POWER PLAY

SUPER SCREAM BROS.

TEAM 14204

PORTFOLIO

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SUPER SCREAM BROS. TEAM 14204

Howdy! We are the Super SCREAM Bros Team 14204, a 5th year FTC team based in Macon County, Illinois.

We are a 4-H affiliated team made up of 12 members from various schools in Macon County and we're excited to share our season with you!

Our motto: "A Rising Tide Raises All Ships"

Our team strives to make a positive impact on our community, in and out of FIRST, in order to improve not only ourselves, but everyone we interact with. We accomplish this through:

Learning

- Learning from experts
- Taking inspiration from another team's grabber design
- Virtually meeting with other teams to learn about programming

Collaborating

- Strategizing and scrimmaging with other teams
- Hosting Meets with other teams
- Working with another team to help them laser cut number plates

Sharing

- Sharing our CAD files and Portfolio
- Sharing our designs and meets on YouTube
- Hosting presentations to help educate other FTC Teams
- Doing STEM Demos and classes for our community

Mission Statement:

The Super SCREAM Bros. strive to promote the pursuit of knowledge and the FIRST® organization and its values, to build a successful robot using refined engineering skills, programming knowledge, and design principles, and to demonstrate Gracious Professionalism by learning, sharing our knowledge, and inspiring others to do the same.

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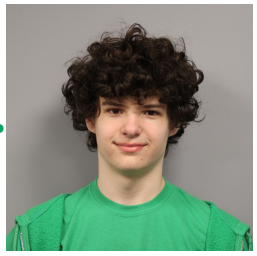
TEAM 14204

OUR TEAM

Logan
Design

Ben E
Programming,
Arm driver



Noah
Design, Chassis Driver

Ben S
Media

Owen
Programming,
Outreach, Drive Coach

Preston
Design

Bounty
The quicker picker upper

Owen
Programming

Clayton
Design

Zach
Design

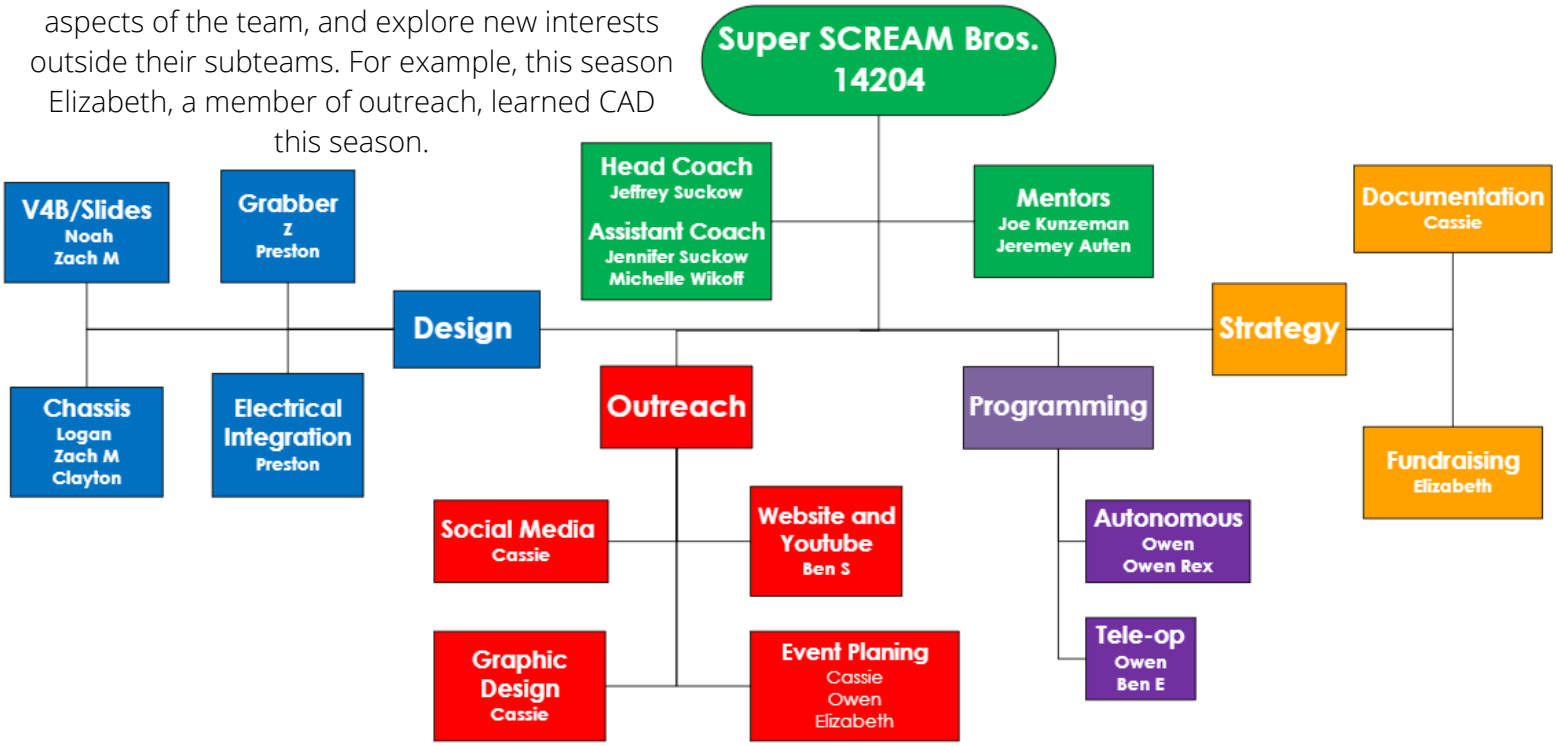
Elizabeth
Outreach, Design

Cassie
Outreach, Portfolio

Zedekiah
Design

Our team is split into subteams: Design, Programming, Outreach, and Strategy.

We encourage our members to be involved all aspects of the team, and explore new interests outside their subteams. For example, this season Elizabeth, a member of outreach, learned CAD this season.



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SEASON GOALS

Outreach Goals	Status
Reach people outside our local community	Completed, sent robots to Kenya
Improve the standing of our Division	Completed, hosted scrimmages resulting in higher point totals
Improve livestreams	Completed
Reach more people digitally	Completed, reached 2.4M people via Instagram
Create events that leave a deeper impact on our community	Completed, Robotics in the Classroom went deeper than a traditional demo
Interact with teams outside of our division	Completed, collaborated with teams from all over IL

Design Goals	Status
Keep center of gravity low and centered	Completed
Facilitate pass-through cone delivery	Completed
Flexible pick up and drop off, dual pick-up sides	Completed
Symmetrical design	Completed, rotational to minimize designs
Communicate driver info via lights	Completed
Fast, versatile cycles	Completed
Facilitate odometry implementation	Completed
Iterate in CAD	Completed

Programming Goals	Status
Implement Roadrunner and odometry for navigation in auto	Completed
Implement logging for testing with data	Completed
Add more driver feedback	Completed
Transition new team members into the programming team	Completed, 2 new team members have joined the programming team

Strategy Goals	Status
Simplify note taking	Completed
Simplify the pit design making process	Completed, started using Canva for formatting
Make portfolio more reader friendly	Completed
Strategize with other teams to improve game performance	Completed, held multiple strategy meeting with other teams
Ensure new team members understand requirements for judging and portfolio	Completes, provided judging workshop and judging cheat sheet

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OUTREACH OVERVIEW

We have two main outreach goals:

1. Spread FIRST and STEM in general to as many people as possible, and encourage them to pursue it
2. Strengthen our FIRST community through sharing, hosting, and collaborating with other FIRST teams

LESSONS LEARNED

- The importance of preparation before outreach events
- How to utilize social media to reach a wider audience
- We can make an impact outside of just our community
  - We pushed ourselves to spread our outreach to other countries where robotics isn't as prevalent!
- How to standardize some of our outreach methods to be able to reuse them in the future
- To prioritize our impact on people rather than just going for high numbers of people reached
- Receiving help is just as important as giving it to others
  - We received advice from several Experts and from other teams

OUTREACH STATS

Total Outreach Events	38
Total People Reached	8,778 (2,413,215 with social media)
Total Team Hours	112
Total Man Hours	865

Outreach Events	
Total Events	25
People Reached	3603
Team Hours (at events)	89
Man Hours (at events)	709

Expert Events	
Total Experts	13
Expert Meetings	23
Design Experts	5
Programming Experts	1
Fundraising and Outreach	4
Team Organization and Strategy	4

Media	
Total Media Reach	2,410,548
YouTube Reach	6,111
Social Media Reach	2.4M
Subscribers and Followers Gained	2,877
YouTube Videos	13
Instagram/Facebook Posts	143

OUTREACH EVENTS

SPREADING STEM & FIRST

We have participated in 25 Outreach Events this season, here are some of our most notable ones:

KENYA BOTS

We designed small robotics kits and sent them to a village in Kenya with a missionary group called Caring for Kenya. This was these student's first experience with robotics.

People Reached: 12
Team Hours: 8
Team Members: 6

COMMUNITY DEMOS

We have hosted 5 demos for schools and community organizations at which we allowed students to drive our robots and learn about FIRST.

People Reached: 82
Team Hours: 7
Team Members: 12

ROBOTICS IN THE CLASSROOM

After designing a curriculum, we went into the 4th-6th grade class at the local Montessori school and taught 4 lessons about robotics, including programming and CAD lessons.

People Reached: 25
Team Hours: 10
Team Members: 6

FORSYTH FEST

We spent the day at a local fair allowing passers by to drive our robots. Through this fair we were able to introduce robotics to hundreds of people of all ages.

People Reached: 1,000
Team Hours: 6
Team Members: 7

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STRENGTHENING OUR FIRST COMMUNITY

SCRIMMAGES AND STRATEGIZING

We have scrimmaged, strategized, and shared designs with other teams on 7 occasions to help improve robot and season performance for all teams involved.

People Reached: 35
Team Hours: 16
Team Members: 12

HOSTING MEETS

We co-hosted 2 FTC meets providing field supplies, the livestream, and set-up assistance.

People Reached: 250
Team Hours: 14
Team Members: 12

JUDGING WORKSHOP

We hosted 3 teams to a workshop to help improve judging performance to help more people from our division make it to state. We provided sessions about Public speaking , pit design and judging from a Judge's perspective.

People Reached: 20
Team Hours: 3
Team Members: 10

HELPING 4H SCREAM

We went to the Clinton Nuclear Power Plant with our sister FLL Team, 4H SCREAM, to help them learn more about nuclear energy for their project.

People Reached: 7
Team Hours: 3
Team Members: 7

HOSTING FLL TOURNAMENT

We hosted the local FLL Qualifier, providing game materials, a livestream, and even acted as judges. We also had an area where FLL members could drive our robots to teach them about FTC.

People Reached: 250
Team Hours: 9
Team Members: 10

KICKOFF PRESENTATION

At the Illinois State Kickoff event we did a livestreamed presentation sharing how our design process and how we prototype

People Reached: 50
Team Hours: 2
Team Members: 9

Overall, our outreach events have allowed us to:

- Introduce a community across the globe to robotics
- Host 3 FIRST Events
- Teach an entire class in depth lessons about robotics
- Collaborate with 7 other FTC teams
- Support an FLL Team
- Expose hundreds of people to FTC

Other events:

- Kiwanis Club Presentation
- CRI
- Engineering night at DCS
- Goat Prosthetic with Macarthur FFA
- Illinois FLL State Competition

EXPERTS

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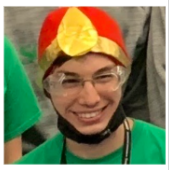
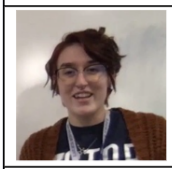
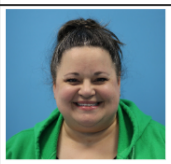
How our team connects with experts:

IDENTIFY PROBLEM → **RESEARCH** Find an individual who has expertise in the field that we wish to improve in → **CONTACT + PLAN** Inform expert about what our team desires to learn. Set a date and time at which to meet → **MEET + LEARN** We meet with experts both in person and virtually → **APPLY** Use the information and skills we have learned in order to solve our problem and improve our team

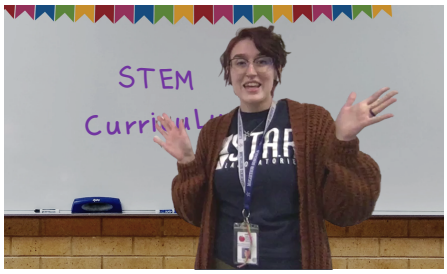
OUR EXPERTS

						
MR. JALLEY Design	MR. PASQUARIELLO Design	MR. KUNZEMAN Game strategy and design	MS. MERRILL Public Speaking	MR ALWORTH Design, System Integration	MR. AUTEN OBS and Resin/3D printing	CLINTON POWER PLANT Real world application
						
MS. BREHM STEM Education	MS. CLARK Media	MR. SUCKOW Design and game strategy	MR. BRAUN Programming Roadrunner	MRS. SUCKOW Outreach and team management	MRS. WIKOFF Documentation, team management	

We meet with experts to help solve problems we face as a team

Our Team also recognizes that other teams know more than us on some subjects, and often meet with them to learn. for example, we met with team 13356 to learn how they use RoadRunner

OUTREACH EXPERT: MS. BREHM



PROBLEM: We needed to create a STEM curriculum for our Robotics in the Classroom Event, but lacked experience in teaching children.

EXPERT: We reached out to Ms. Brehm, a local science teacher who specializes in designing STEM curriculum due to working as an activities planner for the Chicago Museum of Science and Industry. In our meeting she helped us come up with activities and reviewed our PowerPoint

IMPACT: With Ms. Brehm's advice we were able to design 4 comprehensive lessons to educate 4th-6th graders at the local Montessori school about STEM and Robotics.

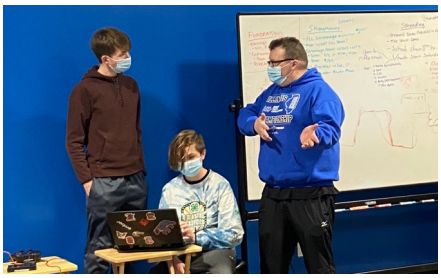
DESIGN EXPERT: MR. ALWORTH

PROBLEM: We were struggling to effectively identify the scope of the requirements needed to implement a design change, leading to shortcomings such as being unable to use our new chassis for a meet.

EXPERT: We held a meeting with Mr. Alworth, a systems integration engineer at Caterpillar, who presented to us how he uses design review strategies at his job, and discussed how we could implement strategies to help avoid integration issues for our designs.

IMPACT: After learning from Mr. Alworth, our team has implemented requirement documentation and strategies to check the impact of design changes which both help us avoid integration issues when making changes to parts in CAD.

PROGRAMMING EXPERT: MR. BRAUN



PROBLEM: We desired to implement RoadRunner and odometry into our field navigation system, but struggled with consistency during training.

EXPERT: We participated in 4 meetings with local technology teacher, Mr. Braun, in which he leveraged his programming experience to show us better ways to implement RoadRunner in our current structure, improve our testing methods, and assist in trouble shooting.

IMPACT: Mr. Braun's help gave us enabled us to implement our first ever RoadRunner program, that is both well tested and consistent.

MEDIA

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We use media to spread FIRST to people outside our local community, to help share our season with loved ones who can't witness it in person, and to help our fellow FTC teams by sharing our CAD designs, outreach, and portfolio virtually. Overall, we have reached 2.4M people through our media outreach.

We're even livestreaming this qualifier!

YouTube

We use our YouTube Channel to share videos of our innovations with others and to also host livestreams of big events to allow those who could not attend in person to participate. Our YouTube has promoted FIRST to thousands of people and shared all of our matches and designs with other teams. Our YouTube has directly helped other teams, such as team 21426 who has successfully designed a center grabber based off one of our videos.

VIDEOS (4)

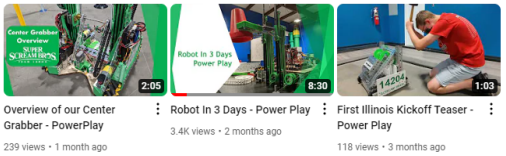
1. Ri3D RECAP - A review of all of the prototypes and findings we made during our Robot in 3 Days
2. Center Grab Overview - A look at our center grab mechanism, detailing our inspiration, design innovation, and its use for our team
3. Mid-Season Update - a robot reveal and a walkthrough of our design choices and future plans.
4. Judging Workshop - A recording of the workshop we hosted for those who couldn't attend

LIVESTREAMS (7)

- Each day of our Robot in 3 Days (3)
- One for each FTC Meet (3)
- Decatur FLL Qualifier (1)

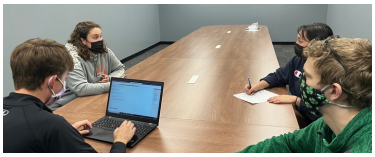
STATISTICS

- 210 subscribers
- 7,229 views
- 70.2K impressions



Social Media

After meeting with Communications Expert Ms. Clark, we realized the importance of using social media, especially short form content, to reach a wider audience. with the help of her advice, we posted a video that got 2.4 million views on Instagram alone.



INSTAGRAM- Used to share our teams progress on design and outreach and communicate with other FTC teams

2.9K FOLLOWERS, 2.4M REACHED

FACEBOOK - Used to inform family and our community about our team's events and designs

165 PAGE LIKES, 4.4K REACHED

TIK TOK - Used to reach a wider audience to share about FIRST, our first time experimenting with TikTok

37 FOLLOWERS, 73 LIKES

Local News

When we sent robotics kits to Kenya, we were featured in the Herald and Review, a local newspaper

2559 REACHED

EDUCATION

Watch now: Decatur teens create robotics kits for children in Kenya

Valerie Wells | Aug 19, 2022

The Super SCREAM Bros. robotics team created a robotics kit to send to students in Kenya, to introduce the children there to robotics and STEM activities.

Website

On our website, we share our CAD Designs and our Portfolio with the goal of helping other teams learn from our work. This year we revisited our website design to make it more user friendly.

First Updates Now

After seeing some of our YouTube content, one of our members was hired by FUN as a Content Creator. Our team allocates resources to create videos, helping FUN spread FIRST farther than we can alone.

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SUSTAINABILITY

Our team gains new members through our sister FLL Team (4-H SCREAM), Outreach Demos that inform people about FIRST, media, and recruitment. Due to our sustainability efforts, we gained 4 members this season.

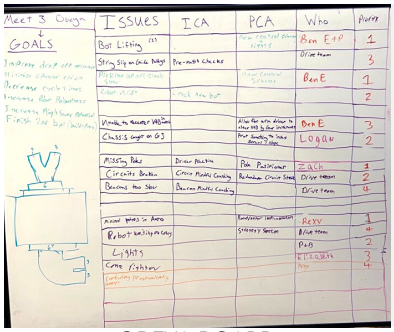
Our team also remains in contact with our graduated members, using them as experts!

AGILE DEVELOPMENT SYSTEM

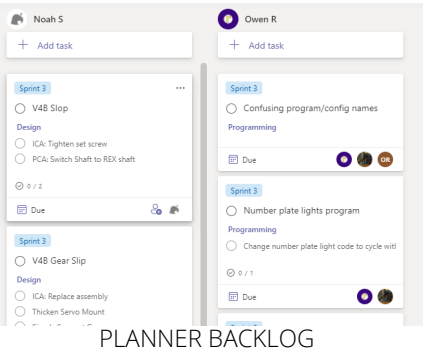
We use a modified Agile Development System to make our season more efficient and organized

- Agile Development is a system in which productivity is encouraged in a workplace through the utilization of sprint goals guided by timelines and an emphasis on reflection after each sprint is done.
- We were inspired to use Agile development by our sister FLL team and furthered our knowledge of it by talking with Mr. Jalley, an Agile Expert from State Farm
- We center our Design and Programming sprint timelines around the important landmarks in our season (Ri3D, Meets, and Qualifier)
- Agile helps our team be more efficient, organized, communicative, and prepared for the future

Our season is organized into SPRINTS, sets of tasks with a set timeline attached to it, that are made up of goals, tasks, and a reflection



OBEYA BOARD



PLANNER BACKLOG

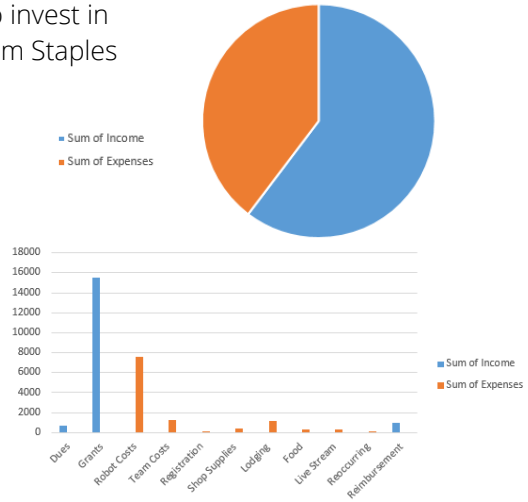
We write our tasks in Microsoft Tasks and assign them to a team member. Once we complete our task, we document the progress of our sprint in Microsoft OneNote

After every Meet we hold an Obeya Meeting in which the entire team comes together to identify problems that were noticed at the Meet and then assigns the solutions to different members (solutions are then put into the Microsoft Tasks)

BUDGET

We had more income than expenses, allowing us to invest in things such as more expensive servos and prints from Staples for our pit design

Row Labels	Sum of Income	Sum of Expenses
Dues	715	
Grants	15489.3	
Robot Costs		7555.88
Team Costs		1291.35
Registration		125
Shop Supplies		449.47
Lodging		1125.64
Food		305.95
Live Stream		295.22
Reoccurring		129.9
Reimbursement	960	
Grand Total	**17164.3**	**11278.41**



Our sponsors:

MACON COUNTY 4-H & EXTENSION FOUNDATION
Creating Leaders for a Stronger Community

FlipSide Technologies

CATERPILLAR

C and P Custom Printing

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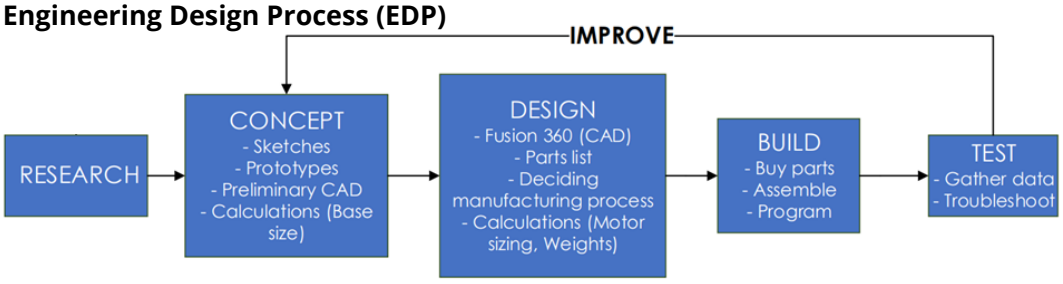
DESIGN STRATEGIES

1. DESIGN PROCESSES

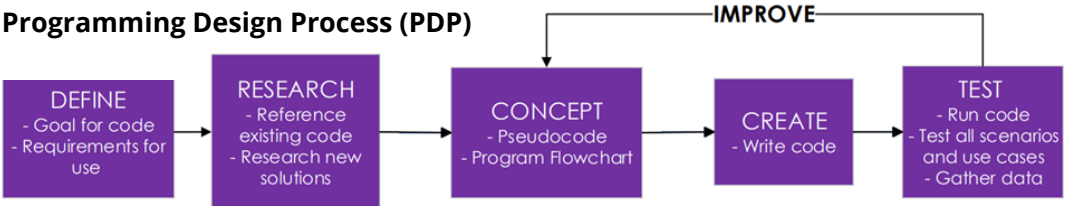
Our design processes help us effectively transition from concept to design, placing an emphasis on prototyping and iterating upon our designs.

This season we created a presentation about our design process and presented it at the Illinois State Kickoff. this helped us teach both other teams and our new members about how we use our design process.

Engineering Design Process (EDP)



Programming Design Process (PDP)



2. THE MUSK METHOD

Inspired by an interview with Elon Musk, we choose to "eliminate dumb requirements"

By using this philosophy, we make our season more efficient by reevaluating the requirements we set for ourselves to eliminate the unnecessary things we do to hold back our progress.

One example of our use of this strategy is how we altered our Pit Design, deciding to format it digitally instead of physically like we did last year, cutting down on work time and allowing for easier editing

3. RAPID PROTOTYPING

We are able to rapidly prototype our design ideas through the utilization of machinery

We make custom designs through the use of laser cut cardboard and wood and 3D printed PETG and resin

The rapid pace of prototyping and specificity to our requirements allows us to rapidly innovate our parts without having to rely on purchasing parts from other manufactures

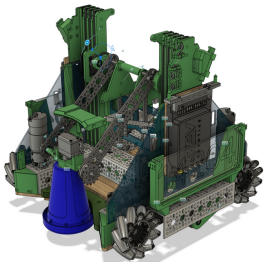
We rapidly iterated upon the grabber with the use of machining

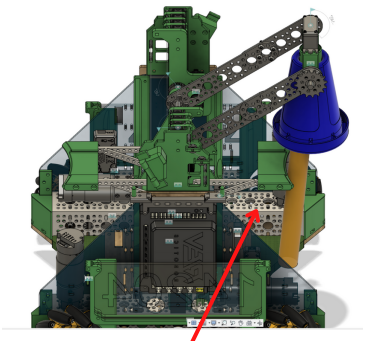
We also were able to experiment with different materials to get the best results

4. TOP-DOWN DESIGN

In our CAD designs, we create a top-level model in Fusion 360 and use that model to validate the parts we design before manufacturing.

The top-level model that we use to see whether our parts will fit on the robot prior to actually printing or cutting them





We could measure the size of the positioner relative to the rest of the bot, a cone, and a pole all digitally

Example:

Our Design team made use of it's in-CAD validation strategy with the pole positioner.

The pole positioner had very specific requirements, because it heeded to be farther out than the cone funnel, but not so far that it would interfere with the V4B, grabber, or cone.

Because of our top-level CAD model, we were able to design our pole positioner with the perfect proportions before printing it, avoiding trial and error.

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GAME STRATEGY

Takeaways from our strategy meeting with Expert Mr. Kunzeman:

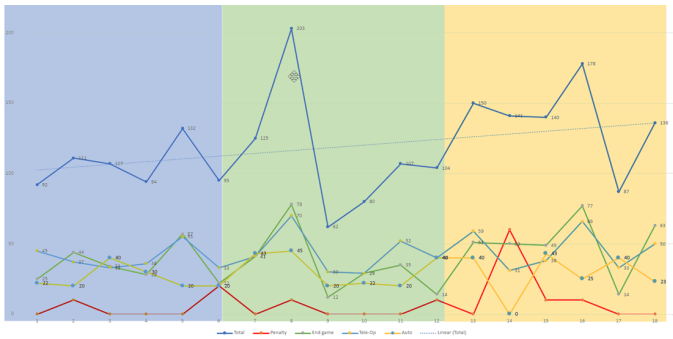
1. It's about winning matches, NOT accumulating points, therefore defensive strategies may be involved
2. Spread out cones instead of cycling on one pole (Controlling Bonus)

Our strategy:

AUTONOMOUS: Prioritize parking with sleeve

TELE-OP: Spread cones out to control maximum junctions, choreograph circuit with partner prior to endgame

ENDGAME: Use beacon on most vulnerable poles in circuit



Due to our game strategy, our point totals have remained consistently at the top of our division, and are expected to grow due to implementation of cycles in autonomous

Game Strategy + Design

Our game strategy directly influences our robot design, ensuring our robot works best within the current season's rules

- Small bot to help navigate between poles
- Pass through design removes the need for turning during cycle
- Low center of gravity prevents bot from falling over even when slides are extended

Game Strategy + Outreach

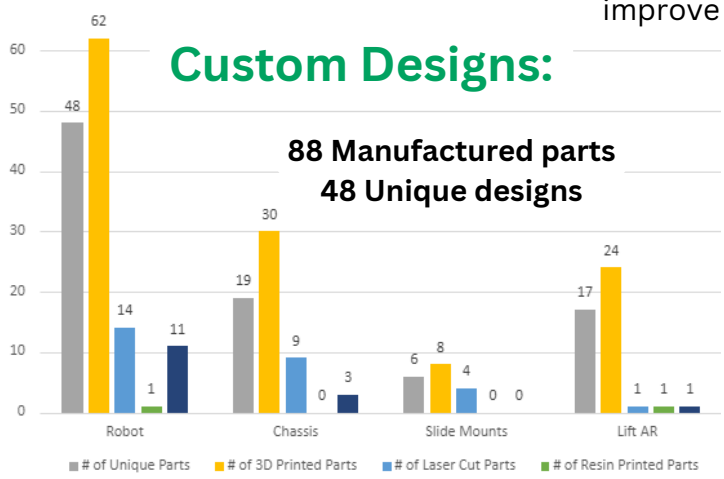
Strategy is a part of the game that relies on other teams as much as our own. We focus heavily on collaboration with other teams to inform ourselves and strengthen our division

- Meeting with a strategy expert after Kickoff
- Establishing new strategies with other teams by hosting strategy meetings
  - After a strategy meeting with Team 12971 we scored the highest match of all 3 meets with a score of 203.
- Completing time trials with different strategies to see what produces the best cycle times
- Creating and dispersing scouting papers to inform others of our robot's capabilities
- Being active in the FTC forum

DESIGN OVERVIEW

In our design we strive to balance function and aesthetics, and prioritize constant iteration to continually improve our designs.

Custom Designs:



We value creating our own custom designs to ensure they will fill our requirements and to allow for iteration

Design + Outreach

To improve our designs, we learn from experts and other teams. We also try to share our designs with other teams as much as possible to help them succeed.

LEARNING: We learned about design integration from a CAT engineer. We received help from team 14840 to improve our wiring and slides. We took inspiration from an Alaskan team when designing our center grabber.

SHARING: We have directly shared our CAD designs with other teams, helped another team design their number plates, and inspired a team to use a center grabber. We also digitally share all of our CAD online, and post videos about our designs.

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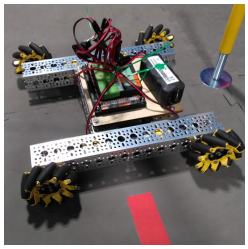
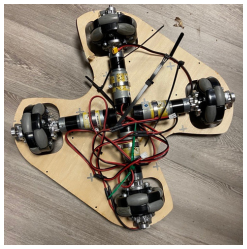
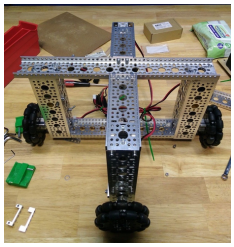
CHASSIS

We wanted our chassis to be small and fast to be able to maneuver between the poles, and overall easy to drive.

Ri3D:


Mecanum


Holonomic


Lifted Holonomic

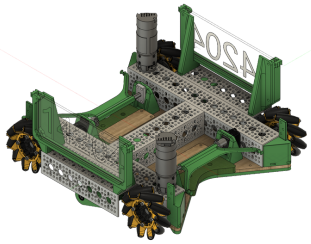
In Robot in 3 Days we built and tested 3 chassis, and decided on Mecanum because of its customizability, speed, and reliability

Iterations:

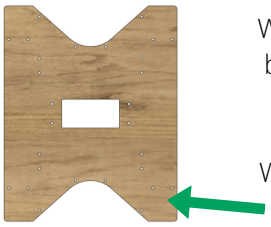
V1: Chassis filled most of our requirements, but we wanted it to be smaller to speed up movement

Final: We decreased our chassis length by 24mm (one hole spacing)
This size change caused us to orient two drive motors vertically.
We also redesigned:

- Slide mounts
- Motor mounts for pulleys
- Number plate mounts
- Center board
- Battery Mounts

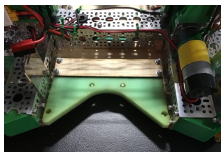


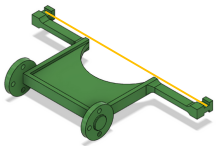
Overall Design:

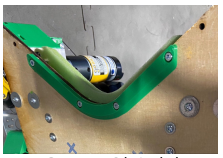


We wanted a design that could allow cones to be picked up and dropped off on both sides.
To allow this, we made our chassis completely symmetrical.
We also created a funnel on the bottom plate to center on cones for pick-up accuracy

Other features:


Cone Dampener


Cone Righter

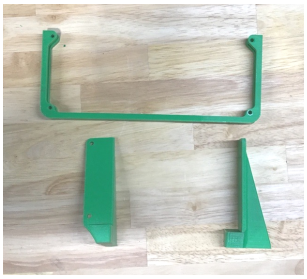

Cone Shield

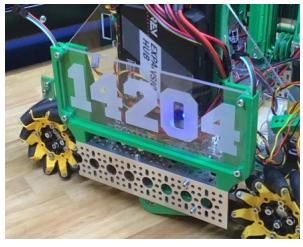
NUMBER PLATES

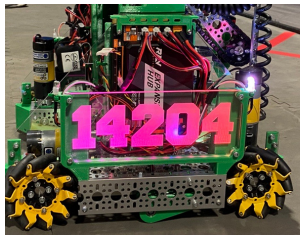
The purpose of the number plates is to communicate our team number

We designed and 3D printed holders that have an LED strip in the bottom, lighting up the laser cut acrylic plates.

These lights communicate information to our drivers such as the time in the match and our pick up mode (from substation or from stack), improving our ability to better make split second decisions in a match.



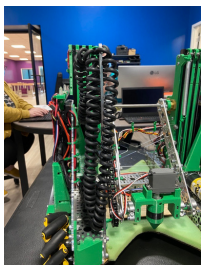


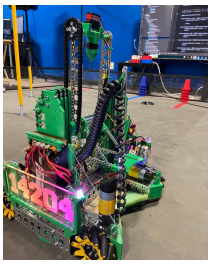


WIRING

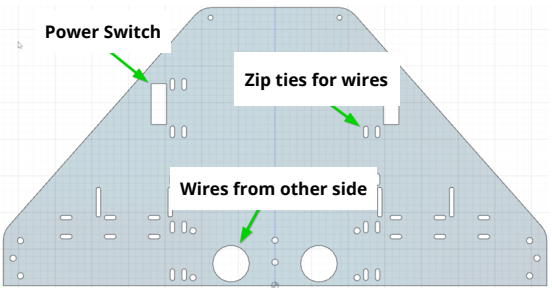
Due to the small size and tall height of the robot, we needed to be thoughtful with our wiring.
We use a coiled wire to avoid tangles when powering the grabber and V4B

We changed from 2 to 1 coiled wires after receiving a wire with 6 conductors from Team 14840

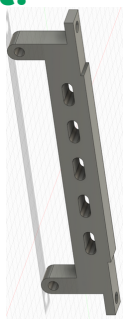




Wire management:



Wire Board


Wire router

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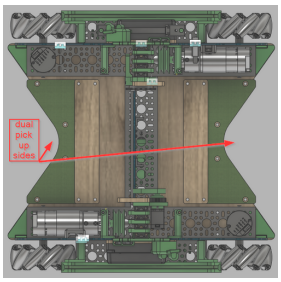
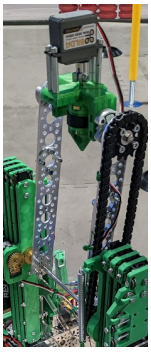
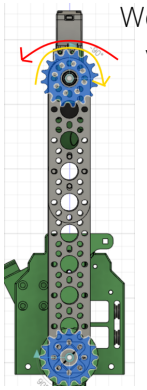
VIRTUAL 4-BAR



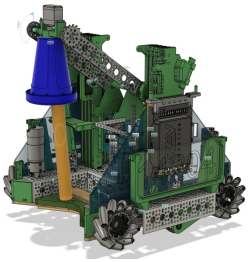
To eliminate turning within our cycles, we utilized dual pick up and drop off sides, facilitating a double pass through design





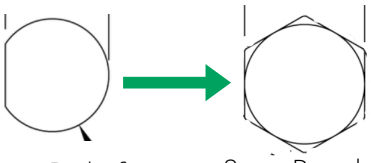
We chose a Virtual 4 Bar because it keeps the cone vertical as it passes from one side to the other

The V4B has a fixed chain that rotates opposite to the V4B relative to the V4B, but does not rotate relative to the ground, keeping the grabber level

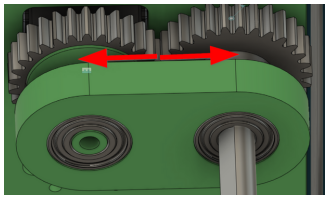


Changes:

The V4B had too much slop, making it difficult to tune so we made these 2 changes.



6mm D shaft → 8mm Rex shaft



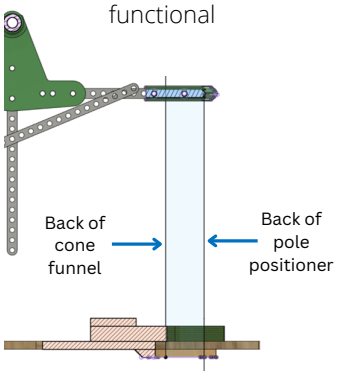
Added gear bar to counter the force from the gears pushing each other away, preventing gear slipping.

POLE POSITIONER

We wanted to lower the number of missed drop-offs, even when the pole has been bent to a diagonal, so we created the positioner to better align our V4B with the pole.

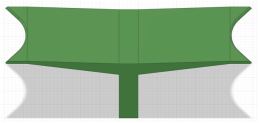
Requirements:

Design goal: light, simple, and functional

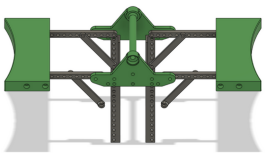


The pole positioner needs to be father out than the cone funnel on the base while avoiding any contact with the V4B and grabber

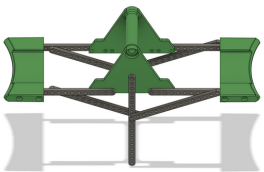
Iterations:



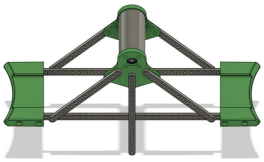
V1: Too heavy.



V2: Lighter wire frame design, but too complicated.



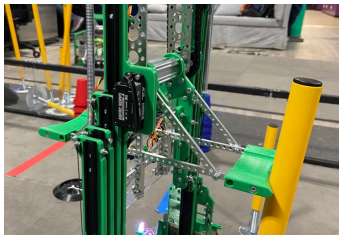
V3: Lighter and simpler, but too weak



V4 (final): Slightly heavier, but much stronger, fewer parts, and most functional

Results:

Increased drop-off accuracy, enabling higher point totals and more accurate autonomous programming



SLIDES

We wanted our cone drop off system to be light and fast. We chose to use Long robotics Slides because they are light and we have experience using them.

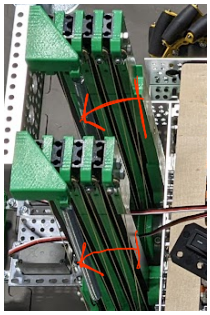
These slides use pulleys. The strings pull on he points of the slide causing them to move closer together, raising the slide.

Red lines: length of string that stays constant

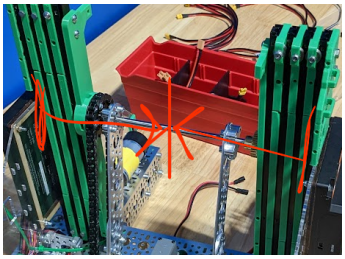
Yellow lines: length of string that shrinks

Changes:

These slides are weak in one direction.



We stabilized them by mounting the slides with both weak sides facing inward so they support each other.



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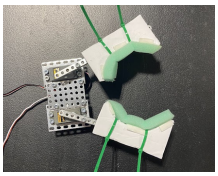
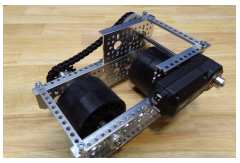
CENTER GRABBER

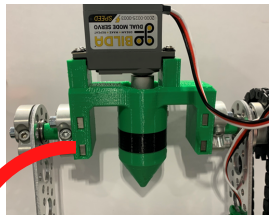
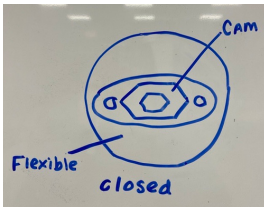
We were inspired by a Robot in 3 days video posted by Lawton Skaling, in which a robot picked up the cone from the inside. During our Ri3D, we tested 3 pickup methods: a claw, a counterrotating wheel mechanism, and the center grabber. We settled on this design because it was the lightest and most consistent.

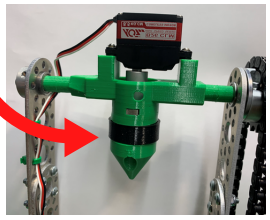
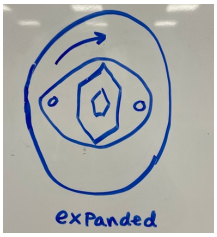



Other Ri3D pick-up designs

The General Design:

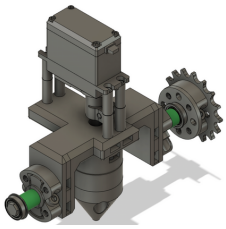
Our design consists of a cam inside of a ring of flexible filament. When rotated, the cam pushes out the flexible ring and holds against the inside of the cone. The pointed nosecone helps guide the grabber into the hole of the cone

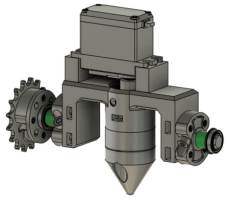



Iterations:

As the season progressed we improved our grabber by making it lighter and solving design issues, such as hitting the wall during pickup

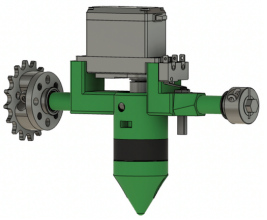


Meet 1:
Design from Ri3D with V4B attachments



Meet 2, 3:

- Rotated servo 90°
- Made grabber expand on both sides
- Blocks to hold servo
- Added hole to connect servo to shaft
- Aluminum shafts



Current:
Large holes in body to attach shafts, reducing the number of 8 Rex Hubs from 4 to 1

We significantly lowered the weight, allowing for faster delivery

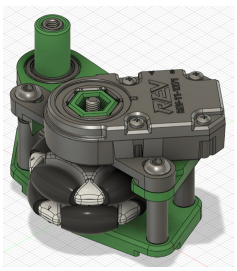
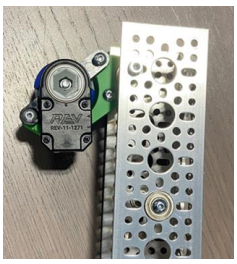
MEET 1 9.6 oz → MEET 2 8.8 oz → MEET 3 7.6 os → CURRENT 3.8 oz

ODOMETRY MODULES

We wanted to create odometry modules to allow the programmers to implement odometry and RoadRunner. Because RoadRunner needs nearly perfect readings, the odometry modules must be designed with accuracy in mind.

1st Design:

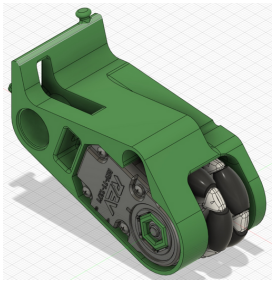
We printed and assembled odometry modules from a source called Open Odometry by Team 18219.

This design did not work for our programmers because it had inconsistent ground contact and the design also presented isues with wiring and fitting in the robot.

Final Design:

We designed our own modules that had improved ground contact for better accuracy, less parts, and the capability to fit inside a GoBILDA U-Channel




The accuracy of these modules has given our programmers to implement odometry into our programming for the first season ever.

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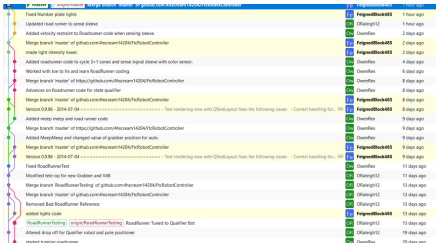
PROGRAMMING OVERVIEW

As a programming team, we would split into two major roles: autonomous programming and tele-op programming

Version Control

With more programmers than ever this season, our team needed a simple method to share code.

We use Git as our version control system in order to allow all 3 of our programmers to work simultaneously and to protect code from being lost Throughout the season, we have developed a series of protocols within Git in order to make merging code as simple and reliable as possible.



Programming + Outreach

We learn from others to improve our programming, and also help others when we can.

LEARNING: We reached out to Programming expert Mr. Braun and teams 14840 and 13356 to help learn about how to implement RoadRunner and MeepMeep

SHARING: We helped team 14840 train their Tensor flow models when they were struggling with it

TELE-OP

Control Scheme

We strive for simplicity in our control scheme to make driving as easy and efficient as possible.

DRIVER BREAKDOWN:

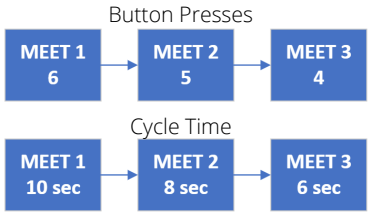
We try to balance the responsibility of the drivers so we don't overload one driver. This also allows for equal tasks to be added to both drivers

We also decide which driver gets which responsibility based on testing with the drivers what works more efficiently

SIMPLICITY:

As the season has gone on, we have automated our driver control through the use of encoders, waits, sensors, and combining button presses

Every iteration of our code has lowered our button presses, making our driving more efficient and score higher.



Driver Feedback

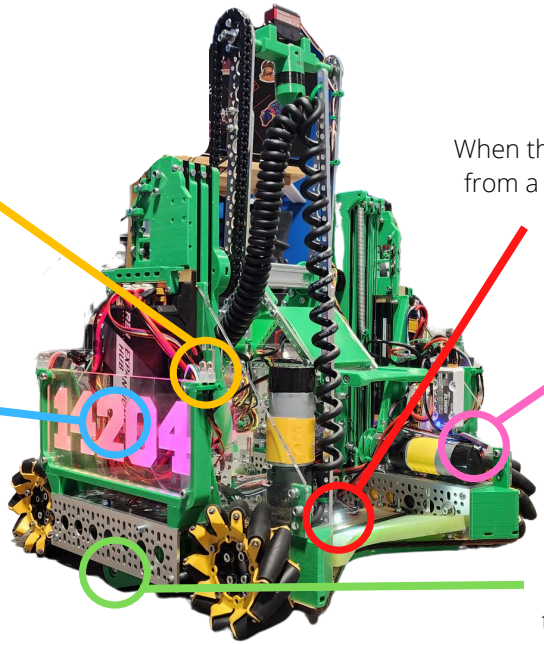
Forward and Reverse Lights

Indicates the V4B direction, showing which way is pickup and drop-off so drivers can quickly drop cones without messing up the direction

Number Plate Lights

Match time feedback: Changes color when it hits endgame to alert drivers when to switch to endgame strategy

Ground/Stack Pick up feedback: Indicates our pick up mode, allowing drivers to avoid being in the wroing mode



Key Sensors

Color/Distance Sensor

When the sensor reads that it is a certain distance from a cone or pole, it will automatically drop off or pick up without a button press

Encoders

Use a PID to make preset slide positions, enabling drivers to extend to each pole height with a single button press

Odometry

When picking up from the wall cone stack, we manually center on the stack with the cone funnel, then use odometry to move slightly away from stack to legally pick up cones

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Autonomous

Our goal was to create a high scoring and consistent autonomous. to accomplish this, we tested and used many methods in both object detection and autonomous navigation.

Object Detection

We needed to use object detection to recognize three distinct patterns on the sleeves to park properly in autonomous We tested many object detection methods to find the most reliable way.

Tensor Flow ✗

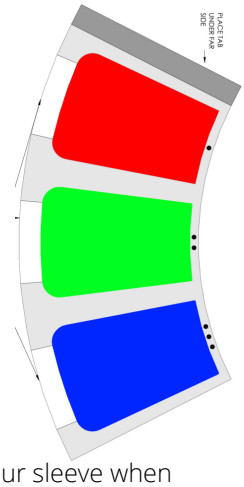
- We used the FTC machine learning application to build and train our own models.
- We tested multiple different colors and shapes for consistency, the best being colored April Tags for shape and color
- Inconsistent readings despite extra training time

Open CV ✗

- We attempted to sense April Tags with Open CV, but did not have the time to do it properly

Color Sensors ✓

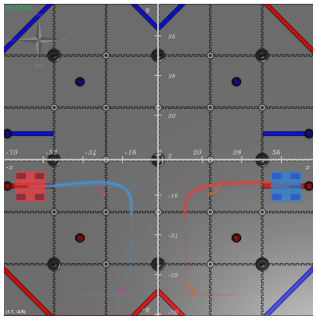
- We used the forward-facing color sensor within our cone funnel, to sense a tri color sleeve.
- We used red, green, and blue because they are very distinct for the sensor



Our sleeve when using color sensors

Roadrunner

Roadrunner is a motion planning library that uses a field corrodent system to generate complex tasks while maintaining velocity and acceleration. We use it to autonomously navigate around the field.



MeepMeep Testing

Implementation

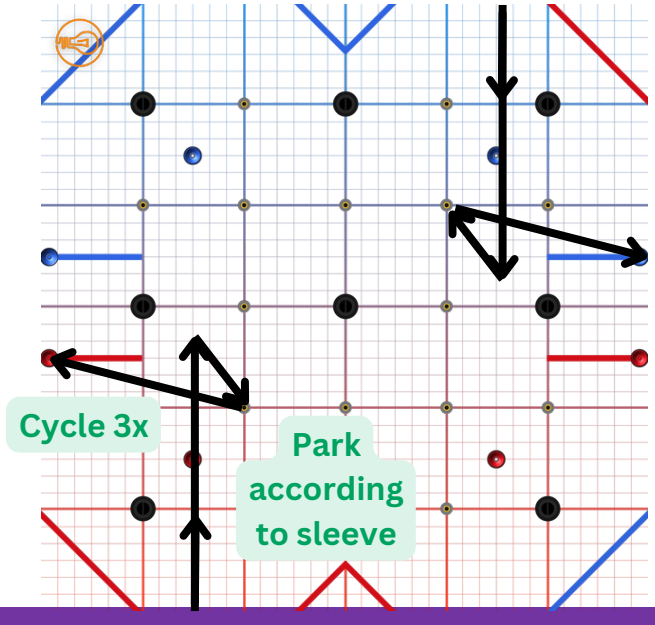
- Each autonomous program combines Roadrunner movement system for the chassis and our own system for the attachments.
- We worked with two other teams and an expert to help implement Roadrunner.

Use

- We used the Learn Roadrunner guide step by step to make sure our code worked properly.
- The quicker movements have allowed us to cycle multiple cones in autonomous.

Testing

- We use MeepMeep (a virtual view path tester for roadrunner) to prefect our movements before testing them on the field, speeding up testing and preventing accidents on the field.
- We use the ten times test to make sure our movements are consistent before moving on the next step.



Our Autonomous:

- Sense using sleeve
- Drop off preloaded cone
- Cycle till five seconds remain (Typically 3 more cycles)
- Then Park according to sleeve