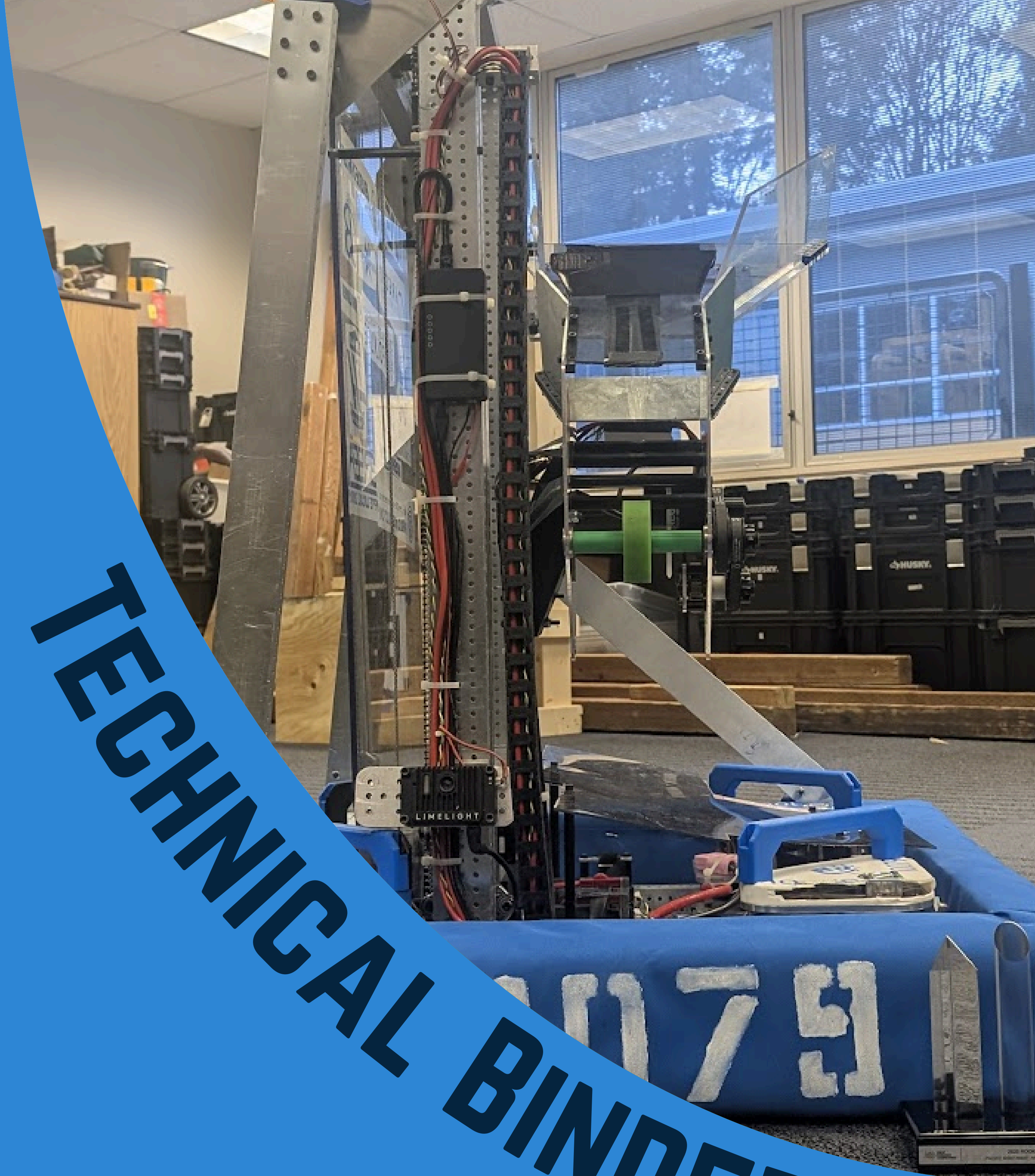
10079



TECHNICAL BINDER

ARROWDYNAMICS 10079

Website
https://tinyurl.com/AD-10079

Email
roboticsbothell@gmail.com

Instagram
@arrowdynamics10079

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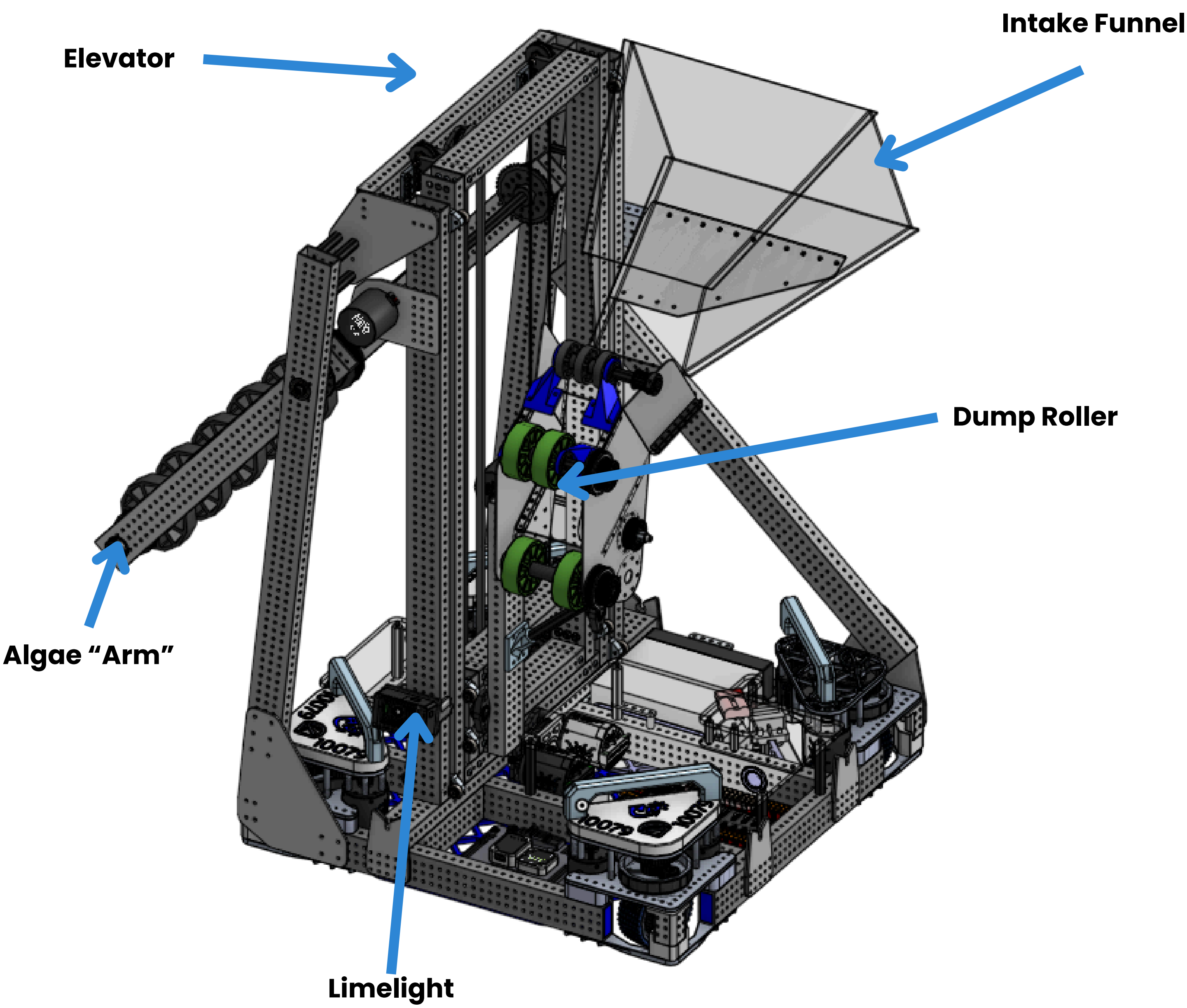
OUR ROBOT: KEVIN



ROBOT SPECIFICATIONS

- **Robot Size**: 34x34 in
- **Robot Size w/o bumpers**: 26x26 in
- **Height** : 41n (Min) - 74in (Max)
- **Weight**: 144.5lbs
- **Weight w/o battery & bumpers**: 113.5lbs
- **Motor Module**: SDS MK4i
- **Drive Ratio**: L2+ 16T - 5.202:1

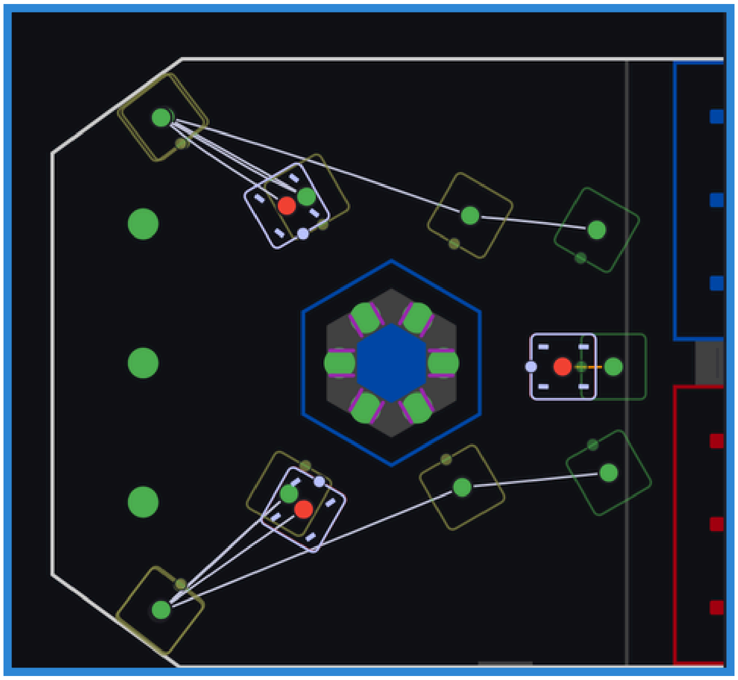
SCORING CAPABILITIES

- Process Algae
- Reef Algae Removal
- Ground Algae Intake
- Station Coral Intake
- Swerve Defense
- L4
- L3
- L2
- Park

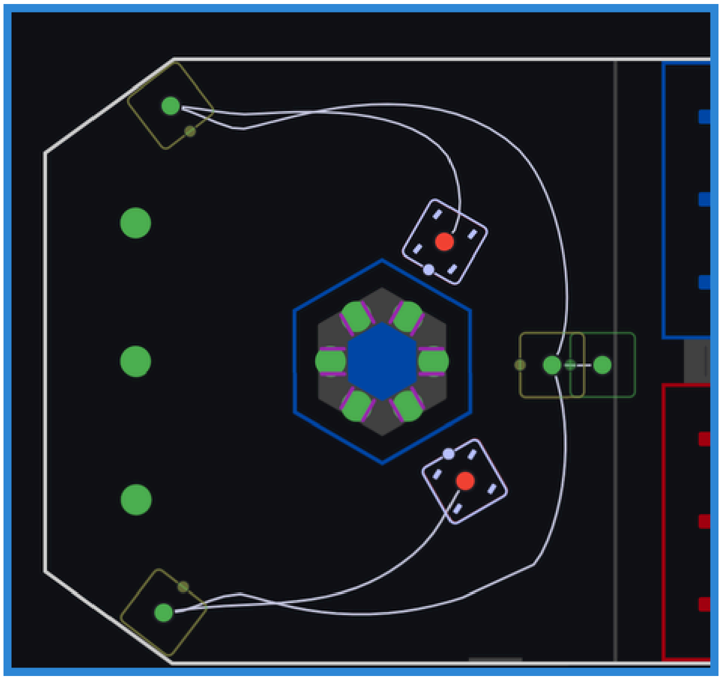
STRATEGY

Our Gameplans are created around our robot's strengths and weaknesses to figure out how we can optimize them during the game.

Our Autonomous can start on **any side of the barge**. For all our autos, we **preload 1 coral**. We have recently created 2 new autos to work on the **same side coral stations** as other teams with high scoring autos.



Left, Center, and Right Auto.



Center Co-op Auto that is out of way.

LEFT

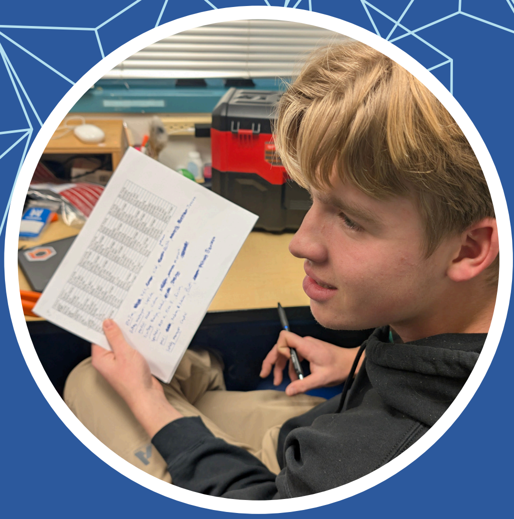
- Scores 3X on L4.
- Scores 2x on L4, out of the way for other alliance partners.

CENTER

- Scores 1x on L4.
- Stops to be out of the way.

RIGHT

- Scores 3X on L4.
- Scores 2x on L4, out of the way for other alliance partners.



STRATEGY

Our Gameplans are created around our robot’s strengths and weaknesses to figure out how we can optimize them during the game.

TELE-OP GAMEPLAN

- Primarily **Cycling Coral**
- We can **Process Algae**
- Aim to go for **Coral Ranking Point**
- Willing to go for **Co-op point** by processing

ENDGAME GAMEPLAN

- Continue **Cycling Coral**
- **Park** if there is time

Our Kickoff Table

	Autonomous	Reef	Processor	Climb
Must Have	Move + Place 1 Coral on L1	L1, L2, L3 Remove Algae Place Coral	Push Algae into	Park
Nice to Have	Multiple Autos Single L4 Auto	Coral & Algae intake Ground Intake Coral Pick up Algae	Place Algae into Processer	
Explore	Multiple L4 Autos	L4	Score Stage at Net	Deep Climb Shallow Climb

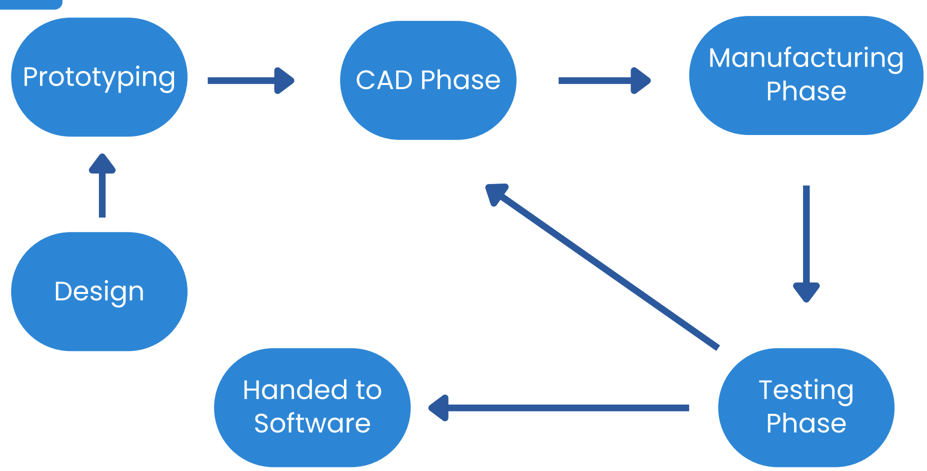
ENGINEERING PROCESS

From manufacturing to programming, our team follows an engineering process to build and improve our robot.

HARDWARE

6-step process

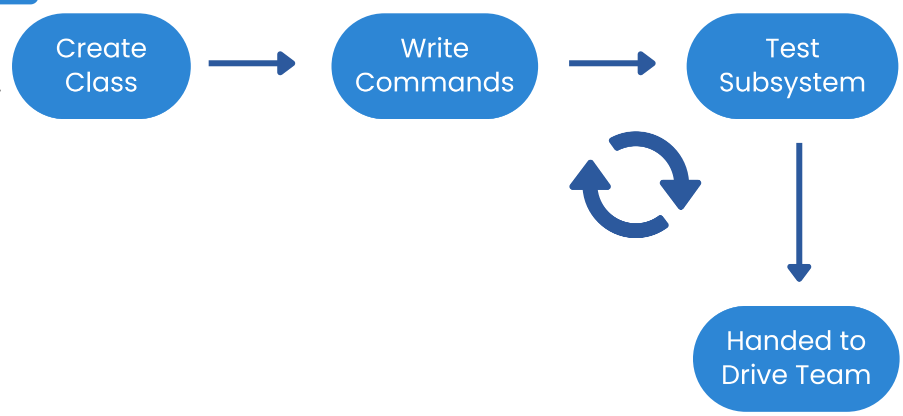
- Sketches & **decision matrixes**.
- Rough testing of ideas.
- **Onshape** to CAD designs.
- Manufacture & test.
- **Iterate** over problems.
- Ready for Software.



SOFTWARE

4-step process

- **Define & Create** Subsystem class.
- Write Commands.
- **Iterate** over problems.
- Ready for Driving.



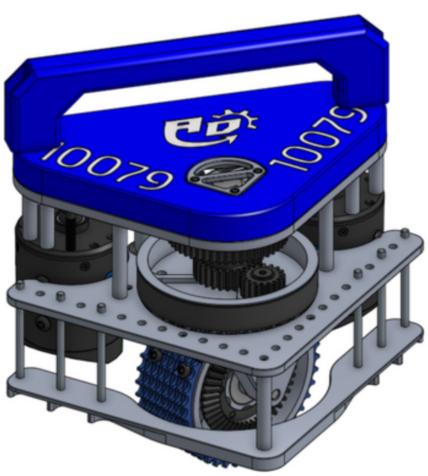
MECHANICS

Our Robot is divided into separate subsystems that create a fully functioning automaton.

Our robot has 4 main functionalities:
Drivetrain, **Elevator**, **Dump Roller**, & **Algae Arm**.

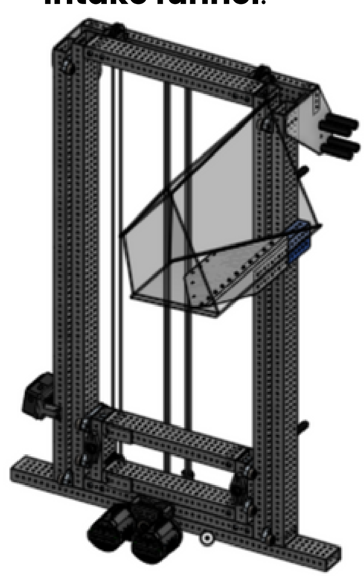
DRIVETRAIN

For our robot, we run **Swerve drive**, which means we have swerve pods attached to each corner of the robot. The Swerve pods are controlled by **2 Kraken motors per wheel: one for turning** and **one for driving**. Although we are a rookie team, we decided to forego a simple tank drive in exchange for the complicated swerve drive. We use **custom branded 3d printed covers** to keep debris out and **3d printed handles** to easily move the robot on and off the field.



ELEVATOR

Our cascade elevator subsystem is the main way our robot can score. Our robot runs a **2-stage elevator,** which gives us enough height to reach the L4 level. **The elevator is controlled by 2 Kraken motors** driven together in a 7.78:1 gearbox and using a pulley and chain in a **cascade** rigging to move up and down. The mast of the elevator also mounts the **Limelight 4** and **1/8th Lexan intake funnel**.

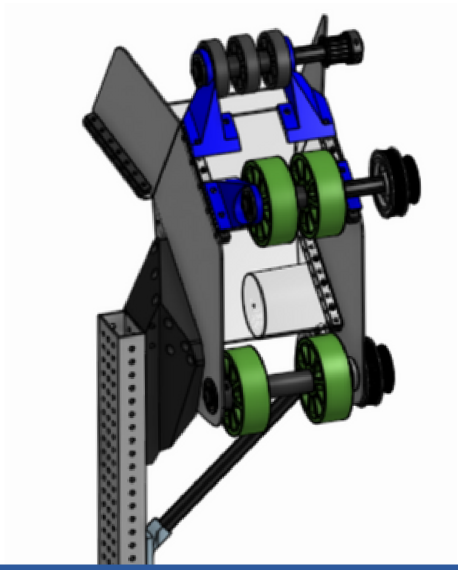


MECHANICS CONT.

Our Robot is divided into separate subsystems that create a fully functioning automaton.

DUMP ROLLER

The Dump Roller (Coral Outtake) is comprised of **1/16th aluminum** and **1/8th Lexan,** connected with nut strips and standoffs. The **outtake** is a bay with an NEO attached to a flywheel used to drop the coral into the proper Reef level. The outtake is at a **35-degree angle** where it can drop the coral properly between **levels 2 to 4**, with only **One Degree of Freedom.** Allowing us to limit our software requirements which as a design contrate this year as a rookie team. The back **3x 2in 30a durometer** compliant wheels aid with indexing the coral from the funnel. The **4x 3in 35a durometer** compliant wheels are to securely hold the coral in front of the outtake box to help with driver alignment.



ALGAE ARM

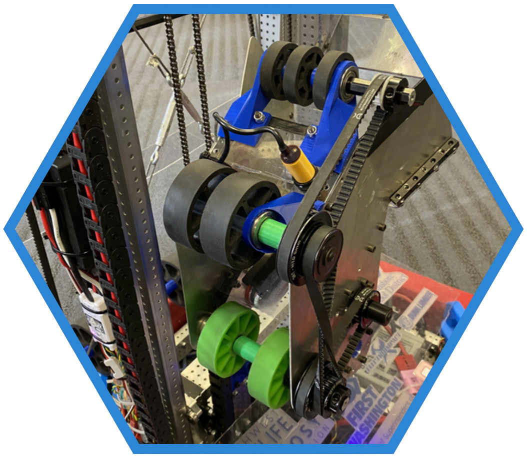
Our Algae arm **has 2 motors, one for controlling the motion of the arm** and another for **controlling the flywheels** attached to it. The arm raises up to remove the algae from reef and then by spinning flywheels in the opposite direction its able to grab the algae hold it in place to then place in the processor. We decided this would be a simple, yet effective, change we make to our robot so it becomes more versatile in competition.

CORAL DETECTION

We have added 2 different ways to know when we have a coral in our robot during auto and tele-op to increase auto consistency and decrease cycle times.

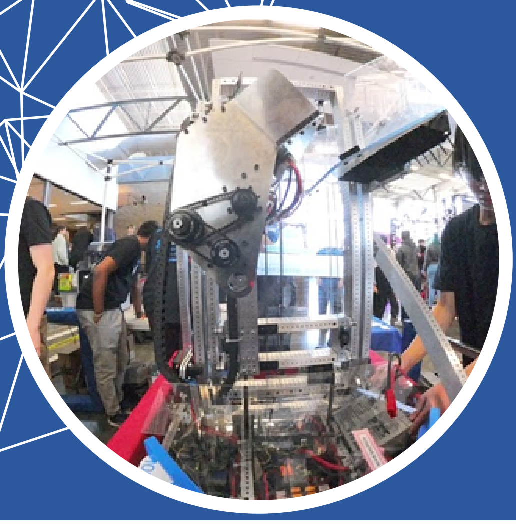
PHOTOELETRIC SWITCH

This sensor, located on top of the Coral intake, **allows us to detect whether there is a coral within the box or not.** It is to stop the intake process once a coral has been loaded. <u>This is to prevent the coral overshooting</u>, we had encountered a problem where Coral would feed from the station all the way through accidentally.



CURRENT LIMIT CHECK

At rest, the box will always be pulling a **small amount of current in order to constantly spin**. When a coral comes into contact with the wheels and the hard stop, the current will spike. The code will detect the spike, and stop the wheels so the coral will **be sucked into the box effectively and consistently.**

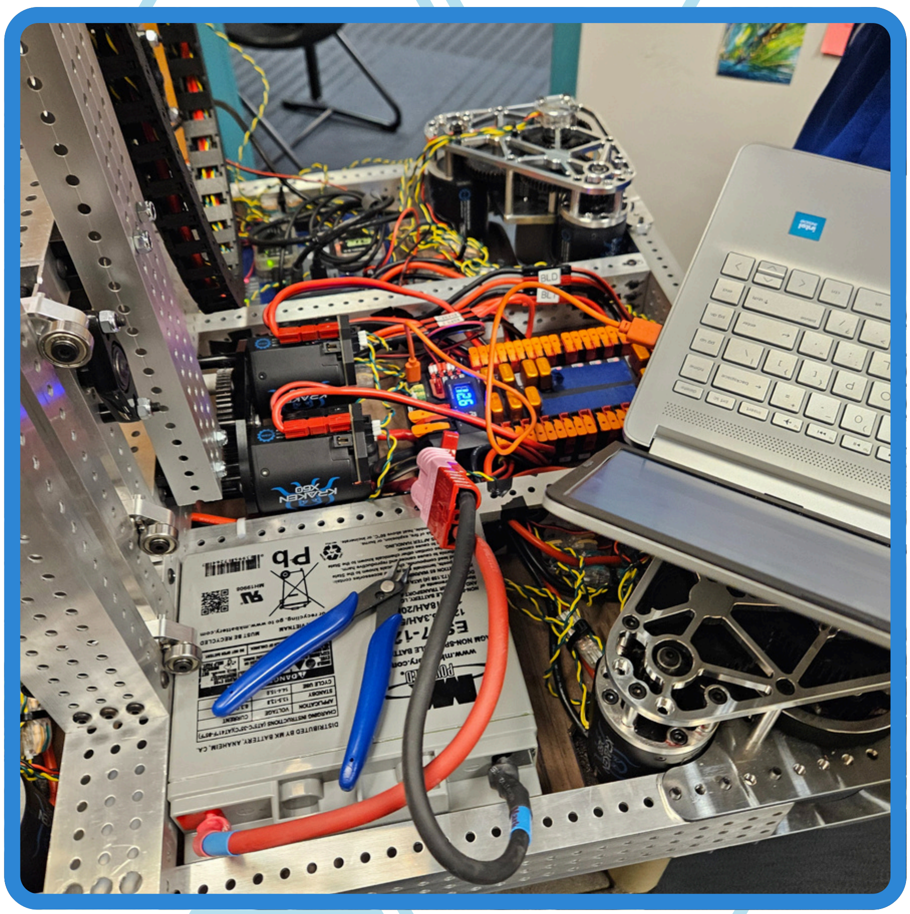


ELECTRICAL

Our robot is wired for proper usage and controlled current and voltage throughout the robot.

CANBUS

We run **two** different CAN loops: One off the RIO itself, and one off the CANIVORE. Swerve runs off the CANIVORE, the rest off of the RIO. This is in the case that if **the RIO loop were to fail, we can still drive and not be immboilized.**



ROBORIO

The **roboRIO** is the central embedded computer on our robot. It processes sensor data and executes team-written code to control the robot's actions.

PDH & MINI PDH

The **PHD** powers all of the motors with **10 gauge wire** and the RoboRio, Radio, and Canivore in its 12v ports. Alongside the PDH, we employed a **mini PDH** to power smaller electronics like the CanCoders, Pigeon IMU, and Limelight.

AUTONOMOUS

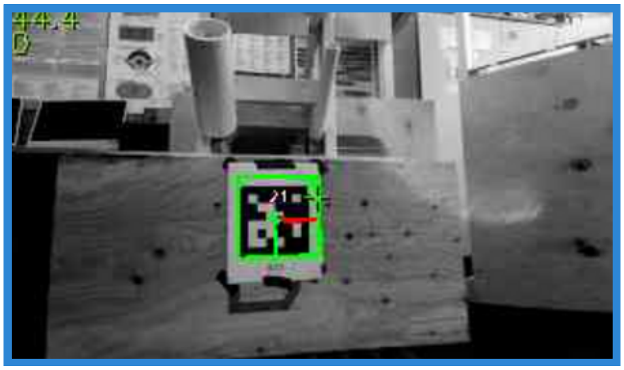
Our robot combines commands and on-field detection to move and score, utilizing PathPlanner, PID Control, and Limelight Vision.

One of the most critical element of our robot is it's ability to accurately score the coral onto the reef—**consistently**. To ensure this, we decided to prioritize **April Tag Vision**.

PATHPLANNER	Allows us to create splines of the robots movements, using a sequence of paths and commands to complete a full auto.
PID CONTROL	Optimized robot movement, increasing speed, accuracy, and preventing overshooting and oscillation.
LIMELIGHT 4	Provides **MegaTag1** pose estimation to help the robot determine its position on the field.

REEF ALIGNMENT COMMAND BREAKDOWN

The Reef Alignment Command is a complex process involving many steps:



- Using the **Targeted Tag ID**, we create a Pose2D object representing the tag's **X, Y, and Yaw**.
- We apply an offset to the robot's X and Y position, using **trigonometry** to calculate the field-oriented position based on its rotation.
- A Pose2D object is created for the target position.
- The difference between the robot's current and target position represents the **error** that the robot must correct.
- A **PID controller** calculates the necessary velocities in each direction based on this error.
- A **SwerveRequest** is applied to the drivetrain, moving the robot according to the calculated velocities.
- As the robot approaches the target position, the required velocities decrease, eventually reaching zero within an acceptable tolerance.

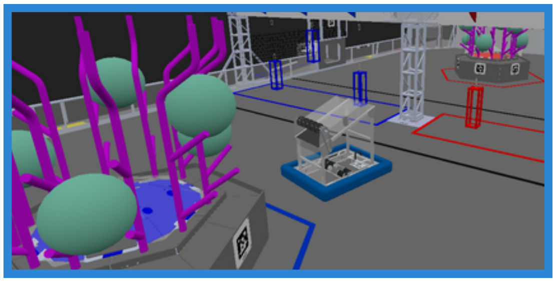
TELEMETRY

Keeping track of data and maintaining organized code is essential to efficiently debug and solve problems.

SMARTDASHBOARD & ADVANTAGESCOPE

SmartDashboard & **AdvantageScope** enabled us to effectively identify problems and visualize data.

- Log values in an easy-to-access place.
- Help us quickly evaluate problems.
- Able to check values during match (elevator position).
- See Limelight Camera View.
  - See Coral on the blocked side of the reef.
  - Identify April Tag the camera see's.



EFFECTIVE PROGRAMMING

Command-Based programing splits our code into **subsystems**, **commands**, and a central **container**.

We heavily **documented** our code and compiled an **81-page notebook** for integration so that the code was **configurable** for our hardware teammates (Example slide on the right).

TEAM SUPPORT

<u>Team 2928 *Viking Robotics*</u> generously donated a Limelight 2 for us to use. <u>Team 9450 *Velocity Raptors*</u> guided us through the setup process and provided helper methods for us to get started. <u>Team 4512 *Otter Chaos*</u> helped us create a realistic goal.

<u>Team 9450 *Velocity Raptors*</u> offered a lecture on understanding PID control and we worked with <u>Team 9442 *Miso Mechanics*</u> to tune our values and help with programming PID and Motion Magic on our elevator.

<u>Team 1778 *Chill Out*</u> and <u>Team 2522 *Royal Robotics*</u> hosted the North End Practice field where we spent 30+ hours getting essential practice.

THANK YOU

Our first year in FRC has been an incredibly fun and unforgettable experience, filled with challenges and immense growth. None of it could have ever been possible without the support we've received from such amazing people and our community. Every bit of help, no matter how small, has meant so much for us, and our entire team is deeply grateful for everyone who made this experience happen.

Mentors & Volunteers

- Kevin Finney
- Chris deVidal
- Tim Swartz
- Sobby Thakalath
- Miguel Pinto
- Derek Jacobsen
- John & Criselda Bush
- Andrea Madrigal
- Rita Slaney Gillian
- Jeremy Warren
- Brian Tax
- Oliver Kruaprasert
- Grace Yan
- Tamryn Dove
- Sudha Kumar
- Thuy Hong
- Salim Mohammed
- Will & Pamela Blakemore
- Nick Sykes
- And all our incredible parents we appreciate you!

Community Supporters

- Step It Up Camp (Maurice Leary)
- Creekside Senior Living Center
- Jordan & Greg Fisk

Supporting Schools

- Bothell High School (Juan Price, Angela Menon, & Lori Hendricks)
- Westhill Elementary
- Maywood Hills Elementary (Renee Huizenga & Larry Pierce)
- Canyon Park Middle
- Innovation Lab High
- Shelton View Elementary
- East Ridge Elementary
- Skyview Middle
- Arrowhead Elementary
- Hollywood Hills Elementary
- Cottage Lake Elementary

Fellow FIRST Teams

- Velocity Raptors (9450)
- Miso Mechanics (9442)
- Chill Out (1778)
- Royal Robotics (2522)
- SOTAbots (2557)
- Robototes (2412)
- Jack in the Bot (2910)
- Otter Chaos (4512)
- Saints Robotics (1899)
- S.K.I.D (FTC 417)

Sponsors & Partners

- Northshore School District (Damen Schunamen)
- FIRST & FIRST WA
- Dunn Lumber
- Electroimpact
- Boeing
- SPEEA
- Gene Haas
- OSPI
- NASA
- Argosy Foundation
- Northwest Folklife
- Bothell Kenmore Chamber of Commerce
- Cottage Lake Elementary PTA