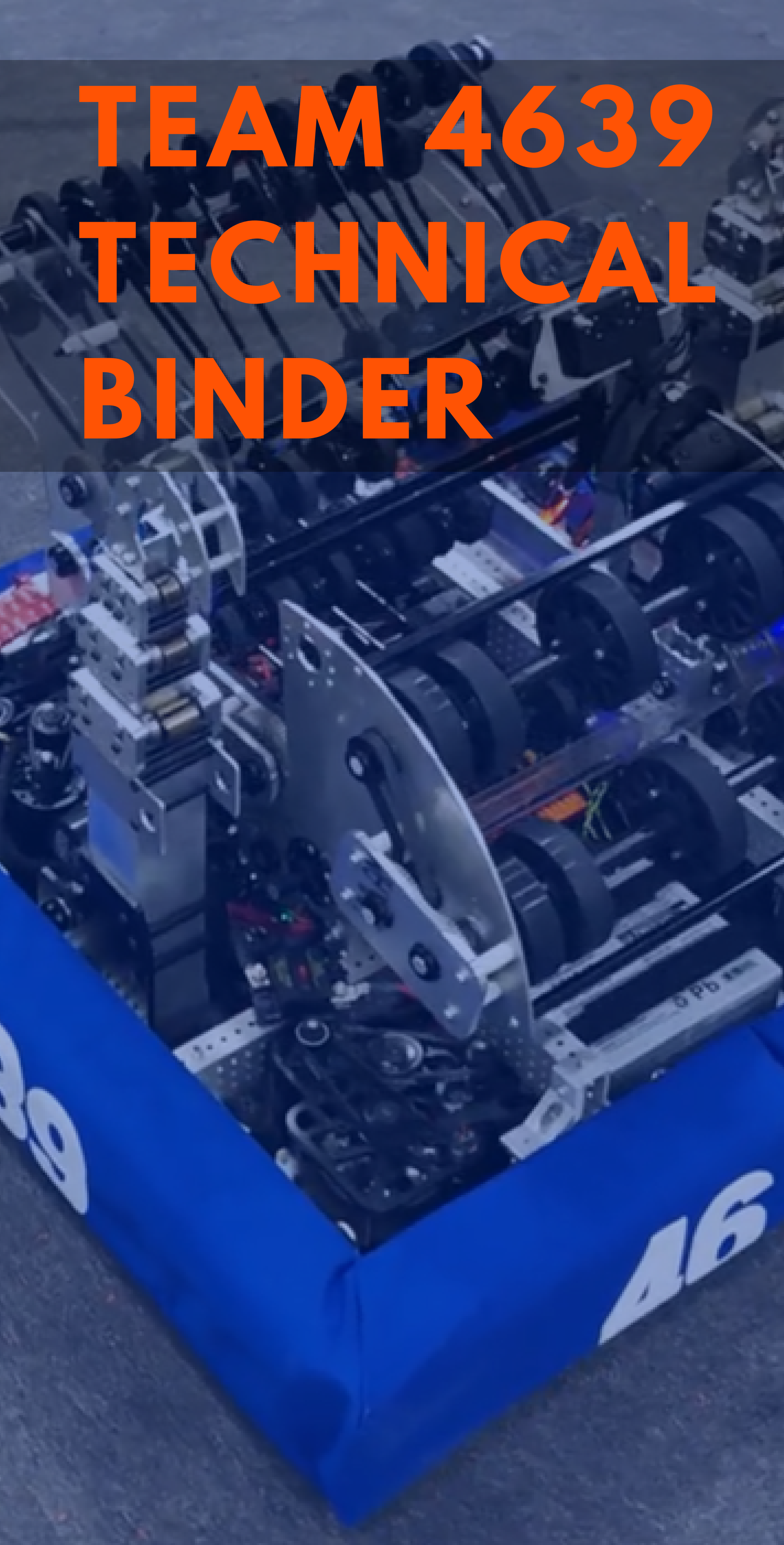
TEAM 4639 TECHNICAL BINDER



THE ROBOSPARTANS

CRESCENDO[SM]

2023-2024

TABLE OF CONTENTS

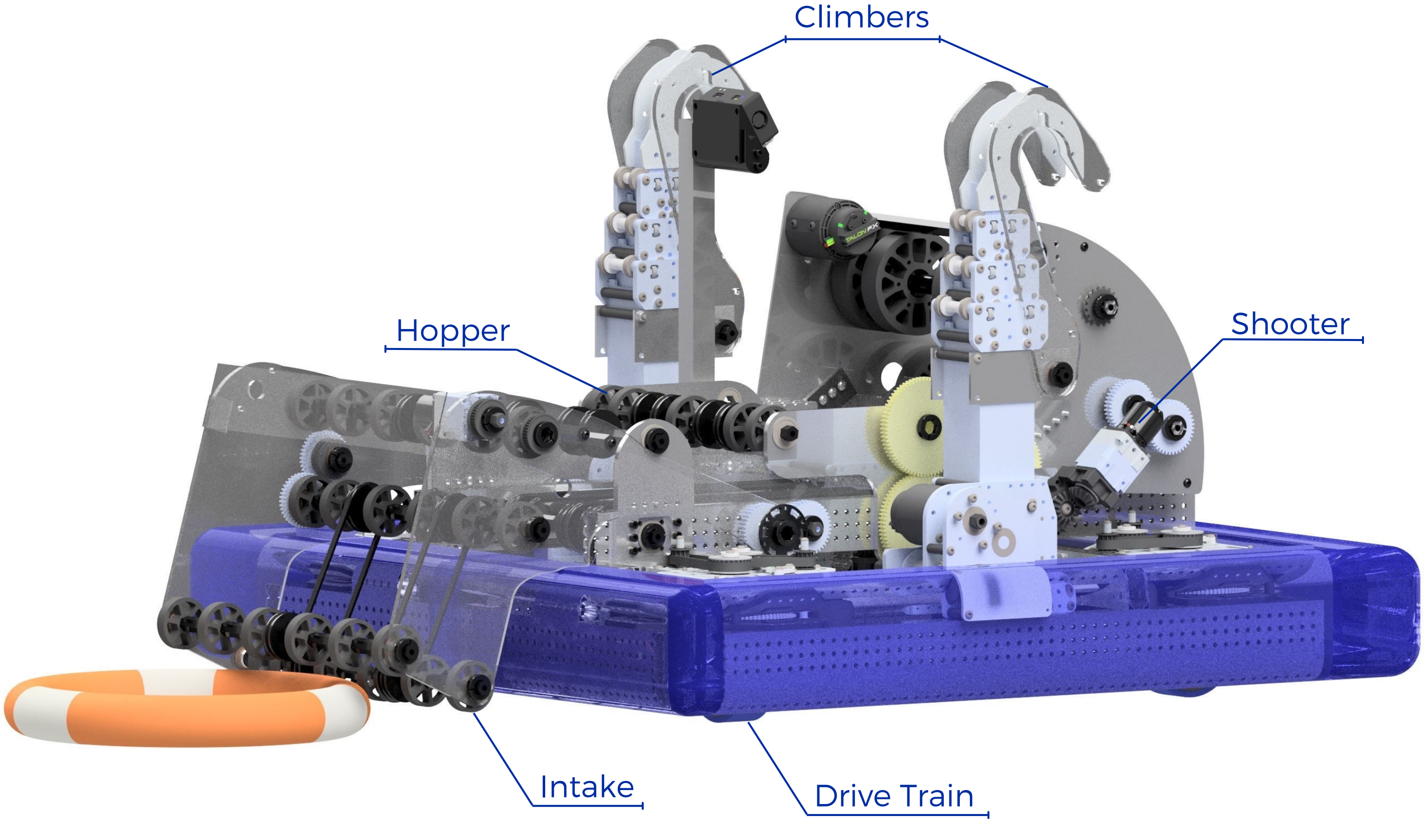
SUBSYSTEM STRATEGY

DRIVE TRAIN	We made the early decision to use a Swerve Drive based on the nature of the game as observed during our Human Simulation at Kickoff. A big discussion point was the size. Weighing the pros (like maneuverability) and cons (like a lack of space for electronics), we settled on a 27.5"x27.5" frame (33.5"x33.5" with bumpers). Another design consideration was to keep the height under 2'4" to be able to drive under the Stage.
INTAKE	Our main philosophy was "touch it own it," something we saw as vital considering the many areas where game pieces will be contested for. We also put a lot of thought into the pivot point and its integration with the Hopper and Shooter.
HOPPER	We prioritized having a simple but effective Hopper with almost total control of the note. This system also needed to integrate with Intake and Shooter well.
SHOOTER	We realized early on the importance of having a variable angle and Vision system along with fast shooting to excel at Crescendo. We decided not to include a turret because of our swerve capabilities. Shooting into the Amp and Speaker from a variety of locations was a top priority.
CLIMBER	We needed the climber to be short when retracted and around 4' when extended. We also decided on using hooks early on and focused on optimizing them for gripping the chains.

CADENZA

WEIGHT: 100 lbs

27.5" x 27.5" x 25"
(l x w x h)



DRIVE TRAIN

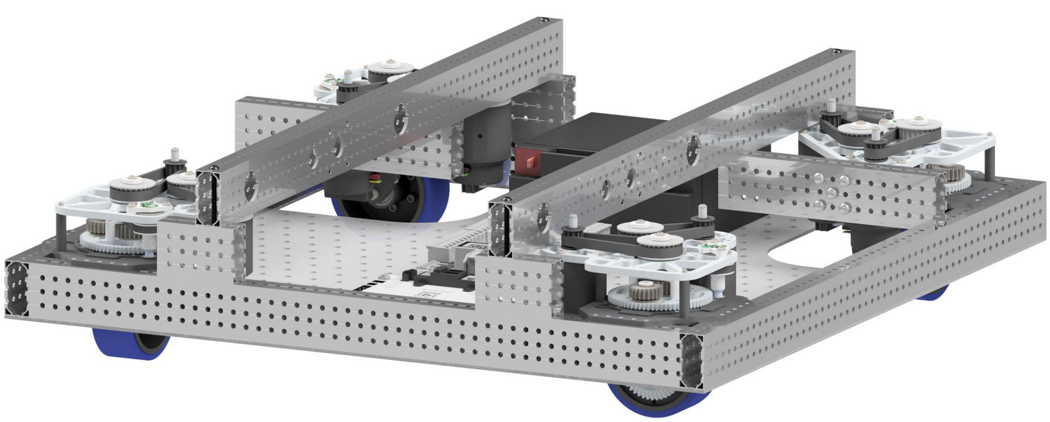
This year, our team opted to use a swerve drive for the second time. A swerve drive was selected for this game because it allowed our robot to maneuver around the field and other robots in a precise manner and assisted us in aligning to the Speaker and Amp. It opens up many opportunities for us in terms of driver strategy and automation due to its speed and degrees of freedom.

WCP SwerveX Modules

- Field Oriented
- Falcon Motors
- Inverted Module
- 6:55:1 gear ratio
- Mounted above the frame

Chassis

- 1/8” thick 2x1 bars
- Mesh polycarbonate electrical board
- Flat support bar running across the bottom
- Crossbars to support subsystems



INTAKE

In our hours of testing, we figured out the optimal distance between the top and bottom layers along with the optimal distance of the intake from the ground. All of these constants helped us design an intake that can pull in notes consistently and from all corners.

Structure

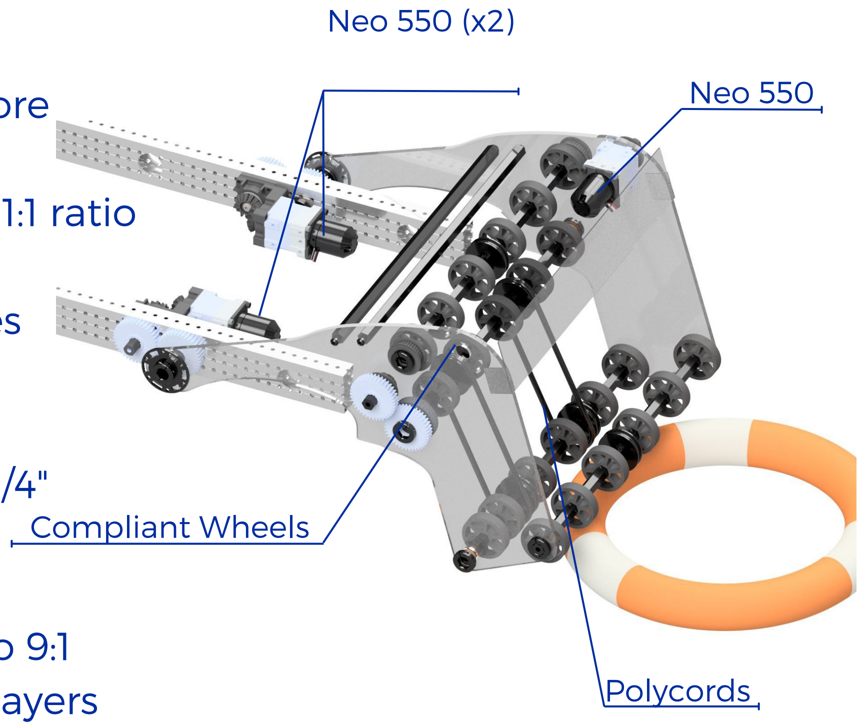
- 27.5" long 1/8" thick 2x1 aluminum crossbars
- 1/4" thick polycarbonate plates on both sides

Pivot

- Two Neo 550s and thru-bore encoder
- Reduction gearboxes w/ 81:1 ratio on each motor
- Connected to intake plates via Versahubs

Rollers

- 2" compliant wheels and 1/4" polycords
- Neo 550
- Reduction gearbox of ratio 9:1
- Around 1.5" gap between layers without compression and/or stretch



HOPPER

The main reason for having a hopper is to ensure a smooth and consistent transition of the note from the intake to the shooter. We want to be able to safely stow our note while the robot is moving etc. Similar to the intake, we found constants like distance between layers to design an effective hopper.

Structure

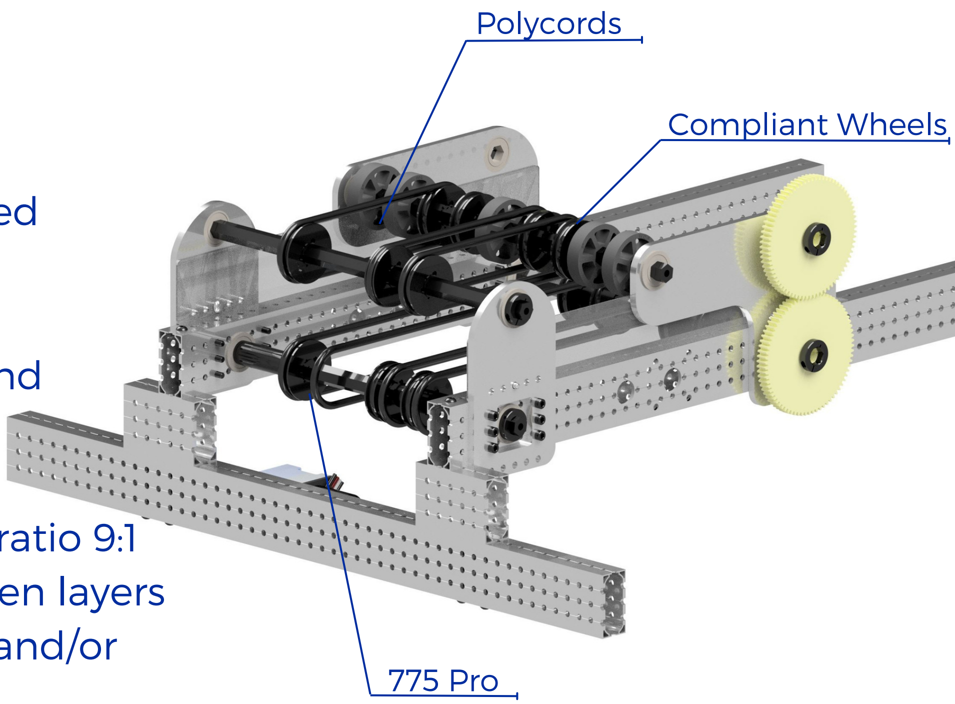
- 27.5" long 1/8" thick 2x1 aluminum crossbars
- 1/4" thick custom CNCed aluminum plates

Rollers

- 2" compliant wheels and 1/4" polycord
- 775 Pro
- Reduction gearbox of ratio 9:1
- Around 1.5" gap between layers without compression and/or stretch

Infrared Sensor

- Detects when note is in hopper
- Prevents note from jamming into shooter



SHOOTER

During the design process, we went through many iterations of our shooter with different materials and types of wheels. We CNC'd polycarbonate plates to test different configurations. A major debate was top and bottom shooter vs. side wheel shooter; in the end, we went with top and bottom due to its higher consistency and ease.

Structure

- 27.5" long 1/8" thick 2x1 aluminum crossbars
- 1/8" thick aluminum plates on both sides
- 15.5" long 1/8" thick 1x1 aluminum for limelight mount

Pivot

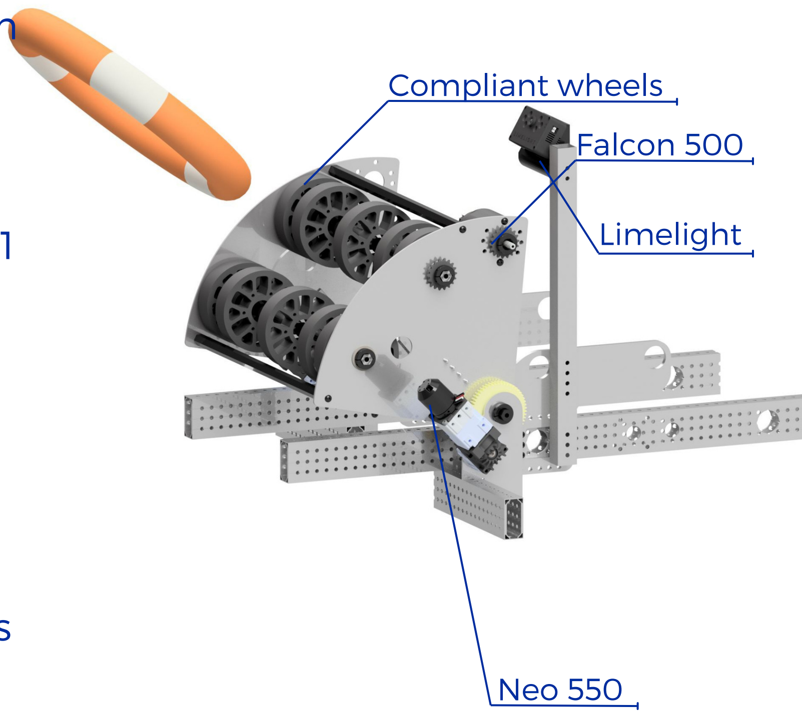
- Neo 550 and thru-bore encoder
- Reduction gearboxes of ratio 81:1 on each motor
- Connected to shooter plates via versahubs

Rollers

- 4" compliant wheels(60A)
- Falcon 500
- Around 1.5" gap between wheels

Limelight

- Vision system using april tags
- Passive aiming while driving



CLIMBER

Our climber is an almost direct copy of our climber from 2022 as we saw little difference in climbing on a solid rod versus the chains. A challenge we had to consider was how to ensure the robot remained in the air when disabled at the ends of matches. We also created custom hooks that secure the robot's grip.

Structure

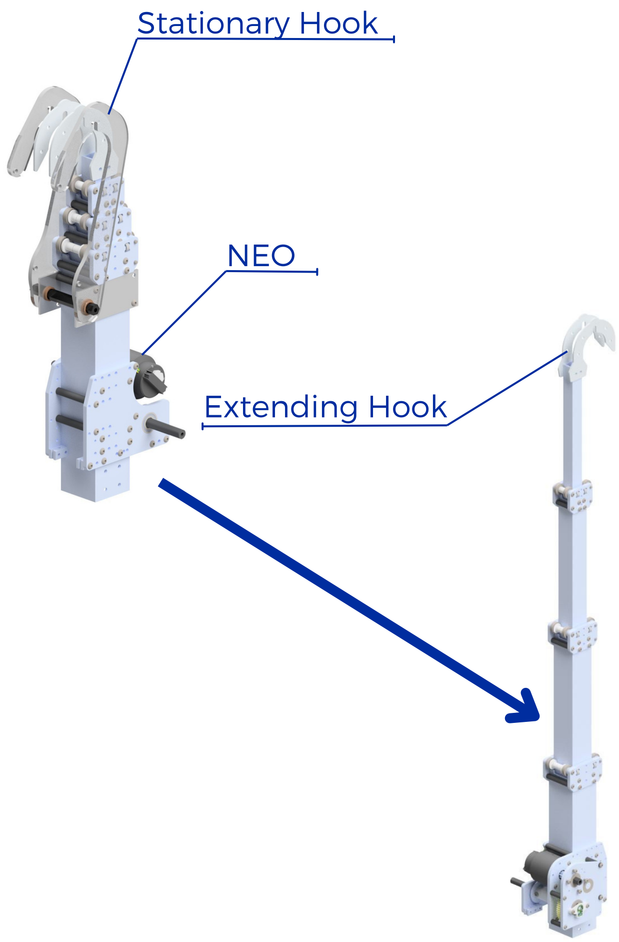
- Customized GreyT Telescope
- 1/8" thick aluminum tubing(2.5"x2.5", 2"x2", 1.5"x1.5", 1"x1")
- 1/8" thick aluminum custom CNCed extending hooks
- 1/8" thick lexan stationary hooks

Winch System

- NEO Motor
- Powered by gears
- Wraps a string, going against constant force springs

Limits

- We created a mechanical stop for the telescope extension by cutting internal string to keep it below 4'.



OVERALL DESIGN

ELECTRICAL

PDH port #	Can Id	Motor Description	Fuse	Wire Guage	Motor Type	Current Limit:	Default Disable Mode:	CAN Bus	Device	Ideal Op Volt	Mini Op Volt	Max Op Volt	Power Draw
0	15	Back Left Drive	40a	12	Falcon			1	Falcon 500	12v			
1	5	Back Left Rotator	40a	12	Falcon			1	CANivore	12v	5.2	28	0.1A
2	6	Climber Left	40a	12	NEO		Brake	2	CANcoder	12v	6	16	0.06A
3									Radio	12v	12	24	1A
4									Network Switch	5v			0.6A
5		Shooter	40a	12	Falcon				Limelight	12v	4.5	12	
6		Shooter Pivot RIght	30a	12	NEO 550				Roborio	12v	7	16	
7	16	Climber Right	40a	12	NEO		Brake	2	NEO				
8	7	Back Right Drive	40a	12	Falcon			1	NEO 550				
9	8	Back Right Rotator	40a	12	Falcon			1					
10	3	Front Right Drive	40a	12	Falcon			1					
11	4	Front Righ Rotator	40a	12	Falcon			1					
12		Intake Pivot Left	30a	12	NEO 550								
13													
14	18	Hopper Feed	30a	12	775 pro								
15	24	Intake Feed	30a	12	NEO 550								
16		Intake Pivot Right	30a	12	NEO 550								
17		Mini Power Module	40a	12				n/a					
18	1	Front Left Drive	40a	12	Falcon			1					
19	2	Front Left Rotator	40a	12	Falcon			1					
20		Roborio Power	15a	18									
21		Vrm Power	15a	18				n/a					
22		Limelight Power	10a	18				n/a	1 = CANivore	10v	7	12	80mA
23									0 = Roborio				

- All components were drawn out on a chart to ensure space wasn't cramped and to keep organization.
- Utilized a CANIVORE for the drive train to isolate its CAN subsystem from the main RoboRIO-PDH connection for added security and to solve CAN issues faster.
- Usage of both the Mini Power Module and VRM to distribute power efficiently and cater to the amps components such as the Limelight pull.
- Used 4 gauge wires for the battery connector to lower resistance.

Vrm Ports:	Device:	Description:
12V/2A	#REF!	Radio Power
12V/2A	Barrel Jack	Radio Redundant Power
12V/0.5A	CANivore	Redundant Power
12V/0.5A		
5V/2A	Barrel Jack	Network Switch Power
5V/2A		
5V/0.5A		
5V/0.5A		

Mpm Ports	Can id	Description:	Fuse	Load:	Can Bus:
0		BR Cancoder	5		12
1		FR Cancode	5		10
2		BL Cancoder	5		11
3		limelight			
4					
5		FlCancoder	5		9

FABRICATION

All of our parts consisting of bars, shafts, and plates are handmade and designed specifically to our need. Using tools such as the Mill and CNC, these parts come out with great precision and accuracy. This allows us to create ideal, optimized, and intricate designs as we have little to no limitations on precision and accuracy when fabricating them.

Mill

- Manufactured our tube bars with dimensions to the thousandth
- End-milled bars to a highly accurate length
- Open holes in metal tube bars for assembling our robot

CNC

- Used Fusion 360 Router
- Helped end-mill and drill holes in flat metal plates, polycarbonate, and aluminum tubes

3D Printer

- Used Dremel DigiLab 3D
- Allowed us to print custom parts of irregular shapes
- Used our in-house Rockstar max v2 3D printer
- Gave us more flexibility with our robot's design

PROGRAMMING

Our programming team has been implementing automated functions to lighten the pressure on our drivers by replacing the need to manually execute simple routines including picking up and shooting Notes. With the help of various sensors such as encoders, an infrared sensor, and a Limelight, the robot is able to react responsively to its environment with minimal driver action required.

Encoders

- Track motor positions and velocities, allowing us to implement precise control systems such as PID, feedforward, and trapezoidal motion profiling
- Track the robot's location on the field which increases our capabilities in the Autonomous period

Infrared Sensor

- Mounted in the Hopper to detect if it contains a Note
- Allows for the drivers to know when the robot has acquired a Note and automatically retracts the Intake to minimize the risk of damage.

Gyroscope & Accelerometer

- Track the rotation and translation of the robot throughout the match
- Enable us to precisely navigate around congested areas of the field in both Autonomous and Tele-Op
- Continuous readings allow our Swerve Drive controls to be Field Orientated

Limelight

- April Tag tracking
- Allows our robot to rotationally align itself and raise the Shooter to the correct angle for both the Speaker and Amp.

CONTROLS

DRIVER

LEFT TRIGGER: AIM W/ LIMELIGHT AT SPEAKER
LEFT BUMPER: EXTEND BOTH CLIMBERS

RIGHT BUMPER: RETRACT BOTH CLIMBERS

LEFT: LEFT CLIMBER UP & RIGHT CLIMBER DOWN
RIGHT: RIGHT CLIMBER UP & LEFT CLIMBER DOWN

DRIVE TRAIN TRANSLATION

DRIVE TRAIN ROTATION

OPERATOR

LEFT TRIGGER: SHOOT INTO SPEAKER (MANUAL)
LEFT BUMPER: SHOOT INTO AMP

RIGHT TRIGGER: SHOOT INTO SPEAKER (W/ AIM)

UP: INTAKE UP
DOWN: INTAKE DOWN

X: INTAKE
Y: OUTTAKE