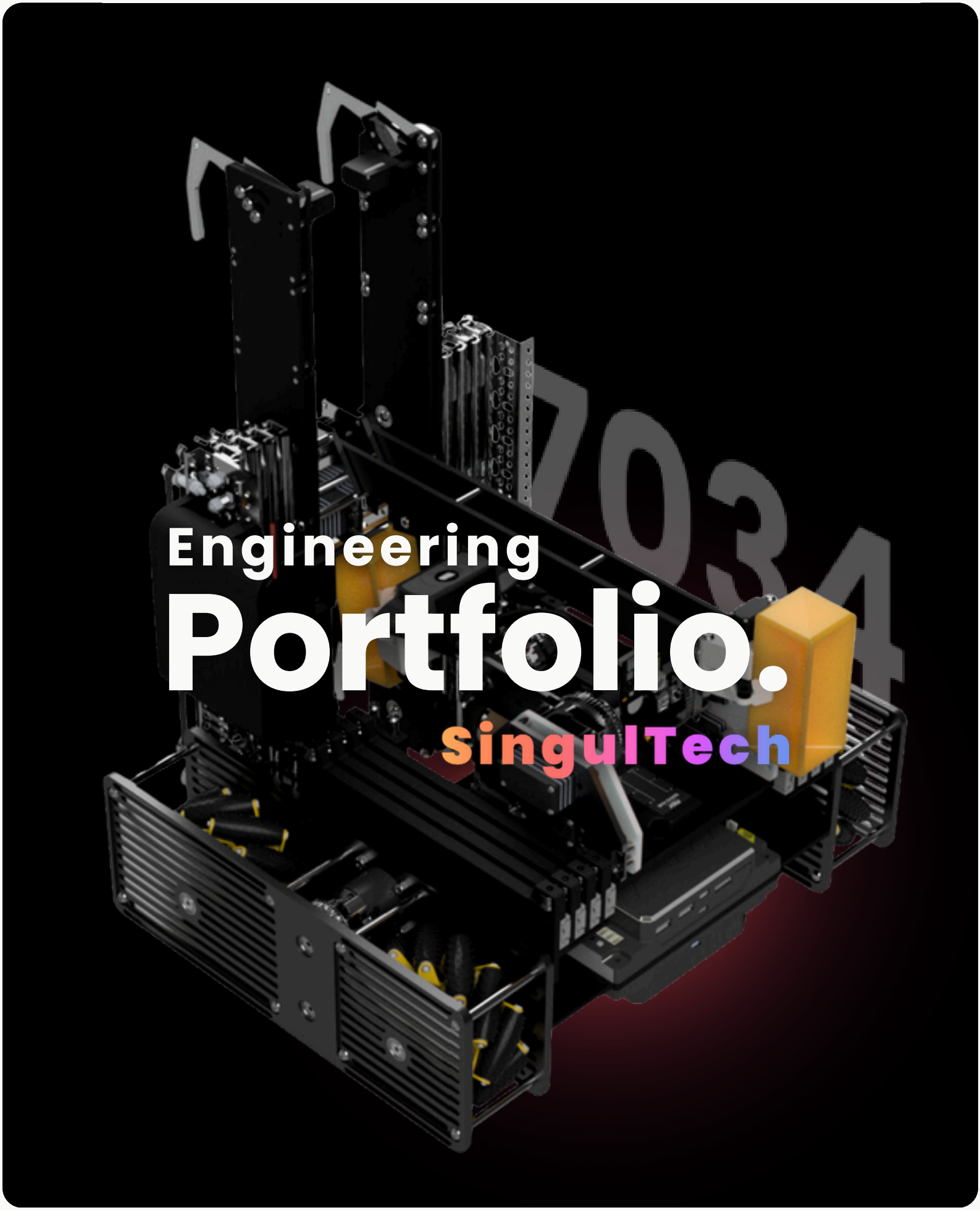


Engineering Portfolio.

SingulTech

5,460+ people • **1,328.5+** outreach hours • **16** countries • **20** initiatives

Team Members, Mentors, & Requirement

SingulTech

Team Introduction

We are **FTC Team 7034, Singularity Technology,** from Wilton, Connecticut. We're a student-led team focused on creating a competition ready robot with custom parts for FTC, whilst leading in FIRST, Technical, Local, School, and Open-Source communities to promote and spread **STEM expertise** and **FIRST values.**

Over the last **11 years of competing** out of Wilton Library, we have earned **45 awards**. We currently have 12 members on our FTC team, 3 mentors, and 8 members on our FLL team.



FIRST-Veteran-Recruit | STEM Recruit | New-to-STEM Recruit



William O.
Captain, Build Lead
- 5th Year



Leo K.
Programming Lead
- 2nd Year



Angela V.
Outreach, Build
- 3rd Year



Vidit P.
TAP - Programming
- 1st Year



James R.
Programming
- 3rd Year



Anaya U.
TAP - Build, Outreach
- 2nd Year



Anirudh N.
Outreach, Build
- 5th Year



Saara S.
TAP - Outreach, Build
- 2nd Year



Vivaan U.
Programming
- 2nd Year



Siddharth A.
TAP - Build
- 1st Year



Henry L.
Outreach, Build
- 3rd Year



Arav G.
TAP - Build
- 2nd Year

Team Sustainability Plan

Goal: To recruit diverse perspectives & build a sustainable talent pipeline.

Steps to Achieve Goal: We've built a talent pipeline from our new FLL team to our TAP team to our Main-Team to ensure long-term success. Main-team members lead FLL and mentor TAP members, passing down knowledge. To foster diverse perspectives, we recruit from FIRST, STEM, and non-STEM backgrounds.

Mentors



Valmai H.
WLA Teen Librarian
- Team Coach



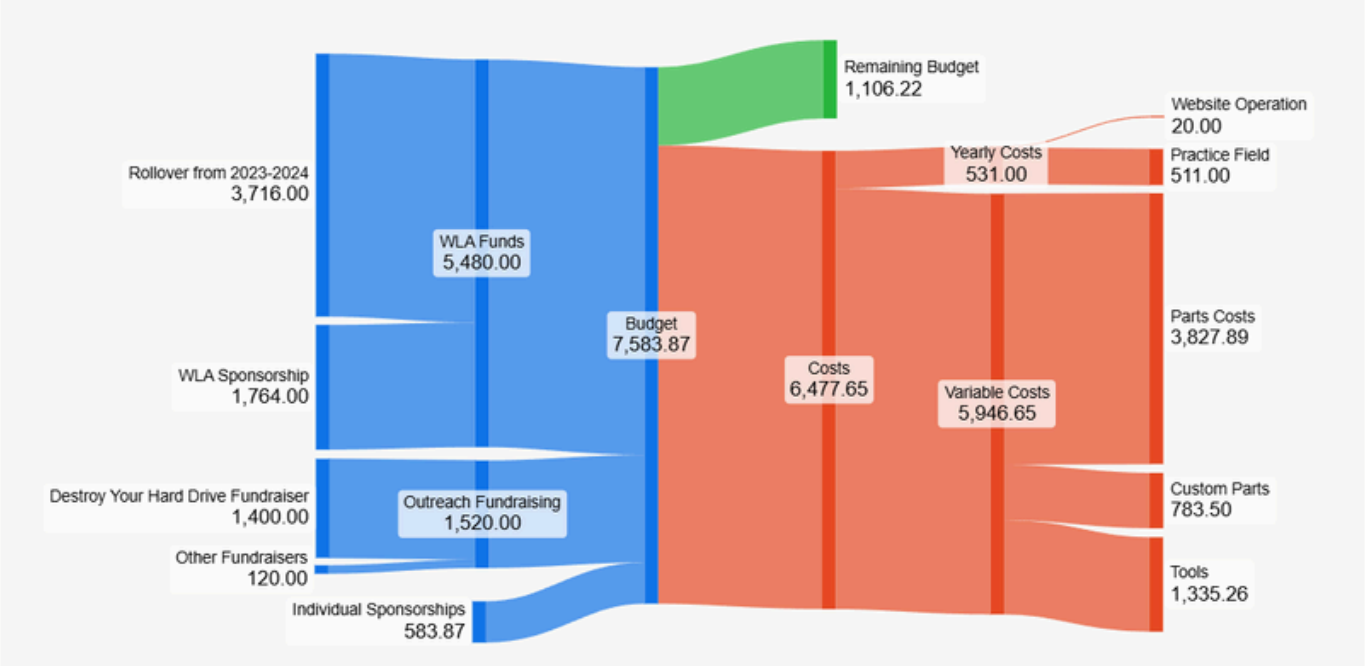
Valmai H.
ASML Optics Engineer
- Mentor



Aarushi A.
Northeastern University
- Alumni Mentor

Our Finances

Updated: April 14, 2025



Financial Sustainability Plan

To ensure long-term financial stability, we began diversifying funding this year. Along with Wilton Library's sponsorship, we created a partnership packet and order form tracker for responsible financial management.

Partnership Packet

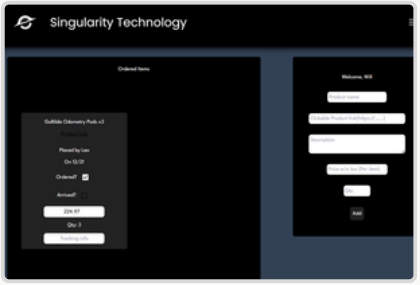
We created a partnership packet to share with our local community for **mentor and sponsorship acquisition**. Wilton Library **director, Mrs.Caroline Mendler**, helped us revise and improve the packet, for more efficacy.



Our Sponsor

Wilton Library has been the continued benefactor of SingulTech for **11 Years** now; it has supported our mission by providing the necessary funds through their sponsors, granting us outreach opportunities and providing the space for meets.

Custom Order Form



With advice from **Moody's financial investors**, we developed a custom order page on our **self-made** website. Using a **MySQL database backend**, orders are sent to our coach and archived for an organized finance sheet, seen above.

Organizational Plan - Motivate

Season Timeline

Pre-Season - March to August
-Recruited & Onboarded new recruits
-Made Outreach Plan & Opportunities
-Developed Sponsor Partnership Packet

Kick-Off - September
-Organized, Set Team & Financial Goals
-Began Drivetrain Development
-Began School & FIRST related Outreach

Early Season - October to November
-Created Prototypes & First Iterations
-First Drivetrain Revisions
-Created Website - Singultech.app
-Began Pre-Programming Robot

Mid Season - December
-Finalized Drivetrain and Slides
-Begin Intake / Grabber Design
-Participated in Windsor Scrimmage
-Helped Add Robotics Courses to School

Qualification Season - January
-Participated in Qualifier 1 & 4
-Built & Coded Final Sub-Assemblies
-Shifted Focus to Expanding Outreach

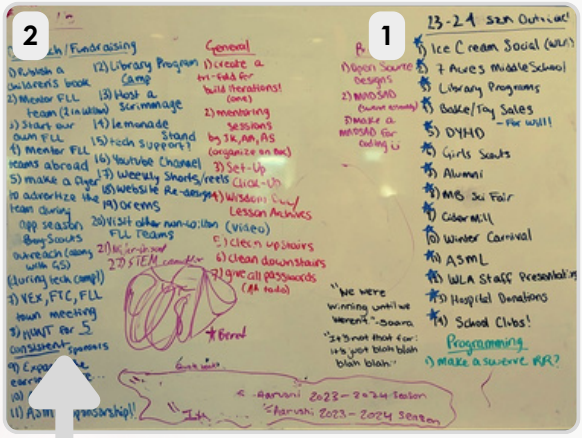
States Competition Season - February
-Improved Autonomous and Endgame
-Open-Sourced CAD, Claw, and Code
-Revisited and Reflected on Goals

Risk Management SWOT Analysis

Strengths: Structured Talent Pipeline, Effective Outreach, Recruitment, Custom Machining
Weaknesses: Time Management Challenges, Limited Financial Independence
Opportunities: Growing International Collaboration, Expansion of STEM programs, Open-Source Contributions
Threats: Outreach & Competition, Technical Knowledge Loss, Funding Instability

Team Goals - Into The Deep

Engineering: Develop a modular drivetrain for easy sub-assembly integration, while open-sourcing CAD and code.
Outreach: Expand meaningful outreach equally in FIRST, Technical, Local, School, and Open-Source communities.
Team Sustainability: Develop a strong talent pipeline, and optimize time and resource management.



Outreach Planning

In pre-season, we **(1)** listed past outreach events and **(2)** added new ones for the '24-'25 season. Once the season started, **(3)** we sorted these opportunities into **5 categories** and delegated them to team members.

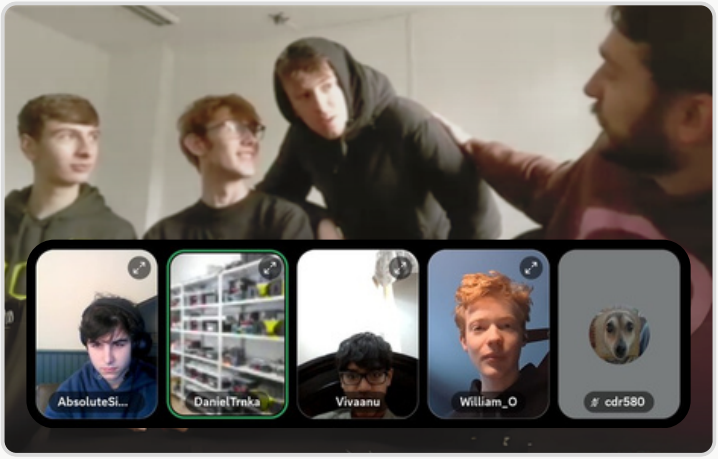
Outreach Summary

We, SingulTech, recognize the importance of collaborating with and inspiring future generations of the STEM community. Our Outreach efforts in **FIRST, Technical, Local, School, and Open-Source** communities aim to promote gracious professionalism, teamwork, and innovation by sharing our passion for robotics.

Impact: **10,818+ Individuals** | Cumulative Hours: **1,836.5+** | Initiatives: **32** | Countries: **17**

Czech FRC Team 9598
17 People, 28 Work-hours

With our connections in the **Czech Republic (Czechia),** we connected with **FRC team 9598 RobUL**, the first FRC team in Czechia, based out of Ústí nad Labem. We have set up and called them in video meetings to share and discuss each other's programs, challenges, & **FIRST experiences.** Since they are a rookie team, we regularly assist them with their C++ and Java coding needs.



Mentoring FLL Team 58590
3 Members, 120 Work-hours

In addition to starting our own FLL team, we mentor FLL team 58590, the **Wilton Lego Team**, sharing valuable design and programming skills. Sid and William from our team facilitated this connection through their past involvement on the FLL team, helping us **promote FIRST** in our local community.



Starting FLL Team 56158
8 Members, 246 Work-hours

This year, we launched **FLL team 56158,** meeting biweekly for two-hour sessions at our local teen center, Trackside. With support from both Trackside and our local middle school, we established a fully student-led team with necessary materials.

Despite first-year challenges, including outdated Mindstorm kits with limited accuracy, we proudly placed **10th at the qualifiers**. After our season's end, we continue to meet weekly to continue developing the team's skills.

Along the way, we trained future members for our FTC team and promoted FIRST's values in our community, inspiring more students to explore STEM competitions, and **growing our team's talent pipeline** to ensure the long-term sustainability and successful performance of our team.



Lessons Learned

Our outreach in the FIRST community taught us the importance of aggregating and developing technical talent by sharing and learning it from both younger and older students, locally and internationally. Our **358 hours of work** taught us that collaboration, especially when applied to STEM, can **transcend age gaps and borders.**

Robotics STEM Committee
3,788 Students, 143 Work-hours

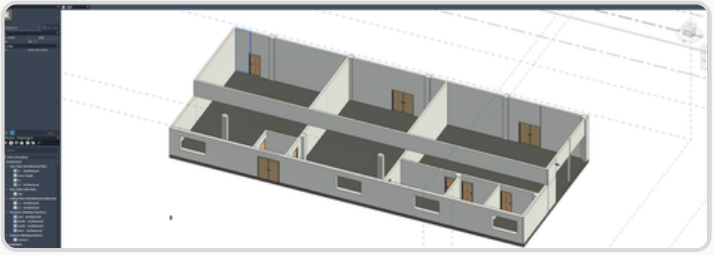
William (Captain) and Leo (Programming Lead) serve as student representatives on the **Wilton Public Schools'** (WPS) **STEM Curriculum Overview Committee** and Robotics Sub-Committee.

Through our involvement, we've helped **revise K-12 STEM programs** by presenting our team's robot and engaging with administrators and the local superintendent. At the high school level, we've proposed integrating robotics classes using our **FIRST experience**, written revised course materials for existing engineering classes, and used our CAD skills to design renovation plans for the **STEM lab.**



After over three years of effort, we're proud to announce that **Robotics I & II** will be offered as courses in the next school year. Additionally, all engineering courses will be split into two 1-semester courses, **improving accessibility for students.**

At our latest meeting on March 27th, 2025, we presented the architectural and interior plans for a **new STEM lab** at our high school, which will receive over **$1,000,000 in funding.**



HS Engineering Club
41 Students, 76 Work-hours

We run our local high schools' engineering club, organizing weekly meetings for over 41 students. Utilizing **FIRST leadership and technical skills**, we teach design principles through hands-on projects and instruct using **3D printers and laser cutters.**





Starting HS Robotics Team
8 Students, 105 Work-hours

This year, the WPS STEM Committee tasked us with starting a robotics club at our high school. Over the summer, we organized **VEX parts** and **sought grants** to support the club. We created a proposal outlining costs and resources for approval. Now, using our **FIRST skills**, we successfully run the club, meeting every Monday for an hour, we expect to register in **competitions next year.**



HS WISTEM Club

11 Students, 16 Work-hours

During our pre-season, we helped found and lead the **Women in STEM Club (WISTEM)** at our local high school. Using our **FIRST experience** in technical and leadership skills, we provided a platform for girls to explore different STEM fields. As a FIRST team, supporting WISTEM is extremely important to us as it **breaks the traditional boundaries** and biases of STEM and allows for greater diversity in FIRST.



5th Grade Presentations

~180 students, 34 Work-hours

For the **seventh year,** the technology media specialist at our local elementary school library has graciously allowed us to present to roughly **180 5th grade students.** During our four presentation sessions, we taught engineering concepts, the iterative design process, and taught programming concepts that pertain to the **students' current computer science unit.**



School Equipment

1,100 people, 193 Work-hours

With our FIRST experience and knowledge in using state-of-the-art machines, we manage and maintain 3D printers and laser cutters for our local school's STEM lab. We also **organized a $8,000 grant** to purchase new equipment, including 6 additional **3D printers, a laser cutter, and a resin printer.** Additionally, the administration has asked us to laser-engrave over 1,100 laptops for staff and students.

Middle School Science Fair

~300 People, 46 Work-hours

Upholding a yearly tradition in Wilton, we presented and judged student entries at our local middle schools' science fair for the **5th consecutive year**. In between helping students with their projects with **1-on-1 support**, student project judging, and the awards ceremony presentation, we **presented to over 300 students, parents, and teachers** about FTC and the various challenges we faced during the season. Kids also had the opportunity to drive our robot, ask questions, and learn about STEM opportunities in our town. One of the students we mentored continued on to **win the Connecticut State Science fair**, receiving 1st place Pepsico award, 1st place Infosys award, 2nd place in physical sciences, and a **$30,000 Quinnipiac scholarship.**

Lessons Learned

Our school outreach initiatives taught us the importance of integrating **STEM and FIRST** principles into curriculum and extracurriculars for sustainable growth. While securing grants, writing proposals, and planning activities **required over 529 hours**, these efforts promise **long-term benefits**, with an ever-expanding impact as more students enroll in these programs, even after members of our team graduate. For example, **112 hours of our time** was dedicated to the creation of robotics courses at our school, but this will have an impact that will last many years, if not **decades** after we graduate in our school

Destroy Your Hard Drive
67 People, 44 Work-hours

Each year, we host our Destroy Your Hard Drive event at the library, safely destroying hard drives to **protect personal data.** This event helps us hone our skills with power tools and promotes community engagement by showcasing our robot and sharing information about FIRST. We also refurbish computers by replacing their drives **for donation.**



Scouts Presentation
42 Scouts, 7 Work-Hours

We presented to our local **girls and boys scouts** in Troop 125 for the first time, covering our core engineering principles, showcasing our robot, and **promoting STEM opportunities** in the community. We hope to continue this relationship next year.



Summer Camp Programs
75 Students, 72 Work-hours

Over the summer, we ran a camp with 3 sessions in which we educate about many **essential STEAM concepts** through interactive projects such as rubber band cars, and rube goldberg machines, through which we have **recruited team members.**

Library Walk-Ins
~112 People, 8 Work-Hours

Our workspace in the library has large windows, allowing patrons to see our work. During biweekly meetings, we have opportunities to **explain FIRST** and our robot to students, teachers, and parents walking by. At our February 7th meeting, **our original founder,** who started the team 11 years ago, stopped by to ask some questions!

3D Printed Hospital Toys
126 toys for kids, 14 Work-Hours

Last year, we 3D-printed toys for a nearby children's hospital, and its success inspired us to make it a tradition. With our new **Prusa MK4S printer**, we have printed tons of toys, which we gave to our local contacts at **bridgeport hospital,** who shared them with sick children.

Lessons Learned

Through our **109 hours of local community outreach** we learned about the many parallels of robotics and FIRST values that exist around us. Problem solving, patience, collaboration, creativity, and leadership **manifested themselves** in all our events, giving us hope that our future STEM careers can have local root impacts too.

ASML Outreach Discussion
1 Person, 4 Work-Hours

ASML, the largest **semiconductor infrastructure company**, has a large factory in our town, employing thousands. In an attempt to connect within our community, we discussed with their **outreach director, Brian Amero** to understand their **involvements in STEM and FIRST** in our community.

Prusa3D Factory Visit
2 People, 5 Work-Hours

Over the summer our captain toured **Prusa3D in Prague, Czechia**, with FRC Team 9585. The visit highlighted the challenge of running a **fast growing STEM company**, and emphasized the importance of producing quality parts while remaining committed to the **open-source movement.**





IMTS 2024 Conference Visit
2 People, 144 Work-Hours

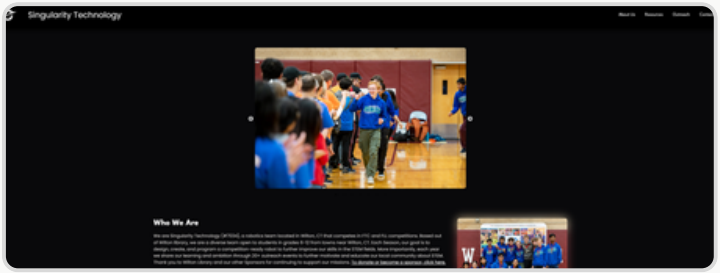
As part of our technical outreach, we talked to the **Vice President of Audience & Content at IMTS** and were invited to fly down to **Chicago** and attend the **6 day conference**. Talking to presenters we learned about how real manufacturing companies apply the same **STEM principles** we use in **FIRST**

Library Staff Presentation
33 Library Staff, 22.5 Work-Hours

In order to establish a more **involved relationship** with staff members at **Wilton Library, our home,** we presented our robot and season game to them, in return providing us with valuable insights into

New Website (Marketing)
250 People, 187 Work-Hours

In an effort to improve our digital presence, we **coded our own website**, helping us gain many valuable skills along the way. Our **Open-Source, Contact, and Outreach** pages greatly expanded our outreach and **helped recruit** for next year**.** So far, we have had **250 impressions** in **9 countries.**

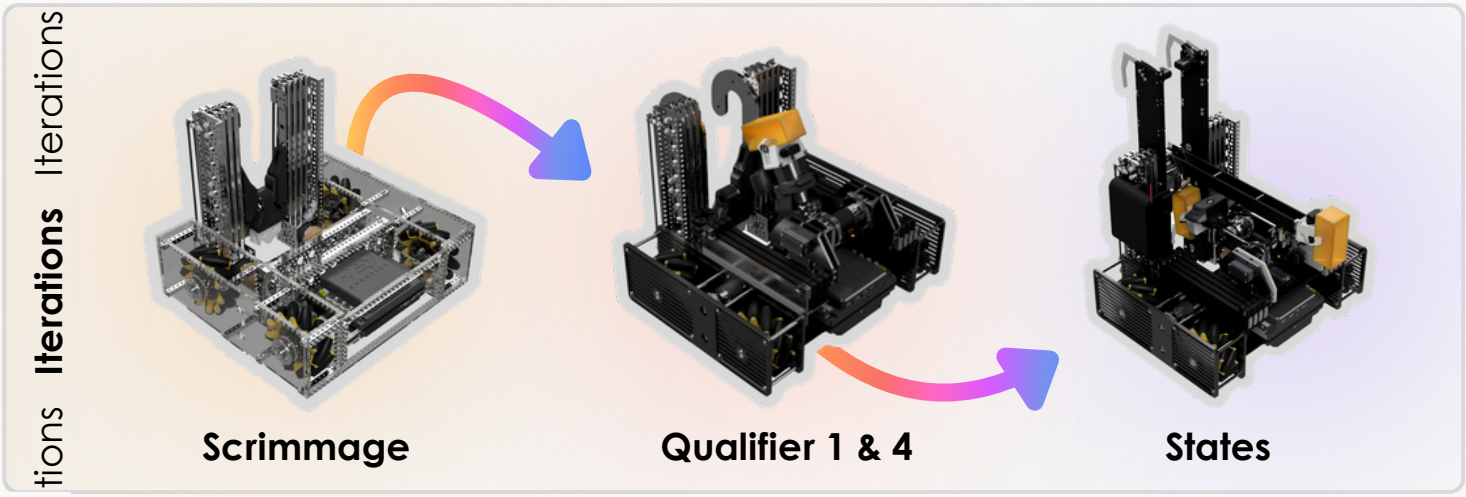


Lessons Learned

Our **332.5 hours** of technical outreach taught us how STEM principles transcend borders, from **ASML in Wilton to Prusa in Czechia.** Through our discussions at Prusa, IMTS and ASML we learned the value of efficient management while maintaining a user-centered approach, a strategy we applied in the **making of our website.** We also learned how technical outreach doesn't end at observing (companies) or making (a website), it includes presenting (to library staff), completing the **iterative design process** that technical outreach embodies.

Season Goals

Building on last year's experience with **custom laser-cut and CNC parts,** we prioritized refining our custom manufacturing skills. This focus aimed to enhance **modularity, elegance, and rigidity,** resulting in tailored components that have improved **performance, durability, and ease of maintenance** this season.



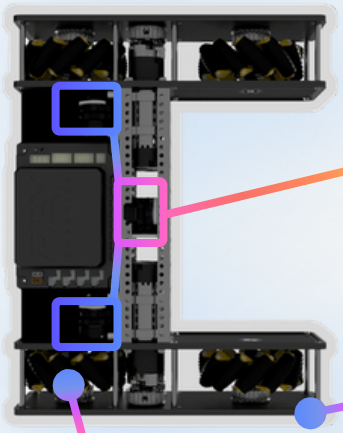
Lessons Learned

This season, we prioritized our drivetrain, achieving great results but at a time cost. We learned the **need for a structured timeline** and, with a perfected drivetrain, can focus more on other mechanisms next year, teaching us the value of quality designs that can be **reused year-to-year.**

Game Strategy

We focused on **fast specimen scoring** in both autonomous and tele-op, using a shorter arm for most of the season. Our final design adds high-bucket scoring for more versatility and security.

Drivetrain



3 Wheel Localization
GoBILDA Odometry Pods

Powder Coated Plates
6061 Aluminum, custom

Mecanum Wheels
GoBILDA Ø 104mm Gripforce

Custom Manufacturing

After successfully custom manufacturing our robot last year with **laser-cut acrylic** and **CNC steel parts**, we decided to continue its evolution using industry-leading platforms such as **PCB-Way and GlowForge.** Materials and parts such as **6061 Aluminum, carbon fiber, and PCBs** keep our robot strong, organized, and resilient, while staying light.

glowforge PCBWay SendCutSend

Drivetrain Iterations

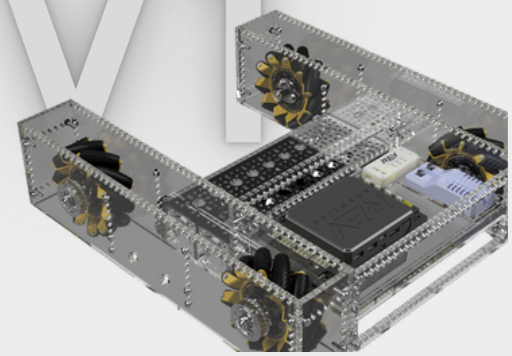
Goals

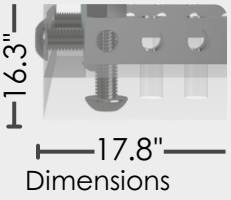
Last year we created our first drivetrain with custom parts, continuing in this spirit we applied this knowledge to create our first iteration chassis at the beginning of the season.

Needed Revisions

After our first iteration, we found the drivetrain too heavy and large for hanging and mobility, so we reduced its size.

V1





Dimensions



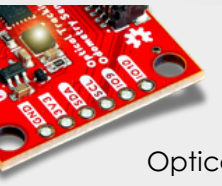
6mm Clearance

REV Servo Power Module



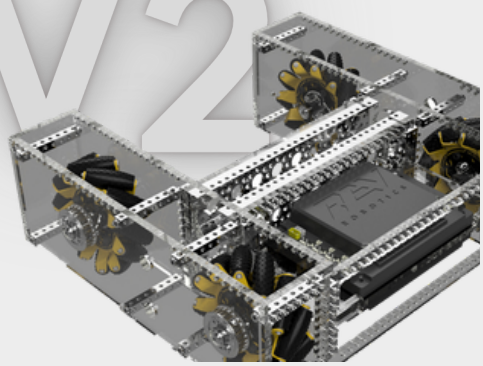
Laser Cut Acrylic
Semi-Modular Design
Low Mounted Motors

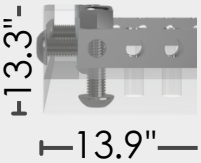




Optical Laser Odometry

V2





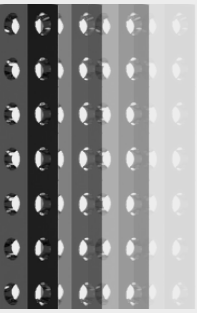
Dimensions



6mm Clearance

Goals

Building on our first iteration, we aimed for a more compact, lightweight drivetrain to improve mobility and enable hanging. In V2, we reduced its size while maintaining strength and efficiency.



Square Steel Beams

Laser Cut Acrylic (Stronger)
Semi-Modular Design
Stacked Mounted Motors



Needed Revisions

While V2 improved mobility and hanging, we need to strengthen the drivetrain, increase clearance, and enhance consistency for better performance.

Design Goals

Our third iteration focused on creating an elegant, efficient, and modular robot — engineered for both practicality and precision.

Key Insight

Designing for compactness revealed new demands: elegance, modularity, and purposeful simplicity.



Dimensions



V3





Gobilda Odometry



8mm Clearance

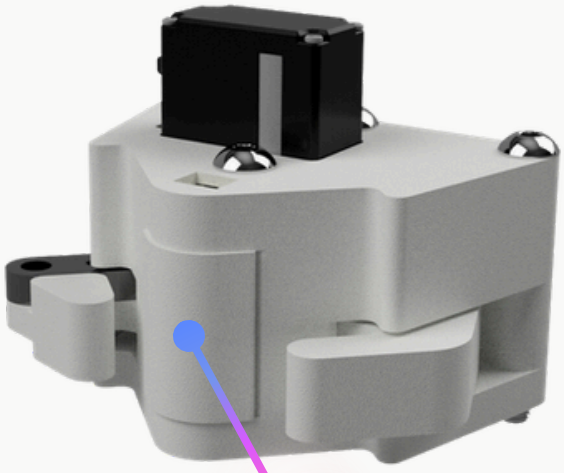


Modular Aluminum M4 Slots

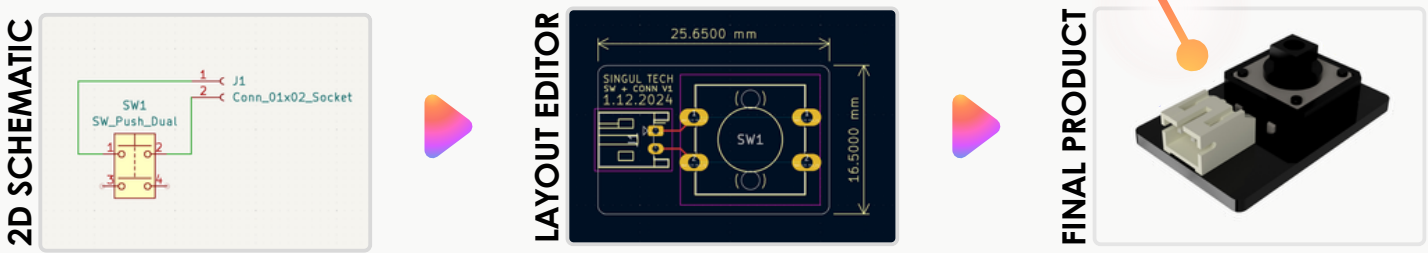
Grabber

Our compact grabber is **dense with innovative features.** It includes 2 arms attached to a set of 3D-Printed gears which close themselves smoothly in parallel. Due to its **reliability and quality** we use two of them for both our intake and deposit systems.

Our second iteration (right), features a button front and center, mounted to a **custom pcb circuit board**. The button reliably activates itself when picking up specimens from the field wall and samples from the submersible. The button is integrated with our code to **consistently and automatically** grab samples, making for quicker cycles.



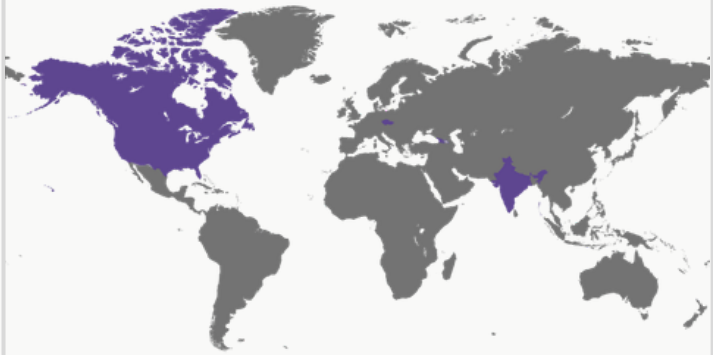
Our PCB Design Process



This year, we expanded our skills by designing a **custom PCB** for our grabber using **KiCAD**. We created the schematics, layout, and 3D model, then ordered it through **PCBWay**. After soldering the components and adding a 3D-printed cover, we slid it into place, and open-sourced the design.

Open Source Outreach

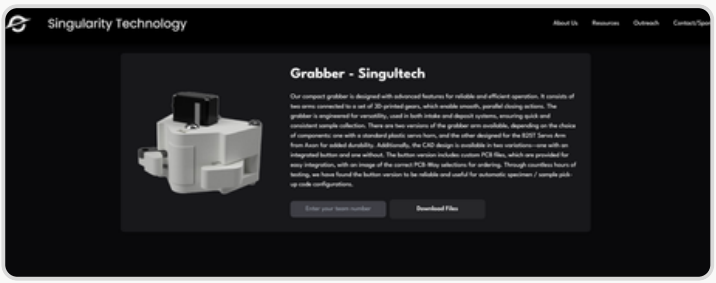
~759 people, 27 Work-Hours



Downloaded by **68 teams** across x Continents in 10 **countries**

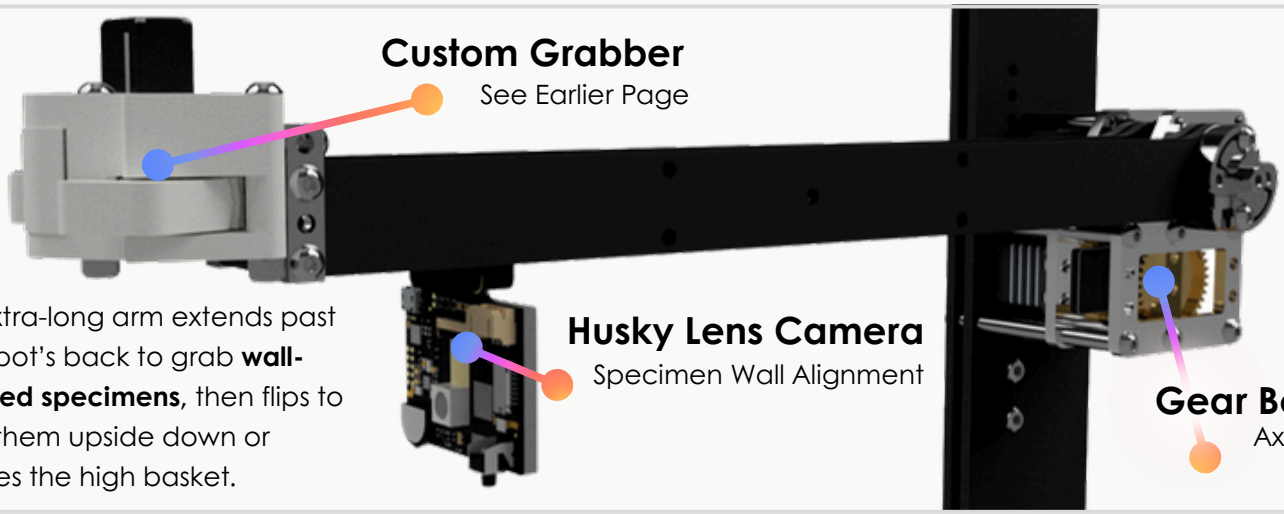
*Average FTC team has 11 people

Inspired by the spirit of outreach and the open-source philosophy we encountered during our Prusa Factory visit, we decided to open-source our grabber to the **FTC community**, by sharing it through our new website. Open-Sourcing our design has taught us how to integrate **valuable feedback** into our iterative process for a **communal benefit.**



Arm, Climb, Slides

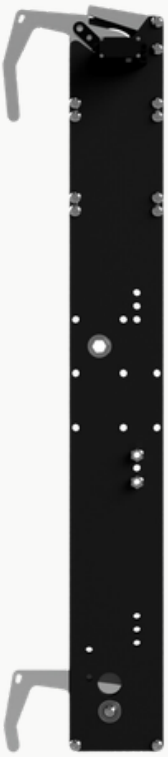
Arm



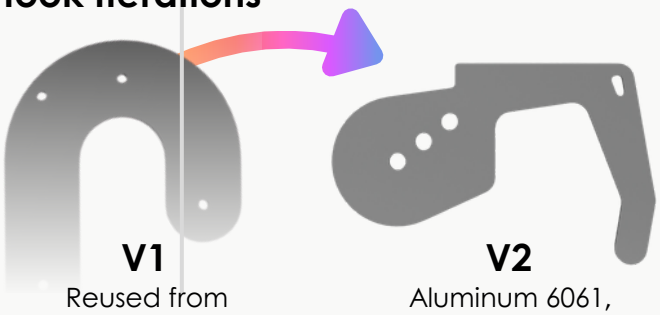
Our extra-long arm extends past the robot's back to grab **wall-mounted specimens**, then flips to hang them upside down or reaches the high basket.

Climbing

Our climb begins by hooking the bottom hook onto the low bar. The top hook, controlled by an **Axon micro servo**, starts retracted, facing up. As the robot lifts a few inches, the top hook aligns above the top bar. The servo lowers, locking it in place, and the slides retract again to complete a **level 3 ascent.**



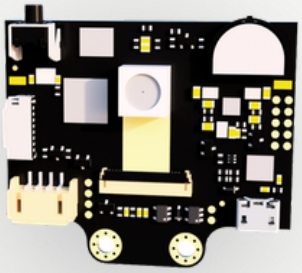
Hook Iterations



V1
Reused from 2023 Season

V2
Aluminum 6061, Retractable

HuskyLens



Our HuskyLens locates wall specimens using **machine learning,** allowing us to align the grabber automatically.

Mitigating Risk

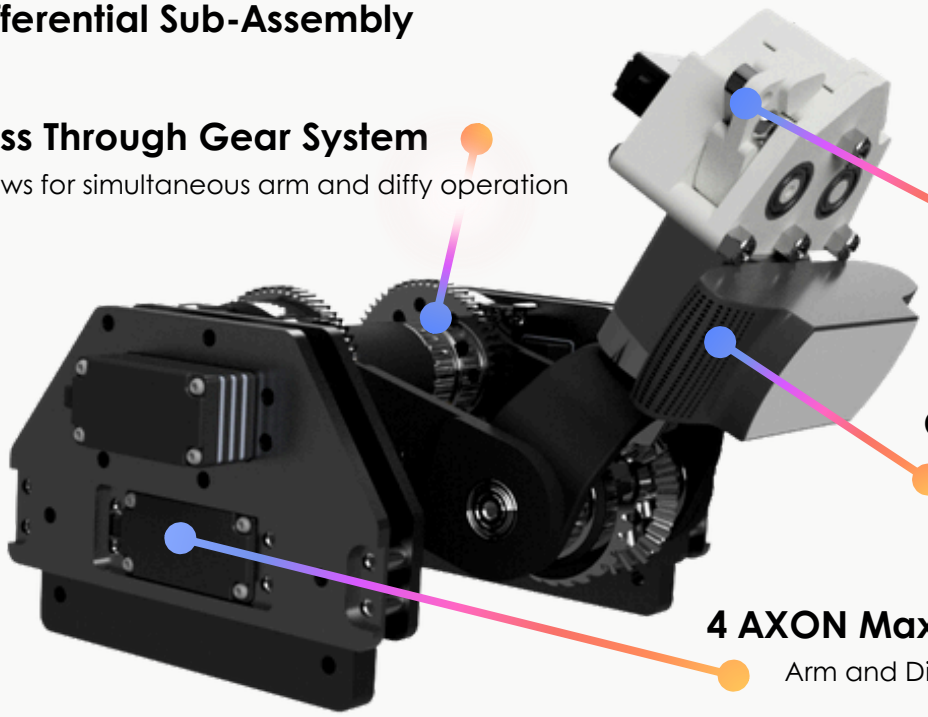
Early in the season, we noticed these 3D pieces would be weak, which is why we used PC filament.

Misumi Horizontal Slides



While our GoBilda slides work well for vertical expansion, we designed our own custom horizontal slides using 3D printing, Misumi slides, and a **gearbox**, which allows us to drive the slides with **compact servos**. Mounted to our modular drivetrain side plates, they extend the differential system outward, allowing us to **grab from the submersible** while reinforcing the drivetrains' success.

Differential Sub-Assembly



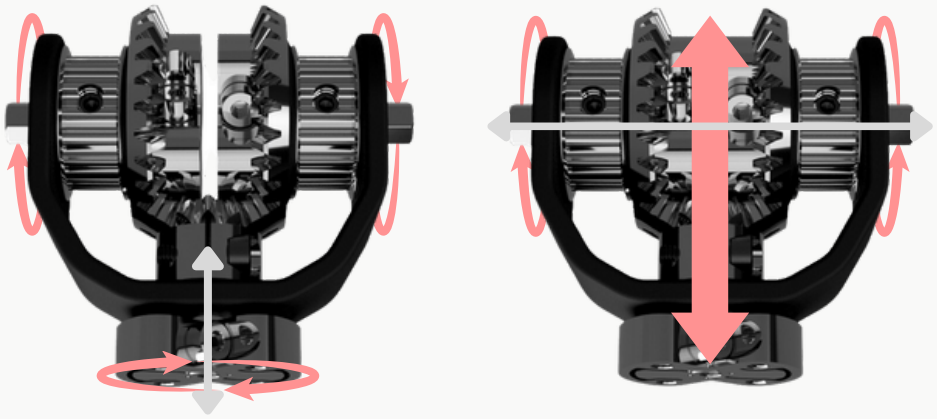
Pass Through Gear System
Allows for simultaneous arm and diffy operation

Custom Grabber
See Earlier Page

C920 Pro HD Logi-Cam
Sample Orientation Tracking

4 AXON Max Servos
Arm and Diffy Control

Differential Gearbox



Camera Grabber



Our intake grabber syncs with the camera to adjust its position, optimizing sample collection based on **orientation, color,** and **proximity** to other samples.

How does it work?

A differential system enables motion along **two axes:** when the side gears spin in opposite directions, the output gear moves the **grabber perpendicularly**, and when they spin in the same direction, the output gear **rotates the U-shaped part** along the larger gears' axis.

Cost-Benefit Analysis

	Diffy	3 Servos, Stacked
Cost	higher	lower
Reliability	higher	lower
Complexity	higher	lower
Balance	higher	lower
Durability	higher	lower
Precision	higher	lower

Diffy is higher complexity but superior.

Autonomous Strategy

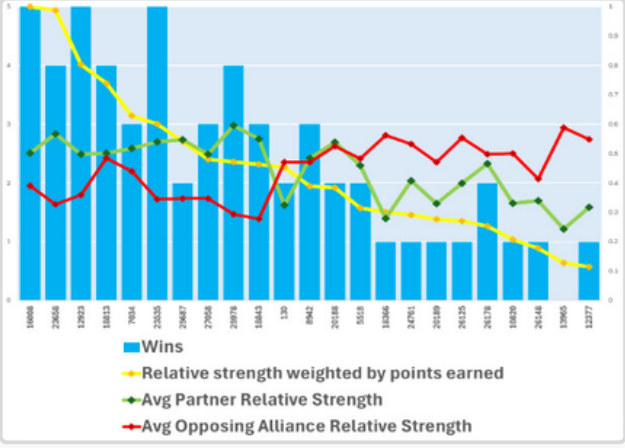
Prioritizing specimens, we developed a **4-specimen auto worth 80 points.** However, since most teams excel at basket scoring in our scouting, we never need a strong sample auto.

Scouting Strategy & Data Analysis

While, FIRST's ranking system is a good balance for determining the placement of teams overall, it heavily prioritizes **win-loss ratios and alliance scores over individual contributions**, making it unreliable for alliance selection. To counter this, we coded a in house tool to **re-rank teams based on raw scoring and consistency, without penalties factored in.** This gives us a strong bade to use in alliance selection, and lets us better strategize with teams before each match.

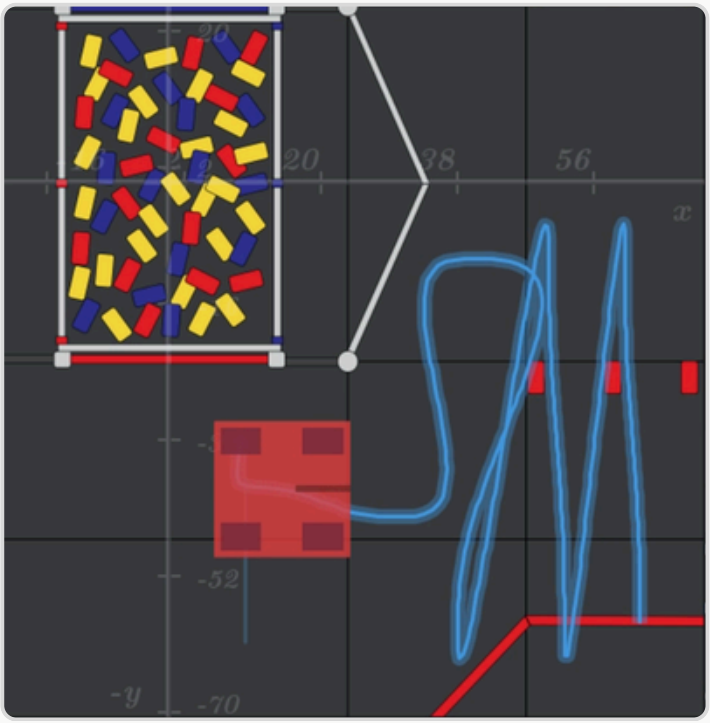
Our TAP members do scouting: Saara pre-scouts, Anaya & Vidit track matches, and Sid inputs data. This lets us quickly gather the required data to do effective scouting, all while **teaching TAP about FIRST and how other teams compete**.

Beyond raw scores, we analyze alliance and opponent strength, We set the #1 team to 1, compare others' cumulative scores, and average them across alliances. When graphed, this **helps us visualize which teams do good under pressure and which teams are good at working together**.



Scouting helps win games, and using our **data analysis** knowledge we've come prepared.

Path Visualization



Looping Position Calculation

ΔL = Change in left wheel position
ΔR = Change in right wheel position
ΔP = Change in perpendicular wheel position
L = Distance between parallel wheels

Change in heading = $\frac{\Delta L - \Delta R}{L \times 2}$

Forward/Backward(ΔxL)= $\frac{(\Delta L + \Delta R)}{2}$

Left/Right(ΔyL) = ΔP

robotXGlobalChange =

$$\Delta X \times \cos\left(\theta + \frac{\Delta\theta}{2}\right) - \Delta Y \times \sin\left(\theta + \frac{\Delta\theta}{2}\right)$$

robotYGlobalChange =

$$\Delta X \times \sin\left(\theta + \frac{\Delta\theta}{2}\right) - \Delta Y \times \cos\left(\theta + \frac{\Delta\theta}{2}\right)$$

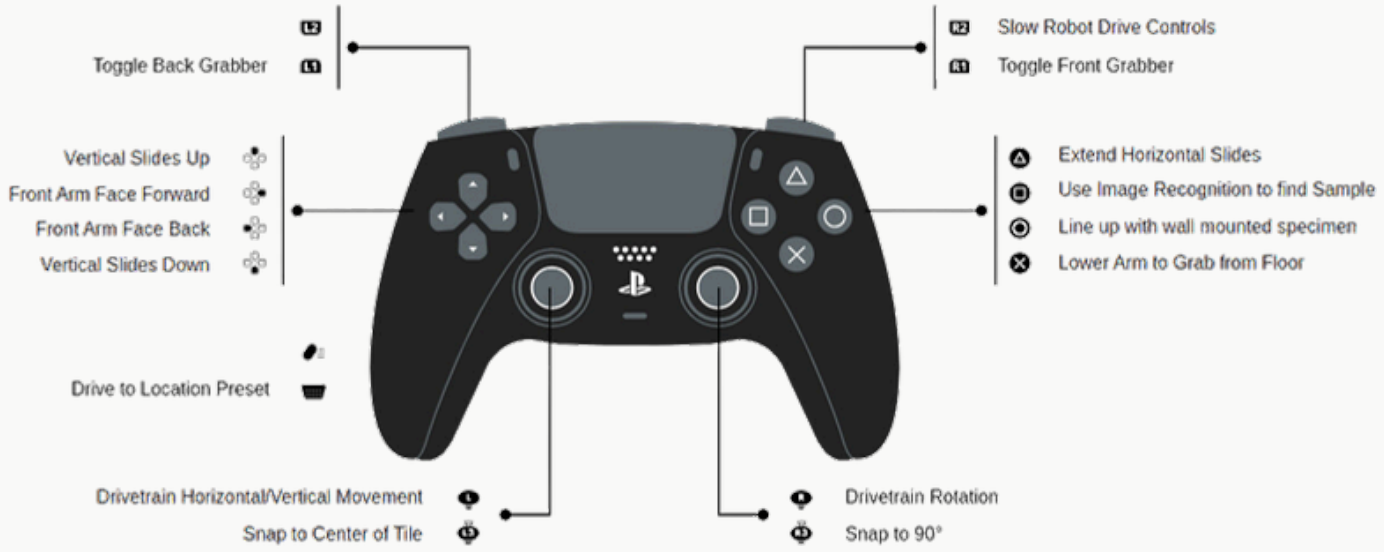
newXGlobal =

$$xGlobal + \Delta X \times \cos\left(\theta + \frac{\Delta\theta}{2}\right) - \Delta Y \times \sin\left(\theta + \frac{\Delta\theta}{2}\right)$$

newYGlobal =

$$xGlobal + \Delta X \times \sin\left(\theta + \frac{\Delta\theta}{2}\right) - \Delta Y \times \cos\left(\theta + \frac{\Delta\theta}{2}\right)$$

Controls



TeleOp Strategy

We optimized for specimens in our code and build as they allow for **faster loop times** and yield a greater amount of points. Additionally, with our horizontal slides we are able to **both grab new samples and hang specimens** on the high bar at the same time, further decreasing and optimizing our loop cycle times.

EndGame Strategy

Since we are capable of both scoring 3 specimens (30 points), or a level 3 hang (30 points) during endgame, we can **optimize for either type** of end depending on our position. This call is made by the team coach at the start of endgame depending on how clear the pathway to the bars of the submersible is.

TeleOp Automation

90° Snap

Using our odometry modules, we have a button to snap to 90° to **navigate easily** in TeleOp.

Transfer

If we want to **direct transfer** from submersible to basket, we can do so with grabbers.

Sub Cam Grab

Our camera detects **orientation, color, & proximity** to correctly orient our grabber for pick-up.

Lvl. 2 & 3 Ascent

Our level 3 ascent requires **precise control**, so we automated it to a single button press.

Specimen Snap

The **machine learning HuskyLens** on our arm allows for snapping with wall specimens.

Auto Wall Grab

The custom **PCB buttons** on our grabbers auto-sense specimens, grab, & lift them.

Driver Feedback

Controller LEDS

The LEDs on our controllers flash once when the **camera locks on** to a sample and again when the PCB on our diffy grabber is actuated.

Controller Haptics

As soon as the huskylens snaps, and the PCB detects our wall specimen, the driver's controller receives **haptic buzzing for verification.**