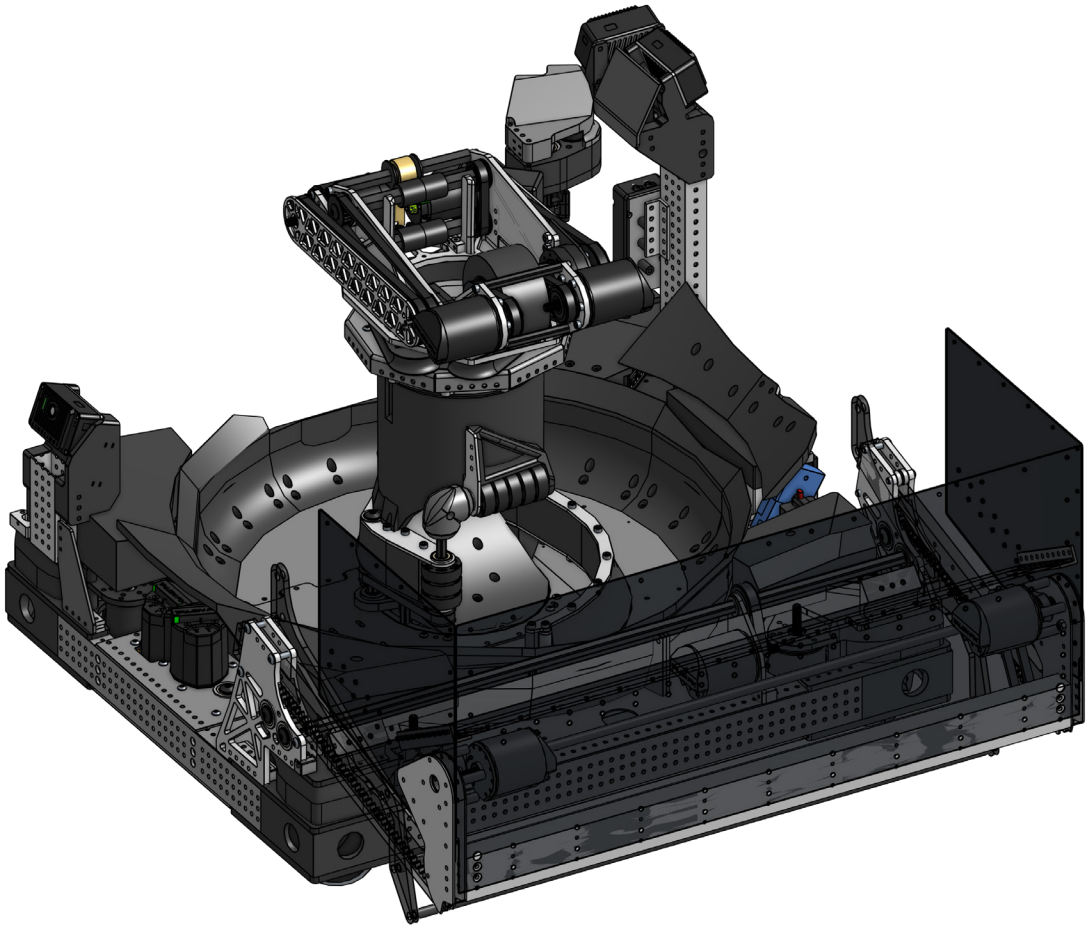
FRC #1987

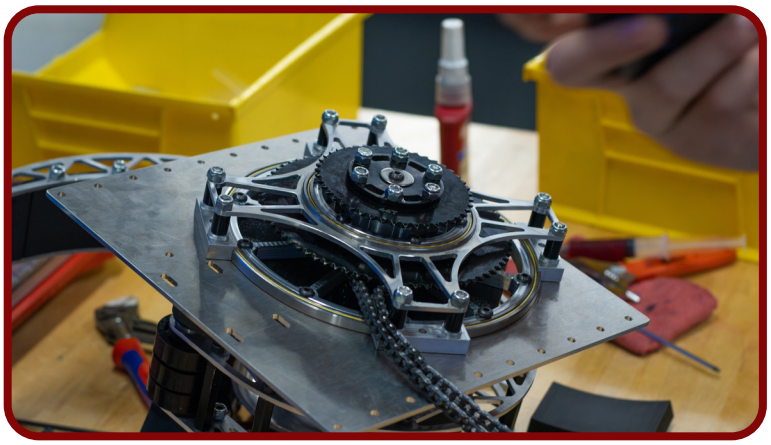
The Broncobots



CYCLONE

2026 Technical Book

6,000+
Student Hours



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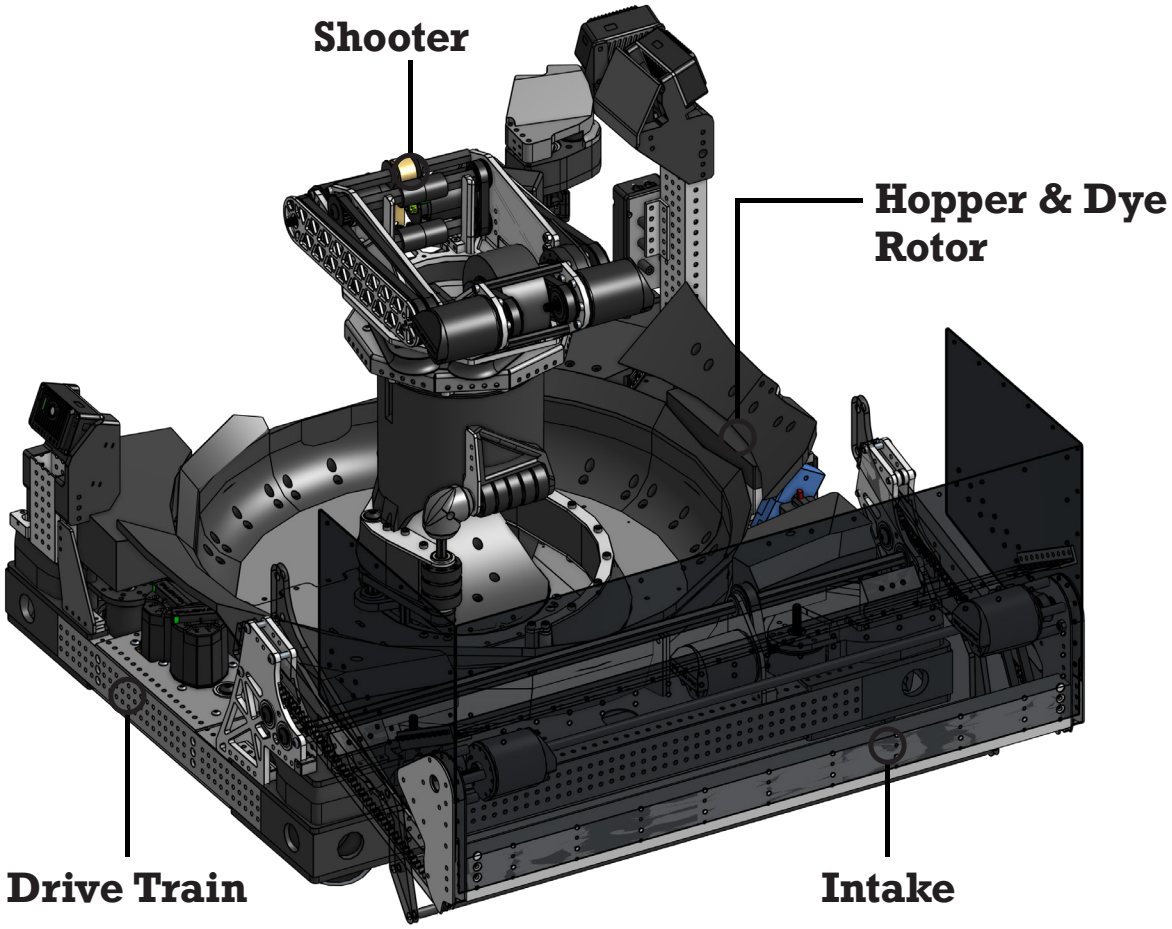
Robot Overview

Meet Cyclone, Team 1987's 2026 robot. The Broncobots are excited to share the design of this all new machine. With 4 subsystems, this year's robot is built to address every challenge Rebuilt has to offer.



Robot Overview

Robot Overview

- Strategic Design
- Robot height 21.75” to traverse the trench with clearance
- Linear Intake integrates for an expandable hopper to maximize fuel storage
- Dye Rotor for utmost throughput of fuel flow from intake to shooter
- Turret with 360° range of motion to score fuel from any side of the robot for when shooting on the move and when defended
- Robot actions are automated, reducing potential for driver & human player errors

Design for Manufacture

- Utilizes COTS components to streamline manufacturing and assembly
- All components go through a manufacturability review prior to manufacture
- Full design compliant with permanent evergreen team design standards for YoY continuity
- Primarily utilizes 3D Printing and in-house CNC fabrication to ensure consistent tolerances and reproducible parts

Design for Maintenance

- Subsystems built with maintenance in mind, compliance with evergreen design standards
  - Reduces cost
  - Reduces pit storage space needs
  - Increases speed and efficiency of repairs
- Subassemblies are easily swappable with spares

Strategy

- Team goal to build a robot with a high competitive ceiling
- Strategy focuses on 15+ balls per second throughput across the three main robot components (intake, hopper, and shooter)

Intake

- Robot must have a ground intake that is wide enough to collect 5 columns of fuel at once
- Allows for the collection of the 5 outermost fuel columns in the neutral zone during auto without risking hitting an opposing robot
- Robot must have a 30" wide effective intake width
- Intake must be able to withstand the stress it will experience during an event
- There are likely to be many collisions during matches
- Must be robust enough to survive head on or side collisions with other robots or any field element
- Must be able to intake at max robot speed without jamming and without pushing balls away from the intake
- Intake speed is critical for strong autos and for offensive/defensive tele-op periods
- Intake needs to have structure low in the bumper zone that prevents the upper leading edge of the intake from entering the frame perimeter of another robot at any time

Hopper

- Must be able to detect when at max capacity
- Tells the driver that it is full and for them to continue
- Clear (non-opaque) hopper
- The hopper needs to be clear to allow the drive team to see the current capacity at all times'

Shooter

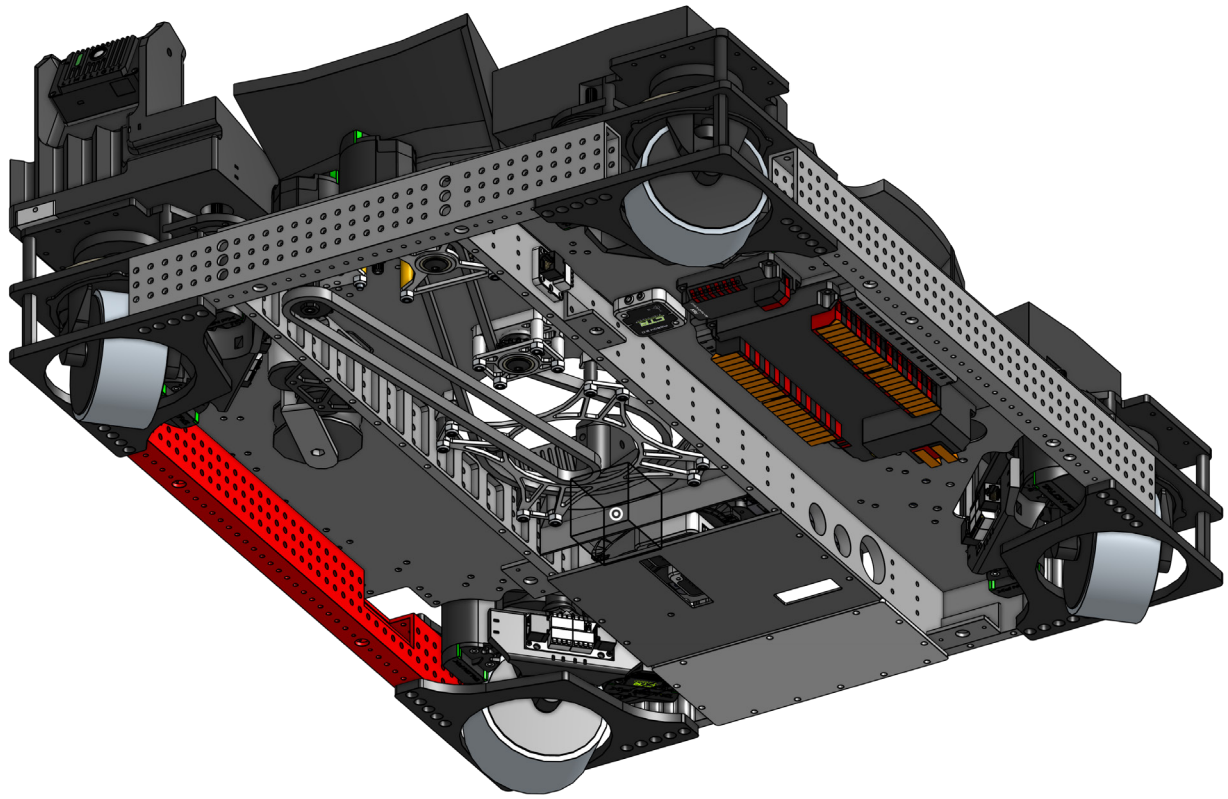
- Needs to be able to shoot while moving
- Allows for scoring while under defense
- Heavy defense is anticipated in this game
- Score in the hub from any position within the alliance zone regardless of robot orientation
- Allows for maximum effective range
- Must be able to collect and score at the same time
- Allows the robot to optimize the scoring periods
- Must be able to pass fuel to team alliance zone from neutral zone

Strategy

- The robot needs to be able to pass to other teams as well as ourselves to be effective
- Shooter must be able to instantaneously (<1s) reach shooting speed
- Allows for scoring preload fuel rapidly before other auto tasks
- High shooter flow rate of 10+ fuel per second to allow for fast scoring during short time periods
- Traversability
- Be able to travel under the trench
- Traveling under the trench mitigates the risk of driving over fuel and being high centered while also reducing wear and tear
- Faster to travel through than bump in many cases
- Be able to cross the bump reliably without getting stuck on the bump or any fuel
- Increases availability of cycle paths and prevents defense from shutting us down

Drive Train

- 4 West Coast Products X2i swerve modules
  - Molded Tread for longevity and durability
- Electronics brainpan allows for a lowered dye rotor and increased fuel capacity while maintaining access to electronics
- Custom 3/8" billet frame rails enable increased dye rotor capacity and throughput by placing the battery closer to the edge of the frame and fully supporting the dye rotor center column
  - Similar rails robot center increase support for dye rotor and turret system
- 0.125" polycarbonate skid plate protects electronics from field elements and game pieces
- Robust single-piece bumpers backed by aluminum sheet metal include integrated hopper walls for robot serviceability

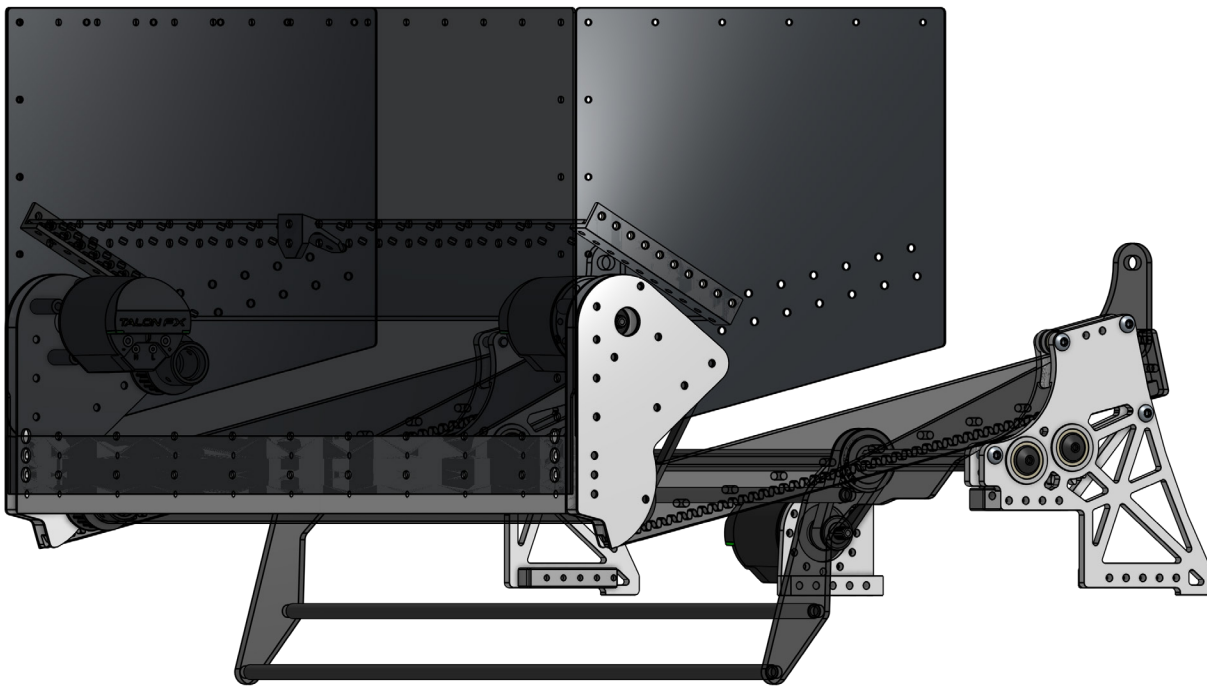


Intake

- Full-width intake collects up to 5 balls in one instance to maximize throughput and allow for faster intaking
- Linear deployable intake increases hopper capacity while maintaining a tight packaging.
- 2-roller system rapidly intakes fuel into the hopper front-to-back and minimizes dead zones while maintaining small packaging
- Durable polycarbonate structure absorbs tough impacts
  - Aluminium hub covers allow for force to be dispersed more evenly throughout the robot
  - Rigid-mounted structure transfers impact forces to chassis
  - Large washers allow for force on rollers to be dispersed throughout the side plates
- Dual motor system allows for high speed intaking while maintaining maximum torque and lowering power draw.

Specs

- Roller Power: Kraken X60 - 1.5:1 gear reduction
- Rollers: 1.125” silicone and cat tongue wrapped polycarbonate
- Deployment: Kraken X60 - 3.6:1 gear reduction



Hopper/Dye Rotor

Gearbox

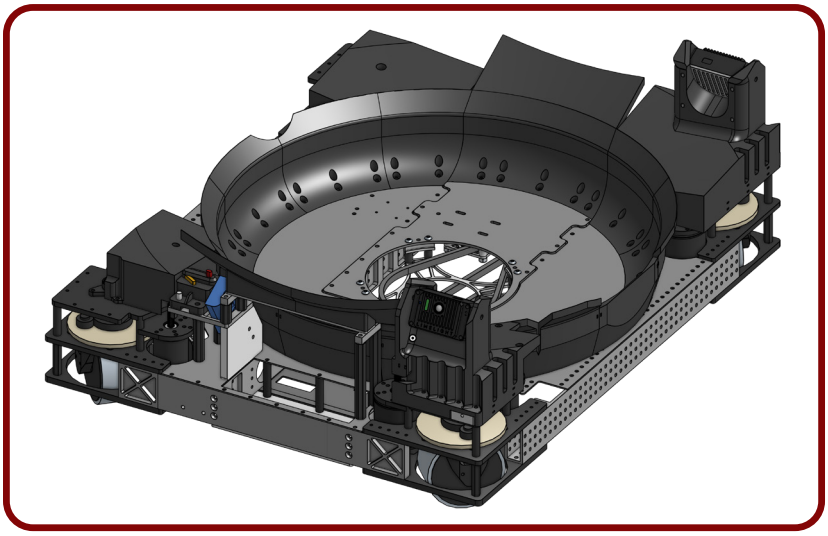
- Coaxially driven with #25 chain
  - Supported by two X-contact bearings
- Rotation: Kraken X60 - 20.67:1 reduction
- Feed wheels: Kraken X60 - 1:1
- Bevel gears fully enclosed to maintain alignment, contain grease, and reduce wear

Dye Rotor

- 3D printed diverter walls funnel balls into the dye rotor directly
- Rigid center column for improved flow into the dye rotor
  - Wedge-shaped hook reduces top footprint, improving fuel flow and allowing backwards rotation for jam clearing
  - Printed with Polymaker Fiberon PA612-ESD to prevent static buildup
  - Reinforced with aluminum rods to support the turret
- All structure stays clear of the dye rotor to prevent jamming
- Dye rotor mounted on separate plate for easy removal, installation, and maintenance

Specs

- Hopper capacity: 50 fuel
- Dye rotor diameter: 22 inches
- Dye rotor ring capacity: 8 fuel
- Dye rotor RPS: 2.5
- Dye rotor interior wheels RPS: 95
- Feed rate: 18 fuel per second



Shooter

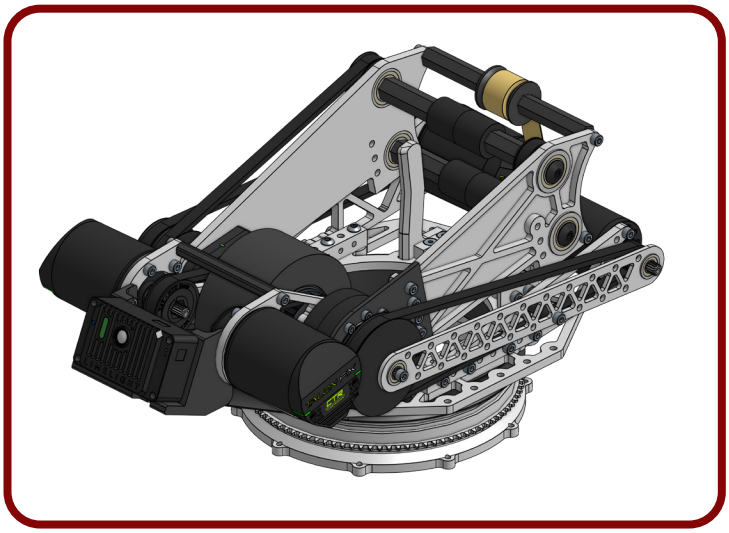
- 360 degree turret allows for shoot-on-the-move even under defense
- Compact 4.25" height gives spaces back to dye rotor hopper for improved fuel flow and capacity
- Flywheel
  - 4" WCP 60A Urethane wheel
  - Custom integrated pulley hub allows for dead axle drive
  - Two Kraken X60 motors geared 1.25:1

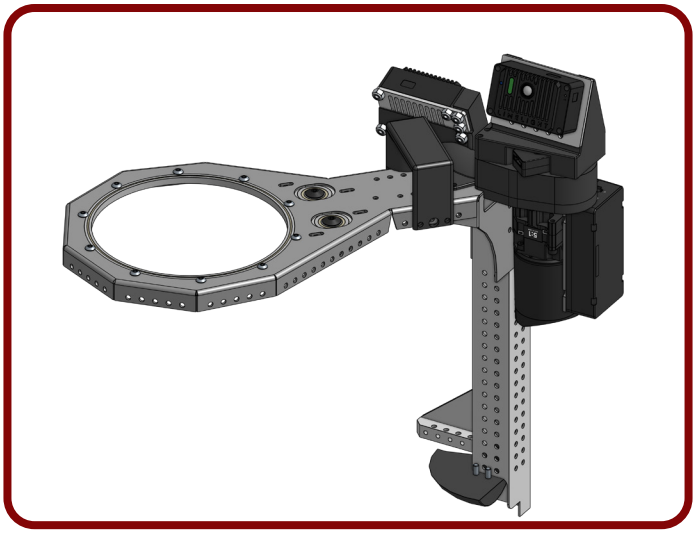
Hood

- "Floating hood" position driven from the rear using Thriftybot cycloidal gearbox
  - Kraken X44 geared 80.5:1 total
- 10lb constant force spring pulls hood down, preventing backlash and increasing precision
- WCP through bore encoder tracks true position
- Integrated 1" 45A durometer wheel hood rollers reduce backspin on fuel and increase shooting distance
  - Kraken X60 geared 28:20
- Hood angle 0° - 90° allows for shooting from anywhere inside alliance zone & full field passing

Turret Structure

- Sheet Metal structure maintains sturdiness and minimizes impact on fuel flow
- 1.5"x1.5" Tube supports turret from the corner
  - Wires feed up through the tube, minimizing footprint of the turret system
  - All cable harness management is done below the robot to protect against damage
  - Reinforced with a carbon fiber round tube that keeps the wires protected
- Additional x-contact bearing between dye rotor and shooter ensures alignment and rigidity of entire system
- Turret chain driven by Kraken X60 - 25.6:1 reduction overall balances speed and control
- Integrated matched-reduction gearbox allows encoder to read absolute position of turret





Electrical

Brainpan Mounting

- Much of the robots wiring and electrical components are mounted to the underside of the brainpan
  - Allows for more space for dye rotor
  - Makes robot superstructure less of an obstacle
  - Gives easy access for maintenance
  - Concentrates and directs wiring paths
  - Protects wires from moving elements

Umbilical

- The umbilical that runs to the shooter starts below the brainpan, runs across a tensioner, and up an aluminum tube into the turret and shooter structure
  - Gives turret greater rotation limits
  - Takes up less space above the robot
  - Cable track has smaller chance of catching on fuel or other objects

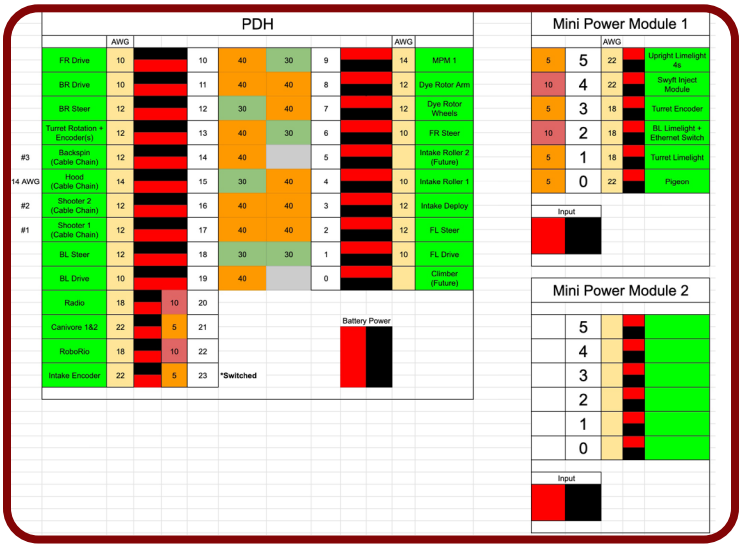
Wiring Documentation Spreadsheet

- Makes it easier to find the source of a wiring problem
- Helpful for knowing what breaker and gauge of wire a component needs
- Allows for locations of components and wires to be planned out ahead of time, making wiring easier
- Dedicated swerve CAN bus uses Swyft CANnect modules to improve reliability and reduce maintenance challenges.

CANbus Layout

	Example	Motor 1	A	Motor 2	B	Cancoder 1	Terminating Resistor			
		^ this would be the can connector labeled A								
up to date 3/14/26 -sage	Rio (Intake + Dyerotor)	Rio	Intake Encoder	PDH	Intake Roller Motor	Intake Deployment Motor	Dyerotor Feed Motor	Dyerotor Rotation Motor	Terminating Resistor	
up to date 3/14/26 -sage	Canfd #1 (Turret + Shooter)	Turret Rotation Motor	CANDLE	Turret Rotation Encoder	Shooter Encoder	Left Flywheel Motor	Right Flywheel Motor	Backspin Motor	Hood Adjustment Motor	Terminating Resistor
up to date 3/14/26 -sage	Canfd #2 (Chassis)	Pigeon	Swift CanInject	Front Right Module	Front Left Module	Back Left Module	Back Right Module	Terminating Resistor (RJ45)		

PDH & MPM Layout



Programming

- Java Command Base
- State machine for superstructure automation
- Signal Fetcher consolidates CAN bus interaction and improves performance
- Shoot-on-the-move implementation for non-stop fuel scoring
  - Velocity control with augmented controls during shooting for increased translational accuracy
  - Gyro latency compensation for increased rotational accuracy
  - Dynamic separation of fuel exit velocity components for accurate distance compensation through variable hood angles
  - Leverages empirically measured data from fuel time-of-flight for better vector predictions
- Real-time swerve wheel slip detection with odometry correction
- Limelight-4 powered localization state with dynamic field zoning for automation
- LED ring indicates hub activity countdown to assist driver controls
- All subsystems are automated for minimal driver input
- B-Line autonomous routines dynamically recover from potential bumps and impacts from other robots
- Variable speed Dye-Rotor control allows for more consistent fuel throughput
- Intake speed directly scales with robot relative velocity to conserve power

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