Dissonance

Droid Rage 3035

FRC 2024 | Technical Binder

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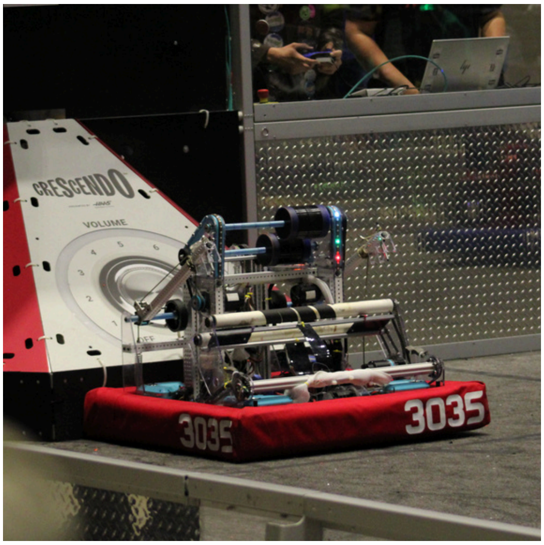
Overview

Our team's efforts began well before kickoff. Members organized the team structure, devised plans to overcome obstacles, taught each other new skills, and worked hard to make this Droid Rage's best season.

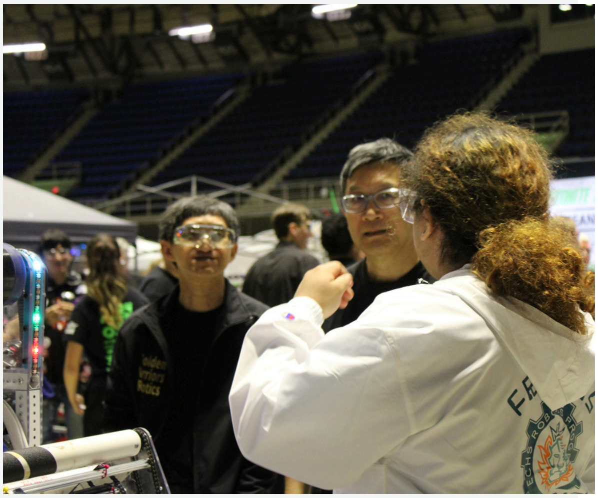
With the unveiling of the 2024 game, our team began the design process including **robot design, prototyping, assembly, and deployment.** Throughout the season, our team has tirelessly pursued achieving the optimal design through various iterations until ultimately arriving at our current design.

This technical binder comprehensively details our game strategy, design decisions, and our 2024 robot: *DISSONANCE*



"The term 'dissonance' was carefully chosen **to embody our team's spirit of embracing challenges and transforming adversity into triumph.** Much like dissonant chords in music, our projects often begin with a certain level of tension, unpredictability, and a need for resolution. The choice of 'dissonance' as our emblematic term symbolizes our willingness to confront the discordant notes of difficulty and uncertainty.

The name reflects our belief that progress often emerges from the discord of the unknown, leading to a harmonious outcome. **It encapsulates the idea that, like skilled musicians, we orchestrate our projects with precision and creativity, molding discord into a beautiful symphony of technological achievement.** Dissonance, for us, is not a setback but a prelude to success, a reminder that the most remarkable feats arise when we confront and conquer the dissonant elements in our endeavors."

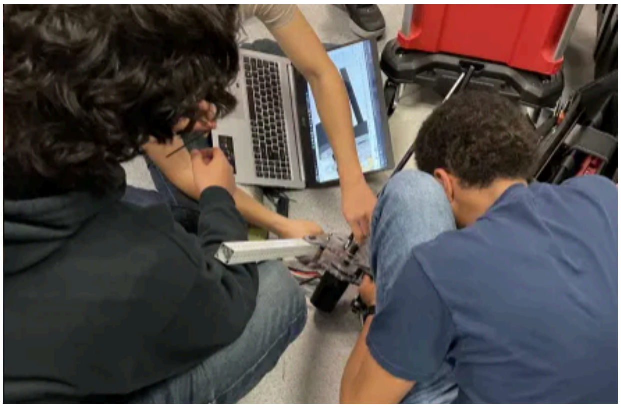


Strategy

Game Analysis

Planning

This year, we took an innovative approach to our team's strategy. We broke up members into small teams to brainstorm fresh and unique ideas.



Jace, our engineer working on shooter

Afterward, we came together to share our findings while reviewing the game manual page by page. Our goal was to design a robot that could navigate the challenges posed by is years game and emerge victorious all while following the key principles of FIRST.

Main Goal

Our main goal in qualification matches is to **obtain as many ranking points as possible**, which will give us the flexibility to choose the type of alliance we want for playoffs.

To achieve this goal, we focus on the following:

- **Earn ranking points** - Specific tasks such as scoring during the cooperation bonus or harmonizing in endgame can significantly improve our team's ranking position, so they are a top priority.
- **Score game pieces** - by scoring notes in the first 45 seconds of teleop, we can amplify and double our points
- **Collaborate with our Alliance** - we work with our alliance partners to develop a cohesive strategy based on our teams robot abilities during the autonomous and driver controlled periods to win our matches. This earns us 2 Ranking Points.
- **Cooperation Bonus** - before a match, we confer with our alliance and discuss what the game plan is; autos, teleop, etc. DISSONANCE or another robot can focus scoring notes to activate the cooperation bonus. This allows our alliance to earn points and collaborate with the alliances.

Game Analysis

Scouting

Scout other teams: Observe the matches of other teams and gather information about their strengths, weaknesses, and capabilities.

Analyze data: Using scouting information, we analyze average score, amount of notes, and driver experience.

Discussing

Evaluate compatibility: Determine which teams are compatible with our's in terms of robot design, communication style, and teamwork.

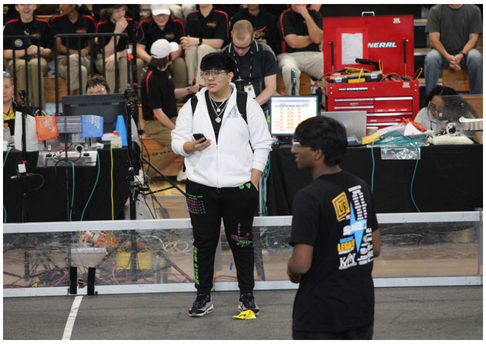
Discuss strategy: Meet with potential alliance partners to discuss strategy and identify which tasks each team is best suited to perform.

Make a shortlist: After evaluating potential alliance partners, we make a shortlist of teams that you would like to invite to join your alliance.

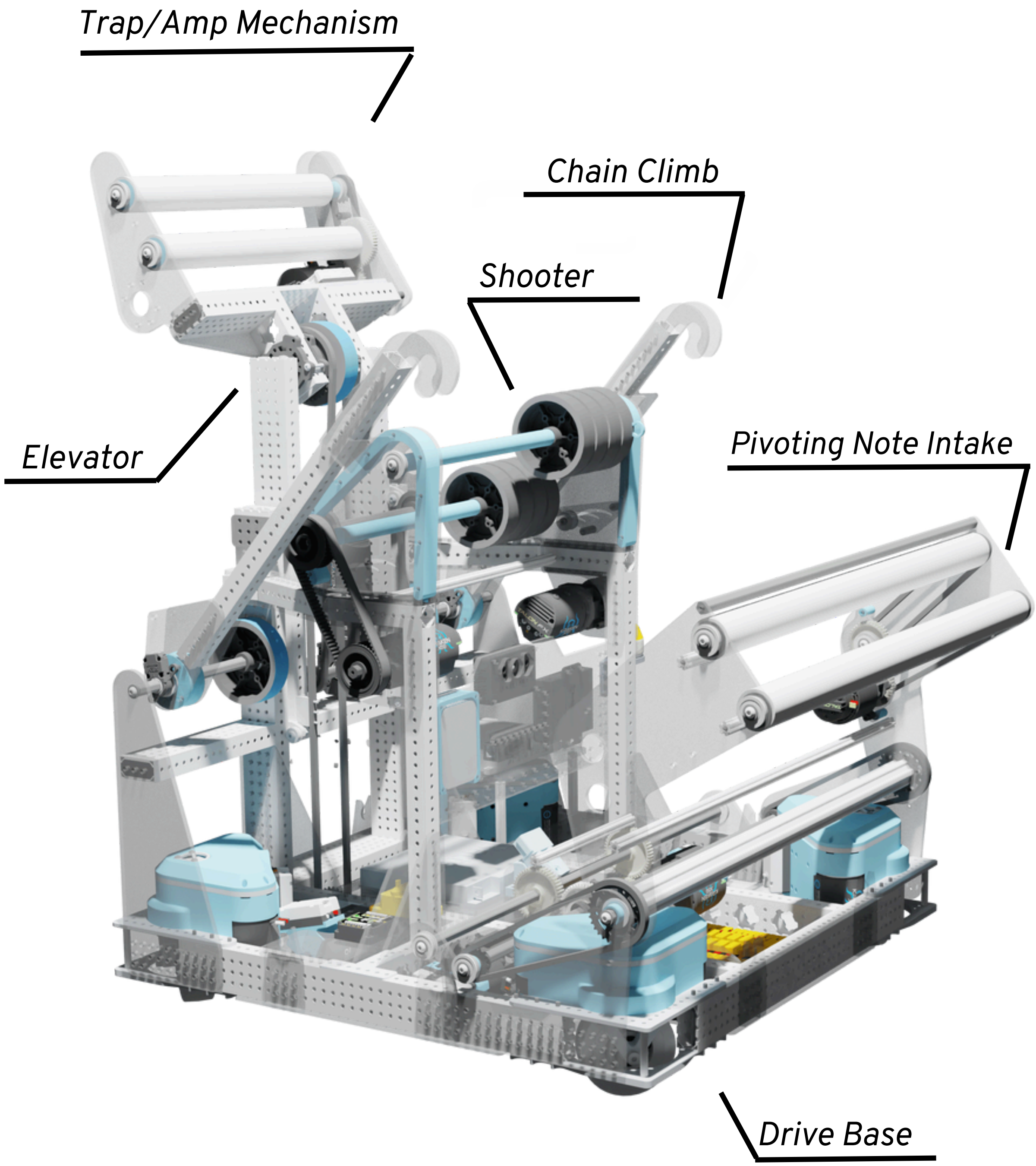
Alliance Selections

Formulate an invitation strategy: Determine the order in which we will extend invitations to teams on our shortlist, considering factors such as the likelihood of acceptance and rejection.

Extend invitations: Once we have formulated our invitation strategy, we extend invitations to teams on our shortlist.



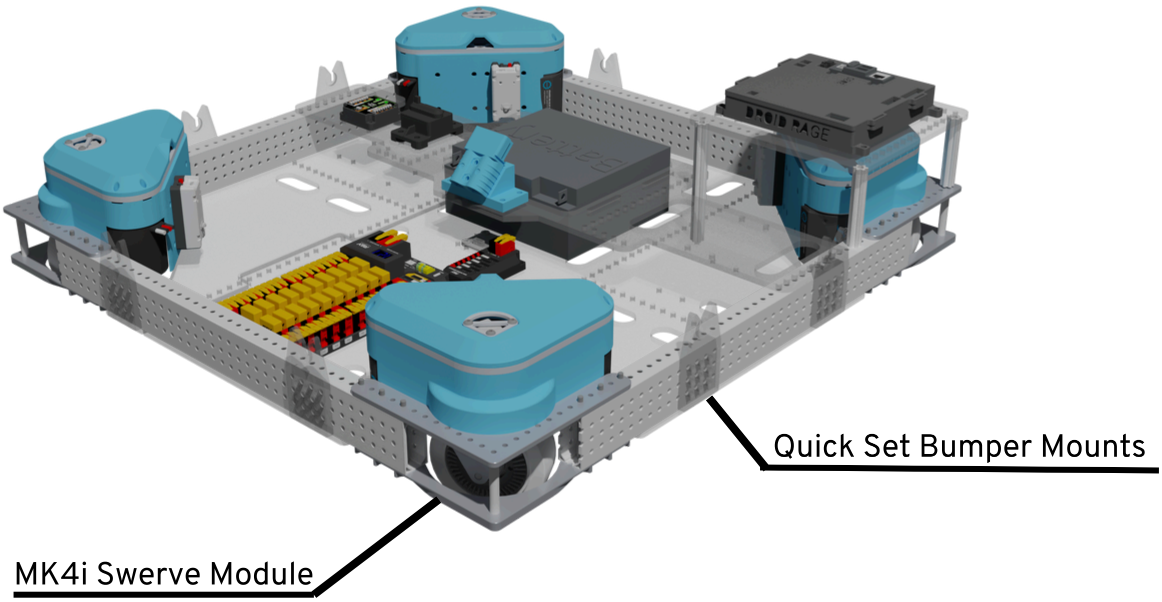
Finalize your alliance: Once we have secured alliance partners, we finalize our strategy and make any necessary adjustments. Practicing and working closely with our alliance partners to ensure that we are well-prepared for the competition.



Robot Design

DriveBase

Drive Base



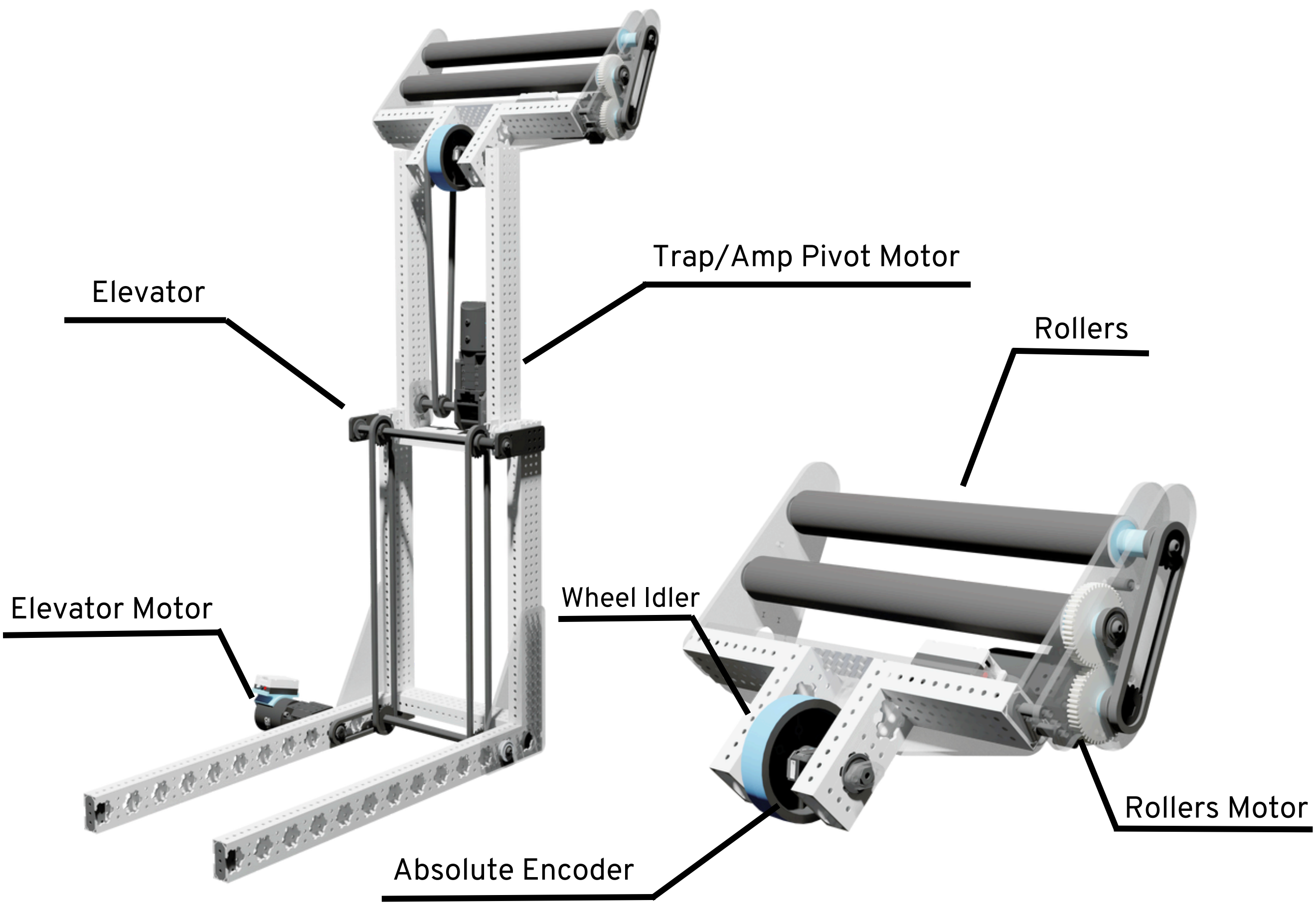
For this years design we decided to go with a swerve drive base. This drivebase allows the robot to maneuver around the field effortlessly to avoid defense and score effectively.

Chassis
- 28.5" x 28.5" Frame
- 1/4" Lightweight pocketed belly pannel
- Low centered battery for increased CG performance

Swerve Drive Specialties MK4i Modules
- L2 Drive Speed (15.5 ft/s) with 4" Colson rubber wheels.
- 4 Krakens for the drive and 4 Neos v1.1 for steering
- Modified MK4i Modules gears to increase drive speed by ~14% compared to stock MK4i L2 Module

Electronics
- Low Centered PDP for easy wiring
- Raised Robo Rio for less static interference from field carpet

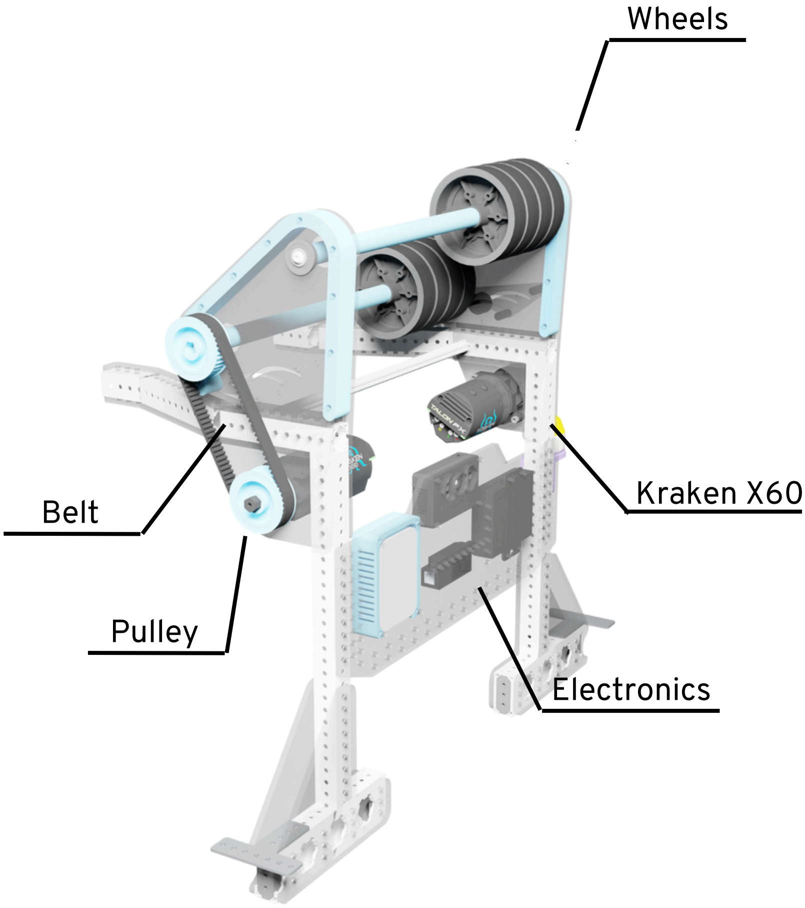
Amp/Trap Mechanism

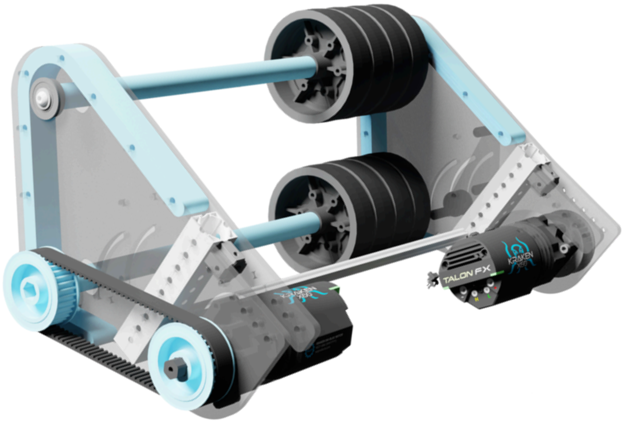


Single Pivot roller intake attached to a elevator carriage. Rotating rollers for quick transfer from the shooter and variable angle deposit for easy trap and amplification scoring.

- 1.625" PVC roller intake for reliability and cost effectiveness
- Roller wrapped with Gorilla grip tape for securing the ring for amp scoring
- Articulating pivot intake powered by a neo v1.1 geared at 96:1 for variable angled trap/amp scoring
- Rollers powered by a Neo v1.1 at a 3:1 reduction via gears and chains
- Rollers on encoder positioning for increased consistency on note intaking.
- Trap/Amp Pivot includes an integrated absolute encoder for consistent angle positions
- 4" Idler Wheel on dead axle for provided structure when climbing on chain

Shooter





Fixed shooter design with a 50 degree angle for reliable scoring and alignment. Custom lightweight design to keep CG low. Fixed shooter for reliability and consistent shots and handoff to TRAP/AMP MECH(Pg 10)

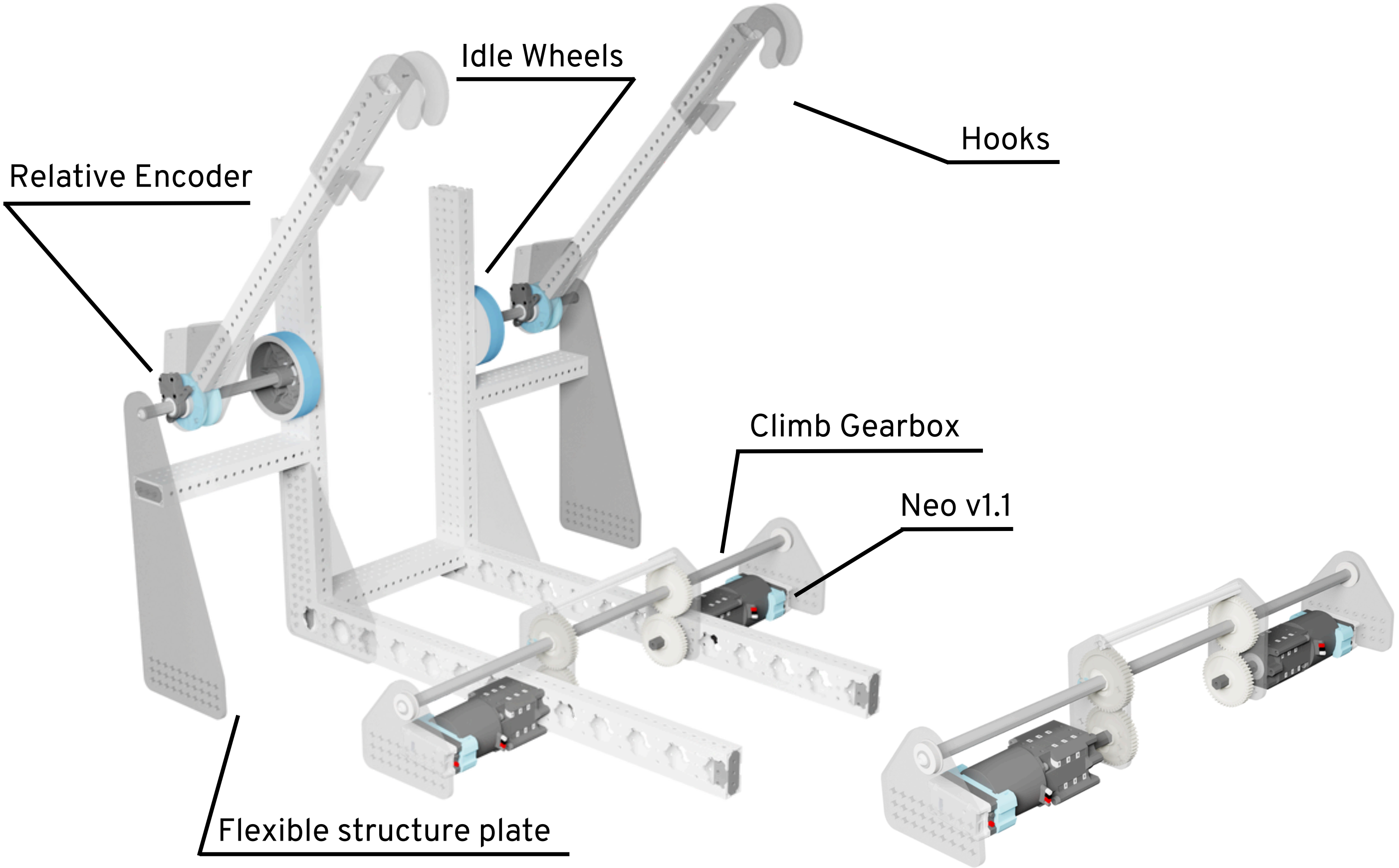
Shooter

- 4" Lightweight Stealth wheels with silicone grip for consistent handoff
- Light inertia for quicker spin up and cycle time.
- 1/4" Polycarbonate structure for flexibility at high speeds.
- 30T:30T HTD 5mm belt from Kraken X60 to shaft.
- 3/4" tolerance flexible structure for high speed collisions
- .46 second rev up time to desired speed

Electronics

- Single plate for crucial electronics
- Raised panel for easy access and diagnosis
- 1/4" custom polycarbonate design for flexibility and shock absorption

Climb



The climb mechanism is the simplest but most structured design of the entire robot. The climb was designed to withstand triple what the robot weighs. The 2 box tube structure gets winched down via nylon string to quickly climb for faster efficiency.

Hooks

- 1/4" custom polycarbonate hooks for flexibility and strength
- 3/4" tolerance for shock impact
- Implemented hook shape for easy line up for the chain

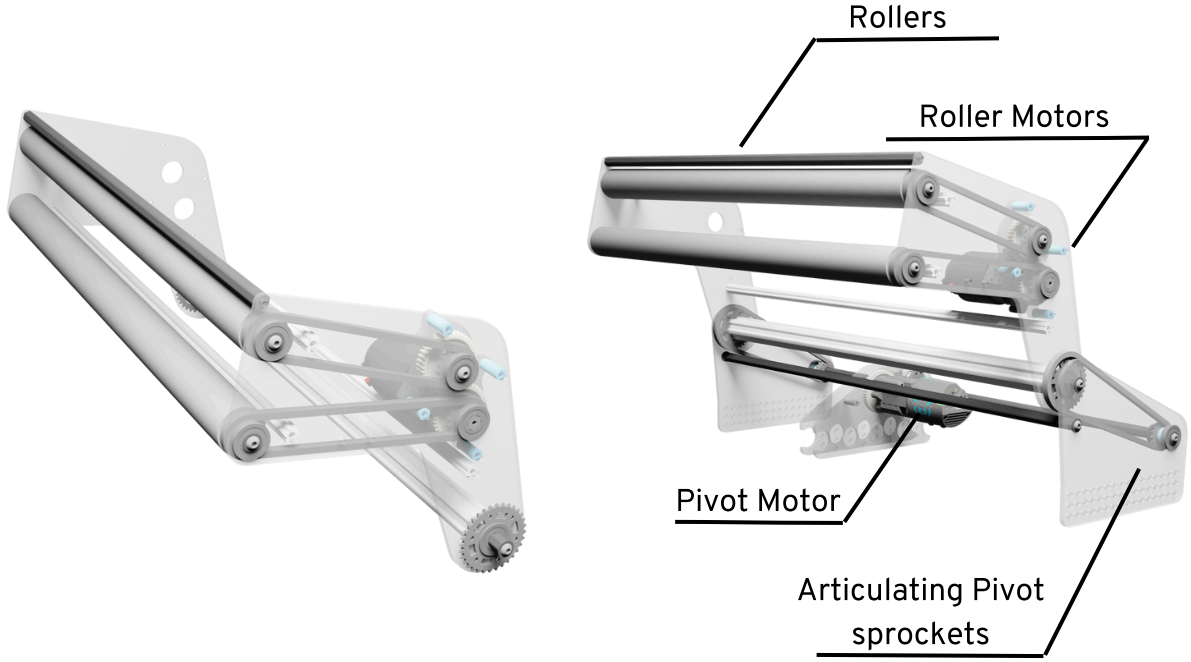
Climber Gearbox

- 36:1 gear reduction for speed and precision power transfer via MAXPlanetary and WCP gears
- 1/4" polycarbonate design to allow malleability for climb
- Low profile design to retain CG performance

Climber Arms

- Aluminum tubing for static structure and strength
- Relative encoder on pivot for reliable position tracking
- 1/4" polycarbonate housing to allow for flexibility
- 1/4" polycarbonate outer structure plates for impact resistance
- Counter tensioned upward via spring to retract and reset the position

Intake



Lightweight robust but reliable pivoting intake for over bumper intaking and then pivoting back to feed into the shooter for a quick seamless transition for scoring. Pivot powered by a motor rather than common pneumatics.

Pivot joint

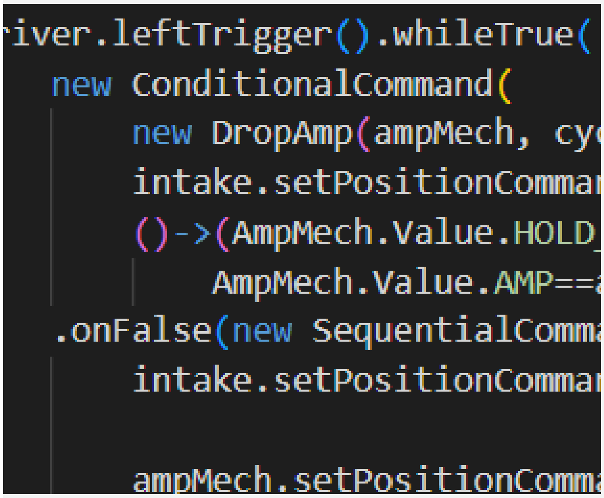
- 96:1 reduction for pivot via MAXPlanetary and sprockets
- 1/4" Polycarbonate design for shock and impact resistance for high speed collisions
- Kraken X60 powering single pivot

Rollers

- 1.625" Outer diameter PVC rollers rolled in gorilla grip tape for maximum grip on the note
- Falcon 500 at a 1:1 gear reduction for speed via gears and sprocket
- 3-D printed standoffs for less weight application (idk abt this sentence I'm tired)
- MaxSpline shaft structuring across the intake

Action

- When intaking the intake pivot heads down and spins the rollers
- When rollers detect resistance the intake automatically recalls back into initial position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new DropAmp(ampMech, cy
intake.setPositionComma
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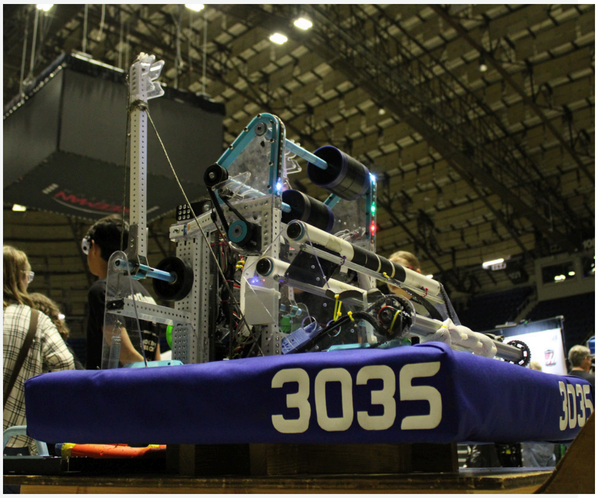
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vate final SwerveDrive drive = new SwerveDrive(isEnabled:
vate final Shooter shooter = new Shooter(isEnabled:true);
vate final AmpMechElevator elevator = new AmpMechElevator
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Software

Safe Hardware

Safety Hardware V1 (2023)

- This allowed for all motor controllers to be implemented similarly
- Software Switch to turn on and off certain motors
- Abstraction of motor controllers: Allows for different companies code be made to be implemented similar
- Writers show the amount of voltage going to the motors and whether it is on or off

Safety Hardware V2 (current)

- Expanded from 2023
- Expanded from being only motor controllers to also include encoders
- Transformed to be a easier user friendly interface
  - Allowed for easy access to turn motors and subsystems on and off
- Created parameters to force implementation of Configs: direction, idle mode, position conversion factor, velocity conversion factor
  - Allows certainty in robot behavior

```
public SafeMotor (configs, isEnabled, voltageWriter){     }
```

All motors are implemented the same

=

=

PID and Feedfoward

FeedFoward

By using feedforward control on our robot, we can model the behavior of any system to intelligently guess the ideal output without feedback from sensors.

Feedforward Code Example

```
// Create new arm feedforward using static constant, gravity constant,
// velocity constant, and acceleration constant.
feedforward = new ArmFeedforward(ks: 0.079284, kg: 0.12603, kv: 2.3793, ka: 0.07);
```

Feedforward equations for our robot

Pivot - ks · Sign + kg · cos(Angle) + kv · Velocity + ka · Acceleration

Vertical Elevator - ks · Sign + kg + kv · Velocity + ka · Acceleration

Drop Down - ks · Sign + kv · Velocity + ka · Acceleration

Intake - ks · Sign + kv · Velocity

Drive - ks · Sign + kv · Velocity + ka · Acceleration

All mechanisms utilize voltage compensation to improve consistency and reliability.

Symbols beginning with k represent a constant.

Proportional Feedback

Since feedforward control does not account for disturbances, we use PID (Proportional Integral Derivative) controllers to account for disturbances using data input from sensors. Since we have feedforward control to do most of the work, our feedback control only needs a proportional constant for accurate movement as shown in the sample below.

Feedback Code Example

```
// Set the proportional correction and tolerance constants.
controller.setPID(kp: 5, ki: 0, kd: 0);
controller.setTolerance(positionTolerance: 0.10);
```

- headingError * kp
- positionError * kp

Kp weights for each mechanism are multiplied by the error from the sensor whether it be a gyroscope, drive train encoders, an absolute encoder, or a relative encoder.

Despite primarily controlling mechanisms through buttons, mechanisms can be controlled manually using sticks to set the desired position and velocity.

Controls

Driver

- Field Orinted Driving
- Change Commands on a button based on the position of the robot; for the left outtake trigger
- Using a Conditional Command
  - true: outtakes into amp
  - false: outtake on the intake
- Reset Yaw Button

Operator

- Transfer Amp Button
  - Moves the note from the intake to the amp mech
  - Knows the location of the note grip, so it ensures the mechanism has a tight grip until scoring
- Shoot Button
  - 1 button makes the robot start shooter, and push note into the shooter
- Climb Buttons
  - 2 Buttons allow for us to easily climb

All buttons are simple to reduce mistakes

Slow Mode

Through a button, the driver can slow the drivetrain for finer control

Field Oriented Drive

Driver's control sticks are rotated by the gyroscope angle to make up on the stick always drive away regardless of bot orientation.

Sensors

Using sensors allows for accurate feedback for the robot. All of the subsystems use through bore encoders or cancoders.

- Cancoder
  - Used on each drive pos
  - Absolute Mode
  - Position carries through reset
- Through bore encoder
  - intake, arm, pivot,
  - absolute mode
  - carries through reset

Cycle Tracker

Tracks average time of cycles

- # of cycles
- Amp #
- Speaker #
- Fastest time
- slowest time
- Allows for drivers to be able to reavalute their driving skills by seeing times
- Allows to show growth throguhout the season