



POI POUNDER XXVII ***2026 TECHNICAL BOOKLET***



MISSION STATEMENT



Team 359 strives to transform the culture of our diverse, historically underserved rural community by preparing students to compete and succeed in post-secondary STEM Education opportunities. Team 359 aims to spread the message of *FIRST* with a global vision, impacting as many individuals, teams, and programs as possible. Our approach is to participate in community events, use media, and collaborate internationally with the Hawaii State Government, Friends of Waialua Robotics, and other local, national, and international teams. Team 359's long-term sustainability plan engages students in real-world STEM experiences and equips them with workplace-readiness skills. We not only focus on ensuring that our team has the funding to support STEM (Science, Technology, Engineering, and Math)-related and non-STEM-related programs in our school, community, and state. Furthermore, our sustainability success has enabled us to extend our resources to other teams and STEM-related programs around the world and to establish a scholarship program that will assist 100% of our eligible graduating members in becoming leaders of tomorrow.

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A person is shown working on a robot, with a red overlay across the entire image. The person is wearing a dark shirt and is focused on the task. The robot's components, including a metal frame and a vertical rod, are visible. The background is blurred, showing what appears to be a workshop or competition arena.

FOREWORD

Team 359's Technical Booklet details the game analysis, decisions, outcomes, and technical designs that guided us to our final robot for the 2026 *FIRST*[®] Robotics Competition Season: REBUILT.

Our season started with a brainstorming session where we analyzed the game, helping the team determine optimal strategies and robot design requirements. With these requirements in mind, subsystems were prototyped, designed, and built. With software unlocking the machine's capabilities, we are ready for competition.

Team 359 is proud to present our 2026 FRC Robot:
POI POUNDER XXVII



DESIGN PROCESS



DESIGN PROCESS

TEAM 359'S PROBLEM SOLVING PROCESS

1. Ask Questions/Pinpoint the Problem

- How is the game played? What are the goals?
- Are there different game stages? What are the objectives of each?
- What are the different ways of scoring?
- What are the different ways to prevent scoring?

2. Brainstorm Ideas

- How are we going to play the game? What is our strategy?
- What is our primary focus? How does this translate into robot characterization?
- What are the strategic limitations?

3. Plan and Design

- How are our objectives to be addressed in physical design?
- What are the design limitations?
- Are there previous robots that could provide design insights?
- What are the underlying assumptions regarding robot capabilities?

GAME STRATEGY

Ranking Points (RPs)

- RP are crucial to seeding high in alliance selections. Alliances can earn ranking points in several ways.
 - The winning alliance will receive 3 RPs, and in the case of a tie, 1 RP each.
 - To maximize our chances of acquiring RP, our strategy will center around consistent Autonomous scoring, high-volume FUEL cycles during active HUB windows, and securing climb bonuses during Endgame.
- During Auto, scoring an ideal amount of 35 FUEL into the HUB and climbing the TOWER is a top priority, as both support our alliance in claiming the RPs noted above, and a high scoring Autonomous grants our alliance the advantage of starting the match with an inactive hub.
- Being able to traverse under the trench as well as over the bump is a necessity in order to maximize maneuverability and flexibility

Autonomous Period (20 Seconds)

- During the Autonomous Period, our goal is to maximize the difference in scoring between our alliance and the opposing alliance by optimizing our scoring output, while disrupting and therefore minimizing the opposing alliance's scoring capabilities. Achieving a higher score than the opposing alliance during the autonomous period also grants our alliance the more advantageous scoring periods during the match. We have a variety of unique autonomous programs designed to accommodate permutations of alliance capability, thereby maximizing the alliance's scoring potential.
- Autonomous routines:
 - Begin on the left, move to the middle of the field to intake FUEL, go through the right trench, and score. Then L1 climb (8 preloads, ~35 floor FUEL).
 - Begin on the right, move to the OUTPOST, score, then L1 climb (8 preloads, 24 OUTPOST FUEL).
 - Begin on the right, move to the middle of the field to intake FUEL, go through the left trench, and score (8 preloads, ~35 floor FUEL). Then L1 climb.

Tele-Operated Period (2 Minutes, 20 Seconds)

- During Teleop, HUBS alternate between active and inactive states based on Autonomous results.
 - When our HUB Is Active: Prioritize rapid FUEL scoring, dump large payloads efficiently, cycle from DEPOT or NEUTRAL ZONE, and minimize congestion at BUMPS.
 - When our HUB Is Inactive: Collect FUEL, stage near scoring location, play controlled defense, and prepare for the next activation window.
- FUEL may be controlled in unlimited quantities, so intake efficiency and cycle time are critical.
- Optimize Alliance points by leveraging each robot's strengths.
- Ensuring FUEL is in our scoring zone through defense, stealing FUEL from the opposing alliance's scoring zone, and passing is a top priority to create the highest scoring deficit possible in our favor.

Endgame (Final 30 Seconds)

- All HUBS become active during Endgame, allowing more scoring.
- Robots may climb the TOWER to earn additional points and secure the TRAVERSAL RP.
- Endgame priorities:
 - Ensure lead over opposing alliance during active hub period, whether by climbing or scoring.
 - Secure TRAVERSAL RP threshold.

DESIGN PROCESS

GAME ANALYSIS

REBUILT™ focuses on two primary challenges: efficiently cycling FUEL into the HUB during shifting activation windows and climbing the TOWER before time expires. Our overarching goal is to create a robot capable of consistently performing high-output autonomous routines, maintaining fast and tolerant FUEL cycles during active HUB periods, and rapidly and reliably climbing during Endgame. We believe these three primary qualities will define a well-performing robot.

- **High Scoring and Adaptable Autonomous Programs:** Starting strong in *REBUILT* is critical to establishing early momentum and influencing HUB activation timing. Some autonomous routines will focus on scoring preloaded FUEL, while others may collect additional FUEL from the DEPOT or NEUTRAL ZONE before shooting. Having multiple prepared, autonomous routines allows us to adapt to different alliance configurations and field-congestion scenarios. A strong autonomous program not only builds an early score advantage but also positions the team optimally for the first Teleop cycle.
- **Tolerant and Efficient Cycles:** Cycles represent the collection and scoring of FUEL into the HUB. In *REBUILT*, robots may control any number of FUEL at a time, making cycle efficiency and intake throughout critical to maximizing scoring potential. Because HUBS alternate between active and inactive states during Teleop, optimizing cycle timing is essential. A tolerant mechanism reduces cycle time by expanding intake forgiveness, allowing for imperfect alignment, and eliminating unnecessary driver corrections. Reducing robot rotation and enabling efficient pathing between intake and shooting locations will significantly improve scoring consistency.
 - Reliable yet flexible maneuverability over and under field obstacles, such as the trench and the bump, is also extremely important for maximizing cycle times and scoring potential by permitting a variety of different playstyles and routes during the match.
- **Rapid and Reliable Engagement with the Tower:** In *REBUILT*, our team found that during the endgame period, scoring FUEL in the HUB was a more efficient means of securing points over climbing the TOWER. With that said, building a robot capable of climbing the TOWER is extremely important during the autonomous period, as it earns bonus points for a successful autonomous climb. A reliable climb, even if only on a low rung, executed consistently during the autonomous period, will provide strong scoring value while minimizing risk. Our robot must maintain a low and balanced Center of Gravity to ensure stability while hanging. Doing so not only helps us win the match but also builds towards the TRAVERSAL RP, further boosting our overall competition ranking.

DESIGN PROCESS

DESIGN REQUIREMENTS

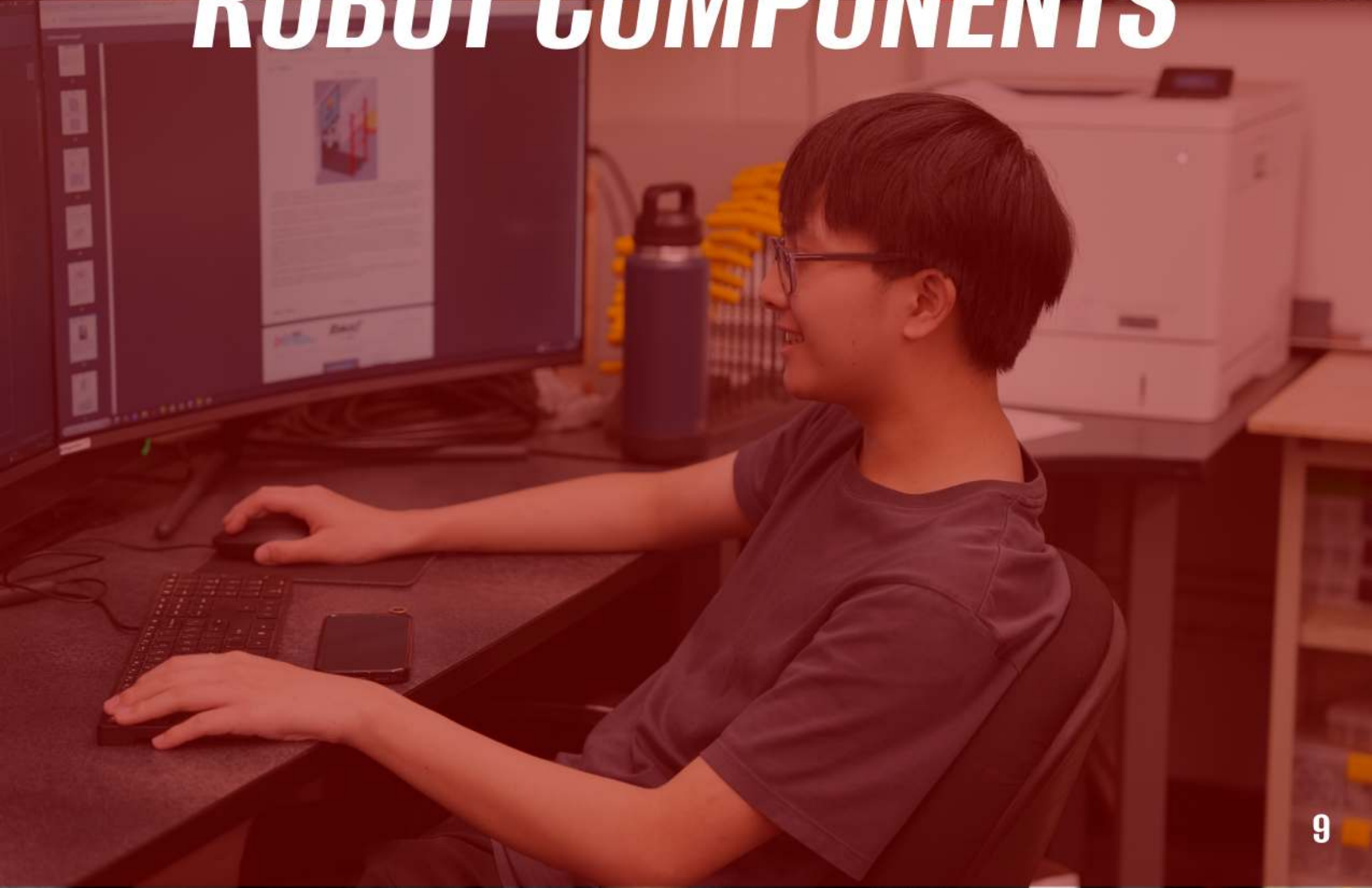
- **High-Output and Adaptable Autonomous Programs**
 - Autonomous Capable of Scoring Preload FUEL Reliably
 - Multi-Piece Autonomous Routines
 - Iterable and Modular Path Planning
 - Precise Trajectory Following
 - Variety of Starting Configurations
 - Rapid Post-Auto Positioning
- **Tolerant and Efficient FUEL Cycles**
 - Swerve Drive for Maneuverability
 - Field-Centric Driver Control
 - Vision Targeting (AprilTag-Assisted Alignment)
 - High-Throughput Roller Intake
 - Wide Intake Tolerance
 - Automatic Intake Stopping
 - Smooth Motion Profiling
 - Protected Traversal Over BUMPS
 - TRENCH-Compatible Robot Height
- **Rapid and Reliable Tower Engagement**
 - Actuatable Climbing Mechanism
 - Redundant and Robust Structural Design
 - Stable Center of Gravity
 - Fast Alignment System
 - Strict Software Protections During Climb
 - Controlled and Repeatable Deployment

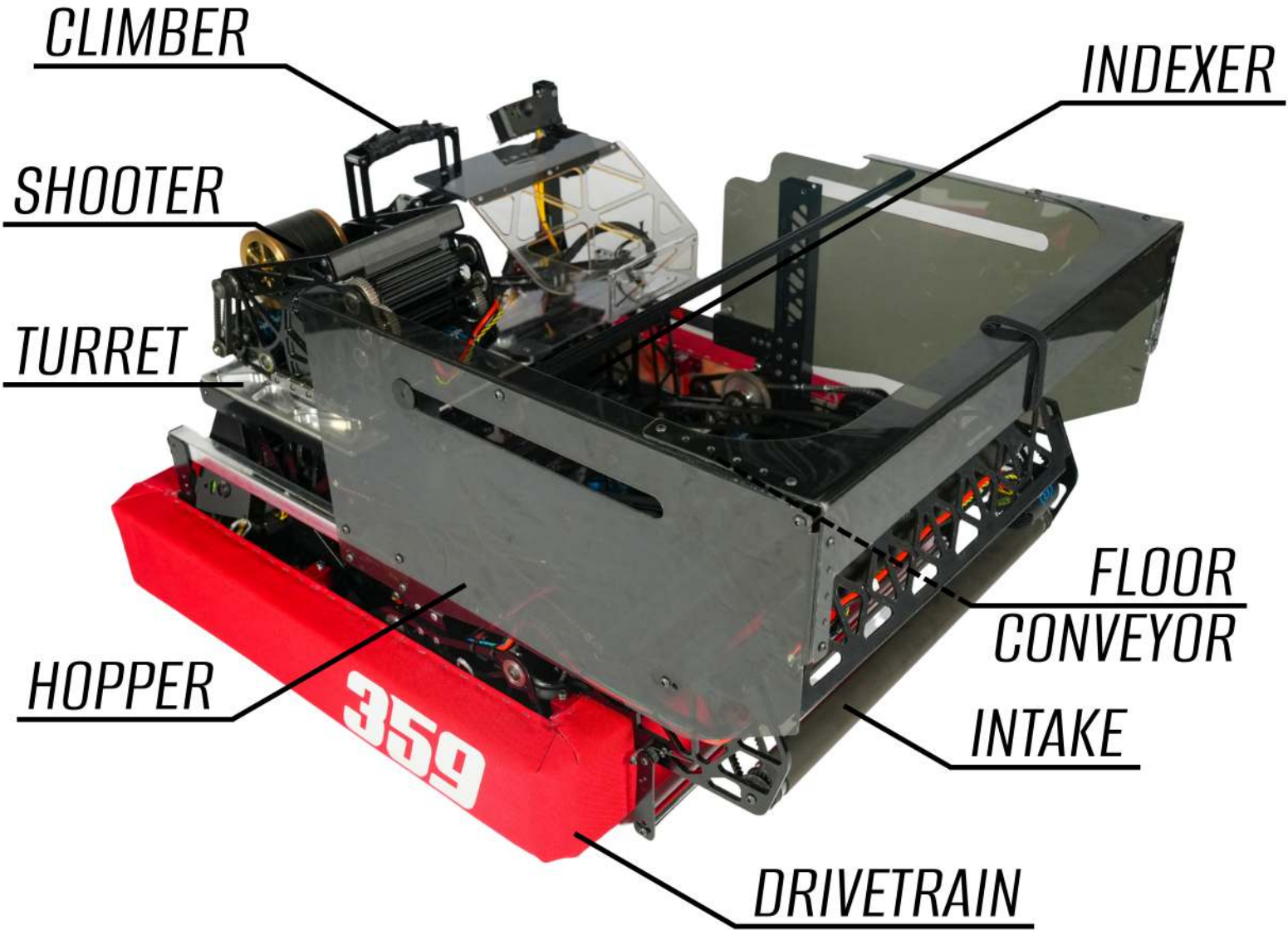
DESIGN DESIRES

- Manual Override on all Systems
- Reduced Software Reliance During Scoring
- Odometry-Based Robot Positioning
- Vision-Based Alignment Correction
- Modular Subsystem Integration
- Minimal Maintenance Between Matches



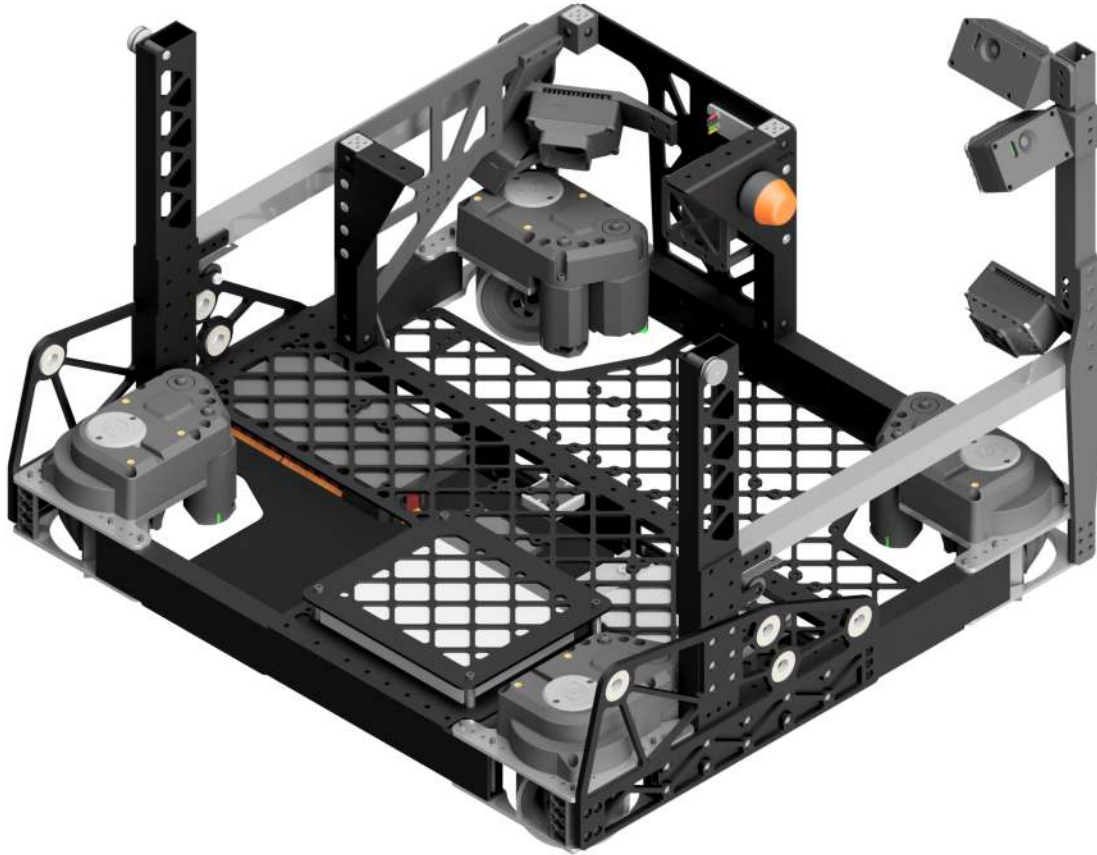
ROBOT COMPONENTS





POI POUNDER XXVII

DRIVETRAIN



The swerve drive consists of four modules: Each of which includes two motors that can rotate a single drive wheel along both its x and z axes. The result is a drive base capable of concurrently translating and rotating omnidirectionally. Manufactured by Swerve Drive Specialties (SDS), the modules are capable of traversing 19.2 feet per second.

SDS Mk5n R3 Modules (4 Total)

Steering Motor

- Kraken X44 Motor
- 26.09:1 Steering Reduction

Driving Motor

- Kraken X44 Motor
- 26.09:1 Steering Reduction

Wheel

- 4" Outer Diameter
- 2.25" Wide
- Molded Spike Grip

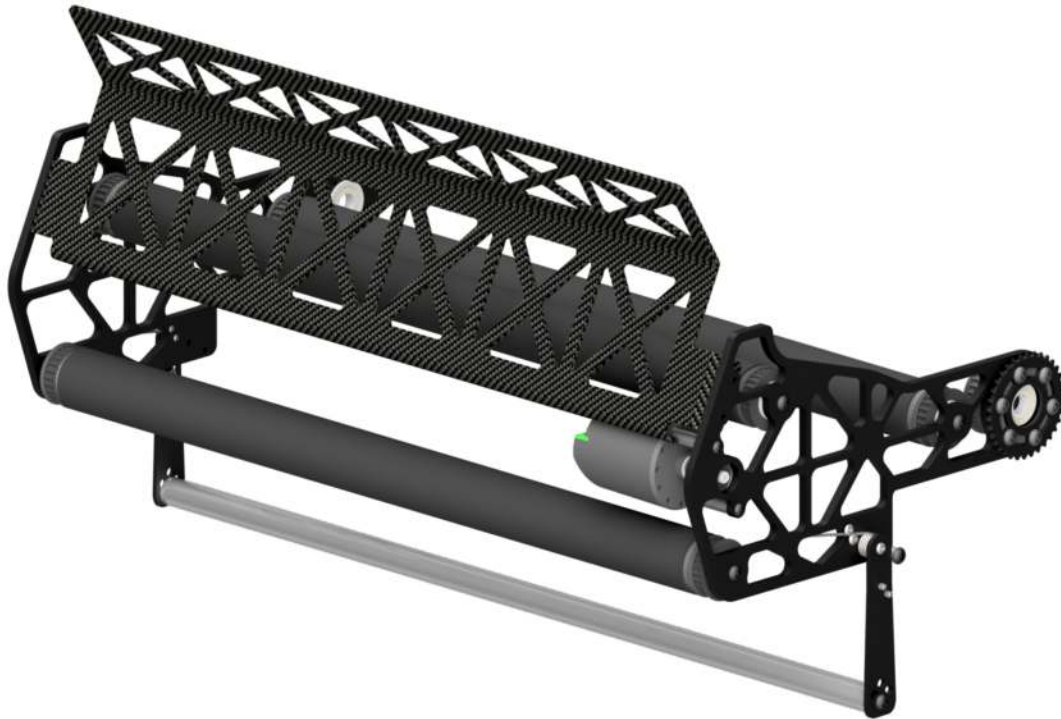
Chassis

- 28" by 26" Rectangle Frame with:
 - 2" x 1" x 0.125" Aluminum Extrusion with Inside Face Pocketed
 - 1/8" Aluminum Pocketed Half Belly Pan/Brain Pan

Sensors

- Pigeon 2.0 IMU perpetually updates the robot heading and pitch
- CTRE CANcoder on all 4 modules used for steering wheel position

INTAKE



The Intake pulls FUEL from the ground and over the bumper into the Hopper. Three full-width horizontal rollers on a motor-powered slakedown intake create a robust touch-it-own-it mechanism. The Intake deployment and retraction also work to actuate the prismatic extension of the sliding hopper.

Structure

- ¼" Pocketed Aluminum 7075 Sideplates
- ⅛" Pocketed Bent Self-Reinforced Polypropylene (SRPP) Front Guard
- Profiled top of the sideplates allows the shaft from the sliding Hopper to ride on when the Intake deploys and retracts

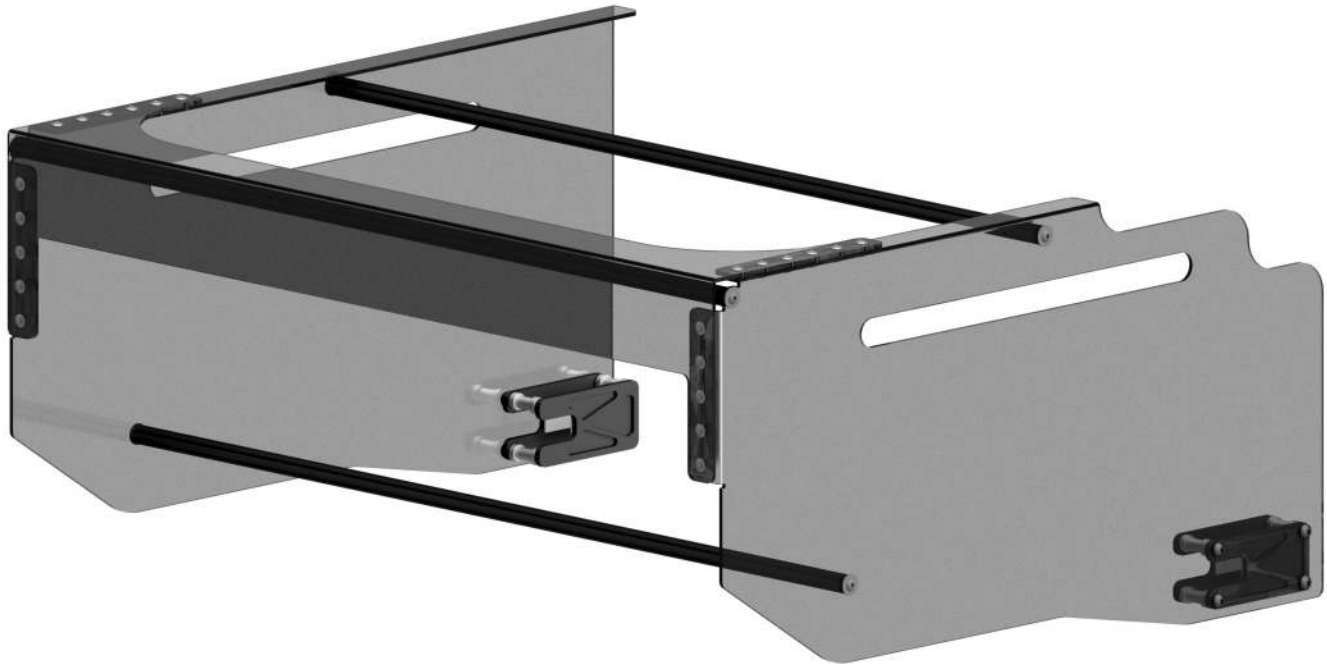
Deployment

- (1) Kraken X44 Motor, 50:1 Gear Ratio
- Driven by #25 chain on a coaxial shaft that drives the floor belts
- ½" Thunderhex jackshaft spans the frame width that drives both sides of the pivot
- Spring-loaded ¾" Aluminum Kicker Bar that deploys at the start of the match

Rollers

- (1) Kraken X60 Motor, 1.60:1 Gear Ratio
- (3) 1.5" OD Polycarbonate tubes wrapped in silicone belt-driven dead-axle rollers
- Back Kicker Roller is driven by a belt connected to a coaxial shaft that also drives the Floor Conveyor with a Kraken X60 on a 6.30:1 reduction

HOPPER



The Hopper stores FUEL from the Intake and keeps it inside the robot until they are to be shot. The entire Hopper assembly is on lateral rails, which allow it to slide outside the frame perimeter along with the Intake to maximize FUEL storage capacity.

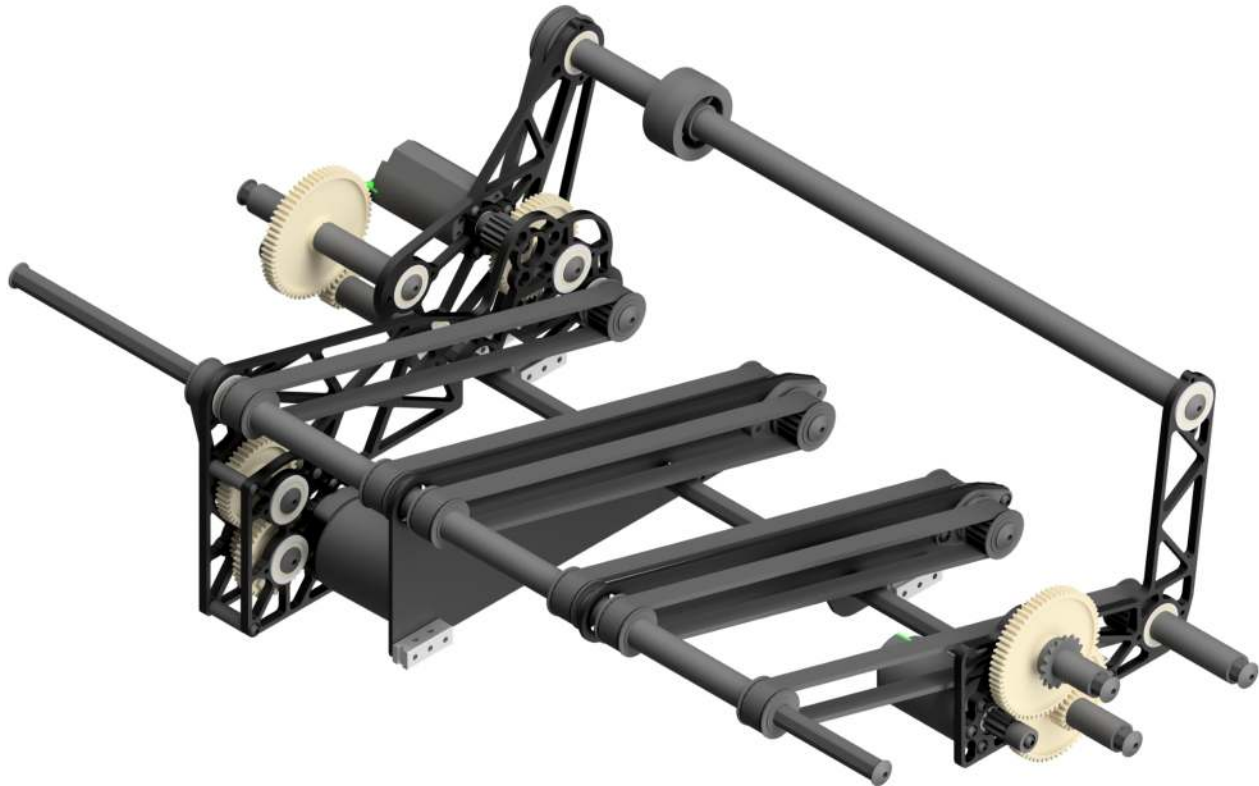
Structure

- 1/8" Polycarbonate Front and Side Plates
- 1/2" Hex Lite Shafts (Used as Standoffs)
- 1 x 1 x 1/16" Aluminum Extrusion
- Provides a rail for the Hopper bearing blocks to slide on
- 2 x 1 x 1/16" Pocketed Aluminum Extrusion
- Provides a mounting location for the Hopper rail tube

Deployment

- Expands and retracts in tandem with the Intake pivot that slides along the bottom support shaft of the Hopper
- Custom bearing blocks that clamp to the sides of the Hopper that slide along the 1x1s with constant force springs that assist deployment
- Slots on the sides of the side plates roll on bearings to ensure smoother Hopper movement and prevent misalignment.

FLOOR CONVEYOR



The Floor Conveyor feeds the FUEL into the Tunnel in three lanes and helps to funnel the FUEL. The belts span a majority of the front of the frame which control the flow of FUEL to the top roller that feeds into the Tunnel.

Structure

- ¼" and ⅛" Pocketed Aluminum Support Plates
- ½" Rounded Hex Shafts

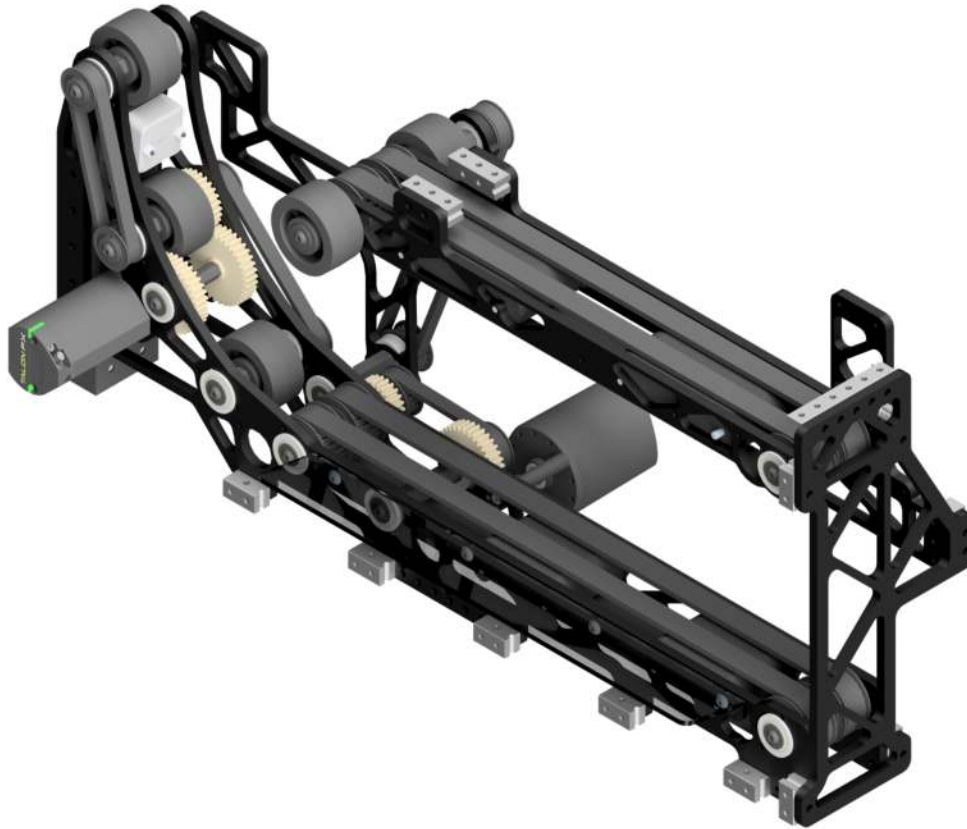
Belts

- (1) Kraken X60 Motor, 5.04:1 Gear Ratio
- Linked to Intake Kicker Roller, 6.30:1 Gear Ratio
- Three FUEL wide lanes with two sets of 18T Pulleys with 15mm belts
- At a slight downwards angle to help FUEL feed into the Top Roller

Top Roller

- (1) Kraken X44 Motor, 4.17:1 Gear Ratio
- (1) 2" Stealth Wheel with 0.75" OD spacers spanning the three lanes

INDEXER



The Indexer consists of two integrated mechanisms – the Tunnel and the Accelerometer – which work together to transfer FUEL from the Hopper to the Shooter. The Tunnel organizes and aligns the FUEL into a single, controlled stream using synchronized top- and bottom-timing belt conveyors. The Accelerometer then increases the FUEL's velocity using a series of powered wheels, delivering it upward into the Turret for shooting.

Tunnel + Accelerometer Structure

- Integrated into a unified structural assembly consisting of two parallel ¼” pocketed aluminum plates
 - Plates are spaced using standoffs and reinforced with a 2" x 1" x 1/16" aluminum tube
- The entire assembly mounts to the bellypan and turret frame via Nut Strips

Tunnel

- (1) Kraken X60 Motor, 1.88:1 Gear Ratio
- Top and bottom conveyors each have two side-by-side 15mm wide belts

Accelerometer

- (1) Kraken X44 Motor, 1.46:1 Gear Ratio
- (3) 2” Stealth wheels and custom lathed 2.5” Colsons are used to accelerate FUEL into the Turret

TURRET & SHOOTER

TURRET

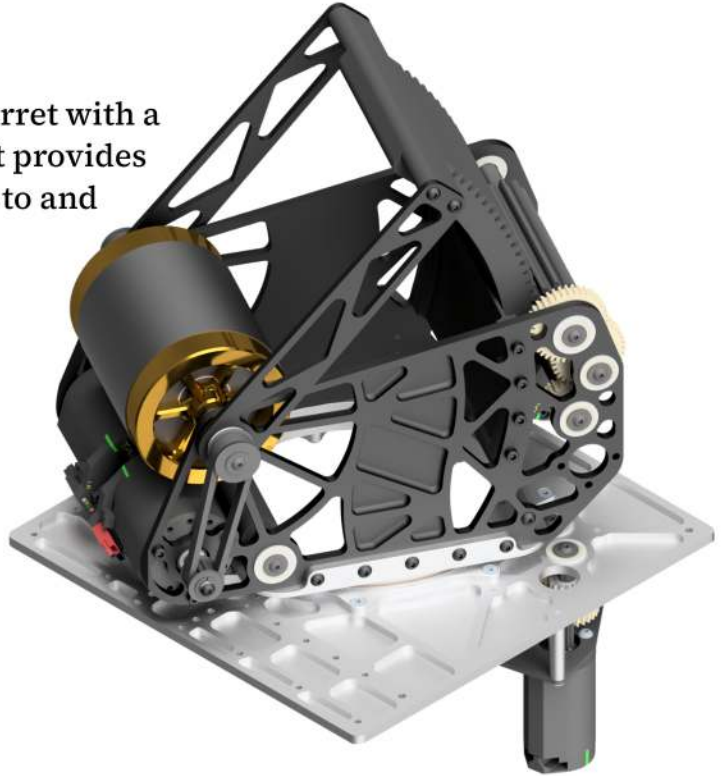
To enable accurate shooting while moving, a Turret with a large range of motion was necessary. The Turret provides a rigid mounting point for the Shooter to attach to and is biased to the back-left corner of the robot.

Structure

- 7.5" ID X-Contact bearing held by clamping rings inside a ¼" half-pocketed aluminum
- Custom 85T, 10DP gear machined from ¼" aluminum plate
- ±200° (400° total) Rotational Mobility

Gearbox

- (1) Kraken X44 Motor, 50:1 Gear Ratio



SHOOTER

The high accuracy, large shooting range, and volume of FUEL shot drove the need for a flywheel shooter with a lot of moment of inertia, grip, wrap (acceleration time), and an adjustable hood.

Structure

- ¼" Pocketed Aluminum Side Plates (Half-Pocketed in the Ballpath)
- ⅛" Adjustable Hood Side Plates
- 3D-Printed back ramp provides a surface for the FUEL to compress against when shot

Flywheel + Accelerator Wheels

- (2) Kraken X60 Motor, 1:1 Gear Ratio
- (3) 4" 60A Durometer Stealth wheels
- (2) SDS 4" Brass Flywheels (trimmed off ⅜" from each side) on the outside to increase shooter moment of inertia
- (5) 1" 60A Durometer Sushi Rollers below act as Accelerator Wheels

Adjustable Hood

- (1) Kraken X44 Motor, 167.50:1 Gear Ratio
- 3D-Printed sector gear and pinion create an articulating hood
- 28° Range of motion

CLIMBER



Used to climb the Ladder in both Autonomous and Endgame to achieve a Level 1 Climb. Uses a simple design of a winch and pulley to lift off the floor.

Structure

- $\frac{1}{8}$ " Aluminum Mounting Plates
- 1.5" x 1.5" x 0.0625" Aluminum Box Tubing (Outer Fixed Stage)
- 1" x 1" x 0.125" Aluminum Box Tubing (Inner Moving Stage)
- $\frac{3}{16}$ " "House-Shaped" Aluminum hook allows for easier climb alignment

Deployment

- (1) Kraken X44 on a MAXPlanetary, 45:1 Gear Ratio with a Brake
- Constant force springs pull the Climber up (0.010" Thick, 4.12 lb Load)



CONTROL SYSTEMS

SIMULATION

- All subsystems validated using real physics based simulation.
- Robot interacts with simulated game pieces and game elements.
- Enables a quick and easy testing environment.
 - Base robot code can be developed before the physical robot is built.
 - Some features are easier to develop with a full robot simulation.
 - Allows control system members to work in parallel (one working on the physical robot, others working on new features or bug fixes).
 - Greatly improves iteration speed and reduces hardware risk during development.

LIVE TUNING

- Almost all constants are tunable without restarting the robot.
 - In development we tune constants to any value at any time.
 - In matches, the driver can switch between two slots on the robot: A and B. The value of these two slots are defined in code.
 - Example: we need to test an experimental but crucial change to a constant. We add the experimental value to the B slot and the fallback value to the A slot. The driver tests the change in slot B, and if it fails he falls back to the A slot.
 - Speeds up development time compared to modifying the value in code and redeploying.
- In match shooter lookup table tuning.
 - There is no guarantee the lookup table we tuned at our home field works the same at the event field. The only way to tune the lookup table at the event is to tune in the match.
 - We have a tab on our dashboard dedicated to tuning this. The operator can adjust the flywheel and hood while shooting and, if the FUEL makes it in, automatically adjust the lookup table.

LOGGING

- Logging is critical to debugging issues, especially issues in a real match.
 - We log everything we can to network tables and a USB stick.
 - During matches, all 5 cameras record.
 - Useful for debugging vision issues.
- We make use of Advantage Scope's visualization features when tuning and debugging.
 - 3D field with a full-resolution robot model, with each subsystem articulable. Vision targets, trajectories, and FUEL are modeled in simulation.
 - Graphs are used to tune subsystems.

LOGGING (CONTINUED)

- Logs are replayable.
 - Each log is split into two parts: inputs (controller inputs, motor states, sensor states, etc.) and outputs (motor applied outputs, dashboard values, LED colors, etc.). When we replay a log, we feed the inputs into the robot code and get new outputs. If we make changes to the code since the time the log was originally generated, the outputs will be different.
 - There are many applications for this, but the most important one is testing fixes to issues that are hard to recreate. We can use the inputs from a match where we had issues and test our changes by running our updated code on them.

FIVE CAMERA VISION

- Five Limelight 4s cooled with the off the shelf cooling system we sell.
 - Cooling means the Limelights function in the same thermal settings in testing at home compared to in a match.
- Due to technical constraints, we decided a five camera setup (all cameras static) would be easier to build and program rather than adding a camera to the turret.
- All five cameras are positioned in a way to get a 360o view from the robot.
- Custom vision filtering.
 - All April tags except the hub April tags are filtered out.
 - Out of bounds, invalid, or estimates with high ambiguity are filtered out.
 - Both MegaTag1 and MegaTag2 are used.
 - MegaTag1 is used to update the robot's estimated rotation. MegaTag1 is very inaccurate at times so we assign its estimates with low trust and require two tags in view.
 - MegaTag2 is used to update the robot's estimated translation. MegaTag2 is much more accurate so we assign its estimates with high trust.
- This vision system along with swerve drive odometry results in a smooth accurate position estimate which is still capable of reacting quickly to slippage or error in position.

SHOOT ON THE MOVE

- We use shoot on the move to make extra use out of the time spent driving between locations. To pull this off, we added an extra column in our shooter lookup table: FUEL flight time. We use that extra data to guess where the robot should aim to counteract the momentum from the drivetrain transferring to the FUEL.
- Shoot on the move is inaccurate at high acceleration, so we limit drivetrain acceleration. This is not necessary when passing to our alliance zone because the target is so large.

AUTOS

- We use PathPlanner to create our autos. We split up our autos into modular paths then sequence those paths into an auto.
- PathPlanner allows us to easily iterate on our autos.
 - Full autos can be prepared and working in simulation, so when it comes time to develop them on the physical robot, we spend less time getting them to work.
 - Minor modifications can be made to an auto before a match, and with simulation, we can be confident it will work.
- Climbing requires a lot of precision, so instead of using PathPlanner, the robot switches to a point-to-point controller. Our point-to-point controller uses profiled PID controllers for translation and rotation, which are more precise than PathPlanner's time- and sample-based paths.

AUTOMATION

- We decided to go with only one driver so we can have one more driveteam member free to do other tasks (live shooter tuning, assisting the drive coach, etc). This requires that all the main robot controls be on a single controller.
- We went through many controller layouts, from more complex and stateless to fully automatic, and found the two-button control scheme the most optimal. We have one button for intaking, and one for shooting. Depending on where the robot is on the field when the shooting button is pressed, it will either score in the hub or pass to one corner of the alliance zone.
- The shooter is automatically spun up and aimed towards an alliance zone corner or the hub, depending on where the robot is located. The shooter hood is automatically lowered when traveling under the trench.

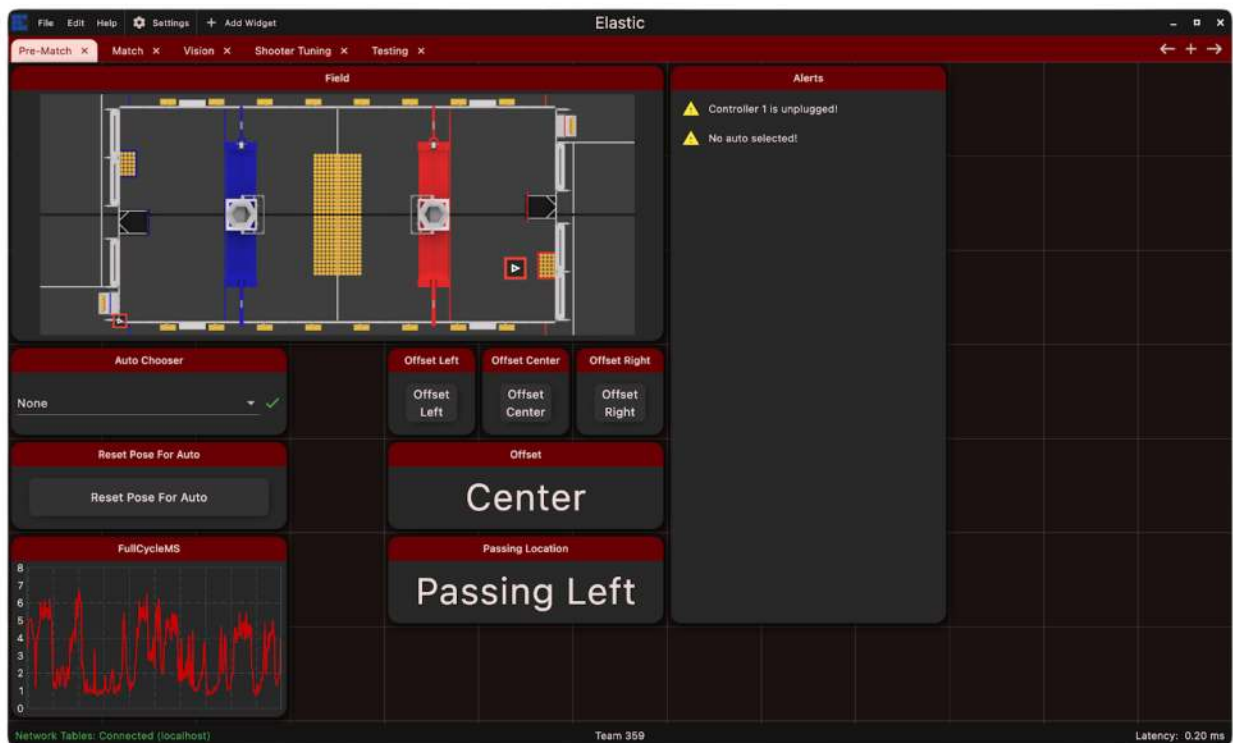
HUMAN MACHINE INTERFACE

- Pre-match setup is crucial to each match. We use a driverstation dashboard, lights, and buttons on the robot to assist with pre-match setup.
 - Robot states are shown on the pre-match dashboard along with alerts and warnings.
 - The robot continuously self-checks for connected devices and alerts the driveteam if there are any issues.
 - Lights on the robot display the state of the robot to the technician. The lights turn solid green once the robot is set up and ready.
 - There are two buttons on the robot to assist with setup.
 - Neutral mode toggle. Toggles between coast and brake modes, allowing the robot to be easily positioned for reset.
 - Reset button. Zeros the intake, turret, and hood.

HUMAN MACHINE INTERFACE (CONTINUED)

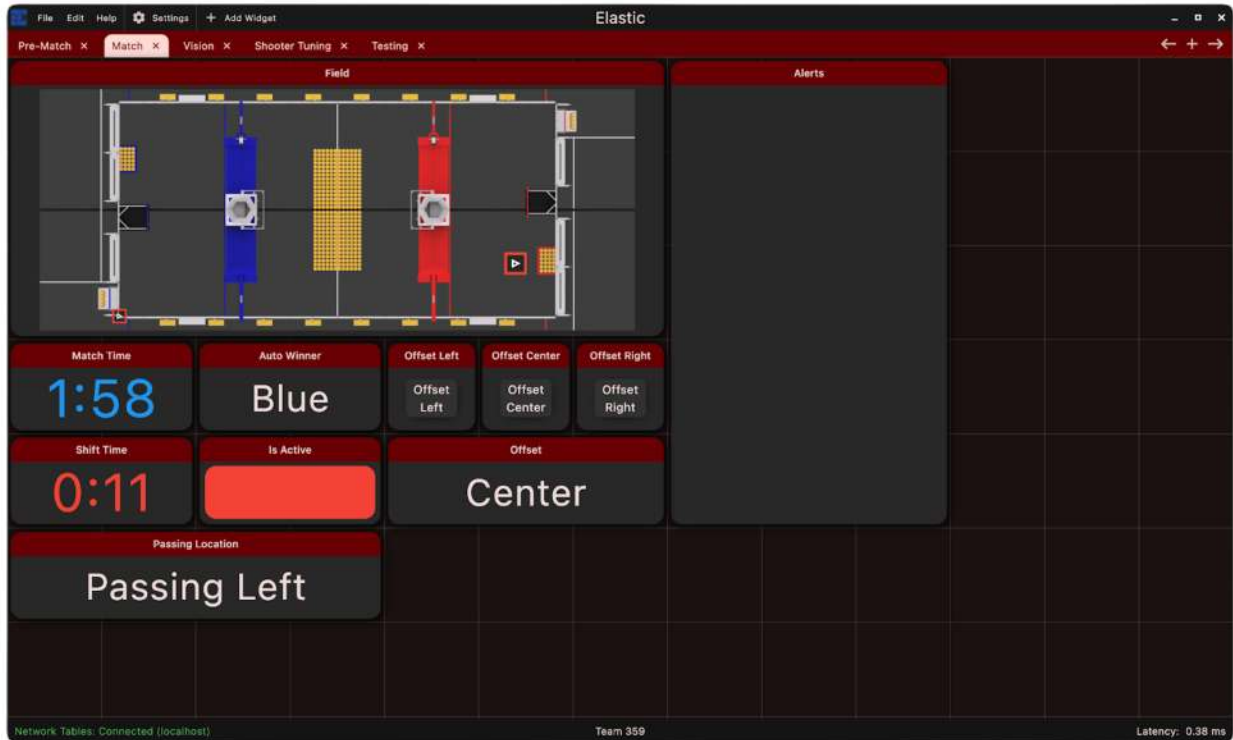
- During a match, signaling the state of the robot and the match is crucial to the match strategy. We use a driverstation dashboard and lights to signal the robot and match states to the drive team.
 - When the match starts, the dashboard tab is automatically switched to the match tab. The match tab contains the robot's position on the field, match time, shift time, and robot states.
 - Lights on the robot also display robot states. Not only is this useful for the drive team, but it's also useful for debugging issues from the stands.

IMAGES

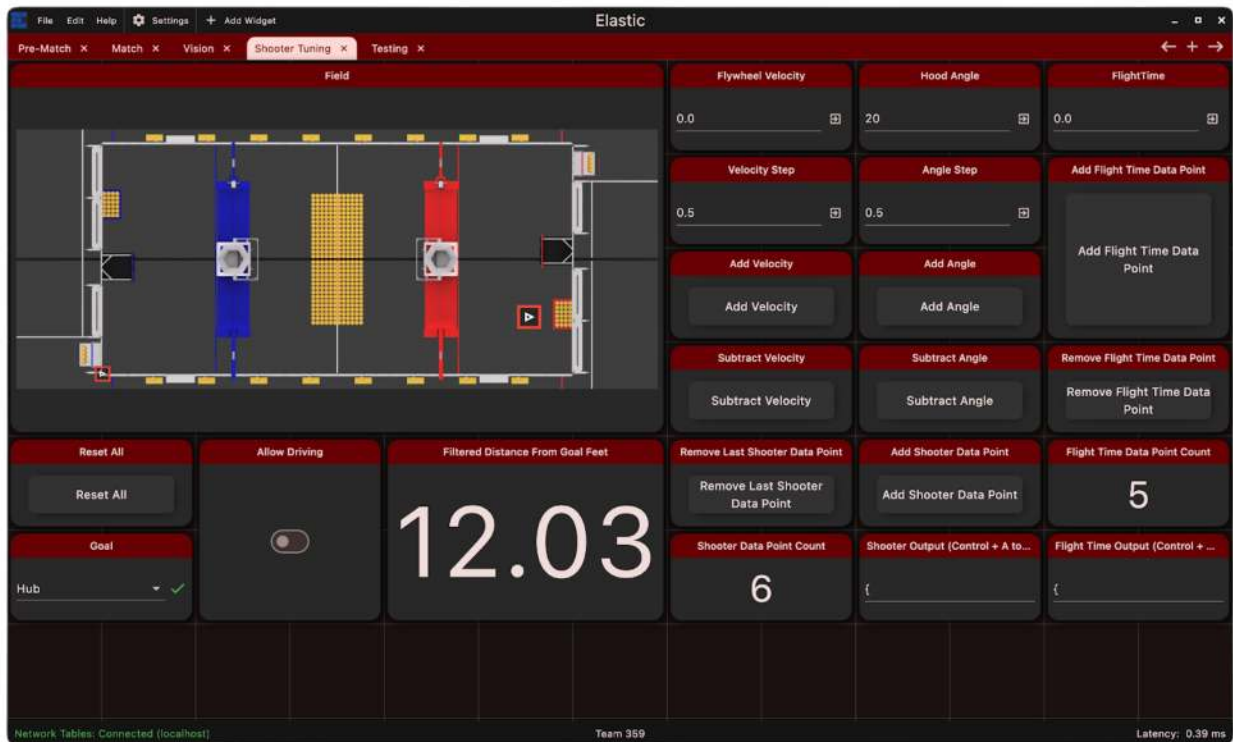


Pre-Match Driver Station Dashboard

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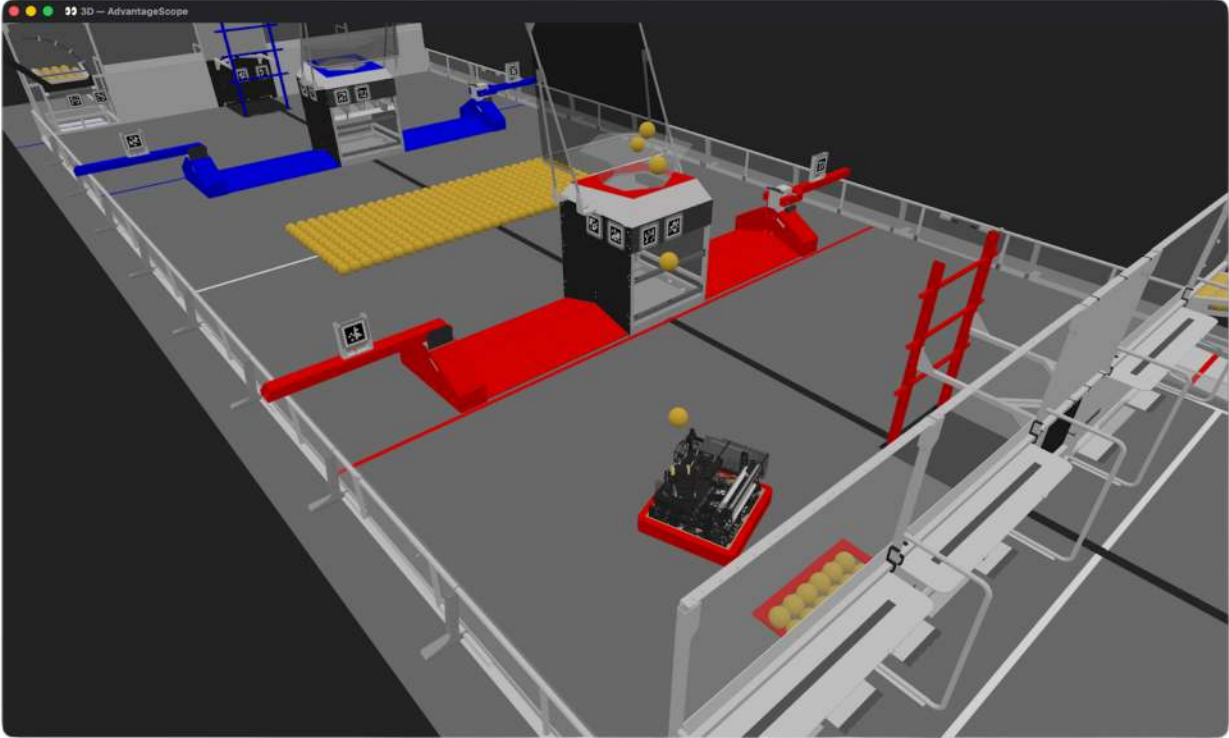


In-Match Driver Station Dashboard



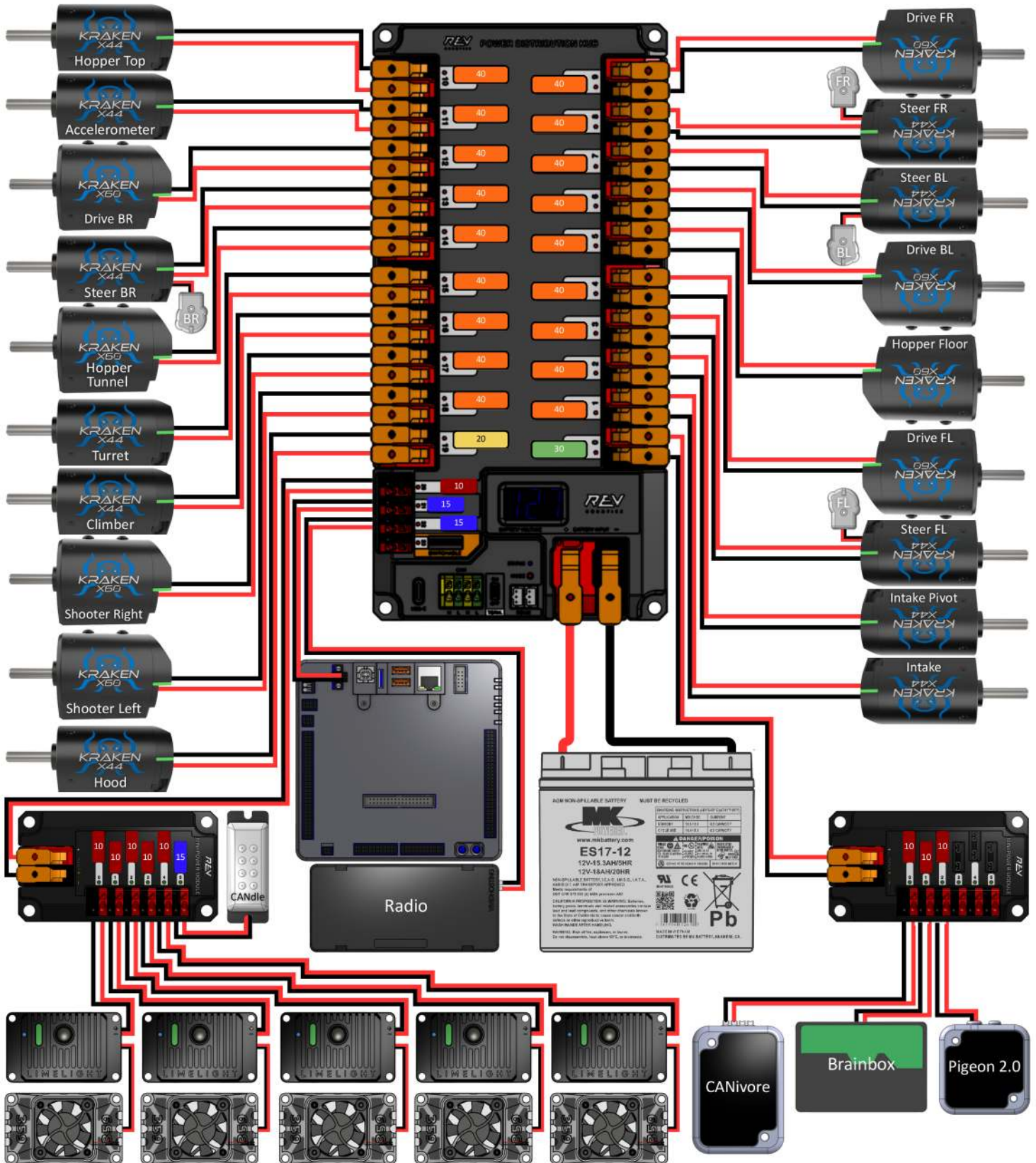
Shooter Tuning Driver Station Dashboard: Used to Create Shooter Lookup Tables

IMAGES (CONTINUED)

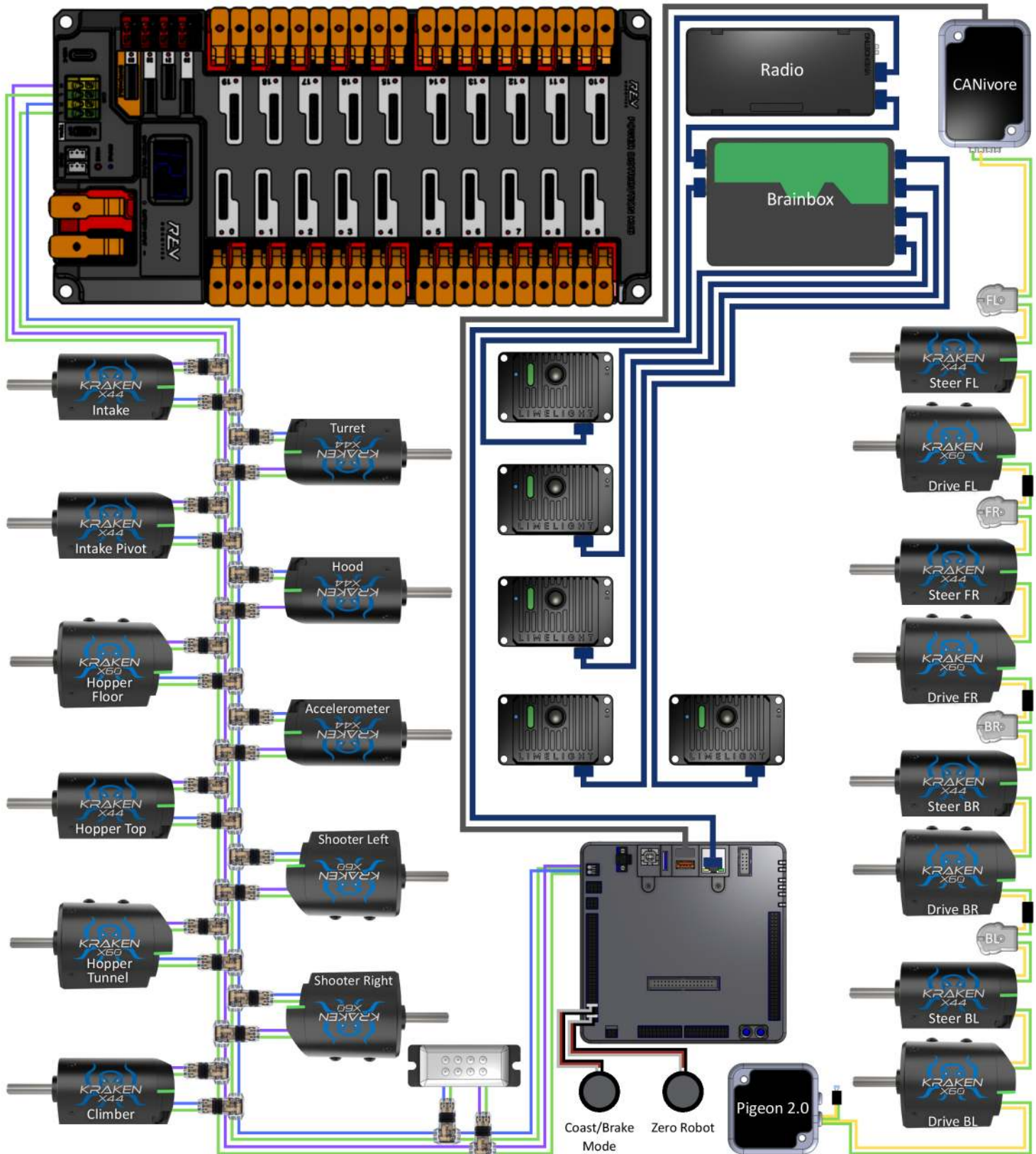


3D Field Simulation in Advantage Scope

WIRING SCHEMATICS



CANBUS LAYOUT





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