WORMGEAR WARRIORS

TEAM PICTURE

Notebook Overview:

The WormGear Warriors have rebranded their engineering notebook.
Focusing highly on the design process and all of its elements, we've begun to apply the steps to each experience. Whether this be a mechanical design or outreach event, our design process helps us make decisions and document those decisions. With our new engineering notebook, our goal is to keep it clean, organized and easy to read.

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1.0 EXECUTIVE SUMMARY

1.1 Mission Statement

WormGear Warriors' mission is to strive for the advancement of Science, Technology, Engineering, and Mathematics (STEM) through participation in FIRST robotics. WormGear Warriors are empowering students to become tomorrow's leaders by teaching leadership skills, giving them mechanical, electrical, programming, and presentation experiences while working as a team. We seek out other students to participate in this activity, leading more students to pursue STEM careers.

1.2 FIRST Description

FIRST® was founded in 1989 to inspire young people's interest and participation in science and technology. Based in Manchester, NH, FIRST® is a not-for-profit public charity that designs accessible, innovative programs that motivate young people to pursue education and career opportunities in science, technology, engineering, and math, while building self-confidence, knowledge, and life skills.

FIRST® encourages both Gracious Professionalism and Coopertition. Both terms are unique to this organization and outline what they stand for. Gracious Professionalism is "a way of doing things that encourages high-quality work, emphasizes the value of others and respects individuals and the community." Coopertition is the combination of Cooperation and Competition. According to FIRST® it is "displaying unqualified kindness and respect in the face of fierce competition."

FIRST®. "Vision." FIRST®. US FIRST®, n.d. Web. 08 Jan. 2015.

FIRST®. "Gracious Professionalism." FIRST®. US FIRST®, n.d. Web. 08 Jan. 2015

1.3 FIRST Tech Challenge Description

A robotics competition targeting middle school and highschool students. Teams compete both with robots and in the judging room. In order to advance teams must be well rounded, showing skills both in engineering as well as marketing and documentation.

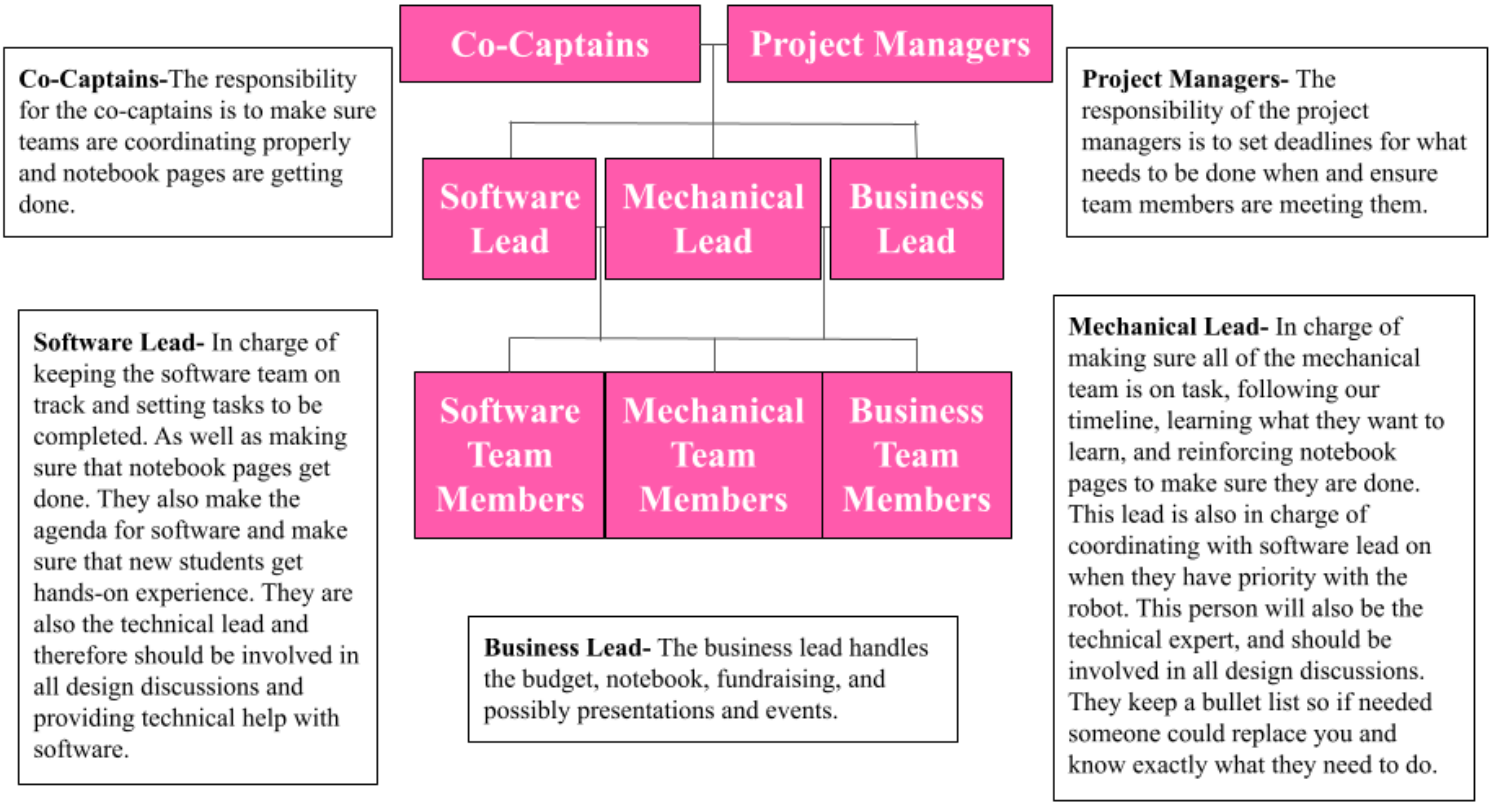
1.4 Team Summary

The WormGear Warriors began eight years ago. Over the past eight years we have received several awards such as the Inspire, Control, and Motivate. We were also honored to partake in the World Championship two of those years. Since then our team has grown to thirteen members, ranging from 8th through 12th grade. As the years went on, we expanded our team not just by number, but also geographically. We currently have members from Edwardsville and Glen Carbon.

1.5 Team Structure

This year our team decided to return to an old team management strategy, which had worked very well for

us. Last season our team had some issues with motivation due to quarantine, not having enough team interaction, and overall Covid being discouraging. Our team thought having ambassadors on our team, such as co-captains and team leads would help keep everyone motivated and learning. Towards December of 2021 our team dissolved the co-captain title. Due to our team restricting meetings, co-captains were no longer able to attend enough meetings for the position to make sense. Software lead and Mechanical leads were able to absorb the responsibilities of these positions since they were still able to attend most of our meetings in person. This team structure is best summarized in the organization chart below:



2.0 TEAM IMPACT

2.1 Objectives

The WormGear Warriors have many team objectives, including spreading knowledge of STEM throughout our growing community.

2.2 Outreach

Each of the following statements is in correspondence to definition as released by FIRST, as of 2022.

- Supported 3 teams
- Reached 60 teams
- Reached 200+ business professionals
- Reached 800 people through social media
- Reached 850 FIRST members

3.0 CONNECTIONS AND SPONSORS

3.1 Overview

An ideal of the WormGear Warriors is to build long lasting connections with teams nationally and abroad. With our 50 States Outreach Program, our team began the journey of fulfilling that goal.

3.2 Connections

TEAM NAME	CONNECTION LENGTH
Gearhead 13365 (IL)	4 years
Polytechnic Puzzle Pieces 16751(IL)	3 years
Robo Knights 19938 (IL)	1 year
SWAT 18093 (IL)	1 year
Wired Warriors 15020 (IL)	5 years
Welded Warriors 15410 (IL)	5 years
Kappa Xi 7649 (Mexico)	1 year
The Winter Soldiers 8813 (IA)	1 year
The Masters 8641 (UT)	1 year
MARS Robotics (India)	2 years
WAFFLES 14825 (HI)	1 year
MEAF 16374 (HI)	1 year
Confidential Robotics 13243 (MN)	1 year
Techno Warriors 3486 (MS)	1 year

3.3 Sponsors

Timothy Donovan
Evermore Gallery
Pathways
Oates Associates
Saint Louis Bank
Bayer
Suzanne Schilling
Ratan Guduru
Katie Davis
Anonymous donor
Sherrill Associates
Gokul Kommineni
Rahul Kommineni
Byron Carlson Petri & Kalb
Boeing
Student fees
Redmon Insurance Agency
Matthew Chrenka
Massage Luxe
Department of Defense (DOD)

4.0 STRENGTH AND WEAKNESS ANALYSIS

4.1 Overview

The SWOT analysis is a methodology used by many teams and we've recently acquired it to apply to our own. It includes: strengths, weaknesses, opportunities, and risks. These 4 components make up team strategy overall & help our team plan for future seasons. Below are the definitions (as created by our team) and responses to each component.

4.2 Strengths

The strengths of our team are our recruitment capabilities and ties to our communities. At the inception of our team, recruitment was a struggle. With the rising interest in STEM, the process became easier; a few years ago we were contacted by an FLL team which we absorbed. This past summer we ran a summer recruitment camp. Through the camp, we reached 15 students interested and gained 3 new members. We consider the camp a large success and hope to do it again. With the remaining younger students, part of

our sustainability goal includes establishing and funding an FLL team. Our connections with our community have become very strong. During Covid our ties to our communities were strengthened due to providing COVID essentials. For example, we've provided over 600 masks. This season, to market, our team spent multiple days walking around downtown, spreading the word about FIRST. This enhances our communities ties as well.

4.3 Weaknesses

The weaknesses of our team are things that we could fall susceptible to and cause damage to our overall work ethic. Some examples include graduating members, time management, and documentation.

- Over the last three seasons we had almost all of our most experienced members graduate. While our team has excelled in recruitment we have also struggled with the turnover. Overall, our new recruits average a younger age. This brings maturity problems and inexperience. We have tried to push an increase of hands-on learning, in attempts to bring more experience and maturity to the team, but these are both things that take time.
- Our team also struggles with division of time between mechanical and software. Due to COVID, we've been limiting meetings as cases spike. Which arises the issue of who gets robot priority.
- We struggle with documentation. We have a hard time getting members to contribute to the notebook and portfolio, especially with younger members. Many would much rather be hands-on building or programming. To solve this, we've decided to implement ten minute review time at the beginning of meetings going forward.

4.4 Opportunities

Team opportunities include:

- Sponsor Expansion - Even with COVID, we were able to expand our sponsor outreach. We'd never gone to each and every small business within Edwardsville, but enlisted upon face-to-face interactions. We've learned that these are necessary to "sell" your team, as a small business owner told us from her own personal experience. Social media was an expansion of our growing-platform and we enlisted upon Facebook and Instagram to raise money as well. While we've always had luck applying for grants, we turned to new forms of sponsors and haven't regretted it.

4.5 Threats

Team threats include:

- Team Graduates - After the Ultimate goal season we lost three of our senior members. All three of these members did a lot of our mechanical work. Two of these members were our mechanical/ notebook lead. With the loss of these big contributors to our team it caused younger students to step into leadership positions. This also caused the average age of our team to go down significantly. We have definitely struggled with the maturity difference as well as having three new leads figure out their places. In the end, this threat has made our team stronger, and given more opportunity for younger students to step up, and learn more about mechanical, CAD, and notebook.
- COVID- Our team continued to be heavily impacted by Covid. Up until the winter/ early fall we were able to hold smaller in person meetings. Since the case rates increased a lot during the winter and our schools shut down we decided to stop meeting with those groups in person. Our team went about two to three months of having no more than 3 people at a meeting. This meant we had to utilize zoom again, as well as communicate with our teammates better. We definitely felt a level of disconnect from our team during this time so this was definitely a rougher time in the season for our team.
- Local Tornado-In mid December a tornado struck just a couple of miles away from our meeting location. Luckily, none of our team was in the worst part of the storm, but it did mean that our second meet would be canceled. From this we lost some of our outreach for the year, as we were going to be host it at Southern Illinois University, as well as it limited our time between meet two and three.

5.0 TEAM GOALS

5.1. Overview

WormGear Warriors use SMART goals, or Specific, Measurable, Attainable, Relevant, and Timebound.

- Specific: A clearly stated plan set in place is considered a specific goal, as it must be simple and systematic. This is in place to ensure that any team member may pick up from a task and goal set

in pace.

- Measurable: to consider a goal measurable, our team has identified that it MUST be incorporated into the "requirements" section of our Design Process. A measurable goal is one which we can test to prove if we have met it or not.
- Attainable: an attainable goal is one that has a strategy along with it and is achievable
- Relevant: A skill that is in need of improvement is designated as relevant
- Timebound: goals need to be achievable within a certain amount of time, as stated by our time.

5.2 Season Goals

- Advance to state
- Connect to a FTC team in each state (plus some who are out of the country)
- Support at least 3 teams
- Bring in new team members
- Structure our code to be easier to edit
- Follow our team structure plan

6.0 SUSTAINABILITY

6.1 Future Plans

In order to further our team's involvement in FIRST we plan to make some improvements in our sustainability. Our current head coach's child will graduate in two years, so we need to start recruiting not only new members, but also more coaches. In order to do this we plan to start an FLL team next season (these students will come from those at our summer camp). The plan for this team is to feed into our FTC team, as well as to provide a good connection for those younger members.

7.0 FINANCES

7.1 Overview

FIRST prides itself in teaching applicable lifes-skills and our team fulfills this task by managing our finances. Our team raises money independently while being a part of a non-profit, called Metro Area Robotics Society. We fundraise through grants, sponsorships, and independent donations. This year, we received an overwhelming amount of independent donations, as to sponsorships. This differs from the past seasons, in which many businesses looked for advertisements from our team. We offer logos on robots, websites, banners, and pits: depending on the amount. Not only were we able to collect monetary donations, but we also were given collectables from companies to distribute as prizes, for events we ran.

7.2 Budget

WormGear Warrior FTC Income:	2021-22	2022-23 Estimated
	6,062	7,500

Sponsors	Amount
Timothy Donovan	$20
Suzanne Schilling	$50
Gokul Kommineni	$25

Redmon Insurance Agency	$100
Evermore Gallery	$20
Ratan Guduru	$50
Rahul Kommineni	$50
Matthew Chrenka	$400
Pathways	$4,000
Katie Davis	$100
Byron Carlson Petri & Kalb	$200
Oates Associates	$500
Anonymous	$20
Boeing	$275
Massage Luxe	$250
Total	$6,060

7.3 Expenses

WormGear Warriors Expenses	**2021-22**	**2022-23 Estimated**
Registration Fees		
Local	$275	$275
Illinois	$200	$200
State	$250	$250
Worlds	$1000	$1000
Team Wear		
Shirts	$25	$20
Hoodies	$20	$15
Parts		
General Parts / Field Kit	$450	$450
Tools	$200	$200
Robot Parts	$5000	$3000
Laptops (?)	$1000	$2000
.		
Outreach		

Outreach Materials	$68	$100
Business Plans Print	$100	$0
Business Cards	$150	$0
Misc.		
Food	$421	$250
Marketing Printouts	$100	$0
Expense Total	**9,259**	**7,760**

8.0 RESOURCES

8.1 FIRST™ Links

- FIRST Website: http://www.usfirst.org
- FIRST Tech Challenge Website: http://www.usfirst.org/roboticsprograms/ftc
- FTC in Illinois: https://www.firstillinoisrobotics.org/ftc/

8.2 Team Links

Website: http://ftc8620.org/
Email: ftc8620@gmail.com
Facebook: https://www.facebook.com/ftc8620
Twitter: https://twitter.com/ftc8620wormgear?lang=e

ABOUT THE DESIGN PROCESS

I. INTRODUCTION

Being in the STEM community our team uses the **design process** to optimize our time, resources, and designs. By using the design process we can ensure a **robust**, streamlined design which completes the tests we had set for it to do.

THE DESIGN PROCESS	
LIST REQUIREMENTS	In this step we list the measurable and testable requirements for our component/design.
BRAINSTORM	In this step we usually break into small groups to come up with drawings of different ideas for the component. We then come together to choose 2-3 designs we think should be prototyped.
RESEARCH	In this stage we research real world solutions to our problem as well as look to see what other teams have done in the past to solve a similar issue.
PROTOTYPE	In this stage we take some of the ideas we came up with in brainstorming and build them out of materials such as cardboard and duct tape.
DESIGN	The design stage includes physically building a model of the brainstormed idea. This typically consists of the aspect that will later be applied to the game.
TEST	In this stage we test the prototypes against the requirements to determine which of our prototypes would be most worthwhile to fully design and produce.
REFINE	In this stage we make any improvements to our design we find necessary to meet the requirements/ better our design. This stage and the test stage are usually bounced back and forth between 2-3 times for a design.

II. MECHANICAL DESIGN PROCESS

Flamingo (Base Design Process)

List Requirements

- Doesn't get caught on warehouse walls
- Doesn't sit on top of shipping elements when robot enters warehouse
- Doesn't knock shipping hub over when placing elements
- 8 seconds from inside shipping hub to correct position for shipping element delivery
- Across the field (12 ft) in under 3 seconds
- No tipping when going into warehouse/ when extending up to place shipping elements
- **Concise**; can travel around pipes and over
- **robust**

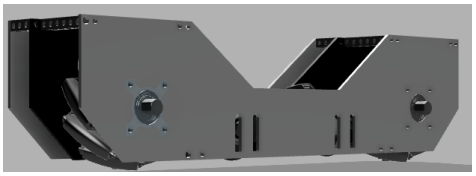
Brainstorm

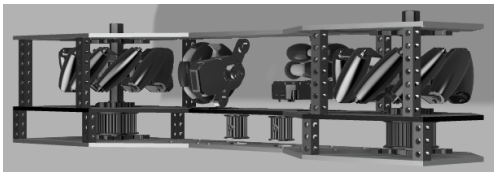
We have been avid users of Mecanum wheels by GoBilda, and the strafing mechanism that they use. We considered using tank treads, low mecanum, and high mecanum. Below you can see a matrix of how we decided which to use:

		simplicity	Reliability	Repairability	Manuverablity	Drivability	into warehouse	over pipes	Robustness			
	Weight (0 low to 10 high)	1	8	5	6	8	6	4				38
Base Name	Base Description											Overall score
Mecanum	normal 18x18 mecanum	6	7	6	10	10	3	0				6.578947368
Narrow & High Mecanum	High clearance and only 12" wide	9	8	10	10	10	10	10				9.552631579
tank treads	Like Mcgyver	6	5	4	5	7	10	10				6.631578947

Research

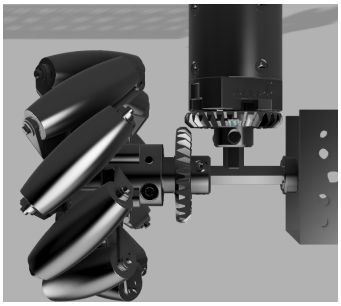
Since our team has been around a while we were able to quickly decide that none of our previous drive trains would allow for us to go both around and over the warehouse walls. We researched by looking into GoBilda's strafer chassis which we overall liked the small, compact design of. The CAD of one of our previous years chassis is pictured below.

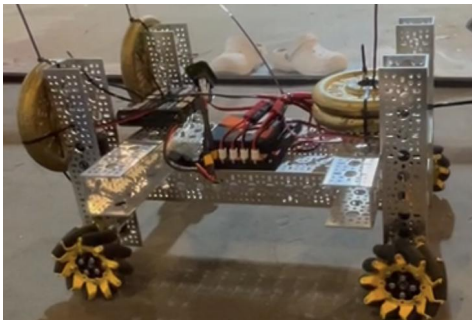


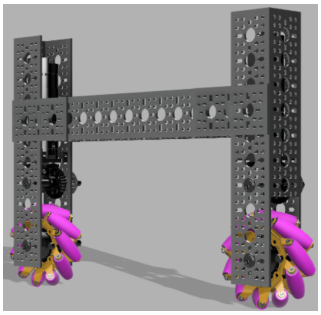
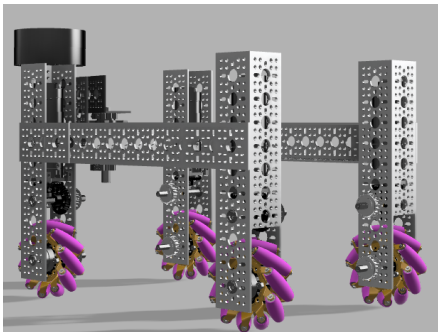
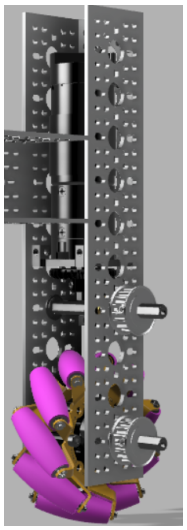


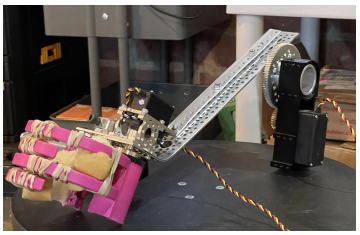
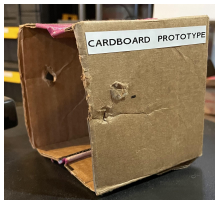
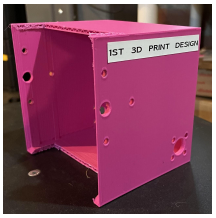
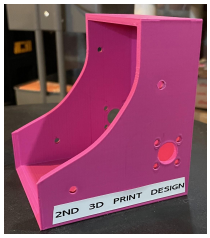
Prototype

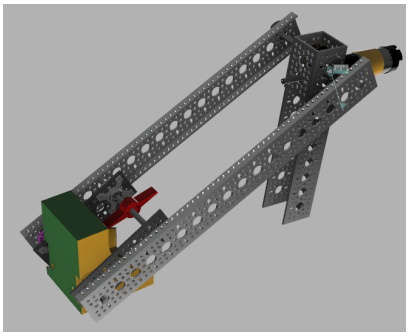
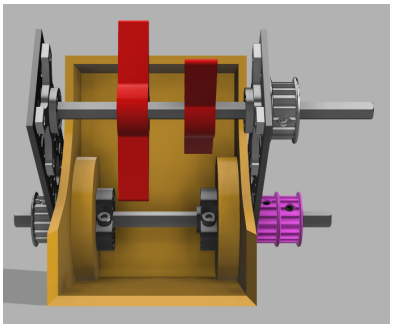
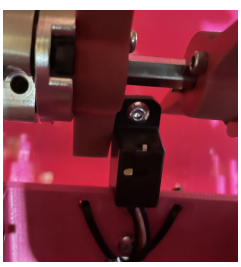
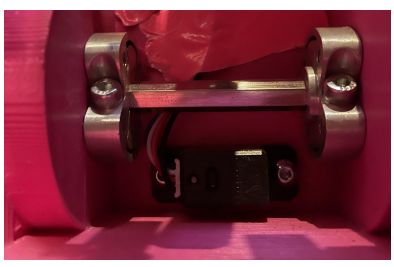
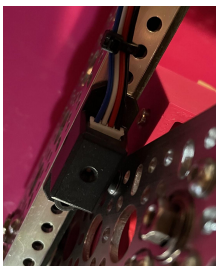
The first prototype of our drive train was used simply to see if the mecanum wheels could handle the pipes and go over them if raised high enough. We attached a battery, REV module, some weights, and went for it. This worked well so we decided that the vertical mecanum would be **robust** enough. We realized that this specific design would be too wide, made some adjustments, and to go forward with the design process and begin a full model that included belts and pulleys, **sensors**, and cameras. Below (left) is the first version of the CAD and below (right) is a photo of the test drive train.

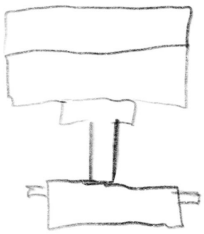
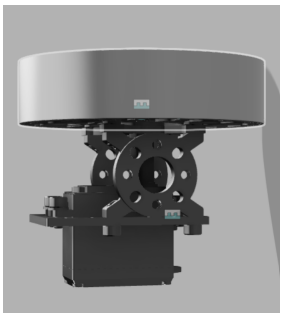
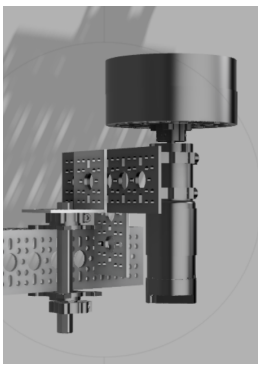
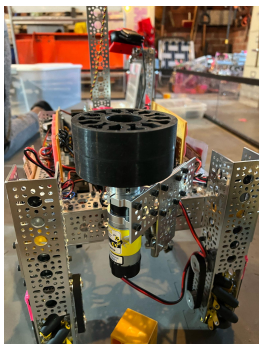




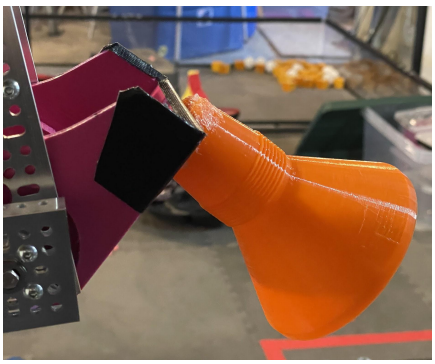
Design	We completely CAD-ed our base. It has four drive motors that are connected to bevel gears at a 90 degree angle, one of which is attached to a shaft that has a pulley connected by a timing belt to the shaft that holds the wheels in place. These are all placed inside of vertical channel and spaced approximately 12 inches out. This allows for use around the pipes and over them.   
Test	To test our base design base we simulated the weight of a robot by attaching weights to our base. This base successfully went over and around the pipes so we proceeded forward with our final design. In order to test this we just let our drive team run some practice matches with the paths they would take to ensure the base could do all the things our **requirements** needed.
Refine	One **problem** we encountered with our base was having the channels we cut in order to fit the wheels properly flexing. This weakened them significantly. In order to combat this we reinforced the channels with steel beams. These beams proved **effective** as they kept pieces that became loose in our robot. While it was not a permanent solution, the wiggling of bearings and gears significantly decreased. Our team has come to call these pieces of steel 'Jack bars'. We call them this because one of our younger member, named Jack, took the task as a learning opportunity and designed these bars, making them, and installing them.
Refine 2	Even though the Jack bars did a good job of keeping the channels from bending we still had bearings and other parts of our drive train wiggling loose and we feared they would fall out again.. We **discovered** the issue was that set screws were the main factor holding it together. This meant if one set screw came loose the whole assembly would begin to fall apart. Our **new** drive train stack up featured many spacers, c-clips, and bolts with washers on the ends of the axles to ensure that there was not even a **millimeter** of movement within our drivetrain stack up.
Lessons	Sometimes it's good to step outside of your comfort zone. We had been using similar styles and frames for our chassis, but this year it simply wasn't an option. However, we got to experiment with a lot of new parts and designs we hadn't considered.

Goose (Collection/Delivery Design Process)	
List Requirements	- Ground to box in 2 secs - Pick up cubes, balls, ducks - Delivers to alliance shipping hub - Pit to shelf in 4 seconds - Only one freight can be collected (sensors or mech.) - Pick up freight in any orientation - Don't have to slam into wall - Potentially collection/delivery on different side (so robot doesn't have to spin)
Brainstorm	We originally realized that a previous season's mechanism would work to carry freight. Our team talked about this arm and box idea as well as reusing a **simple** claw we used last season to pick up the wobble goal. (pictured right) We had strong hopes to implement a faster automatic arm that had less room for error before the season started, but weren't able to. The picture below was the freight collection and delivery in Meet 1 and 2. The photo to the right is the CAD from the original claw.  
Research	The Rover Ruckus season used the same elements as this season, so we were able to use a similar design for our collection box. Our arm is very different, but the box itself is very similar to the one on that robot, it is just smaller. In the past season we could hold two elements and this season we can only hold one.
Prototype	Our first idea for the new arm stemmed from a cardboard box. We did a rough estimate and were able to attach an axle and some rubber bands in order to intake freight. After we decided that would be our new mechanism, We began doing CAD. There were three iterations of the box that all worked, but we knew we could do better. Thus, our box was alive. See our iterations below.    

Design	As you can see in our CAD model we went with a fairly complex but **robust** and **aesthetic** design for our collection and delivery. This design includes a **chain bar link** which allows the collection box to stay in the same orientation to the ground whenever the driver moves the arm up and down. In addition, our driver also has control of the tilt of the box which helps in our **set positions** for delivery/collection. We were able to **integrate** these positions seamlessly **into the teleop by using CAD** and measuring the correct positions. This arm is powered by **three motors**, two attached to worm gears and the third attached to bevel gears. We did this to allow for all of our weight, such as motors, to be located at the **central** part of our robot so our arm didn't have to carry the extra weight. Above right is the entire base arm design, right is the box collection.  
Test	We used a rough prototype to test that the new chain bar link arm would reach the positions we wanted, fit inside our robot, and **effectively intake**. This is when we made minute changes, some last minute CAD, and printing custom parts.
Refine	The general idea of our design didn't change at all with our refine stage. The only aspect we ended up changing was the traction we used to intake the freight. We switched from a rubber band drum to the spintake wheels that Andymark released. The original rubber bands weren't able to get enough traction on both the ball and the box freight shapes. Changing gave fewer failure points and improved our capability to intake freight, especially the balls. We also added **7 sensors** (3 motor encoders, 2 range, 2 magnetic) to help the drive team and drastically improve our autonomous; pictured below. The **motor encoder** allows us to ensure our motors are moving at the same speed no matter what our battery health/ percentage is at. The **range sensors** allow for us to know if we have freight collected, or if freight is in front of us to collect. Our magnetic sensors allow for the arm to have set positions. These **magnetic sensors** are used to home the arm as well as to line up our set positions. These set positions are used for things such as collecting freight to high medium low, and the shared hub. Software: We use a finite state machine in Tele and auto to switch between modes for homing, driving to set positions, and adjusting manually. This allows us to home the arm and box before randomization of auto and store that calibration throughout the rest of the match. The homing for the arm is done using two magnetic sensors and the encoders on the arm and box motors. These have the motors run until the sensors engage and then stop to reset the encoders. Once this process is done, we can give the arm exact encoder positions to run to with incredible consistency. We also utilize a color/distance sensor that detects if there is freight in the box. It then sends a signal to an LED light on the back of our robot, as to whether it has a freight in the box. If it does, the light is green. If not, the light is red. It is this code that also allows us to collect an additional 1-2 blocks in auto.   
Lessons	CAD helps immensely, We completely CAD-ed the arm and were successful in integrating it into our robot during one meeting. Everything fit and lined up perfectly, and also looks **aesthetic** and **clean**.

Duck (Duck Spinner Design Process)	
List Requirements	- Original cycle time: <4 seconds - Refined cycle time (as the season progressed): 3.23 seconds - Score 10 ducks throughout the game - Score 1 duck during auto - Don't fling ducks off of the plate
Brainstorm	This is a simple drawing of how we thought we would spin ducks. This design has two wheels mounted to a Gobilda servo horn. We went with a servo for this design to allow for motors to be used on our other components. 
Research	Our team looked towards many "Robot in 3 days" videos. We came up with the idea as an original, and the necessity to have two inches of motion arose due to inaccurate autonomos at the beginning of the season. In order to accommodate for that, we had to design a **spring loaded spinner** that allowed for a large margin of error.
Prototype	The original duck spinner prototype was made in part by a preexisting channel connected to a servo. The wheel was added to the top with a motor and then connected to a servo tester, where we tested cycle times to ensure it was in compliance with our requirements. 
Design	The original duck spinner prototype was made in part by a preexisting channel connected to a servo. The wheel was added to the top with a motor and then connected to a servo tester, where we **tested cycle times** to ensure it was in compliance with our requirements.
Test	Meet 1: - The duck spinner was consistent in auto 50% of the time, consistent in endgame 80% of the time - The cycle time was consistently 4 seconds, which was laid down as our goal
Refine	Meet 2: - 2.5-3 seconds cycle time - 9 ducks in endgame 70% of the time - 1-2 inches of variance (the spring loaded spinner helped us have no issues with this) Software: - During the time when meet two was postponed, we were able to change our duck spinner code in auto. Before, it would simply drive to a point and spin at that point. Now, it drives backwards until the magnetic sensor lights up and then it spins in that position.   Qualifier Refinement: - Due to an accidental collision with an opposing robot, our L bracket bent, causing the spring to come out of place and not line up with the

	will as well. This was a simple solution, which ended with replacing the bracket, but in the meantime, we noticed the hub on the motor shaft was not tightened. This was due to a stripped screw hole and needed adjustment, which consisted of a new hex hub shaft.
Lessons	In this design we encountered the simplest solution not working. We usually try to simplify as much as possible, but with this design we had to add some complexity in order for it to be consistent. We also learned through this that software truly can make all the difference. Our improvement of duck spinning time was **cut down by a third** simply by our software team adding incremental acceleration and control of the minimum and maximum speeds.

Toucan (Capping Design Process)	
List Requirements	- Picks up variety of shapes - Simple programming - No motors (we are maxed out) - Deliver 2 caps in 20 seconds - Easy line up for delivery (possibly when scoring ducks) - Robust
Brainstorm	The quickest way we could think of adding a capping mechanism to our robot was a magnet. This is pictured ___ and would easily be added to the back of our current arm. The next option was creating an entirely new arm that would spin on a turret and also act as a failsafe in case our intake broke. The last design we considered used a tape measure. We had done this in the past and seen videos on social media of how it would work. We wanted to be able to attach it as a turret so we could cap and spin ducks at the same time
Research	In past seasons we have seen teams use tape measures to score a partial park from all the way across the field, so we knew a team would be using it to cap this year. We did some research to see what tape measures teams said worked the best. We discovered the fat max and Milwaukee stud tape measures worked the best. Due to supply shortages we were only able to get the Milwaukee brand.
Prototype	Many teams in our league have sent out CAD files of "universal" Team Shipping Elements that would be able to double cap. We 3D printed four different options and modified them to be able to pick up with a magnet (bottom right) or a hook then quickly put a hook on a tape measure (bottom left) and added metal to the bottom of the box to see which one would work better for us.   Tape measure: Pros: - Able to cap and score ducks at at the same time. -Innovative and new design. -Gives us two options in a match to score (the other being the arm). Cons: -Not fully developed. -Our drivers have less practice with it. -can be unreliable. Magnet: Pros: -reliable, and our drivers have a lot of practice -compatible with all elements with magnets Cons: -very slow. -can't score ducks and cap. -tends to knock freight off shipping hub Magnetic Box analysis: We were fortunate enough to run **practice matches with Gearheads, team 13365.** During this day we discovered we would be responsible for double capping and scoring ducks if we were to be on an alliance with them. The day we practiced with them we were unable to double cap and get all the ducks, so we decided to design a new mechanism that allowed us to score two caps (which is the tape measure design).
Design	Our initial design utilized a tape measure and

	hook to allow for us to get the distance we need to be able to cap at the same time we are scoring ducks. Since the robot will be sitting still to score ducks, this means the capping mechanism will need to be able to tilt and move the hook side to side. In order to do this we need to use **three servos.** One servo is our turret, which moves the entire capping mechanism so our hook can move side to side. The second servo controls the tilt of the tape measure so we can tilt to pick up the team element and tilt up to place it on the hub. The third servo has a silicone wheel attached to it which is what is moving the tape measure in and out to reach the team element and shipping hub.
Test	At qualifier this arm scored us a whopping 3 points, on a partial park. This was partially due to our drive team not having enough practice, and the arm not being fully developed. The arm was very difficult to control due to the tape measure dropping and the servos being very jerky. Overall we like the design of this,but it needs some added strength and control. A stretch goal for this design would also be to make it look better. State Refinement: - Extends from opposite sides of the field, specifically duck spinner to alliance hub - Must have enough strength to hold team element (previous iteration was wobbly as the weight increased) - Easy to control, driver accessible - Speed, cycle time: 30 seconds - Works on both sides of the field
Refine	For our final design we have kept a lot of our original design and added a few things to make our already innovative design more **robust, reliable,** and easier to control. In order to solve our previous issues of bending, inconsistency, and the tape measure breaking we decided to add a new completely **original, innovative** design. The tape measure is the strength of the arm and the tape measure is used to actuate it. We have yet to see a team using a fishing pole, but we suspect if another team were to they would choose to use string. Our team kept away from string due to complications it has caused for us in years past. 
Lessons	This design has possibly taught our mechanical team some of its biggest lessons. We started the design less than a week before qualifier, and made our implementation the night before. The initial design involved absolutely no CAD. Our mechanical team therefore got very frustrated, and realized how helpful CAD truly is. Our second go around we used **extensive CAD** which made the design and assembly process fairly **seamless.**

Magnetic Arm

List Requirements

- Collect/deliver freight without turning
- Collect heavy blocks
- 4 in 15 seconds, = 3.75 seconds for each block
- First 2 in 10 seconds
- Robot stays stationary when collecting

Brainstorm

Idea 1: Crane (chain-bar link mechanism)

Pluses	Deltas
Easier to drop off blocks	Time consuming
4 second cycle time (predicted)	Would require brand new software code
Possibly faster	Limits space within robot
Robot would still be able to cap if it were to break	May have placement struggle, since dimensions of robot are small
Sturdy	Takes up space

Idea 2: Toucan pt. 2 (previous capping mechanism, fishing pole)

Pluses	Deltas
Simple & unique	May impact capping strategy
5 second cycle time (predicted)	Small surface area of collection itself
Less time consuming to build	Would hurt capping if it were to break
3 ft. extension if hub were to be moved	Placement struggle, angles have to be accurate
Already built	

Research

Not many teams have tried fishing poles, so we used our personalized Decision Matrix to "research" which mechanism we should proceed with.

Mechanism Nam	Simplicity	Reliability	Re[airability	Maneuverability	Driveability	Robustness	Speed	Total
Toucan	8	9	7	10	10	6	5	9.107
Crane	4	8	6	5	5	6	8	6

Prototype

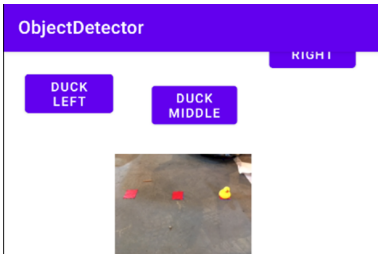
When entering this stage we realized this arm would be doing almost the exact same things as our Toucan (capping) arm would. Taking the similarities and our time constraints into consideration our team decided to combine the capping and shared hub collection into one arm, called Toucan.

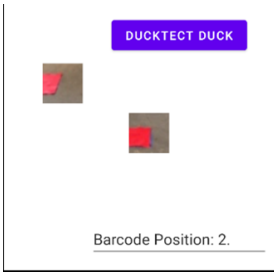
II. SOFTWARE DESIGN PROCESS

Vision Code Design Process	
List Requirements	We need to be able to detect the location of the Duck element 4 out of 5 times. The code should be simple to understand and have a detection time of less than 4 seconds. This is separate from the autonomous code, but should be easily incorporated into our autonomous code.
Brainstorm	Several methods of detecting the object could include repurposing our Vuforia code from last season, starting by using the supplied code from FTC, and modifying some combination of these methods.
Research	We read in the game manual about how the barcode process is different from last year's ring process. We also reviewed our code from the previous season to see what will change
Design	We determined that **creating an android app**, as we did last season, would help us test our code without a running robot. We designed the code, similarly to how it worked last year, to look at RGB values for each pixel found in the cropped images corresponding to the respective barcode positions. On the blue side, we determine "yellow" pixels based on a ratio of 2 red to 1 blue. On the red side we determine "yellow" pixels based on a ratio of 2 green to 1 blue. This is because yellow is made up of equal parts red and green. The barcode with the most "yellow" pixels is determined to have our team element, which, like the ducks, is yellow.
Prototype	Our prototype was the **android app** and initial vision algorithm we created. It completes the algorithm listed above. This app served as an excellent prototype because it allowed us to test our algorithm while the robot and webcam mount were still being constructed.
Test	We were able to begin integrating our code into the autonomous before Meet 1. However, we weren't able to act on detecting our team element until meet 2.
Refine	Throughout the meets, our vision code stayed relatively the same and worked consistently. We did get a smaller web-camera before meet 3 and had to modify the vision crop boxes to accommodate it. We also found that sometimes very yellow shipping elements became washed out in very bright lighting. Orange or more gold-colored yellow shipping elements worked most accurately.
Lessons	Working on the vision code this year has shown us the importance of applying and modifying methods that have worked in the past to each new challenge. In Ultimate Goal, developing an Android app to test our code, before having a robot to test with, was extremely effective. By simply modifying our code from last year that detected rings to instead detect our team element, we saved a large amount of time. This method also assisted in helping us create a vision algorithm that works extremely accurately.

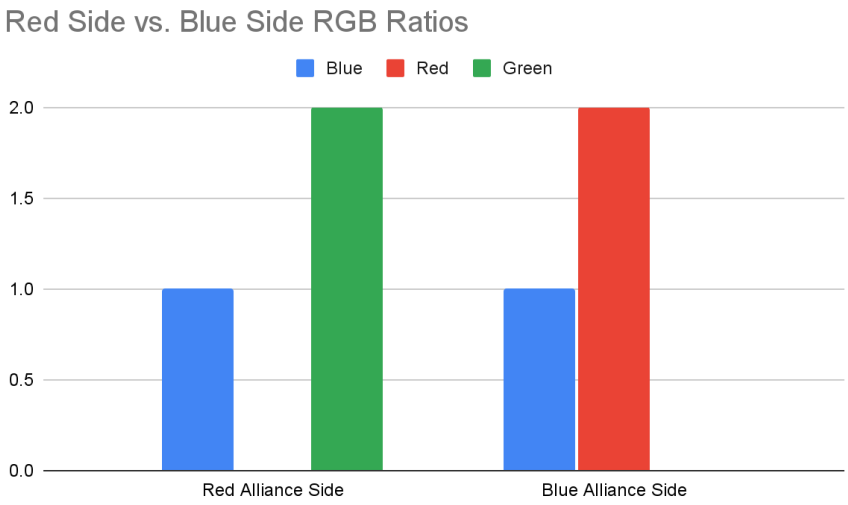
Media

Picture of Android prototype app:

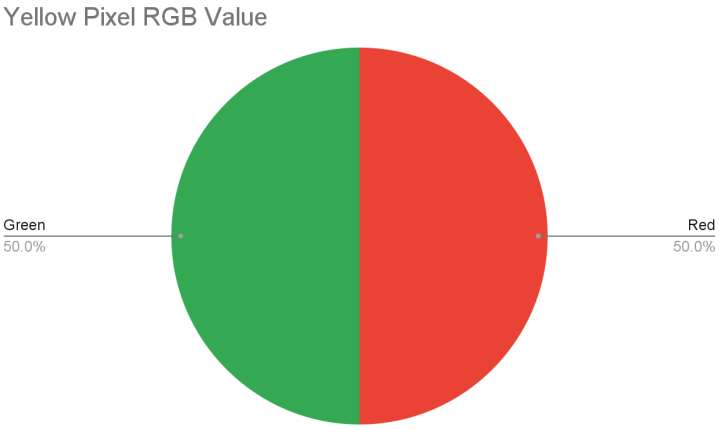




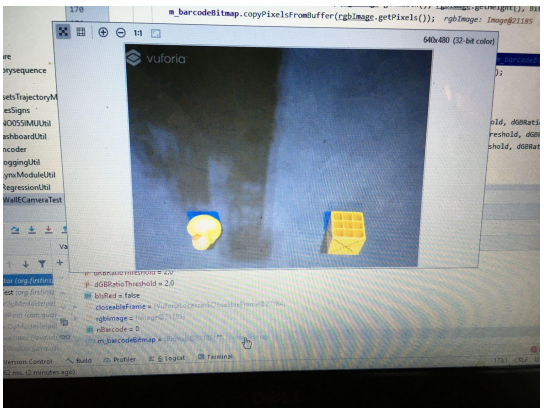
Graph of the red alliance side RGB threshold vs. the blue alliance side RGB threshold; used to determine yellow pixels.



RGB value of what we determine as a “yellow pixel”



Finding where to crop respective barcode positions after taking the first few pictures with our camera.



Autonomous Design Process

List Requirements

- Needs to run as planned every time/Consistency
- Should contribute to being able to achieve 100 points ourselves in matches
- Cycle time of 4 seconds for duck spinner
- 50 points by meet 3
- Should improve every competition

Brainstorm

There were many options of autonomous paths we discussed. Here are a few:

- Detect team element, deliver preload correctly, park in warehouse
  - (20 + 6 + 10 = 36)
- Detect team element, deliver preload, deliver duck, park in storage unit
  - (20 + 6 + 10 + 6 = 42)
- Detect team element, deliver preload, deliver duck, park in warehouse
  - (20 + 6 + 10 + 10 = 46)
- Detect team element, deliver preload, park in warehouse
  - (20 + 6 + 10 = 36)
- Detect team element, deliver preload, deliver 2nd piece of freight, park in warehouse
  - (20 + 6 + 6 + 10 = 42)
- Detect team element, deliver preload, deliver 2nd piece of freight, deliver 3rd piece of freight (4th piece of freight?)
  - (20 + 6 + 6 + 6 = 38)

Research

We created a table at one of our meetings stating a task's point value, efficiency, difficulty level, and time requirements. This table then helped us to determine what tasks to complete during autonomous.

task	points	probability	time	probability*points	efficiency
duck from carousel	10	2	5	20	4
partially in storage unit	3	3	3	9	3
completely in storage unit	6	3	3	18	6
partially in warehouse	5	3	3	15	5
completely in warehouse	10	2	6	20	3.3
freight completely in storage unit	2	3	6	6	1
freight in shipping hub	6	2	6	12	2
pre load box/duck in shipping hub	10	1	8	10	1.25
pre load box detecting team element	20	1	8	20	2.5

Design

- Navigation:
  - After using dead-wheel odometry for our navigation for a couple of years, we made the decision to try out the roadrunner library from acme robotics.

- Classes:
  - As a software team, we came to the consensus at the beginning of this season that our code would be much easier to read and edit if we had classes for each robot component. This would involve, for example, a duck spinner class that is then imported and used in an overarching robot class. The robot class is then called in the op-modes. This allows us to make changes to one of the classes without having to make changes to all of them. It also cleans up our hardware maps significantly.

Prototype

During our off-season, we started working on roadrunner to familiarize ourselves with the program. We started off using exclusively the acme robotics code, but towards the end of the summer we ended up integrating it with some of our older code. The initial version of our autonomous is shown on the diagram below:

Test

Due to a slow start to the season, we had to back off of some of our ambitious auto goals

	for meet one. We ended up with an auto that would deliver the duck and then park in the shipping hub (Due to not enough time to integrate our object detection code). We were also having some issues with the consistency of our movements.

Refine	• After meet one, we were able to integrate our object detection code with our autonomous, and so we were finally able to deliver the preloaded freight according to the team element.
	• When meet two was delayed, we were able to go into our autonomous code to look atour inconsistency issues. We discovered that our problems were rooted in the fact that we had completely missed a step of the RoadRunner tuning process. Once we went back and completed that step, our inconsistency issues were just about completely fixed.
	• Also during this time when meet two was postponed, we were able to change our duck spinner code in auto. Before, it would simply drive to a point and spin at that point. Now, it drives backwards until the magnetic sensor is triggered and then it spins in that position.
	• At meet two, we had the issue of running into our alliance partner during autonomous, because neither team had anticipated the other robot when writing code. Given this issue, we changed our autonomous paths to go around the shipping hub and deliver to the side, so that our robot was always on our side of the field and would not interfere with our partner's robot.
	• During this time after meet two, we also had to edit our autonomous positions slightly in order to accommodate the new arm mechanical had put on the robot. We created a state machine in order to home the encoders and be able to use set positions in autonomous and TeleOp.
	• After our perfect autonomous runs at meet three, we decided to try and improve our point scoring as much as we could in autonomous. On the warehouse side we were able to pick up a second freight and deliver it on the top level as well as park again and load a freight for the beginning of TeleOp. Eventually, we added in delivering a third freight.
	• Duck spinner code:
	  ○ Due to the initial inconsistencies with roadrunner, we decided to improve our duck spinner code in order to more consistently score those points.
	  ■ With the first iteration of our duck spinner, we simply drove to the carousel with roadrunner and turned on the wheel.
	  ■ When the mechanical team built the new (current iteration) of the duck spinner, it was spring-loaded and had a magnetic sensor. The software team decided to take full advantage of these improvements. We changed the autonomous code to line up with the wall and drive backwards until the sensor engages. This allows us to make sure the robot has good contact with the plate as it's spinning.
	  ■ In Tele-Op, the drive team wanted a way to speed up the ducks in endgame. So, we coded the duck spinner to start at a minimum speed and then gradually accelerate each time through the Tele-Op loop.
	• We had many goals for improvement in our autonomous for the State competition. You can see all of these in detail on page 47.
	• All the iterations of our revised autonomous are seen in the diagrams below:

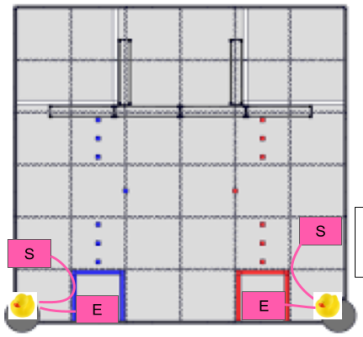
Lessons	This year, our autonomous taught us that you can always improve. Our autonomous program improved drastically each competition this year; in accuracy, consistency, and point value. You can see this improvement as it progresses in the diagrams below.

Media

Key
WallE start/end location = S/E
Deliver duck =
Path =

Meet 1

Missed duck 2/5, only partly parked 4/5, missed park 1/5

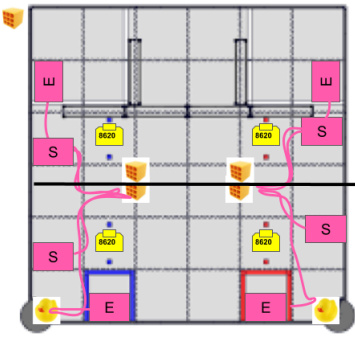


Storage unit auto: 16 points possible

Key
WallE start/end location = S/E
Detect team element = 8620
Deliver pre-loaded freight =
Deliver duck =
Path =

Meet 2

Missed duck 2/5 matches, missed freight scoring 2/5 matches; mostly due to path collisions



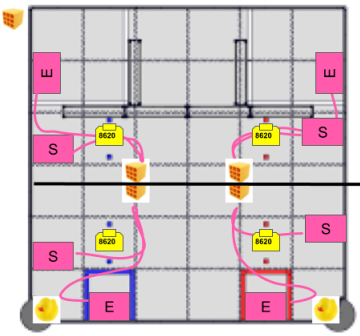
Warehouse auto: 36 points possible

Storage unit auto: 42 points possible

Key
WallE start/end location = S/E
Detect team element = 8620
Deliver pre-loaded freight =
Deliver duck =
Path =

Meet 3

Perfect autonomous 5/5 matches; collision problems solved by new paths



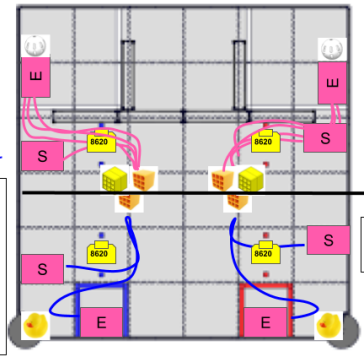
Warehouse auto: 36 points possible

Storage unit auto: 42 points possible

Key
WallE start/end location = S/E
Detect team element = 8620
Deliver pre-loaded freight =
Deliver freight from warehouse =
Pick up 3rd piece of freight to prepare for TeleOp =
Deliver duck =

Warehouse auto path =
Storage unit auto path =

Qualifier



Warehouse auto: 42 points possible -plus additional scoring of freight in Tele

Storage Unit auto: 42 points possible

Speed Mode auto:
The same as Warehouse auto, but it goes straight to the shipping hub instead of around the first time, in order to make another trip to the warehouse to pick up and score another freight. 48 points possible plus additional freight scoring in tele

Key

WallE start/end location = S/E

Detect team element = 8620

Deliver pre-loaded freight =

Deliver additional freight from warehouse =

If time pick up 4th/5th piece of freight to prepare for TeleOp =

Deliver duck =

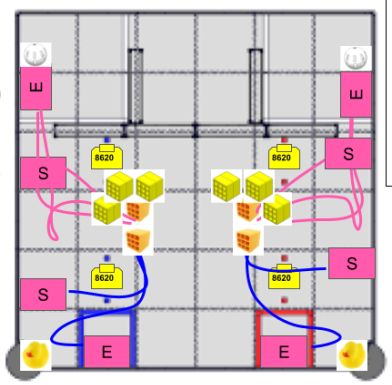
Speed Mode auto path =

Storage Unit auto path =

Not depicted but still possible:

Warehouse auto: 42 points possible
-plus additional scoring of freight in Tele
Essentially different path of speed mode with less additional freight

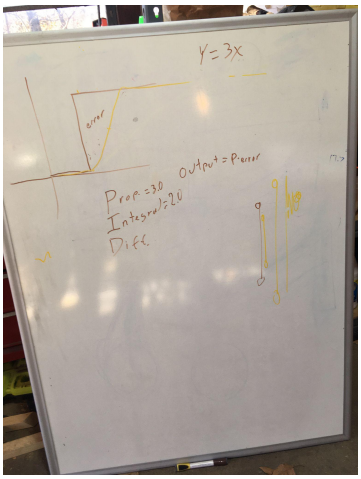
State



Speed Mode auto:
More efficient path than Qualifier version which allows for scoring preload plus 2-3 additional freight in Auto, which also score in Tele. Will collect freight to be ready to score if only has time to deliver 2 additional freight. 48-54 points possible, plus additional scoring of freight in Teleop.

Storage Unit auto: 42 points possible

Navigation Design Process	
List Requirements	Last season, we ran into some unexplained issues with our dead-wheel odometry. Over the summer, we were looking for a more accurate solution. Here are the requirements we came up with: • It must get to the designated position on the field every time • It must be fairly easy to learn and implement/integrate with our robot's code
Brainstorm	There were multiple solutions we came up with to solve this problem: • Staying with our old odometry code • Using acme robotics' roadrunner library with our dead-wheels • Using acme robotics' roadrunner library with simply our motor encoders • Using the roadrunner library with a 3D camera • Mixing together multiple methods such as: using a 3D camera as well as dead-wheels
Research	The 3D camera had a tendency to get "lost" when other robots got in the way. If the dead-wheels did not make constant contact with the field, the positioning was wildly inaccurate.
Design	We made a plan to use the 3D camera as well as deadwheels. We would use the camera method as our primary with the dead-wheels there as a backup in case the camera got "lost".
Prototype	Over the summer, we started working with roadrunner and dead-wheels on our robot from last season. We started out just using the acme robotics code, but towards the end of the summer, we integrated the acme robotics code with the code that we had written. About the time we got roadrunner working on our old robot, the game for this season was released and we learned about the pipes to get into the warehouse. Even with this knowledge, the plan to use dead-wheels and the 3D camera stayed the same, with the slight change of having actuated dead-wheels in order to make it over the pipes.
Test	Due to a slow start to the season, we did not get dead-wheels on the robot in time for meet one. This caused the software team to decide to simply use roadrunner with the existing motor encoders. This was working for meet one, but it was inconsistent.
Refine	• After meet one, with further communication with the mechanical team, it was decided that in order to get the new arm on the robot in a timely manner, getting dead-wheels on the robot would not be feasible. Roadrunner with the encoders was still very inconsistent. • As mentioned above, in the autonomous design process, during the week when meet two had been postponed, we discovered that roadrunner was inconsistent because we had missed an entire step of the tuning process. So, after going through and changing PID values according to the tuning guide, our code finally went to its designated point on the field every time.
Lessons	Implementing RoadRunner as our localization this year taught us the importance of thorough work. In the above design process, you can read about our discovery of the issue in RoadRunner tuning. This was due to us not fully investing in the initial process, in anticipation of using dead wheels later. Later, after re-tuning the missed steps, we discovered that there was a drastic increase in WallE's traveling consistency. This exemplifies the idea that you need to be as thorough and accurate as possible when implementing new methods of control.

Media	The below graphs show 

Teleop Design Process	
List Requirements	• Easy to control and easy to use • Has to be limited to 2 gamepads
Brainstorm	We had a brainstorming session with the drive team and software where we decided on all of the controls. The picture of the control map on a whiteboard is below. We also had our drive team decide what kind of movements they wanted for some preset positions.
Research	We did some research on all of the legal gamepads to see which had the most buttons and by that we decided on the gamepad f310 logitech controller.
Design	We designed the controls to be efficient and easy to remember. The drive team created the controls with the software team so it would be done efficiently.
Prototype	We had a session of drive practice where the drive team switched around some of the controls and some of the preset positions.
Test	We did a combined team drive practice with the team 13365 gearheads and had the drive team take notes on changes they wanted to make.
Refine	We finished up all of the positions and changes that they wanted and also found some new button combinations on the controller. Also, we created an endgame mode for one of the gamepads.
Lessons	We learned that efficiently planning the buttons on the gamepad is really important.

New Autonomous For State Design Process	
List Requirements	• 3-4 freight consistently in total • Needs to run as planned every time/Consistency • Should contribute to being able to achieve 100 points ourselves in matches • Cycle time of 4 seconds for duck spinner
Brainstorm	Early in the season we created a rough draft of code on paper by drawing paths for auto. Shortly after that we upgraded to road runner, a localization library, so we had to use the things called trajectories. This gave us the ability to use a movement called a spline.
Research	We had to research how splines work and we spent some time learning how they work. Splines work by having a curved line from point a to point b.
Design	We designed the auto paths to be efficient but also work well.
Prototype	For meet one and two we had a very simple auto but for meet 3 we had one that never messed up.
Test	We have tested and worked on the auto a ton over the season.
Refine	We created a speed mode auto that can do blocks in 6 or 7 seconds.
Lessons	Auto paths are very important if we want to score well and we also need to learn new tools off season.

Other Software Media

The below chart visually represents the modular organization for our robot component classes this year, and explains why this system is so effective.

Robot Class

The robot class operates as the container for all other hardware-related classes. It holds the arm, the duck spinner, and a class containing variables shared between all of these classes. Within the class is also contained several functions that require the control of multiple mechanisms. For example, the function to drive until the duck spinner touch sensor is triggered, used in autonomous to deliver the duck, is in this class. By having all of our main robot systems included in one class, we are able to only call this one class when we need to access these systems in Autonomous or TeleOp. It makes our code extremely modular and easy to change and understand.

Duck

This class has the functions for control of the duck spinner. This includes all of the motors and servos that make up the mechanism, the acceleration function, and the set positions for all parts of the duck spinner.

Goose

This class has the functions used for the collection mechanism, or Goose as we call it. This includes the state machine that controls the arm and box. It also contains the arm/box motor set positions, the sensors used in the collection, functions that control the intake of freight, and functions to home and update the mechanism.

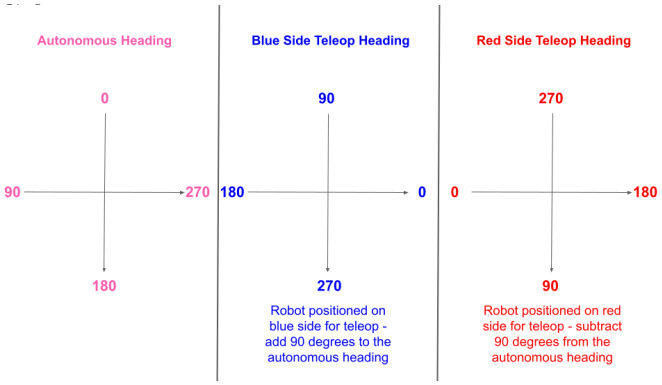
(Grabber Arm)

Though this class is no longer in use, at one point it was used for control of the old collection mechanism, the grabber arm. It is also an excellent example of why this modular system works. To change from using the grabber arm in the autos/tele to using goose was a simple matter of exchanging the arm class called in the robot class.

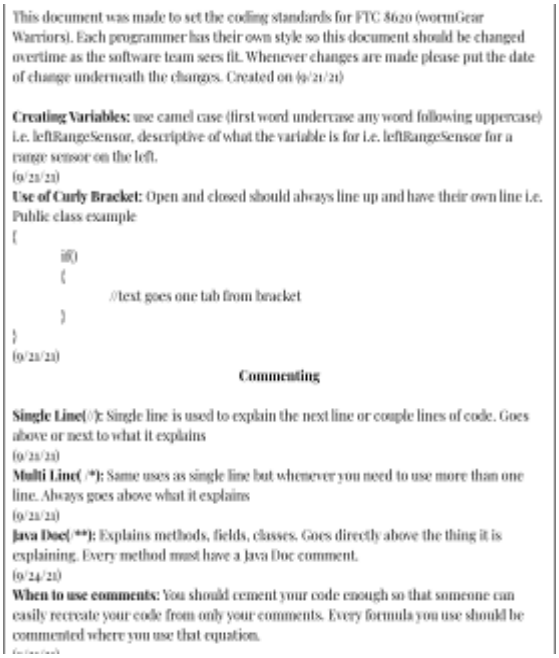
Global Variables

This class contains several variables that are used in multiple autonomous classes. One example would be the variables used to pass heading information from autonomous to tele.
(see Navigation Design Process, Media section)

In order to save driver-controlled time, our team determined that it may be a useful endeavor to try saving the heading at the end of autonomous and transferring it to teleop. However, we discovered that the heading from RoadRunner differed from the assigned heading at the beginning of teleop. This is due to RoadRunner having a set heading for each direction of the field that does not differ based on robot orientation. Whereas, the teleop heading is determined based on the robot's orientation when started. So, it is different based on the blue alliance side and the red alliance side. While trying to transfer the heading from auto to teleop, we discovered that we would need to add 90 to the heading on the blue side, but subtract 90 from the red side heading. This chart (below, left) represents the described heading



The document to the right is a coding standard created to teach our new software members the importance of consistency and readability in formal coding.



This document was made to set the coding standards for FTC 8620 (wormGear Warriors). Each programmer has their own style so this document should be changed overtime as the software team sees fit. Whenever changes are made please put the date of change underneath the changes. Created on (9/21/21)

Creating Variables: use camel case (first word undercase any word following uppercase) i.e. leftRangeSensor, descriptive of what the variable is for i.e. leftRangeSensor for a range sensor on the left.
(9/21/21)
Use of Curly Bracket: Open and closed should always line up and have their own line i.e.
Public class example

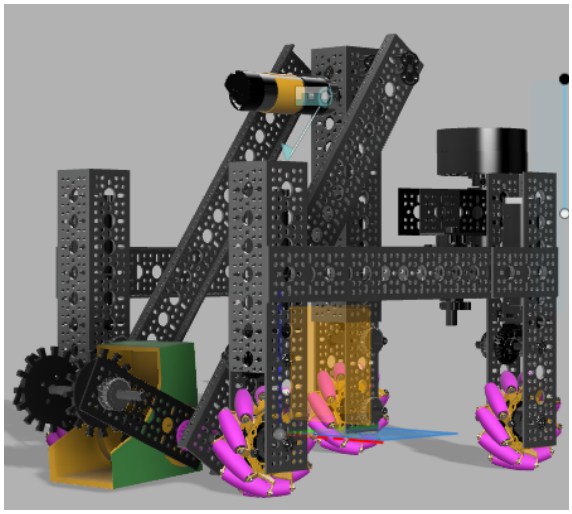
```
{
    if()
    {
        //text goes one tab from bracket
    }
}
```

(9/21/21)

Commenting

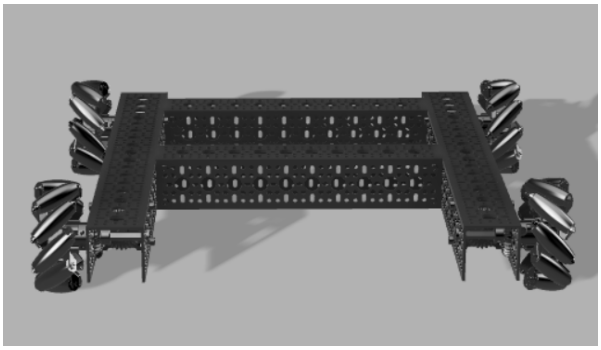
Single Line(//): Single line is used to explain the next line or couple lines of code. Goes above or next to what it explains
(9/21/21)
Multi Line(/*): Same uses as single line but whenever you need to use more than one line. Always goes above what it explains
(9/21/21)
Java Doc(/):** Explains methods, fields, classes. Goes directly above the thing it is explaining. Every method must have a Java Doc comment.
(9/24/21)
When to use comments: You should cement your code enough so that someone can easily recreate your code from only your comments. Every formula you use should be commented where you use that equation.

OUR ROBOT

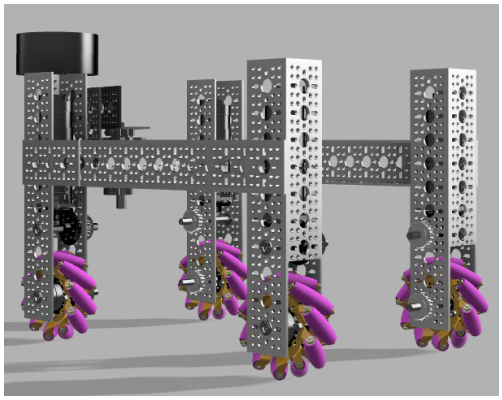


FLAMINGO (CHASSIS)

PREVIOUS ITERATION

ITERATION 1	
	*ANALYSIS:* .We decided not to go with this chassis because we would be unable to get over the warehouse walls. An added challenge to this base was the lack of places to mount things. In terms of maneuverability our driver would have to strafe between the wall and warehouse wall which could cause us to get caught more easily.

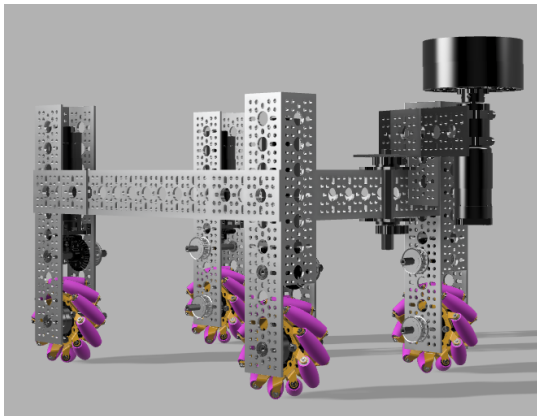
CURRENT ITERATION

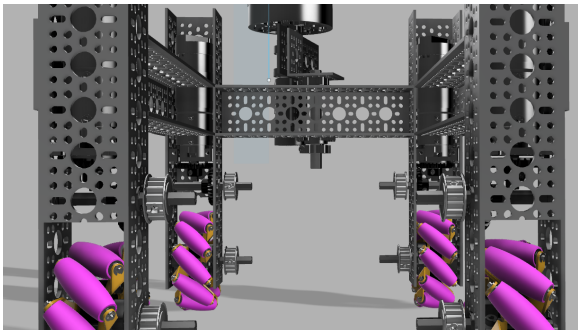


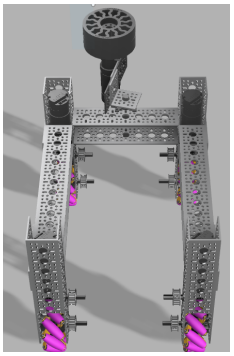
ANALYSIS::

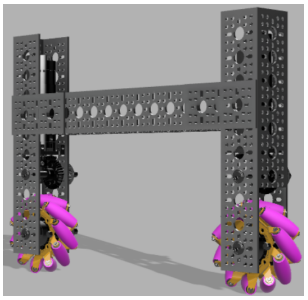
We went with this design because it was high enough that we could easily go over the warehouse walls. An additional bonus to this feature is that we don't have to reach up very high to deliver freight to the highest level. This base allows for us to drive straight between the pipes and the wall which is the easiest way for our drivers to maneuver into the warehouse. Another bonus to this chassis is the motors being mounted vertically so we have almost the entire 18X18 cube to build our components in.

OTHER VIEWS OF THE CHASSIS









DESCRIPTION:

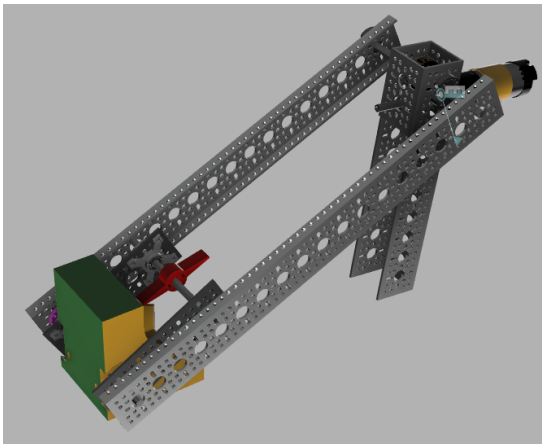
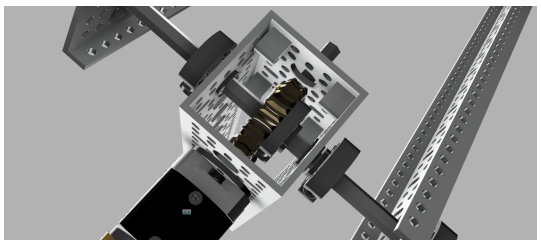
Our current chassis consists of four drive motors that are placed inside of GoBilda channels, then attached to a timing belt on our Mecanum wheels. The vertical design of this chassis allows for our robot to fit between the perimeter and the pipes, but also go over them. Each motor assembly features two bevel gears placed at a 90 degree angle on a shaft; at the end of the shaft there is a pulley that uses a timing belt to connect to the shaft on the wheels.

GOOSE (COLLECTION)

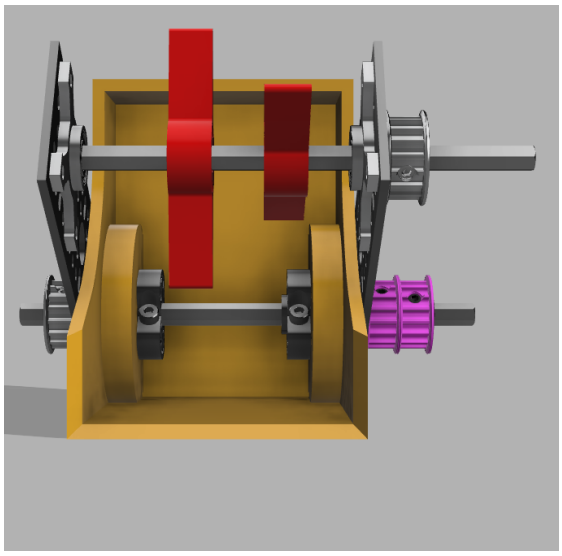
PREVIOUS ITERATION

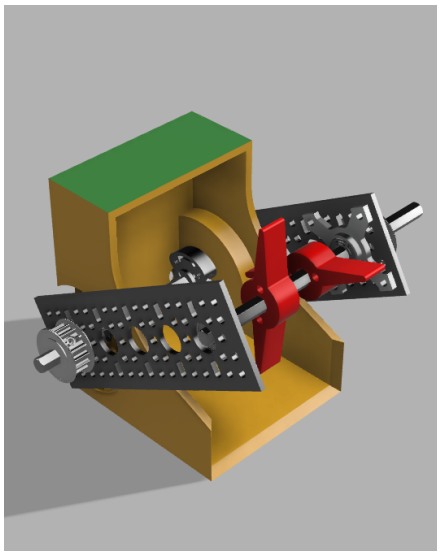
ITERATION 1	
	*ANALYSIS:* This collection was not our first decision. After a late start in the season, we found it best to reuse an old mechanism. This grabber was simple, but didn't allow much margin for error for the drivers. They had to carefully align with freight and were unable to travel over the pipes while holding anything. This arm was also easily breakable and had already been used in a previous season, making it more fragile.

CURRENT ITERATION

 	*ANALYSIS:* The new arm and current iteration on our robot is a chain-bar-link and uses three motors mounted from one convenient place. This arm, although large, actually fit our robot better. The arm is able to do a complete 180 degree turn and deliver freight from the backside of the robot if needed. The extended channels remain parallel and can reach the tallest level of the Alliance hub with ease. This arm took an extreme amount of planning but overall was a better choice for our robot and robot drivers.

OTHER VIEWS OF THE COLLECTION



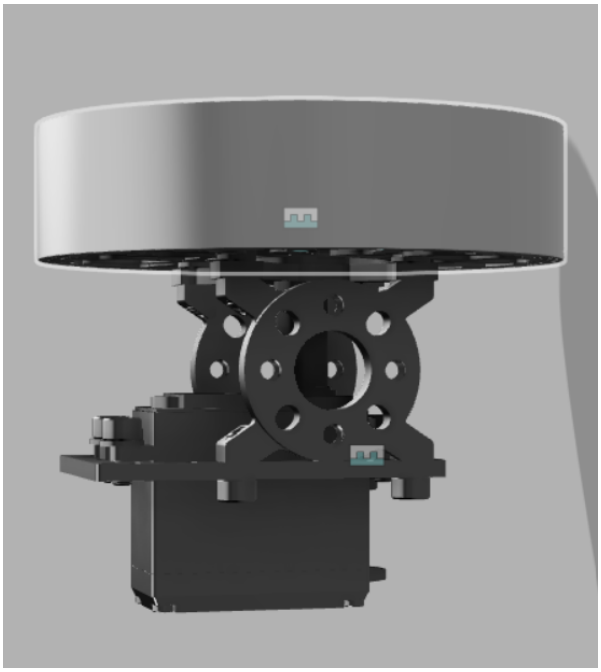


DESCRIPTION:

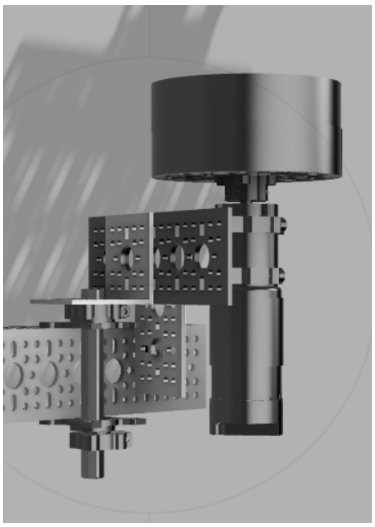
This arm, nicknamed “Goose” has been a great addition. There are three motors, two worm gears, and one collection box. The box was carefully designed using CAD to be able to place bearings, sensors, and axles inside. One motor actuates the up and down movements of the box, another actuates the tilt, and the third powers the Spintake wheels. This system is extremely consistent and always able to score and/or remove freight from the box. The design is simple for drivers and fits easily inside of our base.

DUCK (DUCK SPINNER)

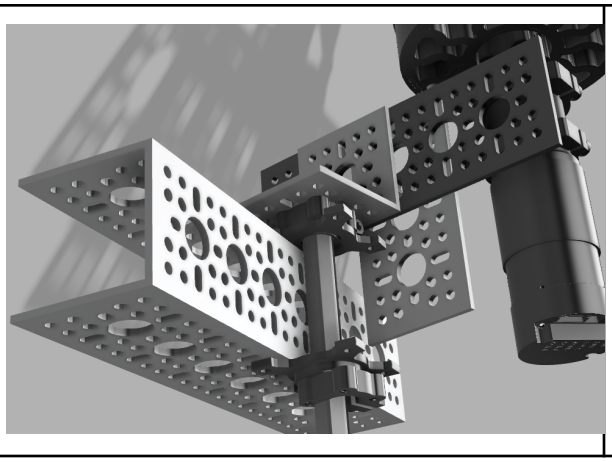
PREVIOUS ITERATION

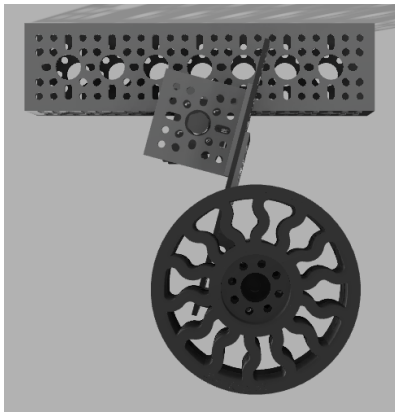
ITERATION 1	
	*ANALYSIS:* This duck spinner worked well in testing, but once we got to our first meet it proved to be unreliable and slow. Our robot would bounce off of the turning plate rather than squishing into it like we hoped it would. This caused some of our autonomous runs to miss a duck. Another issue with this duck spinner was that it was fairly slow so we were unable to get all of the ducks in the endgame.

CURRENT ITERATION

	*ANALYSIS:* Our current duck spinner has added complexity which helps us to score ducks better. This duck spinner is spring-loaded so when we drive into the plate we always make contact instead of bouncing off. In our autonomous, our robot uses a magnetic sensor to make sure it is applying pressure to the plate, this has made our auto get ducks 100% of the times we have run it with this spinner. In addition to the magnetic sensor, our duck spinner accelerates. This has allowed for us to make time in our autonomous for more freight scoring, and in our endgame, we have an extra ten seconds left to do whatever we deem the most important.

OTHER VIEWS





DESCRIPTION: This duck spinner is definitely one of the most reliable scoring parts of our robot. We consistently score all ten ducks with it in our matches. The duck spinner is spring-loaded, which allows for our robot in autonomous to ensure it is making contact with the plate and not bouncing off like we previously had issues with. In autonomous we also use a magnetic sensor to ensure that the duck spinner is applying enough force to get the wheel to move. Another software function of our duck spinner is that in autonomous and endgame it accelerates. This acceleration has bought us ten seconds in endgame to go do whatever tasks we think we need to score the most points. From the start, we went from getting under 9 ducks in 30 seconds to getting 9 ducks in under 20 seconds.

Judging!

State Judging Design	
List Requirements	- Engage judges - Share our story - Share it in a way that makes sense, and is easily understood - Have team prepared for questions - Educate judges about software, mechanical, outreach, and documentation
Brainstorm	Think about who will present what. Formulate a plan of how to organize the order so it best tells our story.
Research	• Estimate judging questions and answer them. • How many student members are there on your team? • Which of your student members participate in community service? • What does your robot do? • What is the one thing that we did not ask about that you most want the Judges to know? (me • How did your team make decisions about assigning roles on the team? • What is the one thing that we did not ask about that you most want the Judges to know? (soft • Which of your student team members took part in an outreach activity? • How do you fundraise? • Does your team reach out to other teams? In what way? Our team started a 50 states program which allowed us to connect to other teams and share ideas to another. • Were there any activities where your team took the lead? For this season we ran and hosted a kickoff which consisted of over 100 participants. • How do you market your team? Tour the Town activity, partnering with small businesses, our pink plays a major role in the marketi team with our community and other teams. It keeps us well known and allows our community mem recognize us at events. • What is the one thing that we did not ask about that you most want the Judges to know? (outreach/notebook) How our documentation design process applies to outreach events and the camp we led. • How does your team attract additional Mentors? • Does your team perform any type of community service? • How did you come up with the overall design? • In what ways is your team unique? • We never back down to anything on this team. I have never heard anyone say, “This seems • too hard,” or “this is too much work.” Obviously we found better solution to problems or • Found better routes than the one we first took, but not once have we plain out given up. • What role does each of your team members play on your team? • How do you manage your time? • What did you learn by being a part of the team? I have learned how to CAD,mechanical and • How FIRST ideals can be used in the real world. • What does it mean to be a Gracious Professional®? It means to be kind to want to lose to a team at it’s best, than beat it at it’s worst. • Describe a way that your team has displayed Gracious Professionalism® • How did you work with the other FIRST team(s)?

Prototype	Each presenting student was assigned their part and wrote up a rough draft of what they would say (word for word or bullet points) this was then reviewed by the team and one of our mentors.
Design	Dave Kloostra, one of our mentors helped us pull together our presentation. He helped us to keep things concise and he helped us further formulate what story we wanted to tell about our team and our journey.

OUTREACH EVENTS

EVENT NAME: FTC CAMP

DATE & TIME: June 7th-11th; 1:30-5:30 PM

I. EVENT DESCRIPTION

- The FTC Camp is a hands-on learning experience for students ages 8-18.
- 15 students were invited to our camp.
- Each day of the camp had theme days and ice breakers to incorporate the fun aspect of FIRST.
- We taught CAD, Mechanical, Software, and completed Team Building activities.
- The 5-day-camp started the recruitment process for our team.
- As a result, 5 members from the camp joined our team for the full season.

II. EVENT SUMMARY

Day 1:

- ☐ Welcome Activity
- ☐ Introduction Presentation
- ☐ Design Process Presentation
- ☐ Collection Requirement Intro.
- ☐ Brainstorming Session
- ☐ Basic Tool Introduction

Homework:

- Paper Bag Icebreaker
- Notebook Page

Day 2:

- ☐ Paper Bag Activity
- ☐ CAD Basics
  - Powerpoint
  - Battery mount example
  - 3D printing/X-carve crash course
  - Design Collar
  - Print Collars
- ☐ Software
  - Powerpoint
  - Phone App

Homework:

- Code Academy
- Notebook Page

Day 3:

- [ ] Walk to watershed
- [ ] CAD
    - Work on base
    - Design new transport
- [ ] Building
    - Assemble new shooter
    - Remove the intake and transport
- [ ] Software
    - Teach auto functions
    - Learn how to control the power of the shots

Homework:

- Code Academy
- Notebook Page

Day 4:

- [ ] Icebreaker
- [ ] CAD
    - Add shooter
    - Add transport
- [ ] Building
    - Install new shooter
    - Build new intake and collection
- [ ] Software
    - Work on software for intake, shooter, and collection

Homework:

- Judging points
- Notebook Page

Day 5:

- [ ] Icebreaker
- [ ] CAD
    - Finish up shooter and transport
    - Fun prints
- [ ] Building
    - Finish collection and transport
- [ ] Software
    - Finish software for intake, shooter, and collection
    - Work on tele
- [ ] Judging
    - Practice
    - Present
    - Practice questions
- [ ] Closing
    - Practice notebook pages due
    - Thank you for coming
    - Assign survey
- [ ] Pizza
    - Eat
- [ ] Bonfire
    - Mandatory for members
    - Optional for guests

Homework:

- Survey

FTC 8620 Tryout Camp 2021

Accomplishments of Monday 6/7

Students...

01 got to know their camp mates.

02 got a rundown for the week.

03 took part in a crash course for tool safety.

04 learned our interpretation of the engineering design process.

05 looked at what was wrong with our collection, and decided what improvements should be made.

06 brainstormed ideas for ring collection.

07 Participated in an icebreaker game.

FTC 8620 Tryout Camp 2021

Accomplichments of Tuesday 6/8

Students learned...

01 CAD basics (custom 3D printed parts).

02 printed their own custom part.

03 how to use a 3D printer.

04 how to use a c&c machine.

05 basic software functions (in java).

06 to change code for a phone app.

07 participated in another ice breaker.

FTC 8620 Tryout Camp 2021

Accomplichments of Wednesday 6/9

Students...

01 learned basic CAD assembly.

02 assembled drive train in CAD.

03 learned building and assembly basics.

04 began assembly shooter magazine.

05 learned basic autonomous functions.

06 began testing autonomous functions.

07 participated in a group walk

FTC 8620 Tryout Camp 2021

Accomplishments of Thursday 6/10

Students...

01 CADed the shooter.

02 CADed the transport.

03 installed the shooter on the robot.

04 started building new collection.

05 finished autonomous functions.

06 worked on more in depth software.

07 participated in another icebreaker.

FTC 8620 Tryout Camp 2021

Accomplishments of Friday 6/11

Students...

01 completed CAD work.

02 finished building the collection.

03 finished last minute software things.

04 practiced judging.

05 presented what they did this week.

06 turned in documentation packet.

07 (optional) bonfire.

Overview

This week we will be evaluating invitees for our team. We want to see your enthusiasm and interest to learn, as well as any knowledge you previously had.

This week our invitees will get hands on experience with java, hardware, CAD (computer aided design). We will also spend a brief amount of time working on and evaluating public speaking/ their ability to collaborate on ideas.

Each day we will have a snack break (snacks provided), and an ice breaker break. On Wednesday (assuming weather permits) we will go on a group walk. We plan on walking the bike paths, and we will stop at a pavilion to have a snack break. Please dress properly for this (walking shoes). If it rains this day, we will move the walk to Thursday.

We hope you (our invitees) have fun this week! please shoot any of our team members a text/ send our team an email with any questions.

Schedule

MONDAY

-icebreakers
-introduction of the camp
-Intro to the design process
-overview of available parts
-brainstorm modifications for competition
-basic tools/ safety

TUESDAY

-basic CAD training
-3D printer how to
-3D print your own part
-basic software functions

WEDNESDAY

-begin modifications of collection
-more in depth (optional) CAD and software trainings

THURSDAY

-continue building collection
-More CAD/ software (if wanted)

FRIDAY

-work day
-collection modifications should be done by the end of the day
-judging session
-if weather permits, we would like to have a bonfire after our camp is over!

Daily

-30 minute snack break (snacks provided)
-30 minute team building/ ice breaker
-homework: complete documentation page for what they did that day.

"Your only limit is your mind."

"Competition not for the sake of destroying one another, but for the sake of bettering and improving both competitors as a result of the competition."
-Woodie Flowers

homework

MONDAY
paper bag with items (for ice breaker)

TUESDAY
CAD (if they want it printed)
Codeacademy

WEDNESDAY
CAD (if they want it printed)
Codeacademy

THURSDAY
bullet points for judging

FRIDAY
post-camp survey

theme days

MONDAY
school colors day

TUESDAY
whiteout/ blackout day

WEDNESDAY
hawaiin/ tropical day

THURSDAY
monotone day

FRIDAY
Dad day

Contact us

WEBSITE
ftc8620.org

FACEBOOK
FTC 8620
WormGear
Warriors

INSTAGRAM
@FTC8620

WormGear Warriors FTC 8620
2021-22 tryout camp
June 7th- 11th

A look at the week

ROBOTICS SUMMER TRAINING

- Training Camp:
June 7-11, 1:30-3:30 PM
- Team Meetings:
Mon/Weds: 1:30-3:30 PM,
Sun: 4-6 PM

- Includes hands-on JAVA training, computer-aided design, mechanical work, etc.
- Students will be given the option to participate in a remote, post season competition which takes place July 12th
- Meetings will follow local & CDC guidelines

FOR MORE INFORMATION, EMAIL FTC8620@GMAIL.COM
FTC INFO: HTTPS://WWW.FIRSTINSPIRES.ORG/ROBOTICS/FTC

III. EVENT REFLECTION

This camp was a great way to recruit people, and introduce more of our community to FTC. It was also a great learning opportunity for our team, about how to **run** and host events.

FTC Camp Design Process	
List Requirements	- Engage all of the attendees - Be able to recruit and introduce more of the community to STEM - Have measurable FIRST interest from at least 5 participants
Brainstorm	Duration: - 5 days - do CAD and software introductions - Include team-building activities each day
Research	- We looked at examples of camps and introductions to FIRST our team has done in the past
Design	- We planned activities that we think would be fun and educational for all the attendees.
Prototype	- We had a trial run through the initial open house. We hosted this with around 25 attendees before the camp. The camp was made up of participants that showed more interest than many of the other potential invitees.
Performance	- The camp was overall very well-received. We gained 4 new members from it and a lot of measurable interest in FIRST, with participants expressing interest in joining our team another season or an FLL team for the time-being. The first few days may have been a little disorganized, but a system was definitely developed over time.
Refine	- We refined by growing more comfortable with the participants and trying to complete more engaging activities together. We planned based on what was well-received the first few days.

Season Kickoff at SIUE Design Process	
Requirements	**-Goal: to interact with other teams while meeting rookies, after an isolated season** -Give all the teams a chance to reconnect/ make new friends since last season didn't allow for much of this -Use this event as a possible segway for the Dean to let us run meets at SIUE -Provide an environment for southern Illinois teams to showcase their robots/ other strengths to other teams -Have an overall fun event to get back into this season!
Brainstorm	-Discuss possible events of the day; -Guest speakers -trivia -invite teams to present on their strengths -Tours of SIUE from the Dean - food -get to know you bingo (as a filler) -prizes -goody bags for each team -Sketch floor plan
Research	-Discuss with Veteran members what Missouri did for activities at their kickoff: -doughnuts and social time after registration -trivia (with prizes) -interaction between teams (optimize this due to the lack of connection with Covid) -teams showcase their robots/ other standout skills -play game reveal video -allow each team 5-10 minutes on the field to inspect the game play -Talk to SIUE admin about COVID guidelines:

	-Masks must be worn indoors at all times -each team will have to provide a list of all students/ parents phone for contact tracing -each classroom had a limit of how many people could be in them, but the atrium did not (this is the space we held our event) -Find out how many teams to invite and who that will be: -all southern Illinois teams -ask Robo Raiders, Da Ex bots, and Wired/ Welded Warriors to bring their robots from Ultimate goal to showcase their robots
Design	Program of events: - Donuts - Notebook Showcase - Presentation - Trivia - Robot Showcase - Game Release - Team Discussions
Prototype	<table><tr><th>ROOM #</th><th>ATRIUM</th><th>EB 1033 (AUDITORIUM)</th><th>Person in Charge</th></tr><tr><td>8:30 AM</td><td>Registration/Donuts and List of Questions for Teams</td><td></td><td>Aubree - Registration, Lance - Donuts - Questions</td></tr><tr><td>9:15 AM</td><td colspan="2">Transition Time</td><td></td></tr><tr><td>9:20 AM</td><td>Core Values and Team Presentations (Jumbotron)</td><td></td><td>Luci and Alan</td></tr><tr><td>9:50 AM</td><td colspan="2">Transition Time</td><td></td></tr><tr><td>10:00 AM</td><td>Robot Showcase</td><td>Notebook Showcase</td><td>Sloan</td></tr><tr><td>10:50 AM</td><td colspan="2">Transition Time</td><td></td></tr><tr><td>11:00 AM</td><td>Trivia (Muted Game Promo)</td><td>Optional 50 minutes of FIRST Pre-Game Video</td><td>Veda</td></tr><tr><td>11:50 PM</td><td>Game video</td><td></td><td></td></tr><tr><td>12:00 PM</td><td>Field Reveal/Choose Prizes</td><td></td><td>Maya and Will - Prizes</td></tr><tr><td>12:30 - 1:00 PM</td><td colspan="2">Optional Engineering Building Tour and Pizza after</td><td>Jack - Pizzas</td></tr></table> -This was the original schedule prototyped, this later led to the finalization of events of the day -Trial runthrough at SIUE: each of our team members practiced our presentation in front of multiple people and set up what we could (this included shifting tables and laying out whiteboards) and clarify
Outcome	**What was learned?** Our team learned how to enhance our planning and time management skills, plus how excited each team is to be back. Below are pictures of each team's whiteboards, which express what they're excited about for the coming season. 
Refine	<u>Kickoff Pluses and Deltas</u> <u>Pluses:</u> - Registration went fast, nobody had to wait and we got through all the teams on time. - No dead time (we adapted our schedule well when we were running ahead/ early)

	- Everyone was engaged throughout the day - Received immediate positive feedback through conversations at the end of the day - Put our name out there for the two rookies in our area to be able to contact us if they need it. <u>Deltas:</u> - Switch up roles for our team throughout the day (don't have the same people doing the same thing all day) - Overall start planning earlier, in hopes to attract more teams. - More diversity in the icebreaker questions - Invite other teams to present about their strengths earlier on so they have enough time to prepare.
Lessons	If you hold yourself accountable and stay up to date on deadlines, you can accomplish a lot.
Media	 Teams at our kickoff event respond to question "What are you looking forward to this season?"

EVENT NAME: Intelligencer Interview

DATE & TIME: February 21st, 2022

I. EVENT DESCRIPTION

Through a team member, we were contacted for an interview regarding our entry into the FTC State competition. The local reporter specializes in Humanity and was looking for a STEM awareness program. We wanted to teach more people about FTC, and encourage more people to join.

II. EVENT SUMMARY

We brainstormed as a team, ways to respond to many questions, one including this prompt. “What all goes into a robotics team and competitions? Can you give me a run-down of how it all works?” (which is the 3rd answer in the publication section). We all submitted responses of our idea of what goes into a robotics team and competition. We combined all of the ideas, and submitted it to The Intelligencer. It was a great opportunity to share the word about STEM, FIRST, and robotics in general!

Q: What is the official name of your robotics team?
A: WormGear Warriors, named after the mechanical part, a worm gear which was initially used on the first robot made. We’ve gotten the privilege to use two this year on our robot and live up to the name.

Q: Are the members all from Edwardsville?
A: Yes, we’re a local community team. We’ve had previous members from all over, but this year we’re exclusively Edwardsville kids.

Q: Can I get everyone’s name and school?
A: Alan Buss, Chase Chrenka, Luci Klingensmith, Aubree Kloostra, Veda Kommineni, William Lukowski, Margaret Paty, Maya Sundar, Sloan Watson, & Xavier Wilson all attend Edwardsville High School. Lance Klingensmith, Shreyas Medikonda, and Jack Paty all attend Liberty Middle School.

Q: What all goes into a robotics team and competitions? Can you give me a run-down of how it all works?
A:

“A competition is a lot of work, but also a lot of fun! We spend months working on our robot, presentation, and engineering notebook. We usually help set up and night before, and we spend the day at the competition. Qualifier, specifically, consists of judging, robot matches, meeting other teams, and the awards ceremony. It's an overall great experience.” -Maya Sundar

“Going to State is an accomplishment for our team and for me personally. With it being my first year on the robotics team, I’ve learned that the true formula for success is team chemistry, communication, and hard work.” & “I’ve always had an interest in robotics and now, I’ve found the perfect hobby and learning experience, all in one.” -William Lukowski

“Being part of an FTC team is an amazing opportunity and a lot of fun! It allows you to have exposure to STEM, it teaches you business and time management skills, and you get to compete with a bunch of cool robots! A lot of time, dedication, and money go into the season! Going to State is going to require a lot of community support and we hope to receive that!” -Luci Klingensmith

“Being a part of a robotics team is a big commitment but is worth it at the end of the day. As a team, we get to work together at accomplishing goals we have set for the season. Through all of the competitions and meets, we learn many new skills by being introduced to the knowledge of STEM professionals and other teams who we compete against.” -Chase Chrenka

“In terms of a team, FIRST goes by the motto of ‘more than a robot’. As students in the FIRST program we are not only challenged to design and build a robot, but also to fundraise, spread STEM, seek professionals, and overall have fun.
This program specifically is a really good opportunity to help students form relationships with other students, whether that be from a neighboring town or another country. Another big contributor to a robotics team is their connections, coaches, and funding. Our team is always looking to learn from mentors, as well as share the unique opportunities with them. On the competition side, each season FIRST puts out a new game or challenge. Teams have approximately three months to design, build, and program their robot before their first competition, which occurs in December. The first three competitions are meets, which are strictly five matches with no judging or presentations. After these three meets, teams are ranked based on their performance. On the day of qualifier, which is usually late January or early February, teams run another 5-6 matches which completes the ranking for robots. After these matches are done the top four teams get to choose two other teams to be on their “alliance”. These alliances then play matches to crown a winning alliance for the day. At all competitions after meets our mornings start out with a 15 minute judging session. This is where teams get to showcase their outreach and robot design. Our season length is pretty much year round. Once we are done competing we take a few weeks off and then hop right back into camps and training.” -Sloan Watson

Q: Is the team affiliated with any schools or organizations in town?
A: No, we are not school affiliated. Though made up of all Edwardsville students, we are a part of the international robotics program, titled FIRST. Within that program is a subgroup, named FTC (First Tech Challenge). We also branch under the non-profit, Metro Area Robotics Society, MARS for short. Our coach founded this to keep our robotics team funded through the 8 years it has existed and with the State Competition being imminent, we’re in dire need for donations and sponsorships.
We participate in many community events. Prior to COVID, we also took part in community-based events and demoed our robot with younger students. They would be given the opportunity to drive our robot and learn more about the STEM field. Our goal as a team is to raise STEM awareness within our community and empower as many young students as we can. We want every voice and idea to be heard, as well as their skills to be appreciated.

Q: When did the WormGear Warriors start?
A: 2014 was the initiation of the team.

Q: Is this the first time the team will be going to state?
A: No, our team has gone to state eight times before. We’ve gone to the World Championship twice, which were previously hosted at Union Station in St. Louis.

Q: When and where will the state competition take place?
A: The State Competition is on March 12th, at Elgin CC in Chicago.

III. EVENT REFLECTION

We learned a lot from this opportunity, including how to teach more people about FIRST, and how to get publication for our team and the STEM community.

EVENT NAME: 50 States

DATE & TIME: January 2022

I. EVENT DESCRIPTION

- **Goal**: To meet with a team from each state, and connect them to each other based on what each team needs help with, and what concepts each team is strong with.
- We have met with 23 teams so far.
- The 50 States Outreach plan enlists upon teams out of state. Two teams from each state were emailed. The email said:

Hi! We're the FTC 8620 WormGear Warriors. We're made up of students from Edwardsville, IL. The team has been a part of FTC for 8 years and over that time, we have received several awards such as Inspire, Control, and Motivate. We were also honored to partake in the World Championship two of those years. Since then our team has grown to twelve members, ranging from 7th through 12th grade. We strive to spread the word about FIRST and to meet with as many teams as we can.

Due to the COVID cases within our area, we've been unable to meet with teams and/or attend Outreach events. But when one door closes, another one opens. Our team is all for making the best of every situation. We'd love to take this time to make friends in other states and hopefully see you at World's one day :)

Depending on your team's preference, we'd love to speak with you about game strategy, innovative solutions, and creative ideas your team has come up with! We can do this by email or through a zoom!! If your team is interested, please get back to our POC!! We'd love to set up a time to zoom or send y'all questions about this season!

Our goal is to contact a team in all 50 states, help us make this possible :)

Contact Information:

- Website: https://ftc8620.org/
- Email: ftc8620@gmail.com
- POC: veda.kommineni@gmail.com

Thank you!!!

Sincerely,
FTC 8620
WormGear Warriors
Edwardsville, IL

II. EVENT SUMMARY

This event has gone really well, so far. We have gotten to meet so many diverse teams, and learn about their seasons, robots, and state! It has been a great experience for our team.

III. EVENT REFLECTION

Many teams were lenient and able to give suggestions regarding issues we were facing. We also problem solved a quick capping-design with the help of Confidential Robotics, from Minnesota. They proposed the tape measure strategy, which was fast and applicable to our robot. We plan to continue to meet and zoom with teams throughout the rest of our season.

50 States Design Process	
List Requirements	- Connect with an FTC team from each of the 50 states - Receive a photo with members from each team holding our logo - Have a sustainable relationship built with each team
Brainstorm	- We knew that social media would be extremely important to find and connect with teams - We discovered that you can search a team on the FTC website by entering their state in the search filter
Research	- We began compiling a list of teams from each state that we found through social media or otherwise - We tried to find teams with websites, ways to contact them, and social media showing that they are still active
Design	- We created a list of questions to ask the teams we were able to connect with via zoom or email. Seen below - We planned a simple agenda for zooms. This included asking if we could record the meeting, introducing ourselves and having them give introductions, asking our list of questions, then offering time for them to ask questions.
Prototype	- The first meeting with a team was a little rocky since we were getting used to the experience. The first team we met also happened to be from Mexico, so there was a small language barrier.
Performance	- Though the first few zooms may have been a little awkward, we learned a lot each time we met a new team. We eventually got into a rhythm of asking questions and conversing in a friendly manner. We were also able to get a screenshot or picture, as well as a picture of them holding up our logo, after most meetings.
Refine	- Over time, the questions and etiquette on the zooms developed as we gained more experience. We also improved our connections with teams after we had met by corresponding with many over email several times. Our note-taking and record keeping of the experiences improved as well.
Lessons	- We learned that FIRST is a very large program with a very large amount of people involved. We learned that FTC is a lot bigger than just our team and there are teams out there not nearly as privileged as we are.

Media	

General

1. How long has your team been a part of the first program?
2. Have you competed yet this season? What competitions have you had?
3. What part of your robot has been the most beneficial in matches? What has been the least beneficial?
4. What has been the hardest challenge you have faced so far? How did you overcome this challenge?
5. What is the most impressive thing your robot can perform?
6. Has your robot improved between each meet, stayed the same, or gotten worse?

Software

7. What type of localization do you use? (Odometry, roadrunner, just motor encoders, etc.)
8. How do you document your code in the notebook/portfolio (specifically with the design process)
9. How do you keep track of your collection/ delivery mechanism position (servos, motor encoders, etc.)
10. How do you manage multiple people working on code? (GitHub, etc.)

Outreach

11. Is there anything you've learned this season you would be comfortable teaching another team?
12. If another team needs help with that thing would you be willing to let us put them in contact with you so you can help them? In light of this, is there anything you would like help from another team with?
13. Favorite outreach event? How was this impactful?

Mechanical

14. What is the most unique part of your robot?
15. Does your team use CAD?
16. How does your team manage multiple team members working on the robot at the same time?
17. How do you manage mechanical vs. software wanting the robot?

FTC open house- At the beginning of the summer our team hosted a community STEM open house. Throughout the open house we exposed nearly **50 students** to the principles of STEM and the FIRST community. As a result of this open house we had many students interested. We invited some of them to join a drone team some of our students have done in the past, and around **20** of them signed up to join our recruitment camp.

FTC summer recruitment camp- This summer we hosted a camp with around 15-20 attendees. The age range of these students was 5th-10th grade. At the camp our goal was to **train** the students to have FIRST skills. We taught CAD, building, public speaking, and worked on team building as well. At this camp the students were put under a similar pressure as they would be in competition season. Based on how the students improved over this week-long camp we decided to invite some of them to our team. We now have three new members who are thriving because of the extra hands on experience and training they got this summer.

Iowa invitational- Over the summer our team was fortunate enough to be invited to an international, remote competition hosted by a university in Iowa. This competition became part of our training to decide what members from our FTC summer camp would be invited to partake as a member of our team this season. At this competition we placed fairly well in robot, but our biggest accomplishment was **winning the connect award.**

Youtube tutorials- Our team has utilized social media heavily this season. We have posted tutorials such as CAD and some software videos. We also post all of our matches to our youtube channel to allow for teams to scout us and for people in our community to watch our matches.

Visiting the County Courthouse- One of our students was invited to the county courthouse over the summer to observe a murder trial. While there the student was able to connect with **8-10** of our county

judges including chief Justice David Hylla. Our student was able to share their journey through FIRST, the way it shaped them and also got to share some common interests with the judges. On being through Covid shutdowns. Though Covid shut many things down, our court system still had to function. In order to function as close to normal as possible a traditional zoom would not work. The county court purchased an **OWL camera** which essentially moves focus dependent on noise. Our student found the application of engineering in the courtroom very interesting.

FTC kickoff- As shown in the design process, our team organized, coordinated, and planned an FTC kickoff event. In previous years our team had attended the Missouri state kickoff, but due to covid our team decided we would rather stick to having an Illinois kickoff. This kickoff was amidst the pandemic and the first in our region. We had just under **10** teams attend, which was an amazing turnout considering the pandemic restrictions and it being a new event. See the design process above for more specific details of how we planned this event.

Hosting meets- Since our kickoff was such a **success**, SIUE reached out to us hoping to continue our connection and community impact. We scheduled and planned **3** meets to have in SIU's engineering building. We successfully held the first meet, but unfortunately a local tornado caused the facility to lose power and the event to be relocated. The third meet ended up being snowed out and then moved to another location to allow for a younger team to take on the responsibility.

SIUE newspaper publication- After hosting kickoff and meet 1 at SIUE their newspaper decided to reach out to us for a publication. The article discussed what the FIRST program is, photos of the event, and quotes from people at the event who were ecstatic to be back to in person competitions. Copies of this **publication** can be found in our pit.

Volunteering at meets- Our team takes pride in our volunteering in and out of FIRST events. Specifically our team commits to being at **all local FTC events** to help with set up and tear down, even if it means sacrificing crucial time the day before a competition. Many of our team members also volunteer to help with other FIRST events in our area.

Tour the Town Over the course of two separate days our team made their way up and down our local businesses going door by door. Our first goal of this day was to do some local fundraising, our second goal was to spread our team's mission and open doors to potential outreach in the future. From these two days we raised approximately 700 dollars. Through this event we communicated with over 300 community members.

Helping the Granite City Band- The Granite city robotics teams 15410 Welded Warriors and 15020 Wired Warriors were asked by their band to help design a robot for the marching band show. The teams eventually asked our team for help, so we were able to send a student down to help them. Our team was able to provide knowledge on LED lighting as well as supplies to help the team get the bot to light up for the show. We consider this event to be very special since we helped **support** this team their rookie year. It was a very good experience to work alongside students who have **developed** so many skills in the FIRST program, and to know that we have been part of the impact on them.

50 states outreach- This year our team made the goal of connecting with teams nationwide. This season we launched our 50 states program. We have connected either through email or through zoom with over **40** teams this season. In addition to this we were able to spread our program internationally. Meeting with teams from **Germany**, **Mexico**, and more. Our team was very satisfied with the input we were able to get on our robot and other elements. Through this program we have been able to provide funding for a less fortunate team located in Mexico, as well as connect with teams who needed our help and vice versa. A map of all the teams we have connected with this season can be found in our pits.

Team 13365 Collaboration- In preparation for qualifying we set up and planned a collaboration event with one of the teams from our area. We were allied with Gearheads (team 13365) in meet 3 and set a league high score of 230 points. On this collaboration day we shared mechanical, software, and judging ideas with them. But, the main focus of this day was to get some alliance team drive practice in with them. We were fortunate enough to be partnered with them at qualifier, but in alliance selection we were chosen by an alliance captain placed above them.

Intelligencer (Newspaper) publication- After advancing to state our local newspaper reached out to us hoping to publish us. We went through an interview process with the author of the article, and eventually the article got put together. We initially got the online version, but the next day it was printed on the front page of the paper. Our team has had publications in the past, but this **spotlight** has brought a large amount of donations and the public eye to our team, which we greatly appreciate.

Northern/southern division advancing teams collaboration- Leading up to state we participated in a small scrimmage with the other teams in our area that advanced to state. This day we were able to share mechanical, software, and judging knowledge with the other teams as well as run some practice matches in hopes we would run together in state matches.

Chicken Salad Chick Fundraiser- Though our team did well with fundraising this season we have made a few big purchases, so we needed more funds later in the season. We decided to combine a fundraiser and **community outreach** into one. Our team partnered with a family owned restaurant (Chicken Salad Chick) to sell chicken salad containers in our community. In order to sell this chicken salad we have advertised on our social media, but mostly we have utilized face to face interactions. Students have gone door to door in our community spreading the word of FIRST while selling chicken salad. Through this fundraiser we reached nearly 1,000 community members.

Interactions with STEM Professionals

Senator Rachelle Crowe- Our 56th District Senator has helped us with funding Team Kappa Xi, in Chihuahua, Mexico.

Zac Waters- Zach is a former software student of SIUE, and a current **engineer**. He's met with us multiple times. The first time we introduced him to the FIRST program, and the second time he came he taught us more about Java.

Caleb Blair- Caleb is a former WormGear Warrior and FIRST alumni. Caleb is currently going to school in Huntsville for an electrical **engineering** degree. Caleb was a CAD lead, so we enlisted on him to help us reach our goal: a fully CADed robot.

Garret Short- He is another former WormGear and FIRST alumni. Garret is going to school at Northwestern in Chicago studying Mechanical engineering. We enlisted Garret to help us streamline our designs, as well as to do some of our testing.

Dustin Franke- Dustin is another former WormGear and FIRST alumni. Dustin is a machinist who has helped us throughout this season with some of our design ideas, as well as the possible ways to fabricate our **robot to look cleaner**. Specifically, Dustin gave us the idea of using steel bars on our drivetrain to prevent possible bending since our channels were weakened.

Reece Watson- Reece is another former WormGear and FIRST alumni. He is currently attending Missouri S&T to get a computer science and electrical engineering major. Reece has helped us with our software organization, code writing, and volunteers with us at all of our local FIRST events as an FTA.

Dr. Klingensmith- An engineering professional and professor at SIUE. Dr. Klingensmith helps us with Java, vision code, project management, and is one of our biggest contributors for a contact at SIUE. This connection led to more connections, where we were able to meet with leaders at SIUE and host many events.

Phantom Heart Stands- Our students had the privilege to meet two graduate students at SIUE, who are working for safe ways to keep phantom hearts in place while undergoing MRI and ultrasound scans. We were able to build a stand for them with the dimensions given and used Fusion 360 to do so. We also taught each student how to use the application. They've invited us to sit-in on their lab experiments.

Deans at SIUE-This season our relationship with SIUE has really flourished. We were lucky enough to attract the interest of one of their mechatronics professors a couple seasons ago, but due to covid we had to delay the development of our relationship. First over the summer we were put in contact with a group of students seeking our help learning CAD. Then, this season we asked SIUE to help us host a kickoff for all of the southern Illinois teams. From this event the university invited us to host two meets on their campus, and want to host them plus a qualifier next year. Through this experience we have also gotten

tours of the campus from their deans. This connection is one we cherish and we hope to continue to further this relationship.

Mason Watson- Mason was never a WormGear Warrior, but he was on a FRC team. He graduated from SIUE with a degree in education, but previously attended Mizzou for an engineering degree. Mason has been one of our mentors this season helping us with his extensive knowledge of 3D printers and other like machines. He has also committed time to our team to help us build PCs since our laptops are beginning to get old.

Chris Zimmerman- Chris is a civil engineer currently in the workforce. He has taught us some of the knowledge to design parts of our robot such as our collection arm, and the base of our robot.

Dave Kloostra- Principal and Senior VP of Operations and Logistics of LowMuTech, has helped us learn about presentations and public speaking. He is currently enlisted upon being our lecture coach, in which he has given us many areas of advice. This includes inclusive pronouns, strategy, and timely convenience while speaking.

Drew Stover- Currently majoring in civil engineering, Drew has helped us begin to introduce FIRST in other areas. He was not in FIRST, but gave us input on why he wished he would have been & how much it may have helped him with his career.

Dave Garthe- Founder and CEO of his own company, Mr. Garthe visited our team to give input on our robot and share marketing skills throughout the community, with fellow business owners.

Cara Lane- Mrs. Lane is a public speaking and english literature teacher at Edwardsville Highschool. She has helped us to improve our public speaking skills and refine our presentation for this season.

Dave Oates- Dave is the owner of a company named Oates and Associates. His company is one of our big sponsors, and he has provided us support mechanically as well as financially. We love to see the connections we have with our sponsors such as Dave, and getting the to see the joy and enthusiasm in his eyes when he is helping us is an amazing reward for our team

Inspire Award Plan

Goal- Win the inspire award	
List Requirements & Brainstorm	☐ Connect with 100+ Professionals ☐ Reach 200 FIRST Members ☐ Reach 750 Students outside of FIRST ☐ Advocate to 100 Business Professional ☐ Score 150 points on average for each match ☐ Be in the top 25% of teams for match scores ☐ Recruit 4 strong Mechanical members ☐ CAD entire robot ☐ Creative Marketing Approach
Research	• A large part of winning inspire is a strong portfolio. We researched the best possible method by looking at FTC Judge Lena's format and advice. • We're in contact with the 2019 Inspire Award winner from the Houston Championship. They've shown us a strategic plan and we've modeled our own based off of that.
Design	The Design Step for the Inspire Award included accomplishing all of our goals and requirements listed above, during the Brainstorming Step. Below are the requirements listed within the previous steps, as well as the task we've accomplished with the said requirement. • Connect with 100+ Professionals: Touring the Town Outreach, seen in the Outreach Tab; as well as Kickoff and enhancing connections with SIUE. • Reach 200 FIRST Members- 50 States Outreach, as well as FIRST Open House with present FTC and FLL members • Reach 750 Students outside of FIRST- Held a FTC camp to get others interested in FIRST. • Advocate to 100 Business Professional- Touring the Town Project, small business owners from the area were able to meet with us and see our robot, as well as fund our team. • Advertised to businesses around our town. • Score 150 points on average for each match- we did this through a perfect auto, which was made in part due to our well-planned meetings, so software could get the robot earlier. As well as our last-minute, yet successful, capping mechanism.
Prototype	- Iowa Invitational- over the summer we had the privilege to participate in the event. It was a remote event, in which we were able to practice our presentation skills and win awards. The result of our performance was winning the "Connect Award" and we were shocked. Outreach had never been our *strongest* suit, so this year we decided to focus more on that aspect of FIRST.
Performance	- We put in the work prior to the Qualifier by completing our notebook, portfolio, outreach events, and our robot.

Refine	Please see the qualifier reflection below.

Qualifier Reflection

Pluses:

- Sloan: Autonomous got the minimum 42 every time! Most of our matches we got the second freight, we also had the 3rd loaded most of the time or were lined up perfectly at the start to pick one up.
- Sloan: NOTHING BROKE! Some things were definitely making Bree and I nervous, but we went through the day only having one servo horn fall off, which was due to it being put together without the screw.
- Sloan: I think Pit interviews went really well. I had been worried about some of the team's knowledge due to us having to be remote for 1-2 months, but I was pleasantly surprised with the knowledge and the manner we talked to judges in.
- Sloan: We won INSPIRE! Our team hasn't even thought we could get that award in years.
- Sloan: We made it to FINALS! We haven't done that in the last 3-4 years at qualifier so I think that puts the drive team in a good place in terms of confidence going into state.
- Veda: We had a hefty group of productive members at the pit in comparison to last time. Pull-up competition with other teams made plenty laugh on such a stressful day. I think we've all noted that chess was a big hit, as well as tic-tac-toe and the google form.
- Luci: Scouting, mostly relating to alliance partners, went really well compared to my previous experience with it. I think this was due to informing our team members about why it's important and what you need to do, compared to two years ago when we were not clear about it. Other parts of scouting, like just conversing and having fun with other teams, went really well also.
- Luci: I agree with Sloan that pit interviews were great and we were lucky that we were around when the judges came by, since many other teams were at lunch.
- Luci: The chess was a great idea and kept lots of people engaging with other teams and doing more than just stuff on their phones.
- Luci: Our documentation came together in like 3 weeks and we were 3rd place in Think..
- Bree: Gotta say the fact that the only thing that broke off of our actual robot was something put together wrong is relieving. There's definitely improvements to make but running ten matches and only breaking the field is pretty good.
- Bree: Idk about y'all but I talked during judging so I'm pretty proud of myself!
- Bree: Also I think it's good that we seemed so appealing to other people and we definitely overheard from MecWarriors that had there been second picks, we would have been it.
- Margaret: There were only like three software issues the whole day. I think I only downloaded new code to the robot once in the whole competition so that's pretty cool.
- Margaret: I feel like between skystone qualifier and this year's qualifier there were a lot more people from other teams in our pit this year. Whether it was chess, the boards, scouting, or something else, it was really cool to see.
- Maya: I really enjoyed qualifier. I think that being able to meet with some really cool teams, and see what their robot could do was so cool. I feel like some of the teams thought of solving problems the way we didn't even think about. I also enjoyed checking out people's pits and engineering notebooks.
- Maya: I was really impressed with our team, we won Connect and got in the top 3 for Motivate, Think, and Inspire. I think overall everyone on our team was excited with how everything played out. (Especially with that third place inspire ;), and I also feel

like we have a really good team dynamic like it worked really well with who was at the pit and how we did judging. I'm just overall very happy with how it turned out.
- Shreyas: Our team did great in matches even though we did not win. Our robot's autonomous worked every single time without much of an issue. We got 3rd in the Inspired award which the team was excited for.
- Veda: When judges visited our pit, we were ready & attentive. The questions were well answered and we'd prepared for them. Our presentation for the judges was under the time limit (can be pro or con), as well as informative.
- William: Obviously made it to state. We won Connect and won in the top 3 for Motivate, Think and Inspire.

Deltas:

- Sloan: I did get some comments from a good friend on another team that people in our pits seemed as if they weren't doing anything. I know the chess went over well in the beginning, maybe we should look into more interactive and quick things like this for state? Another good way to combat this is having anyone who doesn't NEED to be in the pits go to watch matches and help scout.
- Veda: Agreed, we need people to go cheer our drive team on. Having multiple people in the pit who specialize in the same "field" is essentially, not beneficial. 3 people is a good amount. It's understandable that everyone would like to be a part of judges Q&A as well, but crowding the judges doesn't help.
- Sloan: This is just a personal disappointment and a personal improvement I need to make. The judges in the judging room showed no interest in anything mechanical. Obviously we got inspire so it worked out, but I would have felt better about judging if they had been interested in our designs. In addition the pit judges were more fascinated with our capping, which to me is the most ineffective and least interesting part of our robot.
- Sloan: I think the team needs to do more looking into strategizing. I feel that if we had prepped (with the whole team's help) the drive team would have had a better strategy going into finals and we would have won.
- Sloan: The mechanical improvements that are most important are the capping (I think we NEED to be double capping, spinning ducks, and parking every match). We also need to look at the drive train stack up so the drive team doesn't have to check it and panic about it all day.
- Sloan: Bree and I agree on the burn out. I'm not sure if everyone realizes how 'slack' the team leads have had to pick up over the last month or so. My goal is to have our robot be winning alliance captain at state sometime before I graduate, so they had kept me pushing. I know we may seem snarky but Bree and I (as well as others) have spent countless amounts of hours doing extra work because it wasn't done by who/ when it should have been done.
- Luci: I think we could do a better job of keeping our pit area clean, especially relating to food. I know we had to store food boxes there and we weren't totally clear on the food rules at the beginning, but we need to avoid opening/eating food or drinks when it is not allowed. The back part of the pit also dissolved into chaos by the end of the day. I'm not sure if there is a better way to stay organized, this was just my observation.
- Luci: I think we could also do a better job of including multiple team members in pit judging discussions. It is important not to crowd them, but we also want more than just a handful of people to be able to show off their hard work.
- Veda: Trash at pits: I understand that everyone is stressed throughout the day and has way too much to carry, or whatever the case may be: BUT, that does not indicate that you may place your trash and half eaten food in the pits, *especially* when the facility does not allow it.
- Luci: I feel like communication was a bit confusing at times. I liked that most people didn't have their phones as distractions, but it was hard to run back and forth from the matches for scouting to the pits for batteries/judging and know where you needed to be. This is mostly since the pit/match locations were further apart than they might be in other places. This also could be something other people didn't struggle with, but Lance and I did.
- Luci: Robot-wise, I think we were just generally more inconsistent than meet three,

which can be solved with finetuning autos/ lots of practice matches.

- Bree: I think Luci is absolutely right, although we didn't have phones as distractions, only a few people were actually on task and being productive/helpful. I noticed the lack of communication between other team members and simply just not knowing what to do, but again not many of us have been to a qualifier before.
- Bree: We could have been working on specific tasks as well instead of just sitting in our pit; it was a mess by the end of the day and I think that contributed to the stress of others with not being able to find anything needed.
- Veda: We've struggled with personal tasks to make everyone more engaged at meets, but at some point it gets difficult to teach. I know that for a while, it was very empty in the pits; Will and I ended up writing up another notebook page just to be productive. People need to find little things as such, even if that means finding a friend on another team. Though this may seem boring- taking a look at others' documentation may be beneficial. That way you feel productive and contribute to the team.
- Bree: I am still extremely exhausted and overall just kind of burnt out after doing so much. I think this could have been more of a delegation issue, but I would spend 4+ hours working in person and then go home and work remotely for another 4 hours. It was so overwhelming and although we pulled it off, I do not want to have to do it again like ever.
- Margaret: When there are judges in the pits, the whole team does not need to be crowded around them. I feel like there were a couple of times there was like a swarm of pink surrounding the judges, and that can be overwhelming for them and for the people talking to them.
- Margaret: There were definitely times when people were way off task. If there is downtime: watch matches, play chess, talk to people (I know, that one's funny coming from me).
- Veda: We still had people on their phones at the pit. We need more interaction with other teams, chess board was a good way to start. I also played tic-tac-toe which was popular. More organized pit may be nice as well, the visuals were awesome but we need to highlight our notebook and get them to take a look inside.
- Shreyas: We need to start doing a lot more notebook as we have been slacking off, and had to rush to finish it all. Hopefully this can be avoided next time and the notebook can be the last of our concerns.
- Veda: Notebook- winning an inspire award means we did well in our documentation as well. That being said, a select few worked insane hours to get it done. I know I was up until at least 12 with Luci the night before, making around 10 more outreach pages. I know a few others had nights as such. Being a team means putting shared effort in; not winning an award and calling it a day. I know I got intense (to put it lightly) but as Sloan said, it's frustrating to have to ask people over and over to do simple tasks like formatting. If it was something difficult that they genuinely didn't understand how to do, leniency was expressed. But when people just *aren't*, it's disheartening. Countless days in Spanish class were spent on the notebook and I don't want anyone to go through that again. We all deserve to get a good night's sleep prior to and *know* that we did the absolute most that we could, together.
- William: As Sloan said our presentation was under the time limit.

State Goals

Overall

Goal	How Do We Accomplish it?	Who?
Be on the winning alliance	Be a versatile partner (be able to do both hubs, spin ducks at same time as capping, have consistent autos)	It is up to the team leads to delegate this, but everyone's effort must go in.

High average match score (250+)	Make all parts of our match more consistent through software and drive practice.	Drive team with support from everyone.
“Perfect” auto every match - consistently achieve most points possible every time	We worked on more efficient paths that would also remain consistent. Our biggest obstacle in gaining more points in autonomous was our localization accumulating distance error over time. We combated this by different	Software team with mechanical support
More consistent driver-controlled period	Add sensors and smart teleop features as well as more drive practice	Software and drive team
Place in Inspire/Think/Connect/ Control	Continue to develop our outreach, but massively improve on our documentation. For control, reach out to teams who are strong in this award to learn from them.	Entire team
Place higher than other advancers from our league	Take what we learn from our collaboration/ drive practice with these teams to find their weaknesses and strengths so we know where to improve.	Driveteam with support from everyone
A more versatile robot	Come up with a consistent method for shared hub, also have a heavy strategy knowledge.	Everyone
Have all team members involved in scouting/ more interactions in the pit	Divide up tasks better for the pits in order to get more people out to have productive interactions. Have more things in our pit (like chess) to encourage teams to come visit us.	Everyone
Keep the pit more clean	Have a detailed and organized plan of exactly where everything will be stored, how it will be set up, and who is in charge of what.	Pit team with support of whole team plus parents
Feel proud and have smiles on our faces at the end of the day	Go into state being confident in all of our aspects and have a good attitude. The day of, get as many interactions in as possible (these should be fun not just business!), make some friends, and hopefully end up on a finalist or winning alliance at the end of the day.	Entire team!

Software

Goal	Why is this important?	How?
Implement range sensors	This would allow our drive team to have more control over traveling in and out of the warehouse. At the qualifier we had issues with running into the wall and over the beams at an angle that made us get stuck.	We created a method to check the distance of the range sensor to the side wall in teleop. We implemented this on the left and right side range sensors. We also created a way to check that the range sensor is giving accurate values. See more in the design process on page
Speed up auto	Our autonomous, if more efficient and quick-moving, has the potential to score 10+ more points consistently.	We created more efficient paths to get to where we need to faster. We also had sped up the motors.
Visually detect team element and pick it up in Tele before anything else	This would make the capping much more consistent and feasible in matches with less time.	We Take the amount of blue and green for the red side and red and blue for the blue side and based on that we decide the amount of yellow pixels. Based on that we can decide where the team shipping element is.
Pick up more freight in auto more consistently, leave no room for missing a freight	Since implementing our higher-scoring warehouse auto, we have discovered that the randomness of the freight placement sometimes causes us to miss the 2nd part. Any higher-scoring auto is dependent on getting more freight.	We have Implemented a way to reverse the intake and try again to get the blocks. We also added a slight curve to the path.
Score 4 freight in auto using new paths.	This is our main goal to focus on before the State competition. By scoring an additional 2 freight compared to what we are already scoring, we will gain a total of 12 points in auto and 12 points in tele.	We sped up our auto, as mentioned before, and by speeding this up that gave us more opportunity to collect more freight. We delivered the freight over the back of the robot.

Mechanical

Goal	Why is this important?	How?
Make collection more consistent for software	This is important because currently software has a bottleneck with collection in autonomous. If we can get this working software can immensely improve our autonomous score/ consistency.	Try some ideas for collection paths/ anything that can help freight to be in optimal positions to be picked up.
Consistently score on the shared shipping hub	This is important because it will make us more versatile in matches, as well as make us very appealing to all teams if we are in the position to be picked in the alliance selection.	Add another arm (possibly add to what we have) that can score on the shared hub
Consistently double cap and spin all ducks	This is important for us to place high in robots. If we can do this, it's a consistent 80+ points per match, and our partner can continue scoring on the shared hub to ensure us the unbalance.	Continue to develop our capping mechanism and drive practice with it a lot.
Fix our base stack up	This is important so our drive team does not have to stress over if the base is falling apart, or spend time fixing it.	Rethink the way our gears/ wheels are assembled so there is no way that anything can fall out or cause an issue.

Meeting Minutes

AGENDA
Date: 9/19 Attendance: Maya, Xavier, Jack, Shreyas, Luci, William, Veda, Alan, Aubree, Margaret, Sloan, Lance
Kickoff Recap: Plus & Deltas chart listed below
Autonomous/ driver control planning: See chart listed below. (consisting of: tasks, points, probability, time, efficiency)
Filing of all Kickoff documentation
"Thank You" letter to SIUE

Kickoff Pluses and Deltas

Pluses:

- Registration went fast, nobody had to wait and we got through all the teams on time.
- No dead time (we adapted our schedule well when we were running ahead/ early)
- Everyone was engaged throughout the day
- Received immediate positive feedback through conversations at the end of the day
- Put our name out there for the two rookies in our area to be able to contact us if they need it.

Deltas:

- Switch up roles for our team throughout the day (don't have the same people doing the same thing all day)
- Overall start planning earlier, in hopes to attract more teams.
- More diversity in the icebreaker questions
- Invite other teams to present about their strengths earlier on so they have enough time to prepare.

Autonomous Planning Table: (higher number in efficiency means more likely for us to be able to accomplish it, and more worth our time)

Task	Points	Probability	Time (s)	ProbabiliityXPoints	Efficiency
Duck from carousel	10	2	5	20	4
Park in storage unit	3	3	3	9	3
Completely in storage unit	6	3	3	18	6
Park in warehouse	5	3	3	15	5
Completely in warehouse	10	2	6	20	3.3
Freight in storage unit	2	3	6	6	1
Freight in shipping hub	6	2	6	12	2
Freight on correct level	10	1	8	10	1.25
Freight using team element	20	1	8	20	2.5

Teleop Planning Table:(higher number in efficiency means more likely for us to be able to accomplish it, and more worth our time)

Task	Points	Probability	Time (s)	ProbabiilityXPoints	Efficiency
Freight in storage unit	1	2	13	2	0.15
Freight on level 1	2	2	8	4	0.5
Freight on level 2	4	1.5	8	6	0.75
Freight on level 3	6	1	8	6	0.75
Freight on shared shipping hub	4	1.5	8	6	0.75

End Game Planning Table:(higher number in efficiency means more likely for us to be able to accomplish it, and more worth our time)

Task	Points	Probability	Time (s)	ProbabilityXPoints	Efficiency
Duck/ team element delivered	6	2	5	12	2.4
Alliance shipping hub balanced	10	2	10	20	2
Shared hub unbalanced	20	1.5	10	30	3
Park in warehouse	3	3	3	9	3
Completely in warehouse	6	2	6	12	2
Capping	15	1	5	15	3

AGENDA

Date: 9/20
Attendance: Maya, Xavier, Jack, Shreyas, Luci, William, Veda, Margaret, Sloan, Lance

Team Structure -

- Co-Captains -The responsibility for the co-captains is to make sure teams are coordinating properly and notebook pages are getting done.
- Software Lead - The software lead is in charge of keeping the software team on track and setting tasks to be completed. As well as making sure that notebook pages get done. They also make the agenda for software and make sure that new students get hands-on experience. They are also the technical lead and therefore should be involved in all design discussions and providing technical help with software.
- Mechanical Lead - the mechanical lead is in charge of making sure all of the mechanical team is on task, following our timeline, learning what they want to learn, and reinforcing notebook pages to make sure they are done. This lead is also in charge of coordinating with software lead on when they have priority with the robot. This person will also be the technical expert, and should be involved in all design discussions. They keep a bullet list so if needed someone could replace you and know exactly what they need to do.
- Business Lead- The business lead handles the budget, notebook, fundraising, and possibly presentations and events.
- Project Manager- The project manager sets deadlines for tasks to be done by. The project manager also makes sure that tasks are getting done on time. They help to ensure the team completes tasks on time, and helps the co-captains make agendas.

Project Manager Picking: Our team has decided to insinuate a project manager for this season. In the past, we've had issues with organization and we hope to conquer this. Our team is using Trello to accomplish this.

Delegate Tasks For Software: Deciding tasks for this season for software, assigning them to people, and setting dates to have the tasks done by.

Robot Requirements: see table below

Base Brainstorming: please find the table where we brainstormed this

Requirements:	Testing possibilities:
-Capable of moving in/out of warehouse -Correctly detecting barcode 100% of the time -Move ducks to field 100% of the time in 2 seconds -collection ground to our possession in 2 seconds -8 seconds pit to shipping hub -ability to pick up heaviest block -be able to sort (heaviest on shared shipping hub -deliver freight to all levels (3 seconds of vertical stretch and to spit out) 100% of the time -easily maneuverable drive train (doesn't knock over shipping hub) -side to side of field in 3 seconds	-Speed around VS over rails -Rover Ruckus collection -cropbox from skystone for ducks -how fast does macGyver get across the field

AGENDA
Date: 9/23 Attendance: Veda, William, Sloan, Maya, Karis, Shreyas, Aubree, Jack, Lance, Luci, Margaret, Alan
Emailed Dean Karacal: See response below
Started Testing Rover Ruckus Robot: (see more testing on next meeting)
Demo Code for Mechanical Testing:The software team had to work on preparing several of our robots from previous seasons in order to be mechanically-testable. This included making sure that Demo Bot code was on laptops, built, as well as on phones to be able to run. We also had some difficulties with Android Studio updates. We updated Android Studio and, with it, also had to update our SDK and gradle software in order for the versions to sync up. Once we accomplished this, we were able to get the code on phones for the robots to test.
Trello Organization: our team has previously struggled with organization and has decided to conquer this by starting [project management through Trello; see picture below

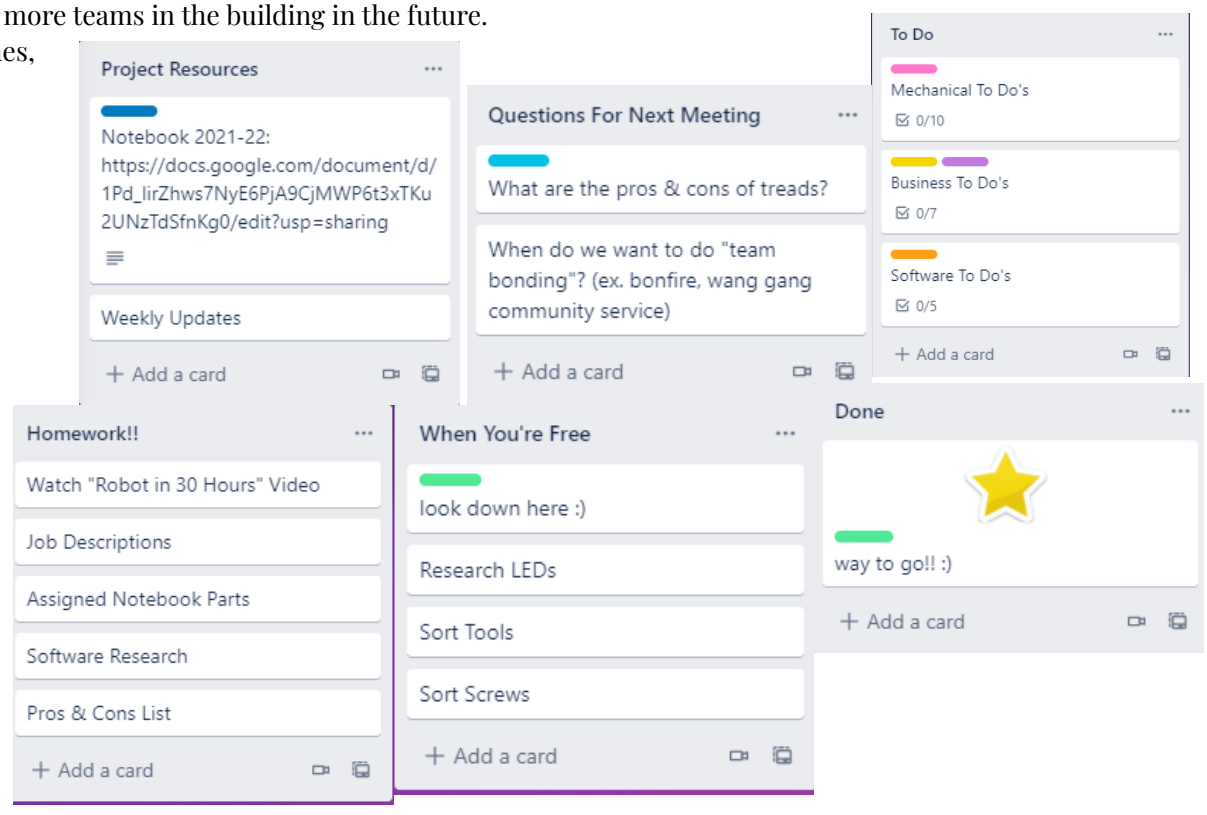
Email Chain from after kickoff event at SIUE:

Team 8620,

Sorry for replying a little late. Thank you for your email. Dr. Kligensmith gave me an update following the event and looks like it went well. We will be happy to be the host site for the event in coming years. I will share your communication with the members of our Engineering Executive Committee. Looking forward to seeing more teams in the building in the future.

Best wishes,

Cem K.



AGENDA

Date: 9/26/2021
Attendance: Jack, William, Veda, Alan, Aubree, Margaret, Sloan

DriveTrain decision matrix: Below is a table of the matrix we set up in order to determine what drive train would be best suited for us this season.

Autonomous Planning

Assemble field: The members in attendance who were not occupied worked on putting the field together so once we had a drivetrain to test we wouldn't have to wait for the team to assemble the field.

		simplicity	Reliability	Repairability	Manuverablity	Drivability	into warehouse	over pipes				
	Weight (0 low to 10 high)	1	8	5	6	8	6	4				38
Base Name	Base Description											Overall score
Mecanum	normal 18x18 mecanum	6	7	6	10	10	3	0				6.578947368
Narrow & High Mecanum	High clearance and only 12" wide	9	8	10	10	10	10	10				9.552631579
tank treads	Like Mcgyver	6	5	4	5	7	10	10				6.631578947

AGENDA
Date: 9/27/2021 Attendance: Jack, Xavier, Shreyas, Karis, Margaret, Luci, Lance, Sloan
Robot testing: base specific requirements, replace rubber bands on ironman (rover ruckus robot collection), pros and cons of drive trains, base design, While we hadn't done very much brainstorming for drive trains, we had a lot of new members we wanted to give hands on experience to, as well as we wanted to see if the strafer chassi would perform well this year. We assembled the chassis exactly like the manual, except we raised the structural rails up in order for the chassis to clear the rails on the field. The semi- major change we made was that we rotated the motors up into channels so that we had the entirety of the robot open for mounting any assemblies we wanted. Shortly after we did this, Gobuilda came out with the exact same thing, which we thought was very cool. Both of these designs are pictured below. As you can see in the decision matrix below we ended up going with a slightly modified version of this chassis.
RoadRunner: made an autonomous opmode in order to compare the different localization methods to implement roadrunner. We were unable to run the opmode due to a lack of space on the field.
Season Vision Code Preparation: We began planning the first steps of writing our vision code for this season. This included thinking about how our code from last year could be modified, looking at the FTC Software Development Kit for an idea about how object detection will work, and planning how our robot's, and our alliance's robot, starting position could affect our approach.

AGENDA
Date: 10/3/2021 Attendance: Jack, Xavier, Maya, Veda, Margaret, Luci, Lance, Sloan, William, Alan
Project Management Planning: Made a spreadsheet to determine tasks, milestones, team members assigned to the task, and dates for them to be done by. - Why? This is to help keep us on track until meet 1. With our prior issues with organization last year, we've decided to be more on top of our checklists.
RoadRunner Testing: We designed an opmode that recreated our movements from last year's autonomous program in order to compare the consistency of roadrunner using deadwheels versus using the 3D camera.
Object Detection: We determined that, by using our robot from last season, we would be able to take pictures, using the robot's webcam, of the possible duck configurations in the barcode. These pictures will allow us to design an app to model cropping the images and detecting in which position the duck will be set. We took one picture using an opmode from last season, but due to the difference of robot setup position from last season to this season, the angle of our webcam did not capture an adequate image of the barcode. To solve this problem, we decided to set up a new control hub and webcam for this season, next meeting, without using a robot. This will allow us to do the same operation as planned, and capture images in order to design a model app.

AGENDA
Date: 10/4/2021 **Attendance:** Veda, Jack, Shreyas, Xavier, Sloan, Aubree, Margaret, Will, Lance, Luci
Strafer chassis assembly: We continued assembling the chassis where we left off. As we were building we started thinking of another possible way to achieve the 90 degree motor mounting we wanted in the chassis since Gobilda had just come out with the design we came up with. We tossed around the idea of incorporating timing belts and pulleys. This will end up being homework/ worked on at the next meeting or so.
RoadRunner Testing: Effectively, we picked up where we left off yesterday. We continued editing and polishing the opmode in order to be able to integrate the road runner code into our code.
Object Detection: We continued our process from the last meeting of attempting to take pictures in order to prototype an app. We also finished setting up the new control hub and wireless network for object detection use.

AGENDA
Date: 10/10/2021 Attendance: Jack, Xavier, Sloan, Aubree, Margaret, Lance, Luci
Attach control hub to strafer chassis: We had the strafer chassis complete, and ready to test with an exception to the control hub, batter, and switch. In order to get the strafer chassis ready for testing we mounted the control hub in the top middle, zip tied the battery securely on a flat face, and plugged the power switch in so that it would not get in the way and drag on the ground. While we used none of this in competition, it was a perfect quick solution to be able to test the strafer chassis. One last thing before we could test the strafer chassis was to simulate the weight our robot would be carrying (from the assemblies on it). So, we secured four- five pound weights to the chassis to simulate this. A picture of this is inserted below.
Run strafer chase teleop not auto

AGENDA
Date: 10/28/2021 Attendance: Lance, Luci, Margaret
Working on fine-tuning vision algorithm
Clean up shed/ organize towers: Since the start of COVID our coach offered up an outside building he had available. We started off fairly organized, but since then our organization has gone to chaos. Since we have switched entirely from actobotics over to Gobuilda, our towers which we use to hold parts/ tools were totally out of date. Some of our team took a few hours tonight tearing apart the towers. We organized what we could part with, and they re-organized all of our Gobuilda parts and gave them new homes in our towers.
Assembly of strafer chassis:

AGENDA
Date: 11/1/2021 Attendance: Lance, Luci, Veda, Margaret, Jack, Will, Sloan, Shreyas, Chase
Assembly of base
Brainstorming for intake
Cad/ parts list for odometry: This year we wanted to have the option for meet 2 to have odometry. In the past our team has had it and last year was a big improvement year for us because we used them to make all of our set positions. In order for our robot to be versatile (go over the pipes on the field) we wanted our odometry to be able to either manually lift up, or be spring loaded so it could raise over these pipes. While we did not implement odometry yet this season due to lack of time, our odometry system has been improved from last season. The CAD model below, shows our design. The module is attached to two beams that are on a pivot point. The next step with this design was to figure out exactly how to mount it, and to add a spring.
We got the object detector app correctly detecting the blue alliance side of duck pictures.

AGENDA
Date: 2/27/2022 Attendance: Jack, Xavier, Maya, Veda, Margaret, Luci, Lance, Sloan, William, Aubree, Shreyas
Software Independent work time
Discussions: - Chicken Salad Chick Fundraiser - MOD fundraiser post state - Judging Questions - Deadline days: Mini run through (2nd on zoom) - Final date (6th)
Packing repair boxes