Engineering Notebook

By: Maplerobot

2023-24

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Team Members & Roles

Alex is responsible for the coding and building team.

Bryan is responsible for finding sponsors and creating the engineering notebook.

Jason is responsible for creating the engineering notebook and the media

Daniel is responsible for coding the robot and helps the media team

James is responsible for the t-shirt design and driving the robot

Hunter is responsible for building and creating the 3D model

Eric is responsible for creating the t-shirt and driving the robot

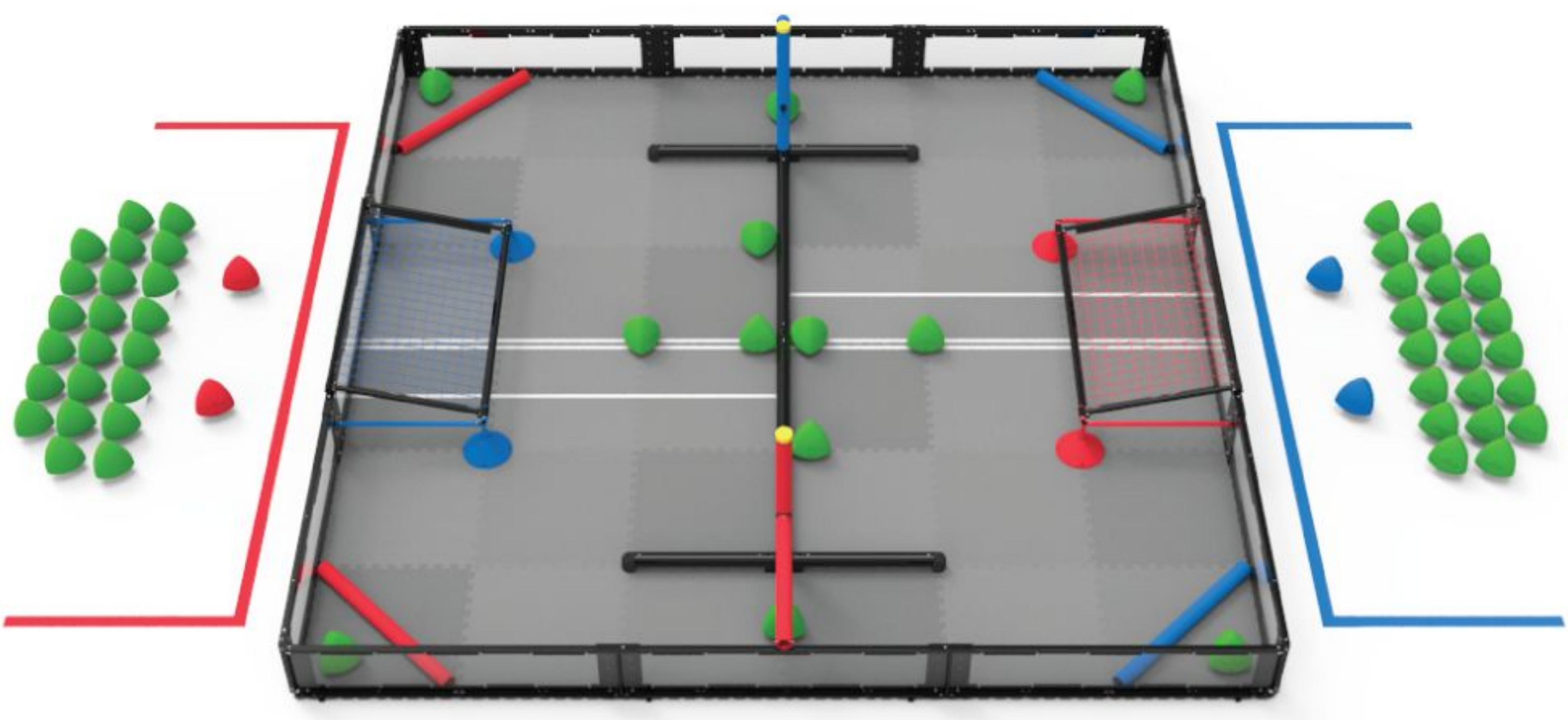
Bob is responsible for creating the 3D models and finding sponsors

Budget

- Field:
- Competition kit
- Two sets of V5 super competition kits
- Tools
- Extra parts
- Playing field mats

Mission

The 2023-2024 VEX season has started! The main objectives are to insert “triballs” under a net to gain points and have our robot do a pull-up.



MapleRobot

Our Plan

1. Create a drivetrain that is suitable
    a. Tank drive
    b. X-drive
2. Add triball shooting and intake system
    a. Flywheel
    b. Catapult or other shooting mechanism
3. Program robot to successfully function during autonomous period
    a. Using the GPS sensor and the optical sensor to move around and sense colour
4. Robot control proficiency
    a. We need to be able to move the robot in all directions
    b. We also need to grab and shoot the triballs with proficiency

Understanding the Tank Drive

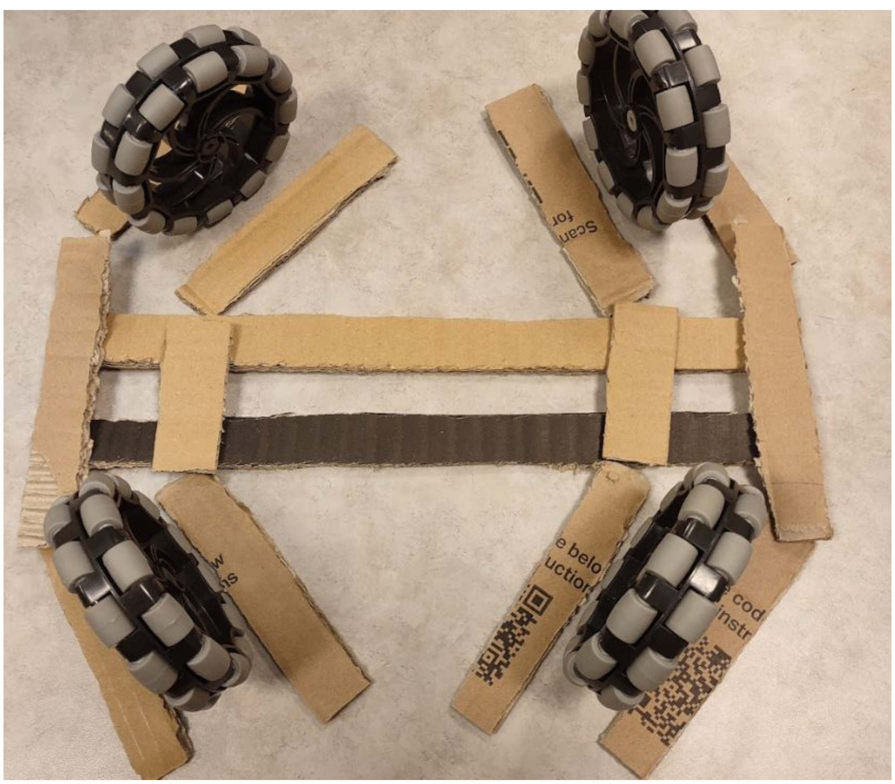
Our team created a tank drive to understand the basics of a drivetrain in order to create more complex drivetrains in the future.

A tank drive is a simple drive train consisting of C-channels and 4 omni/traction wheels. If omni wheels are to be utilized on the robot, they must be locked as a ways to optimize turning.

How we built the X-drive

1. Research the x-drive and its structures.
2. Determine dimensions of the X-drive
3. Create a to scale model of the X-drive
4. Cut the C-channels into correct lengths
5. Used 3D model to create a basic structure with some cardboard to plan it out.
6. Cut C-channels to construct a basic frame for robot
7. Attach wheels to robot to finish the frame.
8. Add the brain and different sensors

Cardboard Model of X-drive



Mecanum drivetrain prototype

The mecanum drive was the first drive we built with Vex parts. We created a simple tank drive, added different sensors, and attached mecanum wheels. The sensors we added were the optical, GPS, and rotation sensors. The mecanum drive will only be used for testing, not competitive purposes.

Right now we are testing the GPS sensor for the Vex autonomous skills challenge where our drivers can also practice with the mecanum drive.

X-drive Prototype Interview - Alex Li

Why did we chose the X-drive?

We chose the X-drive as our first prototype because it is fast and versatile when paired with effective wheel placement and structure of the robot.

What advantages does the X-drive have?

Along with a fast revolution rate, the X-drive can turn smoothly and quickly while being omnidirectional.

How did we find out about the X-drive?

We researched different drives to move the robot and we settled on a tank drive, H-drive, Mecanum drive or X-drive. However, after thorough discussion and testing, we concluded that the X-drive had the most advantages for the “over-under” competition.

What are some disadvantages of the X-drive?

The disadvantages of the X-drive lie in the C-channels. The long, metal components occupy lots space and weigh down the robot which may inhibit its movement.

X-drive Prototype Interview Continued...

What was the most difficult part of building the X-drive?

Squaring the X-drive was the hardest part of building the robot. Usually, squaring the robot is easier because it is comprised of 90 degree angles, but the X-drive is comprised of 30 and 45 degree angles which make the robot harder to square.

How long did it take to build?

The X-drive took about 6 hours to create and build the 3D model.

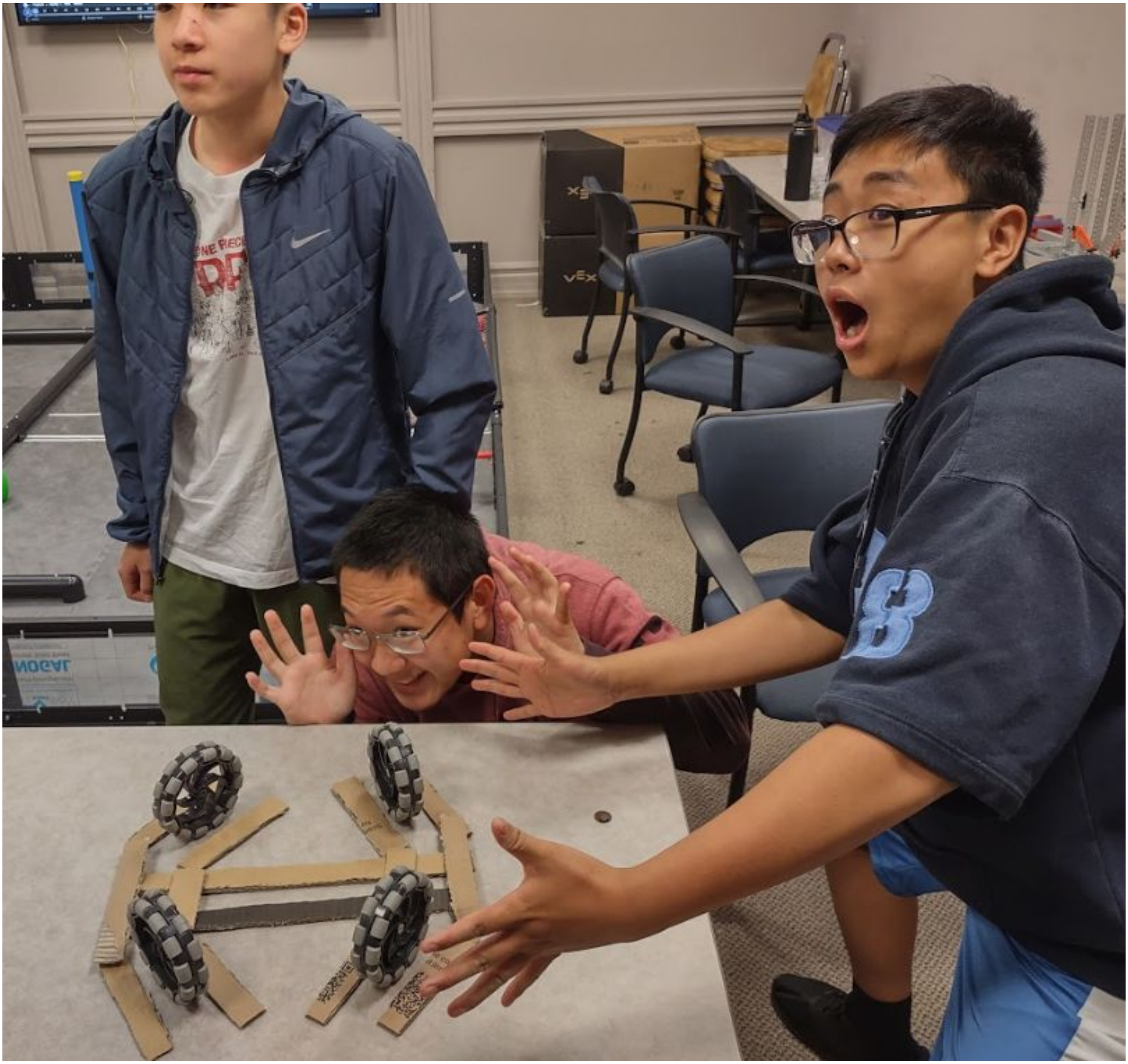
What subsystems does our X-Drive have?

The X-Drive will have a shooting and intake sub-system.

Why is it hard to program the X-drive?

For the programming you can either do the simple way or the complicated way. The simple way is bad so we have to use the complicated way. The simple way is mapping the joysticks to the motors but the complicated way is doing math and many complicated algorithms.

Engineers of basic x-drive frame



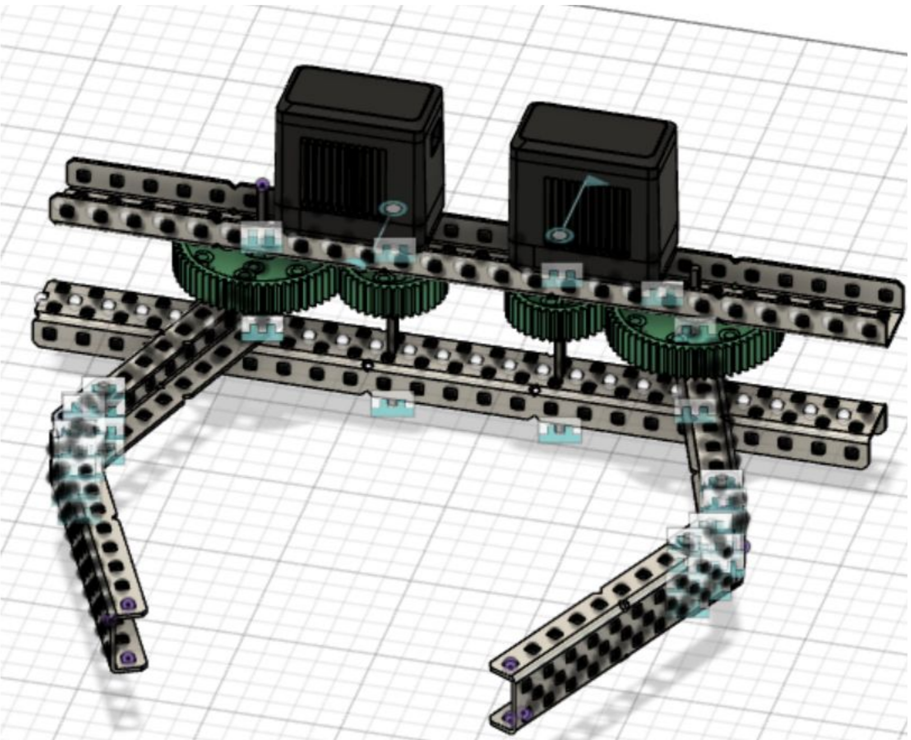
Potential Attachments

We first debated about what attachments we would like to add to the X-drive. Suggestions were filtered to a flywheel or a claw, and we decided to make a claw.

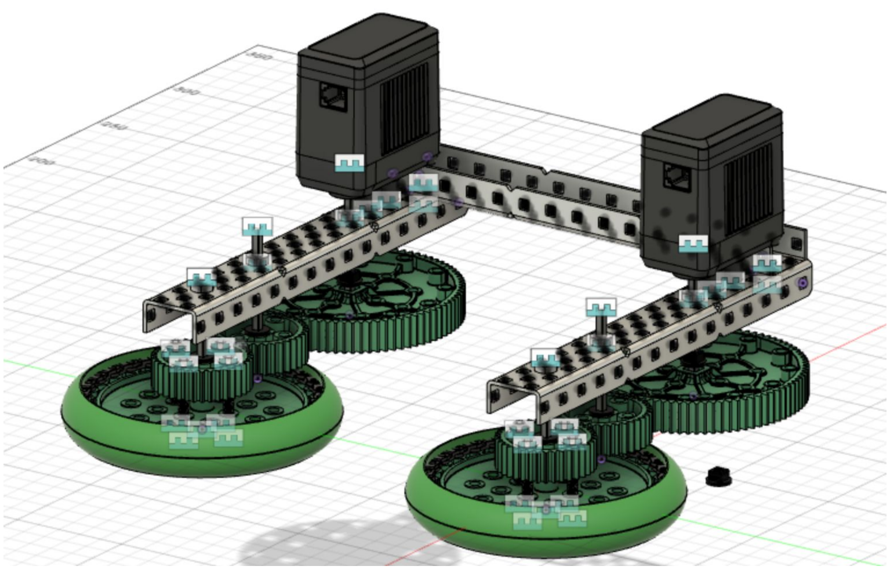
We each sketched an attachment design and presented them in front each other, and after distinguishing a concrete plan, Bob, James, and Jason used Fusion 360 to create claw attachments: Bob created the arm of the claw;, James created the claw, and Jason created a flywheel that can be attached to a claw.

Picture of Potential Attachments

Created by: James and Jason



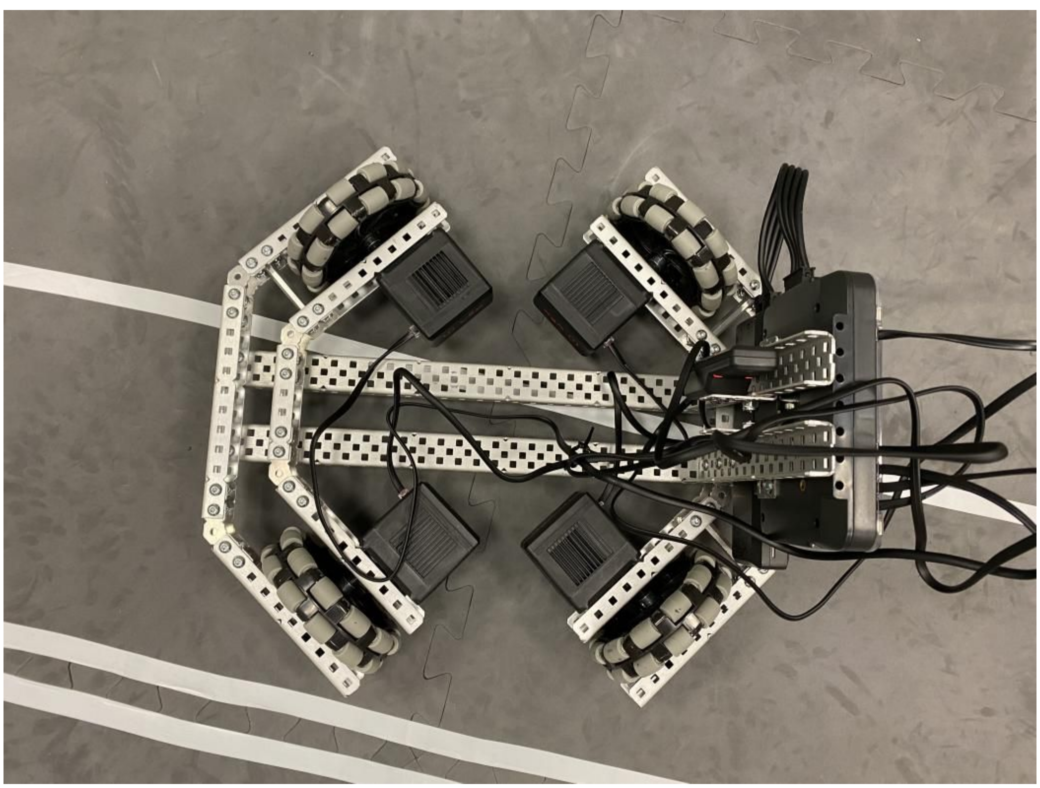
The first design for the X-drive claw attachment in Fusion 360.



A basic design for the flywheel that connects to the claw and collects the triballs.

Drivetrain Experimentation: H-drive

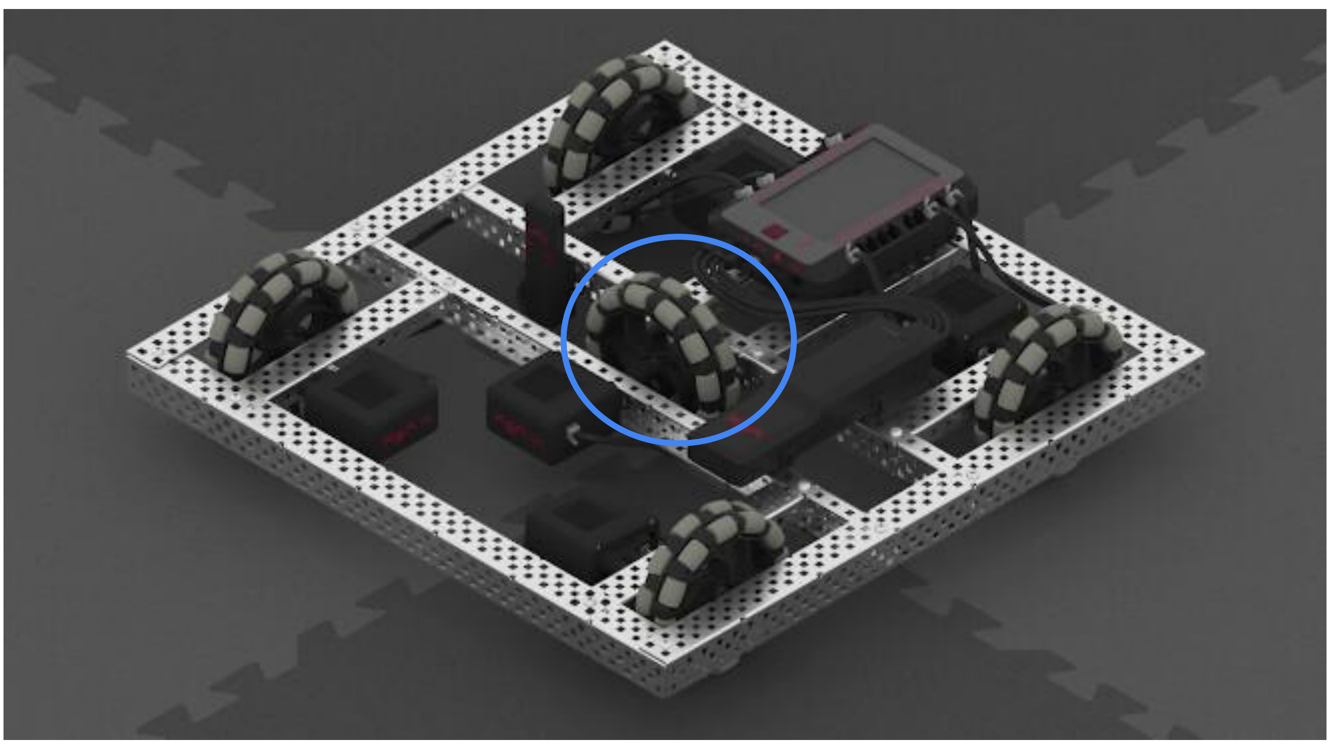
A debate surrounding whether or not we should change our X-drive to another drivetrain arose. We wanted to be able to cross the middle pipe barrier in the playing field, but the X-drive cannot cross the middle pipe barrier because of how the wheels and the frame are placed. We considered an H-drive; it is more versatile than an X-drive for crossing the middle, but we would consequently lose the mobility and speed of the X-drive. Thus, further testing must be performed.



X-drive that we built

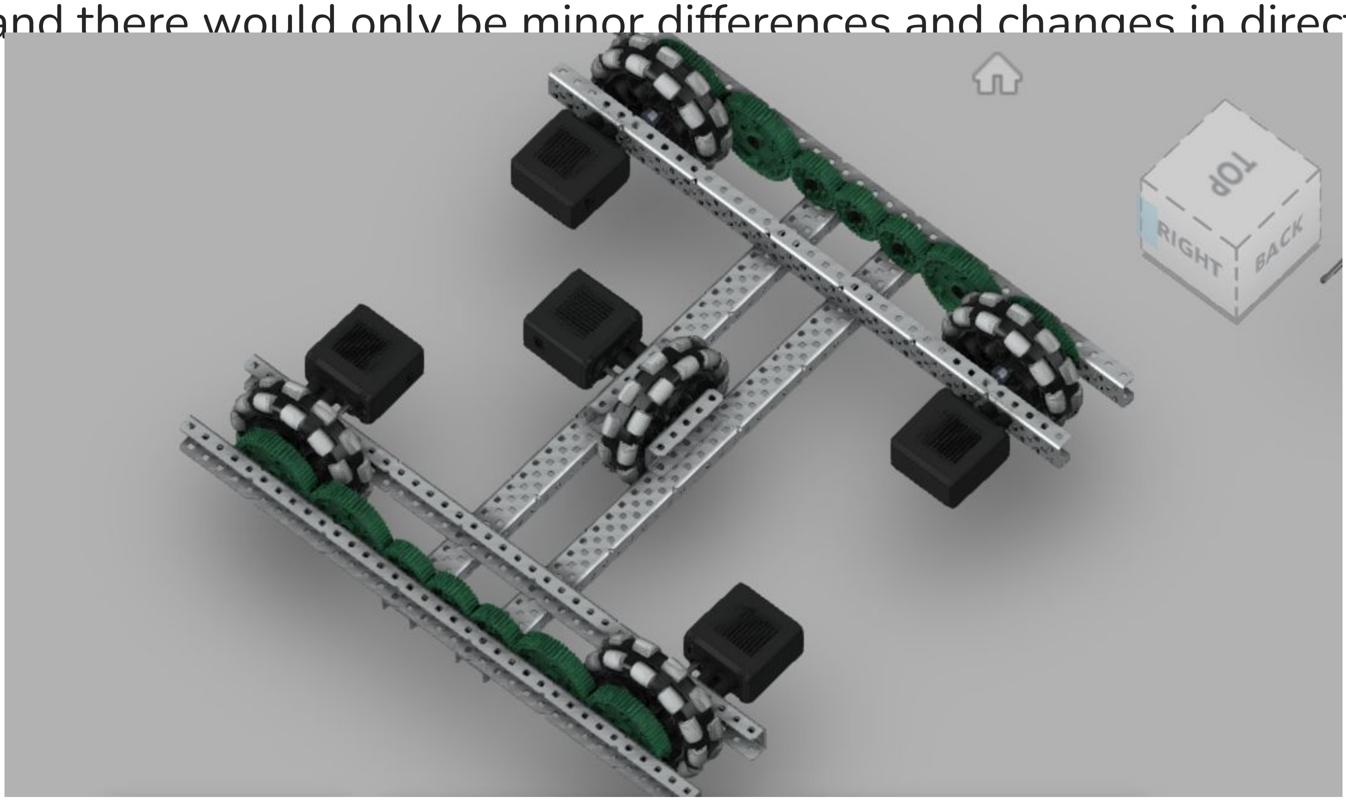
The H-drive

The H-drive consists of a basic tank drive, but contains an additional omni-wheel placed in the centre of the robot. This addition allows the robot to turn more effectively, making the H-drive more versatile because it can move very quickly while still maintaining accurate turning.



Pros of the H-drive

Due to its additional support systems, the H-drive can maintain balance easily. balanced. It is significantly more stable and simple to manage compared to the X-drive. This implies that it can move around during the autonomous phase more steadily. The wheel in the centre gives it greater maneuverability than the tank drive. The extra wheel serves as a pivot, enhancing the H-drive's ability to turn with greater agility. The positioning of the wheels also helps to reduce friction when turning, resulting in smoother turning which would lessen the destruction of the wheel.. It will be particularly effective throughout the autonomous phase because it is very stable and there would only be minor differences and changes in direction.

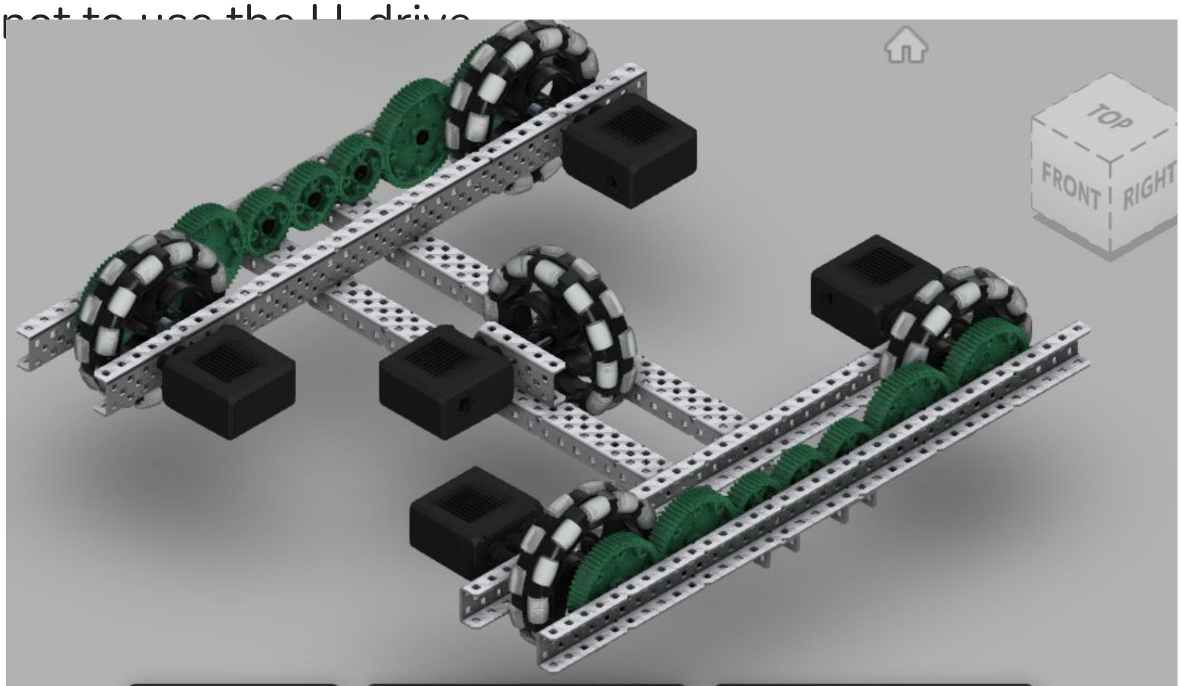


H-drive 3D model from a different angle.

Cons of the H-drive

The design of the H-drive is very complex as a result of the unique arrangement of the wheels and the additional support mechanisms, which make the design more complex than other drive trains. The H-drive is also quite heavy because of how complex it is. The additional support mechanisms increase the weight of the drivetrain. The additional moving parts would increase the risk of mechanical failure. Components like the centre wheel and the support mechanisms would need more inspection than other parts as a result. The H-drive also does not have as much standardization compared to other drive trains. This would make it harder to find and buy the components of the H-drive. After discussing and looking at the 3D model that we built, We found out that the H-drive would not be able to cross the barrier because of the additional wheel in the middle, which blocks it from passing the barrier. In the end, we decided not to use the H-drive.

H-drive 3D model that we built

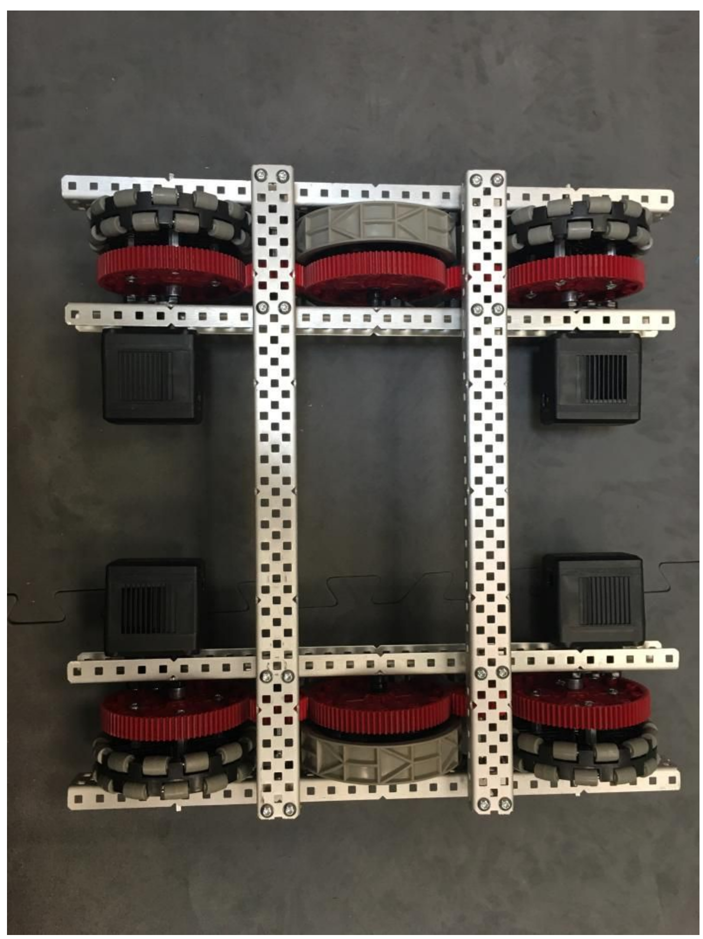


Steps for the Future

After abandoning the idea of an H-drive, we decided to try and use a tank drive. Our 3D design of the tank drive will be similar to the H-drive but without the middle wheel. Our tank drive will benefit from not having the middle wheel and still retain some of the pro's from the H-drive. The tank drive would be stable and versatile like the X-drive, but it would be able to cross the middle pipe barrier. If the tank drive does not work, we will change the drive train back to an X-drive.

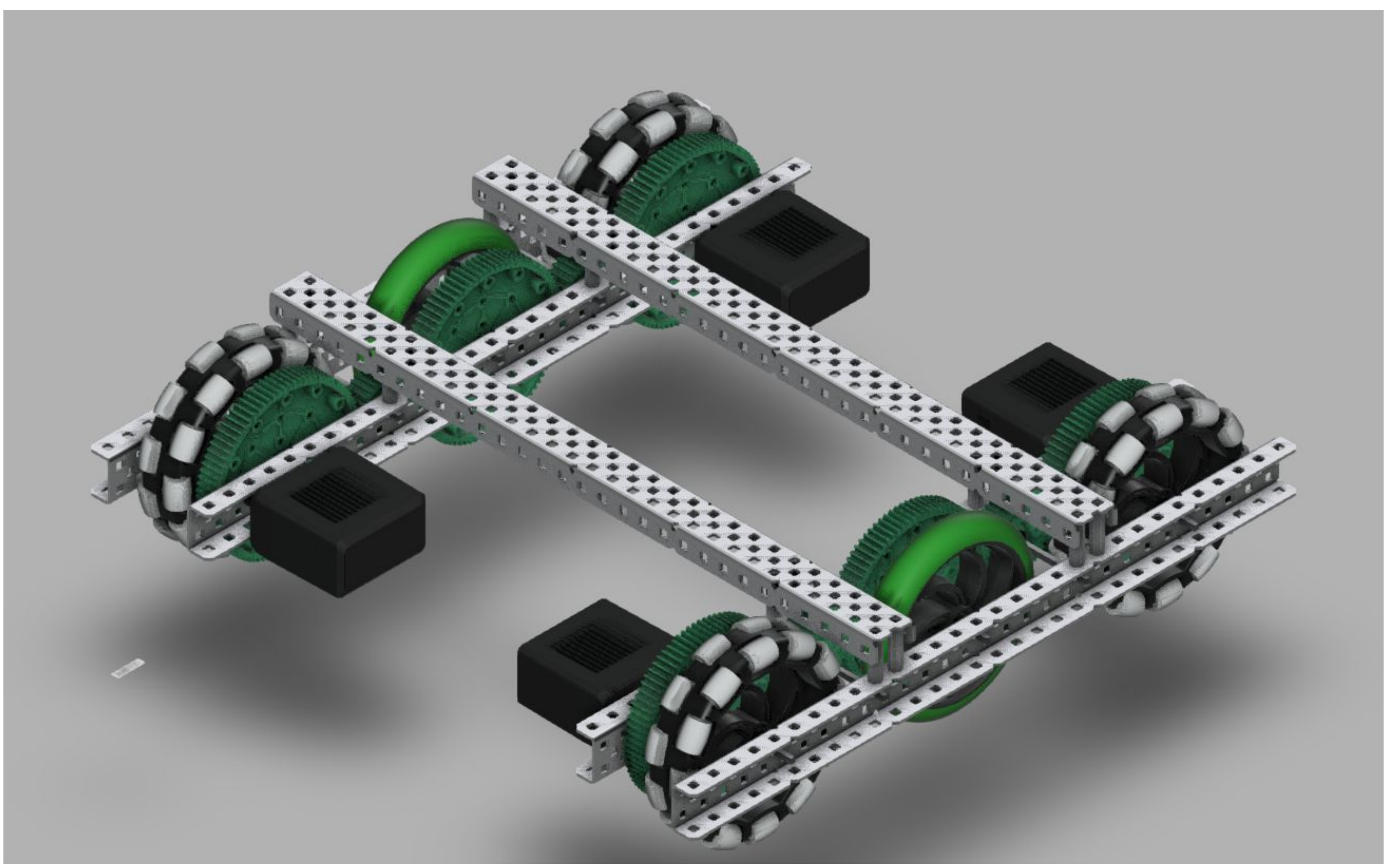
The Tank Drive

After deciding that the mecanum drive was not suitable for this mission, we decided to switch to the tank drive. We designed a 3D model on Fusion 360 and we discussed the location and type of the six wheels on the drivetrain. Eventually, we settled on 4 omni wheels placed on the corners and friction wheels in the middle to maximize turn efficiency. The friction wheels in the middle would grip on the ground and, as a result, would increase acceleration and speed.



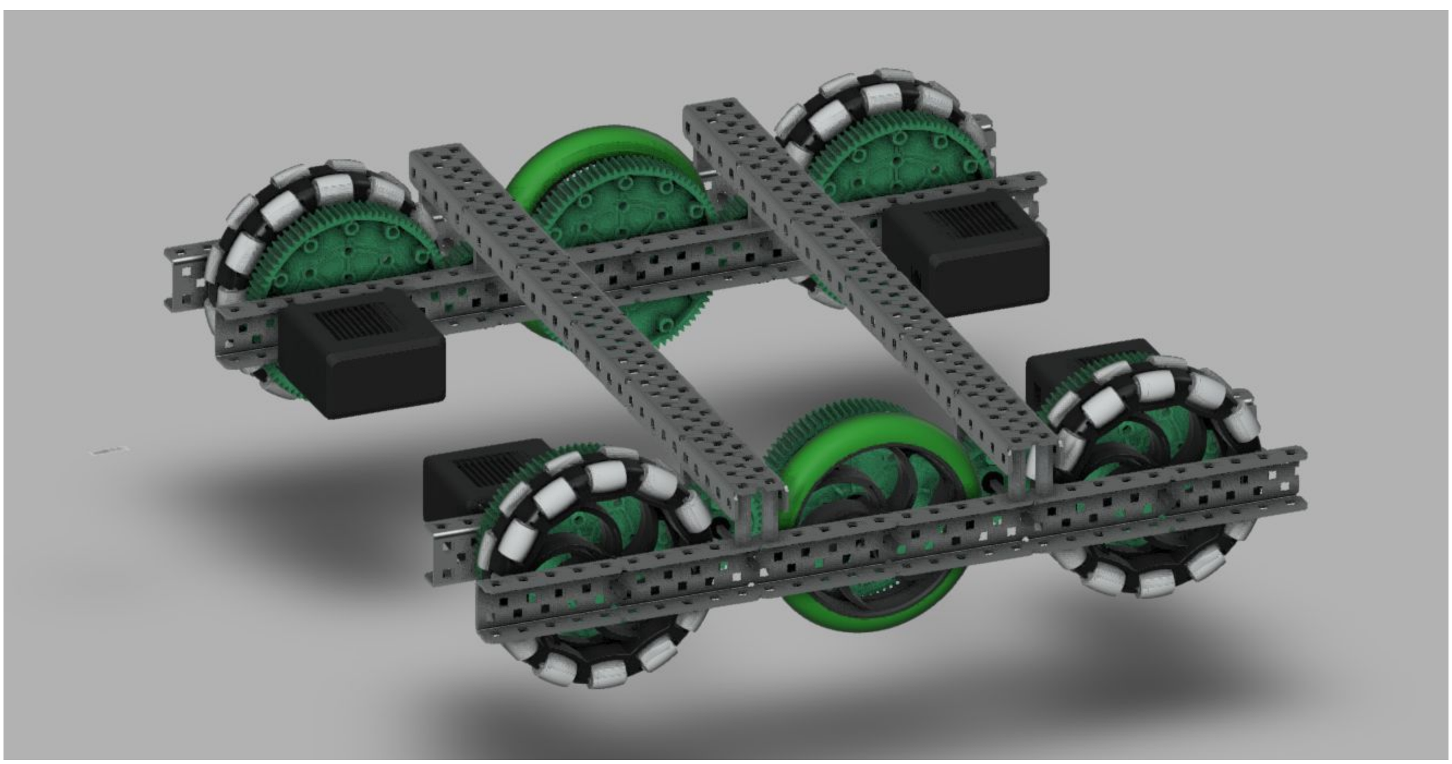
Advantages of the Tank drive

By having four omni wheels and two traction wheels, we discovered that the tank drive will have high forward traction. First of all, the traction wheels allow high horizontal traction because of the four omni-directional wheels. Secondly, the traction wheels will also increase grip on the floor, making the robot harder to push since the traction wheels increase the friction. Finally, there will be reduced compression because of the six wheels. Therefore, as the tank drive has many advantages along with being fairly straightforward to build, we decided to assemble a tank drive.



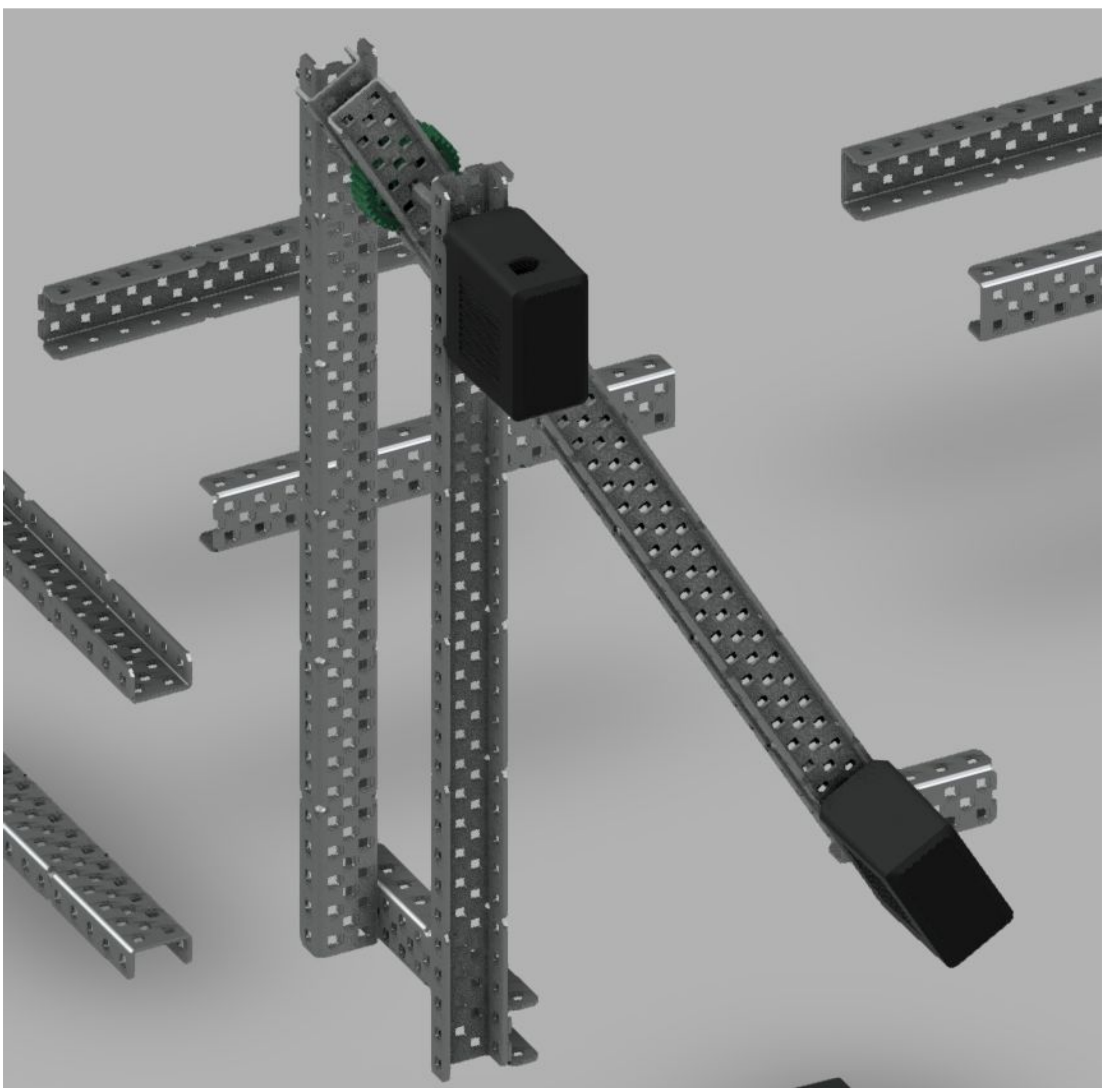
Disadvantages of the tank drive

The six-wheel tank drive is heavier because of the extra wheels, but it also has lower manoeuvrability because of the gears. It also has no sideways movement because it does not have a wheel in the middle like the H-drive does. So therefore, the tank drive can only move forward, back, and turn, but it cannot go sideways. The tank drive is also slower than the X-drive because of the weight, and the wheels are connected by gears.



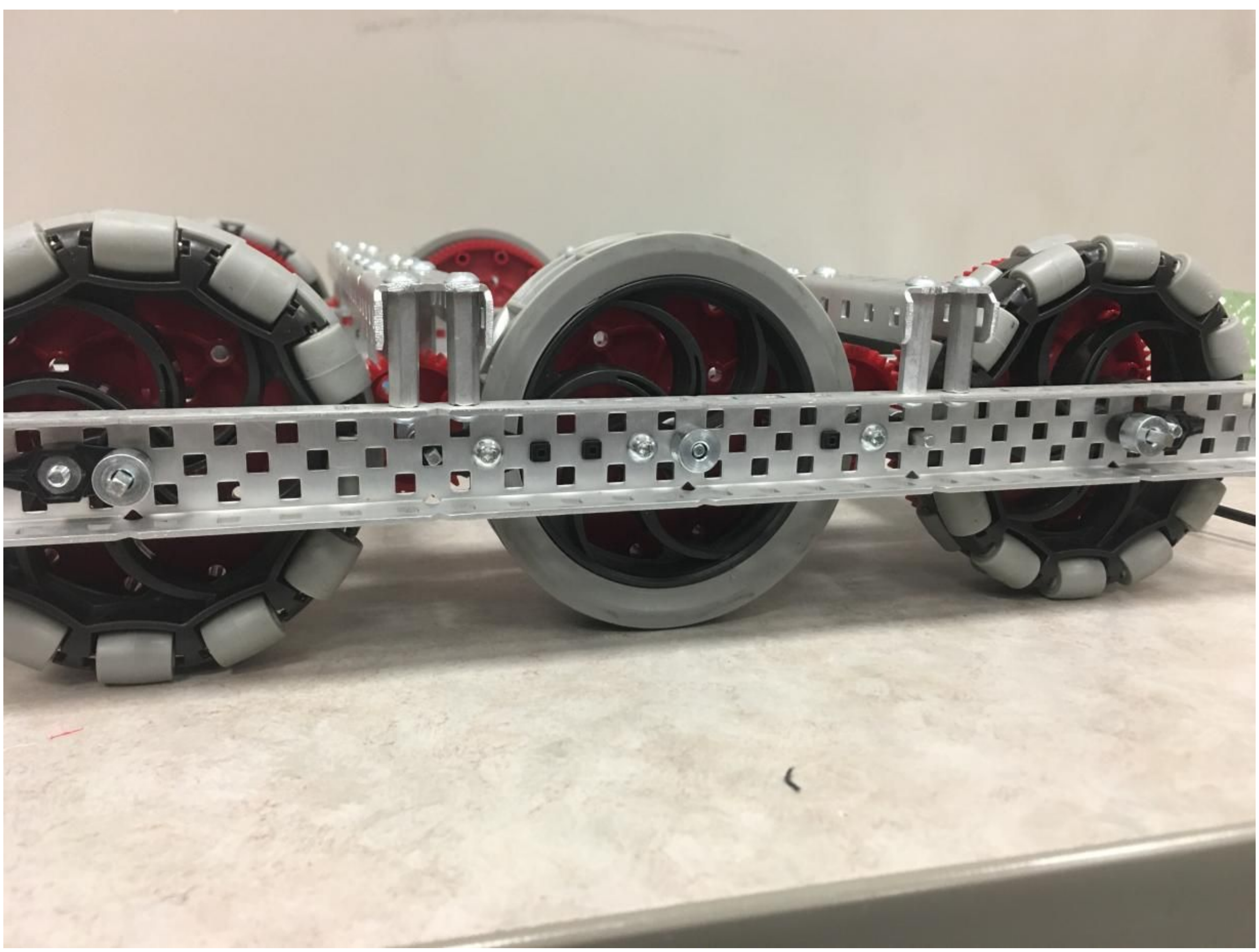
Steps for the Future

We are going to work on the claw and arm next for the intake and outtake system. The result of the systems is to collect and shoot the triballs. We might also use the arm to grab the pole and lift our robot up, but for now we are going to focus on making the arm grab and throw the triballs.



Problem with the Tank drive

We finished building the tank drive, adding omni-directional wheels in the corners and traction wheels in the middle to so that the robot would not be easily pushed sideways. However, we unfortunately realized that our middle traction wheels were not touching the ground. Hence, the increased grip of the friction wheels was not practically exploited. The problem lied in the omni-directional wheels being larger than the traction wheel which lifted the middle friction wheels off the ground and rendering them useless.



First Solution

At first, we thought that putting a rubber band around the wheels would make the wheel touch the ground and still increase the friction. But after testing it, we found out that it indeed will increase the friction, but when it gets pushed horizontally, the rubber band will flip and and go in between the wheels. As a result, the rubber band could get stuck in the wheels prevent it from moving.

Second Solution

The second solution we found was to force the wheels to touch the ground through adding more weight to the robot. Since we finished the drivetrain, we still need to add the shooting mechanism and the catapult. We put a variety of tools on the drivetrain to see how heavy it would need to be in order to weigh the wheels down. We found out that the weight of a saw, a wrench, and a plier shown below was enough weight for the friction wheels to touch the ground. Hence, when comparing the tools to the shooting mechanism and the catapult, we concluded that such attachments would be able to weigh the drivetrain down in similar fashion.

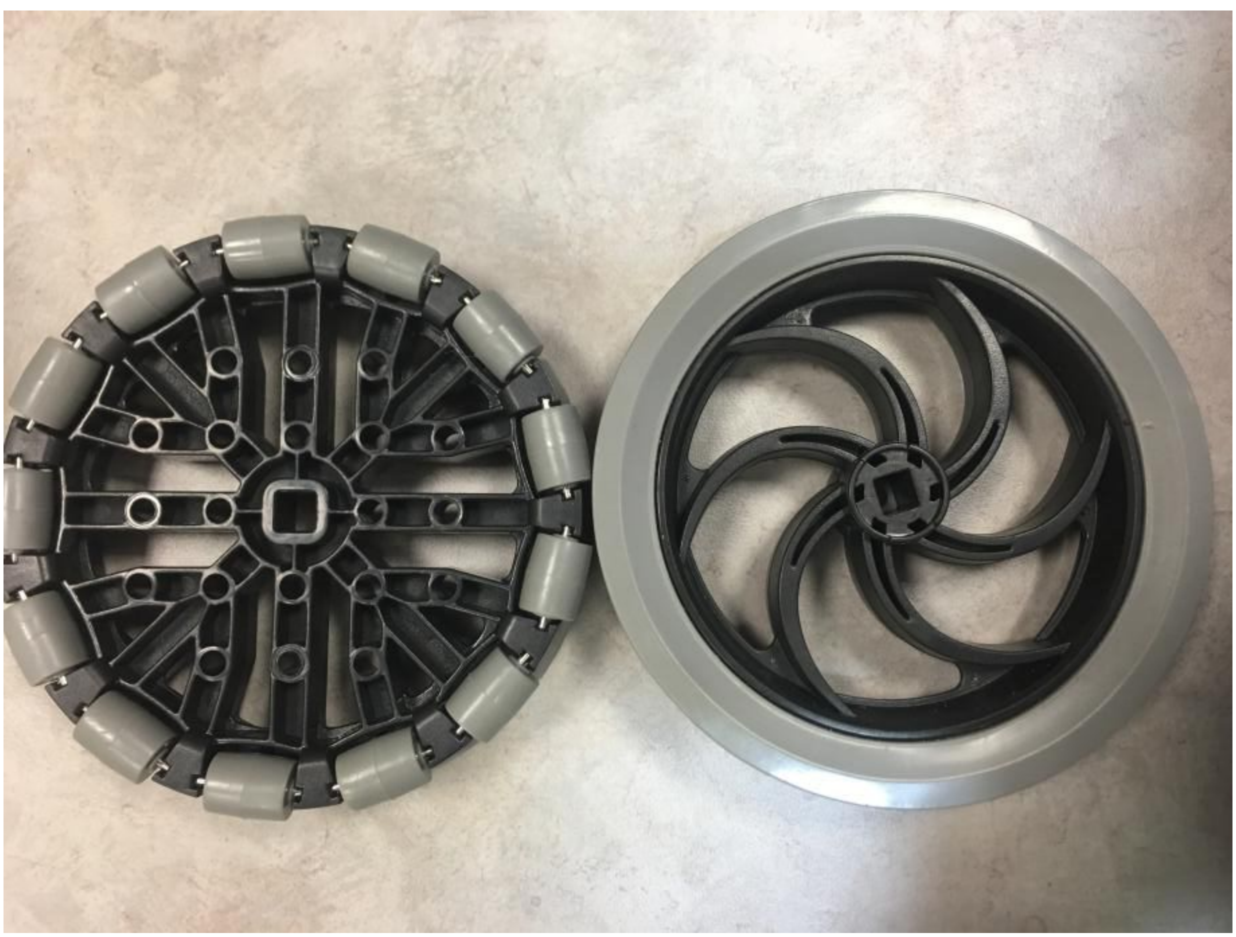
The weight of these three tools were enough to weigh the robot down

Third Solution

Our third solution to the problem is to change all the wheels into traction wheels. It would have a lot of friction, and would not get pushed easily, we would also still be able to go forward and backward. The drivetrain would have a hard time turning because of the traction wheels. The worst case scenario is that the friction completely stop the drivetrain from turning.

Fourth Solution

Our fourth solution to this problem was to change the four omni-directional wheels on the side to traction wheels. Then, we would change the middle traction wheels into an omni-directional wheels. We would use a smaller omni-directional wheel so that it would be off the ground a tiny bit, and as a result, the drivetrain would still be able to turn easier once it was weighed down. However, a major drawback was that the drivetrain would have a hard time turning because of the traction wheels on the side.



Fifth Solution

Our fifth solution was to change the traction wheels into omni-directional wheels, then lock the middle omni-directional wheels. They would not spin horizontally and would basically act like a traction wheel once locked. But the downside of locking the omni-directional wheels is that the screws that you lock the wheels with could break or damage the roller. So, locking an omni-directional wheel essentially breaks it.

What Solution will We Use?

We will most likely make use of solution 2 and add weight (shooting mechanism, catapult, Vex electronics, etc.) to the drivetrain. Additionally, since the side traction wheels prevent the robot from turning, we will also change the middle wheels into omni-directional wheels; they allow the robot to turn easily whilst retaining the grip of traction wheels. We will lock the omni-directional wheels as well.

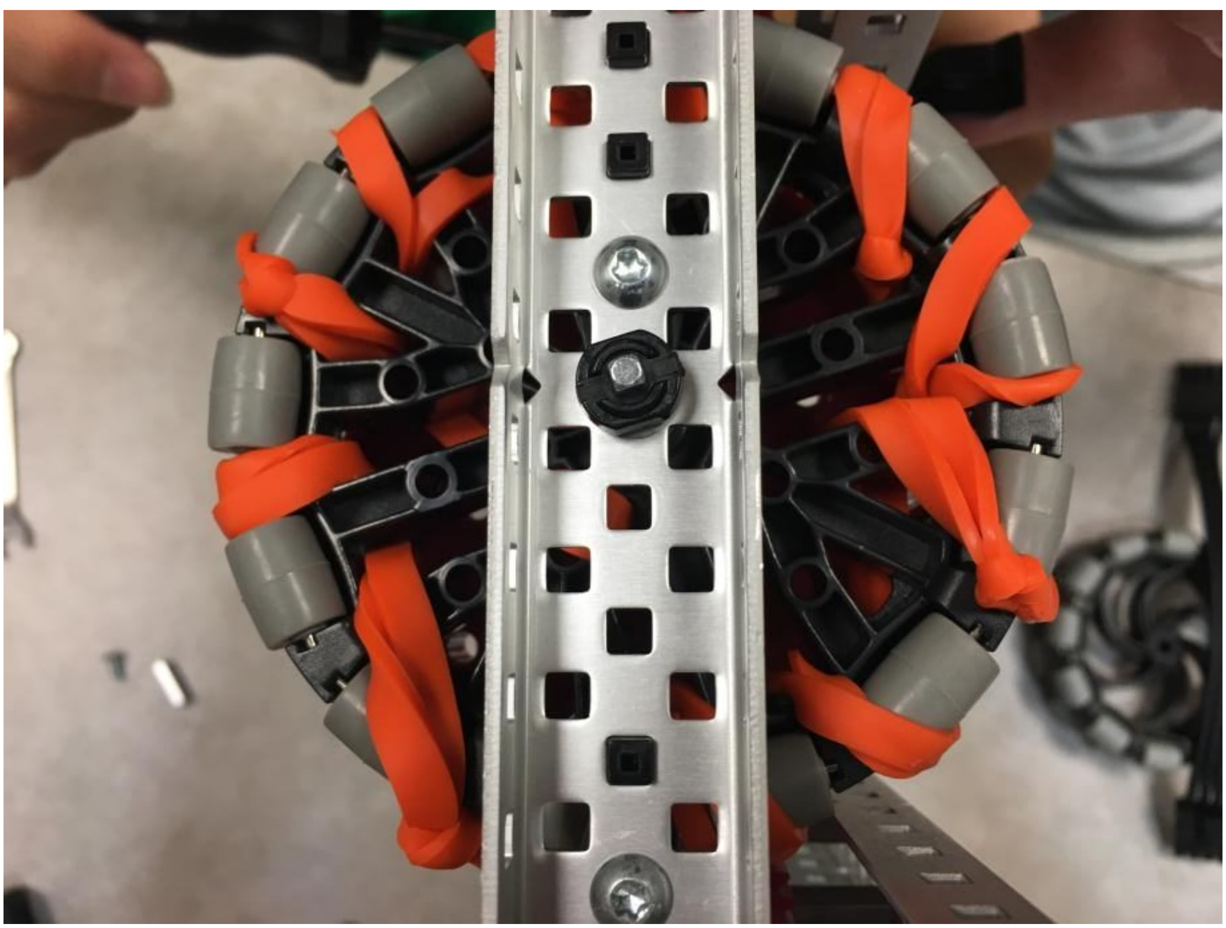
The solution worked, but at the expense of two omni-directional wheels.

Ways to lock the omni-directional wheel

We researched a few different ways to lock the omni-directional wheels. The first method that we found were to put screws in between the mini wheels of the omni-directional wheels. But that would eventually wear the wheel down and could even break the mini-wheel. The second method that we found that could lock the omni-directional is to put two gears closely together against the wheels, but that would leave dents in the mini wheels. We also found using zip ties would work, but they would make the middle wheel taller and the wheels on the side would not be able to reach the ground.

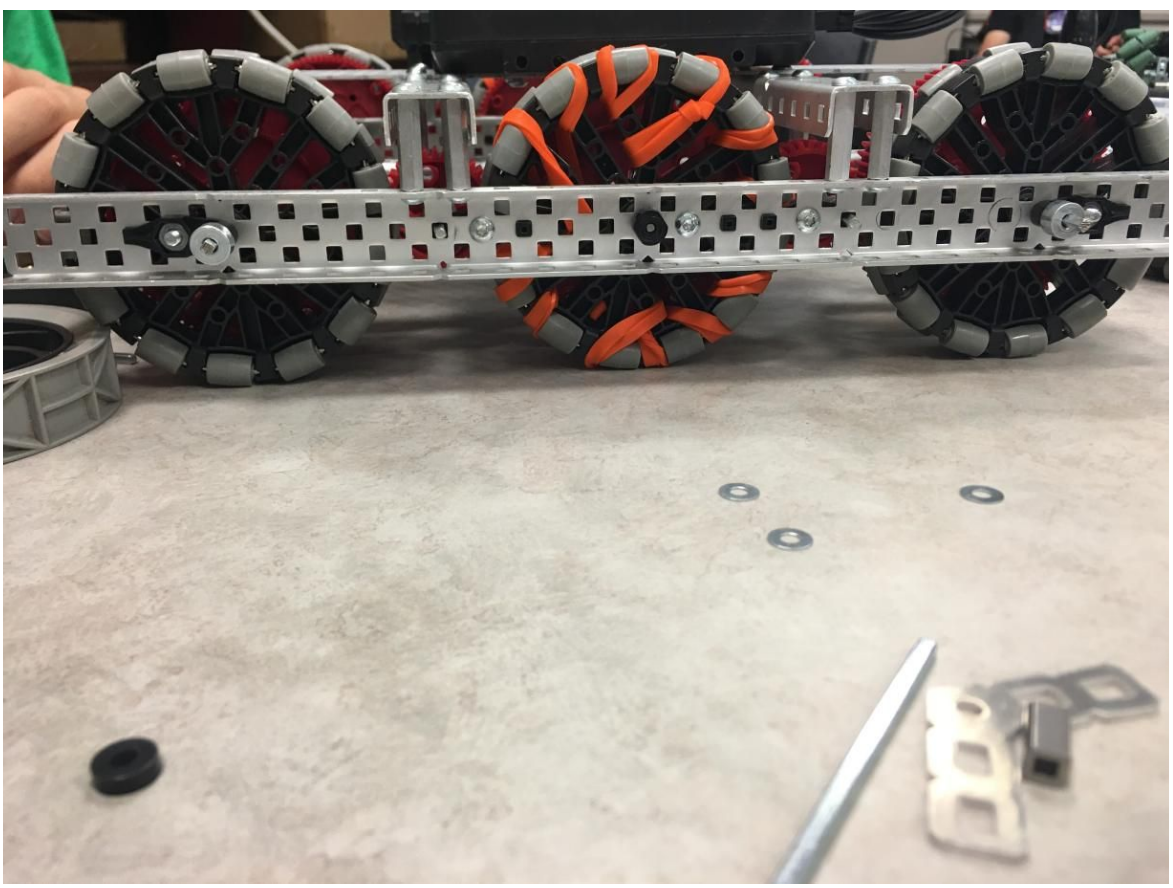
How We Locked the Omni-directional Wheels

To lock the omni-directional wheels for greater robot stability, we decided that we would wrap rubber bands around the omni-directional wheels. We tied multiple rubber bands together and looped them through the spaces between the wheel frames, covering most of the wheels. This ultimately stop[ed the wheels from moving sideways, and paired with the increased friction of the locked omni-directional wheels, we met our goal of increasing the robot's grip.



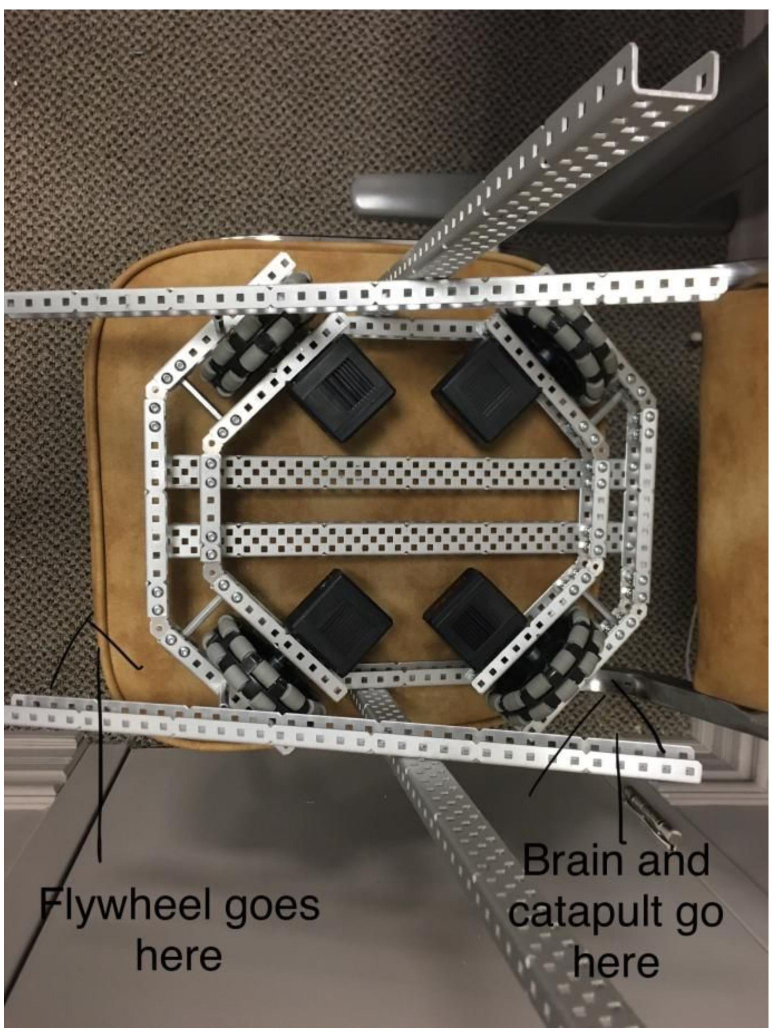
Changed wheels

We changed the larger omni-directional wheels to the smaller omni-directional wheels. The reason behind this is because if we continued to use the larger omni-directional wheels, then the smaller middle wheel would not touch the ground, and therefore the friction would not be increased. But when we changed all the wheels to the smaller omni-directional wheels, all the wheels would touch the ground, and the middle wheels would be able to work. Since all the wheels touch the ground, the friction will increase because of the rubber bands that are rubbing against the ground.



X-drive Changes

We continued to work on the X-drive, deciding on an intake and shooting mechanism. The intake mechanism will be a flywheel and the shooting mechanism will be either a puncher or a catapult. Our flywheels will collect the tribals and then transfer them to the shooting mechanism to shoot them across the map. Additionally, we planned on making the angled C-channel on the frame a bit shorter because the robot has exceeded 18 inches.

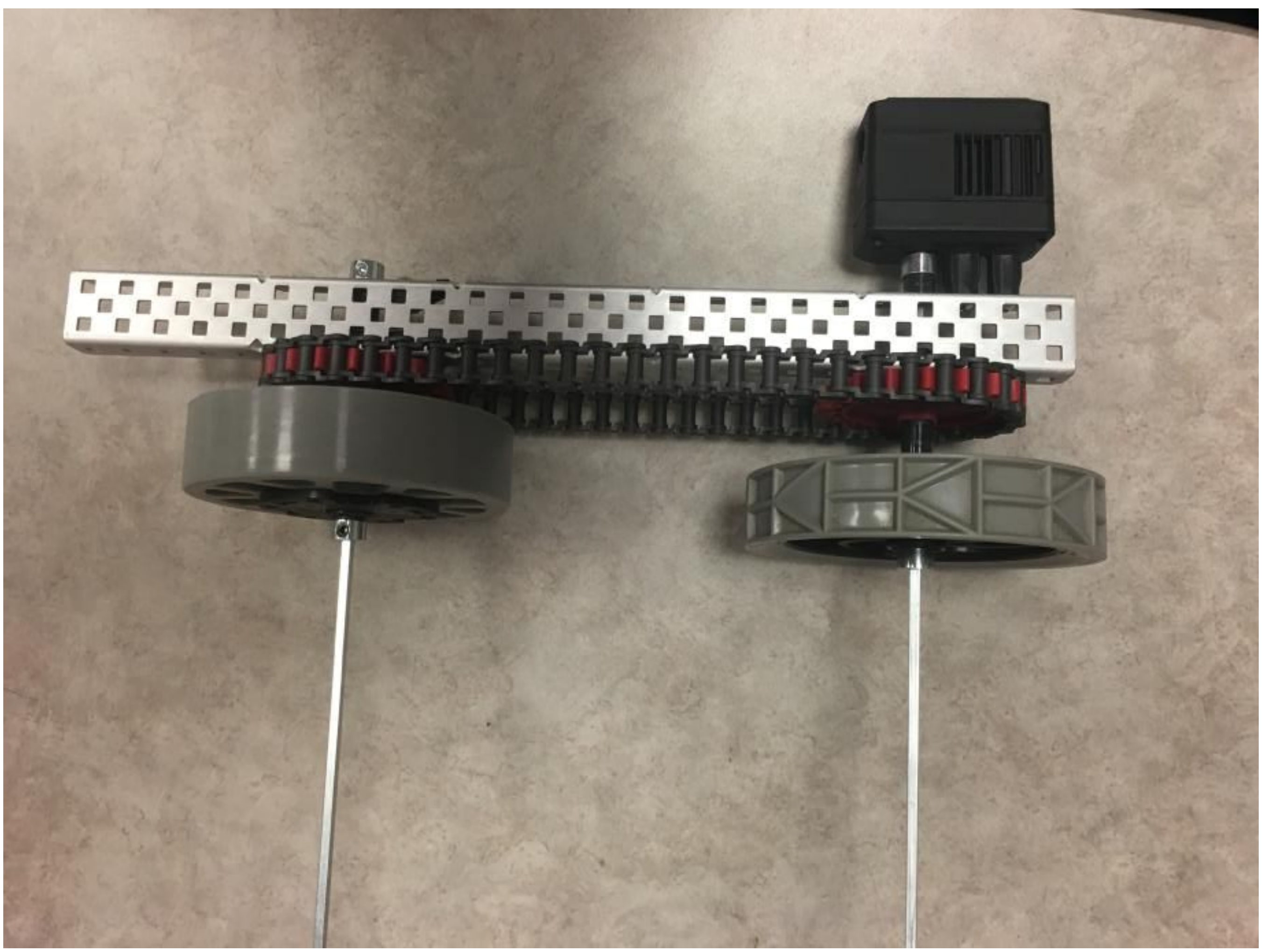


Steps for the Future

Our Steps for the Future are to design an intake and shooting mechanism for the tank drive, which are most likely going to be a flywheel, arm or catapult. After that, we would build and attach the shooting and intake mechanisms. We would also like to finish building the x-drive's intake and shooting mechanism. So, we would have a complete tank drive and an x-drive to test our code on to decide which robot we are going to use for the competition.

Building the Flywheel

To build the flywheel, we used flex wheels because they are flexible and are able to effectively grip onto collected triballs. We used two flex wheels and two traction wheels to create the flywheel. The flex wheels are in the front to grip the triballs first, and then the traction wheels are in the back to move the triballs to the shooting mechanism. The wheels are connected using tank treads and sprockets which mirror a conveyor belt.

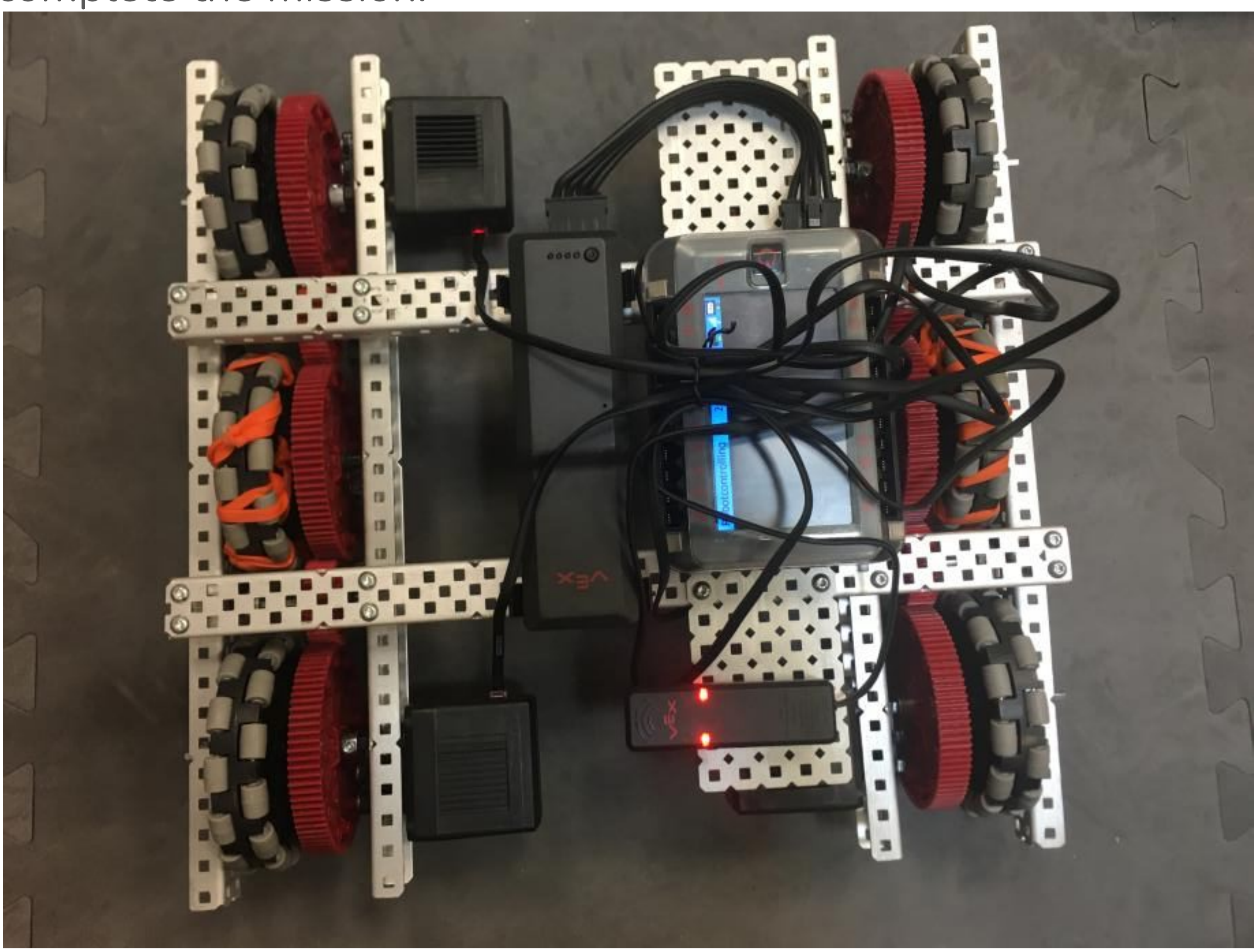


Pneumatics

We tested the pneumatics out, and we successfully made the double-acting cylinder move in and out. We added air to the reservoir, and then we turned the switch on and off to successfully release air into the double-acting cylinder. Next, we programmed the reservoir to release air when we press a button on the controller and then suck the air out when we press another button. So when we pressed a button on the controller, the double-acting cylinder moved outwards, and when we pressed another button, it went back. If we use two double-acting cylinders, we can only use them 17 times before we need to put more air in the reservoir. A problem that we found out is that the pump we have can only add 150 PSI to the reservoir while the reservoir can contain 250 PSI. Therefore, we need to find a stronger pump to pump air into the reservoir.

Tank Drive Success

After completing the construction of tank drive base, we tested the tank drive and it worked; the robot could go forward, backward, and turn left and right smoothly and very quickly. The robot will also not be pushed sideways very easily because of the rubber bands on the wheels. Thus, our tank drive design is a success, and if we add an intake, shooting, and climbing mechanism, we will be able to use it to complete the mission.

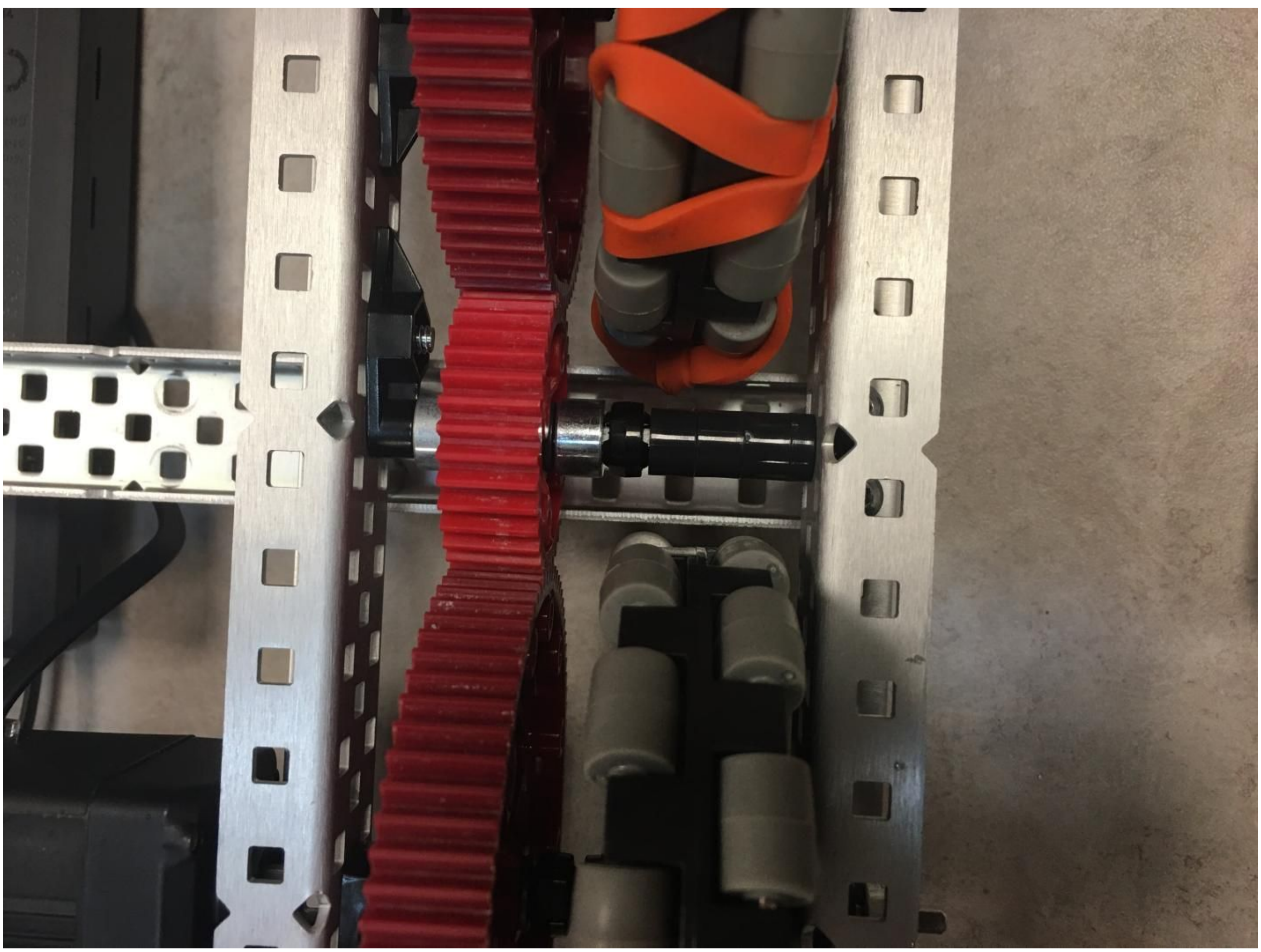


Steps for the Future

After we finish the flywheel on the x-drive, we will build the shooting mechanism, which will most likely be a catapult or puncher. Then we will build a climbing mechanism for the X-drive. We will also build an intake shooting and climbing mechanism for the tank drive to test and compare it to the X-drive and see which one is better. We will most likely stop testing with pneumatics because we have reached our goal of getting to know pneumatics and making them work. We also don’t have a use for pneumatics in our robot design.

Tank Drive Discovery & Changes

After further inspection of the tank drive, we caught a minor issue: the gears that were attached to the wheels were not aligned. Hence, we needed to disassemble the robot and adjust the gears. We added shaft collars to the sides of the large gears to stop them from shifting, and we also inserted shafts into the little gears to further stabilize them.

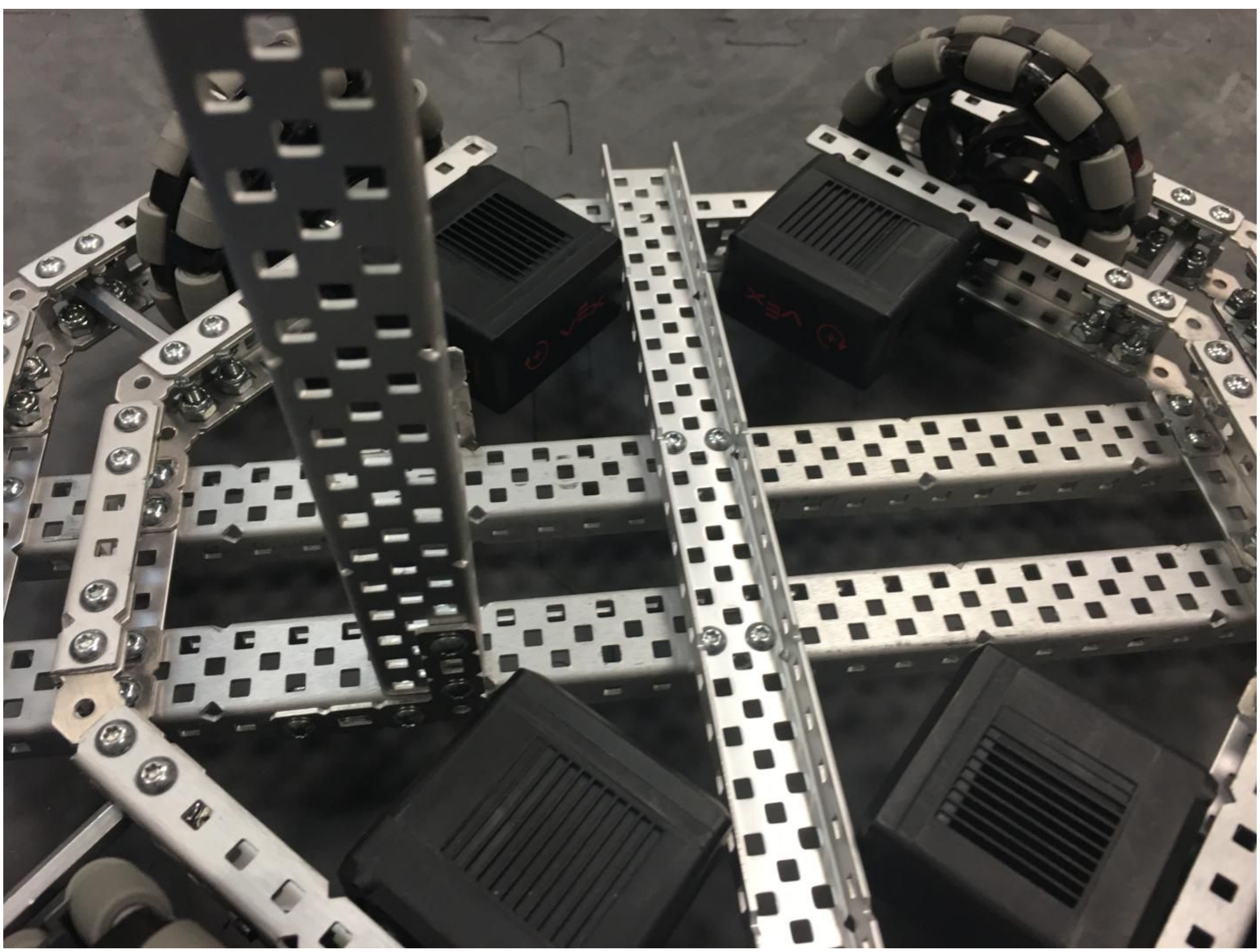


Smart Field Controller

The purpose of the smart field controller is to automatically stop the robot when it reaches the time limit. This is meant for the autonomous period, which is 15 seconds, and the driving period, which is 1 minute 45 seconds. The smart field controller connects to all four robots on the playing field, and when the timer stops, the smart field controller stops all four robots simultaneously.All four teams controllers need to be connected to the Smart Field Controller for it to work. The teams will also need to download a special program. The Smart Field Controller does not have a battery, so it can only be charged with a wire.

X-drive Modifications

We made some adjustments to the X-drive. First of all, we moved the two flywheels down and closer to the end of the C-channel for easier triball collection. We also changed the C-channels that would support the flywheels into larger ones because the flywheel, when angled down, would hit the frame if the C-channels were too short.



Steps for the Future

We will continue building the flywheel and create the shooting mechanism and improve the design of the tank drive and then create the shooting and intake mechanisms. We finished testing the smart field controller because when the timer reaches zero, the smart field controller automatically stopped the robot.

A Refreshing Hiatus

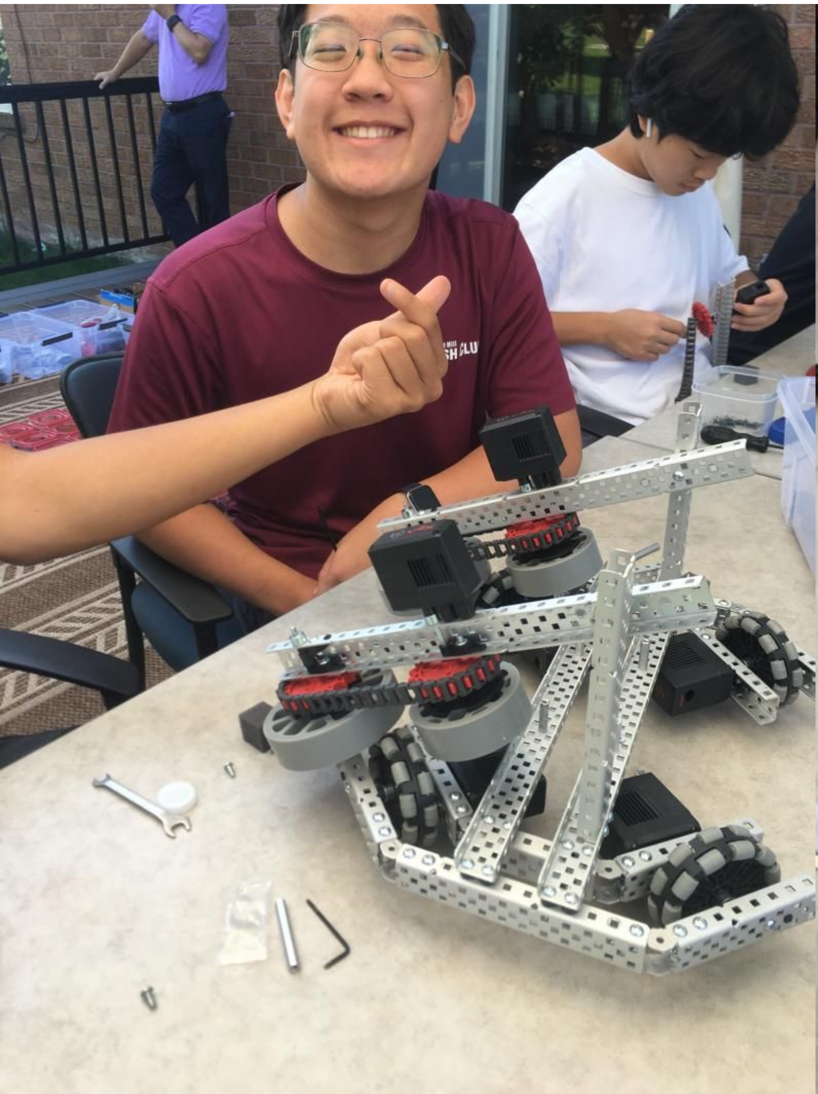
As we entered summer break, many team members went on vacation and thus progress was stagnant. However, the break was a way to revitalize the team’s focus, and now that everyone is back in office, progress has been systematic, steady, and superb.

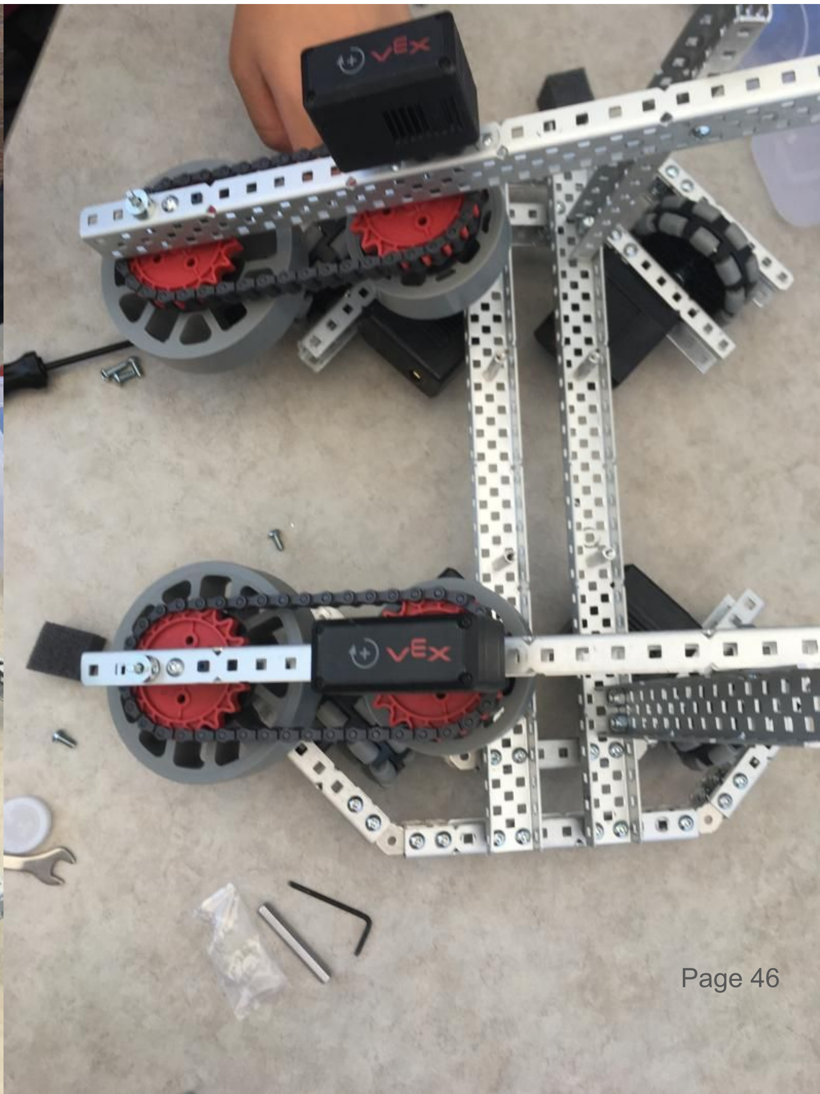
Flywheel adjustments

We tested the original flywheel on the tank drive but found out that it was too big and exceeded the length limit of 18 inches. No matter how much we tried to change the position of the flywheel, it always exceeded the length limit, albeit by a little. Our solution was change the traction wheels into smaller flex wheels and moving the wheels closer together. That way, the flywheel would not surpass the length limit and the triballs would be able to enter the flywheel quicker and more efficiently.

X-drive Attachments

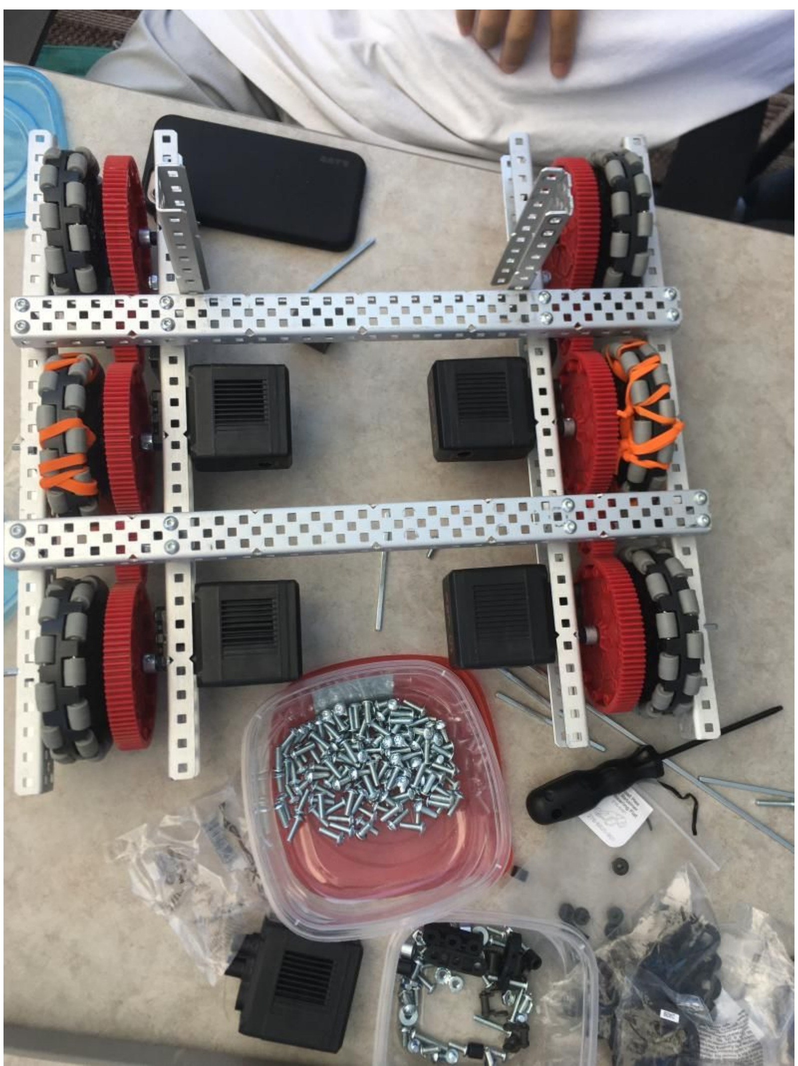
We attached the newly adjusted flywheel to the X-drive. When we tested the flywheel by using it to grab the triball, it worked! The big wheels at the front are to grab and hold on to the triball while the small wheels at the back are to move the triball to the shooting mechanism. The flex wheels are situated close to each other so the triball can move to the shooting mechanism easier and quicker than if the wheels were farther apart.





Tank Drive Adjustments

We adjusted the position of the motors to the middle. The motors were originally placed on the two sides of the robot, and we moved one pair of motors to the middle to make space for the flywheel. But after that failed, we put the flywheel on the X-drive. We also made the motors face inwards in order to make space for a new shooting mechanism that we plan to attach on the tank drive. We kept our the position of the motors on the edge to make space for a new flywheel that we are building.

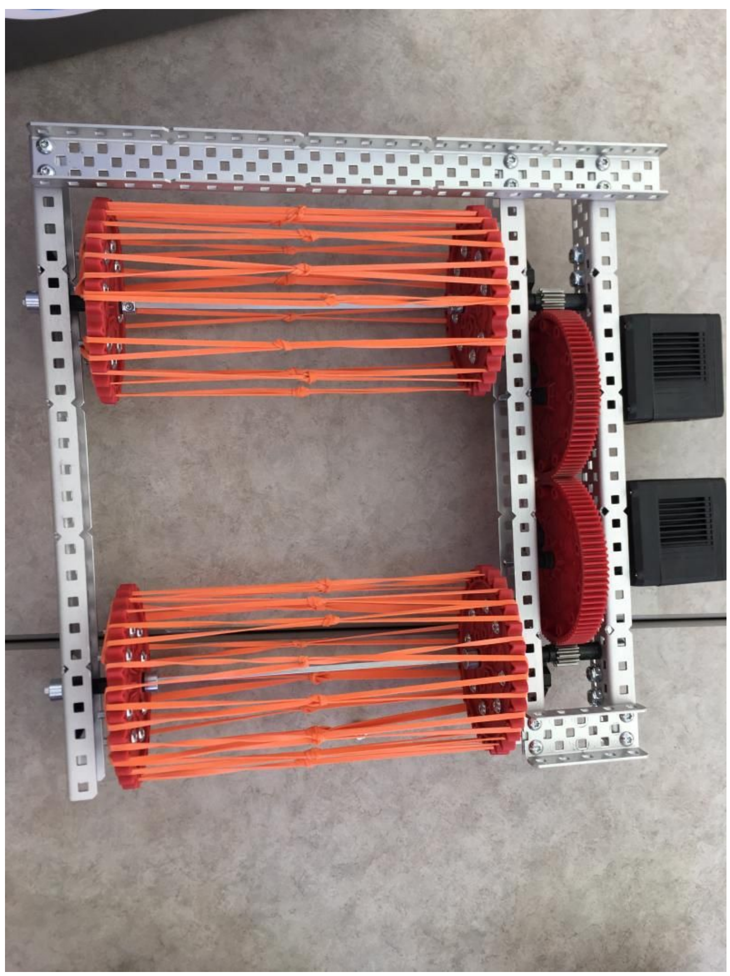


New flywheel

We built another flywheel to attach to the tank drive. The design is the same as the flywheel on the X-drive; we still used one bigger flex wheel and one smaller flex wheel so it was faster and more efficient. We also have little space between the flex wheels so the triball can move to the shooting mechanism quicker and more efficiently.

Tank drive shooting mechanism

We built a new shooting mechanism that will be attached to the tank drive. It has two c-channels on the sides as support and one at the top to attach the two c-channels together. Inside the frame are four sprockets two on each side, each tooth on the sprocket is connected by rubber bands. When the motors move, the sprockets will also move since they are connected to the motors by gears. The flywheel will move the triball towards the shooting mechanism which will shoot the triball out using the rubber bands.

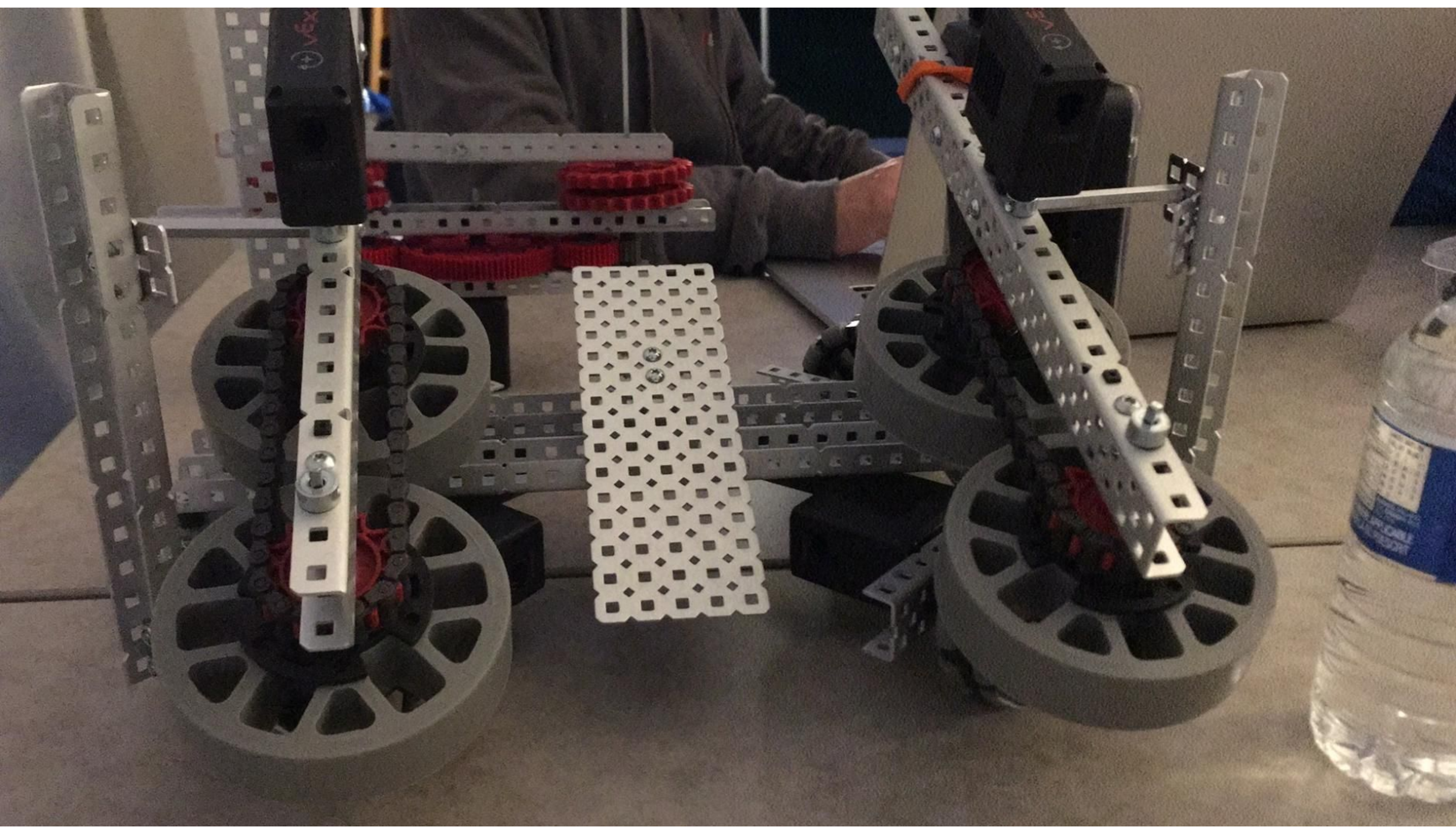


Steps for the Future

We will need to attach the newly built flywheel to the tank drive to create the intake and shooting mechanism. Then, we will need to create a shooting mechanism for the X-drive. The shooting mechanism will double as a catapult as well.

Flywheel Size Adjustments

We changed the flywheel on the X-drive to have bigger wheels. The reason why we changed the flywheel to have the same size wheels was because the flywheel would not work properly if we mixed the two different wheels. So we changed all the wheels on the flywheel to large wheels so that the wheels could grip onto the triballs properly.

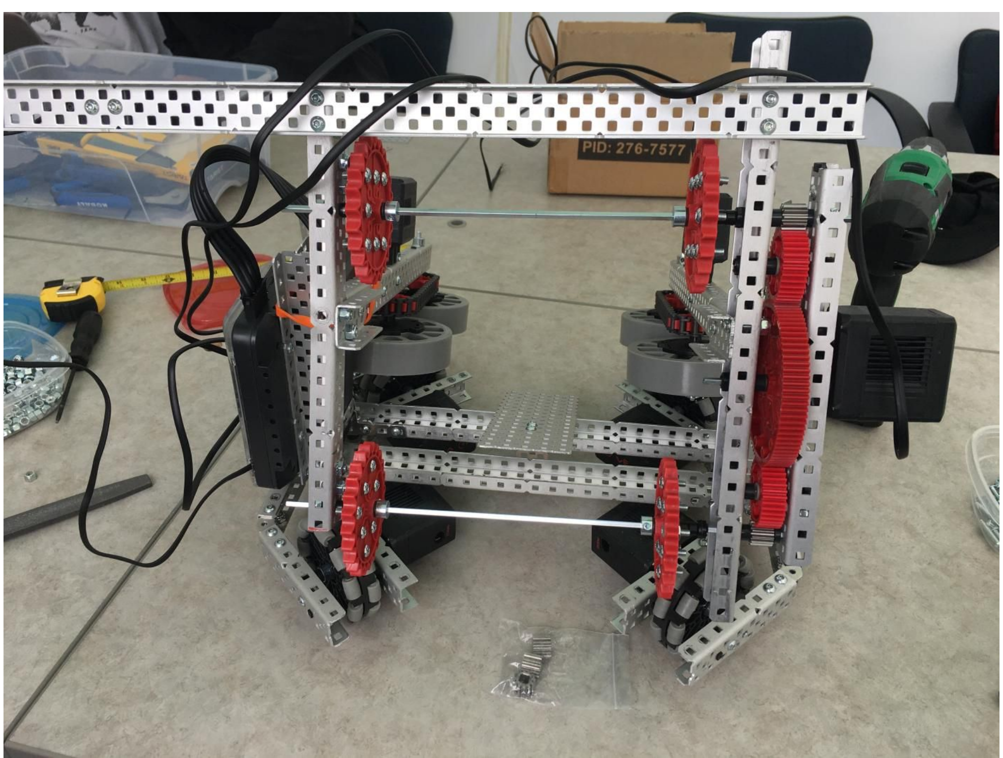


X-drive Shooting Mechanism.

The shooting mechanism on the X-drive is fundamentally identical to the one we built for the tank drive; the attachment uses rubber bands connected to the teeth of two sprockets to launch the trigger, and the frame is connected to the X-drive by the flywheel. However, the sprockets used on the shooting mechanism are smaller than the ones built for the tank drive, so only one motor is needed to power the shooting mechanism. The radio is attached to the C-channel at the top of the shooting mechanism close to the brain.

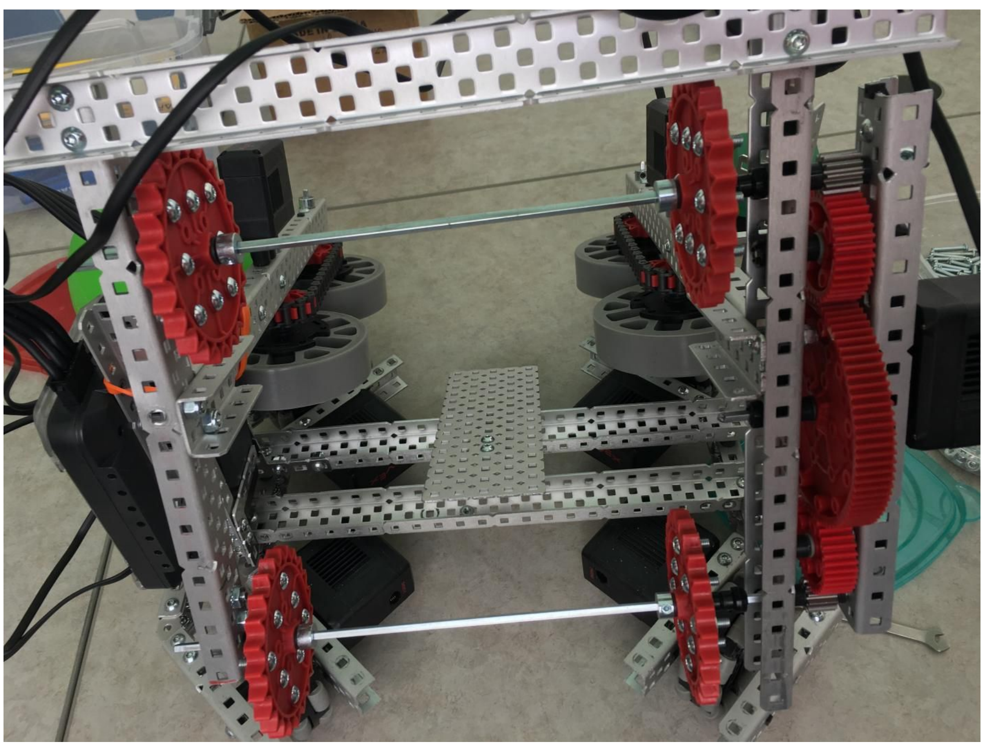
X-drive changes

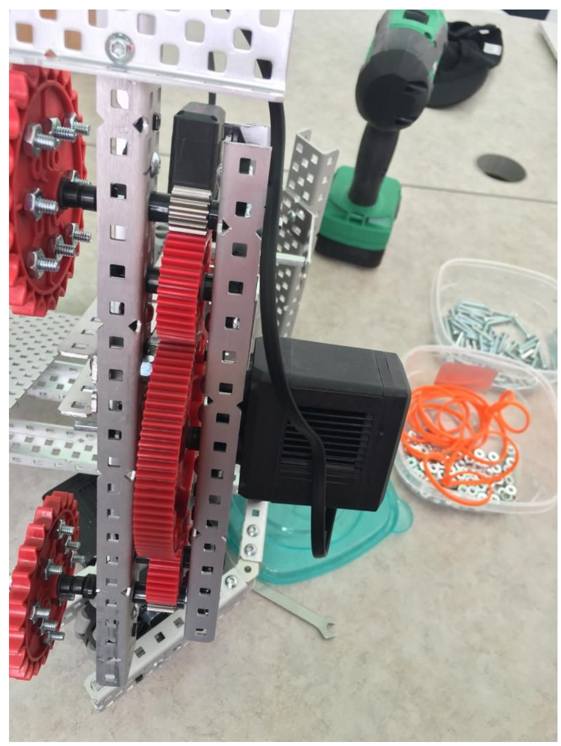
We added the pair of flywheels with the large wheels to the X-drive to ensure that we could collect and grip onto the triballs easier. In order to support the flywheel, we used c-channels that act like pillars and standoffs to connect the flywheel to them. We also added the brain and the battery to one of the pillars. The brain is facing outwards so we could utilize it easier, we screwed the bottom of the brain to the C-channel so it is secure. A rubber band was used to hold the brain and battery together to ensure it would not fall off. We also added a piece of sheet metal in between the flywheel so the triball would be able to use it and travel to the shooting mechanism. A shooting mechanism like the one on the tank drive was also added to shoot the triballs out the back of the robot.



Shooting Mechanism Error

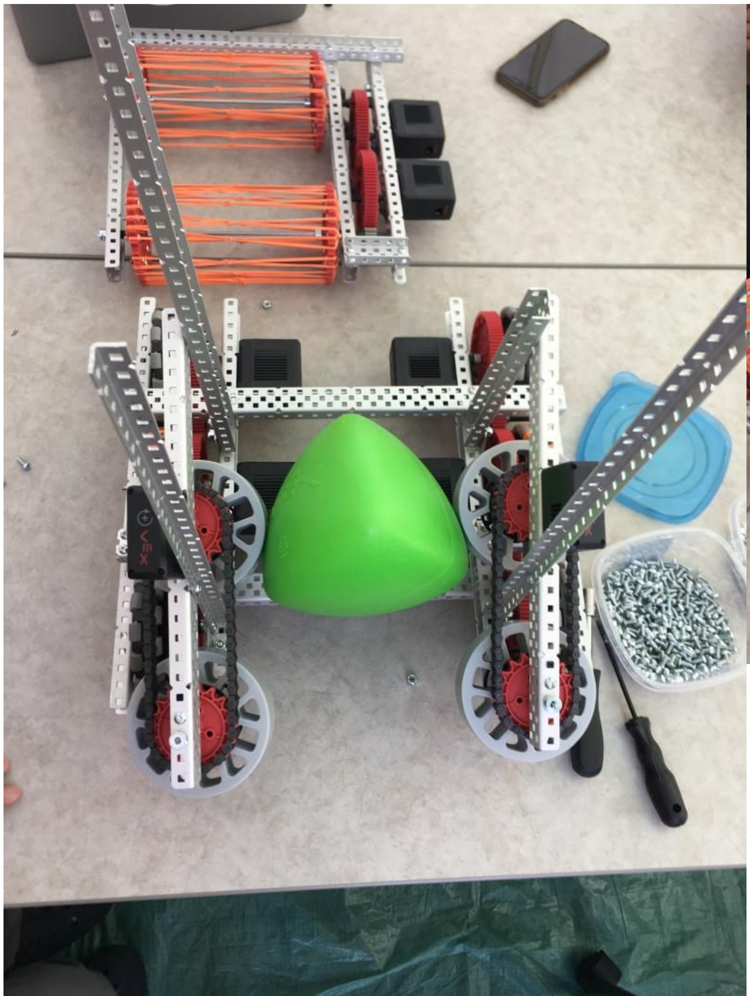
After testing the shooting mechanism on the X-drive, we discovered that the sprockets were spinning in the same direction. However, they needed to be spinning in different directions to shoot the triball. Thus, in order to fix the mistake, we plan to add another gear so that the two sprockets spin in different directions.

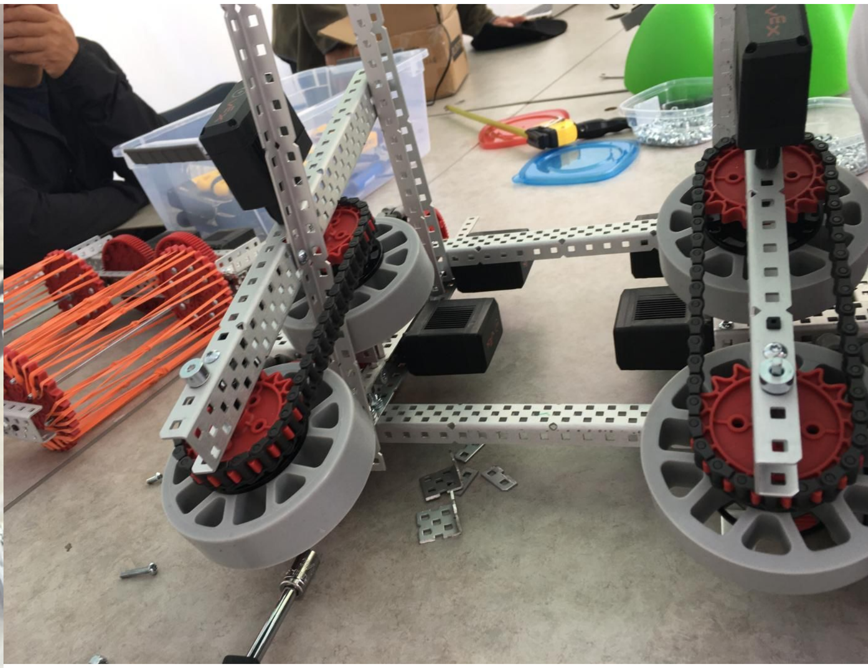




Tank drive changes

We cut one of the c-channels that connected the two sides of the tank drive and moved another C-channel to the bottom of the robot. Like the X-drive, we also used four pillars that we built on the tank drive to secure the flywheels. The back two pillars use cut c-channels, while the front two pillars use two angles to attach the flywheels. We used two angles to attach the flywheel because they are skinny enough to fit between the tank treads and would not interfere with the movement of the flywheel.





Steps for the Future

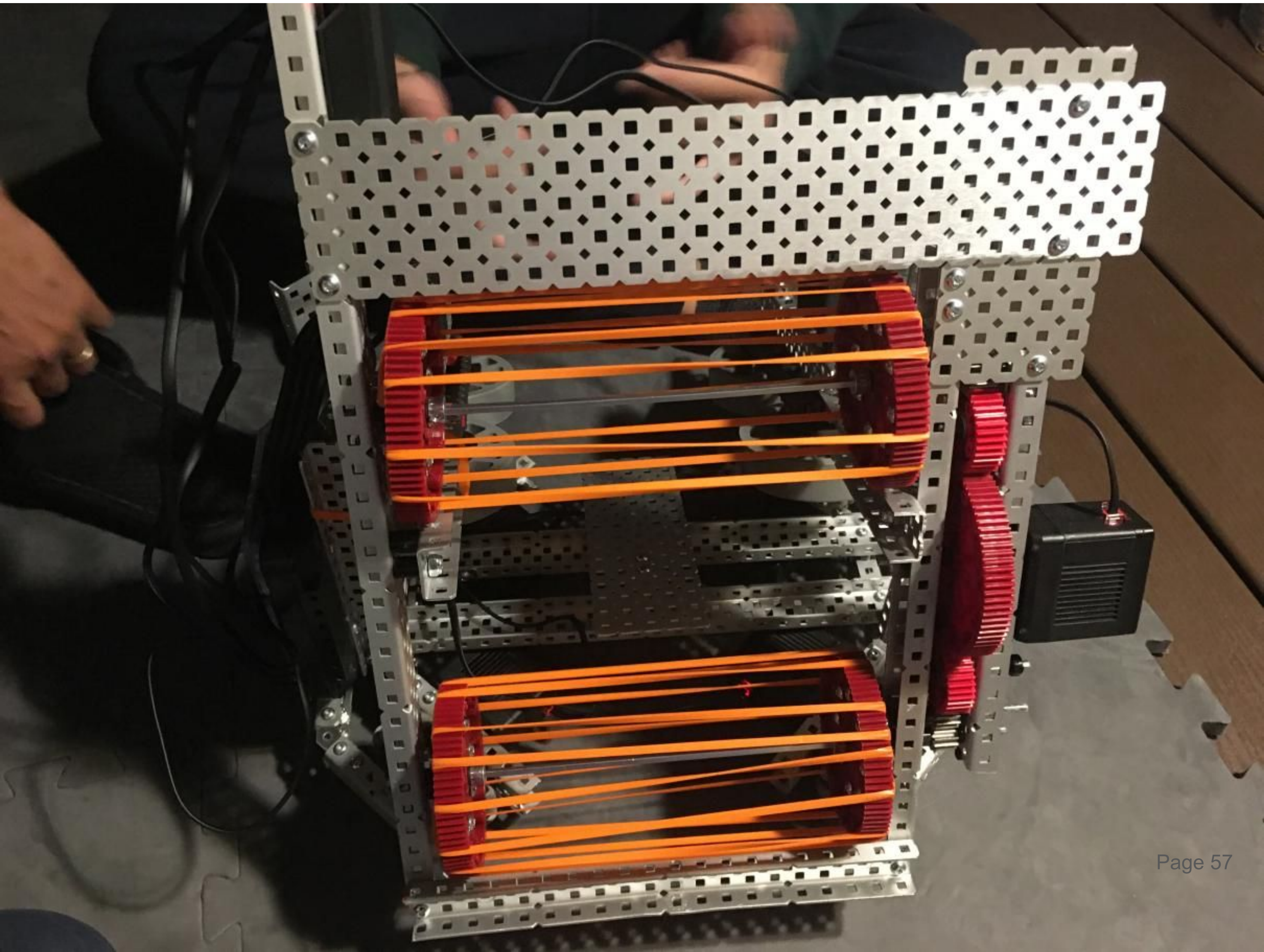
In order to fix the shooting mechanism on the X-drive, we need to add another gear so that it spins in different directions.

We also need to finish stabilizing the flywheel and attach the shooting mechanism to the back of the tank drive.

After finishing both of those, field testing can begin.

Updated Shooting Mechanism

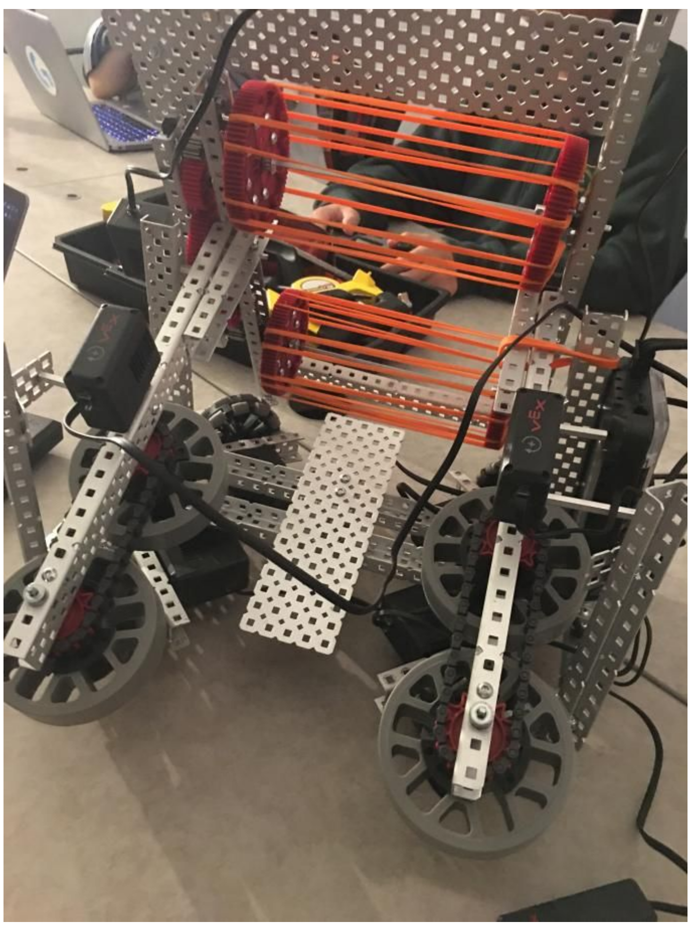
After finding the mistake with the shooting mechanism we got to work immediately. We came up with the idea of adding one more gear so the sprockets would move in different directions rather than the same. This allowed our robot to shoot triballs out a certain distance and not get stuck in the mechanism.

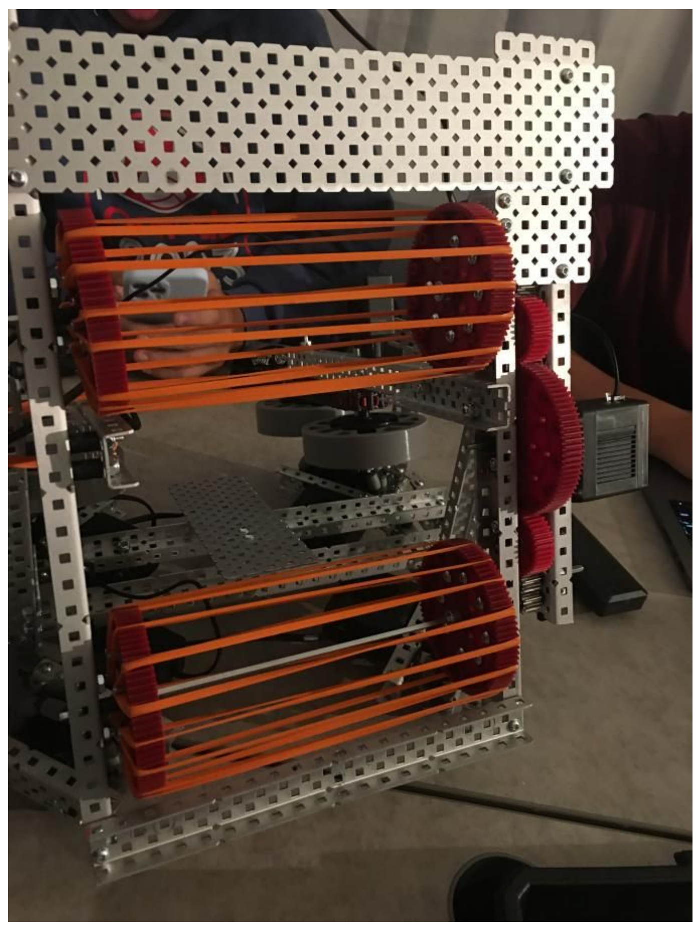


X-drive

After fixing the mistake with the outtake shooting mechanism, we had to find a new way to connect it to the robot. We attached the shooting mechanism by screwing it to the pillar C-channel and then using a 120-degree gusset to secure it.

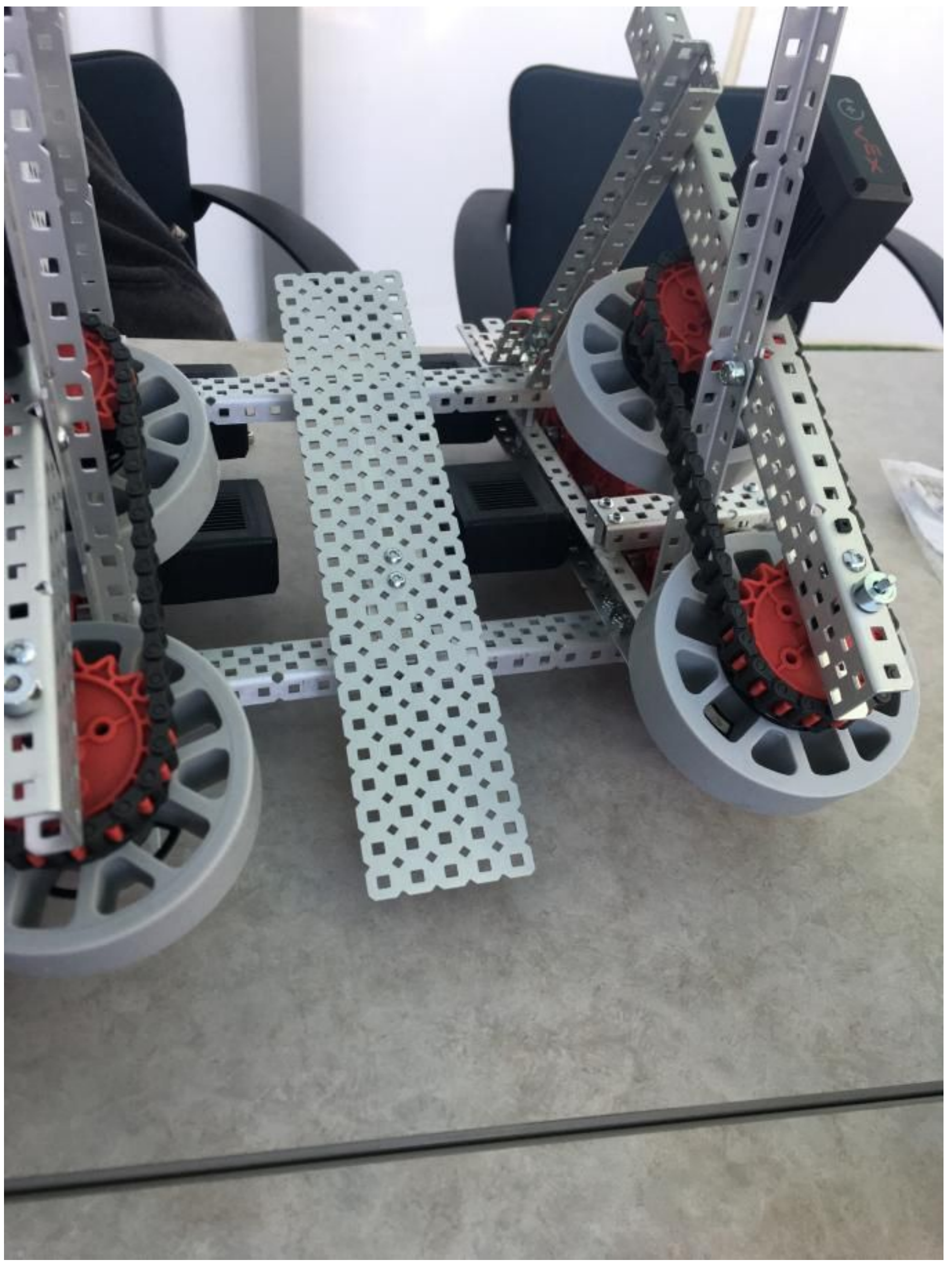
The frame of the two-rubber-band shooting mechanism uses a C-channel and a sheet of plate metal to attach the two-rubber-band shooting mechanism. The radio is also attached to the C-channel.





Tank drive

We added a sheet of plate metal to act as a ramp so that the triballs could go up the ramp and into the shooting mechanism. We secured the ramp to the c-channel using a 120-degree gusset. The 120 degree gusset was was enough to angle to sheet metal towards the shooting mechanism.



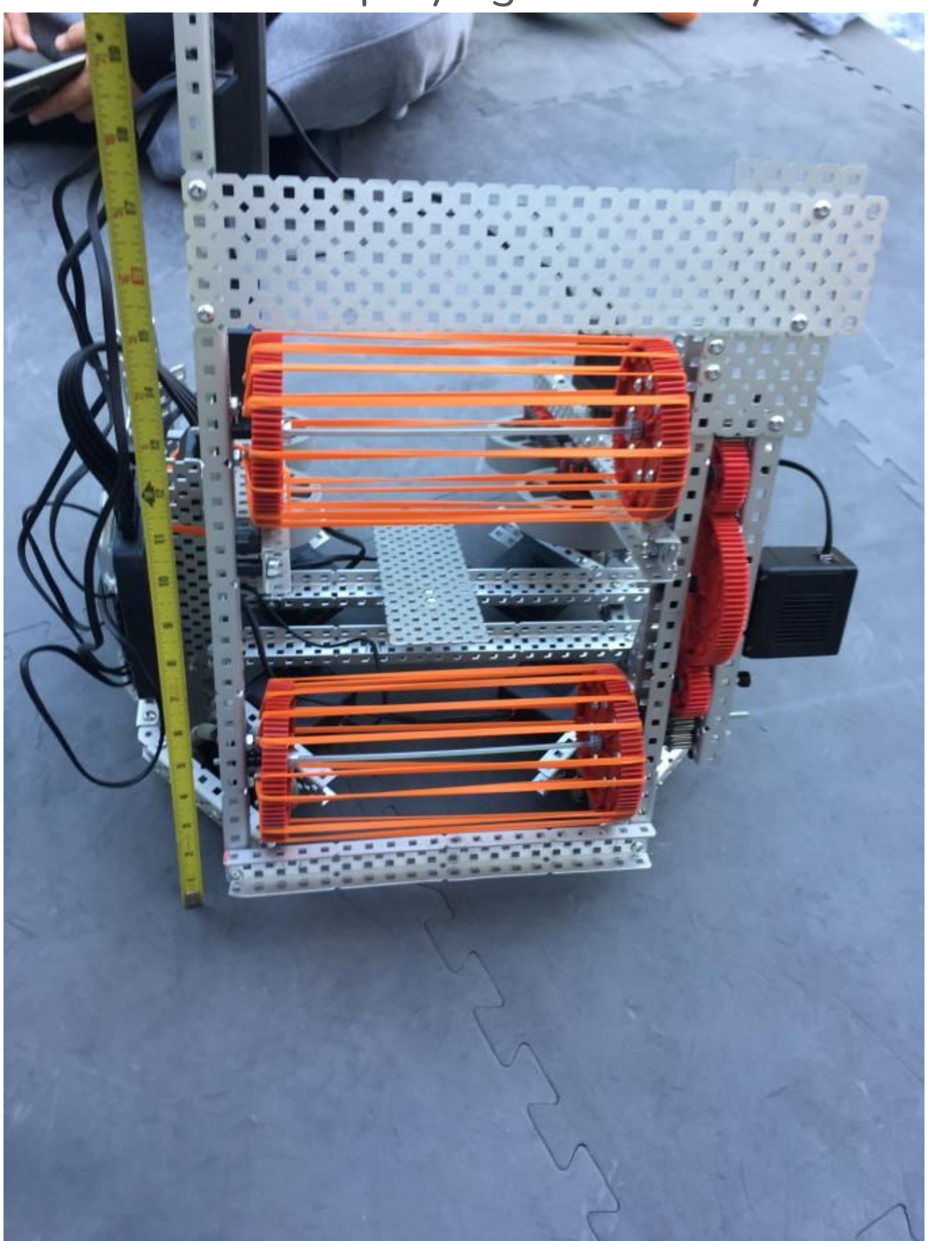
Driving Experience

After completely finishing the X-drive, we drove the robot for the first time and it succeeded in shooting the triballs out. However, there were a few things we needed to change.

First of all. we needed to angle the flywheel system a bit higher so that it can shoot farther and more upward. By angling the attachment upward, it will also shorten the height of the robot. Secondly, we need to put the flywheels closer together for better grip, and if possible, make the motor a bit stronger so the flywheels can spin faster and shoot farther. Finally, the wires need to be organized to prevent their entanglement in the outtake mechanism.

Dimension error

While we were building, we realized that when we attached the outtake shooting mechanism to both robots, it would not be able to drive under the overpass. The height from the ground to the overpass is about 9.5 inches. So we will need to decrease the height of both robots by about 9 inches to ensure that they will be able to cross to the other side of the playing field if they need to.



Steps for the Future

Our main issue is to decrease the height of the two robots so that they can can cross under the side bars of the playing field. However, we believe that angling the shooting mechanism to shoot triballs further will simultaneously mitigate this issue.

Other than that, we need to attach the outtake shooting mechanism to the tank drive to ensure that it will be able to shoot the triballs out and put the flywheels closer together on the X-drive.

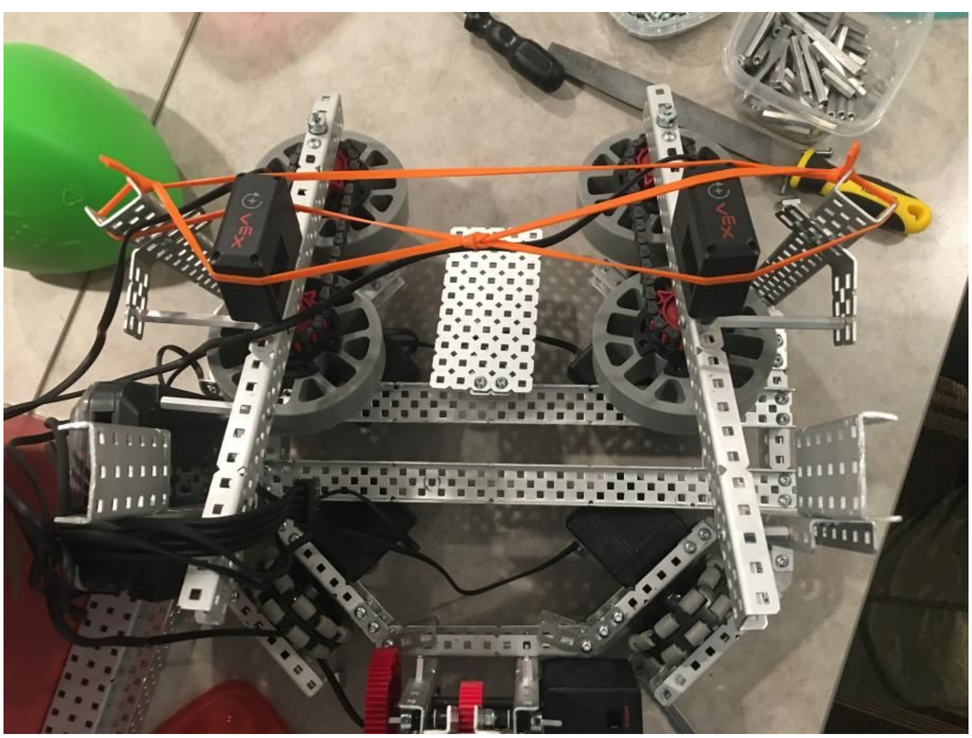
New shooting mechanism

We changed the shooting mechanism for the X-drive from the outtake shooting mechanism to a catapult that we built. The catapult is essentially a normal slip gear catapult. It has one slip gear,and it uses eight rubber bands to increase the tension. The catapult will be able to shoot with a lot of force because of the eight rubber bands. A standoff is used to stop the catapult from shooting too forward and hitting the ground or the robot. A square frame made out of C-channels is used to hold the triballs.

X-drive Changes

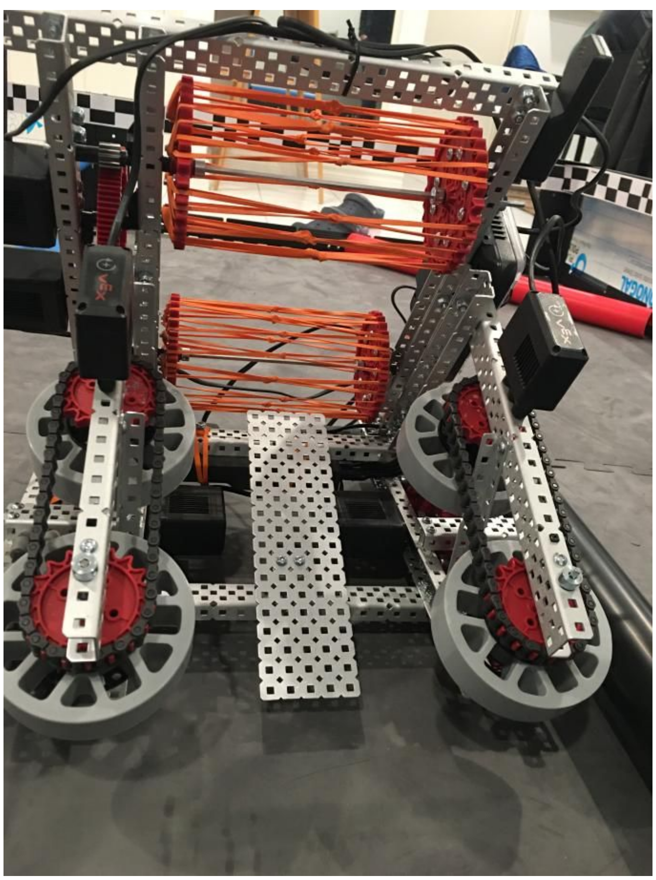
We decided to change the outtake shooting mechanism into a catapult to significantly decrease the height of the X-drive. When tested, the robot was able to successfully pass under the side pipes.

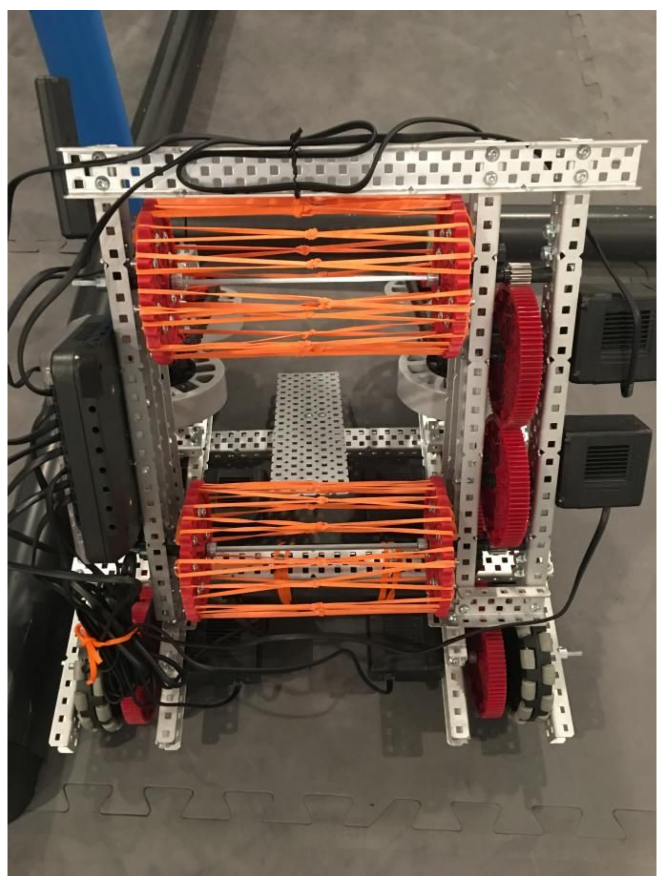
We also changed the motor cartridge for the motor-moving catapult; the resistance of the rubber bands was too strong for the normal motor cartridge to move, so we changed the normal green cartridge to a stronger red motor cartridge. We also added rubber bands on top of the robot to decrease the distance between the flywheels to center the triball and shoot it when required. If we did not decrease the distance between the flywheels, the lack of grip on the triballs would make shooting impossible.



Tank drive Outtake Installation

We successfully attached the outtake shooting system to the tank drive. There are three c-channels on each side that connect the flywheel to the outtake shooting mechanism. The structure of the outtake shooting mechanism on the tank drive is the same as the one that used to be on the X-drive. It has two sprockets on each side, and each tooth of the sprocket is attached to the opposite sprocket by rubber bands. The function of the outtake shooting mechanism is the same as the one that was on the X-drive before.





Steps for the Future

We need to build a hanging mechanism for the X-drive for the end of the driving period. We will most likely use two arm-like grippers to hold on to the pole so that we can raise our robot up. Although the raised altitude will be quite small, we can still earn points for being off the ground.

For the tank drive, we need to test the outtake shooting mechanism and ensure that it works. After that, we need to build a hanging mechanism like the one on the X-drive so the robot can hang on a pole at the end of the match.

Catapult flaw

After testing the catapult's ability to throw the triballs across the playing field, we found out that the catapult was too strong. The catapult would slowly break the teeth on the gears we used. The teeth on the gears would slowly fall off and would affect the performance of the catapult.We tested two different gears, one metal and one plastic. Both gears did not work and the teeth started breaking off.

X-drive Changes

Since the catapult was too strong for the gears, we decided to remove the catapult entirely from the X-drive. Our plan is to create a new and better catapult that is able to shoot the triballs across the playing field without damaging the gears that are attached to it.

We also added a limit switch to the X-drive in order to stop the slip-gear catapult when it is pulled back; the catapult will stop drawing back when it touches the limit switch, maintain a consistently precise position.

Tank Drive changes

There were a few changes that we made to the tank drive. First of all, we decreased the space between the flywheels. The reason behind this is so the flywheels would be able to grab the triball easier than if they were further apart. Secondly, we added a GPS sensor to the robot for the autonomous period. We tested the GPS sensor, and it worked. We programmed the tank drive to move to the goal autonomously and it succeeded in moving to the goal. We could use it during the autonomous period to move around the field and try to score goals.

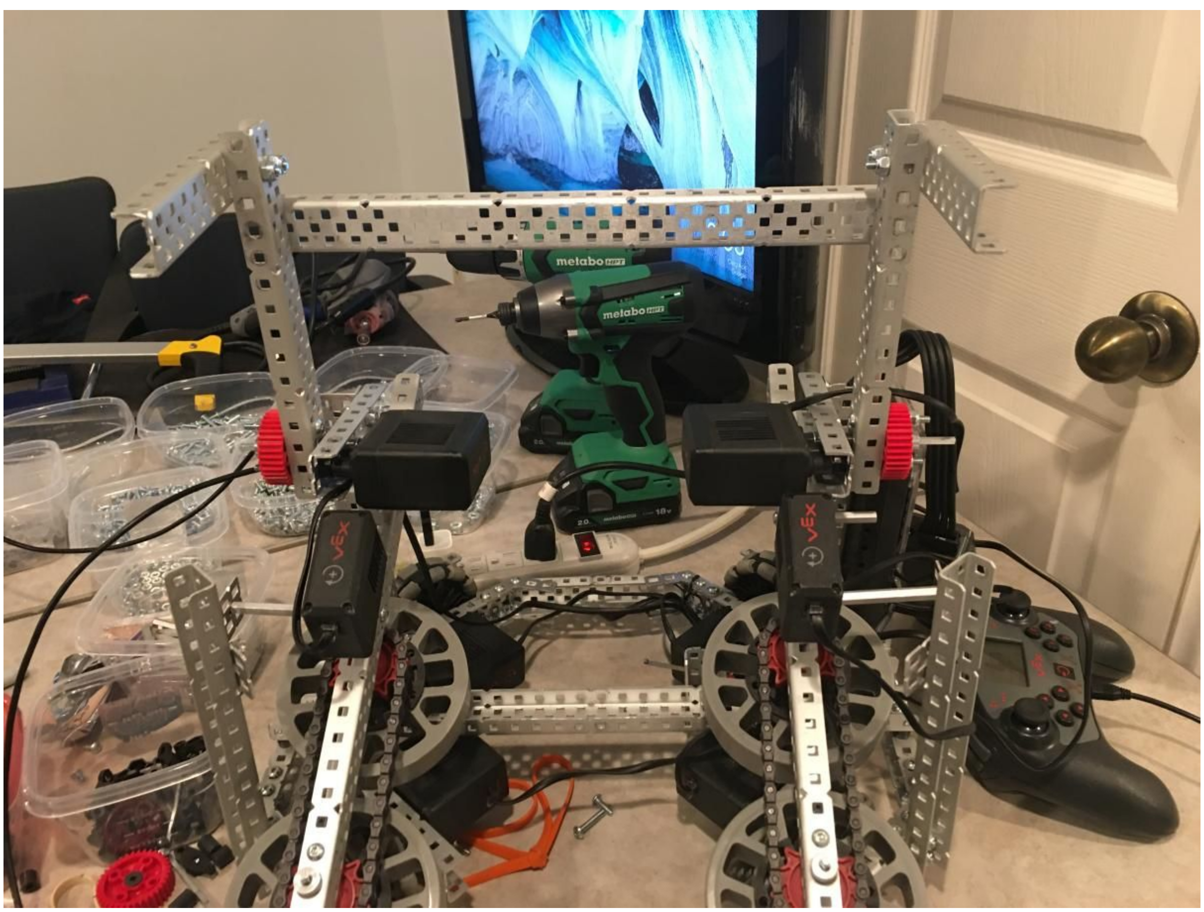
Steps for the Future

For the X-drive, we need to build and attach the new catapult to the X-drive, and then test to see if it will break the gears. We also need to construct the clamping mechanism that will hold onto the pole at the end of the match.

For the tank drive, we need to test out the flywheel since we adjusted the distance between the wheels.

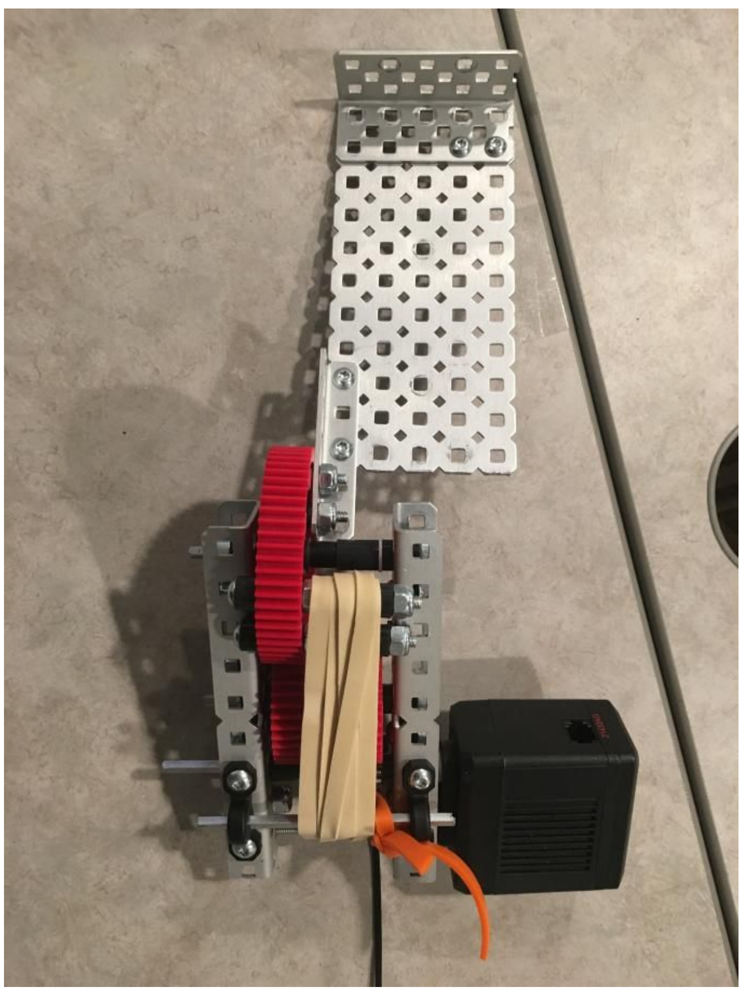
X-drive hanging mechanism

We created a basic hanging mechanism for the X-drive, which consists of two L-shape arms. The hanging mechanism is meant for the pole supporting the climbing pole. That way, when the match ends, the robot can just grab onto the pole and lift itself off the ground. We also ensured that the hanging mechanism was tall enough to reach the pole and grab onto the pole. Currently the hanging mechanism is meant to grab onto the overpass pole and not the actual hanging pole.



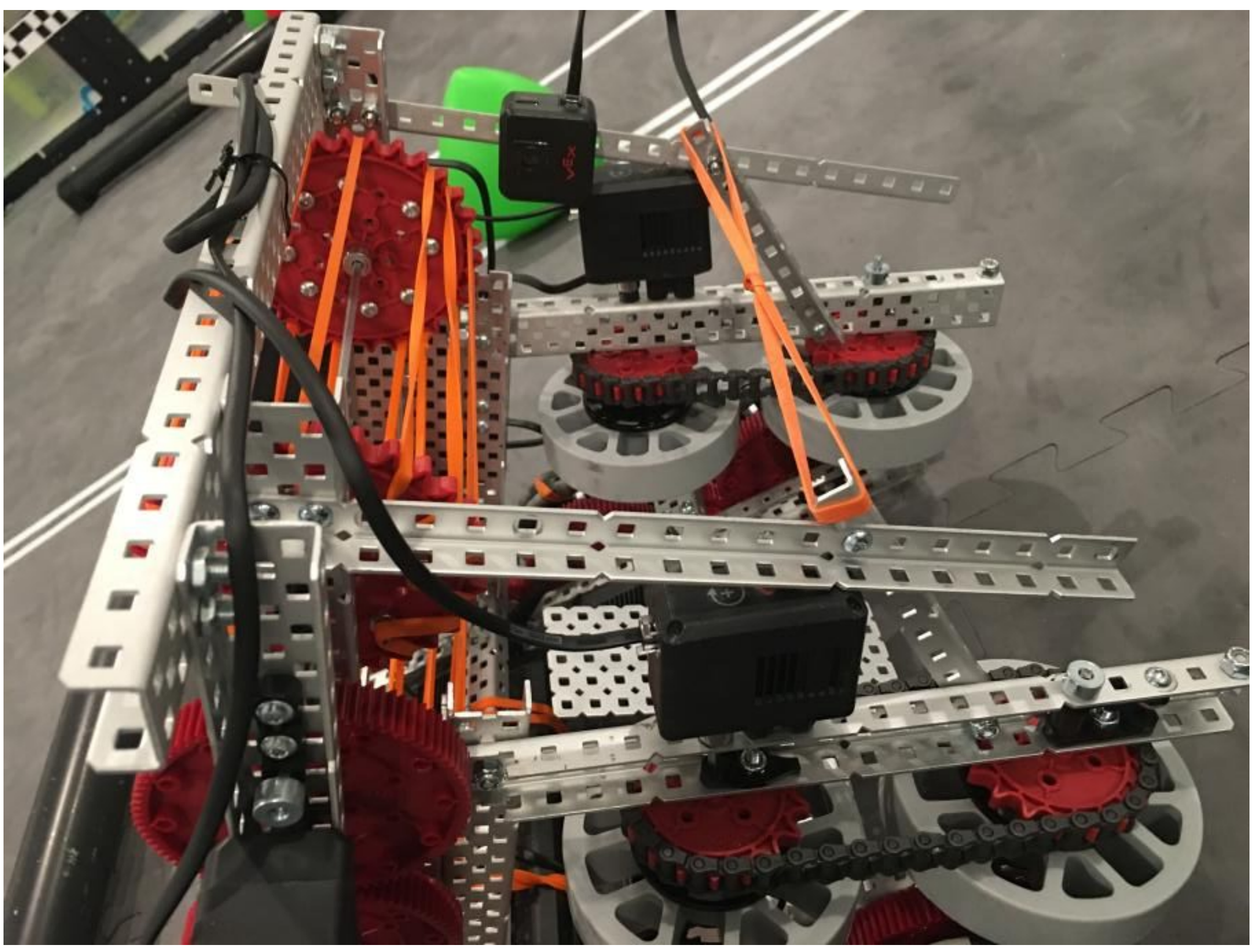
New X-drive Catapult

After discovering that the old catapult broke its gears slowly, we decided to create a new and better catapult. This version would be strong enough to throw the tribals across the playing field without breaking the gears that are attached to the catapult. We used a two-level system to power the catapult; a small gear to power a larger gear, which in turn powers another gear and another larger gear. This consecutive array of gears along with five rubber bands will ensure the catapult's substantial strength.



Tank drive changes

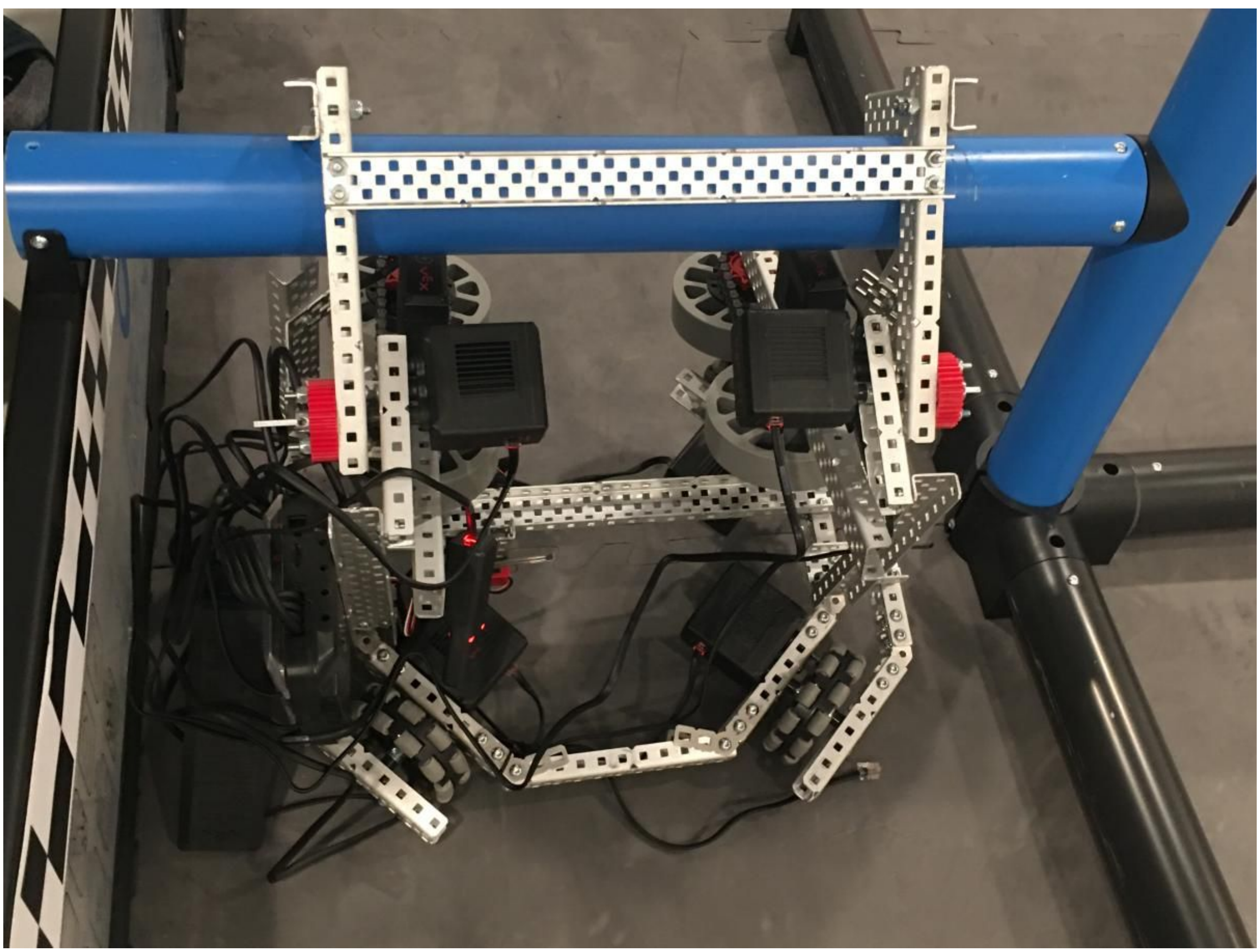
We added stabilizers to the tank drive, which would support both the shooting mechanism and the flywheel. This is because before we had the stabilizers, the flywheels would move up and down. This is unsatisfactory because the positions of the flywheel could randomly move up or down during the competition, and that would change the result of collecting the triball. The stabilizer connected the flywheel to the outtake system, which is very secure. In the end, by adding the stabilizers both the flywheel and the outtake system would be stable.



Hanging Mechanism Error

After testing the hanging mechanism on the X-drive, we found out that the mechanism was not strong enough to lift the robot entirely off the ground. The robot was only able to lift its front, leaving the back half of the robot touching the ground.

Our solution is to use claws on each side of the robot to clamp onto the pole and use the force to push itself off the ground.



Pro’s and con’s of middle pipe crossing

Pro’s:

The gussets at the front of the robot act like a ramp getting the front of the robot onto the ramp. Once the front of the robot is on the ramp wil back will also be able to get over it. The gussets at the front of the robot succeeded in getting the robot over the middle pipe.

Con’s:

The impact of the robot crossing over the pipe was too large so it would break the robot. For example, the flywheel would fall off, multiple square inserts and shaft collars would fall off as a result of the impact. If the robot breaks during the competition then the result would be very bad.

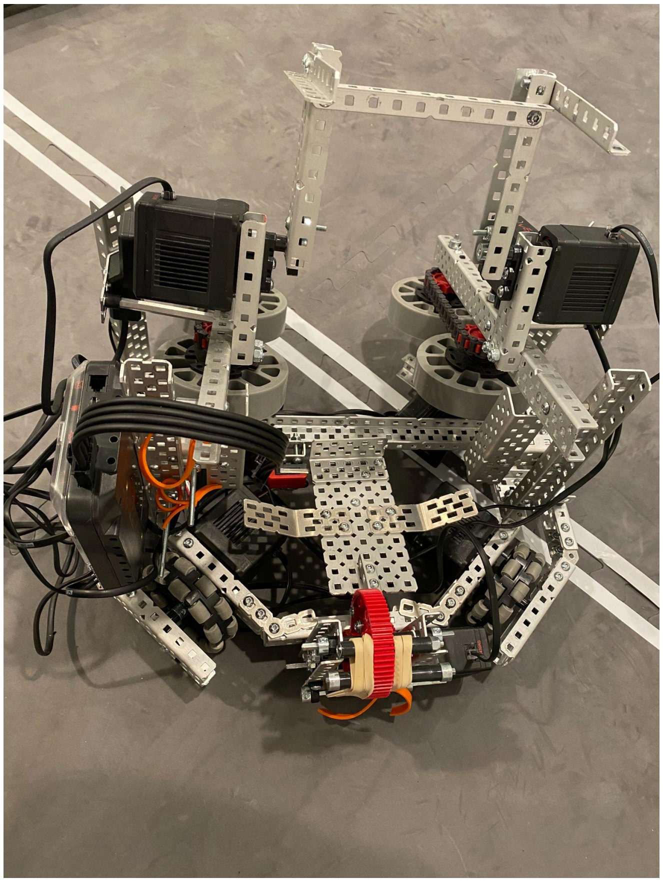
Steps for the Future

There are a few things we need to change. First of all, we need to find a way to ensure that the tank drive can pass over the middle PVC pipe and get to the other side. After that, we also need to build a hanging mechanism for the tank drive.

For the X-drive, we need to redesign the hanging mechanism because the arm is not strong enough to lift the robot up. We need to build two clamp-like arms on either side of the robot and use the force of the two arms to pull the robot up.

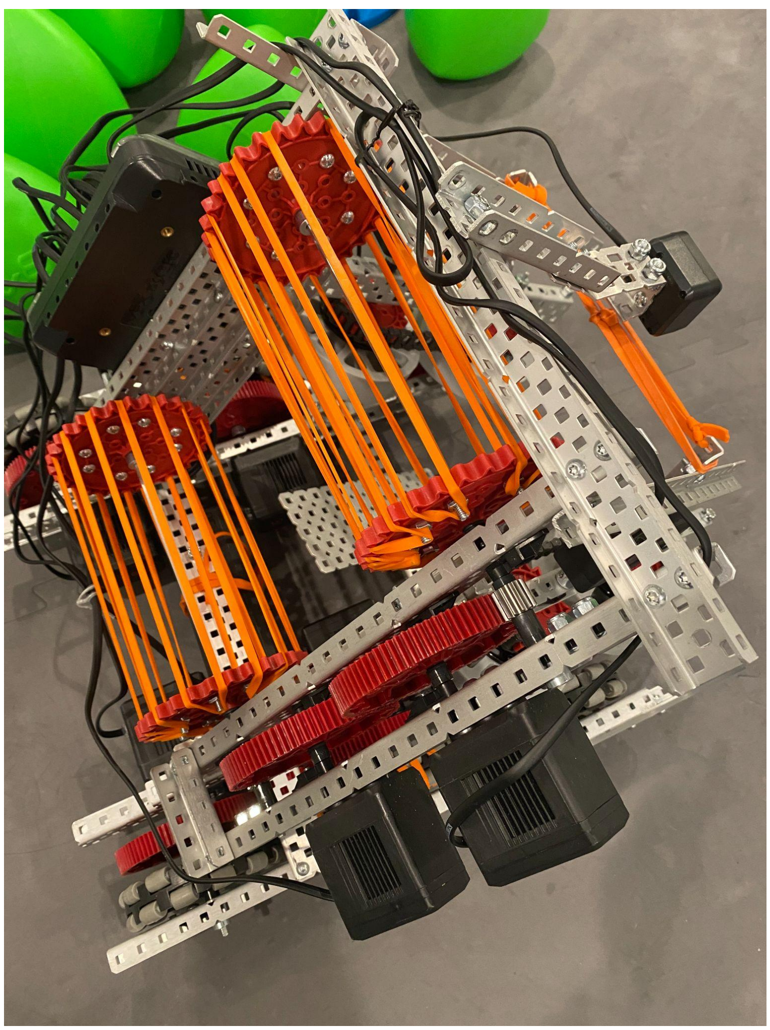
X-drive functions

After testing the X-drive, we have succeeded in making all of the mechanisms work. The intake and outtake system both work and are able to collect and shoot out triballs. The intake system is a flywheel that can collect the triballs and the outtake system is a catapult which can throw the triball across the field. The hanging mechanism also works, it will use the L shaped c-channels to grab onto the overpass pipe. Using the strength of the motors, the robot will be able to lift off the ground at the end of the match.

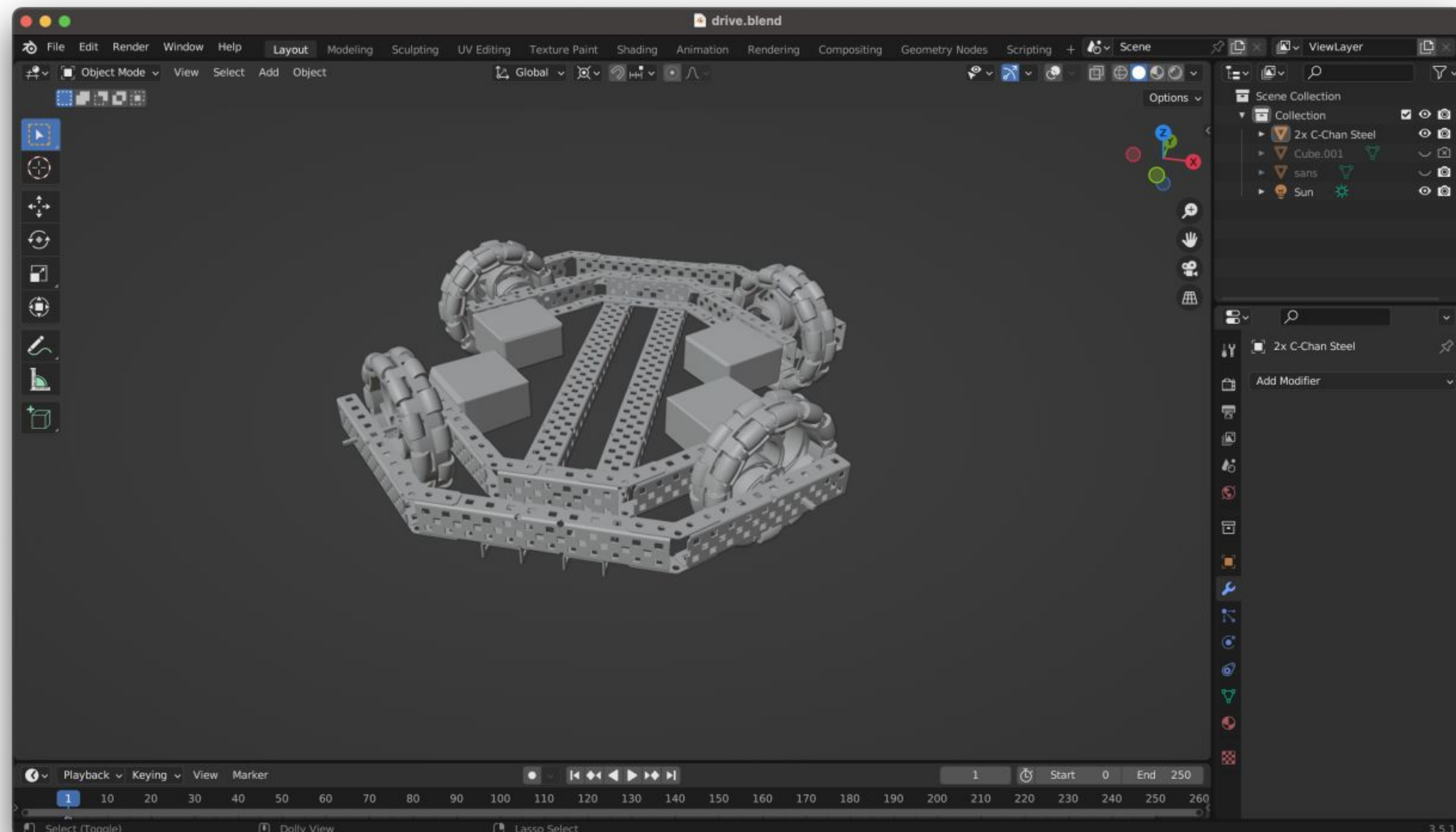


Tank drive status

Two mechanisms for the tank drive work properly. The intake and outtake systems both work, they are able to collect and shoot out the triballs. We also found a method to cross the middle PVC pipe. We used two curved pieces of plexiglass to move the tank drive upwards when it is against the pipe. The force of the tank drive moving forward will push the tank drive upwards and it will be able to pass the pipe barrier.



X-drive 3D Model



The first 3D model of the x-drive that was made on Blender

Tank drive 3D Model