Team 22985

PARADUCKS

Mumbai, India

FIRST TECH CHALLENGE

CENTERSTAGE PRESENTED BY RTX

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Introduction

This is team 22985, the Paraducks. We hail from Mumbai, Maharashtra, and range from ages 12 to 14. We all belong to various schools such as Ascend, Don Bosco and more, yet we were united together by an organization called TIS (The Innovation Story). Our team belongs to a legacy created by the Paraducks the year prior, our team now hopes to reach levels of greatness not seen before, completing our duties as successors to the Legendary name, Paraducks whilst focusing on our motivational motto; Quacking Smart

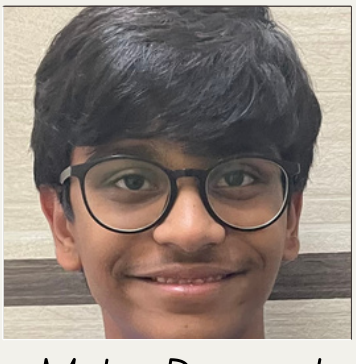
Meet our Team!

Kiaan Shah

Hello I am Kiaan Shah and I am team captain. I study in Don Bosco International School. I am very excited to participate in the competition, and I think my team can win this. I am very grateful to be in the paraducks team and there are very fabulous and skillful members. My role is the human player and the backup driver.

Hello, I'm Shiven Shah. I am a student at Ascend International School. I am the operator of this team. I am thrilled to be taking part in the competition, and I believe my squad has what it takes to win. Being a part of the Paraducks team makes me very happy, and its members are incredibly talented.

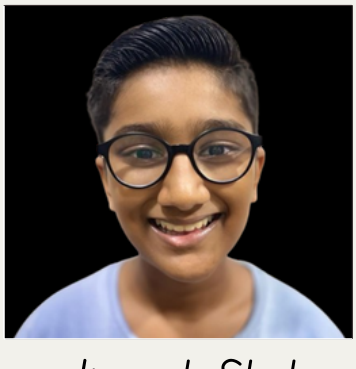
Shiven Shah



Mahir Ranawat

Hello, I am Mahir and I study in JBCN International School Parel. I am the driver of this team and I am determined to win FTC 2024. I have participated in other robotics competitions so I have some experience in this field. I am very happy to be in team Paraducks with the best members.

Hello!, I am Jinansh Shah, enrolled in Grade 8 at Don Bosco International School. I am enthusiastic about participating in the upcoming competition as a core member of the CAD design & assembly team. I am grateful for the opportunity to collaborate with the proficient & supportive members of the Paraducks team.



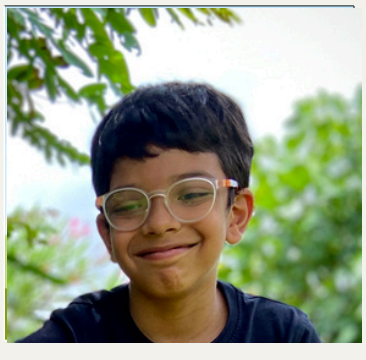
Jinansh Shah

Meet our Team!

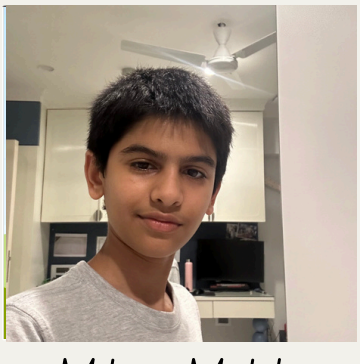
Medhansh Nanavati

Hi, My name is Medhansh Nanavati and am currently in the 8th grade. I have always loved robotics and am extremely grateful to be on Team Paraducks! I have been doing CAD for the team and working on additional documents such as this notebook.

Hello! My name is Kahaan Shah, and I'm a seventh-grader at Don Bosco International School. I'm a member of a skilled team of coding and CAD experts, and we work together seamlessly. My primary contribution to the team is designing a claw using CAD.



Kahaan Shah



Mihan Mehta

Hey! My name is Mihan Mehtal study in The Cathedral and John Connon School, Mumbai. I am very excited to participate in the competition, and I think my team can win this. I am very grateful to be in the Paraducks team and there are very fabulous and skillful members. My role is being a programmer.

Hello, My name is Nirvaan Doshi and I am doing CAD for our team. I am a student at Ascend International School. This is my first time doing robotics, and I am thrilled to participate in this robotics competition. I believe our team has the talent and determination to win!

Nirvaan Doshi

Meet our Team!

Shivin Shah

Hello, I'm Shivin Shah, and I study at the Ascend International School. I have joined the Paraducks team in hopes of developing my skills in CAD and enhancing my skills in working as a team. I am the head of photography and manage the social media. I am extremely grateful to participate in the FTC completion along with many talented peers. My role in this team is a CAD Designer for the robot.

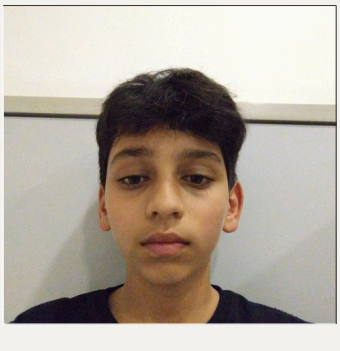
Hi, my name is Aman. I study at the Cathedral and John Connon School. I joined Paraducks to enhance my CAD skills and to gain experience in building a robot. I am determined to win FTC 2024 and am willing to help out my team in any way I can.

Aman

Zidaan

Hi, I am Zidaan. I am in 7th grade, at Ascend International School. I find coding interesting and have done a few other different types of coding, which have been fun. I am happy to work with all the skilled members at Paraducks. My role is a coder.

Hi, my name is Vivaan. I am 13 years old and study at Hill Spring International School. I enjoy coding and joined Paraducks to enhance my coding ability. I am grateful for the opportunity to work with many other skilled members. My role is a coder.



Vivaan

Vedanth

I am a seventh-grade student studying at Ascend International School and my age is 12. I've always had an interest in building Lego bricks and experimenting with new things, such as coding. I'm currently an active member of FTC Paraducks, where I hold the role of a coder, and I look forward to expanding my knowledge in this field.

Aadya Sachdeva
Hi, my name is Aadya Sachdeva, i am 13 years old and I study at Ascend International School. I am in programming and have enjoyed robotics so much and I am very gratful for the oppurtunity to be apart of the team, I believe that we have the determintation to win.

Aadya Sachdeva

Our Mentors

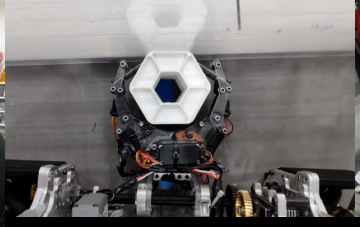
Siddhi Sawant

Shruti Pandey

Manav Mepani

Our Vision

Although we may be amongst the youngest teams this year, Team Paraducks is eager to take on any challenge we encounter in the FTC. As newcomers to this competition, we recognize that we have much to learn and improve in our design process. Our past mistakes have served as valuable lessons, helping us to grow and enhance our skills. Our primary objective this year is not solely to win, but to learn from this experience and reach our full potential. The members of Team Paraducks express our deep appreciation for this opportunity.

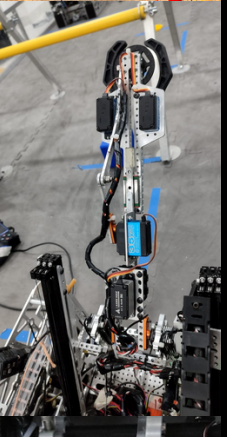
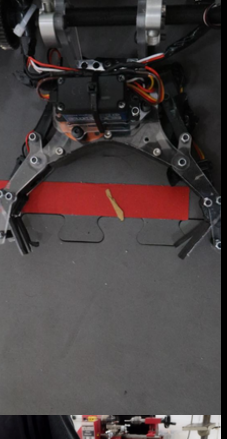
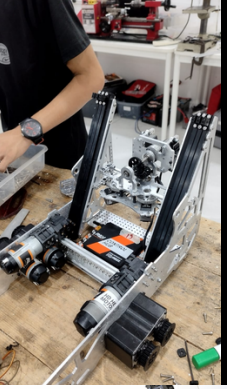
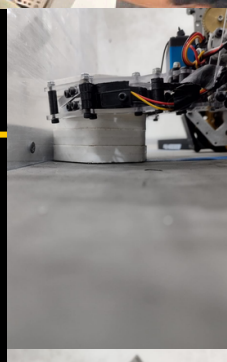
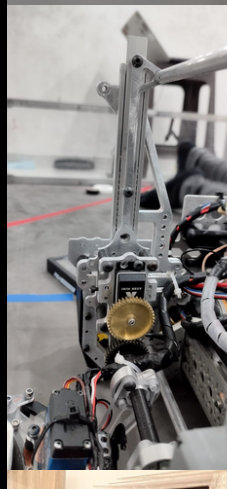


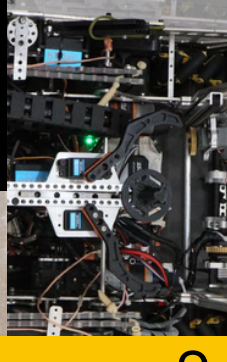
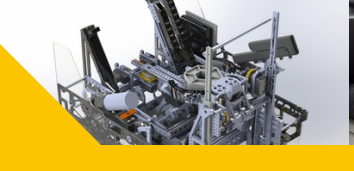
Our Journey

Team Paraducks distinguishes itself as a unique assembly within the realm of competitive robotics. Comprising fourteen students in Grades 7 and 8, our team embarked on the FTC journey in late June 2023, having been strategically united by The Innovation Story as their youngest team for the year. The ensuing adventure involved delving into the intricacies of constructing and programming a sophisticated robot, a process that proved to be both challenging and enlightening.

Hailing from Mumbai, we eagerly anticipate our participation in the Indian FTC Championship. Crafting the robot emerged as a highlight, providing us with invaluable hands-on experience and insights into the meticulous construction of a capable robot. This immersive process shed light on the substantial effort and time required for success in the upcoming tournament. From meticulous wiring sessions to fine-tuning the bot to match the drivers' preferences, we confronted challenges that demanded us to delve into advanced mathematics to comprehend the intricacies of coding.

Following the completion of the bot, our workload intensified, with drivers engaging in constant practice and the rest of the team diligently working to meet deadlines. Amidst the chaos, we forged numerous amusing memories, making the journey a delightful experience. From the outset to the conclusion, not a single day passed without laughter and enjoyment, yet the journey was not without its lessons—we gleaned significant insights that will undoubtedly serve us well in the future.

Sustainability Plan

Embarking on our inaugural year in the realm of FTC, we find ourselves in the midst of a transformative and exhilarating journey. As newcomers to this dynamic field, each day unfolds as an exploration into the intricacies of FTC, providing us with an invaluable learning experience. The challenges and discoveries that accompany our nascent journey contribute to a deeper understanding of the intricate world of robotics and competition. Despite being novices, the unfolding adventure has proven to be nothing short of amazing, laying the foundation for our growth and proficiency in the years to come. This initial foray into FTC has not only broadened our perspectives but also fueled a genuine passion for the field, making this introductory chapter an extraordinary and foundational phase in our ongoing pursuit of excellence.

Gracious Professionalism

With Gracious Professionalism, fierce competition and mutual gain are not separate notions.

Gracious Professionalism stands as the bedrock of our program, advocating for all participants—students, mentors, and volunteers—to engage in interactions characterized by respect, kindness, and professionalism within the competitive context. This principle transcends the notion of victory as the sole objective, emphasizing the creation of an environment that prioritizes learning, collaboration, and mutual support.

As members of Team Paraducks, we wholeheartedly embrace the values of fair play and integrity. Recognizing that success extends beyond the outcome of a competition, we value the positive influence one can have on others. Our commitment to assisting fellow participants, sharing knowledge, and collaboratively addressing challenges extends even to rival teams. This cooperative approach not only defines our team culture but also contributes to cultivating an inclusive and supportive community, where collective growth and success become shared aspirations.

Monthly Progress

June, July

We had just about started to learn about the basics of Robotics and were being educated on what FTC is, we were starting to know each other better as well. During the first month most of us didnt't improve but spent a lot of time just understanding the basics of FTC.

August, September

We had long lectures every weekend teaching us about wheels, gears and the basics of constructing robots. We also did presentations on each topic we learnt to reflect on what we had learnt.

October, November

We learnt about Java and how an object-based language works. We also split up into a CAD and a coding team and dived deeper into each department. During this month, we perfected the skills and concepts we would require to build and program a bot.

December

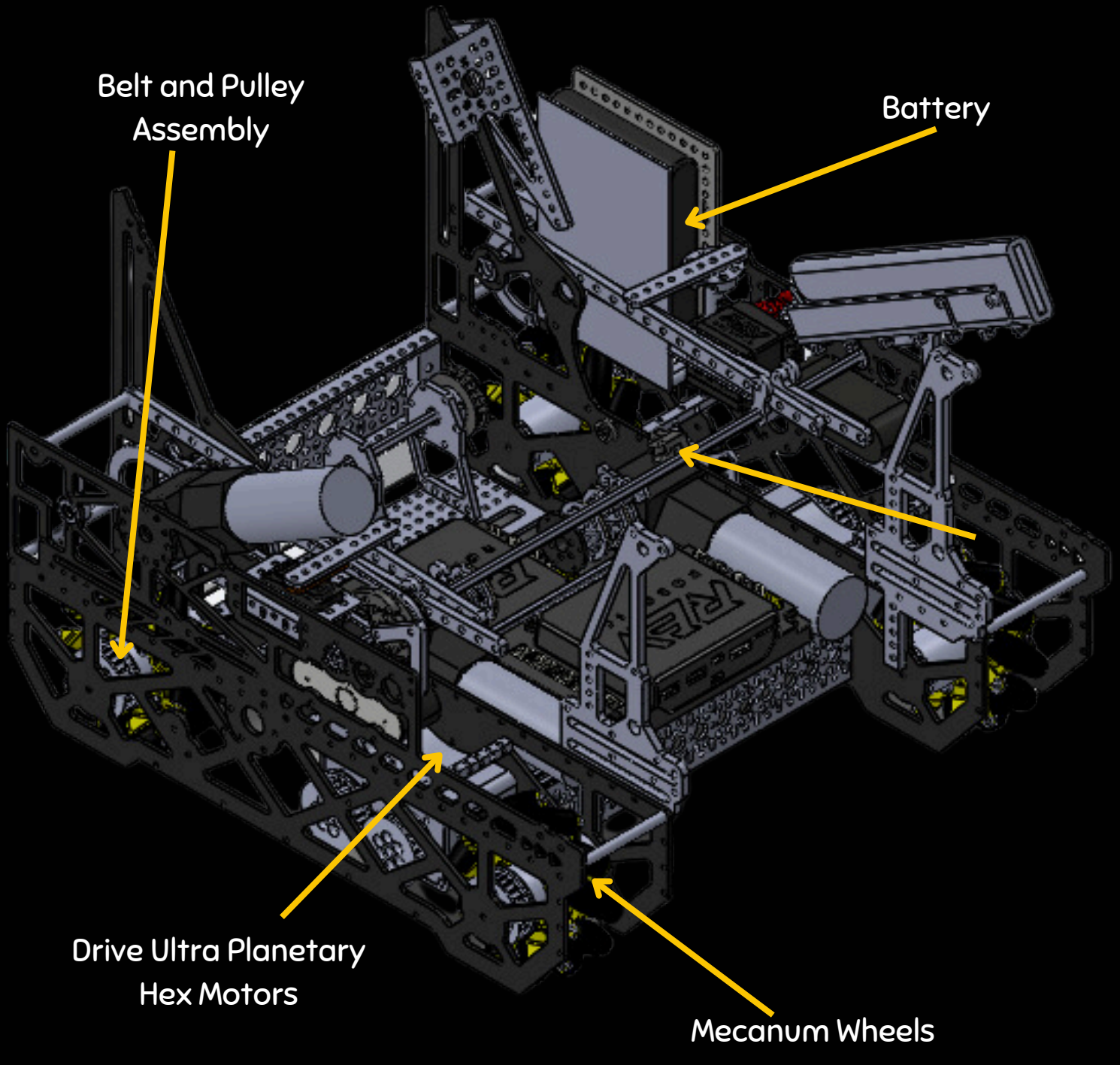
We continued learning in our departments and started to test our skills by making the basic codes and designing parts on CAD for our robot.

January

Our preparation for our regional went into full swing as we started to work on the other aspects of the competition while improving our skills and perfecting our robot. Our CAD and programming lectures took a back seat and we shifted into just coding the bot.

Design & Construction

Design Strategy - Drive



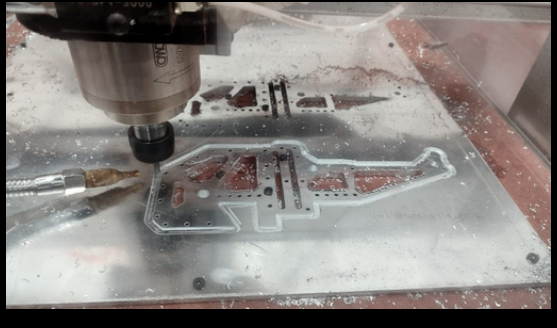
CAD of Intake

Design Strategy

DRIVE TRAIN

The chassis of the robot was made such that it gives the robot a sturdy drive and does not break down upon impact with the field or other robots. The base is a four-wheel mecanum drive which is connected using a belt pulley mechansim to the motors. We have used Rev Ultra Planetary HD Hex motors with gear ratio of 20:1.

The foundational structure of the base, comprising the plates, underwent a meticulous design process utilizing SolidWorks, followed by precision manufacturing through either laser cutting or CNC machining, tailored to specific requirements.



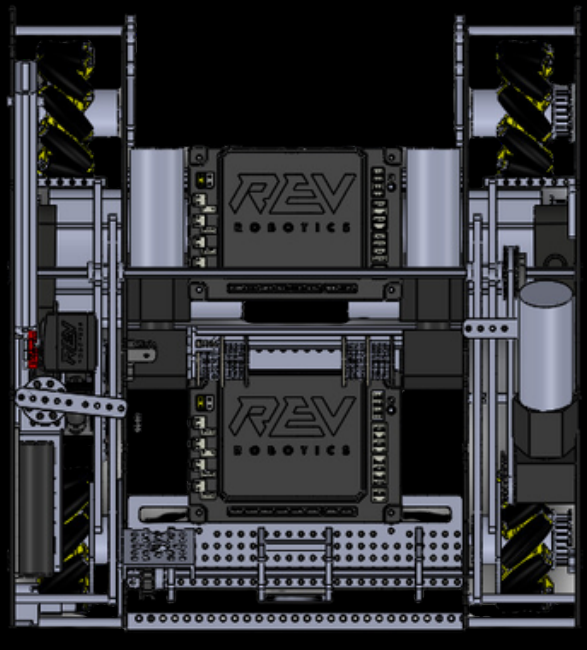
CNC Machining Of Plates

Equipped with a mecanum drive, our robot exemplifies agility and facilitates holonomic movement. Its adeptness allows for swift and seamless positional transitions without necessitating a change in its heading, demonstrating an exceptional capability to traverse distances efficiently in minimal time.

Construction of the chassis

Design Strategy

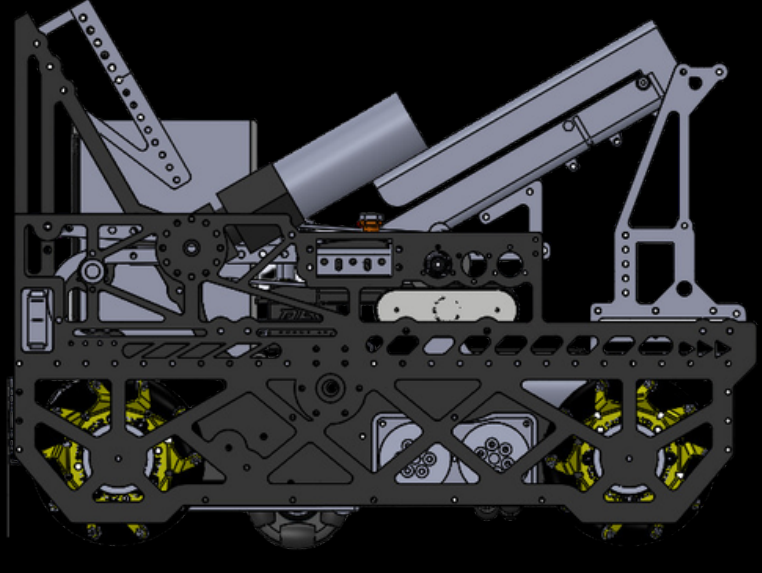
Drivetrain



Top View Of The Chassis

A mecanum drive requires all the wheels to be driven by individual motors. So, 4 motors are placed slightly behind the centre of the robot keeping weight distribution and odometry in mind. rephrase this professionally and make it descriptive

The current dimensions of our drivetrain are 15x16 inches with a track width of 14 inches. This is in agreement with the game manual and allows our bot to strafe through game elements with ease



Side View Of The Chassis

Design Strategy

DRIVE CALCULATION

W=13kg (measured)

=(13*9.81) N

W=127.53N

1

Weight per wheel. w =127.53/4

w =31.8825N

Wheel diameter. 96cm

Radius. r = 0.48m

*torque=Z

Z=r*w

=0.48*31.8825

=15.3036Nm

base motor torque. with 5:1&4:1 gearboxes

Total reduction = 20:1

Z motor=(15.3036*20)Nm

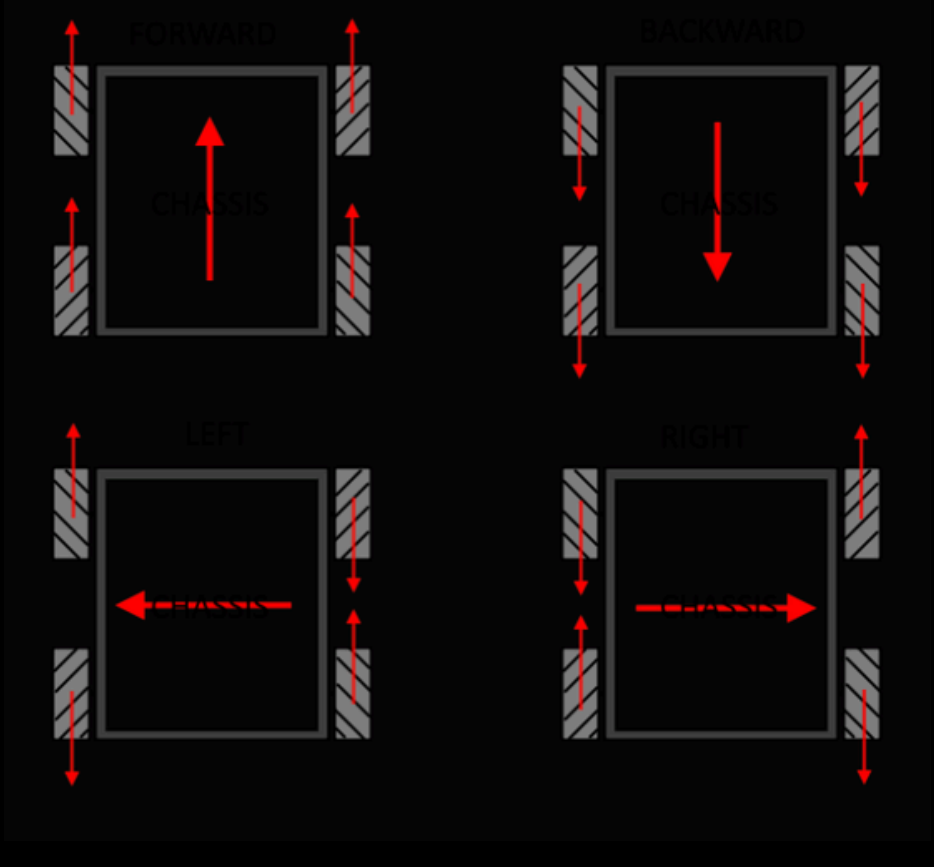
Z motor=306.072Nm

Z motor> Z required

Design Strategy

Why did we use mecanum wheels?

Mecanum wheels are a specialized type of wheel used in robotics that enable a robot to move in any direction independent of its orientation. The mechanism comprises a wheel hub and angled rollers. Typically, a set of four mecanum wheels are employed, with the rollers on either side mirroring each other. By altering the speed and rotation of each wheel, the robot can move in various directions, such as forward, backward, sideways, or diagonally. Mecanum wheels offer exceptional maneuverability, making them especially useful for tasks that require precise and agile movement, such as navigating obstacles or grasping objects from multiple angles.

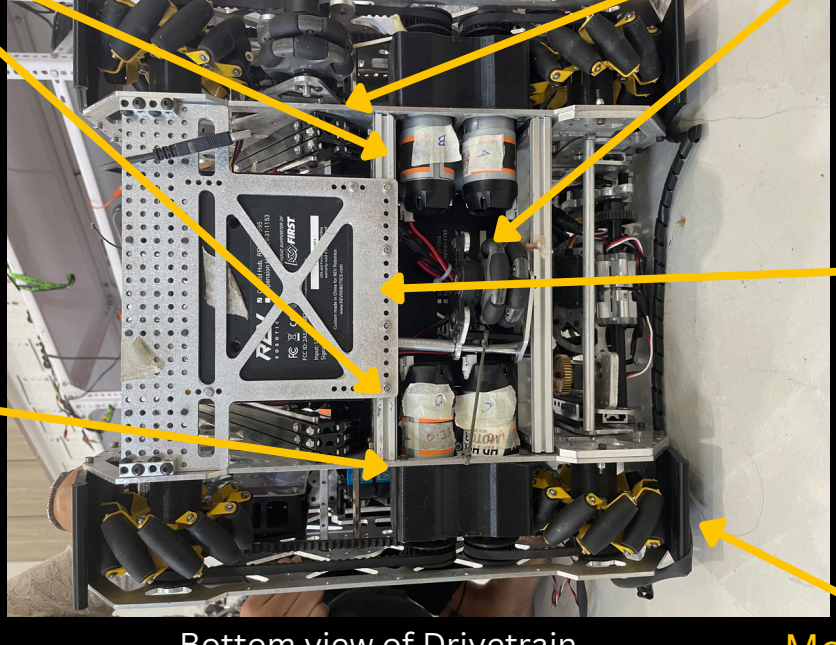


Mecanum Wheels

Design Strategy

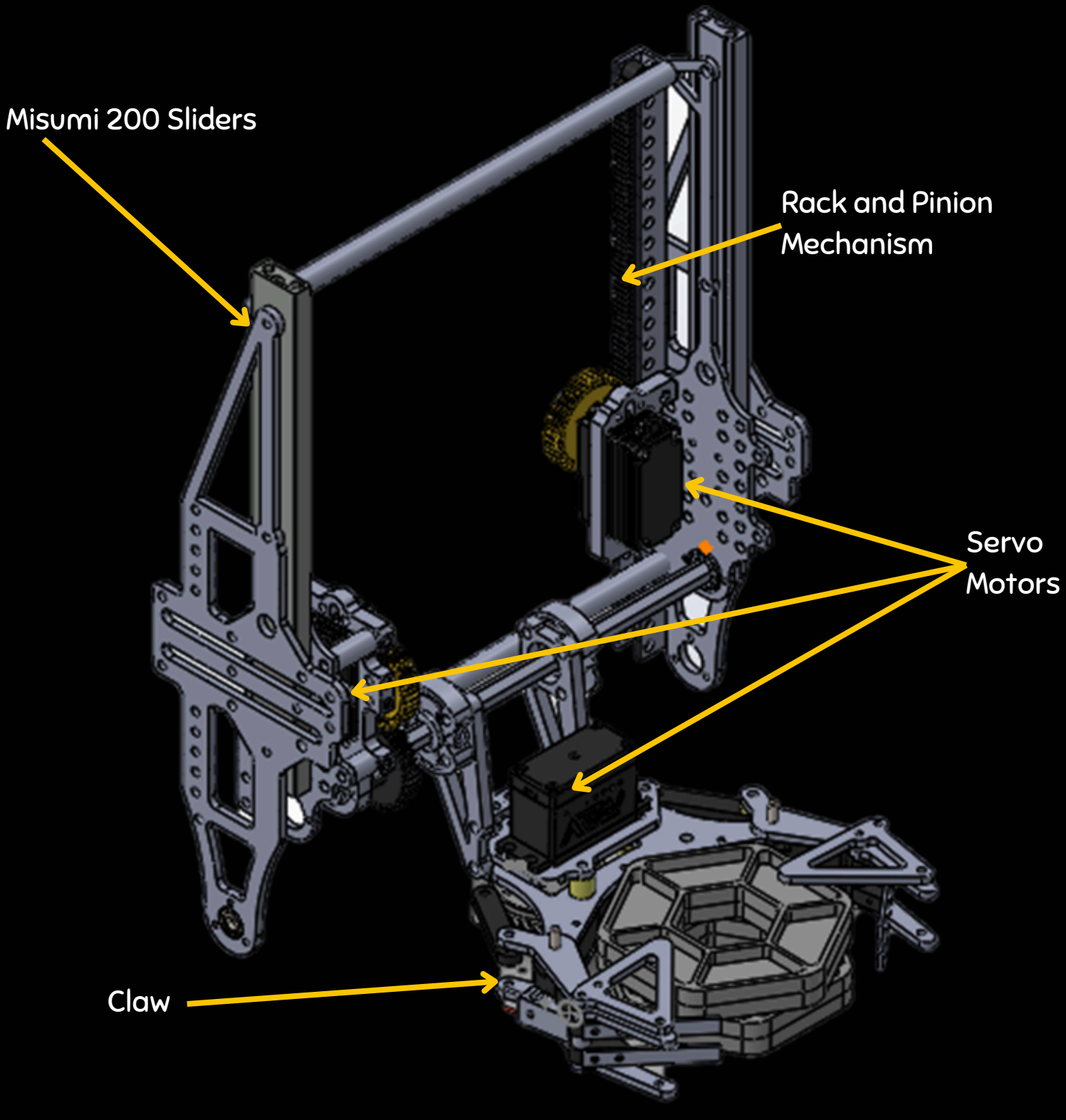
Odometry and Feedback

We have designed slots on the bottom plate of the robot for encoders. These encoders are used during the autonomous period to provide feedback to the controller and help the bot with localization.
We are using 2 external encoders attached to dead wheels over the inbuilt motor encoder for higher accuracy and to avoid the slippage and inconsistency of the mecanum wheels.
To ensure that we get accurate readings, we need to make sure that the dead wheel is in contact with the ground at all times so, we used a spring for flexibility.
A library called RoadRunner was used to develop the Drivetrain controls and get Odometry and Localization data. A two Dead Wheel Encoder setup was utilized, with the IMU onboard the Control Hub being used for Pose Correction periodically.



Bottom view of Drivetrain

Design Strategy - Intake



CAD of Intake

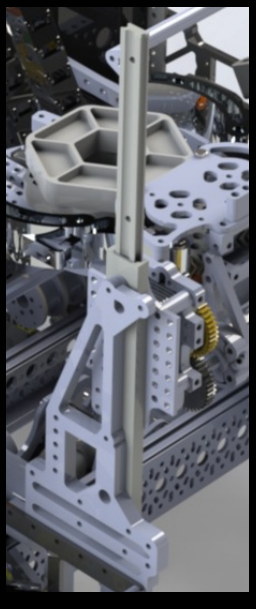
Design Strategy

Intake

Our main aim was to make the intake as fast and efficient as possible. Hence we used claws to make the pickup of pixels as quick and reliable as possible.

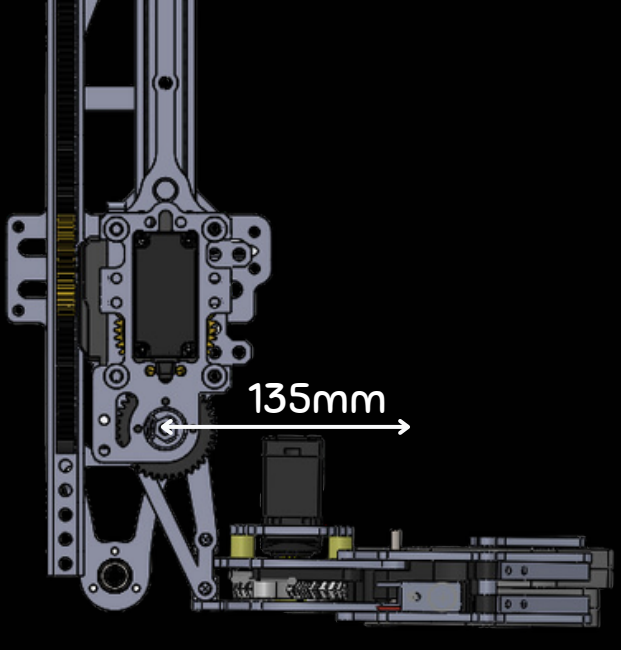
We have designed the claw to rotate 180° inside the robot to transfer the pixel to the outtake. This rotation is provided with an Axon mini servo motor.

Furthermore, we also have a unique rack and pinion mechanism that allows the claw to pick up pixels from different heights. This mechanism resulted in a faster autonomous cycle.



Rack and Pinion Mechanism

The goBILDA servo motor has been used to deliver good amounts of torque.



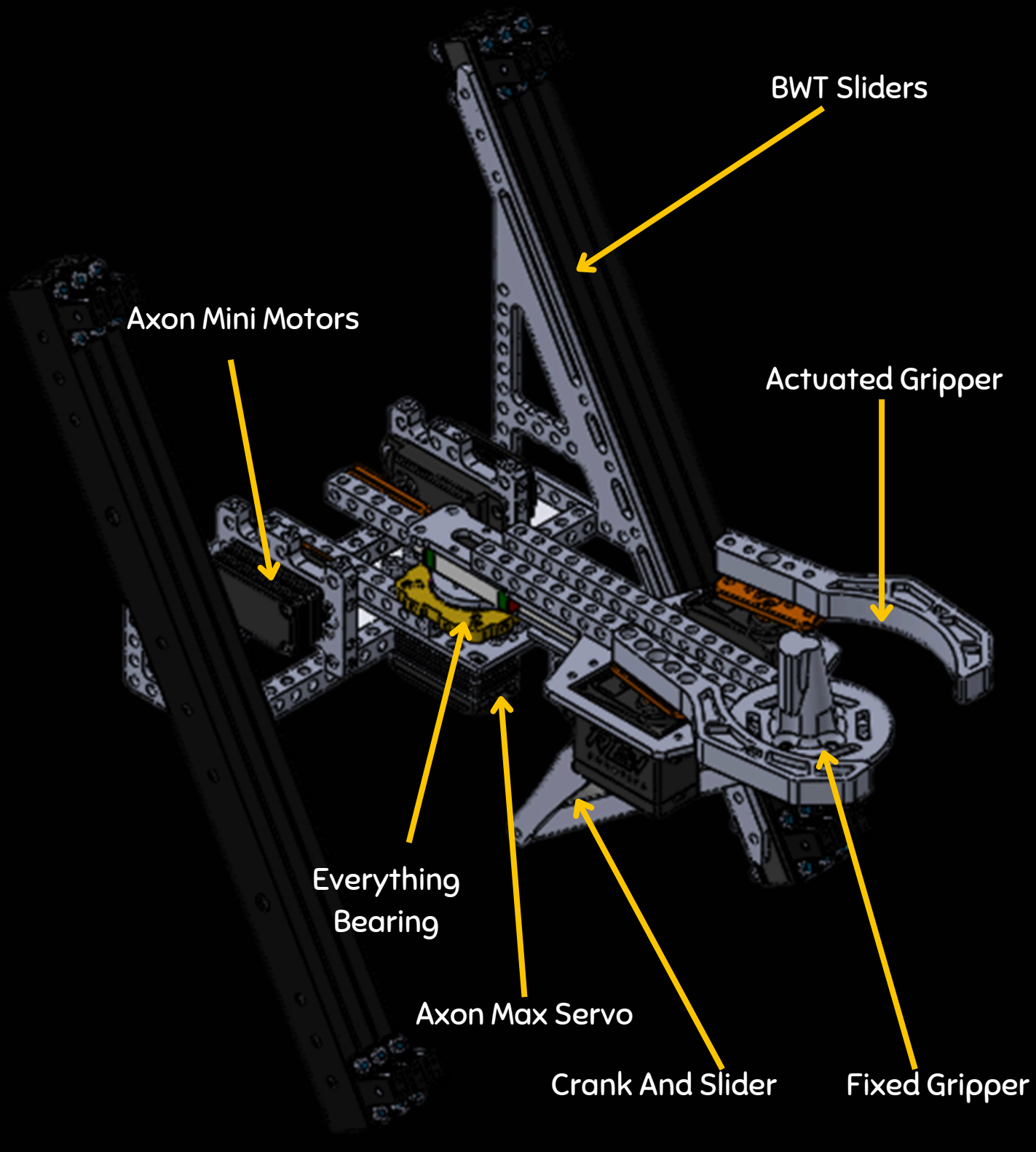
Weight of two pixels = 36g

Weight of the claw =

Torque = Force x distance from rotating centre

T = m x 135mm

Design Strategy - Outtake

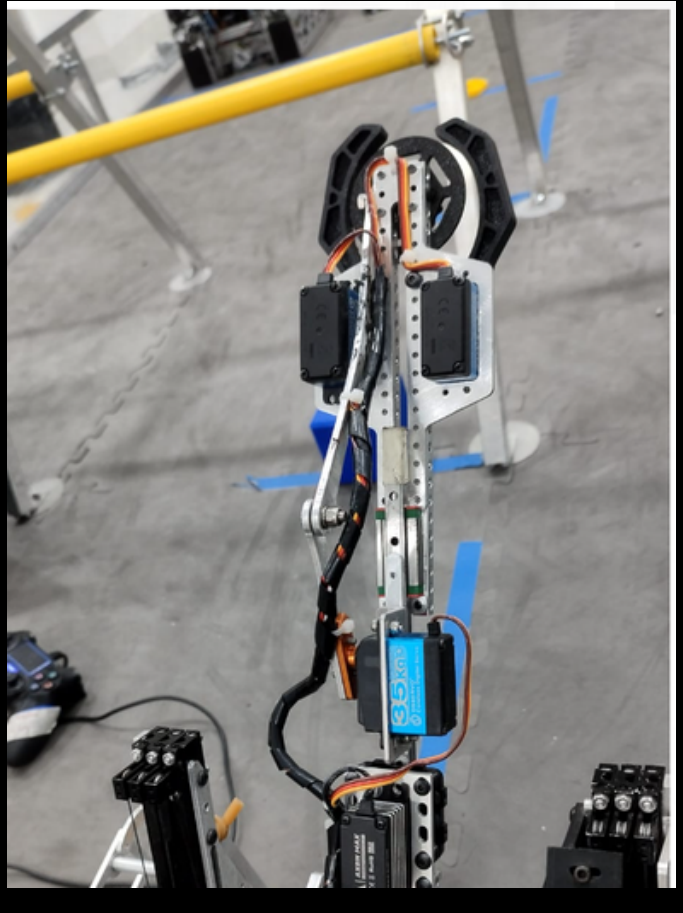


CAD of Outtake

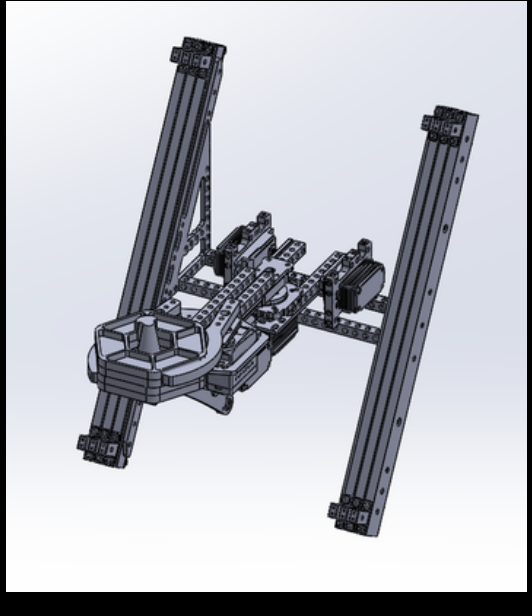
Design Strategy

OUTTAKE

- Out outtake system consists of a single arm that rotates 135 degrees to switch from two stages, the initial stage is when it collects pixels from the intake and the other stage is when it drops pixels onto the backdrop.
- We also have sliders to extend the arm up the backdrop and cross lines.
- Another servo helps move the arm left and right to make it easier to create small changes to where the pixels are getting placed.



Contruction Of Arm



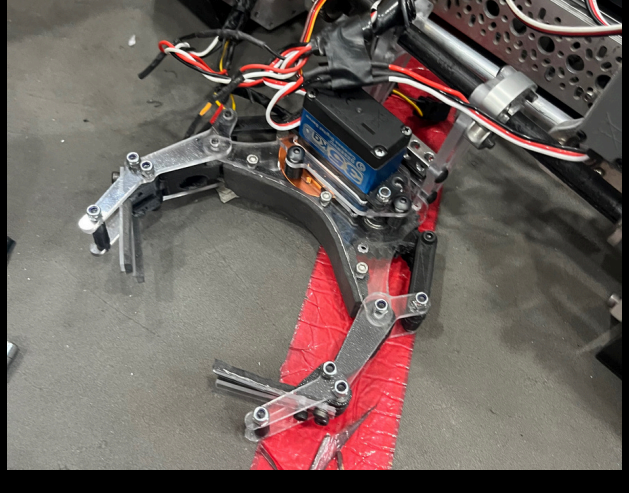
CAD of Arm

Design Strategy

END EFFECTORS

- We have two end effectors on the robot, each with a unique design

Mention design of claw in detail
Beam breaker
Explain conical shape of outtake
Polycarbonate spikes on intake gripper
Use of herringbone gears on intake gripper



Intake Gripper

Outtake Gripper

Calculation for Outtake

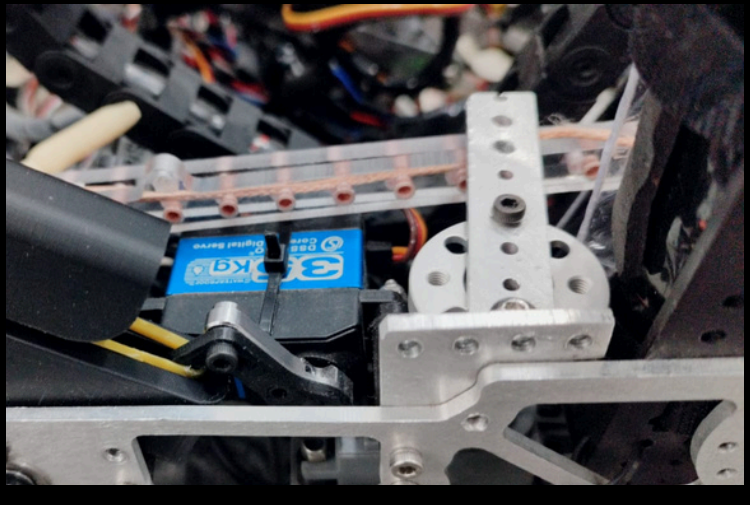
Torque or servo = 33 kgf
Length of arm = 12 inches (1 foot)

2 Axon servo motors = 33x2
= 66 kgf
2 pixels = 0.018 x 2 kgs
= 0.036 kgs
= 36 grams

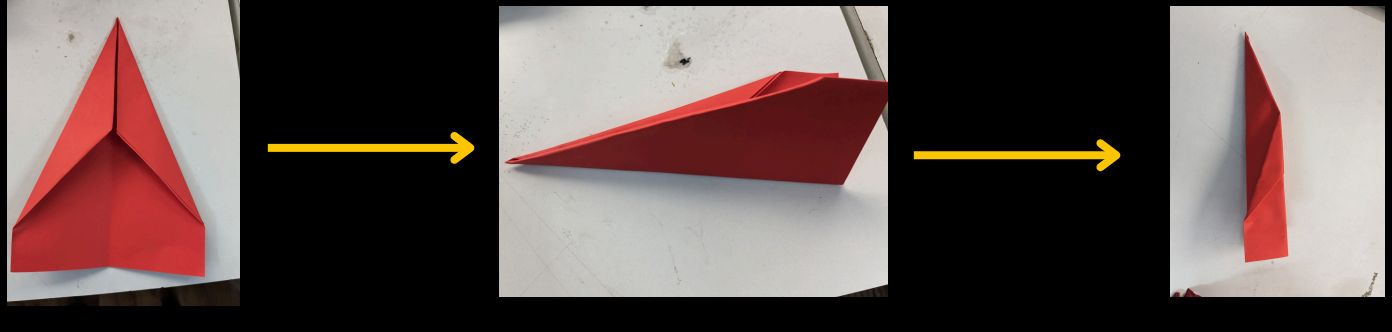
Torque required = 36 grams
Torque provided = 66 kgs

Design Strategy - Drone

- Our drone launcher works through a sling shot mechanism with a rubber band to launch the drone with just enough energy to get it to the first line and score maximum points.
- The rubber band gets launched with a servo motor. A 3d printed lock is mounted on the servo horn.
- When the servo is actuated, the lock rotates and the drone is launches using elastic energy.
- Our drone is also designed accordingly to fit in the slim drone launcher design.

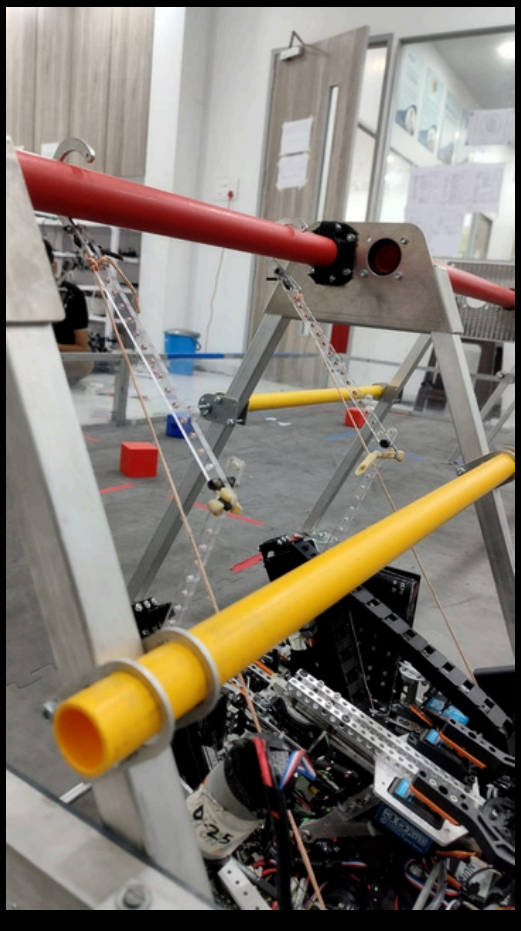


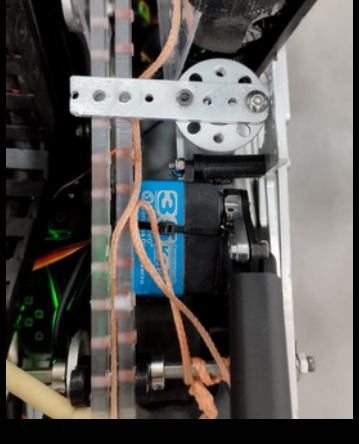
Steps to make the drone-



Design Strategy - Rigging

- Our rigging mechanism works with a using the concept of elastics. The links of the hanger have surgical tubes and the ends so that upon releasing the hanger reaches the desired height.
- The links of the hanger are made of polycarbonate and are of 5mm thickness so that the hanger does not break easily.
- Once the hangers are in place we have two strings attached to motors to create a pulley and pull the robot up
- We used REV ultraplanetary hex dc motor instead of servo motors for higher torque to lift the 13kg robot.





- Each link is locked using a servo motor.
- The motor for rigging is connected to the main shaft using belt and pulley transmission.

Weight of the robot = 13kg

Distance of the motor shaft from the com of the robot = 60mm

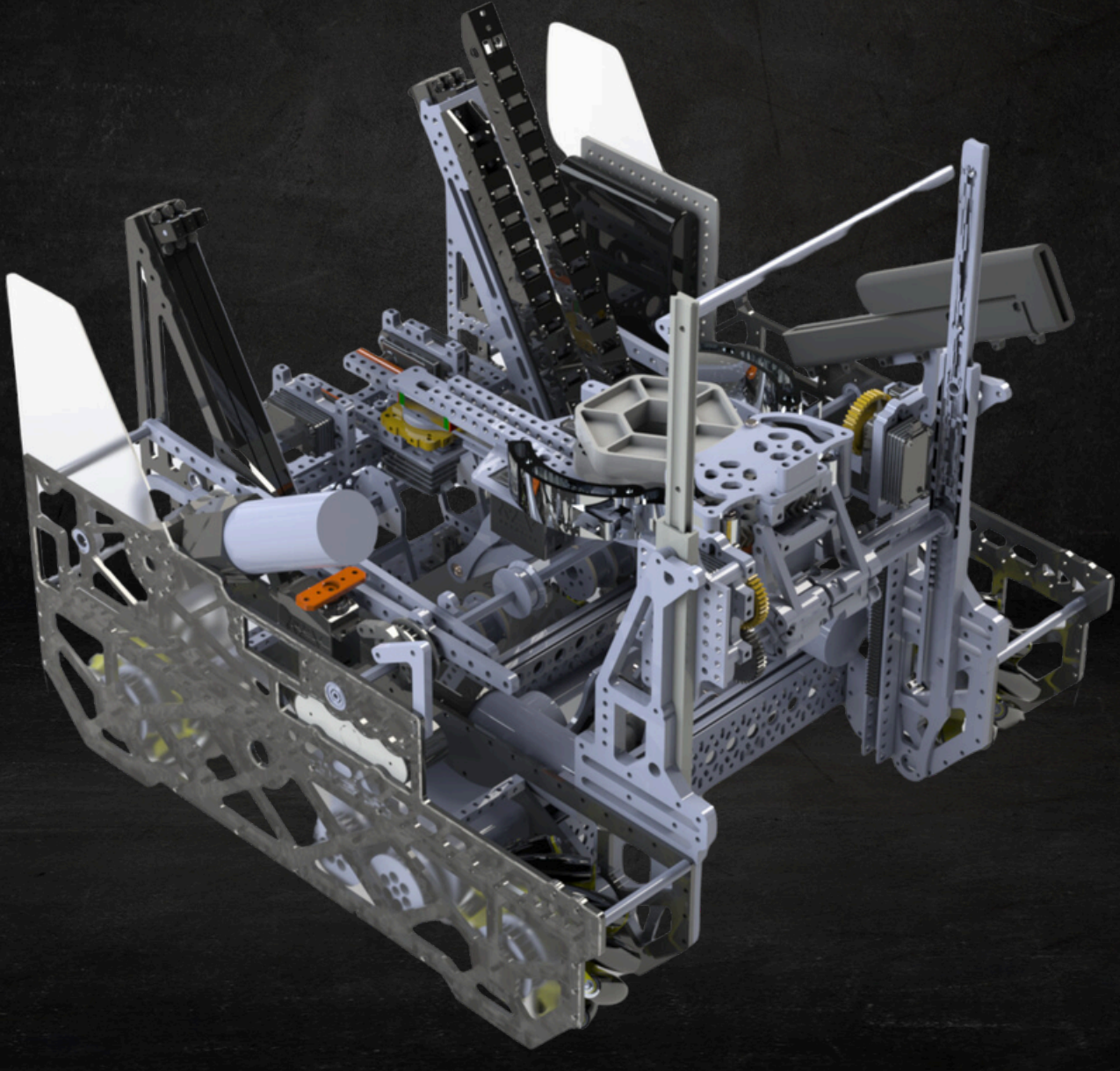
Torque required = 13 x 0.06 Nm = 0.78Nm

Gear ratio on motor = 25:1

Torque provided by motor = 2.6Nm

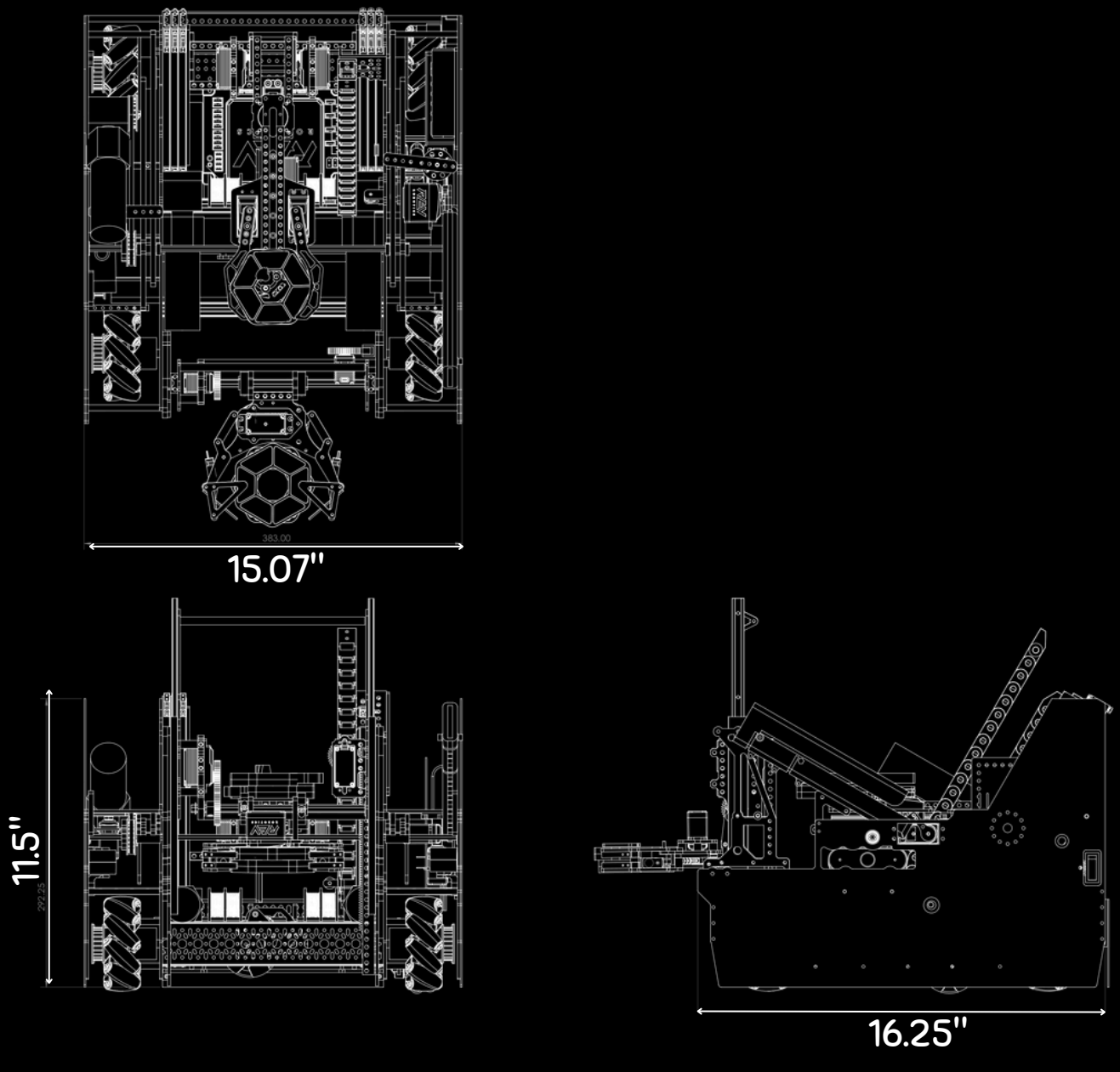
CAD

Our experience with SolidWorks, CAD software, has been eventful and rewarding. We began by familiarizing ourselves with the interface and basic tools through tutorials and training. At first, it was challenging for us to think in three dimensions and visualize complex assemblies. But with practice and hands-on projects, we eventually overcame these difficulties. Collaboration was important, and we learned terms like extrusion, fillet, coincident, loft, sweep, assembly mates, configurations, and many others. Overall, SolidWorks became an essential tool in our design workflow and greatly aided us while constructing our robot.



CAD of Final Bot

CAD



Dimensions of the robot

While focusing on the mechanisms, we also made sure that our robot follows all the rules and regulations as per the game!
At the start of the match, all of our subsystems are programmed to be in the INIT position, so that the robot does not go beyond 18 inches.

RED_RIGHT_V2.java | SampleMecanumDrive.java

```
ArrayList<AprilTagDetection> currentDetections

if(currentDetections.size() != 0)
{
    boolean tagFound = false;

    for(AprilTagDetection tag : currentDetectio
    {
        if(tag.id == paraDucks_IDS[PARKING_ZONE
        {
            tagOfInterest = tag;
            tagFound = true;
            break;
        }
    }

    if(tagFound)
    {
        telemetry.addLine( lineCaption: "Tag of int
        tagToTelemetry(tagOfInterest);
    }
    else
    {
        telemetry.addLine( lineCaption: "Don't see

        if(tagOfInterest == null)
```

PROGRAMMING

Programming Strategy

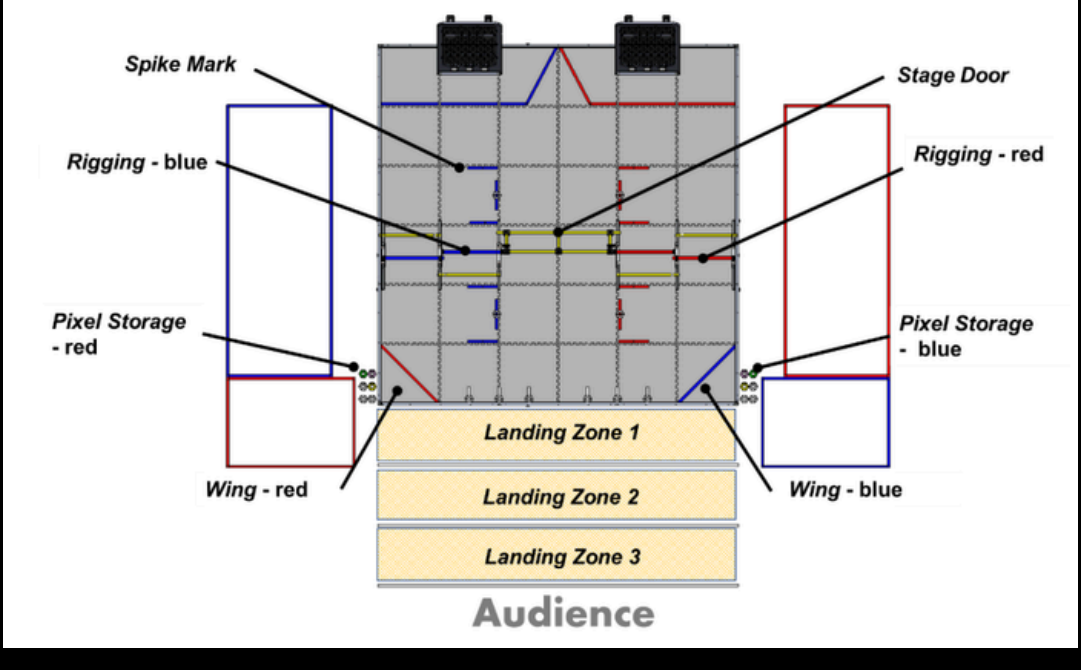
As the game demands we divided and developed our software program into two parts – AUTONOMOUS and TeleOp.

AUTONOMOUS:

-We have used a 2-wheel odometry setup – this allows us to know the current position of our bot with the help of telemetry data and allows the bot to follow a trajectory laid out for it.

-To code our bot, we've used Java on Android Studio. We have also used GitHub to share and improve code.

-We have also developed varius subsystems to avoid confusion between the numerous codes.



ENTERSTAGE Field

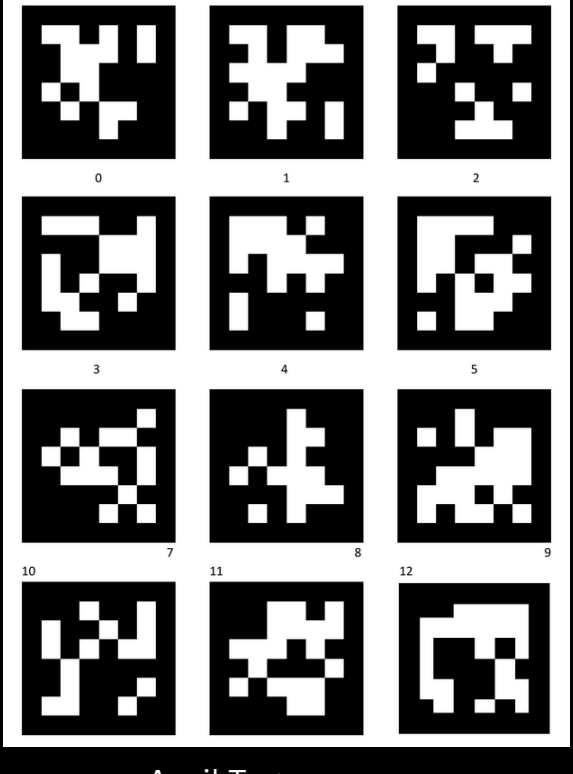
Programming Strategy

The robot utilizes cameras positioned on both sides to identify the team prop. Upon detection, the robot autonomously navigates to the specified location and deposits a purple pixel. Depending on the proximity of our initial position, the robot strategically parks either adjacent to the backdrop wall or on the left side, following predetermined coordinates.

For enhanced perception, we have integrated Hikvision cameras to provide to provide the bot with data from its surroundings.

Initially, the team prop detection was accomplished through Machine Learning (ML). However, the current approach involves utilizing OpenCV for this purpose.

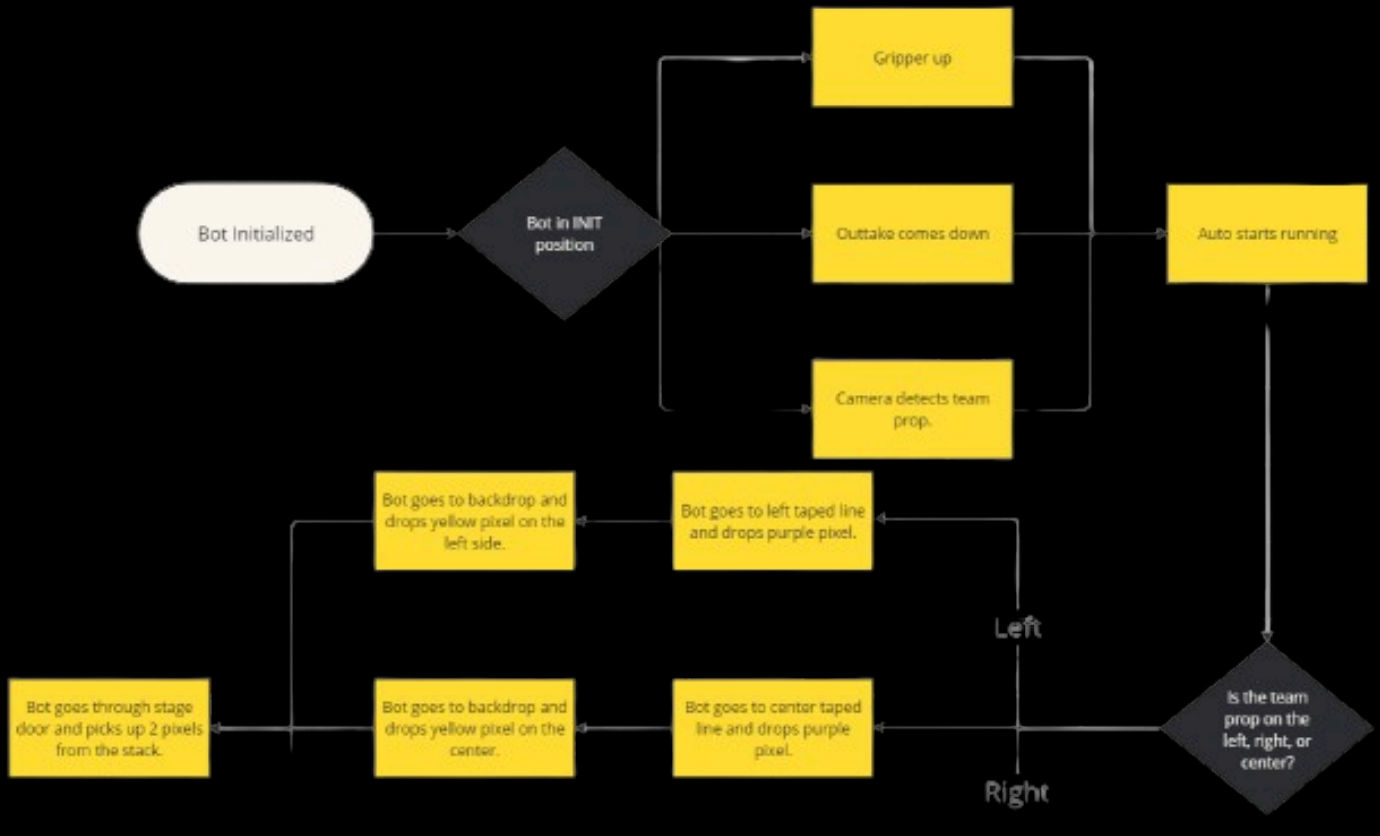
Throughout the 30-second autonomous period, the robot accurately places purple and yellow pixels at designated locations. Additionally, during one cycle, the robot adeptly retrieves two white pixels from a stack and places them on the backdrop.

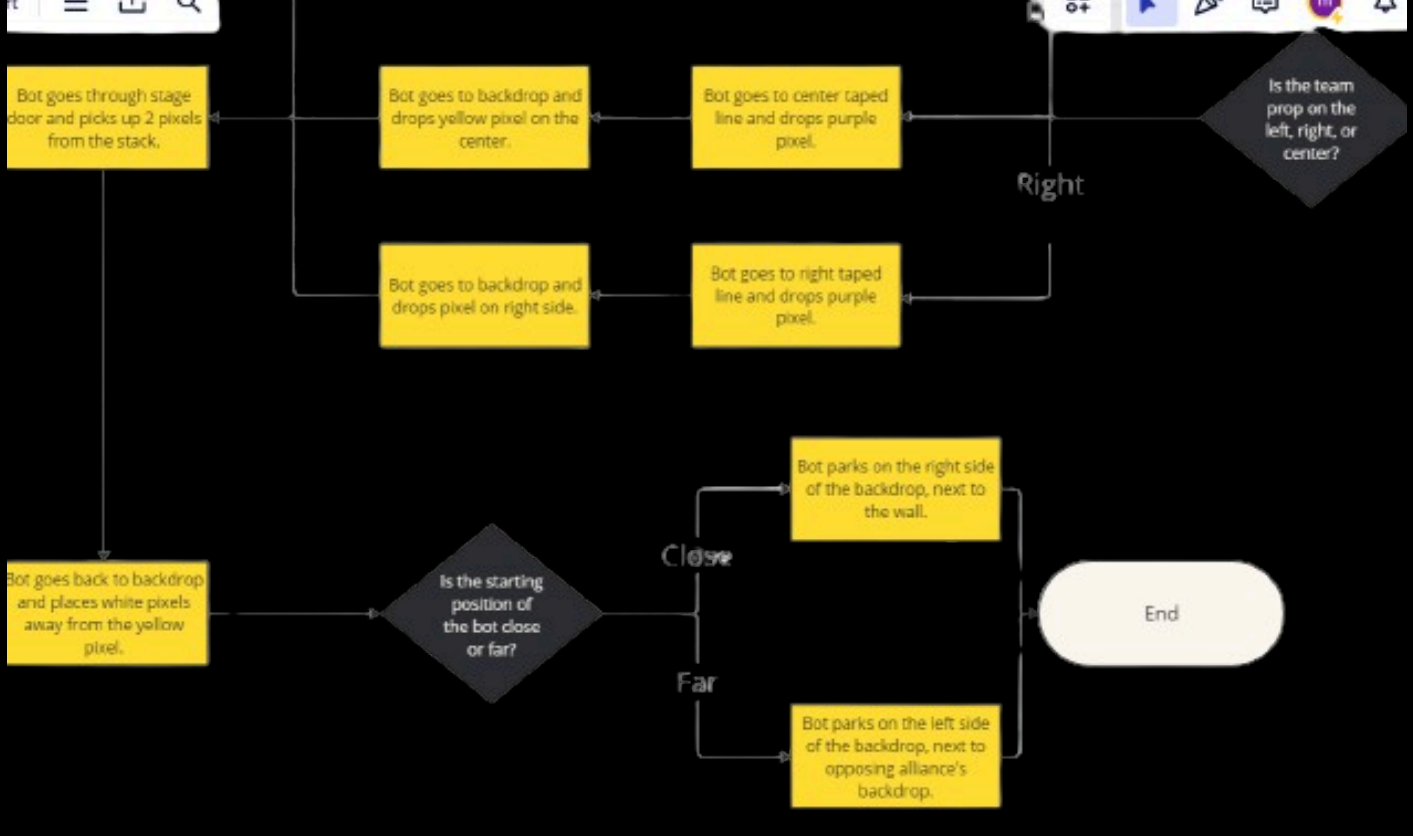


April Tags

Hik Vision

Programming Strategy





Programming Strategy

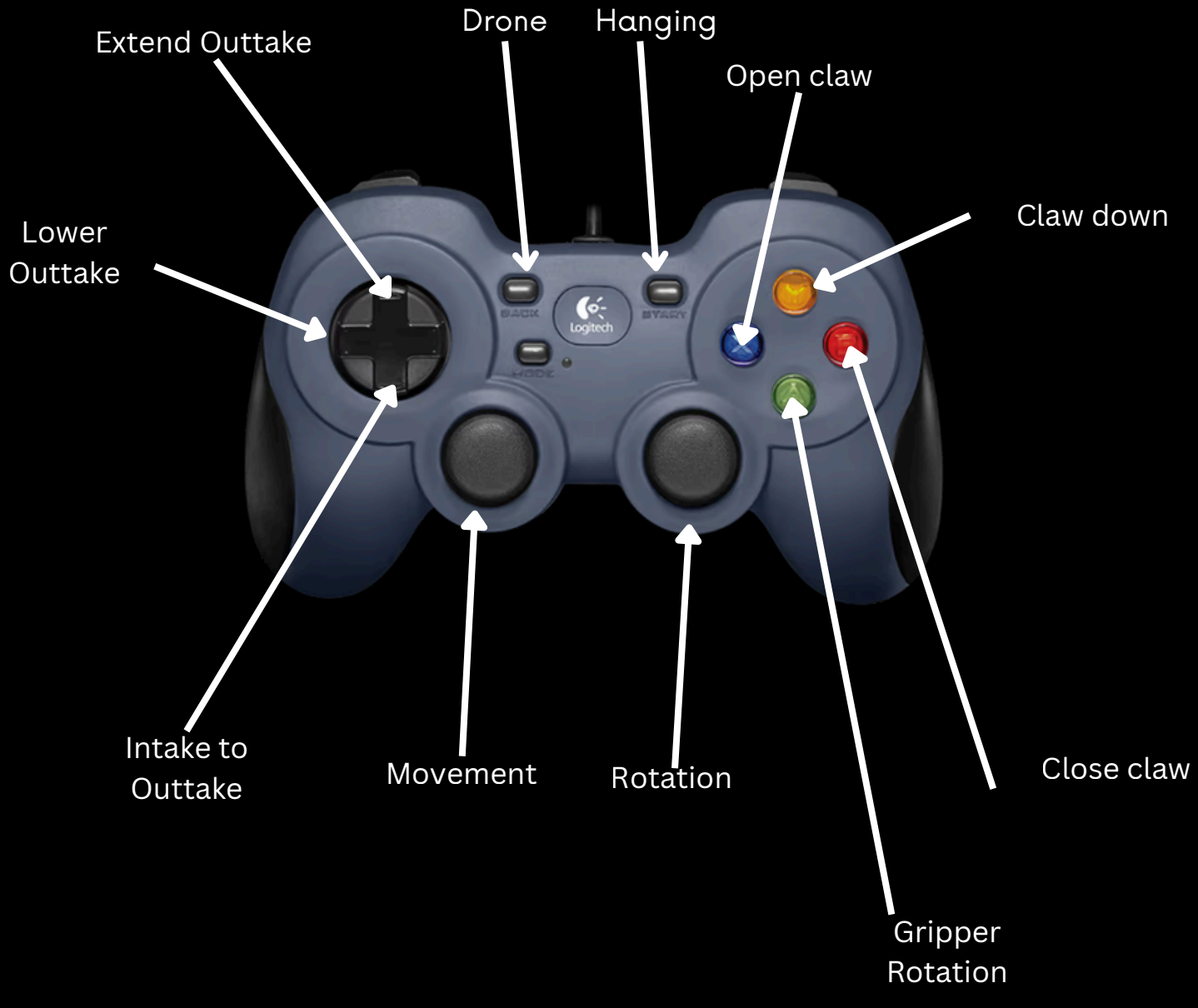
Tele-OP:

Since we have a mecanum drive, we have two types of driver control – Robot Centric and Field Centric control. We went for a "Field – Centric" control. Field Centric means all directions are relative to the driver. This helped our drivers to move faster and maneuver through the field efficiently and quickly.

Further, we added various functions to our gamepad. These functions were changed and updated multiple times according to our driver's needs.

Field Oriented

Gamepad Controls - Driver



Gamepad Controls - Operator

Programming Strategy

Toggle

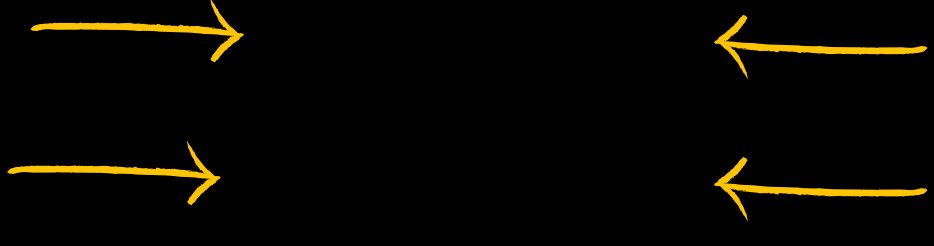
We have 2 controllers, to minimize the stress of one driver using one controller. Since we have added many subsystems to our bot and have separate intake and outtake systems, we use toggle switches to deploy and call back parts. In our vertical sliders, we use the bumpers to extend the sliders to full-length, half-length and back with 3 seperate buttons. For our intake system, with the push of one button, the, claw grips the pixel, and with the push of another, it transfers the pixels to the outtake. Overall, Toggle switches help us better our controller and code.

Programming Strategy

Servos

We have used 12 servos all over the robot- 6 in the outtake, 3 in the intake, 2 for the hangers, and 1 for launching the drone. Servo motors are special motors that are commonly used in robotics and automation. They are smaller and have their own control circuits to control their movements very precisely. These motors have a shaft that can be rotated to specific angles, making them great for tasks that need accurate positioning.

In FTC, servo motors are important because they help control different parts of the robot. They are used for things like opening and closing grippers, moving arms, or turning sensors. By programming the servo motors, we could make our robot move in precise and controlled ways. This allows the robots to perform specific actions and complete tasks accurately. Servo motors are really useful in FTC because they give the robots versatility and the ability to move exactly how they need to.



Servos located in the arm

Game Strategy

Our bot is very versatile so we can work around our opponents if needed. These are some strategies that work with our strengths.

AUTONOMOUS:

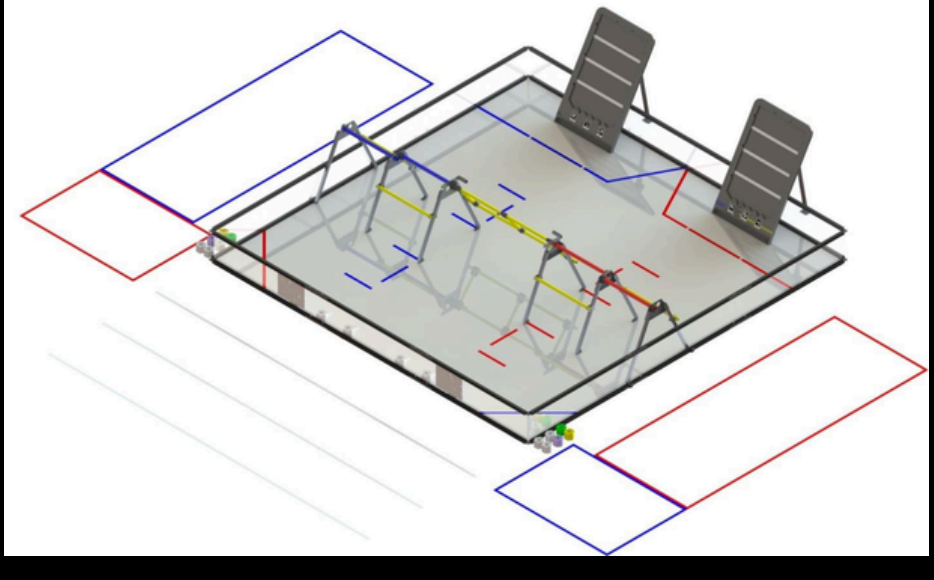
- Our main goal for autonomous is to get at least 50 points. We start by placing the purple pixel and yellow pixel in their designated spots. And we get 5 points by parking.

- Furthermore, we try to get 1 cycle during autonomous to earn points by placing pixels.

TeleOp:

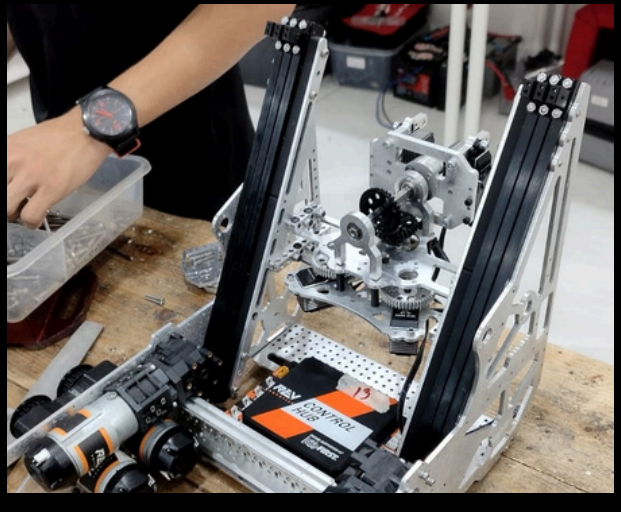
Case 1:The partner alliance is quick and makes a mosaic after the first cycle. We come in with coloured pixels for 2 or more cycles to make another mosaic on the other side. After, both bots will help get 1st set line and also cross the 2nd set line in the process. We try 5 or 6 cycles per game.

Case 2: Our partner alliance places white pixels after we get coloured pixels and finish the first mosaic. After we make another mosaic by placing coloured pixels and getting 1st set line. We need 5 to 6 cycles if our partner isn't quick enough.

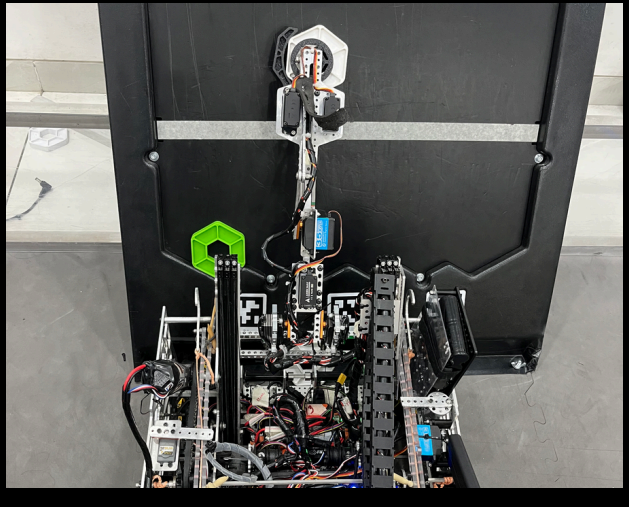


Robot Transition

Outtake- During our first iteration, the outtake that we designed and manufactured consists of an extra degree of freedon to rotate the outtake arm to reach the backdrop easily. Upon making the assemby, we realised that it was too complex and was increasing weight to the entire robot Hence we simplified the entire assembly.



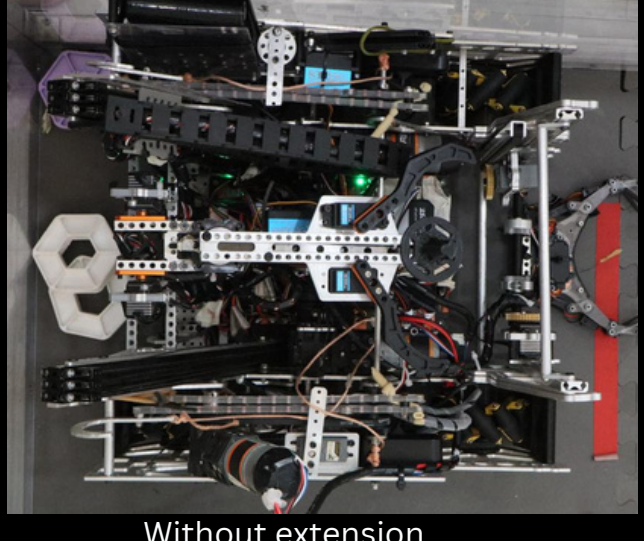
Outtake V1



Outtake V2

Extension-There was an extension near the back wheels which was essential before for the autonomous. But it was causing problems like draining the battery of the robot, getting stuck in the hanger. It was mainly removed to decrease the weight of the robot.

With Extension
Weight- 13.5 kgs



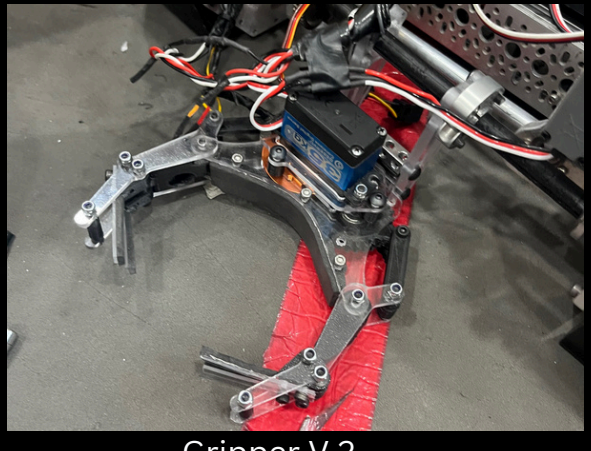
Without extension
Weight

Robot Transition

Claw:

The old claw couldn't pick up 2 pixels at a time, reducing our total points. The new claw has a sleek and slender design and picks up 2 pixels more consistently.

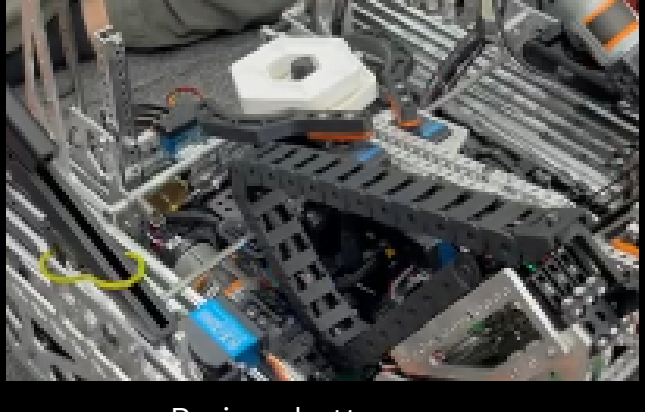
Gripper V.1



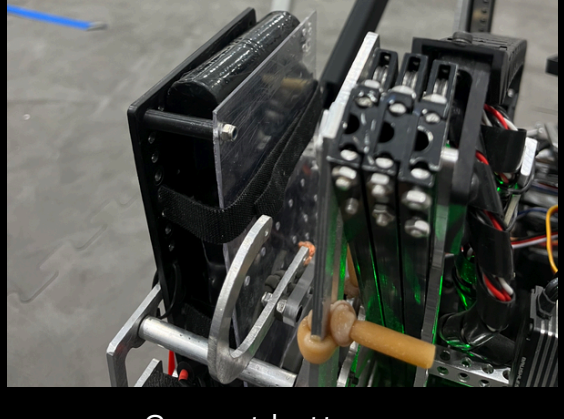
Gripper V.2

Battery Position-

Originally, the battery was placed at the resting position of the outtake. This caused the outtake to bang into the battery whenever moved to its resting position. We even added foam tape to reduce the force, but ultimately changed the position to the right front side of the robot, where it was also more secure.



Prvious battery position

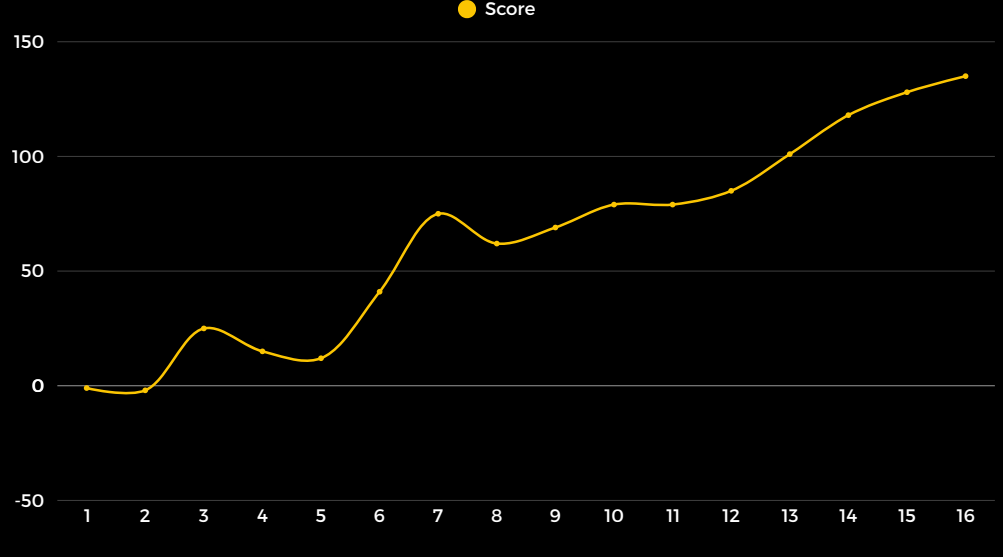


Current battery position

Drive Team Progress

DRIVERS EXPERIENCE

By the time our bot was ready, our d!rive team still wasn't finalized. We had our final drive tests and the driver and operator was selected. We immediately started playing matches and barely got 2 cycles. We practiced more after everyone left and now usually get 4–5 cycles with drone and hang in the matches. The TeleOp strategy still needs more improvement and the aim is to get 6 cycles. We play scrimmages whenever we get the chance and the bot has run into many problems making some matches much slower. We are sure we will achieve our goal!



OUTREACH

Outreach

Interview with Team Matrix

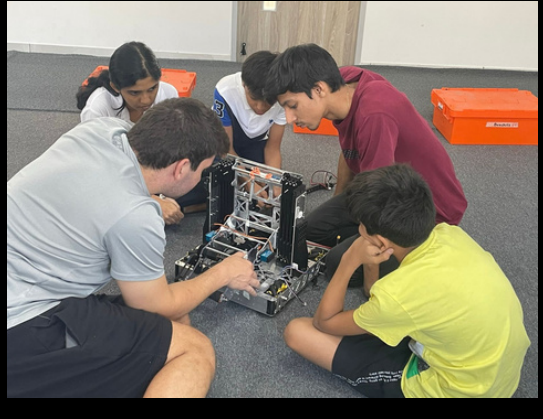
Matrix is one of the teams from DAIS who are participating in FTC. We interviewed Aaryan, the captain of Matrix. He told us about the struggles of being a team and how he kept spirits high even at their lowest points. Since Matrix has been a team since last year, they have more experience than us and were able to share some tips with us.

Interview with FRC Paraducks–

FRC Paraducks are our seniors who are now participating in FRC. In this interview, we talked to Tara, Paraducks' Captain. She spoke about her experience last year and gave us some tips about what we should do.

Advice from a mentor-

Mr Jeser Becker from Barker Robotics, a team from Australia, visited the centre. He is experienced in the field of robotics and after seeing our bot in a match, was able to identify places which we could improve on like our stringing method, which was going diagonally instead of straight, and our third pulley which wasn't able to retain tension. After receiving this feedback, we were able to re-string our pulleys and add a zip tie to the spring so it wouldn't move and hence, keep retaining tension. He also gave advice to our driver and human player about game and alliance strategies.



Social Media-

Paraducks has created an Instagram page to share updates from our experiences with the world of FTC and have reached 221 teams.

7 Posts

355 Followers

361 Following

Team Paraducks #22895

FTC Team Paraducks 2023-2024