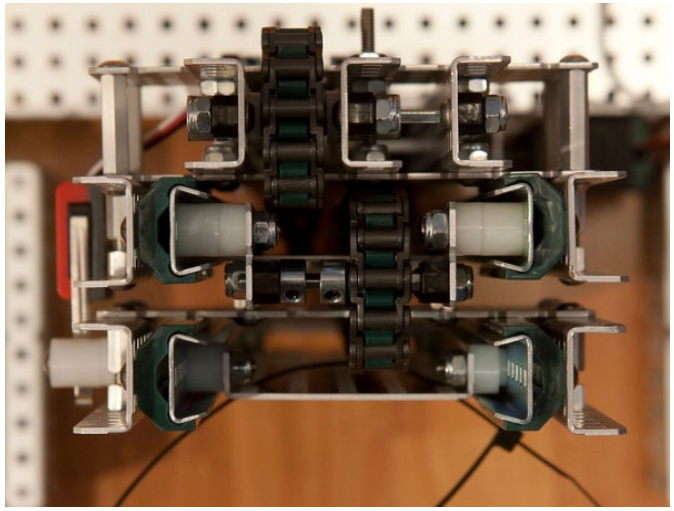


Link to Linear Slide

- https://jpearman.smugmug.com/Robotics/NewTrippleLift/i-krzBzd8/A
- Video







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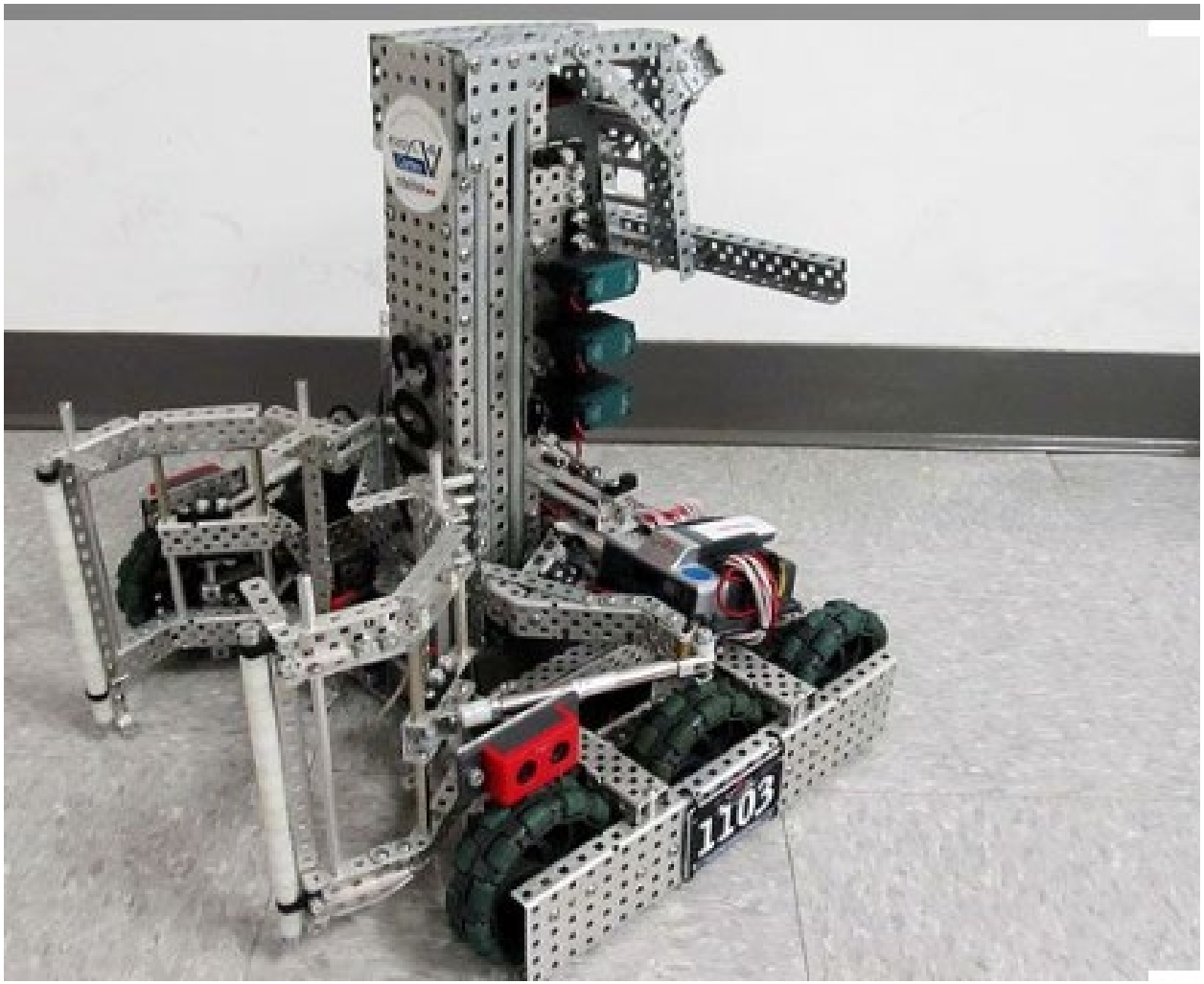
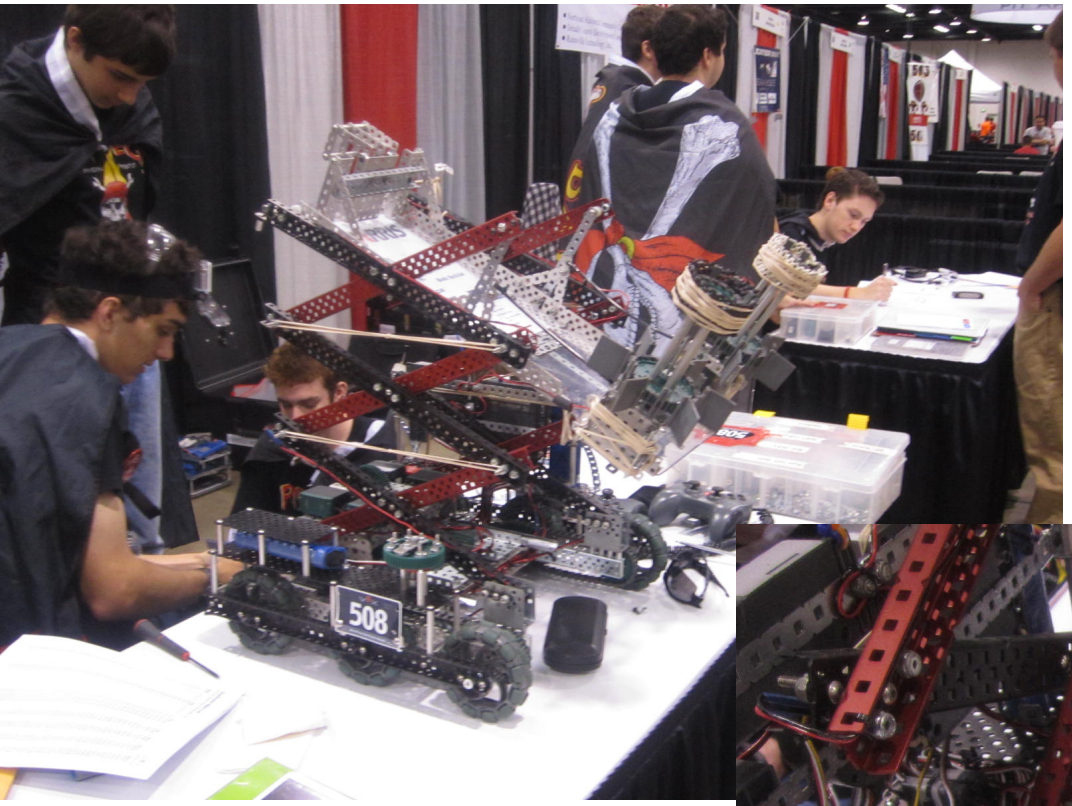
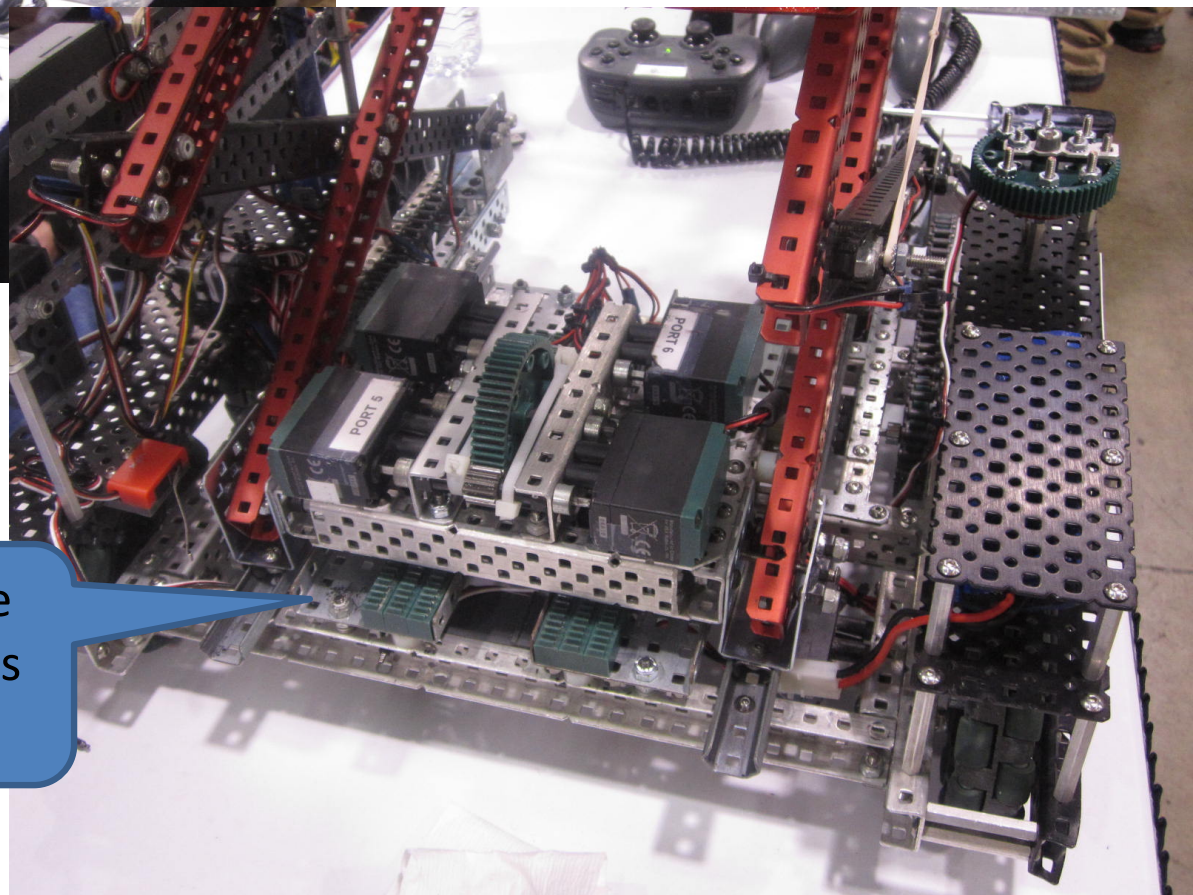
- https://www.youtube.com/watch?v=DvTzVi32BWo
- Video



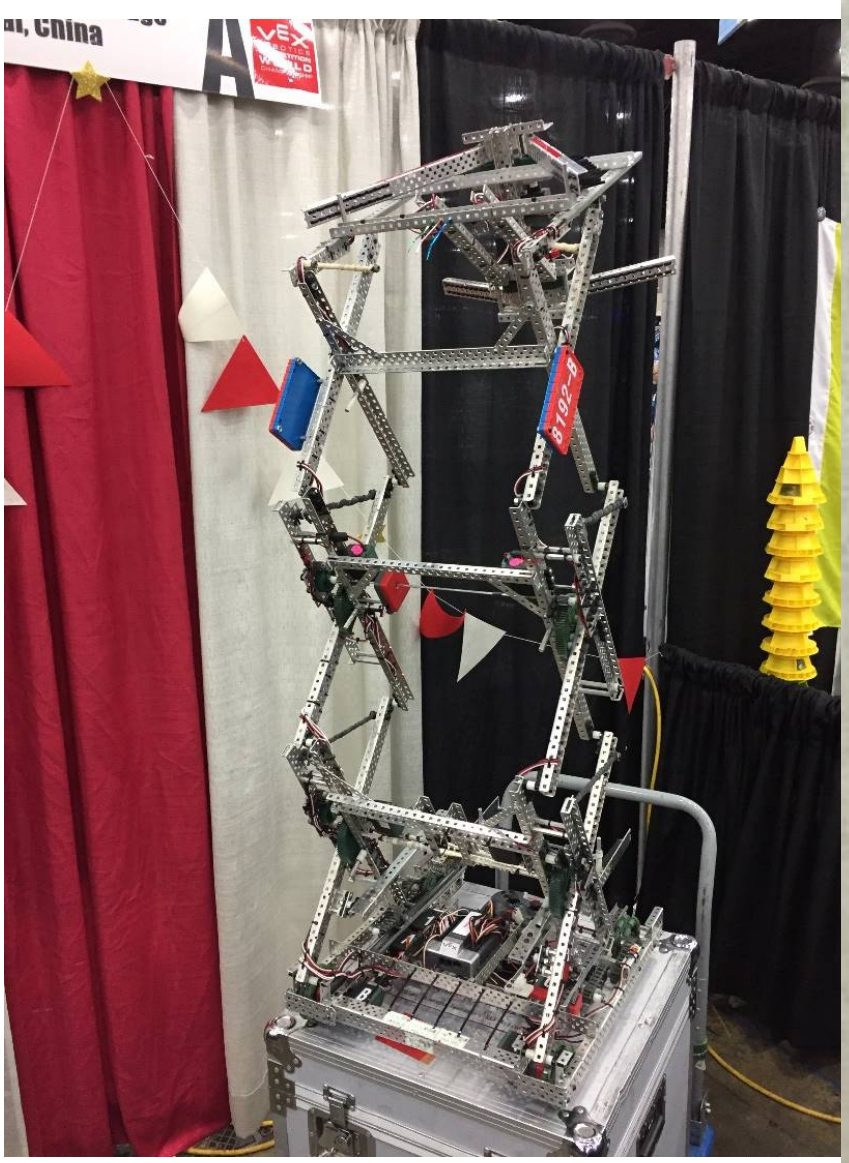
Scissor Lifts

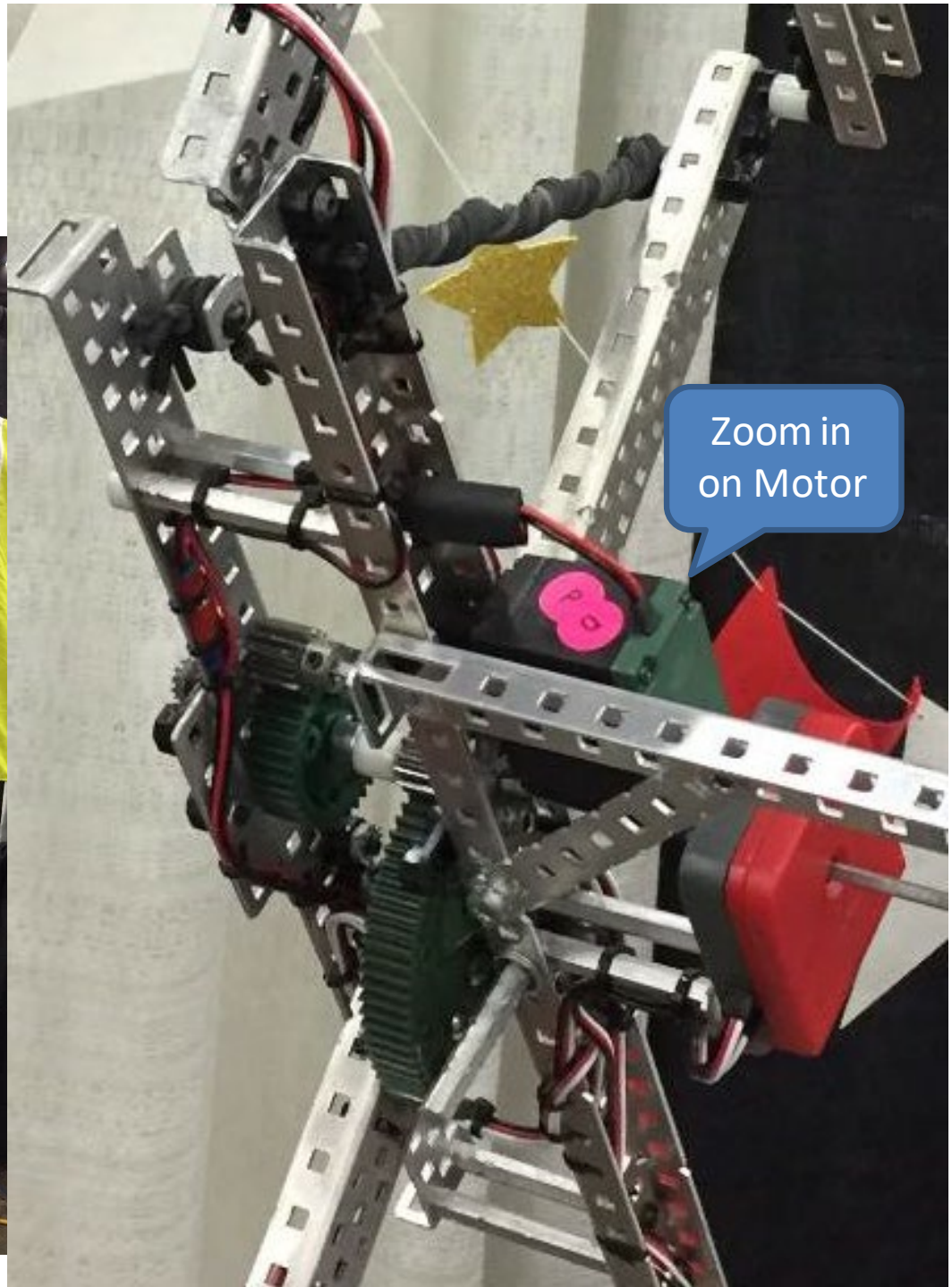




Motors move the base which moves the arms.

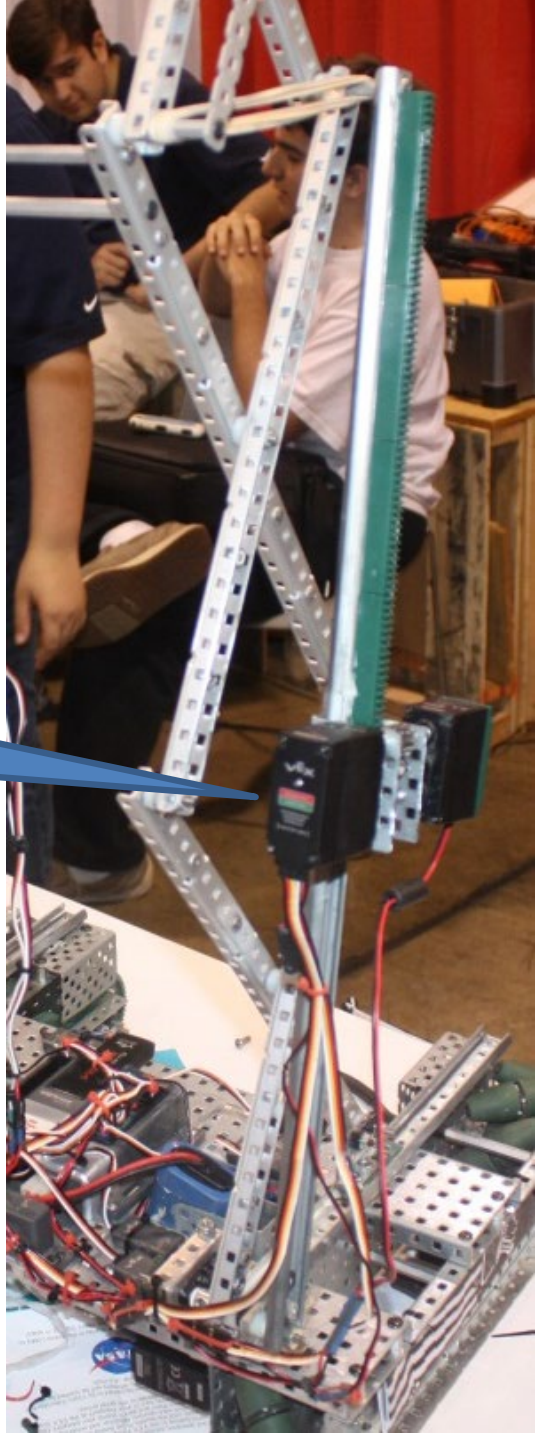
Scissor Lift





Scissor Lift

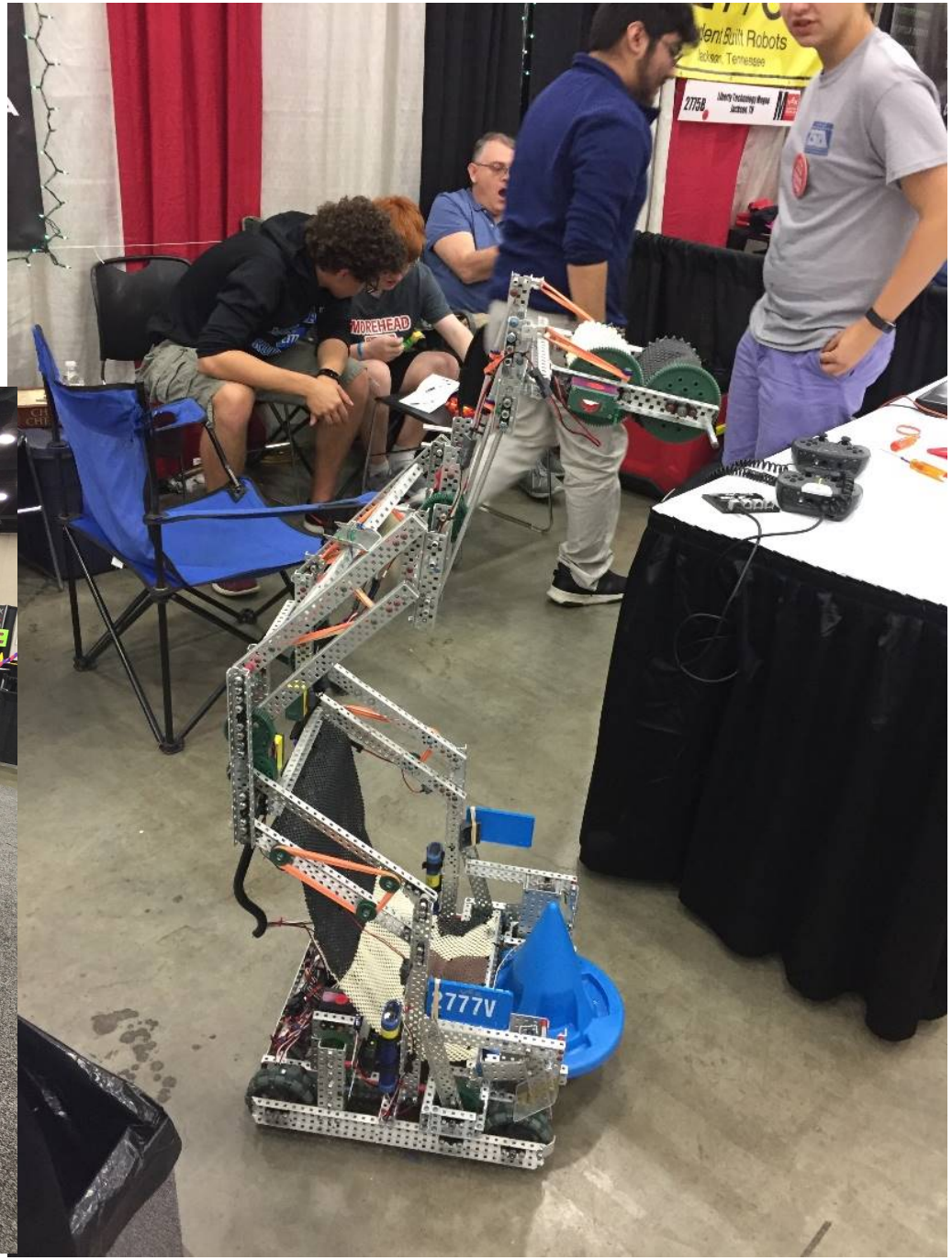
Rack and Pinion for lifting



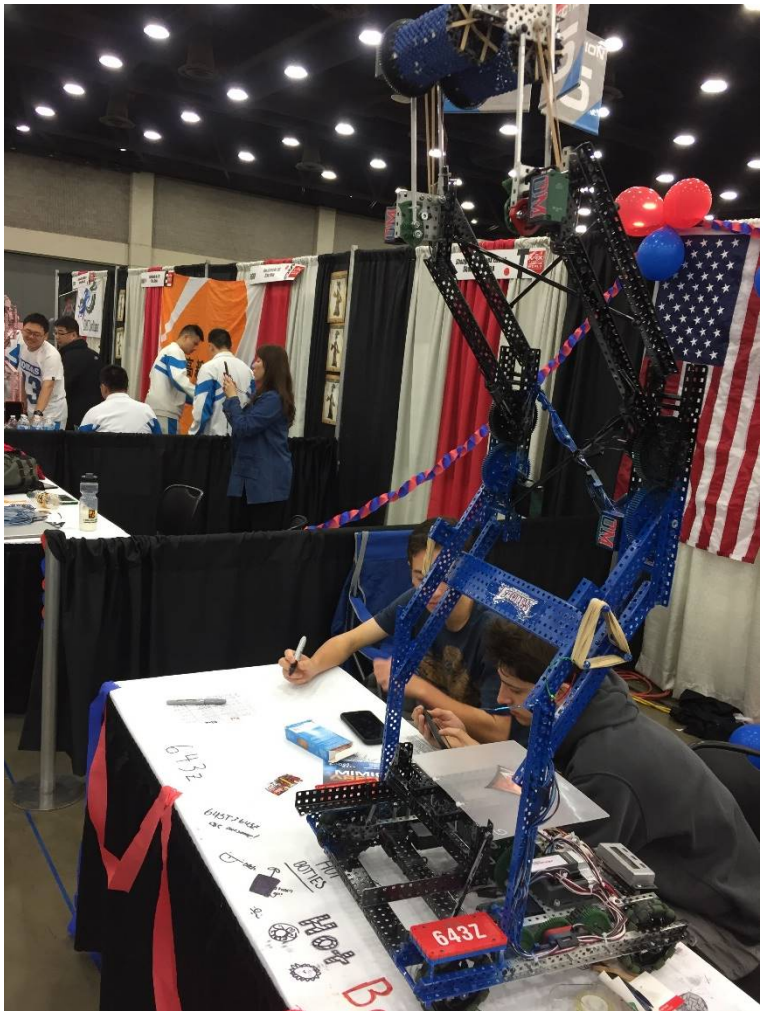
Scissor Lift Pros and Cons

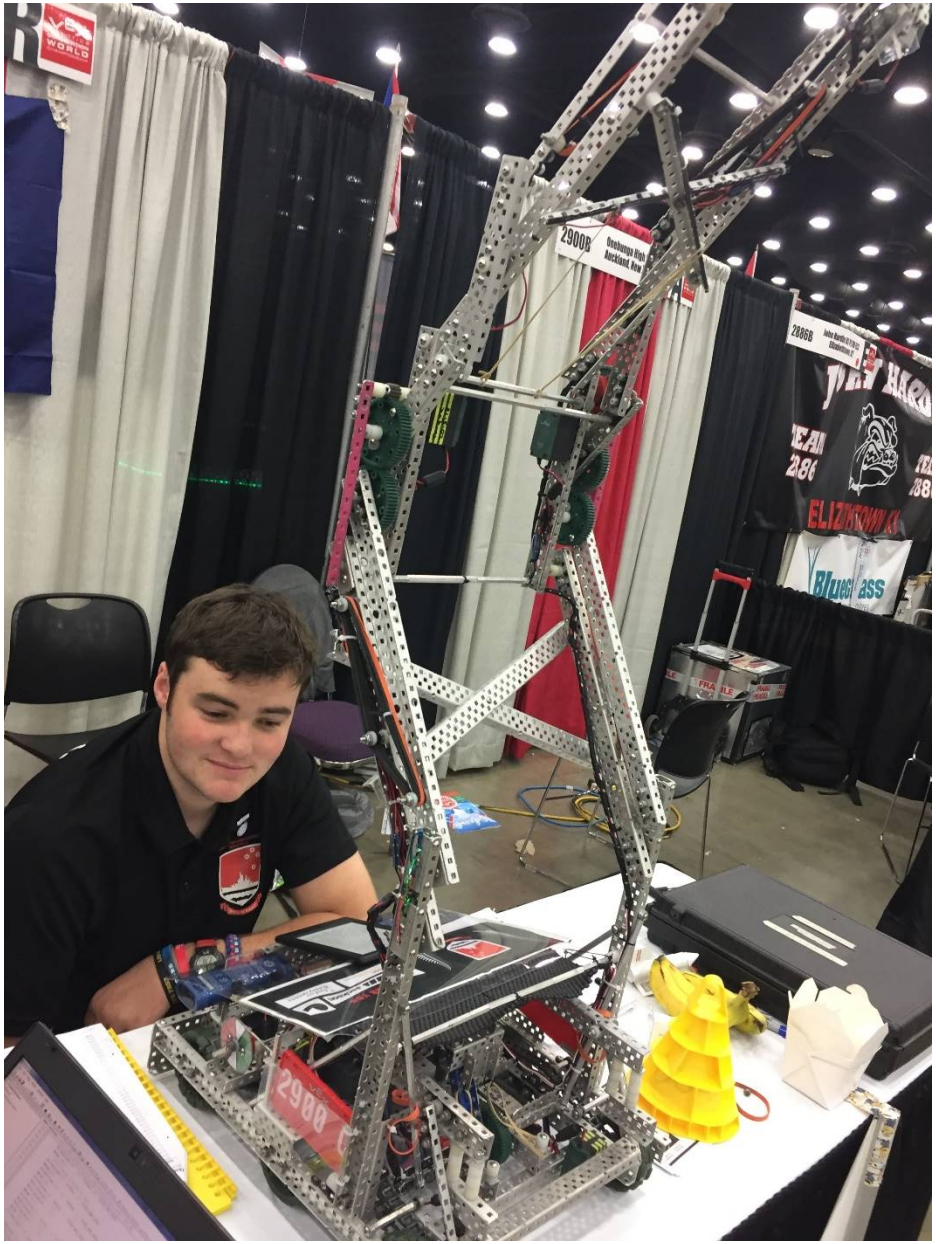
- ***Advantages –***
- Can **expand a great distance** for very little linear motion.
- Can be expanded horizontally as well as vertically.
- Rubber bands can be used to expand the lift.
- ***Disadvantages –***
- Complex
- The **further apart the legs** and the lower the center hinge point, the **more force** is required to lift the structure.
- Scissor lift systems **must be well designed**, or they will bind. Scissor lifts take up a great deal of volume on a robot.
- Creates a higher center of gravity when lifted.
- ***Summary: The Great Tormentor! Great on paper, can be difficult to implement with multiple stages.***

Reverse Four-Bar



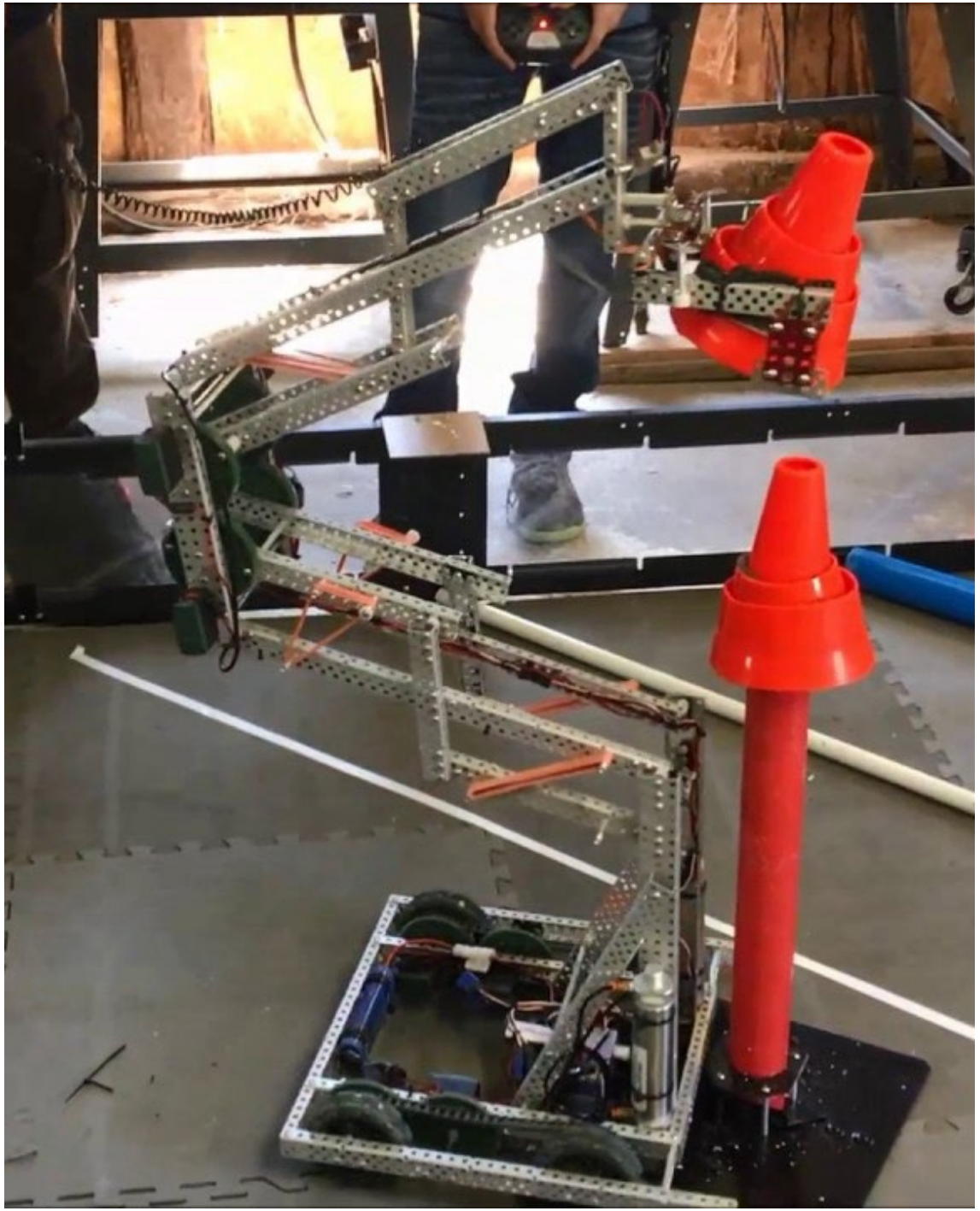
Reverse 4-Bar



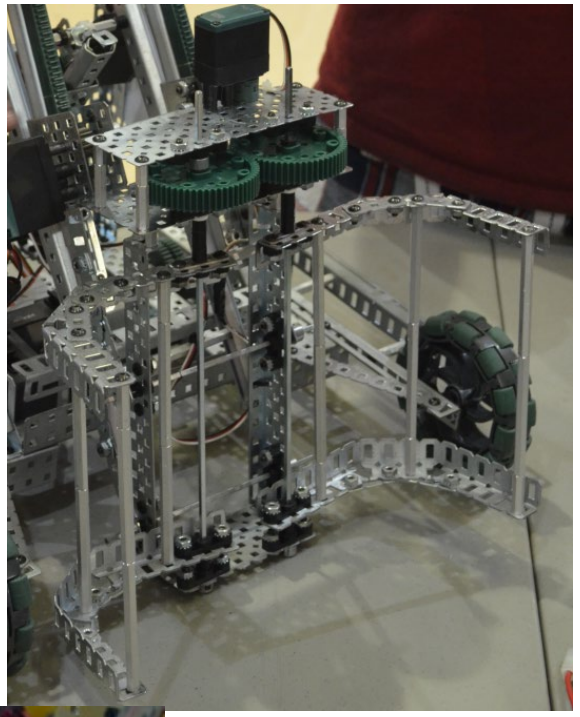


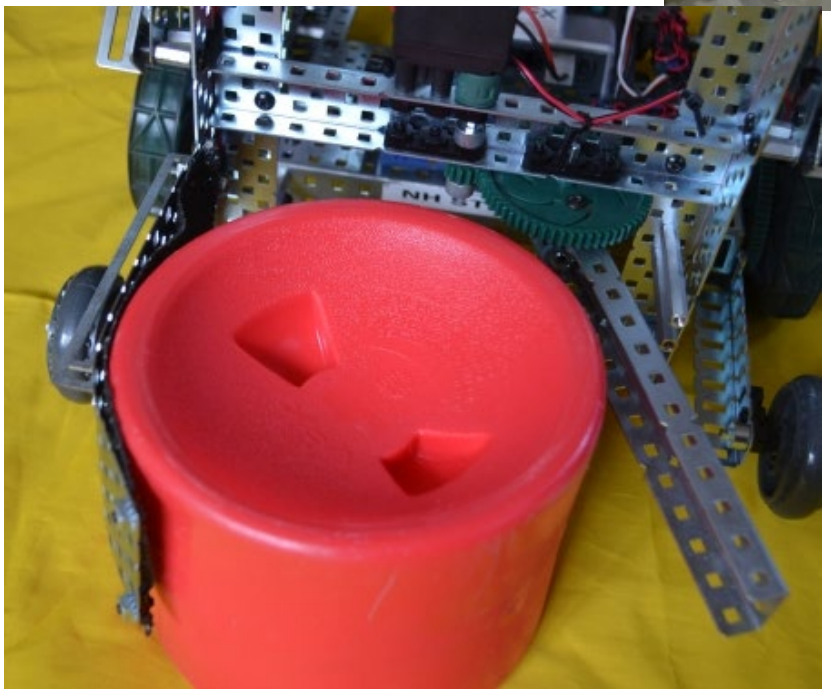
One-Sided Reverse 4-Bar

Reverse 6-Bar



Some Gathering Options

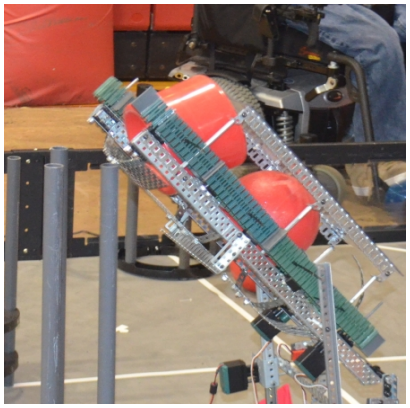




Claws/Hands Pros and Cons

- ***Advantages –***
- Relatively simple to build
- Requires a low to medium torque application.
- ***Disadvantages-***
- Usually can only hold one item at a time
- **Summary: Great start and good for manipulating one item at a time.**

Conveyor Belts

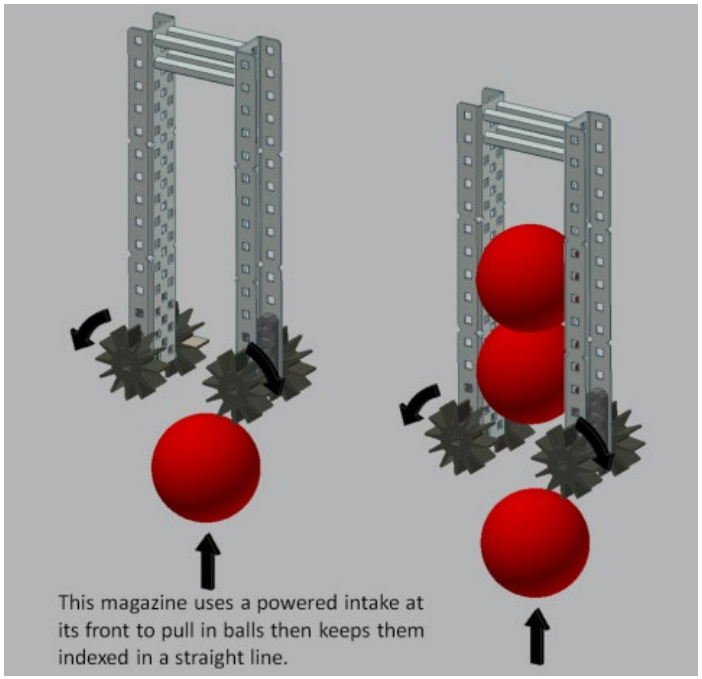


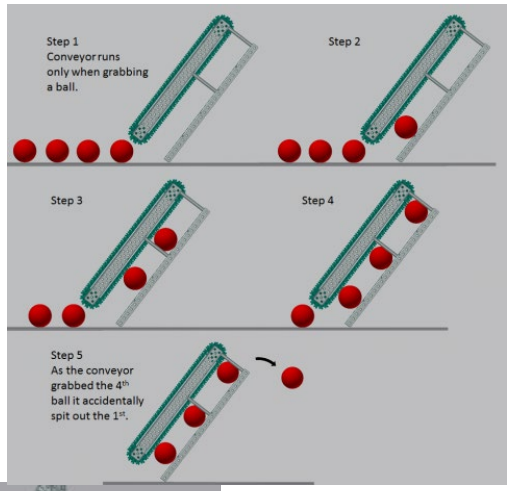
- **Conveyer belts**- These manipulators can be used to lift objects or move them horizontally.
- They consist of the tank tread kit or chain from the high strength or regular sprocket sets.
- Can combine with Tank Tread Upgrade kit for flaps.
- Many times the conveyer belt is integrated into a roller claw.
- All conveyer belts require at least one motor to activate

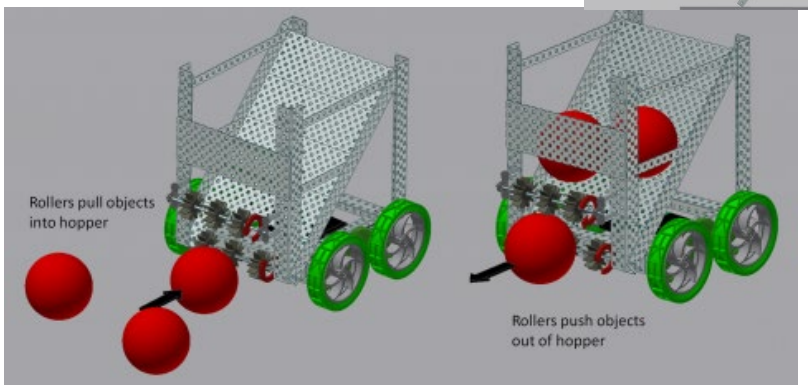
Conveyor Belts Pros and Cons

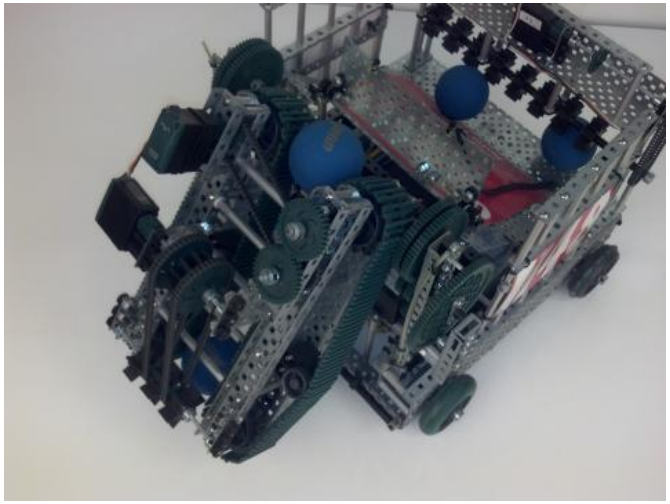
- ***Advantages –***
- Can move objects horizontally or lift them vertically.
- Requires a low to medium torque application.
- ***Disadvantages-***
- Takes up a large volume on the robot, can raise the center of gravity of the robot
- **Summary: More complex than a claw, but lets you control more than one scoring element at a time.**

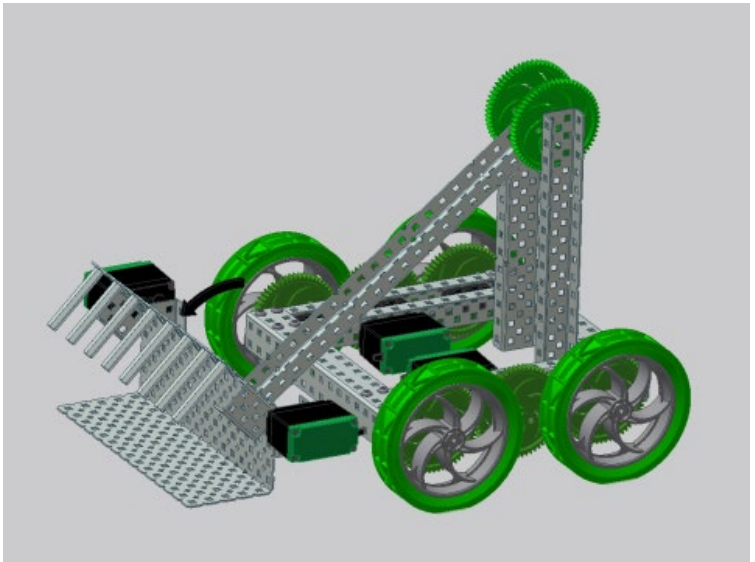
Accumulators











Side Gatherer

Approximate Schedule

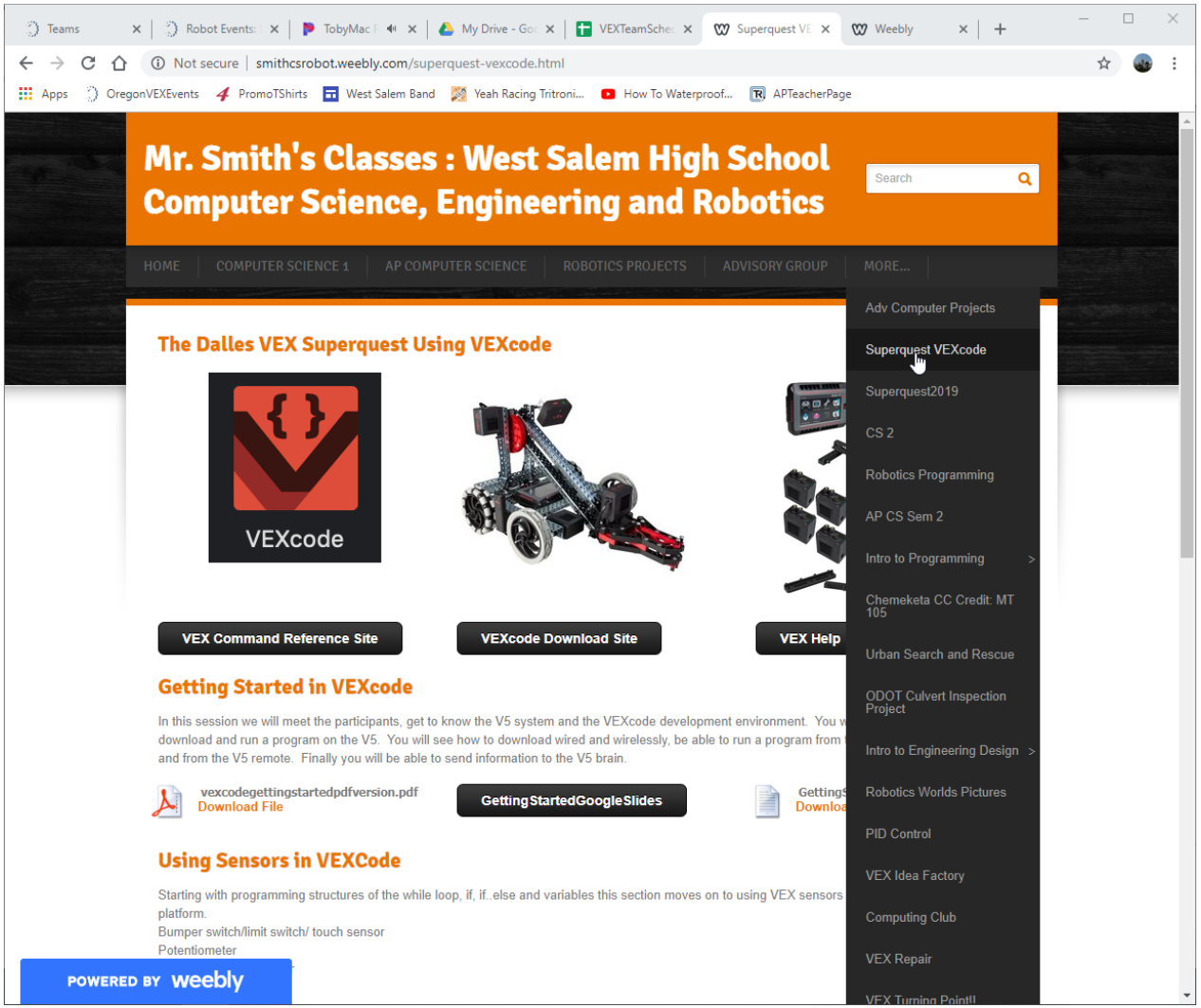
Students will be available to help your teams get going throughout the event.

- 9:00 Welcome/ Opportunities
  - Introductions
  - VEX in Oregon Program Overview
  - SkillUSA Mobile Robotics Technology/ Urban Search and Rescue
- 10:30 Best Practices: Drive systems, arms, manipulators.
- 12:00 Lunch
- 1:00 After Lunch Teams Select what would help your team the most

Computer Lab (A116)	Fabrication Lab (A117)
VEXCode	Build, practice, Scrimmage
Getting Started: Write/compile and download first program	Build, practice, Scrimmage
Autonomous Motion	Build, practice, Scrimmage
Driver Control Coding	Build, practice, Scrimmage
Using the Competition Template	Build, practice, Scrimmage
Scrimmage	Scrimmage

Programming VEXCode

- http://smithcsrobot.weebly.com/superquest-vexcode.html



References

- www.simplerobotics.org
- http://curriculum.vexrobotics.com/curriculum
- http://vexsuperquest.weebly.com/