RUNTIME TERROR

22105

PRESENTS

terror 481

INTO THE DEEP 2024-25 | SAN DIEGO REGIONALS

POWERED BY

Team Introduction

We are FTC Team #22105 Runtime Terror, from San Diego, California. We are a student-led **high school team** who is competing in our 3rd year of FTC.

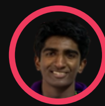
We have gone to San Diego Regionals twice and have won the **Connect, Motivate,** and **INSPIRE-1** award in the past. While building competitive robots, our team frequently engages with underrepresented communities to spread STEM. We've enjoyed our last few years and can't wait to have another successful season!

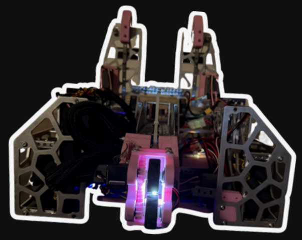
Team Management

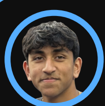
Our team is entirely **student-led**, with Co-Captains and Division Leads managing meetings, projects, and team goals. This structure encourages **leadership, personal growth, and accountability** within the team. We have **acquired our mentors** through developing connections at outreach events and online FTC communities.

Meet The Team!


Rahul V.
Co-Captain
CAD, Build
Designed the boxtube for this season's bot

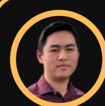

Tarun J.
Co-Captain
Software
Lead driver and coder for this season



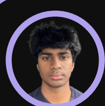

Sai T.
Build Lead
Built Intake and arm


Aadit M.
Software Lead
Coded path following

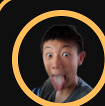

Sri S.
Business Lead
Manage fundraising


Kyle L.
Outreach Lead
State advocacy manager


Kanishka I.
CAD, Build
Wire management


Tanuj N.
Software, Build
Developed robot hang

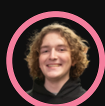

Saathvik G.
Business
Sponsor networker

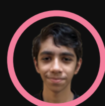

Bryan C.
Outreach, Build
4S library correspondent

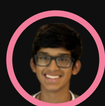
Mentors

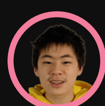
Mentors provided **specialized skills** and knowledge to our team. Their guidance helps us improve coding efficiency, refine our design process, and strengthen game strategy. We acquire our mentors through **STEM outreach events,** online **FIRST Forums,** and **networking** with other FIRST teams.


Dr. Antassonov
Software Mentor
UC San Diego


Johnathan K.
Strategy Mentor
FRC 2429


Saket T.
Design Mentor
FRC 1294


Vin
Electrical Mentor
FTC 3888


Allen H.
Design Mentor
FTC 14343

[redacted]
Design Mentor
FTC 23396

Team Sustainabilty & Plan

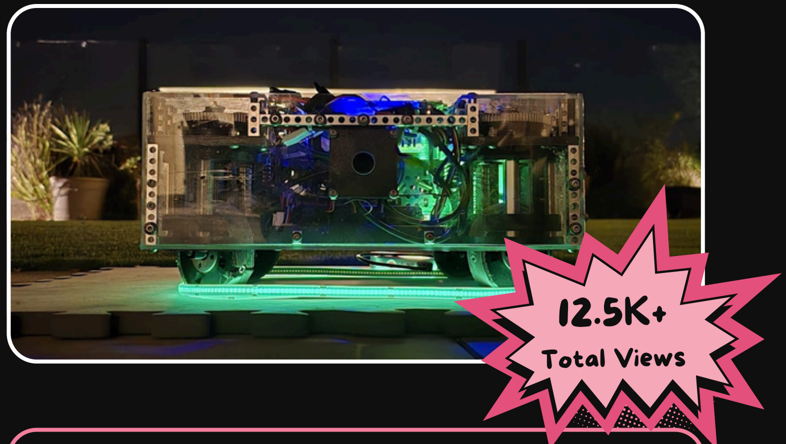
Skills Development: Suspension Swerve

We used the summer to create the all new **Suspension Swerve Drive**—the **first in FTC history.** Throught his process, we learned how to develop a fully custom robot.

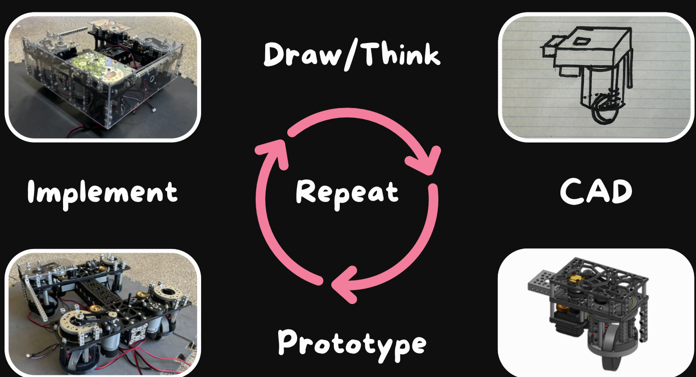
Mechanical Skills Learned: Manufacturing, Assembly, Gear Trains, MGN Rails, Belts, etc.

Software Skills Learned: Swerve Kinematics, Absolute Encoders, Custom Wrappers, etc.

Overall, this project taught our team many new skills and instilled our **team's design process** (see below) into our team culture. We carried these skills into this season's robot.



Swerve Design Process

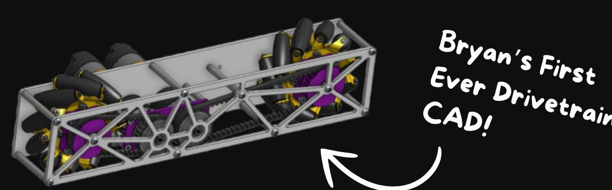


New Recruit Training

We developed a plan to train new recruits to our team. To teach everyone how to CAD, each member of our CAD team (both new and old members) designed a **full FTC Drivetrain** from scratch.

"CAD is something I could see doing in my ***professional career****, and making this drivetrain taught me so much."*

-Bryan (Build & Driver)



SEASON TIMELINE

- **SEPT-OCT** — Iterate & Finalize CAD, Build V1.1 Robot for Meet 1
- **NOV-DEC** — Focus on Minor Improvements & Basic Auto
- **JAN-FEB** — Driver Practice & High Auto Scores
- **MAR-APR** — Optimizations, Driver Practice, & High Auto Scores

FUTURE TIMELINE

- **Year 3 - 24-25** — Qualify for Worlds, Compete at MTI
- **Year 4 - 25-26** — Worlds Elims, Publish TerrorLib, MTI
- **Year 5 - 26-27** — Transition Leadership, Focus on Learning
- **Year 6 - 27-28** — Worlds Elims, Mentor Many Teams, MTI

Financial Sustainability

Our Sponsors

Our team is very thankful for our **gracious sponsors**. We secured these sponsors through the hard work of our Business Division. We have achieved these sponsors through **making connections** at outreach events, cold calling/ emailing, and developing an extensive sponsorship packet. Our sponsors recognize the **passion and drive** our team has!

Financial Indepedence

Through our Business Division, we have learned **real-world skills** in securing sponsorships, managing budgets, and ensuring **sustainable funding** for our operations.

*"Networking with sponsors and becoming **financially sustainable** is one of my greatest accomplishments this season!"*

-Saathvik (Business)

Summarized Budget

Item	Expense/Income
Company Sponsorships	+ $2,000
Company Matching	+ $500
Fundraisers	+ $40
FTC Specific Grants	+ $1,500
Total Income	**+ $4,040**
Outreach	- $200
Mentoring	- $200
Robot Plates	- $300
Robot Parts	- $3,200
Total Expenses	**-$4,000**

Sponsorship Tierlist

Our team developed many **sponsorship packages,** using a tier-list to determine the perks for our sponsors. This gives our sponsors a clear vision of what they will receive by supporting us.

Hack-Club Bank (HCB)

Through Hack-Club Bank, our team is a **registered 501(c)(3) non-profit**, enabling us to make purchases and receive donations. HCB gives us **full financial control**, teaching us real-world skills from budgeting to money management, allowing us to operate more efficiently.

165+ Reached

Fundraisers

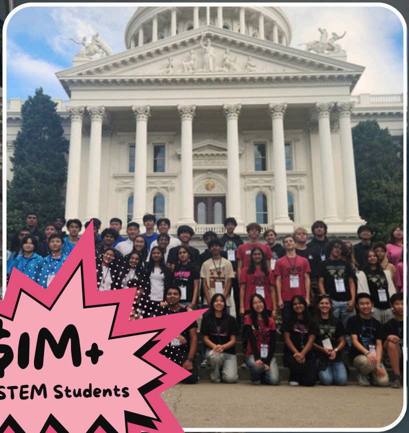
We took part in FTC Team 16392's **Fundraising Challenge** (located in Alberta, Canada) to raise over $500 for FIRST Programs across North America. We held fundraisers at our local Chipotle and Panera Bread, giving our com-munity a chance to **support FIRST** directly!

Outreach - Spreading STEM

Student Association for STEM Advocacy

In collaboration with MSET Cuttlefish 6165, Team Spyder 1622, and other California FIRST/VEX teams, we travelled to **Sacramento, California** to meet with our state representatives: **Assemblymember Maienschein, Senator Jones, Senator Ochoa Bogh**, and many others.

At the California Advocacy Leadership Conference (CALC), we met over a **dozen legislators** to advocate for robotics and STEM funding. This experience deepened our understanding of California's government and helped us support future students in STEM.



$1M+
For STEM Students

Our Impact on California

We advocated for a **statewide grant program** for school robotics, similar to Wisconsin and Michigan, and a $1 million increase in funding for the **Expanded Learning Opportunities Program (ELOP)/ Assembly Bill (AB) 130**, from **$4 million to $5 million**.

We're grateful for the chance to share our passion for robotics with **millions of Californians** who lack the opportunities we had!

California State Legislature whose support we secured for an increase in funding for the **Extended Learning Opportunities Program**

Refugees for Robotics

By bring together **five FIRST teams** and refugee support organizations across the world, we've began many initiatives bring **STEM education to underprivileged communities**. Our pilot project with **Kenya's Youth Voice Community** develops self-reliance in refugee students through coding & design services in the international workforce.

*"Through planning, coordinating, and partitcpating in Refugees for Robotics, I've witness firsthand the **impact STEM education** has on my local community and world-wide!"*

-Kyle (Outreach Lead)

300+
People Reached

Outreach - Promoting STEM

Outreach Lessons Learned

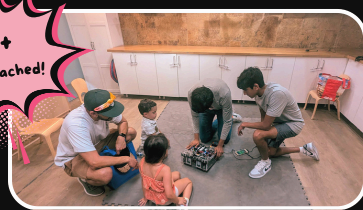
We constantly refine our outreach for a larger impact. After low sign-ups for paid classes, we switched to free sessions. Also, due to low scrimmage turnout, we have focused on **accessibility** and **strategic outreach** to grow engagement.

4S Ranch Country Library

In collaboration with CodeRobo.AI, we we're ran a **four-week Python/Scratch Course**. Our library provided guidance in expanding our presence through **social media/physical ads,** areas which we've struggled with before. We also held various robot demonstrations with **FRC Team Optix** and **FLL Team Tech Titans.**

Southeast SD Science & Art Expo

Co-exhibitors with UCSD Create, General Atomics, Google, and SD Air & Space Museum



SDCDM Science & Engineering Night

Co-exhibitors with Thermo Fischer Scientific and Sally Ride Science Program

1st Annual Del Sur STEM Fesitival

Our team hosted the first annual Del Sur Stem Festival early this season. We organized a festival across **twelve different STEM-oriented organizations** to give children in our community a chance to experience the many fields of STEM.

Society of Women Engineers (SWE)

At the 3rd Annual WiSTEM Forum, our team **showcased STEM pathways** and opportunites through FIRST to local middle/high school girls.

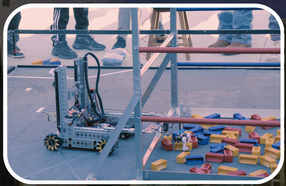
Outreach - Supporting FIRST

2nd Annual Del Norte Scrimmage

For the second year, we hosted the Del Norte FTC Scrimmage with FRC Team 3749, having **100+ attendees** and giving teams **vital driver practice** before Meet 2. Congrats to Team Patent Pending #11285 on their win!

*"As a new recruit to FTC, coordinating and playing in this year's scrimmage gave me **key insights in game strategy**."*

-Sri (Human Player & Business)



We closely guided **two local FLL teams,** assisting them with their project and robot build.

We mentored **two FTC teams** with their box-tube designs (from **New York City** and from **Turkey**). We frequently have driver practice with **local FTC Teams**: Clueless 11212, Green Griffins 10092, C.A.R.T. 23280, and Fusion 18142

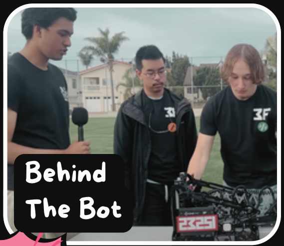
We mentored **FRC Team Optix #3749** for the **REEFSCAPE Season,** especially in CAD.

FUN Robotics Network

Rahul is the SD correspondent for **FIRST Updates Now (FUN),** hosting interviews/shows to spread FIRST to thousands across the world.

*"Interviewing teams from San Diego has shown to me how amazing, intelligent, and truly inspiring the **FIRST community** is."*

-Rahul (Co-Captain and CAD)

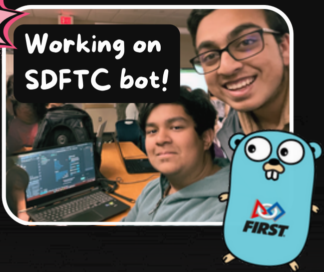


8.3K+ Views on YT

SDFTC Discord Mod

Aadit is an **SD FTC Discord** moderator and has created a bot for **community engagement.**

300+ People Reached!



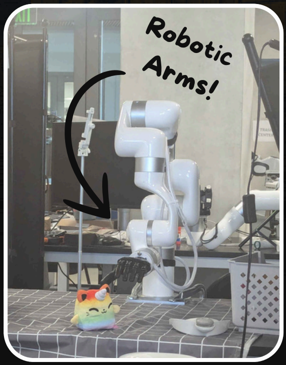
OUTREACH STATS

15+	FIRST Teams
50+	Events Hosted
500+	Hours
20K+	People Reached
20+	STEM Organizations
35K+	Social Media Views
7+	States
8+	Countries

Connecting with Experts

UCSD Makerspace Collaboration

In the off-season, we visited **Dr. David Lesser** at UCSD's **Makerspace** for training on **laser cutting**, **CNC machinery**, and **3D printing**. Our Build Division was able to experience these tools in action and develop the skills for our current season.



UCSD Professor Nikolay Antassonav

In addition, we met with Professor Nikolay Antassonov and his PhD students to learn about UCSD's work on **drones**, **arm robots**, and **self-driving vehicles**. Our software division was able to discuss adaptive pursuit with ellipsoids, control algorithms, path planning and other **FTC applications** in-depth with Professor Antassonov.

Xometry

To assist with our design this year, our team met with **Industry Professionals** from **Xometry** to manufacture Boxtubes. We learned about Tube Cutting, CNC Machining, Laser Cutting, Water Jet Cutting, and many more methods of industrial machining.

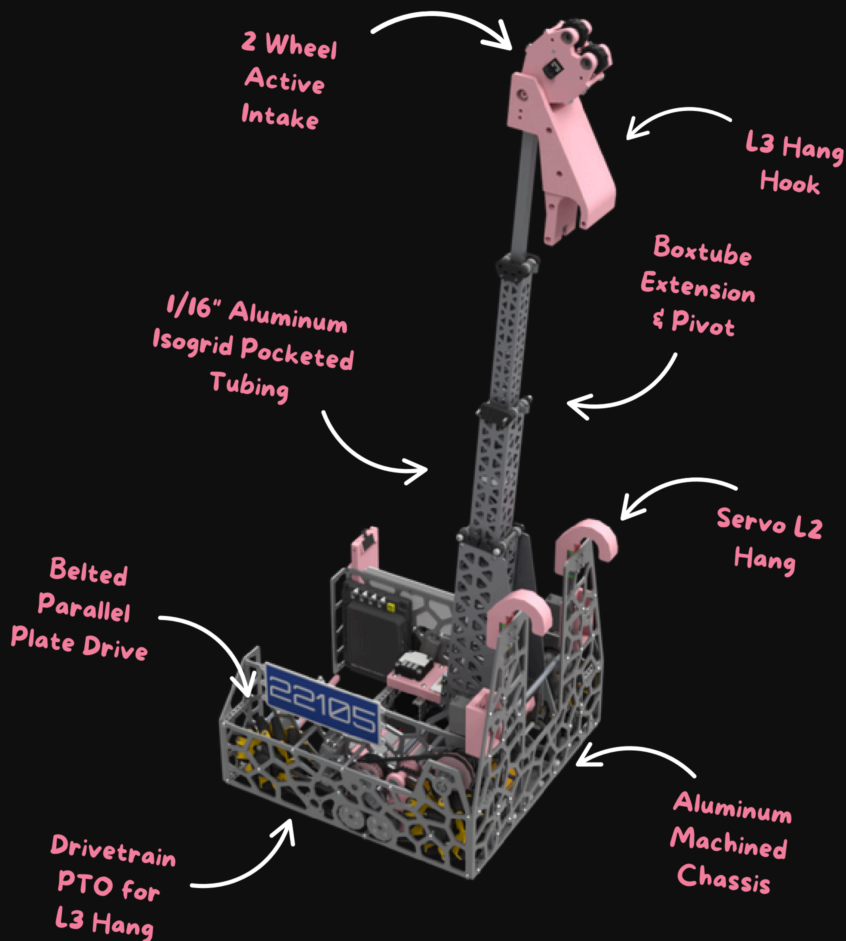
North Carolina School of Science & Mathematics

We collaborated with **FTC Team 5064** from North Carolina to laser cut our boxtubes using the machining facilities at the North Carolina School of Science & Mathematics. NCSSM's **large scale machining facilities** were invaluable in pocketing our robot's main scoring mechanism.

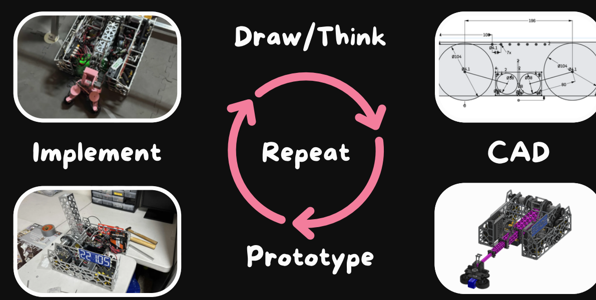
BrainCorp Daniel Hoffman

We contacted Daniel Hoffman, the **Senior Software Director** at Braincorp, to learn more about the real-world applications of robotics (particuarlly autonomous mobile robots/AMRs). Mr. Hoffman provided guidance and advice for a **future career in robotics** and STEM.

Meet TERROR-481



Engineering Design Process



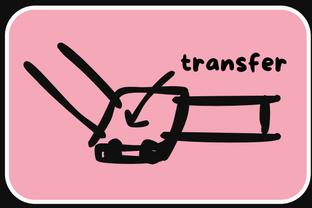
Risk Management & Mitigation

Due to our complex design, we implemented strategies to counteract, avoid, and reduce risks:

- **CAD Review Sessions:** Team picks apart design to avoid financial risk
- **Contingency Planning:** Backup plans and alternatives for high-risk components, and stay on track
- **Prototype Testing:** Testing and iterating designs with 3D prints before placing orders

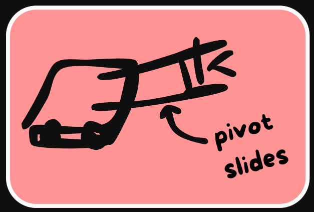
Design Considerations

DOUBLE EXTENSION



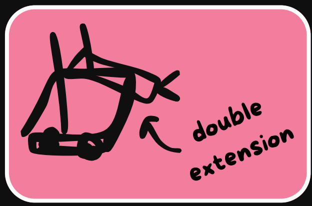
- Stable, Efficient, Simple
- Extend Intake (Specs)
- Slow/Unreliable Transfer
- 4x Linear Slides (Heavy)

PIVOTING SLIDES



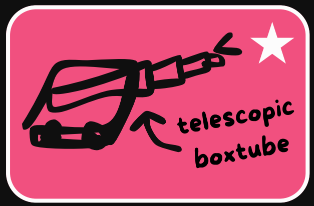
- No Transfer Required
- Fast/Efficient Cycles
- Heavy Pivoting Slides
- Potentially Unstable

CRANE BOT



- No Transfer Required
- Fast/Efficient Cycles
- 4x Linear Slides (Heavy)
- Slower Vert. Lift Speed

BOXTUBE PIVOTING



- 50% Lighter Than Slides
- No Transfer Required
- 100% Custom Designed
- Complex Mechanism

Game Strategy

Sample Focused Scoring

AUTO

- **Goal:** 7 Sample Autonomous using Computer Vision
- **Current:** 7 Sample Autonomous using Computer Vision

↓

TELEOP

- **Goal:** Consistent **24 samples** with a **5 second cycle time**
- **Current:** Consistent 20 samples with a 6s cycle time

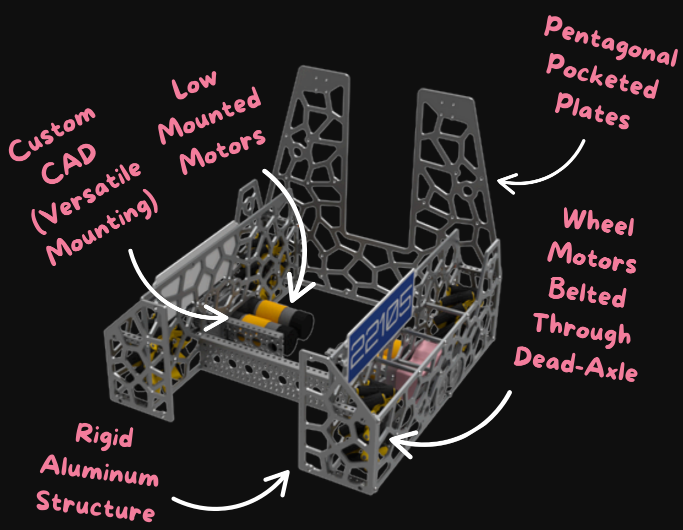
↓

ENDGAME

L3 Ascent

- L3 Ascent **Under 6 Sec.** (Without a Sacrifice in Extension Speed)
- **Power Take-Off** Through Drivetrain

Drivetrain & Electrical

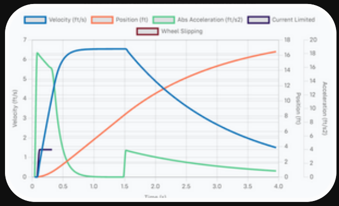


Key Features

- **13.6:1 Ratio** optimized for acceleration and speed (1.46s 8ft. Sprint Distance)
- **Compact** Belted Parallel Plate Drive
- **1/8" Pocketed Alu.** Plate Superstructure for Rigidity (Pocketing Saves **~50% Weight**)
- **14"x14"** & **Low COG** to Stop Tipping
- Fully Designed in CAD

Drivetrain Design Considerations

SWERVE

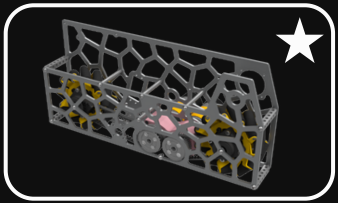


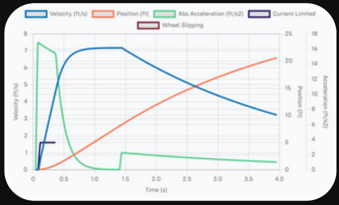
- Full Speed (4-way)
- +57% Pushing Power
- More Failure Points
- ~$1200 Cost
- ~2.5A+ Current Draw

Statistics

- **1.36s** 8ft Sprint Dist.
- **8.42ft/s** Max Speed
- **~1.1** Coef. of Static Friction

MECANUM





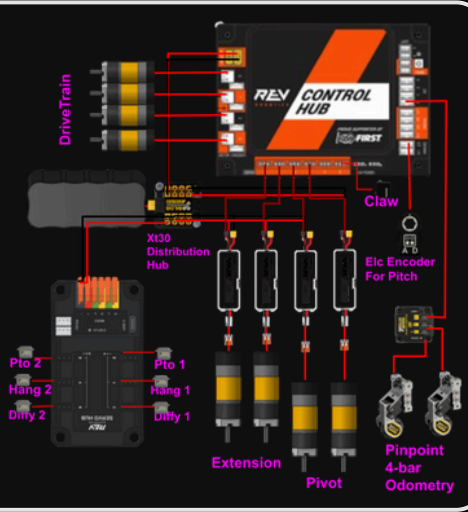
- Few Failure Points
- Grip-Force Traction
- ~$500 Cost
- Only 70.7% Power in Strafe

Statistics

- **1.46s** 8ft Sprint Dist.
- **7.17ft/s** Max Speed
- **~0.7** Coef. of Static Friction

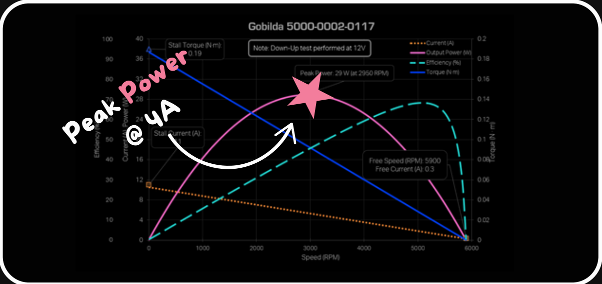
Electronics - Schematic

We are the **only team (worldwide)** that skips an expansion hub for Spark Minis and the REV Servo Hub, saving **100g** and having better packaging. Our Software and Build Divisions gained skills in **soldering**, **crimping**, and using **WAGOs**.



"I am proud of soldering and crimping our wiring, ensuring our electronics are ***reliable and dependable.****"*
-Kanishka (Build)

Current Optimization



Last year's current draw issues led us to focus on keeping each mechanism **under 15A**, allowing a 5A safety margin below the 20A fuse. We used the equation $\tau = rF\sin\theta$ to calculate the required motor torque and identified the corresponding current on the **motor curve**, aiming to operate around **peak power at 4A per motor**.

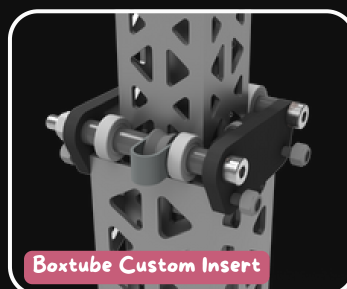
Custom Boxtube Extension & Pivot

Why Boxtube?

Our team chose to create a **fully custom** designed, manufactured, and built boxtube extension & pivot mechanism. It provides:

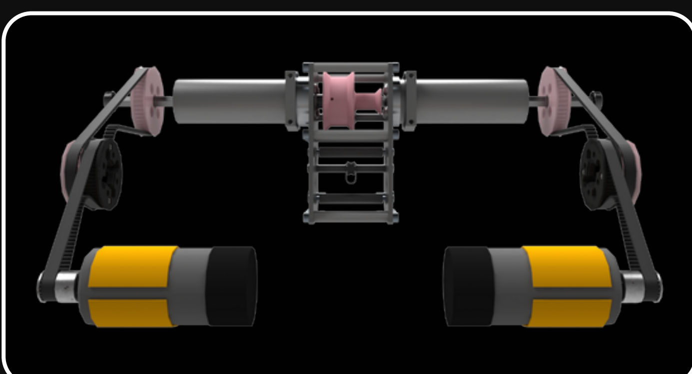
- **Rigidity & Strength** in all four directions with outer and inner bearing inserts
- **47% Lighter** than Linear Slides (395g vs. 758g)
- **Super Speeds** of **0.4s** Full Extension Time and **0.25s** 90° Pivot Time
- Compact in a **2" by 2"** boxtube dimensions

Every piece on our boxtube is **custom**, making it harder to manage & create. However, we **mitigated risk** by carefully planning out stringing, accessible pocketing, and **CAD feedback** from **FTC #5064**, who have experienced in boxtube mechanisms.



*"By **building and improving** our robot's boxtube, I've improved our robot's **durability & consistency.**"*
-Sai (Build Lead)

EXTENSION POWERTRAIN CAD



- 6000 RPM geared 6.94:1 for **1440 RPM** (**20.82kgf·cm** torque)
- **12mm** extension, **36mm** retraction spool (cascade)

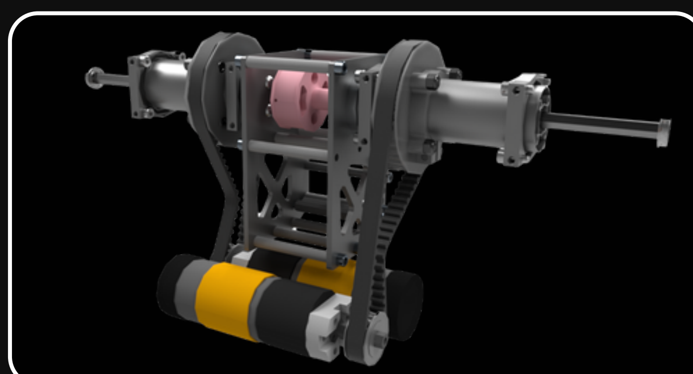
$\tau = 20.8\,kgf\cdot cm$

$\tau = r \cdot F$

$(20.8 \cdot 1/2) = r \cdot 0.6 \Rightarrow$ **r = 18, d = 36**

50% = Peak Power; 0.6kg Extension

PIVOT POWERTRAIN CAD



- 223 RPM geared 2.63:1 for **85 RPM** (**199.88kgf·cm** torque)
- Spool Axle is **Coaxial with Pivot** Tubing

$\tau = r \cdot F$

$\tau = 122 \cdot 0.6 \Rightarrow 73.2\,kgf\cdot cm$

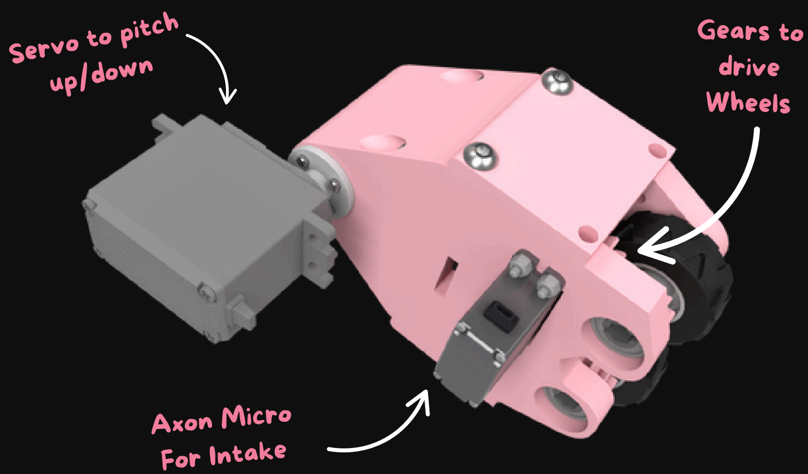
122cm; 0.6kg

2.5x ⇓ **200 kgf·cm required**

Unified Intake & Outtake

Since our pivoting boxtube **negates the need for a transfer**, our intake doubles as an outtake. We've spent a lot of time this year **iterating** on potential intakes, before settling on a **dual wheel active intake** as the best option.

3D Printed Active Intake



How Does the "Dual Wheel Active Intake" Work?

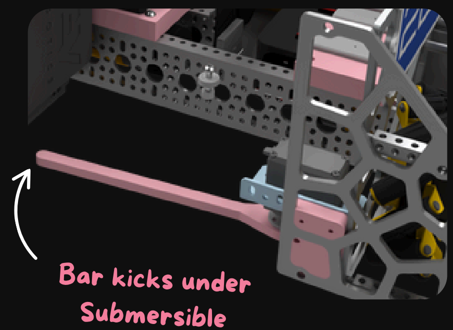
Our intake follows the principle of **K.I.S.S: "Keep is Simple, Stupid."** It utilizes two spinning wheels that are powered through an overdrive by an Axon Micro servo, which enables it to have high **vectoring** capabilities. A **color/proximity sensor** is housed internally to stop the intake when it detects a sample.

Furthermore, we also use an **under the submersible bar sweeper** to clear samples for placing the intake down.

Intake Risk Management

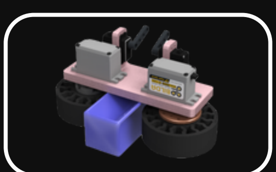
We developed multiple intake **prototypes** in **parallel** rather than committing to a single design path. This iterative approach, as shown in our intake evolution from **V1 to V5**, allowed us to test different mechanical concepts while having **backup options** if any design proved unfeasible. Furthermore, by doing **cost-benefit analysis** on intake versions, we were able to find the best one.

Under-Submersible Sweeper



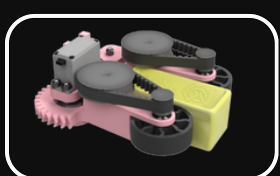
Intake Evolution

V1 "Double Wheels"



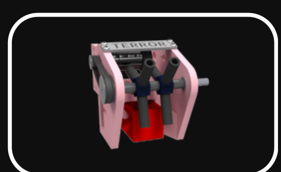
- Simple to Design
- Bad Vectoring of Samples
- Heavy & Bulky
- Cannot Place Specimens

V2 "Active Claw"



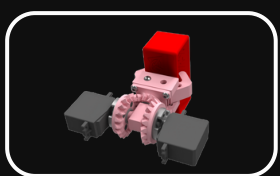
- Decent Vectoring of Samples
- Can Place Specimen
- Bulky for Intake
- 4 Servos

V3 "Active Claw 2.0"



- Good Vectoring of Samples
- Can Place Specimen Through Claw
- Heavy & Bulky

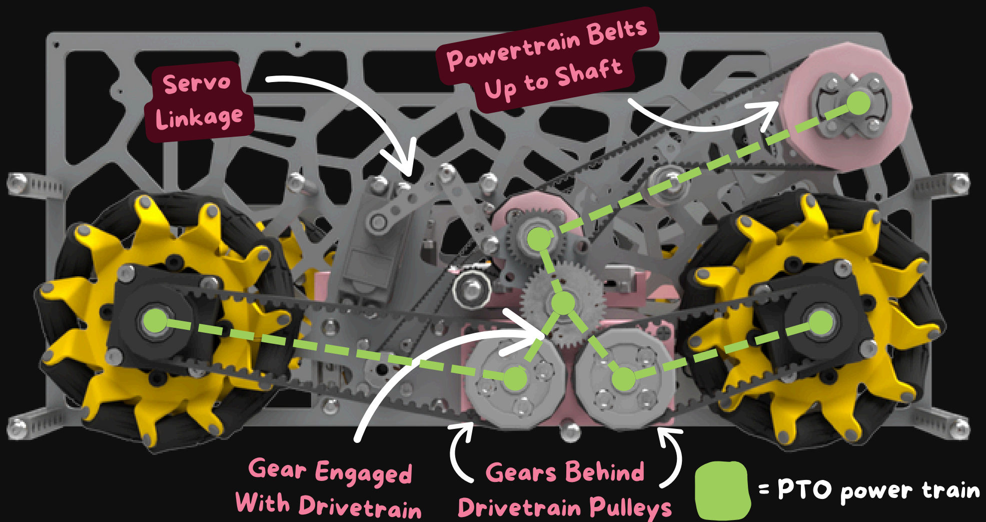
V4 "Diffy Claw"



- Precision for intaking
- Can Place Specimen
- Slow cycle times
- Hard to deposit

Level 3 Ascent

Drivetrain Power Take-Off (PTO)



Why Power Take-Off?

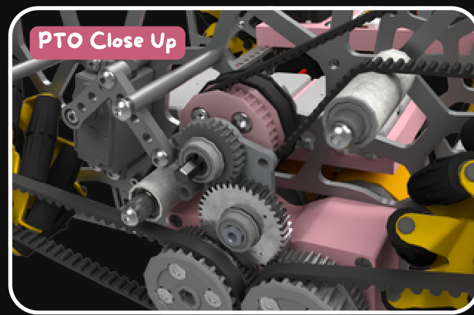
We wanted the ability to hang **without sacrificing the speed** of our extension, so we created a PTO system.

In endgame, a **servo linkage** engages a gear with our **drivetrain motors**, allowing us to use the **torque of six motors** while hanging. The drivetrain motors torque down the linkage, keeping it in place. This has led us to achieve a **Level 3 Ascent** in ~6 Seconds!

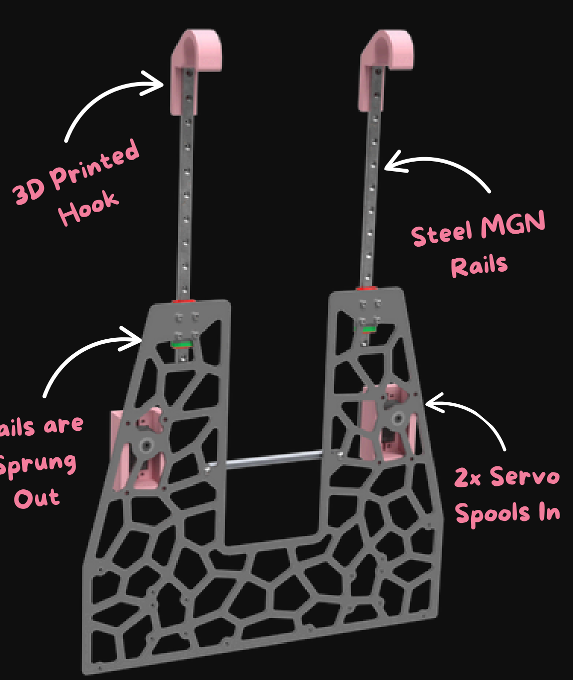
Our **PTO** allows us to **choose** between **high speed** for fast cycles or **high torque** for hang in endgame.

PTO DISABLED
- 2 Motors
- 1440 RPM
- 1.24 Nm Torque
- 0.4s Extension

PTO ENABLED
- 6 Motors
- 400 RPM
- 8.58 Nm Torque
- Hang Possible



Servo-Based L2 Ascent



Key Features

- **Steel MGN Rails** sprung outwards, retracted with 2 servos on 24mm spools
- Robot **balanced** against front bar to allow for **Level 3 Ascent**
- Mounted on aluminum back plate for strength

*"Taking our team's PTO from **concept to reality** became my **proudest achievement** this season. Seeing our crazy idea come to life reminded me why **I love being part of this team.***

-Rahul (Co-Captain and CAD)

Calculations

- Servos Powered with **6V** on REV Servo Hub
- Calculated with **40% Safety Factor**

$$\tau = 43.2\,\text{kgf}\cdot\text{cm}$$
$$\tau = r \cdot F$$
$$(43.2 \cdot 1/2) \cdot \frac{4}{5} = r \cdot 10 \Rightarrow r = 12\text{mm},\ d = 24\text{mm}$$

40% Safety
50% = Peak Power
10kg Bot

Software: Sensors & Autonomous

Sensors

Our team uses an **Absolute Analog Encoder** for pitch and a **motor encoder** for extension. The absolute position eliminates the need to re-zero pitch. We also use a **REV Color/Proximity Sensor** to detect when samples are in our intake in tele-op and autonomous.

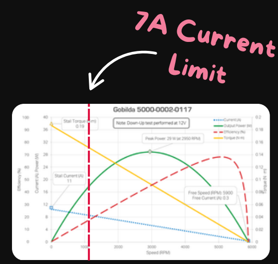
ELC Encoder for pitch

Motor Encoder for Extension

Color & Proximity Sensor for Intake

Current Sensing

Because of a few **blown fuses**, we sense for when the **current goes above 7A** to stop applying as much power. This helps retain the life-span of the motors.



Localization

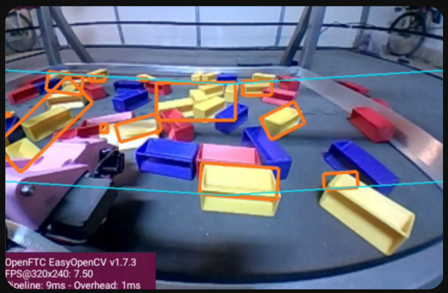
Currently, we use the **Gobilda 4-Bar Odometry** and the **Pinpoint Odometry** Computer to localize our robot in auto.

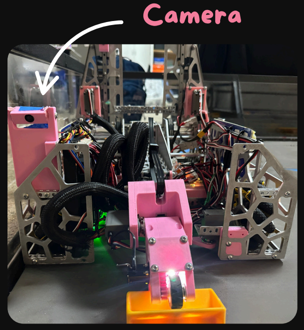
V1. OPTICAL ODOMETRY
- *Error-prone due to dust*

V2. DEADWHEELS
- *Consistent on all fields*

Computer Vision - Sample Detection

Our team uses the **OV5640 Fisheye camera** to implement autonomous that can grab blocks from the center using vision. Using OpenCV, we identify a **"blob" of yellow samples** by **drawing contours** around shapes and merging them together. Lastly, we extend the boxtube to retrieve a sample from the blob.

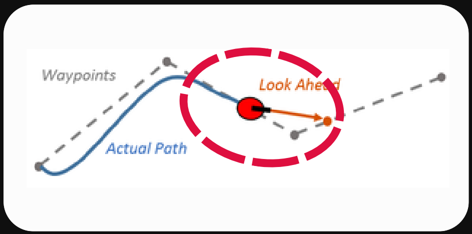




Path Following

We've gone through **two custom iterations** of path following, before deciding to use **open source software**.

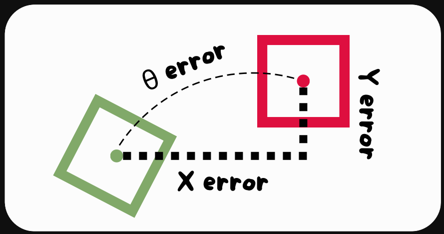
MEET 1 - PURE PURSUIT



Custom Implementation of **Pure Pursuit & Quintic Hermite Splines**

- Speedy & Consistent Auto
- Adaptive to Robot's Momentum
- Extremely mathematically complicated & unreliable

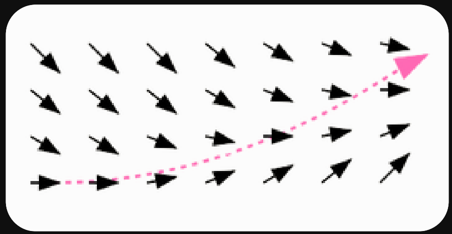
MEET 2/3 - PID 2 POINT



Setting Targets on X, Y, and Heading to Travel in a Straight Line—**"PID 2 Point"**

- Simple Algorithm to Code (Less Bugs)
- Easy to Create Autos
- Too Slow for High Scoring Autos

LT/REGIONALS - PEDRO



Open Source Software **Pedro Pathing,** with **Guided Vector Fields** to Traverse the Field

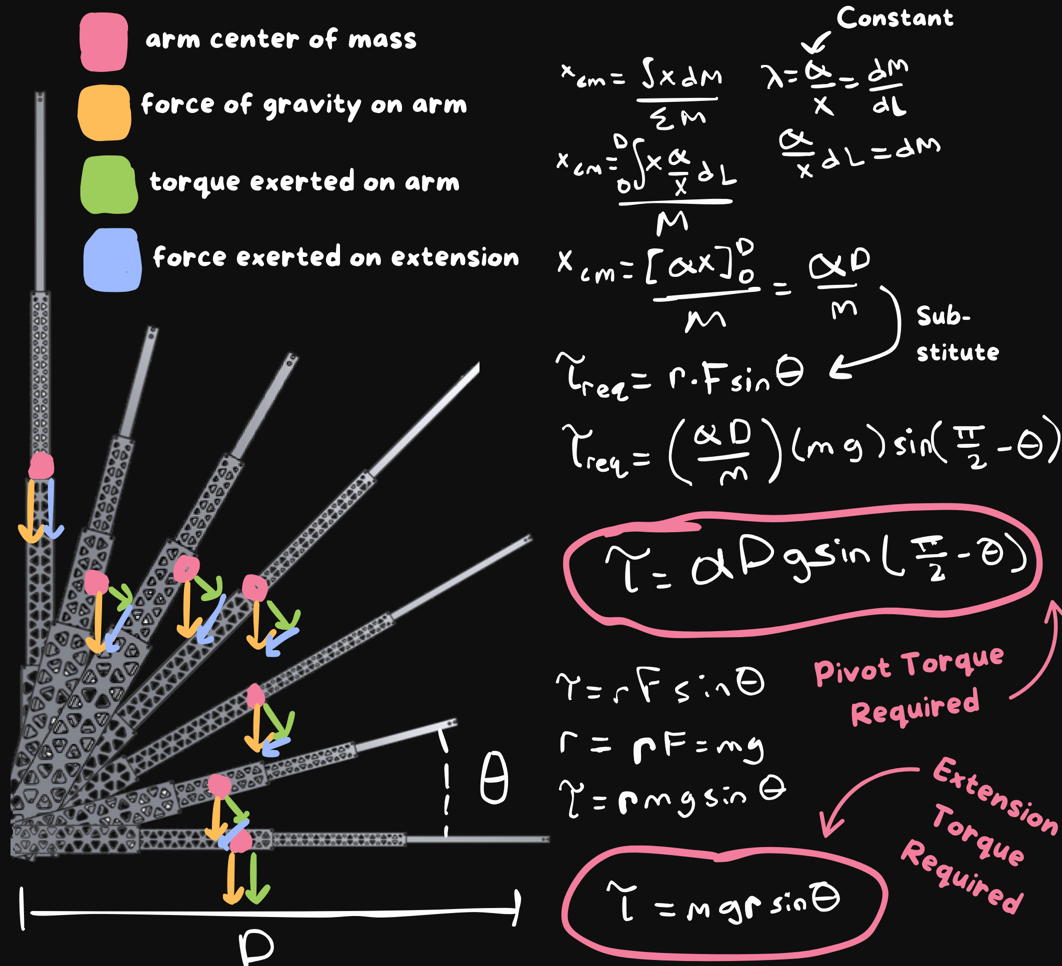
- Open Source Software, so it is Simple to Implement
- Speedy & Consistent Auto
- Adapts with Centripetal Force Corrections

Software - Control Systems for Boxtube

Gain Scheduling Adaptive Feedforward System

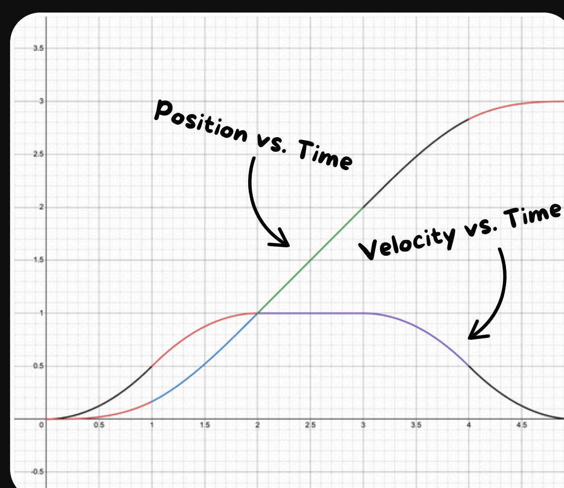
Our team's main scoring mechanism is an arm that can rotate and extend, giving it a constantly varying **center of mass**. This caused a simple PID loop to be **ineffective**.

We created a **gain scheduling feedforward system** which approximates the **necessary torque** to keep the **mechanism steady** depending on the angle of pivot and extension.



S-Curve Motion Profiling of Arm

Due to the speed of our pivoting arm, we created for a **fully custom S-Curve Motion Profile**. This limits the acceleration of the system and ensures that the acceleration is continuous, unlike a trapezoidal motion profile, which is commonly used in FTC. We then further improved the process to use the **Newton-Ralphson Method** to increase reliability.



S-Curve Velocity Equation

$$
v(t) = \begin{cases}
v_0 + j_m \cdot \frac{t^2}{2} & t \leq 1 \\
v_h + a_s \cdot \left(t - \frac{T}{2}\right) - \frac{j_m\left(t - \frac{T}{2}\right)^2}{2} & t \leq 2 \\
v_s\{T \leq t \leq T + r_{shift}\} & t \leq 3 \\
v_s - \frac{a_s}{T} \cdot \left(t - T - r_{shift}\right)^2 & t \leq 4 \\
v_h \quad a_s \cdot \left(t - 1.5T - r_{shift}\right) + \frac{a_s}{T}\left(t - 1.5T - r_{shift}\right)^2 & t \leq 5
\end{cases}
$$

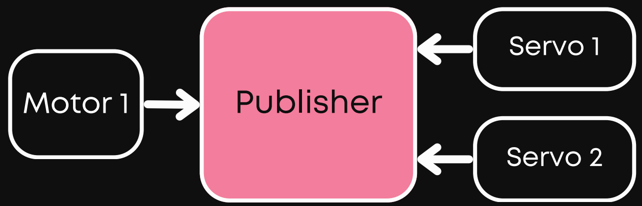
*"Developing S-Curves has shown me how the **advanced calculus** I learned in school has **real-world applications** on our team."*

-Tarun (Co-Captain and Software)

Software - Modular Programming

Publisher-Subscriber Model

To write to devices such as motors and servos, we use a **publisher-subscriber model.** Instead of writing new motor powers immediately, we simply store those powers. Each device is **"subscribed"** to a **"publisher"** class, which sends all the commands to the hardware. This ensure that each device is only written to a single time in each loop iteration.



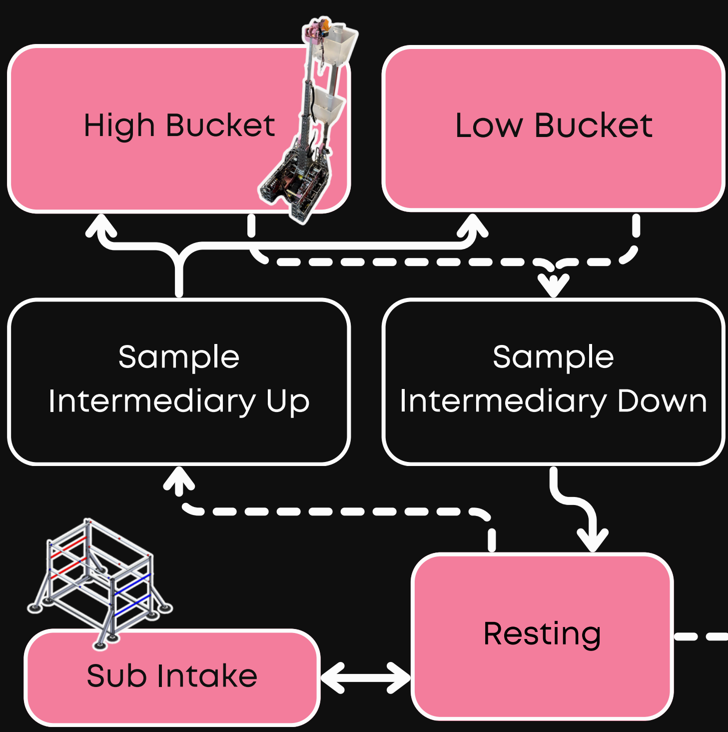
Auto Actions System

For our autonomous, our team developed an actions system to greatly simplify the creation and management of tasks. We used a **queue** in Java to store **pending tasks,** and completed tasks from the front of the queue. The following **commands** are used to modify the queue in our auto program.

- `executeUntilTrue()` runs a task until some condition is met
- `executeForTime()` runs a task for a specific amount of time
- `addPoint()` drives the robot to the specified point and runs all previous actions
- `finishActions()` runs any previously defined actions without setting a new point to drive to

*"I'm proud of reducing our robot's central loop times from **25 milliseconds. to 4 milliseconds**. through motor caching and bulk read optimizations, which increased the **stability and convergence** of our PID loops."*
-Aadit (Software Lead)

Robot State Machine



Our team utilizes a **state machine** to control our robot in both auto and tele-op. This controls the robot on the backend, greatly **simplifying creation of auto programs** and the **amount of controls for the drivers**. With just **two buttons**, the driver can transition from intaking to resting to being ready for high bucket deposit.