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CENTERSTAGE

PRESENTED BY Raytheon Technologies

G2 GEAR GIRLS

Judged Awards Pages:

Connect - 6
Think - 8,9,10,11,12,13
Innovate - 9
Design - 11
Motivate - 5,6,7
Inspire - 1, 3-14
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TEAM INTRODUCTION

GEAR GIRLS - 23469

Abbie

Gabby

Olivia

Tristyn

Snooki

Moira

Aria

Trinity

- Portfolio Designer
- Coding & Testing
- Engineering
- Social Media & Outreach
- Scouting
- Drive Team

For our teams roles, we ensured that each team member would have more than one aspect to work on. They also work on challenges they specialize at as well. Each dot above a teammate's name corelates to the roles key above.

Cynthia
Is our first FTC robot that we've ever built. She took a lot of time and care, and we are proud of how far she's progressed.

OUR MISSION

As a Girl Scouts robotics team, our overall mission is to get young girls more involved in the STEM community, within and out of FRST. We strive to change the status quo, and break gender barriers. We believe that it is extremely important for women to be more involved in the STEM community.

Coding and Testing:
Abbie-Subsystems
Moira-Autonomous
Trinity-Quality and Insurance
Aria-Engineering Insights

Engineering:
Tristyn/Moira-Lifts
Olivia-Claw
Aria/Olivia-Launcher
Trinity-Robot #2
Olivia-CAD
Gabby-Engineering Notebook & Portfolio

Outreach:
Trinity-Sponsorship
All Team Members
- Help FLL teams
- Girl Scout Troops
- Stem Nights
- Girls Who Code

Website+Socials:
Gabby/Moira-Social Media
Aria/Olivia/Moira-Website

SEASON GOALS
GEAR GIRLS - 23469

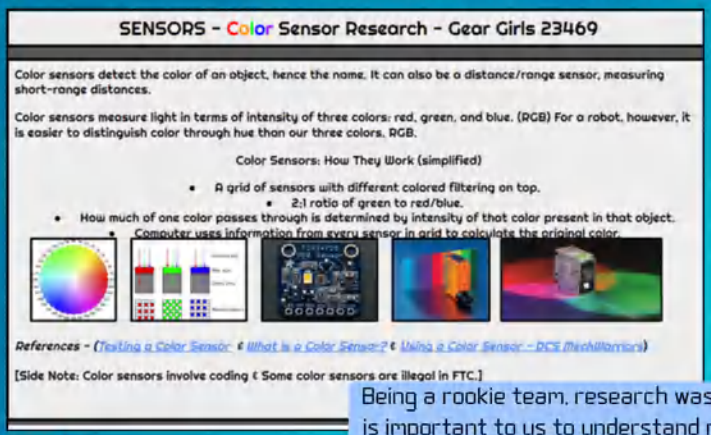
Outreach Goals Head to Page 5–7 For more!	Status
Assist Girl Scout and Junior High FLL teams.	Completed. Assisted 3 FLL teams.
Lead badge workshops.	Completed. We helped at a Girl Scout badge workshop for their engineering badge.
Volunteer at FLL events.	Completed. Volunteered at the scrimmage, qualifier, and the sectional.
Lead STEM projects at the local library.	Currently working. Talking to people at the local library.
Share info. about First with the adults in our community.	Completed. Presented at Girl Scout leader meeting.

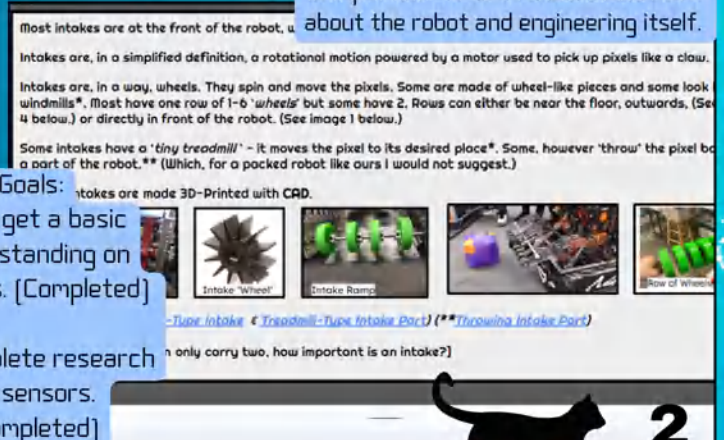
Design Goals Head to Page 10 For more!	Status
Keep robot small enough to go under the trusses.	Completed. We have made sure our robot is small enough all season.
Create a hanging device.	Completed. We have created iterations of our current hanger.
A small claw to pick up 2 pixels at once.	Completed. Multiple iterations that a team member designed in CAD.
Use CAD in our robot's design.	Completed. We made our claw and game element with CAD.
A small drone launcher that doesn't take up space.	Completed. Experimented with multiple drone launchers. Found one that works well.

Programming Goals Head to Page 14 For more!	Status
Train people in Java.	Halfway completed. Some team members went to a Java summer camp.
Use an image recognition system.	Completed. We have a Logitech camera on the front of our robot for image recognition.
Use utilities for auto.	Completed
Use subsystems to simplify work needed on the robot.	Completed. We regularly use subsystems in our robot.

Strategy Goals Head to Page 11 For more!	Status
Have a consistent 50 point auto.	Completed. We have a consistent 50 pt. auto. every time.
Hang and shoot the airplane consistently	Partially accomplished.. Hanging in meet #3 consistent. We have a new drone launcher.

Team Research and Learning Goals





Being a rookie team, research was and is important to us to understand more about the robot and engineering itself.

Goals:

To all get a basic understanding on sensors. [Completed]

To complete research on sensors. [Completed]

ORGINAZATION

GEAR GIRLS - 23469

Finances:

Girl Scouts of Southern Illinois sponsors our team, which helps us pay for our robot and every aspect of it. Our robot, being an estimated $1,374, is made and bought through our sponsorship

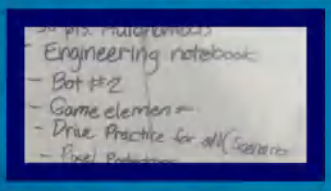
To—Do Lists

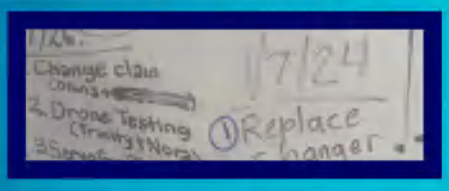
We use to-do lists to stay on task and direct the work on the robot. we build from our goals into broader topics. To-Do lists change about every week to month.

Assignments

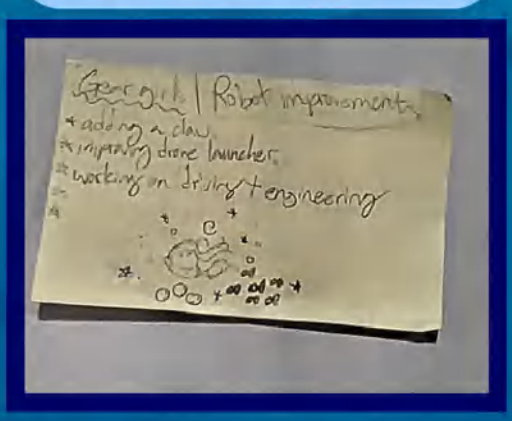
Our assignments, or jobs, are assigned to different members of the team based on their choice/interests concerning the robot. These assignments help us multitask, getting to goals faster. we work from our original assignments and branch out into jobs while also introducing members to foreign topics.

Things we needed to fix

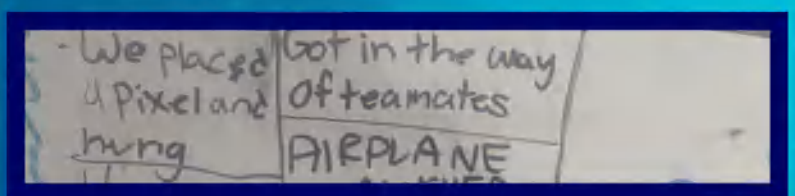




Improvements list



List from after meet



OUTREACH

GEAR GIRLS - 23469

People reached: **818**

192 hours

17 experts

FLL Mentoring

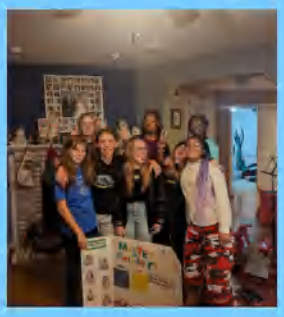
4 Teams

Fulton FLL Teams - Lego Lunatics and Lego Rookies

September 15th and November 11th, several members of our team met with both Fulton Jr. High FLL teams and **listened to their presentations and gave feedback**, as well as watching some of their robot runs. Our team helped them **better develop their presentations** and continued to create a positive stable connection between the teams and the FIRST programs.

Minecraft Bees FLL Team

Two of our team members went to help out a Girl Scout team and help them with their robot. **We troubleshooted missions** and helped them **progress in their skills**.



Master Builders Fll Team

Two members of our team met with the Master Builders, a local rookie FLL team. **Our dedication inspired us to help them to write a satisfactory robot design presentation, despite the short notice**. Though they did not move up to the regional competition, **the team was proud of their accomplishments** and excited at their successful first season.

Girl Scouts

Girl Scout Leader Meeting- 11-14-23

Girl Scout Leader Meeting- 11-14-23

During our season we gave demonstrations to the Girl Scout leaders of both our current FTC bot and our previous FLL bots. Doing this, we showed leaders how their troop members **could grow in their understanding of STEM**. We offered to complete badgework with the troops and give demonstrations of our robot, as well as **mentor or work with any start-up FLL teams** they might start.

Brownie Badge Workshop- 1/25/24

Five of our team planned and executed a brownie workshop on robotics. First we **explained to the girls different types of robots and prompted them to give their own examples.** Then, we gave them each a paper bag filled with lifesavers. They smelled the bags and had to use their senses to guess what it was, ending with taste. We came up with different stations for them to do and they rotated around and had fun!

OUTREACH

GEAR GIRLS - 23469

Girl Scouts

Girl Scout Campfire Event

Three of our team members went to help out at a Girl Scouts event and showed children from **preschool to third grade** the basics of coding and how robots follow code. We were able to **inspire** an **interest in FIRST & robotics.**

FLL Competitions

FLL Scrimmage

Three of our members went to help out at an **FLL scrimmage** and gave advice in the judging room as well as set up. **Multiple** teams said they were **inspired by the Gear Girls' success in FLL**.

FLL Qualifier

Five team members went to help out at the FLL qualifier at SIUE. They worked as **judges**, queuers, and practice table watchers. **Giving back to FIRST** is important to our team.

FLL Sectionals Set-Up

Five of our members helped set up for the competition the next day. We also **gained valuable insight** on how to **plan** a competition.

FLL Sectionals

Six of our members gave back time and effort into **judging** the teams and giving them **helpful feedback**, as well as **offering to mentor some advancing teams.**

Future Outreach Goals

Our team has really enjoyed our season and learned a lot about both the robot and our outreach. We can't wait for our next season! Some of our future outreach will include: a Girl Scout FLL Invitational, mentoring teams, a library workshop, and summer camp. Several of these events have already begun to be worked towards, but we look forward to putting them into action.

EXPERTS

GEAR GIRLS - 23469

Ehrardt Automation Systems

An employee gave us a tour of their facility and we demonstrated our robot to a few employee's. One of the employee's suggested we add weights into the back of our robot to prevent it from tipping over because of our lift.

Mrs. Dollahon– Local Technology Teacher

We presented our portfolio to Ms. Dollahon. She gave advice on our presentation as well as how we displayed our information. Ms. Dollahon's experience as a yearbook club advisor was extremely helpful.

Sameep Sanghavi– Cybersecurity engineer

Mr. Sanghavi taught us about different ways to pick up things. With this information we created our original claw design, with the three prongs and the screw through the middle to push the pixels off one by one versus all at once.

Matt Saibo– Innovation Lab at Scott AFB

Mr. Saibo is helping us to prevent our 3D printed claw from breaking.

Holly Waites, Katie Thompson, Emily collins,– Engineers. Hannah Houtz – Masters student at Missouri S&T

We got on a zoom call with them and told them about FTC. We did some Q&A with them, then asked them to help us figure out some math for our hanger.

Jonathan Weiland– Illinois FIRST

Mr. Weiland got on a Zoom meeting with us and helped us complete a java block code challenge.

Mr. Harvey– Southern Illinois FIRST Representative

Mr. Harvey gave us advice on planning our invitational, as well as many of our numbers on cost and possible locations.

Francis Beecher– Bayer Data Platform Lead

Mr. Beecher was excited to see our robot and was very impressed by our work. We recruited him as a volunteer for any of our future events.

Vanessa Diaz– Instrumentation Supervisor

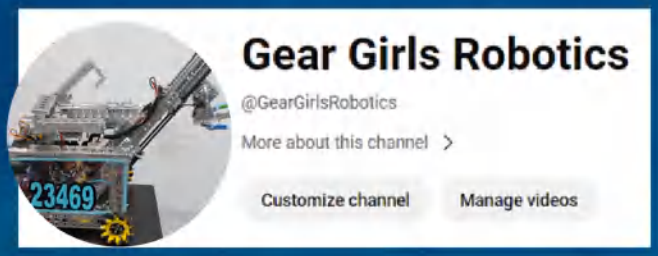
Mrs. Diaz told us that having a two pronged claw would be easier to operate than a three-pronged claw. because its less prone to error. Because of this we changed our claw design to two prongs instead of three.

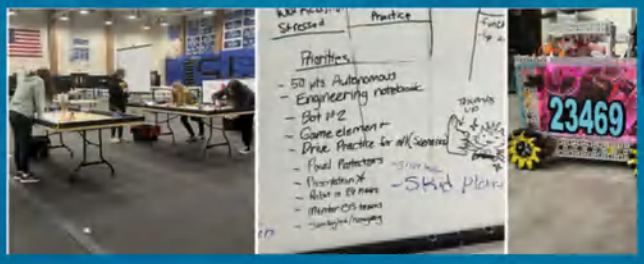
MEDIA

GEAR GIRLS - 23469

Youtube

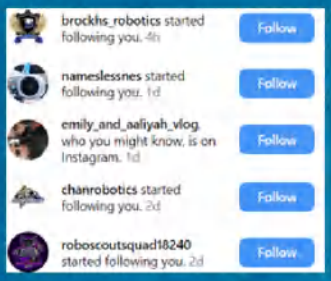
We use Youtube in a similar way to our TikTok account, where we post fun, engaging videos. We also use Youtube to share tutorials and useful information to new or struggling FLL teams. With our multiple years of FLL experience, we think that our advice can help teams thrive.





Instagram

We utilize Instagram to share what we do during outreach, our goals for the season, and the fun activities we occasionally do. For Example, on January 1st we had our “FLL in 20 hours challenge”, where we attempted to build a robot, program missions, and create an FLL innovation project within 20 hours.



Tiktok

We use Tiktok to share humorous and relatable robotics-themed content. TikTok can give us the traction that we need to become a more well-recoginized FTC team.

GAME STRATEGY

GEAR GIRLS - 23469

Autonomous:

The first 30 seconds of a match is autonomous. If we are on Blue Alliance we either start on tile A2, or A4 and if we're on the Red Alliance we start on F2 or F4. Starting on the 4th tile, A or F depending on our alliance, we preload one yellow and one purple pixel then drop them onto the backdrop then parks in the back stage. One program is to park in the far left the other is to park in the far right. Different programs start at various intervals of 10 second delays to avoid collision with our alliance partner.

Pixel:

Teleop:

The minute and 30 seconds following Autonomous is Teleop. This means the robot is now driver controled. We start from backstage - the back half of the field- then collect a green pixel from our alliances wing -a taped off corner in the front of the field- then place it onto the back drop to create a mosaic- 3 pixels in a pyramid, either all the same color or all different colors surrounded in white pixels- then collect and surround the mosaic with white pixels. After that is to create more mosaics and cover them with white pixels.

Backdrop:

End Game:

The last 30 seconds of a match after Teleop is End Game. In End Game we move to the back of the field, launch our drone - a traditional paper airplane made from one continuous sheet of paper that is your alliance color. After that we get into the correct position near the truss, then hang from the corresponding alliance rigging.

Truss:

DESIGN STRATEGY
GEAR GIRLS - 23469

We chose to use angled slides so we could fit the claw in the space beneath them. There are two slides each powered by one motor. The motors have special holders because of the slant to accommodate the claw.

CLAW

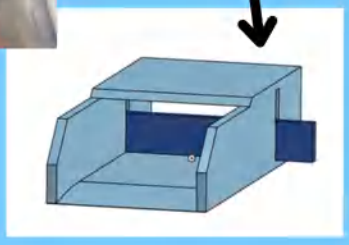
HOW IT IS USED

The claw is used for collecting **two pixels at the same time** and dropping them in different places. Our claw pieces overlap for more **compactness** in the front. This was the only attachment that was **CAD**ed by a **team member.**

VERSIONS & ITERATIONS

At first we explored a **three finger claw design**, but it wouldn't have been able to attach to our robot easily. The second design used **four-point bars** to open and close. We decided to change our focus because the claw's code wouldn't work. Our third design was a 3d printed **loony claw** used for last year's competition. Our final design was **CADed** and printed by our team. We **took inspiration** from common designs in other teams. The claw has **two spaces** for intake and uses **two servos.**

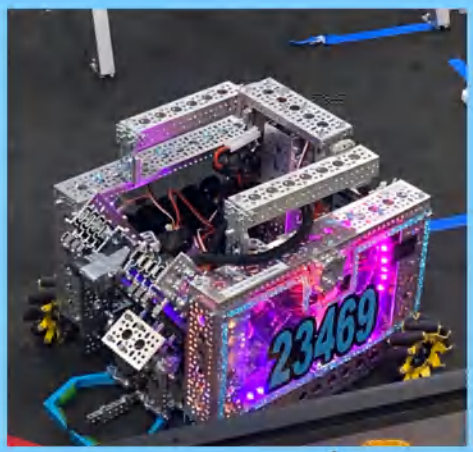
In the **future** we plan to use a **scoop** with a spinning piece and bar in the back for a more **innovational** approach.



SIZE

HOW IT IS USED

This year we decided to create a more compacted design. Our robot needed to be small so we could fit under the truss. The hanger happened to be a problem because it was already screwed as far down as we could get it. With the "T" shaped addition on top, the height was to large to fit under the truss so we cut the support bar down to fit the needed parts on top.



ROBOT OVERVIEW

GEAR GIRLS - 23469

Robot Overview

Claw: Our claw can hold two pixels, and has **three different positions**: **1)** Down position, used for picking up pixels. **2)** straight forward position, used so the claw won't drag on the ground while driving. **3)** Up position, used for angling the claw over the drop board before dropping pixels.
Drones- Our drones are short, fast, and aerodynamic. And thanks to our drone launcher, they shoot out very far.
Why our robot is special- Our robot, whom we named Cynthia, is very important and special to us. She is the embodiment of our creativity and imagination.

Claw+Lift

Our lift is our main way to gain points. During our season. we adapted the lifts in many ways. One of the challenges we faced was allowing our two lifts to move in sync. Another challenge was ensuring the claw and lift never had conflicting motions that might break the claw.

Drone Launcher

Our drone launcher functions similar to a sling shot. It launches the drone across the field and lands in a precise location. The coding for our drone launcher was quite simple, as all we had to was code the servo that controlled the angle, and the servo that releases the rubber band, or the sling.

Hanger

Our robots hanger is used to support our robots weight on the truss. Its extremely reliable and was simple to code.

Lights

The lights on our robot is able to indicate when we have 10 seconds remaining in the match. We utilized some code for P3 to do this..

LAUNCHER, SLIDES,& HANGER

GEAR GIRLS - 23469

8 Iterations

REDONE

INNOVATED

MODIFIED

AIRPLANE LAUNCHER

HOW IT IS USED

Our first airplane launcher was taken from a video by the **Darbots**. We modified it to fit our robot and added a **'seatbelt'** so the airplane stays in place while we drive around on the field. Currently, we are using a **CADed** design by the **Blue Bot Builders.**

LINEAR SLIDES

HOW IT IS USED

We chose to use **angled slides** so we could fit the claw in the space beneath them. There are **two slides**, each powered by one motor. Each of the motors have **special holders** because of the slant **needed to accommodate the claw**.

LINEAR ACTUATOR (or HANGER for short)

HOW IT IS USED

The Hanger has **three** different **modes** that allow us to suspend our robot about **three inches** off the ground. So far in the previous games our robot has been able to hang **every** time. The modes are: **arms up; arms up and pole up; and pole up, arms down.**

AUTONOMOUS

GEAR GIRLS - 23469

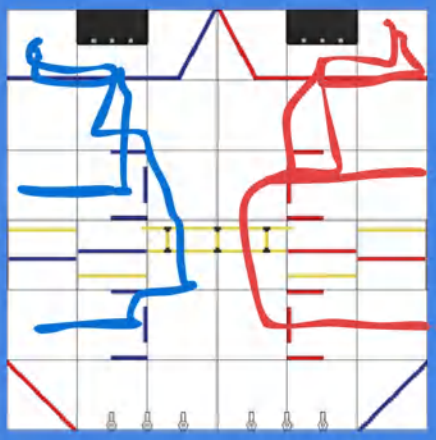
Improving

We have improved everything on our robot and in our code to make sure we get as many points as possible. To assist in this, we added custom logging into our autonomous programs to help diagnose issues with the IMU.

Custom Subsystem Utility Classes

We used utilities within the code to help make coding both autonomous and teleop simpler. Through shortening our long, tedious, and complicated

Autonomous Strategy



Vision

We utilize cameras and Open CV for image processing to allow Cynthia to detect the Team prop and follow directions accordingly.

Roadrunner

Roadrunner
We use Roadrunner in our autonomous programming to make coding simpler. WI.R.E.S made a simpler version of Roadrunner for newer teams.

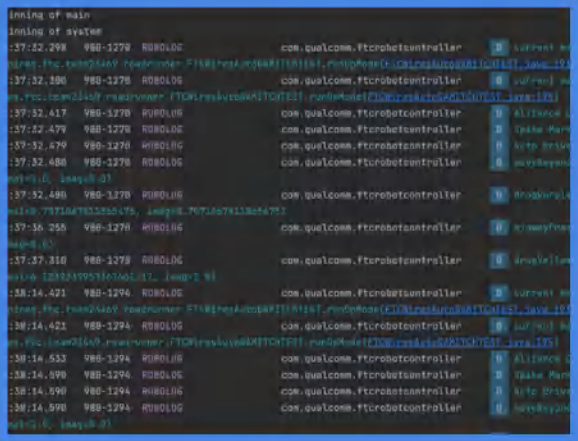


Image Recognition

```
//Averaging the colors in the zones
Scalar avgColor1 = Core.mean(zone1);
Scalar avgColor2 = Core.mean(zone2);
Scalar avgColor3 = Core.mean(zone3);

//Putting averaged colors on zones (we can see on camera now)
zone1.setTo(avgColor1);
zone2.setTo(avgColor2);
zone3.setTo(avgColor3);

double distance1 = color_distance(avgColor1, ELEMENT_COLOR);
double distance2 = color_distance(avgColor2, ELEMENT_COLOR);
double distance3 = color_distance(avgColor3, ELEMENT_COLOR);

double max_distance = Math.min(distance3, Math.min(distance1, distance2));

if (max_distance == distance1){
    //telemetry.addData("Zone 1 Has Element", distance1);
    color_zone = 1;

}else if (max_distance == distance2){
```

To guarantee the **image recognition system** worked with our camera, we needed to calibrate our camera and develop a functional recognition algorithm. We learned that before matches, it was crucial to **adjust the position** of the camera to ensure all game elements were within its line of sight. **Calibration** was essential for handling variations in lighting and background. For the recognition algorithm, using **OpenCV** to build a program to **reliably identify target colors**, ensuring **consistent** performance during matches.

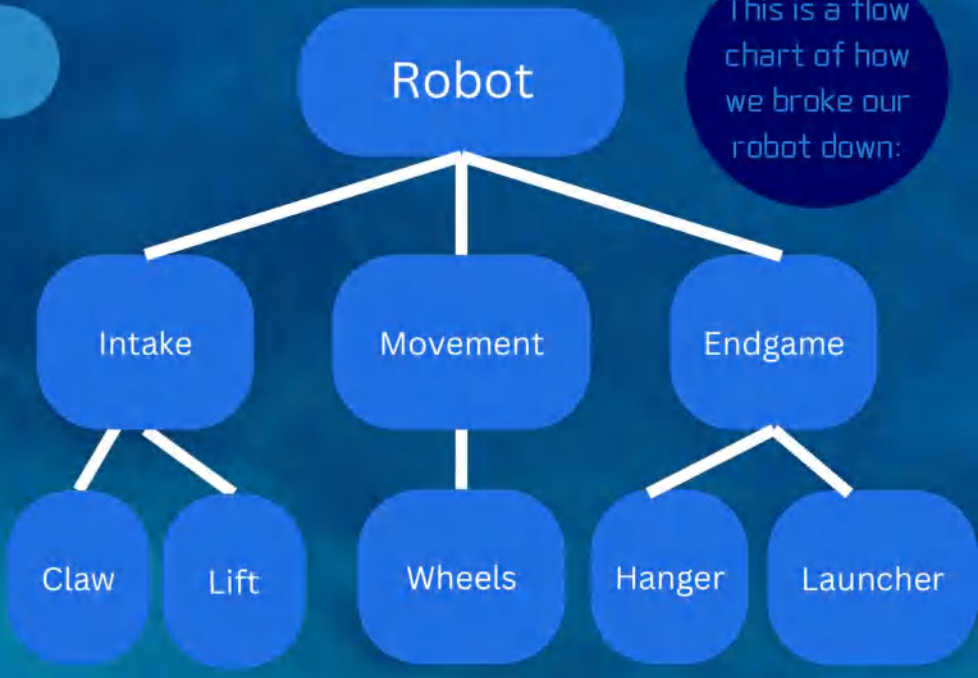
PROGRAMMING

GEAR GIRLS - 23469

Subsystems

In order to make our programming of autonomous and the functions for tele-op simple and more easily accessible, we decided to create **pre-coded methods** we could call when coding. To do this, we grouped our robot's features into three generic categories: **intake**, **endgame**, and **movement**. Within each of these we listed the systems we would need to program. From there, we created programs to define the **motors**, **servos**, or **sensors** each of them subsystem used, and then coded the generic movements the system would need to complete. This process made coding **accessible** for all team members, and allowed our programs to be easily understood.

This is a flow chart of how we broke our robot down:



During this season we implemented and switched to **Field Relative driving** to help us as an inexperienced drive team. Field Relative drive control is a system within the robot that allows it to always move forward **respective to the driver**, rather than respective to the robot. It uses **trigonometry** and the **IMU sensor** to calculate and interpret the robot's location. This reduced the mental load on the driver by **removing the need to reorient** themselves and the controller inputs in relation to the robot and the field.

In teleop and autonomous, we utilize a **Finite State Machine (FSM)**, a program that sets the available positions so you can only move to one of the positions set, to combine movements of our lift and wrist to **preset locations** for **acquisition** and **scoring**. This helps **improve cycle times** for the drivers by reducing the number of simultaneous movements they would need to individually control. A FSM also give us **greater control** over the behavior of the lift.

MEETING SUMMARY

GEAR GIRLS - 23469

Meet 1

We had a push bot, our drone launcher was not consistent and often malfunctioned, and we could not hang and didn't get any pixels on backdrop.

Meet 2

The first iteration of the hanger was semi efficient, we had functional lifts, our claw was a looney claw that some what worked, our airplane launcher often twisted to the side, and despite the working claw, no pixels were placed.

Meet 3

We had very consistent hanging, got a pixel on the backdrop, but our lifts didn't work for a majority of the time. We also had trouble with our autonomous code.

Lift

We needed to modify the fourstage belt driven lift. we decided to use a belt driven lift because teams had trouble with string lifts. modified the motor placement to fit within the constraints of the robot. had to mirror the lifts so that they face inward. challenge with keeping lifts connected through code, though they were connected mechanically

Hanger

We started by cutting off part of the channel to meet height restrictions, of hanger servo was slightly off center which caused an imbalnce in center of gravity so we changed to help with weight disribution on trusses noticed speed of arm was too slow and increased the speed

Claw

We started with our firts 3d printed claw but after meet 3 it broke, so we made our claw stronger so it wouldn't brake anymore.

STATISTICS PAGE

GEAR GIRLS - 23469

Thank you FIRST volunteers!

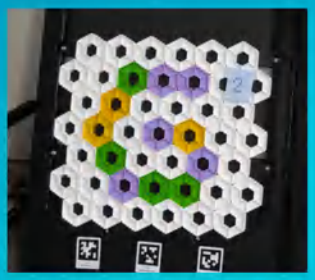
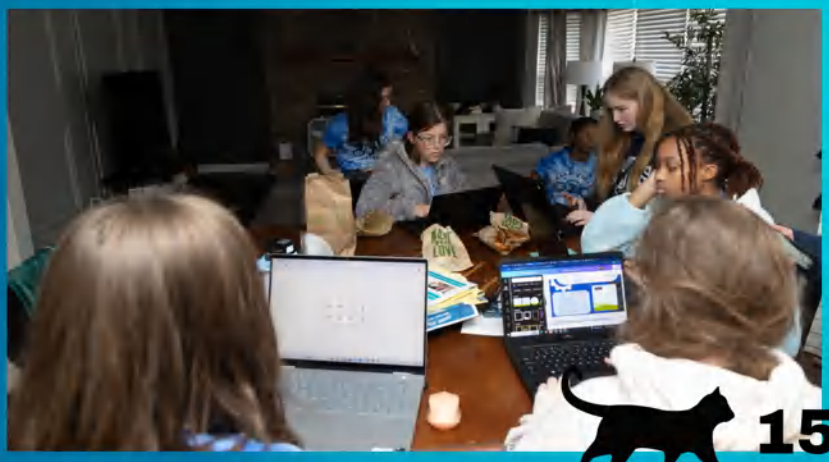
7 Motors

192 Hours

818 People reached

49 Followers (Instagram)

17 Experts

7 Servos

292 Views (Tik Tok)