24-25 EDITION

ROCKVILLE, MARYLAND

* Red White & Bots *

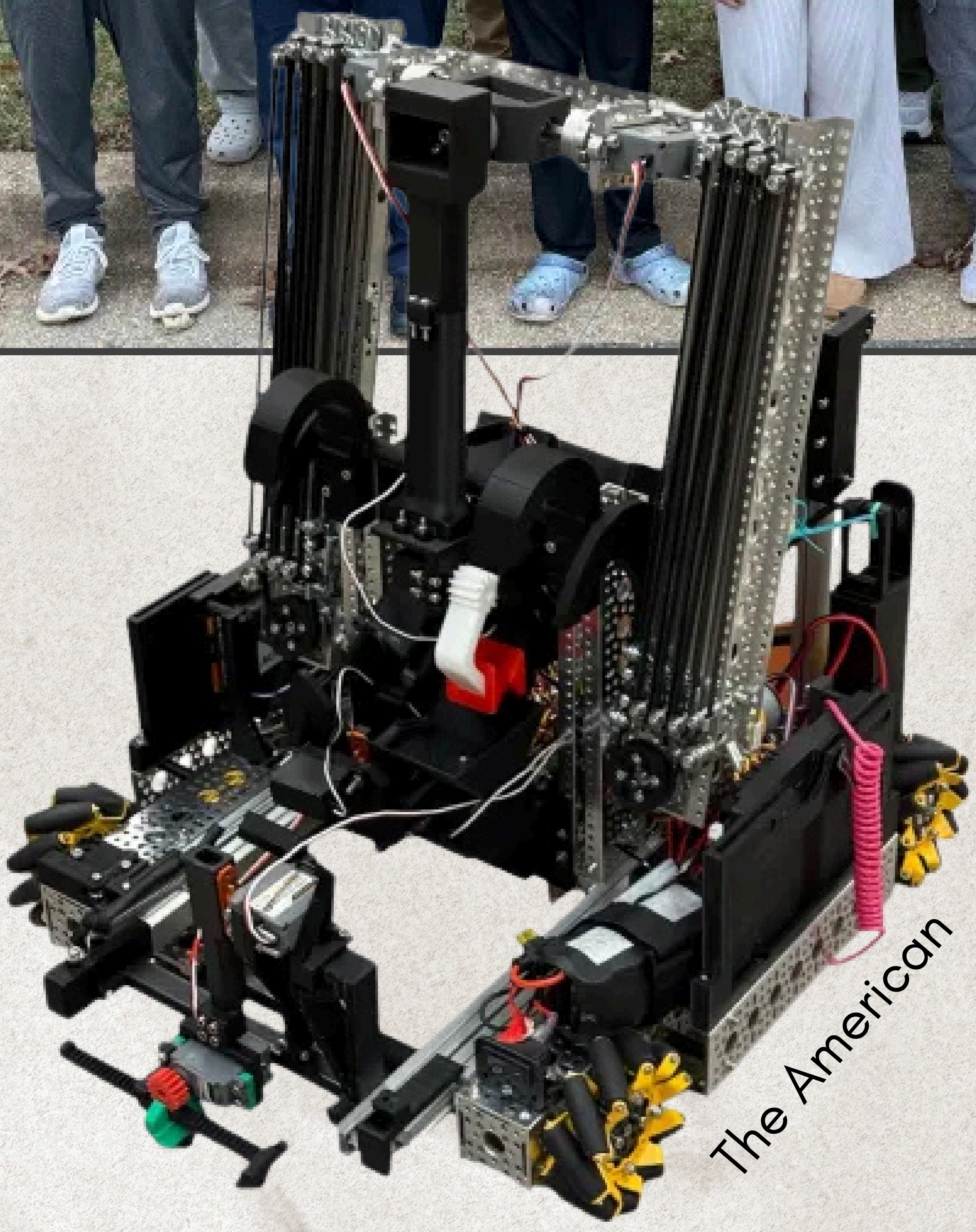
DECEMBER 7TH, 2024

INTO THE DEEP

ENGINEERING PORTFOLIO

#26163

RED, WHITE, AND BOTS



INTO THE DEEP

PRESENTED BY RTX

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RED WHITE & BOTS

Meet The Team

Who Are We?

Red White & Bots is a first-year team comprised of 14 students ranging from grades 10-12. Our team represents our school, Thomas S. Wootton High School, and are a 100% student-led project inspired by our school's robotics club, where we started our competitive journey by hosting weekly LEGO robot competitions. The club and affiliated team were reinstated over the past year after having faded away prior due to COVID-19 and lack of financial support.

- ★ 4 seniors
- ★ 6 juniors
- ★ 4 sophomores

Mission Statement:

Our mission is to provide students in our community, regardless of prior experience, with opportunities to explore the field of robotics. By forming a welcoming and collaborative environment for students to gain exposure to robotics through hands-on experiences, we aim to help students cultivate the technical and soft skills that are essential across all areas of STEM.

Our Spirit Acronym:

U - Unite students in our community
S - Spread opportunities for students to get involved in robotics
A - Adapt through challenges and setbacks to reach goals

Our Coaches:

Gavin Kramar

Thomas S. Wootton High School AP Physics 1 and Honors Physics Teacher
1st Year in FIRST

- Coach Kramar graduated from Brown University with an undergraduate degree of Chemical Engineering and later pursued a Master's degree at the University of Maryland at College Park.
- Although Coach Kramar does not directly work with us on the robot, he helps guide us in the right direction and keep us on task.

Michael Thompson

Thomas S. Wootton High School Science Department Head and Honors Physics Teacher
1st Year in FIRST

- Coach Thompson graduated from Notre Dame University with a degree in Mechanical Engineering
- Similar to Coach Kramar, Coach Thompson, while not directly involved with the bot, provides us with guiding tips and questions, reminding us to consider ideas or conditions we had not previously taken into account.

Partha
Mechanical

Abhinav
Mechanical

Hyunjoon
Mechanical

Tariq
Mechanical

Cody
Software

Atharv
Software

Ethan H
Software

Janhita
Software/
Outreach

Shulammite
Outreach
Lead/Mech

Marco
Mechanical
Lead

Asher
Software
Lead

Alex
Software
Lead

Naysa
Captain

Ethan M
Captain

Goals & Organization

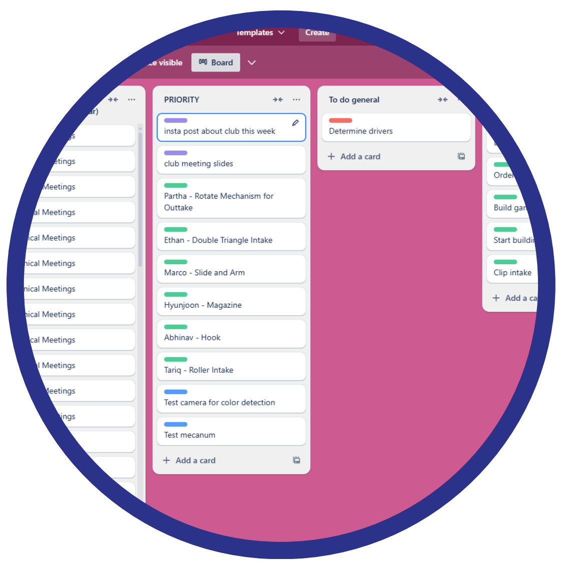
Make Connections!

Goals 2024 - 2025

Develop Strong Technical Skills:	1. Learn and expand on coding basics over the summer	2. Engage in personal CAD projects for practice (ex. Toothbrush Holder)	3. Research past season builds and identify their successes and failures
Promote STEM in Our Community:	1. Heavily advertise the robotics club and team around the school	2. Engage in social media to expand reach and provide updates on opportunities	3. Work with local businesses to hold fundraisers and STEM workshops
Document and Reflect on Our Progress:	1. Record meeting agendas and personal reflections in Engineering Notebook	2. Start each new week with a full team status update from the previous week	3. Regularly engage with our coaches for external feedback on team trajectory

Shuffle Deselect All Submit

Team Organization:



Trello:

Our team collaborated in real time virtually using the project management tool Trello. In order to keep the entire team on track and on the same page, we used Trello to create a visual board of our goals, share status updates on tasks, and plan weekly agendas for each sub-team.

Weekly Meetings:

To accelerate our progress our team made a commitment to meet in-person once a week at the minimum with full team meetings on Sundays and Wednesdays, and sub-team meetings throughout the week as necessary. These meetings allowed us to brainstorm together, test prototypes, and address any immediate concerns.

Discord:

For efficient communication, we used Discord to schedule meetings, chat on-the-go, hold virtual calls, and share CAD drafts. Using the server and text channel features of Discord we were able to organize our sub-team and full-team chats within the same location for top convenience.

Timeline & Strategy

TIMELINE

1 PRESEASON
- Focused on recruiting team members & assigning roles
- Applied for grants and finalized funding strategies.
- Team members practiced CAD and learned FTC tools
- Purchased parts and tools necessary for robot building

2 9/16 - 9/30
- Brainstormed initial design ideas and game strats
- Reviewed competition rules and constraints
- Started prototyping intake and drivetrain systems.
- Initiated grant applications & outreach planning

3 10/1 - 10/15
- Discussed intake & drivetrain prototypes
- Conducted tests on drivetrain functionality.
- Worked on TeleOp & Autonomous coding
- Finalized plans for Fall Festival outreach event.

4 10/16 - 10/31
- Improved intake & outtake prototypes
- Redesigned robot structure for better efficiency and compliance with competition rules.
- Began drafting the engineering portfolio.

5 11/1 - 11/15
- Tested prototypes for objects on vertical slides
- Collaborated across subteams to ensure design integration of mechanical & software
- Finalized & confirmed grants

6 11/16 - 12/6
- Assembled hang prototype
- Conducted field tests
- Finalized materials for judges questions & engineering portfolio
- Strengthened outreach efforts with social media

STRATEGY

DIVIDED INTO THREE DISTINCT PHASES TO MAXIMIZE SCORING EFFICIENCY

Phase 1: Autonomous

The robot is pre-programmed to score a preloaded specimen onto the high rung. It then uses a claw or triangle intake to pick up samples from the ground and deposit them into a corner bucket for later scoring. This continues until the final 3 seconds, when the robot parks in the designated zone to earn extra points.

Phase 2: TeleOp

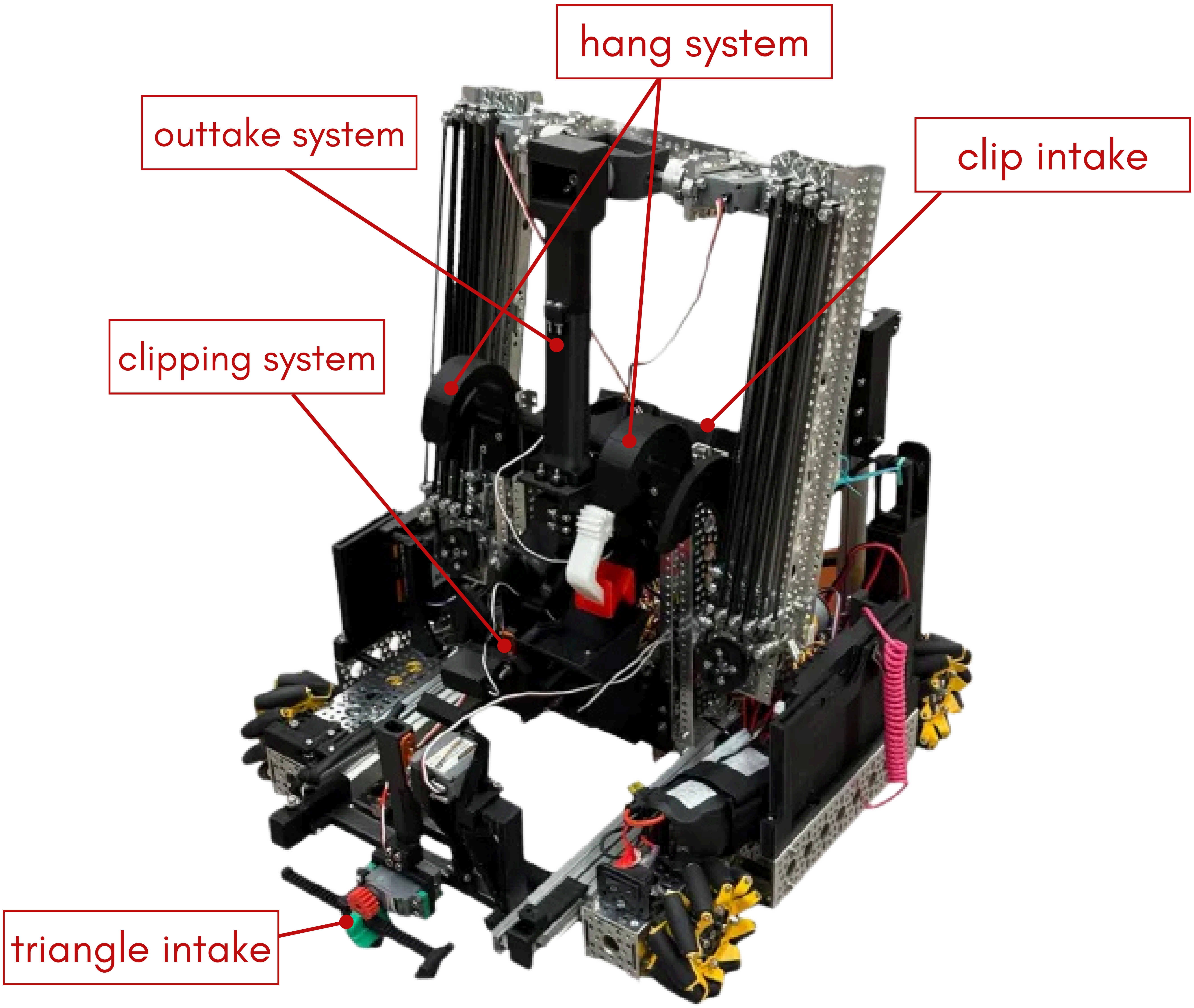
The robot collects 6-8 clips from the human player area and loads them into its clip magazine. It then gathers samples from the submersible using its triangle intake, clips them, and places them onto the high rung. This process repeats with periodic restocking.

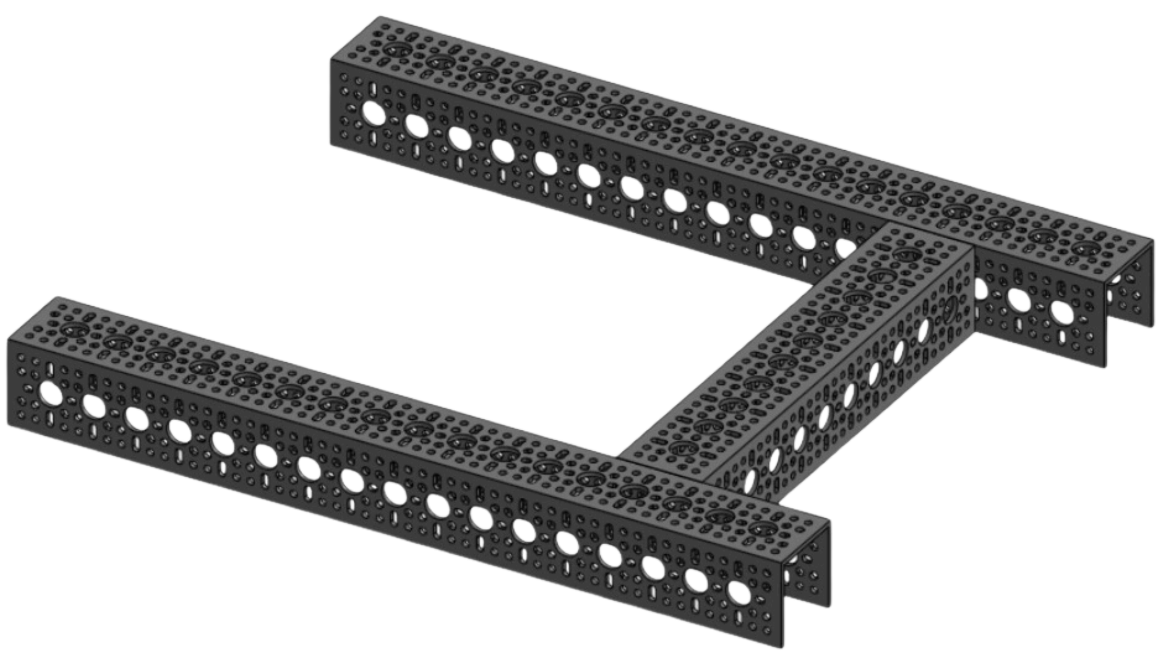
Phase 3: Endgame

In the final 30 seconds, the robot extends its vertical slide to latch onto the second hanging rung with a hook and retracts to lift itself for endgame points.

⁕ Intro to The Bot ⁕

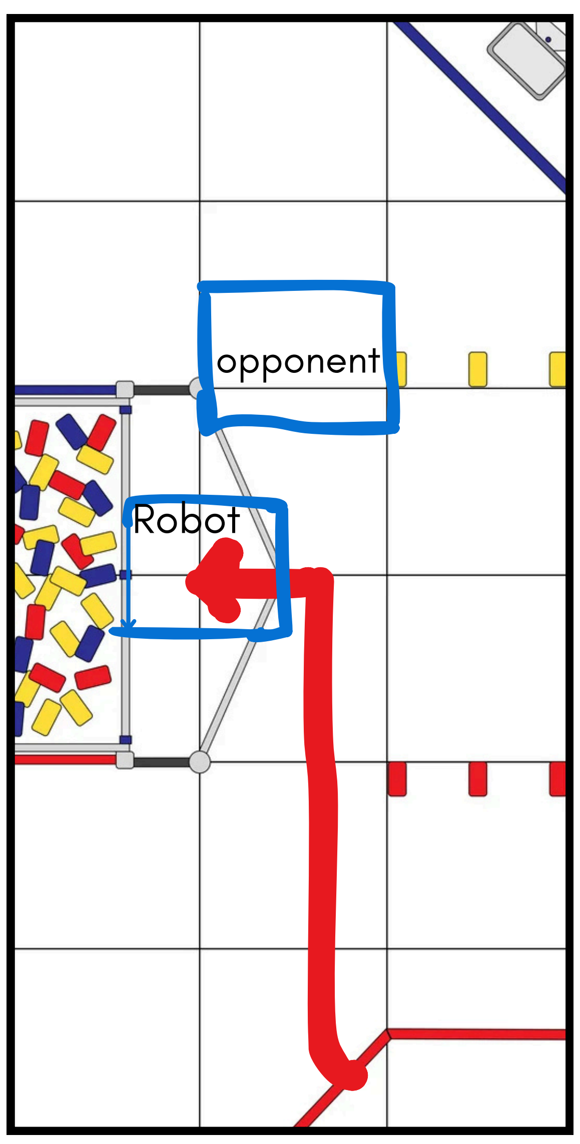
The American





Drivetrain:

The robot has a 17x14-hole base to support its subsystems, using GoBuilda mecanum wheels for versatile omnidirectional movement.



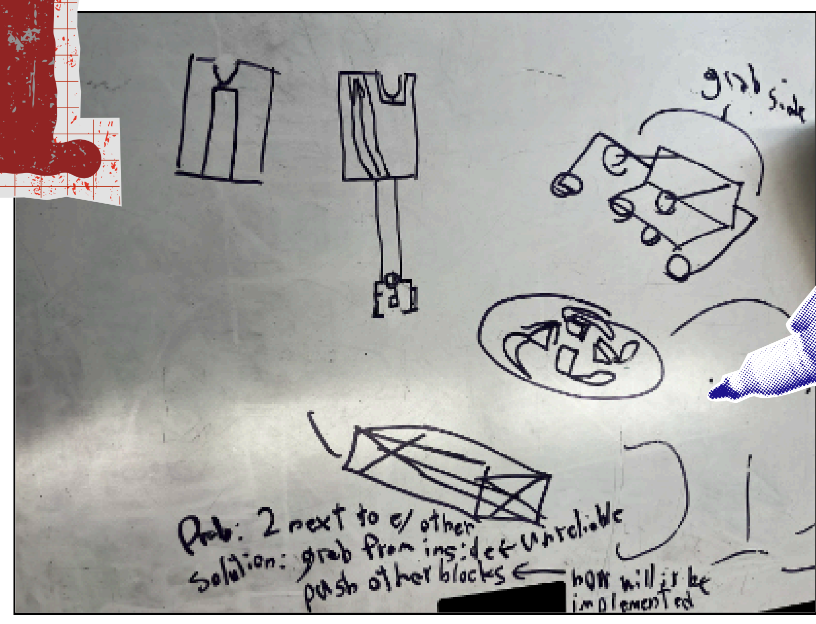
At the start of TeleOp, the robot secures clips before moving to the submersible zone, where the robot collects samples and converts them into specimens without human player input. Staying in the submersible zone disrupts opposing teams' sample cycles and lets us cut down on time lost to travel.

Design Process

BRAINSTORM

1

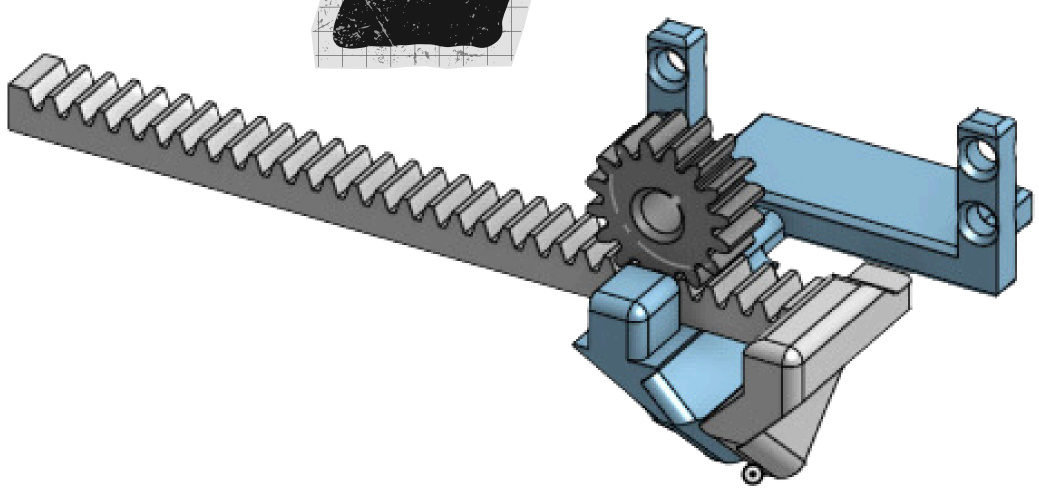
We started by drawing and discussing our ideas for each subsystem.



DESIGN

2

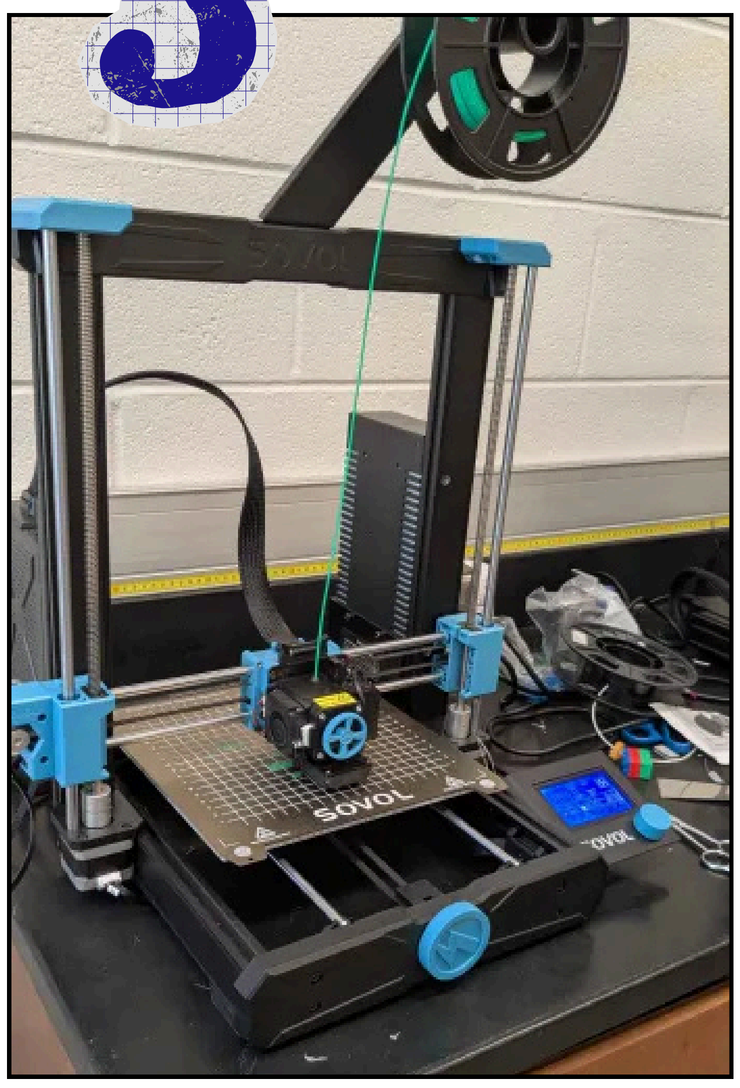
We then 3D modeled our designs using OnShape.



PROTOTYPE

3

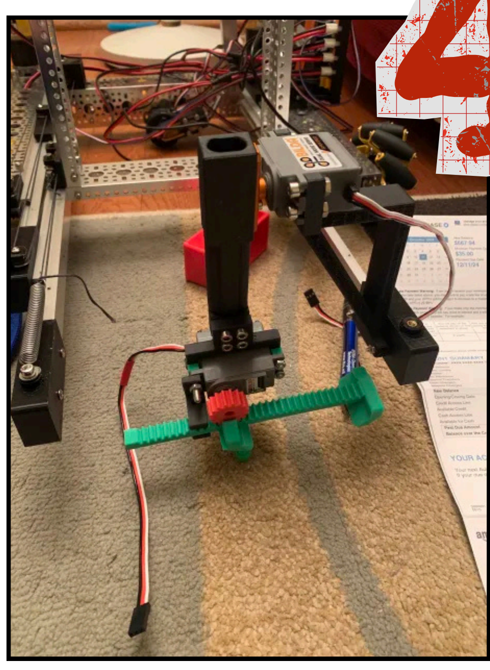
We 3D printed our design and compared different designs for each subsystem.



TEST

4

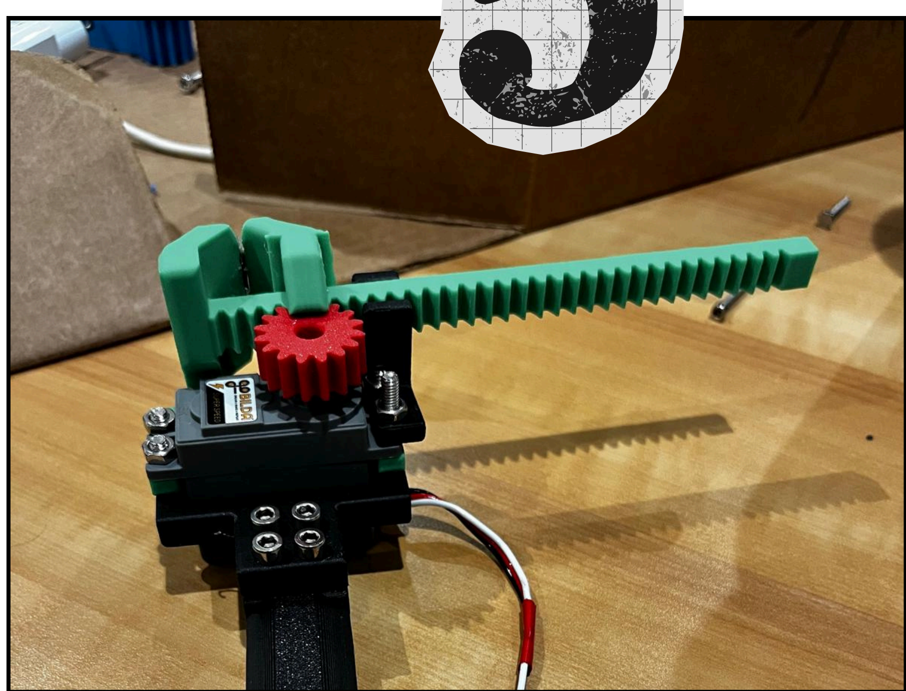
After printing each prototype, we tested them and were able to choose which prototype we liked best.



ITERATE

5

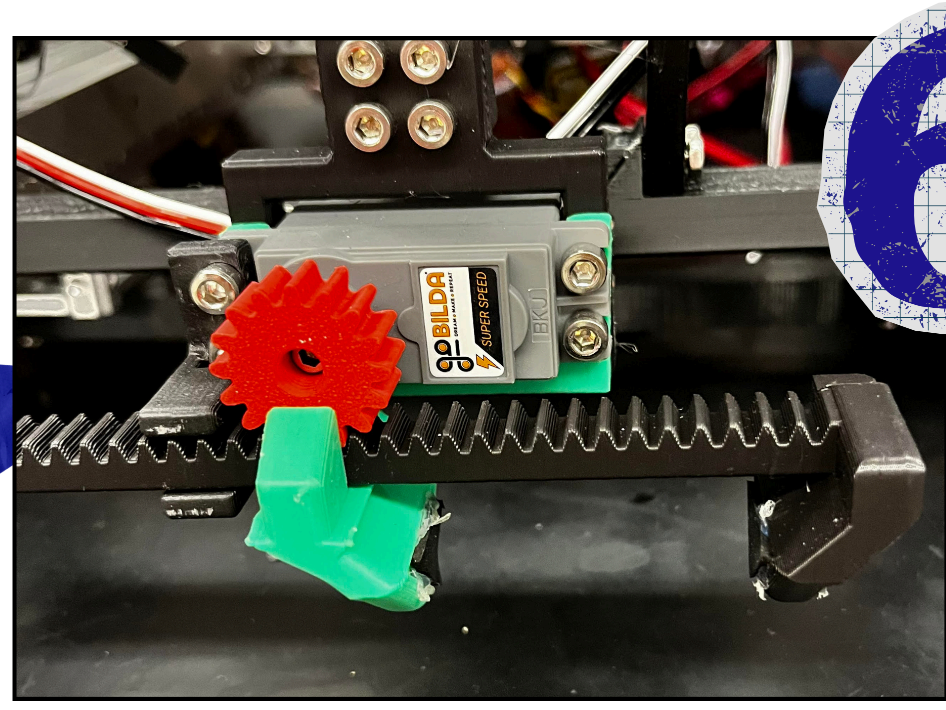
We improved the prototypes we liked best to increase maximum efficiency.



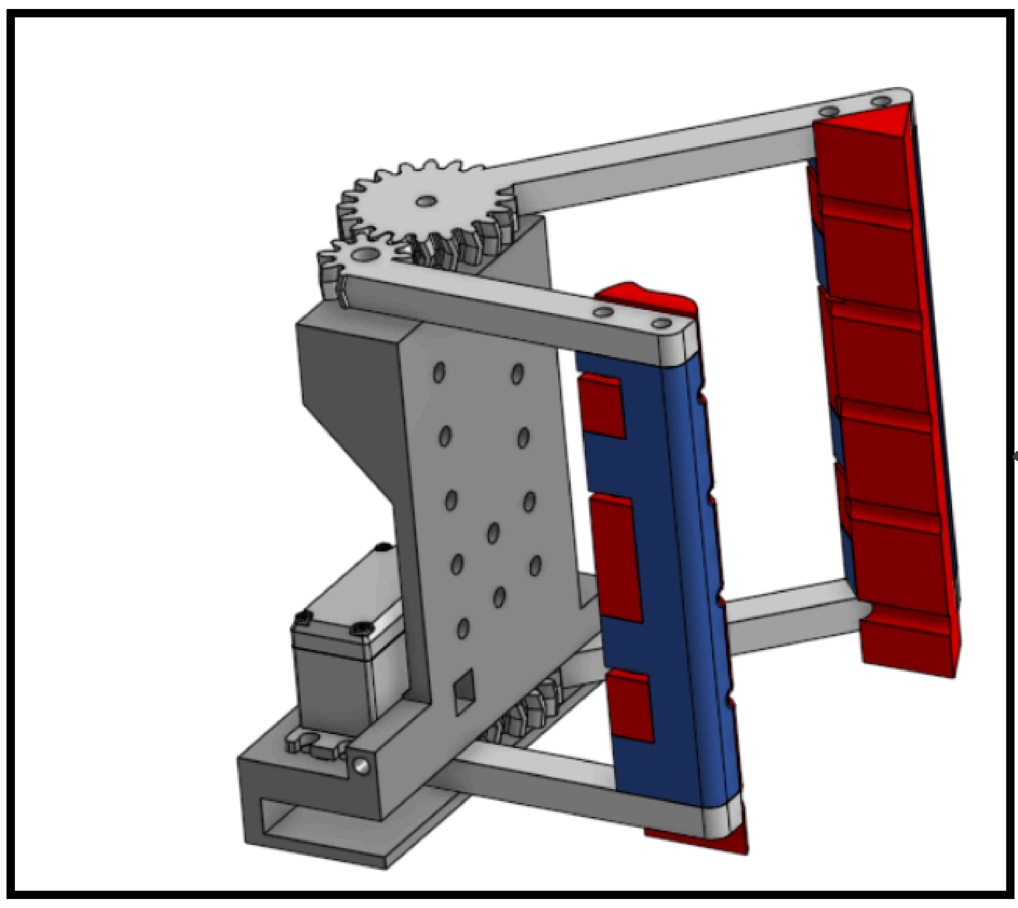
FINALIZE

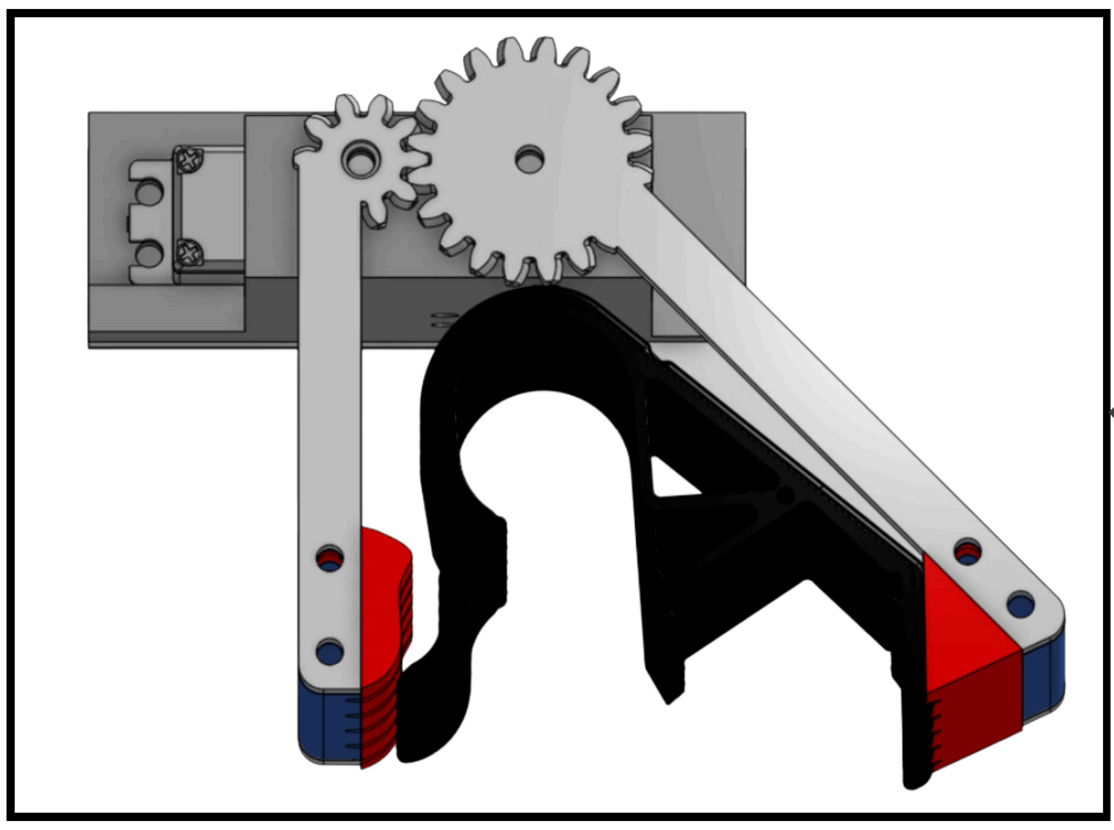
6

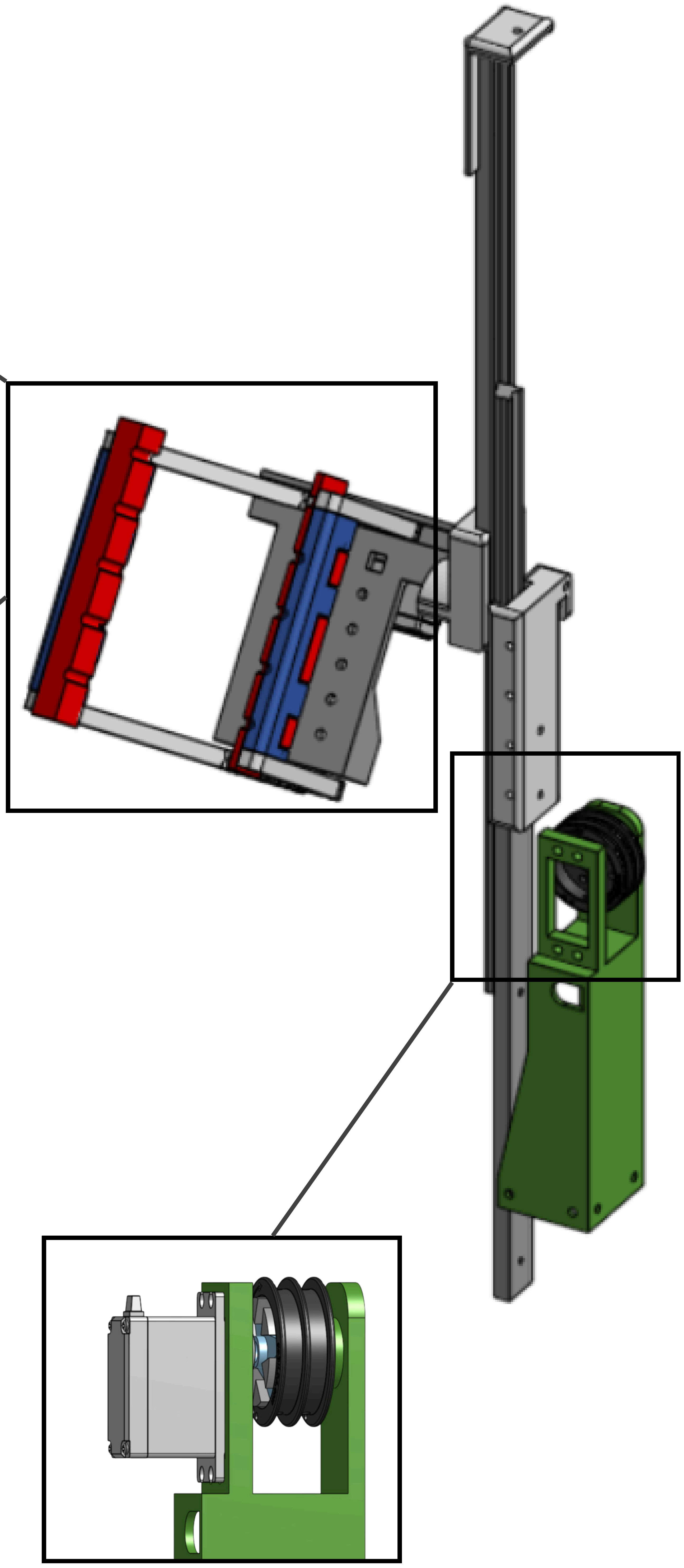
After iterating, we made last changes and polished the robot overall.



⁕ Intake ⁕





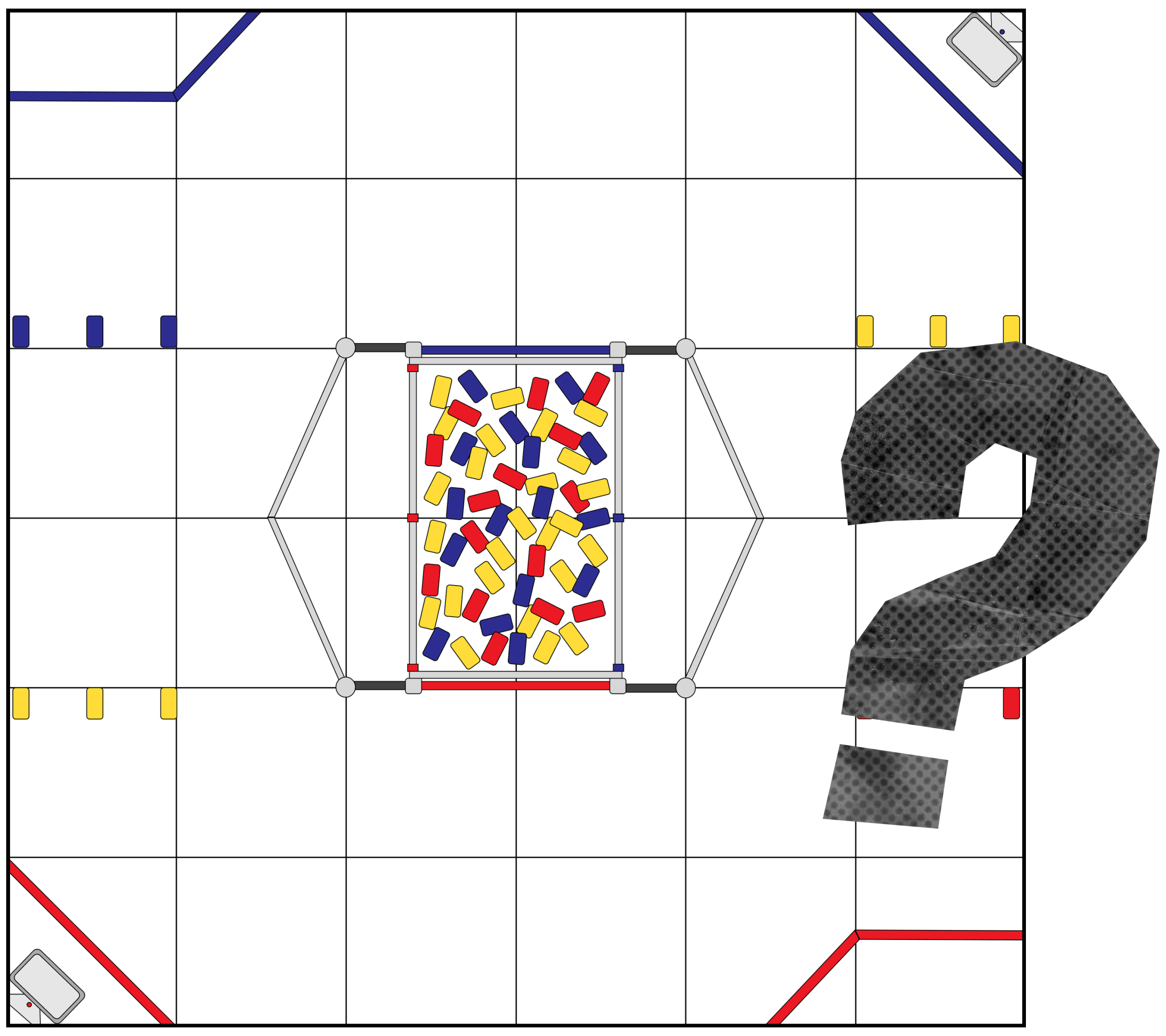


Clip Claw

Our Clip Claw is a mechanism designed with precise geometry to pick up a stack of up to five clips and deposit them into the Clip Mag for storage. It is mounted on the back of the robot to save space and provide easy access for the driver. The claw is powered by a GoBuilda speed servo for fast intake, while the vertical motion of the claw is controlled by a servo connected to a stringing mechanism.

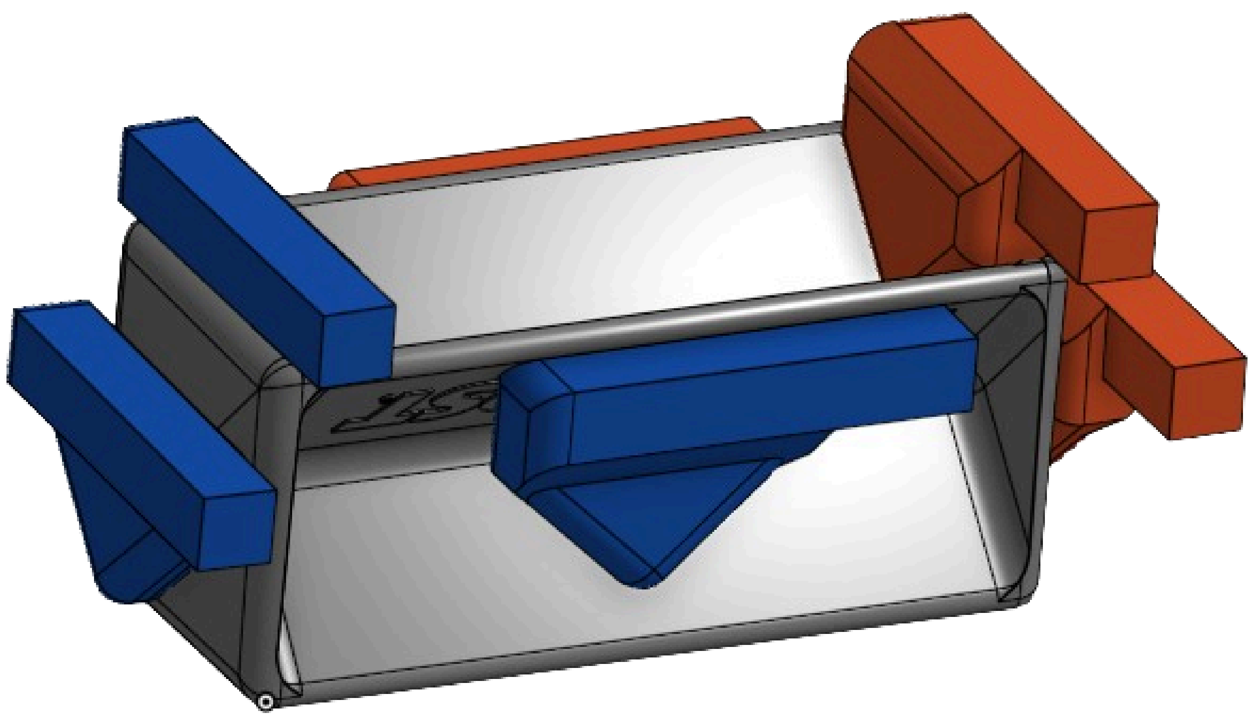
While we originally considered using a roller intake, we ultimately decided we would be losing valuable game time to have the robot have to sort the samples into a specific orientation for the Clip Mag. With the Clip Claw we can save time by having the human player place the clips in a tower rotation that is ready for the robot to then grab and insert into the Clip Mag. The leftover linear slide then moves the Clip Claw up to a certain height where it can then rotate and drop the clips into the Clip Mag.

⁎ Intake Pt. 2 ⁎

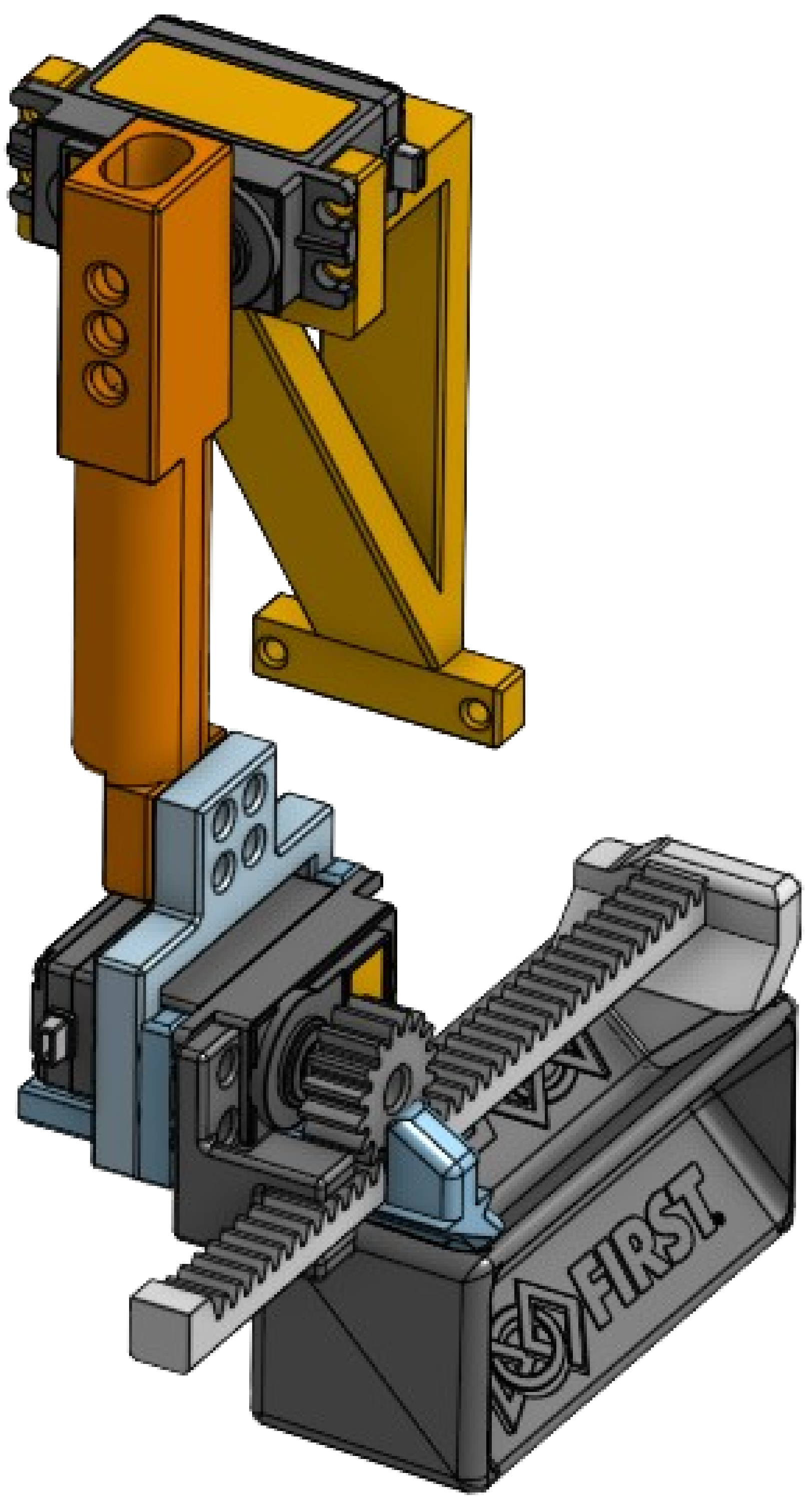


Triangle

We observed early on in the field that the extremely close proximity of the samples could lead to intake issues. To maximize our sample collection, we decided that the most reliable method would be to grab them from the top.



We designed our triangle so that we would not only be able to grab from the inside of the sample but also from the edges along the square faces of the sample. Additionally, with our triangle design we can perform a non-friction grab from the sides, allowing the mechanism to function like a standard claw when needed. Additionally, to minimize the number of servos used, we designed the system to be auto-aligning by incorporating smooth, rounded edges on the triangular ends.



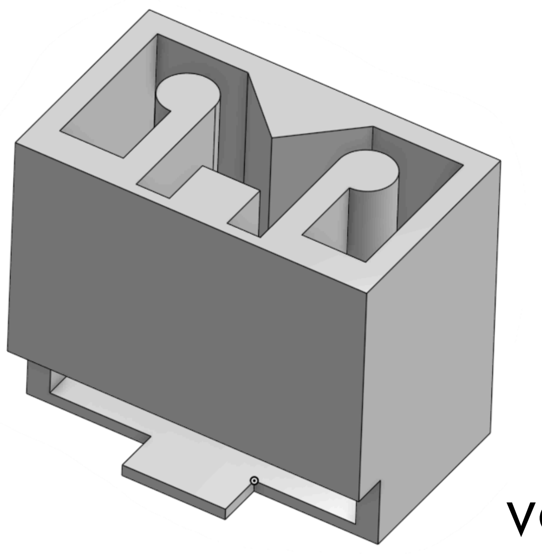
After deciding to mount the clipping mechanism on board and extend it into the submersible, we then created a swing arm that enables both vertical and backward motion using a single servo.

This led to us encountering issues with the rack wobbling because it was secured by only one gear. However, to address this, we added a leveling attachment and increased the flat surface area for the rack to rest on.

We are also currently in the process of implementing cameras that will automatically detect the samples for pickup and assist with auto-alignment. This feature is still under development at the moment, but we have plans of implementing it by our next event.

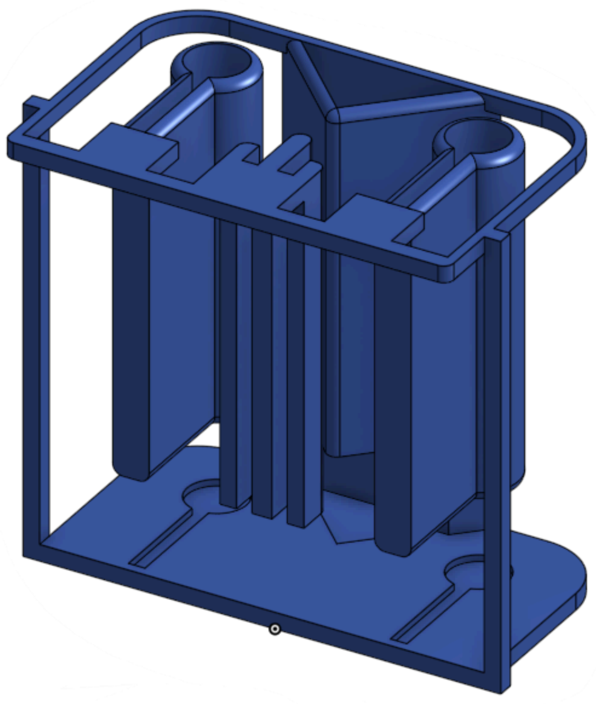
Clipping & Bucket

Clip Magazine

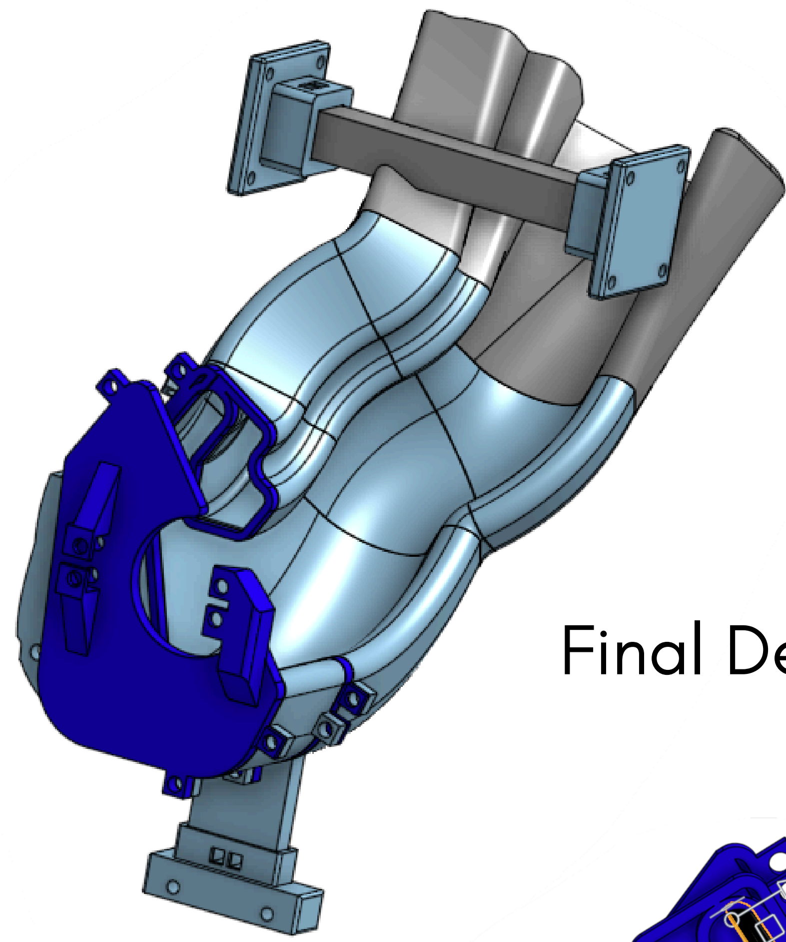


ver 1

First iteration was designed so the clips will fall vertically and stack into either orientation if the clip falls in random. Version 1 was figuring out the initial design and Version 2 was designing to efficiently save print filament while still keeping the necessary features.

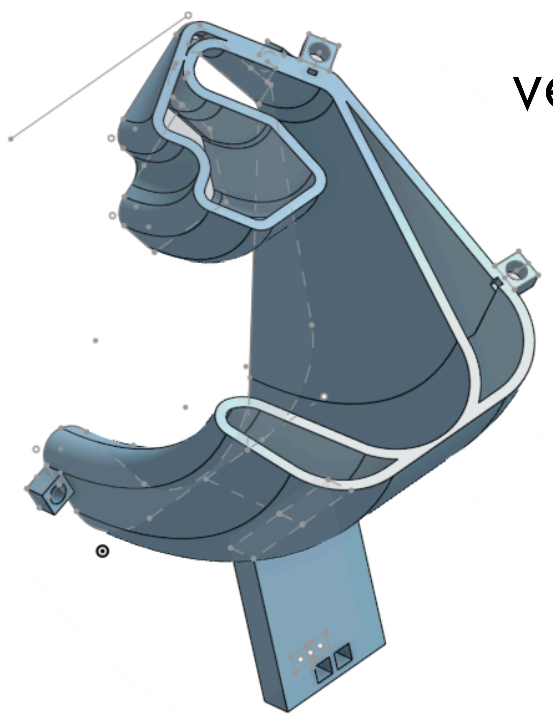


ver 2



Final Design

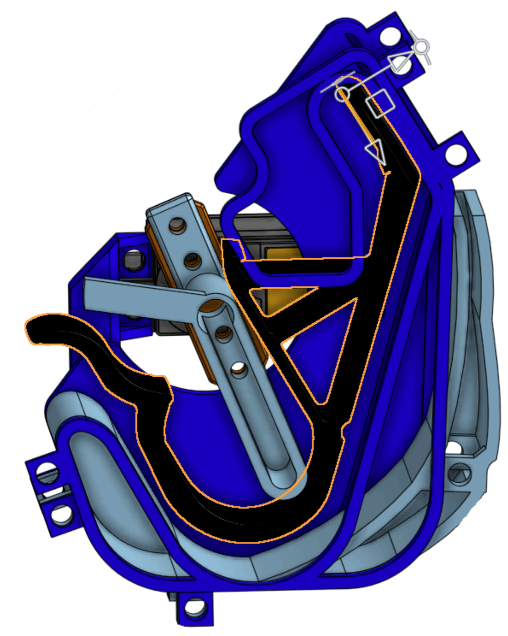
The Final design was made when we figured out how to put the clips in one specific orientation that needed to be angled and maneuvered through other systems. To do this we made multiple parts consisting of the clip mag and connected it with screw holes, finally arriving to clipping it onto the sample.

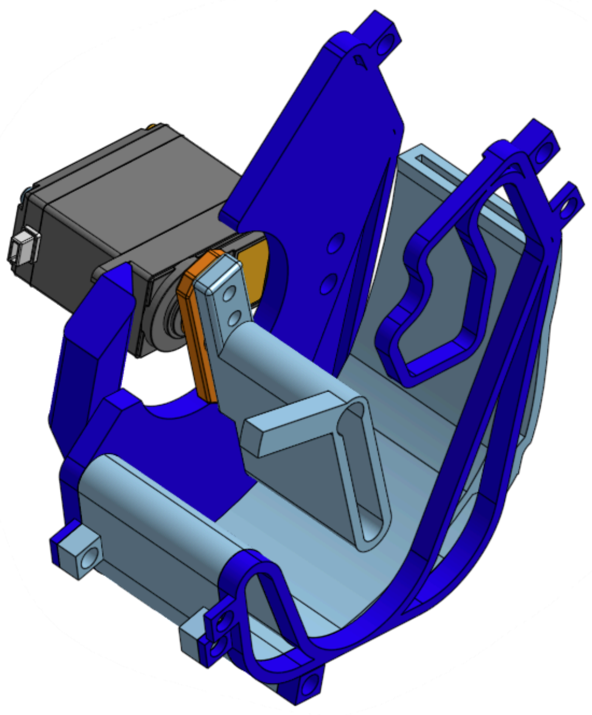


Rotational Part of Final Design

Clipping System

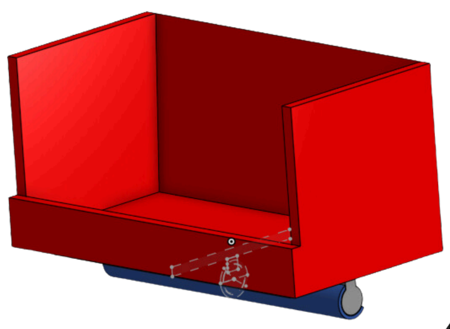
To actually make a sample into a specimen, we designed a system that allows a clip to clip onto a sample and then be picked up by the outtake and a back wall that supports the clip. Multiple iterations were considered and made as this posed many challenges. Our final design landed with the sample being directly above the clip.





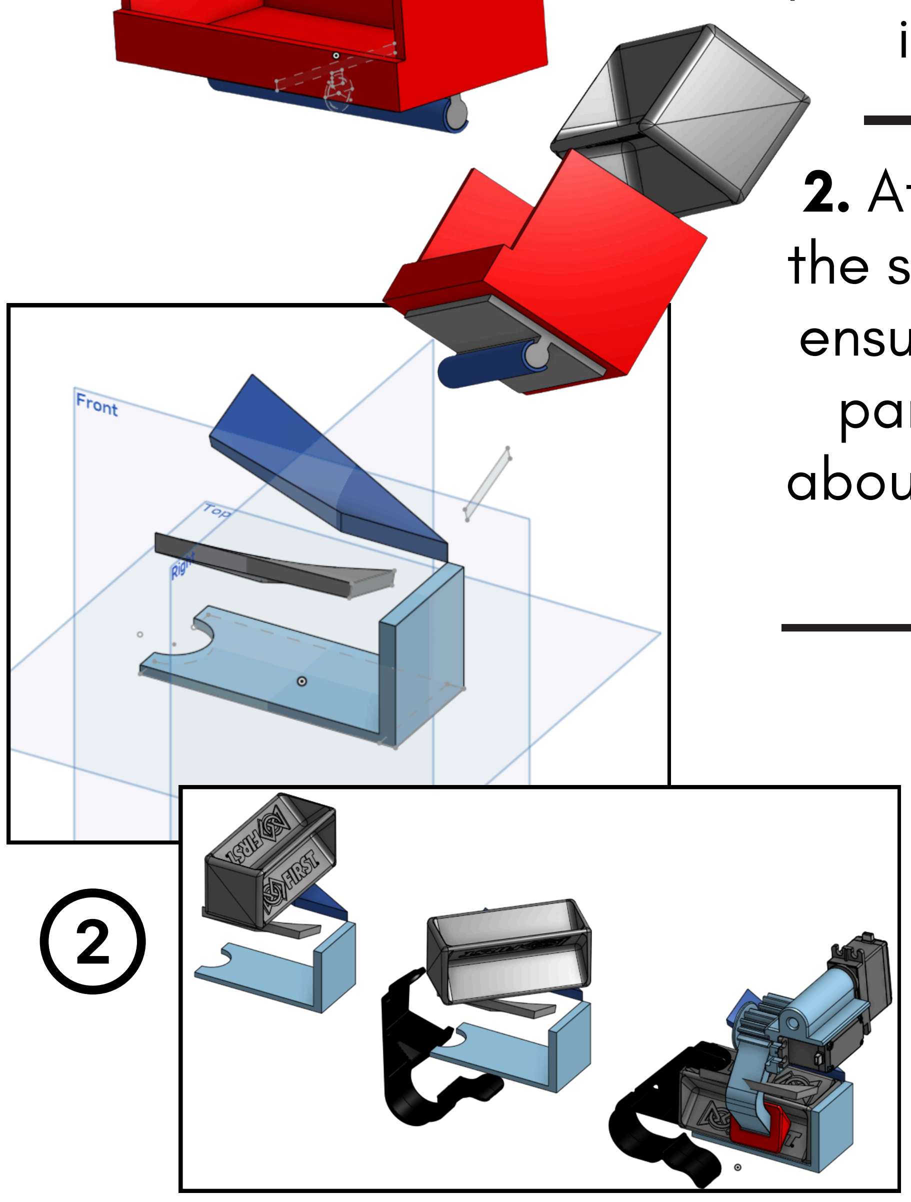
Clipping System

Sample Bucket



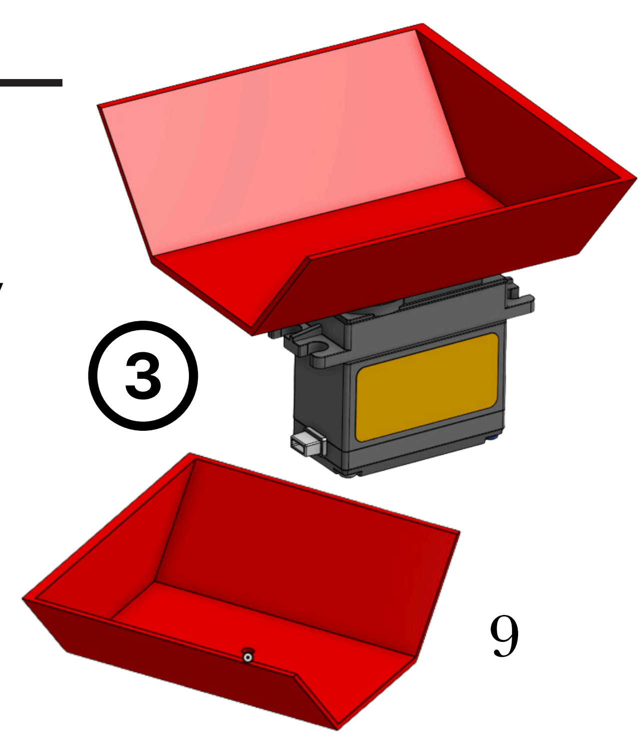
1

1. Initially, we designed the sample bucket to work with a roller intake. The prototype featured a box shape with a shortened front wall to retain samples inside. It could then rotate to dump the sample onto a conveyor belt.



2

2. After switching to a claw intake with a clipping mechanism, we modified the sample bucket to have an open-walled design with a cut-out bottom. To ensure the sample falls into the bucket in the correct orientation, we added panels above the bucket for reorientation. However, this raised concerns about the claw interfering with the panels and the panels creating too much friction for the sample to slide easily into position.

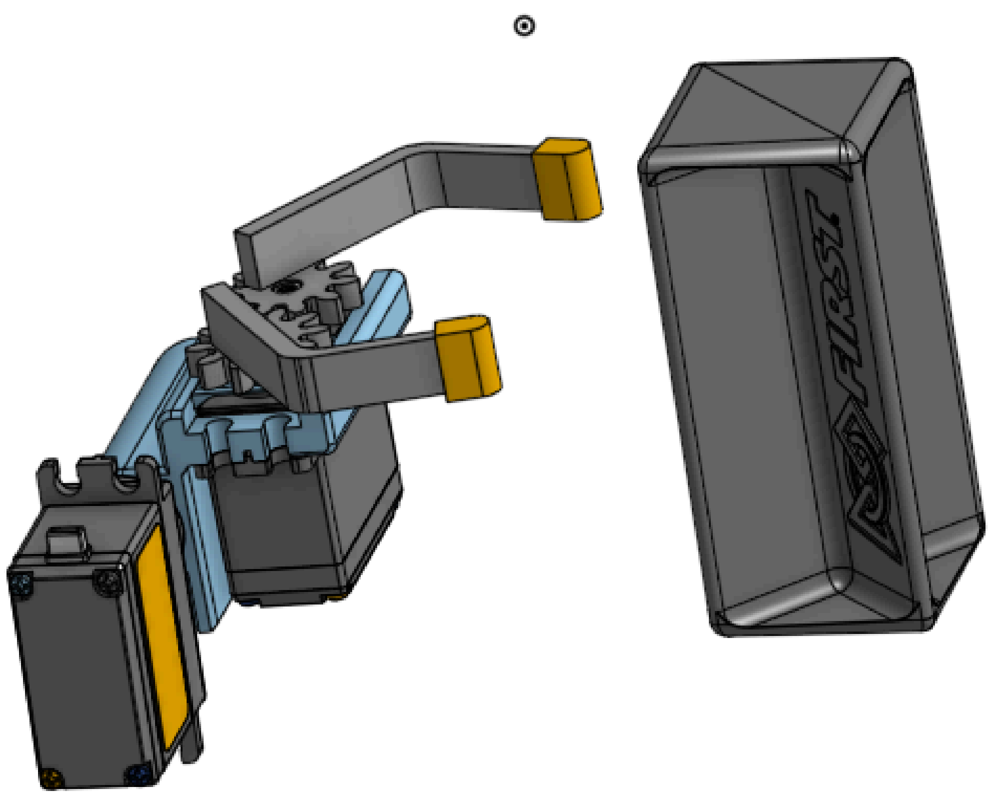


3

3. Our final design was an open-ended bucket with 3 slanted walls that would keep the sample from sliding out while also being wide enough not to interfere with the claw intake. A hole was made at the bottom of the bucket for a servo to attach to, which will allow the bucket to quickly rotate 90 degrees into the correct orientation for the clipping mechanism, regardless of how the sample was initially picked up by the claw.

Outtake

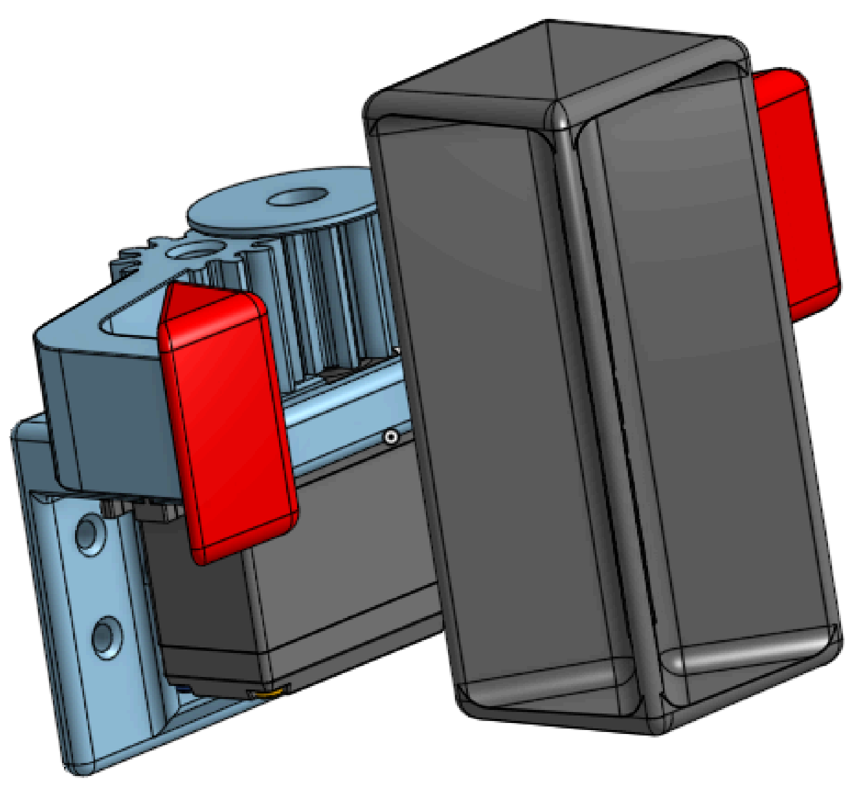
Outtake Claw Ver 1



Progress Over Time

At the beginning of the season, our goal was to design a claw specifically optimized for clipping a specimen. We made significant progress early on, focusing on refining the claw's functionality for this purpose. However, as we progressed into mid-October, we encountered challenges, including insufficient friction between the servo and its attachment. Despite these setbacks, we successfully resolved these issues and have developed the final version of the claw.

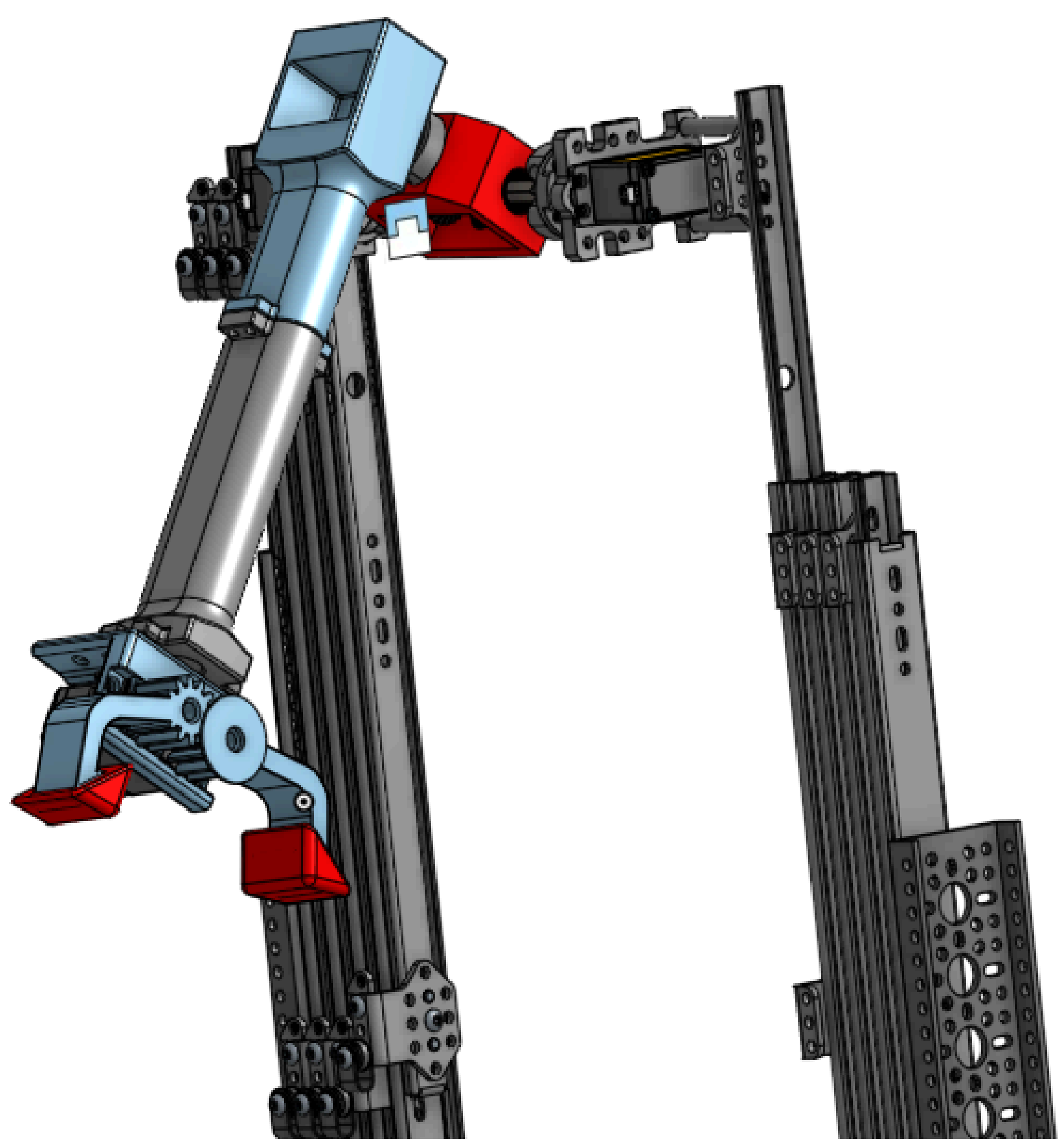
Outtake Claw Final



Claw's Specialty

The claw tips were 3D-printed using TPU material to enhance grip, ensuring a secure grab. Additionally, the tips are designed to be removable, allowing for quick replacements if they become damaged between rounds. The claw has been engineered to provide a precise fit, enabling efficient and reliable clipping of specimens.

Full Outtake System



Outtake System Walkthrough

The outtake system is initiated when the intake system places the sample into the sample bucket. At this stage, the clipping mechanism attaches a clip to the sample. Following this, the outtake claw picks up the specimen with assistance from the outtake arm and vertical slides. Once the specimen is secured, the arm provides a wide range of movement across the X, Y, and Z axes, allowing for the clipping process to be performed efficiently and effectively onto the submersible.

Hang

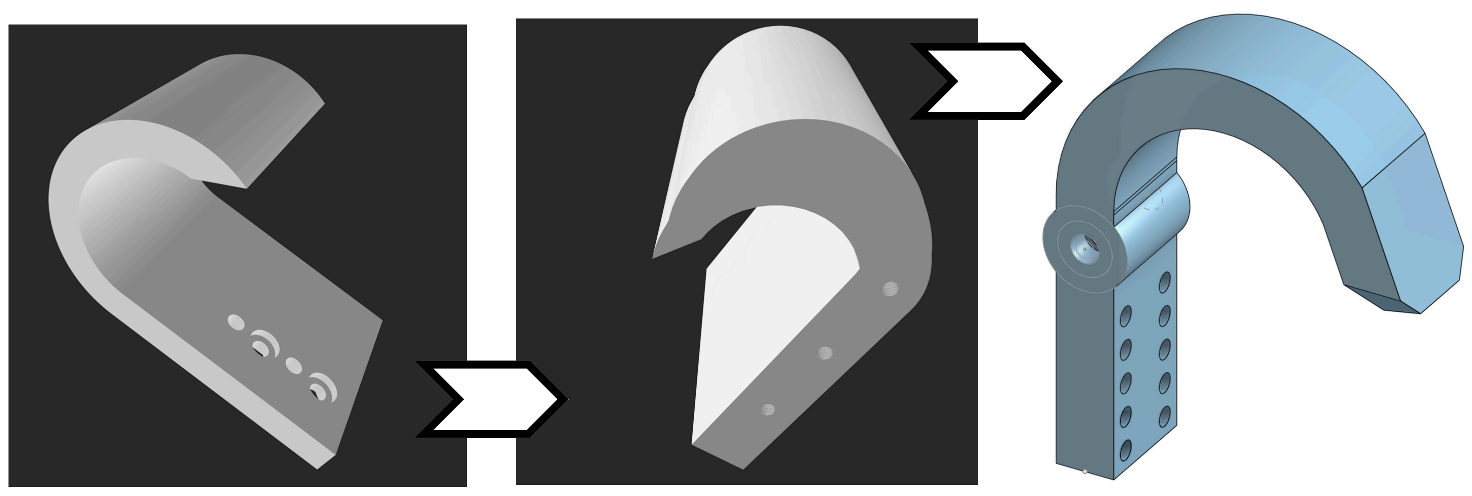
BRAINSTORM - DESIGN - PROTOTYPE - TEST - ITERATE - FINALIZE

Phase 1 : Brainstorming Ideas

Researched 3 different hanging styles : Motorized Hang, String Attached Hook, Viper Slide Hook. Drew out the designs on paper individually and a version of them on the robot.

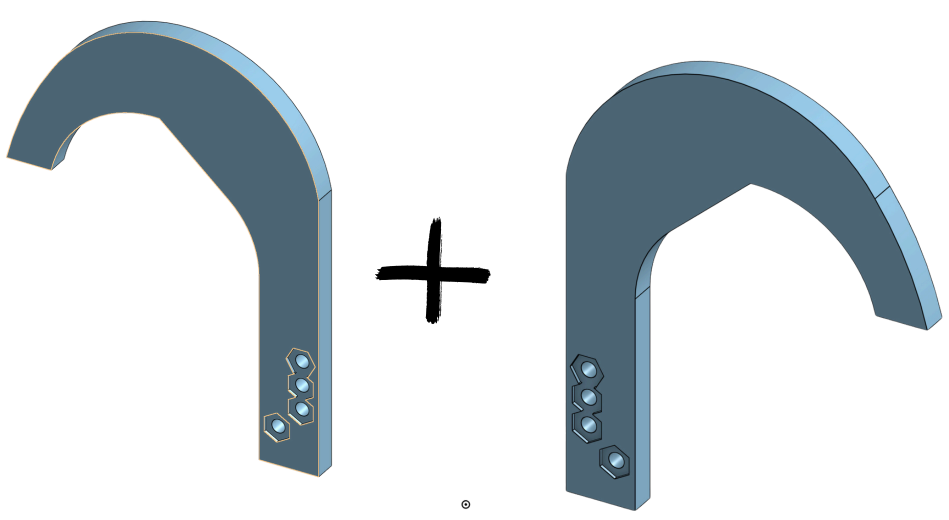
Phase 2 : Designing On CAD

Designed and customized all 3 versions on CAD software to allow team members to see which one fits best, instead of wasting print material on several used parts.



Phase 3 : Printing Prototypes

Decided on printing the viper slide hooks and customized the design more in CAD to allow it to seamlessly fit on to the robot.

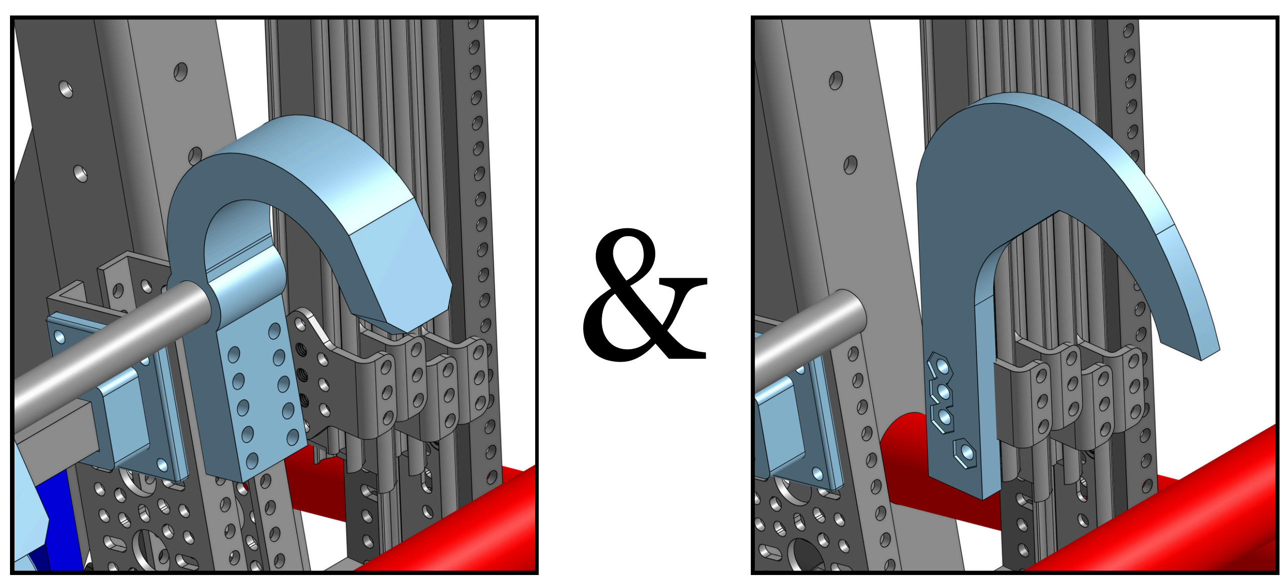


Phase 4 : Testing Drafts

Attached the hooks on the viper slides. The strategy is to hang with primary hook on 1st bar, then lower the bot so secondary hook holds on → Primary hook goes up with vertical slides and robot hangs on 2nd bar.

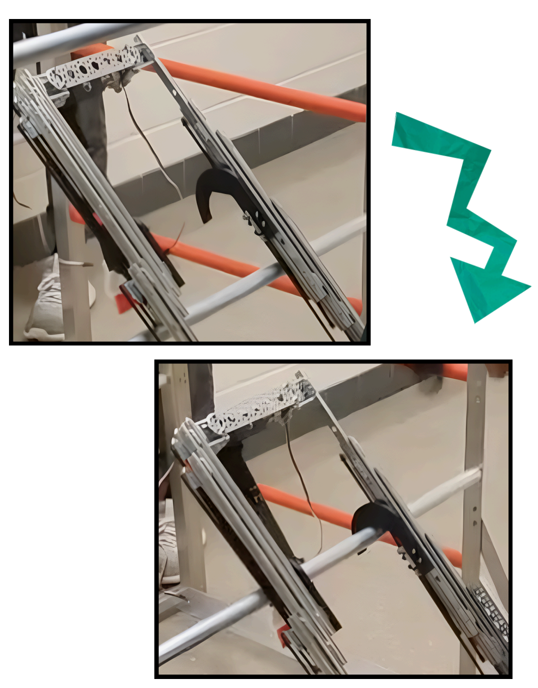
Phase 5 : Reiterating on CAD

Went back to the CAD software to identify the exact issues in the prototype. Redesigned the holes on the piece to allow the M4 nuts to better latch on and hold the design to the viper slides. Furthermore, we made the design thicker to prevent any future incidences of breaking when it can't resist the magnitudes of stress from multiple practices and competitions anymore.

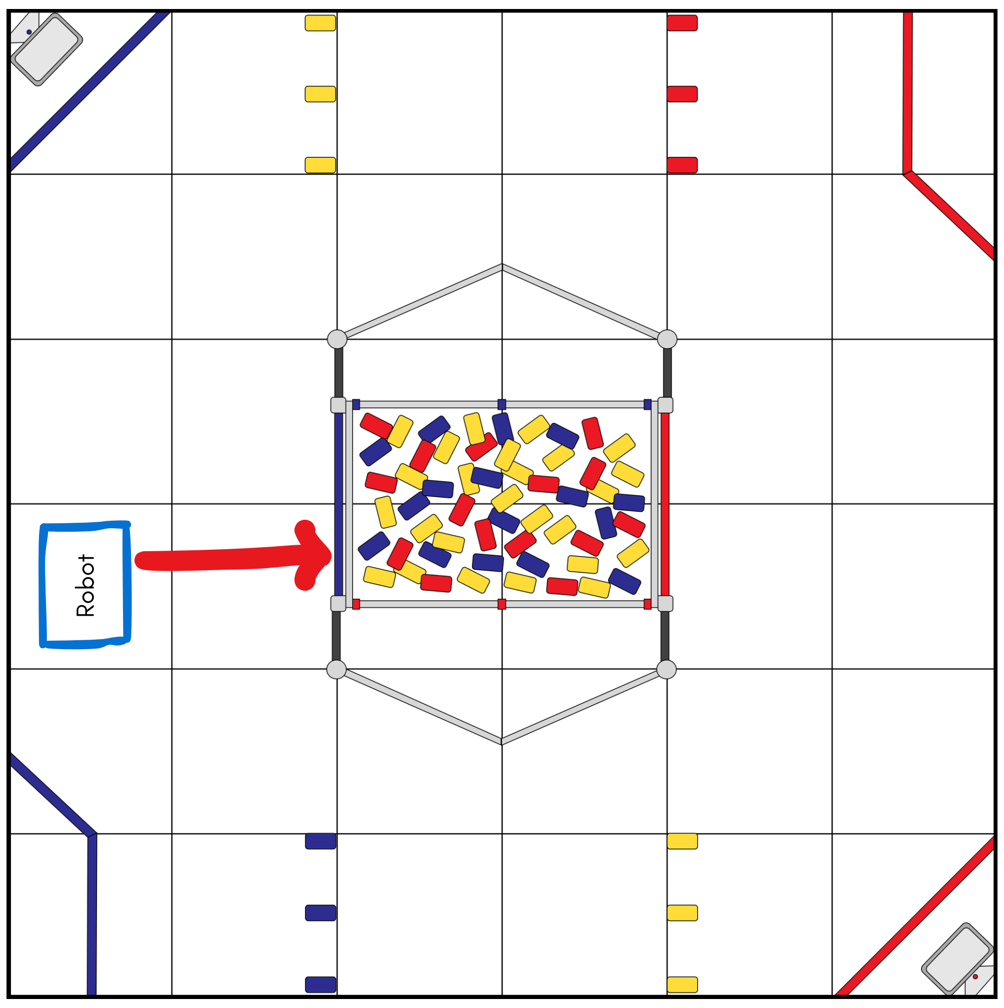


Phase 6 : Finalizing Last Print

Printed & screwed in the latest version of the prototype on the robot with the M4 nuts & bolts in the redesigned holes.



* Auto. & TeleOp *

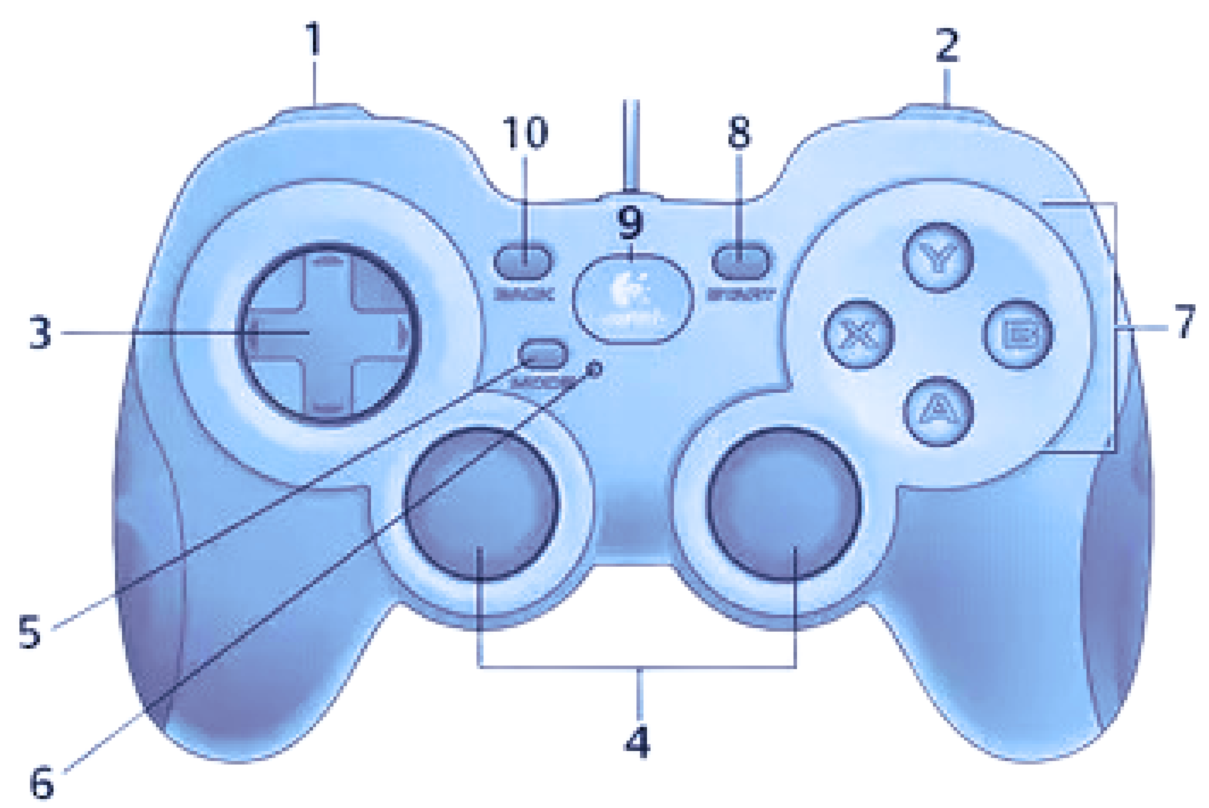


Autonomous

To prioritize scoring during the autonomous period, our robot will follow a simple path forward up to the submersible where it will then hang a preloaded specimen, scoring our team a total of 13 points.

TeleOp Controls

Driver 1



1 – horizontal slide backward movement, triangles open
2 – horizontal slide forward movement, triangles close
4 – drivetrain movement control
7 – arm movement (A – rotates backward, Y – rotates forward)

1 – open outtake, upward movement of vertical slides
2 – close outtake, downward movement of vertical slides
3 – clip and sample bucket rotation (left – counterclockwise, right – clockwise)
4 – vertical slide and claw movement
7 – outtake orientation (X – rotate clockwise, Y – move up, A – move down, B – rotate counterclockwise)

Driver 2

Outreach Overview

483 people reached

830 total hours spent

Wootton Robotics Club

Our school's very own robotics club inspired us to embark on our FTC journey; we cultivated an environment in which students could team up and combine their ideas to build a robot to complete specific tasks, very much like FIRST does with FTC. We found comfort in the robotics community we built at school and constantly sought for new ways to challenge every members' creativity and intellect. However, we wanted to extend further outside school and found that FTC offers us to dive deeper into the world of robotics while still aligning with our club's core values.

First Robotics Meeting of the 2024 - 2025 School Year!

KID Museum

Since October we have been in contact with the KID Museum Bethesda Metro Center, working together to host a robotics workshop for elementary school children 8 through 12 at their establishment. In this event, we plan to have different activities for the children to interact with different stations all revolving around CAD, LEGO building, and block coding. This event will allow young children to get exposed to some key concepts with robotics and help them learn new skills that can help them in the future in their STEM classes.

Fall Festival

Another one of our outreach events include having a booth at our community fall festival held at Wootton High School. During the fall festival, we were able to reach out to families and give them a summary of what we do as a robotics team. We also had sign-ups for children who were interested in participating at our event at KID Museum. Through this event, we promoted robotics to fellow students at Wootton HS and gave younger children a summary of what they would be doing if they chose to participate in robotics events held for them such as FLL.

Sustainability

MSDE Grant

We recently received a $6.6k robotics grant award from the Maryland State Department of Education. As part of the application process, we completed a comprehensive 24-page project narrative, signed by the Montgomery County Public Schools (MCPS) Superintendent, which outlined our goals and budget plan for expanding our school's robotics club and team. This document demonstrated how the grant would help us address previous setbacks related to our school's lack of robotics resources and support our mission of increasing opportunities for students in our local community to engage with robotics.

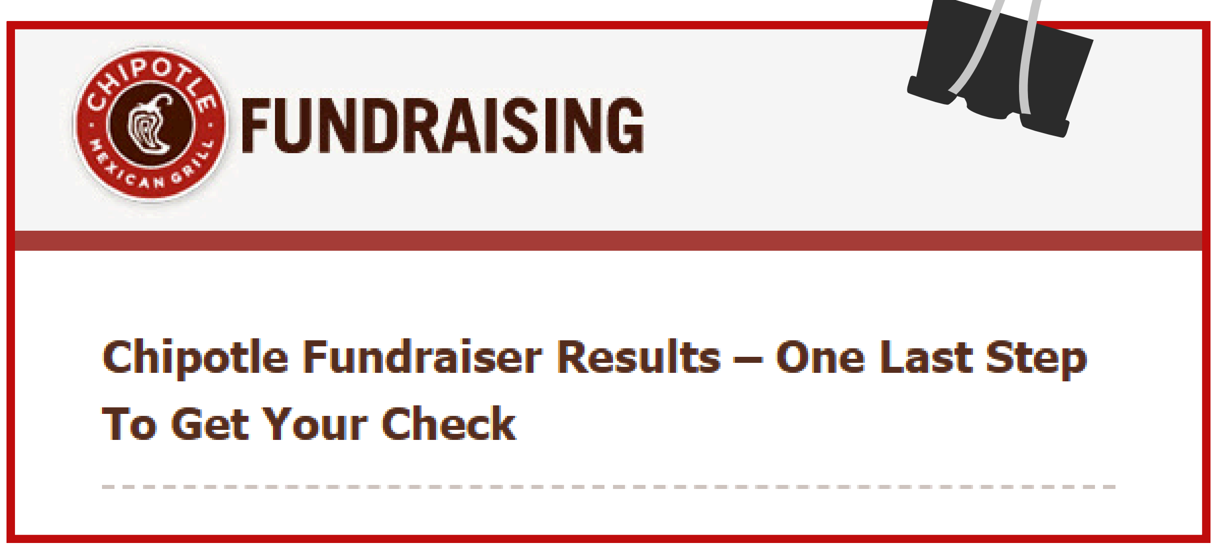
Securing this grant was crucial for our outreach and competition efforts this season, especially as we are unable to take on sponsorships under MCPS regulations as a school-affiliated team.

Maryland
STATE DEPARTMENT OF EDUCATION

As our team makes its debut this season, it has been particularly essential for us to secure financial support to establish a strong foundation for future seasons, as these funds are an investment not only in our current team but also in the future teams of Wootton students. With the grant, we were able to acquire the necessary resources to complete our robot and expand our hands-on activities within the club. Obtaining this grant has allowed us to prioritize the STEM aspects of the competition rather than being preoccupied with financial concerns, allowing our students to embrace the full benefits of the educational and professional experience FTC offers. After the funding cycle concludes, the materials and robot parts used by the club and team for both competitions and practice can also be repurposed for future use, allowing us to continue expanding the STEM resources available for students in our community.

Fundraisers

In addition, we have also held a couple of fundraisers at our community restaurants. Last year, we hosted a fundraiser with Ledo's Pizza which helped us raise the funds to start our FTC team. Along with that, we hosted a fundraiser at Chipotle to be able to fund more materials for our team and club. These fundraisers allowed people in our community to help support the expansion of robotics in our high school.



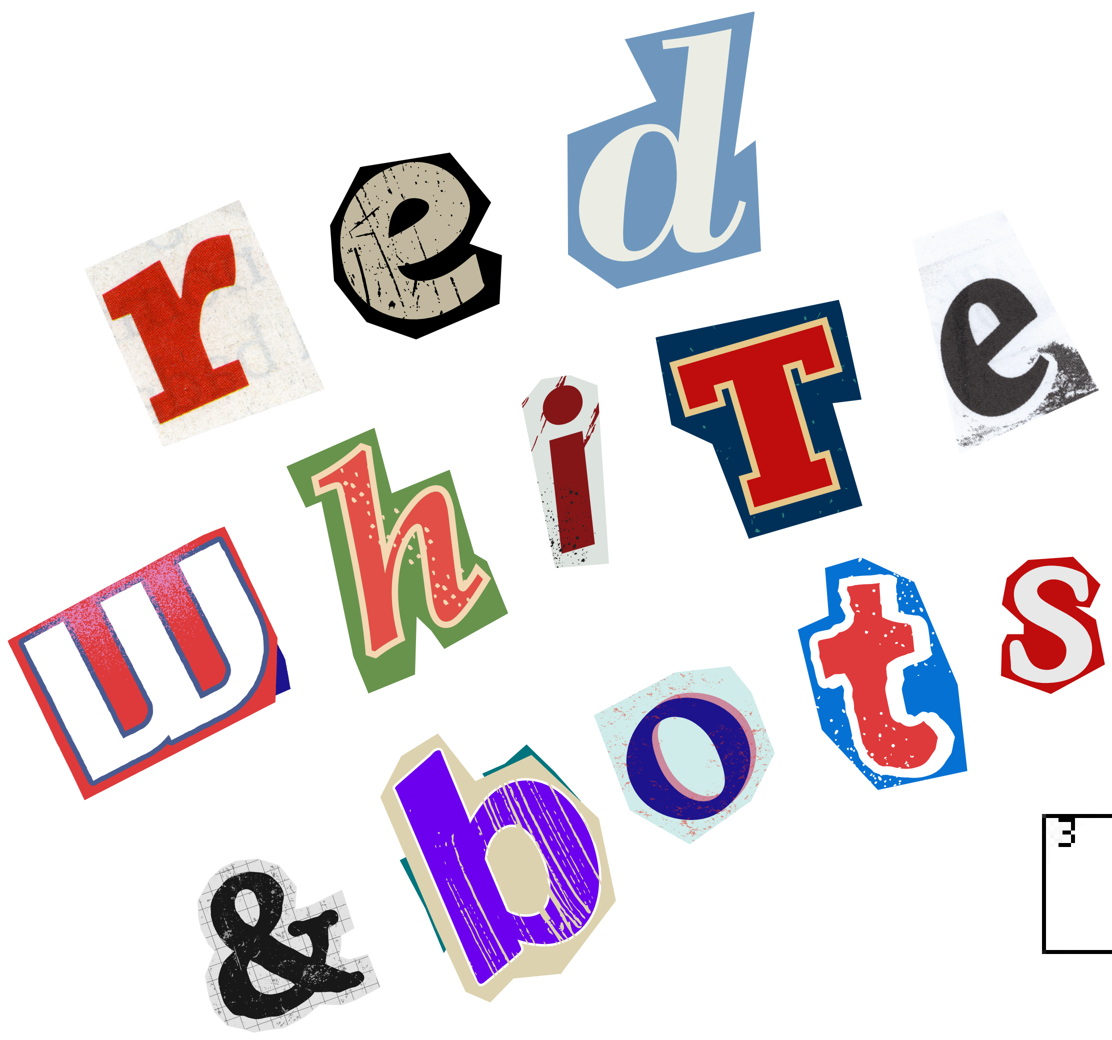
Future Endeavors...

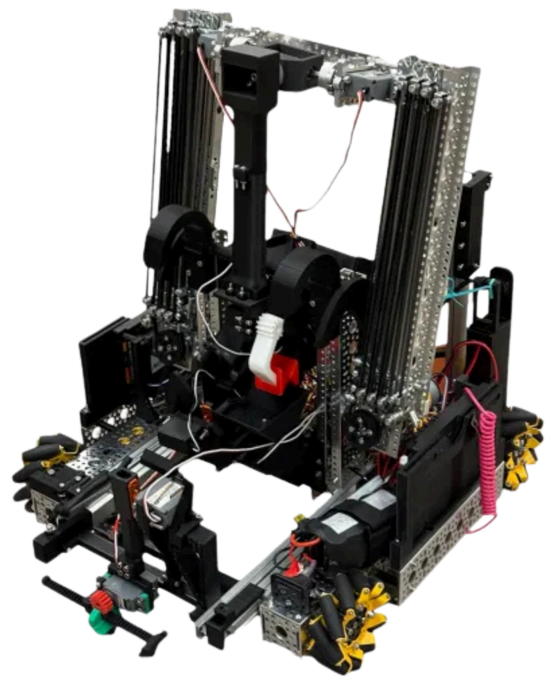
As we look toward the future, our team is committed to continuous growth and innovation; our prime goal is to consistently display gracious professionalism as we continue to attract more people to our school robotics community. Currently we have been able to allocate much of our robotics club meeting times to teaching members how to use different tools such as CAD and allowing them to learn coding basics. We will continue to hold these educational lessons and strongly advocate for the members to join our FTC team as they have acquired the technical skills, allowing them to apply them in competition.

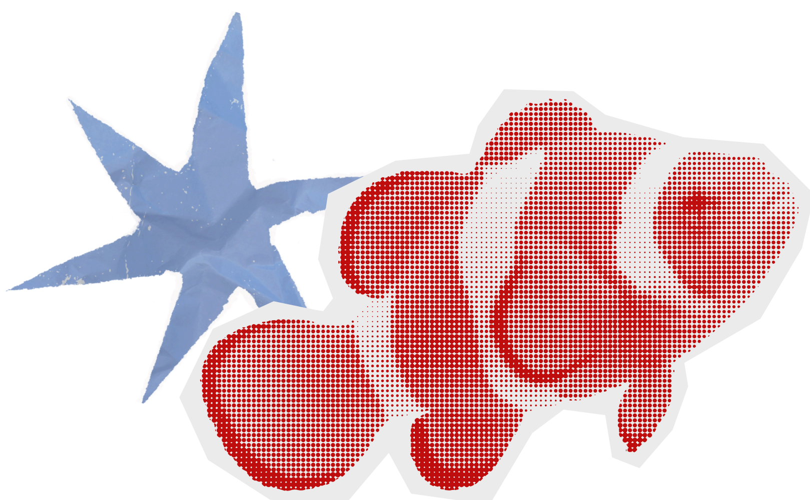
- Red White & Bots

Thank You

Enjoy this crossword puzzle!







DOWN:

1. Name of this season's game
2. The type of hat our team members are wearing
4. Intake object with a clip
5. The animal that is on the back of our crewnecks

ACROSS:

3. One of our team colors (hint: it's not an alliance color)
4. The structure that robots hang off of during endgame
6. Intake object
7. Name of the school we are based at