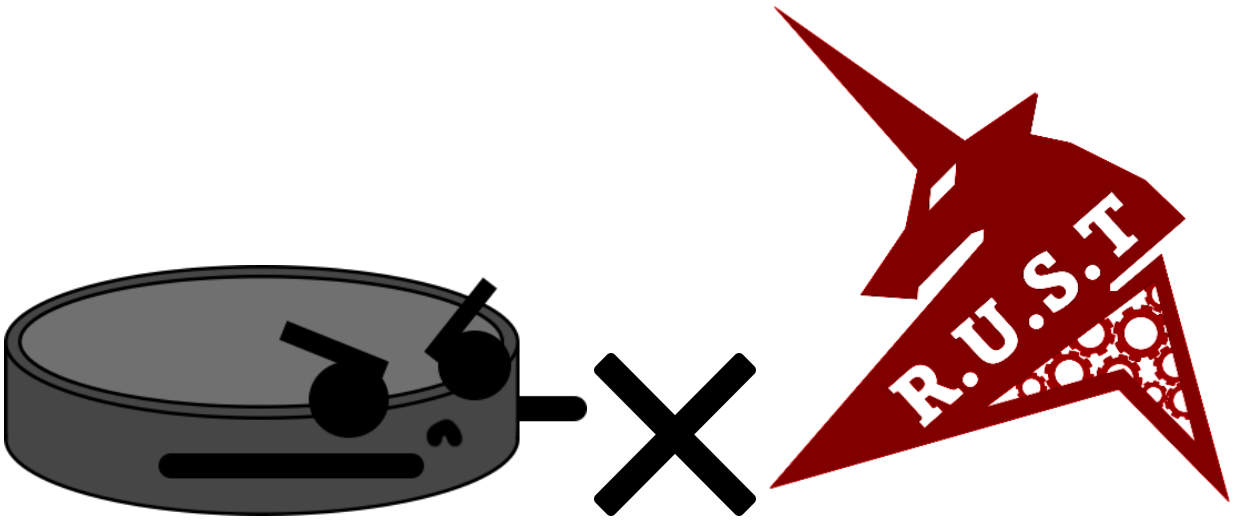
MtSac2 (Rust)

Engineering Notebook



(2021 - 2022 Tipping Point)

MT. SAC
Mt. San Antonio College

VEX U

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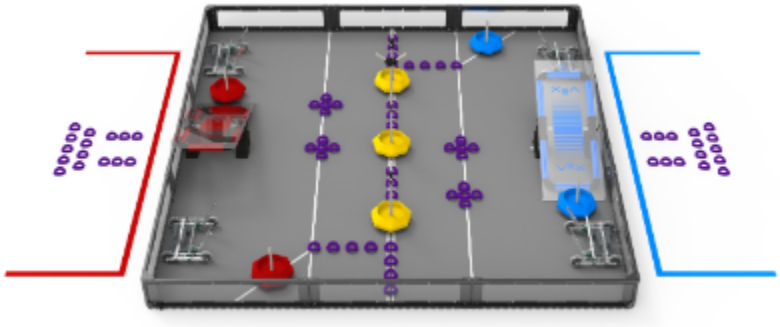
VEX Robotics Tipping Point Rundown



Tipping Point is a match between two alliances, red versus blue, each consisting of two robots. The match takes place on a 12'x12' playing field and runs for a total of 2 minutes. The 2 minutes is broken up into two separate phases: a 45 second autonomous phase and a 1 minute and 15 second driver phase. The scoring is broken down in the table below.

Mobile Goal Scoring	In Alliance Zone	In Neutral Zone	On Balanced Platform
Alliance Goal	20 Each	0	40 Each
Neutral Goal	20 Each	0	40 Each
Enemy Alliance Goal	0	0	0

Ring Scoring	In Base	On Low Stem	On High Stem
Alliance Goal	1 Each	3 Each	10 Each
Neutral Goal	1 Each	3 Each	10 Each
Enemy Alliance Goal	0	0	0

Robot Scoring	Not on Platform	On Balanced Platform
Alliance Robots	0	30 Each

Roles of Team Members

Abdul Fejleh

Original Founder of Rust & Backup Coach

Responsible for the first iteration of rust and after his departure Oscar Rodriguez took over

Oscar Rodriguez

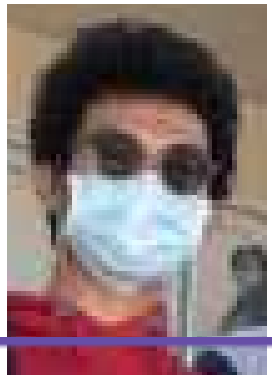
Team Captain and Coach

Manage team's meeting scheduling, documentation of the robot, and setting up goals for the team to accomplish on a weekly basis. Responsible for in game strategies before and communicate with driver & partner coaches to guide each other through.

Nathan Vuong

Programming Lead & Driver

Programming driver control functions and autonomous routines. The person who is controlling the robot during the match.



Angelo Legaspi

Mechanical Repair & Backup Coach

Keeps track of the time during matches and will give physical signals to the coaches on the field to know the time. Any repairs needed on the robot will be fixed.

Trevor Chow.

Builder & CAD Designer

Designing, building, and maintaining robot

Ethan Bobadilla

Mechanical Repair

Any repairs needed on the robot will be fixed. Throughout the week if the main driver is unable to meet with the coach to practice or during competition they will take over.

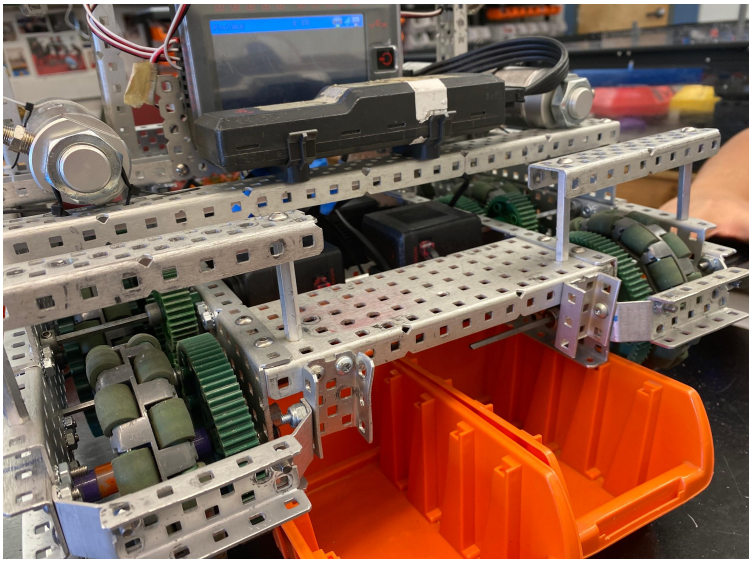
First Iteration of Rust

Design goal:

A large 24x24 robot with the ability to hold at least 2 goals, and have a manipulator.

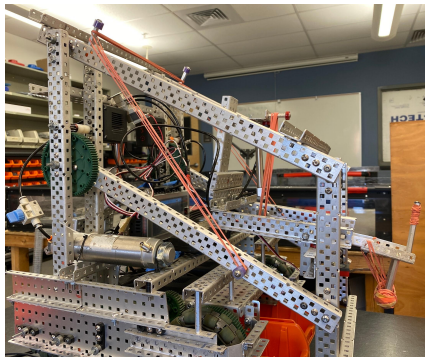
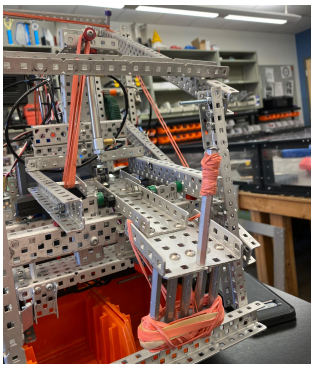
Drive train:

A 15x15 platform with 6 wheels and 6 motors (3 on each side). The smaller driver train allows for easier turning and however it sacrifices some stability, this issue can be overcome with careful and skillful driving. The 4 outer wheels are omni wheels and the two center wheels are “locked omni wheels”. The locked omni wheels are omni wheels that have been modified to not allow side motion. Each side of the drivetrain has all the motors and wheels geared to get her in a 3:8 ratio to increase torque. To combat the loss in speed we used turbo (blue) motors. The idea behind our design is that we would have a high torque drivetrain that would allow for easy turns but not be able to be pushed as easily.



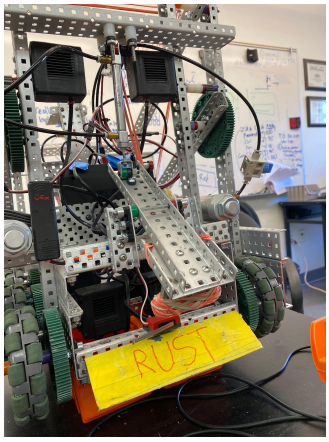
Four bar lift (front intake):

This is a powerful manipulator capable of lifting moving mobile goals and holding with clamping the floor. The four-bar lift is powered by two geared motors for more torque. The gears help with the strength of the lift but sacrifice speed, however the decrease of speed is an advantage because it does not interfere with the robot's stability as much. The lift includes rubber bands that support the motors with lifting. The rubber bands are placed in such a position that when the lift is up the rubber bands are less stretched than when the lift is lowered.

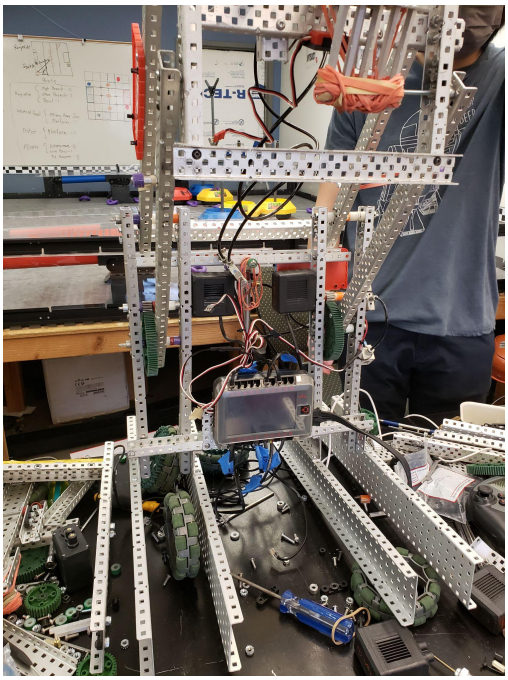
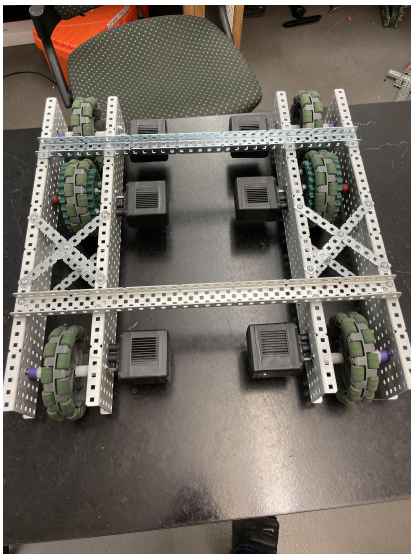



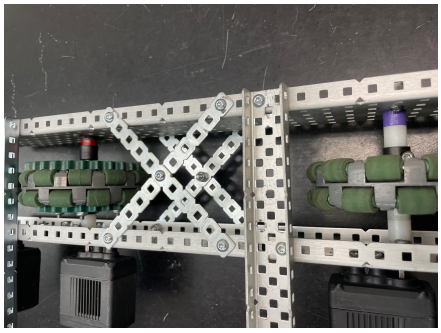
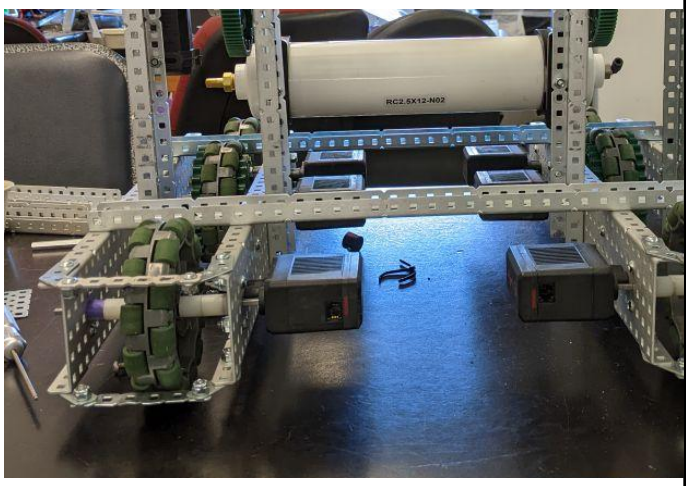
Pneumatic clamp (back intake):

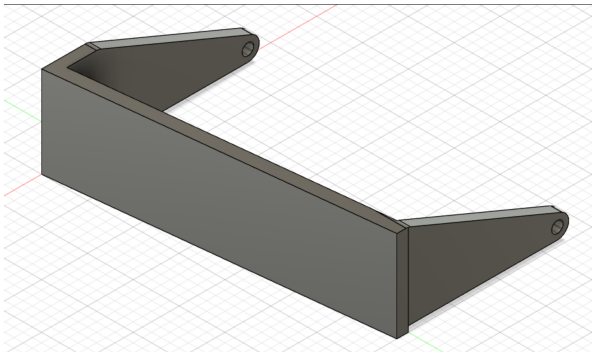
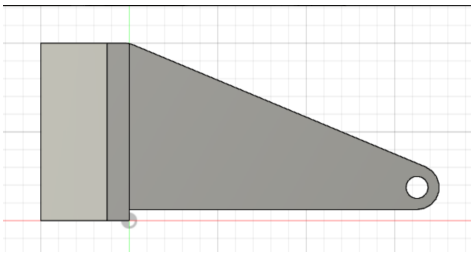
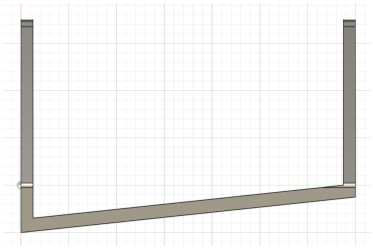
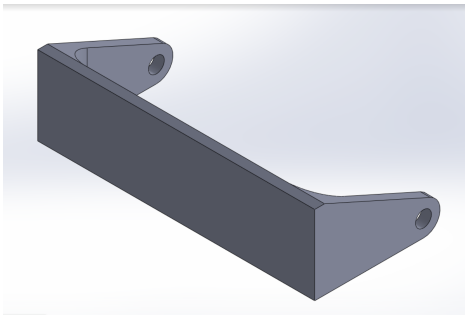
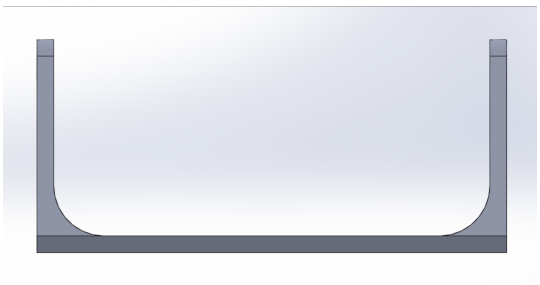
The clamps are how our robot holds the mobile goals. Our robot has two of these clamps, one in the front and one in the back. The clamp works with pneumatic pistons, when the piston is not extended the clamp is closed and held closed with rubber bands. When the piston is extended, the clamp opens to hold the goals. The clamp grips on to the mobile goals with the use of rubber bands. With the rubber bands holding the clamp closed and the rubber bands gripping to the inside of the goals, the clamps hold the goals very tight. This design makes it so when you have the goals it is hard for you to accidentally lose the goals or have it taken by another robot.

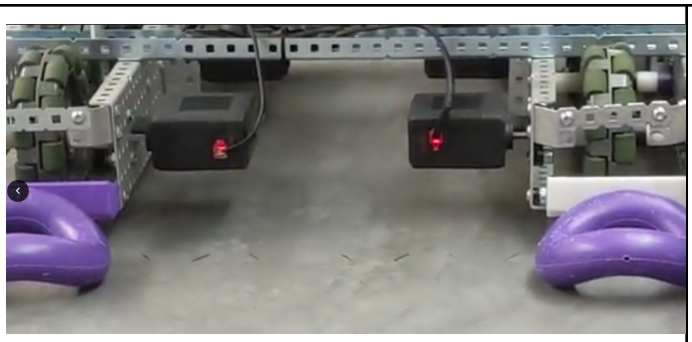
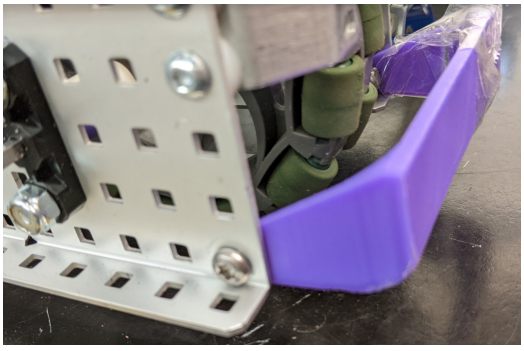
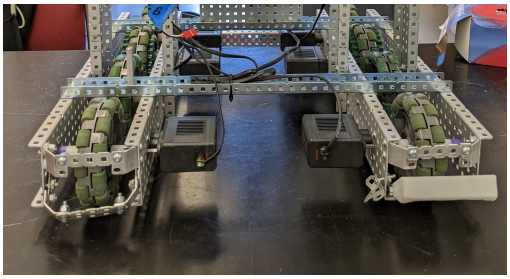


Drivetrain Timeline

Picture(s)	Description
	1/14/2022 1) Dismantled original 15x15 drivetrain - Plan to increase size to 18x18 Reason: having a smaller base with a front heavy lift caused tilting errors. 2) Trevor and Angleo also changed the cartridges of the drive motors to green ones Reason: the way the blue ones were geared (improper gear ratios) caused overheating of the motor as matches went by.
	1/21/2022 Rebuilt drivetrain spacing to 18”. Discussed potential drivetrain options resulting in replacing turbo motors with regular motors and removal of gear ratio. Swapped the motors to green one’s, repositioned the wheels, adjusted the spacers so that the wheels line up well, and started working on bracing the

	frame
	1/26/2022 Added tire bracing to prevent lift from dropping/ pushing against the front wheels (Tireguards V0.5) Added metal single bar to push rings out of the way and try to prevent rings from sliding under Issue: it's too thin to push rings and once a ring slide under it got stuck

  	1/27/2022 (Tireguards V1) 3D print front tire guard to push rings out of the way and try to prevent rings from sliding under Must be able to move up and down enough though to climb the balance Issue: Hole to insert a screw was too small
 	2/2/2022 Added another 4th wheel on both side to prevent rings from sitting between wheels in a empty space - Removed x shaped bracing (Tireguards V2) 3D print front tire guard to push rings out of the way and try to prevent rings from sliding under Must be able to move up

<table>
<tr>
<td> 
 
  </td>
<td>and down enough though to climb the balance

Issue:

Durability the tire guard was too thin and couldn’t withstand the constant contact of other robots during matches

- Had to temporarily replace it with a metal piece alternative for the day (Tireguard V2.5)
- Issue: with the metal piece tire guard was it wasn’t able to move up and down for climbing</td>
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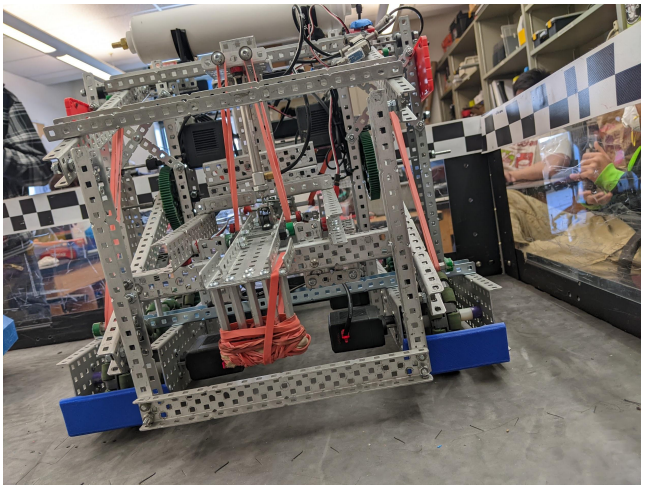
<tr>
<td>  </td>
<td>2/4/2022

-added short wheels, if robot tilts

(Tireguards V3)

3D print front tire guard to push rings out of the way and try to prevent rings from sliding under

Must be able to move up and down enough though to climb the balance

Durable enough to withstand other robots</td>
</tr>
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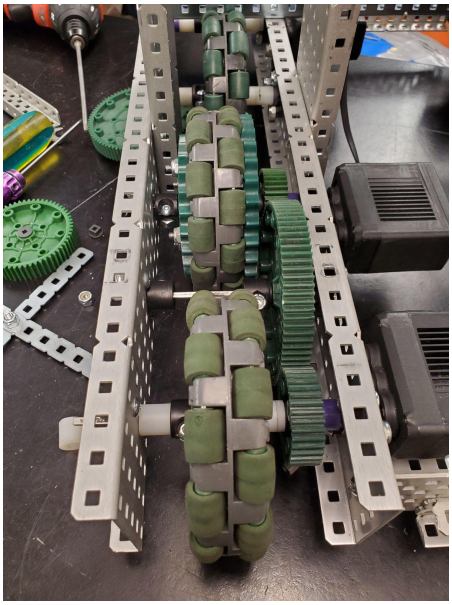
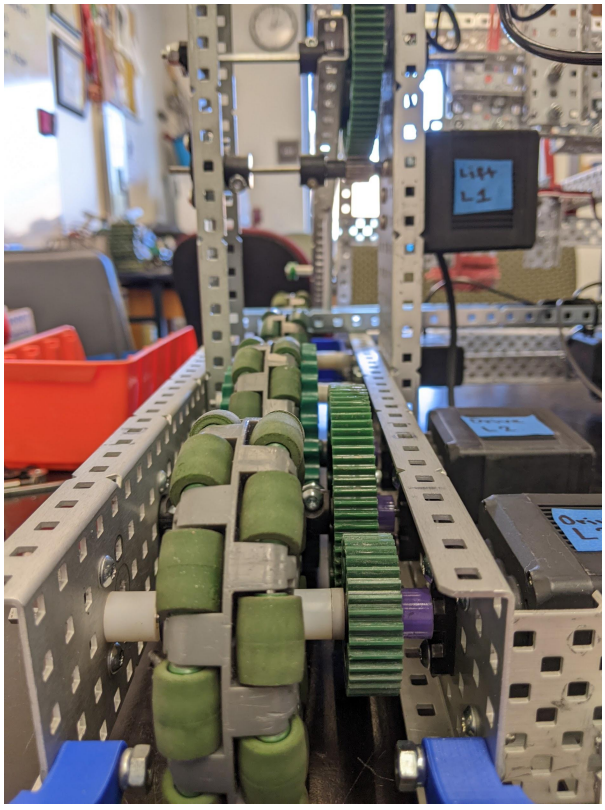
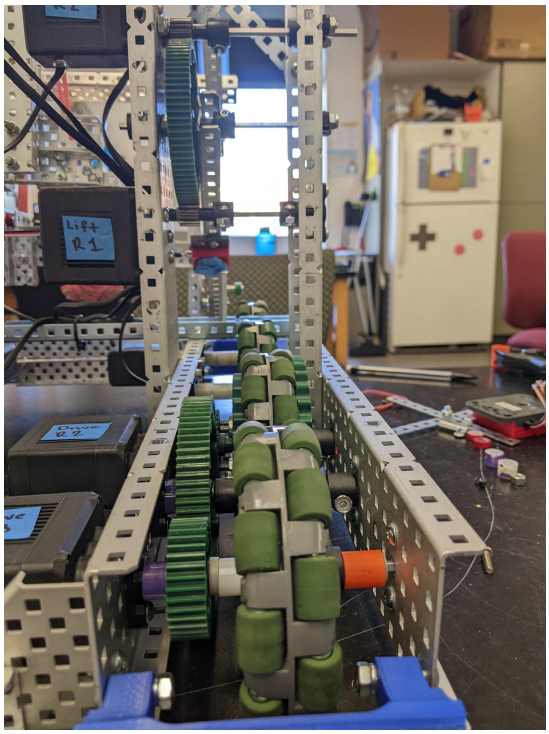
	hitting it Issue: It was perfect for the back tire guard, however for the front the constant pressure of the front lift pushing down on it snapped it
	2/7/2022 left and right back wheels were geared to allow the wheels to keep traction when climbing up the balance Issue: now the front wheels are unaligned with the rest

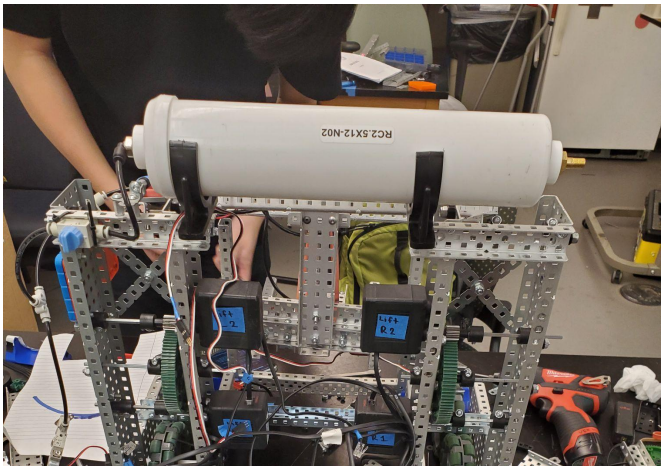
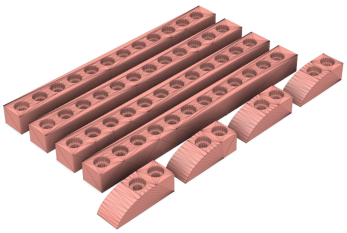
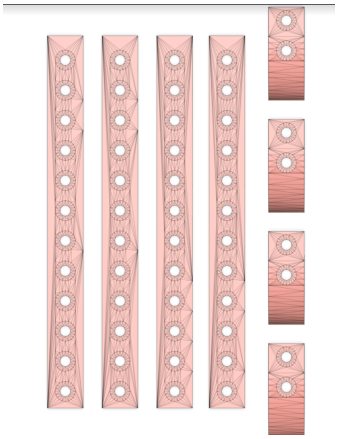


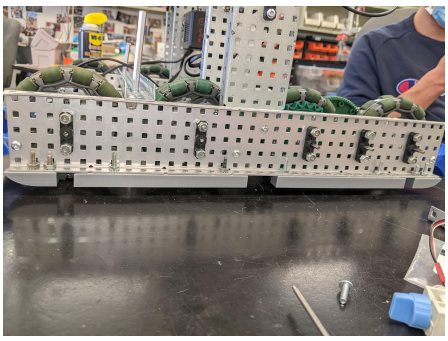
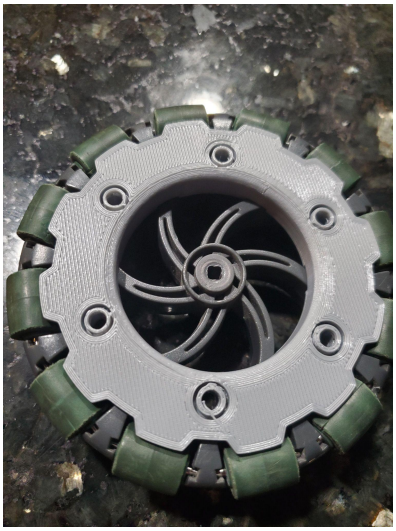


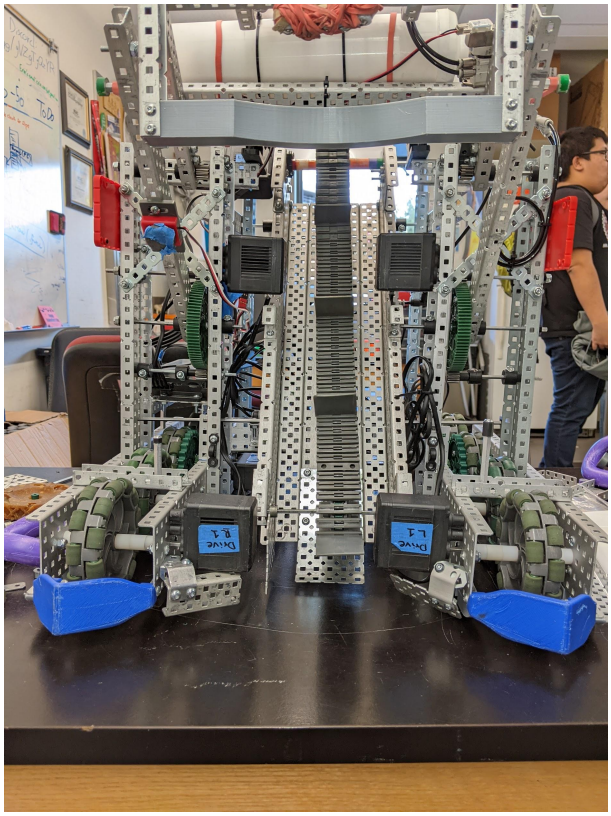
2/9/2022

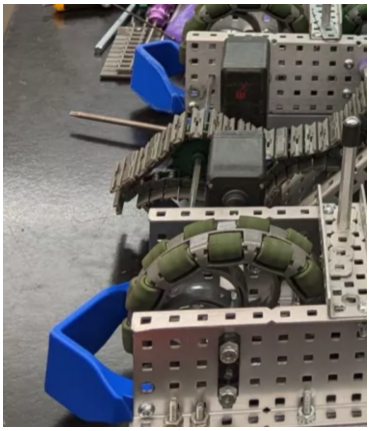
aligned front wheels x4 to match the back geared wheels

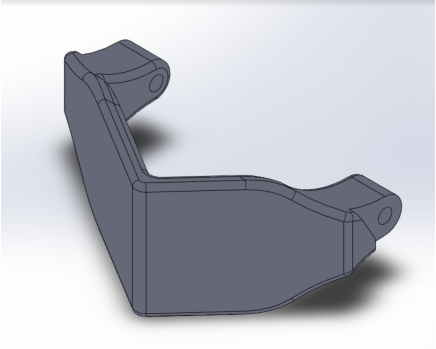
Issue: the gearing right side back wheel spacing wise might be too tight. Due to drivetrain not being proper reinforced evenly

	2/9/2022 Move pneumatic tank to the top of the robot
  	2/17/2022 Side Skirt V1 Must be able to prevent rings from sliding under the robot, when turning either direction Issue: lost the clearance to be able to climb

	
	2/20/2022 Prototype of 3D printed wheel guard Purpose is to eliminate using gears as ominilocks Issue: when screwed on tightly the 3D part isn't thick enough to be making contact in order for it to be locked







2/24/2022

Removed the front long steel C channel holding the left and right side together as well as straight down the middle

- Reason is to clear the center of the robot for a conveyor belt ring intake

- Fix was to attach two separate smaller C channels to hold it together

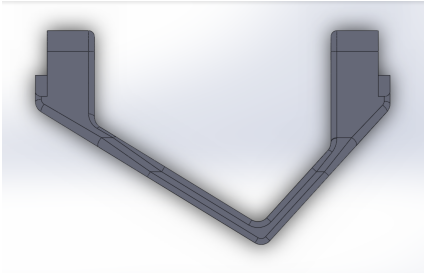
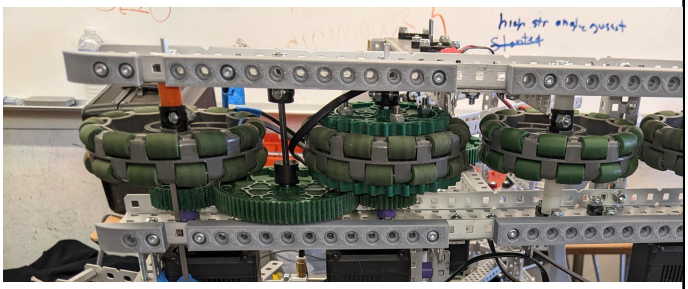
Flipped front left (L1) and right motors (R1) vertically to allow rings to pass and not get what's stuck between

(Tireguards V4)

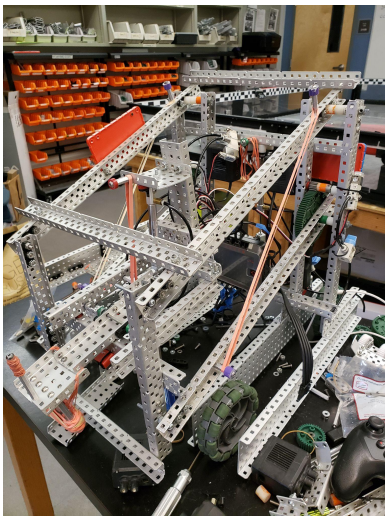
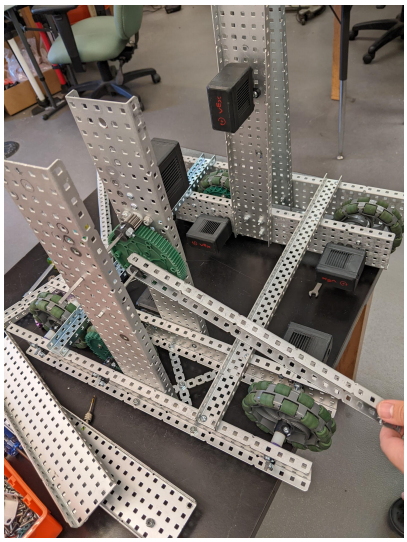
3D print front tire guard to push rings out of the way and try to prevent rings from sliding under

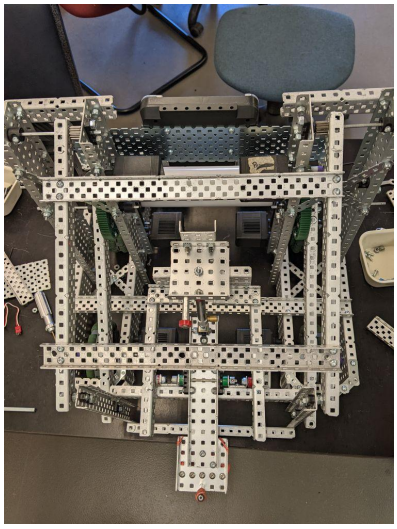
Must be able to move up and down enough though to climb the balance (for the future)

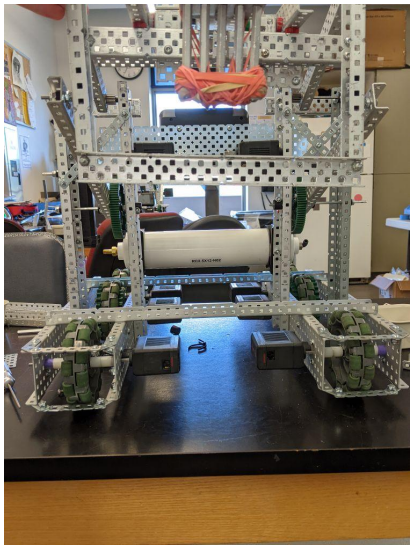
Durable enough to

	withstand other robots hitting it and angled to not interfere with the front lift
 	2/24/2022 Added the inner 3D printed low skirt (side along the motors) This is so when rings enter through the front they don't slide under from the inside

Front Lift Timeline

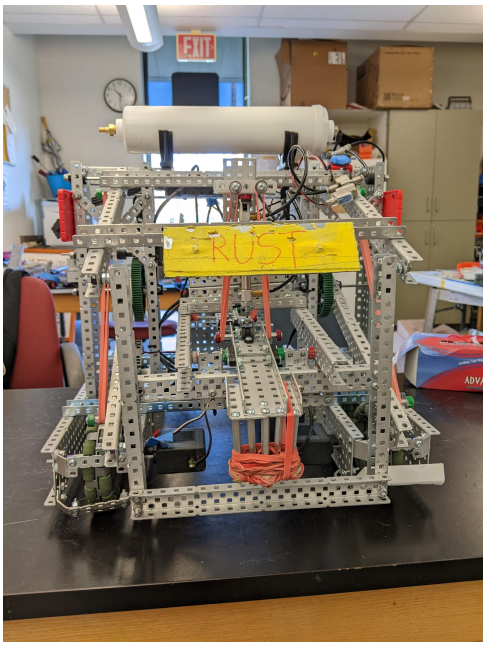
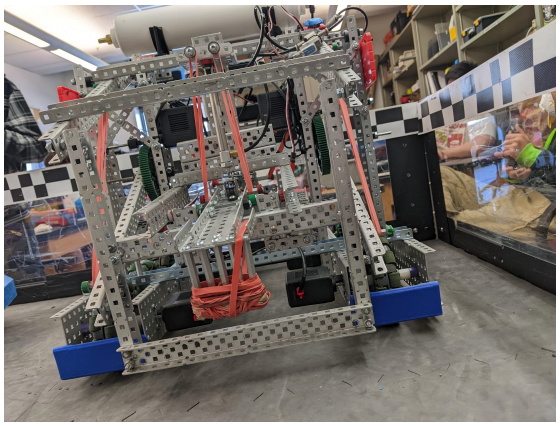
Pictures	Description
	1/14/2022 Dismantled previous 4-bar lift for improvements
	1/25/2022 Repositioned drivetrain wheels to make room for lift Utilized smaller bars for four bar lift and decreased the lift's height

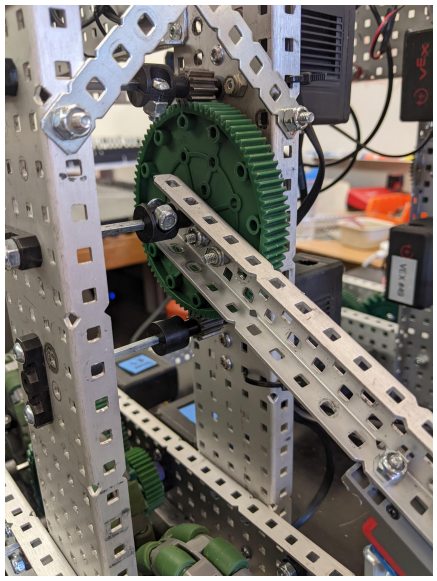
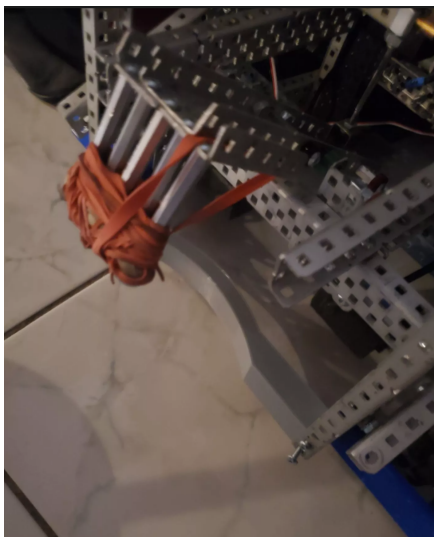
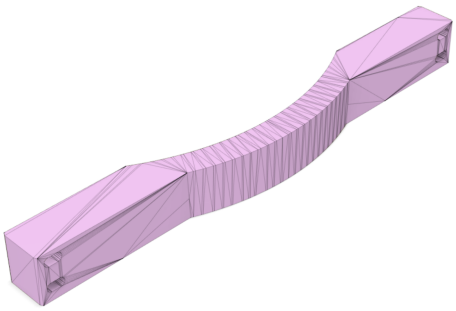


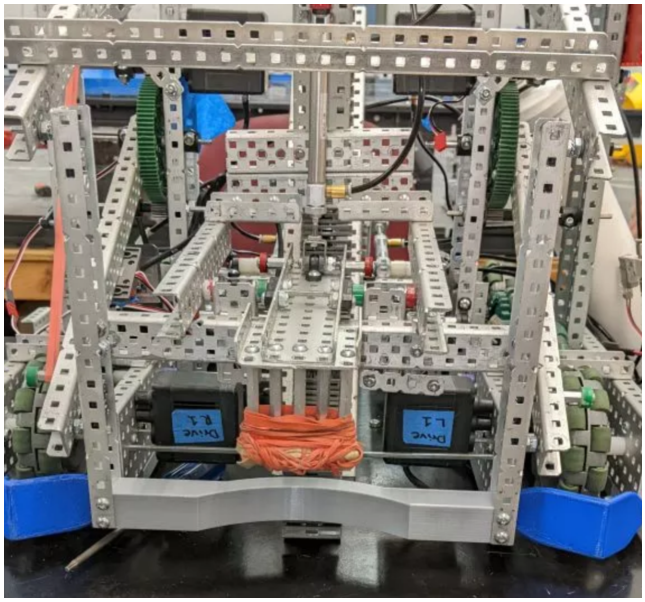


1/26/2022

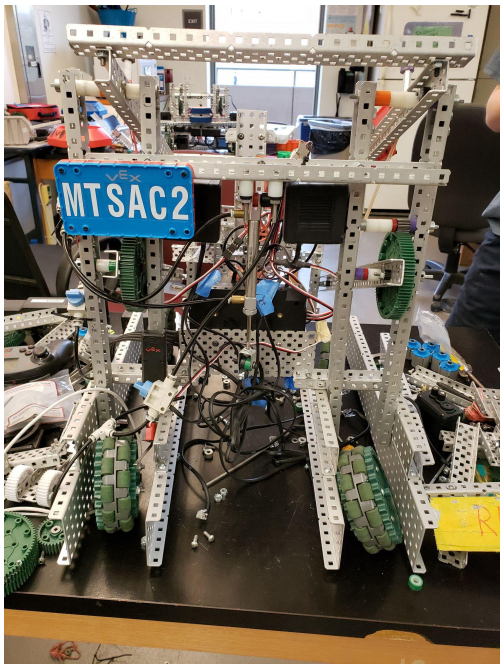
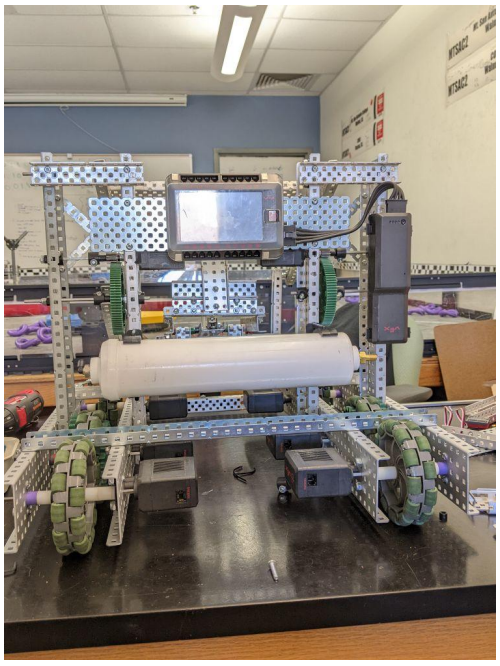
We shrunk front clamps and added additional collars to the four bar lift, reducing instability. Shrunk overall robot spacing to fit within 24” requirements. Removed wasted space in the front clamp and added tire bracing to prevent lift and tire conflict.

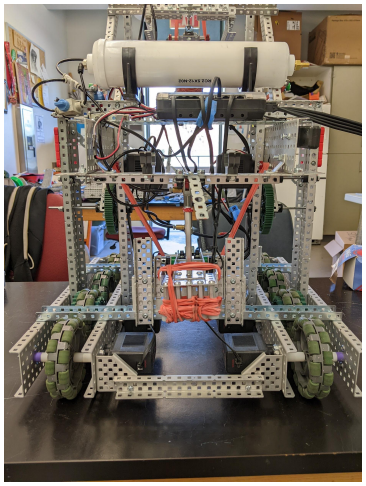
	2/2/2022 Reached standoff for rubber bands to attach from the lift to the frame
 	2/7/2022 - added two motors on front lift - added one shaft and high strength gear to strengthen right front lift (unfinished)

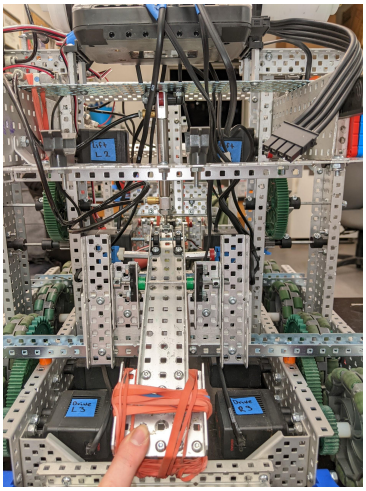
	2/9/2022 - finished adding shaft and high strength gear to left side front lift
  	2/20/2022 - 3D printed goal conforming front bar for the four bar lift (Front goal conforming bar V1) Issues: Wasn’t wide enough to go around the base of the mobile goal Too thin even with the slight amount of pressure you can feel it bending (Front goal conforming bar V2) Worked as attend

	conformed around the base of the mobile goals and was strong enough to even hold the tall yellow goal

Back Clamp Timeline

Pictures	Description
	1/14/2022 Dismantled back pneumatic systems for improvements.
	1/26/2022 Used the backspace as a temporary mount to test out the new pneumatic tank on the robot



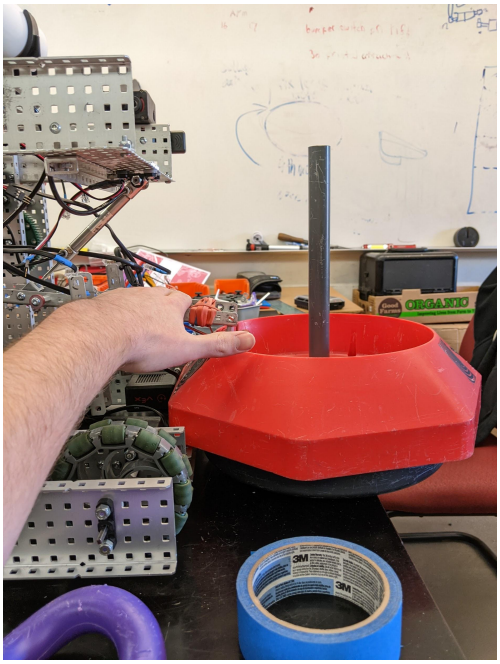
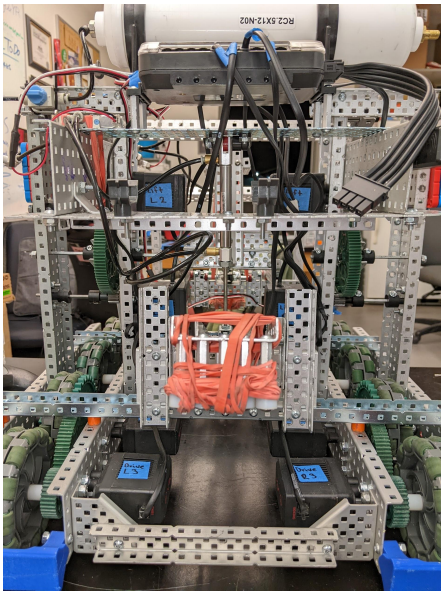


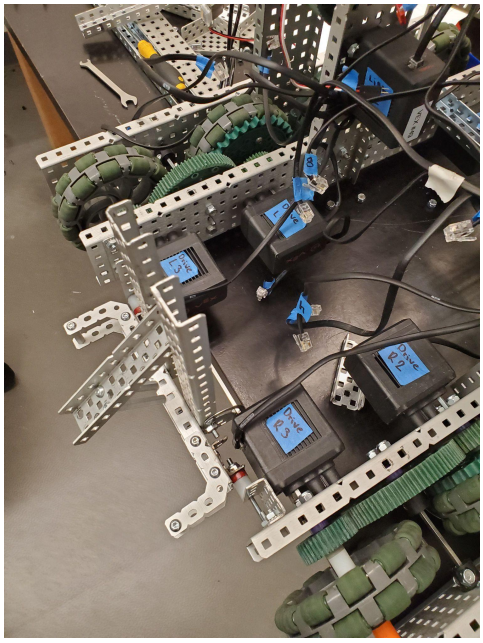
2/2/2022

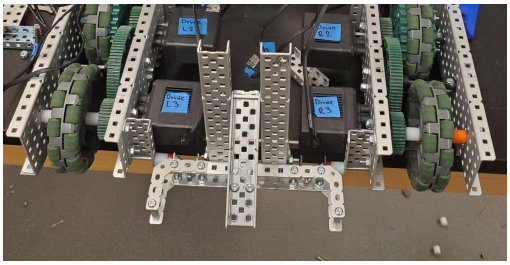
Reattached the odd back clamp and put int on standoffs on top of the back wheels

Added a new back ramp using metal to hold in the bottom base of the mobile goal + protect the motors

Issue: Since the clamp was relativity low to the ground it dragged the goal thus it was slowing us down and made us unable to climb the balance

	2/2/2022 - noticed future ring manipulator won't work with current back intake (length wise) - would need to design a back clamp that allows the goal to tilt at an angle to reach around the center of the robot
	2/11/2022 Me and Gabriel moves the pneumatic tank up straight (back clamp is stronger in less wobbly when moving side to side) - also put the brain on standoffs -lastly the back bar that goes across we moved it up one hole so that it goes under the goals to help clamp it better from the back



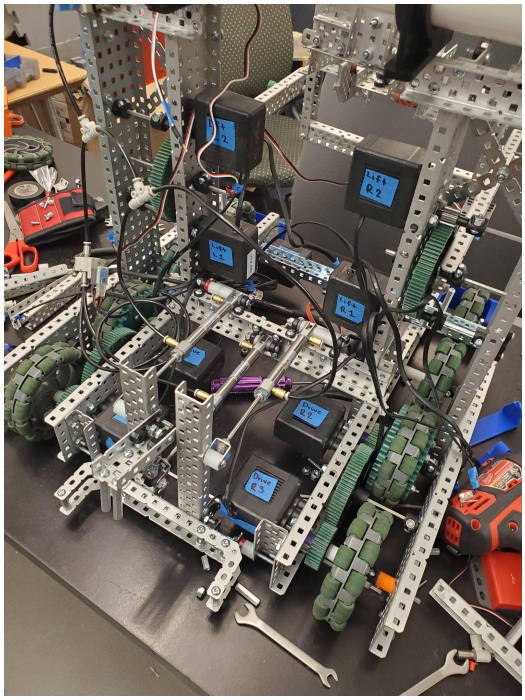
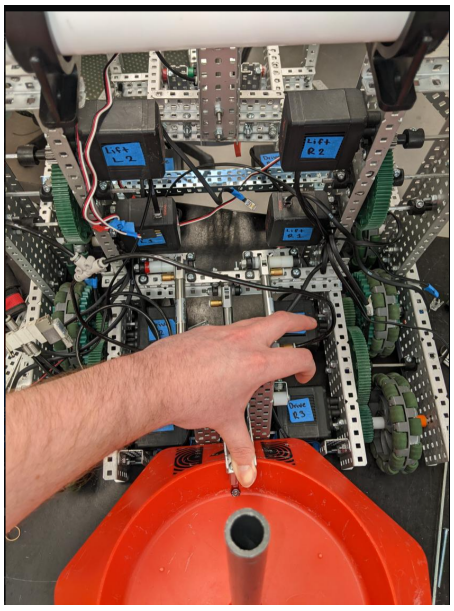


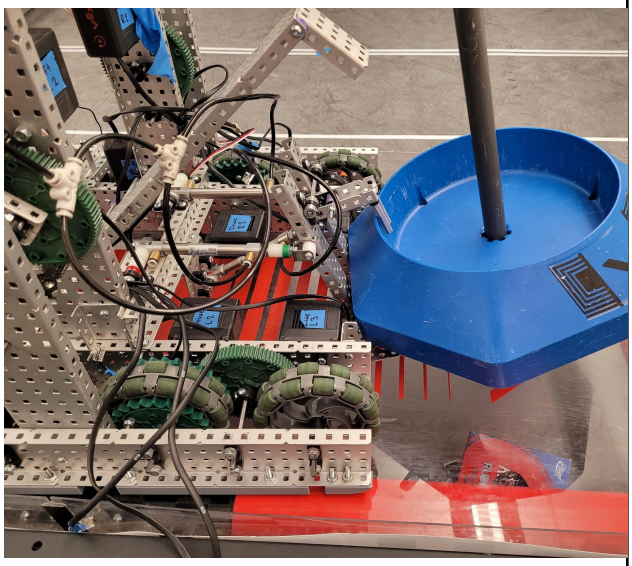
2/17/2022

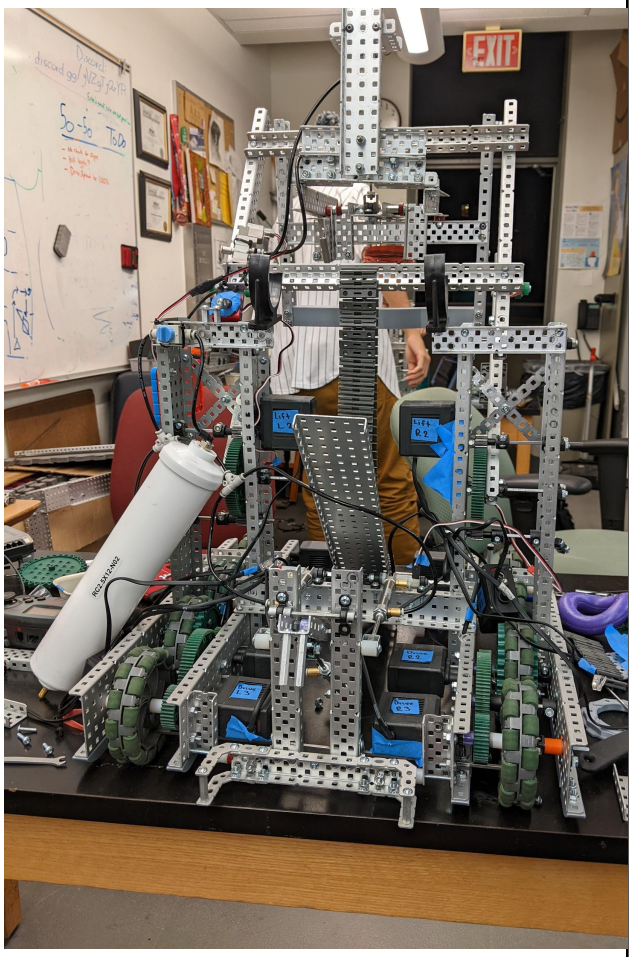
- built a prototype for a c shaped arm to curl up mobile goals on the back intake (didn't work out as planned sizing wise) would of been out of size limit

- built another frame for a pneumatic based back intake

- more compacted and would allow us to tilt goals and hold it in securely with the clamp

	2/18/2022 - continued back intake prototype added x2 pneumatics to curl in mobile goals - In addition a third pneumatic that will push down a clamp to secure it more (needs to be repositioned) Issue: the middle pneumatic that is supposed to push down the clamp is weak
	2/23/2022 Even with the motors flipped the starting point is super tight between the c channel holding the robot together and where the pneumatic mount is - it's going to be a very steep and coming downward it's going to hit the mount

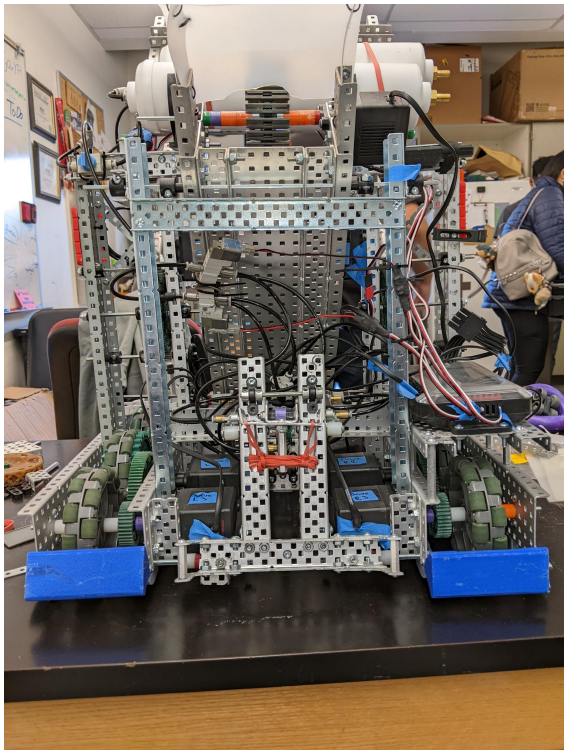


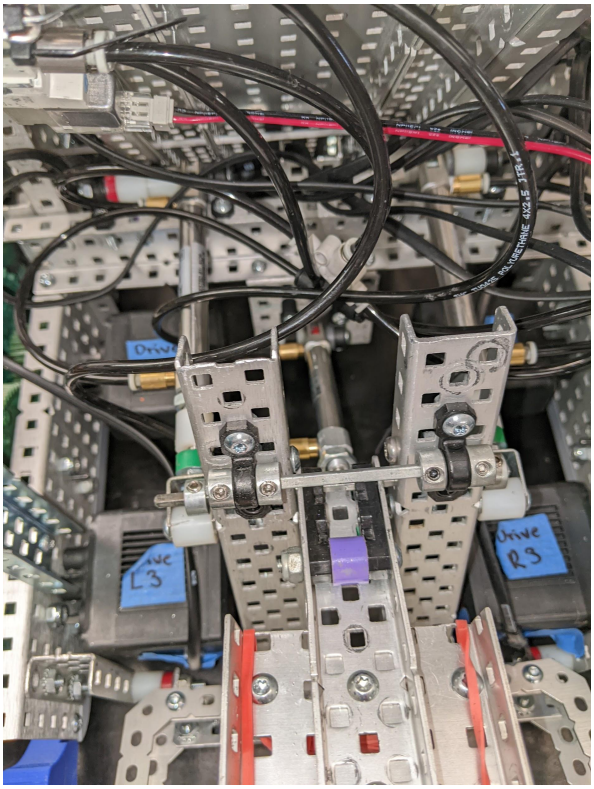


2/24/2022

Reattached the back intake pneumatics

- reposition the middle pneumatic at a better angle to push the clamp in the directions so that it holds the goal





2/26/2022

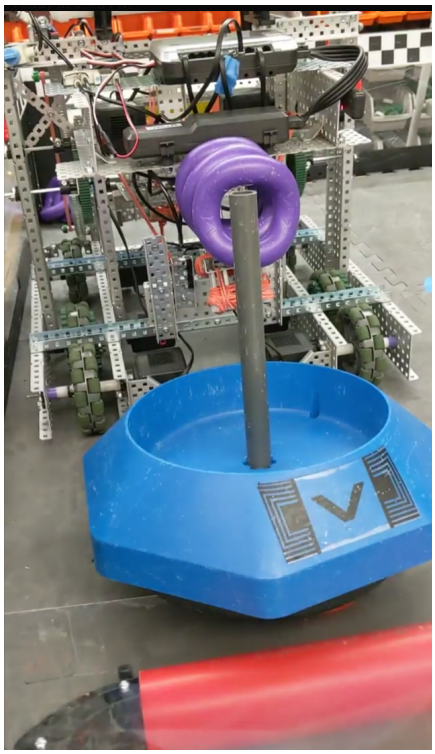
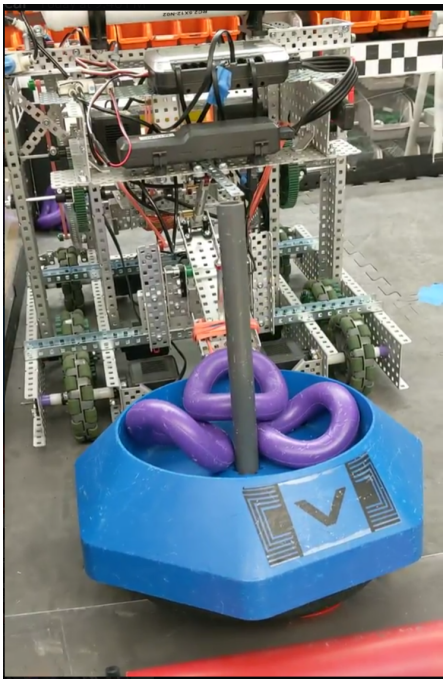
Got longer wires to connect to the ports (specifically the left side was too short to reach the brain) which lead to wires getting tangled up near the back intake

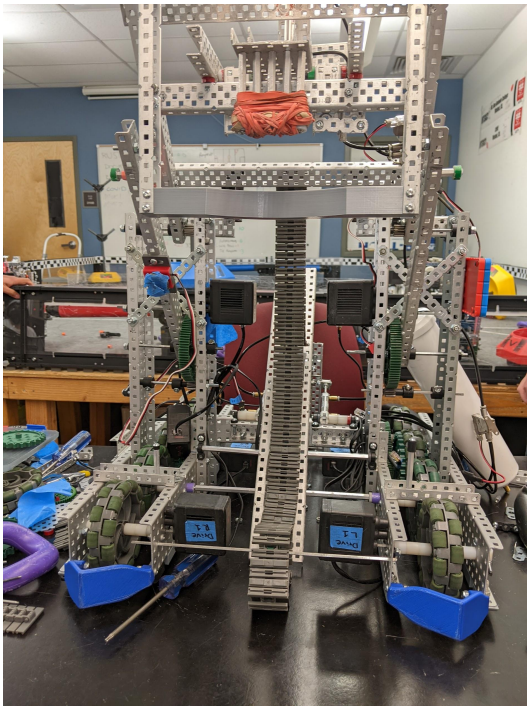
Solution: wire management with zip-ties

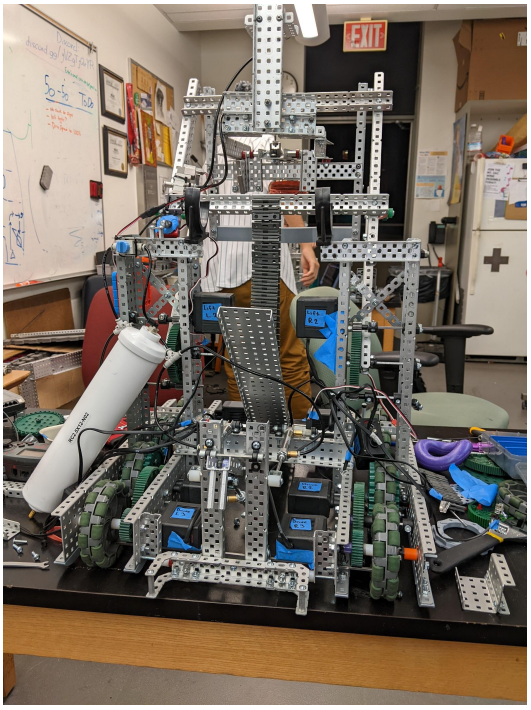
Added shaft collars to the back clamps

Added rubber bands to the front hook

Ring Mechanism Timeline

Pictures	Description
 	2/7/2022 Added temporary ring mechanism used in drivers/ programing skills A single bar piece of metal would be sticking out from on top of the back battery/ pneumatic mount and was capable of holding all three preloads A standoff with a red spacer and screw was attached to the back pneumatic clamp - When retracted it will sit behind low of the bottom of the rings above - When pushed down in the normal pneumatic clamping mechanism the standoff would fling rings into the lower part of the alliance goal





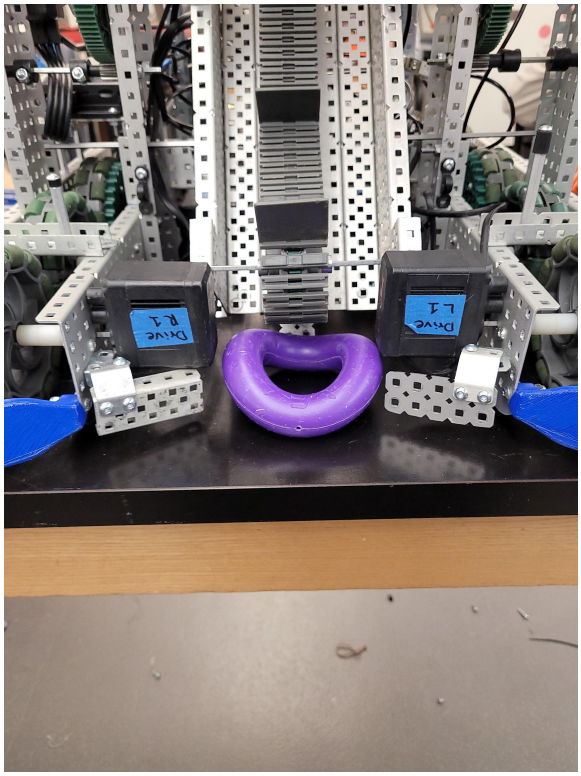
2/24/2022

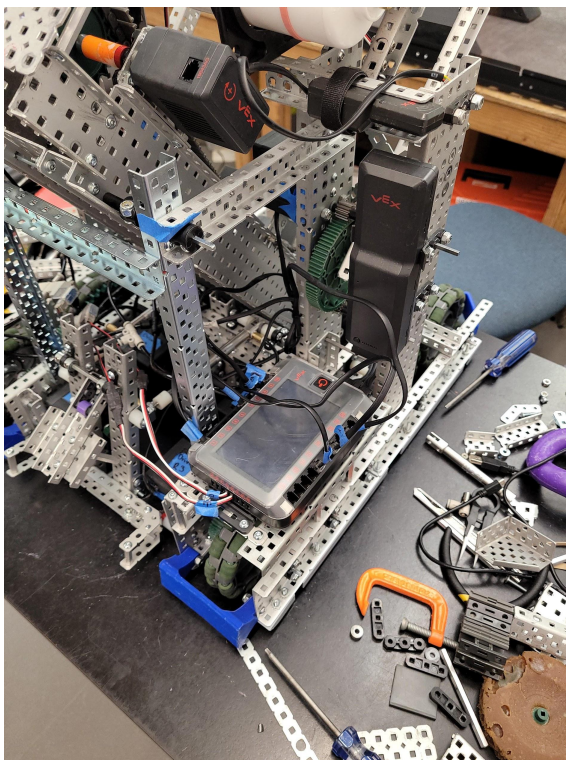
Goal is to design a conveyor belt system that collects rings positioned in the middle of the robot from the front and diagonally transport them to the back.

Where a mobile goal's branch will be positioned leaning against to pile rings on it.

- backboard was position in place, so that it can reach goal

- messed around to figure out the amount of chain need for the conveyor belt length





2/25/2022

•Ring mechanism

- added second pneumatic tank

- shorten the front clamp's pneumatic positioning

- removed bottom lift motors (L1 and L2)

- added backboard for the conveyor belt

- added 2x c channels on each side (oriented on the back) to support and hold up the back board on the ring mechanism

- attached green motor, sprockets, and conveyor belt

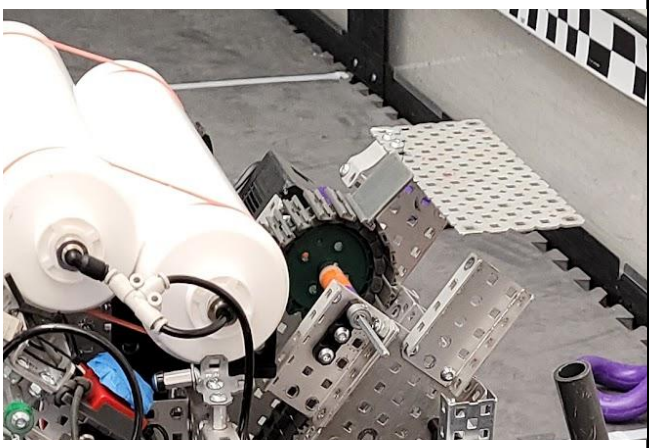
- added five bar flat metal at the top of the bring mechanism to prevent rings from flying across the field

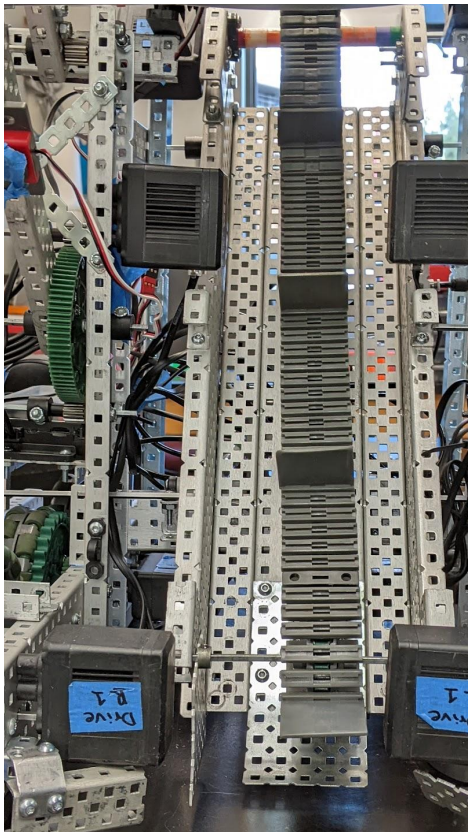
- we ran shafts to hold the conveyor and the backboard (used shaft collars to hold it in)

- relocated the brain to the back Right side

- reposition back middle pneumatic

- reposition the battery

	mount - Added front inner angular metal pieces to guide rings to go to the middle instead of the side (basically like a funnel)
	2/25/2022 Added metal top plate to prevent rings from staying/ attached to the flaps or dropping out at an angle Issue: it was not tall enough and too stiff, which caused rings to get stuck

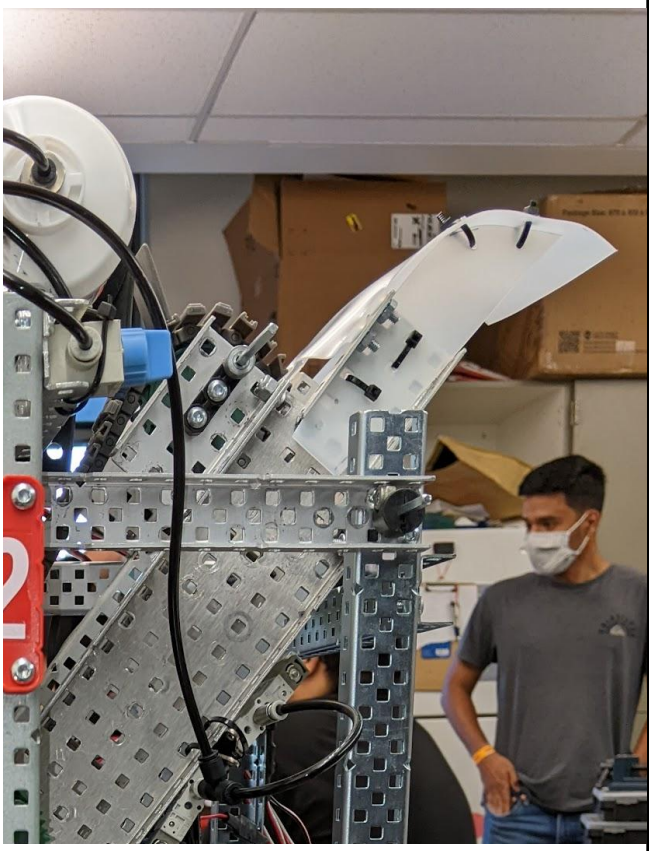


2/26/2022

- added shaft collars to the back clamps

- Added flat bar scope to the bottom of the ramp

- Added flat bar (next to motor R1) to funnel rings into the middle

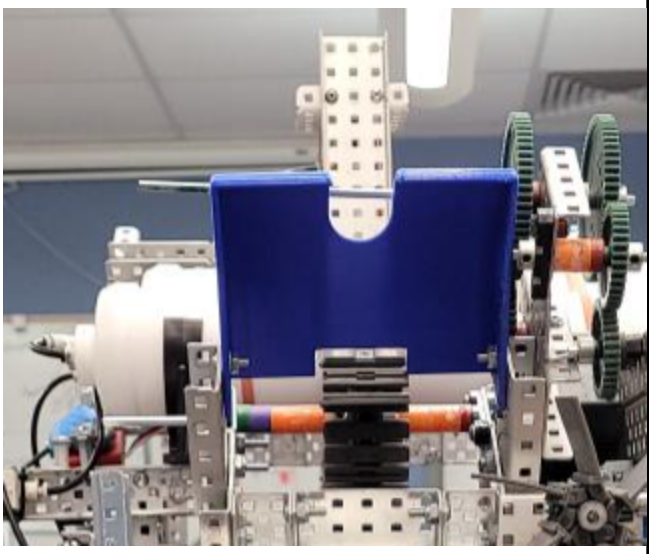


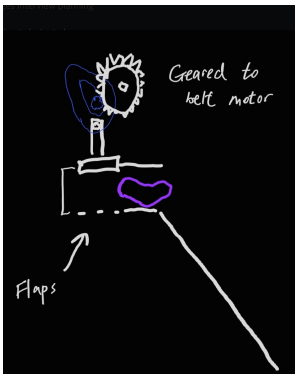
2/26/2022

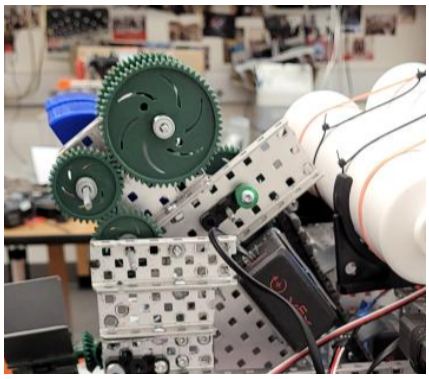
Added non-shattering plastic to the top end of the converter belt (metal flat bar was removed)

Issues: not supported enough/ strong to withstand rings being pushed against it and the converybelt flaps hitting it

Didn’t guide rings accurately as intended







3/2/2022

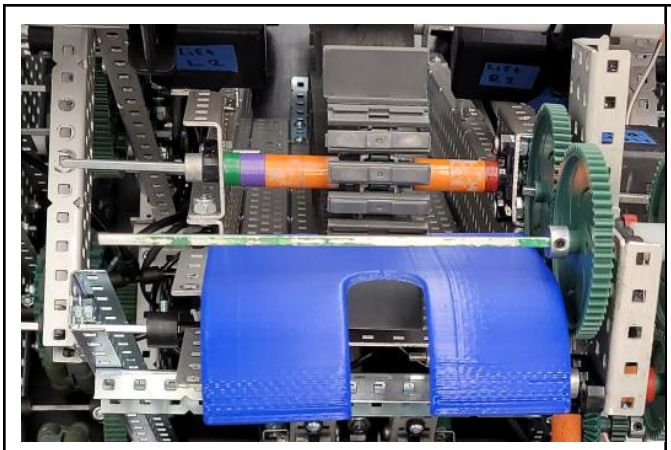
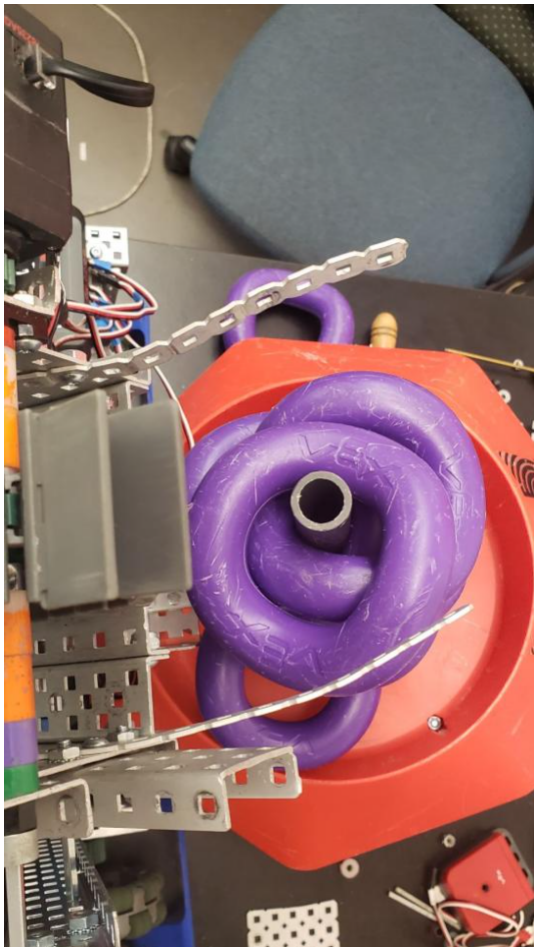
(Unfinished)(I don't even know if it'll work) it's supposed to get the rotation from the belt motor, transform the rotation axis and push the donut flat into the pole

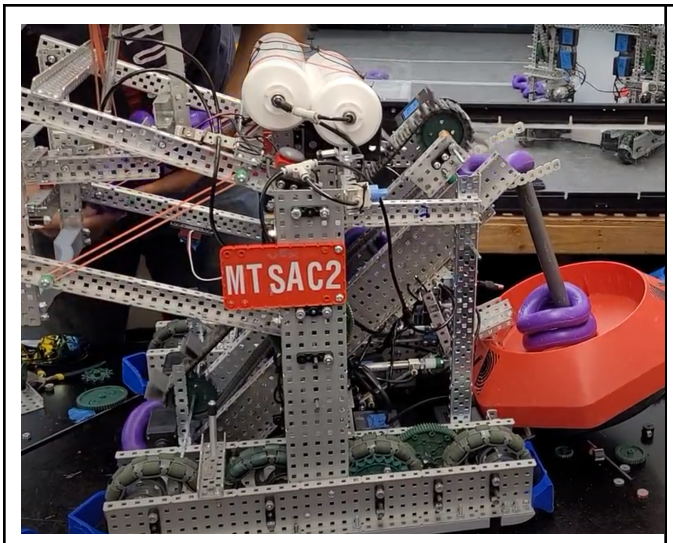
Issues:

It did not fix the problem of rings flying out or severely undershooting it (very inconsistent)

The flap guides seem a bit overcomplicated

They're also gonna have a lot of slippage

	
	3/3/2022 Slowed downed the converybelt speed The overall angle of the conveyer, extended the end of the belt a bit, added bar guides at the end Issue: Just need to adjust the intake plate angle

 MT SAC2	

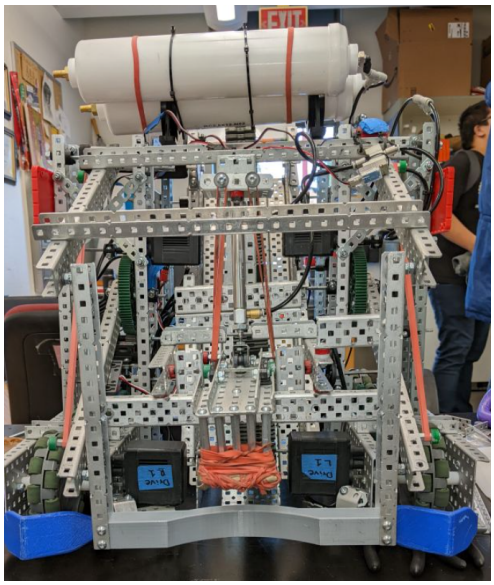
☐ Project: Pneumatic Mount Changes

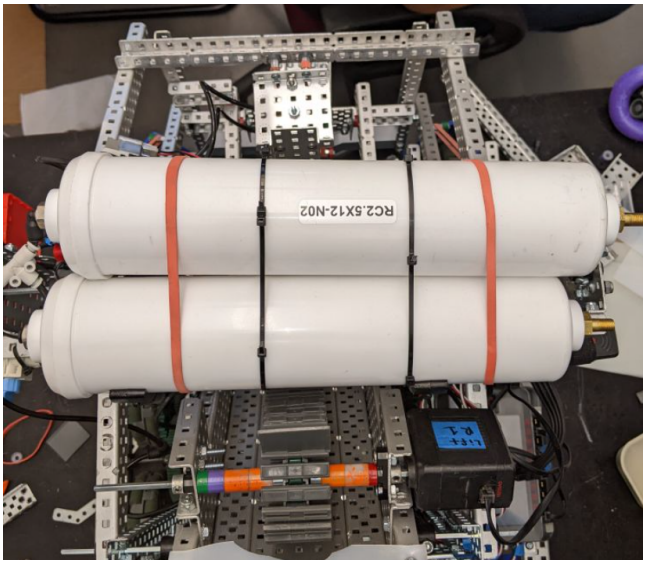
03/07/2022 - 03/14/2022

Description: 3D print a pneumatic mount to secure the pneumatic tanks x2. Ensure vertical height does not exceed 25inches by the end of these changes. Make sure the pneumatic is still accessible from either side of the robot to put air in, stays relatively around the original tubing setup, and holds the top/ bottom pneumatic tanks together.

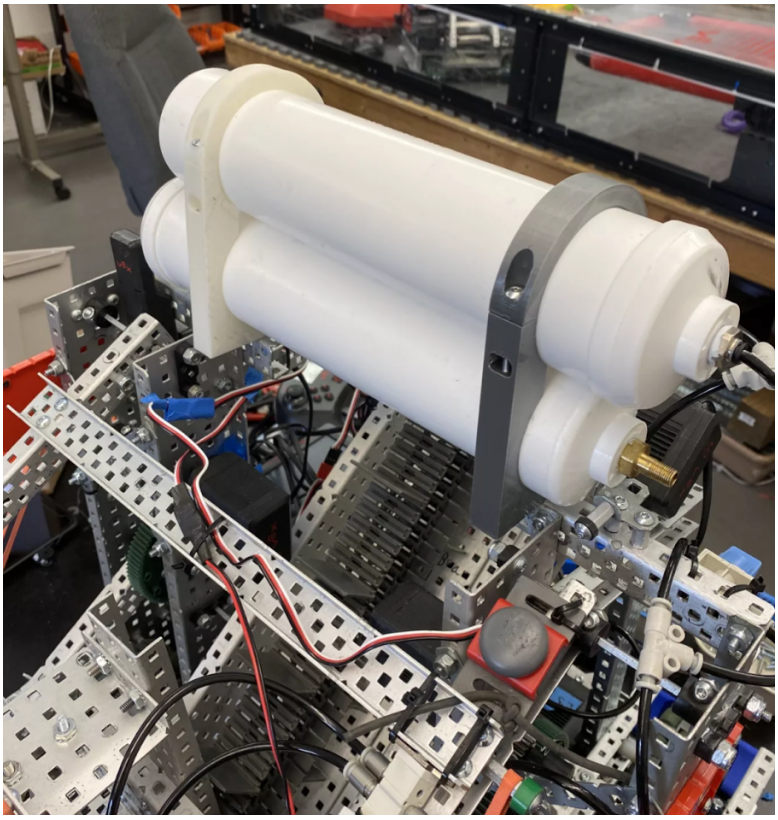
Completion Notes:

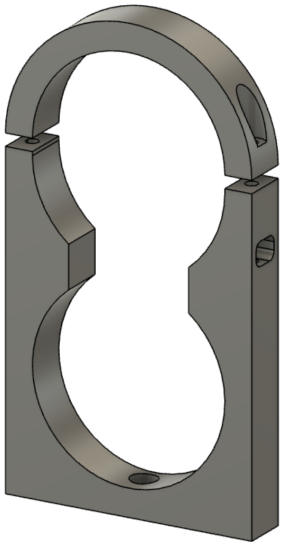
- Successfully changed the “illegal” pneumatic mount warned to us by the USC inspection people. Another issue was that the original mount did not fit the pneumatic tank properly and broke off a piece when we tried to force it on. Another issue was securing two pneumatic tanks side by side or on top of one another, we didn’t have additional mounts of the original. Thus after 3D printing a new custom fitting pneumatic mount we first removed the older mount and replaced it with the new one. Current issue with the new mount now is that it is slightly too loose fitting wise and the screw holes are too small. I'm currently working on adjusting the width of the mount and screw holes to accommodate the errors.
    - Before Photo:





- After Photo





- AF 03/14/2022

☐ Project: Conveyor Belt Intake Lip Changes

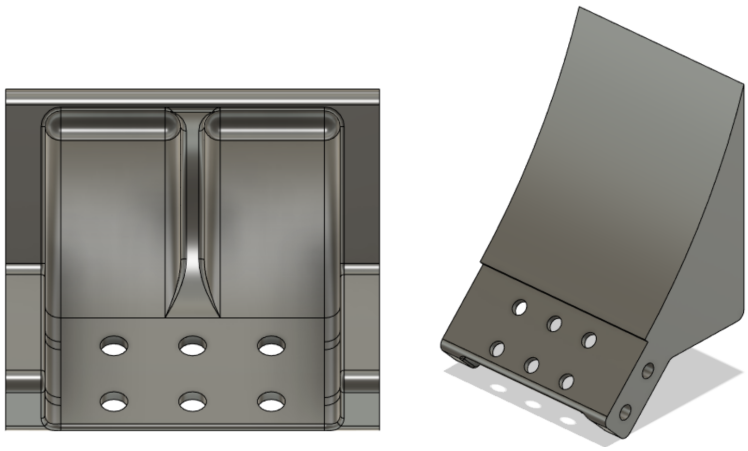
03/09/2022 - 03/14/2022

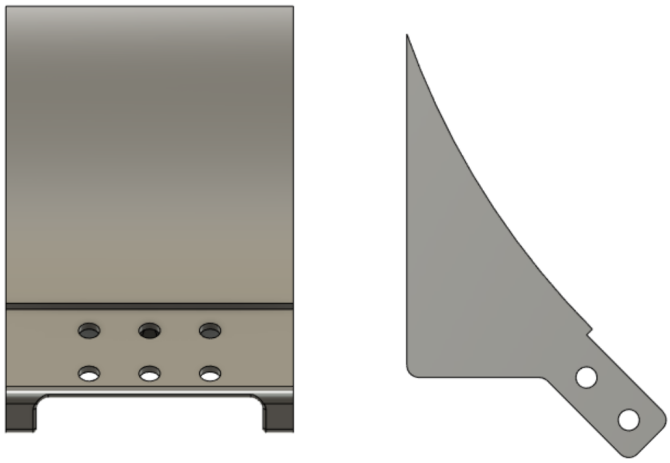
Description: 3D print a conveyor belt intake lip to better scope up the rings for the converybelt flaps to better make contact with the rings and pull them up. The intake lip must be low enough to scope up rings, strong enough to not break or bend, and angled/ aligned with the ramp backboard of the conveyor belt.

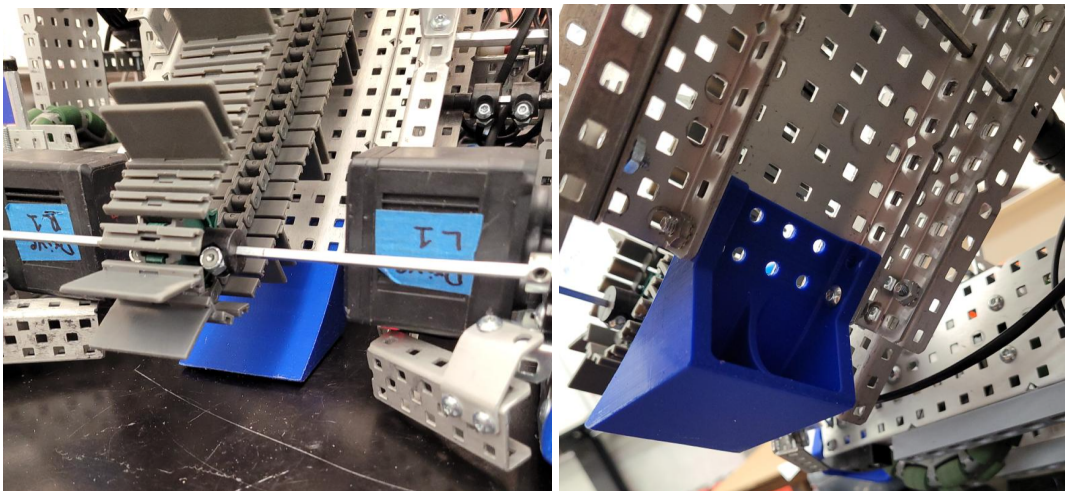
Completion Notes:

- Successfully changed the old conveyor belt intake lip, which was just a metal flat bar that was bent by hand to align with the conveyor ramp. Issue with the old one was that it was easily bent by other robots during collision and the metal piece would drag damaging the tile floors. With this new 3D print iteration being perfectly aligned with ramp and unable to bend inward or outward it can last long, while staying in a fixed position to collect rings by pushing them slightly up to be grabbed by the conveyor belt flaps.
    - Before Photo:

- After Photo:







- TC 03/14/2022

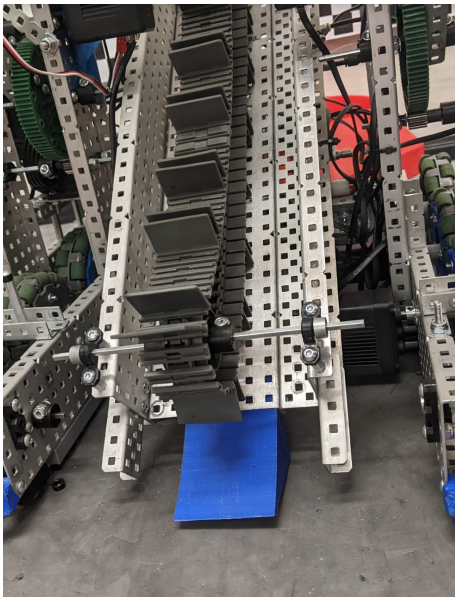
☐ Project: Ring Guide Changes

04/20/2022 - 05/01/2022

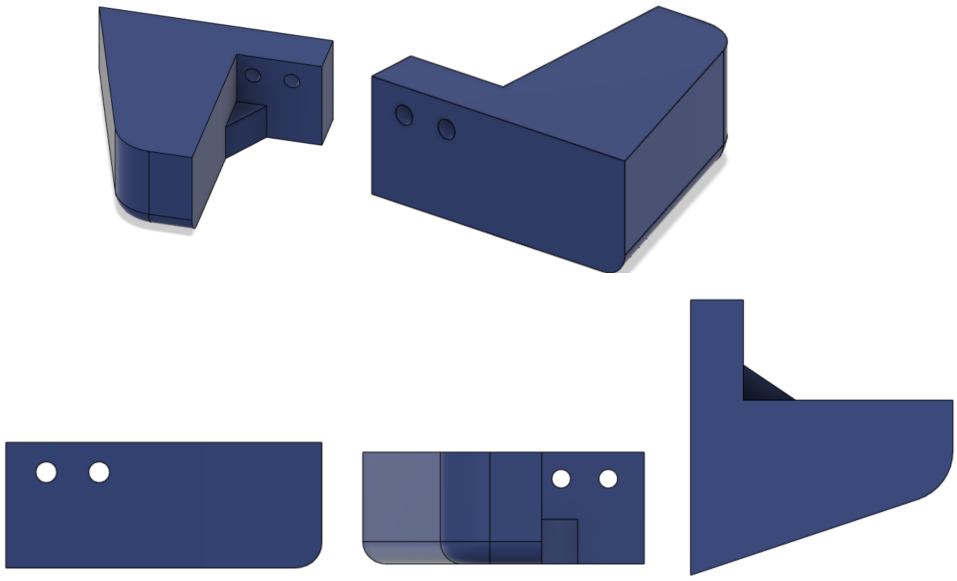
Description: 3D print a ring guide to funnel in the rings that we drive forward into and guide the rings into the center converybelt to pick up

Completion Notes:

- Successfully made a CAD prototype of the ring guide
  - Before Photo:



  - After Photo:



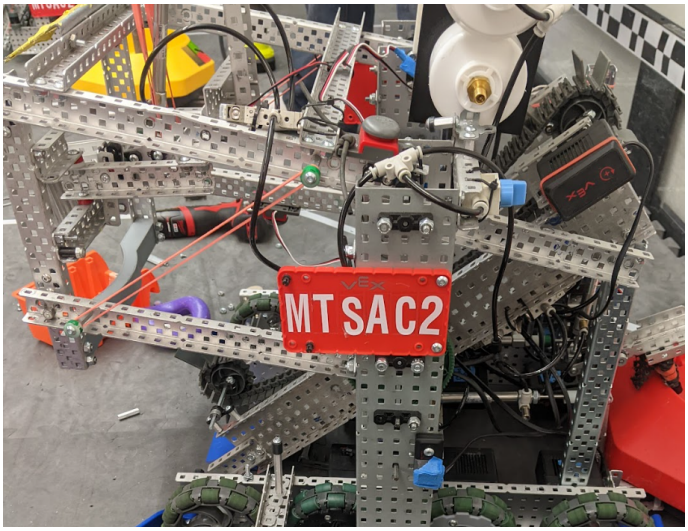
  - NV 05/01/2022

☐ Project: Clamp Bracket Changes

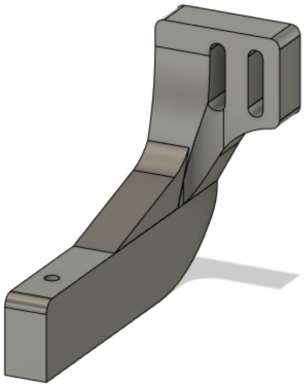
04/20/2022 - 05/01/2022

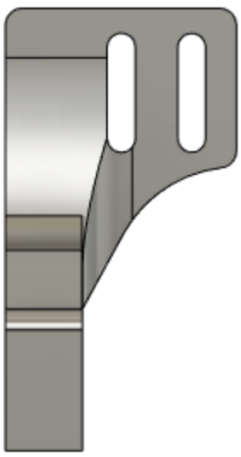
Description: This 3D print part was made to replace the vex c channels on the clamp
Completion Notes:

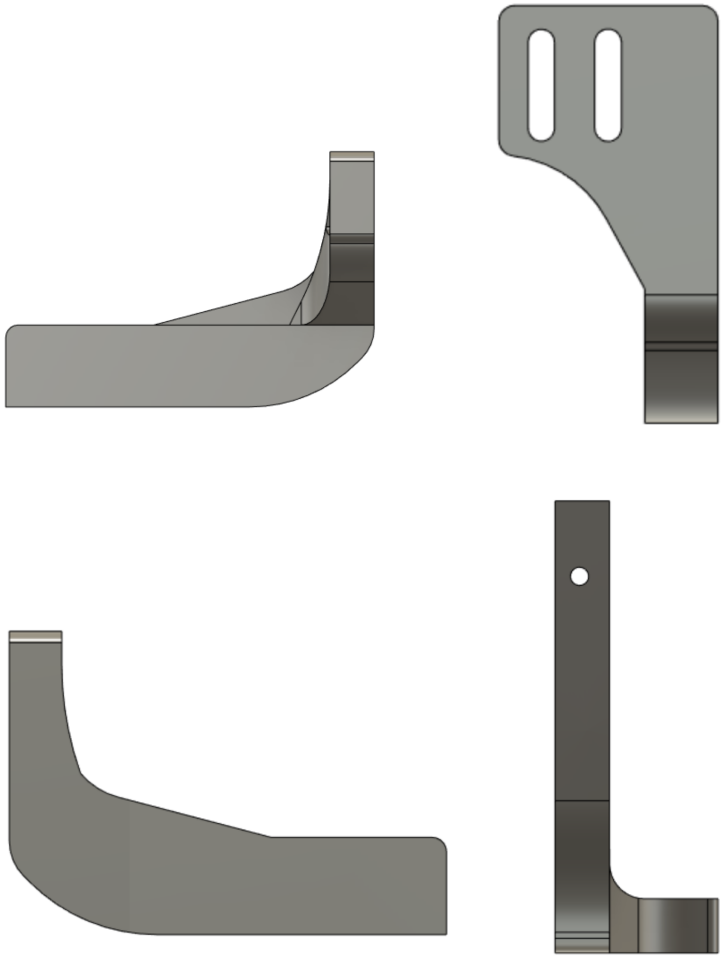
- SIt allows for more clearance of the conveyor belt, reducing interference when the pneumatic would actuate.
- It was intended to increase the stability of the clamp, reducing the wobble that occurs when clamping onto goals.
    - Before Photo:



    - After Photos:







- NV 05/01/2022

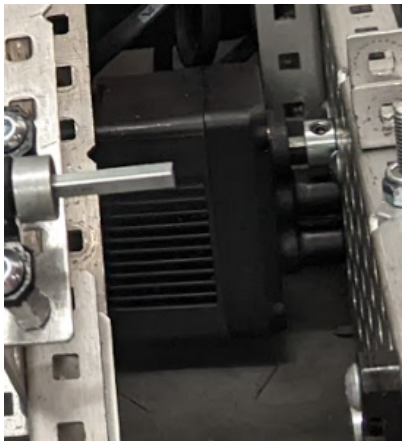
- # Project: Motor Mount Changes

  04/20/2022 - 05/01/2022

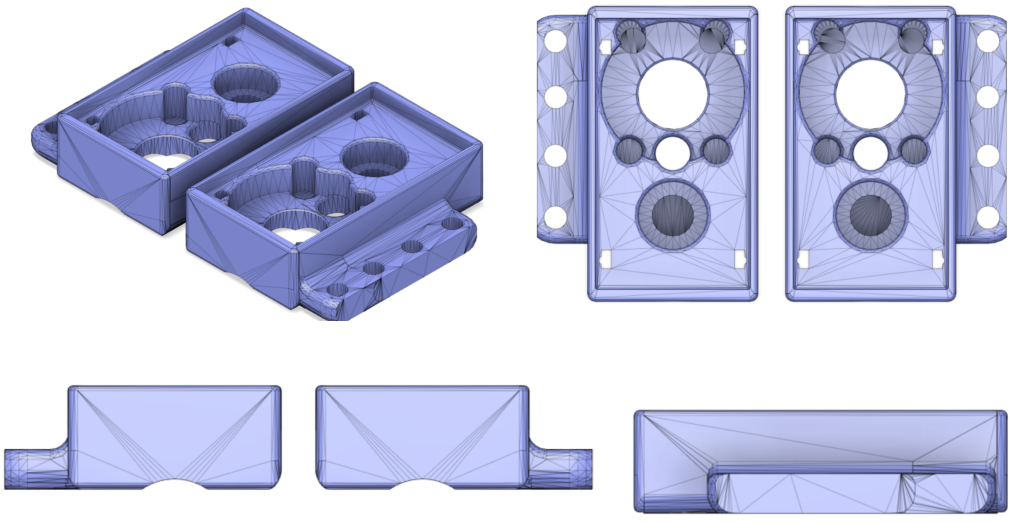
Description: 3D print motor caps intended to allow for better clearance on the motors and prevent motors from coming loose due to frame vibration

Completion Notes:

- Motor mounts, intended to allow for better clearance on the motors and prevent motors from coming loose due to frame vibration
- Allow for use of nylocks to secure motors instead of needing to use threadlocker to secure motors onto robot frames.
  - Before Photo:



  - After Photos:



  - NV 05/01/2022

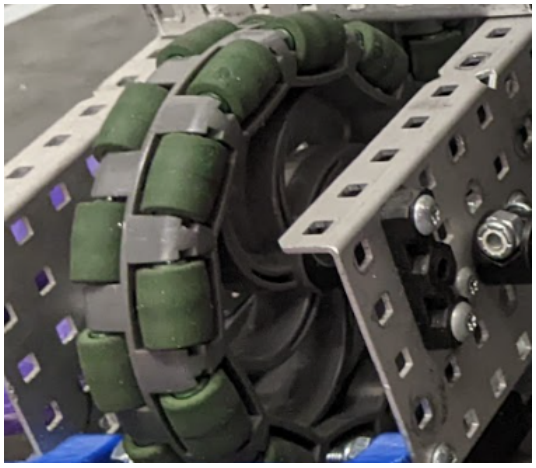
- # Project: Omni-Locks

  04/20/2022 - 05/01/2022

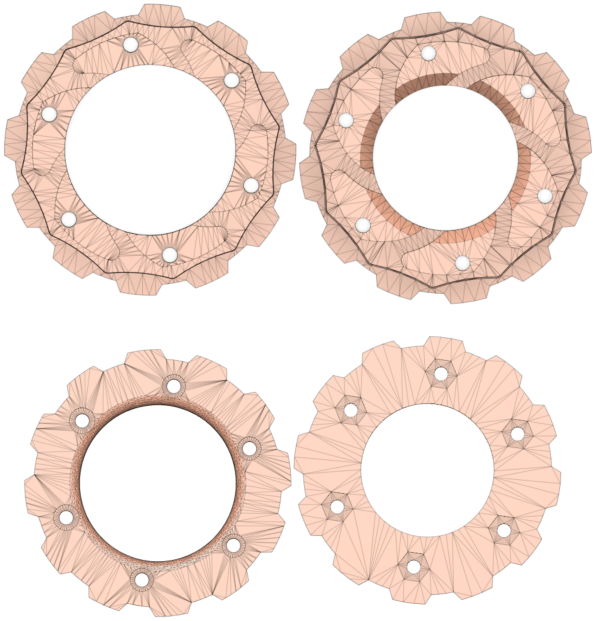
Description: 3D print a omni-locks to prevent sideways movement during driving or from being pushed

Completion Notes:

- Intended to prevent omni wheel rollers from spinning.
- Would prevent sideways movement during driving. This helps with being pushed and allows for better handling of the robot.
  - Before Photo:



  - After Photos:

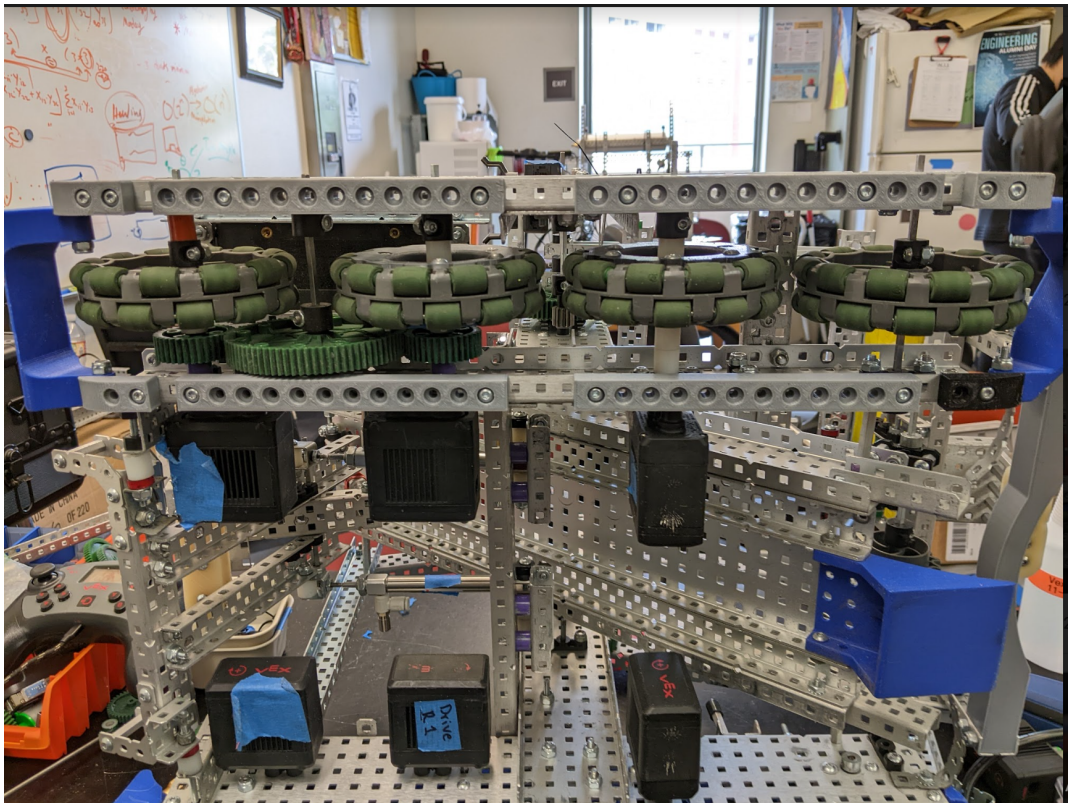


  - NV 05/01/2022

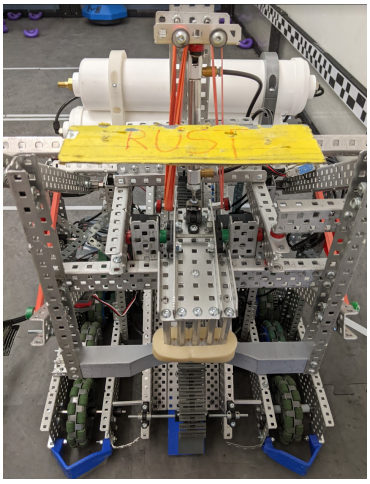
Final Design of Rust

Design goal:
To create a large 18x18 inch robot with the ability to lift mobile goals high on the balance, to carry a mobile goal securely on its back and position at an angle to reach the ring manipulator and to build a conveyor belt ring manipulator that intakes rings from the front and carry it up through the middle diagonally to the back.

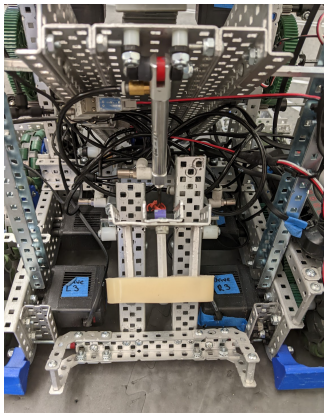
Drivetrain:
A 18x18 inch drivetrain platform with a total of 8 Omni wheels powered by 6 motors, 4 wheels, and 3 motors on each side. The larger drive train allows for more stability, to hold two goals at the same time, to lift goals on top of the ramp without the fear of tilting over, and to allow us to install a conveyor belt system. The 4 rear wheels are geared together to allow for higher torque. The second to last wheels on each side are “locked” Omni wheels. The locked omni wheel is modified to not restrict lateral movement to prevent being pushed by other robots. The 2 front wheels are not geared, which allows us to make repairs much easier, while the rear wheels aren't.



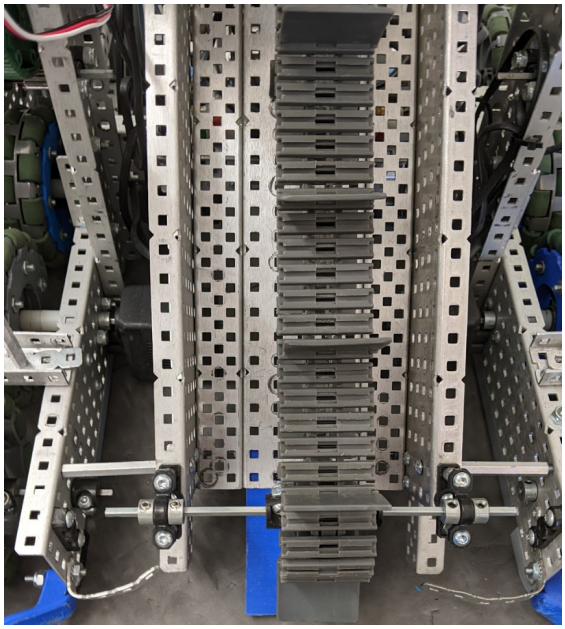
Four bar lift (front intake):
The lift is a powerful manipulator with the ability to lift mobile goals and to keep the clamp on the front level with the floor. The four-bar lift is powered by two geared motors for additional torque. The gears help with the strength of the lift but sacrifice speed. However, the decrease in speed is an advantage, as additional speed interferes with the robot's stability. The lift includes rubber bands that support the motors with lifting, which are placed in a way to increase the speed of the lift when rising, but also decrease the descending speed.

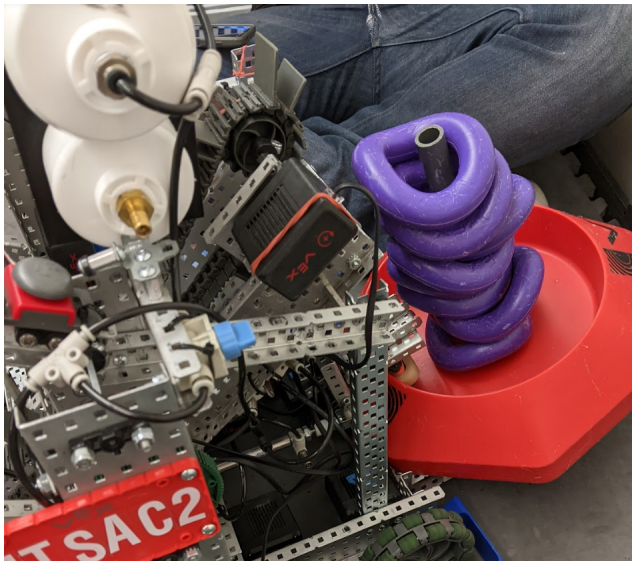


Pneumatic clamps (back intake):
Our robot is equipped with two pneumatic clamps, one located on the lift and the other on the back. When the piston retracts, the clamps are pulled up with rubber bands. When the piston is extended, the clamp closes to secure the target. Rubber bands are wrapped around the clamp for added grip. By using both pneumatic pistons for a tight hold and rubber bands for added grip, the two combine to become a highly effective way of holding and securing goals. Compared to motor-powered clamps, pneumatic clamps are more compact and are easier to install. Powering these multiple pistons are two large plastic pneumatic tanks located on top of the robot. These tanks hold much more air compared to their VEX counterparts while being much lighter.



Conveyor Belt (Ring Intake):
The conveyor ramp consists of 7 VEX unit long C channels with the flat side facing downward with a side rail held together with shafts. We used two sprockets, one located on top connected to a motor (green) and the other below. The conveyor belt is equipped with a track with two medium flaps, spaced out four gaps each flap. A bent metal flat plate is used as a lip to collect rings. Two single bars are located at the top to align the rings to the branch of the mobile goal.





Breaking Down the Code

CODE	DESCRIPTION
`//Global Variables (Wheel and robot size)` `const float g_wheelDiameter = 10.16; //[cm]` `const float g_wheelCircumference = g_wheelDiameter * M_PI;` `const float g_drivetrainGearRatio = 36/36;` `const float g_clampGearRatio = 12/84;//teeth of driving gear/teeth of driven gear` `const float g_trackwidth = 28;//cm` `const float g_wheelBase = 33;//cm` `const float g_robotRadius =` `sqrtf(powf(g_trackwidth/2,2)+powf(g_wheelBase/2,2) ) ;//cm`	Variables used in calculating for turns based on robot wheels/size
`//Global Variables (Wheel and robot size)` `const float g_wheelDiameter = 10.16; //[cm]` `const float g_wheelCircumference = g_wheelDiameter * M_PI;` `const float g_drivetrainGearRatio = 36/36;` `const float g_clampGearRatio = 12/84;//teeth of driving gear/teeth of driven gear` `const float g_trackwidth = 28;//cm` `const float g_wheelBase = 33;//cm` `const float g_robotRadius =` `sqrtf(powf(g_trackwidth/2,2)+powf(g_wheelBase/2,2) ) ;//cm`	Snippet of turn calculation for forward movement. Turn calculation based on global variables
`void PointTurnClockWise(float ThetaDegree, int SpeedPCT, int Timeoutsec)` `{` `  setMotorTimeout(Timeoutsec);` `LeftDrive.rotateFor(forward,(g_robotRadius/g_wheelCircumference) * ThetaDegree * (M_PI/180) * g_drivetrainGearRatio ,rev);` `RightDrive.rotateFor(reverse,(g_robotRadius/g_wheelCircumference) * ThetaDegree * (M_PI/180) * g_drivetrainGearRatio ,rev);` `  setMotorTimeout(0);` `}`	Function used to turn robot, uses global variables and encoder to calculate more accurate turns

`` void FrontClamp_auto(bool ClampEnable){ if(ClampEnable == true) { FrontClamp.set(1); } else if (ClampEnable == false) { FrontClamp.set(0); } } ```	Function used to automatically set clamps up or down Same function utilized for back clamp and back tilt Used in autonomous routine
`` void liftControl() { timer liftTimer; liftTimer.reset(); if(Controller1.ButtonL1.pressing() && bumperSwitch.pressing()==0) { liftTimer.reset(); if(liftTimer.time()>=100 && bumperSwitch.pressing()==1) { Arm_Motors.stop(hold); } Arm_Motors.spin(fwd, 90, pct); printf("bumper switch is %ld\n",bumperSwitch.pressing()); } else if (Controller1.ButtonL2.pressing() && bumperSwitch2.pressing()==0) { Arm_Motors.spin(reverse, 100, pct); } else if (bumperSwitch.pressing()==1 || bumperSwitch2.pressing()==1) { Arm_Motors.stop(hold); } else { Arm_Motors.stop(hold); } } ```	Function used to control 4 bar lift • 100ms timer to account for debounce. • Bumper Switch state used to prevent over turning of four bars and to prevent grinding.

```
void InertialTurn(turnType dir, double speed, double angle, double
timeout)
{
  if(dir ==right)
  {

while(((Inertial1.rotation(degrees)+Inertial2.rotation(degrees)+Inertial3.
rotation(degrees))/3)<angle)
    {
      LeftDrive.spin(forward, speed, pct);
      RightDrive.spin(reverse, speed, pct);
      wait(5, msec);
    }
  }
  if(dir ==left)
  {

while(((Inertial1.rotation(degrees)+Inertial2.rotation(degrees)+Inertial3.
rotation(degrees))/3)>angle)
    {
      LeftDrive.spin(reverse, speed, pct);
      RightDrive.spin(forward, speed, pct);
      wait(5, msec);
    }
  }
  LeftDrive.stop(hold);
  RightDrive.stop(hold);
}
```

Function used to turn based on inertial sensor heading.

- Averages three inertial sensor readings to account for drift
- Turn direction dependent on direction specified in function, will make full 360 degree turns if needed to reach angle.

```
void tournamentAuton(void) //this code starts on the right of the field
{
 printf("Rountine RIGHT side of field \n");
  FrontClamp_auto(true);//raise front clamp
  routineTimer.reset(); //reset timer to 0
  //do while to move forward utilizing time polling
  do
    {
      LeftDrive.spin(forward, 100, pct);
      RightDrive.spin(forward,100, pct);
      wait(20, timeUnits::msec);
      if (frontSwitch.pressing()==1)
      {
        break;
      }
    }
  while(routineTimer.time()<=925);
  LeftDrive.stop(coast);
  RightDrive.stop(coast);
  wait(200, msec);
  FrontClamp_auto(false); //lower FrontClamp
  MoveReverse(45, 60, 5); //reverse after grabbing goal
  Arm_Motors.setVelocity(100, pct); //set velocity of lift
  Arm_Motors.spinFor(fwd,  g_clampGearRatio*500, deg, false); //move lift
up
  PointTurnCounterClockWise(85, 30, 5);
  BackClamp_auto(false); //set BackClamp_auto to raise Backclamp
  MoveForward(95, 50, 5); //Move to the left of the field, lines up with
the balance
  PointTurnCounterClockWise(85, 30, 10); //turn towards the balance

    if(bumperSwitch.pressing()==0) //raise lift completely up
  {
    while(bumperSwitch.pressing()==0)
    {
      if(bumperSwitch.pressing()==1)
        break;
      Arm_Motors.spin(fwd,70,pct); //raise lift
    }
  Arm_Motors.stop(hold);
  }

  MoveForward(40, 40, 5); //move towards the balance
    BackClamp_auto(false); //set BackClamp_auto to raise Backclamp
  MoveReverse(85, 20, 5); //reverse towards middle goal
  wait(200,msec);
```

Routine utilized during USC tournament. This code contests the yellow goal on the right side of the field and aims to gain possession of the tall middle goal and to score a goal high.

It starts by moving forward as quickly as possible, grabbing the yellow goal with its front clamp and elevating it.

The robot will then align itself with the middle balance so as to grab the tall middle goal and place the short yellow goal in its possession on the balance.

The robot will then turn towards a blue/red goal on the right side of the field and orient itself in a position that allows the driver to gain possession of it once driver control is enabled.

```
  LeftDrive.stop();
  RightDrive.stop();

  BackClamp_auto(true); //lower BackClamp
    MoveForward(85, 40, 5);//Move forward towards the goal
    Arm_Motors.spinFor(reverse,g_clampGearRatio*15,deg); //lower lift
    wait(500,msec); //wait before goal drop
    FrontClamp_auto(true); //raise FrontClamp, releasing goal
  MoveReverse(50, 50, 2); //reverse
  PointTurnCounterClockWise(55, 20, 20); //turn towards red/blue corner
goal
  MoveForward(160, 50, 5); //drive towards red/blue corner goal
  PointTurnCounterClockWise(60, 60, 5); //pushes goal off line
  printf("End Tournament Auton\n");
}
```

```
void tournamentAutonRing(void) //this code starts on the right of the
field
{
  printf("Rountine RIGHT side of field \n");
  FrontClamp_auto(true);//raise front clamp
  routineTimer.reset(); //reset timer to 0
  do
    {
      printf("DRIVE FORWARD DO WHILE\n");
      LeftDrive.spin(forward, 100, pct);
      RightDrive.spin(forward,100, pct);
      wait(20, timeUnits::msec);
      if (frontSwitch.pressing()==1)
      {
        break;
      }
    }
  while(routineTimer.time()<=925);
  LeftDrive.stop(coast);
  RightDrive.stop(coast);
  wait(200, msec);
  FrontClamp_auto(false); //lower FrontClamp
  MoveReverse(45, 60, 5); //reverse after grabbing goal
  Arm_Motors.setVelocity(100, pct); //set velocity of lift
  Arm_Motors.spinFor(fwd,  g_clampGearRatio*500, deg, false); //move lift
up clampGearRatio wrong
  PointTurnCounterClockWise(95,30,10);
  MoveReverse(20,50,5);
  wait(50,msec);
  BackTilt_auto(false); //set tilt down, ready for goal
  BackClamp_auto(true); //Raise clamp for goal
  PointTurnCounterClockWise(85, 30, 5);
  BackClamp_auto(true); //Lower clamp on goal
  BackTilt_auto(false); //Tilt goal towards conveyor
  PointTurnClockWise(85, 30, 5);
  conveyor_motor.spin(forward,60, pct);
  MoveForward(100,30,5);
  MoveReverse(100,30, 5);
  MoveForward(100,30,5);
  MoveReverse(100,30, 5);
  wait(200,msec);
  LeftDrive.stop();
  RightDrive.stop();
  conveyor_motor.stop();
  printf("End Tournament Auton\n");
}
```

Autonomous Routine that utilizes the conveyor belt.

Routine starts by contesting the middle goal.

Robot will then line itself with blue/red goal in the corner.

Will utilize back tilt/back clamp to grab clamp and tilt it towards robots conveyor belt.

Will turn towards the driver
And start the conveyor belt to continuously run

It will move forward and backwards as the driver feeds robot rings.

Meeting Logs

Monday 11/1/2021

We assembled our drive train. Our team decided to use a 6 wheel and motor drive to ensure sufficient speed and torque for the wheel.s

Wednesday 11/3/2021

We started designing a four bar lift for the robot. The lift is supposed to be able to lift the goal off the ground so it will allow us to be able to place on the ramp. As of now, the lift is capable of lifting the goal but the robot itself struggles to stay balanced.

Friday 11/5/2021

Today we worked on adding a clamp to hold the goals. The clamp works off of pneumatics. So we secured two tanks on our robot and ran the tubes from the tank to the piston that controls the clamp. The clamp is placed in a 4 bar lift.

Monday 11/8/2021

We modified the clamp so that the default position would be closed and strong enough to hold the goals. Then the position would open the clamp so we can grab the goals.

Wednesday 11/10/2021

We constructed the back clamp for the robot. This one does not lift but will pull the goal up a small ramp so it does not just drag the goal around

Friday 11/12/2021

We added the ramp for the back clamp ramp and programmed the clamp. Minor adjustments were made for the robot

Monday 11/15/2021

Minor fixes: tightening screws, fixing tubing, and making clamps more grippy by adding rubber bands around the clamps.

Wednesday 11/17/2021

We attached end stop sensors inside of our clamps and programmed an autonomous program that will clamp the goal when the sensor is tripped.

Friday 11/19/2021

We worked on debugging the autonomous program and fixed a leak in our pneumatic pipes.

Wednesday 11/24/2021

We replaced a bad motor, moved the brain to be more accessible and worked on autonomous programming.

Wednesday 12/01/2021

We got our robot ready for skills and finished up the autonomous program.

Friday 1/7/2022

Added new members to the group and chose a new team leader. Added additional pneumatic tanks and bracing to prevent tipping

Friday 1/14/2022

Dismantled current drivetrain, 4-bar lift, and front and back pneumatic systems for improvements.

Friday 1/21/2022

Rebuilt drivetrain spacing to 18”. Discussed potential drivetrain options resulting in replacing turbo motors with regular motors and removal of gear ratio.

Tuesday 1/25/2022

Repositioned drivetrain wheels to make room for lift. Utilized smaller bars for four bar lift and decreased the lift’s height.

Wednesday 1/26/2022

We shrunk front clamps and added additional collars to the four bar lift, reducing instability. Shrunk overall robot spacing to fit within 24” requirements. Removed wasted space in the front clamp and added tire bracing to prevent lift and tire conflict.

Thursday 1/27/2022

We re-attached the ramp and rebuilt the back lift. Made a new structure for back pneumatic and added additional bracing to the wheels.

Friday 1/28/2022

Conducted skills testing all day, made adjustments during so

- since we got a feel of all of the flaws of our robot

1) add the new 3D printed tire guards

2) add the conveyor belt ring manipulator in the middle (probably move the battery mount)

3) maybe a side skirt?

4) Worst case scenario move the tires up for donuts if all fails

Wednesday 2/2/2022

- tried to gear the back wheel (spacing complications)

- had to move front and rear wheels to try to fit gears

- noticed ring manipulator won't work with current back intake (length)

- added tape to label ports of the motors

-cleaned up a bit

Friday 2/4/2022

- Nathan coded an auton for regular 2v2 competition, that grabs the right yellow goal and scores it high on the balance

- added Trevor's v3 3D printed front tire guards

-added short wheels, if robot tilts

Monday 2/7/2022

- removed back clamped

- added two motors on front lift

- added one shaft and high strength gear to strengthen right front lift (unfinished)

- left side back wheels geared

- added Trevor's v3 3D printed back tire guards

Wednesday 2/9/2022

- finished adding shaft and high strength gear to left side front lift

- aligned front wheels x4 to match the back geared wheels

- geared right side back wheel (spacing might be too tight

- organized tool box

Friday 2/11/2022

Me and Gabriel moves the pneumatic tank up straight (back clamp is stronger in less wobbly when moving side to side)

- also put the brain on standoffs

-lastly the back bar that goes across we moved it up one hole so that it goes under the goals to help clamp it better from the back

-only issue is front bar that goes across is slanted

Thursday 2/17/2022

- attached 3D printed gray low skirt on the robot (outer sides)

- built a prototype for a c shaped arm to curl up mobile goals on the back intake (didn't work out as planned sizing wise)

- built another frame for a pneumatic based back intake

Friday 2/18/2022

- continued back intake prototype added x2 pneumatics to curl in mobile goals

- In addition a third pneumatic that will push down a clamp to secure it more (needs to be repositioned)

Sunday 2/20/2022 (Nathan's house)

- 3D printed Omni wheel locks

- 3D printed goal conforming front bar for the four bar lift

- 3D printed new angle front tire guards (so now the four bar lift won't hit against it anymore)

Thursday 2/24/2022

1) added the inner 3D printed low skirt (side along the motors)

2) Removed the front long steel C channel holding the left and right side together as well as straight down the middle

- Reason is to clear the center of the robot for a conveyor belt ring intake

- Fix was to attach two separate smaller C channels to hold it together

3) Flipped front left (L1) and right motors (R1) vertically to allow rings to pass and not get what's stuck between

4) Not finished attaching conveyor bar ring intake mount

- backboard was position in place, so that it can reach goal

- messed around to figure out the amount of chain need for the conveyor belt length

5) Reattached the back intake pneumatics

- reposition the middle pneumatic at a better angle to push the clamp in the directions so that it holds the goal

Friday 2/25/2022

•Ring mechanism

- added second pneumatic tank

- shorten the front clamp's pneumatic positioning

- removed bottom lift motors (L1 and L2)

- added backboard for the conveyor belt

- added 2x c channels on each side (oriented on the back) to support and hold up the back board on the ring mechanism

- attached green motor, sprockets, and conveyor belt

- added five bar flat metal at the top of the bring mechanism to prevent rings from flying across the field

- we ran shafts to hold the conveyor and the backboard (used shaft collars to hold it in)

- relocated the brain to the back Right side

- reposition back middle pneumatic

- reposition the battery mount

- Added front inner angular metal pieces to guide rings to go to the middle instead of the side (basically like a funnel)

Saturday 2/26/2022

- got longer wires to connect to the ports (specifically the left side was too short to reach the brain)

- connect and program new motor connected to conveyor

- wire management

- re added the plates

- added non-shattering plastic to the top end of the converter belt (metal flat bar was removed)

- added shaft collars to the back clamps

- editor flat bar to the bottom of the ramp

- Added flat bar (next to motor R1) to prevent donuts from going in

Update 4/1/2022

- swapped out the two front motor caps for Nathan's custom 3D printed on (do not screw them in all the way)

- fixed motor ports

- front entry conveyor funnel is gone and no longer fits (we may need a 3D printed one)

- added metal standoff to better guide the rings (temporary/ quick solution to deal with how wide the backboard is)

Update 4/7/2022

Repoured the rubber mold in Abduls new slightly taller 3D print mold

Update 4/8/2022

°Robot:

- Angelo reattached the two loose pneumatics screw thingy that wasn't making contact with the metal part which was improperly over tightened (TBH might of been me by accident joy or idk)

- cain drive nothing was done I believed was

- 3D printed funnel part wasn't put on

- Adbul's rubber mold looked like it fit well, however after lifting a goal it kinda slipped off (I think we should just screw it in like Gabe's team)

Update 4/13/2022

Attached Nathan V 3D printed funnel triangle

- not tall enough to stop rings from sliding under

- screwing it in to the ring guard causes it to go up and down

- Battery mount top broke

- Straighten out the converybelt

Update 4/14/2022

1) I poured another rubber mold for backup and used one of Gabe's mold for our back clamp

2) I tightened up and realigned everything overall

3) Gabe came in and we tried to do that 22 to 16 chain drive layout, however we didn't have enough of the 22s (off by 2 sprocket 22s)

- then we tried doing 36 to 22 chain drive with red motors and that went horribly spacing wise placing the back vertical motor as the driver making contact with the back clamp space issue (scrap that) also we would've only been 25% faster

- final drive chain changed, we just did a 1 to 1 chain drive on the back wheels. The results were the same compared to the geared side (wasn't worth the waste of time :upside_down:) only one side is chained, however the output is the same. Only benefit was a it clears up space in between

- Next we moved the front motor to the 2nd free spinning wheel. Now there is no motor blocking in the front

° we did not chain the front wheels b/c it wouldn't be that worth it plus time

The robot does drive tho still at 100% as before and technically is the same as before no gear ratios

The ring mechanism

Work in progress however somewhat works and is attached somewhat however it won't be dragging

- we angled it lower

- we shorten the length of the conveyor belt to make as less contact with the front clamp / lift

- the motor of conveyor belt was moved to the opposite side of the robot b/c there's more room

- one of the arms that supports the converybelt system was slighted to fit the motor

Update 4/21/2022

- Intake has been secured and changed the placement of the bottom roller to be able to grab rings in the field (OA)

- The piston got wrecked because of the pillow bracket (OA)

- Move the pillow bracket up one space and replace the piston and you should be good to go after that (OA)

- I tightened some things down and moved the left tilt pneumatic mount one hole to the right

- had to cut the left bar to stop it from cutting into the pneumatic

- had to go through all of Nathan's personal code to redo port's, directions, and auton

- Nathan's Stars program code was interfering with the back clamp button B thingy

- also Gabe did something to the inertia sensors math to make it spin correctly

Tomorrow

- front left tire guard screw is off

- top pneumatic mount is loose

- motor shafts on both sides might need to be re tightened (L1 and R2)

- auton might need some more slight adjustments to be more consistent and speed for me to put rings needs to be reasonable