Chip, our robot

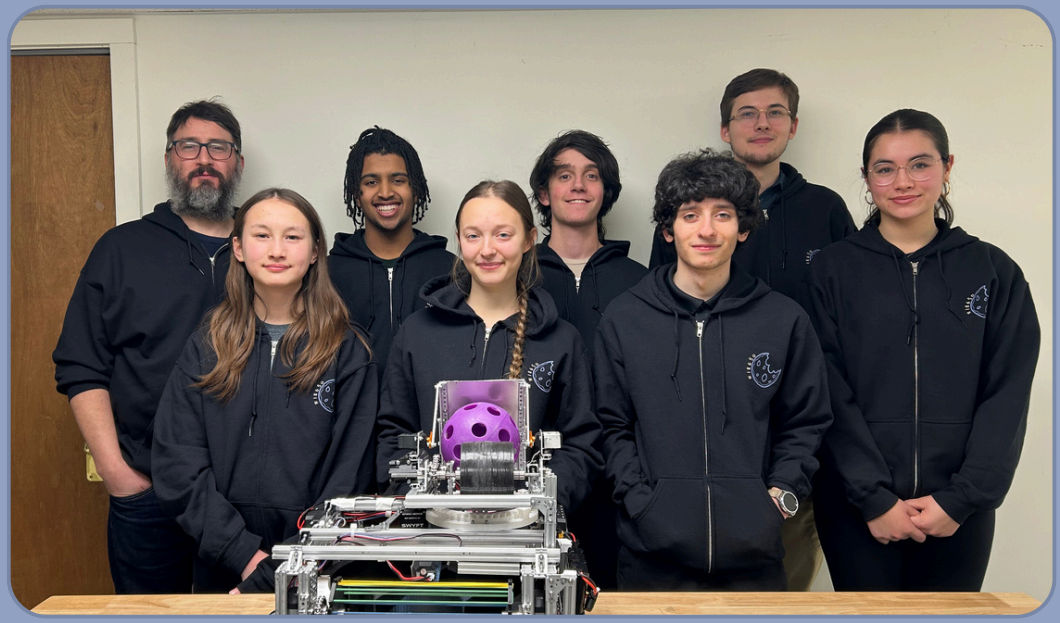
The Cookie Clickers

FTC 18650

Bennington VT, 05201

VT State Champions

Decode, 2025-2026 season



*Not pictured: Nolan, Tony, Eben, Chris

Meet the team

Callam Jomaa
Senior
Team Captain
Software

Nolan Hunt
Senior
Mechanical and CAD

Abeh Woods
Senior
Mechanical and CAD

Jenna Babushkin
Senior
Mechanical

Althea Radocchia
Junior
Outreach and Documentation

Colton Gigliotti
Junior
Mechanical and CAD

Eleanor Radocchia
8th grade
Mechanical

Coaches & Mentors: Peter Radocchia, Chris Callahan, Ben Schwartz, Tony Jomaa, Eben Radocchia, Fanglai Wang

Season timeline

September 6: start of season

- Hosted game reveal with team #16221, Manchester Machine Makers.
- started thinking game strategy — what did we want to do/focus on?
- Scheduled scrimmage with the Manchester Machine Makers (11/6)
- Started brainstorming and prototyping

October 6-November 5

- Finished first prototypes and started to test them
- Figured out what needed to be fixed
- Started the second round of prototyping and iteration

November 5-January 5

- November 6th — scrimmage with Manchester Machine Makers
- Discussed different game strategies/designs/ exchanged ideas
- Continue to iterate on designs
- Begin work on engineering portfolio

January 1-March 7

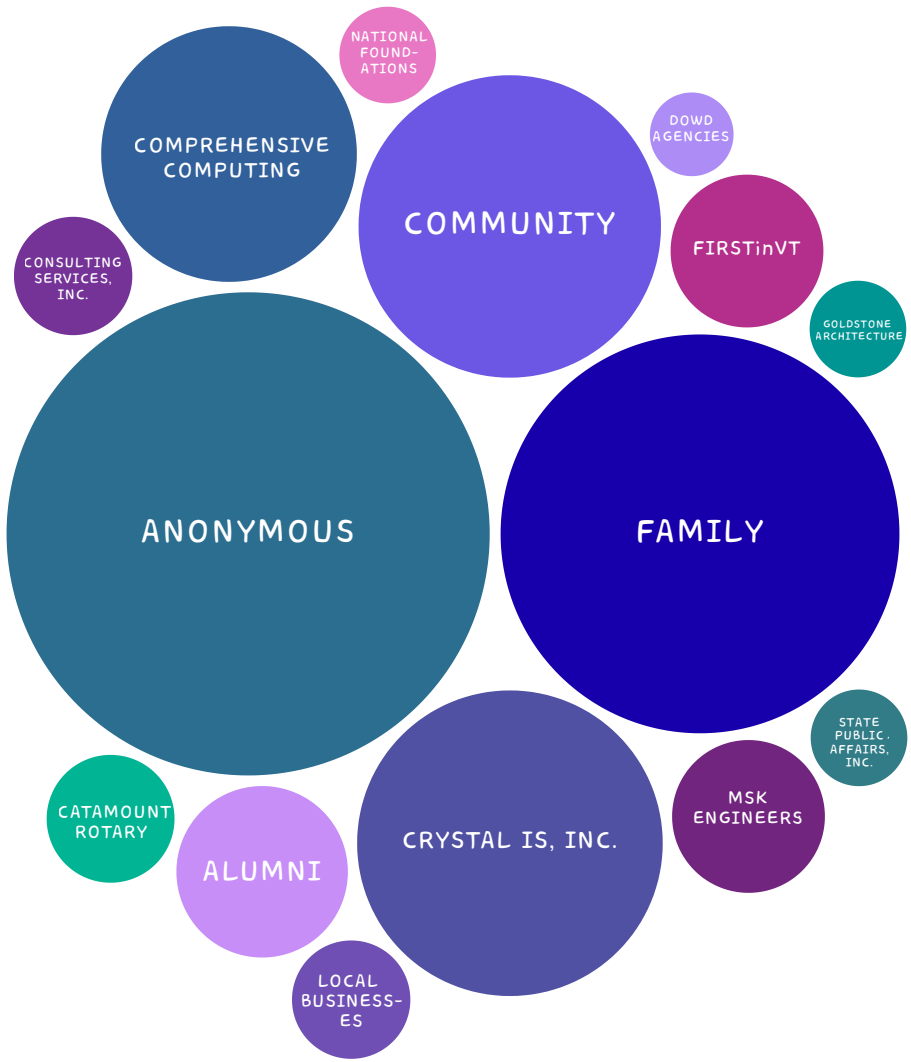
- Planning and hosting the 1st ever Bennington Qualifier (Playoffs & Control Award!!)
- adjusting and fixing our robot based on our expierence at the Bennington Qualifier
- Norwich Qualifier (Playoffs & Inspire Award!!)
- reprinting, copper taping etc to prep for states

March 7 - April 29

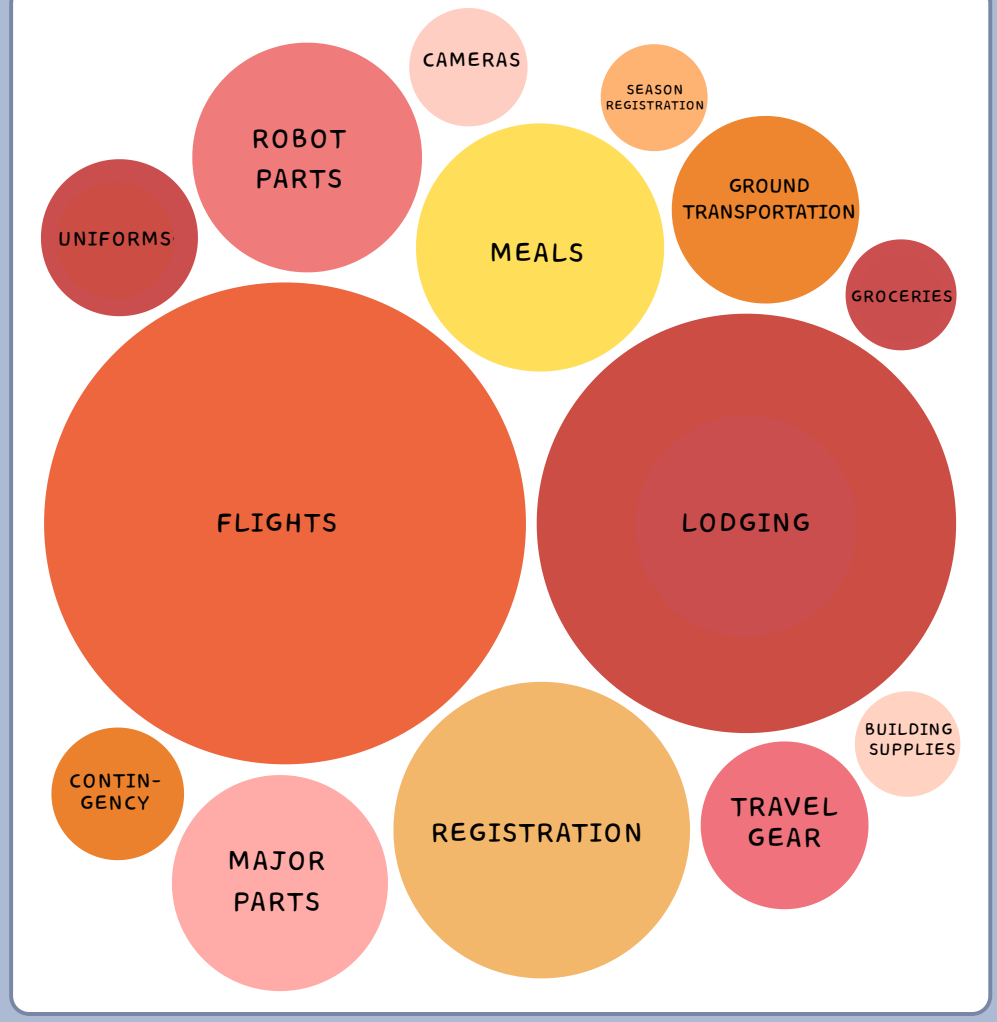
- VT State Championship INSPIRE AWARD 1ST PLACE IN STATE
- replacing the aluminum hood with a 3D printed one
- Lots and lots of fundraising (goal $23,500)
- modifying current subsystems and adding volleyfire

Finace

Income



Expenses



In-kind Support from:

- Ramunto's
- our families: Radocchia, Jomaa, Hunt, Woods, Gigliotti, Schwartz, Callahan, and Babushkin.
- Southern Vermont Supervisory Union

Awards

2021 — Control Award, Think Award, Innovate Award

2022 — Motivate Award

2024 — Innovate Award, Winning Alliance (1st team selected), New England Premier Event

2025 — Control Award (Bennington Qualifier), Inspire Award (Norwich Qualifier), Inspire Award (VT State Championship)

Pre-season outreach

Spring 2025

brought our robot to an FRC scrimmage where we had a table

New England Premiere event - we placed 15th in our division

Visited lego robotics club at our local middle school, Mount Anthony Union Middle School

Visited Catamount Rotary

Visited our local high school, Mount Anthony Union High School

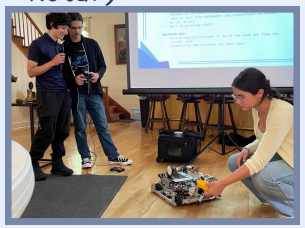
Summer 2025

Visited Beech Street School

Co-hosted an Open House with the Manchester Machine Makers

Visited Mack Molding, a leader in custom injection molding, and recruited a new mentor

Visited Bennington Rotary



Visited and presented at Camp Ondawa

Recruited 7 students and 3 mentors

In-season outreach

Fall 2025

Co-hosted a season launch party with the Manchester Machine Makers

Started a new team with the new recruits+mentors, #32473 Bennington Bolts & Biscuits. meet at the same times, exchange ideas, and mentor

Co-hosted scrimmage with the Manchester Machine Makers: exchanged ideas/experiences and brainstormed problems together

Presented our robot and our team to the Bennington Select Board

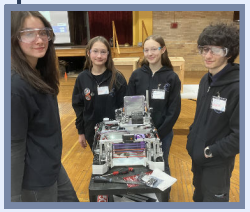
Winter 2026

Co-hosted the first ever Bennington Qualifier with the Manchester Machine Makers and Bennington Bolts n' Biscuits

Many of our volunteers we found through our outreach to Mack Molding

Attended the Norwich Qualifier in Northfield VT

INSPIRE AWARD!!!!



Spring 2026

VT State Championship

INSPIRE AWARD 1ST place in VT!!!

Presented to SVSU Board

Fundraising through social media, newspaper, flyers, word of mouth

This is our 1st year attending the FIRST CHAMPIONSHIP!!!

Strategy and scoring goals

We began the season by identifying all the various ways to score points. In previous years we had not focused on the patterns. This year, however, we wanted to be able to consistently follow the patterns on the obelisk

We wanted to be able to identify which colored artifacts we had in the mixer so we could launch in whatever order and pattern we wanted

- We achieved this through the use of color sensors and RGB Indicators.
    - When we collect the artifacts, the lights on top of the robot light up with the respective colors of the artifacts

We also wanted to automate as much of the robot as possible to make the whole match less stressful and also run smoother. We wanted to minimize the chances for human error

- Our robot can detect which colors we have in our mixer at a certain time and spin and shoot the desired color with the press of a button
- One of our reach goals this season (which we have achieved!!) was to be able to be able to shoot from any of the designated shooting zones
    - we also wanted our robot to be able to fully rotate to the turret and aim itself (which it can also do now yay!!)
        - this would allow us to avoid defensive tactics of the other alliance and also allow us to me more flexible with positioning during the match and thus a better alliance partner

we are also focusing on parking and more specifically, being the first robot back to the base at the beginning of end game

Risk Management

Within the Engineering Process:

This season we wanted to find away to both explore our many different ideas but also stay on track to have a reliable robot built in time for competitions.

To do this, we prototyped and built our subsystems separately and then mounted them like puzzle pieces onto our robot. This ensured 3 things:

1. our robot would be easy to disassemble and therefore easy to mend should something break
2. no two subsystems would become overly reliant on each other. This ensures that if one part of the robot fails, it doesn't cause a chain reaction
3. we could work more efficiently —> different members could work on different parts of the robot simultaneously, allowed for parallel growth

We keep all of our early prototypes and sketches in our Engineering Notebook to maintain an archive that we can look back on.

In Game:

We went into the season unaware of how large a role defensive maneuvering would play and so we had taken very little protective measures with our robot. At the Bennington qualifier we lost a wheel and our collector got broken by another robot and so we decided we needed to add fenders and shields.

- reduced the size of our base substantially to make room.
- Now all the important things (control hub, battery, etc) are protected.
- This also had the added benefit of allowing us to open the classifier with any side of our robot.

We have also added a way to manually adjust our mixer to recenter it during matches to prevent jamming.

We use two controllers/drivers (less on one person —> more focus —> better performance):

1. to actually to drive the robot, launch artifacts, run the collector/flywheel etc
2. To use any of the failsafes we have should we need them, ex. Recentering the mixer

Summer Fun

Over the summer, we experimented with various different types of bases. In the past we had only ever used a square base with mecanum wheels. Although our current robot still uses this base design, the lessons we learned from our experimentation were very valuable

Swerve Base

Objective: have a unique base that was still functional

How it worked:

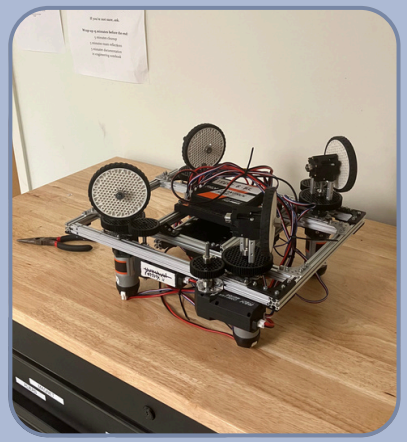
- wheels that rotated independently of the base
- achieves strafing and 4 wheel steering.

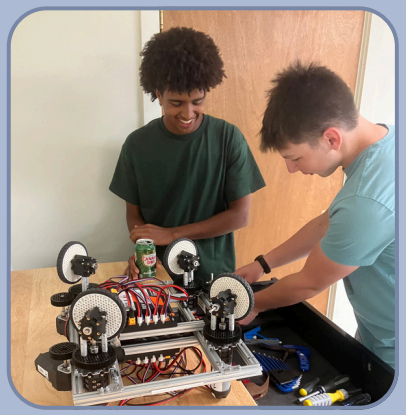
Why we didn't use it:

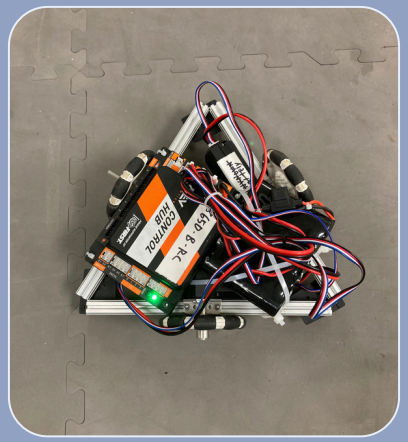
- too complex
- slow directional changes
- inefficient space and power draw.

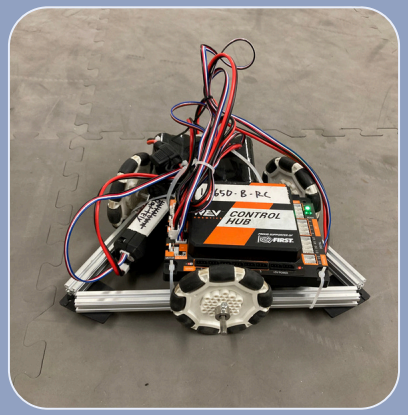
Discovered that the delta drive would be much better

- much simpler (equilateral triangle)
- able to change linear direction and orientation by varying the wheel power.









Delta Drive

Objective: to solve the issues of weight and a large number of drive motors while also keeping the maneuverability of mecanum wheels

This design utilizes three individually powered wheels that are each 60 degrees out of plane with each other

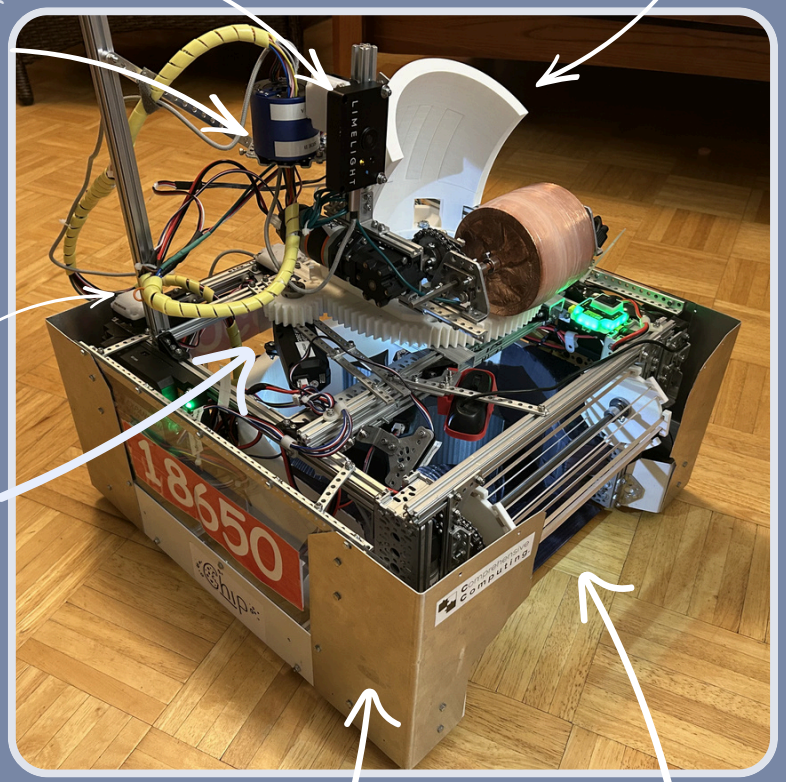
- allows you to spin them differentially
- achieve omnidirectional movement
- effective turning.

The wheels each have rollers on them

- if something is not moving directly in line with the wheel it wont stick to the ground or lose traction.

Our Robot

3/4 View



limelight camera

Launcher

slipring for 360 rotation

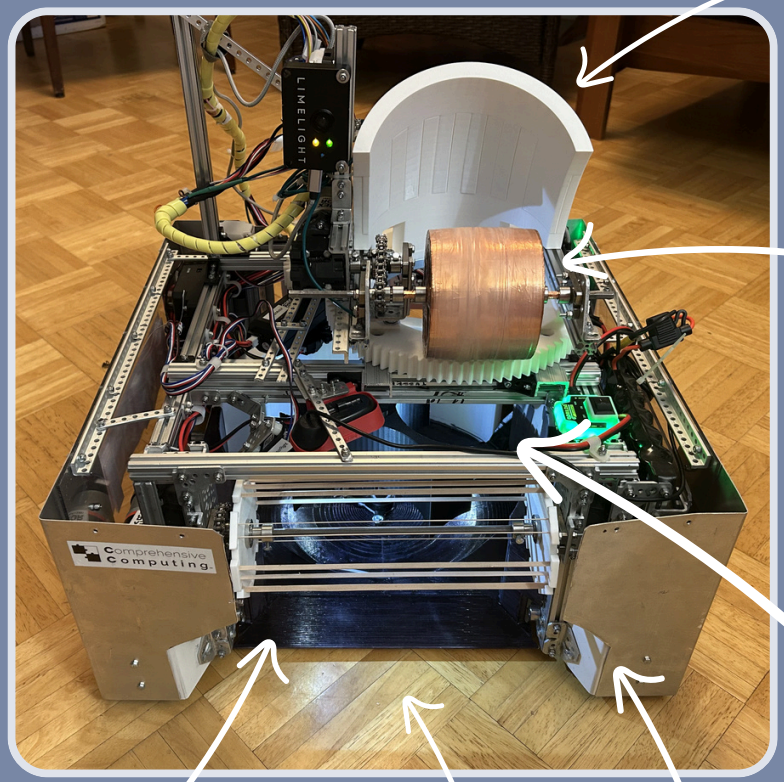
RGB indicators to tell us the color of the artifacts

3D printed turret

Shields to prevent damage

Old Rubber Band Collector that is being replaced (Come to the pits to see the new one!)

Side View



Launcher and flywheel

copper tape to ground the flywheel + protect camera

Mixer

Old Collector

Ramp to make collection into the mixer easier

Shields

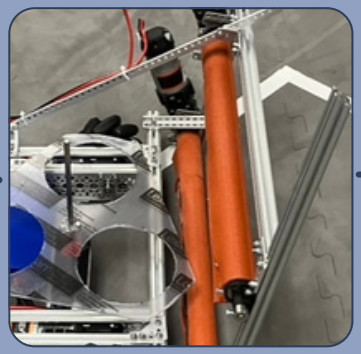
Unfortunately, due to the deadline for the Eng. Portfolio many of our subsystems were unfinished in time to make it into the portfolio. However please come visit our booth in the pits to see the final product and the culmination of our seasons work!

Design Process

Step 1: jot down ideas on design sheet, describe plan out prototype → Step 2:make a rough prototype out of spare parts/cardboard → Step 3: test it, find out the problems → Step 4: update/change the prototype from results of testing → Step 5: test and test again!!

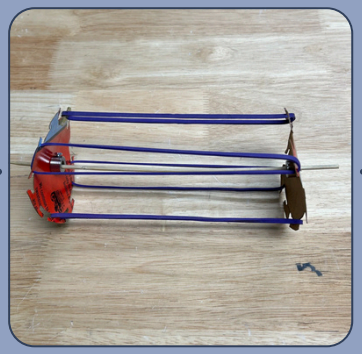
Collector

First prototype of collector – no design on paper

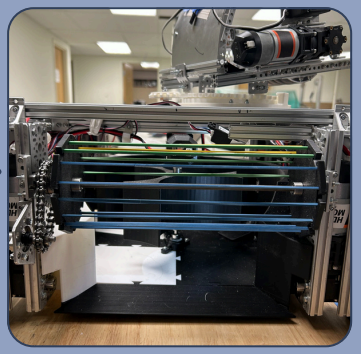


Second design of the collector, mounted on the robot

The collector with better mounting and rubber bands for grip

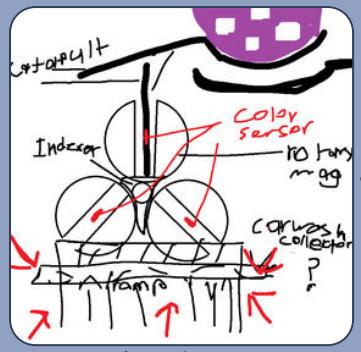


cardboard rubber band collector



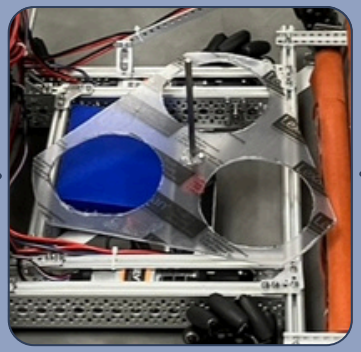
Current design of the rubber band collector

Mixer

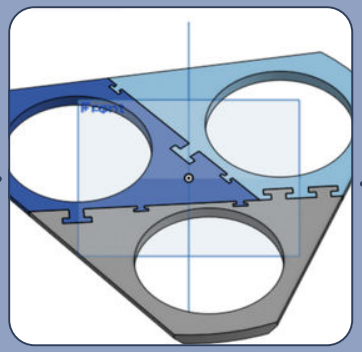


Initial sketch of mixer/storage of artifacts

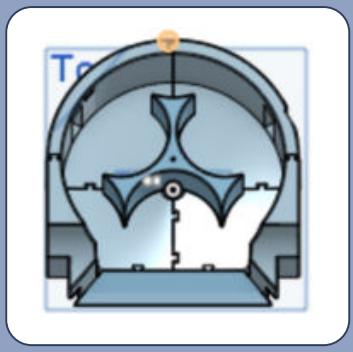
First cardboard prototype (way too big, but showed us we were on the right path)



Plexiglass design, was too difficult to trim

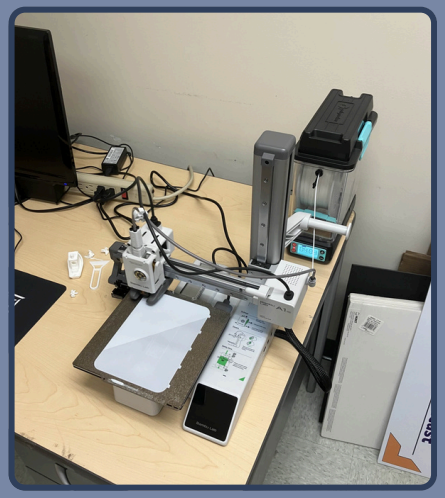


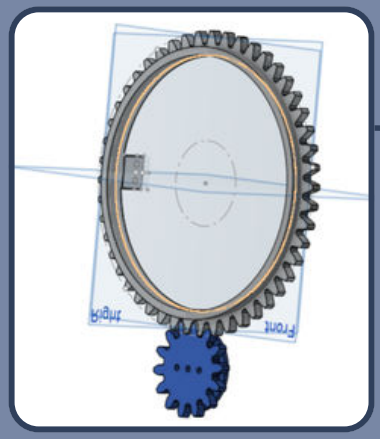
CAD design of turntable, design didn't work well with both collection and storing artifacts



Current CAD design of mixer – a lot better for collection and storing artifacts

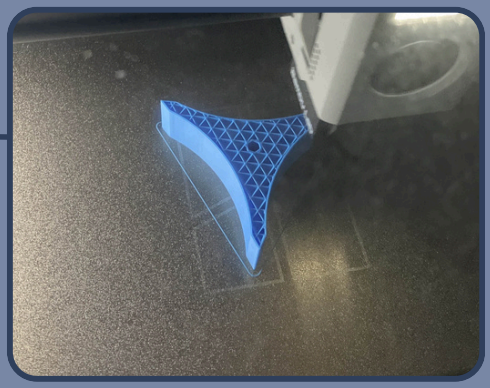
CAD and 3D printing



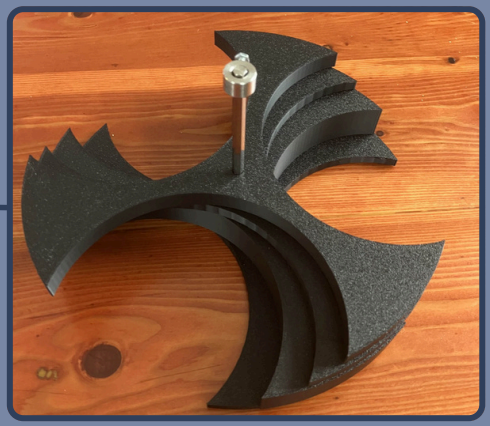


Iterations of the turret

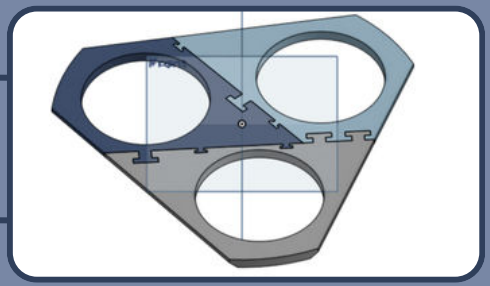
- CAD and 3D printing is new to our team this year, all of our previous robots had little to no 3D printed elements.
- we wanted to use CAD and 3D printing because they allowed for faster prototyping and better adaptability
  - they allowed us to save time and labor as well as have archives of our old work should we need it
- We invested in a $180 Limelight 3A mini from Bambu Lab in the beginning of the season
- Designed and printed many prototypes and final designs with it this year:
  - the mixer
  - The turret
  - collector pieces
  - the turntable
- Our new mentor, Ben, who we recruited through our visit to Mack Molding, works in 3D design and mentors us.
- one of the biggest challenges we faced while figuring out CAD was how to optimize print time and strength while also designing for tolerances
- To address this, we added fillets and thickened the walls of the mounting points for the turret
- We found that designing for tolerances was almost entirely trial and error



Iterations on the indexer centerpiece



side part of rubber band collector



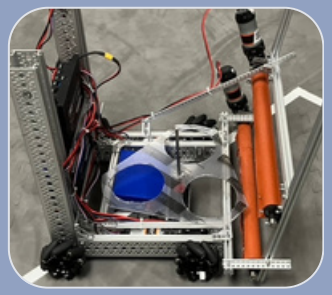
turntable design

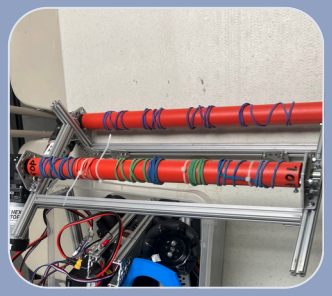
The Collector

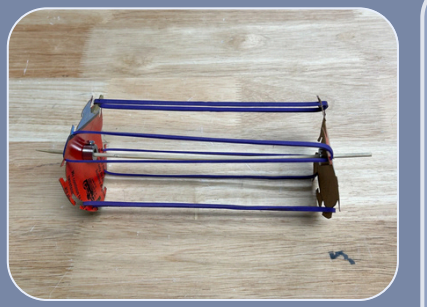
Design No. 1

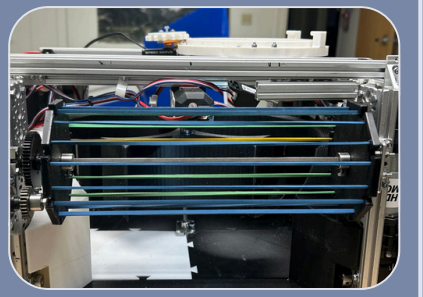
Two-bar collector:

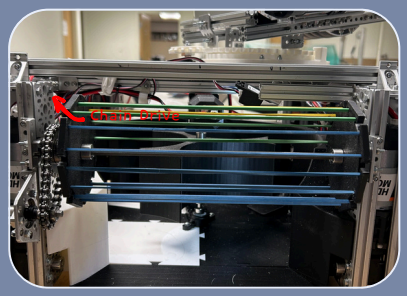
- Inspired by an FRC collector design
- made out of 2 poles with grippy foam, placed at an angle 12 3/8 inches apart
- the wideness of the collector was intended to be more forgiving
  - in previous years, we used pincher type collectors that needed very accurate placement
  - while we ultimately scrapped this design, this wideness continued to the next
- To collect, the robot would drive into the artifacts, grabbing them with the foam rollers, then launching them into storage
  - Ended up not working well: we struggled to consistently collect into the storage
  - also very big and unwieldy.











Design No. 2

Rubber band collector:

- Our first design for this collector was made of cardboard with rubber bands taught between the two end pieces.
- Our final design we made in CAD
  - Later changed the length of the hooks
- At first, we connected it to the motor with two gears
  - Later connected by a chain drive which was more adjustable
- This design has a similar idea as our two bar collector (wide opening and rotating inwards)
  - Has better grip and was way more consistent
  - Better to collect into mixer
- between the Norwich qualifier and the VT Championship we improved our collector mount
  - Used screws through plastic with washers instead of directly relying on plastic sizing
  - We also pinned axel mounts

Vector Wheel Collector

- After observing higher level teams play and studying their robots and design, we noticed a few common threads between the top teams, one of them being full width collectors
- one of our weaker/slower parts of gameplay was our collecting, cause we had to be precise
  - Give a larger mistake allowance and simplifies collecting by requiring less precision
- We use gripped vector wheels to drive intact balls into the proper intact zone (no longer needs to be lined up perfectly to intake)
- unfortunately, this wasn't finished in time to make it into the portfolio with pictures, but come see us in the pits to see the final product!

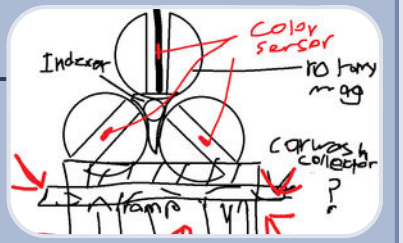
The Turntable & Mixer

We knew that we wanted to be able to carry multiple artifacts at a time and have a way to select which one to fire

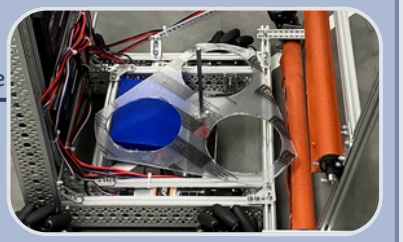
- We didn't want to be confined to shooting them in the order we collected them

The Turntable

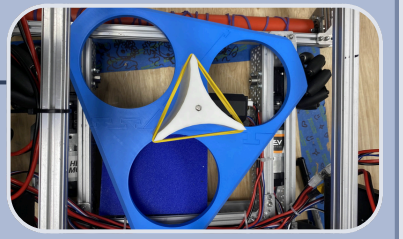
Callam's sketch



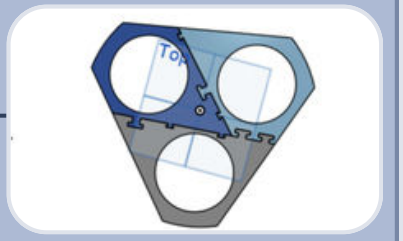
First prototype



final prototype



Design in CAD



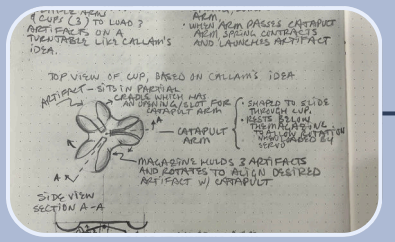
The Turntable:

- The turntable was our first solution: three cups in a triangle with an indexer separating them taking up most of the interior space of the robot
- The idea was to have it rotate as the collector sucked in artifacts, and then also rotate so we could select one artifact to be launched
- Our first prototype was made from plexiglass, which turned out to be too difficult to modify and cut into the shapes we needed.
- Our second was designed in CAD
- we discovered that it was too hard to collect into, and so we moved on to the mixer

The Mixer:

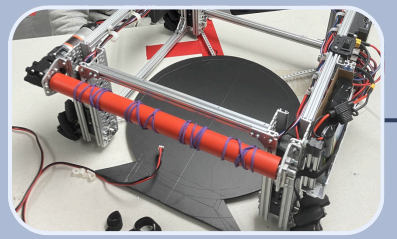
- The mixer was a very similar design as the indexer, but instead without the holes in the bottom
  - A bowl with an indexer in the middle that rotated to sort artifacts collected with walls on all sides
- We made our first prototype in cardboard, which was way too big
- Second in CAD
  - Measured out on hard plastic to make sure we could mount it without having to disassemble the entire frame of the robot
  - Iterated many times according to changing robot and new ideas
- We added color sensors so the robot could see what colors we had and autorotate and launch
- between the Norwich qualifier and the VT state championship, we retrofitted a ramp onto the front of the mixer for easier and smoother collection

The Mixer

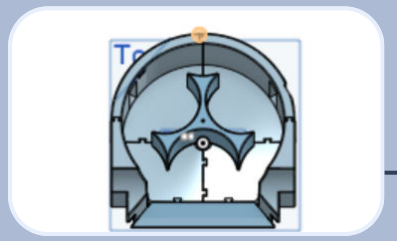


initial sketches

Cardboard prototype

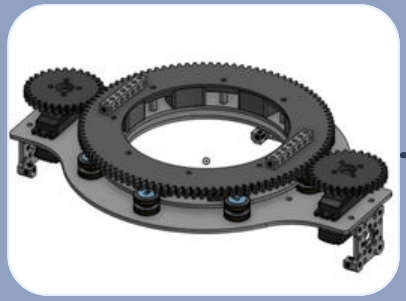


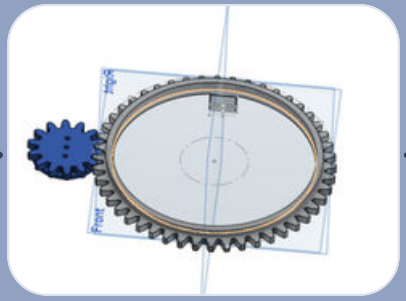
Design measured out on plastic

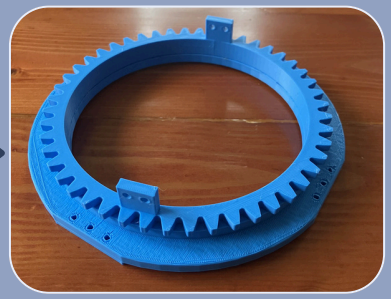


Current design

The Turret







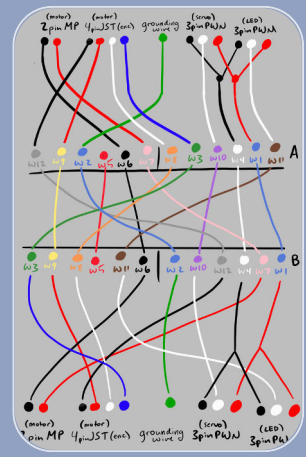
purpose: rotate the launcher to aim for the goal
- unable to rotate fully at the Bennington/Norwich qualifiers but it now can consistently

we wanted to be able to score from any scoring zones and not need to manually readjust
- It pivots itself automatically to always be aligned and aimed at the goal

- Our first prototype was 3D printed but it was too weak and broke (we later switched to printing in gyroid)
- also changed from using bolts + washers to designing integral 3D printed supports for the massive gear
- Found gear design on Onshape —> modified it to fit our robot
- the bearings and mount broke at the Norwich qualifier and we had to reprint it
  - we also replaced the guides for the artifact in the launch chamber to prevent jamming

One of our earliest dreams for the turret was 360 continuous rotation.
problem with this was wiring —> we are attempting to solve it via a slip ring
- fun, post season experiment
- learned how to solder

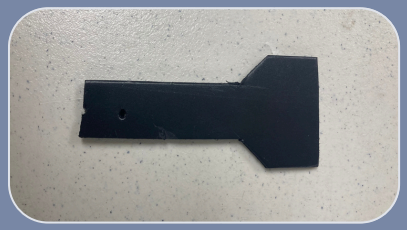
the slip ring would also help with target lock and automated firing

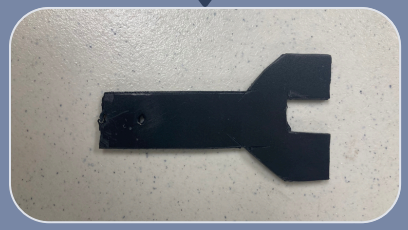


Wire map for the slip ring

The Lever Feeder

- Goal: push the artifacts up out of the mixer and into the launcher.
- We found that a lever was faster and more efficient than a lift
- it was difficult to find a design that would both fit under the artifact and not go through the holes in the artifact
- mounting was also difficult because we had to 3D model a hole through the wall of the mixer and find a spot to mount the servo
  - Needed to reprint a section of the mixer with a hole modeled for the feeder
- this was the design we used in the VT State Championship



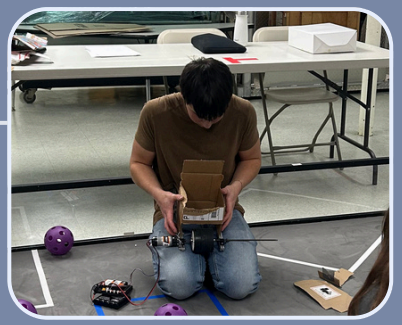


Ramp Feeder + Volleyfire

- Goal: to be a more competitive team
- We observed the most successful teams and found a common thread (volleyfire)
- We are replacing our lever feeder with a ramp feeder
- Our design has 2 parts
  1. a fixed ramp (all balls go over this) and
  2. a second stage (movable ramp, if not engaged, balls return to spindexer)
- Allows for order changes based on color selection
- When 2nd stage engages, any ball that hits it is volleyfired
- Unfortunately this was unfinished in time to make it into the portfolio but come visit us in the Pits to see the final product!!

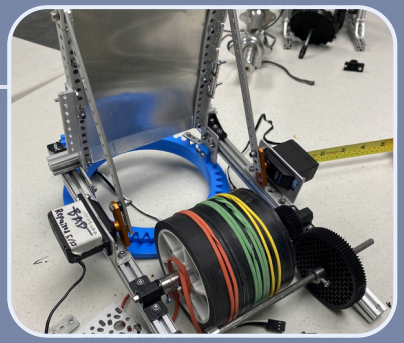
The Launcher and Flywheel

- We wanted to find a way to make the angle from which the artifacts were launched adjustable so we could accurately launch from different parts of the field.
- We decided on this type of launcher because of the fast spinning wheel, its fast spin up time and also because of how simple it was
- First prototype — cardboard hood launcher
  - Too flimsy, wouldn't launch well, and wasn't reliable
- Second prototype – adjustable aluminum hood
  - Wheel didn't have enough grip
  - but a lot more reliable when launching
- Third prototype – added rubber bands on the wheel, connected to the turret
  - Motor stuck out too much, didn't fit within the 18x18in cube
- Fourth prototype – changed motor mounting
  - However, the gears would slip off each other and get worn down
- Current design – changed to a chain drive and added electrical tape on the wheel
  - the flywheel automatically adjusts itself to the correct velocity to score depending on the robots location on the field
- At the Norwich Qualifier, the spinning of the flywheel generated electrostatic discharge that traveled through the camera wire and into the control hub, causing the entire robot to crash mid match
- Obviously this was a huge problem and we solved it by grounding the flywheel and turret with a grounding wire and copper tape. We also added a shield between the camera and flywheel for extra protection
- After the VT State Championship, we decided to replace the aluminum hood with a student designed 3D printed hood.
  - this new hood has much better adjustability of the angle of shooting — the old one could be adjustable but wouldn't keep a consistent contact patch so it wasn't a viable option.
  - The 3d printed design incorporates adjustability while keeping consistent contact patch with the ball.
  - This leads to consistent firing, helps with rapid fire, and additional firing stability

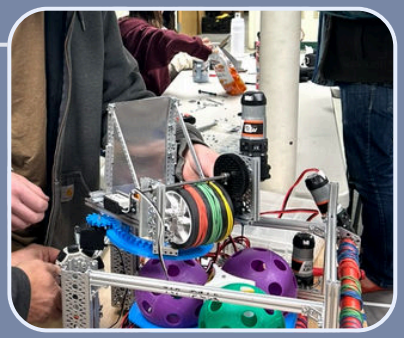


Cardboard prototype

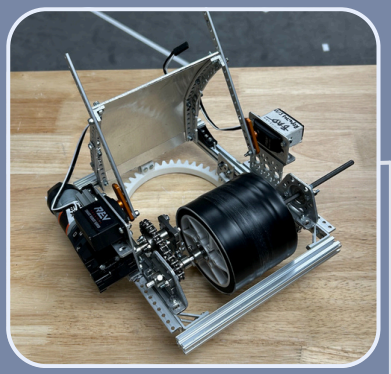
Prototype in aluminum



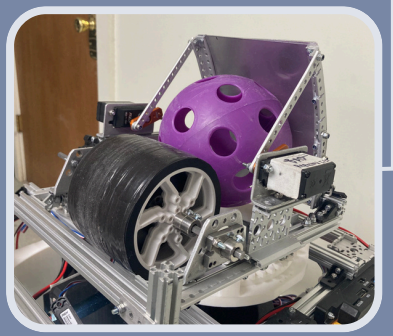
Modified prototype

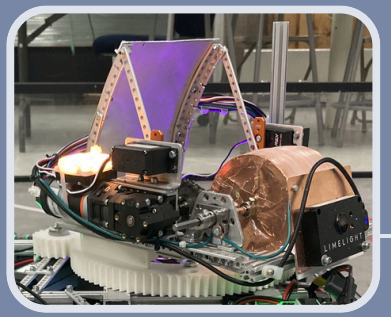


Launcher with motor sideways

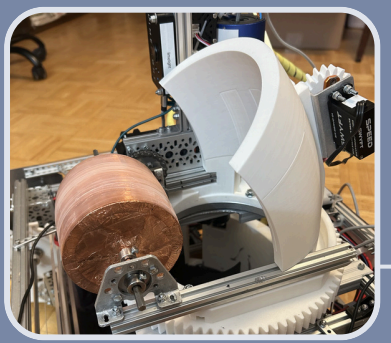


Design for VT State Championship (minus copper tape)





Added copper tape to help ground



New 3D printed hood, very adjustable!!

Autonomous

Core

Over the summer we created a modular system that abstracts away some of the most common FTC programming 'gotchas', and creates simple interfaces to implement common FTC systems, including:

- rising/falling edge detection for gamepad keypresses
- manual or auto caching modes, handled using simple caching strategies
- external PIDs and other control loops
- op-mode control flow, for both autonomous, and tele-op
- interacting with REV potentiometers and thru-bore encoders
- Using vision pipelines (april tags) with standard webcams, and aggregating multiple vision processors/cameras
- Matching for simple colors using raw HSV color sensors
- combined telemetry
- defining, visualizing, and adapting poses
- storing information persistently on the control hub

We then used that codebase as a starting point for this season's codebase.

Autonomous

largest challenges:

- migrating from RoadRunner to PedroPathing for our pathing.

This year we made use of the LimeLight 3A (pattern detection) and GoBilda Pinpoint Odometry (localization) systems.
Using pathing, combined with our odometry, vision, color sensors, and control logic, allows us to have several options for scoring multiple volleys of artifacts, while allowing for another robot to path around us.

Our current autonomous mode features a three ball volley and parking

Teleop

Simple Teleop

For the sake of both testing, and practice, we started by creating a "Simple Tele Op", given the moniker "SimTel". This op-mode was built with two main things in mind.

1. Simple and adjustable operation, do not strongly abstract the hardware from the user and allow nudging/adjusting values such as launch and collect power for easy testing, without being too sluggish to actually compete using.
2. Tolerant to missing/changed systems. Gracefully handle some subsystems/components not being available, to allow testing without the robot being fully assembled

Main Teleop

Once SimTel was functional, we moved onto making a more advanced version, with a similar core of tolerant design and lightweight operation, This op-mode was given the returning name of "Main Tele Op" as it was intended to be our main, competition-ready op-mode, and assigned the same style moniker of "MainTel"

- also adding on top of it more complex systems
  - storage state management
  - player assists such as auto-advance, select-fire, and aim-assist to tailor it toward are specific game strategy.

Auto Advance

- checks for when a new artifact has been collected (new detection from color sensor)
- 'advances' (rotates) the collector to allow the intake of another artifact
- This allows the user to simply control the drivebase, and allow the robot to handle intake and storage.

Select Fire

uses the fact that we know the color and status of artifacts in the storage to automatically

1. READY (prep by rotating to feeder position) and then
2. LOAD (feed into launcher flywheel) an artifact of either color by pressing a single button.

This is powered by a state machine combined with a command queue that together track the state of and control the indexer, collector, and feeder.

Tele-op Tasks

We have implemented extensible and interruptible teleop tasks that simplify the driver experience. For example, we have a preprogrammed mode that travels between the shooting zone in the back to the human player to be loaded and back again to shoot. This is all done in one smooth motion without the driver having to touch the controller at all but it is interruptible, so if something should go wrong, the driver can easily take control again.

Turret Auto Aim

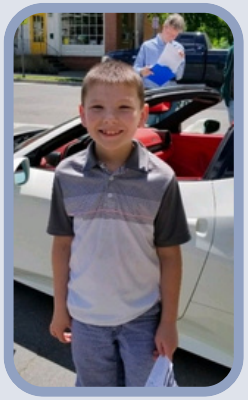
This is exactly what it sounds like: our turret autorotates to always face the April tag on the goal. This means that the driver has one less thing to worry about and it also lessens the time it takes to set up to shoot as we no longer have to manually adjust the turret and flywheel (which automatically speeds up to the correct velocity to score depending on where we are on the field and will alert us when it is ready through the RGB light on top)

Team reflections

Callam

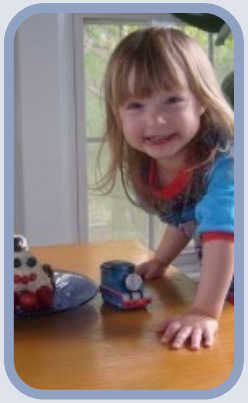
Over the course of my 6 years in the FTC program I have gained a lot of experience in working with others, practical programming and engineering skills, and team leadership. I have found what I have learned to be extremely valuable experience in the real world. I am excited to see how we do in this year's competitions and how our sister team performs and improves in the coming years.

Nolan



FTC robotics has helped me develop many technical skills over the 6 years I've been on Cookie Clickers. One of my biggest challenges overall was learning how to bring something from my mind and create it. I also learned about multiple different drive bases (a triangular "delta base" and a 4 wheel steering "swerve base") and their pros and cons.

Jenna

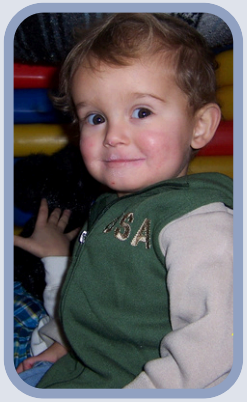


When I joined robotics I didn't know anything about it. I didn't know how to code or do anything mechanical. As the years progressed I learned not only some software and mechanical skills but also organization, management, and public speaking skills. I will definitely miss FIRST as I step into the next chapter of my life. .

Abeh

My time at FTC 18650 has been filled with kindness and compassion from all the members and advisors. For being someone who has no experience with robotics or engineering, the team took their time to help me and gave me roles to fulfill. Community is one of the most essential parts of building a successful team, and FTC 18650 excels at building a fantastic community.

Colton



First robotics has given me experience in the enginnering process. First robotics has also allowed me to learn CAD and 3d design. I have also been able to learn more about robotics and apply that knowledge to the real world.

Althea

FTC has taught me the importance of teamwork and how much a single person can contribute. Through Robotics I have been exposed to the engineering process and have learned mechanical, managerial, and public speaking skills. My work on the engineering portfolio has also taught me how to properly convey ideas to a wider audience

Eleanor

Throughout the 2025-2026 season, I helped build many of our robots subsystems and our engineering portfolio. From these projects, I learned how to design in CAD, how to use a chain kit, and how to express your and others ideas through writing. Also from the four years I've been on this team, I've improved my public speaking and learned how to communicate your plans to other people.

For our team, there is something bittersweet about this season. The 2 remaining founding members are seniors this year and will be graduating. Over the course of the past 6 years our team has grown with them: we have gone from a inexperienced rookie team to the state champions and there is something poetic about going to the FIRST Championship in their final season. It is a fitting finale and we will miss them greatly in the coming years.