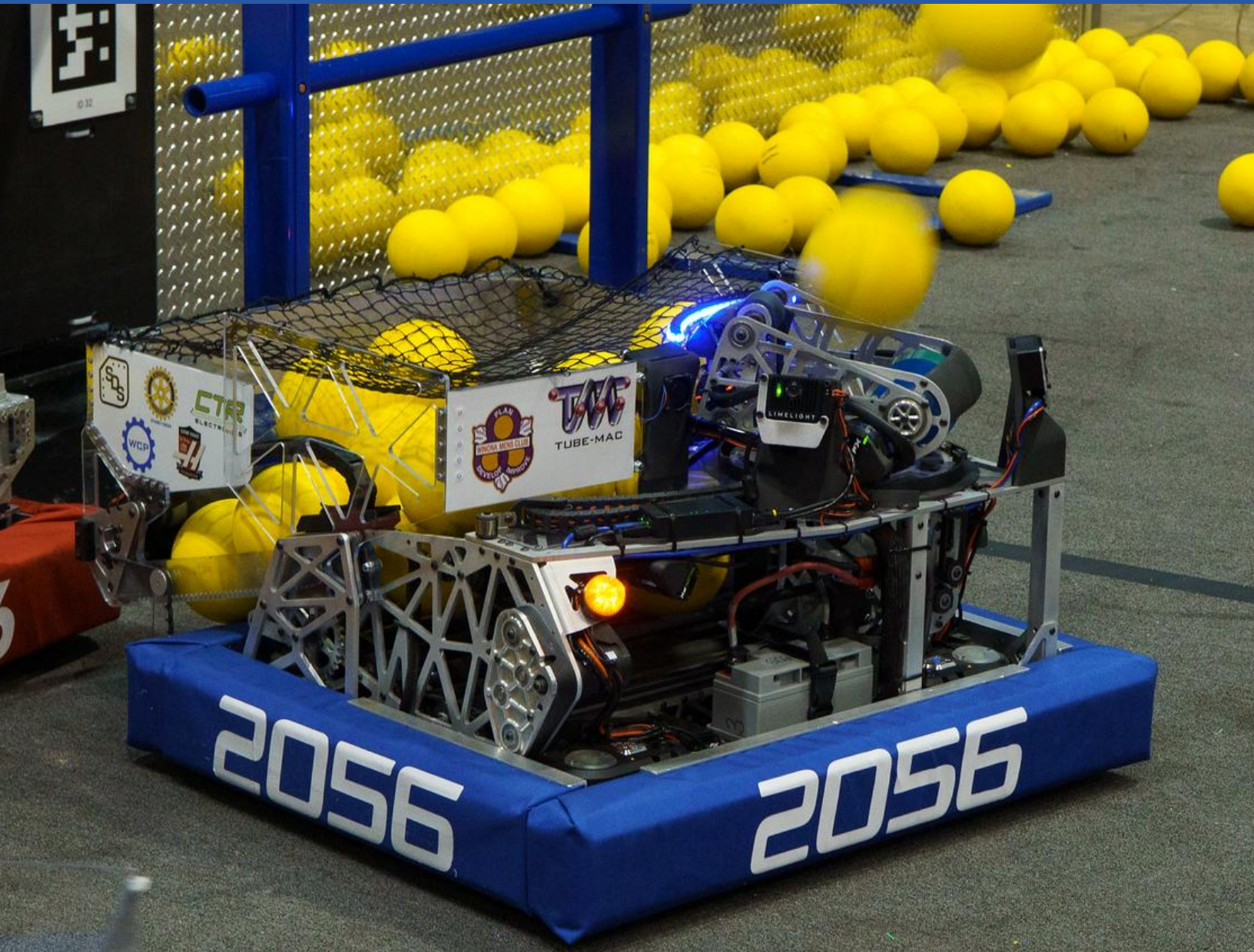


2056



DESPERATE MEASURES

Orchard Park Robotics
2026 Rebuilt Technical Binder

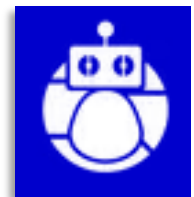
FOREWORD

This technical binder documents the design, development, and engineering behind Team 2056's robot. Great robots are rarely built in isolation. They are the result of a culmination of novel ideas and those shared throughout the FIRST community. This robot is no exception.

We would especially like to recognize and thank **Orbit - 1690**. Their approach to robot design, engineering, and problem solving provided the primary inspiration throughout our redesign process. Nearly all aspects of our robot's redesign were directly influenced by ideas we saw in Orbit's machine, and we are grateful for their willingness to share their knowledge and inspire the broader FRC community.

One of the things that makes FIRST special is that teams can compete fiercely on the field while still learning from, supporting, and inspiring one another. Orbit's work is a great example of that spirit. Their designs challenged us to think differently, question our assumptions, and push ourselves further.

We hope this binder reflects not only what we built, but also the process of learning, iterating, and improving that went into it. To everyone who has shared an idea, a design, a lesson, or a few minutes of advice with us along the way: **thank you.**



ROBOT ARCHITECTURE

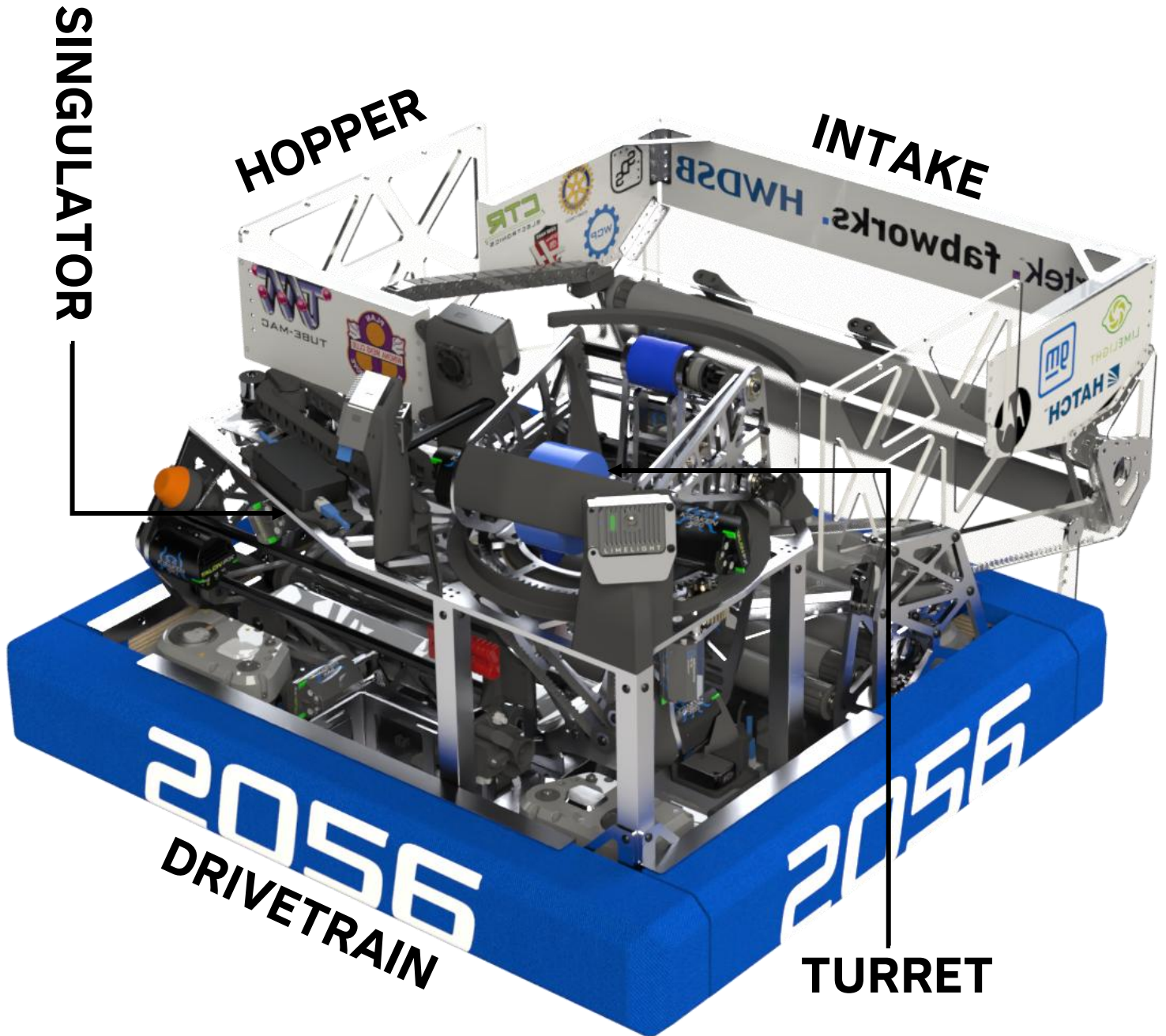


TABLE OF CONTENTS

DRIVETRAIN

INTAKE

HOPPER

SINGULATOR

TURRET

ELECTRICAL

CONTROLS

SOFTWARE

FABRICATION

DESPERATE TIMES

OUR SPONSORS



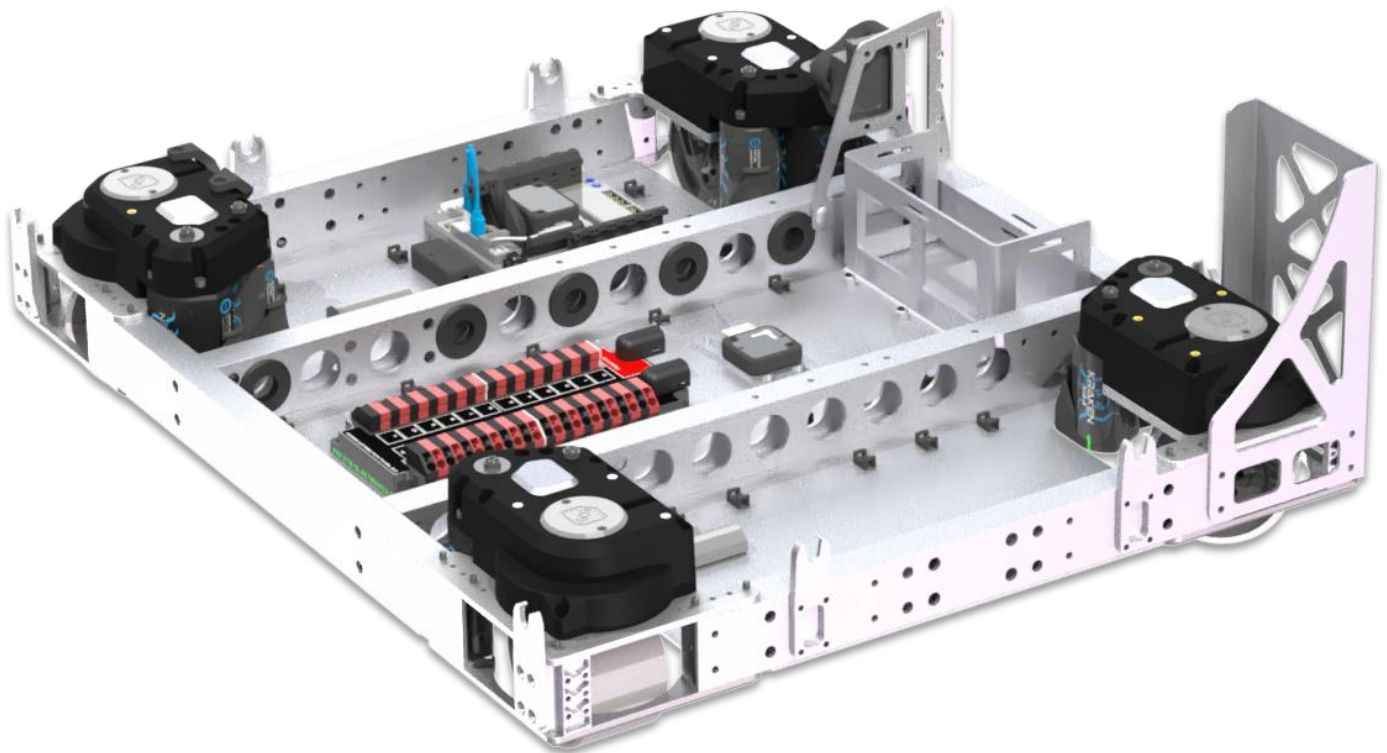
DRIVETRAIN

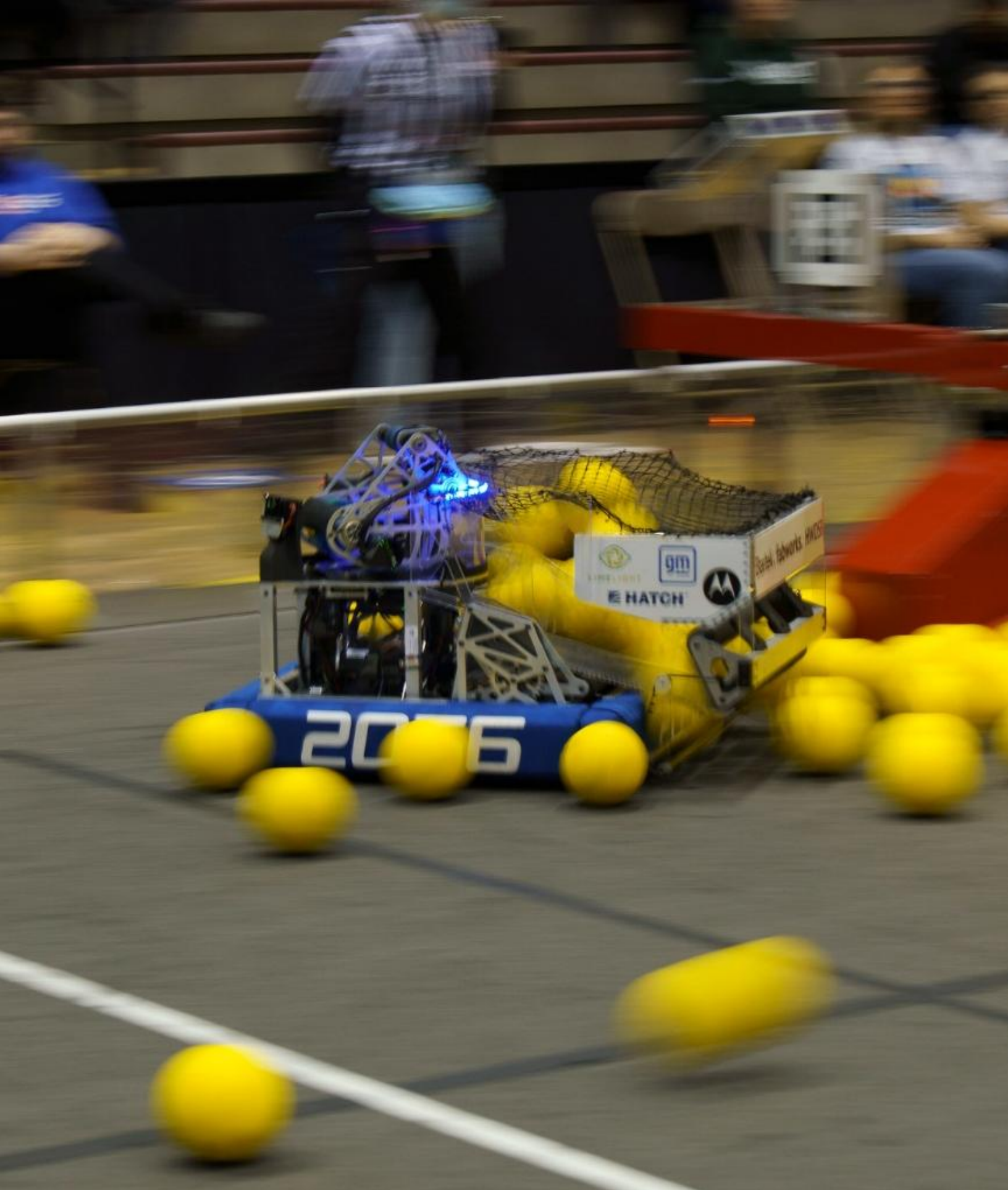
Requirements:

- Agile, responsive, and highly controllable.
- Extremely robust, rigid, and reliable.
- Low centre of mass (CoM).
- Must provide a rigid structure for mounting subsystems.

Detail:

- Constructed of 2" x 1" x 1/8" aluminum tubing and a 1/16" solid aluminum baseplate acting as a shear plate and providing a mounting surface for electronics.
- Maximum chassis size at 25.5" long by 29.5" wide to ensure stability and maximize volume.
- The corners of the baseplate are bolted, providing extra support to the rivets.
- Utilizes the **Swerve Drive Specialties MK5n** modules,
- Powered by Kraken motors, achieving a top speed of 15 ft/s. The R1 gear ratio was selected to optimize the balance between speed and acceleration, considering the short cycle distances of the game.
- SDS spike grip wheels provide maximum traction on carpet.





INTAKE

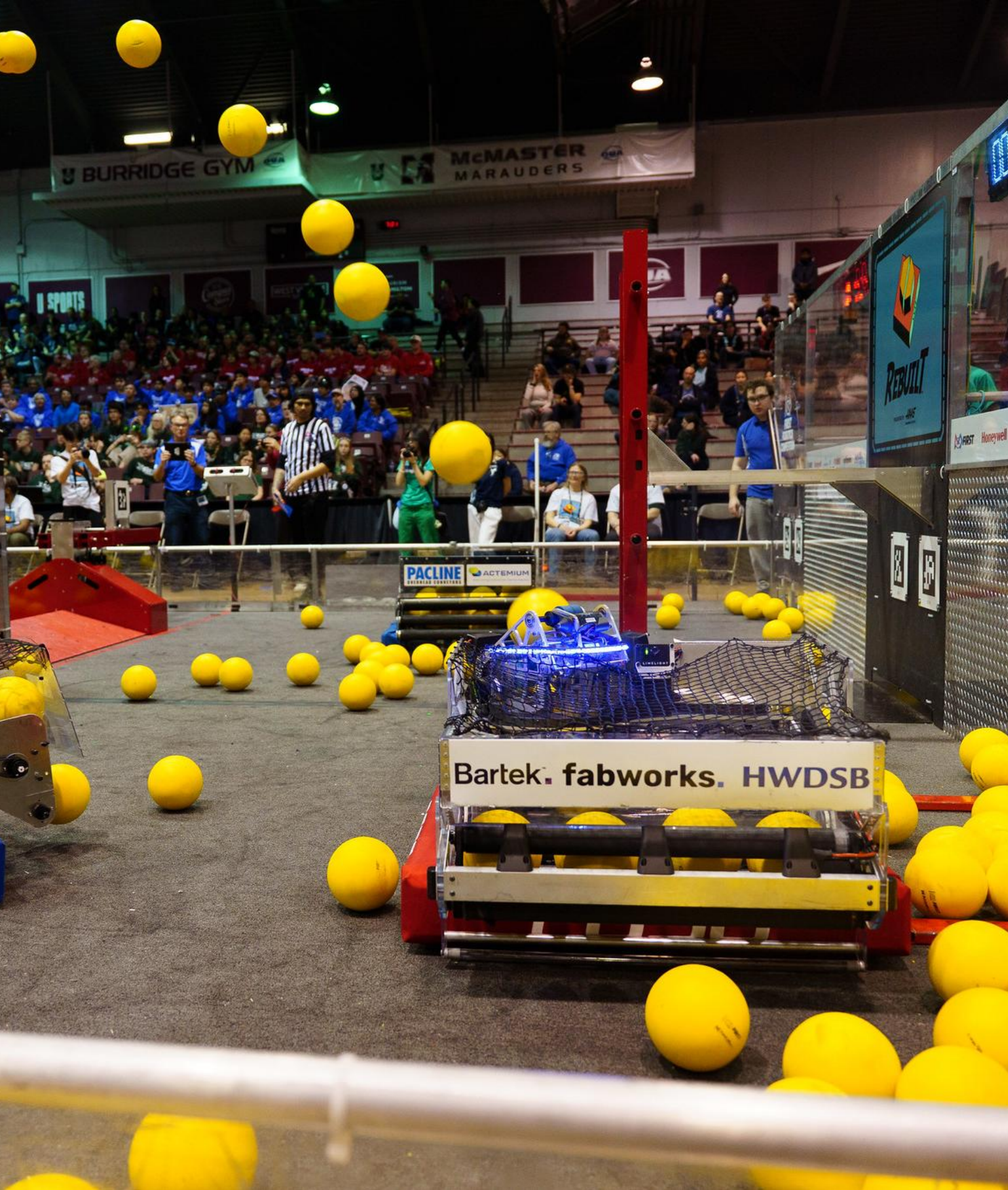
Requirements:

- Extremely robust, must withstand high energy impacts.
- Large acquisition area.
- Fast deployment.

Details:

- Linear-extending two-roller intake with robust polycarbonate side arms and 2" x 1" bash bar.
- Rollers: Two 2" polycarbonate rollers coated with WCP silicone tubing.
- Gearing:
 - 12:30 5MHTD timing belt reduction driving the 2" rollers powered by a Kraken X60.
 - 8:40 20DP spur gear reduction – 12 tooth 8DP pinion drives a rack for linear extension, powered by a Kraken X44.
- Side arms: Double-layered 1/4" polycarbonate with one acting as the rack and the other as just a structural member.
- Extension control: CTR's Dynamic Motion Magic for distinct extension and retraction speed.
- Utilized a low stator current limit allowing the intake to retract like a spring during impacts.





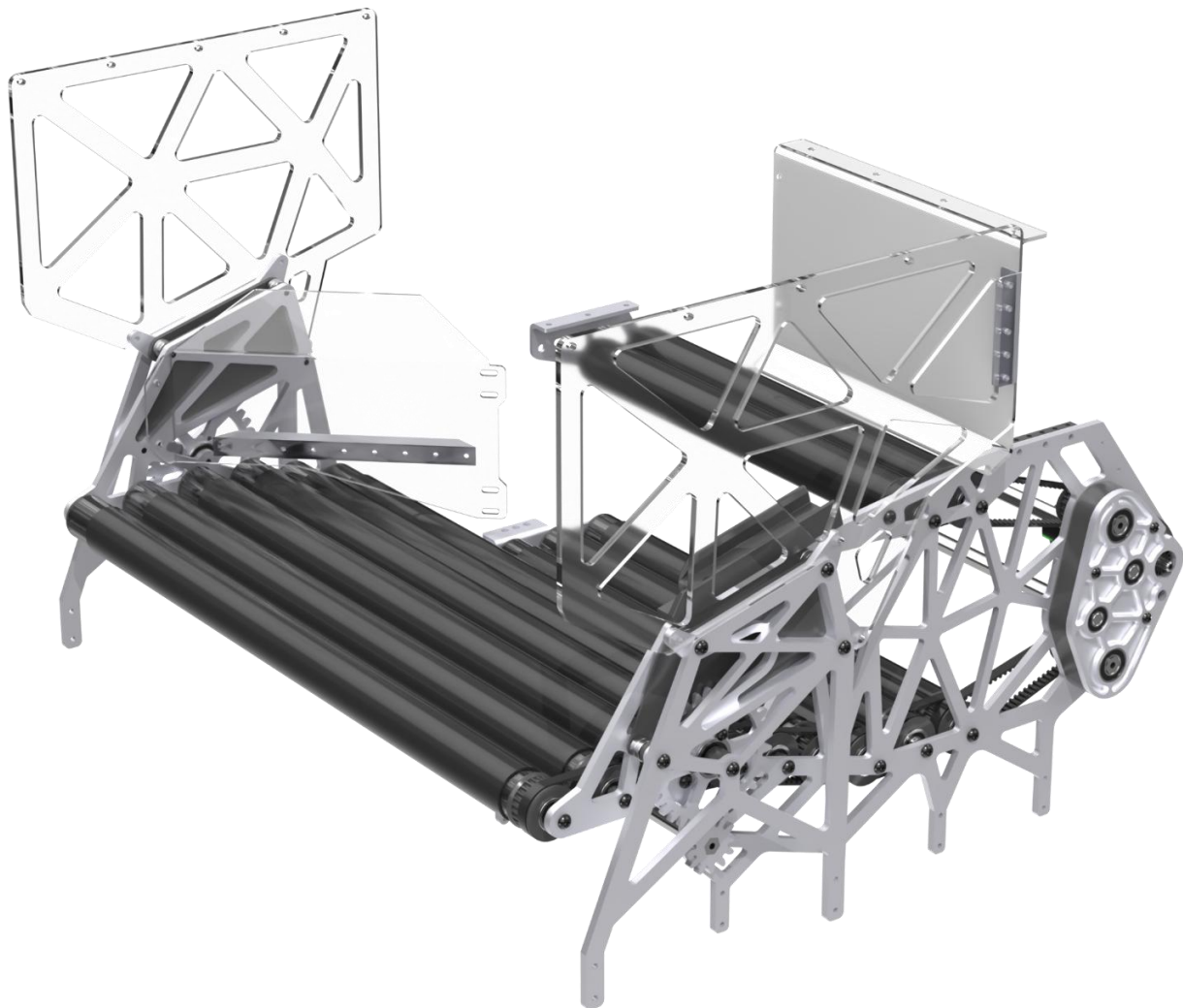
HOPPER

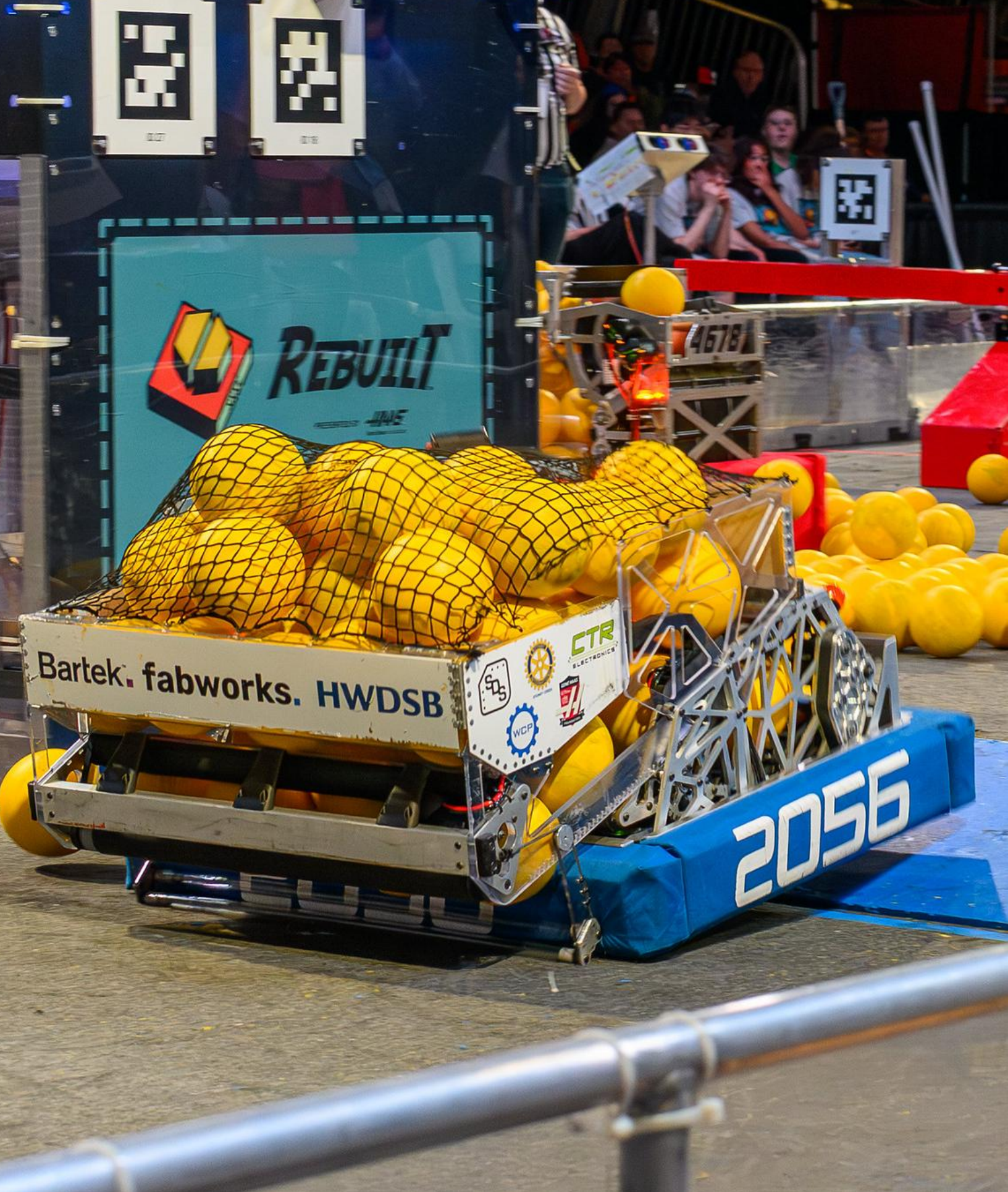
Requirements:

- Maximize fuel capacity.
- Fill completely.
- Feed the singulator.

Details:

- Active Roller Floor: 1-1/2" polycarbonate rollers covered with WCP silicone.
- Kraken X60, 14-36 20DP spur gear – 18-25 5MHTD timing belt.
- A CANrange aimed into the hopper automatically manages the hopper level when passing in the neutral zone maintaining a minimum hopper level.
- 2025 barge net top to prevent fuel from escaping the hopper.





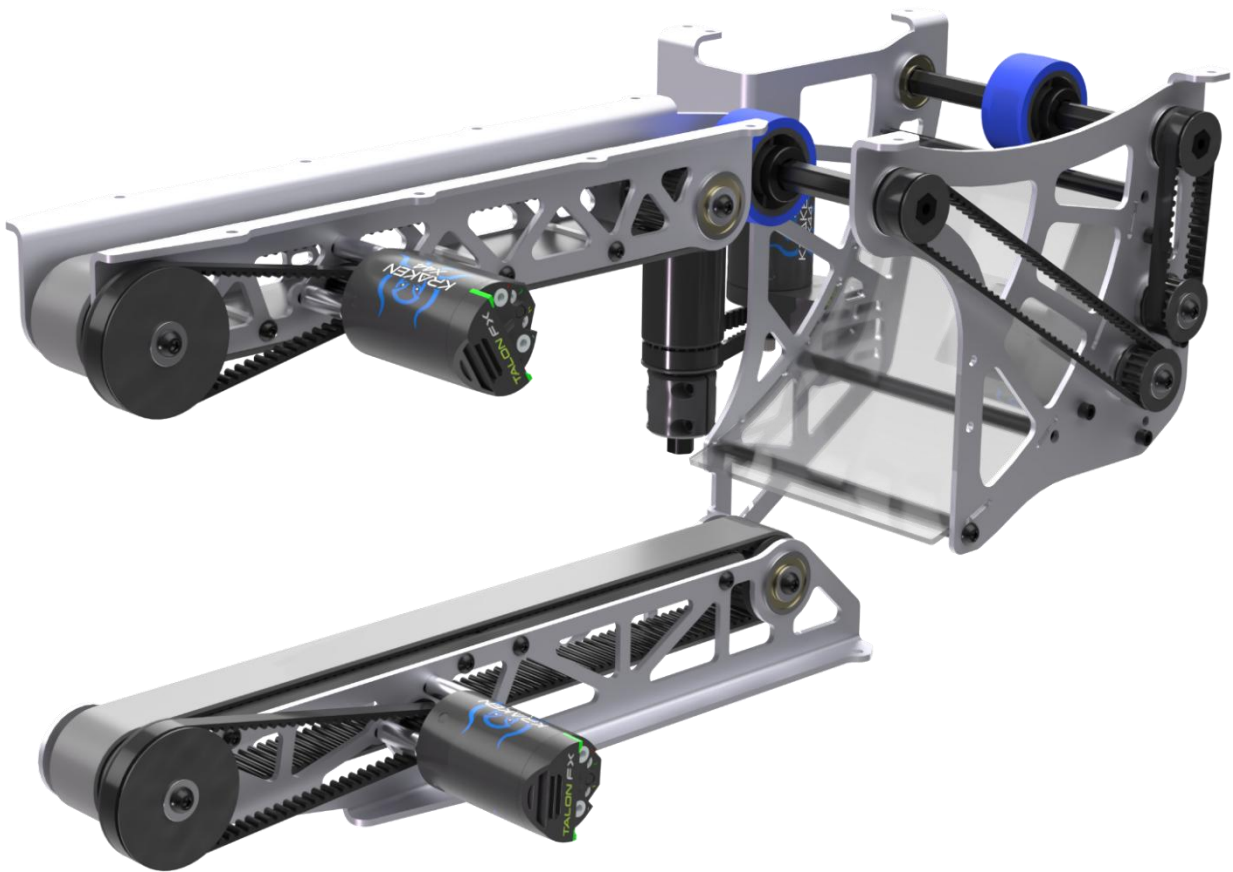
SINGULATOR

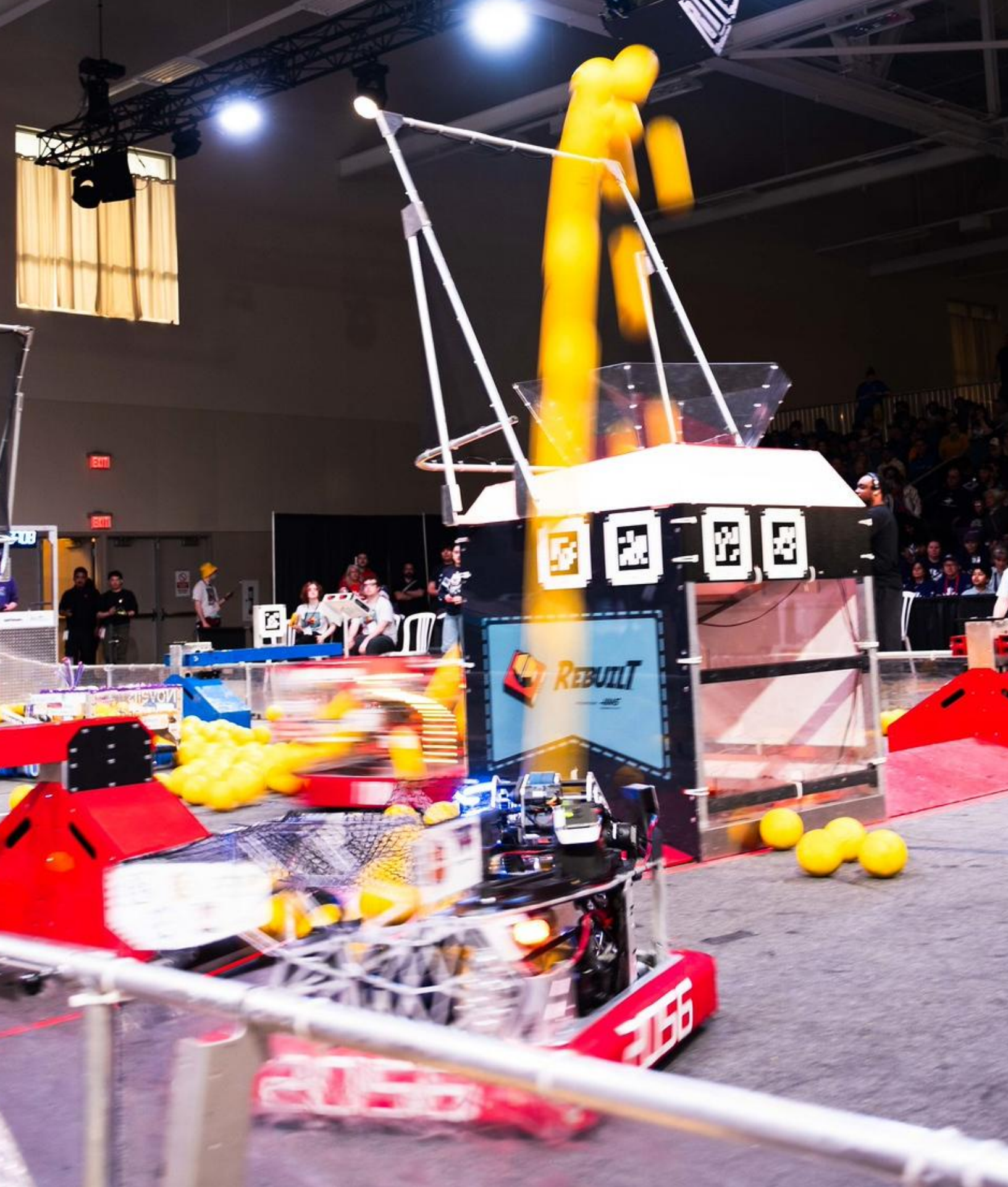
Requirements:

- Never jam.
- High throughput.
- Process fuel in mass from the hopper into a single stream.

Details:

- Dual rubber coated timing belt drive feeds fuel into the quarter pipe shooter feed rollers.
- Timing belt rides in a 3D Printed carry way to ensure consistent compression.
- 2x Kraken X44 on feed conveyors with a 12:36 5MHTD reduction and 24 tooth pulleys on the conveyor drive and idle.
- Vertical kicker roller powered by Kraken X44 to sort fuel collisions at quarter pipe infeed.
- Dual 2" stealth wheel shooter feed on Kraken X60 geared 16:28 20DP spur gear reduction.

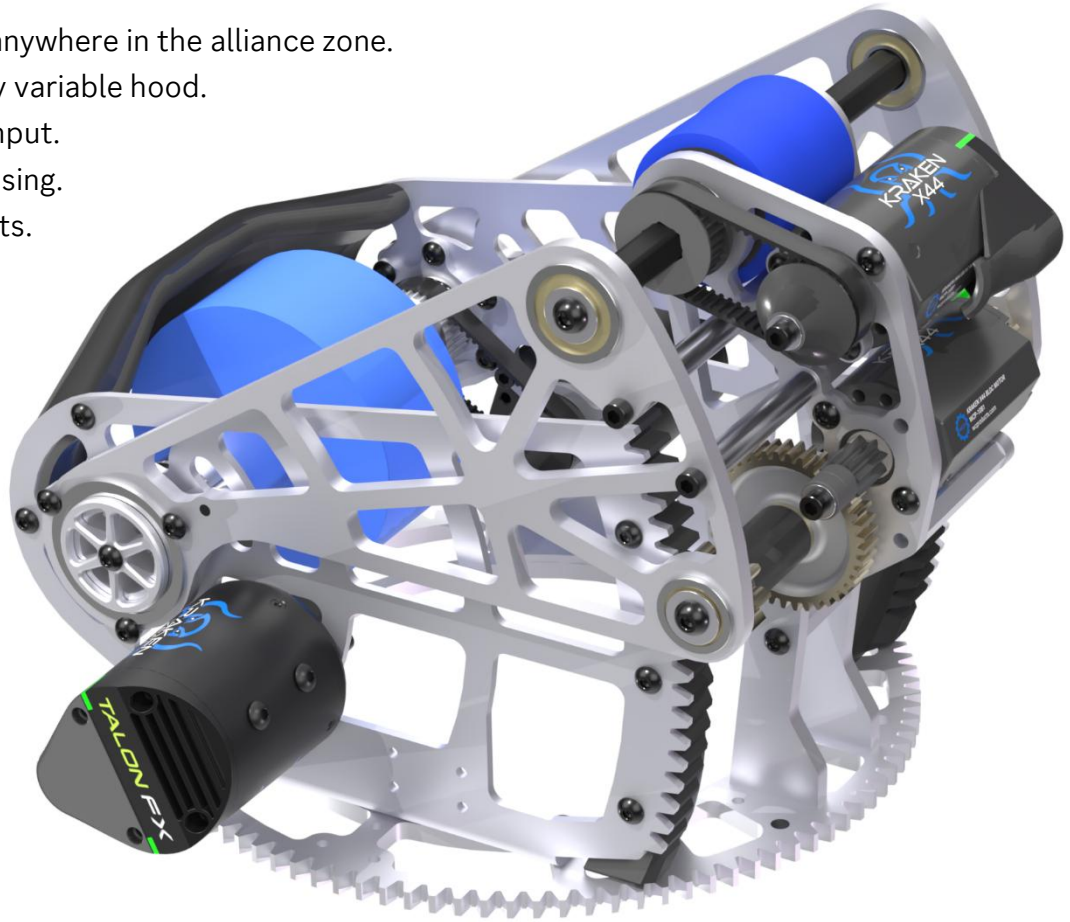




TURRET

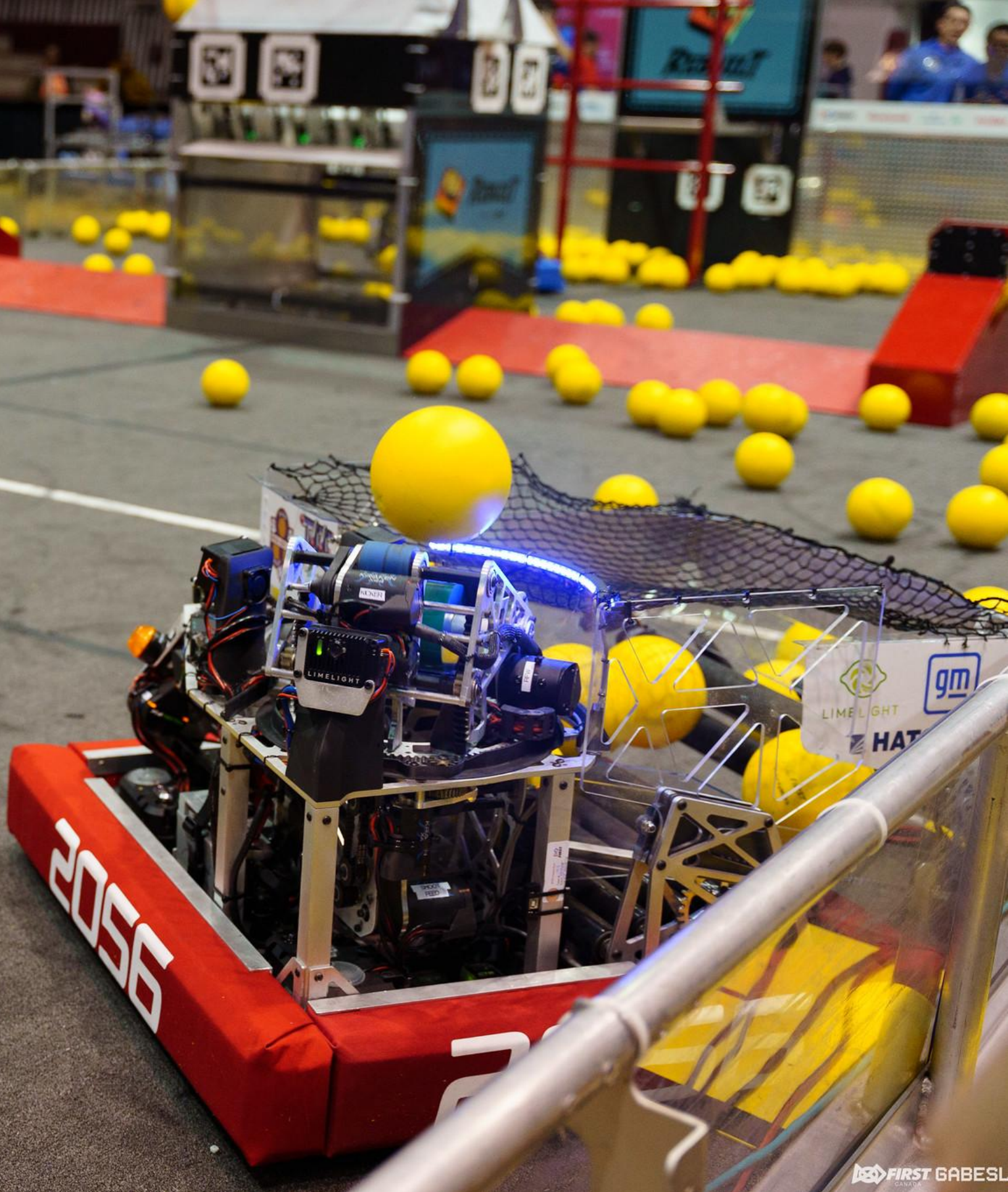
Requirements:

- Score from anywhere in the alliance zone.
- Continuously variable hood.
- High throughput.
- Full field passing.
- No dead spots.
- Rigid.



Details:

- Designed around an 8" ID X contact bearing from Lilly Bearing.
- 1/4" Thick 6061-T6 – 10DP turret gear laser cut by Fabworks.
- Magnetic Prox switch for turret homing.
- 2x Kraken X60s on flywheel, 28:34 3MGT2 reduction.
- 1x Kraken X44 on backspin kicker, 32:32 3MGT2.
- 1x Kraken X44 on turret rotation, 8:40 – 10:100 reduction.
- 1x Kraken X44 on hood rotation, 8:40 – 10:155 reduction.
- 4" Fairlane shooter wheel, dual 2" stealth wheel kicker wheel.
- Fairlane shooter wheels press fit on 1-1/4" Aluminum tube.
- +/- 185° of rotation with custom printed energy chain.
- Range of motion of 34°, 73.5° to 39.5° release angle from horizontal.



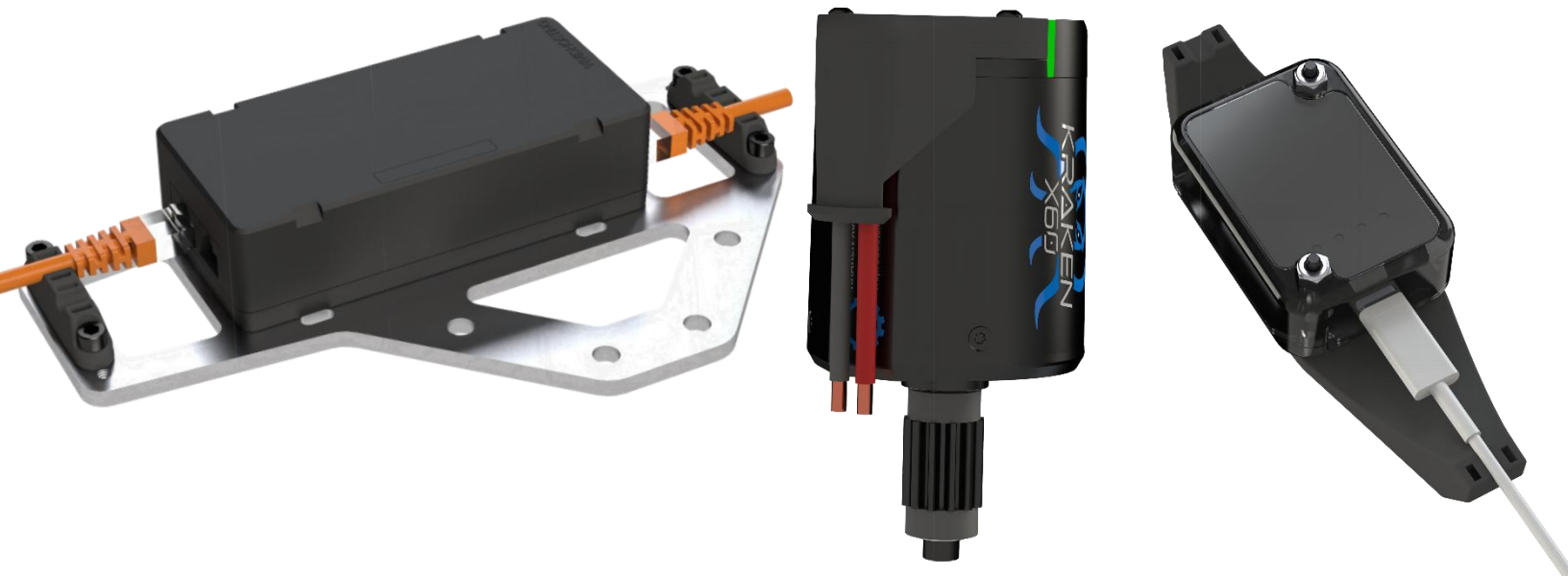
ELECTRICAL

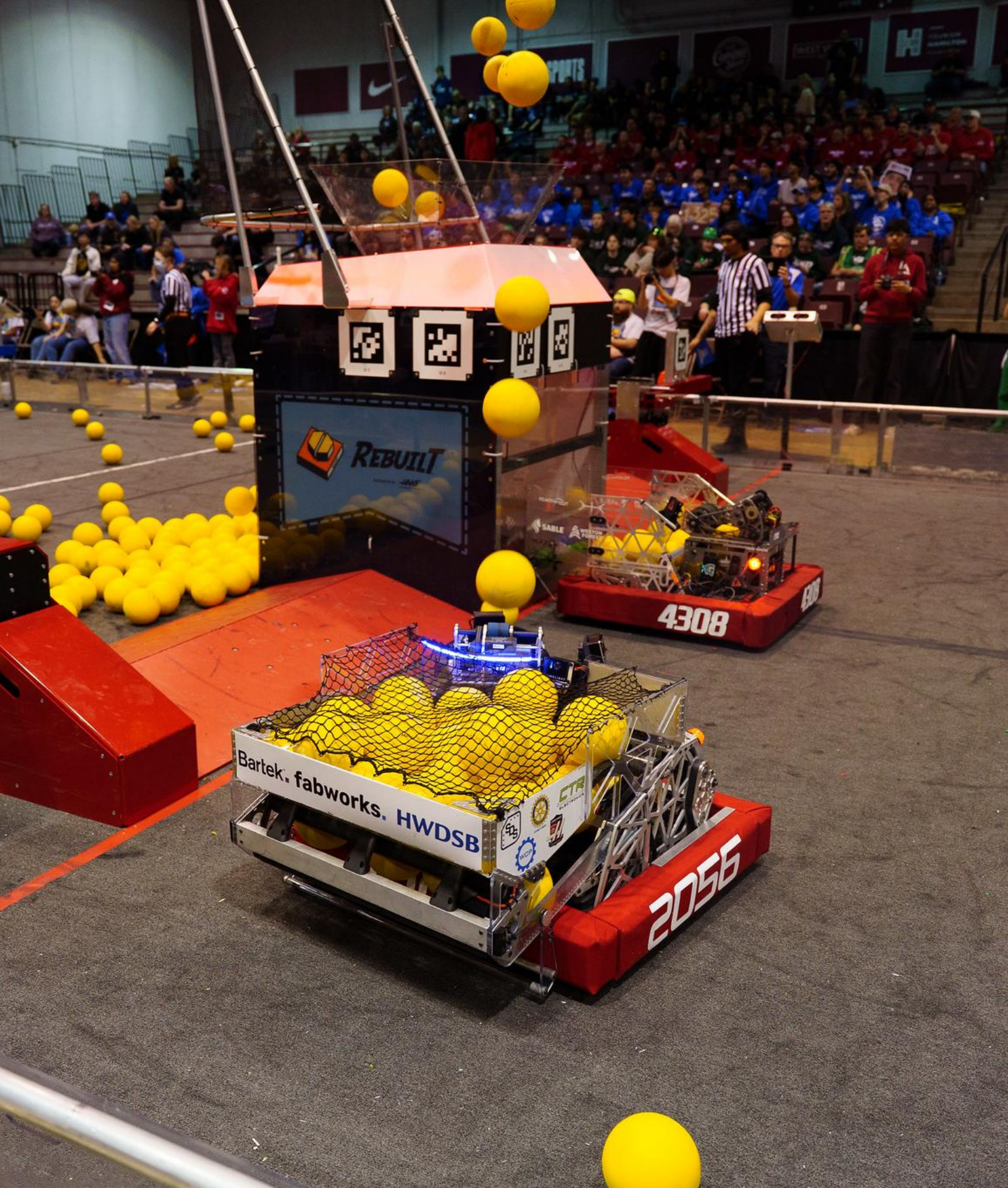
Strain reliefs:

- Nearly all connections such as those to the RoboRIO, CANivore, Radio, etc. were strain relieved in some way using many custom 3D Printed parts and zip ties.
- Custom sized, 3D printed strain reliefs to clamp on the perfect spot for ethernet entering the switch and radio.
- Custom Kraken X60 and X44 terminal covers that fold the wires around and get zip tied to the motor body to act as a strain relief.

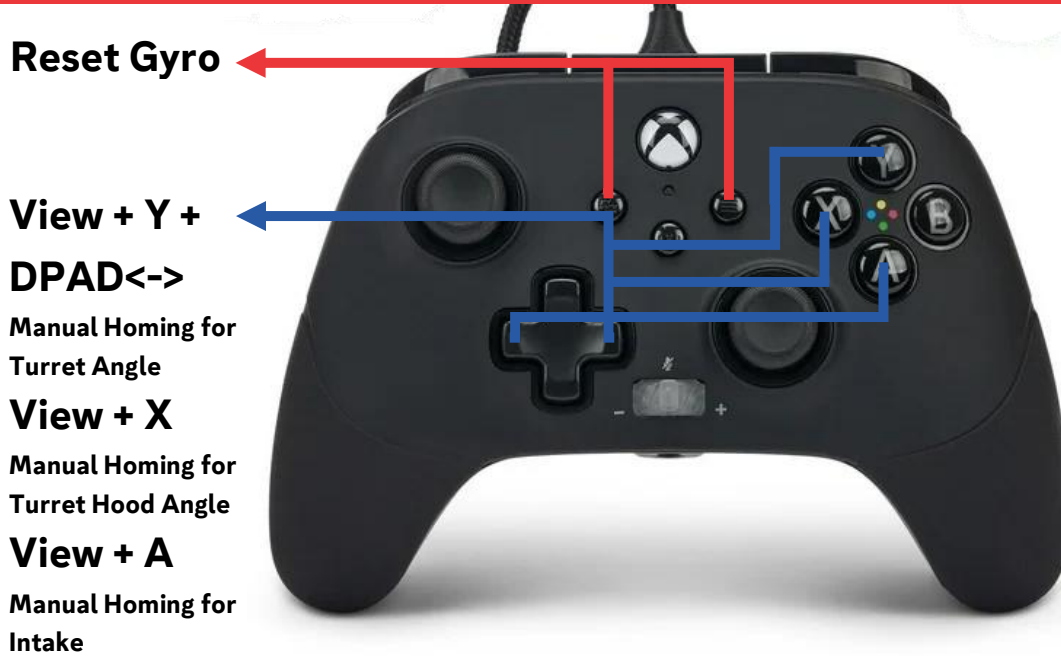
Details:

- Electrical baseplate layout is preplanned keeping in mind wire routing, access holes, grommets, zip tie mounts, and conduit routing.
- Wire loom is used for cleanliness and mechanical protection of wiring.
- Jacketed CAN wires are used for a clean look and extra mechanical protection.
- Every CAN Bus connection is either soldered, bolted with a ring terminal, or in a spring-loaded terminal.
- All power to the Kraken X60s and X44s is direct from the PDP to the ring terminals with no breaks in-between, and all CAN goes from ring terminal to the ring terminal on the next motor.
- A lever terminal block is used to power multiple low power devices.
- 3D printed main breaker cover to prevent anything hitting it and cutting power to the robot.



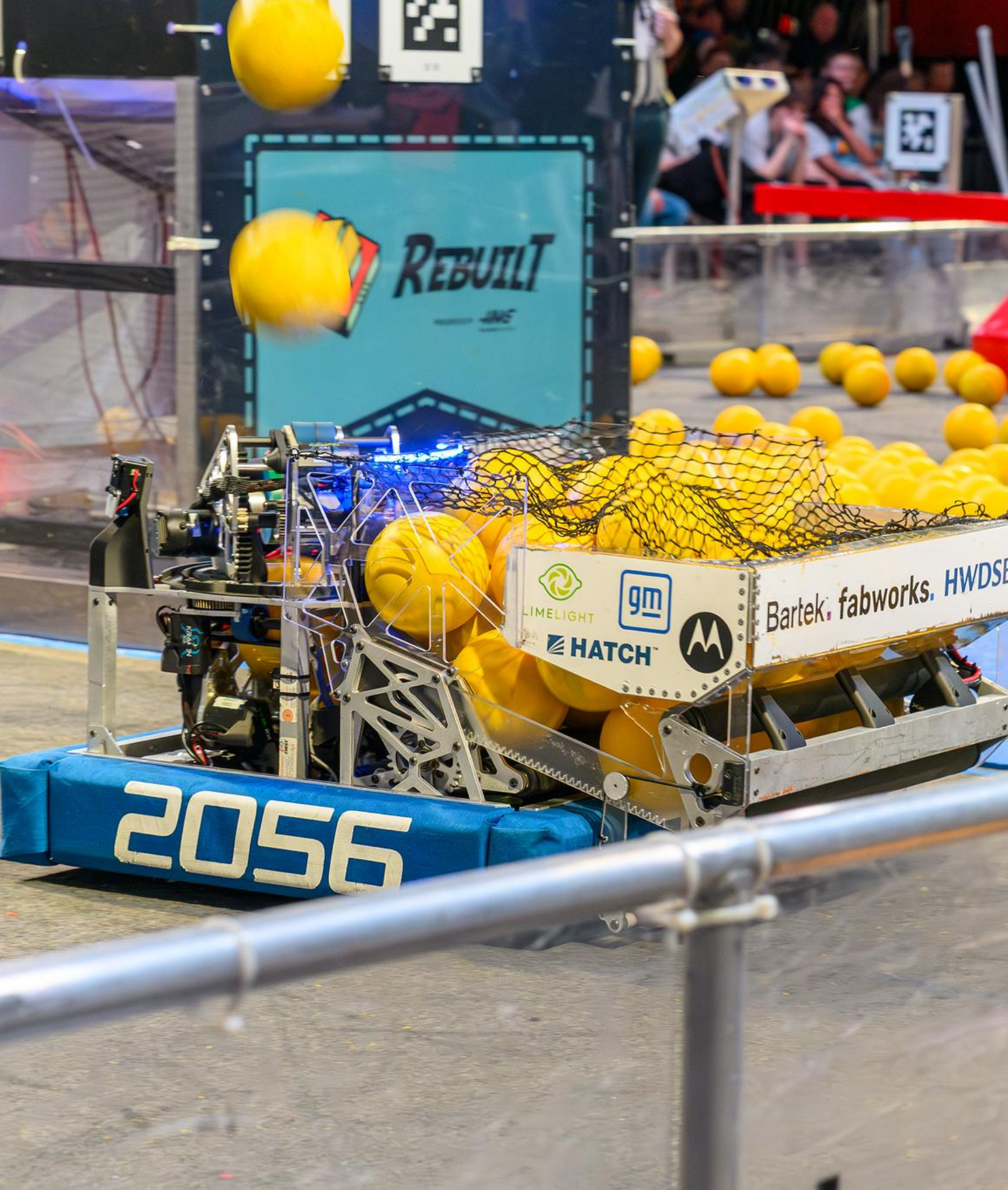


CONTROLS



Xbox PowerA FUSION Pro 3 Controller





SOFTWARE

C++ Programming Language Timed Base - Finite state machines control all subsystems

- CTRE's Motion Magic used to drive all mechanisms to their desired setpoints to provide a controlled and smooth motion with standard PID for continuous targeting.
- Smart stator current monitoring used to detect jams and automatically unjam hopper.

Self developed swerve control & odometry with CTRE's Phoenix Pro

- Velocity FOC Control Mode for Drive.
- Odometry with Phoenix Pro FusedCANCoder and Time sync for accurate swerve odometry.
- Field relative Tele-Operated Driving.
- Simple PID drive to point autonomous driving algorithm.
 - A series of points are connected to form a complete auto "path".
 - Continuous maneuvers allow the transition to new point without slowing down when approaching the current point.

Auto Aim and Vision

- Three fixed **Limelight 4's** to track April Tags.
- Utilized Limelight's ambiguity free MegaTag2 pose estimation fused with wheel odometry.
 - Dynamic camera and odometry confidence for localization fusion.
- Polygon zone localization: drives turret targeting (pass/score) and reduces trench-hood collisions.
- Kinematically computed shot vector with time-of-flight compensation for shooting on the move.
 - Manually tuned coefficient to map desired exit velocity to wheel speed, this allowed for very easy "retuning" of the shot if fuel at a given event behaved differently.

CANrange Hopper Level Control

- CANrange pointed into hopper measures hopper fill level.
- During "Passing" robot automatically fills hopper to a minimum level before starting to pass.
- While passing, if hopper level drops below minimum, robot stops passing and starts accumulating. This maintains a minimum hopper volume, so we always have fuel to start the next offensive shift.

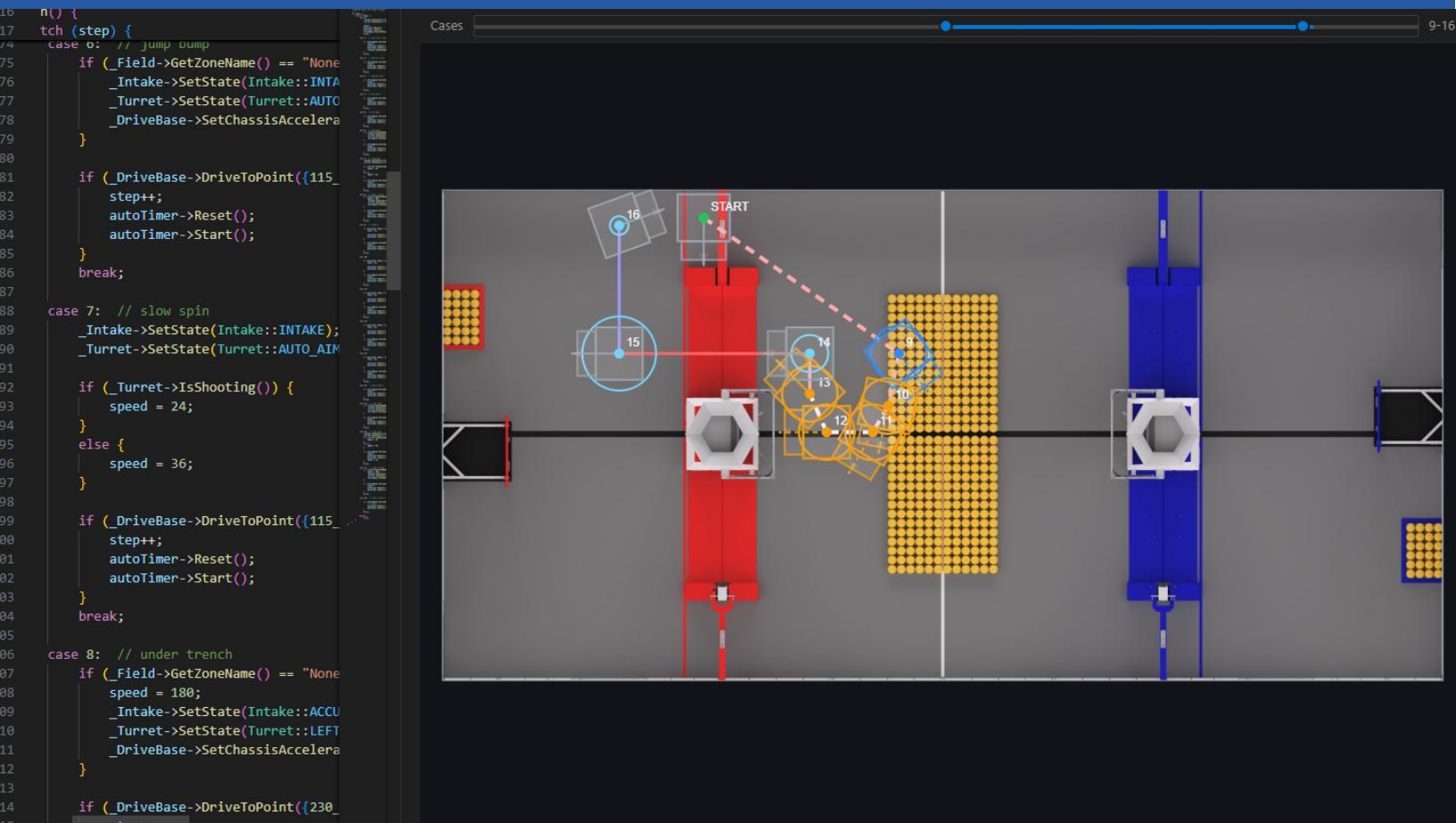
Automatic Shift Timing

- Reads the game data and match time from FMS with a manual override.
- If shooting is requested by the driver, the robot automatically decides when to shoot to maximize the offensive shift time.

LEDs and Driver Feedback

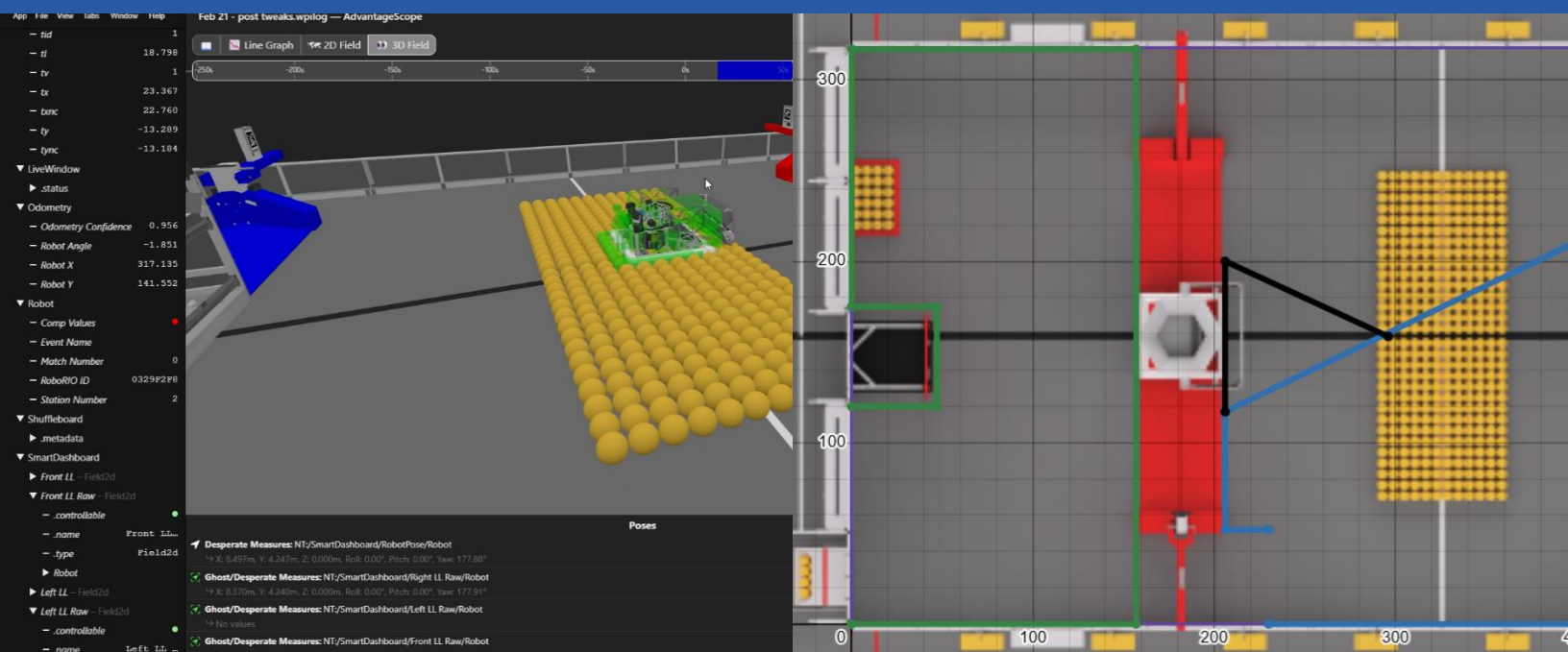
- LEDs become solid red while aiming, blue while ready to shoot.
- LEDs flash red on Limelight disconnection.
- Green LEDs and controller rumble on low battery voltage condition.
 - Throttles mechanisms until battery voltage recovers.
- Flashing yellow LED's while passing with empty hopper.

VIBE CODED AUTO PATH VISUALIZER FOR VS CODE



CTRE HOOT LOGGING

POLYGON ZONES



FABRICATION

In House Resources

Haas TM-1P CNC Mill:

- For manufacturing medium-size parts with high precision and speed. (New machine for this season)
- Commonly used to machine 1/8" to 1/2" flat bar such as the climber plates.

CNC Router:

- For manufacturing large parts with precision and speed.
- Commonly used to cut out 1/8" to 1/4" polycarbonate.

Manual Lathes:

- For machining and end facing round stock.
- Commonly used to turn, drill, and tap Hex and Round shaft.

Two Bambu Lab X1C 3D Printers

- For 3D printing strong components out of PA-CF.
- Commonly used for things like timing pulleys and camera mounts.

Sponsor Manufacturing Resources

CNC Tube Laser:

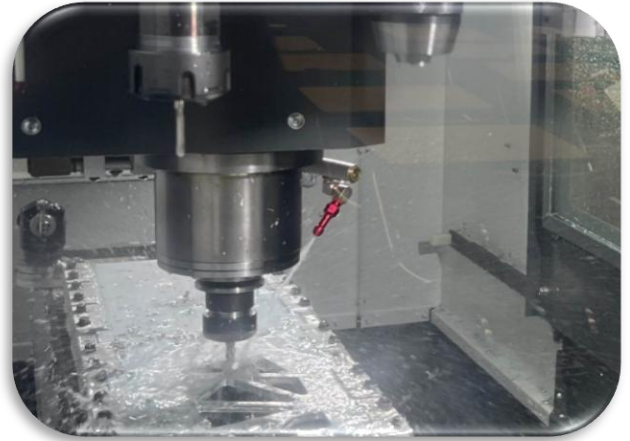
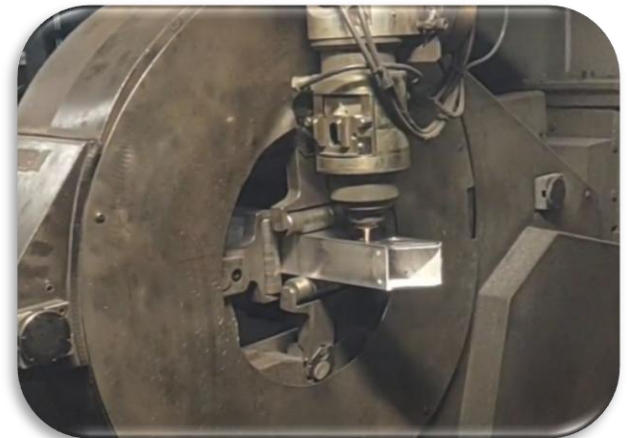
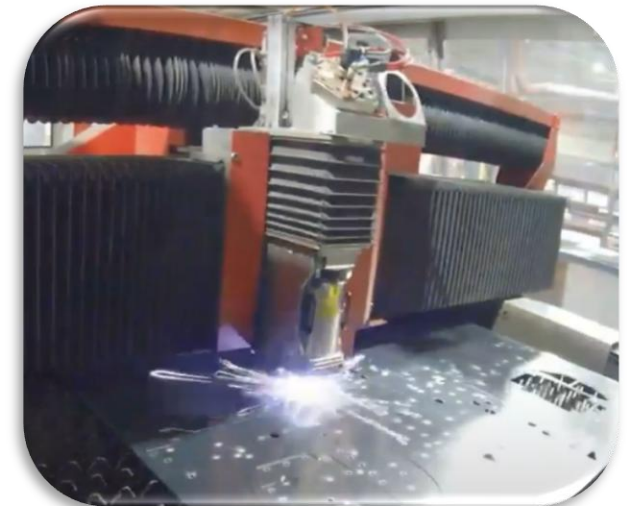
- Quickly cuts every face of aluminum tubing in one setup.

CNC Laser:

- Quickly cuts large sheets of aluminum.
- The baseplate, formed brackets, and turret gear were all cut by a CNC laser.

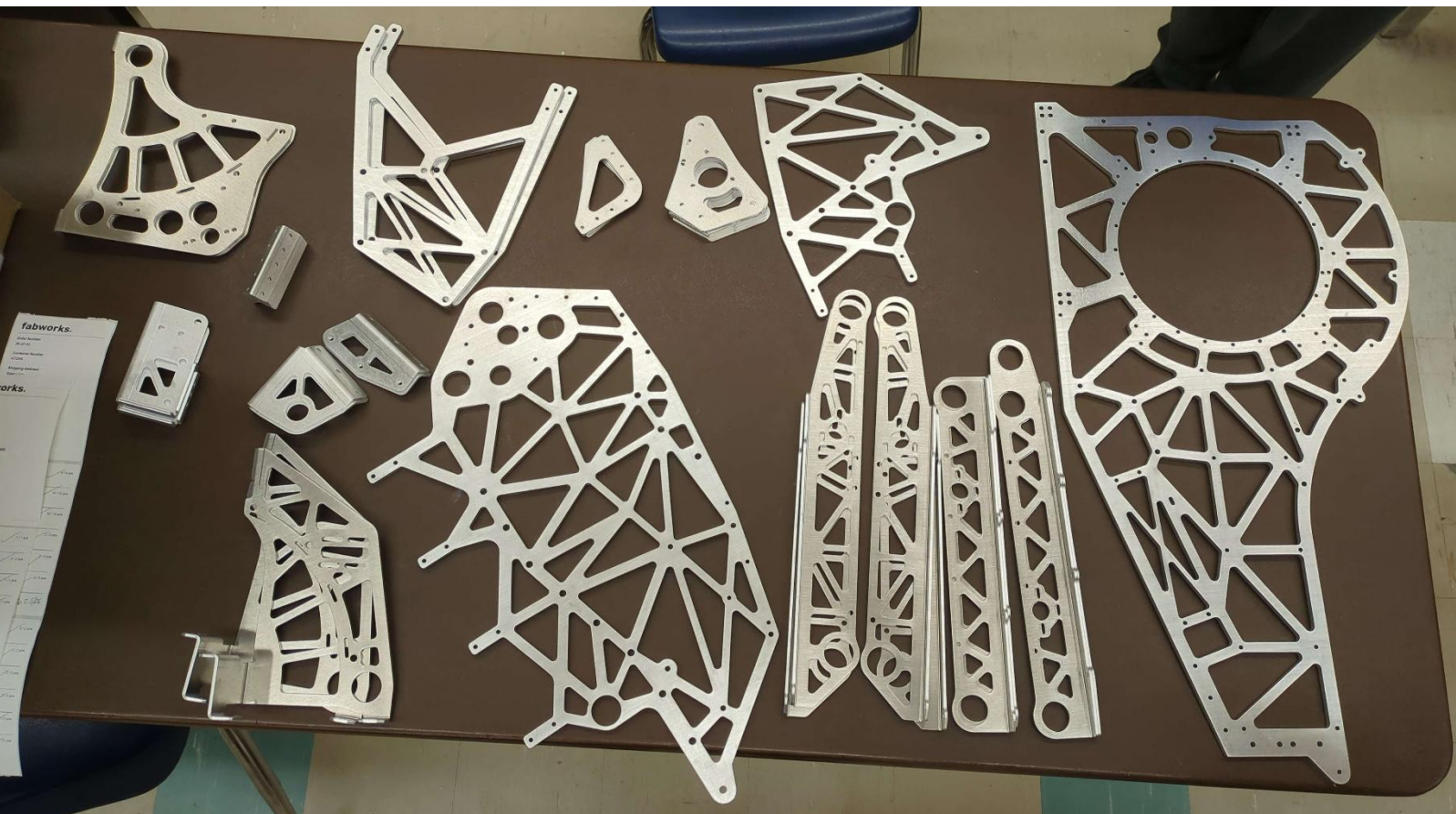
CNC Brake:

- For precisely bending and forming sheet metal.
- Sheetmetal turret sides were formed using a CNC brake.



fabworks.

- Starting 2026, and moving forward, FRC2056 relies on [fabworks](#) for all laser cutting, and sheet metal forming.
- Across 3 orders placed in 2026, we received components shipped to Canada on average less than 3 business days from order placement.
- Even with shipping, this is faster than any local shop has ever been able to manufacture parts for us.
- Parts arrived fully deburred and ready for assembly.
- Edge cut quality was exceptional for laser cut aluminum.
- On the formed sheet metal parts we ordered, the measured bend tolerance on flange lengths was $<0.005"$. This accuracy is unheard of in the sheet metal fabrication world.
- Use promo code "FRC2056" for 5% off your next order!



DESPERATE TIMES

Concept:

- Initial robot concept featured a “Hopperless” design prioritizing throughput.
- Ultimately, we couldn’t achieve a high enough throughput to justify lack of storage capacity, and the decision was made to pivot architectures reusing the turret and continuing software development on this machine until “Desperate Measures” came online 3 weeks later.

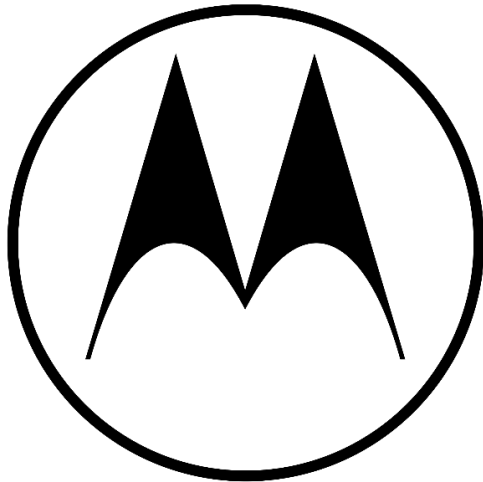
Function:

- The intake used 2” mecanum wheels to centre fuel from a four-fuel stream down to two into the bumper cutout between the narrow modules.
- The conveyor was comprised of 1-1/2” rollers that gradually accelerated thus increasing the gap between fuel, with side driven rollers necking down to feed the shooter in a single stream.
- The turret was functionally identical to that of Desperate Measures.



In another world, there would be an entire binder dedicated to *Desperate Times*. Instead, it became the foundation upon which *Desperate Measures* was built. It served as a test bed for two major new software developments for our team: our swerve based SOTM, and 3D pose estimation. While we were never able to achieve the performance we had hoped for, it ultimately gave us the tools to build what came next.

OUR SPONSORS



MOTOROLA



GOLD



STONEY CREEK

Bartek™
Malic. Fumaric. Dynamic.

CTR
ELECTRONICS

fabworks.


LIMELIGHT



HATCH



HWDSB

Westbrook
SYSTEMS

SILVER

**ACCESS
STORAGE**

Taylor
STEEL INC.


SAMUEL 1855
KELSEYS
original
ROADHOUSE

The Morse Family

i-cubed.

Wawanesa

WINONA  **GARDENS**
SINCE 1863

IN-KIND

Digital T's Inc.



US Mail Box



BRONZE



Battlefield Optimist Club

Team 2056 Alumni

City of Hamilton

