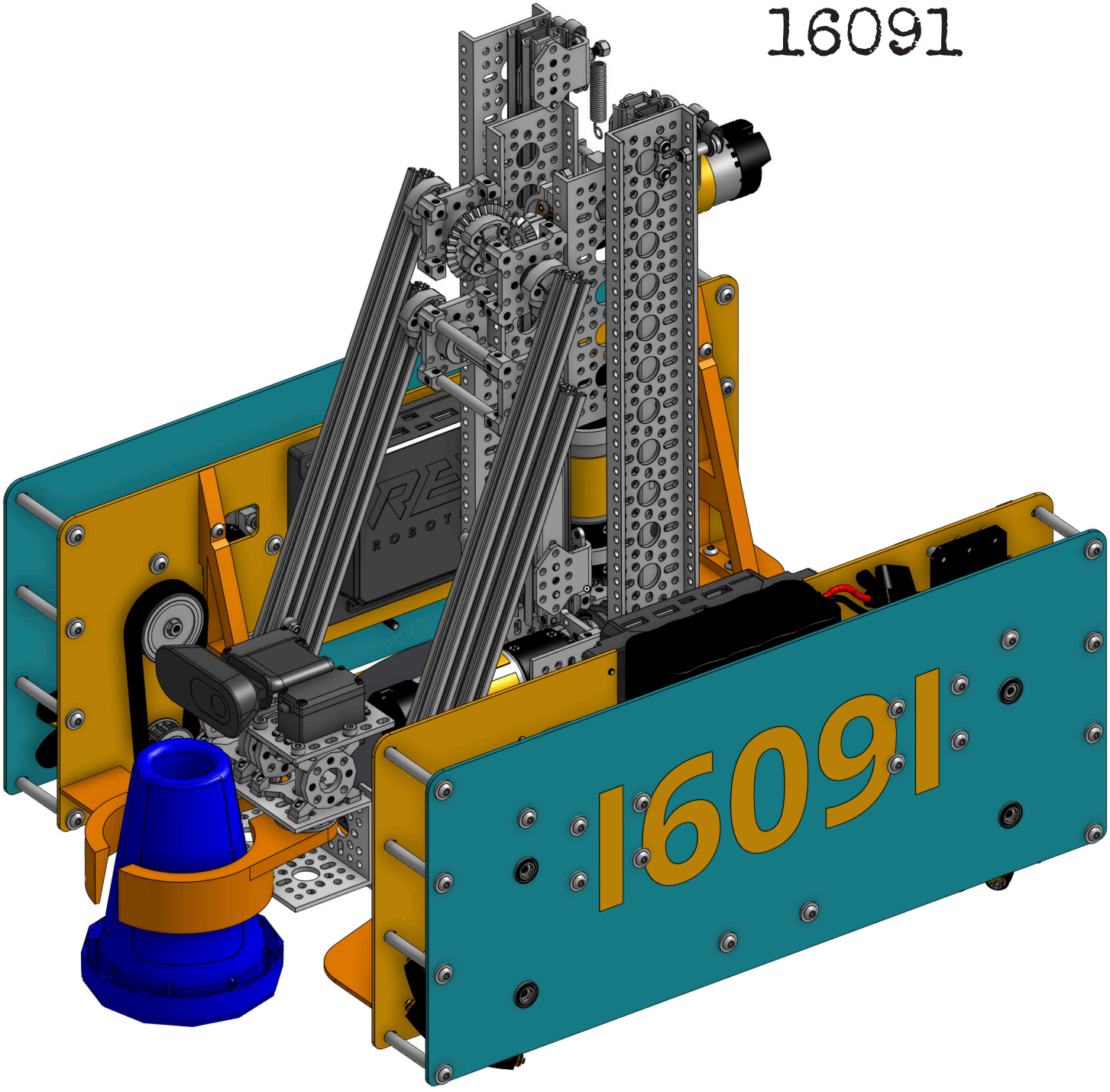
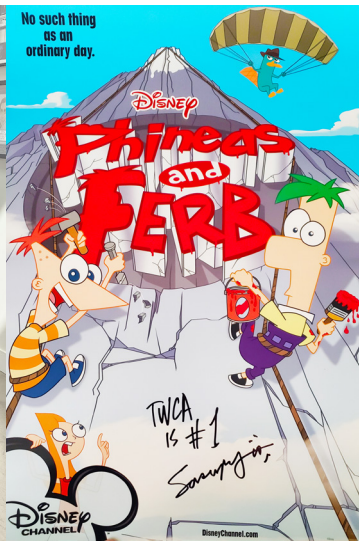
Team Without a Cool Acronym 16091



Power Play Engineering Portfolio
2022-2023

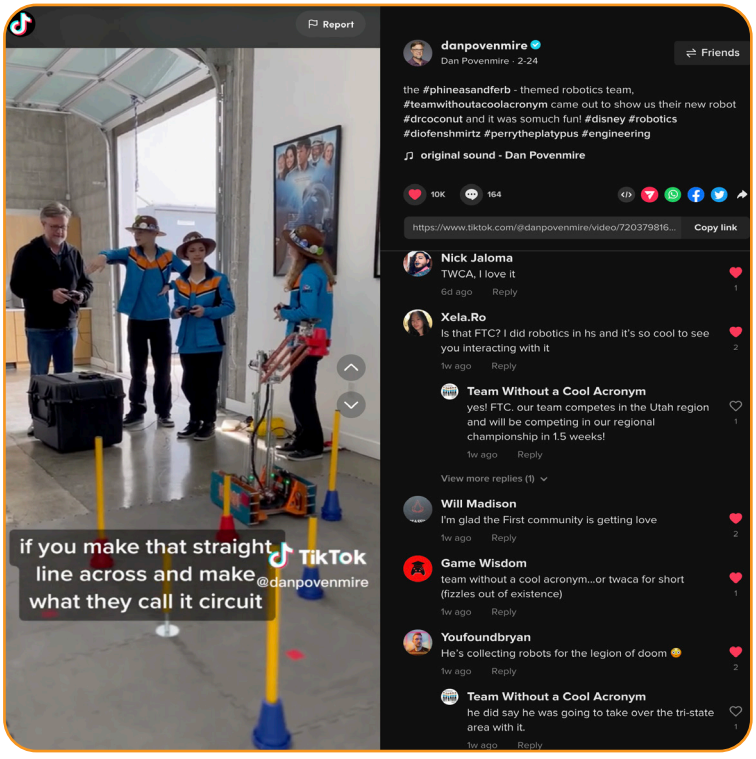


Jeff "Swampy" Marsh, Dan Povenmire, and David Errigo (Ferb) with TWCA Feb. 17th 2023

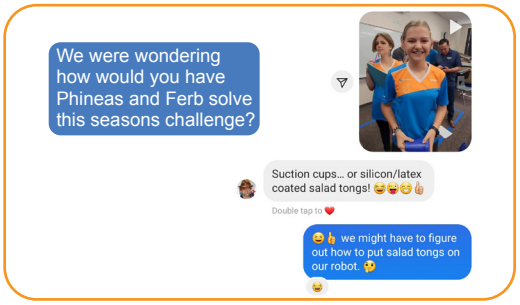
Meet the Team!

Team Without a Cool Acronym (or TWCA for short), is a 4th year FTC team of neighborhood friends organized with Washington County 4H in Hurricane, Utah. After experiencing the graduation of 5 seniors last May, we are enjoying a season of regrowth and learning with 50% of our team being rookies!

Over 2.3 MILLION Views on TikTok, YouTube and Instagram!



A unique thing about our team is that it is based on the animated television show Phineas and Ferb. This show inspired us because it is about inventive children, (brilliant with mechanical engineering), and their pet platypus, Perry. Perry is a secret agent for the Organization Without a Cool Acronym (or OWCA for short).



Both Dan and Swampy share our team with their 7+ MILLION Instagram and TikTok followers. There are plans in the works to include us in their PR campaign for the new season of Phineas and Ferb!

Phineas and Ferb Creators, Jeff "Swampy" Marsh and Dan Povenmire, LOVE our team. We have enjoyed gaining mentorship both online and in person and annually travel to Santa Monica to show them our robot and talk about FIRST Tech Challenge.

Motivate

Team Outreach, Community Service & Fundraising Goals

- Recruit new members.
- Perform over 500 hours of outreach.
- Fundraise $22,500.
- Reach 1,500 followers on Instagram & TikTok by the end of the season.
- Volunteer at non-tech events.
- Befriend new FIRST teams from all over the world.
- Create Engineering Portfolio Resource for teams.

Community Garden Clean-up

3	905	1,810	9,695	25,605
New Members	Outreach Hours	Social Media Follows	Website Views	All Time Portfolio Downloads

How We Made & Reached Our Goals:

We made a plan for our goals by discussing what we wanted to accomplish at planning meetings throughout the season and writing our goals down. We reached our goals by watching for volunteering opportunities at local STEM events and camps. We also made our own opportunities, for example we created workshops on using the engineering process that we taught at multiple events.

Ask The Inspire Webinar

We gave a presentation on qualities that made our season successful to hopefully inspire other teams.

Kids Innovate Day Camp

We worked with InfoWest to host a STEM activity on the engineering process & taught participants about FIRST

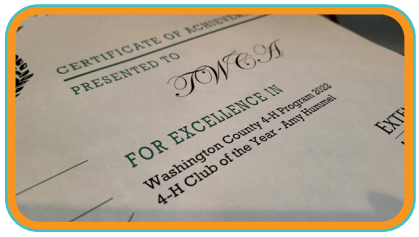
STEM Day on the Hill

We visited with representatives from our county as well as speaker of the house Brad Wilson and former Canidate for Governor Greg Hughes.

DIY Fest - Demo

We traveled to Salt Lake City and did a FTC demonstration with other FIRST teams from Utah at Craft Lake City DIY Fest.

4H Club of the Year



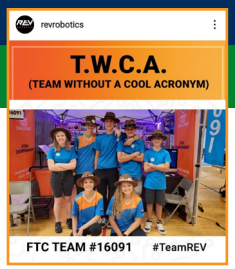
TWCA was named the Washington County 4H Club of the Year and had the opportunity to share at an Awards Night.

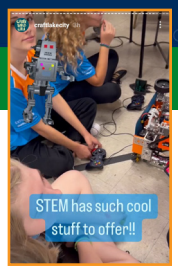
Car Show Demo

We set up our FTC field at a car show and soapbox derby where we talked about FIRST and let the public drive our robot.

Home › Meet DoD STEM › Blog ›

Student Innovators Develop Robots to Solve Technological Challenges





FTC Team 16091 at FIRST Championship in Houston.

Working with other teams and organizations help us reach our outreach goals!

2,381,325 Estimated Worldwide Impact

3,872 Miles Traveled to Outreach

$24,000 Season Funds Raised

32 Teams Mentored or Assisted

FIRST Utah

FLL

- Mentor 6 FLL Explore Teams
- Refereeing & Volunteering at FLL Utah South Scrimmage.
- Refereeing & Volunteering at FLL Utah South Qualifier.
- Craft Lake City - SLC Utah Demo and distribute info for all FIRST programs.
- Provide Judging Presentation Video for FTC Utah Judging Workshop.
- Virtually Mentor FTC 17604 T.N.T.
- Mentor FTC 19417 Iron Lions

FTC

Community

Camps & Clubs

- Three Falls Elementary STEM Camp
- Hurricane Elementary STEM Camp
- LaVerkin Elementary STEM Camp
- Three Falls Elementary Code Camp
- Southern Utah Code Camp
- InfoWest Kids Innovate Day Camp
- Three Falls Elementary Weekly STEM Club

Presentations

- Present our team to the Washington County Utah Commission
- Homeschool Demo & Workshop
- Farmer's Market Weekly Demo
- Soapbox Derby Demo
- Team Highlight at Astronaut Presentation
- Team Highlight 4H Club of the Year
- Talk about FIRST with Utah House of Representative members at State Capitol

Volunteer

- Serve Thanksgiving Dinner to Elderly
- Volunteer at Huntsman Senior Games
- Volunteer at Ironman World Championship
- Volunteer at Local Church Building Cleanings
- Community Garden Clean-up
- USU Extension Office Clean-up

Country

Coopertition

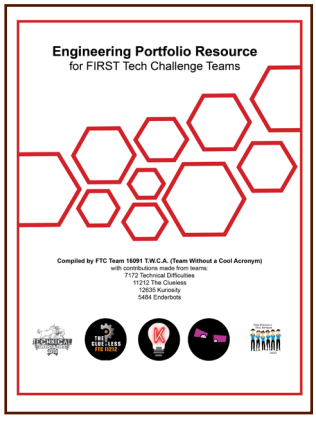
- Mentored Team 20152 BattleBots from PA with fundraising
- Create Engineering Portfolio Resource with:
  -11212 The Clueless
  -12635 Kuriosity
  -5484 Enderbots
  -7172 Technical Difficulties
- Assisted 14116 Information Overload from GA with EP.
- Assisted Iowa FTC with EP Support
- Assisted 21229 Quality Control from WA with Outreach and Fundraising
- Assisted 20099 Inconceivable from NH with Outreach Ideas
- Assisted Jonathan Weiland Illinois FTC Director with EP Documentation Techniques
- Assisted 18240 RoboScout Squad from Montana with general troubleshoting
- Assisted 19539 Tele-Ops from Charlotte, NC with EP Support
- Assisted 14374 Dark Matter from St. Tammany Parrish, LA - Outreach Documentation
- Assisted 13201 Team Hazmat from Brookfield, WI - Outreach and robot design ideas.
- Assisted 4628 Suit Bots from Monrovia, CA - Turret and Linear Slide discussions
- Assisted 19417 Superstellar from Brookfield, WI with general season questions and robot game strategy
- Assisted 17847 Velocity Raptors from North Kingstown, RI by contributing to their open source EP website.

World

International Influence

- Presenter: 2022 Ask The Inspire Webinar
- Website: TWCArobotics.com Our website has been viewed over 15,900 times by people from 67 countries.
- Instagram: @t.w.c.a We make friends with robotics teams from all over the world. 1,344+ Followers.
- Instagram Reel Views: 21,000+
- YouTube Views: 524,000+
- TikTok Views: 1,790,000+
- Our Engineering Portfolios have been downloaded over 24,124 times.
- EP Resource has been downloaded over 1,800 times since Feb, 2023
- Assisted Team 21058 NIS KYRAN from Kazakhstan with Expansion Hub Sourcing
- Mentor Еркеназ Сулекенова from Kazakhstan with Robot Design
- Assist 21100 Voyagers from Cyprus with general season
- Assist 22940 AENTA from Almaty, Kazakhstan with their EP.
- POCs of FIRST Ambassasdor Team

Engineering Portfolio Resource



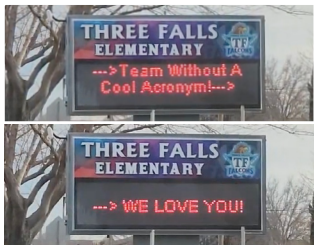
Over 1,800 Downloads

For 4 years we have shared versions of our EP which have been downloaded over 25,600 times. This season we spearheaded the creation of an Engineering Portfolio resource for teams.We collaborated with 4 World Championship teams including a World Inspire Finalist, World Design Winner, and two World Think Finalists!


Three Falls Elementary STEM Club

Our largest undertaking has been volunteering at STEM Camps & Clubs in the Hurricane Valley.

- Volunteer at 4 Summer STEM Camps
- Volunteer at TFES Code Camp
- Volunteer 3X a week at STEM/Robotics Clubs.



Connect

Individual Team Member Learning Goals & Team Plan

Our plan is to use professionals and mentors to learn new skills.

Status: Freshman - 3rd FTC Season

Teslyn: Co-Captain

Goal: I want to learn how to program using Android Studio.

Contribution: Turret Design and All Programming. I used mentors and studied online resourses to successfully program driver controls, autonomous, and learn how to use Feature Scripts in OnShape.

Status: Sophomore - 2nd FTC Season

Codi: Co-Captain

Goal: I want to learn about how individual robot systems work and how they all come together.

Contribution: Cone Gripper Assembly. I helped the mechanical team by sketching designs and build systems and learned how to troubleshoot when things didn't work from one of our mentors.

Status: Junior - 4th FTC Season

Calvin: Build Assist

Goal: I want to help more with the robot mechanically.

Contribution: Custom Wiring and Wire Management. From an engineering mentor, I learned how to create custom wiring. This skill was used a lot to extend wiring for motors, servos and encoders on our linear slide and 4-bar systems.

Status: 8th Grade - FTC Rookie Season

Cru: CAD/Mechanical

Goal: Im interested in learning how to use CAD to build the physical robot subsections.

Contribution: Linear slide and 4-bar design & assembly. I helped design our 4-bar system and also worked with a mentor to learn how to mirror and connect our linear slides so that they work together.

Status: 7th Grade - FTC Rookie Season

Taft: Pit Crew

Goal: I want learn how to maintain the robot during competitions.

Contribution: Pit Crew Checklist. I worked with other team members to create a checklist that we use in our pits inbetween matches. This makes sure our robot is in top shape and ready to go for the next match.

Status: Sophomore - FTC Rookie Season

Gideon: CAD/Mechanical

Goal: I want to learn how to CAD, and help with whatever needs to be done

Contribution: Drivetrain Build. I have been working through tutorials to learn how to build in OnShape and helped with the final CAD models. I also helped assemble and now maintain the drivetrain.

Mentors and Professionals That Have Helped Us Along the Way:

Our team aggressively seeks out professionals to help educate us on the best way to reach our technical goals. We meet and recruit professionals to mentor us by attending community STEM events. We enjoy sharing FIRST with our technical community by setting up robot demos.

RAM Aviation, Space & Defense

- **Gregg Robison, CEO of RAM** presented our team and our Freight Frenzy season accomplishments at a STEM event at Dixie Technical College in St. George, UT. He has helped fund our team and provides us with engineers to review our mechanical designs.

- **James Wigton, Senior Mechanical Engineer** meets with us in person to review our mechanical design and offer support. This season he mostly helped us with getting our linear slide working.

d.B Systems Inc

- **Halley Bonfanti, CEO**, provides us with engineers from her company to review our designs and provides us with access to industrial equipment. We were able to 3D print a custom pulley on their industrial size 3D printers 10" build plate.

- **Jared Hummel, Director of Engineering**, provides us with programming tutorials, review and helps with troubleshooting both programming and mechanical.

Washington County Commission

County Commissioners **Victor Iverson and Gil Almquist** met with our team where we talked about STEM in our community. The commission provides our team funding.

Kuker-Ranken - (New)

- **Douglas Spotted Eagle - Chief Revenue Officer**
- **Brady Reisch - VDC Reality Capture Specialist**, Doug and Brady listened to our judging presentation and gave us tips on how to improve "selling our team." They also gave us the opportunity to operate their robotic surveying equipment and showed us how what we are doing in FTC is relevant to their field.


Megan McArthur - Astronaut


Gregg Robison - RAM a.s.d


James Wigton - RAM a.s.d.

Washington County Commission


Kuker-Ranken & ANYmal Robotic Dog


Paul Hill, PhD - Utah State University


Jeff "Swampy" Marsh & Dan Povenmire - Phineas & Ferb

TWCA Powered By:

University Partners:

Utah State University - Extension

- **Paul Hill, PhD**, helped us brainstorm initial build ideas during season launch and continues to provide our team with support though finding funding and mentor connections. We reached out to him and invited both him and his son to help with our Power Play season!

University of Utah - Engineering (New)

- **Kate Hummel & Madi Bringhurst Mechanical Engineering Students,** FTC alumni of our team. They look at our CAD and mechanisms and helps us with tips and tricks. They have been a big help with brainstorming. We mostly communicate by phone, text, Instagram message because they arent local, but sometimes they can see our progress over holiday breaks.

Disney Animation

- **Jeff "Swampy" Marsh & Dan Povenmire**, Phineas and Ferb, Milo Murphy's Law, Hampster and Gretel and Pete the Cat. They don't give us much in the way of technical support, but they have fun interacting with our team, and helping us with things like portfolio design suggestions, (don't cute font it to death), and fun robot tips like, Phineas and Ferb would use salad tongs to solve this season's challenge. They also help us with spreading FIRST worldwide by marketing with us over social media. February - April we have had over 2.7 Million social media views.

Sand Hollow Resort - (New)

- **Rick Snyder, Professional Engineer**, reviewed some of our 3D printed parts and gave suggestions to help strengthen our parts, specifically our cone gripper. He also helped when we got stuck in some of our mechanical designs by helping brainstorm.

NASA - (New)

- **Megan McArthur, International Space Station Astronaut**. We had the chance to talk with Megan's experience in space. We told her about our ideas for our robot design. She thought the design would work well and told us about using a similar design to do a task during a space walk while at the ISS.

Zonos

- **Joshua Aikens, Chief of Staff**, has made sure that Zonos is a sponsor of our team for 3 seasons. He helped us this year by suggesting we add an alumni page to our website so that the Southern Utah tech industry could keep up to date with what graduates from our team are doing! He also makes sure to introduce professionals to us whenever we are at the same events, like Southern Utah Code Camp.

Infowest (Internet Company) - (New)

- **Thomas Dyches, Marketing and Design,** We met Thomas working at a summer STEM camp. He had some thoughts on how we could improve sponsor experience on our team website and helped us link back companies to their website to improve traffic flow and help boost search search results.

IME Automation - (New)

- **Leo Wright, Owner,** One of our team alumni had a contact with this company and we asked if they would be interested in learning about FIRST and a demo. Leo loved our meeting and showed us the manufacturing automation that his company develops. He is excited to continue meeting with us to provide mentorship next season.

Brainstorm

IDEA to SOLVE PROBLEM → **SKETCH** → **CAD MODEL** → **BUILD** → **TEST** & REPEAT IF NECESSARY

GAME ANALYSIS AND PLAN:

We participated in **round robin brainstorming** where one person would write down an idea and others would build upon the idea to improve it.

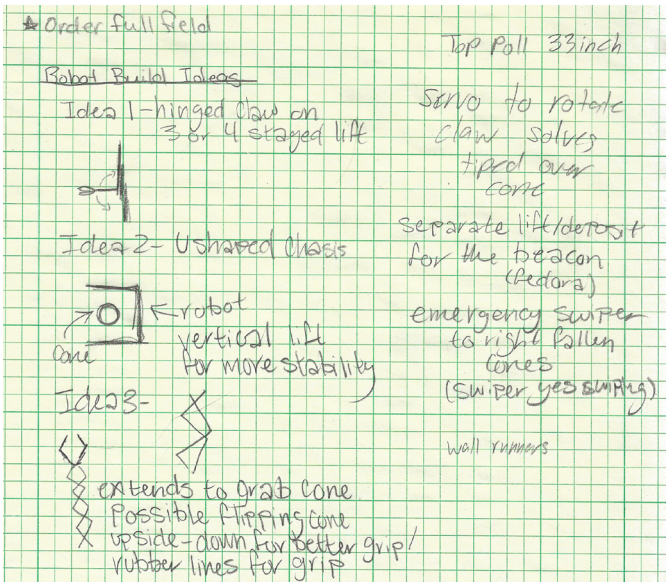
 slanted claw for better grip; cone	cool idea!	Textured rubber for better Grip	amazing

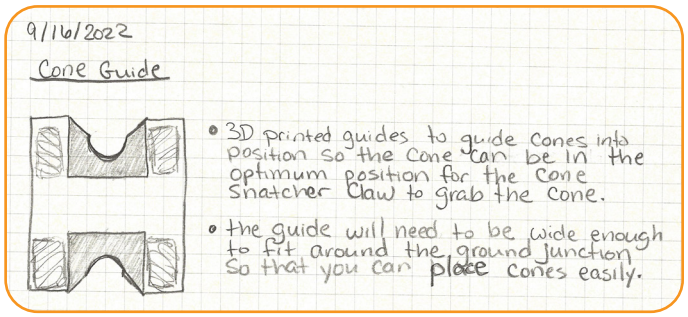
We made notes of all the ways it was possible to score and wrote down if we thought it would be worth it to go after those points. We also made a timeline for which competitons we would like to be able to achieve our scoring goals by.

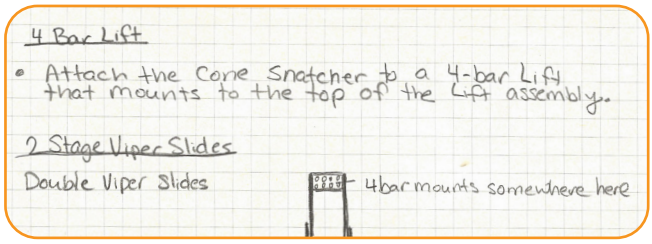
	Task	Points	Early Season Plan	State Championship plan	Notes/ Comments
Auto	Robot parked in terminal or substation	2	No	NO	We dont want to do this because we want to take the risk of parking in the Signal Zone for 20pts.
	Cone placed in a terminal	1	maybe	No	For Early qualifiers this will be a good idea to get a 1point advantage and get 1 terminal out of the way to get a circuit.
	Cone placed on Ground Junction	2	No	No	
	Cone placed on Low Junction	3	No	NO	It isn't worth the time to score ground-medium Junctions in Auto since our robot can easily reach the high Junction. It would be best to spend effort there.
	Cone placed on Medium Junction	4	No	No	
	Cone placed on High Junction	5	No	Yes, possible multiple Cone cycle by rotating turret	
	Robot Parked using Supplied Signal	10	No	NO	For a early qualifier we may not have vision working. In that event, for strategy we plan to use a custom signal sleeve because we will have a 1in3 chance of getting 20 points
	Robot Parked using Team Signal	20	Yes	Yes	
Tele-op	Cone scored in terminal	1	No, unless not Scored in Auto.	Yes	We will score cones in terminals, only once per terminal so that we can complete a circut.
	Cone scored on ground Junction	2	yes/difficult	Yes	Score ground junction near opposing alliance's substation first to complicate their Cone grabbing ability.
	Cone Scored on low Junction	3	Yes	Yes	
	Cone Scored on medium Junction	4	Yes	Yes	Only score low & medium as necessary to own junction
	Cone Scored on high Junction	5	Yes	Yes	Score most cones on high junction near substation to maximize points hold 4 back for endgame junction owning
End game	Junction Owned by Cone	3	Yes	Yes	Hold back a minimum of 4 cones for end game so that they can be used to own junctions.
	Junction Owned by Beacon	10	Yes	Yes	Make a beacon that is hard to tip over.
	Completed Circut	20	Yes	heck, Yes	Yes, get that Circut. (A game of robot Chicken w/ the other alliance)
	Robot parked in terminal	2	Yes	Yes	

Free thinking design process:
The first thing we did was give team members time to come up with any idea without seeing designs from other robots (seen in right image).

Inspiration based design process:
After everyone had some time to free think, Calvin, Tess and Codi showed new team members designs from previous season robots to see if there were any ideas we wanted to use. We then finalized a plan for what type of robot we wanted to build and looked at previous season documentation to help us.







Statistic Driven Strategy (Crane on Turret):
In brainstorming we decided it was important to spread out and make a circut. We estimated that we could place 8 cones in tele-op/end game so we planned a crane on turret design, rather than a passthrough that would be a good "cycle bot."

Points	2	3	4	5	3			
	Ground Junction	Low Junction	Medium Junction	High Junction	Junction Ownership	Junction Points	Ownership Points	**Total Tele-op Points**
	8	0	0	0	8	16	24	**40**
	0	0	0	8	1	40	3	**43**
	0	4	0	4	8	32	24	**56**
	0	0	4	4	8	36	24	**60**

Spreading out to gain more junction ownership is better than cycling

Season Experience + Statistic Driven Strategy for Improved Scoring:
After we competed in a couple of qualifiers we realized that our stragety was working pretty well. We were able to create a circut during most matches and we learned that we were cycling about 11 cones, plus beacon during matches. We updated our tele-op/end game plan to include placing cones in both alliance terminals to complete a circut and to include placing a beacon.

Points	1	2	3	4	5	3			10	10	
	Terminal	Ground Junction	Low Junction	Medium Junction	High Junction	Junction Ownership	Junction Points	Ownership Points	Circut Points	Beacon Points	**Total Tele-op Points**
	0	0	0	0	11	1	55	3	0	10	**68**
	0	0	0	0	11	4	55	12	0	10	**77**
	0	0	0	4	5	2	41	6	0	10	**57**
	2	0	4	3	2	9	36	27	20	10	**93**
	2	0	2	5	2	7	38	21	20	10	**89**

Ultimate Winning Strategy? (Circut bot + Cycle bot = Win)
We realized through experience that the best alliance combination is one robot that can quickly cycle on a single junction and another robot (like ours) that can work on creating or blocking circuits. If two robots spread, they tend to get on each other's way. This strategy worked for us as the captain of the winning alliance at 2 qualifiers and than as a finalist alliance pick during our region championship!

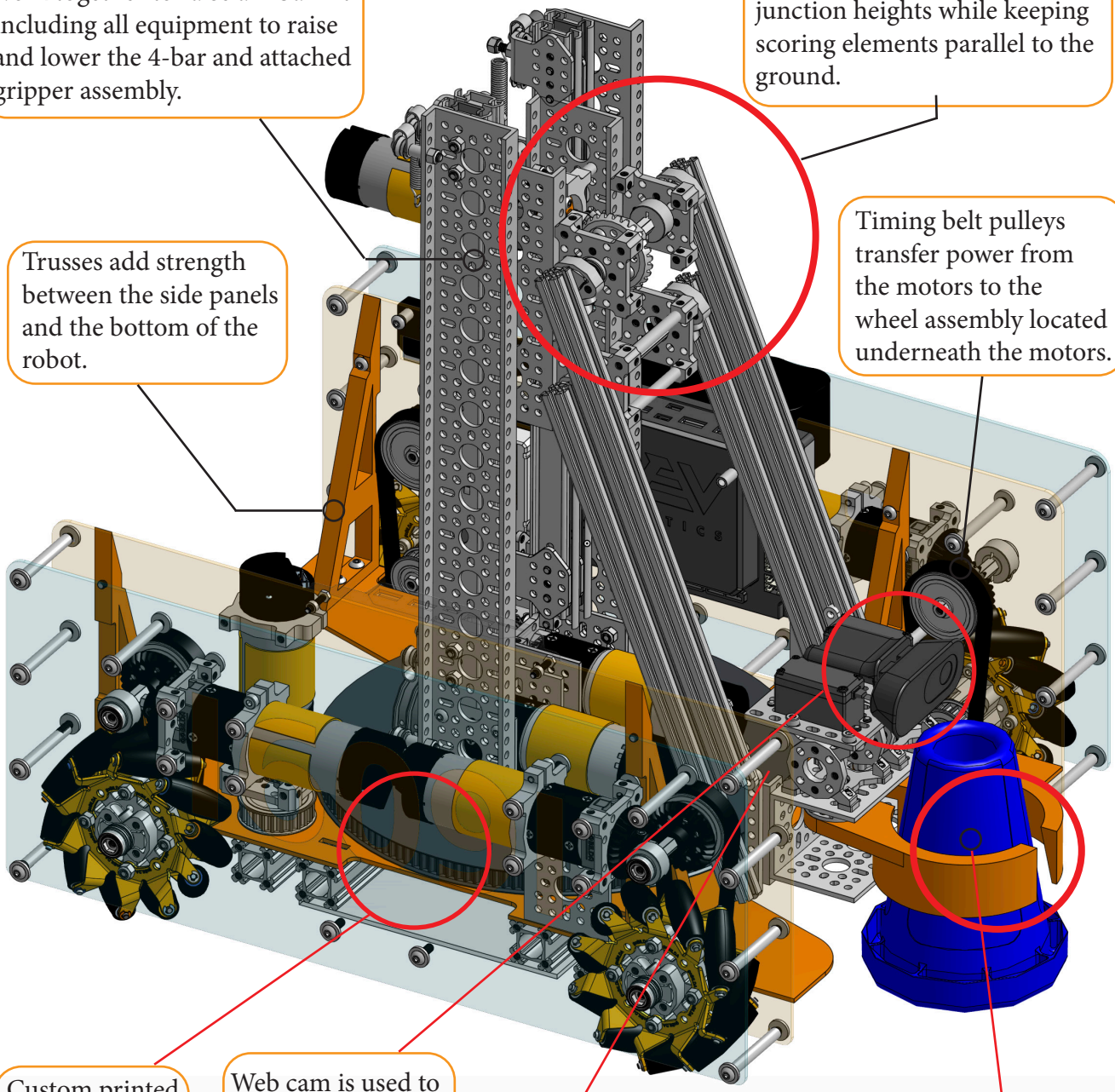
FULL CAD FINAL DESIGN

Mirrored 2-stage linear slides work together to raise a 4-bar lift including all equipment to raise and lower the 4-bar and attached gripper assembly.

2:1 bevel gears attached to a 117RPM motor moves a 4-bar lift making it so we can reach all junction heights while keeping scoring elements parallel to the ground.

Trusses add strength between the side panels and the bottom of the robot.

Timing belt pulleys transfer power from the motors to the wheel assembly located underneath the motors.



Custom printed 150 tooth timing belt pulley driving a turret that rotates the lift assembly 360 degrees.

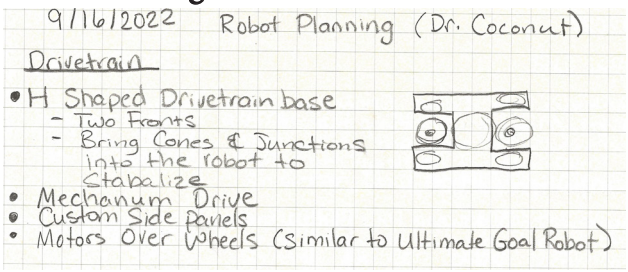
Web cam is used to detect three diffrent signal colors to make autonomus descions

A geared cone gripper powered by a servo holds position and keeps a firm grip on cones until they are ready to be released.

Cone gripper built with an interior angle that mimics the shape of the cone to increase surface area and improve grip.

DRIVETRAIN

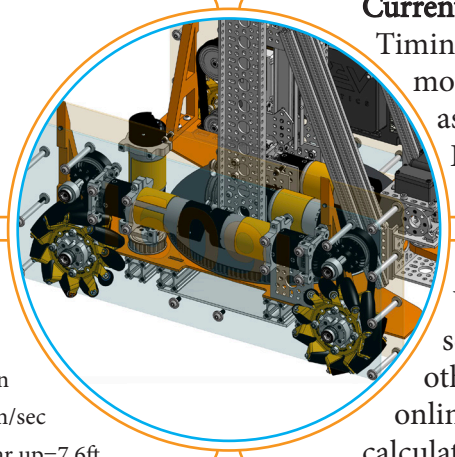
Brainstorming:



What's so Innovative? We've seen a lot of robots over the last 4 seasons and ours is the only robot that uses this wheel/motor configuration. What's so great about this design is that it frees up the middle of the robot for low mounting assemblies where the motors would typically be. This also leaves space for other items like web cameras, odometry pods or wire management space.

Design Must Haves:

- Mecanum wheels
- Motor over wheels
- H-shaped for intaking from 2 sides
- Custom side panels



Current Design:

Timing belt pulleys connect the drive motors to the mecanum wheel assembly in a 1:1.5 gear ratio. Everything is held together with custom aluminium side plates.

Calculations:

At full speed, our drivetrain can move 7.6 feet per second.

(301.44mm)(312 rev/min)= 94,049mm/min

(94,049mm/min)(1min/60sec)= 1,567.4mm/sec

or 61in/sec = 5.08 feet/sec + 2.5 feet/sec gear up=7.6ft

Research Performed:

We looked through previous season designs and designs from other teams online. We searched online for formulas on how to calculate robot speed.

Pros:

- **Mecanum wheels allow strafing.**
- **Lots of room for mechanisms**
- **2 sided intake availability**

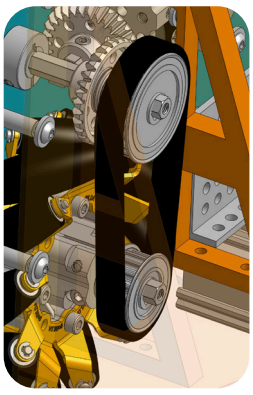
Cons:

- **Footprint too large to easily play game.**
- **Heavy = wheel sink.**
- **Too low to the ground to drive over ground junctions.**

Tess and Gideon start assembling the drivetrain.

Design Process:

After writing down our criteria and sketching out some ideas, we built our drivetrain as a CAD model. We chose to mount our motors over our wheels so that we would have room available in the center of the robot while keeping the height of our side panels low. This was important so that we would have plenty of open space vertically for rotating our 4-bar 360 degrees.



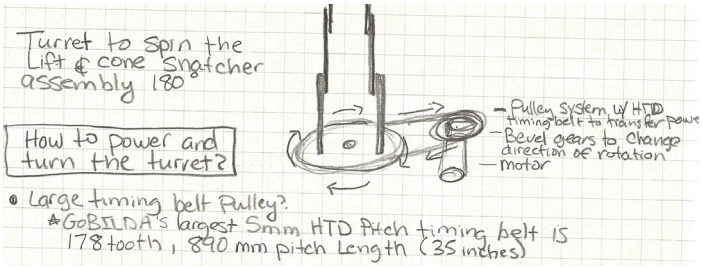
Testing & Lessons Learned:

After testing in drive practice, we've realized that the drivetrain works well mechanically. However, it is too big to move around the field easily. This is something that we have been able to overcome with lots of drive practice. A bonus we have noticed is that our robot is not a tip-over risk like many other robots.

TURRET

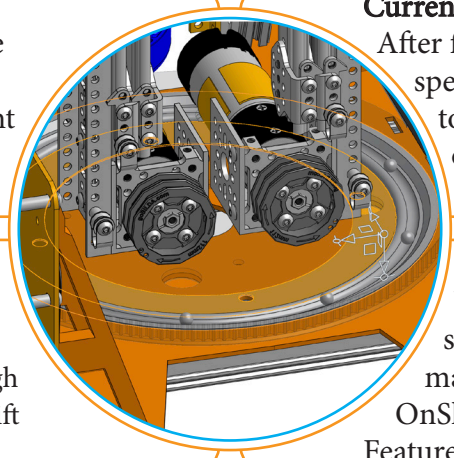
What's so Innovative? Our turret design makes it so we have 360 degrees of scoring opportunity. Our robot is able to make fine adjustments to cone positioning in relation to junctions with no movement from the drivebase. This equals a faster cycle speed, especially during autonomous, and less clashes with other robot bases.

Brainstorming:



Design Must Haves:

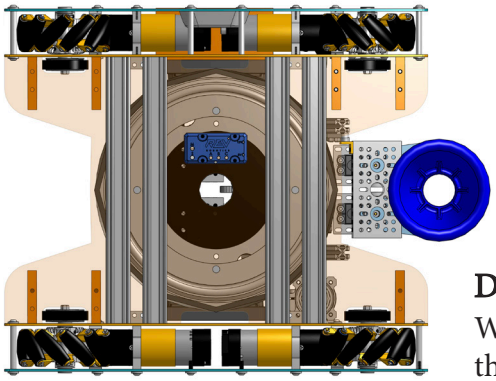
- Turntable used as turret base would need to be 7-9"
- Strong enough to hold weight of all mechanisms.
- Custom printed pulley.



Current Design:
After finding a turntable that met our specifications, we designed a 150 tooth timing belt pulley that fits over the top of it. It is connected to a second pulley & motor.

Calculations:
Galvanized steel turntable from McMaster-Carr is rated at 750lb capacity. This was more than enough strength to be able to support any lift mechanism we could think of.

Research Performed:
We looked at other robots online, specifically FRC to see how they made turrets. We also watched OnShape tutorials on how to use Feature Scripts to make custom pulleys.

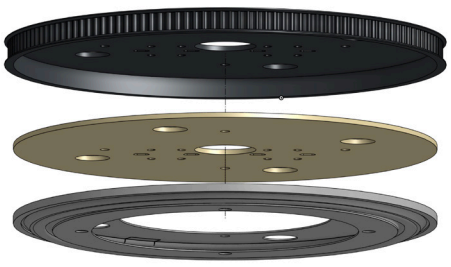


Pros:

- Reach more of the field with minimum drivetrain movement.
- Coolness Factor 1000.

Cons:

- Complicates driver controls.
- Breaks the rule of keep it stupid simple.
- Wire tangle risk.



Exploded view of our turret sandwich

Design Process:
We found a steel turntable that fit in our size requirement. To power the turret we needed to design a custom pulley which turned out to be too big for our 3D printer. Luckily one of our sponsors printed it for us in their industrial printer. Since the PLA we used for our timing belt pulley isn't strong enough to hold a linear slide + 4-bar assembly, we designed a support plate that is sandwiched between the turntable and timing belt pulley.

Testing & Lessons Learned:
The turret is probably the coolest thing we have ever built! That said, it does complicate driver controls. We have a rookie programmer, so one of the things she has spent a lot of time doing is learning how to automate enhancements to make operating the turret less stressful.

4-Bar Lift & Gearing

What's so Innovative? We decided to go with a 2-stage linear slide paired with a 4-bar as opposed to the 4 stage slide we have seen most teams use. This means we can extend vertically from our robot (doing less drivebase work). We added 2:1 bevel gears not for the torque but for added control.

Torque Servo Calculations for Lifting 4-Bar + Cone

goBILDA Torque Servo Stall Torque = 300oz-in

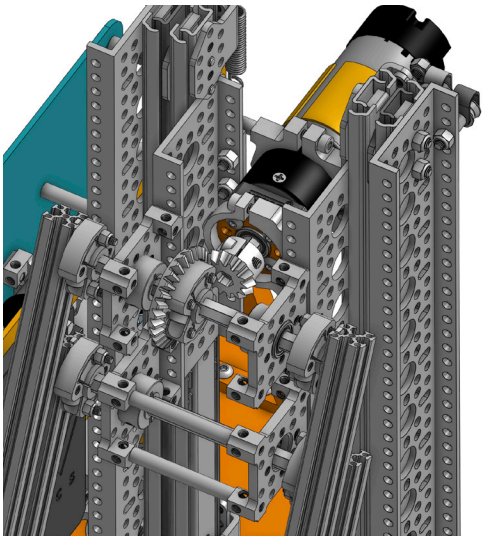
4-Bar Arm Length = 17 Inches
4-Bar + Cone Weight = 2 lbs

Servo with No Gearing: $\frac{\text{300oz per inch}}{\text{17" 4-bar length}} = 1.1$ lbs

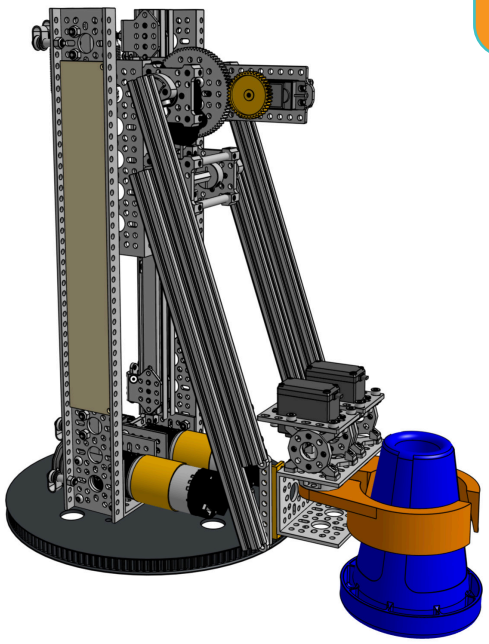
Servo with 2:1 Gearing: 1.1 lbs (2:1 gear ratio) = 2.2 lbs at length

Problems and Solutions: According to our calculations a goBILDA torque servo geared 2:1 would lift our 4-bar assembly with cone. **We learned that these calculations were correct, however the servo would quickly get hot.** To solve this, we regeared to a 4:1 ratio.

Servo with 4:1 Gearing: 1.1 lbs (4:1 gear ratio) = 4.4 lbs at length



Previous Design for 4-Bar Geared 2:1 with torque servo.



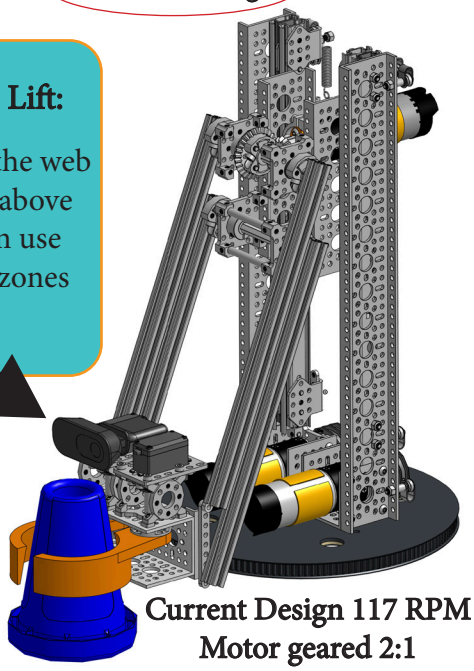
The 4:1 servo gearing worked but we decided to update our servo to a 117RPM motor with 2:1 gearing so we could use encoders to move to position for autonomous cycling.

goBILDA 117 RPM Motor Rated Spec 950 pz per inch: $\frac{\text{950oz per inch}}{\text{17" 4-bar length}} = 3.49$ lbs

3.49 lbs (2:1 gear ratio) = 6.98 lbs at length

Camera Integrated onto Lift:

A new feature to our lift is the web camera mounted directly above the gripper so that we can use OpenCV to detect signal zones during autonomous.



Current Design 117 RPM Motor geared 2:1

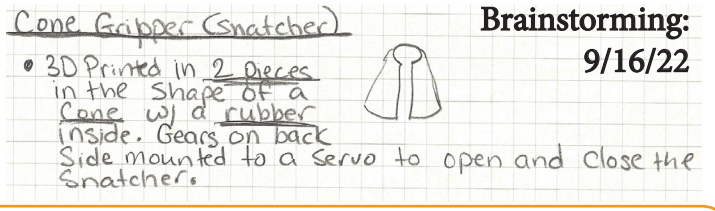
Pros:
- Can reach up and out.
- Stability from dual lifts.
- Built in redundency with dual motors.

Cons:
- 4-bar is hard to control when going down.
- Camera gets bumped on cones.

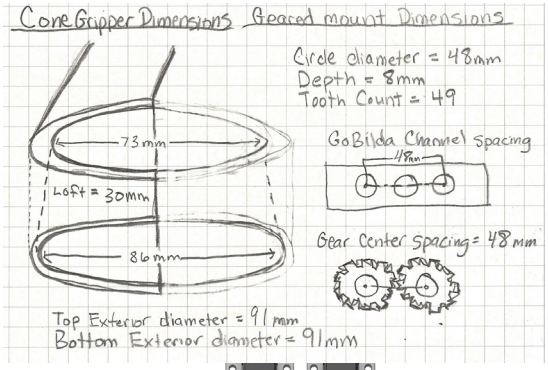
Cone Gripper

What's so Innovative? By watching other teams, we realized that most intakes were grippers out of structure with surgical tubing. Our intake was the first in our region that mimiced the exterior shape of the cone for improved surface area grip.

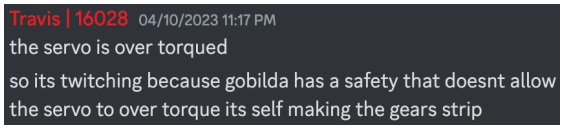
Brainstorming: 9/16/22



Design Must Haves:
- 2 piece part (pincher)
- Angled to match cone shape.



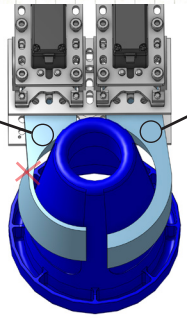
Research Performed:
-We watched OnShape tutorials to learn how to create multiple planes to loft between.
-A professional looked at our original design, pointed out weak areas, and gave us tips on how to strengthen it.
-We asked questions on Discord.



V3 Cone Gripper Design

Current Design:
We finally went with our original idea. If you look at our brainstorm above, we originally wanted to make a single servo geared gripper. We tried to take the easy way with 2 servos because we didn't know how to make gears in CAD. After struggling through 2 qualifiers with 2 servo complications, we learned how to make a geared gripper with OnShape FeatureScripts.

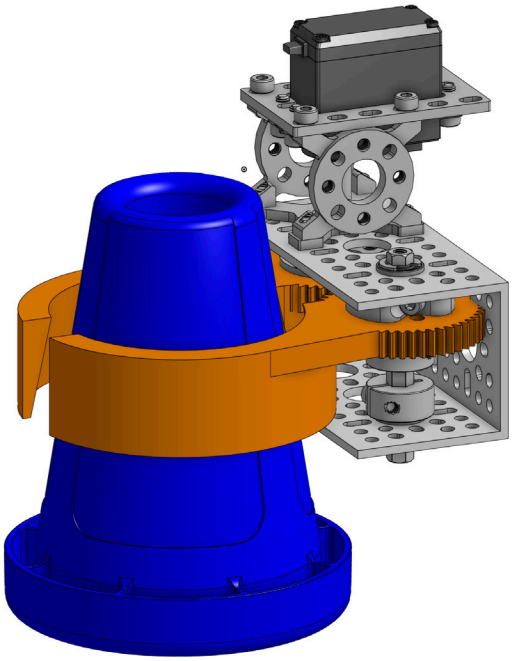
V1 gripper design, interior too small and contains structural weak points



V2 gripper design increased size for the addition of rubber grip & strenthened weakpoints

Testing, Cons, & Lessons Learned:

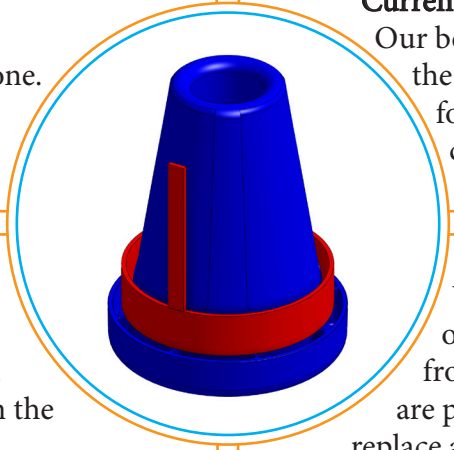
- **Incorrectly Sized**: On our first design we forgot to account for the thickness of the rubberized mat used to add grip to our gripper so the print was too small.
- **Weak Points**: Trying to save filament we accidently designed some weak points (shown by a red X on the V1 illustration above. A professional engineer showed us where to make it stronger.
- **Servo Lag**: Because of servo lag, the pieces of our 2 servo design didnt move together. This caused us to knock over stacks of cones several times.
- **Jittering Servo:** We learned that goBILDA torque servos have a safety built in as to not over torque and strip gears. This safety caused our gripper to open at any resistance and drop cones. We researched new servos without this safety because we need the slight overgrip to tightly hold cones.



Beacon

Design Must Haves:

- 3.9 x 3.9 maximum.
- Must rest on bottom lip of cone.
- Vertical piece must be thin enough that it won't interfere with cone grip.



Current Design:

Our beacon is slim and easily fits over the cones giving plenty of room for the cone gripper to grasp the cone, scoring both at once.

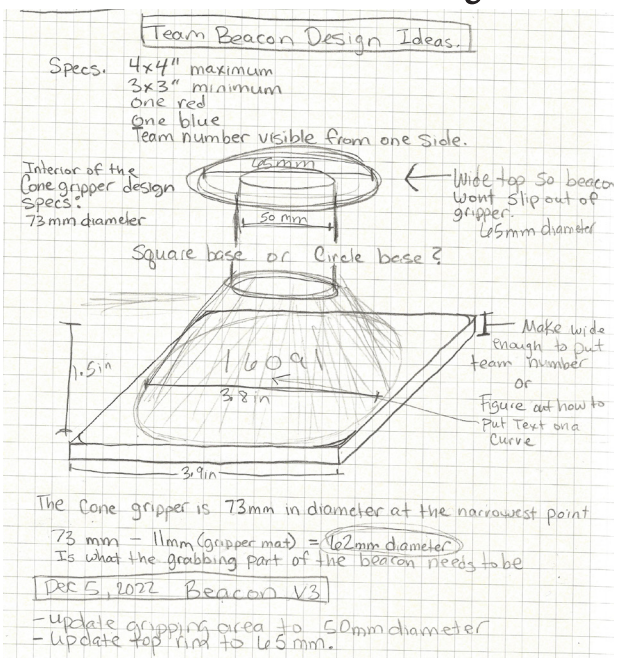
Possible Problems

Because of the thin nature of the vertical piece of the beacon, there is a possibility that it could be snapped off if it is dropped on the playing filed and ran over.

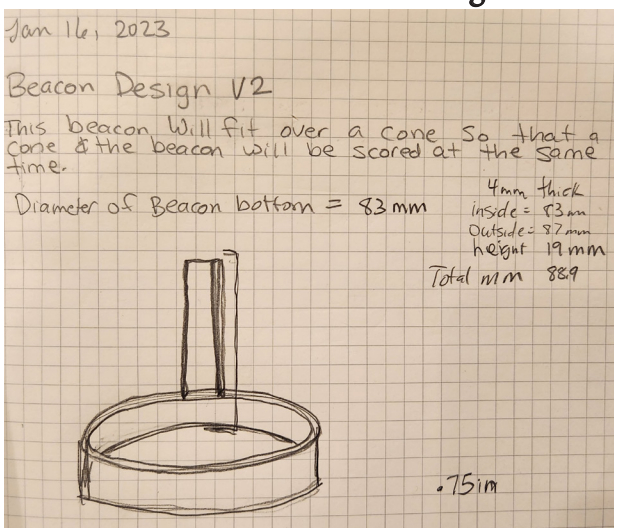
Solutions:

We brainstormed a solution to our vertical piece snapping. Aside from having back-ups available, we are predrilling a hole so that we can replace a broken piece with a blue or red zip-tie to keep the beacon in dimension.

Beacon V1 Brainstorming:



Beacon V2 Brainstorming:



What's so Innovative? We designed our beacon to fit easily on the bottom lip of the cone and a thin piece that rises up to fit dimensions. Because of this design, our human player is able to place the beacon on a cone while in a substation scoring both at once..

Design Process:

We originally brainstormed a large beacon that was maximum dimensions so that we could easily grip and move it. After going to a competition we realized that we could design a slim beacon that the human player could place on a cone, so Gideon sketched out and created a new slim beacon.

Control

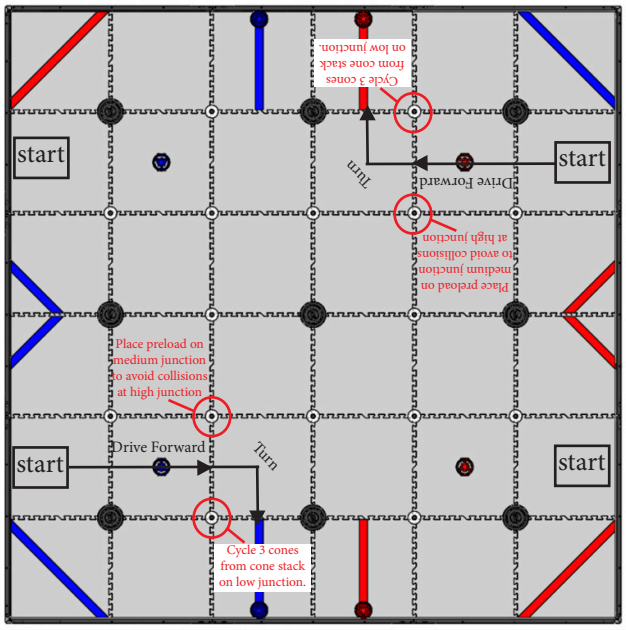
Autonomous Objectives:

Teslyn is our programmer this year and this is her first year ever programing a FTC robot! She has been quickly learning Java and has programmed the robot to:

- Read the correct program from custom signal sleeve using a webcam and OpenCV.
- Place preloaded cone on medium junction.
- Cycle 3 cones on to low junction from the cone stack.
- Park in the correct zone.
- If camera fails to make a detection, program will default to parking in the location closest to the wall.

Senors Used:

Motor encoders	2M Distance Sensor
Onboard gyro	Web Camera



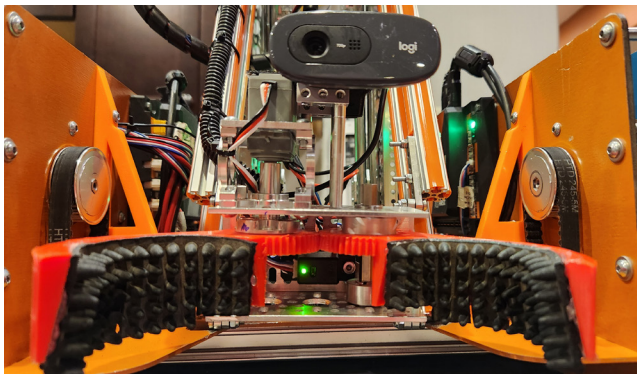
Programming Goals: 33 Point Auto

Once we met our previous goals of being able to read the signal sleeve, place a preload cone, and park in the correct zone, we updated our goal to include cycling cones from the cone stack. We have been successful and can do the following:

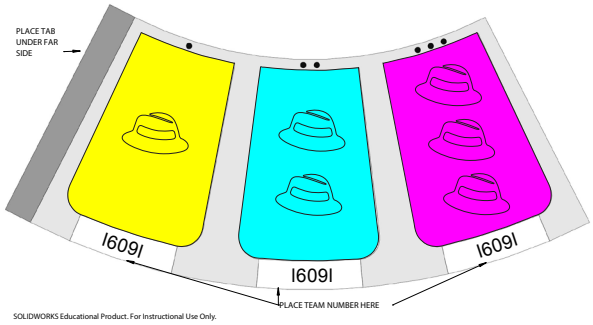
- Place preload on medium junction.
- Cycle 3 cones onto low junction.
- Park in correct zone.

Driver Control Enhancements:

- Motor encoder limits for linear slides so that it can't overextend or over retract and break strings/burn out motors.
- Motor encoder limits set for the turret so that it can't just spin in circles and twist wiring.
- Turret can not turn unless the lift or 4-bar is higher than the side panels to keep from damaging stuff.
- Pressing d-pad adds counts to 4 bar encoder for more precise movement.
- Linear slides will lock in place when the joy stick is not being pressed to keep slides from slipping down.
- Grip default is closed so it's harder to accidently drop cones.



Webcam detects colors to choose the correct parking zone. A distance sensor mounted in the cone gripper assembly in addition to under the robot makes sure the robot is the correct distance from cones before gripping in autonomous.



The idea for the colors on our signal sleeve came from the FTC team KookyBotz Vision Pipeline