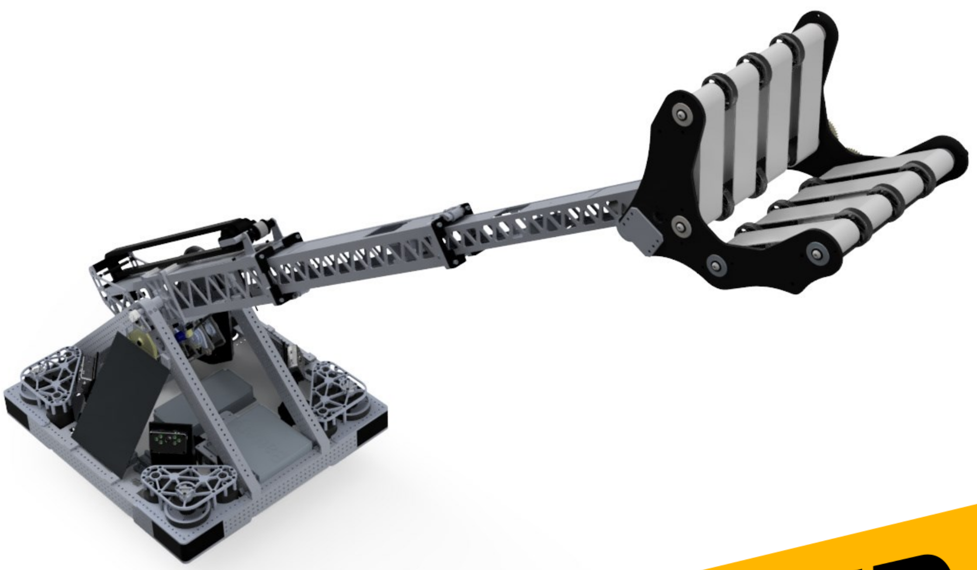
FRC Team 1987 The Broncobots



CHARGED UP

PRESENTED BY HAAS Gene Haas Foundation

2023 Technical Book

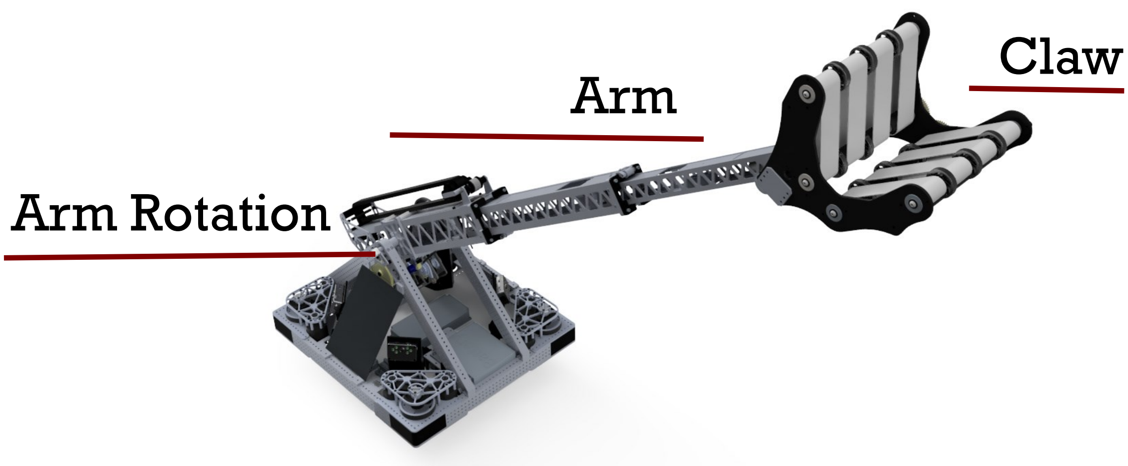
6,734+ Student Hours

26 Students

Our student led team designed, built, and programmed the robot. Students designed the robot in Onshape and programmed in Java. Mentors stepped in when needed.

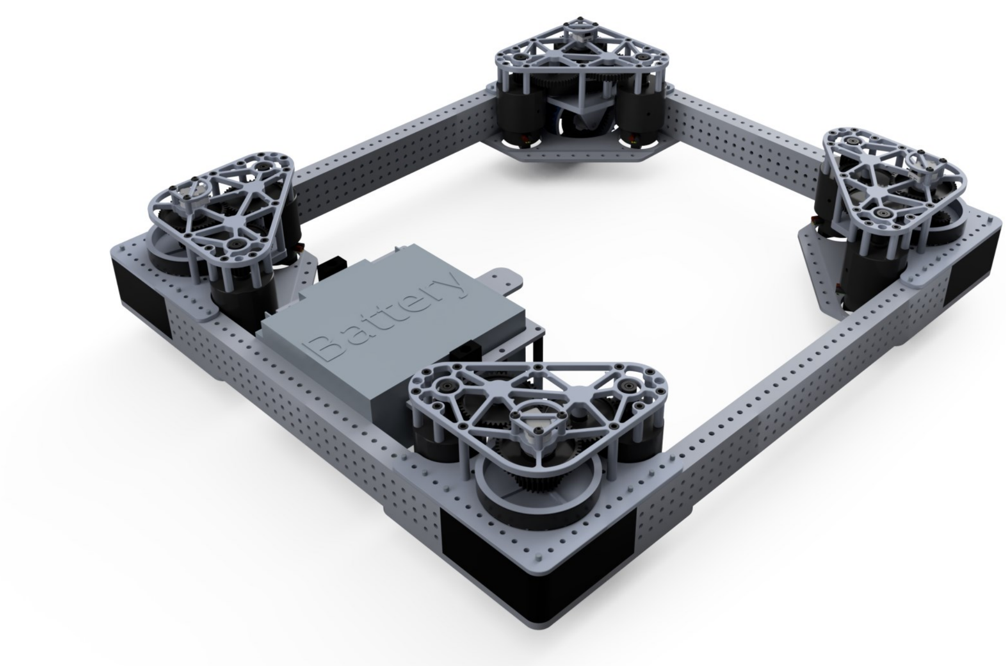
Table of Contents

FlipSide


Claw
Arm
Arm Rotation

DRIVE TRAIN

Mechanism



- 4 Swerve Drive Specialties MK4i Modules
- Powered and Driven by a total of eight Falcon 500 motors
- Modules are inverted for motor protection, space saving and lower center of gravity.

ARM ROTATION

Mechanism

- Two Falcon 500s on a 139.5:1 reduction
- Chain runs from the gearbox to 54T sprocket
- Chain tensioned using COTS clamping bearing blocks with CAMS integrated with custom gear-box plates
- Arm rotates on two custom aluminum hub shafts spinning on angular contact bearings for in-creased robustness
- Low gearbox for optimal CG

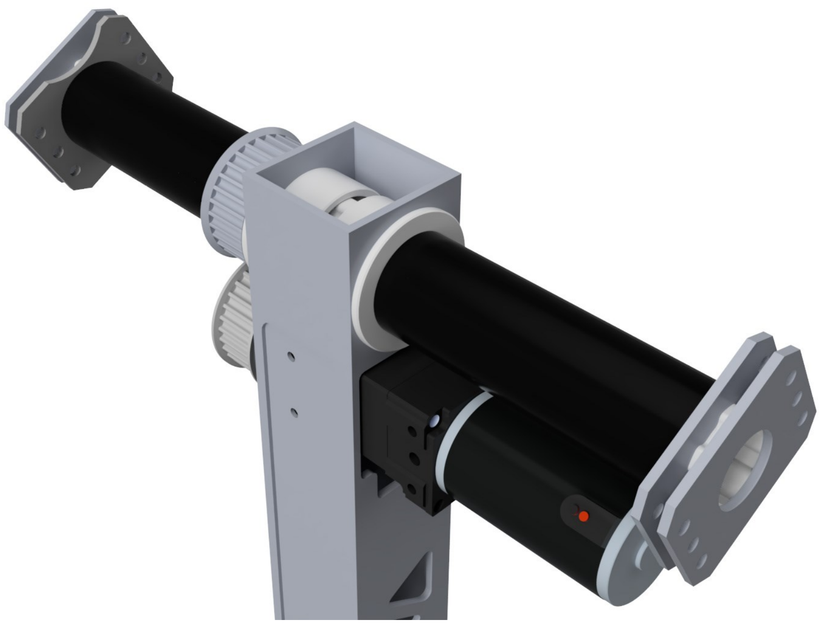
TELESCOPING ARM

Mechanism

- Made up of 4x4, 3x3, and 2x2 inch 1/8'' wall lightened tubes in cascading configuration
- One Falcon 500 powering a 10:1 reduction
- 15mm wide, 5mm HTD timing belt runs on a 30T driven pulley to form a U-shape belt path for max belt contact
- Belts run around tubes on aluminum tensioner pulley mounts with 5/8'' OD bearings
- Energy chain tensioned using constant force spring in order to properly organize and protect wiring

WRIST

Mechanism



- One BAG motor powering a 150:1 reduction VersaPlanetary gearbox and belt to reduce shock
- BAG Motor is set in the top of the 2x2 tube
- Collector rotates on two oil-embedded flanged bronze bushings
- Claw attached to wrist with 12.125" MAX spline shaft and MAX pattern plates

CLAW

Mechanism

- Collects cones and cubes using 8, 2'' wide poly belts
- Four rollers comprised of 2'' compliant wheels, 2.5'' 3D printed poly belt rollers
- Intake rollers powered by a NEO 550 with a 9:1 reduction

PROGRAMMING

Software

Drivetrain

- Magnetic encoder on each of the four swerve modules to measure steering absolute position (CANCoders)
- Closed loop PID control for velocity and position of the swerve module Falcons
- Autonomous commands utilize the Path Planner tool to follow paths using motion profiling
- Odometry fuses data from Falcon internal encoders, CANcoders, and a pigeon to track field-relative pose
- Falcon motors and CANcoders within the drivetrain are linked via a CANivore, providing a differentiated CAN bus, and allowing for more bus bandwidth
- Swerve modules can be oriented in an X stance to prevent rolling off of an unbalanced Charge Station

PROGRAMMING

Software

Arm

- Falcon motors operate arm rotation and extension. The arm has a rotation range of 240° with an extension capable of reaching up to 42 inches
- Arm rotation is monitored with a CANcoder using absolute position, while the extension fuses a 10-turn potentiometer with absolute position and the internal encoder of the Falcon for relative position
- Rotation and extension movements are controlled using synchronized closed loop trapezoidal motion profiles
- An interpolated data table of arm length to arbitrary feed-forward values is used to offset gravity across the full range of rotation and extension positions

PROGRAMMING

Software

Wrist

- The desired wrist position is maintained by using a closed loop trapezoidal motion profile which references a Mag Encoder for absolute position
- The BAG motor is stalled while holding position the entire match. Additional voltage and current limits are set to protect the motor and operate within manufacturer specification

Claw

- The claw detects when a game piece is collected by sensing a current spike on the NEO 550 and remembers whether it is grasping a cone or cube
- If the grasped game piece is a cube, then the claw will continuously pull the cube into the claw to maintain grip

PROGRAMMING

Software

Vision

- There are multiple Limelight™ 3's positioned facing outward giving a front-facing view on both sides of the robot to periodically update the robot pose
- The updated pose removes any error from the limelights and keeps the position accurate at all times

Driver Controls

- Driver uses an Xbox controller with commands and command groups assigned to buttons
- While driving, the driver has the ability to reset the gyro, making field orientation as easy as a single button press
- Once a game piece is collected, the robot knows whether it's a cone or cube, and changes its scoring position accordingly
- The co-driver is able to set the robot's scoring height with three buttons, allowing the driver to score with a single button press
- The driver has a "finesse" button that moves the robot at half speed allowing for easier collecting and scoring of game pieces
- Using the d-pad, the driver can lock the robot heading to any cardinal direction

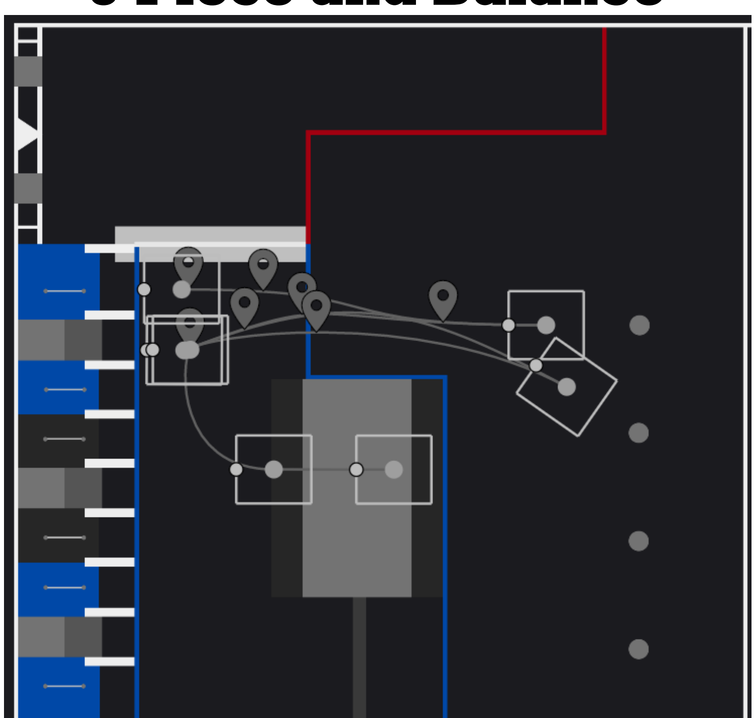
PROGRAMMING

Software

<u>Automation:</u>

- The superstructure and drive train are synchronized to optimize autonomous routines
- Before each match the drive team can pick between multiple autonomous paths, with some ending auto-balanced given match strategy
- Auto-balancing is achieved using an IMU and PID controller to dynamically control the speed of the robot given the pitch of the drivetrain

3 Piece and Balance



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