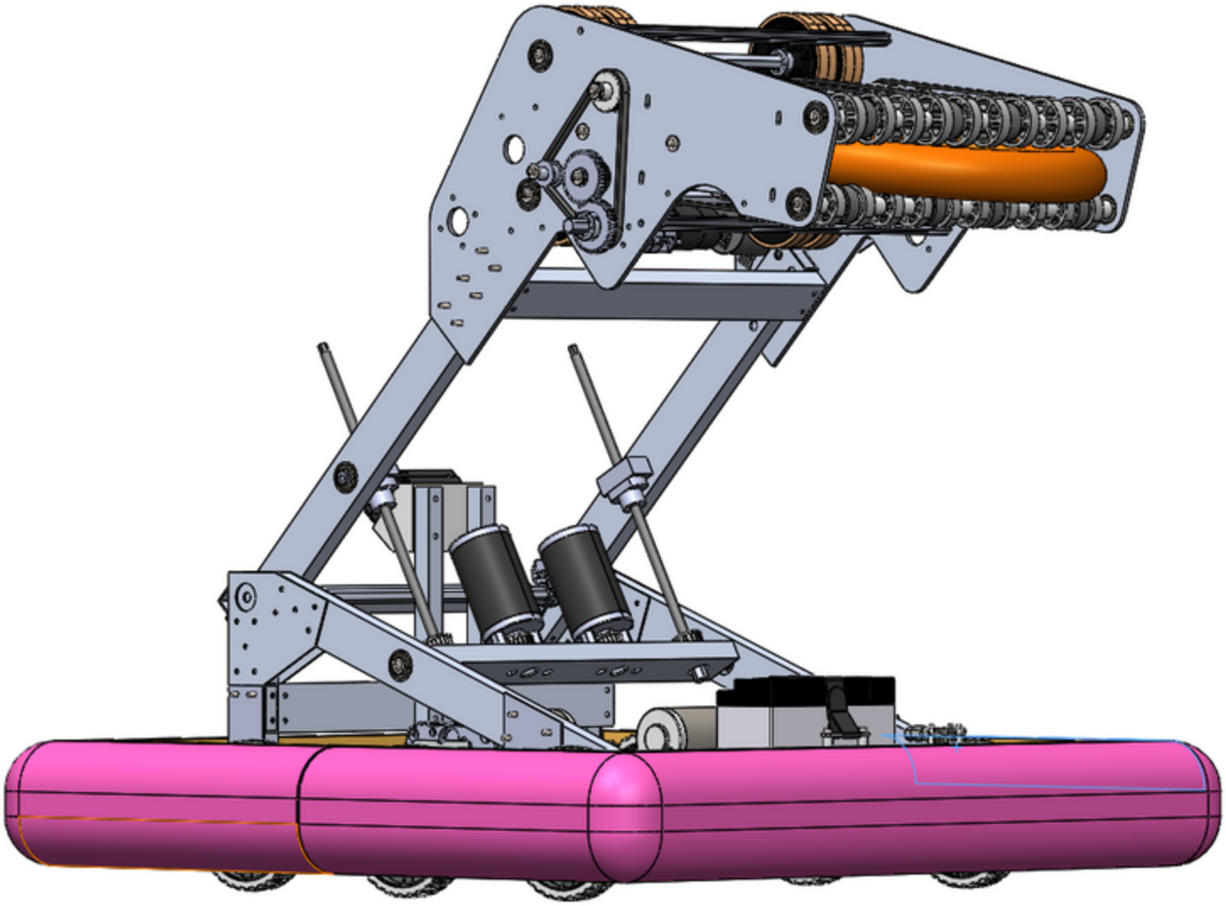
Technical Binder

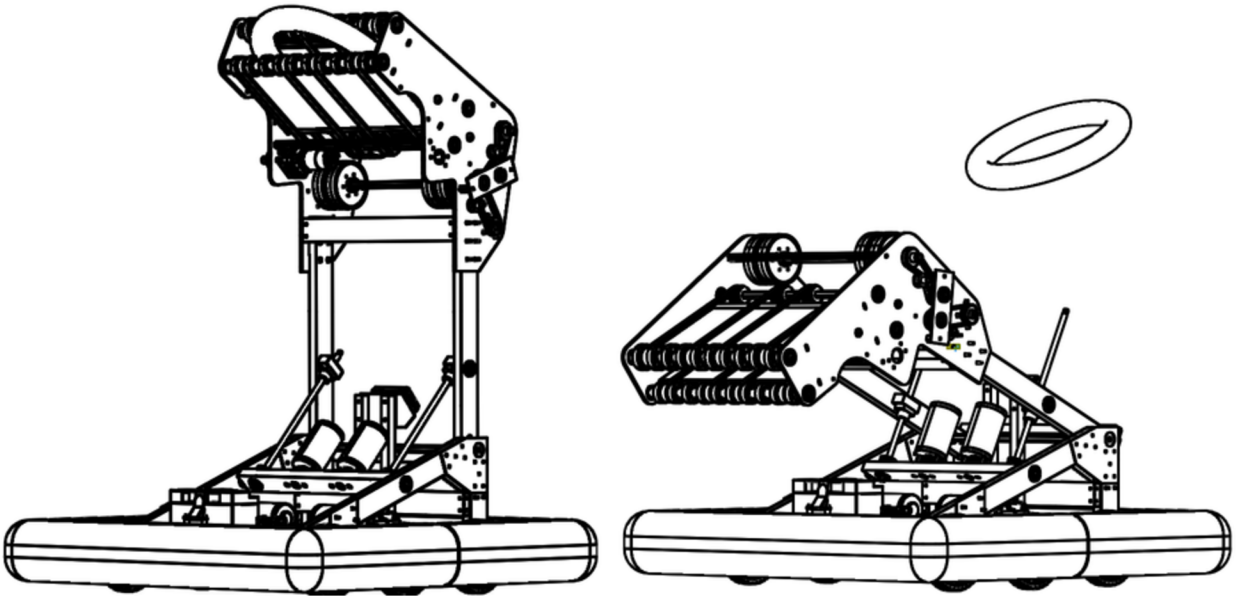
2024 CRESCENDO - Dopamine



9738 Ionic Bond

9738 Ionic Bond

Table of Contents



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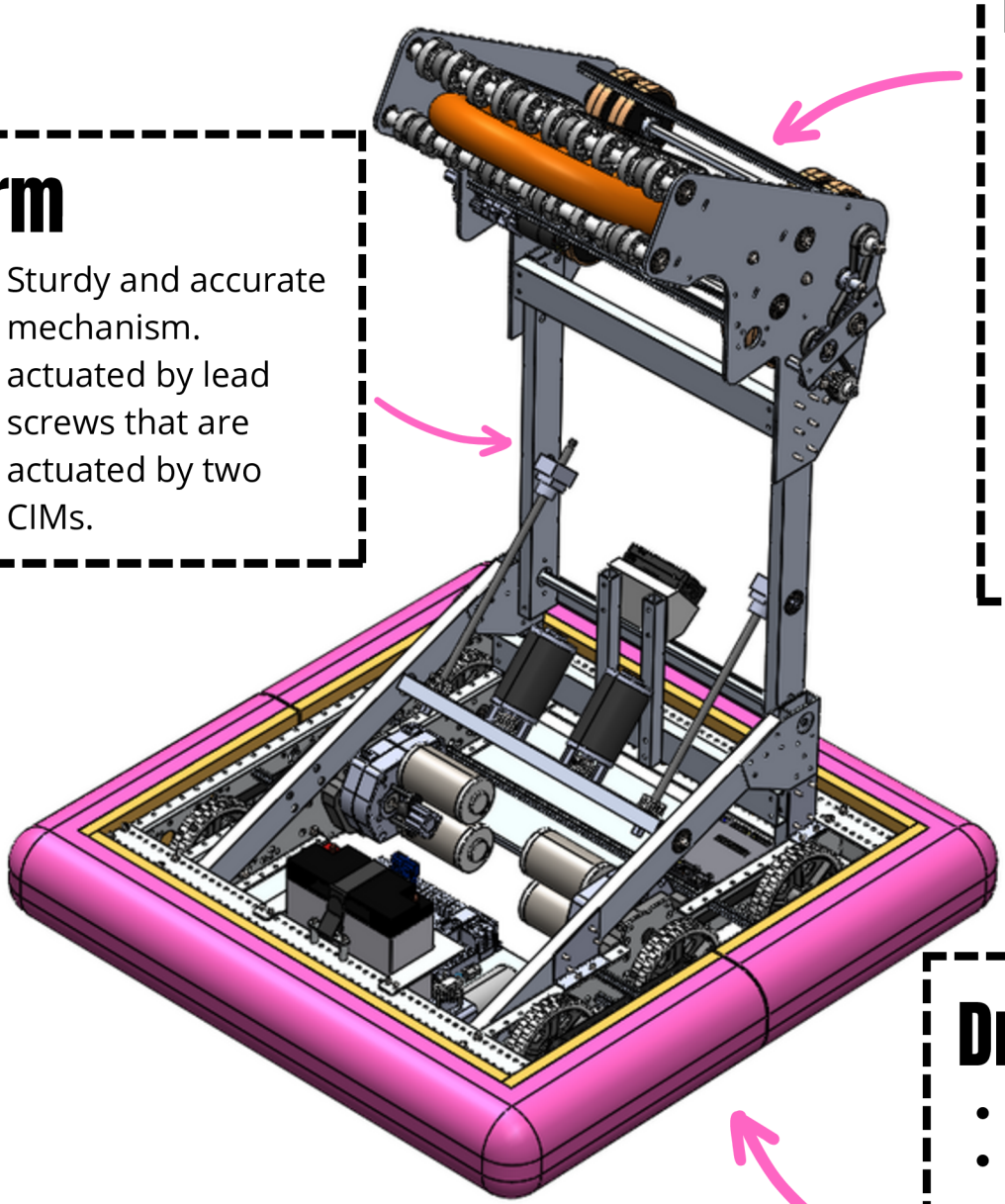
Dopamine

Box

- Compact, simple, robust and multipurposed mechanism.
- Used for intaking, climbing and scoring to both amp and speaker.
- Intake is driven by a 775pro, and the shooter by a NEO.

Arm

- Sturdy and accurate mechanism.
- actuated by lead screws that are actuated by two CIMs.



Drivetrain

- Square KOP chassis.
- VEX ball shifters are used and automated for maximal performance.
- Driven by 4 CIMs.

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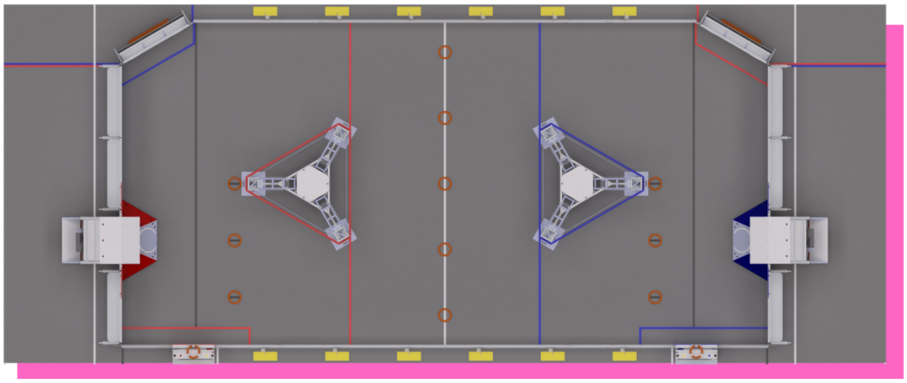
Game Analysis

Scoring Points

- **Cycle time can be reduced** by a fast and maneuverable robot.
- **Intaking from one side and scoring on the other** is valuable, especially in autonomous.
- **Driving under the stage** is critical to overcome defense and increase maneuverability.
- **Speaker scoring is more crucial than amp scoring**. Speaker scoring will be the main task that awards points, and although amplifications are important, they are only important for making speaker scoring more effective. We decided to focus more on scoring the speaker while still giving importance to amp scoring.
- **Stage points are not as significant**, and are only important for RPs.

Obtaining Ranking Points

- **The trap is a trap -** trap scoring is a very effective method of securing the Ensemble ranking point, but it also takes a lot of time and requires a lot of movement.
- **Climbing is essential -** If a robot doesn't score the trap, it should be able to get as many stage points as it can (including Harmony), in order to get the Ensemble ranking point.

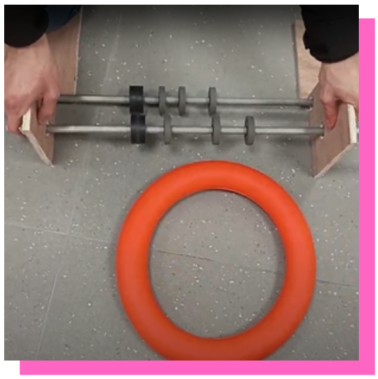


9738 Ionic Bond

Research & Prototyping

Intake

- After looking at previous games (2013 Ultimate Ascent - FRC, 2017 Steamworks - FRC, 2019 Deep Space - FRC, 2021 Ultimate Goal - FTC) we came to the conclusion that rollers would work the best for our intake.
- Vertical Rollers and horizontal rollers were checked.
- We tried different sizes of wheel (2in vs 4in) and different heights from the floor.



Shooter

- We checked vertical rollers from one side, vertical rollers from both sides and horizontal rollers.
- We found out that it's easier to apply pressure the Note if we have horizontal rollers, than the other variations.

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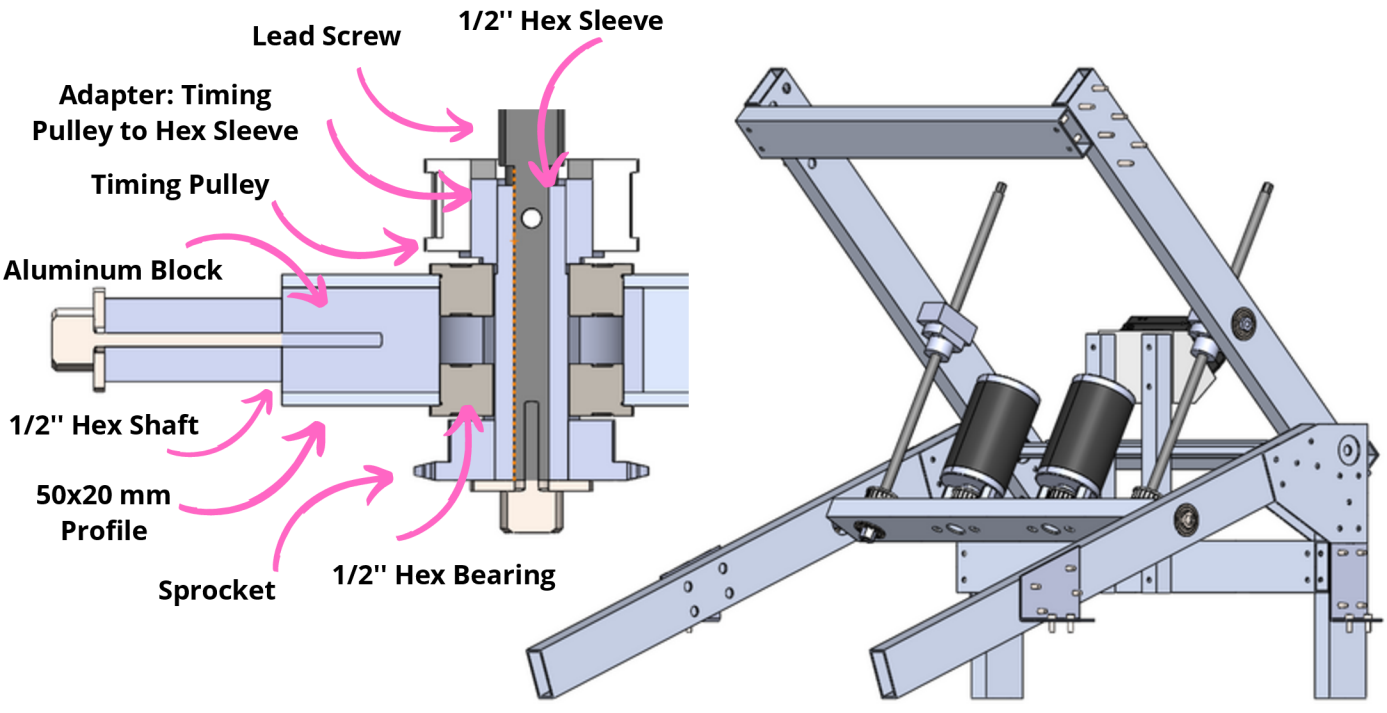
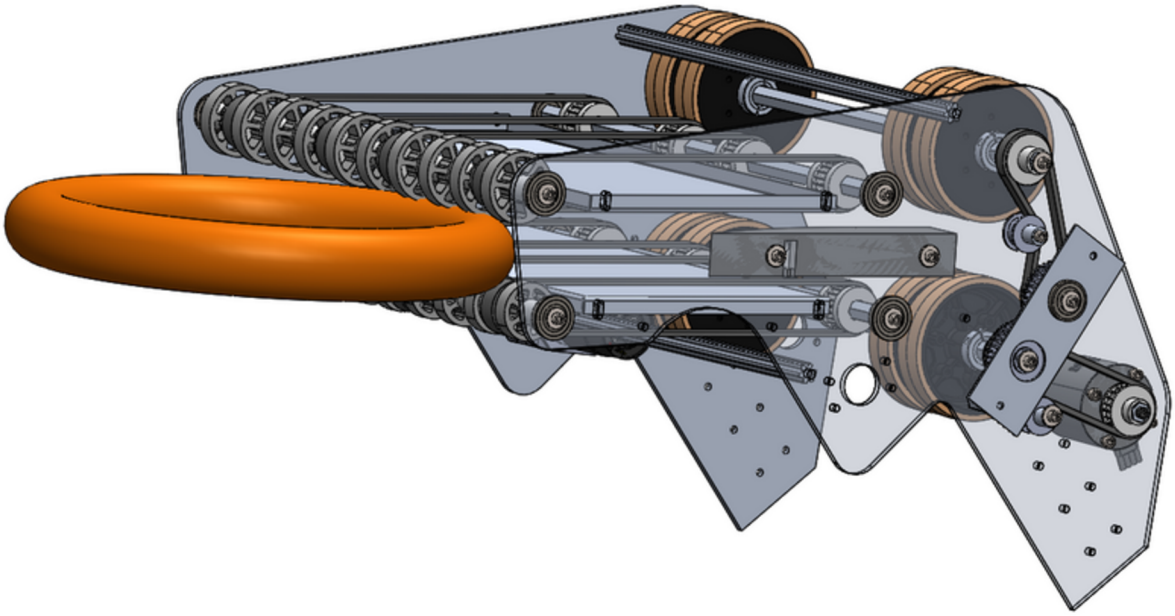
Arm

- **The arm is driven by lead screws** with two CIMs connected to the arm via 1.1:1 reduction. The effective length of the screw is ~240 mm (~9.4''). We used lead screws because of their accuracy, sturdiness and their mechanical locking ability (the mechanism can use less energy and doesn't relay completely on the software).
- **For transferring motion**, the CIMs are connected via a timing belt to the lead screw, and a #25 chain is used to coordinate between the two lead screws.
- **Climbing** is executed by pulling the arm downward and lifting the robot from the ground.
- **For monitoring the arm's movement**, a REV through bore absolute encoder is used.
- **To prevent the arm from moving too far,** we used a limit switch connected to the motor-controllers for the arm.



9738 Ionic Bond

Box (Intake, Amp & Speaker, Climb)

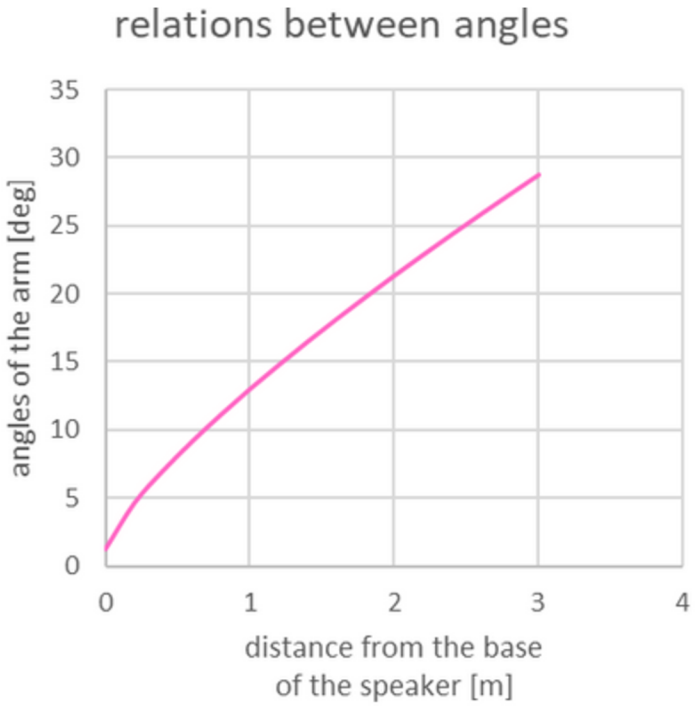


- **The box is made of** 5mm polycarbonate plates. Two AndyMark churros are used to support the structure.
- **The intake** is driven by a 775pro motor with a 15:1 reduction, using a MAXPlanetary gearbox. Belts are used to prevent jamming inside the box, holding the Note still and eliminating dead-zones where the Note isn't touching anything.
- **5mm beam break sensors** are used to detect when the Note inside the mechanism.
- **The shooter** is powered by a NEO motor with 1:1 ratio. 1/2 inch of compression is used on the shooter. We decided to use 2 wheels on each side of the shafts, because if we were to put ones in the middle, they would compress the Note violently right before it exits, which will cause inaccuracies.
- **The centers are used** to center the Note before the shooter shoots it, so shooting the Note will be as accurate as possible.

9738 Ionic Bond

Programming

- **The code is built around a state machine**, and each subsystem has its own class.
- **To control the shooter better**, we made a graph for the shooter motor power (x axis) as a function of the shooter speed in RPM (y axis).
- **In order to score to the speaker automatically**, we found the relation between the distance from the Speaker to the angle of the arm empirically. The ballistic equation of the Note was too complicated to calculate due to the Note's shape and deformation during shooting. We also found out that the shooting speed could be kept the same at all positions (4000 RPM).
- **Using both navX and Limelight**, with each being ranked for their accuracy, we can create a more accurate autonomous and auto-aiming.



- **The graph is based** on different tests we made, and has a range from the lowest point the Note got into the speaker, and the highest.
- **We use this graph** in the autonomous part in the game and for automation during the teleop.