

<project: Peacock>

10355




<award Reference>





Sustain Award-----	1-3
Connect Award-----	1-4
Reach Award-----	4-6
Innovate Award-----	7-12
Think Award -----	2, 4 8-12
Design Award -----	8-12
Control Award-----	13-15

DECODE™

PRESENTED BY  RTX



TULSA ROBOTICS CENTER
HOME OF STEAM POST 26

<meet the Team>

Project Peacock is a **community-based** FTC team from Tulsa, Oklahoma. Now in our 11th season, we are the founding team that meets at the Tulsa Robotics Center (TRC). Through everything we do, we **inspire** others by sharing our passion for FIRST and living its Core Values by building leaders, strengthening our community, and growing the future of STEAM.



Jaxon

5 Years

Team Captain, Lead Designer

Goal:

To design a turreted launcher with an adjustable hood.



Wren

1 Year

Vice Captain, Lead Portfolio, Outreach

Goal:

To create a cohesive, professional team portfolio.



Andrew

4 Years

Lead Manufacturing and Mechanical, Design

Goal:

To design and 3D-print our competition chassis.



Addy

1 Year

Lead Social Media, Outreach

Goal:

To grow our global outreach through team social media.



Amelia

4 Years

Quartermaster, Portfolio, Outreach

Goal:

To develop a clear and effective judging presentation.



Eli

2 Years

Mechanical

Goal:

To advance my CAD skills to support robot design.



Jensley

1 Year

Lead Photographer, Social Media

Goal:

To capture our season through photography and media.



Luke

2 Years

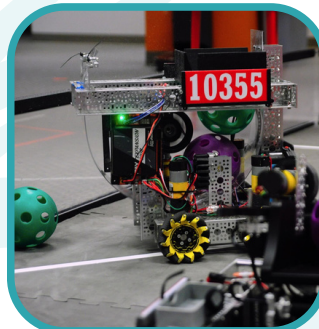
Lead Software, Design, Web Design

Goal:

To use trigonometry to build an auto-aiming system.

<team Leadership>

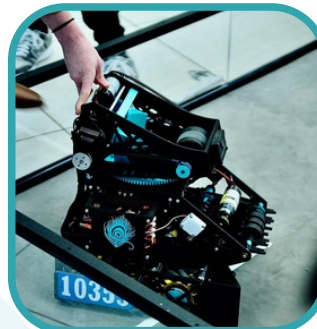
- Youth-led, student-driven decision making
- Leadership succession through role shadowing and cross-training
- Mentors guide through questioning and review
- Documented processes to ensure smooth leadership transitions
- Character development, including Eagle Scout & Girl Scout leadership
- Annual leadership workshops to develop skills



Larry Bird Bot V1

Goal:

To be reliable during the early season



LeBronette V2

Goal:

To win State!

Our three **newest members** came from a dissolving team that was unable to continue due to limited members and resources.

Project Peacock welcomed them and their experience, resilience, and passion, with "open wings," ensuring they could continue participating in FIRST. By providing a place for students to belong and grow, we help **sustain** FIRST programs when teams dissolve and extend the reach of FIRST by keeping opportunities accessible within our community.

Together, we continue learning, building, and growing stronger as one team!

"Our leadership structure ensures long-term sustainability and prepares members for careers in engineering, communication, and project management." ~ Addy

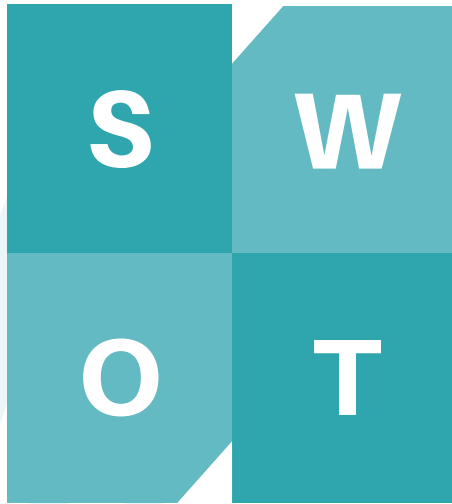
<Sustainability>

STRENGTHS

- Engineering community connections
- 19 years FTC experience
- 5 Oklahoma Dean's List Finalists
- 48+ years of mentor FTC experience
- Diverse skills and interests
- Tulsa Robotics Center resources

OPPORTUNITIES

- Expanding technical skills
- Networking with engineers
- Collaboration with other FTC teams
- Increased outreach and visibility



WEAKNESSES

- Communication challenges
- Time management skills
- Scheduling building, programming, drive practice
- Workspace organization
- Limited recruitment

THREATS

- Loss of knowledge when members graduate
- FRC impact on team dynamics
- Loss of donated TRC space
- Sustainability for low recruitment

MITIGATION STRATEGIES

- Active recruitment through outreach events and community partnerships
- Defined communication channels and meeting agendas
- Structured schedules separating design, programming, drive practice & FRC/FTC
- Workspace organization standards and cleanup checklists

<tracking Progress>

Project Peacock is entirely student-run, with members leading sustainability planning through a comprehensive SWOT analysis to determine how to focus on communication, member retention, and intentional leadership transitions, **reducing the risk** of knowledge loss when students graduate.

Through student mentorship new members learn from shared responsibilities and **documented processes** until they are confident and prepared to step into new roles themselves. We **track progress** during weekly meetings and record schedules, decisions, goals, fundraising, lessons learned, etc, in the appropriate Discord channel. This team-owned system **minimizes the risk** of leadership gaps, preserves team knowledge, and ensures Project Peacock progresses and remains sustainable year after year.

<team Goals>

Season Goals	Plans and Steps Taken
Having a successful robot	<ul style="list-style-type: none"> Multiple robot designs and new iterations of robot mechanisms Creating different strategies and picking the best one
Robot Shooter Targeting	<ul style="list-style-type: none"> Math-based programming to calculate trajectory and hood position Lots of trial and error
Advance to Worlds	<ul style="list-style-type: none"> Studying new award requirements and adapting this season's plans Continually improving our robot, outreach, and documentation
Increase members' skills	<ul style="list-style-type: none"> Led classes in CAD Outlined steps to learn how to do basic programming New members built the prototype chassis New members work with existing members to learn both hardware and software skills Basic Safety & Skills Certification courses offered in the Google Classroom
HAVE FUN!	<ul style="list-style-type: none"> Held parties, team building exercises, and scrimmages
Long Term Goals	Steps to Take
Recruiting	<ul style="list-style-type: none"> Interact with FLL teams Host open house and outreach events Participate in STEAM events with other youth
Spread FIRST Globally	<ul style="list-style-type: none"> Hold outreach events to spread awareness of FIRST Create resources for schools/teams to use to start new teams Participate in scrimmages to connect with different communities Help other teams in the online community via Discord Continue to cultivate relationships with teams across the world to better understand each other!



<Sustainability>

<financial Planning>

Project Peacock is not funded by the Tulsa Robotics Center (TRC) and works hard to remain strong and **sustainable** by careful budgeting, fundraising from multiple sources, and spending responsibly. Managing our resources ensures that the team continues to thrive year after year.

Donations: \$8,081.55
 Expenses: \$2,518.8
Net Program Support: \$5,562.69

As we enter our 11th season, maintaining a positive balance allows us to plan for the future by investing in shared tools and equipment, such as batteries at the TRC, supporting outreach events, and providing educational opportunities for future team members. Monthly finance reports are reviewed on a regular basis to guide **informed decision-making**.

<fundraising & Sponsorships>

Community partnerships are essential to Project Peacock's overall **reach** and **sustainability**.



Sponsor support **reduces financial barriers** by funding travel and critical robot components, allowing the team to compete, collaborate, and grow beyond our region.

Additional in-kind donations provide necessary items such as 3D-printing materials, enabling frequent prototyping, custom part fabrication, and hands-on engineering experience while keeping cost low.



RECRUIT

We welcome new members through outreach events, camps, and community partnerships, ensuring students always have a place in FIRST.



TRAIN

All members complete Basic Safety Training, followed by role-based certifications in CAD, manufacturing, programming, and build principles.



SHADOW

Newer members shadow experienced teammates, assist with real tasks, and learn through hands-on experience and mentorship.



LEAD

As seniors graduate, trained members step into leadership roles with confidence, keeping knowledge, skills, and team culture in place.



<operations & Risk Management>

Project Peacock uses structured training and required safety certifications to keep members safe, support **leadership development**, and ensure long-term sustainability.

Certifications are self-paced and flexible to accommodate academic and extracurricular **time constraints**, while ensuring students demonstrate tool competency before hands-on work.

The team **tracks** completion and **reviews** readiness to adjust roles as needed. This reduces safety risks, preserves knowledge as members graduate, and keeps Project Peacock student-led and **sustainable** year to year.

Task	Basic Safety	Hand Tools	Hand Drill	Drill Press	Bench Grinder	FTC Build Principles I	FTC Build Principles II
ADDY	✓	✓	✓	✓	✓	✓	✓
AMELIA	✓	✓	✓	✓	✓	✓	✓
ANDREW	✓	✓	✓	✓	✓	✓	✓
ELI	✓	✓	✓		✓	✓	✓
JAXON	✓	✓	✓	✓	✓	✓	✓
JENSLEY	✓	✓	✓	✓	✓	✓	✓
LUKE	✓	✓	✓			✓	
WREN	✓	✓	✓				

<how we Connect with Mentors>

Our mentors are engineers, STEAM professionals, teachers, business owners, and FIRST alumni who **support** us with design reviews, problem-solving discussions, and thoughtful questioning that strengthen our ideas and help us grow both technically and personally, on and off the field.

Our mentors **guide and encourage** us while ensuring we remain responsible for our own decisions and outcomes, ultimately learning from our failures. They teach us about engineering, manufacturing, programming, finance, communications, and leadership, showing us how we can apply these skills in the real world.



Christopher Smith
Electrical Engineer
Programming /Mechanical



Scott Pollard
Mechanical Engineer
Manufacturing /Mechanical



Edward Sullivan
Industrial Engineer
Mechanical



Bonnie Griffin
Musician & Communications
Team Management



Anita Hundley
Teacher
Treasurer



Angela Hall
Business Owner/Operator
Team Photographer



Josh Hayes
Image Technologist
Quartermaster



Allison Pollard
Teacher
Team Management



Matt McLain
Data Analyst
Strategy & Communication

“Our mentors don’t just give us answers; they ask questions that help us think through the problems on our own. Their real-world experience helps us **learn** what we need at any given moment, which helps us also make better decisions as a team.” – Amelia, Quartermaster

<how we Connect with Engineers>

Our team regularly connects with engineers and STEAM professionals through various outreach events and tours, gaining insight into real-world design, manufacturing, and project management. These relationships strengthen our technical and professional skills and help us learn, gain access to new resources, and share FIRST with others. Our 10,000 sq. ft. space at the Tulsa Robotics Center allows us to welcome community members, host events, and expand outreach beyond our team.



To extend our impact beyond our team, we created **STEAM UNPLUGGED** at the Tulsa Robotics Center to **connect** students and community members with STEAM professionals. These sessions allow participants to learn directly from experts, ask questions, and explore future career paths.

Through STEAM UNPLUGGED, Project Peacock **reaches** new audiences by **introducing FIRST** to individuals who may not otherwise be involved, while also **connecting** students with professionals from fields such as chemical engineering, aerospace engineering, and additive manufacturing. By sharing our passion for FIRST, we inspire others to engage with STEAM and become part of the broader FIRST community.

<meaningful Connections>



Project Peacock collaborates with our sister teams at the Tulsa Robotics Center (TRC) on various outreach events to strengthen the overall program. Individually, Project Peacock is known as a **FIRST ambassador**, where our **outreach objectives** grow, sustain, and strengthen the FIRST community by supporting teams at every level. Through both STEM and non-STEM outreach, we intentionally select events that create meaningful community impact that reflects **FIRST's mission** to develop compassionate leaders who inspire future innovators.

<global Leadership>

We actively manage and participate in both Oklahoma & National FTC Discord servers, connecting over 20,000 students, mentors, and alumni worldwide. We provide technical support, share resources, and facilitate collaboration among teams.

Lesson Learned: Being the **ONLY Oklahoma** team invited to participate in international events is humbling and empowering!



<research & Development>

We were selected to participate in System Core Testing, allowing us to provide feedback that improves FIRST infrastructure and team experiences.

- Impact:
- Contribution to program development
 - Improved system usability

Lesson Learned: Continuous improvement can strengthen the entire FIRST community!

<team Marketing>

Through our Instagram account and our *newly designed* website, we **creatively** share achievements, outreach events, tutorials, and team updates.

- Impact:
- 630+ followers
 - Increased event participation
 - Expanded online STEAM community

Lesson Learned: Digital platforms extend our impact beyond physical boundaries.



<community Engagement>

TRC Open Houses (4+ Annually)
We co-host open houses with our sister teams that welcome families, educators, and community members into our workspace. Visitors learn about FIRST, explore our robots, engage with our team, and oftentimes, **JOIN** our program!

- Impact:
- 100+ visitors annually
 - New members and mentors recruited
 - Greater community awareness of FIRST

Lesson Learned: Hands-on experiences inspire long-term involvement in STEAM.

<rookie Support>

We mentored FTC Team 32076 Quantum Quails, supporting them throughout their rookie season with technical training and organizational guidance.

- Impact:
- Improved competition readiness
 - Increased student confidence
 - Sustainable team growth

Lesson Learned: Personalized mentorship builds strong, independent teams.



<FLL Mentorship>

We mentor 4 FLL Challenge teams and 1 FLL Explore team, guiding students in robot design, coding, and presentations. Many of our members are former FLL participants, allowing us to provide experienced and relatable support.

Lesson Learned: Investing in the youth is a future investment in our team!



<team Branding>

Project Peacock **makes FIRST loud** with our signature **"PA-KAW!"** reflecting our confidence, creativity, and team spirit! Wherever we go, everyone knows our ostentation!

While our branding has evolved, our logo and identity remain constant. This season, we introduced turquoise, amethyst, and obsidian to symbolize growth, collaboration, and a fresh chapter with new team members.

Meaningful Connections

15+ Events

20,000 People Impacted

Countless Hours Served



Working Across the World

"We believe **outreach** works best when it's consistent, welcoming, and meaningful. By building long-term relationships, we help students grow and strengthen the global FIRST community. We focus on lasting connections instead of one-time events!" - Wren, Lead Portfolio

<outreach Timeline>

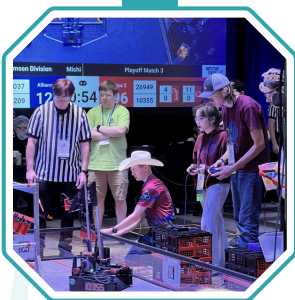


June Michiana

-60+ teams in attendance

-Competed with other teams at this Premier Event! Finished 3rd Pl w/ fellow OK team, Royal Society of Robots! Also 2nd Pl Think Award

Lesson Learned: It is crucial to have backup drivers trained who can take over if needed.



July Chicago Robotics Invitational

-38 teams in attendance

-Attended this Premier Event to compete in a modified game & take classes from other teams. Was the 3rd Pl Alliance 2nd pick.

Lesson Learned: Off-season events are more fun and effective with more team members.



June & July TRC Summer Camp

-60+ kids in attendance

-Helped plan & facilitate 2-week-long FLL, 3D printing, & FTC basic build summer camps for new youth!

Lesson Learned: There are kids with all kinds of challenges, and we need to be kind and patient when working with them.



August Twisted Oaks Races

-160+ people in attendance

-Volunteered to time the races & help with registration. We also gave a robot demonstration to introduce people to FIRST.

Lesson Learned: It is rewarding to use our gifts & talents to help raise money for a good cause!



August Tulsa Maker Faire

-1,000+ people reached

-With our sister teams, we held robot demos, shared info about the TRC, & answered questions to new people.

Lesson Learned: Attending STEAM-based outreach events can bring new people to the robotics community.



September DiscoverFest

-11,163 guests attended

-The team participated in the DiscoverFest scrimmage with fellow OK FTC teams.

Lesson Learned: Our early robot design worked well for an early season scrimmage, which gave us drive practice with local teams.



November FLL Qualifier

-9 teams in attendance

-We helped set up, co-host, and tear down the FLL State Qualifier at University School with our sister teams.

Lesson Learned: Helping the next generation with FIRST is very fulfilling!



November Black Friday Scrimmage

-10 teams in attendance

-We co-hosted a scrimmage at the Tulsa Robotics Center where many teams competed.

Lesson Learned: Competing can be very relaxed and a lot of fun, especially with new teams!

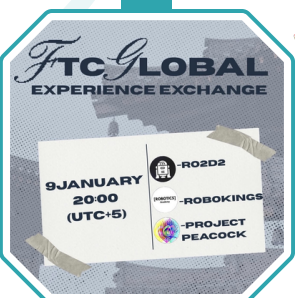


December Toy/Blanket Drive

-100+ people benefitted

-TRC teams collected blankets and toys to give to foster children in the Reed Park Community,

Lesson Learned: The holidays are always a great time to give to the community!



January JuzzTogyz Conference

-35 youth in attendance

-Multiple countries met on Zoom and talked about strategies and robot ideas to help them in their rookie season.

Lesson Learned: Mentoring rookie teams, even from across the globe, is a fulfilling way to share our knowledge and gain communication skills.

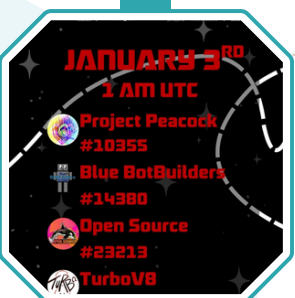


January RoSophia Conference

-12+ teams in attendance

-We shared our experiences, design process, & strategies for Inspire Around the Globe, hosted Team 21455 RoSophia from Romania!

Lesson Learned: Inspiring others around the world helps us fulfill our team mission!



February Russian Collaboration

-7 youth in attendance

-We met with team 16950 Phantom from Russia on National Discord & talked about robot designs, portfolios, & ways they can improve

Lesson Learned: Countries might disagree on politics, but that can't stop us from helping each other!



<engineering Process>

Our **engineering and design process** begins with brainstorming ideas for the season's challenge, followed by CAD models, and finally building them to test out as many prototypes as possible. We test early, evaluate what works (and what doesn't), and then **iterate to improve**.

As a team, we believe our robot can always be better. We hold youth-led design reviews to get the opinions of our entire team, as well as feedback from our mentors.

WE LIKE TO FAIL EARLY - learning from mistakes helps us build stronger robots and stronger people!

<design process Flowchart>



<design Review Outcomes>

- Our shooter motors should be geared together so their speeds will be more constant and equal.
- Shooter also needs to be faster. We can use servos to adjust how fast our shooter and drivetrain are.
- **Mentors helped us with the math** to determine what was needed.



<drivetrain Table Studies>

Choosing Drivetrain	Agility	Cost \$\$\$	Complexity of Design	Reliability	Traction	Experience	Total:
Mecanum	2	2	3	3	1	3	14
6WD	1	3	2	2	2	1	11
Swerve	3	1	1	1	3	1	10

1 = Worst | 3 = Best

<analysis of Drivetrains>

- While swerve would be advantageous for this season's game, it isn't cost-effective, and we would have a steep learning curve to implement it
- 6-wheel drive would also be a good drivetrain, but it doesn't meet our design goals of being very fast and maneuverable because it is slow and cannot strafe to align to shoot.
- So, after evaluating multiple drivetrains using performance metrics, we selected mecanum based on agility, cost, and reliability.

<lessons Learned>

- **DO THE MATH!!** Mathematical modeling prevents unnecessary redesign
- Open communication improves problem resolution
- Mentor experience accelerates our development
- Early failure leads to stronger final systems

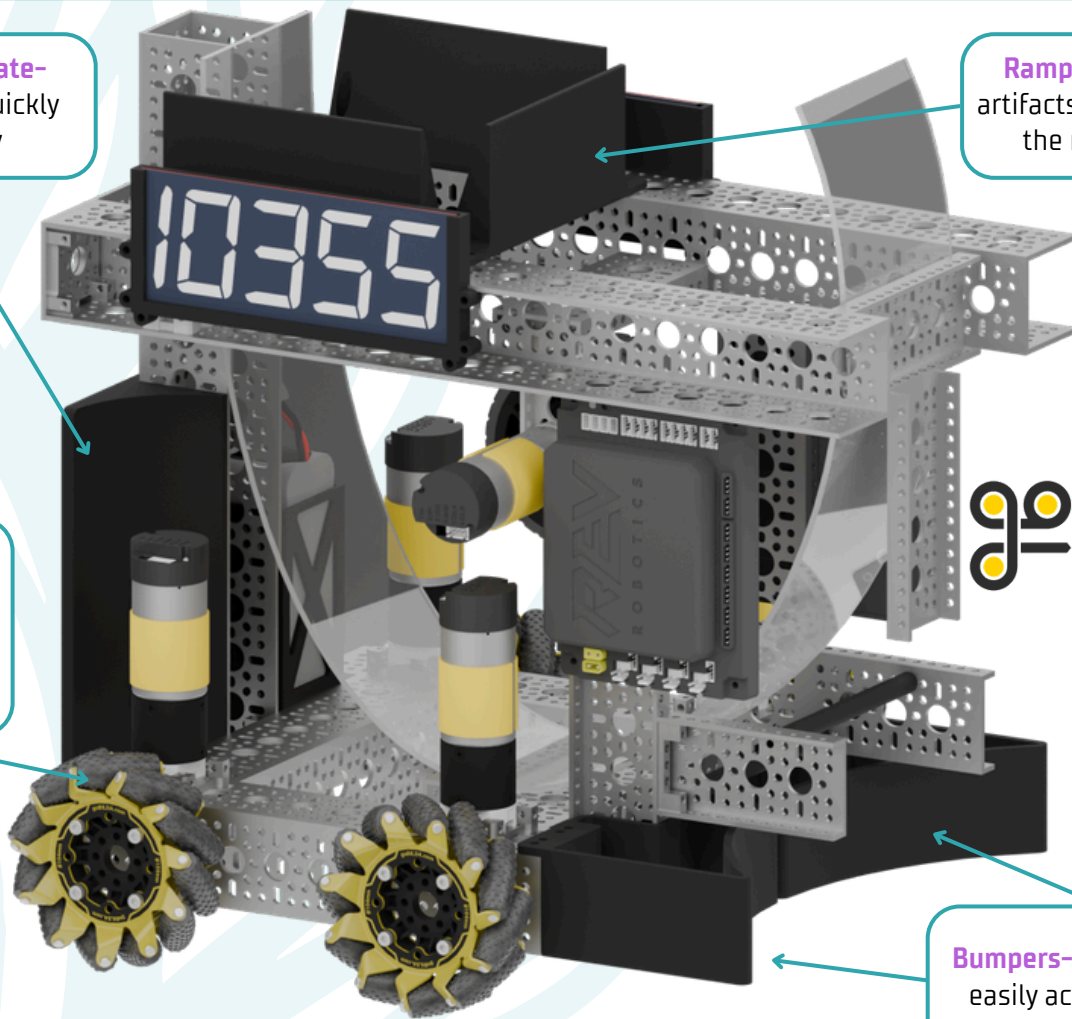
<V1 robot Design>

<our Objective>

- To build a starter-style robot with COTS parts early in the season, which gains us time to develop a custom robot design.
- To enable early testing, driver practice, competition practice, and concept validation

Gate Opening Plate- opens the gate quickly and efficiently

Ramp- holds three artifacts and loads into the robot easily



Mecanum Drivetrain- easy to build and gives us a lot of maneuverability

goBILDA
DREAM • MAKE • REPEAT

Bumpers- push artifacts easily across the field

<robot Strategy>

- **Autonomous:** scoring 3 artifacts in the classifier and moving off the line
- **Teleop:** rapid scoring in the classifier ~ 13 artifacts
- **Endgame:** fully park

Our strategy emphasized early scoring & reliable endgame performance.

<challenges>

- Tips very easily
- Cannot intake from the field; must be loaded by a human player
- Inconsistent flexible polycarbonate ramp

<robot Specs>

- 435 RPM mecanum drivetrain + gripforce wheels
- 6000 RPM flywheel shooter
- goBILDA Pinpoint odometry + ODO pods
- Robot weight: ~20 lbs
- Polycarbonate ramp and bumpers
- 3D-printed intake and ramp components

These specifications balance speed, control, and manufacturability.

<lessons Learned>

- Active intake increases cycle times
- Shooter consistency is key for competitive scoring
- Having an adjustable angle so that we can shoot from further back will be helpful in the later season
- Stability is essential when driving at higher speeds
- Rapid fire capability improves scoring potential
- Adjustable shooting angles increase field coverage

<V2 robot Design>

<design & Strategy Goals>

After analyzing our V1 robot performance, match data, and driver feedback, we identified several priorities to improve our competitiveness, including speed, consistency, shooting accuracy, and clear driver feedback systems. These objectives guided all major engineering decisions for our V2 robot.

Limelight 3A - senses the April tags on the classifier to improve auto aim

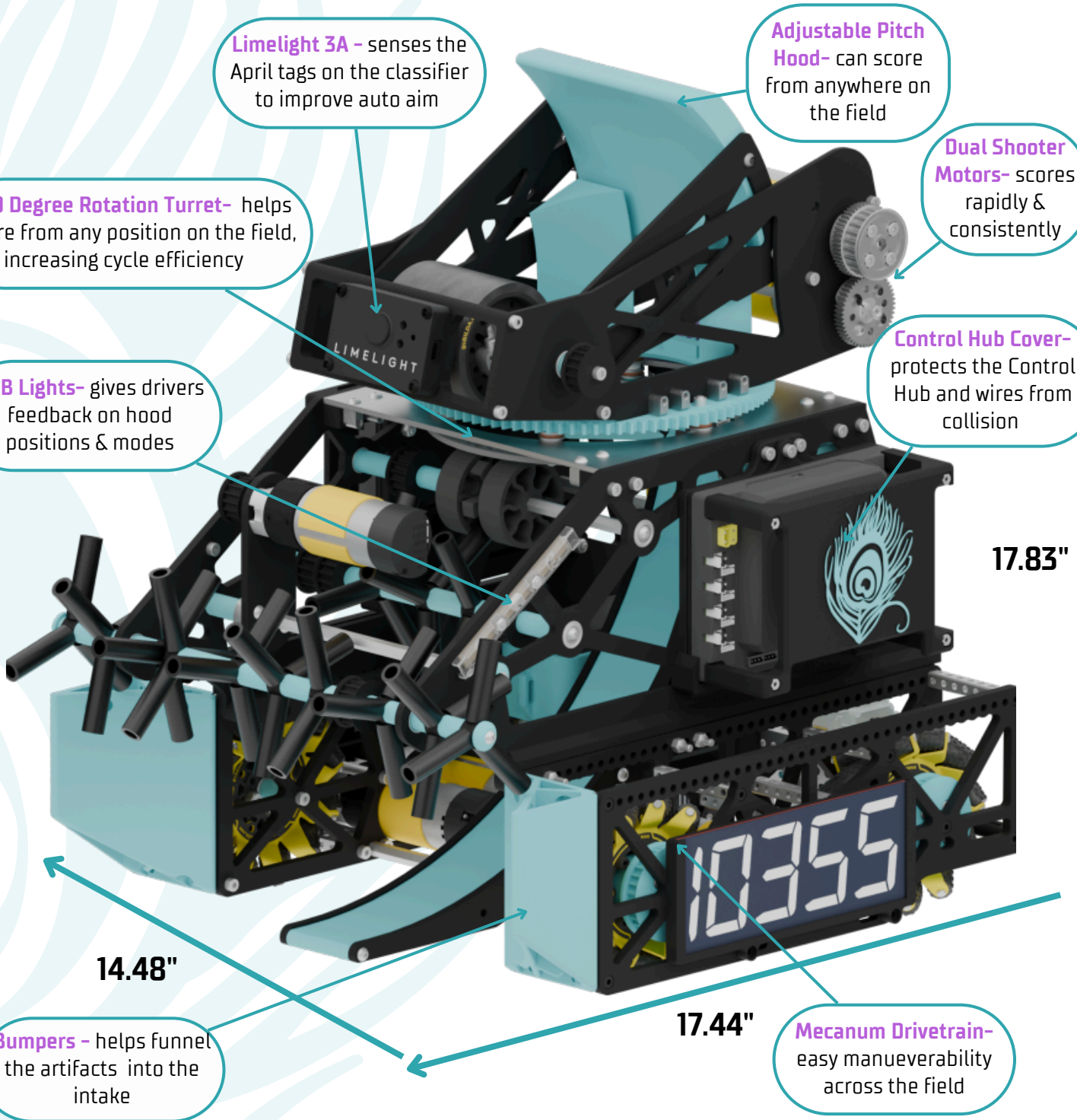
Adjustable Pitch Hood - can score from anywhere on the field

270 Degree Rotation Turret - helps score from any position on the field, increasing cycle efficiency

Dual Shooter Motors - scores rapidly & consistently

RGB Lights - gives drivers feedback on hood positions & modes

Control Hub Cover - protects the Control Hub and wires from collision



14.48"

17.83"

Bumpers - helps funnel the artifacts into the intake

17.44"

Mecanum Drivetrain - easy maneuverability across the field

<lessons Learned>

Through V2 development, we learned that:

- Integrated software and hardware design improves consistency
- Vision-assisted localization increases match reliability
- Dual-motor shooters outperform single-motor systems
- Driver feedback systems reduce operational errors
- Modular design speeds up iteration
- 3D printed robot CAN be robust if the right material & print settings are chosen

These lessons directly shaped our final robot design.

<impact on Team Growth>

Developing V2 strengthened our team's skills in:

- CAD-based iteration
- Data-driven decision making
- Systems integration
- Collaborative design reviews
- Advanced manufacturing techniques

This process reinforced our commitment to continuous improvement and innovation.

<V2 chassis Design>

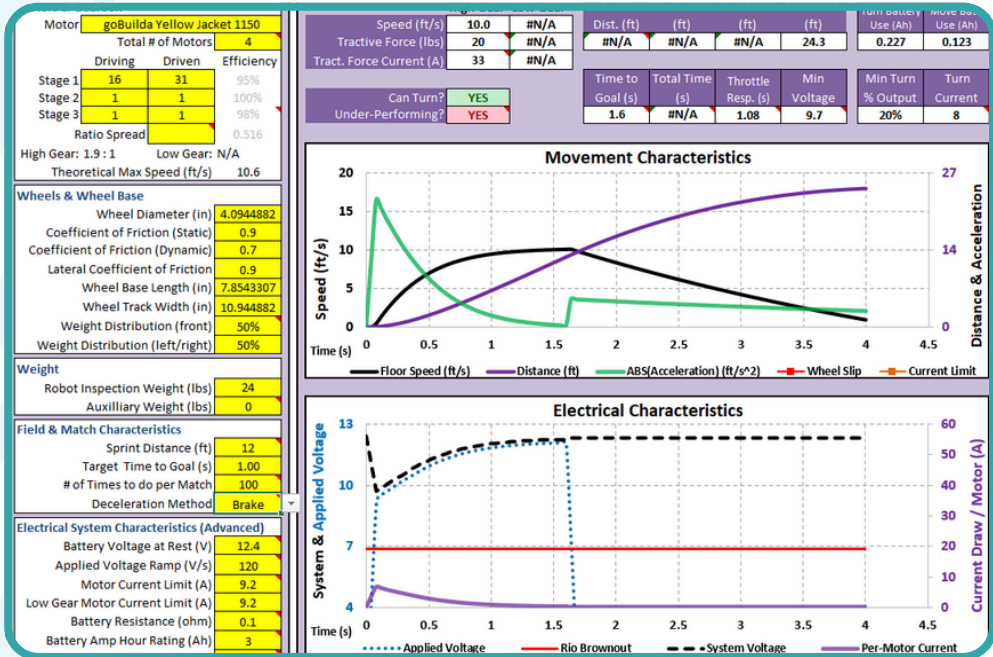
<engineering Rationale>

- The V1 Robot was limiting us on how we wanted to approach this year's game strategy.
- Learning where we can improve based on the V1 performance, we designed a custom chassis to test the mechanisms we lacked on the first design.
- The V2 chassis is faster and will be more consistent in both scoring and driving, therefore meeting our team's **design & strategy objectives**.

<drivetrain Calculations>

<why we Calculate>

- We use engineering calculations to guide all drivetrain design decisions.
- Our goal is to balance acceleration, control, and efficiency rather than maximizing top speed.
- Using drivetrain modeling software, we analyze:
 - Acceleration
 - Wheel slip
 - Top speed
 - Current draw
 - Electrical efficiency
- These calculations establish measurable performance targets and reduce trial-and-error during prototyping.

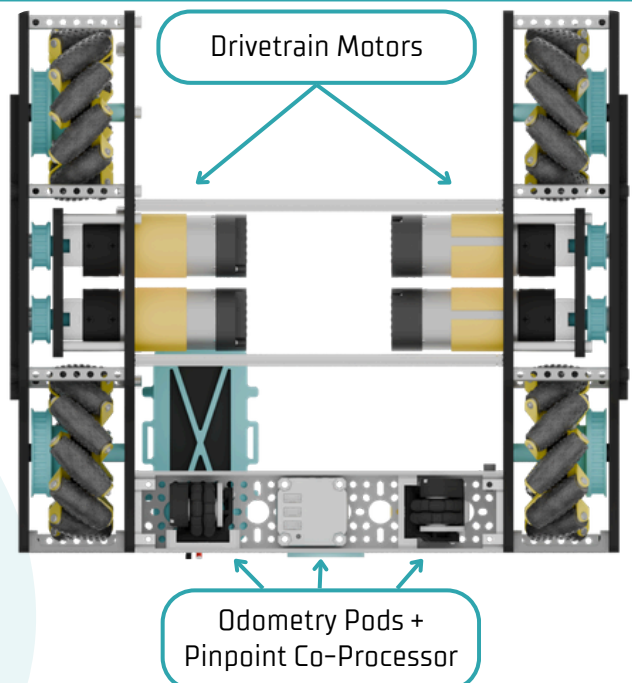
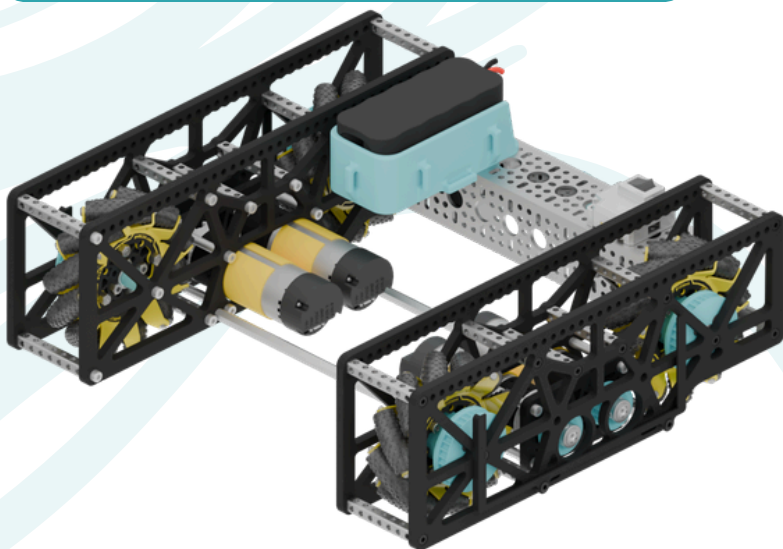


<robot Specs>

- Dimensions: 12.59 in × 14.48 in
- Drive Type: 4-Motor Mecanum
- Gear Ratio: 10.1:1
- Odometry: 2-Wheel Odometry with Co-Processor
- Construction: 3D Printed [PLA Pro]
- Final Wheel Speed: 582 RPM
- Wheels: GripForce Mecanum 30A Rollers
- Mounting: Multi-Iteration Mechanism Holes
- Alliance Markers: Dual-Sided
- Weight: 24 lbs

<custom Manufacturing>

- Our drivetrain includes over 25 custom-manufactured parts.
- Parts are designed using CAD and produced through 3D printing and machining.
- Modular mounting holes allow rapid redesign and mechanism testing.
- This flexibility enables us to implement improvements quickly throughout the season



<mechanism Innovation>

<shooter Features>

- Dual 6000 RPM motors geared together to help with RPM loss when shooting
- Maximum of a 30 Degree angle hood
- Adjustable hood with herringbone gears so they do not come off or slip due to the constant vibration of the flywheel
- Limelight 3A to relocalize with the April tags on the classifier



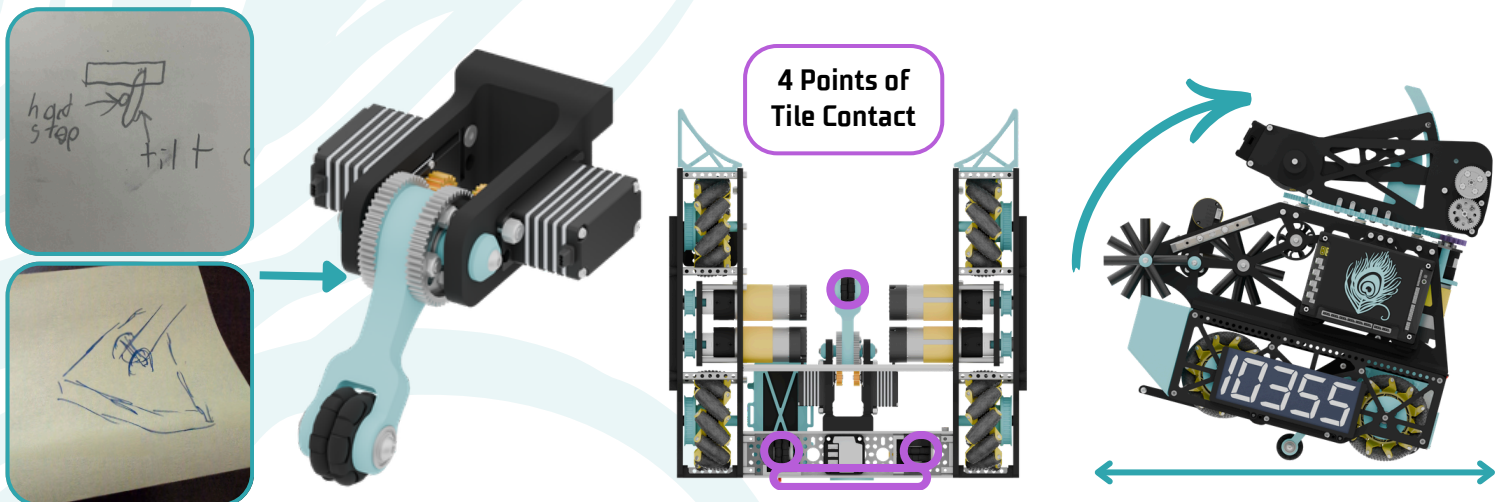
<kickstand System>

Features:

- Dual Axon Max motors with a 2:1 gear ratio
- Output force of approximately 80 in-lb
- Omni wheel for guided deployment
- Four points of tile contact for stability
- Self-aligning design requiring minimal driver input
- Fully deploys in approximately ONE second

Design Rationale:

- Prioritize rapid and reliable deployment in high-pressure endgame scenarios.
- Omni wheel reduces friction and prevents binding.
- Four-point contact decreases the amount of driver error when aligning to park.



<iteration & Testing Process>

Lessons Learned:

- Initial 3D-printed turret plates were flexible and increased friction.
- Aluminum machining reduced deformation and improved rotational smoothness.
- Magnetic limit switches lacked sufficient precision for homing.
- Lubrication significantly reduced rotational resistance.

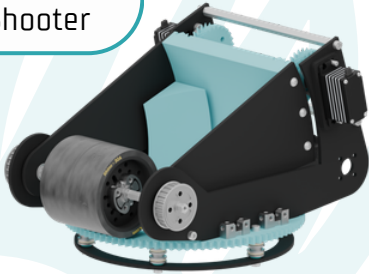
Design Improvements:

- Replaced printed turret plates w/ machined aluminum components.
- Evaluated alternative homing methods for increased accuracy.
- Reduced turret friction through material and bearing optimization.

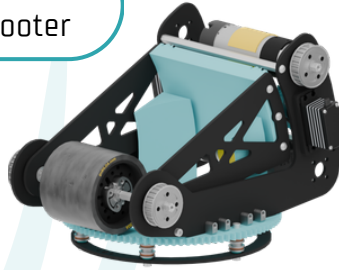
<strategy + Design Process>

We believe that our designs are never perfect and can always be better. We continually **iterate** on our design process until we meet our strategy goals. Based on **testing data**, match analysis, and driver feedback, we have made **over 20 iterations** of various parts of the robot to help us fulfill our game strategy!

V1 Shooter



V2 Shooter



V3 Shooter [Current]



<challenges Identified>

- Excessive side-plate flex
- Slow firing rate
- High RPM loss under load
- Flywheel shaft misalignment

Resulting Issues:

- Reduced shot consistency
- Limited scoring potential

<what Improved>

- Added second motor
- Modified gear ratio to increase speed
- Reinforced mounting structure

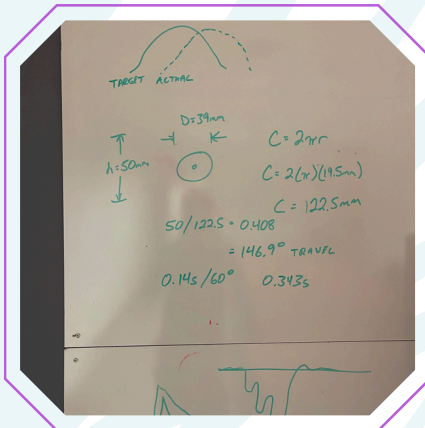
<new Issues>

- Remaining plate flex
- Reduced torque at high RPM
- Continued energy losses

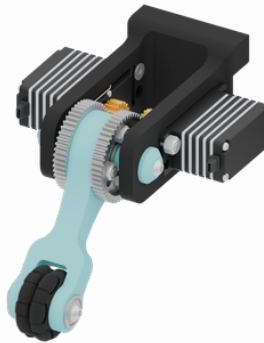
<current Design>

- Geared motors together for balanced torque output
- Increased hood angle range
- Integrated Limelight 3A vision system
- Removed redundant servo
- Reduced plate mass and size

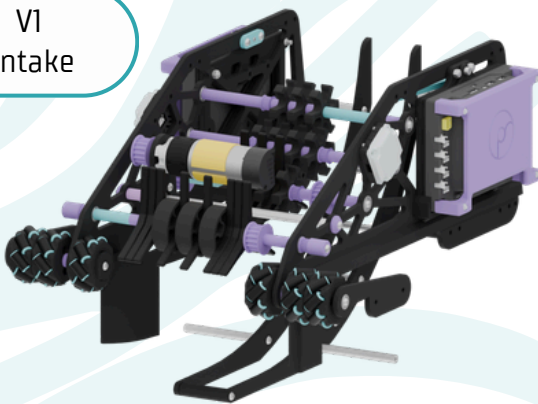
Math for servo hood speed



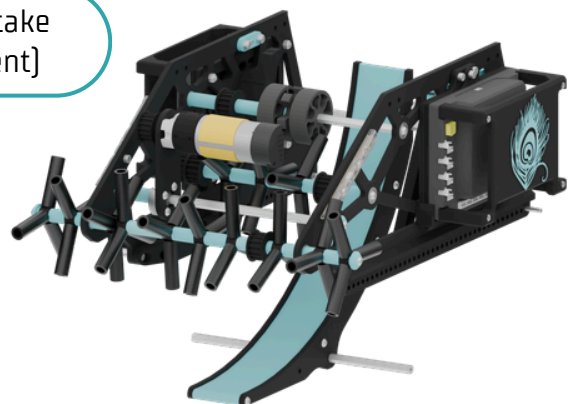
Woohoo! The kickstand design worked on the first try!



V1 Intake



V2.5 Intake [Current]



<challenges Identified>

- Artifact jamming
- Insufficient contact force
- Stiff TPU rollers
- Belt skipping
- Inefficient wheel geometry

Resulting Issues:

- Slower cycle times
- Frequent interruptions

<current Design>

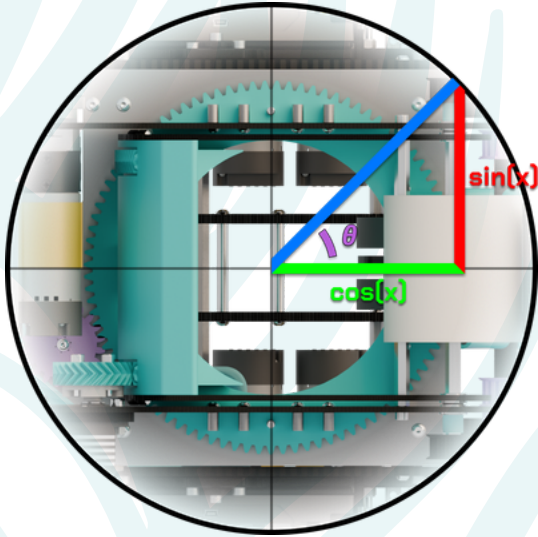
- Higher RPM motor
- Improved belt tensioning
- Redesigned funnel geometry
- Surgical tubing rollers

How this meets our design & strategy goals:

- Faster intake speed
- Reduced jams
- Improved cycle efficiency
- Higher scoring throughput

<automatic turret aiming With Sensor Feedback>

Our automatic turret aiming system uses trigonometry and **closed-loop feedback controls** to achieve accurate targeting. The external GoBilda Pinpoint Odometry Computer V2 provides real-time position data, allowing our software to calculate the angle to the goal using trigonometric functions. A PID controller uses encoder feedback to correct errors and precisely position the turret. By modeling the system as a unit circle, we **verify** our calculations and **improve consistency and reliability** during matches.



<advanced Localization>

- **External Hardware:** GoBilda Pinpoint Odometry Computer V2 (Dead-wheel odometry) + Limelight 3A (Vision)
- **The Algorithm:** The robot prioritizes the Pinpoint data for high-frequency updates (0.00065s refresh rate). However, if the robot collides with a field element and wheels slip, the Limelight 3A recognizes AprilTags to "relocalize" and correct the x/y coordinate drift.



Using our robot's X and Y position, we calculate the angle to the goal with trigonometry:

$$\theta = \arctan\left(\frac{\Delta y}{\Delta x}\right)$$

This angle is sent to the control system to automatically aim the turret.

<mitigating Risks>

- Limelight 3A camera corrects position errors
- Helps fix odometry drift
- Keeps localization accurate under defense
- Improves match reliability

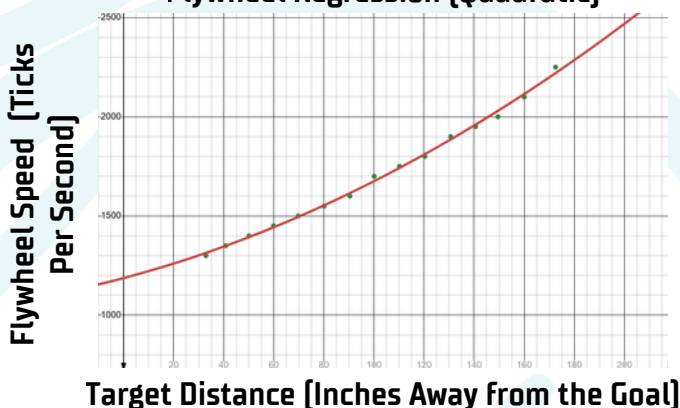


<distance based Shooting Control System>

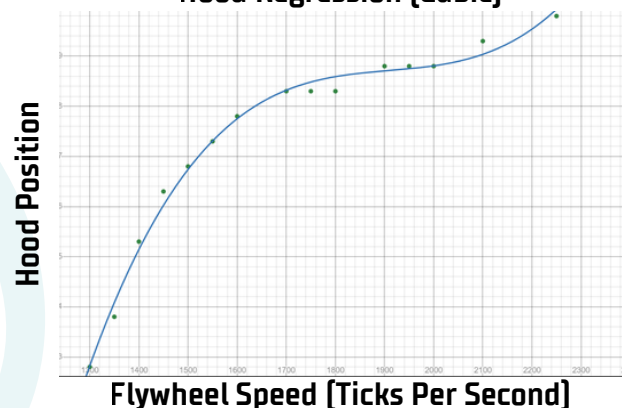
As our distance from the goal changes, our robot automatically adjusts flywheel speed and hood angle to maintain accurate shooting. During TeleOp testing, we **collected data** by manually finding optimal shooter RPM and hood positions at different distances. These values were displayed on the driver station and analyzed using Desmos to create quadratic regression models for the flywheel and cubic regression models for the hood.

These regression equations are used in real time to calculate precise control values based on distance, allowing the robot to consistently adapt its shooting system while moving and **maintain accuracy throughout matches**.

Flywheel Regression (Quadratic)



Hood Regression (Cubic)



<programming Strategy>

This year, we've emphasized innovating our code structure to become more adaptable, user-friendly, and open to change. As a result, our code has been extensively overhauled to maximize efficiency!

<control System Architecture>

Challenge: As our robot complexity increased, a single hardware profile created latency and made debugging hardware failures during match play nearly impossible.

Control Solution: We implemented a subsystem-based architecture (similar to FRC command-based structures). This isolates failures, if the intake jams, the drivetrain logic remains unaffected.

Impact: This structure reduced our loop times by [insert number] ms, ensuring our PID loops for the flywheel and turret run at the necessary frequency for accurate aiming.

<close Autonomous>



Move forward & shoot three

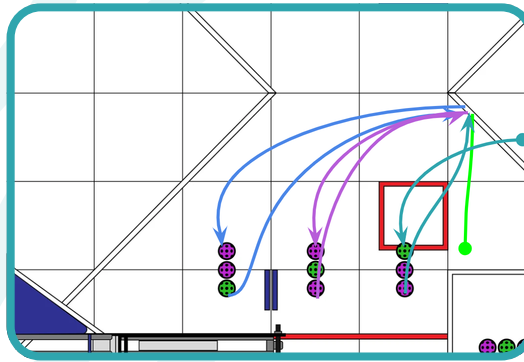
Pick up three, clear the gate, move to launch zone & shoot three

Pick up three, move to launch zone & shoot three

Pick up three, move to launch zone & shoot three

Park

<far Autonomous>



Shoot three, pick up three, move to launch zone & shoot three

Pick up three, move to launch zone & shoot three

Pick up three, move to launch zone & shoot three

Park

<new Structure>

Our code is split into multiple folders with a structure like this:

- **Classes**
 - Field.java
 - RGBLightController.java
 - etc.
- **OpModes**
 - TeleOps
 - MainTeleOp.java
 - HomeTurret.java
 - Autos
 - Auto.java
- **pedroPathing**
 - Constants.java
 - etc.
- **Robot**
 - HardwareManager.java
 - **Subsystems**
 - Intake.java
 - Turret.java
 - Drivetrain.java
 - Lights.java
 - etc.

<optimization & Iteration>

Pedro Pathing Implementation: Transitioned from RoadRunner to Pedro Pathing to utilize Bezier Curves (a smooth curve defined by a set of control points)

Benefit: Allowed for non-stop curved paths (continuous curvature) rather than stop-and-turn movements, shaving time off our Auto!

Pedro Pathing vs. Road Runner



Pedro Pathing

✓ Smoother Transitions

✓ Faster Execution

✓ Dynamic, Real-Time Adjustments



Road Runner

✗ Outdated

✗ Jerky Motions

✗ Can't React to Change Mid-Path

<major Improvements>

- Moved Pinpoint odometry values to a separate thread to solve I2C timing conflicts.
- Refined Pedro Pathing parameters to achieve smooth, continuous-curvature motion.
- Switched to a Subsystem-based architecture, isolating hardware faults for faster debugging.
- Achieved absolute field localization through combining physical mapping and sensors.
- **Created an adaptable framework to rapidly create autonomous strategies for different alliance partners!**

<drive system Integration>



Key lessons we have learned over the years:

- The fewer buttons, the better.
- If you can automate a mechanism, **DO IT!**

<intelligent Automation>

- **The Challenge:** Manually adjusting hood angles and flywheel speeds for different field positions wastes valuable cycle time.
- **The Solution:** We utilize a cubic regression algorithm that takes our distance from the goal (calculated via Pinpoint Odometry) and automatically sets the hood angle.
- **How it Works:** {Hood Angle} = $ax^3 + bx^2 + cx + d$, where x is the velocity of the flywheel. This allows the driver to shoot instantly from anywhere in the launch zone.

<driver Feedback>

- **The Challenge:** Drivers often lose track during the game...(e.g., "Is the turret locked?" or "Is Endgame started?") during the excitement of a match.
- **The Solution:** We use RGB LED indicators to provide real-time state machine feedback throughout the entire game!



<manual Controls>

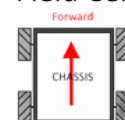
- **Hardware:** DualShock 5 with rear-paddle mapping.
- **Ergonomics:** Critical functions (Intake/Fire) are mapped to rear paddles. This allows the driver to execute complex subsystems without ever lifting their thumbs from the drive sticks, maintaining 100% motion control during scoring actions.
- **Automation:** Single-button presets instantly set the flywheel RPM and hood angle for specific field zones using our regression tables.
- **Fail-Safes:** If the IMU drifts due to the static discharge in heavy collisions, it resets the robot's global heading
- **Turret Zeroing:** A secondary override forces the turret to recalibrate against its limit switch, ensuring the encoder count remains synchronized with the physical mechanism even after skipped teeth or belt slips.

<vector-based Field Centric Driving>

Why? We implement a coordinate transformation algorithm that rotates joystick inputs by the robot's current IMU heading

Benefit? This decouples translation from rotation. The driver can strafe blindly while the turret autonomously maintains its orientation toward the goal, significantly reducing cycle time under defense.

Field Centric



The Robot uses absolute orientation

