# BELEN JESUIT PREPARATORY SCHOOL

WOLVERINE ROBOTICS FTC TEAM 19442

2023-2024 SEASON

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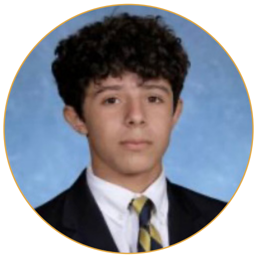
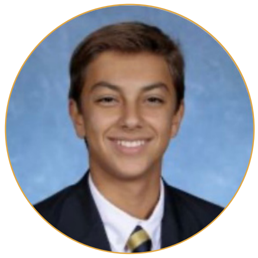
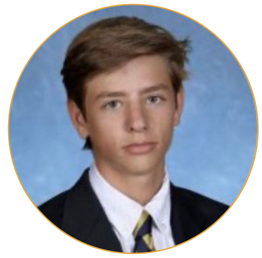
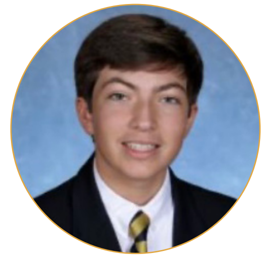
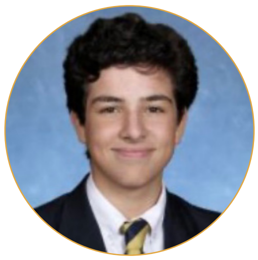
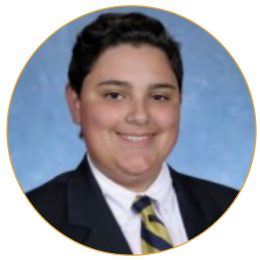
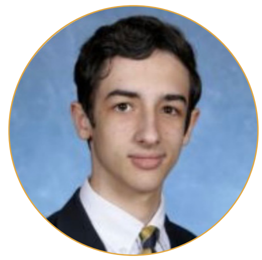
# WOLVERINE ROBOTICS (19442)

## Engineering Portfolio 2023-24

**Team Introduction**

Hello world! We are Wolverine Robotics, FTC Team 19442, from Belen Jesuit Preparatory School in Miami, Florida. Our team was established in 2021 as a group of eighth graders. As we have progressed, we have gained experience and practice in robotics and aim to continue shaping our team into the best versions of itself.

### Our Story

The Belen Robotics Club was founded in 2019. At the time we were a VEX Robotics Challenge team. When the class of 2021 graduated the entire team left with it and the Belen robotics program shifted to FIRST Tech Challenge (FTC). The club was left without leadership and the more experienced students to mentor the younger ones.

Our team, 19442, consisted of a 9th grader and a group of 8th graders. As we have progressed in robotics, we have redefined the robotics club. We have organized the club to have an executive board, written an engineering portfolio for the first time, recruited new members to be in our club, and gained significant experience in building robots. As we continue to progress, we aim to keep elevating the club to new heights and keep improving it for the future students who will join the club.

### Team Goals

1. Learn from our mistakes and aim to make improvements.
2. Employ the values of men for others taught at our Jesuit school, being uplifting and supporting to our own team, the other teams, the volunteers, and everyone else involved with FTC.
3. Helping the younger and newer members of the team to learn about robotics and to also spark an interest within them on the subject.
4. Familiarize ourselves with areas of inexperience, particularly OnBotJava and operating camera sensors.

### Team Awards

Despite the fact that our team is yet to achieve any awards in FTC, we are constantly aiming to better ourselves as we reach new heights. We are very grateful that we are able to participate in this competition with the support that we have from our moderator and our school, and hopefully soon we will achieve awards in FTC.

### Mr. Peter Perez, Club Moderator

### Gracious Professionalism

As our team embarks on our journey in the field of robotics, we will work to completely embrace and embody the ideal of gracious professionalism.

At the matches we have supported other teams when they have needed parts, strategized before each match with the other teams in our alliance in a way that promotes working together toward a greater goal. We want to build mutual respect and collaborate to actively contribute to the field. The ultimate goal is continued innovation within our robotics community.

As our school has taught us, the most important aspect of life, whether it be in school or a club, is to be men for others, ensuring that we serve and treat each other with respect. Additionally, we hope to carry this ideal throughout the rest of our lives, implementing it into our work and personal lives.

## Sustainability Plan, Team Organization, and Communication

We hope to always have a robotics team under the name of Wolverine Robotics. To ensure we always have young engineers enter the program, we try to recruit younger students who have a passion for engineering. For instance, we always display our team at the club fair. Additionally, students from our middle school teams can join the Wolverine Robotics team once they reach high school. We then develop these young students to become essential parts of our program until they graduate and a new set of ambitious young students rise to fill their roles.

## Sustainability Goals

- Create interest from middle school and young high school students in our engineering classes, robotics club for middle school, and the club fair where we showcase our team
- Older, more experienced members of the team teach and educate younger members of the team
- Obtain sponsors to fund our team for the upcoming years

### Team Roles


#### Engineers

***Software:*** Raul Gomez-Piña, Santiago Felix-Padilla.

Primarily responsible for writing the codes for the autonomous and tele-op phases, and ensuring that everything runs as planned.

***Hardware:*** Santiago Felix-Padilla, Lucas V. Diaz, Jose Zequeira, Oliver de Armas.

Primarily responsible for designing and building the robot, using CAD to create new pieces, and repairing any issues with the robot.

#### Documenters

*Engineering Notebook:* Alejandro Lurigados, Santiago Felix-Padilla, Nicholas Barales

Primarily responsible for taking photos, updating the Engineering Notebook, and organizing and designing the Portfolio.

## Communications Platform

Our team communicates primarily through discord. This keeps all members up to date on how building the robot is progressing and what we need to work on. This also allows members working on certain aspects such as hardware and software to communicate easily in smaller channels with members exclusively from those teams.

## Team Plan

In our first year in FTC, we were an unrefined team that did not have a defined plan or team roles. Over time, we have exponentially grown as a team and gotten way more experience through our few years of participating in FIRST. Our team has grown in size as well throughout the years, mostly due to our planning and recruiting strategies. During the Belen club fair, we try to attract newcomers by setting up a booth. There, we show videos of the times we participated in tournaments and of our practice. We bring out and control the previous year's robot to show how a fully-fledged robot should look, and educate the audience on how the League and club work. Club Fair is a key part of our growth as a team because it allows us to recruit new 8th graders and students from any other grade who are interested, and normally the 8th graders that decide to join spread the word about the club themselves and stay in the club for their time in high school, helping further build the new club.

During our time in FTC, especially as a relatively new team with little previous experience, we plan out our goals for the year and what we plan to learn in the competition. The team is committed to live out the school's motto, to be "Men for Others." The FIRST League helps build that sense of selflessness by emphasizing the importance of Gracious Professionalism, growing us not only as teammates, but as young men.

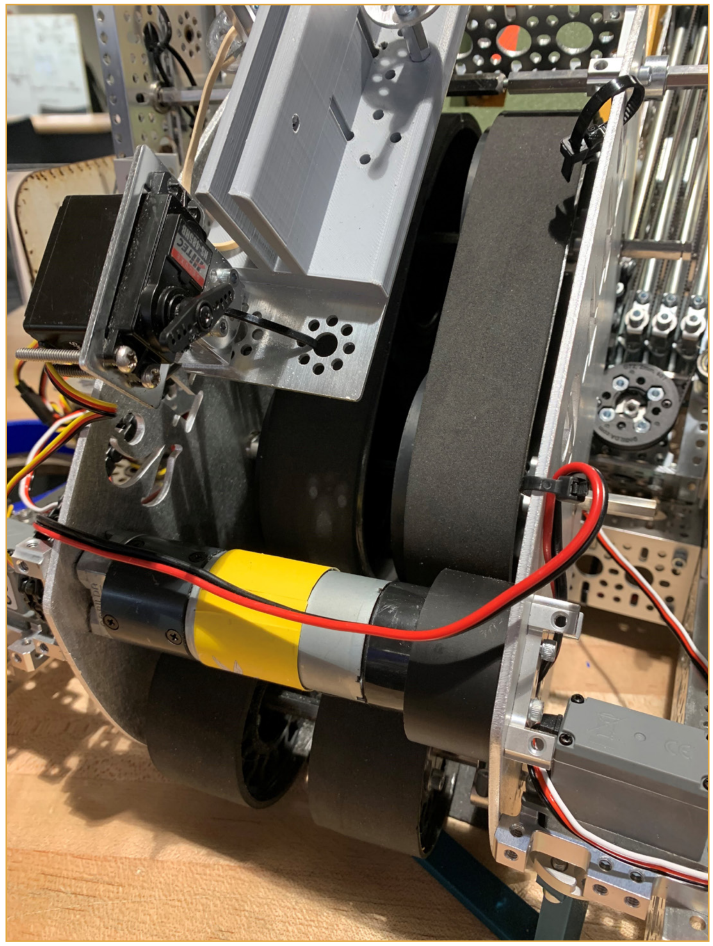
We also plan to network with other teams and others in FIRST. Belen hosted the third League qualifier this year, taking initiative on being Men for Others and helping to know the other teams better by providing a good tournament experience for them. We have also tried to talk to the other teams more, learning not only how to get better as a team and how to optimize our bot, but also how to better ourselves as people and cooperating with likely teammates or opponents.

Throughout our time in FTC, we plan to build ourselves as people through our experiences in the tournaments and prepare for the future by simulating future work environments and giving the experience we need to become the best versions of ourselves.

## Design Process

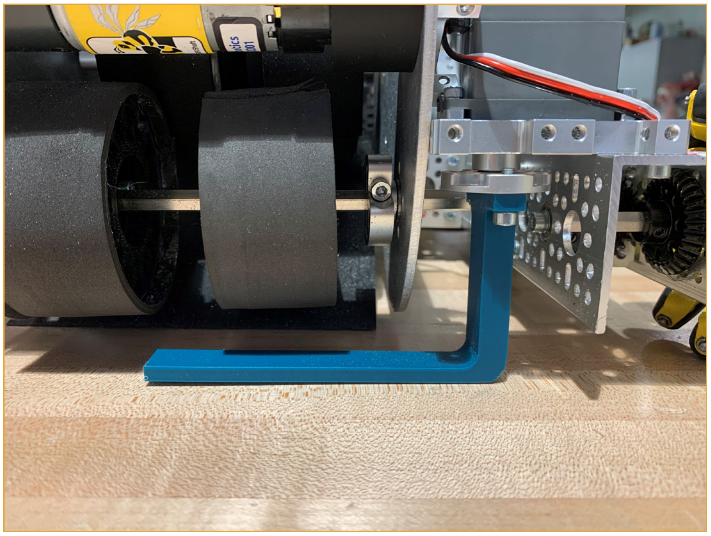
Throughout the season, we created several different designs and went through several different iterations of the robot. We have strived to make our robot as efficient and consistent as possible, taking inspiration from each other, other teams, and our mentor Mr. P. During our design process, we drew out each of our designs, and as a team collectively decided what would be best for the robot.

### Intake:



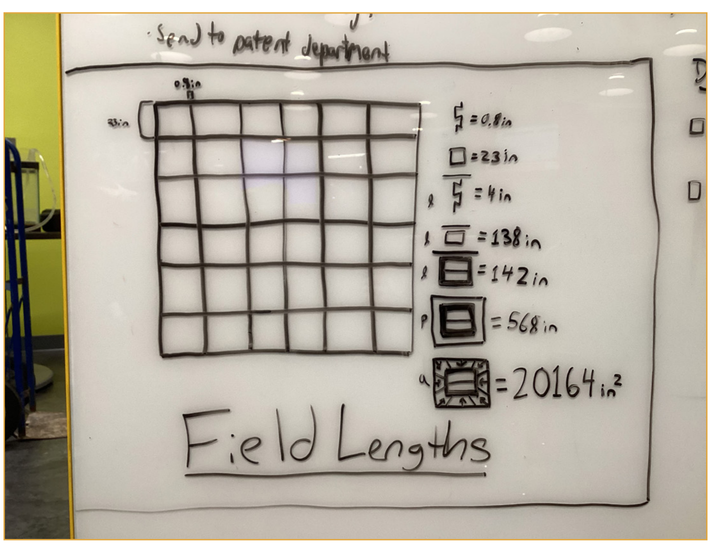
***Current Design:***

- Our current intake system uses 3 rows of wheels powered by a motor. They are connected by a sprocket and chain and have a soft belt around them, which helps them to push against the pixels. The wheels are held in between two 3-D designed aluminum plates. To raise the pixels into our output system, we laid our wheels upon a 3-D designed ramp, which was made to fit snugly into our robot while also lining up with the angle the wheels were built with. To finish off our intake system, we 3-D designed L-shaped pincers, which are turned by servos to push the pixels into our intake system.



***Previous Designs and Problems:***

- 1st Design:
    - Our first design was very rushed because we wanted to have it ready for scrimmage. We had no pincers, the wheels consisted of only 1 row rather than 3, and the ramp was made of cardboard zip tied to the sides of the robot. Obviously, this design was extremely flawed, especially considering the fact that it was unable to push pixels to our output system.
- 2nd Design:
    - Our second design was very similar to our current design, but it was much more inefficient and inconsistent than it is now. The plates were made of wood and acrylic, so they cracked and were very unstable while we were building. Additionally, instead of using a sprocket and chain, we attempted to use a gear ratio that would make the intake system spin quickly. However, the gears were difficult to properly align, so they skipped often and as a result the intake system was extremely inconsistent. Additionally, this design struggled to grab the pixels, which is why we decided to later add pincers.




**Output:**

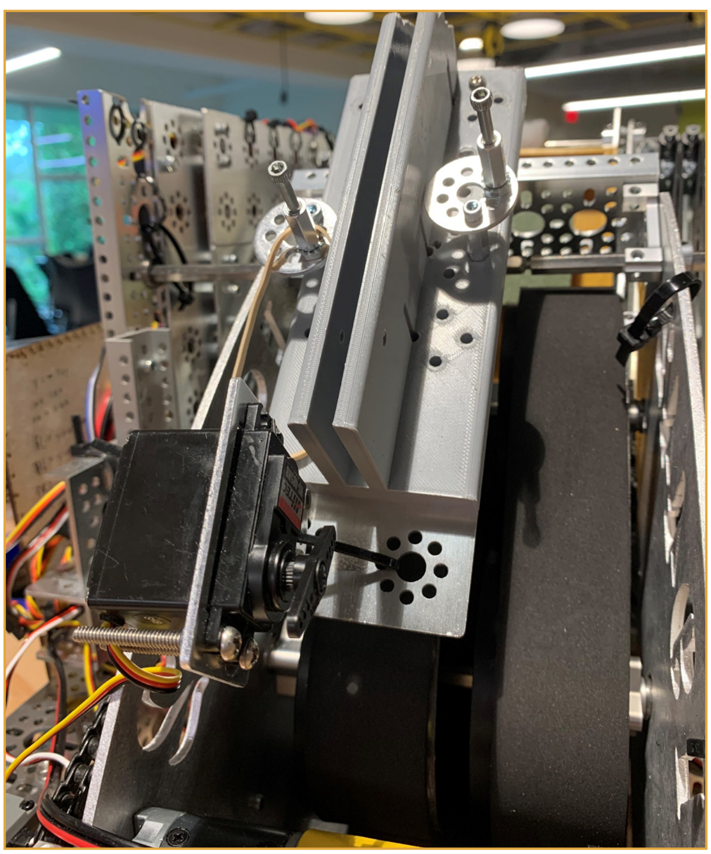
***Current Design:***

- Our current output consists of two different parts: a linear slide, and a 3-D designed box. Although this design still has a few inconsistencies, we have found it to be a huge improvement on all of our past designs. The box, attached to the linear slides, is where the intake system deposits the pixels. Once the slides rise, we have a servo on the box that lifts up the front so the pixels can slide through and land on the backdrop. The flaws in this system are that the servo cable unplugs often, and very occasionally the servo gets stuck in the lifted position, so we can no longer drop pixels.

***Previous Designs and Problems:***

- 1st Design:
  - Since we used linear slides for the competition last year, we gained lots of experience with them and were able to have our two linear slides for our output system ready before the scrimmage. However, the major flaw came in our box. We didn't have time to 3-D design one, so we built one out of cardboard. However, this design was very large and bulky. Additionally, rather than raising the front of the box with a servo, we attempted to have flippers powered by two servos that would let out one pixel at a time. However, this took up too much space and we were unable to mount on to our robot.
- 2nd Design:
  - Our second attempt at an output system was very similar to our current design. The major difference came from its unstableness. Although the system was designed the same way, the box would fall apart often, which led us to add a small piece to the side of the box that would keep it from falling apart.

**Plane launcher:**



***Current Design:***

- Our current plane launcher is a 3-D designed slit, with holes along the bottom. We put screws into the holes, and then we tied a rubber band around the screws. Then, we put a servo at the back and tightened the rubber band around it. To launch the airplane, the servo turns to release the rubber band and send the plane flying forwards.

***Previous Designs and Problems:***

- 1st Design:
  - Although our design has remained the same throughout the season, we changed where we mounted it to. Before, we mounted it on the side of the robot, but then we found that the wings of the plane would get caught and as a result it wouldn't make it far enough. This is why we decided to move it to be on top of our intake system, where it gets a clear shot to get out of the field.

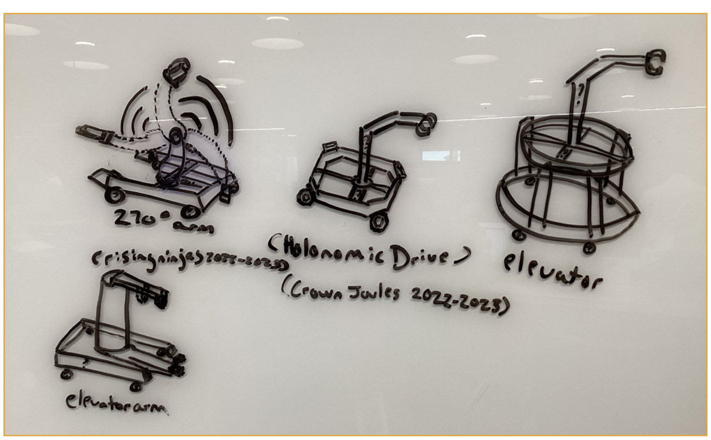
**Hanging Mechanism:**

***Current Design:***

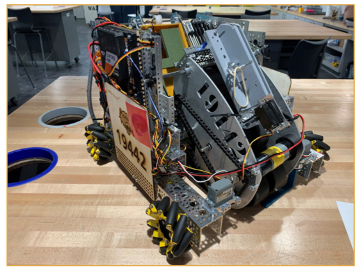
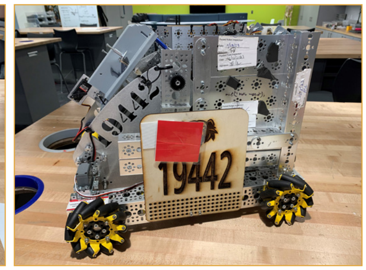
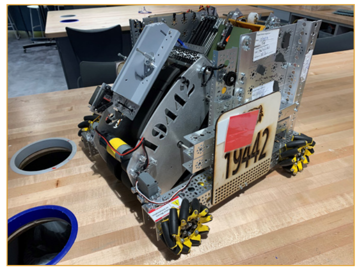
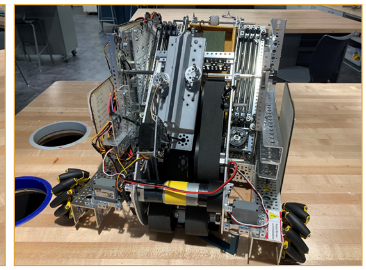
- The hanging mechanism is the most recent addition to our robot, and it is still a work in progress. Our robot is very bulky, so we figured that it would not be able to be lifted by a metal arm. For this reason, we designed a winch that used a motor with a gear ratio to increase the torque. This spun an axle which had a belt on it. The belt is attached to a metal hook, so that we could lift the hook onto the poles and lift the robot up with the belt. To lift up the hook, we put Velcro on the top of it, and we attach it to the back of the box on the linear slides with the Velcro. However, in order to not have the hook attached to the box the whole match (this would inhibit our ability to drop pixels on the backdrop), we place the hook on an axle attached to a servo, so we can raise the hook to the box where it attaches with Velcro, and then we can lift up the hook to the bars and raise the robot. The major problem with this design is that it takes too long to fully lift, so we are currently unable to lift our robot within the endgame. Our future plans include making the robot lighter and changing the gear ratio to have less torque so that our winch can pull up faster and can fully hang itself.

***Previous Designs and Problems:***

- 1st Design:
  - Our first design had the hook permanently placed on top of the box. However, there were two problems with this design. First, the winch had to be fully unwinded to reach the height of the fully extended linear slides, which extended the time it took us to hang. Additionally, the belt would create a slide for the pixels and block them from landing on the backdrop. Because of this, we added the servo and the Velcro to lift our hook to attach to the box.




## Final Robot Build

## Community

Team 19442 has been focused on figuring out design, parts, coding, and everything related to building a competitive robot. This year we were able to work on building community and camaraderie.

With a newly designed team mascot and logo we are creating identity in the robotics community. For the first time we have buttons and stickers to share with our fellow challenge teams.

Our team worked with the school administration for approval to bring FTC to the Belen campus. We learned what it takes to build the playing fields, logistics before and during an event, organizing team check-in and registration, and we look forward to hosting again.

We are proud to have welcomed the teams, coaches, and volunteers to our home.

## Attracting New Members

### Club Fair:

We represent our team at the annual school club fair, trying to attract new members who have an interest in engineering. We showcase our robot and let students see the team and how we work together.

### Open House:

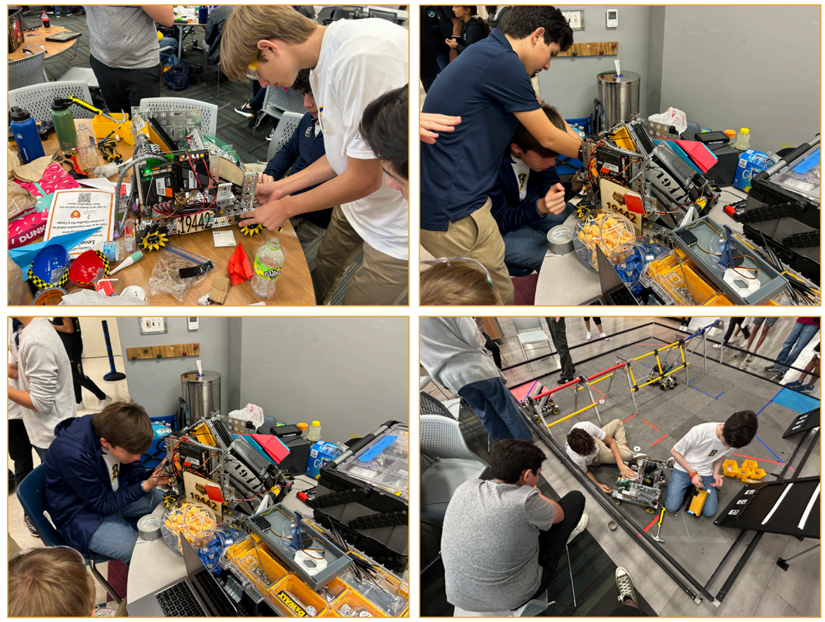
Recruitment for the club begins at open house, prior to admission into our school. This year we tried something different at open house. Instead of just showcasing the robot, we were actively building the robot and showing parents and students touring the school how our team works. This allowed for more interaction between those touring the school and the members of the team.

### Courses:

Our school offers an introductory course in 8th grade that helps students who may be interested in learning more about engineering and robotics. Most of the students on our team took this course and are able to take additional engineering courses in high school. These courses allow for students to gain an understanding of certain engineering terms and principles, which they can then apply in the robotics club as we design and build the robot.

## FTC Events

For the third consecutive year we have been participating in FTC events. Although we are relatively new to the league, we are extremely happy to have hosted our first ever league qualifying matches on January 13, 2024. It was a wonderful experience and gave us immense insight into all the work by the FTC staff and schools that host these events to make them the best possible. Despite not winning any awards in our three years in the league, we are extremely proud of our progress as a team and robotics program and hope we can soon reach the top and begin winning more to reflect the time and effort put in by everybody involved in our program.



## Scrimmage and Robot Work

### Practice Scrimmage:

We attended a practice scrimmage hosted at St. Anthony's Catholic School on October 14. We used the scrimmage to see ideas and designs other teams came up with and how we can use those ideas and implement them into our own robot and designs. Additionally, it allowed for us to understand how the matches worked and what to expect from the qualifying matches in the upcoming months.

### Robot Work:

We work on our robot during club hours after school, weekends, and days off. We had a good base going into the scrimmage and after each competition we take notes of what we can do better and work on those improvements until the next match. After a few months of these improvements we finally came up with our final design and are now making small adjustments to maximize the amount of points our robot can score in the autonomous, tele-op, and eng game periods.

## 3D Modeling

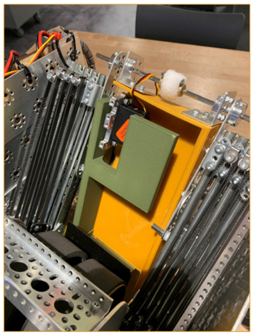
### Background:

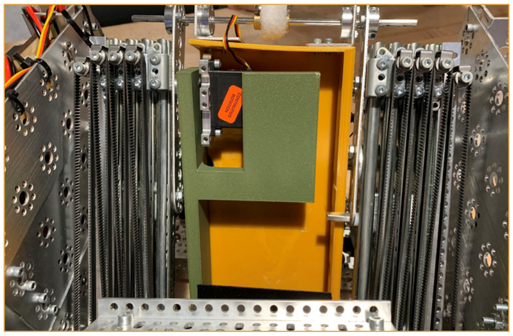
In the last two seasons, our team was inexperienced in 3D design and did not utilize it well. However, towards the end of last year we realized its value, and through practice and the intro to engineering classes, a few of our members have become adept at designing and printing new pieces. For design, we use Fusion360, and we have used it for several essential components of our robot.

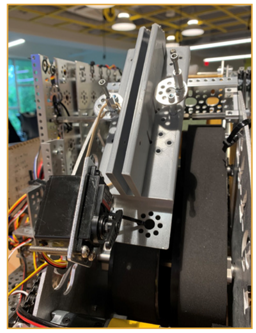
### 3D Modeled Components:

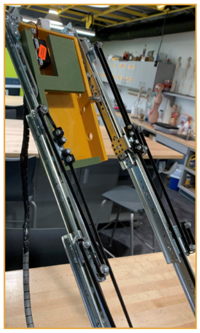
***Ramp:*** We took measurements of the robot to see the size constraints of the linear slide, and we designed our intake system to line up with the ramp that we designed. This ramp is used to take the pixels up to our output system.

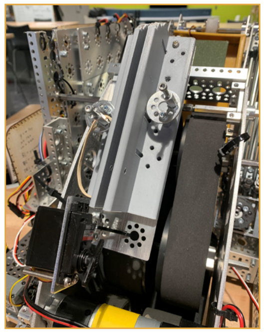
***Box:*** This component of the robot is mounted onto the linear slide. We 3D designed a box that can hold 2 pixels and release them once the linear slide is raised using a servo. Additionally, the box has a platform printed onto it that is used

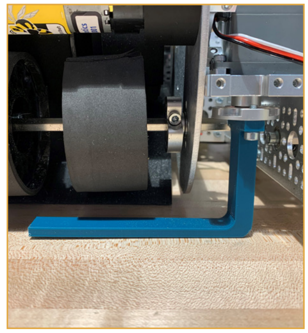












to hold the claw that we use to hang our robot.

Pincers: The pincers on our robot are placed in front of the intake. They are used to push pixels into our intake system and they are powered by servos.

## Strategy

Because our robot plays a generalist role, we try to play off of our teammates as much as we can, ensuring that our teammates can operate at maximum efficiency while we do all that their robot cannot do or is not doing.

| Autonomous | TeleOp | Endgame |
|---|---|---|
| Currently, we have a minimal Autonomous phase as we have been focusing on other aspects of the bot first. Our robot has 1 Autonomous script it can run for both of the teams we can be in. These both park the robot in the backstage area, giving our team points. However, we can also adapt to our teammates if we see that they can score more points than our parking can in Autonomous, we can switch sides if needed. | In the TeleOp phase, if our teammates are limited in what they can do or are better at some things than others, we will try to enable them as much as possible. We have spikes at the front of our robots to carry the pixel into the intake, so we do not have to pick the pixels in the wing in a specific order or orientation. Because of that, if our teammates need the pixels to be placed in a specific area or orientation in order to be picked up, we can tell our human player to do so or let them use their human player. Mainly, we are going to be focusing on picking up colored pixels from the wings to try and score and make mosaics, going through the backdrop aisle and the trusses when going from the wings to the backdrops and vice versa. Just before Endgame starts we position ourselves to fire our plane since our Endgame is a time crunch. | Our team had to work on optimizing time for Endgame since the things that we were planning on doing were taking longer than the 30 seconds we have. The first thing that we do in Endgame is launch the plane. We position ourselves before Endgame starts in order to give us time for the rest of the phase. We deposit any pixels we have in the box, and then hang the bot. Since our hanging mechanism has more steps than other hanging mechanisms, it takes a bit more time than other bots' mechanisms, usually taking around 15-20 seconds. This section we are less generalist in because of the extreme time crunch the drivers are in, but we are able to score a lot of points in this section if it all goes well. |

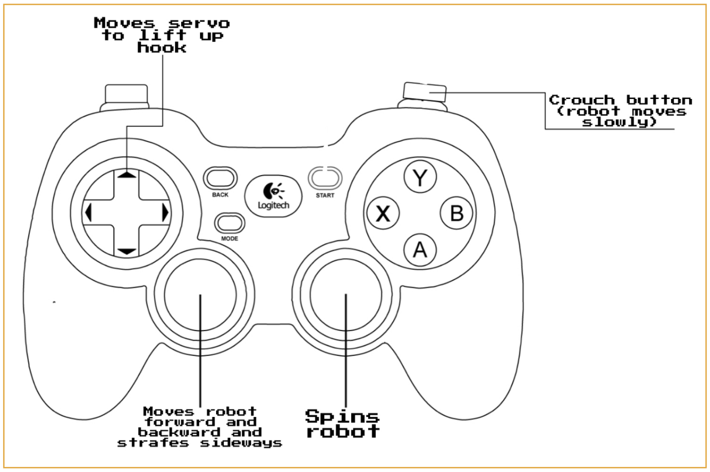
## Software

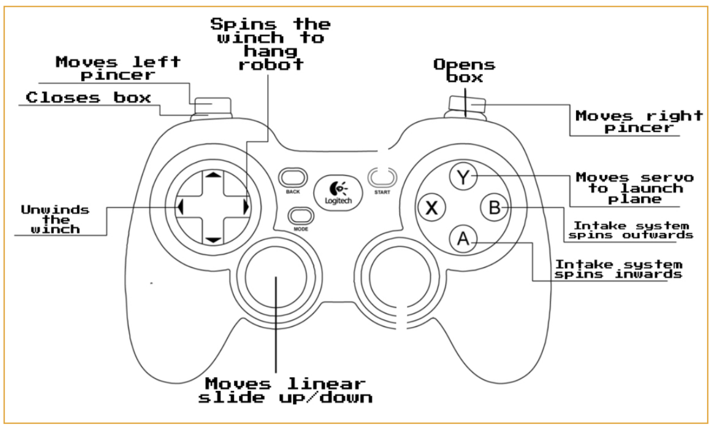
### Autonomous:

The initial plan for our autonomous stage was to use the camera sensors to maximize our total amount of points. However, the code for the sensor took longer than expected. To fill in, we coded an autonomous that attempted to park the robot next to the backdrop and to also drop two pixels on the backstage. The parking component of the autonomous was successful, however we experienced difficulties with the linear slide, and due to time constraints were unable to complete that section of the code. So, for the first two competitions, our autonomous stage parked the robot next to the backdrop.

The code with the sensor, which was finished before the third competition, identifies the april tags and then identifies certain values that are of use to us, such as distance and angle. Then, the distance and angle is used to alert the robot as to where it is on the field. After this the robot performs the task of placing the purple pixel on the strike mark line marked by our team prop. It then places the yellow pixel on the backboard using the corresponding april tag.

## TeleOp:




Our TeleOp consists of two controllers. One driver drives the robot, the other driver controls each component that scores points. Throughout the season, our code has become more complex as we have added more components to the robot. At the scrimmage, we did not have our plane launcher, hanging mechanism, or pincers, so they were not coded. The plane launcher was added before the first competition, the pincers before the second competition, and the hanging mechanism before the third competition. Additionally, our driving for the first two competitions was extremely sensitive and did not function properly, so that was improved for the third competition so the robot would drive in a sensible manner.

***Controller 1:***

*Left joystick: moves robot forward and backward and strafes sideways*

*right joystick: spins robot*

*D-pad up: moves servo than lifts hook up*

*rt: crouch button (robot moves slowly*

***Controller 2:***

*A: Intake system spins inwards*

*B: Intake system spins outwards*

*Y: moves servo to launch plane*

*Left joystick: moves linear slide up/down*

*RB: opens box*

*LB: closes box*

*D-Pad right: spins the winch to hang robot*

*d-pad left: unwinds the winch*

*rt: moves right pincer*

*lt: moves left pincer*

## Costs

| Income | Amount Earned |
|---|---|
| MWL (in-kind donation/sponsor) | $200.00 |
| Belen | $16,535.00 |
| Expenses | Amount |
| 3209-0001-0005, Strafer™ (96mm Wheels) x2 | $1,199.98 |
| 3210-0004-0004, 4 Stage Viper-Slide Kit, (Belt-Driven, 240mm Slides) $209.99 x2 | $419.98 |
| 5203 Series Yellow Jacket Planetary Gear Motor (99.5:1 Ratio, 24mm Length 8mm REX™ Shaft, 60 RPM, 3.3 - 5V Encoder) | $42.99 |
| 5203 Series Yellow Jacket Planetary Gear Motor (19.2:1 Ratio, 24mm Length 8mm REX™ Shaft, 312 RPM, 3.3 - 5V Encoder) x4 | $171.96 |
| 2000 Series Dual Mode Servo (25-2, Torque) x2 | $63.98 |
| Control/Expansion Hub | $277.27 |
| National Registration (Annual) | $295.00 |
| League Registration (Annual) | $250.00 |