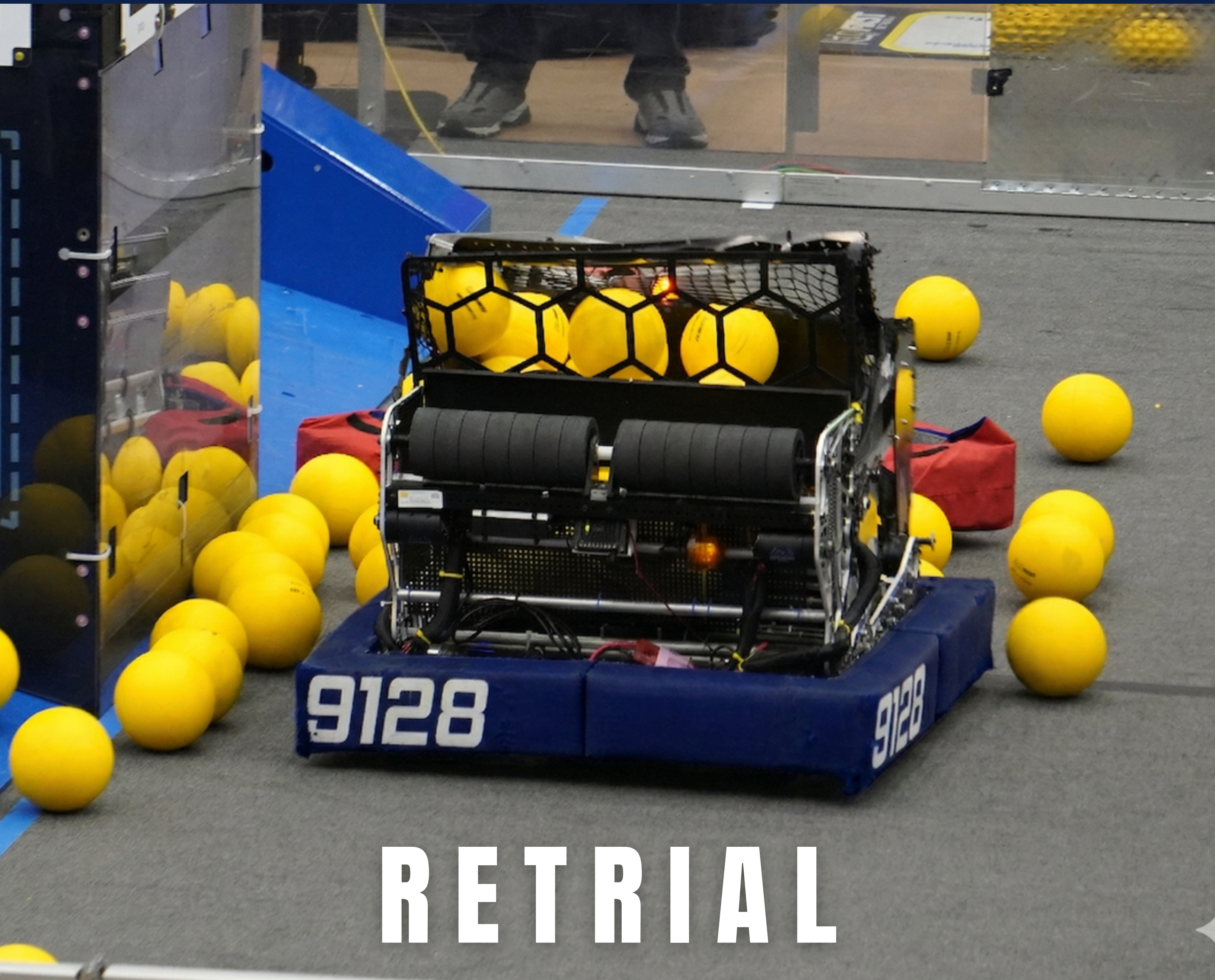


RETRIAL

9128

Itkan Robotics

2026 Rebuilt Engineering Notebook

Table of Contents

Principles and Philosophy

Goal:

Win the Texas State Championship

Team Principles

At ITKAN Robotics, our team culture is built on a foundation of fellowship, continuous learning, and relentless objective decision-making.

Strategy Philosophy

- Playoff-level gameplay
- Reduced but quick cycles
- Adjustable autonomous on the fly

Design Philosophy

- “Perfection is achieved, not when there is nothing more to add, but when there is nothing left to take away” - Antoine de Saint-Exupery
- "Do less, better" - Tyler Holtzman (2056)
- “Continuous improvement isn’t rocket science.” - John V. Neun (148)

Objectives

- **Robust**; designed to be durable without interfering with design
- **Fast**; ~<0.5 for all actions
- **Stable**; Low center of gravity to avoid tipping when full
- **Simple**; avoid complexity in design, and familiar parts and materials.

Game Analysis

Game Overview

In this year's game, REBUILT, presented by Gene Haas, requires robots to score efficiently while maintaining the ability to play defense when needed. Our team focused on designing a fast, reliable robot capable of quickly cycling game pieces and adapting to different alliance strategies.
Our main objectives are to develop consistent autonomous routines, maximize scoring efficiency during teleop, and maintain strategic flexibility to either score or play defense depending on the needs of our alliance.

Autonomous Phase

Because the Autonomous period is vital to TeleOp advantage, we took extra time refining our autonomous routines to emphasize precision and reliability, all while scoring as many points as possible. Creating multiple paths allows alliance compatibility.

Teleop Phase

During the Teleoperated Phase, drivers focus on scoring game pieces quickly and efficiently while adapting to match conditions. Our robot is designed to maintain fast cycle times, coordinate with alliance partners, and switch to defense when it benefits the alliance.

Game Analysis

Scoring Strategy

Scoring Objective	Subsystem Requirements
Score FUEL Efficiently	Highaccuracy shooter Fast indexing system Vision-assisted targeting
Maximize Climb Points	Multilevel climber Fast and stable Reliable engagement
Achieve Bonus RP	High scoring Consistent auto routines Alliance coordination
Win Matches	Balanced scoring + climb Driver efficiency Strategic adaptability

Match Performance

Objective	Subsystem Requirements
Consistent Wins	Reliable auto High cycle speed Low failure rate
Secure Ranking Points	Specialized systems Efficient cycles Team coordination
Adapt to Matches	Driver feedback systems Flexible strategy Defensive awareness

Subsystem Strategy

Intake	• Floor pickup • Wide funnel • Fast deploy
Conveyor	• Transfers pieces • Controls spacing • Prevents jams
Hopper	• Stores pieces • Organizes feed • Continuous output
Shooter	• High accuracy • Fast spinup • Adjustable output
SCORE	• Processor scoring • High consistency • Fast cycle reset

Subsystem Strategy

Drivetrain

- High acceleration for short cycles
- Swerve drive for full mobility
- Stable during rapid direction changes
- Prevent tipping with optimized base
- Precise alignment for scoring

Intake

- Fast floor pickup of game pieces
- Wide intake for misalignment tolerance
- Funnel pieces into the indexer smoothly
- Deploy in <0.5s
- Intake while moving

Indexer

- Smooth transfer to the shooter
- Prevent jams and backflow
- Maintain piece spacing
- High throughput
- Sensors for piece tracking

Subsystem Strategy

HOPPER

- Store multiple game pieces
- Organize for consistent feeding
- Prevent bouncing or jams
- Compact and efficient design
- Continuous feed capability

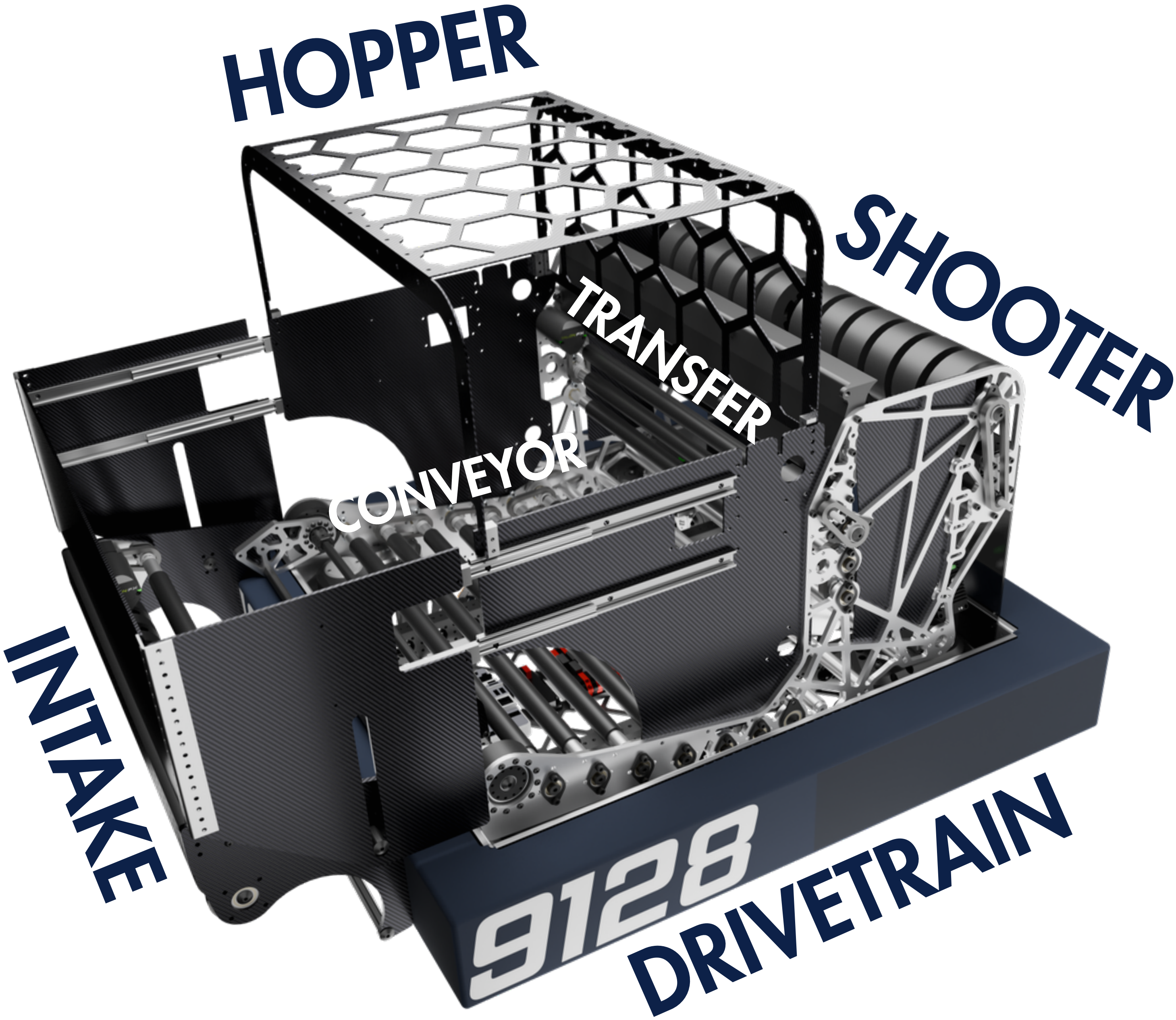
SHOOTER

- High accuracy into processor
- Fast spinup (<1s goal)
- Adjustable speed/angle
- Consistent trajectory
- Minimal alignment required

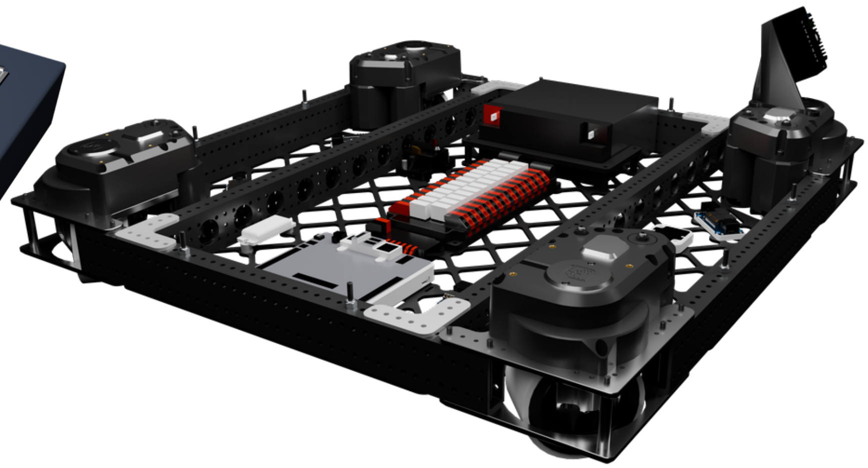
CLIMBER

- Reliable endgame climb
- Fast alignment (<1s goal)
- Secure latch mechanism
- Climb in <1–2s
- Stable execution

Robot Architecture



Drivetrain



Requirements

- Low center of gravity
- High reliability, robustness, and rigidity
- Responsive, highly controllable, quick
- Modular and rigid mounting of subsystems

Specifics

- 2"x1" x 1/8" Tubing for higher ground clearance, more stiffness, and a lowered CG
- 110" Frame Perimeter to maximize fuel capacity
- Swerve Drive Specialties MK5n modules for their compactness and low weight
- Horizontal battery to reduce CG
- Kraken X60s at an R2 ratio for a max speed of ~17.5 ft/s to have a balance between speed and agility
- Limelight 4 for auto localization

Intake

Requirements

- "Touch it, own it” Mindset
- Robust and reliable, must withstand collisions of over 20 MPH
- Wide intake area to acquire more fuel per second
- Low backlash, ~<0.5 second deployment

Specifics

- 2"x1" bash bar for robustness and to prevent intake shafts from bending
- 24" Wide to fit 4+ balls to prevent jamming and to assist driving
- SRPP Plates for flexibility
- Aluminum 7075 reinforcement and wrist plates to prevent plastic deformation
- 2 X44s driving 2 rollers at a linear speed of ~30+ ft/sec
- X60 driven cycloidial pivot for low backlash and to “agitate” fuel when shooting

Hopper

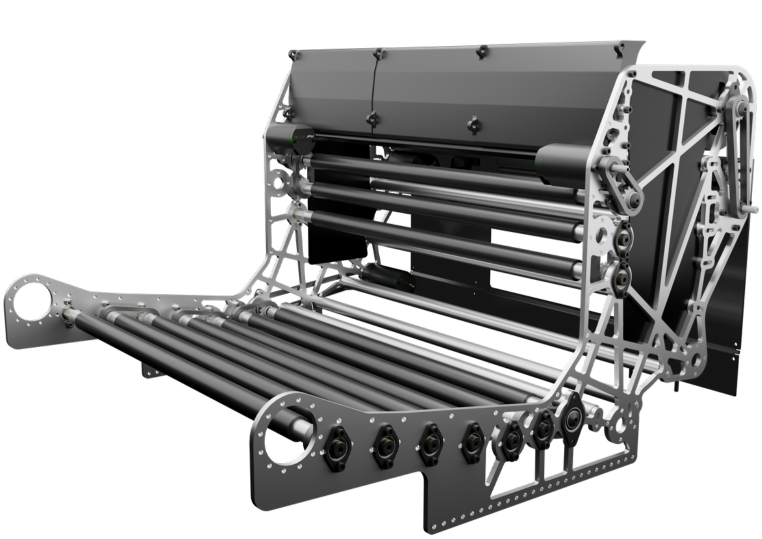
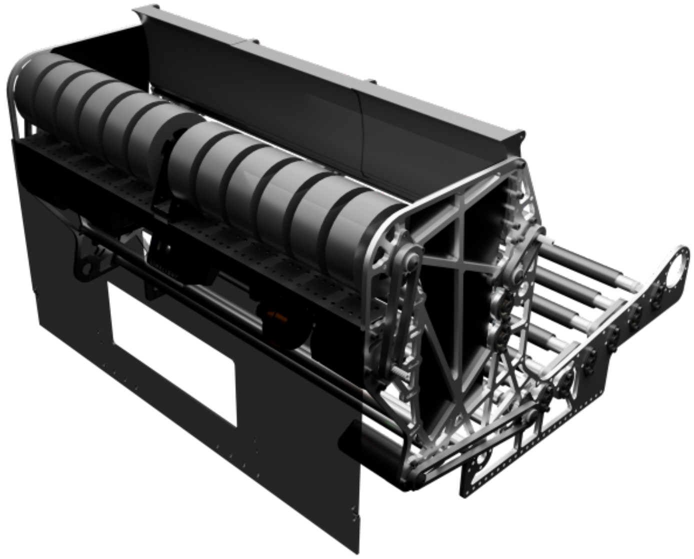
Requirements

- High ball Capacity
- Lightweight
- Must be able to fit under the trench
- Expanding mechanism must never fail

Specifics

- SRPP Plates for a high strength-to-weight ratio
- Expands forward to increase ball capacity
- Flexible top that folds to go under the trench while still having high capacity
- Holds 75+ Fuel
- Passively driven by the intake deploying with a pin and slot to prevent adding actuators and to agitate fuel with the hopper while shooting

Indexer and Shooter

Requirements

- Avoid jamming and maintain a high throughput
- High reliability, robustness, and rigidity
- Consistency with a quick spin up
- Modular and rigid mounting of subsystems

Specifics

- Full-width, 4.5 fuel wide indexer and shooter to avoid jamming from funneling
- 1 Kraken X44 driving the floor at a 1.4:1 ratio for low weight, 2 X44s driving the feeder at a 1:1.67 ratio for high throughput, and 2 X60s driving the flywheel for quick spin up
- The combined indexer and shooter allows for easier integration and a lower center of gravity
- Pocketed 1/4" Aluminum 7075 Plates for low weight and high rigidity, providing easy mounting for the intake and hopper

Robot in 3 Days

Robot Architecture

- Low Profile Design: Prioritized a sub trench height and lightweight frame for high agility and full access to the field
- High Speed Drivetrain: Utilized SDS MK5n swerve modules (R3 ratio) to maximize top speed across the field.
- Integrated Fixed Shooter: Chose a single over a turret to reduce complexity, center of gravity, and build time (12-hour total assembly).
- Linear Intake System: Employed a rack-and-pinion linear deployment to maintain a compact footprint and trench clearance.

Performance Impact

- Agility vs. Durability: The light frame enabled rapid cycles but lacked the mass to resist defensive "bullying."
- Strategic Miscalculation: Trench access proved less valuable than hopper capacity; the 30-ball limit capped scoring potential compared to higher-volume bots.
- Mechanical Fragility: The rigid linear intake lacked compliance, leading to collision damage, while the dropped bellypan caused the robot to "beach" on field obstacles.

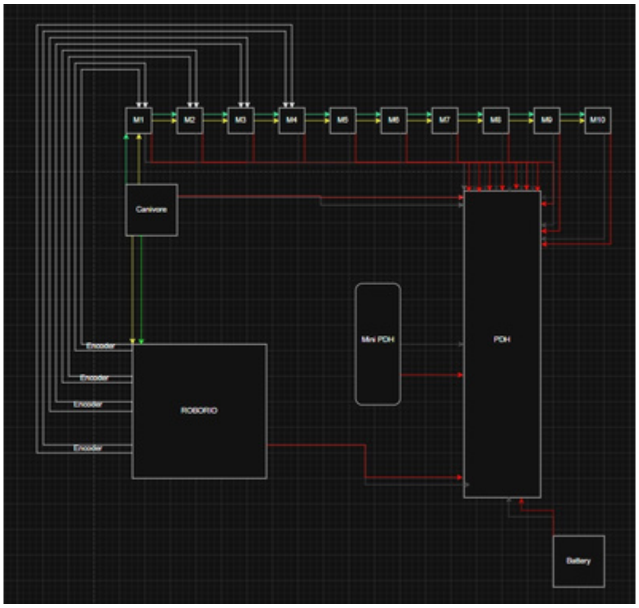
Module: Wide Drum Shooter & Feed

- Internal Serializer: Designed to move fuel from the hopper directly into the drum to maintain a steady stream of fire.
- Fixed Geometry: Fixed the shooter at a low angle to ensure a predictable trajectory while keeping the robot's vertical profile minimal.

Performance Impact

- Reliable Accuracy: Outperformed early turret prototypes in consistency and ease of fabrication.
- Feed Rate Limitations: The internal serializer bottlenecked the drum, limiting output to ~8 balls per second—insufficient for high-volume scoring.
- Intake Dead Zones: The linear geometry created gaps where fuel remained trapped, hindering seamless transfer to the shooter.

Electrical



Operation Bulletproof

Quality Assurance & Reliability Standard

The Standard:

- Zero Tolerance Philosophy: A team wide mandate for mechanical, electrical, and software reliability to guarantee zero onfield failures.
- Design for Impact: Every mechanism is engineered under the assumption it will endure maximumimpact collisions and relentless defense in every match.
- Holistic Integration: This standard dictates all hardware choices, wiring protocols, and pit operations.

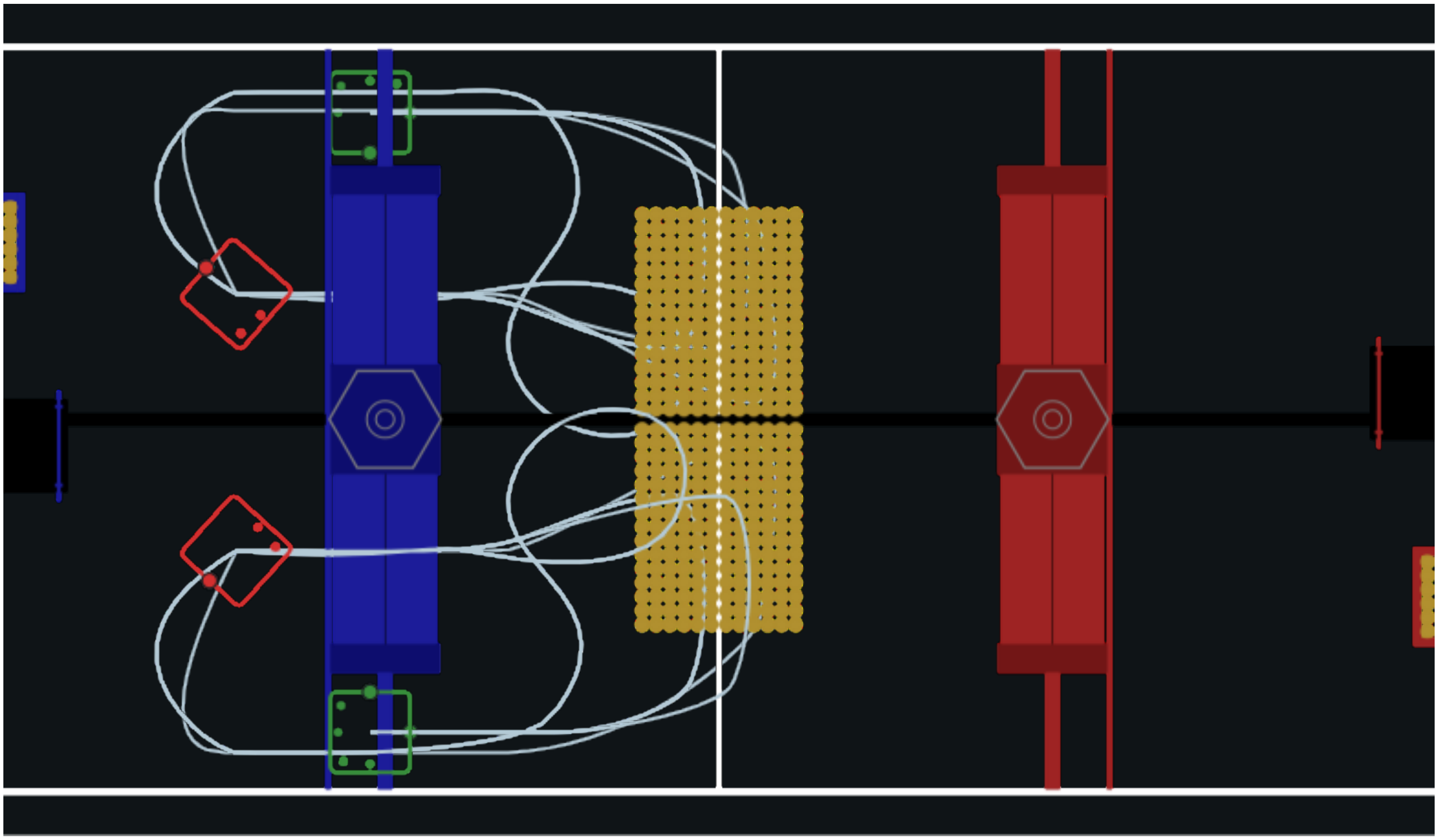
Electrical Integrity:

- Meticulous Wiring: Every wire is precisely cut, properly ferruled, and secured with heavy strain relief to prevent fatigue at connector joints.
- Rapid Repairability: Exclusive use of WAGO terminals ensures absolute wire retention and allows for lightningfast pit repairs.
- Protected Bandwidth: A divided CAN network utilizing a CANivore physically isolates Kraken X60 and X44 motor controllers onto a dedicated CAN FD bus.
- ShockProof Comms: Delicate sensor connections and radio ethernet ports are physically secured and strainrelieved to eliminate dropped packets during highG impacts.

Software Protection & Pit Operations:

- Software Safeguards: Strict stator current limits on all Kraken motors prevent brownouts and burnout when mechanisms stall against heavy defense.
- Active Diagnostics: Constant system diagnostics and fault logging alert the drive team to sensor anomalies before they become catastrophic.
- PreFlight Checklists: Rigorous topdown physical inspections are executed before every single match.
- Readiness Verification: The pit crew systematically verifies battery internal resistance, checks CAN bus health, and retightens highstress joints to ensure 100% capacity on the field.

Autonomous



During the autonmous period, the robot uses PathPlanner to quickly collect and score fuel. This improves cycle speed by optimizing our paths based on our drivetrain's constraints, and supports our overall match strategy by ensuring we score the most amount of fuel possible during auto in order to have an inactive hub during the first shift.

Autonomous Routine Choices

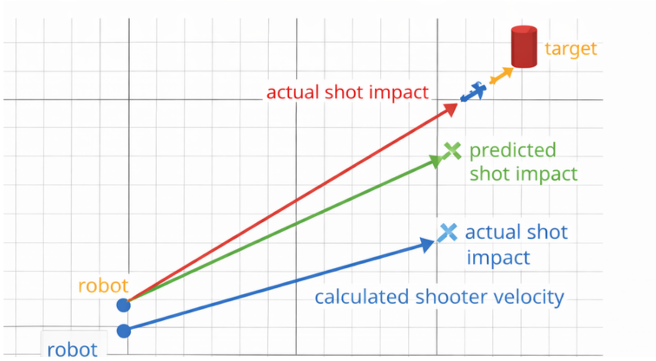
We made a few key decisions when designing our autonomous. We decided to prioritize 2 cycles in autonomous to allow us to have a higher chance of winning autonomous, which gives us a stronger start in teleop. Additionally, we designed our paths to work with a variety of alliances as we stick to our half for our first cycle, going into the neutral zone further when an alliance robot is less likely to be there, increasing our scoring capacity while maintaining compatability.

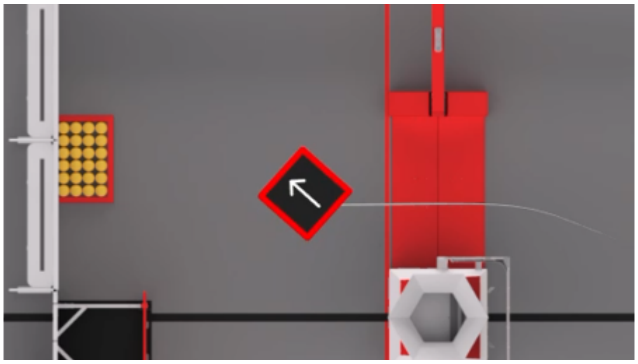
Constant Relocalization

We use our limelight to constantly relocalize our robot when we can see an april tag. This allows us to maintain accuracy while driving, and mitigate the risks to accuracy caused by traversing over the bump. Additionally, this improves our shot accuracy in autonomous as we can make sure we have the true robot position for correct aiming and ranging.

Only Undefeated Auto at 53-0 after Week 7

Teleop





During the match, the robot uses a variety of programming features to maximize scoring potential. These aid driver control by increasing automation on the robot and providing drivers with critical information, making driving easier for them.

Shoot on the Move

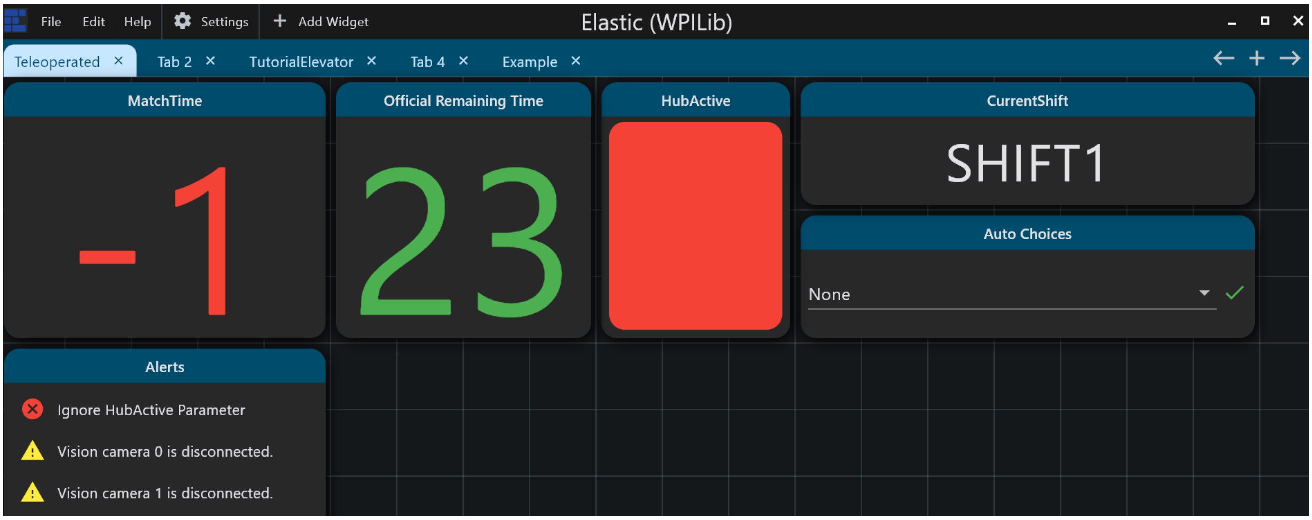
Our robot compensates for translational and rotational motion during shooting by predicting the robot's future pose at projectile release. Shooter RPM and auto align angle are continuously updated using measured velocity and angular rate to maintain accuracy while driving.

Vision Pose Fusion

We reject new poses based on a variety of factors, including tag count, ambiguity, Z error, and field bounds. Our pose estimate standard deviation scales with averageTagDistance^2 / tagCount, with extra factors for MegaTag 2 and per-camera weights. Each accepted pose observation is sent to our drive's pose estimator, which combines vision-based poses and the robot's current pose with regard to standard dev

Alerts and Operator Feedback

We have a variety of alerts and visual feedback for the drivers to refer to in a match, displayed on their driver station laptop through Elastic, including disconnects and shift information.



Contact Us

itkan.one.frc@gmail.com

itkanroboticsfrc

itkan.one