OPERATION P.E.A.C.C.E. ROBOTICS

FRC 3461

TECHNICAL BINDER 2022

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EXECUTIVE SUMMARY

MISSION STATEMENT

Our mission at Operation PE.A.C.C.E. Robotics #3461 is to teach students to explore and appreciate STEAM, encourage students to realize their capabilities, and to inspire others to learn and improve skills.

TEAM HISTORY

Operation PE.A.C.C.E. (Practicing Engineering and Cooperative Competitive Excellence) Robotics was established in 2010 to excite students to pursue STEM through competitive robotics within Bristol, Connecticut. Although our main program is open to all students ages 12-18, we hold smaller classes and initiatives to excite people of all ages with the future of engineering. Early in the formation of the team, PE.A.C.C.E. did not have a permanent build space. We rented a storefront, partnered with high schools in the area, then held meetings in a member's garage for a time. After searching for a new location, we found our current main sponsor and our home, The Arthur G. Russell Co., Inc. (AGR) with help from our work with the local Chamber of Commerce.

AWARDS

2011
- Highest Rookie Seed at Northeast Utilities FIRST Connecticut District Event

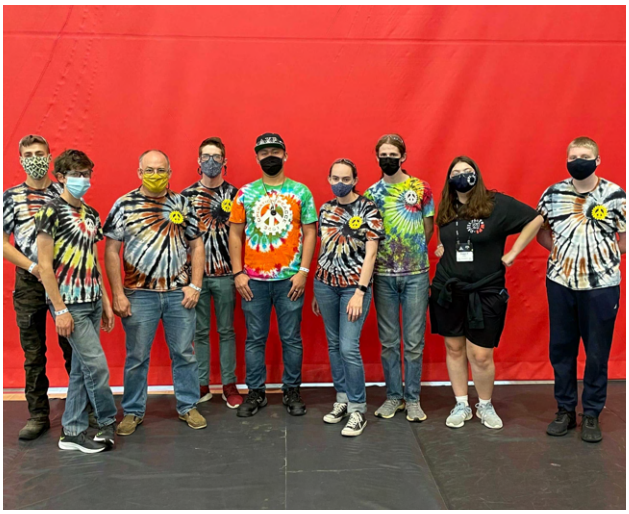
2014
- Team Spirit Award at Southington District Event
- Quality Award at Pine Tree District Event

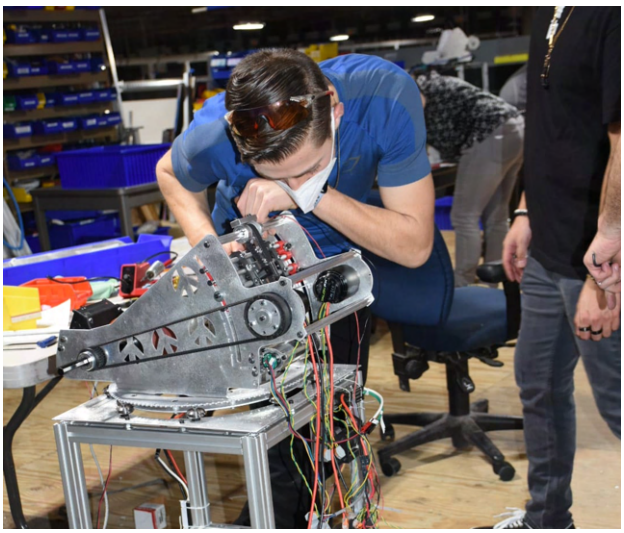
2016
- District Event Winner at Hartford District Event
- Dean's List Finalist Award (Johnny Chea) at New England District Championship

2017
- District Engineering Inspiration Award at SE Mass District Event
- District Event Finalist at Hartford District Event

2018
- District Engineering Inspiration Award at Rhode Island District Event

2019
- District Event Finalist at Western New England District Event





TEAM STRUCTURE

TEAM CAPTAIN(S)

The team captains are typically two students who are elected by students and mentors on the team. The team captains are meant to help keep the team organized and on track during build season and competition season. They are the students leaders of the team who regularly discuss with the mentors the team's goals and how they will achieve them.

MENTOR(S)

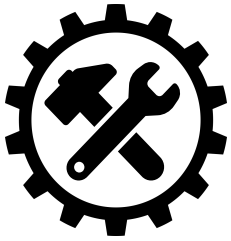
The mentors of Operation PE.A.C.C.E. oversee decisions that the team captains and committee chairs make, while also managing the team to accomplish their goals. They take care of scheduling and other tasks of the team that does not involve the production of the robot or the team brand.

COMMITTEE CHAIR MEETINGS

Our team is split into multiple committees that have student leads voted upon by students and mentors of the team. Committee Chair meetings are meant to keep team captains on track with current team goals, and address any potential future issues. The meetings occur once a week throughout the FRC build season. Committees are split based on responsibilities of the team: Awards, Finance, Public Relations, Mechanical, Programming & Electrical, and Scouting & Safety.

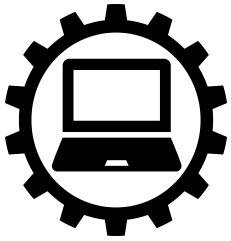
COMMITTEES

MECHANICAL



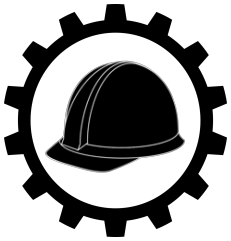
- Drivetrain
- CAD & Design
- Intake
- Traversal
- Climber

PROG & ELEC



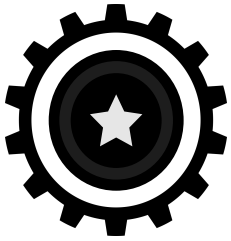
- Wiring
- Vision
  - Limelight
- Autonomus
- Wheel Drive

SCOUT & SAFETY



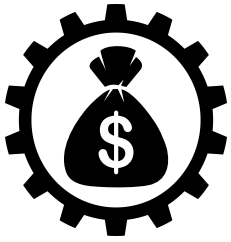
- Data Collection
- Organization
- Equipment

AWARDS



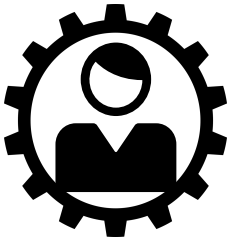
- FIRST Awards
  - Chairman's
  - Imagery
  - Eng. Insp.
- Photography

FINANCE



- Sponsorships
- Grants
- Budget

PUBLIC RELATIONS



- Recruitment
- Social Media
- Marketing
- Comms
- Outreach

DESIGN PROCESS

NEED

- Autonomous driving and scoring
- Pickup cargo
- Score cargo in low goal
- Hold two balls in traversal

WANT

- Score cargo in high goal
- Climb first and second rung

WISHLIST

- Autonomous pickup
- Traverse to final rung

On January 8th, Operation P.E.A.C.C.E. Robotics gathered to watch the reveal of the 2022 Game: RAPID REACT. First, we were to read everything in the manual including the rules. This is to allow our students to understand our constraints, while also brainstorm possible designs. Second, we were to review the provided field videos to get a feel for the size, to understand how large we would need to make these viable mechanisms. Finally, we looked to meet a day after the reveal to decide on what we should focus on at a team. We use this time for every student to provide drawings of their ideas, and explain what they feel we should focus on. After this, we vote on our priority list, and we begin work. At this point, each subteam meets to discuss their own to-do list for the season, and how to collaborate with other subteams.

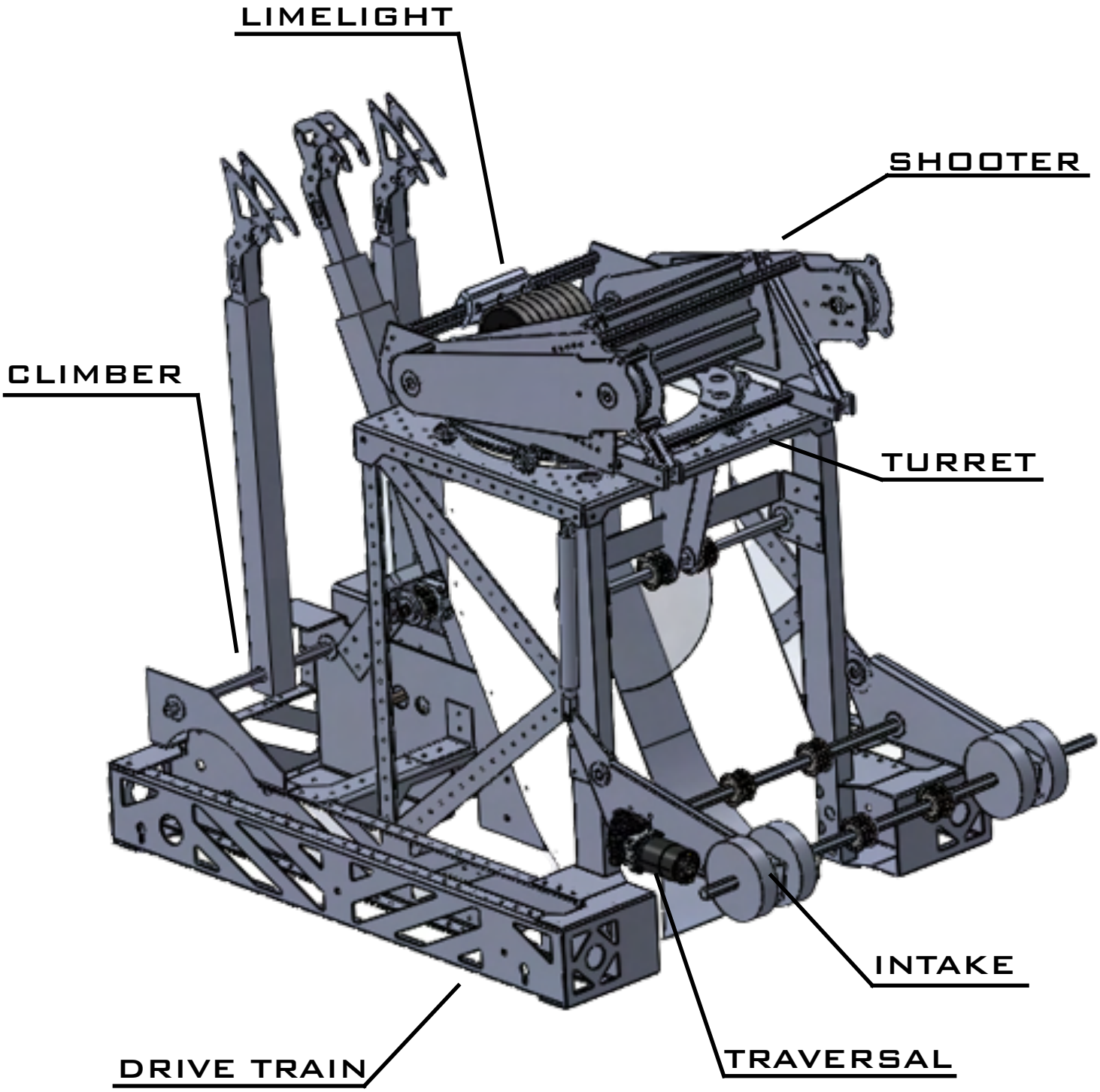
We approach our build season with the same mindset: **engineering is an ongoing and iterative process**. Even when we have developed solutions, there are ways to optimize them further. Because of this mindset, we decided to spend longer on prototyping potential designs and researching new ones. The team focused heavily on creating physical prototypes, utilizing a variety of material including wood, maytec, bent sheet metal, and plexiglass. Furthermore, we tested out materials we already had, in order to understand their capabilities for this year's game. For example, we tested both 6" and 4" wheels in order to recognize how much monumental force it outputs. We also collected data on potential power, angles, and distances it would take in order to reach the high goal. We learned that the more power it released, the further it went and higher arch it would get. This data was used to help narrow down design choices on the robot, and open the option for new designs to be created.

When prototyping, we look for creating designs that fit a certain criteria.:

- Effective
- Lightweight
- Simpicity

By the end of Week 4, the team started fully CAD-ing designs and started assembly.

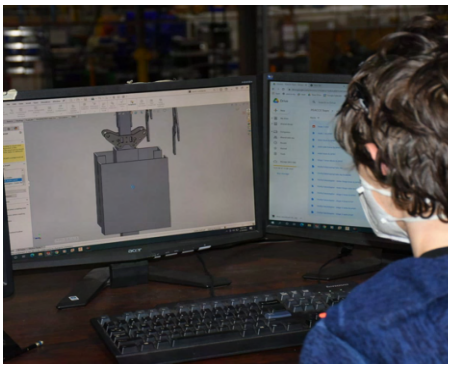
OVERALL DESIGN



OVERALL DESIGN

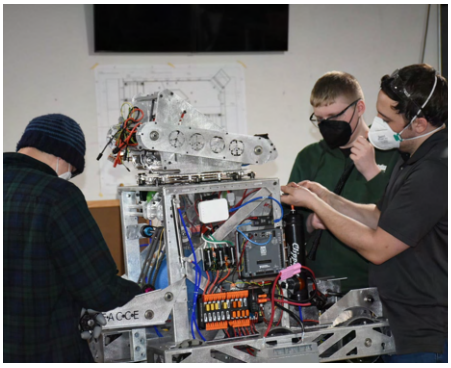
FEATURES

- Shoot cargo into high and low goals
- Can hold two cargo at a time
- Can climb to high bars and traversal bar



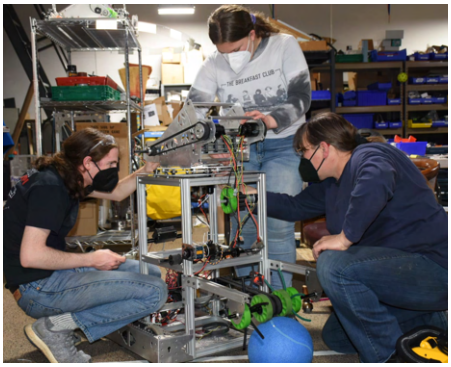
CONSTRAINTS

- Perimeter no greater than 120 in. (~304 cm)
  - At start of match, robot must be contained within the perimeter
  - Cannot extend higher than a total of 5 ft. 8 in. (~173 cm)
- Cannot exceed 125 lbs. (~56kg)
  - not including bumpers and battery weight
- Under 4 ft. 4 in. (~132 cm) tall



This season, Operation PE.A.C.C.E. Robotics presents [NAME].

When creating [NAME], we kept our main objectives in mind: shooting cargo consistently and accurately. To match this purpose, [NAME] comes with a adjustable hood on the shooter, limelight for vision, and a turret on the base for wide range of shots.

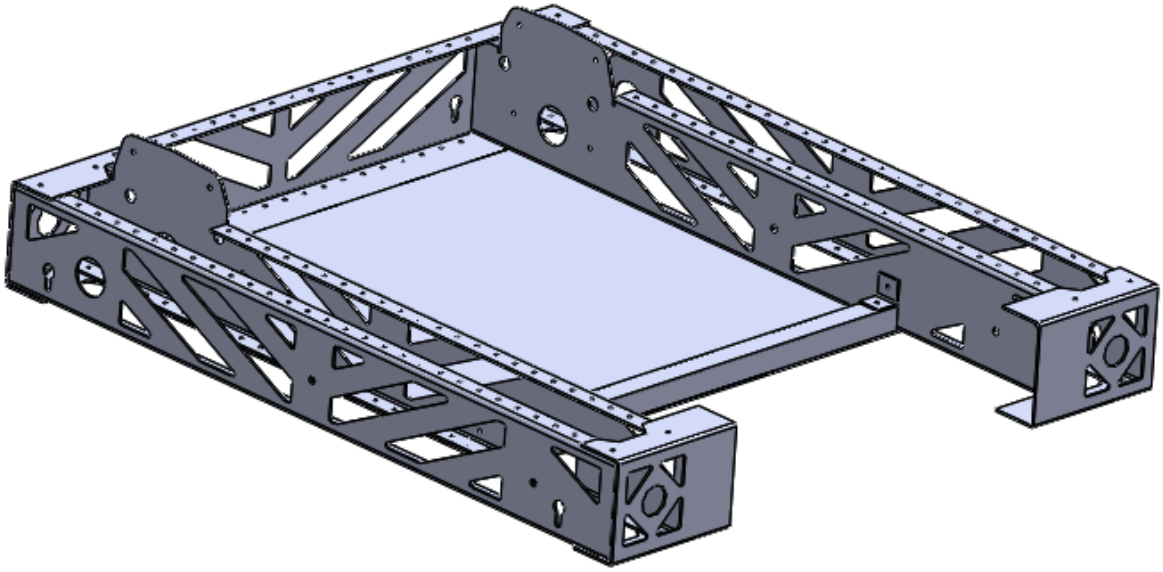


By week 6 of build season, various prototypes for the climber were created. The current iteration of [NAME]'s climber consists of two parts: a traversal climb, and a set climb. By using these two, the robot can make it's way to the traversal rung while giving alliance partners room.

The drive train of the robot is a customized tank drive. With six wheels, ball shifters, and custom gearboxes, the drivetrain allows us to have more creative freedom in the robot perimeter, size, and weight in the robot. Furthermore, it's easy to repair in between matches.

FRC 3461 primarily uses materials such as lexan, sheet metal, box tubing, and aluminum sheets. These materials proved to create a sturdy robot to mount systems on, while also being aesthetically pleasing. The robot is primarily powered by multiple Falcon 500 and 775 Pros, because of the power and consistency they possess when powering mechanisms.

DRIVE TRAIN



When creating the robot, the first step involves the drive train. As the base of the robot, we wanted a drive train that can withstand hits, be easy to repair, be customiziable, and be powerful. After much deliberation Operation PE.A.C.C.E. Robotics decided to make our own drive train. As a tank drive train, we can manuver on the field with ease with our ball shifters, without sacrificing speed and power thanks to our Falcon 500's.

DESIGN

- Custom designed
- Tank Drive

WHY

- Customizable to game challenge
- Robust and easy to repair

HOW IT'S DESIGNED

- 6 Wheels
- 4 Falcon 500's
- VexPro Ball Shifters 54:30 and 64:20

INTAKE

DESIGN

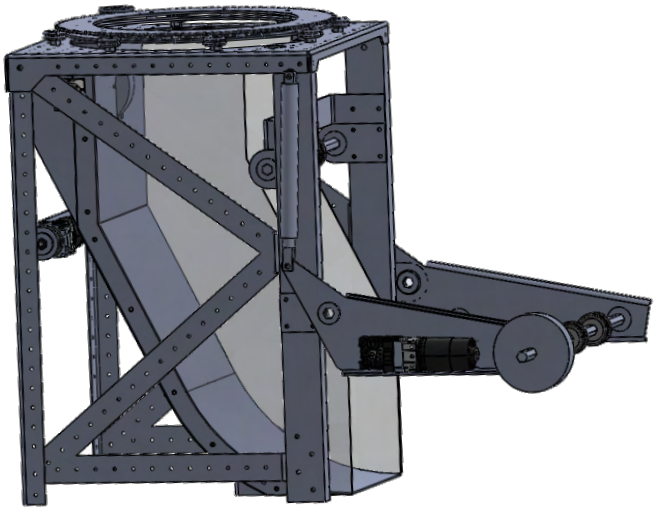
- Custom-made arms
- Pneumatic pistons to lift arms

WHY

- Multiple ways to intake cargo
- More reach
- Arms lift to prevent damage to robot when hit

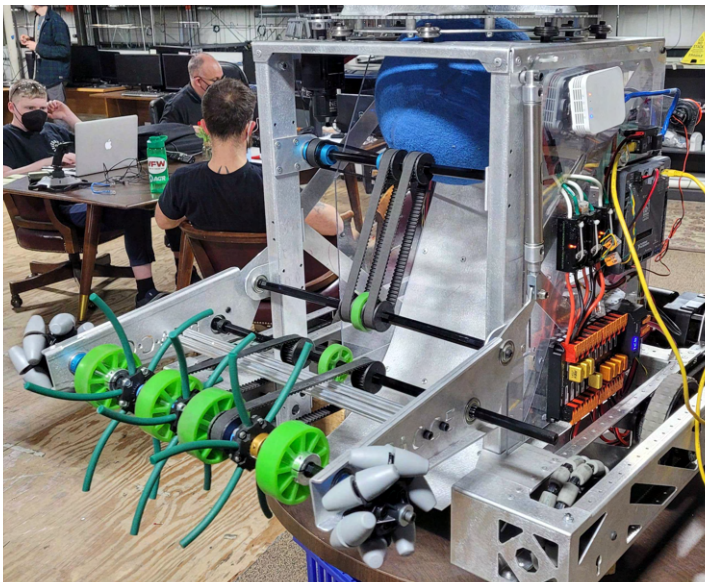
HOW IT'S DESIGNED

- Two rollers with three wheel types: mecanum, flogger, and grip
- Pneumatic pistons
- 775 Pro and 10:1 Versa Planetary gearbox 90 degree

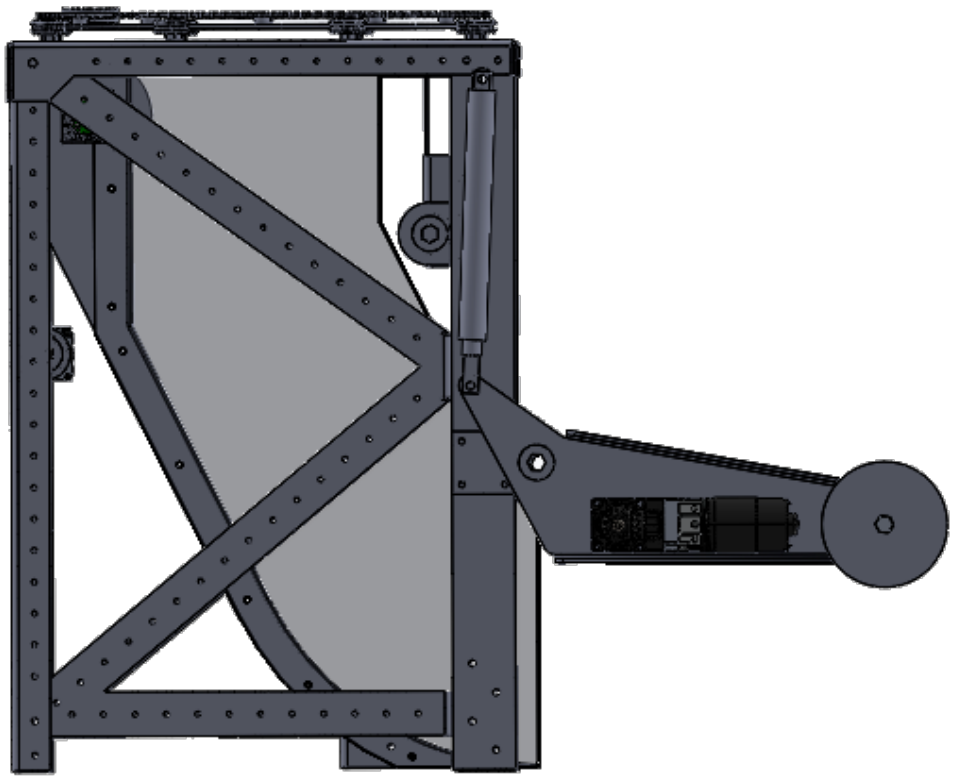


To maximize the possibility of a cargo coming into our possession, Operation PE.A.C.C.E. uses three different types of wheels: 4" mechanum, 3" gripwheels, and 8" flogger wheels. The mecanum wheels allows for cargo to be directed into our intake, they're positioned facing inward into our other wheels in the center. Both of the grip wheels and flogger wheels are used to maximize possibility that cargo will come into our possession, instead of being pushed away by an opposing robot.

Our intake is held up by two custom made arms, engraved with our acronym on the sides. These arms have two bars that spin to direct cargo into our traversal. Furthermore, this intake is powered by pneumatics. By using air power, we can quickly move our arms up and down to fit within the robot perimeter at the start of the match.



TRAVERSAL



Our custom made traversal was made with space and weight in mind. In contrast to our climber, we decided to make the traversal compact, while still holding two balls at once. The rollers on the traversal are powered by 775 Pros, which allows for a fast cycle time between intake and shooter. It's made out of both aluminum sheet metal and lexan, so the drivers can see inside of it while being sturdy.

DESIGN

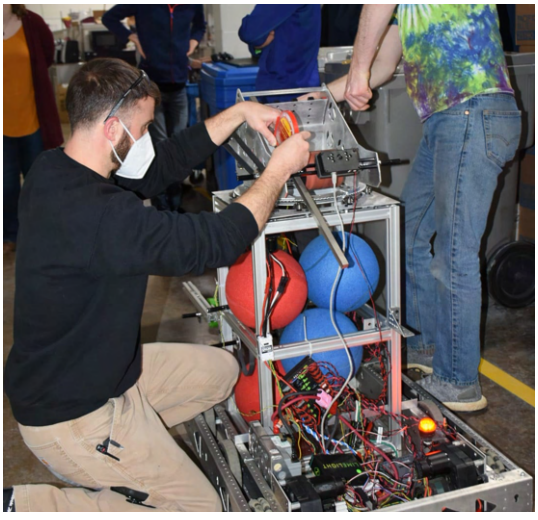
- Sides made of lexan to be clear to see balls, rest is made of sheet metal
- Holds 2 balls at same time

WHY

- Specific ratio that could be fast and pushing power
- Close to front to make room for climber short to manuver under objects

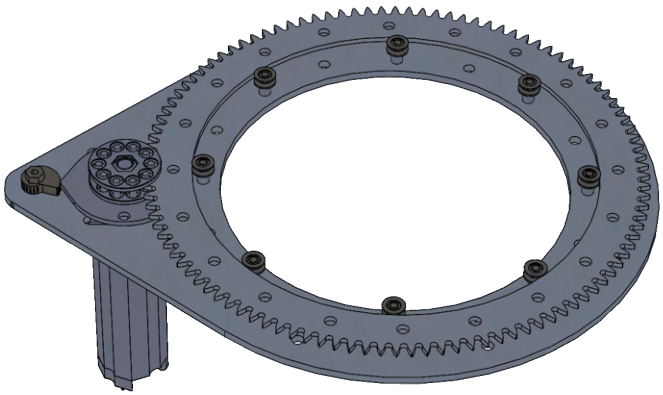
HOW IT'S DESIGNED

- 1 775 Pro
- 5:1 Ratio on VersaPlanetary Gearbox
- 2 Rollers, one on bottom to pull in top, held in place by two trigger wheels
    - EX Grip Wheels



OUT TAKE

TURRET



DESIGN

- Spins 360 degrees
- Able to shoot anywhere on the field

WHY

- Access to wide range of shots with little adjustment

HOW IT'S DESIGNED

- Lazer cut sheet alumninum
- Two plates

When creating the shooter, the team took inspiration from past robots to create [NAME] The final design includes a turret previously designed in 2020, recreated for 2022. This turret can spin 360 degrees uncontrolled, allowing the shooter to have a wide access of possible shots. Furthermore, it can adjust itself without the need of the drivetrain, with the assistance of the Limelight. These qualities made it a must-have when desigining for RAPID REACT.

SHOOTER

DESIGN

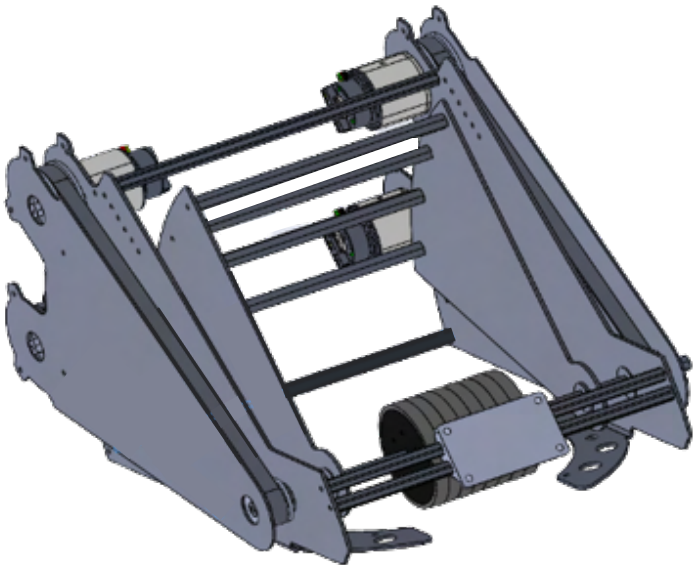
- Mounted ontop of turret
- Continous vision alignment to auto-angle to target
- Adjustable hood

WHY

- Ease of use when tracking game pieces
- Prebuilt program to track items

HOW IT'S DESIGNED

- 42 to 24 ratio
- Hidden flywheel weights in wheels
- 2 Falcon 500s



The shooter of [NAME] includes an adjustable hood for ease of shooting. With two Falcon 500s, it allows us to have a wide range of power when activating our fly wheel. This lets us have a variety of ways of scoring cargo in both the upper and lower hubs. To connect the motors on the electronics panel, we use an "umbillical" cord that allows the turret to spin freely.

CLIMBER

DESIGN

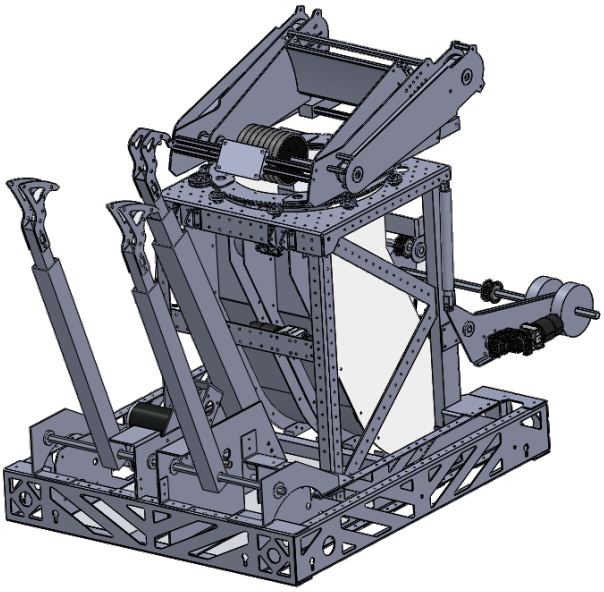
- Two designs - one mount and one traversal
- Custom designed hooked

WHY

- Able to traverse to final rung
- Ability to pick where to climb for alliance partners

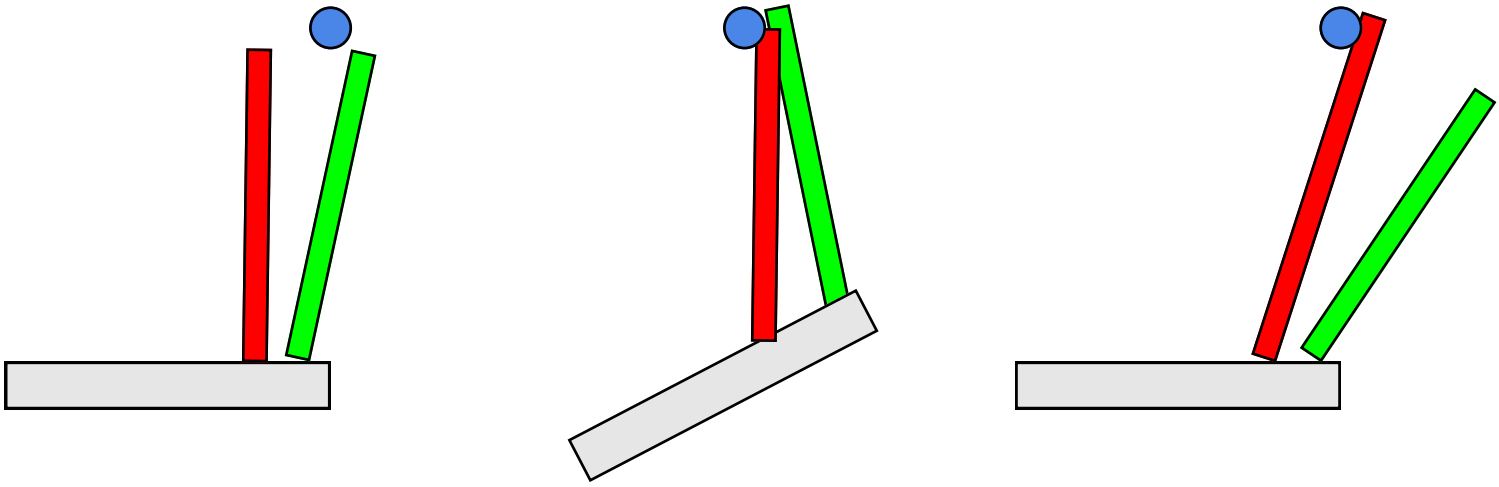
HOW IT'S DESIGNED

- 2 Falcon 500's, ToughBox mini for main winch
- 1 Falcon 500 100:1 VeraPlanetary Gearbox for movable winch arm
- Andymark extendable box tubing lift design, slightly modified



When designing our climber, we wanted to ability to pick what rung we wanted to climb, in the event our alliance partner could climb as well. We decided it was best to create two sets of climbers: one mount climber and one traverse climber. This allows us to level the robot, using our weight to our advantage, to climb without moving the arms from the bar. We also power the climber with pneumatics, so we can solely rely on power to reach the next set of rungs without momentum from swings.

HOW IT WORKS



Key

Red : Mount Climbers

Green: Traversal Climber

Blue: Bars

Gray: Robot

SYSTEMS & SOFTWARE

PROGRAMMING

AUTO
- Shoots one ball
- Moves off of tarmac

TELE-OP
- Driver Controls
- Detects wrong color balls

SHOOTING
- Auto-Aiming feature with Limelight

LIMELIGHT

- Mounted in front of fly wheel on shooter
- Vision alignment to auto-angle to target

WHY
- Ease of use when tracking game pieces
- Prebuilt program to track items

ASSISTED TARGETING
- When turned on, follows goals with the turret
- Can be switched on and off with ease
- Alignment speed reduced, easier cycle time

SOFTWARE

CODE

GITHUB
- Allows multiple people to collaborate on code
- Multiple branches for feature

VISUAL STUDIO CODE
- Easy to organize code
- Supports WPILib

CAD

SOLIDWORKS
- Industry use
- Wide capabilities

GRAB-CAD
- Allows multiple people to share designs when at home
- Can be accessed anywhere

THANK YOU SPONSORS!

The Arthur G. Russell Co., Inc. (AGR) is a world leader in custom assembly machinery, with a focus in the medical device and diagnostics industry. They provide us our build space, access to their shop tools and machines, and contributes financial aid. We have a close working relationship with the engineers and machinists, providing guidance and advice on our designs

Our team has sustained a relationship with our 501(c)3 sponsor, 4-H, since our inception. They help us maintain independence from any schools, thus giving us the unique ability to recruit students from any high school that doesn't have a FIRST team as well as homeschoolers, who otherwise wouldn't be able to access FIRST's programs.

Lockheed Martin is an aerospace, information security, and technology company. Founded in 1995, their mission is to keep people safe through innovative technology they create. As a new sponsor this year, we are excited to create a flourishing partnership for years to come!

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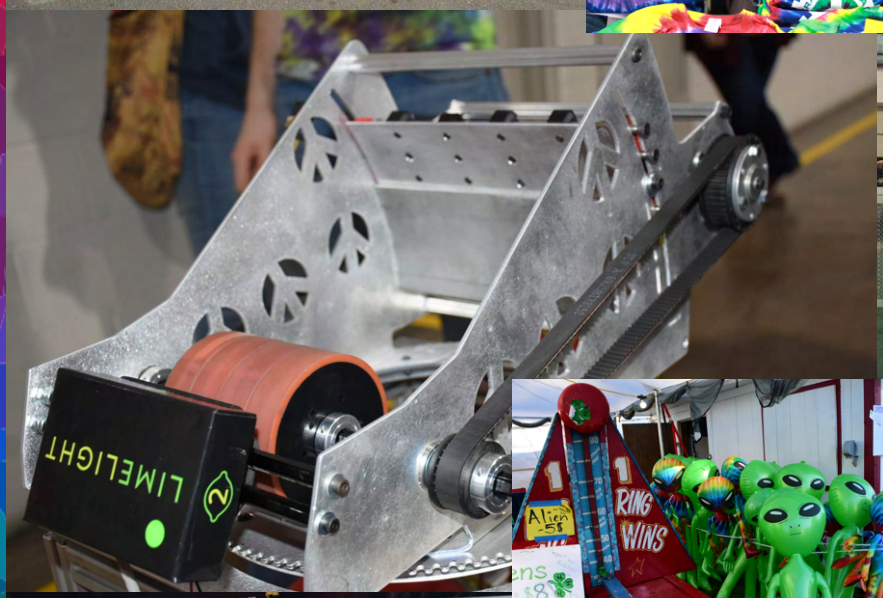
OPERATION P.E.A.C.C.E. ROBOTICS


OPERATION P.E.A.C.C.E. ROBOTICS
TAFFY


FIRST
POWER
UP


LIMELIGHT


FIRST
ROBOTICS
COMPETITION
WINNER

RING
WINS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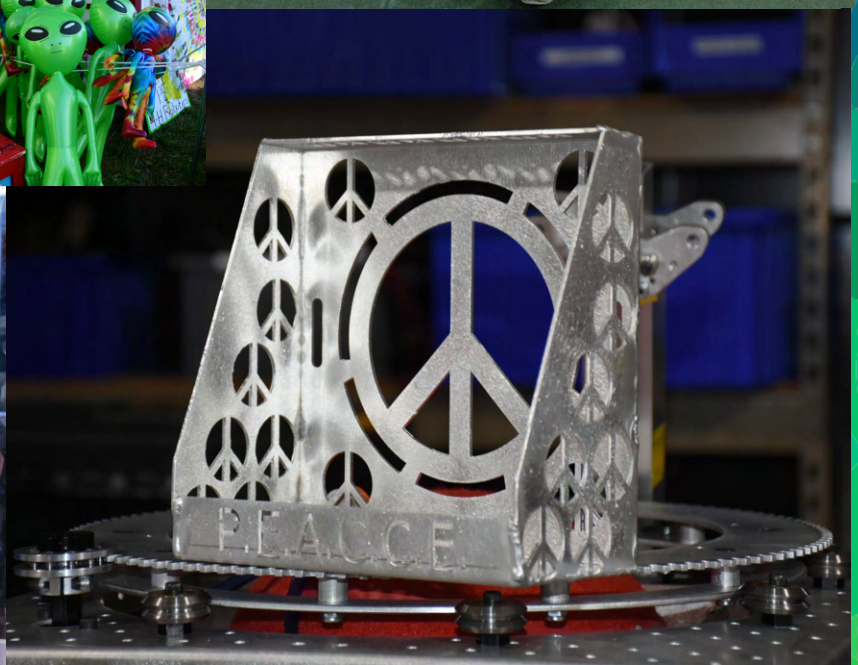
PEACCE