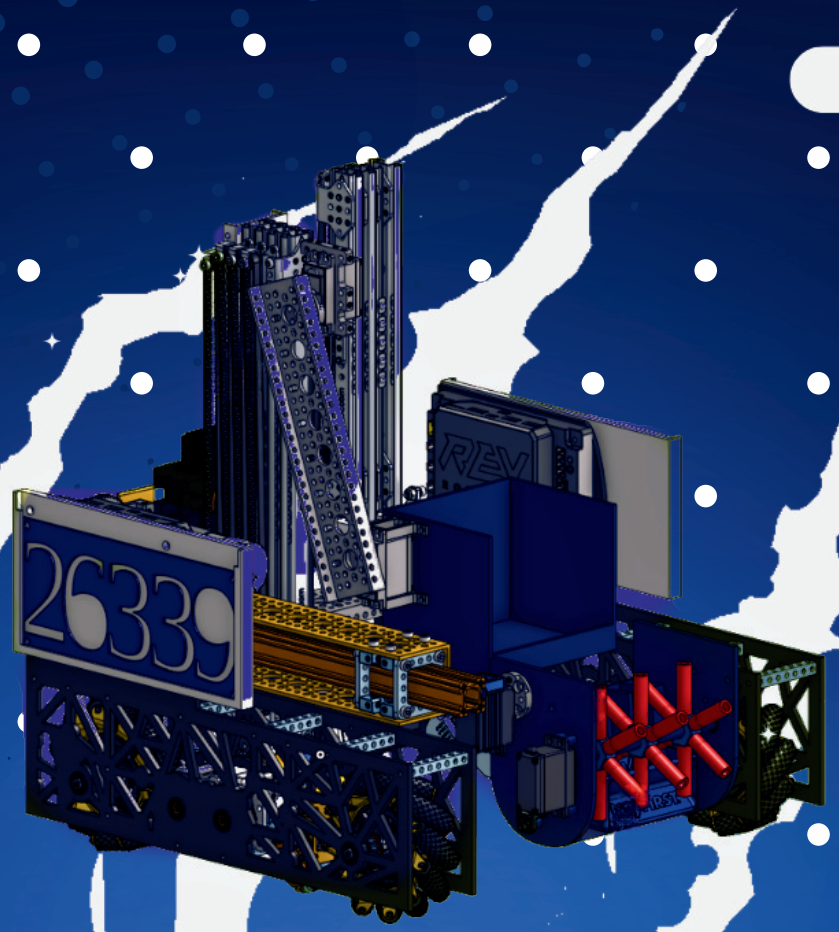


The Mittens 26339 Portfolio
2024-2025
Into the Deep

jetBlue

goBILDA
DREAM • MAKE • REPEAT

polymaker

GENE HAAS FOUNDATION

EAC madness

Underground Printing

TEXAS WORKFORCE COMMISSION

Table Of Content

Our Team

Mittens 26339 is a Rookie Community team during the 2024-2025 Into the Deep Season. Our team consists of 6 dedicated Members and 2 amazing first time coaches!

Coaches

Our two first time coaches, Yusuf and Ashley have been super supportive throughout our FTC season giving up their time to help our team with technical and moral support!

Members

Muhammad - Captain. Loves every role equally!

Anderson - Main Builder and Designer. Way too good at building for his own good!

Zeynep - rookie member with great building potential.

Mikhail - Media and Machinist

Norbert - Fill for build, media and documentations

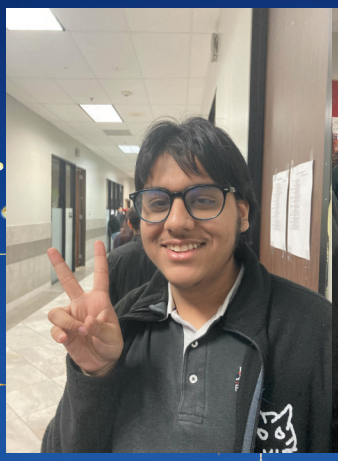
Ihsan - Mentor Builder

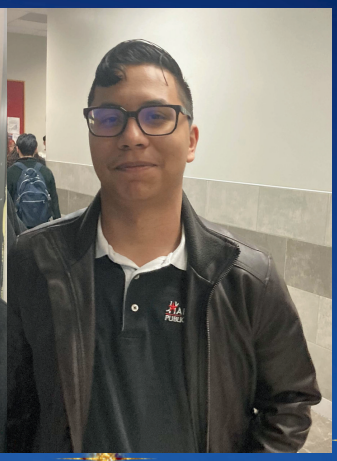
Future Plans

After a fun Rookie year as a rookie team we plan to continue our robotics team and invite new members to join and participate in FTC. We have gotten requests for people to join as well as potential sponsors for next year making it highly likely for us to join the 2025-2026 year even stronger!

Our Team

Muhammad Khan:
About: Captain of the team, focuses on programming but also designed helped with Outreach. Main mentor of teams that we didn't physically communicate with.
Favorite thing about robotics: A working autonomous code
Fun Fact: Once took 30 minutes to unscrew two screws but can also contribute towards the mechanical side of the Robot



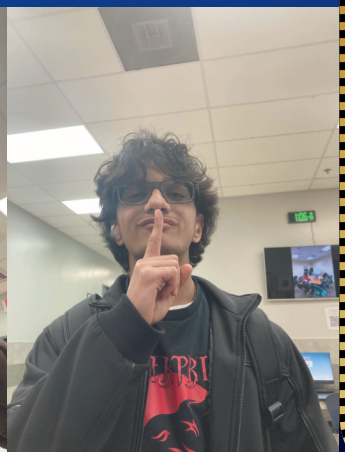


Anderson Rojas:
About: Lead Builder and Lead Momentum Mentor, Manages to fix things a little bit too easily. Builds subsystems in single days.
Favorite thing about robotics: Watching the robot not fall over (Successful iteration of a fully built robot.
Fun Fact: Once Mentees worked on a part for 2 hours and he came and fixed it in under a minute, quite the lesson

Ihsan Cizmeci:
About: Second builder and mentor builder for momentum.
Favorite things about robotics: Machining/cutting parts using big machinery.
Fun Fact: Manages to do 10 hours of work in 30 minutes and 30 minutes of work in 10 hours.

Vuslat Zeynep Ozturk:
About: Rookie Builder and emotional support for veterans
Favorite thing about robotics: Learning everything she can about robotics
Fun Fact: Managed to break so many weird things such as screw heads that managed to leave even the veteran members/mentors baffled!

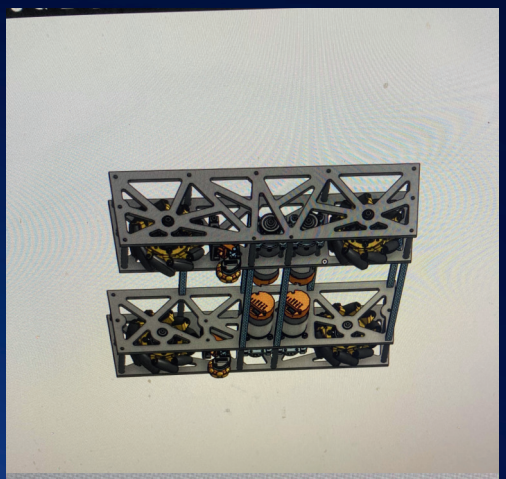
Norbert:
About: Lead Media and build assistant.
Favorite thing about robotics: Spending his free time with the team helping them build subsystems no matter how small the task may be!
Fun Fact: Changed roles from technical to non technical so many times he's an all rounder assistance at this point.



Mikhail Master:
About: Lead PR and Outreach.
Favorite thing about robotics: Spending time learning from mentors about how robots work even while having not being a part of the official build team.
Fun Fact: Sometimes reschedules life in order to be present for machining/soldering/anything that big and scary really.
Has the ability to find any part in the workshop no matter what.

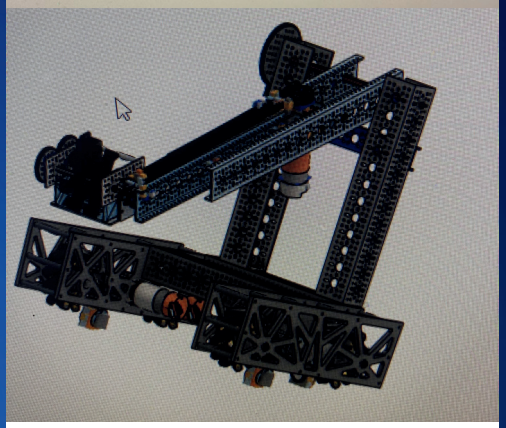
First Design and iterations

Beginning of the year we saw the kickoff event and began drawing and CADding potential ideas for the robot. We start with materials on hand for 1st designs, 9/7/2024.



First Build

Finished Building the first robot design with about 2 weeks for programmers to code. Works consistently but was slow because of how much time it took to move the arm, 11/1.

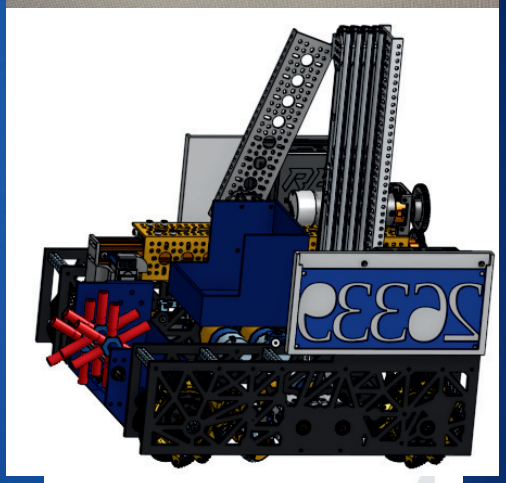


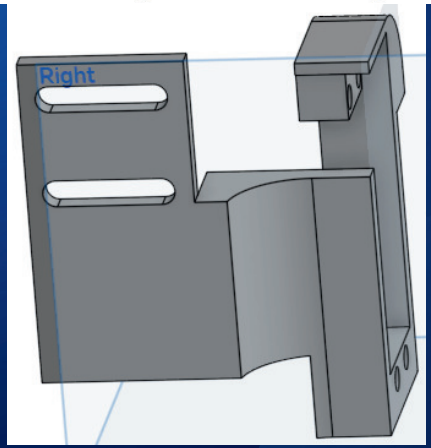
First Meet

We saw our flaws in our robot and decided to start working on a design. We chose to let our current robot as is for the next two meets to improve our chances at qualifications, 11/16.

Redesign

We improved many aspects of our robot namely moving from the arm design to an extension and a transfer system to a linear slide making out robot more stable through a better center of mass and no longer needing to extend too far out. Additionally we moved the hubs to the side of the plates for better wiring and wire access, 1/14/24.





Coding

Tested the coding and found some issues with the mechanical that could be improved such a better servo mount for our intake, 1/25.

Ready for qualifiers

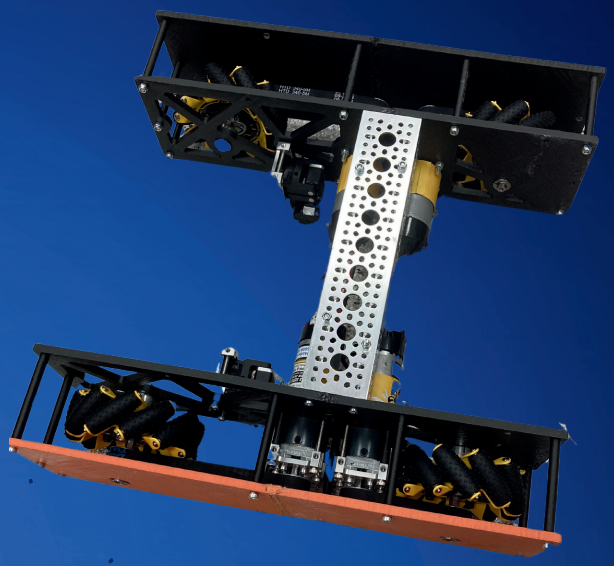
Robot working, portfolio done, members excited, fans zealous! Everything ready to go!!!

Engineering Design Process

Chassis

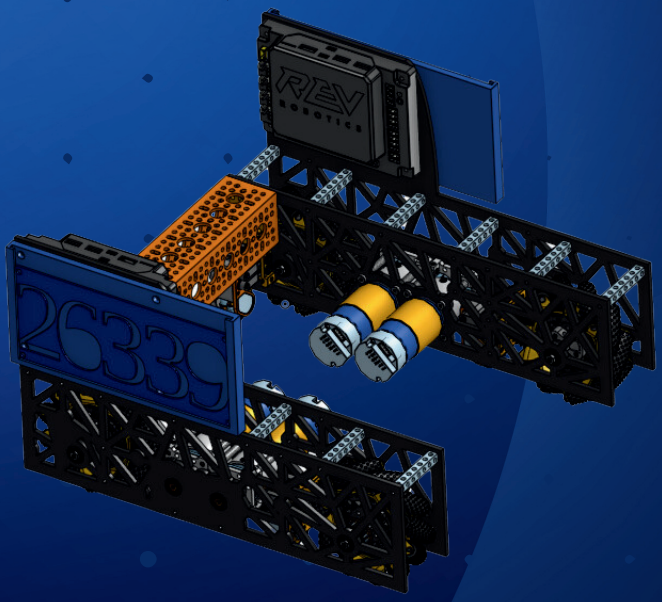
Parallel plates

Pros: Compact motors, customizable holes to mount attachments, 3d printed so can be cheap to modify or replace, kept the stable enough to run it for 2 league meets.
Cons: Weak so it cracks/bends easy, version1 of the chassis had the wheels rubbing on parts, no space for odometry pods, 80 mm width on each side for plates alone, little tolerance so we needed to put the odometry pods on the outside.



We decided to modify our parallel plate Mecanum Chassis to carbon fiber because:

- **Center of mass is closer to the center of the robot**
- **Customizable direct mounting positions for heavier hubs and attachments directly mounted on the plates**
- **Sleek looks and stronger resistance from machined carbon fiber**
- **Only 55mm width**

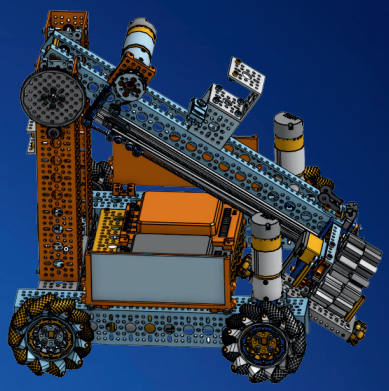


Engineering Design Process

Initial Scoring Mechanisms

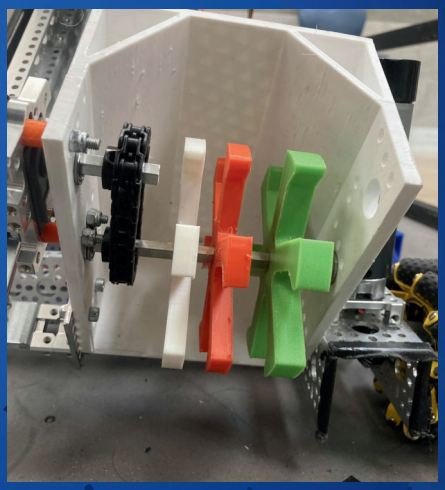
Initial Design: Swinging Arm mechanism

Pros: Simple to build and code, consistent scoring, Parts came as kit from Gobilda, Ability to do high basket and hang.
Cons: Needs driver precision, Slow cycle speed, Shaky and sometimes tips over at high speeds, can't do specimen.



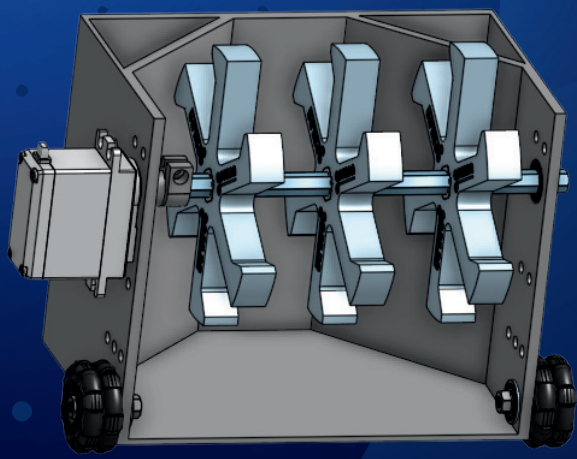
Intake V1

Pros: 3D printed so iterations were easy, reliable, easy to pick up samples, Box design so samples couldn't fall out
Cons: Barely fit samples, broke a few times, Wheels were placed too low so samples wouldn't go in all the time



Intake V2

Adjustments: Wheels placed higher so intake would happen faster, Intake made wider to allow more tolerance from drivers while intaking samples, Used rubber wheels instead of TPU for more grip. Used spacers to evenly space out the wheels for even intaking.

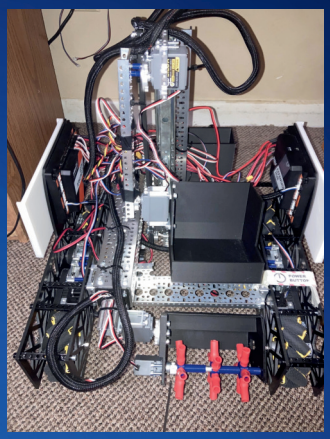


Engineering Design Process

Updated Scoring Mechanism

Modified Design:

Pros: Easier to control with set software controls, faster cycle times, didn't tip over from more balanced weight distribution.
Cons: Required more complex designing and harder to build, Less stable, Easy to break 3D printed parts, wires got stuck in the mechanism.

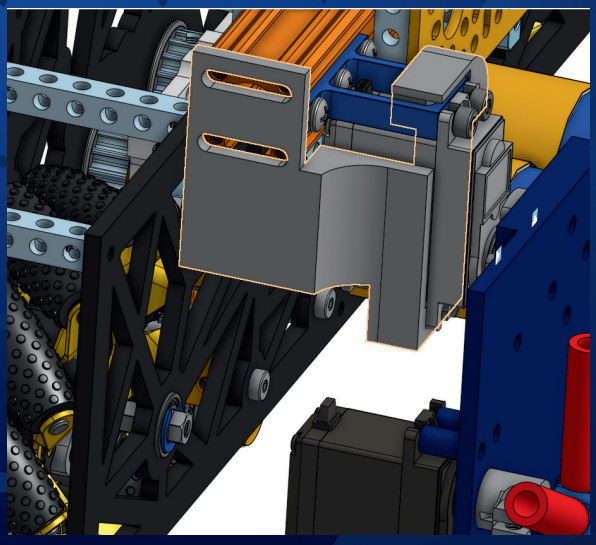


Update One:

Modifications: Cleaned up the wiring so our dumper didn't get stuck, added Loctite to the screws holding the slides so they wouldn't shake as much, Adjusted the servo cable guides to not get stuck while the linear slide retracts.

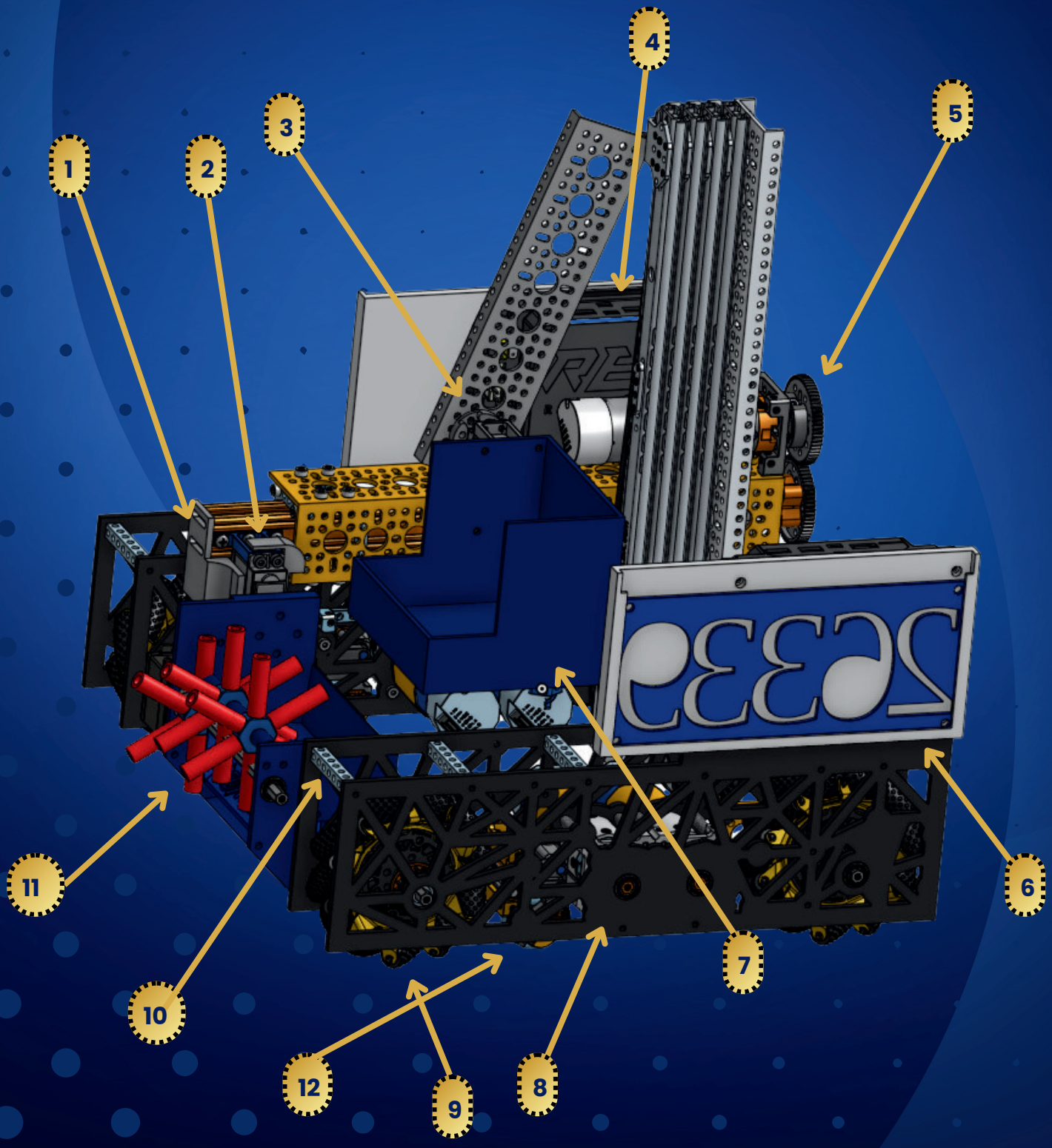
Update One:

Modifications: Cleaned up the wiring so our dumper didn't get stuck, added Loctite to the screws holding the slides so they wouldn't shake as much, Adjusted the servo cable guides to not get stuck while the linear slide retracts.
The servo for moving the intake was shaky and would fall out with the slightest bit of pressure, so we 3D printing a custom attachment that held the servo in place making intaking much easier and reliable.



Engineering Design Process

Final CAD and explanation



Engineering Design Process

Final CAD and explanation

1: Mount for the servo as without it the servo that moves our intake up and down would slide off making our intake useless. We supported the servo from the bottom and connected it to the GoRail for stability. Also increases intake stability

2: Servo using set positions to lift our intake up to transfer samples or take the intake down to pick samples from the floor.

3: Servo connected to the dumper and powered to allow the dumper to be set to a specific tested angle and not worry about angled mounting.

4: Rev Control and Expansion Hub mounted on the side of our parallel plates for easy access and organizability of wires. Additionally it also saved up space towards the center of the robot where we initially placed it allowing us to use that space for our transfer mechanism

5: Linear actuator used to send out our intake to be able to pick up samples from the submersible zone. We chose to use an actuator over a linear slide as the GoRail found in the linear actuator serves as a way to balance the intake through the use of the custom servo mount as described in explanation one

6: Number plate used as an identification of our robot. However these plates are not just for aesthetics. 4 Screws go through these plates that interconnected through the control hub and keep our robot nice and properly assembled allowing us to be, competition legal, have a robot identification and keep our robot together all at once!

7: Dumper used as our main scoring mechanism. It is powered and set to a specific angle by a servo as shown in explanation three. A servo spins the channel it is connected to and allows us to essentially dump samples into the high basket.

8: We replaced the original 3D printed parallel plates with machined carbon fiber plates given by our sponsor CNCmadness. This proved crucial as after we replaced our chassis we realized that not only has our mechanism stability increased due to strength but that our 3D printed chassis started cracking and was about to give up. So far since we've swapped over to carbon fiber plates we had not received any issues related to that!

9: We chose mecanum wheels for holonomic motion connected to our motors via belt and pulley systems for keep our weight from the motor close to the center.

10: We used beams between our plates to hold them together as those beams are threaded and allowed easy and tight connections.

11: intake wheels made by latex tubes for custom sized intake wheels that had amazing grip compared to our TPU intake wheels that would struggle to properly intake a sample

12: Odometry wheels used for tracking robot location for precise autonomous. We decided to put the pods in between our two parallel plates as it proved to be a safe way to ensure that nothing came in the way of our odometry pods tracking the robots position

Software Control

Autonomous

For this year's autonomous we decided to use roadrunner with odometry wheels to ensure our consistent autonomous to score 4 samples!

Implementation

By using roadrunner we were able to implement a closed loop PID tuned drive system to accurately move across the field to pick up and score elements. Odometry or "dead" wheels were places on our robot to track it's movement in the X (sideways), Y (front & back), and theta (rotational) directions. We fed this information back to our program which spontaneously updated the amount of power each motor would receive in order to get to our destination smoothly and in the right time. Using this we were able to set a location right in front of the basket that our robot would attempt to reach every time is got a sample, run a routine to lift the arm, dump the sample and retrieve another one. Each time we scored our robot would move to one of the pre placed samples on the field and using our transferring mechanism would obtain another piece to score. Using this method we were able to gain 64 points from scoring then another 2 points by parking in the observation zone all within the thirty second timeframe.

Visualizing

We used the Pedro Pathing visualizer to represent where and how our robot would move throughout our fields through plotted points and lines.

Improvements

Some improvements we'd like to make are:

- Adding path correction so our robot can still score even if accidently interfered with.
- Increase speed efficiency to score more samples
- Tune our robot better to have less errors due to some slight error margins having a chance to not score properly.

Software Control

TeleOp controls

For our TeleOperated section for our robot we decided to implement an automatic system for our robot to move to certain positions in a certain order. By doing this we can easily have the drivers change between what "phase" the robot is in: Intaking, Transferring, Lifting, Dumping and Returning. By running these phases our drivers have an easier time not only driving the robot but also communicating with each other on the loud, distracting field in making critical decisions through the match.

Driver Controls

1 = driver 1
2 = driver 2

Returning 2

Lifting 2

Dynamic speed control 1

Transferring 2

Intaking 2

Dumping 2

Strafing 1

Turning 1

Forward and back

Non-Technical Outreach & PR

Outreach

This year our teams outreach has been made up of:

- Connecting with teams online
- Connecting with non robotics community, local and international about FIRST& FTC
- Connecting through social media

Guests

Our school invites guests we speak FIRST to, including:

- Governor of Texas
- Indonesian Ambassadors
- Steam Festivals targeting Parents, MS and HS students and teachers
- District Admins
- NOV company ambassador
- Future robotics students

Presenting FIRST to Indonesian ambassadors

Social Media

We connect with out fellow teams and communities through our Instagram. This season we have reached over 10,000 accounts and gained 50,000 collective views. Additionally we communicate with our fellow teams whether it's technical or just motivating each other. We also sometimes connect with teams in one on one where we discuss our diverse experiences in FIRST. Our outreach reached five continents, North America, South America, Asia, Africa and Europe.

Sustainability

Company sponsorship

Sustainability is a major part of being a FIRST team thus we partner with several companies for cash and in-kind sponsorships. In kind sponsorships included: 3D Printing filament for testing and iterating designs from Polymaker, Carbon fiber machined plates for our chassis from CNCmadness, Team apparel from Underground Printing and Discounted robotics parts from and finally travel vouchers from JetBlue. We also have 3 sponsors that donated over $1000: Martrans Shipping, Gene Haas, and Texas workforce Commissions!

Team Members

Being a rookie team made of veteran members our main focus was making a name for ourselves. This year we have only scouted one new high school freshmen, Zeynep, to join our team and has made great progress in learning robotics. We have additionally scouted about 8 new members who were willing to join and take over the team as our veterans graduate and become mentors. Over the years we hope to encourage new students to find their passion is STEM and FIRST.

Technical Outreach

Technical Outreach

Since the summer of 2024 our team has been dedicated to helping the FIRST FTC community in finding their place in FIRST, with building, programming, CAD and other FTC related issues, how to run a team, and other robotics related projects that take place in school and outside of it.

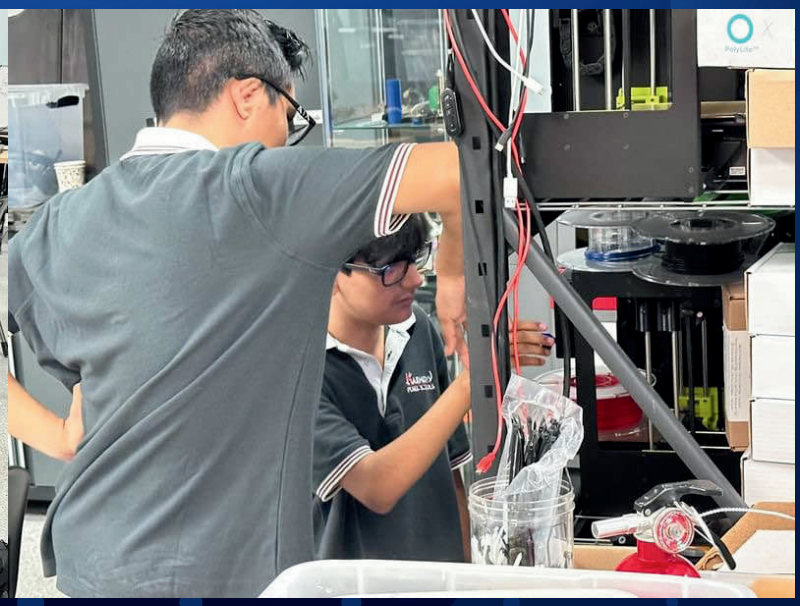
Helping others

Our team is dedicated to sending out help to other members of the robotics community. Examples of what we've done over the past year is: Assist students from HSA high school in learning many skills such as java, building, 3D Printing, 3D designing and so on. These don't just stay in the realms of robotics, we also mentored students who were simply interested in learning how to 3D print and use an Arduino for biotech research, collecting the data on the growth of algae, to create a foundation for them to find and explore their passion in STEM. Additionally we help teams by communicating through social media and help them resolve any issues that they may be facing. This year we have assisted approximately 20+ teams and 10 individuals outside of FIRST through social media and we hope to increase this number as the years go by!

Teams officially being mentored

Momentum - 10055
While True - 24161
I forgot - 21336. Under the Ignite Program*
.Momentum -3728 FRC*

Aside from these teams 26339 also unofficially connect with several teams regarding technical issues they may be facing and connected through the FTC discord server or FTC subreddit.



Lessons Learned

Wiring

One big issues we faced throughout many years is our wires getting damaged or tangled making our robot incapable of functioning.

Wire solution

We introduced carbon fiber cable guides to prevent wire ripping and tangling as well as guiding cables through slides without worrying about ripping.

Tight constraints in CAD

One issue we had in designing is understanding our constraints work. While designing we didn't check the full rotations of our servos and gears.

RoadRunner

Being our first year using a motion profiling software we had several issues namely, forgetting the sign of the values (+-), how generated paths lined up together interact, acceleration and velocity limits and physical chassis issues affecting out software tuning.

Automation is key

Towards the beginning of the season we didn't focus on making it as easy as possible for drivers but rather decided to work on mechanical consistency which made it harder for drivers to get the mechanisms in the perfect orientation. Then after the redesign we decided to work on automating driver controls through software controls making driver two only need to click certain buttons once for the mechanism to run on its own!

Connect with teams

This year we made the effort to connect with multiple teams across the globe. By meeting up with people from different regions, leagues, nationalities we were able to open ourselves into a diverse environment that FIRST has created. Meeting these teams has truly opened us to some new creative ideas!

Stability

In our earlier designs we only powered our mechanism from one side of the of the mechanism leading to the gears slightly bending as over 100kg-cm of torque entered the mechanism. Our initial idea to fix this was to add a second motor from the other side to counteract the force entering the mechanism from one side but decided to scratch that and move into a mechanism that didn't factor sending power to a long axle and risking bending. Additionally our current CNCed parallel plates suffered with instability due to the channels being placed parallel to the floor allowing the robot the bend outwards leaving our autonomous tuning impossible as the state of our chassis would shift by a large margin. To counter this issue we went back to our good friend zipties and interconnected the plates holding the chassis together at one angle.

Funds make life easier

In the past years we've only relied on the funds that our school gave us to keep our team running. However once we moved on as a community team apart from our school we decided to emphasize our economy as budgeting for parts, registrations and any other fees that might come our way was crucial if we wanted to thrive as a FIRST team. After maximizing our budget through sponsorships we realized that having access to companies that were willing to support our journey through in-kind and cash sponsorships made it easier for us to go through several iterations of a particular design knowing well that if we ever needed to fall back and redesign a subsystem our partners were more than willing to support their sponsee.

Fundraising

Past few years we struggled to make good robots due to money constraints so this year we emphasized grant apps and sponsorship emails and raised over $7000 in cash and in-kind sponsorships helping us get as far as we have this season.

Testing

In previous years and and first meet we never did a thorough driver test to see how our robot would act on the field leading to unexpected issues arising due to mechanisms not acting in their Ideal conditions. Now we eliminated that thread of unexpectedness by making sure to simulate actual games played at our workshop

Final thoughts and Plans for 2025-2026

Community Engagement

One of the many things that our team enjoyed throughout this season was the extra attention we had put into our community. After starting a team social media account we began connecting with even more teams all throughout the world. Before this we had only been active for technical reasons leaving us only "mentoring" other teams but now we have opened ourselves to connect with more teams with a purpose beyond building robots but to spread the love of FIRST together. As we continue our next seasons we intend to lend a hand and work together with several other teams to push the boundaries of FIRST together!

Community STEM

Along with FIRST we intend to expand our scope to more than just a high school competition. Our team has already pledged to mentor our schools biotech projects led by one of our teachers and experimented by high school students. By using our technical skills and their knowledge of science we plan to maximize what we can learn from and teach to others whether it be directly related to robotics or touching the outskirts of STEAM.

Mentoring FTC Teams

A big part of our season was helping other grow. We have helped many teams including one being a part of the same league being 10055 momentum. We had a great time teaching them the basics of robotics and helping them create their own robot starting from design to building to programming. Along with this we have dedicated our time to teach other FTC teams similar principles usually through communicating through the FTC public threads. We were able to meet hundreds of teams from all around the world and despite us not being able to stay in contact for more than a few weeks we were able to cherish those times through our shared passion of learning and teaching about STEM.

Off-seasons

The biggest and most nerve wracking part of FTC is most certainly the off season where we see the most of the creative robots that teams have prepared and await for FIRST to announce their next big competition. We plan to attend events hosted by teams across the state made possible by our partner Jetblue. Additionally our primary focus for this off season would be scouting and training potential recruits by holding robotics showcases and events that demonstrate the highlights of robotics to students and parents alike. Finally we also plan to improve our own skills in programming, CAD and fundraising as those three subsections prove to be the most essential aspects of our team. Funds give us the opportunity to create many iterations of subsystems and overall designs. Having a proper CAD allows us to visualize our plans in a properly formatted way which allows us to ensure that the parts we buy will work with each other and not run into any issues while building. Finally our programming had been fairly shaky this year as we weren't able to implement many things such as Pedro Pathing, a community made motion profiling software, or Kotlin, a programming langauge that runs on the same bytecode as java, which would have enhanced our performance throughout the season. We wish to learn and teach everything we can about FIRST, FTC and robotics.

Mentors

Throughout our season our mentors Ashley and Yusuf have been ever so supportive in teaching us complex engineering processes and boosting moral support. Mittens had been made through the support and dedication of these mentors and we wish them the best of luck in their outside of robotics activities and hope to gain more mentors as we connect with more FIRST alumni's in our region.