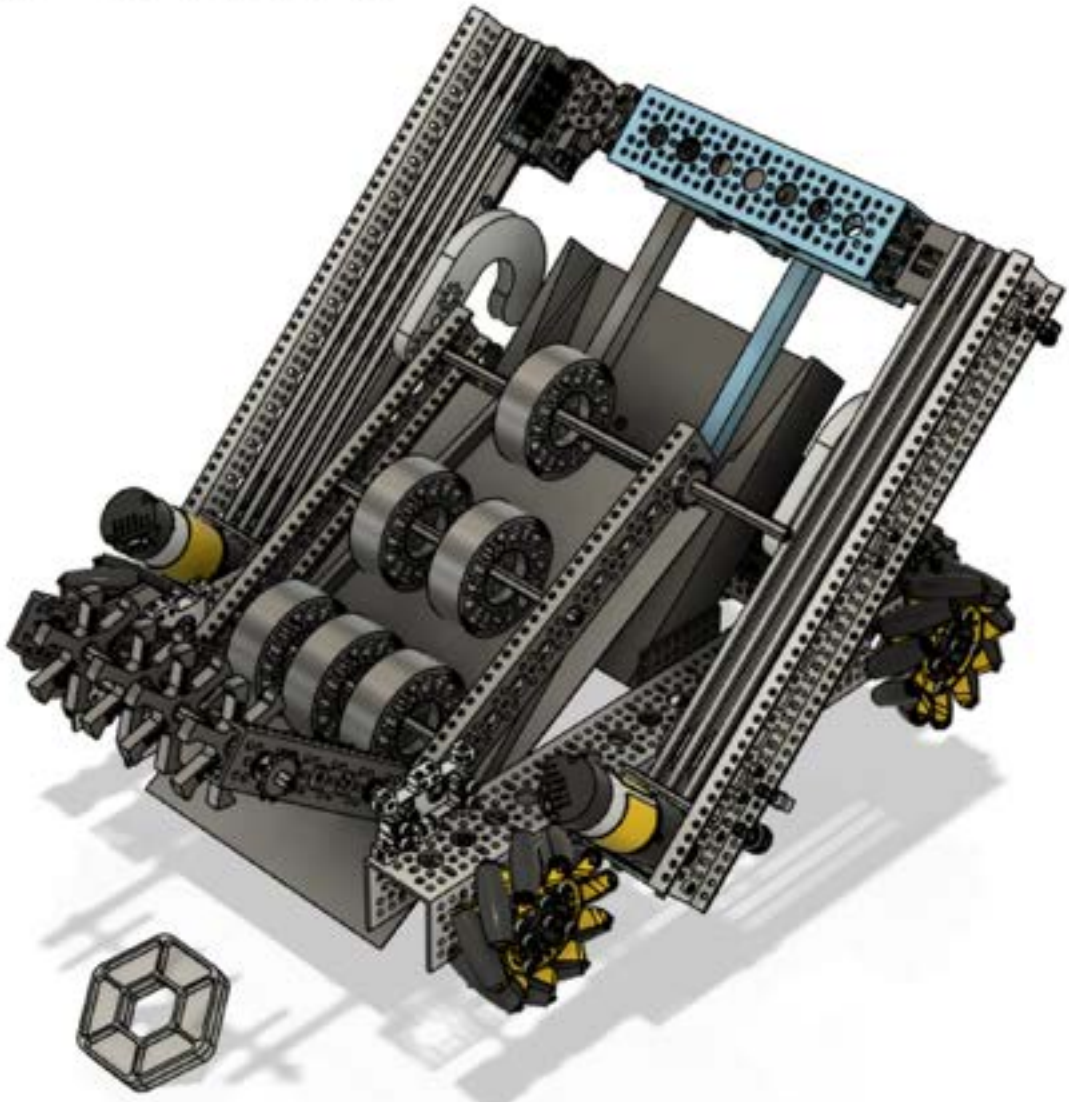
WOLVES ROBOTICS ENGINEERING PORTFOLIO 2023/2024

#5661



FIRST TECH CHALLENGE

CENTERSTAGE

MEET THE TEAM

From Left to right : James Bennett (Junior), Wesley Aldridge (Junior), Luis Valledor (Junior), Deagan Miller (Junior), Carson Philips (Sophomore), Shawn Surrey (Sophomore), Baden Armstrong (Junior), Derek Lara (Junior), Ethan Huskinson (Junior), and Samantha Campbell (Junior)

WHO ARE WE?

We are a FTC team #5661 ~ Wolves Robotics 1 (Varsity), located in Goodyear, Arizona at Estrella Foothills High School.

We are a non-profit team and solely rely on concessions during home games, merchandise, sponsors, and donations. Our team hopes to provide a chance to learn important life skills such as teamwork, communication, leadership, and self-confidence within the community.

EFHS ROBOTICS HISTORY

Our first president Sarah Charles founded the EFHS robotics club during the 2010-2011 School year. Initially, front loader robots were made from kit parts. Given that we were a new club, we were underfunded which meant the kit robots were affordable and fun. Following a TV special about FIRST Robotics, our team was motivated to pursue greater challenges, and the future was clear. Fundraising opportunities were seized, and a rookie team grant allowed us to afford our first set of parts. The rest is EFHS Robotics history!

SOMETHING UNIQUE ABOUT OUR TEAM

A Unique attribute about our team is that we maintain a public website that holds our code, portfolio, and our info. Additionally, our drive team loves to dress up for each competitive event to bring some fun spontaneity for us and other competitors.

OUR MEMBERS

JAMES BENNET
JUNIOR - FTC YEAR 2

Hey! I'm James and I'm the Lead Software Developer for out team. This year I've designed our new Autonomous and Teleop systems to enhance driver and game performance. I've also spent some time teaching incoming and current members about programming to expand our software team. This is my first year really being apart of FTC and it has been a wonderful experience.

BADEN ARMSTRONG
JUNIOR - FTC YEAR 3

I'm Baden and I'm a Junior and I've been in FTC for 3 years. I'm the Lead CAD Designer and builder for our team. This year I've helped design our bot in CAD so when we get into the classroom we are building from a Lego set. I've have also helped teach our sister team and other members how to CAD and 3D Print. I also help with Sponsor outreach and I help with the communications with the booster club to get parts we need.

CARSON PHILLIPS
SOPHOMORE - FTC YEAR 2

Hey there! I'm Carson, and as the youngest member of our Robotics team I have had tons to learn from the upperclassmen this year. My main job this season was prototyping and designing the Drone launcher in so that if fires consistently and for points. This season has really shaped me into the engineer I aspire to be in my later life, and I hope that I can continue to learn CAD and time management through the rest of this year.

SAMANTHA CAMPBELL
JUNIOR - FTC YEAR 3

Hi there! I'm Samantha and this is my third year in FTC and my second year on 5661. This season I strive to assist our drive team in being human player and strategizing the best set up to optimize points gained by the pixels. This season has allowed me to obtain more problem solving skills and create game plans. Although the season is closing up, I strive to help our hardware team in finalizing designs and creating the ultimate game plan.

DEREK LARA
JUNIOR - FTC YEAR 3

Hey, I'm Derek. This is my 2nd year on 5661 and my 3rd year in FTC. As the 1st driver, I strive for efficiency and quickness when it comes to competing. 5661 hasn't made it to Worlds since 2017 and I strive to change that this year. So far, this season has been really successful and it has taught me the importance of time management and communication. Even though it's been a successful season, we can always do/be better in the end.

LUIS VALLEDOR
JUNIOR - FTC YEAR 3

Hi! I'm Luis and I've been on the 5661 team since my sophomore year. This season I was always off put by how my mentor team and teams before them always had a bland portfolio. I wanted to be the person this year that changes that for the younger generations that will eventually fill my position. I am also the 2nd driver on the team, operating the arm and claw to score points.

BRENDAN LOCKSA
SENIOR - FTC YEAR 3

Hello there, I'm Brendan I have been a member of 5661 for 2 years and I've been apart of FIRST for 3 years. my contributions to our Centerstage bot was brainstorming and designing elements of the bot. Since I'm 5661's only member in their final year of high school I have been committed to ensuring that our sister team 7156 has an approachable and qualified member that they can come to when they're confused or need a quick solution in the heat of a competition.

DEAGAN MILLER
JUNIOR - FTC YEAR 3

Hi, I'm Deagan! I've been on team 5661 for 2 years and have been competing in FTC for 3 years. This year, I've been focusing on basic systems and mechanical subsystems. This includes the chassis and linear slide. As the coach on the 5661 drive team, I strive for efficient communication between our team's drivers, human player, and our alliance's drivers. It's been a successful season for us, but I've been able to learn so much from my team and other teams.

GOALS & REFLECTIONS

Community

- Inspire the younger generation at elementary schools using STEAM.
- Bring more women into the STEAM field.
- Give younger generations an interest in FTC and other FIRST competitions.

Team

- Learn more about mechanisms to do even better next year.
- Find and develop new strategies.
- Communicate with other teams and learn what they have to offer.

Robot

- Continuously learn from our robot's failures to create new and better iterations.
- Constantly work on improving mechanisms and improving structural integrity.
- Develop new ways to fancy up our robot to make it stand out among other teams.

QUALIFIER REFLECTIONS

Location	Successes	Problems	Improvements
Chandler Christian High School "Road Runner"	Our autonomous was successful and we communicated our strategies excellently	Our bot consistently broke and we lacked an airplane launcher.	1.) Create a working airplane launcher. 2.) Strengthen the robot using different engineering ideas.
Trivium Preparatory "Palo Verde"	We were able to consistently score high and communicate between our drive team.	Our autonomous failed a few times and our airplane launcher failed frequently	1.) Finish airplane launcher. 2.) Strengthen our hooks to hang.
ASU West Campus "Valley Of The Sun"	We Placed loads of pixels onto the backdrop Hanging was much easier	Bad batteries messed us up 2+2 auto failed Servos broke Servo Wires disconnected	Quicker intake Tweak code Practice mosaic placements Finalize airplane launcher

OUTREACH

Partnered with
6
Clubs and schools

8
New Members
To our club

5
New club Sponsors

6,000+
Dollars
In club revenue

250+
People inspired
by FIRST

"The way that FIRST Robotics has impacted my life is by allowing me to meet a new group of people that introduced me to so many new things and gave me experiences that I wouldn't have experienced otherwise."
-EFHS Alumni Armando Rodriguez-Beltran

"FIRST really helped me grow and make new friends going into high school, and all the coding I learned here has been a huge help in College"
-EFHS Alumni Jack Morris

"I've been waiting ALL DAY for this!"
-One Student's excited words upon entering into STEAM camp.

STEAM CAMP

From May 22 - 26 we volunteered at our local middle school, Westar Elementary, to work the robotics section of STEAM Camp. Every day from 8:30 to 2:30 we worked with kids from kindergarten up to grade 6. During this, we encouraged students to work together to demonstrate teamwork by building robots with VEX parts. The biggest goal for the groups was to encourage creativity and communication. We accomplished this by encouraging students to convene and voice their ideas with each other. This allowed them to work at their rate and understand the core values of FIRST. In conclusion, we were granted the chance to teach young students the value of teamwork and introduce them to an exciting section of the STEM field. We believe we were successful in our goal because of the excitement that the students displayed over their achievements as a group, and through the cohesive work that was developed through their consistent communication.

CLUB SUSTAINABLILITY

Sustaining our club is very important to us so we participate in many events to maintain the engagement on our community and our school. We gain members during our school's many events such as: Future Freshman Night, Gear up day, and Club Rush. We also have our own booster club which helps bring in a new crowd while also bringing in a profit to the club! During these events we display our robots and talk to students about FIRST. These on average bring in a bunch of new students to the club and allows us to continue participating in FTC.

School Carnival

GEAR UP

HOCO PARADE

GIRL SCOUT BADGES

This season, we also had the pleasure of working with the girl scouts to help them earn their robotics badges. We had them create small robots while also showing off our robots from the season. We do this every year further inspiring the younger generation and pushing the amazing ideologies FIRST has to offer.

FUNDRAISING

This season we made fundraising a major priority as using old Tetrix and Rev parts just wasn't cutting it during competition. To begin, we started with no money at the start of the season. We also had roughly 400 dollars in grants. To register and compete we paid about 1,100+. This left a large dent in our wallet and we needed new strategies to bring in money besides concession stands. Our first work of action was to redesign our sponsorship portfolio and send our new redesigned team portfolio to companies. This made us loads of money and allowed for us to purchase new parts and prepare for the new season (our sponsors listed below). Shortly following our search for sponsors, we created a booster club so parents, coworkers, and everyone in the community can be apart of our robotics team.

Item	Description	Income and Cost	Balance
Savings	Leftover from last year	0 (no numbers)	0
Sponsors, donations, and fundraising	Transworld, Hickmans, West Coast, and Symphonic	8,023	8,023
Participation Fees	Registration, field pieces, merch	-1,149	6,874
Robot Parts	Tools, electronics, general parts	-3230	3644
Total			3,644

Thank you to our Sponsors and Booster club!

TRANSWORLD Business Advisors

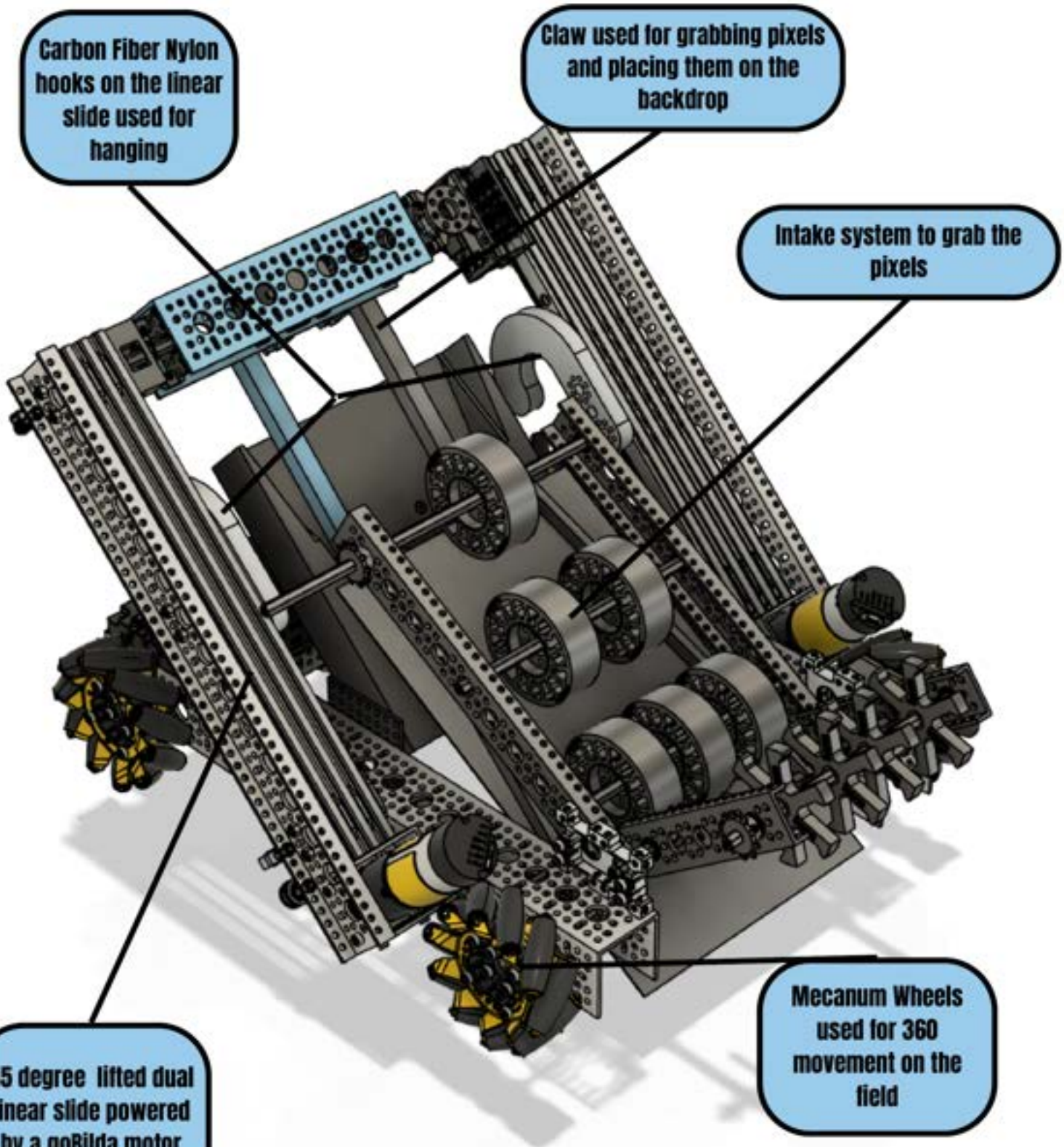
HICKMAN'S FAMILY FARMS

SYMPHONIC

WEST COAST AUTOMATION

@efhsroboticsboosterclub

ROBOT OVERVIEW



GAME STRATEGY

AUTONOMOUS

- Place Purple pixel on spike mark designated by prop.
- Place the yellow pixel on designated part of the backdrop.
- Goes to the white spike marker and grabs 2 white pixels.
- Places on the backdrop and parks.

TELE-OP

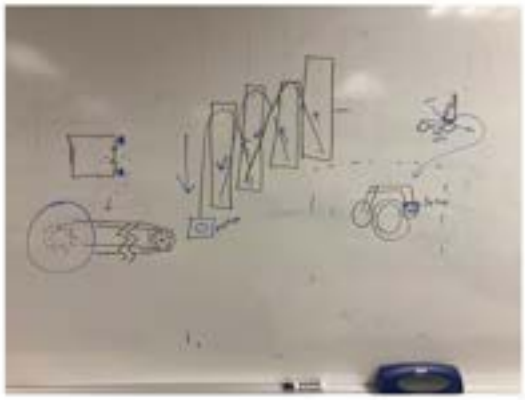
- Create a start to a purple and yellow mosaic using the elements from auto.
- Finish the 2 mosaics then go for height using white pixels from either the spike marker or the warehouse.

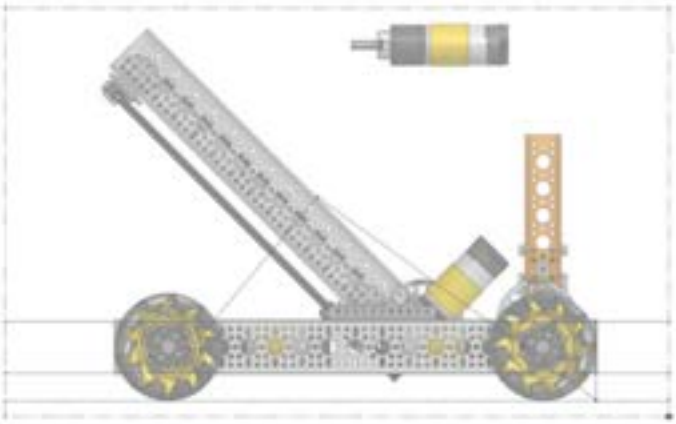
ENDGAME

- Continue to place white pixels until 10 seconds remain.
- Launch plane.
- Quickly hang off the nearby truss.

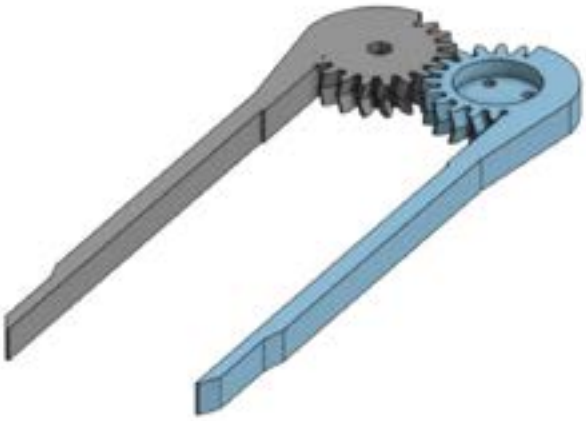
DESIGN PROCESS

BRAINSTORMING



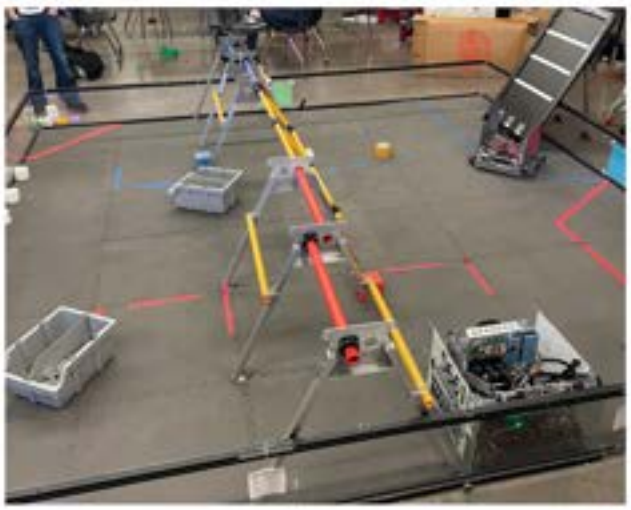


CADING



BUILDING

TESTING



Our team participating at trivium's scrimmage game

Iterate

CAD DESIGN

This year we decided to use Computer Aided Design (CAD) to build our robot in a virtual space before building it for real. So, all we need to do when we start our meetings is put it together like a Lego set. At first, we were using Onshape because it was free and you can use it in your browser, but we quickly realized we were limited by the software, so we switched to Fusion 360, using their assembly mirroring tool and other features. The downside with Fusion 360 is that you need a beefy computer to run it and that it is a .exe program which we can't run on our school computers. Now we use both Onshape and Fusion 360. We use Fusion 360 for our assembly of our bot. We use Onshape for quick CADing and CADing at school since we can use it on any computer with internet.

CHASSIS ITERATION

Ver. 1

GoBILDA Strafer Kit fully assembled

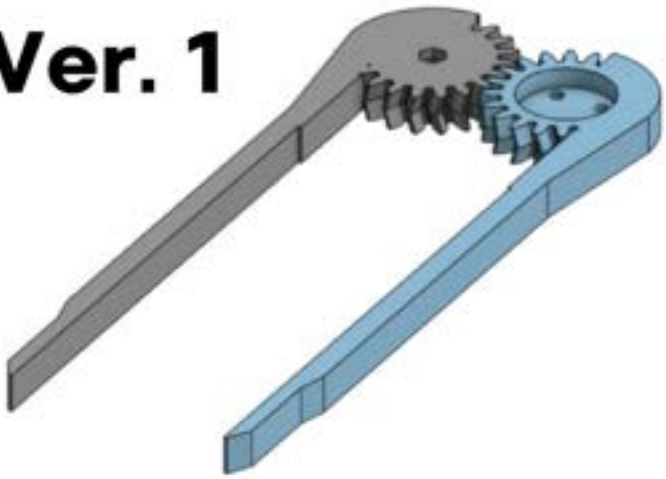
To begin our new journey using our new goBILDA parts, we wanted to start our learning process and robot base using the provided strafer kit. This gave us a good idea on how to use the new parts and the benefits that came with using them. We were able to see just how fast and efficient these new parts were, however, they weren't perfect to fit our constraints of a 18in x 18in x 18in box as it was too wide. This brought us to our second configuration in version 2.

Ver. 2

Elaborating on version 1, the chassis was too wide to fit our linear slides on the outside of the chassis frame. To fix this, we made the chassis thinner and put the linear slides on the outside of the bot. This change also allowed us to create a bigger intake. All these changes are present in our final bot.

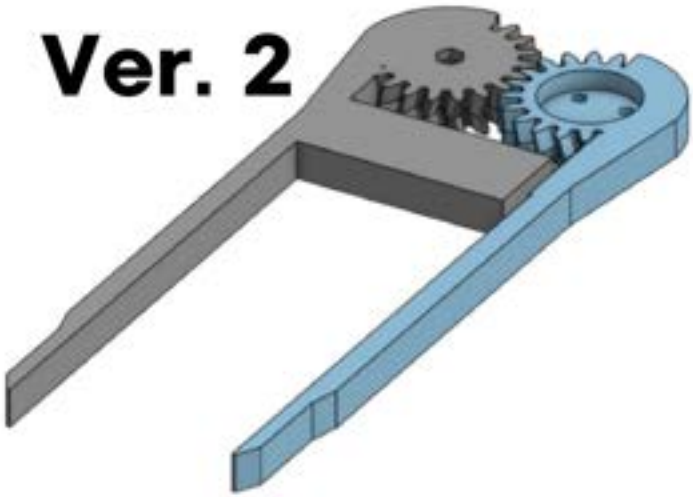
CLAW ITERATION

Ver. 1



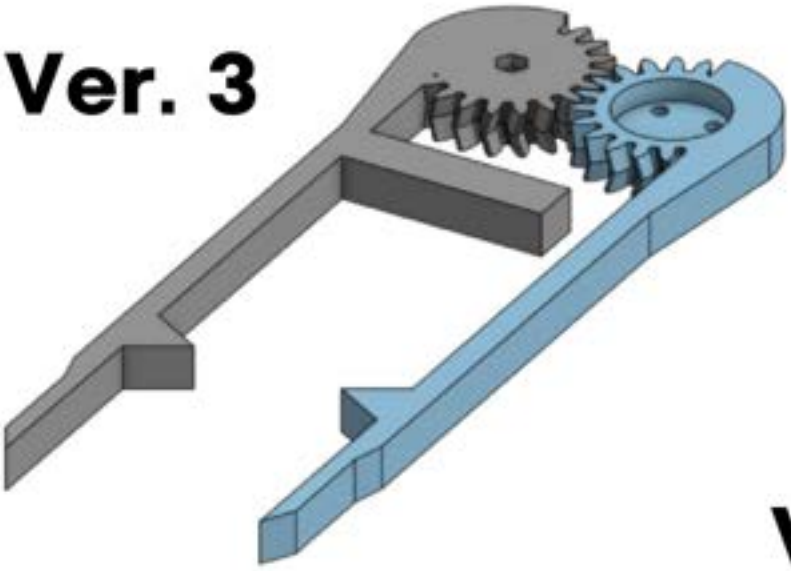
The first ever design of the claw was a simple "chopstick" like design that wasn't perfect, however, it was able to get the job done. It would need the right amount of grip on the claws to pick up 2 pixels at once. This could be improved upon in the later versions.

Ver. 2



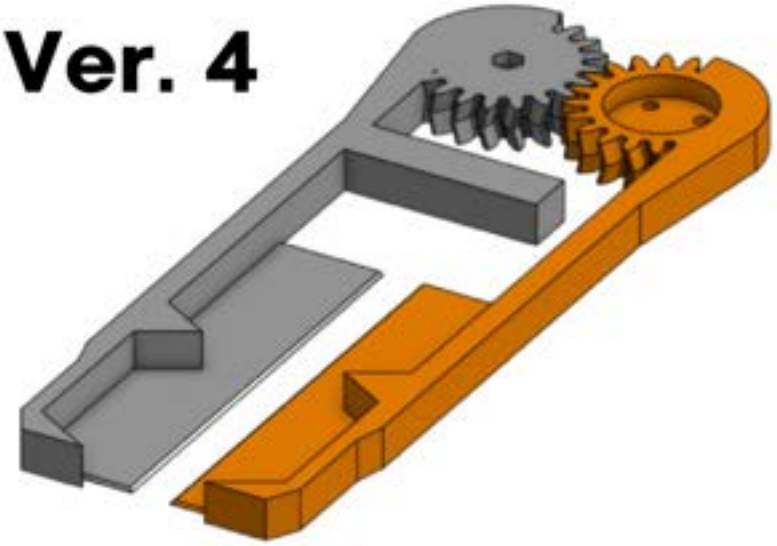
The second design wasn't very different from the first one. However, if you notice, there is a rectangle attached to the left side of the claw. That block was used to fix the problem in our intake where it would accidently fire the pixel out of the placing side of the bot. This accident got us a few penalties and the block was added to the claw to prevent that.

Ver. 3



In version 3, we wanted to fix the issue with only picking up one pixel most of the time and missing the other pixel. Our first attempt at this was to use the triangles to correctly orientate the top pixel so when the top one is offset, it gets corrected and gives more of a chance to grab the second pixel.

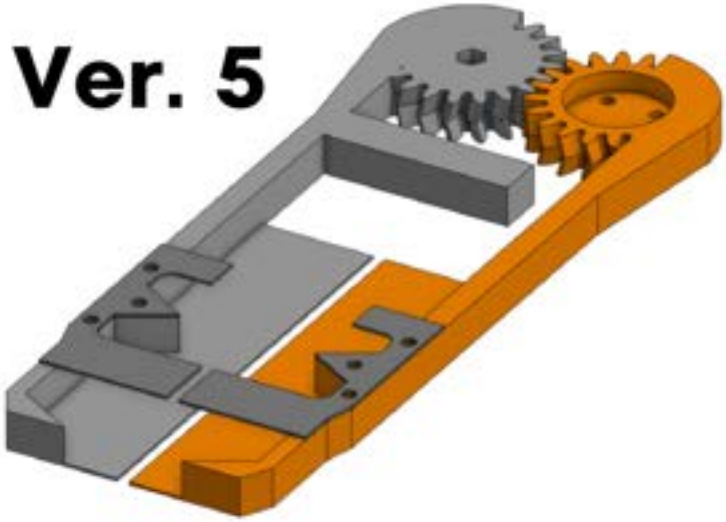
Ver. 4



In version 4, we tried to fix all our problems. The bottom triangles facing in allowed for both pixels to be held more efficiently. The back panels on the claw also provide extra initial support and doesn't need to rely on the backdrop to fix the miss-held pixels.

CLAW ITERATION cont.

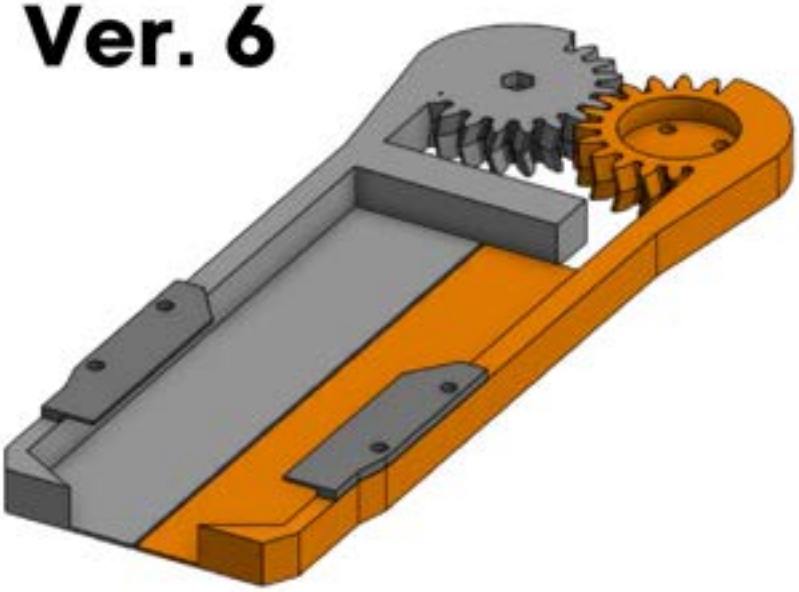
Ver. 5



Very similar idea from the last design, only minorly tweaking the code so the claws work more efficiently. This version of the claw uses a small bracket. This further improves the claws ability to hold the pixel and at an even more stable position. With the front and back of the pixel secured, we can fully drop one pixel at a time. This will help us make mosaics faster and place white pixels more efficiently.

In practice, the previous method proved to be a little too over complicated and there were too many instances where a problem could happen like picking up one too many pixels and it would break. We decided to remove the middle triangle and cut back on how big the top supports were so they were less mechanically flimsy. so far this has been our best design

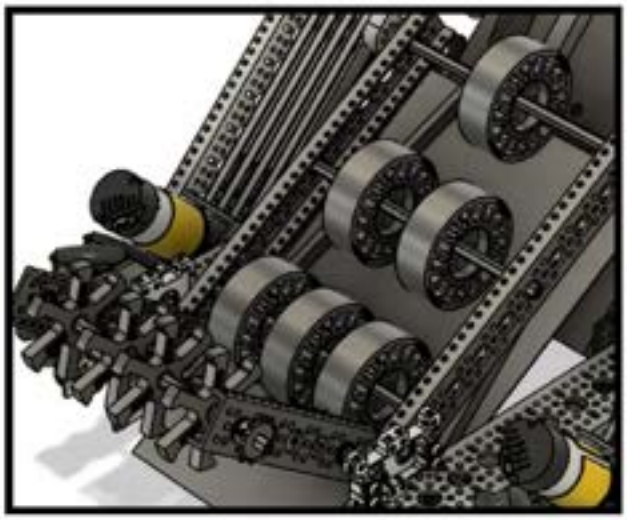
Ver. 6



LINEAR SLIDE

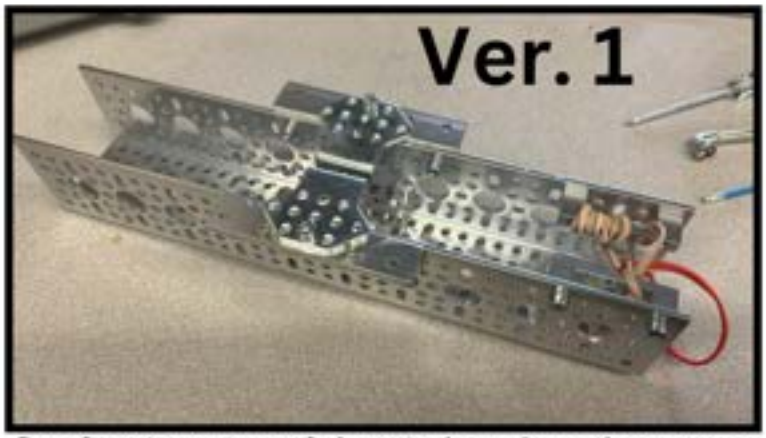
We ordered two linear slide kits from goBILDA and assembled them whilst following the instructions. We weren't familiar with these new goBILDA parts, but we eventually figured out that we could attach them to the robot at an angle. This would be a huge advantage because the backdrop for the pixels is set up at a 60 degree angle. The closest we could get was a 45 degree angle, so we needed to figure out how to make up those last 15 degrees to get a controlled pixel drop. The linear slides were far enough apart that another goBILDA bar could be attached between them. We used the advantage of placing servos inside the bars to attach a servo onto each side of the bar. This allowed us to rotate the bar separately from moving the linear slides. That solved our 15 degree problem, all while providing us with an area to attach our 3D printed claw.

INTAKE SYSTEM

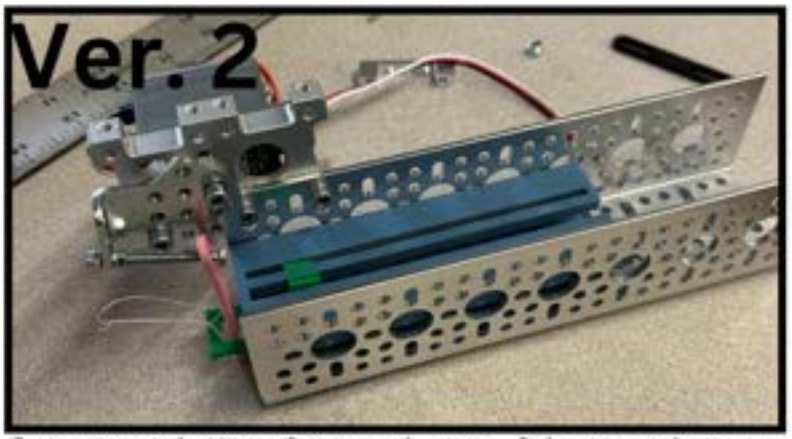


This year, our intake system was kept simple yet effective. There were no hardware based changes in this mechanism. The way the intake system works is the four rubber boot shaped wheels would drag in the pixels into the wheels in the middle. These middle wheels would send the pixels up and into our storage container. This proved to be the fastest way to quickly run into the warehouse and grab the pixels. As we drive to the board, we keep the intake engaged to allow the pixels to fully make it through the line.

AIRPLANE LAUNCHER ITERATION



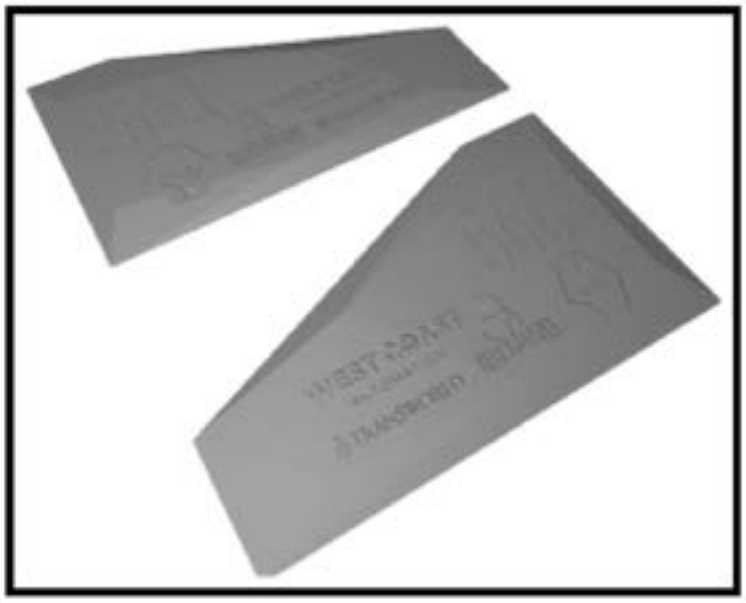
Our first iteration of the airplane launcher was a quick design we found on YouTube. Originally, we thought the airplane launcher was going to be the easiest mechanic to perfect on the whole robot, but we were far from that idea. This design failed (technically) every time and never had one successful launch that actually scored points. It was either accidently launched into a ref or inside of the field. This gave us multiple things to think about in change for our next design.



Our new design featured new 3d printed parts. These provided a new and easier way of loading the plane while also making the plane more stable and ready to launch. One downside was the plane launcher was placed too close to the wall and wouldn't allow the plane to fly without sliding on the walls and messing up its trajectory. That being said, this new design was much improved and we were getting closer to the answer.

SIDE PANELS

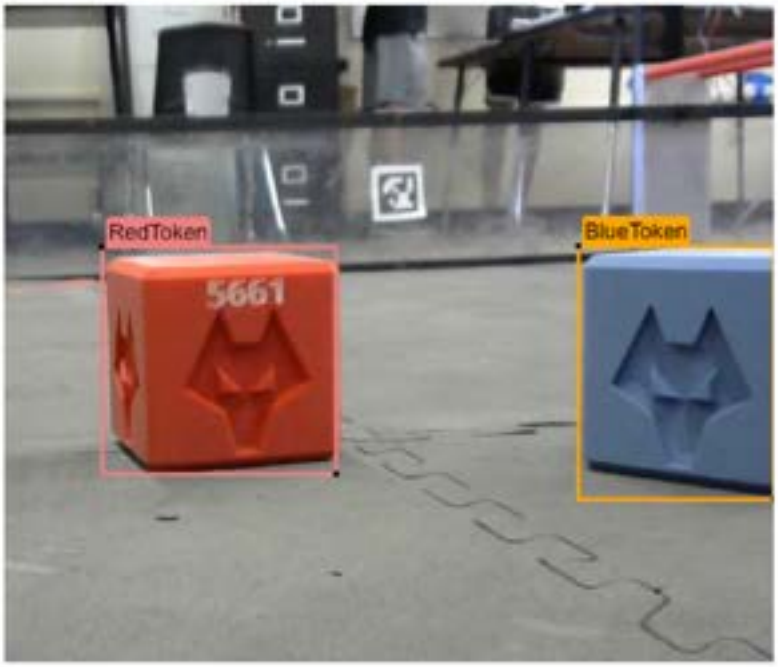
Our side panels were a synonymous fix with our airplane launcher. The lowered sides allow our airplane to stick out a little more. This should allow our plane to launch correctly more times, and is a cool flashy idea for our robot that helps incorporate the A in STEAM.



BASIS JAVA BEANS LAB HELP

One of our members, James Bennett, had told us that we would be having some visitors to our lab. The BASIS Java Beans team had contacted us and had asked if we had space in our lab to work on their bot and also to borrow our field. We graciously told them they could use our field as needed to help prepare for the "Valley of the Sun" qualifier that was quickly approaching. They were able to get a lot done and figure out what they need to fix faster.

AUTONOMOUS



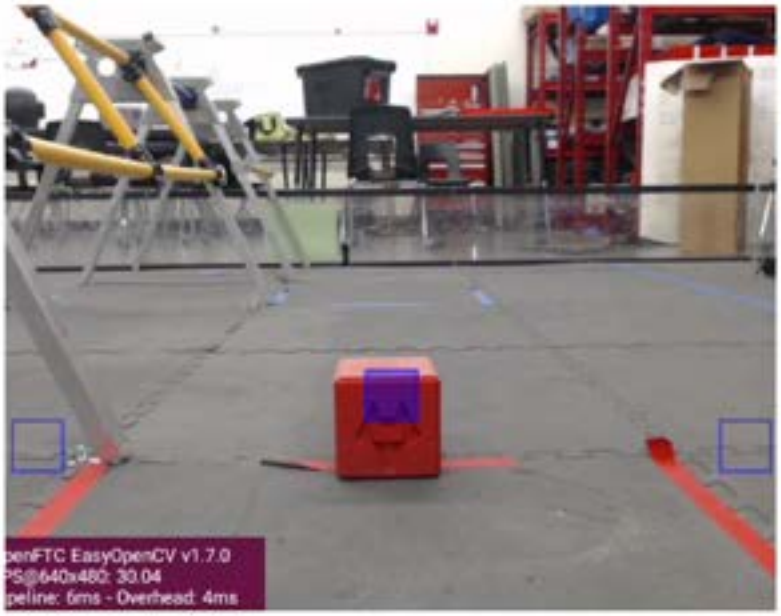
TensorFlow

This season we've chosen to incorporate a lot of new software to enhance the driver experience and make an efficient autonomous. One of the core systems needed for autonomous is one to recognize a team prop.

Our original idea was to use TensorFlow for prop recognition, however, we found it to be slow and time-consuming to train.

OpenCV

In its place, we've opted to use a simple OpenCV algorithm. This takes in camera input from the front-facing camera and takes samples from it to determine the average color in a given area to identify the placement of the prop. The AprilTag processor and OpenCV pipeline are enabled and disabled through some simple commands to save processing resources during autonomous and teleop.



On top of using OpenCV to detect the prop and RoadRunner for pathing (discussed later), we also make use of the several AprilTags around the field. Through some math we are able to estimate the robot's pose based on the tags seen. This allows the robot to re-center itself in the appropriate place to account for any localization drift from the odometry pods.

AUTONOMOUS cont.

Another essential system we needed for autonomous was a versatile path following system. We've opted to use RoadRunner, a popular path following and kinematics library.

This new system works alongside some new sensors we're using this year: 3 GoBilda Odometry Pods and 2 Logitech C920 cameras.

Although we have 3 installed, we've opted to use 2 odometry pods for this competition as it gave us the best results with minimal tuning. Any error can be accounted for with the AprilTag re-centering.

TELEOP

Another part of our goal for this season's software was to enable our drivers to perform the best by making use of software-driven driver enhancements.

This Includes:

Automatic bot orientation for backdrop placing through PID control

Collision avoidance for the backdrop to avoid de-scoring

State management to allow better cooperation between driver and placer

Automatic slide retraction for efficient pixel placement

TELEOP CONT.

The most interesting of these enhancements is the collision avoidance. Now it may seem complicated, but with localization enabled by our odometry, detecting collision on a virtual field is trivial. Using the localization, some box collision is applied and the vector in order to keep the robot out of designated areas can be calculated.

On top of all these enhancements, we've also integrated FTCLib into our software. This allows us to control our robot with a robust, command-based system that allows for the complex actions you may see in autonomous and teleop while keeping our code organized.

Past Software Issues

Slide Control

The hardest part to work around mechanically is the dual linear slide. Because the motors are driven separately and the slides are not linked, it required some software that ensured the slides maintained their height and were in sync. This was achieved by using encoder values for both slides.

Claw Control

Based on how our intake works mechanically, it's evident that some issues would arrive with the claw. The margins for placing the claw inside the pixel deposit is tight, requiring some extra overhead maintaining the appropriate claw position by reading the slide encoder values.

Future Recommendations

Based on what we have seen this year and what we have seen other teams accomplish, there are obviously some changes to make regarding the control of the robot. The most prominent is using sensors to identify whether a desired piece of hardware has successfully completed its task. We would also like to do some more data-driven design in the future.