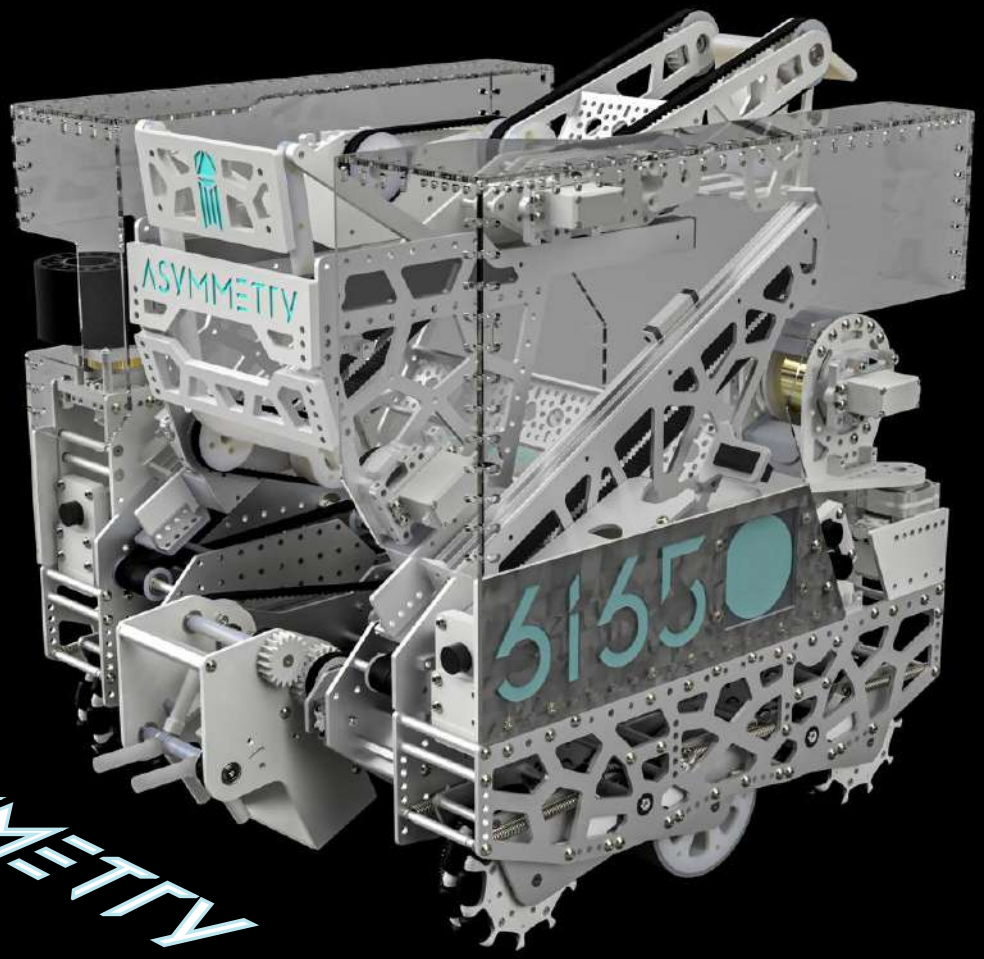
6165 MSET CUTTLEFISH

Lam Research · KLA Foundation · Intuitive Foundation · Qualcomm · Gorman Group · SilverLake · FESTO · SOLIDWORKS · TE Trial & Error Robotics

FREIGHT FRENZY presented by Raytheon Technologies · SendCutSend · MSET Families & Freinds · Micron · BILDA Dream • Make • Repeat · FIRST Tech Challenge



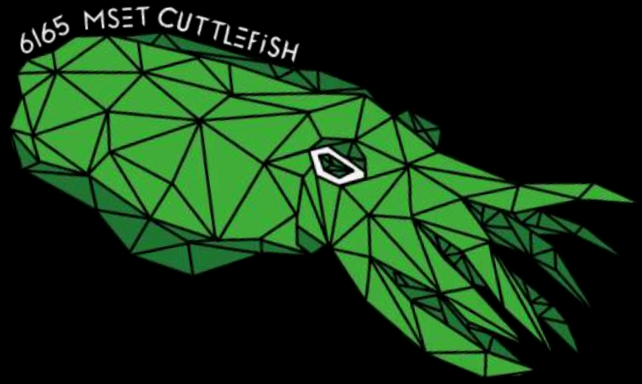
ASYMMETTY

#NOTCALFTC

TEAM PLAN

GAME STRATEGY

- **Versatile autonomous** to score the highest possible amount on either side
- Take **shortest path from Shipping Hub to Warehouse** to ensure quick and efficient cycles
- Be able to **traverse everywhere on the field**, including going over terrain, in order to maximize adaptability and flexibleness
- Be **resistant to opponents' defensive strategies**
- **Self-Reliant Endgame** of Double Capping + 9 Ducks



TEAM GOALS

Creating a Network of Knowledge

- Pair members of different experience level on our team on every hardware and software module
- Have new Cuttlefish lead outreach initiatives under the guidance of the management leads.
- Work with our **manufacturing sponsor** to learn CAM, or **Computer-Aided Manufacturing**
- Create a **sustainable pipeline** into our program by mentoring our sister teams, starting a FTC program at our middle school, and training adult mentors for the new teams
- Maintain **extensive documentation of best practices**, tips, and tricks we learned for future Cuttlefish

Professional Management

- Use visual management systems inspired and modeled off of **industry professionals** for deadlines, timelines, and task delegation
- These include our master **Visual Management Spreadsheet**, as well as **GitHub and Trello** for software management

Impactful Outreach

- Have **every member of our team** pitch ideas and participate in outreach
- **Apply skills and the design process** learned through robotics in **impactful and challenging endeavors**

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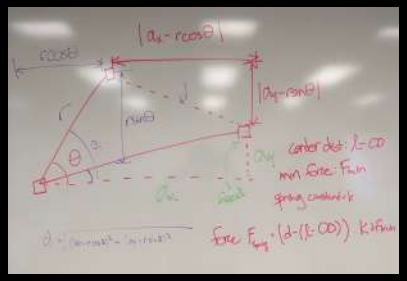
DESIGN PROCESS

Brainstorming and Analysis

- After coming up with ideas, math and physics are used to **assess and analyze potential constraints and performance**, including initial spring calculations for the suspension, and torque estimations for arms and lifts

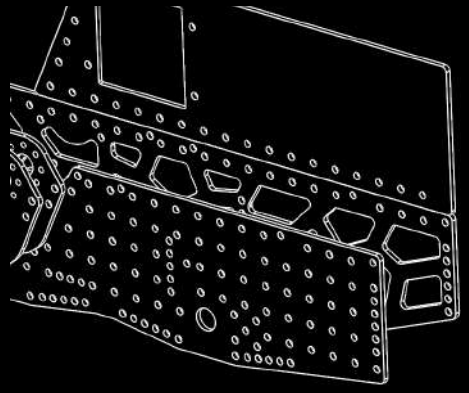


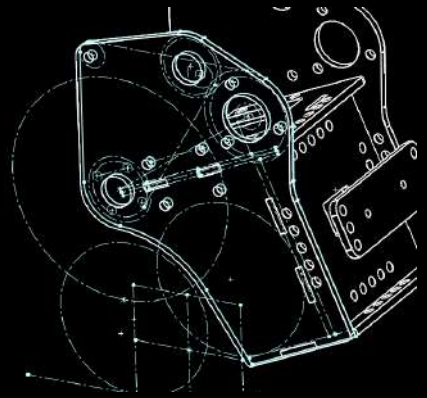
Rapid Prototyping

- CAD and assemble **prototypes and testbeds** to evaluate viable ideas
- **Fast fabrication** with laser-cut MDF to speed up redesign and **iteration cycle**
- Manufactured final metal parts using CNC Machining **learned from engaging with sponsor Trial & Error Robotics**

Design for Testing

- **Universal hole pattern** grid maximizes **cross-compatibility** between different parts and allows for easy future mounting
- **Slots** allow for making **quick adjustments** without having to re-manufacture parts



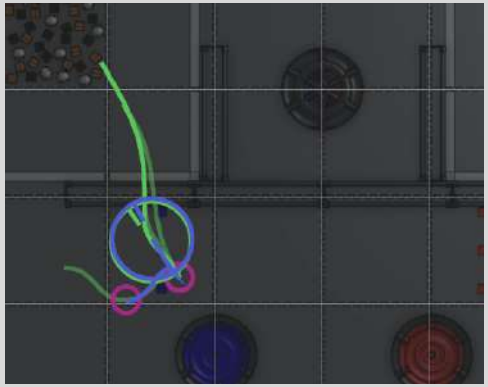


Multibody Modeling

- Multiple bodies designed together in a single part **simplifies file structure**
- Enables faster CAD iteration of modules by editing parameters in a **"master model"** to dynamically update multiple components at once

Modify the Wheel

- Build on top of **Open Source software** such as **RoadRunner** autonomous trajectory generation and the **MeepMeep Simulator**
- **Publish our own open-source software**, in turn, to keep the cycle going

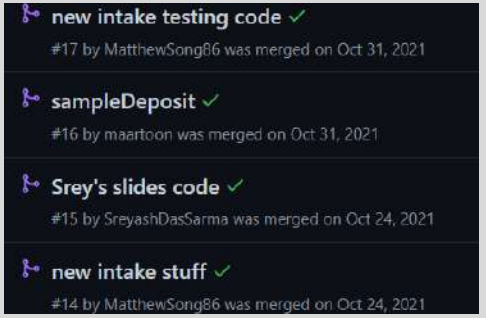


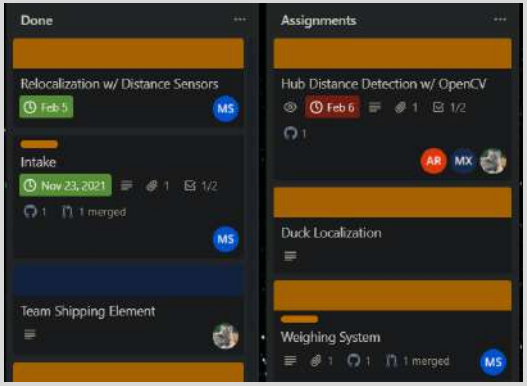
Modularized Code / Workflow

- Splitting up tasks and classes in Android Studio by hardware components
- **Finite State Machines'** abstract structure allows for members to **optimize a single module** to fit into the larger program's **macros** and **automations**

GitHub

- Allows members to code their modules in **version control** to allow for rapid improvements while maintaining a **Minimum Viable Product**



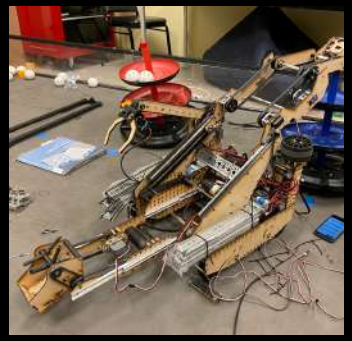


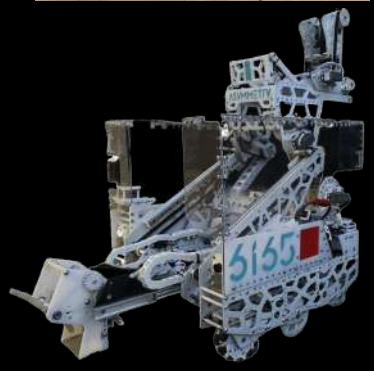
Trello

- An organizational tool used in tangent with **GitHub** to support our modular workflow
- Allows us to set deadlines and assign members to specific tasks


⬇ FREIGHT FRENZY ⬇





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5/2/21
Invited to the Maryland Tech Invitational
6/1/21
Started prototyping for MTI
6/3/21
New members onboarding
7/31/21
Maryland Tech Invitational
Loss at MTI
8/5/21
MTI Retrospective
9/19/21
Freight Frenzy Kickoff
9/27/21
V1 Robot CADed
10/8/21
V1 Robot Prototype
11/21/21
V1 Robot Final
12/11/21
Sacramento Qualifier
Inspire Award
Winning Alliance
12/19/21
Tournament Retrospective
V2 Redesign Planning
12/22/21
V2 Robot CADed
1/8/22
V2 Robot Prototype
1/22/22
V2 Robot Final
3/13/22
NorCal Regionals
Narrow Defeat in Finals
Inspire Award
4/1/2022
V3 Robot Prototype
4/4/2022
V3 Robot Final
4/19/2022
Hello Worlds!

Pre-season - Maryland Tech Invitational

Strengths:
- MeepMeep Simulator streamlined autonomous pathing
- Learned new manufacturing for final parts such as laser-cut delrin and CNC machining from sponsors

Weaknesses:
- Low traction mecanum drive vulnerable to defense
- T265 webcam localizer gave noisy readings

V1 | Winter - Sacramento Qualifier

Strengths:
- 6 wheel drive resistant to defensive strategies
- Larger robot frame maximizes stability while driving
- Intake extension minimizes interference with partner

Weaknesses:
- Rigid wheels had difficulties crossing barriers quickly and smoothly
- Crossing barrier caused loss of traction and localization in auto
- Shock loads broke intake extension servos
- Deposit unable to score on the "far end" of the shipping hub
- Unreliable and slow capping in endgame
- Default RoadRunner path follower did not work for Tank Drives

V2 | March - NorCal Regionals

Strengths:
- Independent-sprung suspension drivetrain easily traverses terrain
- Distance sensors accurately re-localize robot position
- Spring-loaded servo savers absorb shock loads on intake extension
- Reliable multitasking for capping and duck delivery
- Custom Ramsete controller allows robot to follow complex paths

Weaknesses:
- Blew fuses against other robots with traction wheels
- Unable to reach alliance hub if another robot is blocking

V3| Now - World Championship

Key Features:
- New deposit: **2-stage extension** reaches over any robot
- Active current limiting safety in combination with higher drivetrain ratio prevents motor fuses from being blown
- Modified suspension gear ratios to increase torque and reduce motor load

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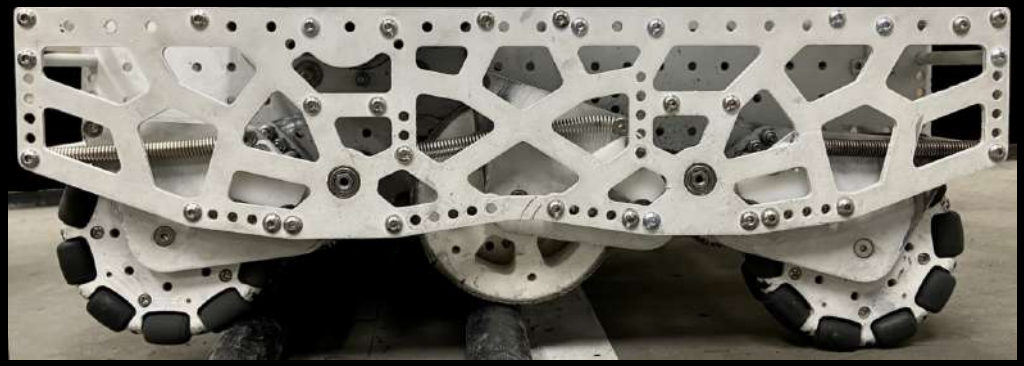
DRIVETRAIN

6 Motor 6 Wheel Drivetrain

- **Problem:** Driving time is a **limiting factor** for faster cycles and **vulnerable to defense**
- **Solution:** 6 motor 6 wheel drivetrain has **high traction** and **more acceleration** than 4 motor drives, allowing it to **move quickly to anywhere** with an **immunity to defense**
- **Key Feature: Flipped bare motor gearbox** packages compactly for **more center space**

Independent Suspension

- **Problem:** Standard drivetrains cannot cross terrain without **losing traction**, making it difficult to use strategy of taking most direct path from warehouse to goal to score
- **Solution: Independently sprung wheel modules** absorb forces from crossing barriers and **maintain traction everywhere** on field, both on ground and terrain
- **Key Feature:** Easily adjustable spring strength and end-stops **enabled independent tuning** of suspension modules to account for shifting weight distribution
  - **Stronger springs on back wheels maintain balance** during fast deposit extension
  - Wheels spaced further apart in **larger frame for maximum stability**

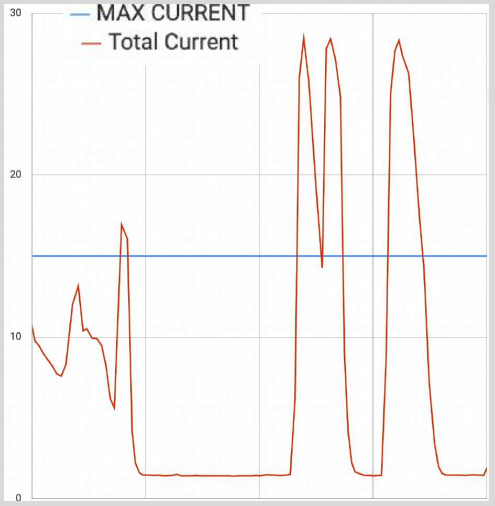


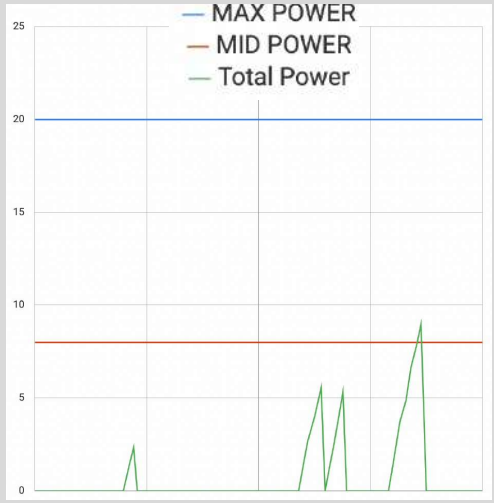
Automatic Wheel Lifting

- **Problem:** With standard drivetrains, **traversing the poles slowly is difficult**, since they can't easily go over without building up enough **momentum to raise the entire robot**
- **Solution:** When crossing the barrier, **redirect motor power into lifting wheels only**
- **Key Feature: Inverse gear powertrain** in each suspension pod redirects wheel driving force to **automatically rotate wheel pods up** when wheels pushed against obstacles

Active Current-Limiting

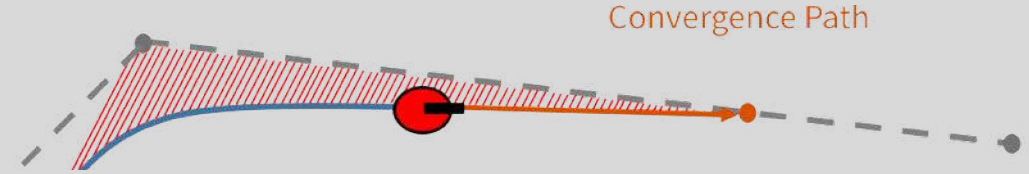
- **Problem: 6 motor** drivetrain **blows battery fuse** if motors stall for too long
- **Solution:** We proportionally **decrease the motor power draw** based on the **integral of current over time** after the total current output exceeds **the fuse's limit**





Custom Ramsete Controller

- **Problem:** Having traction wheels **prevents the robot from strafing** to manage horizontal error while following autonomous trajectories
- **Solution:** Our **custom-developed Ramsete Controller** is based on the ones used in **FRC**, with a **velocity controller** layered on top of a **non-linear time-varying feedback controller**, allowing us to map out **convergence paths** to mitigate horizontal error
- **Key Feature:** After modifying this algorithm for FTC use, **we have helped 8 other teams set up** the Ramsete algorithm, and have **open-sourced our code**. (**see Page 12**)



Ultrasonic Re-localization

- **Problem:** Encoder **position trackers slip over time**
- **Solution: 4x Ultrasonic Distance Sensors** allow the robot to **re-localize its position**
- **Key Feature:** Our calculations also factor in the robot's **pitch, tilt, and heading** into the existing distance sensor offsets for **more accurate estimates** with a suspension drivetrain.

MB1242
I2C - 40 Hz
Front of robot
Long Range
Faster refresh rate

MB1643
Analog - 10 Hz
Side of robot
Close Range
Slower refresh rate

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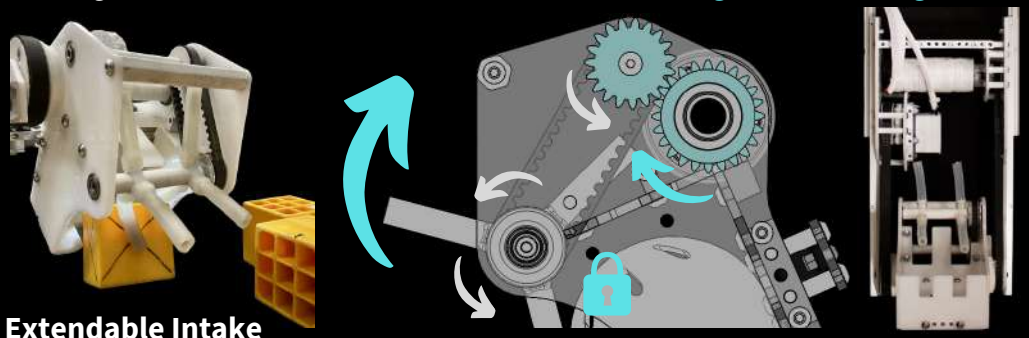
INTAKE

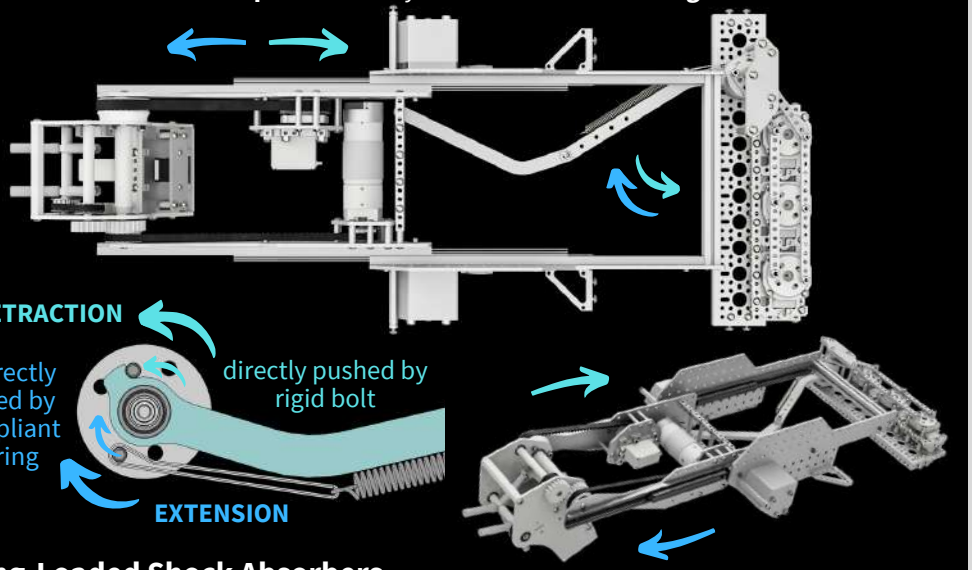
Drop-Down Collection

- **Problem:** "Touch it, own it" strategy can **accidentally grab two** in large pile of freight
- **Solution:** Surgical tubing pulls freight into box **sized to hold exactly one** which then **flips up to transfer** them to deposit, for near instant intaking **without risk of penalty**
- **Key Feature: Coaxial gearing** similar to drivetrain - when tubing locks up against freight in box, **intake motor force is redirected to assisting servo in rotating box up**



Extendable Intake

- **Problem:** Large frame gives alliance partners **less space to maneuver** when intaking
- **Solution:** Intake **extension on linear slides** reaching into minerals from farther away **accommodates alliance partner** of any size and **reduces driving distance**

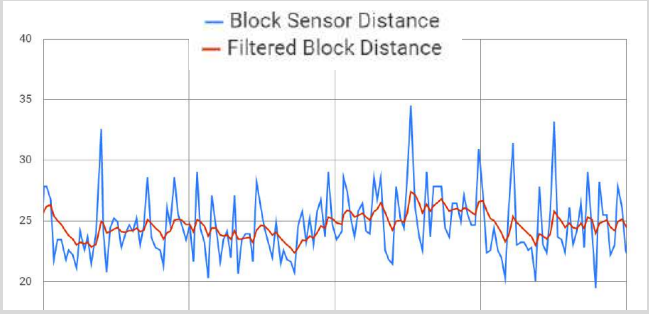


Spring-Loaded Shock Absorbers

- **Problem:** Direct-driven extension linkage **broke servo gears** from **shock loads**
- **Solution:** One-way **spring-loaded shock absorber** integrated into linkage arm
  - **Extension:** pulls on arm **indirectly with spring** to extend with **compliance** - any shock loads from **impacts are fully absorbed by spring** stretching
  - **Retraction:** pushes on arm **directly with rigid bolt** to retract without delay
- **Key Feature: 3 servos** power extension in **unique locomotive-style linkage** which **allows for misalignments** that would make rigidly joined servos fight each other

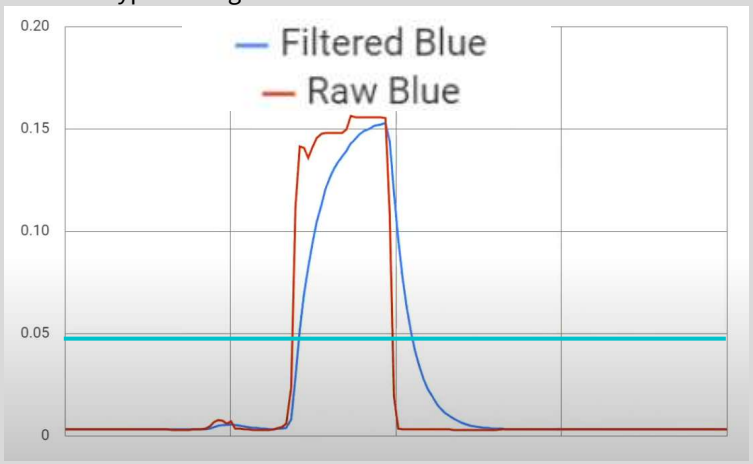
Auto Retract

- **Problem: Limited field of view** causes **delayed driver response** to freight pickup
- **Solution:** An **Infrared Distance Sensor** detects when the intake has collected freight
- **Key Feature: Low-Pass Filter** applied to smoothen the sensor's noisy readings
  - **Haptic Feedback** on the controllers informs drivers when intake has collected freight



Freight Classification

- **Problem:** Cargo **spheres occupy more space** and **lower the holding capacity of the alliance hub**
- **Solution:** White Cargo has more "Blue" than Yellow Cubes, so **Color Sensor readings** allow us to identify what freight we are holding.
- **Key Feature:** We **dynamically change the target level** of our deposit mechanism based on the type of freight in the intake.



Servo Position Estimation

- **Problem: Intake drops on top of freight** due to **extension being faster than dropdown**
- **Solution:** Using an internal timer, we **estimate the real position** of every servo on our robot - **even while they are transitioning**
  - Position estimation allows the **intake to fully drop down before extending**
  - Cancellable by the driver to allow extension **servos to lock in their real position**
  - Enables more accurate **Open-Loop Control**

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DEPOSIT

Far Reaching Extension

- **Problem:** Strategy of **scoring anywhere on hub** incompatible with **short extension**
- **Solution:** Belt-driven **angled linear slides** have long horizontal and vertical extension, and an **arm adds additional reach** over hub and more possible deposit positions
- **Key Feature:** Optimized to **extend fast** while also **maintaining stability**
  - **Constant-Force Springs** on lift **counterbalance gravity** to speed up extension
  - Arm and linkage driven through **belt absorbs shock** and keeps servos mounted low for stability

Horizontal Arm Extension

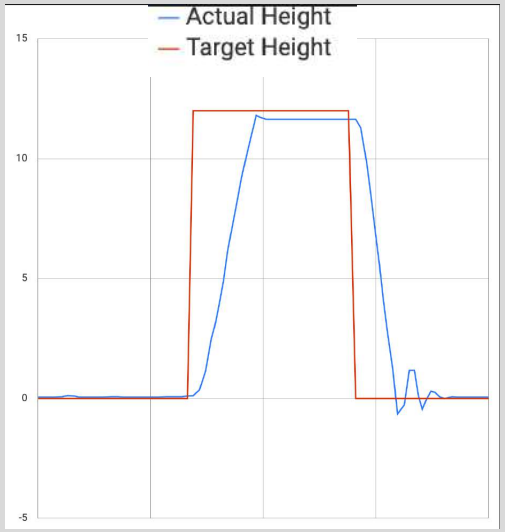
- **Problem: Unable to score against "Defensive Robots"** when the opponent is directly between us and the alliance hub.
- **Solution:** Pivoting arm extends out on second set of horizontal slides.
- **Key Feature:** Box rotation driven through **two belts coaxially** with **arm and box pivot shafts** keeps servo completely off of the arm to **reduce its moment of inertia**

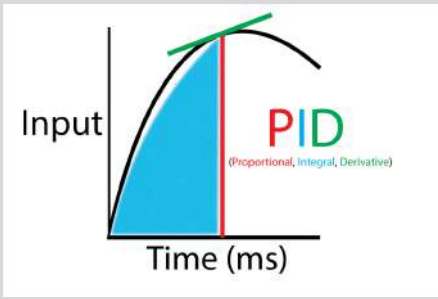
Flip + Lock Box

- **Problem:** Deposit box is prone to freight falling out from shaking and general motion
- **Solution:** Freight is constrained in the box by a **locking door**, which closes to hold freight transferred from the intake, and opens to deposit when box is in position
- **Key Feature:** **Coaxial power transfer** allows for deposit arm to stay light.

PIDF Control Loop

- **Problem:** Gravity **pulls the lift down** if left unpowered
- **Solution:** We utilize a **tuned PIDF Control Loop** to adjust the height of our lift to the 3 discrete levels of the shipping hub

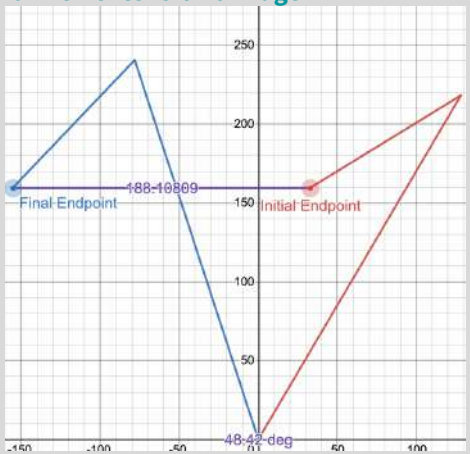


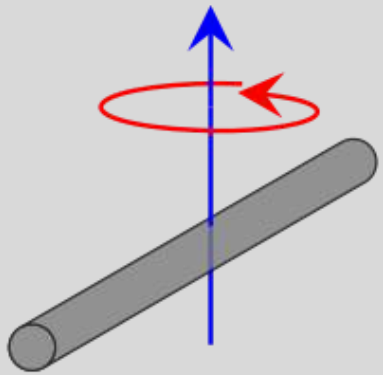


Deposit Extension PID

Inertial Compensation

- **Problem:** Far extension **significantly increases moment of inertia**, making the robot **highly resistant to turns on its axis**
- **Solution:** The robot **internally estimates the robot's instantaneous change in moment of inertia** using the estimated weighted displacement of the deposit arm, and **proportionally adjusts the power delivered to turning the robot**
- **Key Feature:** We layered linkage geometry equations on top of our servo-position-estimation algorithms to **accurately estimate the real-time displacement of the servo-driven extension linkage**





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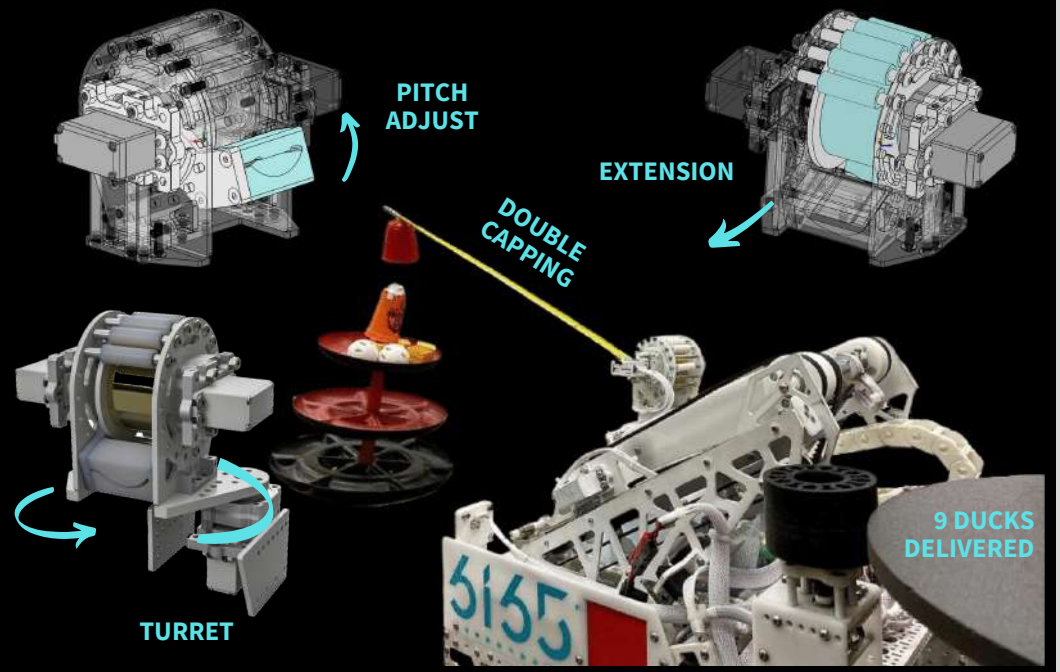
CAPPING + CAROUSEL

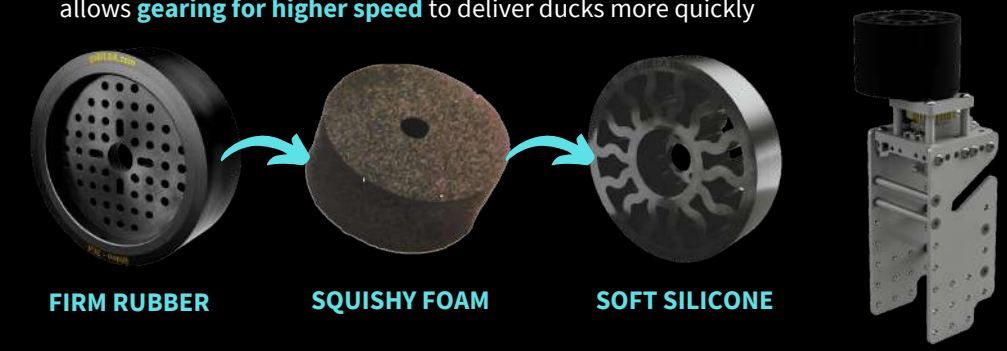
3 Axis Tape Measure Capping

- **Problem: Not enough time** for strategy of reliably doing all endgame tasks solo
- **Solution:** Deliver ducks and cap simultaneously - **multitasking** for efficiency
- **Key Feature:** 3 degrees of freedom capping design **requires no drivetrain motion**
  - **Extension:** Custom tape measure spool constrained with rollers extends to nearly anywhere on the field and **attaches to a magnet** on any TSE
  - **Pitch Adjust:** Guide arm **lifts** tape measure, **raising TSE to required height**
  - **Turret:** The entire module **rotates** left and right to **position precisely over hub**



Compliant Carousel Spinner

- **Problem:** Spinner must be **forgiving** to account for **varying force against carousel**
- **Solution:** **Tested different wheel materials** such as hard tread and soft foam, and found **soft silicone compliant wheel** had best combination of grip and squishiness
- **Key Feature:** Wheel on separate axle **decouples axial loads** from the servo and also allows **gearing for higher speed** to deliver ducks more quickly

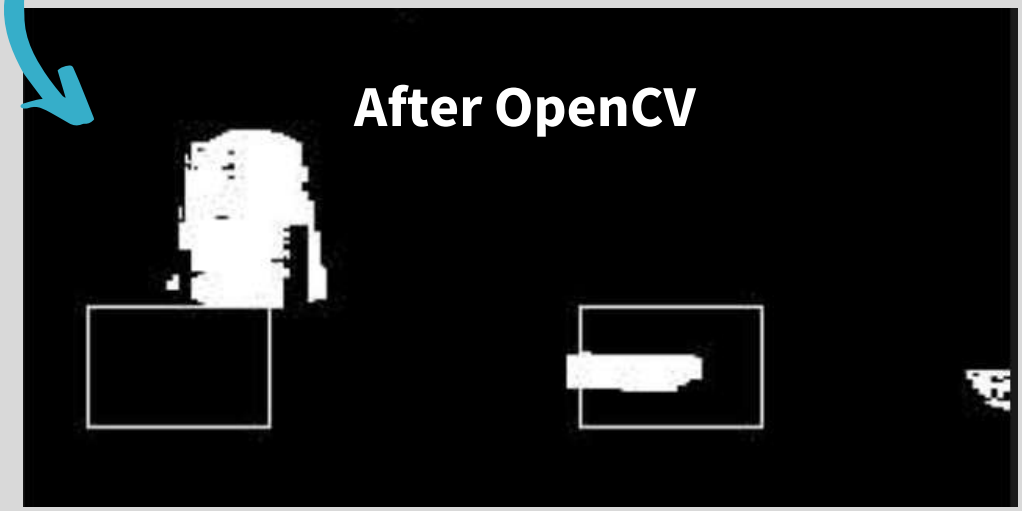


TSE Detection

- **Problem:** Another team could ask us to use their capstone if they wish to cap in endgame
- **Solution:** Using a custom **OpenCV vision pipeline** paired with a **Logitech C270 camera**, we detect the position of the Team Shipping Element on the barcode by setting 3 bounding boxes on the tape markers and **checking which box has the lowest amount of detected red or blue pixels**.
- **Key Feature:** **HSV filter** layered on the **RGB matrix** given by the camera allows our algorithm to be **consistent under different lighting conditions**.

Fig_1: RGB Color Space

Fig_2: HSV Color Space



CORPORATE OUTREACH

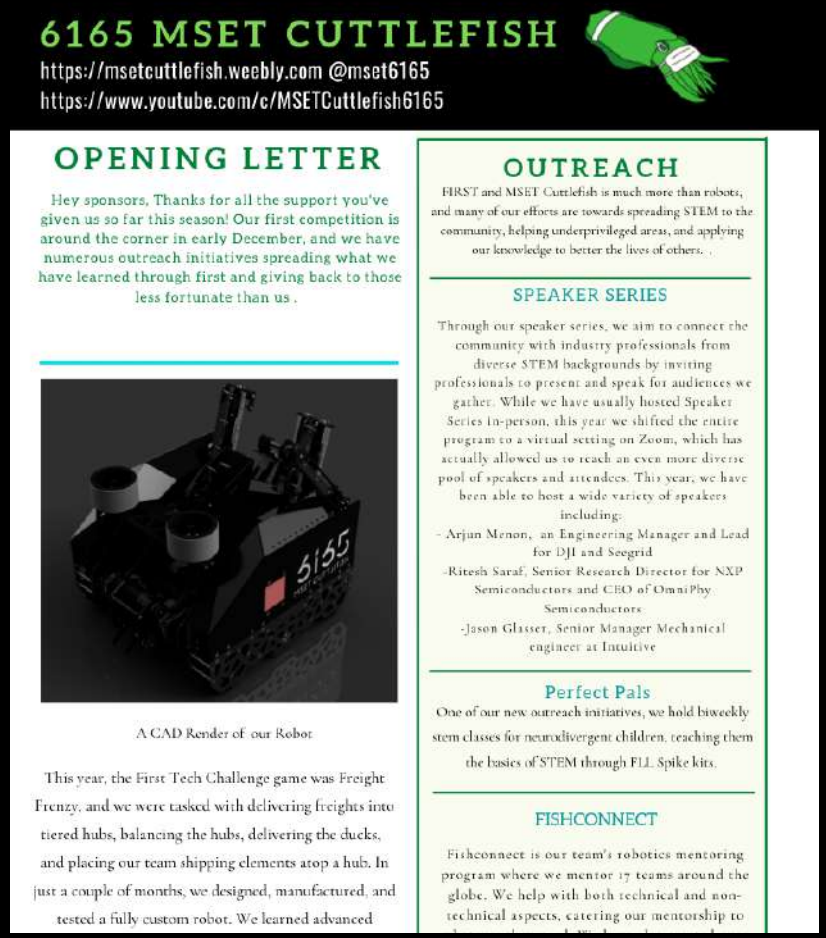
CUTTLECAST

Last season, we were able to **impact 500+ students** through our **online Speaker Series program**, wherein we invited speakers from companies including **Disney Imagineering**, **Blizzard Entertainment**, and **Qualcomm** to speak about their experiences and inspire our local community of middle and high schoolers. This year, in an effort to make our presentations **more interactive**, we transitioned to a **podcast interview** style with live audience participation.

This year, we have interviewed **7 different speakers** through our **CuttleCast**: Arjun Menon, a **drone roboticist** from DJI; Ritesh Saraf, a **director of research at NXP Semiconductors**; Alan Lu, a **CS student at NYU**; Achille Verheye, a **Senior Robotics Engineer at Freedom Robotics startup**; Kyle Schultz and Wade Marquette, **industrial engineers at the University of Washington partnered with Boeing**; and Damon Civin, a **data scientist at Facebook (Meta)**.

SPONSOR LETTERS

Because we are part of a larger organization, MSET Robotics, **gaining sponsors is a club effort for us**. In hopes to **better connect with our sponsors** and show them our **appreciation for their support**, we compiled a list of our proudest achievements, both technical and non-technical, and **created a letter to send to sponsors** to show them what we are able to accomplish with their help. This helps with club sustainability as well as sponsor transparency and retention.



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https://msetcuttlefish.weebly.com @mset6165
https://www.youtube.com/c/MSETCuttlefish6165

OPENING LETTER

Hey sponsors, Thanks for all the support you've given us so far this season! Our first competition is around the corner in early December, and we have numerous outreach initiatives spreading what we have learned through first and giving back to those less fortunate than us .

A CAD Render of our Robot

This year, the First Tech Challenge game was Freight Frenzy, and we were tasked with delivering freights into tiered hubs, balancing the hubs, delivering the ducks, and placing our team shipping elements atop a hub. In just a couple of months, we designed, manufactured, and tested a fully custom robot. We learned advanced

OUTREACH

FIRST and MSET Cuttlefish is much more than robots, and many of our efforts are towards spreading STEM to the community, helping underprivileged areas, and applying our knowledge to better the lives of others. .

SPEAKER SERIES

Through our speaker series, we aim to connect the community with industry professionals from diverse STEM backgrounds by inviting professionals to present and speak for audiences we gather. While we have usually hosted Speaker Series in-person, this year we shifted the entire program to a virtual setting on Zoom, which has actually allowed us to reach an even more diverse pool of speakers and attendees. This year, we have been able to host a wide variety of speakers including:

- Arjun Menon, an Engineering Manager and Lead for DJI and Seegrid
- Ritesh Saraf, Senior Research Director for NXP Semiconductors and CEO of OmniPhy Semiconductors
- Jason Glasser, Senior Manager Mechanical engineer at Intuitive

Perfect Pals

One of our new outreach initiatives, we hold biweekly stem classes for neurodivergent children, teaching them the basics of STEM through FLL Spike kits.

FISHCONNECT

Fishconnect is our team's robotics mentoring program where we mentor 17 teams around the globe. We help with both technical and non-technical aspects, catering our mentorship to

PROMOTING FIRST

ROBOT DEMOS

We gave **presentations** about FIRST and FTC across the Bay Area where we talked to **elementary** and **middle schoolers** about our experience with FTC and demonstrated our robot, **encouraging future engineers** to join and fostering an **early interest in STEM**.

While it was challenging finding places to present to this year due to a transition period between online and in-person events, we were able to **present to a summer camp for children of low-income families** as well as **our local middle school**. In addition, we talked with an **FLL team in Pennsylvania**, answering their questions about the **transition to FTC** and encouraging them to start an FTC team. We spoke about both the various outreach projects we started and the various **technical and nontechnical skills** we have learned along the way.

As more places open up further, **we plan to give many more presentations** at libraries and science museums.

NATIONAL ADVOCACY

During the offseason, we presented to the National Advocacy Conference and met with **members of the United States Congress** including Representative Anna Eshoo and Senators Alex Padilla and Dianne Feinstein to advocate for **increased funding on federal grants** from the **Student Support and Academic Enrichment (SSAE)** program under the 2015 **Every Student Succeeds Act (ESSA)**.

SASA
Student Association for STEM Advocacy

NAC
NATIONAL ADVOCACY CONFERENCE
WWW.FIRSTNAC.ORG

Funding for the SSAE program was initially **authorized at up to $1.6 Billion** when passed, and it was **funded at $1.22 billion in FY21**.

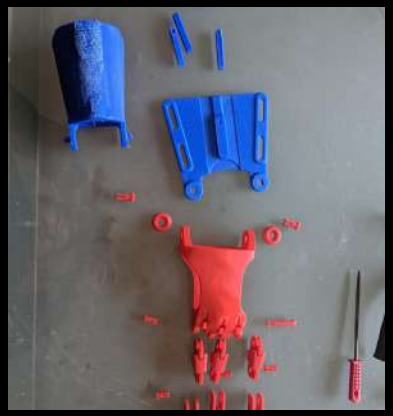
The Congress members **approved our request** to pursue increased funding, and the FY22 appropriations bill approved in July funded SSAE grants **at $1.3 billion, a roughly $85 million increase** in the allocated budget.

$85M for STEM

ENABLE

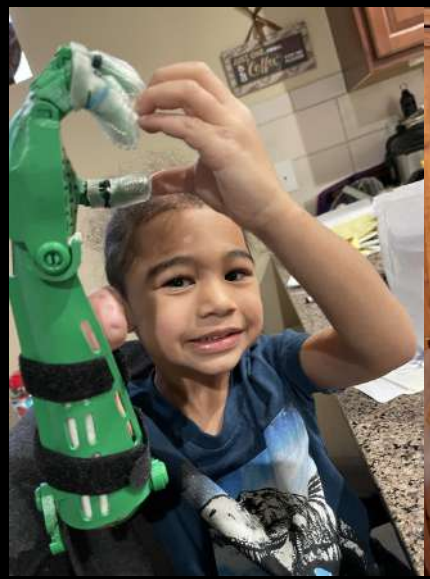
Overview

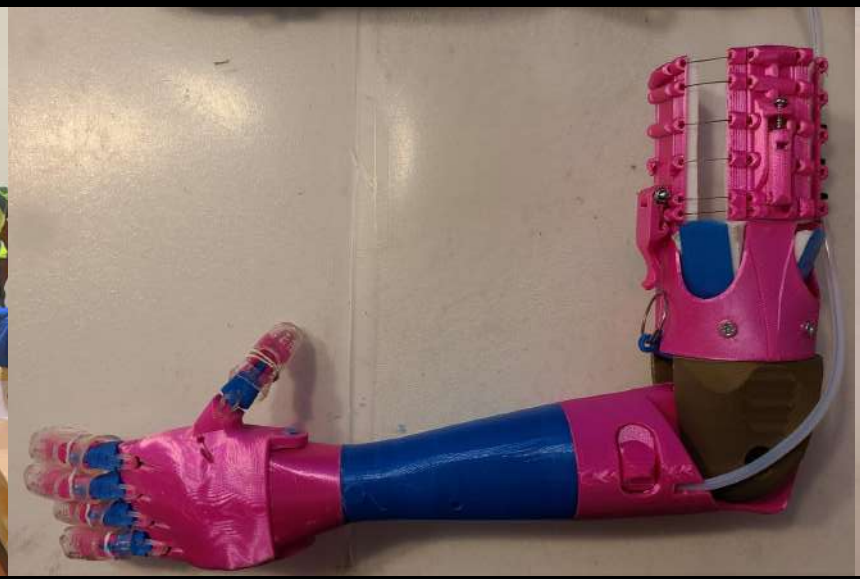
Working with the organization **Enabling the Future**, we have **created** and **donated 3 custom prosthetic hands** for children in the **Philippines, New Jersey, and Washington,** and a **prosthetic arm** for a **child in Brazil**. These hands, which are modified, sized, manufactured, and assembled by our team, are **much cheaper** to produce than a traditional prosthetic.

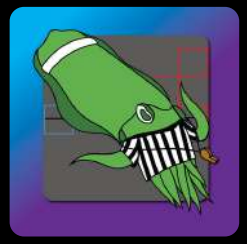




Manufacturing Process

After initially discussing with the patient and their family, we take pictures and precisely size them using modeling software, including **Blender**. Modifications to the **CAD models** are also made to accommodate and best fit the hand. From there, we scale each part of the hand and **3D print** it. Because of the high impact of this project, the prosthetics then go through a **strict quality control** process by our team, ensuring that the dimensions match and the hand is made durably and precisely.



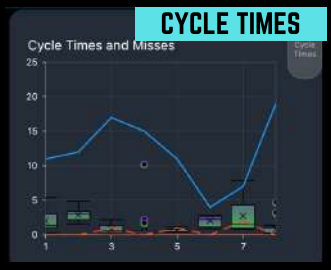


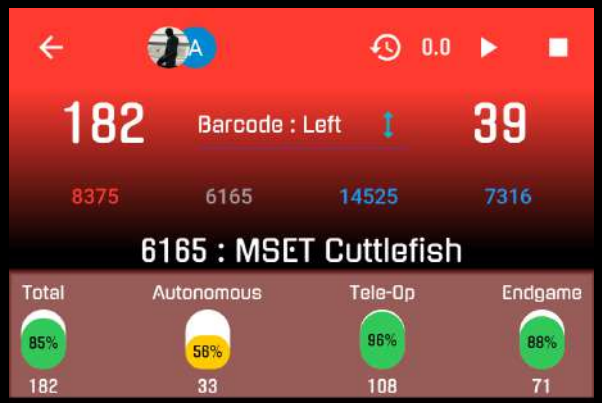



TEAMTRACK

Download on the App Store

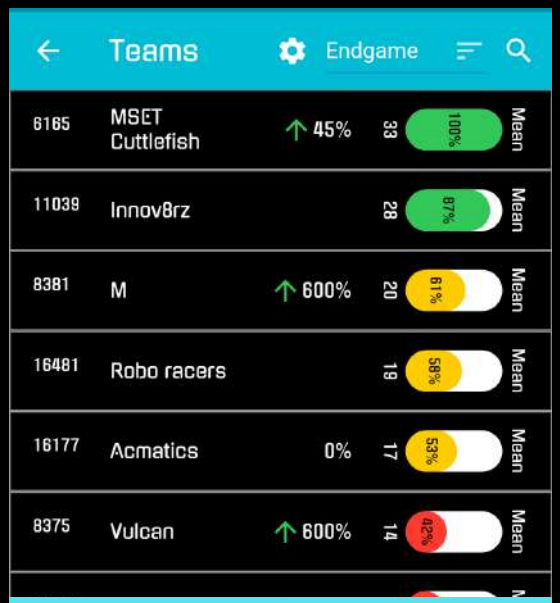
GET IT ON Google Play



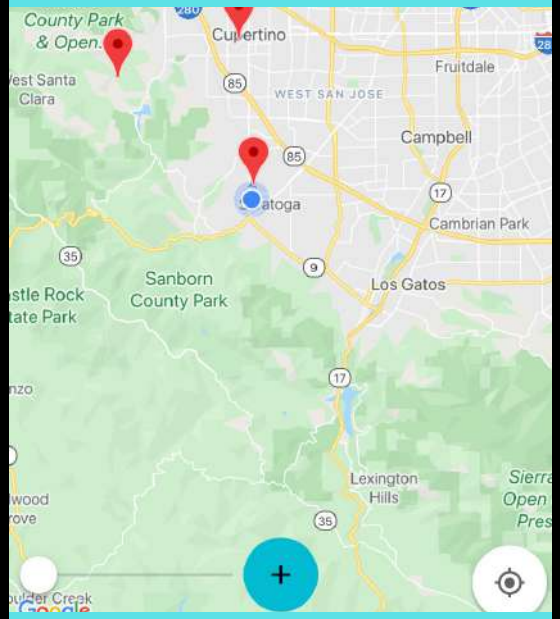


COLLABORATIVE MATCH SCOUTING INTERFACE

USERS MAP



TEAM SORTING



EVENT TEMPLATES

Problem: **Spreadsheets** and **paper scouting** is **tedious** and **ineffective.**

Solution: We developed a **cross-platform app** - available on iOS, Android, and the Web - called 'TeamTrack: FTC Scouting'. TeamTrack has **700+ users from over 23 countries** and is designed to be intuitive for all FTC teams: rookies and veterans alike. Along with **providing powerful analytics** on every page, TeamTrack includes many **robust features** that are unique to it:

Key Features:

- **Collaborative Match Scouting**
  - **Share events** with other users
  - Adjust user **document permissions**
- **Event Templates**
  - Publish scores on a map that is accessible for everyone
  - Import these events into your local repository
- **Cycle Times**
  - **Track the cycle times** of teams based on the frequency of button presses while scoring
  - Calculate the number of **cycles in tele-op and endgame**
- **SubScore analysis**
  - Sort teams based on **desired qualifiers** (auto, tele-op, and endgame)
  - Analyze scoring potential for each element (Alliance Hub, Shared Hub)
- **Outlier Removal**
  - Remove outliers in data analysis (useful for self-scouting)
  - **Fair assessment** for all teams in the event of robot malfunction or disconnections
- **Iterations Log**
  - **Track how different changes made to the robot (hardware or software) tangibly affect scoring performance**
  - Feature Inspired by our own **Driver Practice Analysis**
- **Additional Context**
  - Pulls data from the **FTC API** to provide additional information about teams while scouting

FishConnect

FishConnect is our team's **international mentorship program** where we reach out to FTC teams around the world. **Founded in 2019** when we mentored 2 teams, we now **actively mentor 14 teams** from across 5 countries as part of our program.

The organizational strategies that we have pioneered for our own team are the bulk of what we share. This is because many of the teams that we mentored had difficulties with **finding sponsors** and **team management**. However, we also help rookie teams in the program get a head start through our **video crash-courses in software and hardware** as well as hands on mentorship to cover advanced technical concepts.

With the teams we help set up at **our local middle school**, we **mentor both the students** and the **parent coaches**. The program is **completely new**, and mentoring the parents creates **longevity** and **sustainability** for our own robotics program at MSET.

TEAMS MENTORED:

20916 Esquimalt High School
20405 Redwood Robotics
20367 RMS Cerberus
20326 RMS Khrysaor
20373 RMS Chimera
20370 RMS Phoenix
20368 RMS Thunderbirds
20366 RMS Werewolves
20383 RMS Yetis
18346 AA Batteries
14493 Comet BOTs
16481 Robo Racers
19752 - Mack Attack
17106 PlanTech
21185 Apollo 15

TEAMS HELPED WITH RAMSETE:

14473 Future
10862 Droid Rage - Nebula
5890 e-lemon-ators
18275 SubZero
17576 TITANS
6901 Droid Rage - Phantom
13266 Droid Rage - Apex
7161 ViperBots Hydra

Ramsete is an **FRC path following algorithm**, designed specifically for 6-wheel drivetrains, that we adapted for use in FTC. **We have helped 8 teams** get the Ramsete software set up and have **open-sourced our code to reach many more**.

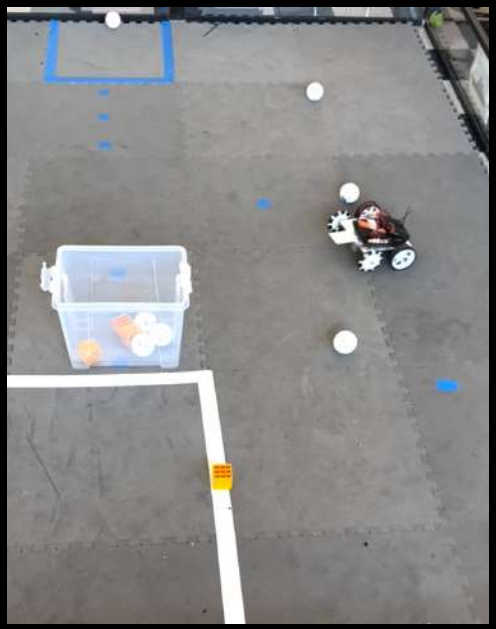
TEAMS ASSISTED WITH MANAGEMENT:

13050 Sharkbytes
20916 Blue Blizzards
15166 Robo Troopers

MENTORSHIP

CURRICULUM DEVELOPMENT

We created an extensive **8 week long robotics curriculum** and donated materials to 19752 Mack Attack for their **senior capstone engineering course**. Their engineering class functioned as their work sessions for FTC. Even though their robotics season ended early, they still needed curriculum for the rest of the school year.



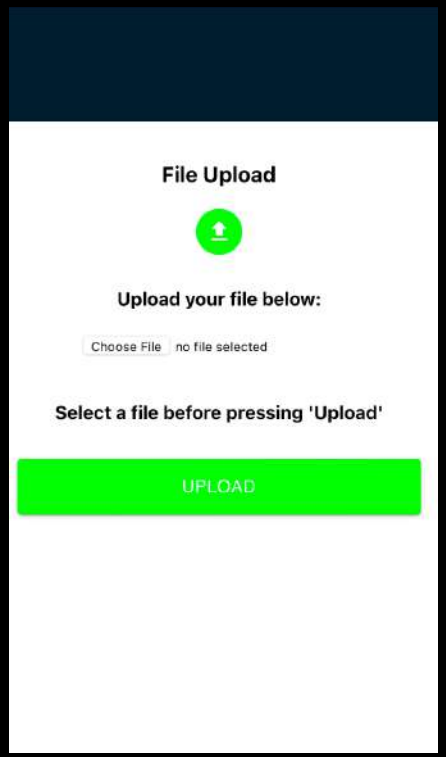
Our curriculum splits up this year's game into **smaller subgames**. We walked them through each mechanism while giving them **creative freedom** with intentions to **prepare them for engineering careers upon graduating**. The curriculum we created is now the **standard curriculum for McClymonds High School** and will be used in their **engineering class** for years to come.

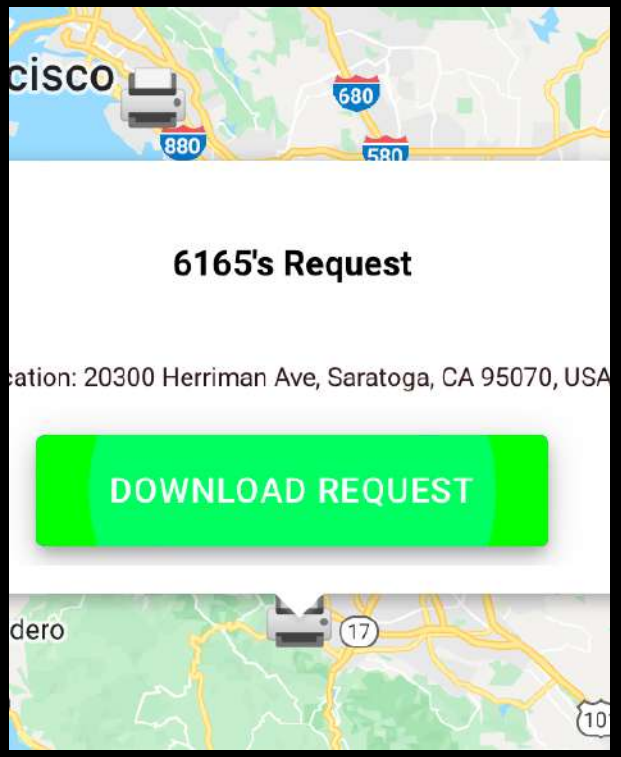
ZIPPY PRINTS

Problem: Many of the teams we mentor through our FishConnect program do not have easy access to machining equipment or 3D printers.

Solution: We created a website called 'ZippyPrints' so they could **upload their CAD files** on the ZippyPrints website and have neighboring teams, or us, **print the parts they need**.

Future Plans: We plan to further develop and release Zippyprints in the future for the entire robotics community. This way, we can **create a network of FIRST teams to support teams or programs in need.**





COMMUNITY OUTREACH

SWENEXT

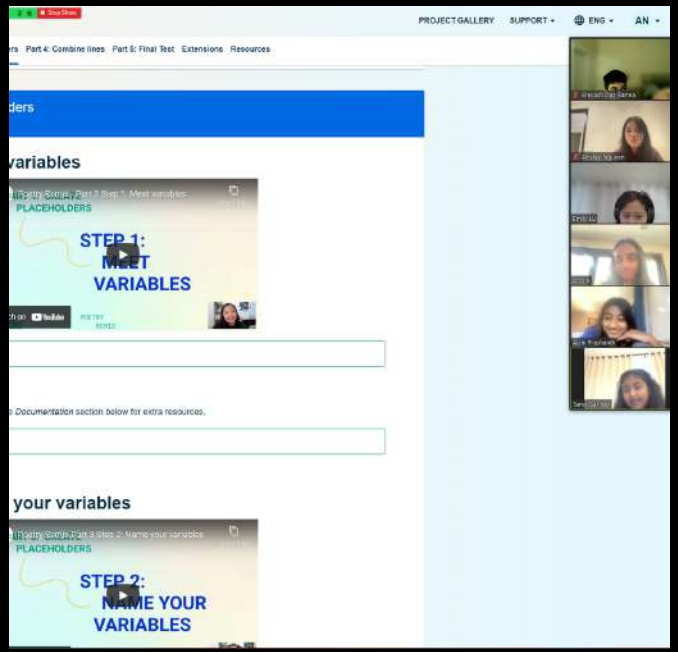
Our team **started** a **local SWENext chapter** in collaboration with our **alumni** and **UC Berkeley SWE**. SWENext allows students to become part of the **Society of Women Engineers** (SWE) community before college.

Our goal is to further involve **young girls** and **students of all genders** in the STEM and engineering community, **inspiring and empowering students to careers in these fields**.

We explore many aspects of engineering through **career and college speakers**, **engineering competitions**, and workshops. We compete in various SWENext challenges, allowing members to explore their interests. Regardless of knowledge, background or skill, we create an inclusive and safe environment where all students can build both soft and technical skills.

GIRLS WHO CODE

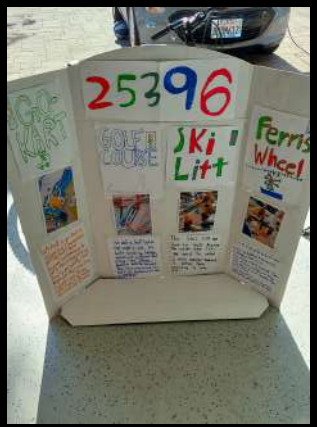
Our team **founded** a **Girls Who Code** club in our community to provide girls interested in STEM an avenue to pursue one of its basic building blocks: **programming**. Working with **Python**, we **taught** sixth graders **principles of computer science** through **fun and interactive projects**. Our weekly class covers a new topic and a new application, keeping the members engaged and interested.



FLL TEAMS

Many of our own members started doing robotics at a young age. To help instill a love for STEM for the next generation of innovators in our community, we started a local garage FLL team, and interactively mentored young elementary school children in the basics of using **FLL pieces** and **coding**.

Helping them complete their challenge this year is also a great way for us to **sustain FIRST and our own robotics program** in the long run as we introduce them and their families to the many wonderful programs FIRST has to offer.

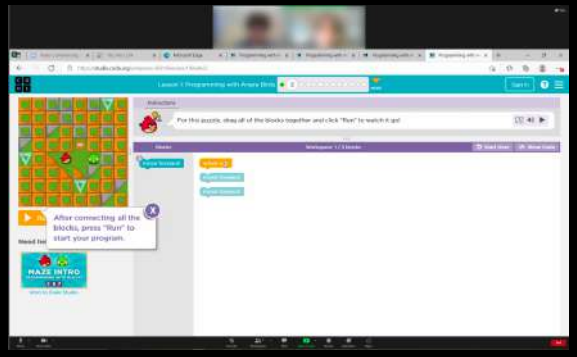


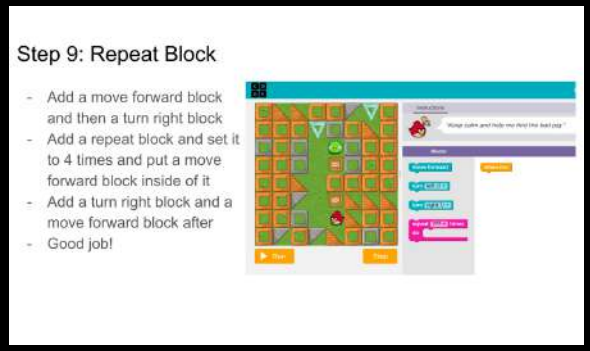
NEURODIVERSITY

FRIENDS OF CHILDREN WITH SPECIAL NEEDS

We partnered with Friends of Children with Special Needs (FCSN) to **build** a **bridge** between our team and the **special needs community**. FCSN's mission is to help individuals with special needs and their families find love, hope, respect, and support through integrated community involvement — this is exactly what we have accomplished.

Our experience with computer softwares aligns perfectly with FCSN's computer science program, and we **created** and **teach curriculum** that **inspires young adults** in the **special needs community** to **enter the world of STEM** through the **weekly classes**. Our simple curriculum based on Code.org block programming courses and popular video games are easily accessible. By maintaining a 1:1 or 1:2 teacher to student ratio, teachers tailor make each class for the student, creating a nurturing and comfortable learning environment.





Friends of Children with Special Needs
華人特殊兒童之友

PERFECT PALS

We partnered with **Perfect Pals**, a club at our school, to introduce **neurodivergent children** in our community to **STEM and robotics**.

We wanted to open opportunities for special needs kids to be actively involved, who are often forgotten to be included in STEM. **Twice a month**, we meet with the special needs students at our high school and explore **Lego kits to build projects**.