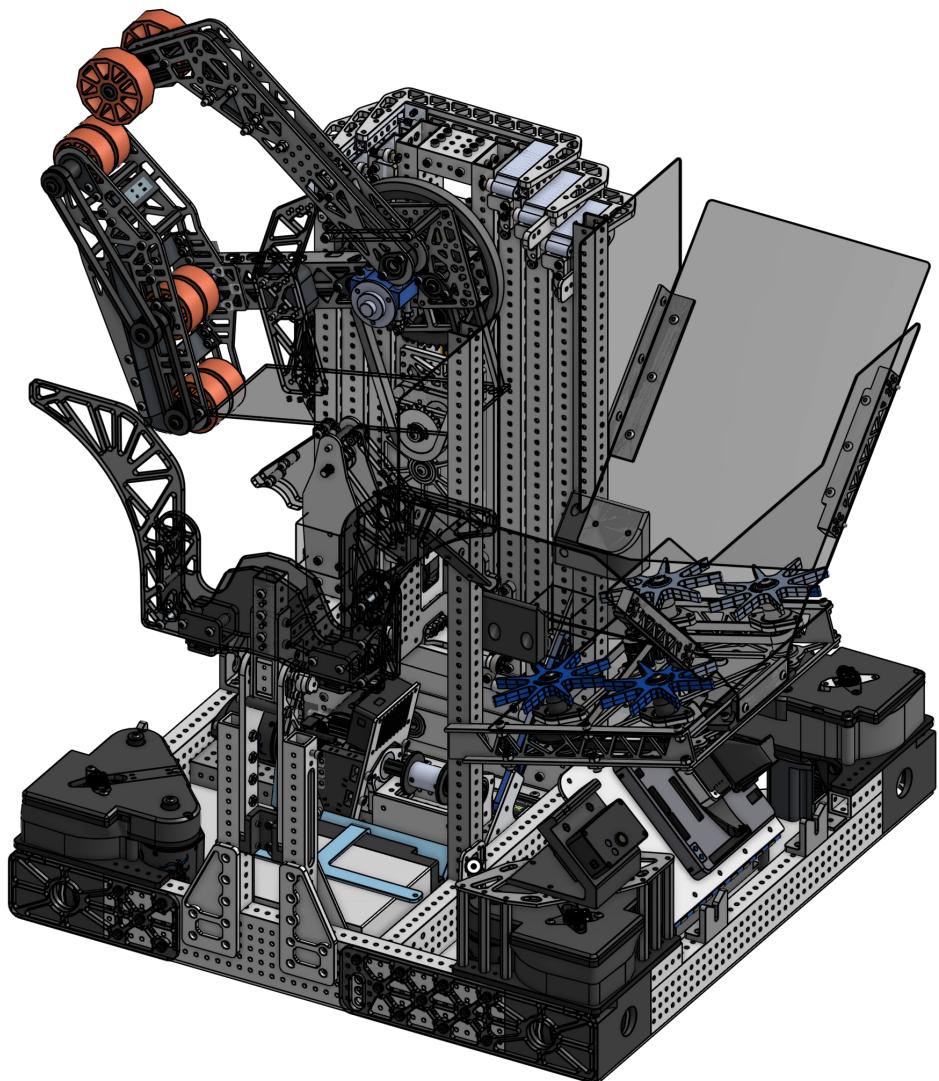


FRC #1987

The Broncobots



2025 Technical Book



5,200+ Student Hours

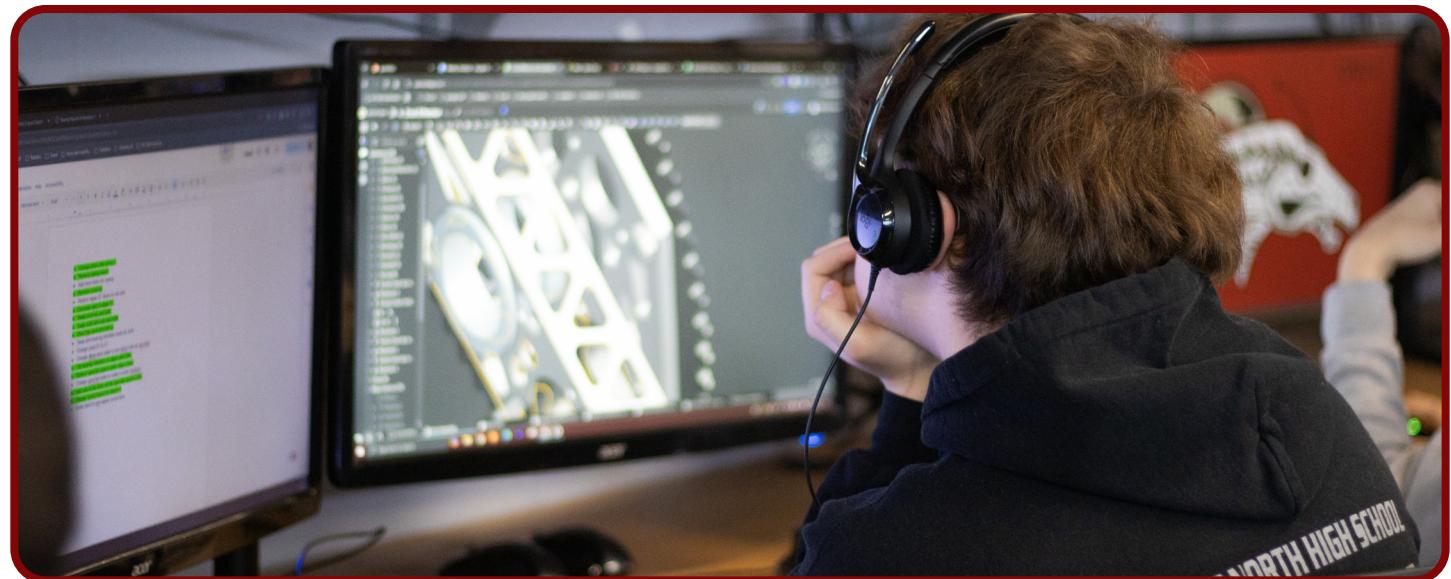




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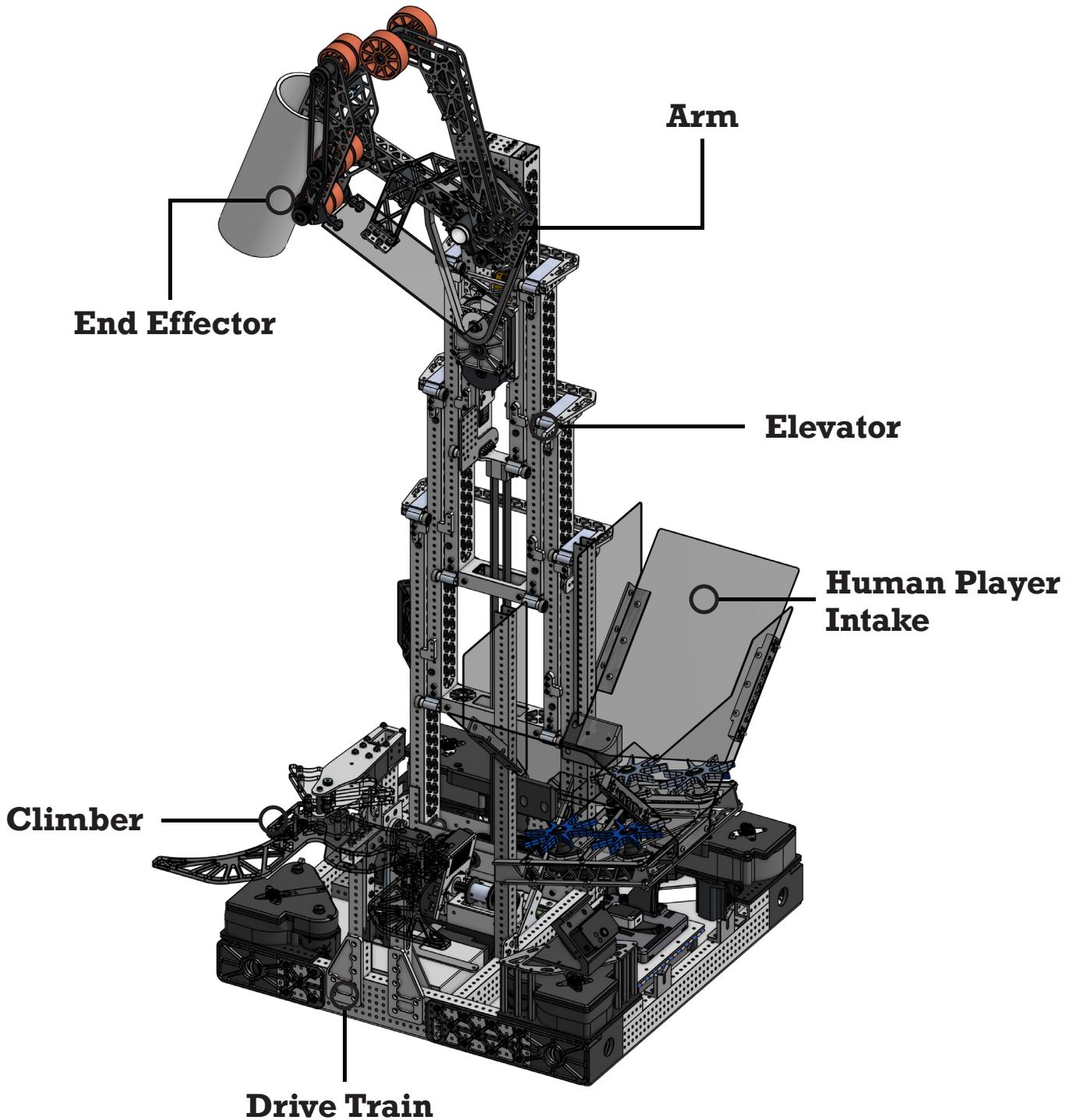


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Robot Overview

Meet RipTide, Team 1987's 2025 robot. The Broncobots are excited to share the design of this all new machine. With 6 subsystems, this year's robot is built to address every challenge ReefScape has to offer.





Robot Overview

Strategic Design

- Coral scores opposite the intake for autonomous efficiency
- Robot actions are automated, increases driver/human player room for error

Design for Manufacture

- Heavily utilizes COTS components to limit manufacturing need
- All components go through a manufacturability review for sponsored sheet metal or in-house fabrication
- Extensive 3D Printing and CNC fabrication ensures consistent tolerances for repeatable parts

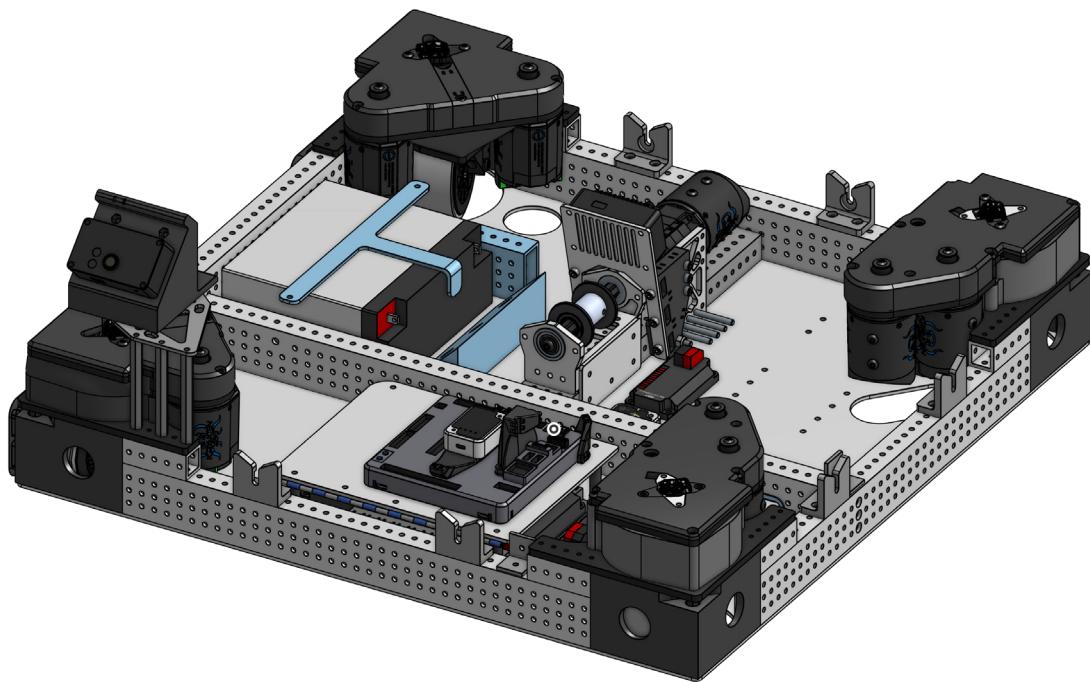
Design for Maintenance

- Subsystems utilize minimal varieties of COTS components
 - Reduces cost
 - Reduces pit storage space needs
 - Increases speed and efficiency of repairs
- Sub-assemblies are easily swappable with spares
- No buried hardware philosophy prevents frustrating repairs



Drive Train

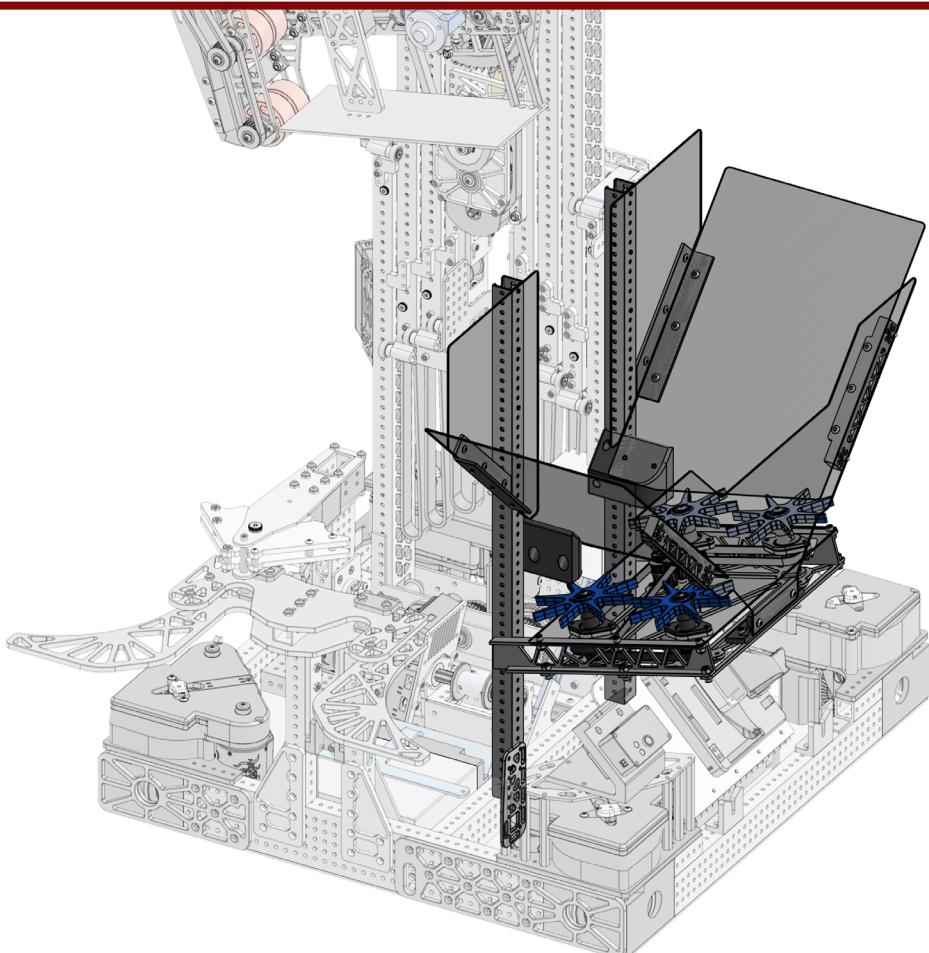
- Swerve-X Drive w/Kraken Drive Motors
 - 2 Swerve X2i's & 2 Swerve X2t's (Left & Right) geared for acceleration and speed on short cycle distances
 - Nylon 3D printed swerve covers keep grease in and dirt out
- 1" frame drop reduces ground clearance, lowers center of gravity, and increases space for mechanisms and electronics
- Hinged electronics shelf above PDH for improved packaging
 - Polycarbonate panel permits for visibility to PDH status lights
 - RoboRio placement for easy FTA viewing
- Robust single-piece bumpers backed by aluminum sheet





Human Player Intake

- Powered star wheel quickly gain control of and orient Coral
- 1/16" Polycarbonate minimizes weight and allows compliance for rapid Coral collection
- Pivoting front plate allows additional compliance to accommodate all Coral intake orientations
 - Magnet retention retains the plate within frame perimeter when not in use
- Integrated Gear reduction and direction reversal minimizes weight of power transmission assembly





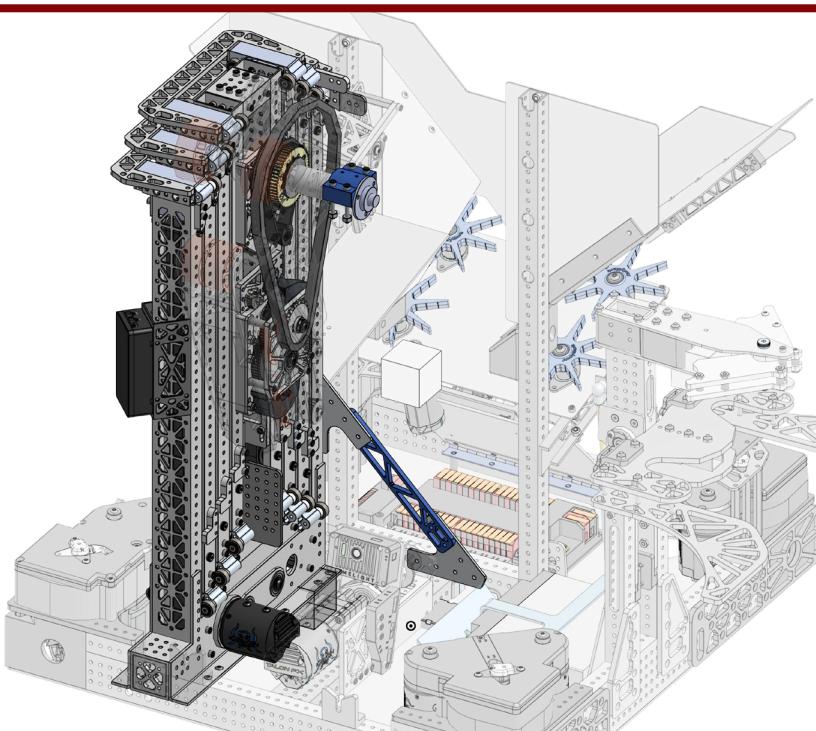
Elevator

Structure

- Belt In Tube 3 Stage Elevator
 - Kevlar Strengthened Belt
 - Continuous Rigging
 - Weight-reduced aluminum tube
- Achieves 51 inches of extension and reaches 79 inches of height
- Keeps robot under 30" tall when stowed, allowing the robot to drive underneath a Shallow Cage
- Stable adjustable reinforcement structure

Elevator Gearbox

- Integrated with Elevator Base
- Compact size stays below chassis height and maximizes belly pan space for other components
- Dual Kraken X60 minimizes current draw and eases power control
- 6.75:1 gear ratio keeps extension time under a second while minimizing current draw



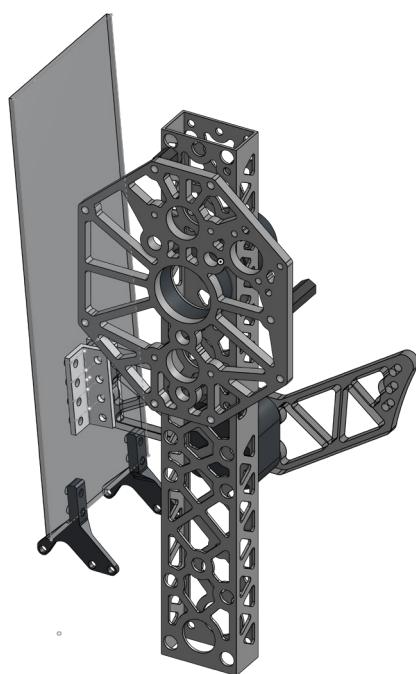


Arm

- Coaxial drive keeps all motor weight off the arm and low on the carriage
- Dead axle maximizes arm rigidity and minimizes tolerance stack up that normally causes arm wobble
- Coral and Algae systems ran by a single motor, minimizing weight and simplifying automation
- Extensive weight reduction to reduce moment of inertia, including 1/2" thunderhex shafts and pocketed parts
- Mounted coral and algae blockers maintain full control of game elements

Arm Gearboxes

- Integrated into elevator carriage
- Floating pivot gearbox allows chain tensioning
- Custom 3D printed encoder system allows absolute position control of the arm
- Coral and Algae systems ran by a single motor, minimizing weight and simplifying automation
- Rotation gearbox geared to rotate arm into scoring position in a fraction of a second while maintaining low power draw





End Effector

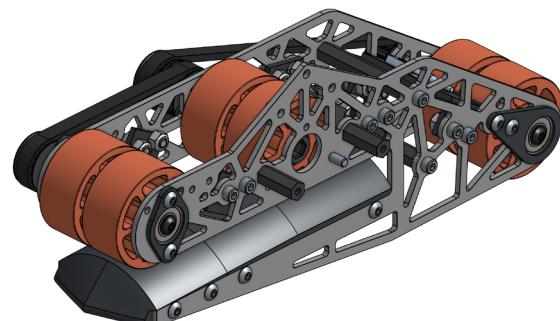
Coral End Effector

- Top 2.25" rollers with passive interior support minimizes overall footprint
- Front wedge creates redundant centering during collection, easing collection hand off
- Two proximity sensors allow full automation
- Lightweight to minimize moment of inertia, utilizing 3/8" thunderhex and pocket parts

Algae End Effector

- 2.25" Wheels integrated on Coral Eng Effector and 3" wheel position on Algae arm
- Algae arm spring loaded to allow early control of Algae off the Reef and extended contact time to maximize control when scoring in the Net
- Offset belt path minimizes arm footprint and minimizes moving part count
- Integrated sensor for full automation

Coral End Effector



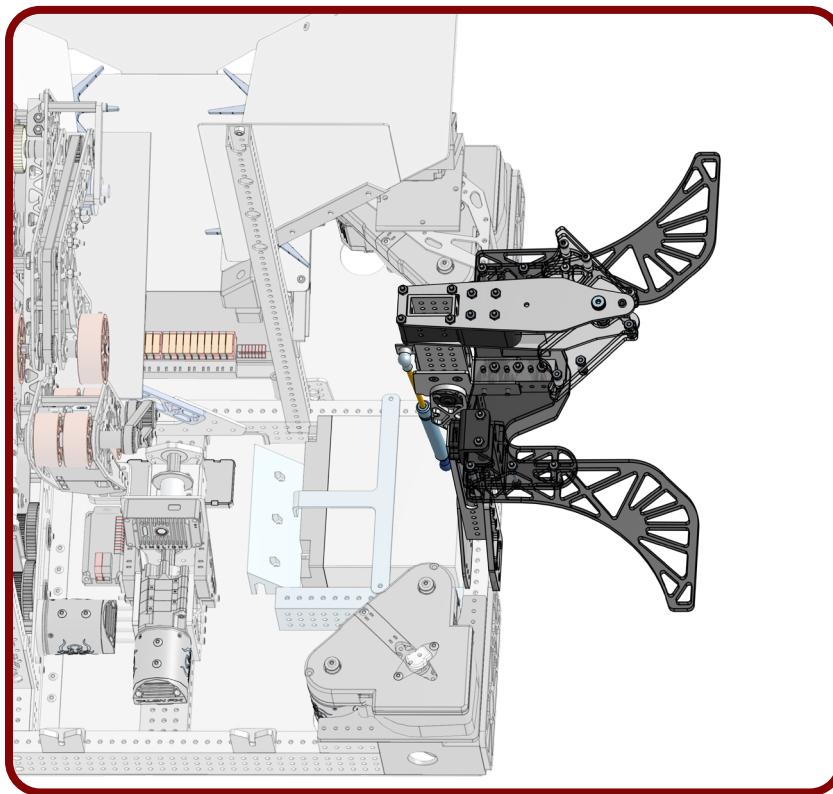
Algae End Effector





Climber

- Everybot Style Claw provides rapid full control of the Cage
- Added W-Shape guide funnels the Cage and provides cantilever support during climb
- Simple COTS winch system provides quick power climbs and minimizes backdrive
 - 100:1 Max planetary Gearbox (5:1, 5:1, 4:1 slices)
 - 1 Kraken X60
 - GreyT Telescope Winch
 - Shock-absorbing abrasion-resistant strap stands up to the toughest matches
- 2 LaserCan Sensors to detect Cage position and absolute encoder on pivot shaft allow full automation
- 20lb Gas Shock deploys the system, simplifying winch usage and overall design





Programming

- Java Command Base
 - State machine for superstructure automation
 - Auto Align to collect and scoring locations, updates dynamically with one-touch control
 - Path finding to desired locations
 - Strategy defined
 - Sensor and state driven
 - Path Following Autos
 - Automation with a healthy amount of manual input
- Auto Align with
 - Score Coral Command
 - Drives to nearest coral scoring location
 - Collect Algae Command
 - Drives to nearest algae collection location
- Vision
 - Use of a Limelight 4 placed on scoring side of robot allows for highly accurate pose estimation
- Arm Rotations minimized when elevator is elevated
- End Effector
 - Coaxially linked, so Arm rotation and end effector wheel positioning is coordinated to maintain control of game pieces
 - 3 censor design allows robot to understand position, state, and type of game piece
 - Close loop position control
- Elevator
 - Position control via mechanism ratio to understand elevator state
- Arm
 - Contains absolute position encoder
- Climb
 - Push-Button for Climber Deploy
 - Laser range finders detect when to begin climb
 - Contains absolute encoder for climb position reading

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